

Waterworks Advisory Committee (WAC)  
**DRAFT Meeting Summary**  
September 5, 2018

**Members Present:** Dwayne Roadcap, VDH (chair); David Van Gelder, Hanover Public Utilities (vice-chair); Roger Cronin, ACEC; Bailey Davis, DCLS; Andrew Hammond, DEQ; Ignatius Mutoti, VSPE; Jesse Royall, Small Waterworks Owners; Steven Herzog, VWEA; Eric Rosenfieldt, VA AWWA; Andy Crocker, SERCAP; Mark Estes VRWA;

**Guests in Attendance:** Gregory Prelewicz, Fairfax Water; Theresa O'Quinn, Prince William County Service Authority; John DeRosa, Prince William County Service Authority; Donald Shelton, Prince William County Service Authority; Christopher Gill, (Christian & Barton, counsel, City of Norfolk); Tom Fauber, VA ABPA/JCSA; Louis Martinez, Newport News Waterworks; Michael Hotaling, Newport News Waterworks; Jeff Wells, VDH; Bob Edelman, VDH; Jim Moore, VDH; Nelson Daniel, VDH; Bennett Ragnauth, VDH; Barry Matthews, VDH; Steve Pellei, VDH; Dan Horne, VDH; Bryan Wade, VDH; Sherri Sullivan, VDH; Andrea Wortzel, (Troutman Sanders, counsel, Mission H2O); Harry M. Johnson, (Hunton Andrews Kurth, counsel, Fairfax Water), Robb Bohannon, (Hunton Andrews Kurth, counsel, Fairfax Water), Patrick Bradley, City of Richmond; Bob Steidel, City of Richmond.

**Call to Order: Introduction**– Dwayne Roadcap

WAC members introduced themselves and the organization they represent.

Mr. Roadcap informed the group that guests may participate by raising hands.

Mr. Roadcap asked if WAC members had any changes to the agenda. They did not.

**Adoption of Minutes from the 5/17/18 and 7/24/18 meetings – Dwayne Roadcap**

For each WAC meeting, the Office of Drinking Water (ODW) posted copies of the following records on the Regulatory Town Hall: draft minutes, presentations, handouts, and the current draft of the Waterworks Regulations. Steven Herzog moved to approve the past meeting summaries, David Van Gelded seconded. The WAC approved the motion unanimously.

**Public Comment Period**

No members of the public spoke during the public comment period.

**Virginia Commonwealth University Performance Management Group (VCU PMG) Update – Dwayne Roadcap**

VDH ODW contracted with the VCU Performance Management Group to examine and report on:

1. ODW's organizational structure;
2. How ODW delivers services to customers; and
3. How ODW can improve efficiency.

To date, VCU PMG has completed an online employee survey to get a baseline measure of how things are going throughout ODW and to gather suggestions for improvement. VCU PMG will report results of the survey in aggregate to protect confidentiality of survey respondents. The VCU PMG will meet with ODW staff in each field office and the central office in focus groups to collect information, and hold external discussions with ODW's stakeholders, including the U.S. EPA, WAC members, FCAP customers, CapDev customers, and local health district directors.

The WAC recommended VCU PMG contact representatives from the following additional stakeholder groups: engineering consultants, different size plants or waterworks and operators, and larger waterworks (Fairfax, Newport News, Prince William, Loudoun).

ODW expects VCU PMG to complete the evaluation and recommendations by December 2018, or early January 2019. ODW plans to share a summary report and recommendations with the WAC.

**HJ 94 Report from 2018 GA Session. Review draft recommendations. – Barry Matthews**

Mr. Matthews provided an executive summary of the report. See the PowerPoint and the handout listing recommendations. The HJ 94 Report focuses on the nexus of aging infrastructure and contaminants. The report focuses on the contaminants in the Lead and Copper Rule (lead and copper) and the Revised Total Coliform Rule (total coliform and *e. coli*).

Analysis: The EPA “needs assessment” found an \$8.3 billion funding need over 20 years in Virginia (approximately \$415 million per year). In the past, this need has been described as a funding gap; however, description as a “gap” is not completely correct. A portion of the need is covered by funding sources available from various government agencies, including the Drinking Water State Revolving Loan Fund (DWSRF). ODW does not have data on how much local General Fund, Bond Fund, Reserve Fund, and Private Investor mechanisms are used by Virginia waterworks. As a result, the true funding gap is not completely known. ODW recommends contracting a center of higher education to undertake a study on types and amounts of infrastructure funding through local General Fund, Bond Fund, Reserve Fund, and Private Investor mechanisms.

**Discussion**

Is the initial needs assessment available? Yes, it is available through EPA and the American Society of Civil Engineers (ASCE). EPA uses the needs assessment every four years to proportion capital funding for DWSRF state programs, based on the 20-year needs of waterworks. This assessment does not ask how much money waterworks need outside of their own resources. Virginia received 1.64% multiplied by the total amount of money available from EPA for 4 years.

Most utilities are planning 5 years into the future and do not have cost estimates for projects after this time period. Beyond 5 years, utilities look at projects only at a conceptual level. Fairfax Water has found the FCAP process administratively burdensome.

ODW is proactively addressing HJ 94 even though the General Assembly did not pass the bill. This report will advance the General Assembly’s discussion to solving problems rather than asking for a report. The Environmental Finance Center at the University of North Carolina School of Government, in Chapel Hill, NC, is uniquely qualified to complete the study of financial needs. ODW asked the WAC for any other recommendations on who else might complete the study. The WAC had no additional recommendations.

The WAC provided the following comments on the list of recommendations (see handout):

Recommendation	Comment
Various	Several recommendations are to incentivize, but do not say how to do this. HJ94 needs more details on the incentives.

Recommendation	Comment
18-3	Loss of staff through retirement is a current problem, not a future problem.
18-6	The balance between renovation and replacement versus new system installation depends on the status of the community.
18-10	Planning District Commissions (PDCs) may not be the correct agencies to assist. The PDC help available is dependent on the area of the state.
NA	Go Virginia is economic development focused rather than infrastructure focused.
18-12	Consolidation could affect or change some other recommendations. Some waterworks are too small to be sustainable. What would a legislative proposal look like to make this happen? County governments need to look at the cost of picking up an unfunded mandate.
18-15	Utilities are already required by code to regularly review rates.
18-22	Recommend ODW manage the private side of the lead service line (LSL) replacement program so that when a utility approaches a customer, there is an existing and ready program to fund customer side LSL replacement. The Department of Community & Housing Development (DCHD) and HUD should be funding LSL replacement since the private side was installed under the plumbing code, not the waterworks regulations.
18-4	Preserve tax exempt bonds and eliminate the cap on the private equity bonds.
NA	Funding sources for addressing emerging contaminants are needed. EPA is dedicating some money for this. VDH has sponsored the Virginia Tech course on emerging contaminants. The University of Virginia contacted ODW about doing some research on PFOS/PFOA. There is no state funding source for studying unregulated contaminants. Other states are going beyond EPA guidance to establish MCLs and HALs. Should PFOS/PFOA be addressed within the spirit of the HJ94 request? A lot of trust has been lost in NC over unregulated contaminants.

Timing: ODW plans to share a draft report to the Office of the Commissioner (OCOM) in October, 2018. How involved does this group want to be, going forward? The WAC suggested a willingness to review the final report, not draft copies. Mr. Roadcap asked individual members to contact him if anyone would like to review a draft document and provide feedback.

**EPA Metrics for PWSS Grant – Bob Edelman**

Major points from Mr. Edelman’s presentation were as follows:

- EPA has Measures and Indicators that EPA calculates for each state.
- These are the “strings” that come with the PWSS Grant.
- Numeric Goals associated with the Measures were agreed by each state.
- Virginia is generally meeting the Goals, with the exception of the source water protection goal.
- Virginia should begin calculating the Measures to know what the Measures are in advance of EPA providing that information to ODW.
- ODW defines how the source water protection Measure is calculated.
- EPA calculates several Indicators for each state.
- The indicators show level of activity in the state, for example, the number of new waterworks.
- EPA intends to make changes to the Measures, but no firm date is known.

Refer to Mr. Edelman's PowerPoint for more information.

### **Drinking Water State Revolving Fund & 60-day Public Comment – Steve Pellei**

The Intended Use Plan (IUP) for FY 2019 is available on ODW's website. VDH prioritizes the project list per EPA requirements. VDH has not received any projects that involve acute health issues for funding this year. The current projects address chronic health issues and infrastructure issues. Here is the procedure:

1. Rank projects in accordance with EPA approved methodology.
2. Publish proposed project ranking on Town Hall and website.
3. Complete public meeting to receive public comments on Wednesday, October 17th.
4. A 60-day Public comment period opens Sept 17 and runs through November 16, 2018.
5. VDH will address negative comments and then seek EPA approval to start closing loans.

Up to 31% of the SRF grant can be used for set-aside programs. The SRF Program needs to change and evolve to remain helpful to the people of Virginia. Here are the changes, going forward:

- An asset management plan will be required for all Financial Construction Assistance Program (FCAP) applicants. FCAP can fund up to \$15 thousand dollars as part of the construction funding. Waterworks need to know what they have and what they need to replace.
- If a small project applicant has more than two SRF projects incomplete, then FCAP will hold not make new offers to the applicant. This change incentivizes waterworks to finish and close projects promptly.
- Small projects grants now require the applicant to be "disadvantaged." Disadvantaged waterworks are those waterworks that serve a project area where the average monthly bill exceeds the target rate of 1% of Median Household Income (or will by project completion). If not a disadvantaged community, then the waterworks needs to raise rates for funding.
- Lead Service Line (LSL) Replacement funding – This effort goes beyond the regulations because the current applicants are in compliance and are not required to complete LSL replacement. Richmond has 13,000 LSLs and has reapplied. VDH is looking to fund Richmond with federal dollars, but the problem is that federal funds must go to waterworks owners only. State funds could possibly go to homeowners, but there are no state funds..
- VDH will lower an interest rate for a waterworks if the waterworks expedites loan closing or adjusts rates to meet a certain criteria.
- Projects in Eastern Virginia Groundwater Management Area (GWMA) only – Assuming projects are equally ranked using the EPA criteria, HB 1035 from the 2018 General Assembly session gives preference to projects that do NOT involve withdrawal of groundwater from the GWMA.
- A Preliminary Engineering Report (PER) can now be part of the application and be rolled into the project cost. In the past, the PER had to be completed prior to the application.
- Design-build projects can now be funded through FCAP.
- Refinancing loans are now available. Subsidized rates are good for 20 years.
- In comparison to the past, applicants have improved chances of receiving funding. FCAP is attempting to fund all qualified applicants.

- Since about 20% of loan offers do not close, FCAP needs to have a list of projects ready to progress to closing.

Quick SRF Program Facts:

- This year: ODW received 30 applications with a total of \$67 million funding requested.
- Anticipate loan closings end of December 2018.
- VDH expects the 2018 grant to be approved soon. Grant amounts are \$18.1 million for 2018 and \$13.6 million for 2017.
- Virginia needs to have a 20% match of state funds to access the grant.
- Some waterworks do not apply because of the federal requirements and associated paperwork burden.
- VDH would like larger projects from larger waterworks. VDH has a high percentage of loans to small waterworks.

**Discuss “Safe Yield” and report from subcommittee – Nelson Daniel**

See PowerPoint and handout with draft revisions. Originally, VDH recommended amending section 830 to delete reference to safe yield. The subcommittee—comprised of WAC members and other stakeholders—met on August 23, 2018, and developed conceptual language to revise the Waterworks Regulations on the topic of Safe Yield. The conceptual language reflect current ODW practices with regard to determining surface water source yield and retaining the current meaning of “safe yield.”

Objectives of the revised, conceptual language include the following:

- Preserve the meaning or concept of “safe yield.”
- Provide more clarity on how VDH and DEQ work together with respect to surface water withdrawals for waterworks.
- Acknowledge that VDH’s interpretation and application of safe yield (public health protection) is different from DEQ (environmental protection).
- Stop using and referring to 1Q30.
- Use the effective date of the regulations to say what “safe yield” meant, and how, after the effective date of the regulations, VDH will consider “source water capacity” or “capacity” or “the maximum available quantity of water from a surface water source,” which was formerly known as “safe yield.”
- Recommended changes to make consistent with the definition of a “water supply” and acknowledge that a waterworks may have multiple sources. (See PowerPoint, Slide 4)
- Preserved the current definition of “safe yield”, using the effective date of the regulations to phase out its use (See PowerPoint Slide 9).
- After the effective date of the regulations, the source water capacity is based on the Virginia Water Protection (VWP) permit. In the absence of a VWP permit, source water capacity can be demonstrated four ways. (See PowerPoint Slides 11 and 12)
- Inserted language to provide clarity on how VDH and DEQ work together with respect to surface water withdrawals for waterworks. (See PowerPoint Slide 13)

### **Discussion and Comments**

- Mission H2O reported that the Subgroup meeting was productive. Mission H2O appreciated the thought and effort put into the conceptual language as offered by VDH. This concept is a good start. Members are still reviewing and hopes to provide VDH with comments within 30 days. Not prepared to comment on it. Members want to discuss with management. We are getting closer to a resolution.
- Other discussion points included the following:
  - VDH needs to advocate for public health protection. DEQ does not do this. Some reported that DEQ also has a public health mission statement. Some offered that environmental protection equated to public health protection.
  - VDH thought the industry term of art is now “source water capacity.” Safe yield is old, outdated term and is no longer used or found in textbooks. Source water capacity is not necessarily based on 1Q30. VDH does not complete evaluations of source water capacity.
  - VDH is trying to reach middle ground and find stakeholder acceptance. ODW would like the topic of safe yield resolved to the extent possible.
  - What happens when there is a conflict between the four items of the conceptual language? This is not defined, on purpose, and provides for case-by-case decisions. There are 4 factors to consider and they could be in conflict with one another.
  - Maximum capacities of treatment plants exceed 1Q30 in many cases.
  - Items b and c of 12VAC5-590-830 A 3 are about the same (see slide 12).
  - Tidal freshwater withdrawals cannot use a 1Q30 evaluation. DEQ has evaluated one permit that was significantly impacted by upstream uses. DEQ may write a permit to limit the maximum daily flow, but also uses monthly average, or annual withdrawal.
  - VDH looks at the infrastructure of the waterworks, not resource management.
  - A grandfathered “right” may not reflect an actual amount of water that is available.
  - Why is safe yield so hard to agree on? We should be able to agree. Safe yield is not a static number. It changes based on environmental demands. Grandfathering describes a static condition. In Florida, a decrease in safe yields caused municipalities to innovate and find new sources of water.
  - New permits will reflect the changing nature of safe yield.
  - Grandfathered permits document the historic yield, not present day conditions. There are new withdrawals not described in the original determination.
  - Would the grandfathered permits restrict withdrawal in the event of a drought? What would happen if not? DEQ would need a governor’s declaration to conserve water. Most localities have drought management plans and would invoke them.
  - Small systems, with grandfathered 5 MGD, using 1.5 MGD, don’t want to lose it, concern that it will be robbed from them and given to someone else in the basin.

The WAC generally seemed to endorse the conceptual language proposal and recognized a need to tweak and finalize the conceptual language. Mr. Roadcap encouraged the Safe Yield subgroup to meet again, perhaps as early as October, and before the next WAC meeting. Mr. Roadcap stated that he would like to have stakeholder buy-in and acceptance to the extent possible before November, 2018.

**Draft Waterworks Regulations: Discuss changes since 7/24/18 meeting, next steps, and timeframes. Consider recommendation for Board of Health review.**

Refer to the PowerPoint slides for more information. VDH made the last revision to the *Regulations* in 1993. Staff added a section on membrane filtration, reflected changes in state law, reorganized to improve readability, and incorporated the appendices into the main body of the Regulations. Staff is reorganizing, but not otherwise touching the federal requirements, except for the Revised Total Coliform Rule (RTCR), which staff is changing to allow reduced sampling for certain Transient Non-community systems (TNCs).

To date, ODW has resolved issues raised by the WAC, as necessary, and staff believes we are ready to move the draft regulations and revisions forward while the conceptual language is vetted. Staff updated sections covering definitions, operation permits, a waterworks business operation plan, and operator attendance, corrected analytical methods, cross connection control, fluoridation and operation. Since the last WAC meeting, staff added new and revised definitions for: boil water advisory, boil water notice, distribution system, exemption, optimum fluoride ion concentration, site visit, variance, waiver, and water supply.

“Boil water advisory” and “boil water notice” mean a statement that informs consumers that their drinking water is, or may be, contaminated and that the water should be boiled before being used for human consumption.

“Distribution system” means a network of pipelines and appurtenances by which a waterworks delivers drinking water to its consumers.

“Exemption” means allowing a waterworks that satisfies the criteria in 12VAC5-590-150 to deviate from a conventional waiver of a specific PMCL or treatment technique requirement that is granted to a specific the waterworks for a limited period of time.

“Optimum fluoride ion concentration” means that fluoride ion concentration recommended by the U.S. Public Health Service for protection from dental caries.

“Site visit” means a tour of a waterworks by department staff or other authorized persons for purposes including assessing and documenting its physical condition, operations, and compliance activities.

“Variance” means allowing a waterworks that satisfies the criteria in 12VAC5-590-140 to provide drinking water that does not fully comply with the regulations. ~~a conditional waiver of a specific regulation that is granted to a specific waterworks.~~ A PMCL variance is a variance to a primary maximum contaminant level, or a treatment technique requirement. An operational variance is a variance to an operational regulation or a secondary maximum contaminant level SMCL. ~~Variances for monitoring, reporting and public notification will not be granted.~~

“Waiver” means permission from the department to deviate from the monitoring and reporting requirements in the regulations for a specific contaminant.

“Water supply” means the source of water originating from aquifers, rivers, streams, springs, reservoirs, lakes, and other bodies of surface waters (natural or impounded) and the tributaries thereto, and all impounded groundwater taken into a waterworks for the purpose of producing a source of potable water. It shall not include any waters above the point of intake of the waterworks.

Staff made some technical changes for consistency across the entire *Regulations*. For example, for word use, sometimes we called something a groundwater system or groundwater waterworks. Staff will now use groundwater system as the term of choice; disinfectant residual is residual disinfectant. Staff is changing residual chlorine to chlorine residual and replacing the term, commissioner, with department, and blow-off and blowoff. We are using singular for owner.

Remaining tasks:

1. Satisfy style manual
2. RIS data entry
3. OCOM review
4. Board of Health action package
5. Prepare TH-02.

Going forward:

- The goal is obtain recommendation from WAC on the entire regulations, and conceptual agreement with the proposal for safe yield.
- Internal agency review to start soon.
- Another safe yield subcommittee meeting will be scheduled in early October.
- Finalize the safe yield topic in mid-October
- Reschedule WAC from November 15 to earlier in November or late October.
- The complete regulation package will be send to Board of Health members on or about November 13<sup>th</sup>.

Jesse Royall moved and Steve Herzog seconded, that the WAC recommend that OCOM approve the draft Waterworks Regulations, with the exception of safe yield, for submittal to the Board of Health. The motion passed unanimously.

For discussion: Is there any effort to inform waterworks about the Regulations update? The official process is through the Town Hall website. Beyond the Town Hall process, how can small waterworks know about the waterworks revision process? The WAC representatives are responsible to reach out to their constituent groups (for example, AWWA and VRWA) and inform them of the waterworks revision process. VDH will add names to its informal notice email blast upon request.

**Adjourn: Next meeting is scheduled for November 15, 2018 but will be rescheduled to an earlier date in late October or early November.**



# WATERWORKS ADVISORY COMMITTEE MEETING

Sydnor Hydro, Inc., 2111 Magnolia St, Richmond, Virginia 23223

Wednesday, September 5, 2018

8:30 – 1:30 PM

## AGENDA

Subject	Time
Meet and Greet with Stakeholders	8:30 – 9:00 AM
Call to Order: Adoption of minutes from the 5/17/18 and 7/24/18 meetings	9:00 – 9:10 AM
Public Comment Period	9:10 – 9:25 AM
VCU Performance Management Group Update	9:25 – 9:40 AM
HJ 94 from 2018 GA Session. Review draft recommendations.	9:40 – 10:10 AM
EPA Metrics for PWSS Grant	10:10 – 10:25 AM
Drinking Water State Revolving Fund & 60-day Public Comment	10:25 – 10:50 AM
Break	
Discuss “Safe Yield” and report from subcommittee	11:00 AM – Noon
Working Lunch: continue discussion of “Safe Yield” as needed	Noon – 1:00 PM
Draft <i>Waterworks Regulations</i> : Discuss changes since 7/24/18 meeting, next steps, and timeframes. Consider recommendation for Board of Health review.	1:00 PM – 1:30 PM
Adjourn: <b>Next meeting is November 15, 2018</b>	1:30 PM

# House Joint Resolution 94

## Executive Summary

### Recent Events:

Drinking water incidents in Flint, Michigan, Charleston, West Virginia and Toledo, Ohio have placed a spotlight on the condition of infrastructure and challenges waterworks face to provide safe drinking water.

# House Joint Resolution 94

## Delegate Lopez

Develop a report on the condition of the regulatory framework for safe drinking water in Virginia. The Resolution called for ODW to:

- (i) identify issues that may result in contamination of drinking water with lead or copper or other substances
- (ii) develop recommendations for addressing such problems or issues.

# House Joint Resolution 94

## Executive Summary

This study reviews:

- the legal framework for Virginia's drinking water program
- broadly evaluates waterworks performance
- overall condition of the drinking water infrastructure
- discusses ODW's structure to implement the program
- and looks at funding needs and sources.

# House Joint Resolution 94

## Executive Summary

### Legal Authority

- Public Water Supplies Law (Code of Virginia §§ 32.1-167 through 32.1-176)
- Waterworks Regulations (12VAC5-590-10 et seq.)
- Waterworks Operation Fee (12VAC5-600-10 et seq.)

# House Joint Resolution 94

## Executive Summary

### Analysis:

DWSRF and other state and federal agencies cannot provide all the infrastructure improvement funds needed. According to many reports, the need “gap” is billions of dollars just in Virginia alone. What is not clear is the amount of funding utilized primarily by the large waterworks for alternate funding sources not tracked by conventional infrastructure programs.

# House Joint Resolution 94

## Executive Summary

### Recommendations:

Contract a center of Higher Education to undertake a study on types and amounts of infrastructure funding through local General Fund, Bond Fund, Reserve Fund, and Private Investor mechanisms.

## Recommendations

The report enumerates other recommendations to promote, incentivize and encourage waterworks to plan for replacement, renovation and rehabilitation of aging infrastructure.

## VII Recommendations

VDH - ODW requests the General Assembly consider the following recommendations. Several organizations and studies addressed the same concerns and issues that raised in this report. Where related recommendations are used, credit given to the organization making the recommendation. Infrastructure Recommendations (IR) listed below by year (2018) and number.

### IR 18-1

Contract the Environmental Finance Center Network or similar center of Higher Education to undertake a study on the types and amounts of infrastructure funding through local General Fund, Bond Fund, Reserve Fund, and Private Investor mechanisms.

### IR 18-2

Develop a dedicated, flexible funding source managed by the Planning District Commissions (PDCs) to enable waterworks efficiently respond to emergencies (Keating, J. 2018).

### IR 18-3

Develop support mechanisms for vocational training in the drinking water sector as engineers, operators, and maintenance staff begin to retire in large numbers (ASCE, 2018).

### IR 18-4

Preserve tax-exempt municipal bond financing. Low-cost access to capital helps keep lending for drinking water upgrades strong and accessible for communities large and small (ASCE, 2018). Eliminate the state cap on private activity bonds for water infrastructure projects to bring an estimated \$6 to \$7 billion annually in new private financing (ASCE, 2018).

### IR 18-5

Provide support and funding for green infrastructure, watershed permitting, and other programs that promote the concept of “one water” to protect source watersheds (ASCE, 2018).

### IR 18-6

Analyze storage and distribution systems where infrastructure is reaching a critical age. Allocate future funding for renovation and replacement, rather than new system installation (Keating, J. 2018).

### IR 18-7

Establish a website that provides general information about sustainability, useful links, funding agencies information (e.g., VDH, USEPA, PDCs, etc.) and training opportunities (Keating, J. 2018).

## 1) Requirements and Incentives for Consolidation/Regionalization

### IR 18-8

Incentivize and encourage utilities to take regional approaches for water delivery to take advantage of economies of scale (ASCE, 2018).



IR 18-9

PDC Directors should regularly share lessons learned and assist waterworks decision makers with training, identifying resources, and setting up mutual aid agreements (Keating, J. 2018).

IR 18-10

Offer more training at locations more convenient to operators; utilize PDC offices and Community Colleges (Keating, J. 2018).

IR 18-11

Encourage and establish mutual aid agreements, including participation in VA WARN, for small and very small systems (Keating, J. 2018).

IR 18-12

Require counties to assist failing waterworks and struggling and distressed towns (within their county) as a condition for accessing state grant and low interest loan funds through the state agencies. Assistance could be consolidation, purchase or aid agreement if it meets the consent of the funding agency.

## 2) Requirements and Incentives for Rate Increases

IR 18-13

Incentivize funds to utilities that conduct revenue-forecasting models to determine the necessary rate revenues over time and then institute rates that reflect the true cost of supplying clean, reliable drinking water (ASCE, 2018).

IR 18-14

Incentivize small and very small systems of Virginia to establish cash reserves (Keating, J. 2018).

IR 18-15

Require waterworks regularly review their water rates and rate setting procedures (Keating, J. 2018).

IR 18-16

Encourage managers to better understand and track various financial parameters, such as debt ratio, cash on hand, etc., many of these parameters are not widely understood and greatly affect the sustainability of a waterworks (Keating, J. 2018).

## 3) Requirements and Incentives for Asset Management

IR 18-17

Incentivize and encourage utilities to undertake asset management programs (ASCE, 2018).

IR 18-18

Waterworks need to conduct water accountability studies, complete Waterworks Business Operations Plans, and develop plans for Operations and Maintenance, asset management, comprehensive improvement, water source/well head protection, and water drought measures (Keating, J. 2018).

4) Requirements for Waterworks Business Operations Plans

IR 18-19

Require waterworks conduct Technical, Managerial and Financial self-assessments on a periodic basis and utilize the score for benchmarking purposes. Systems that score below a defined threshold on this assessment would then develop a WBOP for a more thorough needs determination (Keating, J. 2018).

5) Adequate Debt Coverage

IR 18-20

Waterworks implementation of revenue growth models that factor in increases (e.g. operational costs, inflation, etc.), other costs (e.g. asset/equipment replacements, technology upgrades, capital improvements, etc.) and takes into account other potential revenue reductions (e.g. future regulations, reductions from water conservation, etc.).

6) Interventions for Distressed Communities

IR 18-21

Develop a process to define and identify distressed communities at it relates to aging infrastructure. Provide priority intervention for communities that have managerial and technical capacity, but lack financial capacity. This may require allocation of funding for these communities.

7) Funding Replacement of Lead Service Lines (LSL)

IR 18-22

Consider applying two million dollars annually in dedicated funds to provide support for Virginia's existing Lead Service Line Replacement (LSL) Program.

# National Water Program Guidance

FY 2018

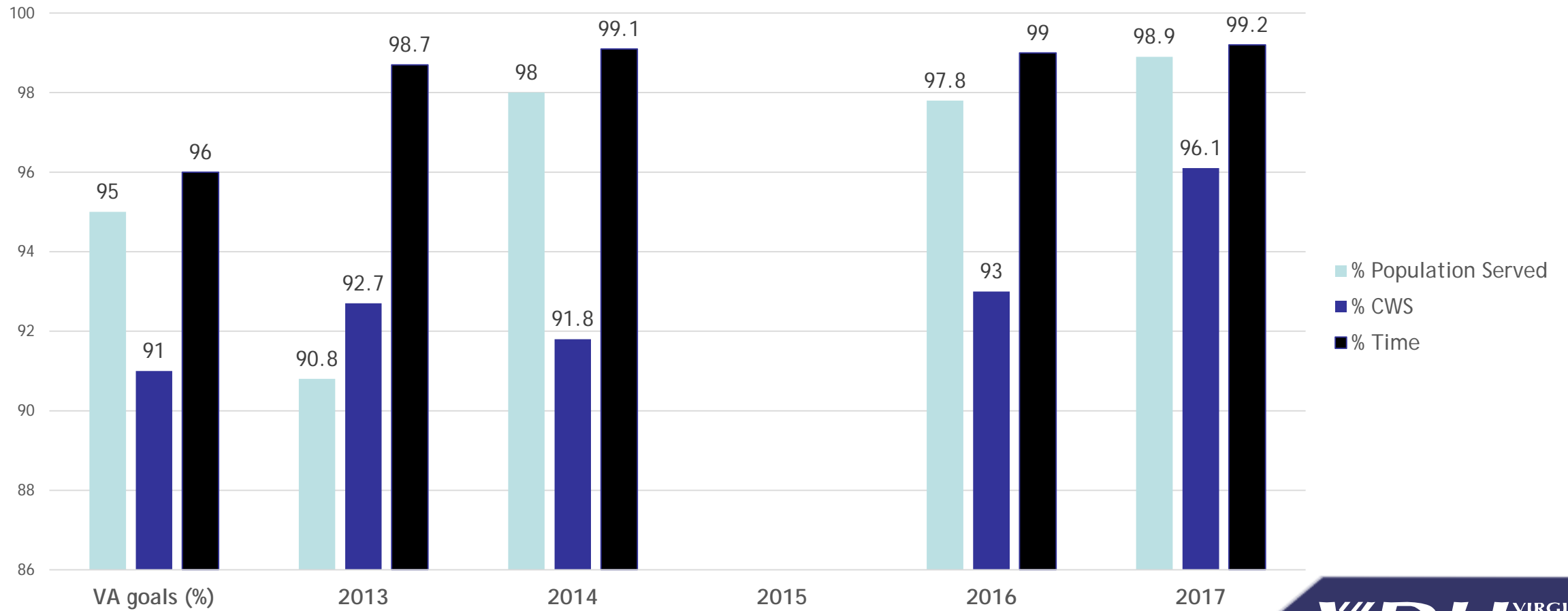
# NWP Guidance Measures

- Measure goals adopted annually by:
  - States
  - EPA Regions
  - EPA
- EPA HQ calculates Measures after end of each FY (October) based on data in SDWIS/FED for the 12 month period ending June.
- Example: goals for FY 2018 are calculated in October 2018 using the July 2017 through June 2018 data.
- Source water protection data is submitted to EPA separately from SDWIS/STATE.

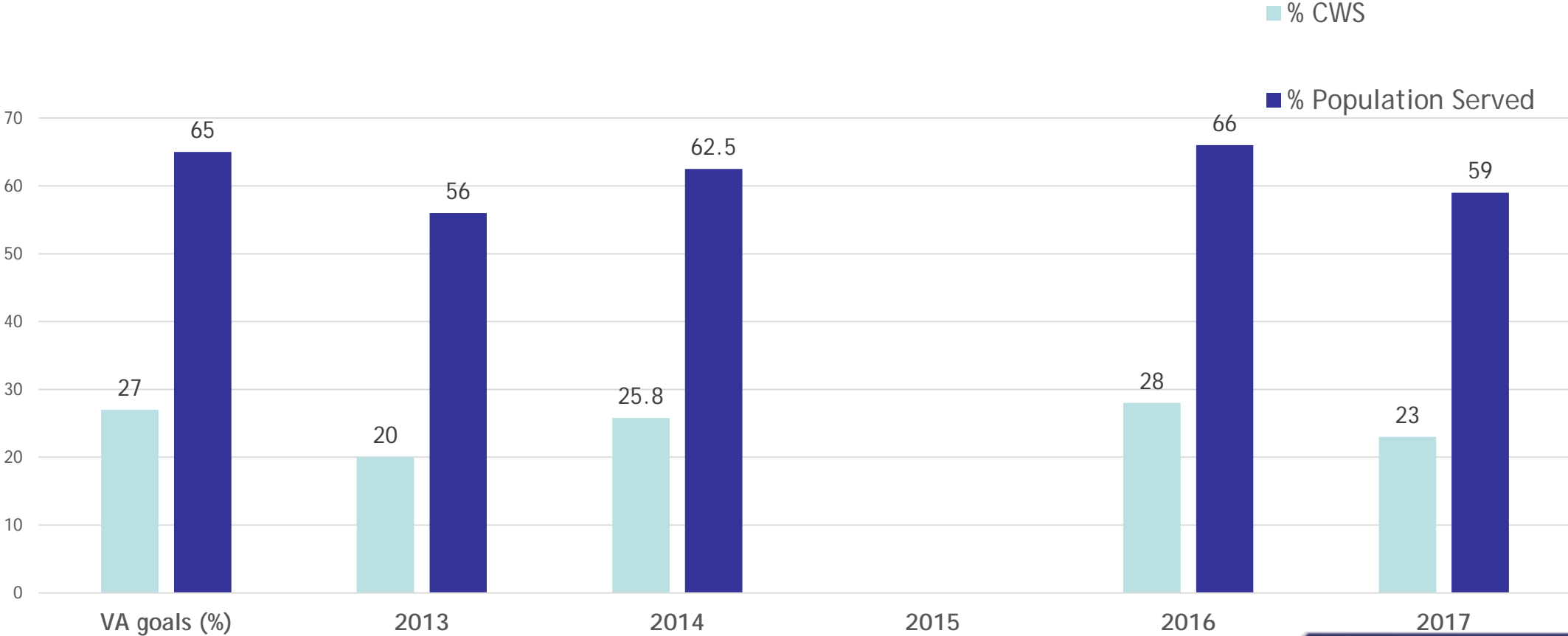
# Measures

- Virginia has kept the goals “same as last year” for many years
- Some measures have been around for over 10 years
- EPA is shifting emphasis to reducing the number of CWS with Health-Based violations.
- EPA will likely change Measures

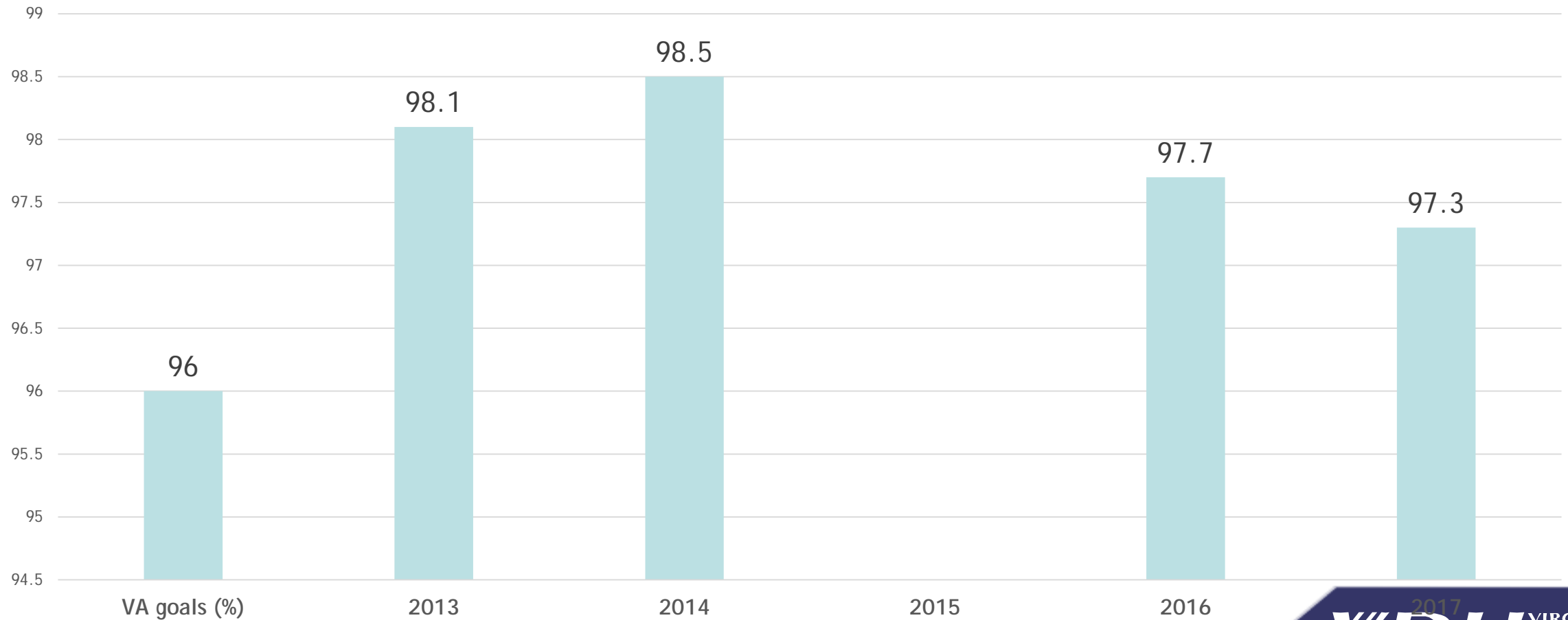
## Community PWS W/O Health Based Violations



# CWS W/ Source Water Protection



## Percent CWS with sanitary survey in last 3 years





# Indicators

- Annually, EPA calculates several indicators for states
- There are no goals
- These indicate level of activity in the states
- Values have not been shared with Virginia
- Calculated annually

# Indicators

SDW-14a	New PWS are those first reported to EPA in the last calendar year
SDW-14b	Percent of New PWS are those first reported to EPA in the last calendar year
SDW-15a	Number of small PWS with repeat health-based violations
SDW-15b	Percent of small; PWS with repeat health-based violations
SDW-16	Average time for small PWS to return to compliance based on state-reported RTC determination date
SDW-17a	Number of schools and child care centers that meet all health-based drinking water standards
SDW-17b	Percent of schools and child care centers that meet all health-based drinking water standards

# Conclusions

- EPA has Measures and Indicators that are calculated for each state
- Measures Goals are agreed by each state
- Virginia is meeting Measures Goals
- Virginia should begin calculating the Measures so we know what they are in advance of EPA
- ODW staff should become aware of EPA's Measures
- More discussion about the source water protection measures
- EPA may make changes to the measures. Stay tuned.

**12VAC5-590-830. Surface water sources; quantity; quality; development structures.**

A. A surface water source includes all ~~tributary streams, rivers, and drainage basins, natural lakes, and other bodies of natural or impounded waters, and the tributaries thereto, artificial reservoirs or impoundments~~ above the point of water supply intake.

1. The quantity of water ~~from the surface water at the source, plus water from other sources available to and used by the waterworks,~~ shall:

- a. Be adequate to supply the water demand of the service area;
- b. Provide a reasonable surplus for anticipated growth; and
- c. Be adequate to compensate for all losses, including evaporation, seepage, flow-by requirements, etc.

2. ~~Waterworks that have an operation permit with an effective date on or before [INSERT THE EFFECTIVE DATE OF THE REGULATIONS]; the~~ The safe yield of the ~~surface water source~~ ~~was shall be~~ determined as follows:

- a. Simple intake (free-flowing stream); ~~:- The safe yield is defined as~~ the minimum withdrawal rate available during a day and recurring every 30 years (30 year - one day low flow ~~or 1Q30~~). To generate ~~a 1Q30~~ ~~the report for this,~~ data ~~was is to be~~ used to illustrate the worst drought of record in Virginia since 1930. If actual gauge records ~~were are~~ not available for this, gauges ~~could are to~~ be correlated from similar watersheds and numbers ~~would are to~~ be synthesized; and
- b. Complex intake (impoundments in conjunction with streams); ~~:- The safe yield is defined as~~ the minimum withdrawal rate available to withstand the worst drought of record in Virginia since 1930. If actual gauge records ~~were are~~ not available, correlation ~~could is to~~ be made with a similar watershed and numbers synthesized in order to develop the report.

Note: ~~Local governments may request this aid from the State Water Control Board (SWCB) by contacting either the Health Department's Office of Water Programs or the SWCB's headquarters office in Richmond.~~

3. ~~For waterworks seeking a construction permit or operation permit after [INSERT THE EFFECTIVE DATE OF THE REGULATIONS]; the maximum available quantity of water from a surface water source shall be based on any applicable withdrawal limit in a Virginia Water Protection permit. In the absence of a limit established by a Virginia Water Protection permit, the maximum quantity of water available from the surface water source (capacity) may be established in the following ways:~~

- a. ~~The safe yield from a waterworks operation permit issued prior to [INSERT THE EFFECTIVE DATE OF THE REGULATIONS];~~
- b. ~~Demonstrate the maximum available withdrawal for a surface water withdrawal in existence on July 1, 1989;~~
- c. ~~Demonstrate grandfathered water withdrawal capacity in accordance with 9 VAC 25-210-310; and/or~~
- d. ~~Provide a hydrologic evaluation of source water capacity prepared by a licensed professional engineer. The evaluation must demonstrate the maximum withdrawal available to withstand the worst drought of record based on historical gauge data. If actual gauge records are not available, gauges shall be correlated from similar watersheds and synthesized.~~

B. ~~Nothing herein, including the calculation of safe yield or capacity of a surface water source, shall alter existing water rights or the owner's responsibility to obtain authorizations from other state agencies for water withdrawals and preservation of instream flow from surface water~~

sources in accordance with State Water Control Law, Chapter 3.1 of Title 62.1 of the Code of Virginia and 9 VAC 25-210-310.

~~C.~~ The owner shall conduct, or have conducted, ~~a sanitary survey and a study~~ an assessment of the factors, both natural and man-made, ~~which that~~ will affect the quality of the water at the ~~source and quantity of the surface water source~~ water. The results of the ~~sanitary survey assessment~~ shall be submitted to the ~~division~~ department with the design. ~~Such survey and study~~ The assessment shall include, but shall not be limited to:

- ~~1. Obtaining samples over a sufficient period of time~~ acceptable to the ~~department,~~ commissioner, to assess the bacteriological, physical, chemical, and radiological characteristics of the ~~surface source~~ water source;
- ~~2. Determining future uses and effects of impoundments or reservoirs;~~
- ~~3. Determining the degree of control over the watershed that may be exercised by the owner; and~~
4. Locating potential sources of pollution within 5 miles upstream from the surface water intake; and
- ~~45. Assessing the degree of hazard to the source by possible spillage~~ surface water source ~~water resulting from a potential release~~ of materials that may be toxic, harmful, or detrimental to treatment processes.

~~D.G.~~ Intake Surface water intake structures shall provide for:

- ~~1. Withdrawal of water from at least three levels in impoundments or reservoirs. Withdrawal of water from more than one level may be required in run-of-the-stream intakes if the quality varies with depth;~~
- ~~2. Separate facilities for release of less desirable water held in storage~~ at impoundments or reservoirs;
- ~~3. Screens on intake ports with provisions for adequate cleaning.~~ Screen opening size and velocity may be restricted by federal or state permit;
- ~~4. Prevention of flooding of access walkways and control valves of intakes on multiple purpose reservoirs; and~~
- ~~5. Velocity of flow through~~ Flow velocity through the inlet structure ~~such so~~ that frazil ice will be held to a minimum.

~~D.~~ A detention reservoir is a structure into which water is stored for pretreatment to improve water quality prior to other treatment. ~~Where a detention reservoir is required, the development shall assure that:~~

- ~~1. Water quality is protected by controlling runoff into reservoir;~~
- ~~2. Dikes are structurally sound and protected against wind action and erosion;~~
- ~~3. Point of influent flow is separated from the point of withdrawal; and~~
- ~~4. Sufficient detention time is provided in the reservoir as recommended by the designer and approved by the division.~~

~~E.~~ In order to protect the public health and guarantee a supply of pure water, terminal reservoirs shall not be utilized for body contact recreation and boats powered by gasoline engines. Large terminal reservoirs may be used for body contact recreation and boats powered by gasoline engines provided a buffer zone acceptable to the division and water purveyor is furnished. Site preparation shall include but not be limited to the removal of brush and trees to the high water elevation, and protection from floods during construction.

# Revisions to Virginia's *Waterworks Regulations*

12VAC5-590-830

Nelson Daniel



# Unresolved Items - Safe Yield

12VAC5-590-830. Surface Water Sources.

- Subgroup met on August 23, 2018
- Members discussed desire to leave the term “safe yield” in the *Waterworks Regulations*
- How?
  - Distinguish between VDH and DEQ roles
  - Preserve historic use of the term
- Developed conceptual language

## 12VAC5-590-830. Surface Water Sources; Quantity; Quality; Development Structures.

A. A surface water source includes all tributary streams and drainage basins, natural lakes, and artificial reservoirs or impoundments above the point of water supply intake.

1. The quantity of water at the source shall:
  - a. Be adequate to supply the water demand of the service area;
  - b. Provide a reasonable surplus for anticipated growth; and
  - c. Be adequate to compensate for all losses, including evaporation, seepage, flow-by requirements, etc.



## 12VAC5-590-830. Surface Water Sources; Quantity; Quality; Development Structures.

A. A surface water source includes all ~~tributary streams, rivers, and drainage basins, natural lakes, and other~~ bodies of natural or impounded waters, and the tributaries thereto, artificial reservoirs or impoundments above the point of water supply intake.

1. The quantity of water from the surface water at the source, plus water from other sources available to and used by the waterworks, shall: ...

## 12VAC5-590-830. Surface Water Sources; Quantity; Quality; Development Structures.

2. The safe yield of the source shall be determined as follows:

a. Simple intake (free-flowing stream). The safe yield is defined as the minimum withdrawal rate available during a day and recurring every 30 years (30 year - one day low flow). To generate the report for this, data is to be used to illustrate the worst drought of record in Virginia since 1930. If actual gauge records are not available for this, gauges are to be correlated from similar watersheds and numbers are to be synthesized; and

## 12VAC5-590-830. Surface Water Sources; Quantity; Quality; Development Structures.

2. The safe yield of the source shall be determined as follows: ...

b. Complex intake (impoundments in conjunction with streams). The safe yield is defined as the minimum withdrawal rate available to withstand the worst drought of record in Virginia since 1930. If actual gauge records are not available, correlation is to be made with a similar watershed and numbers synthesized in order to develop the report.

# Objectives

- Preserve the meaning or concept of “safe yield” as it has been established in the *Waterworks Regulations*.
- Provide more clarity on how VDH and DEQ work together with respect to surface water withdrawals for waterworks.
- Acknowledge that VDH interpretation and application of safe yield (public health protection) is different from DEQ (environmental protection).

# Objectives

- Stop using/referring to 1Q30
- Use the effective date of the regulations to say what “safe yield” meant, and how, after the effective date of the regulations, VDH will consider “capacity” or “the maximum available quantity of water from a surface water source,” which was formerly known as “safe yield.”

# Objective

Preserve the meaning or concept of “safe yield” as it has been established in the Waterworks Regulations.

Use the effective date of the regulations:

2. Waterworks that have an operation permit with an effective date on or before [insert effective date of the regulations]: ~~the~~ The safe yield of the surface water source ~~was shall be~~ determined as follows:

a. Simple intake (free-flowing stream). The safe yield is defined as ...

# Conceptual Language - Looking Forward

Adequate source water capacity or safe yield is based on any applicable withdrawal limit in a Virginia Water Protection permit. In the absence of that, source water capacity can be demonstrated in the following ways:

- (1) Provide the safe yield from a waterworks permit issued prior to [*insert effective date of Regulations*];
- (2) Demonstrate intake capacity for a pre-1989 withdrawal;
- (3) Demonstrate grandfathered water withdrawal capacity in accordance with 9 VAC 25-210-310; and
- (4) Provide a hydrologic evaluation of source water capacity prepared by a licensed engineer.

# Conceptual Language in Section 830

12VAC5-590-830. A.

3. For waterworks seeking a construction permit or operation permit after [insert effective date of the regulations]: the maximum available quantity of water from a surface water source shall be based on any applicable withdrawal limit in a Virginia Water Protection permit. In the absence of a limit established by a Virginia Water Protection Permit, the maximum quantity of water available from the surface water source (capacity) may be established in the following ways:



# Conceptual Language in Section 830

12VAC5-590-830. A. 3.

- a. The safe yield from a waterworks operation permit issued prior to [insert the effective date of the regulations];
- b. Demonstrate the maximum available withdrawal for a surface water withdrawal in existence on July 1, 1989;
- c. Demonstrate grandfathered water withdrawal capacity in accordance with 9VAC25-210-310; and/or
- d. Provide a hydrologic evaluation of source water capacity prepared by a licensed professional engineer. The evaluation must demonstrate the maximum withdrawal available to withstand the worst drought of record based on historical gauge data. If actual gauge records are not available, gauges shall be correlated from similar watersheds and synthesized.

# Conceptual Language

Nothing herein, including the calculation of safe yield or source water capacity, shall alter existing water rights or the owner's responsibility to obtain authorizations from other state agencies for water withdrawals and preservation of instream flow from surface water sources in accordance with State Water Control Law, Chapter 3.1 of Title 62.1 of the Code of Virginia and 9 VAC 25-210-310.

# Conceptual Language

B. Nothing herein, including the calculation of safe yield or capacity of a surface water source, shall alter existing water rights or the owner's responsibility to obtain authorizations from other state agencies for water withdrawals and preservation of instream flow from surface water sources in accordance with State Water Control Law, Chapter 3.1 of Title 62.1 of the Code of Virginia and 9 VAC 25-210-310.

# Unresolved Items

12VAC5-590-830. Surface Water Sources.

- Language has not been finalized - comments rec'd:
  - Needs to more accurately reflect permitting process
  - More requirements for PEs
  - VWP based solely on water where intake is located, doesn't account for storage (i.e., system-wide demonstration of being able to meet need)
- Need to get comments from waterworks' leadership

# Unresolved Items

12VAC5-590-830. Surface Water Sources.

- ODW and other subgroup members independently incorporated the conceptual language into the Regulations
- Additional consideration by the WAC today
- Forward *Regulations* to OCOM, review w/the objective of providing recommended revisions to 12VAC5-590-830 during the review period (Sept - Oct, 2018).

Questions?

# Revisions to Virginia's *Waterworks Regulations*

Nelson Daniel

Robert D. Edelman, PE



# Objectives

- Complete a comprehensive revision to the state's requirements in the *Waterworks Regulations*.
  - Last significant revision in 1993
  - Update to reflect current technologies (membrane filtration, ozonation, UV disinfection)
  - Update to reflect state laws that have been passed since the 1990s (Eastern Virginia Groundwater Management Area)



# Objectives

- Complete a comprehensive revision to the state's requirements in the *Waterworks Regulations*.
  - Re-organize to improve clarity, readability (12VAC5-590-370 split into -370, -372, -373, -374)
  - Correct syntax, inconsistent terminology
  - Remove or revise outdated requirements
  - Incorporate the appendices into the main body of the *Regulations*
- DO NOT change or modify federal requirements.

# Objectives

- Resolve issues raised by the WAC & ODW staff
- Obtain the WAC's support to go forward with the revisions and regulatory process
- Deliver to BOH in advance of December 13, 2018 meeting

# Objectives

- Comply with the Virginia Register of Regulations *Form, Style and Procedure Manual for Publication of Virginia Regulations* (Style Manual)
- Enter revisions in the Regulatory Information System (RIS), finalize the regulatory package

# What has been accomplished so far...?

- ❑ Regulatory Advisory Panel (RAP) - Five meetings & 4 Workgroups - 2014
  - ❑ Stopped process 2015-2016 to add RTCR
- ❑ Waterworks Advisory Committee (WAC) meetings
  - ❑ 2017 (January, March, April, May, September)
- ❑ NOIRA published - October 30, 2017
- ❑ Additional WAC meetings
  - ❑ 2018 (April, May, July)
  - ❑ Sept. 5, 2018 (seeking WAC support to go forward)

# Issues and New Initiatives

- Definitions
- Operation Permits
- Waterworks Business Operation Plan
- Operator Attendance

# Issues and New Initiatives

- Analytical Methods
- RTCR (reduced monitoring)
- Cross Connection Control
- Fluoridation

# New/Revised Definitions

- Boil water advisory
- Boil water notice
- Distribution system
- Exemption
- Optimum fluoride ion concentration
- Site visit
- Variance
- Waiver
- Water supply

# Other Technical Changes by ODW

- Consistency in word usage/terminology: Examples...
  - Groundwater waterworks → Groundwater system
  - Disinfectant residual → Residual disinfectant
  - Residual chlorine → Chlorine residual
  - Commissioner → Department (specific situations)
- Clarify 3 source waters:
  - Surface water sources
  - Groundwater sources
  - GUDI sources
- “Should” → “shall” for confirmation samples



# Registrar - Style Manual Conformance

- Goal - consistency in word usage and terminology
  - Example: "blow-off" and "blowoff". Choose one and be consistent throughout the text
  - Dictionary word usage preferred
- Use singular style; e.g., "The owner shall..." replacing "Owners shall..."

# Unresolved Items

12VAC5-590-830. Surface Water Sources.

- Subgroup met on August 23, 2018, developed conceptual language
- Additional consideration by the WAC today
- Will go forward with OCOM review with the objective of providing recommended revisions to 12VAC5-590-830 during the review period (Sept - Oct, 2018).

# Remaining VDH/ODW Tasks

- Satisfy Style Manual requirements
- RIS Data Entry and QA/QC
- OCOM Review
- Board of Health Action Package
- Prepare TH-02 - Proposed Regulation Agency Background Document
  - Detail of Changes

# Milestones/Schedule

- September 2018
  - To Registrar for courtesy review
  - To Commissioner's Office for review
- By October 12, 2018
  - Notify the Commissioner's Office of BOH regulatory action agenda item
- By November 9, 2018
  - Deputy Commissioner approval
- By November 16, 2018
  - Submit Action Package for Board of Health
- December 13, 2018: Board of Health Meeting

Questions?

Project 5204 - Opened on 4-4-2018 for "shadowing" potential corrections  
DEPARTMENT OF HEALTH  
CH 0590 Update and amend the Waterworks Regulations

Part I  
General Framework for Waterworks Regulations

Article 4  
Definitions

**12VAC5-590-10. Definitions and units of measurement.**

A. Definitions. As used in this chapter, the following words ~~and~~ terms, ~~and~~ abbreviations shall have meanings respectively set forth unless the context clearly requires a different meaning:

"Action level" or "AL" means the concentration of lead or copper in water specified in 12VAC5-590-385, which determines, in some cases, the treatment requirements contained in 12VAC5-590-405 that an owner is required to ~~complete.~~ complete.

"Administrative Process Act" or "APA" means Chapter 40 (§ 2.2-4000 et seq.) of Title 2.2 of the Code of Virginia. The APA is the basic law conferring authority on agencies either to make regulations or case decisions as well as to standardize court review thereof.

"Air gap separation" means the unobstructed vertical distance through the free atmosphere between the lowest ~~opening from any pipe or faucet supplying pure water to a tank, plumbing fixture, or other device and the rim of the receptacle~~ point of the potable water outlet and the flood rim of the receiving vessel.

"Annual daily water demand" means the average rate of daily water usage over at least the ~~most recent three-year period.~~

~~"ANSI" means American National Standards Institute.~~

"Applied water" means water that is ready for filtration.

~~"ASME" means the American Society of Mechanical Engineers.~~

~~"ASSE" means the American Society of Sanitary Engineers.~~

~~"ASTM" means the American Society for Testing and Materials.~~

~~"Approved" means material, equipment, workmanship, process or method that has been accepted by the commissioner as suitable for the proposed use.~~

~~"ANSI" means American National Standards Institute.~~

~~"ASME" means the American Society of Mechanical Engineers.~~

~~"ASSE" means the American Society of Sanitary Engineers.~~

~~"ASTM" means the American Society for Testing and Materials.~~

"Auxiliary water system" means any water supply or system on or available to the premises of the consumer other than the waterworks. ~~These auxiliary waters may include water from a source such as wells, lakes, or streams; process fluids; or used water. They~~ These may be polluted or contaminated ~~or~~ objectionable, or of questionable quality, and constitute an unapproved water source ~~supply or system over which the water purveyor waterworks owner does not have control.~~

"Auxiliary water system" means any separate water supply or system on or available to the premises of the consumer other than the waterworks. These are unapproved and the waterworks owner does not have control over their operation. Such sources of water may be polluted or contaminated, objectionable, and of questionable quality.

"AWWA" means the American Water Works Association.

"Backflow" means the undesirable reversal of flow of water or mixtures of water and other liquids, mixtures gases, or other substances into the distribution piping of a waterworks from any source or sources other than its intended source.

"Backflow elimination method" means the air gap separation or physical disconnection that will eliminate the cross-connection.

"Backflow prevention assembly" means a mechanical unit, designed to stop the reversal of flow that includes an inlet and outlet shutoff valve and test cocks to facilitate testing of the assembly. Backflow prevention assemblies include the reduced pressure principle backflow prevention assembly, the double gate-double check valve assembly, and the pressure vacuum breaker assembly.

"Backflow prevention device" means any approved device, method, or type of construction intended to prevent backflow into a waterworks. a mechanical unit designed to stop the reversal of flow that is not testable because it does not have inlet and outlet shutoff valves or test cocks. Backflow prevention devices are not generally designed or constructed to withstand backpressure. Backflow prevention devices generally include the atmospheric type vacuum breakers and the dual check valve type devices.

~~"Backflow elimination method" means the air gap separation or physical disconnection that will eliminate the cross connection.~~

~~"Backflow prevention assembly" means a mechanical unit, designed to stop the reversal of flow that includes an inlet and outlet shut-off valve and test cocks to facilitate testing of the assembly. Backflow prevention assemblies include the reduced pressure principle backflow prevention assembly, the double gate-double check valve assembly, and the pressure vacuum breaker assembly.~~

"Backpressure backflow" means backflow caused by pressure in the downstream piping that is superior to the supply pressure at the point of consideration.

"Backsiphonage-backflow" means backflow caused by a reduction in pressure that causes a partial vacuum creating a siphon effect.

"Bag filters" means pressure-driven separation devices that remove particulate matter larger than one micrometer using an engineered porous filtration media. They are typically constructed of a ~~nonrigid~~ non-rigid, fabric filtration media housed in a pressure vessel in which the direction of flow is from the inside of the bag to outside.

"Bank filtration" means a water treatment process that uses a well to recover surface water that has naturally infiltrated into groundwater through a river bed ~~or bank(s)~~, bank or banks. Infiltration is typically enhanced by the hydraulic gradient imposed by a nearby pumping water supply or other ~~well(s)~~ well or wells.

"Best available technology" or "BAT" means the best practicable technology, treatment techniques, or other means that the commissioner finds, after examination for efficacy under field conditions and not solely under laboratory conditions ~~and in conformance with applicable EPA regulations, that~~ are available (taking cost into consideration).

"Board" means the State Board of Health.

"Boil water advisory" and "boil water notice" mean a statement that informs consumers that their drinking water is, or may be, contaminated and that the water should be boiled before being used for human consumption.

"BSSP" means a bacteriological sample siting plan.

"Breakpoint chlorination" means the addition of chlorine to water until the chlorine demand has been satisfied and further additions result in a residual that is directly proportional to the amount added.

"CAP" means a corrective action plan.

"Cartridge filters" means pressure-driven separation devices that remove particulate matter larger than one micrometer using an engineered porous filtration media. They are typically constructed as rigid or semi-rigid, self-supporting filter elements housed in pressure vessels in which flow is from the outside of the cartridge to the inside.

~~"Chlorine" means dry chlorine.~~

"Case decision" means an agency determination as defined in § 2.2-4001 of the Code of Virginia.

~~"CCCP" means a cross-connection control plan.~~

~~"CCR" means consumer confidence report.~~

~~"CDC" means the Centers for Disease Control, headquartered in Atlanta, Georgia.~~

~~"CFE" means the combined filter effluent.~~

~~"CFR" means the Code of Federal Regulations.~~

~~"Chlorine gas" means dry chlorine in the gaseous state.~~

~~"Chlorine solution (chlorine water)" means a solution of chlorine in water.~~

~~"Chronically noncompliant waterworks" or "CNC" means a waterworks that is unable to provide pure water for any of the following reasons: (i) the waterworks' record of performance demonstrates that it can no longer be depended upon to furnish pure water to the persons served; (ii) the owner has inadequate technical, financial, or managerial capacity to furnish pure water to the people served; (iii) the owner has failed to comply with an order issued by the board or the commissioner; (iv) the owner has abandoned the waterworks and has discontinued supplying pure water to the persons served; or (v) the owner is subject to a forfeiture order pursuant to § 32.1-174.1 of the Code of Virginia.~~

"Clean compliance history" means a record of no PMCL violations for microbiological contaminants, no monitoring violations under 12VAC5-590-370, and no coliform treatment technique trigger exceedances or treatment technique violations under 12VAC5-590-392.

"Coagulation" means a process using coagulant chemicals and mixing by which colloidal and suspended materials are destabilized and agglomerated into floc.

~~"Coliform bacteria group" means a group of bacteria predominantly inhabiting the intestines of man or animal but also occasionally found elsewhere. It includes all aerobic and facultative anaerobic, gram-negative, non-sporeforming bacilli that ferment lactose with production of gas. Also included are all bacteria that produce a dark, purplish-green colony with metallic sheen by the membrane filter technique used for coliform identification.~~

"Combined distribution system" means the interconnected distribution system consisting of the distribution systems of wholesale waterworks and of the consecutive waterworks that receive finished water.

"Commissioner" means the State Health Commissioner, who is the executive officer of the board.

"Community waterworks" means a waterworks that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

~~"Compliance cycle" means the nine-year calendar year cycle during which a waterworks shall monitor. Each compliance cycle consists of three three-year compliance periods. The first calendar year cycle begins begin January 1, 1993, and ends ended December 31, 2001; the second begins January 1, 2002, and ends December 31, 2010; the third begins January 1, 2011, and ends December 31, 2019 with subsequent compliance cycles continuing thereafter.~~



"Compliance period" means a three-year calendar year period within a compliance cycle. Each compliance cycle ~~has consists of~~ three three-year compliance periods. ~~Within the first compliance cycle, the first compliance period runs from January 1, 1993, to December 31, 1995; the second from January 1, 1996, to December 31, 1998; the third from January 1, 1999, to December 31, 2004. The first compliance period began January 1, 1993 and ended December 31, 1995, with subsequent compliance periods continuing thereafter.~~

"Comprehensive business plan" means a plan detailing the technical, managerial, and financial (TMF) commitments that the owner will make in order to assure that the waterworks will have the capability to provide water that complies with the regulations over the long term. , and herein referred to as a "waterworks business operations plan."

~~"Comprehensive performance evaluation" or "CPE" means a thorough review and analysis of a treatment plant's performance-based capabilities and associated administrative, operational and maintenance practices. It is conducted to identify factors that may be adversely impacting a plant's capability to achieve compliance and emphasizes approaches that can be implemented without significant capital improvements. For purposes of compliance with 12VAC5-590-530 E 1 b (2), the comprehensive performance evaluation shall consist of at least the following components: assessment of plant performance, evaluation of major unit processes, identification and prioritization of performance limiting factors, assessment of the applicability of comprehensive technical assistance, and preparation of a CPE report.~~

"Confirmation sample" means another sample to be collected by the owner within a specified time after the results of the initial sample are known to have exceeded a specified limit or standard, in order to validate the initial result and to determine compliance.

"Confluent growth" means a continuous bacterial growth covering the entire filtration area of a membrane filter, or a portion thereof, in which bacterial colonies are not discrete.

~~"Consecutive waterworks" means a waterworks that has no water production or source facility of its own and that obtains all of its water from another permitted waterworks or receives some or all of its finished water from one or more wholesale waterworks. Consecutive waterworks may provide additional treatment to finished water. Delivery may be through a direct connection or through the distribution system of one or more consecutive waterworks.~~

"Consolidated" means rock made from sedimentary-sedimentary, igneous-igneous, or metamorphic-metamorphic materials that have been metamorphosed or cemented together forming strata or bodies of rock.

~~"Consumer" means any person who drinksreceiving water for human consumption water from a waterworks.~~

"Consumer's water system" means any water system located on the consumer's premises, supplied by or in any manner connected to a waterworks.

"Containment" means the safeguard against backflow into a waterworks from a consumer's water system by installing an appropriate backflow prevention assembly, backflow prevention device, or backflow elimination method at the service connection.

"Contaminant" means any objectionable or hazardous physical, chemical, biological, or radiological substance or matter in water.

"Conventional filtration treatment" means a series of processes including coagulation, flocculation, sedimentation, and filtration resulting in substantial particulate removal.

"Corrosion inhibitor" means a substance capable of reducing the corrosivity of water toward metal plumbing materials, especially lead and copper, by forming a protective film on the interior surface of those materials.

~~"Cross-connection" means any connection or structural arrangement, direct or indirect, to the waterworks whereby actual or potential link, connection or physical arrangement, direct or indirect, between used water, an auxiliary water system, or other source of contamination to the waterworks through which backflow can occur.~~

~~"CT" or "CT<sub>calc</sub>" means the product of "residual disinfectant concentration" (C) in mg/L determined before or at the first customer consumer, and the corresponding "disinfectant contact time" (T) in minutes (i.e., "C" x "T").~~

~~"Daily fluid intake" means the daily intake of water for drinking and culinary use and is defined as two liters.~~

~~"Dechlorination" means the partial or complete reduction of residual chlorine in water by any chemical or physical process at a waterworks with a treatment facility.~~

~~"Degree of hazard" means the level of health hazard, as derived from an evaluation of the potential risk to health and the adverse effect upon the waterworks.~~

~~"DBPPs" means disinfection byproduct precursors.~~

~~"DBPs" means disinfection byproducts.~~

~~"DCLS" means the Virginia Department of General Services, Division of Consolidated Laboratory Services.~~

~~"Department" means the Virginia Department of Health.~~

~~"DEQ" means the Virginia Department of Environmental Quality.~~

~~"Diatomaceous earth filtration" means a process resulting in substantial particulate removal in which (i) a precoat cake of diatomaceous earth filter media is deposited on a support membrane (septum), and (ii) while the water is filtered by passing through the cake on the septum, additional filter media known as body feed is continuously added to the feed water to maintain the permeability of the filter cake.~~

~~"Direct filtration" means a series of processes including coagulation and filtration but excluding sedimentation resulting in substantial particulate removal.~~

~~"Disinfectant" means any oxidant (including chlorine) that is chemical and physical agents, including chlorine, chlorine dioxide, chloramines, ozone and UV light, added to water in any part of the treatment or distribution process for the purpose of killing or deactivating inactivating pathogenic organisms.~~

~~"Disinfectant contact time" ("T" in CT calculations) means the time in minutes that it takes for water to move from the point of disinfectant application to the point where residual disinfectant concentration ("C") is measured.~~

~~"Disinfection" means a process that inactivates or destroys pathogenic organisms in water by chemical oxidants or equivalent agents use of a disinfectant.~~

~~"Disinfection profile" means a summary of Giardia lamblia or virus inactivation through the water treatment plant.~~

~~"Distribution main" means a water main pipeline whose primary purpose is to provide treated convey drinking water to service connections.~~

~~"Distribution system" means a network of pipelines and appurtenances by which a waterworks delivers drinking water to its consumers.~~

~~"District engineer" means the employee assigned by the Commonwealth of Virginia, Department of Health, Office of Drinking Water to manage its regulatory activities in a geographical area of the state consisting of a state planning district or subunit of a state planning district.~~

~~"Domestic or other nondistribution system plumbing problem" means a coliform contamination problem in a waterworks with more than one service connection that is limited to the specific service connection from which the coliform positive sample was taken.~~

"DOC" means the dissolved organic carbon in a water sample.

~~"Double gate-double check valve assembly" means an approved assembly composed of two single independently acting check valves including tightly closing shutoff valves located at each end of the assembly and petcocks and test gauges for testing the watertightness of each check valve.~~

"DPOR" means the Virginia Department of Professional and Occupational Regulation.

"Drawdown" means the difference, measured vertically, between the static water level in the well and the water level during pumping.

~~"Dual sample set" means a set of two samples collected at the same time and same location, with one sample analyzed for TTHM and the other sample analyzed for HAA5. Dual sample sets are collected for the purposes of conducting an initial distribution system evaluation (IDSE) under 12VAC5-590-370-B-3-e (2) and determining compliance with the TTHM and HAA5 MCLs under 12VAC5-590-370-B-3-e (3).~~

"EDR" means electro dialysis reversal.

~~"Effective corrosion inhibitor residual" means, for the purpose of 12VAC5-590-405-A-1 only, a concentration sufficient to form a passivating film on the interior walls of a pipe.~~

"Enhanced coagulation" means the addition of sufficient coagulant for improved removal of disinfection byproduct precursors by conventional filtration treatment.

"Enhanced softening" means the improved removal of disinfection byproduct precursors by precipitative softening.

"Entry point" means the place where water from the source after application of any treatment is delivered to the distribution system. Where two or more sources are combined before distribution, the entry point is the location that is representative of the blended water following all treatment.

"EPA" means the United States Environmental Protection Agency.

~~"Equivalent residential connection" means a volume of water used equal to a residential connection that is 400 gallons per day unless supportive data indicates otherwise.~~

~~"Exception" means an approved deviation from a "shall" criteria contained in Part III (12VAC5-590-640 et seq.) of this chapter.~~

"Exemption" means allowing a waterworks that satisfies the criteria in 12VAC5-590-150 to deviate from a conditional waiver of a specific PMCL or treatment technique requirement that is granted to ~~a specific~~ the waterworks for a limited period of time.

"Filter profile" means a graphical representation of individual filter performance, based on continuous turbidity measurements or total particle counts versus time for an entire filter run, from startup to backwash inclusively, that includes an assessment of filter performance while another filter is being backwashed.

"Filtration" means a process for removing particulate matter from water by passage through porous media.

"Finished water" means water that is introduced into the distribution system of a waterworks and is intended for distribution and consumption without further treatment, except as treatment necessary to maintain water quality in the distribution system (~~e.g., booster disinfection, addition of corrosion control chemicals~~). (e.g., booster disinfection).

~~"First draw sample" means a one-liter sample of tap water, collected in accordance with 12VAC5-590-375 B 2, that has been standing in plumbing pipes at least six hours and is collected without flushing the tap.~~

"Flocculation" means a process to enhance agglomeration or collection of smaller floc particles into larger, more easily settleable particles through gentle stirring by hydraulic or mechanical means.

"Flowing stream" means a course of running water flowing in a definite channel.

"Free available chlorine" means that portion of the total ~~residual~~ chlorine ~~residual~~ remaining in water at the end of a specified contact period that will react chemically and biologically as hypochlorous acid or hypochlorite ion.

~~"GAC10" means granular activated carbon filter beds with an empty bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of every 180 days, except that the reactivation frequency for GAC10 used as a best available technology for compliance with 12VAC5-590-410 C 2 b (1) (b) shall be 120 days.~~

~~"GAC20" means granular activated carbon filter beds with an empty bed contact time of 20 minutes based on average daily flow and a carbon reactivation frequency of every 240 days.~~

"GAC" means granular activated carbon.

~~"Governmental entity" means the Commonwealth, a town, city, county, service authority, sanitary district, or any other governmental body established under the Code of Virginia, including departments, divisions, boards, or commissions.~~

"Gross alpha particle activity" means the total radioactivity due to alpha particle emission as inferred from measurements on a dry sample.

"Gross beta particle activity" means the total radioactivity due to beta particle emission as inferred from measurements on a dry sample.

~~"Groundwater" means all water obtained from sources not classified as surface water (or surface water sources).~~

"Groundwater system" means any waterworks that uses groundwater as its source of supply; however, a waterworks that combines all its groundwater with surface water or with groundwater under the direct influence of surface water ~~prior to~~ before treatment is not a groundwater system. Groundwater systems include consecutive waterworks that receive ~~finished groundwater from a wholesale waterworks~~ potable water from another groundwater source.

"Groundwater under the direct influence of surface water" or "GUDI" means any water beneath the surface of the ground with (i) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as Giardia lamblia, or Cryptosporidium. ~~It also means or (ii) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH that closely correlate to climatological or surface water conditions. The GUDI source determinations shall be made by the commissioner in accordance with 12VAC5-590-430 will determine direct influence of surface water.~~

"GWMA" means the groundwater management area designation by the State Water Control Board.

"Haloacetic acids (five)" or "HAA5" means the sum of the concentrations ~~in milligrams per liter of the haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid), rounded to two significant figures after addition.~~ acids, expressed in milligrams per liter (mg/L) as rounded to two significant figures. For the purpose of this chapter the HAA5 shall mean monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid.

"Halogen" means one of the chemical elements chlorine, bromine, fluorine, ~~astatine~~ astatine, or iodine.

"Health hazard" means any condition, device, or practice in a waterworks or its operation that creates, or may create, a danger to the health and well-being of the water consumer.

~~"Health regulations" means regulations that include all primary maximum contaminant levels, treatment technique requirements, and all operational regulations, the violation of which would jeopardize the public health.~~

"HPC" means the heterotrophic plate count of a bacterial population.

"Human consumption" means drinking, food preparation, dishwashing, bathing, showering, hand washing, teeth brushing, and maintaining oral hygiene.

~~"Hypochlorite" means a solution of water and some form of chlorine, usually sodium hypochlorite the ionic component from the disassociation of hypochlorous acid that performs the function of disinfection. It is the available active ingredient in liquid hypochlorite disinfectants such as sodium and calcium hypochlorite.~~

~~"Initial compliance period" means for all regulated contaminants, the initial compliance period is the first full three year compliance period beginning at least 18 months after promulgation with the exception of waterworks with 150 or more service connections for contaminants listed at Table 2-3, VOC 19-21; Table 2-3, SOC 19-33; and antimony, beryllium, cyanide (as free cyanide), nickel, and thallium that shall begin January 1993 the compliance period in which chemical monitoring begins.~~

~~"Interchangeable connection" means an arrangement or device that will allow alternate but not simultaneous use of two sources of water.~~

"Isolation" means the safeguard against backflow into a waterworks from a consumer's water system by installing an appropriate backflow prevention assembly or device or by installing a backflow elimination method at the sources of potential contamination in the consumer's water system. This is also called point-of-use point-of-use isolation.

~~"Karst geology" means an area predominantly underlain by limestone, dolomite, or gypsum and characterized by rapid underground drainage. Such ~~These~~ areas often feature sinkholes, caverns, and sinking or disappearing creeks. In Virginia, this generally includes all that area west of the Blue Ridge and, in Southwest Virginia, east of the Cumberland Plateau.~~

"Lake/reservoir" means a natural or ~~manmade~~ man-made basin or hollow on the Earth's surface in which water collects or is stored that may or may not have a current or single direction of flow.

~~"Large waterworks" means, for the purposes of 12VAC5-590-375, 12VAC5-590-405, 12VAC5-590-530 F, and 12VAC5-590-550 D only, a waterworks that serves more than 50,000 persons.~~

"Lead free" means the following: (i)

1. ~~When~~ when used with respect to solders and flux, refers to solders and flux containing not more than 0.2% lead; and (ii)

2. ~~When~~ when used with respect to ~~pipes~~ pipes, and pipe fittings, refers to pipes and pipe fittings containing not more than 8.0% lead; pipe fittings, plumbing fittings, and plumbing fixtures, refers to the weighted average of wetted surfaces of pipes, pipe fittings, plumbing fittings, and plumbing fixtures containing not more than 0.25% lead.

3. ~~When~~ used with respect to plumbing fittings and fixtures intended by the plumbing manufacturer to dispense water for human ingestion, refers to fittings and fixtures that are in compliance with standards established in accordance with 42 USC § 300g-6(e).

"Lead service line" means a ~~service line pipeline~~ made of lead that connects the ~~water distribution main~~ to the building inlet and any lead pigtail, ~~gooseneck-gooseneck~~, or other fitting that is connected to ~~such lead line-the lead pipeline~~.

"Leakage" means the loss of potable water from the distribution system, up to the points of service connections, through breaks or defects in piping and piping appurtenances.

"Legionella" means a genus of bacteria, some species of which have caused a type of pneumonia called Legionnaires disease.

"Level 1 assessment" means an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and, when possible, the likely reason that the waterworks triggered the assessment.

"Level 2 assessment" means an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and, when possible, the likely reason that the waterworks triggered the assessment in a more comprehensive investigation than a Level 1 assessment.

~~"Liquid chlorine" means a liquefied, compressed chlorine gas as shipped in commerce.~~

"Locational running annual average" or "LRAA" means the average of sample analytical results for samples taken at a particular monitoring location during the previous four calendar quarters.

~~"Log inactivation (log removal)" means that a 99% reduction is a 2-log inactivation; a 99.9% reduction is a 3-log inactivation; a 99.99% reduction is a 4-log inactivation means the inactivation of organisms expressed on a logarithmic scale. For example, a 99.9% inactivation is a 3-log inactivation; whereas a 99.99% inactivation is a 4-log inactivation.~~

~~"Log removal" means the removal of organisms expressed on a logarithmic scale. For example, a 99.9% is a 3-log removal; whereas a 99.99% removal is a 4-log removal.~~

~~"Manmade beta particle and photon emitters" means all radionuclides emitting beta particles and/or photons listed in the most current edition of "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," National Bureau of Standards Handbook 69, except the daughter products of thorium-232, uranium-235 and uranium-238.~~

"Maximum contaminant level" or "MCL" means the maximum permissible level of a contaminant in ~~pure~~ potable water that is delivered to any ~~user~~ consumer of a waterworks. MCLs are set as close to the MCLGs as feasible using the ~~best available treatment technology~~ BAT. MCLs may be either "primary" (PMCL), meaning based on health considerations, or "secondary" (SMCL), meaning based on aesthetic considerations.

~~"Maximum contaminant level goal" or "MCLG" means the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur and that allows an adequate margin of safety. Applying an adequate margin of safety to the MCLG allows the MCL to be set as the standard. Maximum contaminant level goals are nonenforceable health goals.~~

~~"Maximum daily water demand" means the rate of water usage during the day of maximum water use.~~

"Maximum residual disinfectant level" or "MRDL" means a level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap without an unacceptable possibility of adverse health effects. ~~For chlorine and chloramines, a waterworks is in compliance with the MRDL when the running annual average of monthly averages of samples taken in the distribution system, computed quarterly, is less than or equal to the MRDL. For chlorine dioxide, a waterworks is in compliance with the MRDL when daily samples are taken at the entrance to the distribution system and no two consecutive daily samples exceed the MRDL. MRDLs are~~

~~enforceable in the same manner as maximum contaminant levels. There is convincing evidence that addition of a disinfectant is necessary for control of waterborne microbial contaminants. Notwithstanding the MRDLs listed in Table 2.12, operators may increase residual disinfectant levels of chlorine or chloramines (but not chlorine dioxide) in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems caused by circumstances such as distribution line breaks, storm runoff events, source water contamination, or cross-connections.~~

"Maximum residual disinfectant level goal" or "MRDLG" means the maximum level of a disinfectant added for water treatment at which no known or anticipated adverse effect on the health of persons would occur, and that allows an adequate margin of safety. MRDLGs are nonenforceable health goals and do not reflect the benefit of the addition of the chemical for control of waterborne microbial contaminants.

"Maximum total trihalomethane potential" or "MTP" means the maximum concentration of total trihalomethanes produced in a given water containing a disinfectant residual after seven days at a temperature of 25°C or above.

~~"Medium waterworks" means, for the purpose of 12VAC5-590-375 and 12VAC5-590-405 only, a waterworks that serves greater than 3,300 and less than or equal to 50,000 persons.~~

"Membrane filtration" means a pressure or vacuum-driven separation process in which particulate matter larger than one micrometer is rejected by an engineered barrier, primarily through a size exclusion mechanism, and that has a measurable removal efficiency of a target organism that can be verified through the application of a direct integrity test. ~~This definition includes the common membrane technologies of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis. Included in this definition are the common membrane classifications of microfiltration (MF), and ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO).~~

"Membrane module" means the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet.

"Membrane technologies" means those processes that use a permeable membrane to remove ions, molecules, or particles from the process stream, such as MF, UF, NF, RO, and electrodialysis reversal (EDR).

"Membrane unit" means a group of membrane modules that share common valving that allows the unit to be isolated from the rest of the system for the purpose of integrity testing or other maintenance.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

"Microfiltration" or "MF" means a pressure-driven membrane technology that separates particles, based on the pore-size rating of the membrane, from a feed stream by using a sieving mechanism. Typically, microfiltration can remove particles down to 0.1 micrometer in size.

"Most probable number" or "MPN" means ~~that the density or number of organisms per unit volume that, in accordance with statistical theory, would be more likely than any other number to yield the observed test result or that would yield the observed test result with the greatest frequency, expressed as density of organisms per 100 milliliters. Results are computed from the number of positive findings of coliform group organisms resulting from multiple portion decimal dilution plantings most likely to be present in a water sample, and obtained from method-specific statistical MPN tables.~~

"MPA" means the microscopic particulate analysis method approved by EPA for use in the determination of whether a groundwater is under the influence of surface water.

"Nanofiltration" or "~~NF~~," "NF" means a pressure-driven membrane technology designed to remove multivalent ions ("softening") and other constituents based on the pore size, which ranges from 1 – 10 nanometers. Nanofiltration membranes typically operate under a pressure range of 600 – 1100 psi.

"ND" means "non-detected" typically used by laboratories to express the absence of an analyte in a test sample.

"Noncommunity waterworks" means a waterworks that is not a community waterworks, but operates at least 60 days out of the year.

"Nonpotable water" means water not classified as pure water.

"Nontransient noncommunity waterworks" or "NTNC" means a waterworks that is not a community waterworks and that regularly serves at least 25 of the same persons over six months out of the year. When used in the context of an NTNC, "regularly serves" means four or more hours per day, for four or more days per week, for 26 or more weeks per year.

"NSF" means the National Sanitation Foundation.

"Office" or "ODW" means the Commonwealth of Virginia, Department of Health, Office of Drinking Water.

"One hundred year flood level" means the flood elevation that will, over a long period of time, be equaled or exceeded on the average once every 100 years that has a 1% probability of occurring in any given year.

"Operating staff" means individuals employed or appointed by an owner to work at a waterworks. Included in this definition are operators, whether or not their license is appropriate for the classification and category of the waterworks, and unlicensed individuals.

"Operator" means any individual with the requisite skills, employed or appointed by any owner, and who is designated by such the owner to be the person in responsible charge, such as having full responsibility for the waterworks operations and any subordinate operating staff. The individual may be a supervisor, a shift operator, or a substitute in charge, and whose duties include testing or evaluation to control waterworks operations. Not included in this definition are superintendents or directors of public works, city engineers, or other municipal or industrial officials whose duties do not include the actual operation or direct supervision of waterworks.

"Optimal corrosion control treatment" means the corrosion control treatment that minimizes the lead and copper concentrations at users' consumers' taps while ensuring that the treatment does not cause the waterworks to violate any other section of this chapter.

"Optimum fluoride ion concentration" means that fluoride ion concentration recommended by the U.S. Public Health Service for protection from dental caries.

"Owner" or "~~water purveyor~~" means an individual, group of individuals, partnership, firm, association, institution, corporation, governmental entity, or the federal government that supplies or proposes to supply water to any person within this state Commonwealth from or by means of any waterworks (see Article 2 (§ 32.1-167 et seq.) of Chapter 6 of Title 32.1 of the Code of Virginia).

"PAC" means powdered activated carbon.

"PCBs" means polychlorinated biphenyls.

"PER" means a preliminary engineering report.

"Permit" means an authorization granted by the commissioner to construct or operate a waterworks.

"Permitted capacity" means the limiting hydraulic capability of the waterworks, taking into consideration the source water withdrawal, treatment facilities, finished water storage, ~~delivery~~ delivery, and distribution system.



"Person" means any individual, corporation, partnership, association, ~~cooperative~~ cooperative, limited liability company, trust, joint venture, ~~governmental government~~, political subdivision, or any other legal or commercial entity and any successor, representative, agent, or instrumentality thereof.

"pH" means the negative logarithm of the hydrogen ion concentration of an aqueous solution.

"Physical disconnection" means the removal or absence of pipes, fittings, or fixtures that connect a waterworks directly or indirectly to any other water system.

"Picocurie" or "pCi" means that quantity of radioactive material producing 2.22 nuclear transformations per minute.

"Plant intake" means the works or structures at the head of a conduit through which water is diverted from a source (e.g., river or lake) into the treatment plant.

"PMCL" – ~~See see~~ "Maximum contaminant level".

"Point of disinfectant application" means the point where the disinfectant is applied and water downstream of that point is not subject to recontamination by surface ~~water~~-runoff.

"Point-of-entry treatment device" or "POE device" means a treatment device applied to the water entering a house or building for the purpose of reducing contaminants in the water distributed throughout the house or building.

"Point-of-use treatment device" or "POU device" means a treatment device applied to a single tap for the purpose of reducing contaminants in the water at that one tap.

"Pollution" means the presence of any foreign substance (chemical, physical, radiological, or biological) in water that tends to degrade its quality so as to constitute an unnecessary risk to human health or impair the usefulness of the water.

~~"Pollution hazard" means a condition through which an aesthetically objectionable or degrading material may enter the waterworks or a consumer's water system.~~

~~"Postchlorination" means the application of chlorine to water subsequent to treatment.~~

"Potable water" – see "Pure water."

~~"Practical quantitation level" or "PQL" means the lowest level achievable by good laboratories within specified limits during routine laboratory operating conditions that can be reliably measured within specified limits of precision and accuracy during routine laboratory conditions.~~

"Prechlorination" means the application of chlorine to water ~~prior to~~ before filtration.

"Presedimentation" means a preliminary treatment process used to remove gravel, ~~sand~~ sand, and other particulate material from the source water through settling before the water enters the primary clarification and filtration processes in a water treatment plant.

~~"Pressure vacuum breaker assembly" means an assembly designed to prevent backsiphonage ~~backflow~~ and used for ~~high-high-hazard~~ or ~~low-hazard low-hazard~~ situations, composed of an independently operating, spring-loaded check ~~valve:valve~~; an independently ~~operating-operating~~, spring-loaded air-inlet valve; and tightly closing ~~shut-off~~ shutoff valves located at each end of the assembly; and fitted with properly located test cocks.~~

~~"Primary disinfection" means disinfection to achieve a desired level of inactivation of targeted pathogenic organisms in water by chemical or physical agents as an integral part of the treatment process.~~

"Process fluids" means any fluid or solution that may be chemically, biologically, or otherwise contaminated or polluted that would constitute a health, ~~pollutional-environmental~~, or system hazard if introduced into the waterworks. This includes, but is not limited to:

1. Polluted or contaminated water;
2. ~~Process waters~~;

~~3. Used waters, originating from the waterworks that may have deteriorated in sanitary quality;~~

~~4. Cooling waters;~~

~~5. Contaminated natural waters taken from wells, ~~lakes~~ lakes/reservoirs, streams, or irrigation systems;~~

~~6. Chemicals in solution or suspension; and or~~

~~7. Oils, gases, acids, alkalis, and other liquid and gaseous fluid used in industrial or other processes, or for firefighting purposes.~~

"Process water" means water used for dissolving dry chemicals; diluting liquid chemicals; and operating chemical feeders, treatment facilities, or equipment.

"Project documents" means the engineer's report, design criteria, preliminary and final plans, ~~specifications~~ specifications, and procurement documents for the construction of new waterworks or modifications to existing waterworks.

~~"Protected water source" means a source water by groundwater or surface water within a delineated area where the potential for contamination is mitigated. Protection may be provided by natural conditions (e.g., confined aquifer) or other physical barriers (e.g., covered reservoir) either by known governmental or voluntary initiatives.~~

"Pure water" means water fit for human consumption that is (i) sanitary and normally free of minerals, organic substances, and toxic agents in excess of reasonable amounts and (ii) adequate in quantity and quality for the minimum health requirements of the persons served (see Article 2 (§ 32.1-167 et seq.) of Chapter 6 of Title 32.1 of the Code of Virginia).

"Raw water main" means a water main that conveys untreated water from a source to a treatment facility.

"QCRV" means the quality control release value used in challenge tests of microfiltration and ultrafiltration membrane filters.

"RAA" means running annual average.

"Reduced pressure principle backflow prevention ~~device~~ assembly" or "RPZ ~~device~~ assembly" means a device containing a minimum of two independently acting check valves together with an automatically operated pressure differential relief valve located between the two check valves, an assembly designed to prevent backsiphonage or backpressure backflow used for high or low hazard situations, composed of two independently operating spring-loaded check valves together with an independent, hydraulically operating pressure differential relief valve located between the two check valves. During normal flow and at the cessation of normal flow, the pressure between these two checks shall be less than the supply pressure. ~~In case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the check valves at less than the supply pressure.~~ The unit assembly shall include tightly closing shutoff valves located at each end of the ~~device~~ RPZ assembly, and each device shall be fitted with properly located test cocks. ~~These devices shall be of the approved type.~~

"Regulations" means the Waterworks Regulations (12VAC5-590).

"REM" means the unit of dose equivalent from ionizing radiation to the total body or any internal organ or organ system. A millirem (~~MREM~~) (mrem) is 1/1000 of a REM.

"Repeat compliance period" means any subsequent compliance period after the initial compliance period.

"Residual disinfectant concentration" (~~"C" in CT Calculations~~) means the concentration of disinfectant measured in mg/L in a representative sample of water.

~~"Responsible charge" means designation by the owner of any individual to have duty and authority to operate or modify the operation of waterworks processes.~~

~~"Reverse osmosis" or "RO" means a membrane technology designed to remove salts, low-molecular weight solutes, and all other constituents up to 0.0001 micron in size by applying a pressure in excess of osmotic pressure to force water through a semi-permeable membrane from a region of high solution concentration to a region of lower solution concentration.~~

~~"Sanitary facilities" means piping and fixtures, such as sinks, lavatories, showers, and toilets, supplied with potable water and drained by wastewater piping.~~

~~"Sanitary defect" means a defect that could provide a pathway of entry for microbial contamination into the distribution system or that is indicative of a failure or imminent failure in a protective barrier that is already in place.~~

~~"Sanitary survey" means an evaluation conducted by ODW the department of a waterworks' water supply, facilities, equipment, operation, maintenance, monitoring records, and overall management of a waterworks to ensure the provision of pure potable water.~~

~~"SCADA" means the supervisory control and data acquisition capabilities of a computer-monitored system used by waterworks drinking water facilities to monitor their operations. Typical design features may be are facilities specific to individual waterworks and may include alarm, response, control, and data acquisition.~~

~~"Supervisory control and data acquisition" or "SCADA" means the capabilities of a computer-monitored system used by a waterworks to monitor its operations. Typical design features may be facilities specific to individual waterworks and may include alarm, response, control, and data acquisition.~~

~~"Supervisory control and data acquisition" or "SCADA" means the supervisory control and data acquisition capabilities of a computer-controlled system used by a waterworks to monitor its operations. Typical design features may be specific to individual waterworks and include alarm, response, control, and data acquisition.~~

~~"SDWA" means the Safe Drinking Water Act and its amendments.~~

~~"Seasonal waterworks" means a noncommunity waterworks that is not operated as a waterworks on a year-round basis, and starts up and shuts down at the beginning and end of each operating season.~~

~~"Secondary water source" means any approved water source, other than a waterworks' primary source, connected to or available to that waterworks for emergency or other nonregular use.~~

~~"Secondary disinfection" means disinfection by chemical oxidants or equivalent agents applied at the entry point or in the distribution system to provide a disinfectant residual in water to maintain water quality and safeguard against chance contamination from permeation, leaching, intrusion, regrowth, or biofilms.~~

~~"Sedimentation" means a process for removal of solids before filtration by gravity or separation.~~

~~"Service connection" means the point of delivery of finished water to a customer's building service line as follows: from a waterworks to a consumer's water system, fire protection system, or irrigation system, and to all other temporary or emergency points where finished water is delivered through the distribution system to a consumer. water service connections. Service connections may be permanent, temporary, or emergency.~~

- ~~1. If a meter is installed, the service connection is the downstream side of the meter;~~
- ~~2. If a meter is not installed, the service connection is the point of connection to the waterworks;~~

~~3. When the water purveyor is also the building owner, the service connection is the entry point to the building.~~

~~"Service line sample" means a one liter sample of water, collected in accordance with 12VAC5-590-375 B 2 c, that has been standing for at least six hours in a service line.~~

"Sewer" means any pipe or conduit used to convey sanitary sewage, stormwater stormwater, or industrial waste streams. Combined sewers convey both stormwater and sanitary sewage.

"Significant deficiency" means any defect in a waterworks' design, operation, maintenance, or administration, as well as the failure or malfunction of any waterworks component, that may cause, or has the potential to cause, an unacceptable risk to health or could affect the reliable delivery of ~~pure~~ potable water to consumers.

"Single-family structure" means, for the purpose of 12VAC5-590-375 B only, a building constructed as a single-family residence that is currently used as either a residence or a place of business.

"Slow sand filtration" means a process involving passage of ~~source raw~~ water through a bed of sand at low velocity (generally less than 0.4 m/h) resulting in substantial particulate removal by physical and biological mechanisms.

~~"Small waterworks" means, for the purpose of 12VAC5-590-375, 12VAC5-590-405, 12VAC5-590-530 F and 12VAC5-590-550 D only, a waterworks that serves 3,300 persons or fewer.~~

~~"Standard sample" means that portion of finished drinking water that is examined for the presence of coliform bacteria.~~

~~"SMCL"– See-see "Maximum contaminant level".~~

~~"SOC" means synthetic organic chemical.~~

~~"SOP" mean-means standard operating procedure.~~

"Source water"; water" means water as it is pumped or otherwise withdrawn from a well, spring, stream, lake/reservoir, or any body of surface water (natural or impounded), and before any treatment.

"Supervisory control and data acquisition" or "SCADA" means a computer-controlled system used by a waterworks to monitor its operations. Typical design features may be specific to individual waterworks and include alarm, response, control, and data acquisition.

"Surface water" means all water open to the atmosphere and subject to surface runoff.

"SUVA" means specific ultraviolet absorption at 254 nanometers (nm), an indicator of the humic content of the water. It is a calculated parameter obtained by dividing a sample's ultraviolet absorption at a wavelength of 254 nm ( $UV_{254}$ ) (in  $m^{-1}$ ) by its concentration of dissolved organic carbon (DOC) (in mg/L).

~~"Synthetic organic chemicals" or "SOCs" means one of the family families of organic manmade man-made compounds generally utilized for agriculture or industrial purposes.~~

"Synthetic organic chemical" or "SOC" means any organic compound that is commercially made, such as pesticides, herbicides, polychlorinated biphenyls, and others, which are generally utilized for agriculture or industrial purposes. The EPA National Primary Drinking Water Regulations have identified specific SOCs in Table 340.2 for regulation as drinking water contaminants.

"Synthetic organic chemical" or "SOC" means a man-made organic compound, generally utilized for agriculture or industrial purposes. Table 340.2 lists SOCs regulated as contaminants.

"System hazard" means a condition posing an actual, or threat of, damage to the physical properties of the waterworks or a consumer's water system.

"TDS" means total dissolved solids.

"Terminal reservoir" means an impoundment providing end storage of water prior to treatment a water reservoir providing end storage of source water for the sole use as a drinking water supply.

"TMF" means the technical, managerial, and financial capabilities to operate and maintain a waterworks.

"Too numerous to count" or "TNTC" means that the total number of bacterial colonies exceeds 200 on a 47-mm diameter membrane filter used for coliform detection.

~~"Total effective storage volume" means the volume available to store water in distribution reservoirs measured as the difference between the reservoir's overflow elevation and the minimum storage elevation. The minimum storage elevation is that elevation of water in the reservoir that can provide a minimum pressure of 20 psi at a flow as determined in 42VAC5-590-690 C to the highest elevation served within that reservoir's service area under systemwide maximum daily water demand.~~

"Total organic carbon" or "TOC" means total organic carbon in milligrams per liter (mg/L) measured using heat, oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants that convert organic carbon to carbon dioxide, rounded to two significant figures.

"Total trihalomethanes" or "TTHM" means the sum of the concentrations of the trihalomethanes expressed in milligrams per liter (mg/L) and rounded to two significant figures. For the purpose of ~~these regulations, the TTHMs~~ this chapter, TTHM shall mean trichloromethane (chloroform), dibromochloromethane, bromodichloromethane, and tribromomethane (bromoform).

"Transient noncommunity waterworks" or "TNC" means a noncommunity waterworks that is not a nontransient noncommunity waterworks. A TNC serves at least 25 persons daily for at least 60 days out of the year.

~~"Transmission main" means a water main whose primary purpose is to move significant quantities of treated water among service areas.~~

"Treatment" means any process that changes the chemical, physical, radiological, or bacteriological quality of water.

~~"Treatment technique requirement" or "TT" means a requirement that specifies for a contaminant a specific treatment technique(s) technology or process demonstrated to the satisfaction of the division department to lead to a reduction in the level of such a specific contaminant sufficient to comply with these regulations this chapter.~~

"Triggered source water monitoring" means monitoring required of any groundwater system as a result of a total coliform-positive sample in the distribution system.

"Trihalomethane" or "THM" means one of the family of organic compounds, named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure.

~~"Two-stage lime softening" means a process in which chemical addition and hardness precipitation occur in each of two distinct unit clarification processes in series prior to filtration.~~

"Ultrafiltration" or "UF" means a membrane technology designed to remove particles up to 0.01 micron in size.

"Unconsolidated" means loose sediment that has not been compacted, cemented, lithified, or metamorphosed into rock; sediment may be derived from a sedimentary-type, igneous-type, metamorphic-type rock, which includes clay, silt, sand, gravel, and mixtures of these particle types.

"Uncovered finished water storage facility" means a tank, reservoir, or other facility used to store water that will undergo no further treatment to reduce microbial pathogens (except residual disinfection) and is directly open to the atmosphere.

"Unregulated contaminant" or "UC" means a contaminant for which a monitoring requirement has been established, but for which no MCL or treatment technique requirement has been established.

"USBC" means the Uniform Statewide Building Code.

"Used water" means any water supplied by a ~~water purveyor from the~~ waterworks to a consumer's water system after it has passed through the service connection and is no longer under the control of the waterworks owner.

"UV" means ultraviolet.

"Variance" means allowing a waterworks that satisfies the criteria in 12VAC5-590-140 to provide drinking water that does not fully comply with the regulations. ~~a conditional waiver of a specific regulation that is granted to a specific waterworks.~~ A PMCL variance is a variance to a primary maximum contaminant level, or a treatment technique requirement. An operational variance is a variance to an operational regulation or a ~~secondary maximum contaminant level~~ SMCL. ~~Variances for monitoring, reporting and public notification requirements will not be granted.~~

"Virus" means a ~~microbe~~ virus of fecal origin that is infectious to humans by waterborne transmission, and must be preemptively inactivated through disinfection prior to before human consumption.

~~"Volatile synthetic organic chemicals" or "VOCs" means one of the family families of manmade man made organic compounds generally characterized by low molecular weight and rapid vaporization at relatively low temperatures or pressures.~~

"Volatile organic chemical" or "VOC" means any organic compound generally characterized by its low molecular weight and its tendency to rapidly vaporize at relatively low temperatures and pressures. The EPA National Primary Drinking Water Regulations have identified specific VOCs in Table 340.2 for regulation as drinking water contaminants.

"Volatile organic chemical" or "VOC" means an organic compound generally characterized by its low molecular weight and its tendency to vaporize rapidly at relatively low temperatures and pressures. Table 340.2 lists VOCs regulated as contaminants.

"Waiver" means permission from the department to deviate from the monitoring and reporting requirements in the regulations for a specific contaminant.

"Waterborne disease outbreak" means the significant occurrence of acute infectious illness, epidemiologically associated with the ingestion of water from a waterworks that is deficient in treatment, as determined by the commissioner or the State Epidemiologist.

~~"Water purveyor" (same as owner).~~

"Water supply" means the source of water that shall have been taken into a waterworks from all including wells, streams, springs, lakes, and other bodies of surface waters (natural or impounded), and the tributaries thereto, and all impounded groundwater, but the ~~The~~ term "water supply" shall not include any waters above the point of intake of ~~such the~~ waterworks ~~(see Article 2 (§ 32.1-167 et seq.) of Chapter 6 of Title 32.1 of the Code of Virginia).~~

"Water supply" means the source of water originating from aquifers, rivers, streams, springs, reservoirs, lakes, and other bodies of surface waters (natural or impounded) and the tributaries thereto, and all impounded groundwater taken into a waterworks for the purpose of producing a

source of potable water. It shall not include any waters above the point of intake of the waterworks.

~~"Water supply main" or "main" means any water supply pipeline that is part of a waterworks distribution system.~~

"Water treatment plant" means that portion of a waterworks intended specifically for water treatment; it may include, among other operations, coagulation, sedimentation, filtration, and disinfection.

~~"Water Well Completion Report" means a report form published by the State Water Control Board entitled "Water Well Completion Report," which requests specific information pertaining to the ownership, driller, location, geological formations penetrated, water quantity and quality encountered as well as construction of water wells. The form is to be completed by the well driller.~~

"Waterworks" means a system that serves piped water for human consumption to at least 15 service connections or 25 or more individuals for at least 60 days out of the year. "Waterworks" includes all structures, equipment, and appurtenances used in the storage, collection, purification, treatment, and distribution of pure water except the piping and fixtures inside the building where such water is delivered (see Article 2 (§ 32.1-167 et seq.) of Chapter 6 of Title 32.1 of the Code of Virginia).

"Waterworks business operation plan" – see "Comprehensive business plan."

~~"Waterworks with a single service connection" means a waterworks that supplies drinking water to consumers via a single service line.~~

"Wholesale waterworks" means a waterworks that treats source water as necessary to produce finished potable water and then delivers some or all of that finished potable water to another waterworks. Delivery may be through a direct connection or through the distribution system of one or more consecutive waterworks.

#### B. Units of measurement.

°C – degrees Celsius

CU – color units

ft<sup>2</sup> – square feet of area

ft/min – feet per minute

ft/sec – feet per second

gpd – gallons per day

gpd/ft<sup>2</sup> – gallons per day per square foot

gpm – gallons per minute

gpm/ft – gallons per minute per foot

gpm/ft<sup>2</sup> – gallons per minute per square foot

in – inches

lb – pounds

lb/day – pounds per day

lb/ft<sup>2</sup> – pounds per square foot

MFL - million fibers per liter

MGD – million gallons per day

mg/L – milligrams per liter

min – minutes

mJ/cm<sup>2</sup> – millijoules per square centimeter

mrem – millirem  
nm – nanometer (10<sup>-9</sup> meter)  
NTU – nephelometric turbidity units  
pCi – picocuries  
pCi/L – picocuries per liter  
ppb - parts per billion, or micrograms per liter (µg/L)  
ppm - parts per million, or milligrams per liter (mg/L)  
ppq - parts per quadrillion, or picograms per liter (pg/L)  
ppt - parts per trillion, or nanograms per liter (ng/L)  
psi – pounds per square inch  
psig – pounds per square inch gauge  
scfm/ft<sup>2</sup> - standard cubic feet per minute per square foot  
µm – micrometers (10<sup>-6</sup> meter or microns)  
µg/L – micrograms per liter  
µS/cm – microSiemens per centimeter  
W/m<sup>2</sup> - Watts per square meter

Article 2  
General Information

**12VAC5-590-20. Authority for regulations. (Repealed.)**

~~Article 2 (§ 32.1-5 et seq.) of Chapter 1 of Title 32.1 of the Code of Virginia provides that the State Board of Health has the duty to protect the public health and to ensure that all water supplies destined for public consumption be pure water. In order to discharge that duty, the board is empowered to supervise and regulate all waterworks and water supplies within the state (see Article 2 of Chapter 1 of Title 32.1 of the Code of Virginia).~~

**12VAC5-590-30. Purpose of regulations. (Repealed.)**

~~These regulations have been promulgated by the board to: 1. Ensure that all water supplies destined for public consumption be pure water; 2. Guide the commissioner in his determination of whether a permit for a public water supply or waterworks should be issued; and 3. Assist the owner or his authorized engineer in the preparation of an application, plans, specifications, reports and other data.~~

**12VAC5-590-35. Delegation of authority.**

The commissioner, or the commissioner's designee, may perform any act of the board provided under this chapter, except as limited by § 32.1-20 of the Code of Virginia.

**12VAC5-590-40. Administration of regulations this chapter.**

These regulations are administered by the following parties:

1. State Board of Health, which has responsibility A. The board is responsible for promulgating, amending, and repealing regulations which to ensure a supply of pure potable water.

2. State Health Commissioner, who is the executive officer B. The commissioner is vested with all the authority of the State Board of Health with the authority of the board when it is not in session, and subject to such rules and regulations as may be prescribed by the board.

3. Division of Water Supply Engineering, which C. The department is designated as the primary reviewing-evaluation agent of the board for the purpose of administering this chapter. It examines and passes upon the technical aspects of all applications and plans for waterworks



projects ~~prior to~~ before the drafting of a permit for final approval by the State Health Commissioner ~~commissioner~~. It also has primary responsibility for monitoring waterworks operations to ensure that water supplied to the public is ~~pure~~ ~~consumers is~~ potable water.

~~4. Central and field offices, which are maintained by the division, the central office is located in Richmond, Virginia. The Office of Water Programs maintains six field offices which are responsible for activities of the division within their service areas. Applications for waterworks permits should be submitted to the appropriate field office. The addresses of the field offices and a description of the areas that they serve are listed in Appendix C.~~

~~5. Waterworks Advisory Committee, which shall be appointed by the commissioner, shall consist of thirteen appointed members and three ex officio members specified below. The commissioner shall appoint to the Waterworks Advisory Committee one individual each from the following: a member of the Virginia Section American Water Works Association; a member of the Virginia Society of Professional Engineers; a member of the Virginia Water Well Association, Inc.; a member of the Consulting Engineers Council; a water treatment plant operator having a valid license of the highest classification in waterworks issued by the State Board for Waterworks and Wastewater Works Operators; a faculty member of a state university or college whose principal field of teaching is Environmental Engineering; a community waterworks owner; a nontransient noncommunity (NTNC) representative; a representative from Virginia Rural Water Association; a representative from Virginia Water Projects, Inc.; a representative from the Virginia Municipal League; a representative from the Virginia Association of Counties; and a citizen representative. Ex officio members shall consist of the Director, Office of Water Programs, who shall act as chairman; Director, Division of Water Supply Engineering; and Director, Division of Consolidated Laboratory Services or their designees.~~

~~Appointed members shall serve at the discretion of the commissioner with staggered terms being of three years in duration. The Waterworks Advisory Committee shall make recommendations to the commissioner regarding waterworks and water supply policies, procedures and programs of the division.~~

**12VAC5-590-45. Waterworks Advisory Committee (WAC).**

A. A WAC shall be formed by the commissioner to provide peer review of the regulatory, policy, and legislative aspects of the department's authorities. Committee members shall consist of industry professionals employed outside the department with longstanding expertise or vested interest in waterworks operations and represent a diverse group of stakeholders. Members shall be experts in the fields of water treatment technologies, public health, water quality, economics, environmental science, public utilities, community development, or industry regulations. A minimum of nine persons shall be appointed to the committee by the commissioner.

B. The WAC will convene at least quarterly.

C. WAC meetings will be considered public meetings. Notice of scheduled meetings will be posted on the Virginia Regulatory Town Hall at least seven working days ~~prior to~~ before the date of the meeting. Meeting minutes will be posted to the Virginia Regulatory Town Hall within 10 working days after the meeting.

D. Each member of the WAC shall hold office for a term of three years, except that:

1. With approval by the commissioner, members are eligible for reappointment to consecutive terms.
2. Each member of the WAC serves at the pleasure of the commissioner.

E. The commissioner shall appoint the chair of the WAC.

F. The WAC shall have a department staff member serve as secretary.

**12VAC5-590-50. Application of regulations to waterworks and water supplies in operation or planned ~~prior to before~~ the effective date of the regulations.**

~~Waterworks and water supplies which were in operation prior to the effective date of the regulations may continue operation if they comply with the operational regulations set forth in Part II. Operation permits, which will be in addition to all permits previously received, will be issued to such waterworks as soon as practicable after the effective date of these regulations.~~

~~A. Waterworks and water supplies unable to comply with Part II of this chapter may be issued the appropriate variances and/or exemptions in conjunction with the operation permit to allow continued operation during the period of adjustment. Any variances and/or exemptions will be issued in accordance with the procedures contained in Article 3 of Part I of this chapter. Owners shall comply with Part II of this chapter unless a variance or exemption is issued by the commissioner.~~

~~B. Compliance with design criteria set forth in Parts Part III and IV of this chapter is necessary for waterworks modification limited to modifications to existing waterworks and for all construction of new waterworks commenced after the effective date of ~~these revised regulations~~ this chapter. Portions of waterworks not being modified are not required to comply with the design criteria of Part III. Waterworks construction or modification is deemed to be commenced for purposes of this section upon receipt of final plans and specifications by the field office issuance of the construction permit.~~

~~C. Compliance with the requirements set forth in Parts Part III and IV of this chapter for materials, construction methods, disinfection, etc., is necessary for all repairs to pipes, tanks, pumps, and appurtenances which that are part of a waterworks.~~

~~D. Volatile Synthetic Organic Chemicals (VOCs) and Unregulated Contaminants (UCs) Regulations are effective immediately for those community and NTNC waterworks which serve more than 10,000 persons. The VOC and UC regulations are effective immediately for community and NTNC waterworks serving 3,300 to 10,000 persons. The VOC and UC regulations become effective on January 1, 1991, for community and NTNC waterworks serving less than 3,300 persons. (See Table 2.7.)~~

~~E. The Lead and Copper Regulations establish a treatment technique that includes requirements for corrosion control treatment, water supply (source water) treatment, lead service line replacement, and public education. These requirements are triggered, in some cases, by lead and copper action levels measured in samples collected at consumers' taps. Unless otherwise indicated, each of the provisions of 12VAC5-590-375, 12VAC5-590-405, 12VAC5-590-530 F and 12VAC5-590-550 D applies to community waterworks and nontransient noncommunity waterworks. The requirements set forth in 12VAC5-590-375, 12VAC5-590-530 D and 12VAC5-590-550 D shall take effect on July 7, 1991.~~

**12VAC5-590-55. Relationship of this chapter to the USBC.**

~~A. This chapter governs waterworks' facilities from any water source to all service connections.~~

~~B. In accordance with § 36-98 of the Code of Virginia and the USBC, the USBC (13VAC5-63) governs the construction of buildings and structures, including plumbing systems and backflow prevention methods. The USBC also governs the water service piping from the service connection to a building or structure.~~

~~C. Notwithstanding subsections A and B of this section, this chapter shall govern:~~

- ~~1. Water treatment, storage, pumping facilities, and water piping that are part of a waterworks and housed in any building or structure; and~~

2. Backflow prevention assemblies or elimination methods, or both, installed for containment and located downstream from the service connection, including where located in any building or structure.

#### Article 3

#### Procedures

#### **12VAC5-590-60. Compliance with the Administrative Process Act. (Repealed.)**

The provisions of the Administrative Process Act (Chapter 1.1:1 of Title 9) and Title 32.1 of the Code of Virginia govern this chapter. All procedures outlined below are in addition to, or in compliance with, the requirements of that Act.

#### **12VAC5-590-70. Powers and procedures.**

The board reserves the right to ~~authorize~~ utilize any lawful procedure for the enforcement of this chapter that is consistent with the provisions set forth herein and the provisions of Title 32.1 of the Code of Virginia.

#### **12VAC5-590-80. Procedure. (Repealed.)**

Regulations for the operations, construction, or modification of a waterworks or water supply are established, amended, or repealed only in accordance with the Administrative Process Act.

#### **12VAC5-590-100. Exception; emergency regulations.**

If the establishment of a regulation is necessary for the preservation of public health, safety, or welfare to meet any emergency, not provided for by this chapter, the board or commissioner, acting on behalf of the board when it is not in session, may immediately promulgate and adopt the necessary regulation by complying with the procedures set forth in either § 2.2-4011 and 32.1-13 of the Code of Virginia.

#### **12VAC5-590-110. Enforcement.**

All waterworks must be operated in compliance with the requirements as set forth in this chapter as follows:

4- A. Notice. Whenever the commissioner, his appointed representative, or the division department has reason to believe that a violation of Title 32.1 ~~or of the Code of Virginia or of any section of this chapter has may have occurred or is may be occurring~~, the division department shall ~~so~~ notify the alleged violator. ~~Such~~ The notice shall: (i) be in writing; (ii) ~~shall~~ cite the statute, regulation or regulations that are allegedly being ~~violated, violated;~~ and shall (iii) state the facts ~~which that~~ form the basis for believing that the violation ~~has may have occurred or is may be occurring~~; and (iv) include information on the process for obtaining a final decision or fact finding from the department on whether or not a violation has occurred. ~~A notice of violation This notification is not an official finding, case decision, or adjudication, but may be accompanied by include a request that certain to the owner to respond timely and to take specific corrective action be taken by a stated deadline.~~

2- B. Orders. Pursuant to § 32.1-26 of the Code of Virginia, the ~~commissioner~~ board may issue orders to require any owner to comply with the provisions of Title 32.1 of the Code of Virginia or ~~this chapter any law administered by it, the commissioner, or the department, any regulations promulgated by the board, including any section of this chapter, or any case decision of the board or commissioner.~~ The ~~order shall be signed by the commissioner and commissioner, acting on behalf of the board when it is not in session, will sign the order and it may require:~~

- a. 1. The immediate cessation or correction of the violation;
- b. 2. The acquisition or use of additional equipment, ~~supplies-supplies,~~ or personnel to ensure that the violation does not recur;
- c. 3. The submission of a plan to prevent future violations;

- ~~d.~~ 4. The submission of an application for a variance or exemption;
- ~~e.~~ 5. Any other corrective action deemed necessary for proper compliance with ~~the~~ this chapter; or
- ~~f.~~ 6. Evaluation and approval, if appropriate, of the required submissions, if appropriate.

~~3.~~ C. Compliance with effective orders and this chapter. The commissioner may act as the agent of the board to enforce all effective orders and this chapter. Should any owner fail to comply with any effective order or this ~~chapter~~ chapter, the commissioner may:

- ~~a.~~ 1. Institute ~~a~~ an administrative proceeding to revoke the owner's permit in accordance with 12VAC5-590-320 and § 32.1-174 of the Code of Virginia, or other appropriate administrative remedies;
- ~~b.~~ Apply to an appropriate court for an injunction or other legal process to prevent or stop any practice in violation of the order;
- ~~c.~~ 2. Request ~~attorney for the Commonwealth~~ criminal prosecution by a Commonwealth's Attorney with the appropriate jurisdiction in accordance with § 32.1-27 of the Code of Virginia to bring a criminal action;
- ~~d.~~ 3. Request civil action by the Attorney General to ~~bring an action for~~ impose a civil penalty, ~~injunction~~ seek injunctive relief, or other appropriate ~~remedy~~ legal remedies; or
- ~~e.~~ 4. Do any combination of ~~the above~~ subdivision above subdivisions C 1, C 2, or C 3 of this section.

~~4.~~ D. Special Order. Pursuant to § 32.1-175.01 of the Code of Virginia, ~~the commissioner may~~ after an informal ~~fact-finding~~ fact-finding proceeding held in accordance with § 2.2-4019 of the Code of Virginia, issue a special order that may include a civil penalty against an owner who violates the Public Water Supply Law, §§ 32.1-167 through 32.1-176 of the Code of Virginia, ~~this chapter, or any order of the board.~~

E. Graduated enforcement actions. Nothing in this section shall prevent the commissioner ~~or the division from taking action prior to issuing an order or~~ department from making efforts to obtain voluntary compliance through conference, warning, or other appropriate means before issuance of an order, instituting an administrative proceeding, or requesting an action by a Commonwealth's Attorney or the Attorney General.

~~5. Hearing as a matter of right (see 12VAC5-590-180).~~

#### **12VAC5-590-115. Administrative proceedings.**

A. Types of administrative proceedings. Administrative proceedings before the board, the commissioner, or the commissioner's designee, shall include the following forms depending upon the nature of the controversy and the interests of the named party involved.

1. An informal fact-finding proceeding is an informal conference between the department staff and the named party held in accordance with § 2.2-4019 of the Code of Virginia.

2. A formal hearing is an adjudicatory proceeding before the commissioner or a designated hearing officer held in accordance with § 2.2-4020 of the Code of Virginia.

B. Request for administrative proceeding. The named party may request an administrative proceeding by sending a request, in writing, to the department.

C. Administrative proceeding as a matter of right. The named party whose rights, ~~duties~~ duties, or privileges have been or may be affected by any action or inaction of the board, commissioner, or department in the administration of this chapter, shall have a right to both an informal fact-finding proceeding and a formal hearing; however, the commissioner reserves the right to require

participation in an informal fact-finding proceeding before granting the request for a formal hearing.

**12VAC5-590-120. Emergency Orders orders.**

A. The commissioner may, pursuant to § 32.1-175 of the Code of Virginia, issue emergency orders in any case where there is an imminent danger to the public health resulting from the operation of ~~any a~~ waterworks or ~~the source of a~~ water supply.

B. An emergency order may be communicated by the best practical notice under all the circumstances and is effective immediately upon receipt. The order may state any requirements necessary to remove the danger to the public health, including the immediate cessation of the ~~construction or~~ operation of the waterworks or the use of ~~any the~~ water supply.

C. Violation of an emergency order is subject to civil enforcement and is punishable as a criminal misdemeanor.

D. Emergency orders shall be effective for a period determined by the commissioner.

E. Emergency orders may be appealed in accordance with the provisions of the ~~Administrative Process Act~~ APA.

**12VAC5-590-125. Chronically noncompliant waterworks.**

A. ~~The commissioner may identify a waterworks as chronically noncompliant (CNC) whenever he determines that:~~

- ~~1. The waterworks has a documented performance record that demonstrates the waterworks is not a dependable supplier of potable water;~~
- ~~2. The owner has shown inadequate technical, financial, or managerial capabilities to provide potable water;~~
- ~~3. The owner has failed to comply with an order issued by the commissioner;~~
- ~~4. The owner has abandoned the waterworks and has discontinued providing potable water to the consumers; or~~
- ~~5. The owner is subject to a forfeiture order pursuant to § 32.1-174.1 of the Code of Virginia.~~

B. ~~Once~~ If the commissioner determines that a waterworks is CNC chronically noncompliant as defined in § 32.1-167 of the Code of Virginia, ~~he the commissioner~~ shall issue an order to the owner containing a schedule to bring the waterworks into compliance with this chapter and require the submission of a waterworks business operation plan~~comprehensive business plan pursuant to § 32.1-172-B of the Code of Virginia~~. If capital improvements are necessary to bring the waterworks into compliance, and the owner does not possess sufficient assets to make the necessary improvements, the order shall require the owner to make annual, good faith applications for loans, grants, or both, to appropriate financial institutions to secure funding for such improvements, until ~~such the~~ improvements are complete and operational. The owner shall provide a copy of the order to each consumer ~~with a copy of the compliance schedule~~ within 10 calendar days of issuance of the order.

B. Within 15 calendar days of issuance of the commissioner's order, the owner shall certify in writing that a copy of the order was distributed to each consumer within the 10-day period specified in subsection A of this section.

C. ~~The owner shall provide the commissioner a copy of the notice order was distributed and a signed certification of the distribution completion date within five calendar days of completing the notification required in subsection B of this section.~~

D. ~~C.~~ The commissioner shall send a copy of the order to the chief administrative officer of the locality in which the waterworks is located for appropriate action under § 15.2-2146 of the Code of Virginia.

E. D. In addition to the provisions of § 32.1-27 of the Code of Virginia, any owner who violates this chapter, an order of the board, or a statute governing public water supplies shall be subject to those civil penalties provided in ~~§§ 32.1-167 through 32.1-176~~ Article 2 (§ 32.1-167 et seq.) of Chapter 6 of Title 32.1 of the Code of Virginia.

**12VAC5-590-130. Suspension of this chapter.**

If, in the case of a man-made or natural disaster, the commissioner determines that certain regulations cannot be complied with, then the enforcement of those regulations may be suspended for designated waterworks and a provisional regulatory scheme instituted until the conditions that brought about the suspension have abated.

**12VAC5-590-140. Variances.**

A. The commissioner may grant a variance to a ~~primary maximum contaminant level (PMCL), a PMCL, SMCL, treatment technique requirement, or an operational regulation, or a secondary maximum contaminant level (SMCL)~~ by following the appropriate procedures set forth in this ~~section~~ section:

1. Requirements for a variance. A ~~PMCL~~ variance may be granted to a waterworks from any requirement ~~respecting with respect to~~ a PMCL or SMCL upon a finding that:
  - a. Alternative ~~sources of water supplies~~ are not reasonably available to the waterworks;
  - b. The characteristics of the ~~raw water sources which are~~ source water supply that is reasonably available to the waterworks ~~prevent~~ prevents the waterworks from meeting the PMCL or SMCL requirements, and on condition that the waterworks installs the best available technology, treatment techniques, or other means, which the commissioner finds are generally available (taking costs into consideration); and
  - c. The granting of a variance will not result in an unreasonable risk to the health of persons served by the waterworks.
2. The commissioner may grant a ~~one or more~~ one or more treatment technique ~~variance~~ variances to a waterworks from any requirement of a specified treatment technique upon a finding that the waterworks applying for the variance has demonstrated that ~~such the~~ treatment technique is not necessary to protect the health of persons because of the nature of the ~~raw water source of such~~ source water supply of at the waterworks.
3. The commissioner may grant a variance to a waterworks from an operational regulation ~~or a SMCL~~ if a thorough investigation reveals that the hardship imposed outweighs the benefits that may be received by the public and that the granting of ~~such the~~ variance does not subject the public to unreasonable health risks. ~~An operational variance may not be issued from monitoring, reporting, or public notification requirements.~~
4. An operational variance may not be issued from monitoring, reporting, or public notification requirements.

B. ~~Application~~ Request for a variance. Any owner may apply in writing for a variance. The ~~application should request~~ shall be sent to the ~~appropriate field office~~ department for evaluation. All ~~applications~~ requests for a variance shall include the following:

1. A citation of the regulation from which a variance is requested;
2. The nature and duration of the variance requested;
3. Relevant analytical results of water quality sampling of the waterworks, including results of relevant tests conducted pursuant to the requirements of this chapter;
4. A statement of the hardship to the owner and the anticipated impacts to the public health and welfare if a variance were granted;

5. Suggested conditions that might be imposed on the granting of a variance that would limit its detrimental impact on public health and welfare;

6. Other information, if any, believed by the ~~applicant-owner~~ to be pertinent to the ~~application request~~; and

7. ~~Such~~ Any other information as may be required by the commissioner to make the determination.

~~8C.~~ For any ~~application request~~ made for a PMCL variance, the ~~applicant-owner~~ shall also include:

~~a1.~~ Explanation in full and evidence of the ~~best available treatment technology and techniques~~ BAT;

~~b2.~~ Economic and legal factors relevant to the owner's ability to comply;

~~e3.~~ Analytical results of ~~raw water source water~~ quality relevant to the variance request;

~~d4.~~ A proposed compliance schedule including the date each step toward compliance will be achieved. ~~Such~~ The schedule shall include as a minimum the following dates:

~~(1)a.~~ Date by which arrangement for an alternative ~~raw water source source water~~ or improvement of an existing ~~raw water source source water~~ will be completed;

~~(2)b.~~ Date of initiation of the connection of the alternative ~~raw water source source water supply~~ or improvement of the existing ~~raw water source source water supply~~; and

~~(3)c.~~ Date by which final compliance is to be achieved.

~~e5.~~ A plan for the provision of safe drinking water in the case of an excessive rise in the contaminant level for which the variance is requested; ~~and~~

~~f6.~~ A plan for interim control measures during the effective period of the variance; ~~and~~

~~g7.~~ A plan for notifying the consumers at least once every three months, or more frequently if determined by the commissioner, that the waterworks is operating under the condition or conditions of a variance.

~~9D.~~ For any ~~application request~~ made for a treatment technique variance, the ~~applicant-owner~~ must also include a statement that monitoring and other reasonable requirements prescribed by the commissioner as a condition to the variance will be performed.

~~CE.~~ Consideration of a variance ~~application request~~.

1. The commissioner shall act on any variance ~~application request~~ submitted pursuant to subsection B of this section within 90 days of receipt of the ~~application submittal~~.

2. The commissioner will consider comments received during the comment period and testimony in the record of a public hearing held before making a determination.

~~23.~~ In the commissioner's consideration of whether the waterworks is unable to comply with a contaminant level required by this chapter (~~PMCL variance~~) because of the nature of the ~~raw water source water~~, the commissioner shall consider such factors as the following:

a. The availability and effectiveness of ~~treatment methods~~ BAT for which the variance is requested; ~~and~~

b. Cost and other economic considerations such as implementing treatment, improving the quality of the ~~source source water supply~~, or using an alternate source.

~~34.~~ In the commissioner's consideration of whether a waterworks should be granted a variance to a required treatment technique because ~~such the~~ treatment is unnecessary to

protect the public health (~~treatment technique variance~~), the commissioner shall consider such factors as the following:

- a. Quality of the source water ~~source~~ including water quality data and pertinent sources of pollution; ~~and~~
- b. Source protection measures employed by the waterworks.

45. In the commissioner's consideration of whether a waterworks should be granted a variance to a required operational procedure ~~or SMCL (operational variance)~~, the commissioner shall consider such factors as the following:

- a. The effect that such a variance would have on the adequate operation of the waterworks, including operator safety (in accordance with ~~Virginia Occupational Safety and Health VOSH laws~~);
- b. The cost and other economic considerations imposed by this requirement; ~~and~~
- c. The effect that such a variance would have on the protection of the public health.

~~D.F.~~ Disposition of a variance ~~application request~~.

1. The commissioner may reject any ~~application request~~ for a variance by sending a rejection notice to the applicant. The rejection notice shall be in writing and shall state the reasons for the rejection. A rejection notice constitutes a case decision. ~~The applicant has the right to petition for a hearing within 60 days of the date of the rejection to challenge the rejection pursuant to 12VAC5-590-160 and 12VAC5-590-180. If the commissioner proposes to deny the variance, the owner shall be provided with an opportunity for an informal fact-finding proceeding as provided in § 2.2-4019 of the Code of Virginia.~~

2. If the commissioner grants the variance, the applicant shall be notified in writing of this decision. ~~Such~~ The notice shall identify the variance, the waterworks covered, and shall specify the period of time for which the variance will be effective.

a. For a PMCL variance as specified in subdivision A 1 of this section, ~~such the~~ notice shall provide that the variance will be terminated when the waterworks comes into compliance with the applicable regulation and may be terminated upon a finding by the commissioner that the waterworks has failed to comply with any requirements of a final schedule issued pursuant to subdivision ~~D-F~~ 3 of this section.

b. For a treatment technique variance as specified in subdivision A 2 of this section, ~~such the~~ notice shall provide that the variance may be terminated at any time upon a finding by the commissioner that the nature of the ~~raw water~~ source water supply is such that the specified treatment technique for which the variance was granted is necessary to protect the public health or upon a finding that the waterworks has failed to comply with monitoring and other requirements prescribed by the commissioner as a condition ~~or conditions~~ to the granting of the variance.

c. For an operational variance as specified in subdivision A 3 of this section, ~~such the~~ notice shall provide that the variance will be terminated when the waterworks comes into compliance with the applicable regulation and may be terminated upon a finding by the commissioner that the waterworks has failed to comply with any requirements or schedules issued in conjunction with the variance. The effective date of the operational variance shall be the date of its issuance. A public hearing is not required before the issuance of an operational variance.

3. Schedules pursuant to PMCL and treatment technique variances:

a. The proposed schedule for compliance shall specify dates by which steps towards compliance are to be taken, including where applicable:



(1) Date by which arrangement for ~~an-~~ the alternative ~~water-source~~ water supply or improvement of the existing ~~raw-water-source~~ water supply will be completed- ;

(2) Date of connection to the alternative ~~raw-water-source-~~ water supply or improvement of the existing ~~raw-water-source~~ water supply; and

(3) Date by which final compliance is to be achieved.

b. If the waterworks has no access to an alternative ~~raw-water-source~~ water supply and can effect or anticipate no adequate improvement of the existing ~~raw-water-source~~ water supply, then the proposed schedule may specify an indefinite time period for compliance until a new and effective treatment technology is developed, at which time a new compliance schedule shall be prescribed by the commissioner.

c. The schedule for implementation of interim control measures during the period of variance shall specify interim treatment techniques, methods, and equipment and dates by which steps toward meeting the interim control measures are to be met.

d. The schedule shall be prescribed by the commissioner at the time the variance is granted.

e. For a PMCL variance specified in subdivision A 1 of this ~~section-section~~, the commissioner shall propose a schedule for:

(1)- Compliance (including increments of progress) by the waterworks with each contaminant level requirement covered by the variance; and

(2)- Implementation by the waterworks of such control measures as the commissioner may require for each contaminant level covered by the variance.

EG. Public hearings on PMCL and treatment technique variances and their schedules.

1. Notice of a public hearing shall be provided before a variance and schedule proposed by the commissioner pursuant to subsection ~~D-F~~ of this section may take effect. A notice given pursuant to the preceding sentence may cover the granting of more than one variance and a public hearing held pursuant to such notice shall include each of the variances covered by the notice.

2. Notice of a public hearing on ~~an application~~ a request for a variance and its schedule shall be advertised in at least one major newspaper of general circulation in the region in which the waterworks is located. The notice shall include a summary of the proposed variance and its schedule and shall contain the time, date, and place of the public hearing. If the schedule exceeds five years from the date of the variance, then the rationale for the extended compliance schedule shall be discussed in the notice.

FH. Issuance of variance.

1. Within 30 days after the public hearing, the commissioner shall, taking into consideration information obtained during such hearing, revise the proposed variance as necessary and prescribe the final schedule for compliance and interim measures for the waterworks granted a variance. If the schedule for compliance exceeds five years from the date of issuance of the variance, then the commissioner shall document the rationale for the extended compliance schedule.

2. Such schedule shall establish the timetable by which the waterworks shall comply with each contaminant level and treatment technique requirement prescribed by this chapter. Such schedule shall also consider if the waterworks is to become part of a regional waterworks. Such schedule shall provide the shortest practicable time schedule under the circumstances.

~~G.~~ Posting of variances. All variances granted to any waterworks are nontransferable. Each variance must be attached to the permit of the waterworks to which it is granted. Each variance is a condition to that permit and is revoked when the permit is revoked.

~~H.~~ No variances shall be granted to 12VAC5-590-380, ~~12VAC5-590-400, or 12VAC5-590-420, 12VAC5-590-388, 12VAC5-590-395-395,~~ or 12VAC5-590-411.

#### **12VAC5-590-150. Exemptions.**

A. The commissioner may grant an exemption to any primary maximum contaminant level (PMCL) or treatment technique requirement by following the procedures set forth in this ~~subsection~~ section. An exemption may be granted to a waterworks ~~from any requirement with respect to a PMCL or treatment technique requirement~~ upon a finding that:

1. The waterworks must be unable to implement measures to develop an alternative source ~~of water supply~~;
2. The waterworks cannot reasonably make management or restructuring changes that will result in compliance or improve the quality of the drinking water;
3. Due to compelling factors (which may include economic factors), the waterworks is unable to comply with such contaminant level or treatment technique requirement;
4. The granting of the exemption will not result in an unreasonable risk to the health of persons served by the waterworks;
5. The waterworks was in operation on the effective date of such contaminant level or treatment technique requirement; and
6. The waterworks has not been granted a variance.

B. ~~Application for exemption. A waterworks~~ An owner may request an exemption for a waterworks by submitting a written ~~application request~~ request to the ~~appropriate field office department~~ for evaluation. All ~~applications requests~~ requests for an exemption shall include the following information:

1. A citation to the regulation from which the exemption is requested;
2. Nature and duration of the exemption requested;
3. Relevant analytical results of water quality sampling of the waterworks, including results of relevant tests conducted pursuant to the requirements of this chapter;
4. Explanation of the compelling factors such as time or economic factors ~~which that~~ prevent such waterworks from achieving compliance;
5. Other information believed by the ~~applicant~~ owner to be pertinent to the ~~application request~~ request;
6. A proposed compliance schedule, including the date when each step toward compliance will be achieved; and
7. Such other information as may be required by the commissioner to make the determination.

C. Consideration of an exemption ~~application request~~.

1. The commissioner shall act on any exemption ~~application request~~ request submitted pursuant to subsection B of this section within 90 days of ~~receipt of the request~~ receipt of the ~~application~~.
2. In the commissioner's consideration of whether the waterworks is unable to comply due to compelling factors, the commissioner shall consider such factors as the following:
  - a. Construction, installation, or modification of treatment equipment or systems;
  - b. The time needed to put into operation a new ~~water treatment facility plant~~ water treatment plant ~~which that~~ is not in compliance;

- c. The economic feasibility of compliance;
- d. The availability of Drinking Water State Revolving Fund (a department program to assist waterworks in achieving the public health protection objectives of the SDWA) assistance or any other federal or state program that is reasonably likely to be available within the period of the exemption;
- e. The consideration of rate increases, accounting changes, the appointment of a licensed operator under the state operator's licensure program, or contractual agreements for joint operation with one or more waterworks;
- f. The activities consistent with Virginia's capacity development strategy to help the waterworks acquire and maintain technical, financial, and managerial capacity to come into compliance;
- g. The ownership changes, physical consolidation with another waterworks, or other feasible and appropriate means of consolidation that would result in compliance; and
- h. The availability of an alternative source of drinking water, including the feasibility of partnerships with neighboring waterworks, as identified by the waterworks or by the commissioner consistent with the capacity development strategy.

D. Disposition of an exemption ~~application~~ request.

1. The commissioner may reject any ~~application~~ request for an exemption by sending a rejection notice to the ~~applicant~~ owner. The rejection notice shall be in writing and shall state the reasons for the rejection. ~~A rejection notice constitutes a case decision. The applicant has the right to petition for a hearing within 60 days of the date of the rejection to challenge the rejection pursuant to 12VAC5-590-160 and 12VAC5-590-180. The owner shall be provided with an opportunity for an informal fact-finding proceeding as provided in § 2.2-4019 of the Code of Virginia.~~
2. If the commissioner grants the exemption, then the ~~applicant~~ owner shall be notified in writing of this decision. ~~Such~~ The notice shall identify the exemption and the waterworks covered and shall specify the termination date of the exemption. ~~Such notice shall provide that the exemption~~ Exemptions shall be terminated when the waterworks comes into compliance with the applicable regulation and may be terminated upon a finding by the commissioner that the waterworks has failed to comply with any requirements of a final schedule issued pursuant to subsection F of this section.
3. The commissioner shall propose a schedule for:
  - a. Compliance (including increments of progress) by the waterworks with each contaminant level and treatment technique requirement covered by the exemption; and
  - b. Implementation by the waterworks of such control measures as the commissioner may require for each contaminant level and treatment technique requirement covered by the exemption.
4. The schedule shall be prescribed by the commissioner at the time the exemption is granted.
5. For a waterworks that serves a population of not more than 3,300 persons and that needs financial assistance for the necessary improvements under the initial compliance schedule, an exemption granted by the commissioner may be for one or more additional two-year periods, but not to exceed a total of six additional years, only if the commissioner establishes that the waterworks is taking all practicable steps to meet the requirements of the exemption and the established compliance period. The commissioner will document the findings in granting an extension under this subdivision.

E. Public hearings on exemptions and their schedules.

1. Notice of a public hearing shall be provided before an exemption and schedule proposed by the commissioner pursuant to subsection D of this section may take effect. ~~A Such notice given pursuant to the preceding sentence~~ may cover the granting of more than one exemption, and a public hearing held pursuant to ~~such the~~ notice shall include each of the exemptions covered by the notice.
2. Notice of a public hearing on ~~an application~~ a request for an exemption and its schedule shall be advertised in at least one major newspaper of general circulation in the region in which the waterworks is located.
3. The notice shall include a summary of the proposed exemption and its schedule and shall contain the time, date, and place of the public hearing.

F. Issuance of exemption.

1. Within 30 days after the public hearing, the commissioner shall, taking into consideration information obtained during such hearing, revise the proposed exemption as necessary and prescribe the final compliance schedule ~~for compliance~~ and interim measures ~~before issuing the exemption to for the waterworks, granted an exemption.~~
2. ~~Such~~ The schedule shall establish the timetable by which the waterworks shall comply with each contaminant level and treatment technique requirement prescribed by this ~~chapter~~ section. If the schedule for compliance exceeds five years from the date of issuance of the exemption, ~~then~~ the commissioner shall document the rationale for the extended compliance period. Such schedule shall also consider if the waterworks is to become part of a regional waterworks.

G. Posting of exemptions. All exemptions granted to any waterworks are nontransferable. Each exemption must be attached to the operation permit of the waterworks to which it is granted. Each exemption is a condition to that permit and is revoked when the permit is revoked.

H. No exemption shall be granted to 12VAC5-590-380, 42VAC5-590-400, or 12VAC5-590-420-B-1 b, 12VAC5-590-~~388-388~~, or 12VAC5-590-395.

**12VAC5-590-160. Types of hearings. (Repealed.)**

~~Hearings before the board, the commissioner, or their designees shall include any of the following forms depending upon the nature of the controversy and the interests of the parties involved.~~

1. ~~An informal hearing is a meeting with the district engineer and field director and held in accordance with § 9-6.14:11 of the Code of Virginia. The field director may consider all evidence presented at the meeting which is relevant to the issue in controversy. Presentation of evidence, however, is entirely voluntary. The field office has no subpoena power. No verbatim record will be taken at the informal hearing, but the field director may make preliminary findings of fact, and may submit a copy of those preliminary findings, with recommendations, to the commissioner and or division director for review. A copy of the findings shall be mailed to the appellant.~~
2. ~~The adjudicatory hearing is a formal, public, adjudicatory proceeding before the commissioner or a designated hearing officer held in conformance with § 9-6.14:12. Pursuant to the hearings process:~~
  - a. ~~A Notice which states the time, place, and issues involved in the prospective hearing shall be sent to parties requesting the hearing by certified mail at least 15 calendar days before the hearing is to take place;~~
  - b. ~~A record of the hearing will be made by a court reporter or other approved means. A copy of the transcript of the hearing, if transcribed, will be provided within a~~

reasonable time to any person upon written request and payment of the cost. If the record is not transcribed, then the cost of preparation of the transcript will be borne by the party requesting the transcript;

~~c. All interested parties may attend the hearing and present evidence, expert or otherwise, that is material and relevant to the issues in controversy. The admissibility of evidence shall be in accordance with the Administrative Process Act. All parties may be represented by counsel;~~

~~d. The commissioner or hearing officer, pursuant to § 9-9.14:13 of the Code of Virginia, may issue subpoenas for the attendance of witnesses and the production of books, papers, maps, and records. The failure of a witness without legal excuse to appear or to testify or to produce documents may be reported by the commissioner to the appropriate circuit court; and~~

~~e. The commissioner may designate a hearing officer or subordinate to conduct the hearing, as provided in § 9-6.14:12 of the Code of Virginia, and to make written recommended findings of fact and conclusions of law to be submitted for review and final decision by the commissioner. The final decision of the commissioner shall be reduced to writing and will contain the explicit findings of fact upon which his decision is based. Copies of the decision shall be delivered to the owner affected by it. Notice of a decision will be served upon the parties and become a part of the record. Service may be by personal service or certified mail, return receipt requested.~~

~~3. A regulatory hearing is a public meeting of the board which is held for the purpose of adopting, amending, or repealing rules and regulations. A regulatory hearing requires that:~~

~~a. A notice shall be published, in at least one newspaper of general circulation in the commonwealth, not less than 60 days prior to the day on which the regulatory hearing is to be held. Such notice shall state the time, place, and nature of the hearing and the express terms or an informative survey of the rules that are to be adopted, amended, or repealed;~~

~~b. All interested persons may be present at the hearing and may present comments, arguments, objections, and evidence which concern the proposed rules; and~~

~~c. The board may adopt, repeal, or amend any rule or regulation which was included in the general notice published prior to the meeting. Rules and regulations may be adopted in the form in which they were described in the notice, or as amended at the hearing, provided the amendments do not alter the main purpose of the rule or regulation.~~

**12VAC5-590-170. Request for hearing. (Repealed.)**

Any person may request a hearing by sending a request, in writing, to the appropriate field office or the central office.

**12VAC5-590-180. Hearing as a matter of right. (Repealed.)**

Any person whose rights, duties or privileges have been or may be affected by any action or inaction of the board, its agents, or deputies in the administration of this chapter, shall have a right to both an informal and an adjudicatory hearing; however, the commissioner reserves the right to require participation in an informal hearing before granting the request for a full adjudicatory hearing.

**12VAC5-590-190. Permits.**

A. No owner or other person shall cause or allow any waterworks to be operated in the Commonwealth without a written operation permit issued by the commissioner.

B. No owner or other person shall cause or allow the construction or change in the manner of transmission, storage, purification, treatment, or distribution of water (including the extension of water pipes for the distribution of water) at any waterworks or water supply in the Commonwealth without a written construction permit, or a general permit for distribution mains, from the commissioner. Furthermore, no owner or other person shall cause or permit any waterworks or water supply to be operated without a written operation permit issued by the commissioner which authorizes the operation of the waterworks or water supply. Conditions may be imposed on the issuance of any permit, and no waterworks or water supply may be constructed, modified, or operated in violation of these conditions.

C. Construction permits may not be required for the extension of water distribution piping provided that the projects meet the requirements in § 32.1-172 A of the Code of Virginia.

D. Individual construction permits for distribution mains are not required for waterworks that obtain a general permit (See 12VAC5-590-300).

E. Conditions may be imposed on the issuance of any permit, and no waterworks may be constructed, modified, or operated in violation of these conditions.

**12VAC5-590-200. Procedure for obtaining a construction permit.**

A. Construction permits are issued by the Commissioner-commissioner, but all requests for a construction permit are directed initially to the Field Office-department. The procedure for obtaining the a construction permit includes the following steps:

- (i) the submission of an application, (ii) a preliminary engineering conference, (iii) the submission of an engineer's report (optional at the discretion of the Field Director), and,
- (iv) the submission of plans, specifications, design criteria and other data in the number requested by the Division.

A. An application for a permit shall be submitted by the owner or authorized agent requesting permission to establish, construct, expand, modify, and/or operate a waterworks or water supply. The application shall clearly indicate whether the affected water supply is a community, nontransient noncommunity, or noncommunity waterworks.

B. A preliminary conference with the Division's appropriate District Engineer will be held. The applicant's engineer shall be prepared to set forth the water supply problems and the proposed solution in such a manner as to support his conclusions and recommendations.

1. Owners shall notify the department of all proposed construction projects, except distribution main projects that are permitted under the provisions of a general permit for distribution mains (see 12VAC5-590-300), or when the project is for distribution mains eight inches in diameter or less, and designed to serve less than 15 connections (see § 32.1-172 A of the Code of Virginia).

2. The submission of a waterworks permit application to the department on a form approved by the department.

3. Based on the application received, the department shall notify the owner if a preliminary engineering conference is required. A preliminary engineering conference shall be required for projects proposed using alternative delivery methods authorized under § 2.2-4308 of the Code of Virginia. The preliminary engineering conference shall define the scope of the project, project phasing, milestones, and deliverables. An evaluation procedure shall be agreed upon and the conference shall be documented.

4. The submission of preliminary engineering or intermediate design reports, if required by the department. The need for, and scope of, the reports shall be established during the preliminary engineering conference.

5. The submission of a waterworks business operation plan comprehensive business plan in accordance with § 32.1-172 B of the Code of Virginia; that demonstrates the

~~waterworks' TMF capability how a waterworks will be self-sustaining, have the commitment and TMF capacity to comply with the regulations over the long term. The waterworks business operation plan consists of four primary components:~~

~~a. The Waterworks information component which includes ownership data, a waterworks' facility description, operator requirements, staffing needs, and staff training.~~

~~b. Management information which identifies critical business practices necessary for effective management and operation of the waterworks. Management information includes This information describes the requirements essential for managing and operating the a-waterworks and defines the processes, methods, and tasks necessary for complying with regulations.~~

~~c. Financial information which component projects whether the a-waterworks' revenues and cash flow will be sufficient for meeting the cost of operation and maintenance for at least five full years from the initiation of operations. Financial information also demonstrates This component evaluates the owner's ability to direct the waterworks' finances to support technical and managerial capacities and includes a of the waterworks. A self-assessment consisting of several financial metrics: operating cash reserve, debt service coverage, emergency reserve, and revenue sufficiency is included.~~

~~d. Sustainability improvements which are identified throughout the waterworks business operation plan to WBOP address TMF aspects of the waterworks' business processes that need improvement. This component summarizes the planned sustainability improvements.~~

~~6. The submission of plans, specifications, final design criteria and other supporting design data. This submission may include manufacturers' equipment data sheets, drawings, and specifications, when the specific materials or equipment to be used in the project have been preselected by the owner with the engineer's concurrence.~~

~~B. Well site inspection. When, upon inspection by the department, one or more well locations are found suitable for well sites, tentative approval in writing shall be furnished to the owner authorizing the drilling of the well or wells, the exact location where each well is to be drilled, and the well construction requirements. This tentative approval will become void after a 12-month period.~~

~~C. The engineer's report and preliminary plans for waterworks shall present the following information where applicable:~~

~~1. General information – The report shall include:~~

- ~~a. A description of any existing waterworks and sewerage facilities.~~
- ~~b. Identification of the municipality or area served.~~
- ~~c. The name and mailing address of the owner.~~

~~2. Extent of waterworks system – The report shall include:~~

- ~~a. A description of the nature and extent of the area to be served.;~~
- ~~b. Provisions for extending the waterworks system to include additional areas.~~
- ~~c. An appraisal of the future requirements for service, including existing and potential industrial, commercial, institutional and other water supply needs.~~

~~3. Alternate plans – Where two or more solutions exist for providing public water supply facilities, each of which is feasible and practicable, the report shall discuss the alternate plans and give reasons for selecting the one recommended, including financial considerations.~~

~~4. Soil, groundwater conditions, and foundation problems – The report shall include:~~

- a. A description of the character of the soil through which water mains are to be laid.
  - b. A description of foundation conditions prevailing at sites of proposed structures.
  - c. A description of the approximate elevation of ground water in relation to subsurface structures.
5. ~~Water consumption~~—The report shall include:
- a. A description of the population trends as indicated by available records, and the estimated population which will be served by the proposed water supply system or expanded system.
  - b. Present and estimated future water consumption values used as the basis of design.
  - c. Present and estimated future yield of the sources of supply.
6. ~~Fire flow requirements~~: if fire flows are to be provided, the quantity of fire flow which will be made available by the proposed or enlarged system shall be given.
7. ~~Sewerage system available~~: Describe the existing system and sewage treatment works, with special reference to its relationship to the existing or proposed waterworks which may affect the operation of the water supply system, or which may affect the quality of the water supply.
8. ~~Source of water supply~~: Describe the proposed source or sources of water supply to be developed and the reasons for their selection by supplying the following data:
- a. ~~Surface water sources~~
    - (1) Hydrological data, stream flow, and weather records;
    - (2) Safe yield, including all factors that may affect it;
    - (3) Maximum flood flow, together with approval for safety features of spillway and dam from appropriate reviewing authority;
    - (4) Summarized quality of raw water with special references to fluctuation in quality, changing meteorological conditions, sources of contamination, measures to protect the watershed, etc.
  - b. ~~Groundwater sources~~
    - (1) Sites considered,
    - (2) Advantages of site selected,
    - (3) Elevation with respect to surroundings and 100-year flood,
    - (4) Probable character of geological formations through which source is to be developed,
    - (5) Unusual geological conditions affecting site,
    - (6) Summary of source exploration, test well depth and method of construction, placement of liners or screens; pumping test, hours, capacity; water level and specified yield; water quality,
    - (7) Possible sources of contamination.
9. ~~Proposed treatment processes~~—Summarize and establish the adequacy of proposed processes for the treatment of the specified water under consideration (pilot studies may be required).
10. ~~Waste disposal~~—Discuss the various wastes from the water treatment plant, their volume, proposed treatment and points for discharge.
11. ~~Automatic equipment~~—Provide supporting data justifying automatic equipment, including servicing.
12. ~~Project sites~~—The report shall include:



- a. A discussion on various sites considered and advantages of the recommended one;‡
- b. A description of the proximity of residences, industries, and other establishments;
- c. The location of potential sources of pollution that may influence the quality of the supply or interfere with the effective operation of the waterworks system, such as sewage absorption systems, septic tanks, privies, cesspools, sink holes, sanitary landfills, petroleum storage tanks, etc.

13. ~~Financing~~ – The report shall state:

- a. The estimated cost of integral parts of the system;
- b. The detailed estimated annual cost of operation;
- c. The proposed method of financing, both capital charges and operating expenses.

14. ~~Future extensions~~ – Summarize planning for future needs and service.

~~D. C.~~ Plans for waterworks improvements/construction shall provide the following information, where applicable:

1. A general layout ~~which~~ that includes:

- a. Suitable title, to include name of waterworks;‡
- b. Name of owner of waterworks;‡
- c. Area or institution to be served;‡
- d. Scale, ~~in feet;~~‡
- e. North Point;‡
- f. Datum used;‡
- g. ~~Boundaries of the municipality or area to be served;~~
- h. ~~g.~~ Date, address, and name of designing owner's engineer;‡
- i. ~~Imprint of professional engineer's seal ( see 12VAC5-590-220),~~
- j. ~~Legible prints suitable for microfilming, with size not to exceed 30 inches by 42 inches,~~
- k. ~~h.~~ Location and size of existing water mains, distribution system; and
- l. ~~i.~~ Location and nature of existing waterworks structures and appurtenances affecting the proposed improvements/construction noted on one sheet.

2. Detailed plans ~~which~~ that include where applicable:

- a. Stream crossings, providing profiles with elevations of the stream bed and the normal ~~and extreme high and low water levels,~~ water level;
- b. Profiles having a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch, with both scales clearly indicated;‡
- c. Location and size of ~~the~~ property to be used for ~~the~~ groundwater development with respect to known references such as street intersections or section lines;‡
- d. Topography and arrangement of present or planned wells or structures, with contour intervals not greater than two feet;‡
- e. Elevation of highest known flood level, floor of structure, upper terminal of protective casing, and outside surrounding grade, using United States Coast and Geodetic Survey, United States Geological Survey, or equivalent elevations where applicable as a reference;‡
- f. ~~Schematic drawing~~ A completed Uniform Water Well Completion Report, Form GW-2, and schematic drawings of well construction, showing diameter and depth of ~~drillholes~~ drill holes, casing and liner diameters and depths, grouting depths,

elevations and designation of geological formation, water levels, and other details to describe the proposed well completely;

g. ~~Location~~ ~~If not previously submitted in the PER:~~ location of all potential sources of pollution within 250 1000 feet ~~(or further, depending upon aquifer type and recharge area)~~ of drilled wells, 100 feet of treated water storage facilities, five miles upstream from surface water intakes, and the entire drainage area of springs;

h. Size, length, identity and location of sewers, drains, ~~water mains~~ distribution system, and water treatment plant structures;

i. Schematic flow diagrams and hydraulic profiles showing the flow through various water treatment plant units;

j. Piping in sufficient detail to show flow through the water treatment plant, including waste lines;

k. Location of all chemical feeding equipment and points of chemical application;

l. All appurtenances, specific structures, equipment, water treatment plant waste disposal ~~units~~ units, and point of discharge having any relationship to the plans for ~~water mains and/or distribution system~~ or waterworks structures;

m. Location of sanitary or other facilities such as lavatories, showers, toilets, and lockers;

n. Location, ~~dimensions~~ dimensions, and elevations of all proposed water treatment plant facilities; and

o. Adequate description of all features not otherwise covered by the specifications.

~~E.~~ D. Specifications for waterworks ~~construction~~ improvements ~~construction improvements~~ shall provide the following information, where applicable: ~~Complete, detailed, technical specifications shall be supplied for the proposed project which include where applicable:~~

1. A program for keeping existing waterworks facilities in operation during construction of additional facilities so as to minimize interruption of service;

2. Laboratory facilities and equipment, as well as sampling taps and their locations;

3. Number and design of treatment process components;

4. Materials or proprietary equipment for sanitary or other facilities including any necessary backflow or backsiphonage ~~backflow~~ protection;

5. Workmanship; and

6. Other equipment.

~~F.~~ E. Design criteria. A summary of complete design criteria shall be submitted for the proposed project, containing, but not limited to, the following information, where applicable:

1. ~~Yield of source of supply,~~ Water supply withdrawal capacity;

2. ~~Reservoir surface area,~~

3. ~~Area of watershed,~~

4. ~~Estimated water consumption, including average day, maximum day, and peak hour flows;~~

5. ~~Number and type~~ of proposed services;

6. ~~Fire-fighting requirements;~~

7. ~~Basin capacities;~~

8. ~~Retention times;~~

9. ~~Unit loadings;~~

~~40-8.~~ Filter area and proposed filtration rate;;

~~41-9.~~ Backwash rate; ~~and; and~~

~~42-10.~~ Feeder capacities and ranges.

F. For community waterworks, a copy of the duly recorded (i) plat plan of the well lot or subdivision plan showing the well lot; and (ii) dedication document stating that the well lot shall be used only for waterworks appurtenances as long as the lot is utilized as part of a waterworks.

G. For non-community waterworks, the commissioner may, on a case-by-case basis, require a copy of a duly recorded plat plan of a well lot and a dedication document stating that the well lot shall be used only for waterworks appurtenances as long as the lot is utilized as part of a waterworks. In imposing such a requirement, the commissioner shall take into consideration public health protection and the waterworks' operations, treatment processes, and appurtenances.

**12VAC5-590-210. Formal requirements Requirements for the submission of engineering data.**

A. In accordance with Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54.1 the provisions of Chapter 4 (§54.1-400 et seq.) of Title 54.1 of the Code of Virginia, all drawings, specifications, and engineer's reports submitted for approval shall be prepared by or under the supervision of a licensed professional engineer legally qualified to practice in Virginia; ~~unless submitted under §54.1-408 of the Code of Virginia for practice of land surveying in subdivisions.~~

B. ~~The front cover of each set of drawings, of each copy of the engineer's report, and of each copy of the specifications submitted for review shall bear the signed imprint of the seal of the licensed professional engineer who prepared or supervised the preparation and be signed with an original signature. In addition, each drawing submitted shall bear an imprint or a legible facsimile of such seal. The quantity, format, and method of submission shall meet the review/evaluation needs of the department and shall be consistent with the requirements in Chapter 42.1 (§ 59.1-479 et seq.) of Title 59.1 of the Code of Virginia.~~

C. All reports, plans, and specifications shall be submitted to the ~~field office department~~ at least 60 days ~~prior to before~~ the date upon which action by the ~~division commissioner~~ is desired.

D. If the procedures for obtaining a construction permit in 12VAC5-590-200 are not complied with, or if plans and specifications are found to be incomplete or inadequate for ~~detailed review evaluation~~, then the plans and specifications will be returned to the submitting party. If revisions to the plans or specifications or both are necessitated, ~~a letter will be sent to the owner and engineer who prepared them outlining the will be notified in writing of the necessary revisions. Revised plans or specifications or both constitute a resubmittal; however, the division will make every resubmission. Every effort will be made to complete the review of such evaluation of these revisions promptly. Preliminary plans and the engineer's report should be submitted for review prior to preparation of final plans.~~

**12VAC5-590-220. Compliance with the Manual of Practice.**

A. The design guidelines set forth in ~~the Manual of Practice (Part III)~~ Part III of the regulations, the "Manual of Practice," specify general criteria for the design and construction of waterworks. The ~~division commissioner~~ may impose standards or requirements ~~which that~~ are more stringent than those contained in the Manual of Practice when required ~~for critical areas or special conditions to meet drinking water quality standards~~. Any ~~such~~ special standards or requirements with a federal mandate shall take precedence over the criteria in the manual and will be items ~~which that~~ warrant careful consideration at the preliminary engineering conference, referenced in 12VAC5-590-200-B.

B. Designs submitted for waterworks must demonstrate that the ~~system waterworks~~ will adequately safeguard public health. Submissions ~~which that~~ are in substantial compliance with

the Manual of Practice or additional requirements of the ~~department~~ commissioner, as noted ~~above~~ in subdivision A of this section, or both, will be approved. Justification for a design may be required for those portions of the submitted design which ~~that~~ differ from the criteria of established by the division, commissioner or as set forth in the Manual of Practice, or accepted engineering practices. Deviations from "shall" mandatory criteria contained in the Manual of Practice which the design engineer, in his judgment, believes to be substantial in nature shall be identified and justified. For each deviation, The division the commissioner may require changes in designs which are not in substantial compliance with the manual and which are not adequately justified by the engineer owner issue a design exception or require compliance with the criteria.

C. Final, complete, and detailed plans and specifications submitted in accordance with the provisions of 12VAC5-590-200 and 12VAC5-590-210 will be ~~reviewed~~ evaluated by the ~~division commissioner~~ as soon as practicable upon receipt. ~~Such plans~~ Plans and specifications will be approved if they demonstrate substantial compliance with the design criteria set forth in the Manual of Practice and if the ~~waterworks~~ waterworks, as constructed or modified, will be able to function in compliance with the ~~operating regulations set forth in Part II of this chapter. One set of the approved plans and specifications will be stamped by the division and returned to the owner.~~

D. Compliance with the Manual of Practice for transient noncommunity waterworks is allowed the following exceptions as long as the conditions in subsection E of this section are satisfied:

1. The design of a transient noncommunity waterworks is not required to satisfy the professional engineer licensure requirement of 12VAC5-590-210 under the following conditions:

- a. The waterworks shall serve no more than 100 persons per day.
- b. The waterworks shall consist only of one ~~supply of source water~~ supply, pressure tank no greater than 250 ~~gallon~~ capacity, and single service connection.
- c. The single service connection shall be a building or structure of less than 5,000 square feet total floor space. The determination of square footage shall be calculated using the outside perimeter of the building or structure.

2. Although the owner of a transient noncommunity waterworks is required to use a water well systems provider certified by the DPOR for drilling wells, the remainder of the waterworks facility construction at a transient noncommunity waterworks may be performed by a master plumber or a certified water well systems provider, as defined in § 54.1-1129.1 of the Code of Virginia.

E. The conditions for exceptions to the Manual of Practice for transient noncommunity waterworks specified in -subsection D of this section are as follows:

1. The owner shall submit a signed and dated statement attached to the permit application, certifying that subsection D of this section will be satisfied.
2. The owner shall submit information related to the design, construction, and materials used as required by the commissioner.

#### **12VAC5-590-230. Issuance of the construction permit.**

A. Upon approval of the plans and specifications, the commissioner will issue a permit to the owner to construct or modify ~~his~~ the waterworks ~~or water supply~~ in accordance with the approved plans and specifications.

B. The construction permit shall be valid for a period of five years. If construction has not begun within five years but were to proceed in the future, ~~then~~ the owner shall reapply for a new construction permit.

C. The construction permit may include conditions for securing equipment certifications and performance validations.

**12VAC5-590-240. Revisions of approved plans.**

A. Any deviations from the approved plans and specifications affecting capacity, hydraulic conditions, operating units, the functioning of water treatment processes, or the quality of water to be delivered must be approved by the division commissioner before any such changes of these deviations are made implemented.

B. Revised plans and specifications shall be submitted in time to permit allow the review evaluation and approval of such these plans or specifications before any construction work which that will be affected by such these changes is begun may begin.

**12VAC5-590-250. Statement required upon completion of construction.**

A. Upon completion of the construction or modification of the waterworks-waterworks, the owner shall submit to the field-officeDepartment-office-department a statement signed by a licensed professional engineer stating that the construction work was completed in accordance with the approved plans and specifications, revised only in accordance with the provisions of 12VAC5-590-240. This statement is called a statement of completion of construction and shall be based upon inspections of the waterworks during and after construction or modifications. These inspections that are to be adequate to insure the truth of the statement of completion of construction.

B. The project documents may require a performance validation report to confirm the design, performance criteria, and appropriate emergency procedures for specific processes and equipment. The project documents may also require operator training. If these requirements are included in the project documents, then the statement of completion of construction shall also include the performance validation report and a certification of successful operator training, as applicable.

**12VAC5-590-260. Issuance of the operation permit.**

A. Upon receipt of the 12VAC5-590-250 statement of completion of construction, receipt of all required certifications and test results, inspection by the department to ensure that the project has been satisfactorily completed in accordance with the approved design documents, and verification that bacteriological test results comply with the requirements set forth in Part II of these regulations, as appropriate, the commissioner will issue an operating operation permit. However, the commissioner may delay the granting of the permit pending inspection by the field office to insure that the work has been satisfactorily completed.

B. An owner shall not operate a waterworks without first having obtained an operation permit except as provided in 12VAC5-590-290.

C. The commissioner shall establish the type (community, nontransient noncommunity, or transient noncommunity), classification-classification, and permitted capacity of the waterworks waterworks, and specify these on the operation permit. Conditions may be included with the permit for operator, monitoring, and reporting requirements.

**12VAC5-590-270. Inspection and correction. Startup testing and inspections.**

A. Within 30 days after Before placing a new or modified waterworks or water supply into operation following construction, the owner shall test the water produced at the entry point to the distribution system in a manner acceptable to the division commissioner. The field office will be notified owner shall notify the department of the time and place of the tests. Results The owner shall send the results of the tests will be sent to the field office-department.

B. The commissioner, a member of the board, or a member of the division has a right to inspect any waterworks or water supply and to be present for any testing in accordance with Title 32.1 of the Code of Virginia.

**12VAC5-590-280. Procedure for obtaining a construction permit for well sources. (Repealed.)**

Since the quantity and quality of water from proposed wells cannot be anticipated, the following procedure shall be used:

1. Submittal of application—see 12VAC5-590-200 A.
2. Preliminary engineering conference—see 12VAC5-590-200 B.
3. When, upon inspection by the division's engineer, one or more well lots are found suitable for well sites, then tentative approval in writing will be furnished to the owner authorizing him to proceed with the drilling of the well or wells and this letter will specify the exact location on the lot where each well is to be drilled. Also, the letter will specify that the well shall be Class I or Class II, meeting the specifications set forth in Part III Article 2, Source Development. This tentative approval will become void after a 12-month period and the site must be reinspected before construction when so voided.
4. Submittal of engineer's report and preliminary plans—see 12VAC5-590-200 C.
5. Submittal of plans, specifications, and other data—see subsections D, E, and F of 12VAC5-590-200; 12VAC5-590-210 and 12VAC5-590-840. One of the following must also be submitted:

a. A copy of the plat plan showing that it has been duly recorded and signed by the clerk of the court, giving the deed book and page number and date of recording, will be required before a construction permit can be issued, or

b. If the well lot is identified on a recorded plan of the subdivision as a well lot, then this is acceptable, if recorded as required by this subsection.

In addition, a dedication document duly recorded with the clerk of the circuit court must be furnished stating that the well lot shall be used only for waterworks appurtenances as long as this lot is utilized as part of a waterworks.

**12VAC5-590-290. Procedure for issuance of special permits for new or nonconventional methods, processes, and equipment Issuance of a temporary operation permit.**

A. Water treatment methods, processes, and equipment ~~which that~~ are not covered by the design criteria of Part III ~~or Part IV~~ of this chapter, and which in principle or application are new or nonconventional, are subject to a special temporary permit application procedure ~~in lieu instead~~ of that set forth in 12VAC5-590-200. A special temporary permit may be issued only after detailed ~~review~~ evaluation of all engineering data and after a period of extensive monitoring of ~~the water treatment~~ plant performance.

B. ~~The policy of the board is to encourage~~The department encourages the development of any new or nonconventional methods, ~~processes—processes,~~ and ~~equipment—equipment,~~ ~~which, which~~ by virtue of treatability ~~studies, studies~~ appear to have application for the purification of raw water ~~treatment~~. However, these new or nonconventional developments shall have been thoroughly tested in a ~~full-scale full-scale~~ or representative ~~pilot-plant pilot-plant~~ installation before approval of a plant utilizing ~~this process~~ these methods, ~~processes—processes,~~ and equipment can be employed ~~are approved and an operation permit issued~~. The ~~result of this testing must~~ results shall be submitted to the ~~field office~~department. The testing required on new or nonconventional developments ~~will shall~~ generally follow these guidelines:

1. All procedures used in validating the process shall be conducted under the supervision of (i) a licensed professional engineer experienced in the field of environmental engineering, (ii) the owner's engineering staff, or (iii) a testing firm acceptable to the ~~division~~ commissioner;

2. Samples shall be collected and analyzed in a manner ~~which would~~ that shall demonstrate water treatment plant effectiveness and efficiency under adverse conditions and over extended periods of time in the area of the proposed installation;

3. The data shall be from the continuous operation of a ~~full-scale full-scale~~ or pilot plant treating the type of water to be handled;

4. Automatic indicating, recording, and totalizing ~~flow measuring~~ equipment shall be provided, and the total flow shall be measured and recorded daily;

~~5. At installations treating surface waters, employing coagulation, flocculation, sedimentation, filtration, and disinfection, automatic indicating and recording equipment shall be provided for continuously monitoring the turbidity of the raw water, settled water, and each filter effluent, as well as pH monitoring of the treated water (flash mix effluent);~~

~~6. 5. If the raw water source~~ source water receives upstream discharges of treated industrial wastes or ~~sewage effluents~~ treated wastewater, then automatic indicating and recording equipment shall be provided for continuously monitoring the pH of ~~raw and the source~~ and finished water, ~~finished water and in addition to the~~ chlorine residual of the finished water;

~~7. 6. The minimum sampling and analysis program will be established by the division commissioner~~ in accordance with the process under investigation; ~~and and~~

~~8. 7. All analyses shall be made in accordance with the most current edition of Standard Methods for the Examination of Water and Wastewater, published by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation or analytical methods approved in advance by the division~~ utilize methods that are consistent with 12VAC5-590-440.

C. Detailed plans shall be submitted where possible showing how, in case of nonacceptance, the water treatment plant or unit water treatment methods, ~~processes processes~~, and equipment will be converted to, or replaced with, a proven process. Also, financial resources must be assured to make the conversion; ~~(for example e.g.,~~ funds placed in escrow or a bond posted).

D. After review evaluation of the plans and testing data, the commissioner will issue a construction permit if ~~he is satisfied the performance data verifies~~ that the method, process, or equipment will may efficiently produce water that will meet in accordance with design specifications and the operation standards of Part II of this chapter, ~~and that the method, process, or equipment may be converted to a conventional technique, if necessary.~~

E. Upon completion of construction or modification, a ~~provisional~~ temporary permit for a definite period of time will be issued for the operation of the new or nonconventional methods, processes, and equipment. Not more than one ~~provisional~~ temporary permit will be granted for a similar installation during the evaluation period. The ~~provisional~~ temporary operation permit shall require that:

1. The evaluation period shall be a minimum of 12 months and no longer than 18 months; and

2. The holder of a ~~provisional~~ temporary operation permit ~~must shall~~ submit reports on operation during the evaluation period as required by the ~~division~~ commissioner. The reports shall be prepared by (i) a licensed professional engineer experienced in the field of environmental engineering, (ii) the owner's operating or engineering staff, or (iii) a testing firm ~~acceptable to the division~~ organization.

~~F. The commissioner will issue an operation permit upon lapse of the provisional permit, if, on the basis of testing during that period, he finds that the new or nonconventional method, process, or equipment efficiently meets the operation standards of Part II. If the standards are not met,~~

then the commissioner will issue an order which will require the alteration of the waterworks or water supply in a manner that will enable these standards to be met.

F. The commissioner may issue a temporary operation permit if the waterworks is not in compliance with the regulations and public health will not be jeopardized. The temporary permit may be issued for ~~such~~ a period of time and subject to ~~such~~ conditions as the commissioner may deem appropriate for the owner to achieve compliance with this chapter.

~~1. G. The commissioner may require, as a condition to a temporary operation permit, the submission of a waterworks business operation plan by new waterworks and these existing waterworks that have demonstrated limited TMF capability or significant noncompliance with the regulations.~~

~~2. The waterworks business operation plan shall satisfy the requirements of 12VAC5-590-200 A 5. The commissioner may require submission of a waterworks~~

~~business operation plan in the event of change in ownership of a waterworks, or a newly regulated waterworks. The waterworks business operation plan shall satisfy the requirements of 12VAC5-590-200 A 5.~~

**12VAC5-590-300. Procedure for obtaining issuance of a general permit for construction of distribution mains.**

A. ~~In lieu~~ Instead of obtaining a permit for each distribution main project, an owner may elect to obtain a general permit for the construction of distribution mains. These general permits are issued by the commissioner, but all requests for a general permit are directed initially to the ~~field office~~ department.

B. The following ~~procedure for obtaining the~~ requirements shall be satisfied for the issuance of a general permit ~~shall be used~~:

1. The owner shall develop, adopt, and have ~~division~~ the commissioner's approval of general specifications and plan details covering water distribution main design and construction. The general specifications shall be at least as stringent as the requirements contained in this chapter.

2. The owner shall enter into a ~~memorandum of understanding~~ Memorandum of Understanding (MOU) with the ~~division which outlines the following~~ commissioner. The commissioner will outline the system-specific waterworks-specific requirements, and the owner's method of compliance with such requirements: the requirements. The waterworks-specific requirements include, but are not limited to the following:

- a. The maximum size of pipe to be covered by the general permit;
- b. The means for modifying the ~~division~~ department's approved general specifications and plan details;
- c. The maintenance of engineering capabilities satisfactory to the ~~division~~ commissioner, either on-staff or through contractual arrangements;
- d. The preparation of engineering plans and specifications for individual projects;
- e. The maintenance of up-to-date distribution system maps and other appropriate records; and
- f. The submission by the owner to ~~the division~~ the department of appropriate reports, including an annual report and summary, concerning all projects constructed under the terms of the ~~general permit~~ MOU and information concerning changes to the distribution system.

C. Once the general specifications are approved and the MOU is agreed to by the commissioner, a general permit for distribution mains shall be issued with the MOU attached.



D. The general permit allows for the construction of distribution mains. The duration for the general permit is five years.

**12VAC5-590-310. Amendment or reissuance of operation permits.**

A. The commissioner may amend or reissue a ~~an~~ operation permit where (i) there is a change in the manner of storage, ~~the~~ treatment, or the ~~source of supply of the~~ water supply at the permitted ~~location;~~ location; (ii) the existing permit is no longer ~~valid;~~ valid; or (iii) for any other cause incident to the protection of the public health, or (iv) for the supplying of ~~pure~~ potable water. ~~A provided~~ notice may be required to be ~~is~~ given to the owner, and, if one is required, a hearing held in accordance with the provisions of ~~subdivisions 1 and 2 of 12VAC5-590-160~~ 12VAC5-590-115.

B. The commissioner may require submission of a waterworks business operation plan as a condition to amend or reissue an operation permit. The waterworks business operation plan shall satisfy the requirements of 12VAC5-590- 200 A 5.

**12VAC5-590-320. Revocation ~~or suspension~~ of a ~~an~~ operation permit.**

A. The commissioner may ~~suspend or~~ revoke a ~~an~~ operation permit in accordance with Administrative Process Act ~~the~~ APA. Reasons for revocation ~~of permits are as follows~~ include:

1. Failure to comply with the conditions of the operation permit; or
2. Violation of Title 32.1 of the Code of Virginia or of any of this chapter from which no variance or exemption has been granted;
3. Change in ownership;
4. Abandonment of the waterworks and discontinuing the supplying of pure water; and
5. ~~2.~~ Any of the grounds specified in § 32.1-174 of the Code of Virginia.

B. Procedure for revocation of operation permit. When revoking ~~or suspending~~ permits ~~an~~ operation permit in accordance with ~~the above~~ subsection A of this section, the commissioner shall:

1. Send a written notice of intent to ~~suspend or~~ revoke by certified mail to the last known address of the ~~waterworks~~ owner. The notice shall state the reasons for the proposed ~~suspension or~~ revocation of the operation permit, ~~the authority under which the commissioner proposes to act,~~ and ~~shall give the time and place of the hearing; and offer the opportunity for an administrative proceeding in accordance with 12VAC5-590-115.~~
2. Provide at least 30 days advance notice of the ~~hearing~~ administrative proceeding.

C. An owner who is given notice of intent to revoke or suspend his permit has a right to a hearing as specified in 12VAC5-590-160 and 12VAC5-590-180.

**12VAC5-590-330. Monitoring, records, and reporting.**

A. The commissioner or ~~the division~~ ~~department~~ may require the owner or operator of any ~~waterworks or water supply~~ to install, use, and maintain monitoring equipment for the control and testing of water flowing through the water treatment plant to:

1. Identify and determine the cause of operational problems;
2. Determine the necessary corrective actions for these problems;
3. Ensure compliance with Part II of this chapter; and
4. Prepare the finished water for entry into the distribution system.

B. Sampling and testing shall be by methods approved by the commissioner. Test results shall be recorded, compiled, and reported to the department in a format acceptable to the commissioner.

**Part II**  
**Operation Regulations for Waterworks**

Article 4

General Drinking Water Compliance Standards, Testing, Surveys, and Responsibilities

**12VAC5-590-340. General Compliance standards.**

A. All physical, chemical, bacteriological, or radiological analyses for the purpose of demonstrating compliance with primary and secondary maximum contaminant levels action levels or contaminants that do not have PMCLs but for which compliance samples must be analyzed by certified laboratories the requirements of this chapter shall be performed by the Commonwealth of Virginia, Department of General Services, Division of Consolidated Laboratory Services (DCLS) DCLS or in by laboratories certified by the Division of Consolidated Laboratory Services DCLS for such purposes unless listed in 12VAC5-590-440 C. The owner is responsible for the collection and submission of all samples. The commissioner department may require sampling and testing that exceeds the minimal requirements specified in this chapter. A sample is deemed to have been collected only if and when its results are made known to the Office of Drinking Water ODW department.

B. Specific limits. No attempt has been made to prescribe specific limits for every contaminant that might occur in a water supply or a waterworks. Although the need exists for continued attention to the entry of chemical, physical, bacteriological, and radiological substances into drinking water, the limits are confined to substances recognized as being detrimental to the health or well-being of the consumer or cause significant degradation of the usefulness of the water. Limits for innumerable substances would require an impossible burden of analytical examination. The specific limits included in this chapter are listed in Tables 340.1 through 340.7.

C. Compliance is determined:

1. Based on sample results or calculated averages, where appropriate, rounded to the same number of significant figures as the PMCL, SMCL, AL, or MRDL of the contaminant in question, or
2. By the application of the specific treatment technique for particular contaminants (See 12VAC5-590-391).

TABLE 340.1.  
Inorganic Chemicals.

<u>SUBSTANCE</u>	<u>PMCL (mg/L)</u>
<u>Antimony</u>	<u>0.006</u>
<u>Arsenic</u>	<u>0.010<sup>a</sup></u>
<u>Asbestos</u>	<u>7 Million-million Fibersfibers/Liter-liter (longer than 10 µm)</u>
<u>Barium</u>	<u>2</u>
<u>Beryllium</u>	<u>0.004</u>
<u>Cadmium</u>	<u>0.005</u>
<u>Chromium</u>	<u>0.1</u>

Cyanide (as free Cyanide)	0.2
Fluoride	4.0 <sup>b</sup>
Mercury	0.002
Nickel	No <del>Limits-limits</del> <del>Designated</del> designated
Nitrate (as N)	10 <sup>c</sup>
Nitrite (as N)	1.0 <sup>c</sup>
Total Nitrate and Nitrite (as N)	10 <sup>c</sup>
Selenium	0.05
Thallium	0.002
<u>SUBSTANCE</u>	<u>SECONDARY MAXIMUM CONTAMINANT LEVEL (mg/L)</u>
Aluminum	0.05-0.2 <sup>d</sup>
Chloride	250 <sup>c</sup>
Copper	1.0
Corrosivity	Noncorrosive
Fluoride	2.0
Foaming <del>Agents</del> agents	0.5 <sup>e</sup>
Iron	0.3
Manganese	0.05
Silver	0.1
Sulfate	250 <sup>c</sup>
Zinc	5
<u>SUBSTANCE</u>	<u>ACTION LEVEL (mg/L)</u>
Lead	0.015
Copper	1.3
<p><sup>a</sup> Arsenic sampling results shall be reported to the nearest 0.001 mg/L.</p> <p><sup>b</sup> The fluoride PMCL applies only to community waterworks.</p> <p><sup>c</sup> Significant figures are noted as shown. For values with trailing zeros, significant figures are noted as shown. The limits for nitrate and nitrate-nitrite have two significant figures. The limits for chloride and sulfate have three significant figures.</p> <p><sup>d</sup> Varying water quality and treatment situations necessitates a flexible range for the aluminum SMCL. <del>Owners are</del>An owner is encouraged to maintain as low an aluminum concentration as low as possible. If the aluminum concentration in the finished water causes discoloration, then the owner is urged to contact the department.</p>	

<sup>e</sup> Concentrations reported in terms of Methylene Blue Active Substances.

TABLE 340.2.  
Organic Chemicals.

SUBSTANCE	PMCL (mg/L)
<u>VOCs</u>	
Benzene	0.005
Carbon <del>Tetrachloride</del> tetrachloride	0.005
Chlorobenzene (also called <del>monochlorobenzene</del> Monochlorobenzene)	0.1
o-Dichlorobenzene	0.6
p-Dichlorobenzene	0.075
1,2-Dichloroethane (also called <del>ethylene</del> Ethylene dichloride)	0.005
1,1-Dichloroethylene (also called <del>dichloroethene</del> Dichloroethene)	0.007
cis-1,2-Dichloroethylene	0.07
Trans-1,2-Dichloroethylene	0.1
Dichloromethane (also called <del>methylene</del> Methylene chloride)	0.005
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Styrene	0.1
Tetrachloroethylene (PCE) (also called <del>perchloroethylene</del> Perchloroethylene)	0.005
Toluene	1
1,2,4-Trichlorobenzene	0.07
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethane	0.005
Trichloroethylene (TCE)	0.005
Vinyl Chloride	0.002
Xylene (total)	10 <sup>a</sup>
<u>SOCs</u>	
Acrylamide	11 <sup>b</sup>
Alachlor (also called Lasso)	0.002

<u>Atrazine</u>	<u>0.003</u>
<u>Benzo(a)pyrene</u>	<u>0.0002</u>
<u>Carbofuran</u>	<u>0.04</u>
<u>Chlordane</u>	<u>0.002</u>
<u>Dalapon</u>	<u>0.2</u>
<u>Di(2-ethylhexyl)adipate (also called Bis(2-ethylhexyl)adipate)</u>	<u>0.4</u>
<u>Di(2-ethylhexyl)phthalate (also called Bis(2-ethylhexyl)phthalate)</u>	<u>0.006</u>
<u>1,2-Dibromo-3-chloropropane (DBCP)</u>	<u>0.0002</u>
<u>2,4-Dichlorophenoxyacetic Acid (2,4-D)</u>	<u>0.07</u>
<u>Dinoseb</u>	<u>0.007</u>
<u>Diquat</u>	<u>0.02</u>
<u>Endothall</u>	<u>0.1</u>
<u>Endrin</u>	<u>0.002</u>
<u>Epichlorohydrin</u>	<u>TT<sup>b</sup></u>
<u>Ethylene dibromide (EDB) (also called 1,2-Dibromoethane)</u>	<u>0.00005</u>
<u>Glyphosate</u>	<u>0.7</u>
<u>Heptachlor</u>	<u>0.0004</u>
<u>Heptachlor epoxide</u>	<u>0.0002</u>
<u>Hexachlorobenzene</u>	<u>0.001</u>
<u>Hexachlorocyclopentadiene</u>	<u>0.05</u>
<u>Lindane (also called gamma-HCH and gamma BHC)</u>	<u>0.0002</u>
<u>Methoxychlor</u>	<u>0.04</u>
<u>Oxamyl (Vydate)</u>	<u>0.2</u>
<u>Pentachlorophenol (PCP)</u>	<u>0.001</u>
<u>Picloram</u>	<u>0.5</u>
<u>Polychlorinated biphenyls (PCBs)</u>	<u>0.0005</u>
<u>Simazine</u>	<u>0.004</u>
<u>2,3,7,8-TCDD (Dioxin)</u>	<u>3 X 10<sup>-8</sup></u>
<u>Toxaphene</u>	<u>0.003</u>
<u>2,4,5-Trichlorophenoxypropionic Acid (2,4,5-TP or Silvex)</u>	<u>0.05</u>

<sup>a</sup> The limit for xylene has two significant figures.

<sup>b</sup> Each waterworks must certify annually to the department that when acrylamide and epichlorohydrin are used to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified as follows: (i) acrylamide = 0.05% dosed at 1 mg/L (or equivalent) and (ii) epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent). The certification shall be in writing, using third-party certification approved by the department or the manufacturer's certification.

TABLE 340.3.  
Physical ~~Quality~~Quality.

PARAMETER	STANDARD	CONCENTRATION
Color	SMCL	15 Color Units (CU)
Odor	SMCL	3 Threshold odor numbers
pH	SMCL	6.5-8.5
Total <del>Dissolved-dissolved</del> Solids-solids (TDS)	SMCL	500 mg/L <sup>a</sup>
Turbidity	Treatment Technique	See 12VAC5-590-395 A 2 b <sup>b</sup>

<sup>a</sup> TDS has three significant figures.

<sup>b</sup> Operational goal: Surface water treatment plants with gravity flow granular media filters are capable of producing filtered water with a turbidity consistently less than 0.10 NTU. Therefore, for water treatment plants, the operational goal for filter effluent turbidity for each filter, before any post-filtration chemical ~~addition-addition~~, is 0.10 NTU.

TABLE 340.4.  
Radiological Quality.

PARAMETER	PMCL
Combined radium-226 and radium-228:	5 pCi/L
Gross alpha particle activity (excluding Radon and <del>uranium</del> Uranium)	15 pCi/L
Beta particle and photon radioactivity:	4 mrem/yr <sup>a,b</sup>
Uranium	30 µg/L <sup>c</sup>

<sup>a</sup> The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 ~~millirem~~mrem/year.

<sup>b</sup> Except for the radionuclides listed in Schedule I, the concentration of man-made radionuclides causing 4 ~~millirem~~-mrem total body or organ dose equivalents shall

be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," NBS Handbook 69 issued June 5, 1959 and amended August 1963, U.S. Department of Commerce. If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.

<sup>c</sup>The limit for uranium has two significant figures.

Schedule 1

Average annual concentrations assumed to produce a total body organ dose of 4 mrem/year.

<u>RADIONUCLIDE</u>	<u>CRITICAL ORGAN</u>	<u>PCI/L</u>
<u>Tritium</u>	<u>Total Body</u>	<u>20,000<sup>d</sup></u>
<u>Strontium-90</u>	<u>Bone Marrow</u>	<u>8</u>

<sup>d</sup>The limit for tritium has five significant figures.

TABLE 340.5.  
Microbial Contaminants.

<u>CONTAMINANT</u>	<u>PMCL or TT</u>
<u>Cryptosporidium</u>	<u>TT</u> <u>Minimum 99% (2-log) removal plus additional log removal or inactivation based upon bin classification in 12VAC5-590-401 D.</u>
<u>Giardia lamblia</u>	<u>TT</u> <u>99.9% (3-log) removal/or inactivation.</u>
<u>Viruses</u>	<u>TT</u> <u>99.99% (4-log) removal/or inactivation.</u>
<u>Legionella</u>	<u>TT</u> <u>No limit, but if Giardia lamblia and viruses are removed/or inactivated, according to the treatment techniques in 12VAC5-590-395, Legionella will also be controlled.</u>
<u>Heterotrophic plate count (HPC)</u>	<u>TT</u> <u>No more than 500 bacterial colonies per milliliter. (HPC is not a contaminant, it is an analytic method used to measure a variety of bacteria found in water.)</u>

<u>Escherichia coli (E. coli)</u>	<u>PMCL</u>
	<p>(1) Any E. coli-positive repeat sample following a total coliform-positive routine sample.</p> <p>(2) Total coliform-positive repeat sample following an E. coli-positive routine sample.</p> <p>(3) Failure to collect all require repeat samples following an E. coli-positive routine sample.</p> <p>(4) Failure to test for E. coli when any repeat sample tests positive for total coliform.</p>

TABLE 340.6.  
Disinfection Byproducts.

<u>PARAMETER</u>	<u>PMCL (mg/L)</u>
<u>Total trihalomethanes (TTHM)</u> ■ <u>Bromodichloromethane</u> ■ <u>Bromoform</u> ■ <u>Chloroform</u> ■ <u>Dibromochloromethane</u>	<u>0.080<sup>a</sup></u>
<u>Haloacetic Acids-acids (five) (HAA5)</u> ■ <u>Bromoacetic acid</u> ■ <u>Dibromoacetic acid</u> ■ <u>Dichloroacetic acid</u> ■ <u>Monochloroacetic acid</u> ■ <u>Trichloroacetic acid</u>	<u>0.060<sup>a</sup></u>
<u>Bromate</u>	<u>0.010<sup>a</sup></u>
<u>Chlorite</u>	<u>1.0<sup>a</sup></u>
<sup>a</sup> The limits for TTHM, HAA5, and bromate have three significant figures. The limit for chlorite has two significant figures.	

TABLE 340.7.  
Maximum Residual Disinfectant Level Goals (MRDLG) and Maximum Residual Disinfectant Levels (MRDL) for Disinfectants.

<u>RESIDUAL DISINFECTANT</u> <u>RESIDUAL</u>	<u>MRDL (mg/L)</u>
<u>Chlorine</u>	<u>4.0 (as Cl<sub>2</sub>)<sup>a</sup></u>
<u>Chloramines</u>	<u>4.0 (as Cl<sub>2</sub>)<sup>a</sup></u>
<u>Chlorine dioxide</u>	<u>0.8 (as ClO<sub>2</sub>)</u>
<sup>a</sup> Chlorine and chloramines have two significant figures.	



D. Notwithstanding the MRDLs in Table 340.7, ~~an owners~~ may increase residual disinfectant levels of chlorine or chloramines (but not chlorine dioxide) in the distribution system to a level and for a time necessary to protect public health. This may include specific microbiological contamination problems caused by circumstances such as, but not limited to, distribution line breaks, storm ~~run-off runoff~~ events, water supply contamination events, or cross-connection events.

**12VAC5-590-350. Sanitary surveys Assessments and sanitary surveys.**

A. Frequent assessments shall be made by the owner of the water supply ~~source~~ and waterworks to locate and identify health hazards to the waterworks. The manner and frequency of making these assessments, and the rate at which discovered health hazards are to be removed, shall be the responsibility of the owner. Every effort shall be made by the owner, to the extent of his jurisdiction, to prevent the degradation of the quality of water ~~supply sources supplies~~.

B. ~~The commissioner may perform sanitary surveys. The department is required to perform sanitary surveys and site visits to assess the condition of a waterworks and water supplies and its source water.~~ Pursuant to §32.1-25 of the Code of Virginia, the department personnel have the right, with the owner's consent, of entry onto the waterworks property and the facilities to inspect, investigate, evaluate, conduct tests, and collect samples for testing for the purposes of determining compliance with the provisions of any law, regulation, or order administered by the ~~Board board~~ or commissioner or any conditions in a permit, license, or certificate issued by the ~~Board board~~ or commissioner. ~~Owners The owner~~ shall provide any existing information requested by the ~~commissioner department~~ that will enable ~~the commissioner the department personnel~~ to conduct the sanitary survey or site visit.

C. A sanitary survey includes, but is not limited to, an ~~onsite~~ evaluation of all of the following eight components:

1. Source;
2. Treatment;
3. Distribution system;
4. Finished water storage;
5. Pumps, pumping facilities, and controls;
6. Monitoring, reporting, data verification, and a special monitoring evaluation during each sanitary survey to determine whether the waterworks monitoring is appropriate or needs modification;
7. Waterworks ~~system~~ management and operation; ~~and and~~
8. Number and classification of ~~licensed operator(s) operator or operators required in 12VAC5-590-460. Licensed operators Operators~~ shall also comply with all applicable regulations promulgated by the ~~Virginia Board for Waterworks and Wastewater Works Operators and Onsite Sewage System Professionals, Department of Professional and Occupational Regulation DPOR.~~

D. Significant deficiencies discovered as a result of a sanitary survey shall be addressed in accordance with the following:

1. The ~~commissioner department~~ shall issue written notification describing the significant deficiency to the owner.
2. Within 30 days of the significant ~~deficiency~~ notification, the owner shall consult with the ~~commissioner department~~ regarding the appropriate corrective action with a schedule for implementing ~~the~~ corrective action. ~~Any A~~ waterworks with significant deficiencies must have a ~~Corrective corrective Action action Plan plan~~ (CAP) as described in 12VAC5-590-421 A.

3. Within 45 days of the significant deficiency notification, the owner shall submit to the department a CAP with a schedule for meeting the requirements of 12VAC5-590-421 A.

**12VAC5-590-360. Responsibility; Responsibilities of the owner.**

A. ~~The water utility owner or owner of the property served, to the extent of their respective jurisdictions, shall provide and maintain conditions through throughout the entirety of the water supply system waterworks in a manner which that will assure a high degree of capability and reliability to effect compliance with these standards~~ comply with Part II of this chapter. This requirement shall pertain to the source of supply ~~water supplysource water, transmission, treatment, transmission,~~ storage, and distribution system facilities and the operation thereof. ~~In addition, this requirement shall include specific and continuing assessment of the capability, effectiveness, and reliability of the treatment process in relation to potential contaminants in the source of supply. Finally, this requirement shall include the identification and evaluation of~~ The owner shall identify and evaluate all factors having with the potential for impairing the quality of the water as delivered to customers and appropriate preventive and control the consumers. Preventative control measures identified in Part II of this chapter shall be promptly implemented to protect public health.

B. For the purpose of application of this chapter, responsibility for the conditions in the water supply system shall be considered to be held by:

1. ~~The owner from the source of supply to the customer's service connection; and~~

2. ~~The owner of the property served and the municipal, county, or other authority having legal jurisdiction from the customer's service connection to the free-flowing outlet. For the purpose of achieving compliance with this chapter, the owner shall exercise control of the waterworks from the water supplysource water to the service connection. This requirement does not imply ownership of, or maintenance for, any portion of the service line where local agreements and conditions dictate otherwise.~~

C. ~~The property owner shall exercise control of all buildings, structures, and equipment up to the point of the service connection to the waterworks. This requirement does not limit or modify ownership of, or maintenance for, the service line, that may be specified by local agreements and conditions.~~

Article 2  
General Information

**12VAC5-590-370. Sampling frequency Monitoring requirements.**

~~The commissioner may exempt consecutive waterworks that obtain potable water from another water system for distribution from all monitoring requirements in this section except for bacteriological (subsection A of this section); disinfectant residuals, disinfection byproducts, and disinfection byproduct precursors (subdivision B 3 of this section); and lead and copper (12VAC5-590-375). The required sampling frequencies are as follows:~~

A. Bacteriological monitoring.

1. The owner shall collect total coliform samples at specific sites and according to a schedule that is representative of water quality throughout the distribution system, which shall be documented in a written bacteriological sample siting plan (BSSP). The BSSP shall be established or approved by the department commissioner after investigation of the source water, method of treatment and storage, and protection of the water concerned the final delivery of the drinking water through the distributrion system. The BSSP shall include, but is not limited to, the following:

a. Specific routine, repeat, and triggered source water monitoring sites, identified by address or location.

b. Distribution map showing the location where specific sampling sites will be selected with all monitoring sites identified.

c. A minimum of three routine sample sites identified for each required routine sample for waterworks serving 3,300 or fewer people.

d. Sample collection schedule with the number of routine samples required per monitoring period in accordance with Table ~~2-4~~370.1 and subdivision A 4 of this section.

e. Repeat sample sites for each routine sample site that shall include the original routine location, at least one tap within five service connections upstream, and at least one tap within five service connections downstream with the following exceptions:

(1) Alternative repeat sample sites may be allowed when a routine site is one connection away from or at the end of a water supply distribution system main or as approved by the department commissioner;

(2) ~~Groundwater waterworks~~ A groundwater system -serving 1,000 or fewer people may propose repeat sample sites, such as entry point to the distribution system, that differentiate potential source water and distribution system contamination;

(3) ~~Groundwater waterworks~~ A groundwater system serving 1,000 or fewer people with a single well source and no treatment may propose that one repeat sample be collected at the triggered source water monitoring site, provided that representative sampling of the distribution system is still achieved.

f. A repeat sampling site shall not be eliminated from future collections solely based on a history of questionable water quality unless the sampling point is unacceptable as determined by the department commissioner.

g. A seasonal waterworks may collect special samples in accordance with an approved start-up procedure pursuant to subdivision A ~~40 12~~ a of this section.

2. The minimum number of bacteriological samples for total coliform evaluation to be collected and analyzed monthly from the distribution system of a community or nontransient noncommunity waterworks shall be in accordance with Table ~~2-4~~ 370.1. ~~Owners of all~~ The owner of a (i) transient noncommunity waterworks that ~~use-uses~~ a surface water source or a groundwater source under the direct influence of surface water ~~and or~~ (ii) a large transient noncommunity waterworks (serving 1,000 or more persons per day) ~~waterworks~~ shall collect and submit samples monthly for analysis in accordance with Table ~~2-4~~ 370.1. ~~Owners of~~ For all other transient noncommunity waterworks, the owner shall collect and submit samples for analysis each calendar quarter in accordance with Table ~~2-4~~ 370.1. The minimum number of samples must be collected and submitted even if the waterworks has exceeded the E. coli PMCL or the total coliform treatment technique triggers.

3. The samples shall be ~~taken~~collected at ~~reasonably~~-evenly spaced time intervals as practical throughout the month, except that a waterworks that ~~use-uses~~ only groundwater ~~and~~ serving 4,900 or fewer people may collect all the required samples on a single day if the samples are ~~taken~~collected from different sites.

4. If the results of a sanitary survey or other factors determine that some other frequency is more appropriate than that stated in subdivisions A 3 and A 4 of this section, then a modified BSSP may be required. The altered frequency shall be confirmed or changed on the basis of subsequent sanitary surveys or as otherwise determined by the department commissioner.

5. ~~An~~The owner may conduct more compliance monitoring than is required by this section to investigate potential problems in the distribution system and to assist in uncovering

problems. ~~An-The~~ owner may ~~take collect~~ more than the minimum number of required routine samples. If the samples are ~~taken~~collected in accordance with the existing BSSP and are representative of water quality throughout the distribution system, then all of the results shall be included in determining whether a coliform treatment technique has been triggered.

6. ~~An-The~~ owner may propose repeat monitoring locations believed to be representative of a pathway for contamination of the distribution system. ~~An-The~~ owner may elect to specify either alternative fixed locations or criteria for selecting repeat sampling sites on a situational basis in a standard operating procedure (SOP) in its BSSP. The owner shall design the SOP to focus on the collection of repeat samples at locations that best verify and determine the extent of potential contamination of the distribution system ~~area~~-based on specific situations. The ~~department commissioner~~ shall require modifications to the SOP or require alternative monitoring locations as needed.

TABLE 2-1370.41. Bacteriological Monitoring.	
POPULATION SERVED PER DAY	MINIMUM NUMBER OF SAMPLES <sup>a</sup> (See subdivision A 2 of this section)
25 to 1,000 <sup>b</sup>	1
1,001 to 2,500	2
2,501 to 3,300	3
3,301 to 4,100	4
4,101 to 4,900	5
4,901 to 5,800	6
5,801 to 6,700	7
6,701 to 7,600	8
7,601 to 8,500	9
8,501 to 12,900	10
12,901 to 17,200	15
17,201 to 21,500	20
21,501 to 25,000	25
25,001 to 33,000	30
33,001 to 41,000	40
41,001 to 50,000	50
50,001 to 59,000	60
59,001 to 70,000	70
70,001 to 83,000	80
83,001 to 96,000	90

	96,001 to 130,000	100
	130,001 to 220,000	120
	220,001 to 320,000	150
	320,001 to 450,000	180
	450,001 to 600,000	210
	600,001 to 780,000	240
	780,001 to 970,000	270
	970,001 to 1,230,000	300
	1,230,001 to 1,520,000	330
	1,520,001 to 1,850,000	360
	1,850,001 to 2,270,000	390
	2,270,001 to 3,020,000	420
	3,020,001 to 3,960,000	450
	3,960,001 or more	480

<sup>a</sup> Monthly monitoring is required for the following waterworks: (i) community, (ii) nontransient noncommunity, (iii) ~~All~~-all noncommunity waterworks that use either a surface water source or a GUDI source or both, (iv) all seasonal waterworks, and (v) large noncommunity (> 1,000 people per day). Quarterly monitoring is required for noncommunity waterworks not specifically identified in the monthly requirements. Annual monitoring may be allowed at a transient noncommunity waterworks that meets the criteria specified in subdivision A 8 of this section.

<sup>b</sup> Includes a waterworks that have at least 15 service connections, but serve fewer than 25 persons.

7. All bacteriological analyses shall be performed in accordance with 12VAC5-590-440 ~~by the Division of Consolidated Laboratory Services (DCLS)~~ or by a laboratory certified by the DCLS for drinking water samples.

8. Annual monitoring. The department may reduce the bacteriological monitoring frequency at a well-operated transient noncommunity waterworks from a quarterly sample to one annual sample and the waterworks may remain at the annual monitoring frequency provided that all of the following conditions are continuously met:

- a. The waterworks serves 1,000 or fewer people per day.
- b. The waterworks uses groundwater only and is not under the influence of surface water.
- c. The waterworks has a clean compliance history for a minimum of 12 consecutive months.
- d. The most recent sanitary survey shows that the waterworks is free of sanitary defects or has corrected all identified sanitary defects.
- e. The waterworks has a protected water source.
- f. The waterworks meets existing approved construction standards.
- g. The department has conducted an annual site visit within the last 12 months, and all identified sanitary defects have been corrected. For the purposes of this

section, an annual site visit is equivalent to a voluntary Level 2 assessment that meets the criteria in 12VAC5-590-392 C. A sanitary survey may meet the requirement for an annual site visit in the year in which the sanitary survey is completed if all identified sanitary defects have been corrected.

**89. Increased monitoring.**

a. A transient noncommunity waterworks on quarterly or annual monitoring shall begin monthly monitoring in the month following an event if any of the following ~~were to~~ occurs: (i) the waterworks triggers a Level 2 assessment or two Level 1 assessments under the provisions of 12VAC5-590-392 in a rolling 12-month period, (ii) the waterworks has an E. coli PMCL violation, (iii) the waterworks has a coliform treatment technique violation, (iv) the owner has two monitoring violations under 12VAC5-590-370 A 2, or (v) the owner has one monitoring violation under 12VAC5-590-370 A 2 and one Level 1 assessment under 12VAC5-590-392 in a rolling 12-month period. ~~Owners~~ The owner shall continue monthly monitoring until the requirements in subdivisions ~~A 9 a- A 10 a~~ and ~~A 9 b- A 10 b~~ of this section are met. A waterworks on monthly monitoring for other reasons is not considered to be on increased monitoring for the purpose of this subdivision.

b. A transient noncommunity waterworks on annual monitoring that experiences one monitoring violation of section 12VAC5-590-370 must begin quarterly monitoring in the quarter following the event. The owner shall continue quarterly monitoring until the conditions in subdivision A 11 of this section are continuously met and the department reduces the monitoring frequency.

**910. Returning to quarterly routine monitoring.** The ~~department commissioner~~ may return the monitoring frequency of a transient noncommunity waterworks subject to subdivision A 9 a of this section and using groundwater not under the influence of surface water to quarterly monitoring if:

a. The ~~department commissioner~~ has completed a sanitary survey or a site visit within the last 12 months, and the transient noncommunity waterworks is free of sanitary defects and has a protected water source; and

b. The owner has maintained a clean compliance history, ~~defined as a record of no PMCL violations for microbiological contaminants, no monitoring violations under 12VAC5-590-370, and no coliform treatment technique trigger exceedances or treatment technique violations under 12VAC5-590-392,~~ for a minimum of 12 consecutive months following the event.

**11. Returning to annual routine monitoring.** The department may ~~return~~ reduce the monitoring frequency of a transient noncommunity waterworks subject to subdivision A 9 of this section and using groundwater not under the influence of surface water to annual monitoring if:

a. An annual site visit or sanitary survey is conducted by the department and all identified sanitary defects are corrected. The waterworks may substitute a voluntary Level 2 assessment for the annual site visit.

b. The waterworks has a protected water source and maintained a clean compliance history for a minimum of 12 consecutive months following the event.

c. The waterworks has in place or has adopted one or more of the following additional barriers to contamination: (i) an approved cross connection control program, (ii) a licensed operator, (iii) continuous disinfection and maintenance of a residual in the distribution system in accordance with criteria specified by the department commissioner, (iv) demonstration of maintenance of at least a 4-log removal or

inactivation of viruses in accordance with 12VAC5-590-379 A, or (v) other equivalent enhancements approved by the ~~department commissioner~~.

~~40~~12. Seasonal waterworks monitoring.

- a. ~~All~~A seasonal waterworks shall demonstrate completion of an approved start-up procedure that may include start-up sampling ~~prior to~~ before serving water.
- b. A seasonal waterworks shall monitor every month that it is in operation.
- c. The ~~department commissioner~~ may waive any seasonal waterworks from some or all of the requirements for seasonal waterworks if the entire distribution system remains pressurized during the entire period that the waterworks is not operating.
- d. Failure to complete an approved start-up procedure ~~prior to~~ before serving water is a treatment technique violation and requires the owner to provide public notification under Tier 2 conditions in ~~12VAC5-590-540~~12VAC5-590-540 A 2.
- e. Failure to submit certification of completion to the ~~department commissioner~~ after the owner completes an approved start-up procedure is a reporting violation and requires the owner to provide public notification under Tier 3 conditions in ~~12VAC5-590-540~~12VAC5-590-540 A 3.

~~41~~13. Additional routine monitoring in the month following a total coliform-positive sample.

- a. ~~Owners~~The owner collecting samples on a quarterly or annual frequency shall collect at least three additional routine samples during the month following one or more total coliform-positive samples, with or without a Level 1 treatment trigger. The owner shall use the results of additional routine samples in coliform treatment technique trigger calculations under 12VAC5-590-392 B.
- b. The requirements specified in subdivision ~~A-41-a~~ A 13 a of this section may be waived by the ~~department commissioner~~ if:
  - (1) The ~~commissioner~~department conducts a site visit before the end of the next month in which the waterworks provides water and has determined whether additional monitoring or corrective action is needed;
  - (2) The ~~department commissioner~~ has determined why the sample was total coliform positive and has established that the owner corrected the problem or will correct the problem before the end of the next month in which the waterworks serves water. In this case, the decision and the rationale for the decision shall be documented and approved in writing by the ~~department commissioner~~. The ~~department commissioner~~ shall make this document available to EPA and the public. The documentation shall describe the specific cause of the total coliform-positive sample and what action the owner has taken or will take to correct this problem; or
  - (3) The ~~department commissioner~~ determines that the owner has corrected the contamination problem before collecting the set of repeat samples required in 12VAC5-590-380 D 3, and all repeat samples are total coliform negative. The ~~department commissioner~~ may waive the requirement for additional routine monitoring the next month.
- c. The requirements specified in subdivision ~~A-41-a~~ A 13 a of this section may not be waived by the ~~department commissioner~~ solely on the grounds that all repeat samples are total coliform negative.

~~42~~14. Failure to collect every required routine or additional routine sample in a compliance period is a monitoring violation and requires the owner to provide public notification under Tier 3 conditions in ~~12VAC5-590-540~~12VAC5-590-540 A 3.

~~4315.~~ Failure to submit monitoring results after the owner properly conducts monitoring is a reporting violation and requires the owner to provide public notification under Tier 3 conditions in ~~12VAC5-590-540~~12VAC5-590-540 A 3.

B. Chemical monitoring. The location of sampling points, the chemicals measured, the frequency, and the timing of sampling within each compliance period shall be established or approved by the ~~commissioner~~ department at the time of issuance of a waterworks operation permit, but may be modified as waterworks' conditions and regulations change.

1. The department may increase required monitoring where necessary to detect variations within the waterworks and to provide quality control for any treatment processes that are employed.

2. Analysis of field composite samples shall not be allowed.

3. Samples for contaminants that may exhibit seasonal variations shall be collected during the period of the year when contamination is most likely to occur.

4. Failure to comply with the sampling schedules in this section shall require public notification pursuant to ~~12VAC5-590-540~~12VAC5-590-540 A 3.

C. The department may allow a consecutive waterworks that obtain potable water from another waterworks to limit monitoring to bacteriological, disinfectant residuals, ~~disinfectant disinfection~~ byproducts, and lead and copper.

D. Monitoring requirements for a waterworks developing new sources of ~~supply-source~~ water are provided in 12VAC5-590-820, 12VAC5-590-830, and 12VAC5-590-840.

E. The department may require ~~owners-an owner~~ Owners may be required by the ~~commissioner~~ to collect additional samples to provide quality control for any treatment processes that are employed.

F. Surface water sampling requirements specified in 12VAC5-590-372 through 12VAC5-590-378 apply to GUDI sources.

~~Any other dates contained in this chapter notwithstanding, all waterworks shall comply with all applicable PMCLs listed in Tables 2.2 and 2.3.~~

~~Design criteria for new or modified waterworks or owners developing new sources of supply are found in 12VAC5-590-820, 12VAC5-590-830 and 12VAC5-590-840.~~

~~1. Inorganic chemical. Community and nontransient noncommunity waterworks owners shall conduct monitoring to determine compliance with the MCLs in Table 2.2 in accordance with this section. All other noncommunity waterworks owners shall conduct monitoring to determine compliance with the nitrate and nitrite PMCLs in Table 2.2 (as appropriate) in accordance with this section. Monitoring shall be conducted as follows:~~

~~a. The owner of any groundwater source waterworks with 150 or more service connections shall take a minimum of one sample at each entry point to the distribution system which is representative of each source, after treatment, unless a change in condition makes another sampling point more representative of each source or treatment plant (hereafter called a sampling point) starting in the compliance period beginning January 1, 1993. The owner of any groundwater source waterworks with fewer than 150 service connections shall take a minimum of one sample at each sampling point for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite, and selenium in the compliance period beginning January 1, 1993, for antimony, beryllium, cyanide (as free cyanide), nickel, and thallium in the compliance period beginning January 1, 1996, and for arsenic (for community and nontransient noncommunity waterworks) in compliance with subdivision B 1 d (6) (b) of this section.~~



b. The owner of any waterworks which uses a surface water source in whole or in part with 150 or more service connections shall take a minimum of one sample at each entry point to the distribution system after any application of treatment or in the distribution system at a point which is representative of each source, after treatment, unless a change in conditions makes another sampling point more representative of each source or treatment plant (hereafter called a sampling point) beginning January 1, 1993. The owner of any waterworks which use a surface water source in whole or in part with fewer than 150 service connections shall take a minimum of one sample at each sampling point for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite, and selenium beginning January 1, 1993, for antimony, beryllium, cyanide (as free cyanide), nickel, and thallium beginning January 1, 1996, and for arsenic (for community and nontransient noncommunity waterworks) in compliance with subdivision B 1 d (6) (a) of this section.

c. If a waterworks draws water from more than one source and the sources are combined before distribution, the owner shall sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

d. The frequency of monitoring for asbestos shall be in accordance with subdivision B 1 d (1) of this section; the frequency of monitoring for barium, cadmium, chromium, fluoride, mercury, and selenium shall be in accordance with subdivision B 1 d (2) of this section; the frequency of monitoring for antimony, beryllium, cyanide (as free cyanide), nickel, and thallium shall be in accordance with subdivision B 1 d (3) of this section; the frequency of monitoring for nitrate shall be in accordance with subdivision B 1 d (4) of this section; the frequency of monitoring for nitrite shall be in accordance with subdivision B 1 d (5) of this section; and the frequency of monitoring for arsenic shall be in accordance with subdivision B 1 d (6) of this section.

(1) The frequency of monitoring conducted to determine compliance with the PMCL for asbestos specified in Table 2.2 shall be conducted as follows:

(a) The owner of each community and nontransient noncommunity waterworks is required to monitor for asbestos during the first three year compliance period of each nine year compliance cycle beginning in the compliance period starting January 1, 1993.

(b) If the owner believes the waterworks is not vulnerable to either asbestos contamination in its source water or due to corrosion of asbestos cement pipe, or both, the owner may apply to the commissioner for a waiver of the monitoring requirement in subdivision B 1 d (1) (a) of this section. If the commissioner grants the waiver, the owner is not required to monitor.

(c) The commissioner may grant a waiver based on a consideration of the following factors:

(i) Potential asbestos contamination of the water source; and

(ii) The use of asbestos cement pipe for finished water distribution and the corrosive nature of the water.

(d) A waiver remains in effect until the completion of the three year compliance period. The owner of a waterworks not receiving a waiver shall monitor in accordance with the provisions of subdivision B 1 d (1) (a) of this section.

(e) The owner of a waterworks vulnerable to asbestos contamination due solely to corrosion of asbestos cement pipe shall take one sample at a tap served by asbestos-

~~cement pipe and under conditions where asbestos contamination is most likely to occur.~~

~~(f) The owner of a waterworks vulnerable to asbestos contamination due solely to source water shall monitor sampling points in accordance with subdivision B 1 of this section.~~

~~(g) The owner of a waterworks vulnerable to asbestos contamination due both to its source water supply and corrosion of asbestos cement pipe shall take one sample at a tap served by asbestos cement pipe and under conditions where asbestos contamination is most likely to occur.~~

~~(h) The owner of a waterworks which exceeds the PMCL as determined in 12VAC5-590-410 B 1 shall monitor quarterly beginning in the next quarter after the exceedance occurred.~~

~~(i) The commissioner may decrease the quarterly monitoring requirement to the frequency specified in subdivision B 1 d (1) (a) of this section provided the commissioner has determined that the waterworks is reliably and consistently below the PMCL. In no case can the commissioner make this determination unless the owner of a groundwater source waterworks takes a minimum of two quarterly samples or the owner of a waterworks which uses a surface water source in whole or in part takes a minimum of four quarterly samples.~~

~~(j) If monitoring data collected after January 1, 1990, are generally consistent with the requirements of subdivision B 1 d (1) of this section, then the commissioner may allow an owner to use that data to satisfy the monitoring requirement for the initial compliance period beginning January 1, 1993.~~

~~(2) The frequency of monitoring conducted to determine compliance with the MCLs in Table 2.2 for barium, cadmium, chromium, fluoride, mercury, and selenium shall be as follows:~~

~~(a) The owner of a groundwater source waterworks shall take one sample at each sampling point during each compliance period beginning in the compliance period starting January 1, 1993.~~

~~(b) The owner of a waterworks which uses a surface water source in whole or in part shall take one sample annually at each sampling point beginning January 1, 1993.~~

~~(c) An owner may apply to the commissioner for a waiver from the monitoring frequencies specified in subdivision B 1 d (2) (a) or (b) of this section.~~

~~(d) A condition of the waiver shall require that the owner shall take a minimum of one sample while the waiver is effective. The term during which the waiver is effective shall not exceed one compliance cycle (i.e., nine years).~~

~~(e) The commissioner may grant a waiver provided the owner of a waterworks that uses a surface water source in whole or in part has monitored annually for at least three years and groundwater waterworks have conducted a minimum of three rounds of monitoring. (At least one sample shall have been taken since January 1, 1990.) The owner of any waterworks which uses a surface water source in whole or in part or a groundwater source waterworks shall demonstrate that all previous analytical results were less than the PMCL. Waterworks that use a new water source are not eligible for a waiver until three rounds of monitoring from the new source have been completed.~~

~~(f) In determining the appropriate reduced monitoring frequency, the commissioner shall consider:~~

~~(i) Reported concentrations from all previous monitoring;~~

(ii) The degree of variation in reported concentrations; and

(iii) Other factors that may affect contaminant concentrations such as changes in groundwater pumping rates, changes in the waterworks configuration, changes in the waterworks operating procedures, or changes in stream flows or characteristics.

(g) A decision by the commissioner to grant a waiver shall be made in writing and shall set forth the basis for the determination. The request for a waiver may be initiated by the commissioner or upon an application by the owner. The owner shall specify the basis for the request. The commissioner shall review and, where appropriate, revise the determination of the appropriate monitoring frequency when the owner submits new monitoring data or when other data relevant to the waterworks appropriate monitoring frequency become available.

(h) Owners of waterworks that exceed the PMCLs as calculated in 12VAC5-500-410 shall monitor quarterly beginning in the next quarter after the exceedance occurred.

(i) The commissioner may decrease the quarterly monitoring requirement to the frequencies specified in subdivision B 1 d (2) (a), (b) or (c) of this section provided a determination has been made that the waterworks is reliably and consistently below the PMCL. In no case can the commissioner make this determination unless the owner of a groundwater source waterworks takes a minimum of two quarterly samples or the owner of a waterworks which uses a surface water source in whole or in part takes a minimum of four quarterly samples.

(3) The frequency of monitoring conducted to determine compliance with the PMCLs in Table 2.2 for antimony, beryllium, cyanide (as free cyanide), nickel, and thallium shall be as follows:

(a) The owner of a groundwater source waterworks with 150 or more service connections shall take one sample at each sampling point during each compliance period beginning in the compliance period starting January 1, 1993. The owner of a groundwater source waterworks with fewer than 150 service connections shall take one sample at each sampling point during each compliance period beginning in the compliance period starting January 1, 1996.

(b) The owner of a waterworks that uses a surface water source in whole or in part with 150 or more service connections shall take one sample annually at each sampling point beginning January 1, 1993. The owner of a waterworks that uses a surface water source in whole or in part with fewer than 150 service connections shall take one sample annually at each sampling point beginning January 1, 1996.

(c) An owner may apply to the commissioner for a waiver from the monitoring frequencies specified in subdivision B 1 d (3) (a) or (b) of this section.

(d) A condition of the waiver shall require that the owner take a minimum of one sample while the waiver is effective. The term during which the waiver is effective shall not exceed one compliance cycle (i.e., nine years).

(e) The commissioner may grant a waiver provided the owner of a waterworks that uses a surface water source in whole or in part has monitored annually for at least three years and groundwater waterworks have conducted a minimum of three rounds of monitoring. (At least one sample shall have been taken since January 1, 1990.) The owner of any waterworks which uses a surface water source in whole or in part or a groundwater source waterworks shall demonstrate that all previous analytical results were less than the PMCL. Waterworks that use a new water source are not eligible for a waiver until three rounds of monitoring from the new source have been completed.

~~(f) In determining the appropriate reduced monitoring frequency, the commissioner shall consider:~~

~~(i) Reported concentrations from all previous monitoring;~~

~~(ii) The degree of variation in reported concentrations; and~~

~~(iii) Other factors which may affect contaminant concentrations such as changes in groundwater pumping rates, changes in the waterworks configuration, changes in the waterworks operating procedures, or changes in stream flows or characteristics.~~

~~(g) A decision by the commissioner to grant a waiver shall be made in writing and shall set forth the basis for the determination. The request for a waiver may be initiated by the commissioner or upon an application by the owner. The owner shall specify the basis for the request. The commissioner shall review and, where appropriate, revise the determination of the appropriate monitoring frequency when the owner submits new monitoring data or when other data relevant to the waterworks appropriate monitoring frequency become available.~~

~~(h) Owners of waterworks that exceed the PMCLs as calculated in 12VAC5-590-410 shall monitor quarterly beginning in the next quarter after the exceedance occurred.~~

~~(i) The commissioner may decrease the quarterly monitoring requirement to the frequencies specified in subdivision B 1 d (3) (a), (b) or (c) of this section provided a determination has been made that the waterworks is reliably and consistently below the PMCL. In no case shall the commissioner make this determination unless the owner of a groundwater source waterworks takes a minimum of two quarterly samples or the owner of a waterworks which uses a surface water source in whole or in part takes a minimum of four quarterly samples.~~

~~(4) All community, nontransient noncommunity and noncommunity waterworks owners shall monitor to determine compliance with the PMCL for nitrate in Table 2.2.~~

~~(a) Owners of community and nontransient noncommunity waterworks that use a groundwater source shall monitor annually beginning January 1, 1993.~~

~~(b) Owners of community and nontransient noncommunity waterworks that use a surface water source in whole or in part shall monitor quarterly beginning January 1, 1993.~~

~~(c) For owners of community and nontransient noncommunity waterworks that use groundwater, the repeat monitoring frequency shall be quarterly for at least one year following any one sample in which the concentration is greater than 50% of the PMCL. The commissioner may allow the owner of a waterworks, that uses groundwater, to reduce the sampling frequency to annually after four consecutive quarterly samples are reliably and consistently less than the PMCL.~~

~~(d) For community and nontransient noncommunity waterworks, the commissioner may allow the owner of a waterworks that uses a surface water source in whole or in part, to reduce the sampling frequency to annually if all analytical results from four consecutive quarters are less than 50% of the PMCL. Such waterworks shall return to quarterly monitoring if any one sample is greater than or equal to 50% of the PMCL.~~

~~(e) The owners of all other noncommunity waterworks shall monitor annually beginning January 1, 1993.~~

~~(f) After the initial round of quarterly sampling is completed, the owner of each community and nontransient noncommunity waterworks that is monitoring annually shall take subsequent samples during the quarter(s) which previously resulted in the highest analytical result.~~

~~(5) All owners shall monitor to determine compliance with the PMCL for nitrite in Table 2-2.~~

~~(a) All owners shall take one sample at each sampling point in the compliance period beginning January 1, 1993.~~

~~(b) After the initial sample, the owner of any waterworks where an analytical result for nitrite is less than 50% of the PMCL shall monitor at the frequency specified by the commissioner.~~

~~(c) The repeat monitoring frequency for any owner shall be quarterly for at least one year following any one sample in which the concentration is greater than 50% of the PMCL. The commissioner may allow an owner to reduce the sampling frequency to annually after determining the analysis results are reliably and consistently less than the PMCL.~~

~~(d) Owners of waterworks which are monitoring annually shall take each subsequent sample during the quarter(s) which previously resulted in the highest analytical result.~~

~~(6) The frequency of monitoring conducted to determine compliance with the PMCLs in Table 2-2 for arsenic shall be as follows:~~

~~(a) The owner of each community and nontransient noncommunity waterworks that uses a surface water source in whole or in part shall take one sample annually at each sampling point beginning January 23, 2006.~~

~~(b) The owner of each community and nontransient noncommunity groundwater source waterworks shall take one sample at each entry point during each compliance period starting January 23, 2006.~~

~~(c) Owners of waterworks that exceed the PMCL, as calculated in 12VAC5-590-410, shall monitor quarterly beginning in the next quarter after the exceedance has occurred.~~

~~(d) The commissioner may decrease the quarterly monitoring requirement to the frequencies specified in subdivision B 1 d (6) (a) or (b) of this section provided a determination has been made that the waterworks is reliably and consistently below the PMCL. In no case can the commissioner make this determination unless the owner of a groundwater source waterworks takes a minimum of two quarterly samples or the owner of a waterworks that uses a surface water source in whole or in part takes a minimum of four quarterly samples.~~

~~(e) No waivers shall be granted by the commissioner for arsenic.~~

~~2. Organic chemicals. Owners of all community and nontransient noncommunity waterworks shall sample for organic chemicals in accordance with their water source. Where two or more sources are combined before distribution, the owner shall sample at the entry point for the combined sources during periods of normal operating conditions.~~

~~a. Owners of waterworks that use groundwater shall take a minimum of one sample at each entry point to the distribution system which is representative of each source, after treatment (hereafter called a sampling point).~~

~~b. Owners of waterworks that use a surface water source in whole or in part shall take a minimum of one sample at points in the distribution system that are representative of each source or at each entry point to the distribution system, after treatment (hereafter called a sampling point).~~

~~c. The owner of each community and nontransient noncommunity waterworks shall take four consecutive quarterly samples for each contaminant listed in Table 2-3 VOC~~

~~2 through 21 and SOC during each compliance period, beginning in the compliance period starting January 1, 1993.~~

~~d. Reduced monitoring:~~

~~(1) VOC:~~

~~(a) If the initial monitoring for contaminants listed in Table 2.3 VOC 1 through 8 and the monitoring for the contaminants listed in Table 2.3 VOC 9 through 21 as allowed in subdivision B 2 d (1) (c) of this section has been completed by December 31, 1992, and the waterworks did not detect any contaminant listed in Table 2.3 VOC 1 through 21, then the owner of each groundwater waterworks and waterworks that use a surface water source in whole or in part shall take one sample annually beginning January 1, 1993.~~

~~(b) After a minimum of three years of annual sampling, the commissioner may allow the owner of a groundwater waterworks with no previous detection of any contaminant listed in Table 2.3 VOC 2 through 21 to take one sample during each compliance period.~~

~~(c) The commissioner may allow the use of monitoring data collected after January 1, 1988, for purposes of initial monitoring compliance. If the data are generally consistent with the other requirements in this section, the commissioner may use these data (i.e., a single sample rather than four quarterly samples) to satisfy the initial monitoring requirement of subdivision B 2 c of this section. Owners of waterworks that use grandfathered samples and did not detect any contaminants listed in Table 2.3 VOC 2 through 21, shall begin monitoring annually in accordance with subdivision B 2 d (1) (a) of this section beginning January 1, 1993.~~

~~(2) SOC:~~

~~(a) Owners of waterworks serving more than 3,300 persons that do not detect a contaminant listed in Table 2.3 SOC in the initial compliance period, may reduce the sampling frequency to a minimum of two quarterly samples in one year during each repeat compliance period.~~

~~(b) Owners of waterworks serving less than or equal to 3,300 persons that do not detect a contaminant listed in Table 2.3 SOC in the initial compliance period may reduce the sampling frequency to a minimum of one sample during each repeat compliance period.~~

~~e. Waiver application:~~

~~(1) For VOCs. The owner of any community and nontransient noncommunity groundwater waterworks which does not detect a contaminant listed in Table 2.3 VOC may apply to the commissioner for a waiver from the requirements of subdivisions B 2 d (1) (a) and (b) of this section after completing the initial monitoring. A waiver shall be effective for no more than six years (two compliance periods). The commissioner may also issue waivers to small systems for the initial round of monitoring for 1,2,4-trichlorobenzene.~~

~~(2) For SOCs. The owner of any community and nontransient noncommunity waterworks may apply to the commissioner for a waiver from the requirement of subdivisions B 2 c and d (2) of this section. The owner shall reapply for a waiver for each compliance period.~~

~~f. The commissioner may grant a waiver after evaluating the following factors: Knowledge of previous use (including transport, storage, or disposal) of the contaminant within the watershed or zone of influence of the source. If a determination by the commissioner reveals no previous use of the contaminant within the watershed~~

or zone of influence, a waiver may be granted. If previous use of the contaminant is unknown or it has been used previously, then the following factors shall be used to determine whether a waiver is granted.

(1) Previous analytical results.

(2) The proximity of the waterworks to a potential point or nonpoint source of contamination. Point sources include spills and leaks of chemicals at or near a waterworks or at manufacturing, distribution, or storage facilities, or from hazardous and municipal waste landfills and other waste handling or treatment facilities. Nonpoint sources for SOCs include the use of pesticides to control insect and weed pests on agricultural areas, forest lands, home and gardens, and other land application uses.

(3) The environmental persistence and transport of the contaminants listed in Table 2.3 VOC and SOC.

(4) How well the water source is protected against contamination, such as whether it is a waterworks that uses a surface water source in whole or in part or whether it is a groundwater source waterworks. Groundwater source waterworks shall consider factors such as depth of the well, the type of soil, wellhead protection, and well structure integrity. Owners of waterworks that use surface water in whole or in part shall consider watershed protection.

(5) Special factors.

(a) For VOCs. The number of persons served by the waterworks and the proximity of a smaller waterworks to a larger waterworks.

(b) For SOCs. Elevated nitrate levels at the waterworks supply source.

(c) For SOCs. Use of PCBs in equipment used in the production, storage, or distribution of water (i.e., PCBs used in pumps, transformers, etc.).

g. Condition for waivers.

(1) As a condition of the VOC waiver the owner of a groundwater waterworks shall take one sample at each sampling point during the time the waiver is effective (i.e., one sample during two compliance periods or six years) and update its vulnerability assessment considering the factors listed in subdivision B 2 f of this section. Based on this vulnerability assessment the commissioner shall reconfirm that the waterworks is nonvulnerable. If the commissioner does not make this reconfirmation within three years of the initial determination, then the waiver is invalidated and the owner is required to sample annually as specified in subdivision B 2 d (1) (a) of this section.

(2) The owner of any community and nontransient noncommunity waterworks that use surface water in whole or in part which does not detect a contaminant listed in Table 2.3 VOC may apply to the commissioner for a waiver from the requirements of subdivision B 2 d (1) (a) of this section after completing the initial monitoring. Waterworks meeting these criteria shall be determined by the commissioner to be nonvulnerable based on a vulnerability assessment during each compliance period. Each owner receiving a waiver shall sample at the frequency specified by the commissioner (if any).

(3) There are no conditions to SOC waivers.

h. If a contaminant listed in Table 2.3 VOC 2 through 21 or SOC 1 through 33 is detected then (NOTE: Detection occurs when a contaminant level exceeds the current detection limit as defined by EPA.):

(1) Each owner shall monitor quarterly at each sampling point which resulted in a detection.

(2) The commissioner may decrease the quarterly monitoring requirement specified in subdivision B 2 h (1) of this section provided it has determined that the waterworks is reliably and consistently below the PMCL. In no case shall the commissioner make this determination unless the owner of a groundwater waterworks takes a minimum of two quarterly samples and the owner of a waterworks that use surface water in whole or in part takes a minimum of four quarterly samples.

(3) If the commissioner determines that the waterworks is reliably and consistently below the PMCL, the commissioner may allow the waterworks to monitor annually. Owners of waterworks that monitor annually shall monitor during the quarter(s) that previously yielded the highest analytical result.

(4) Owners of waterworks that have three consecutive annual samples with no detection of a contaminant may apply to the commissioner for a waiver for VOC as specified in subdivision B 2 e (1) or to SOC as specified in subdivision B 2 e (2) of this section.

(5) Subsequent monitoring due to contaminant detection.

(a) Owners of groundwater waterworks that have detected one or more of the following two-carbon organic compounds: trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, 1,1,1 trichloroethane, cis 1,2-dichloroethylene, trans 1,2-dichloroethylene, or 1,1-dichloroethylene shall monitor quarterly for vinyl chloride. A vinyl chloride sample shall be taken at each sampling point at which one or more of the two-carbon organic compounds were detected. If the results of the first analysis do not detect vinyl chloride, the commissioner may reduce the quarterly monitoring frequency of vinyl chloride monitoring to one sample during each compliance period. Owners of waterworks that use surface water in whole or in part are required to monitor for vinyl chloride as specified by the commissioner.

(b) If monitoring results in detection of one or more of certain related contaminants (heptachlor and heptachlor epoxide), then subsequent monitoring shall analyze for all related contaminants.

i. Owners of waterworks that violate the requirements of Table 2.3 for VOCs or SOCs, as determined by 12VAC5-590-410 C, shall monitor quarterly. After a minimum of four consecutive quarterly samples that show the waterworks is in compliance as specified in 12VAC5-590-410 C and the commissioner determines that the waterworks is reliably and consistently below the PMCL, the owner may monitor at the frequency and time specified in subdivision B 2 h (3) of this section.

### 3. Disinfectant residuals, disinfection byproducts and disinfection byproduct precursors.

a. Unless otherwise noted, owners of all waterworks that use a chemical disinfectant shall comply with the requirements of this section as follows:

(1) Owners of community or nontransient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water and serving 10,000 or more persons shall comply with this section beginning January 1, 2002.

(2) Owners of community or nontransient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water serving fewer than 10,000 persons and waterworks using only groundwater not under the direct influence of surface water shall comply with this section beginning January 1, 2004.

(3) Owners of transient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water and serving 10,000 or more persons and using chlorine dioxide as a disinfectant or oxidant shall comply with any requirements for chlorine dioxide in this section beginning January 1, 2002.



~~(4) Owners of transient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water serving fewer than 10,000 persons and using chlorine dioxide as a disinfectant or oxidant and waterworks using only groundwater not under the direct influence of surface water and using chlorine dioxide as a disinfectant or oxidant shall comply with any requirements for chlorine dioxide in this section beginning January 1, 2004.~~

~~b. Owners shall take all samples during normal operating conditions.~~

~~(1) Analysis under this section for disinfection byproducts (TTHM, HAA5, chlorite and bromate) shall be conducted by a laboratory that has received certification by EPA or the state except as noted in subdivision B 3 b (2) of this section.~~

~~(2) Measurement under this section of daily chlorite samples at the entry point to the distribution system, disinfection residuals (free chlorine, combined chlorine, total chlorine and chlorine dioxide), alkalinity, bromide, TOC, SUVA (DOC and UV<sub>254</sub>), pH and magnesium shall be made by a party approved by the commissioner.~~

~~(3) DPD colorimetric test kits may be used to measure residual disinfectant concentrations for chlorine, chloramines and chlorine dioxide.~~

~~e. Failure to monitor in accordance with the monitoring plan required under subdivision B 3 j of this section is a monitoring violation. Failure to monitor shall be treated as a violation for the entire period covered by the annual average where compliance is based on a running annual average of monthly or quarterly samples or averages and the owner's failure to monitor makes it impossible to determine compliance with PMCLs or MRDLs.~~

~~d. Owners may use only data collected under the provisions of this section or the US EPA Information Collection Rule, 40 CFR Part 141 Subpart M, Information Collection Requirements (ICR) for Public Water Systems, to qualify for reduced monitoring.~~

~~e. TTHM/HAA5 monitoring. Owners of community or nontransient noncommunity waterworks shall monitor TTHM and HAA5 at the frequency indicated below, unless otherwise indicated:~~

~~(1) Running annual average monitoring requirements.~~

~~(a) Routine monitoring requirements:~~

~~(i) Owners of waterworks using surface water or groundwater under the direct influence of surface water and serving at least 10,000 persons shall collect four water samples per quarter per treatment plant. At least 25% of all samples collected each quarter shall be at locations representing maximum residence time in the distribution system. The remaining samples shall be taken at locations representative of at least average residence time in the distribution system and representative of the entire distribution system. When setting the sample locations the waterworks shall take into account number of persons served, different sources of water, and different treatment methods.~~

~~(ii) Owners of waterworks using surface water or groundwater under the direct influence of surface water and serving from 500 to 9,999 persons shall collect one sample per quarter per treatment plant. The sample location shall represent maximum residence time in the distribution system.~~

~~(iii) Owners of waterworks using surface water or groundwater under the direct influence of surface water and serving fewer than 500 persons shall collect one sample per year per treatment plant during the month of warmest water temperature. The sample location shall represent maximum residence time in the distribution system. If the sample (or average of annual samples, if more than one sample is taken) exceeds~~

~~PMCL in Table 2.13, the owner shall increase monitoring to one sample per treatment plant per quarter, taken at a point reflecting the maximum residence time in the distribution system, until waterworks meets reduced monitoring criteria.~~

~~(iv) Owners of waterworks using only groundwater not under direct influence of surface water using chemical disinfectant and serving at least 10,000 persons shall collect one sample per quarter per treatment plant. The sample location shall represent maximum residence time in the distribution system.~~

~~(v) Owners of waterworks using only groundwater not under direct influence of surface water using chemical disinfectant and serving fewer than 10,000 persons shall collect one sample per year per treatment plant during the month of warmest water temperature. The sample location shall represent maximum residence time in the distribution system. If the sample (or average of annual samples, if more than one sample is taken) exceeds PMCL in Table 2.13, the owner shall increase monitoring to one sample per treatment plant per quarter, taken at a point reflecting the maximum residence time in the distribution system, until the waterworks meets the criteria for reduced monitoring found in subdivision B-3 e (1) (d) of this section.~~

~~(vi) If an owner elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) shall be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples shall be taken at locations representative of at least average residence time in the distribution system.~~

~~(vii) With prior approval of the commissioner, owners of waterworks that utilize multiple wells from a common aquifer may consider these multiple sources as one treatment plant for determining the minimum number of samples to be collected for TTHM and HAA5 analysis.~~

~~(b) After one year of routine monitoring an owner may reduce monitoring, except as otherwise provided, as follows:~~

~~(i) Owners of waterworks using surface water or groundwater under the direct influence of surface water and serving at least 10,000 persons that has a source water annual average TOC level, before any treatment, of equal to or less than 4.0 mg/L and a TTHM annual average equal to or less than 0.040 mg/L and HAA5 annual average equal to or less than 0.030 mg/L may reduce its monitoring to one sample per treatment plant per quarter at a distribution system location reflecting maximum residence time.~~

~~(ii) Owners of waterworks using surface water or groundwater under the direct influence of surface water serving from 500 to 9,999 persons that has a source water annual average TOC level, before any treatment, equal to or less than 4.0 mg/L and a TTHM annual average equal to or less than 0.040 mg/L and HAA5 annual average equal to or less than 0.030 mg/L may reduce its monitoring to one sample per treatment plant per year at a distribution system location reflecting maximum residence time during the month of warmest water temperature.~~

~~(iii) Owners of waterworks using only groundwater not under the direct influence of surface water, using chemical disinfectant and serving at least 10,000 persons that has a TTHM annual average of equal to or less than 0.040 mg/L and HAA5 annual average of equal to or less than 0.030 mg/L may reduce its monitoring to one sample per treatment plant per year at a distribution system location reflecting maximum residence time during the month of warmest water temperature.~~

~~(iv) Owners of waterworks using only groundwater not under the direct influence of surface water, using chemical disinfectant and serving fewer than 10,000 persons that~~

has a TTHM annual average equal to or less than 0.040 mg/L and HAA5 annual average equal to or less than 0.030 mg/L for two consecutive years or TTHM annual average equal to or less than 0.020 mg/L and HAA5 annual average equal to or less than 0.015 mg/L for one year may reduce its monitoring to one sample per treatment plant per three-year monitoring cycle at a distribution system location reflecting maximum residence time during the month of warmest water temperature, with the three-year cycle beginning on January 1 following the quarter in which the system qualifies for reduced monitoring.

(v) Owners of waterworks using surface water or groundwater under the direct influence of surface water serving fewer than 500 persons may not reduce its monitoring to less than one sample per treatment plant per year.

(vi) In order to qualify for reduced monitoring for TTHM and HAA5 under subdivision B 3 e (1) (b) (i) through (iv) of this section, owners of waterworks using surface water or groundwater under the direct influence of surface water not monitoring under the provisions of subdivision B 3 (i) shall take monthly TOC samples every 30 days at a location prior to any treatment, beginning April 1, 2008. In addition to meeting other criteria for reduced monitoring in subdivision B 3 e (1) (b) (i) through (iv) of this section, the source water TOC running annual average shall be less than or equal to 4.0 mg/L (based on the most recent four quarters of monitoring) on a continuing basis at each treatment plant to reduce or remain on reduced monitoring for TTHM and HAA5. Once qualified for reduced monitoring for TTHM and HAA5 under subdivision B 3 e (1) (b) (i) through (iv) of this section, a system may reduce source water TOC monitoring to quarterly TOC samples taken every 90 days at a location prior to any treatment.

(c) Owners of waterworks on a reduced monitoring schedule may remain on that reduced schedule as long as the average of all samples taken in the year (for waterworks that must monitor quarterly) or the result of the sample (for waterworks that must monitor no more frequently than annually) is no more than 0.060 mg/L and 0.045 mg/L for TTHMs and HAA5, respectively. Owners of waterworks that do not meet these levels shall resume monitoring at the frequency identified in subdivision B 3 e (1) (a) of this section in the quarter immediately following the monitoring period in which the waterworks exceeds 0.060 mg/L or 0.045 mg/L for TTHMs and HAA5, respectively. For waterworks using only groundwater not under the direct influence of surface water and serving fewer than 10,000 persons, if either the TTHMs annual average is greater than 0.080 mg/L or the HAA5 annual average is greater than 0.060 mg/L, the owner shall go to increased monitoring identified in subdivision B 3 e (1) (a) of this section in the quarter immediately following the monitoring period in which the waterworks exceeds 0.080 mg/L or 0.060 mg/L for TTHM or HAA5 respectively.

(d) Owners of waterworks on increased monitoring may return to routine monitoring if, after at least one year of monitoring, their TTHM annual average is equal to or less than 0.060 mg/L and their HAA5 annual average is equal to or less than 0.045 mg/L.

(e) The commissioner may return a waterworks to routine monitoring at the commissioner's discretion.

(2) Initial distribution system evaluations (IDSE).

(a) This subdivision establishes monitoring and other requirements for identifying locational running annual average (LRAA) compliance monitoring locations for determining compliance with maximum contaminant levels for total trihalomethanes (TTHM) and haloacetic acids (five) (HAA5). Owners shall use an IDSE to determine locations with representative high TTHM and HAA5 concentrations throughout the distribution system. IDSEs are used in conjunction with, but separate from running

annual average compliance monitoring locations, subdivision B 3 e (1) (a) of this section, to identify and select locational running annual average compliance monitoring locations, subdivision B 3 e (3) of this section.

(b) This subdivision applies to the following waterworks:

(i) Community waterworks that use a primary or residual disinfectant other than ultraviolet light or delivers water that has been treated with a primary or residual disinfectant other than ultraviolet light; or,

(ii) Nontransient noncommunity waterworks that serve at least 10,000 people and use a primary or residual disinfectant other than ultraviolet light or delivers water that has been treated with a primary or residual disinfectant other than ultraviolet light.

(c) Owners shall comply with the following schedule:

Waterworks Population	Owners shall submit a standard monitoring plan or system specific study plan <sup>1</sup> or 40/30 certification <sup>2</sup> to the commissioner by or receive very small system waiver from the commissioner.	Owners shall complete standard monitoring or system specific study by	Owners shall submit IDSE report to the commissioner by <sup>3</sup>
Waterworks that are not part of a combined distribution system and waterworks that serve the largest population in the combined distribution system			
Equal to or greater than 100,000	October 1, 2006	September 30, 2008	January 1, 2009
50,000-99,999	April 1, 2007	March 31, 2009	July 1, 2009
10,000-49,999	October 1, 2007	September 30, 2009	January 1, 2010
Less than 10,000 (CWS Only)	April 1, 2008	March 31, 2010	July 1, 2010
Other waterworks that are part of a combined distribution system			
Wholesale waterworks or consecutive waterworks	-at the same time as the waterworks with the earliest compliance date in the combined distribution system	-at the same time as the waterworks with the earliest compliance date in the combined distribution system	-at the same time as the waterworks with the earliest compliance date in the combined distribution system

<sup>1</sup>If, within 12 months after the date identified in this column, the commissioner does not approve the plan or notify the owner that the review has been completed; the owner may consider the submitted plan as approved. The owner shall implement the plan and shall complete standard monitoring or a system specific study no later than the date identified in the third column.

<sup>2</sup>The owner shall submit the 40/30 certification under subdivision B 3 e (2) (d) (v) of this section by the date indicated.

<sup>3</sup>If, within three months after the date identified in this column (nine months after the date identified in this column if the owner is required to comply with the schedule for waterworks populations 10,000 to 49,999), the commissioner does not approve the IDSE report or notify the owner that the review has not been completed, the owner may consider the submitted report as approved and the owner shall implement the recommended monitoring in accordance with subdivision B 3 e (3) of this section as required.

~~For the purpose of this schedule, the commissioner has determined that the combined distribution system does not include consecutive waterworks that receive water from a wholesale waterworks only on an emergency basis or receive less than 10% of their total water consumption from a wholesale waterworks. The commissioner has also determined that the combined distribution system does not include wholesale waterworks that deliver water to a consecutive waterworks only on an emergency basis or delivers less than 10% of the total water used by a consecutive waterworks.~~

~~(d) Owners shall conduct standard monitoring that meets the requirements in subdivision B 3 e (2) (d) (iii) of this section, or a system specific study that meets the requirements in subdivision B 3 e (2) (d) (iv) of this section, or certify to the commissioner that the waterworks meets 40/30 certification criteria under subdivision B 3 e (2) (d) (v) of this section, or qualify for a very small system waiver under subdivision B 3 e (2) (d) (vi) of this section.~~

~~(i) Owners shall have taken the full complement of routine TTHM and HAA5 compliance samples required of a waterworks based on population and source water under subdivision B 3 e (1) of this section (or the owner shall have taken the full complement of reduced TTHM and HAA5 compliance samples required of an owner based population and source water under subdivision B 3 e (1) of this section if the waterworks meet reduced monitoring criteria under subdivision B 3 e (1)) of this section during the period specified in subdivision B 3 e (2) (d) (v) ((a)) of this section to meet the 40/30 certification criteria in subdivision B 3 e (2) (d) (v) of this section. Owners shall have taken TTHM and HAA5 samples under subdivision B 3 e (1) of this section to be eligible for the very small system waiver in subdivision B 3 e (2) (d) (vi) of this section.~~

~~(ii) If the owner has not taken the required samples, the owner shall conduct standard monitoring that meets the requirements in subdivision B 3 e (2) (d) (iii) of this section, or a system specific study that meets the requirements in subdivision B 3 e (2) (d) (iv) of this section.~~

~~(iii) Standard monitoring.~~

~~((a)) The standard monitoring plan shall comply with the following paragraphs ((i)) through ((iv)). Owners shall prepare and submit the standard monitoring plan to the commissioner according to the schedule in subdivision B 3 e (2) (c) of this section.~~

~~((i)) The standard monitoring plan shall include a schematic of the waterworks distribution system (including distribution system entry points and their sources, and storage facilities), with notes indicating locations and dates of all projected standard monitoring, and all projected compliance monitoring in accordance with subdivision B 3 e (1) of this section.~~

~~((ii)) The standard monitoring plan shall include justification of standard monitoring location selection and a summary of data relied on to justify standard monitoring location selection.~~

((iii)) The standard monitoring plan shall specify the population served and waterworks type (surface water, groundwater under the direct influence of surface water or groundwater).

((iv)) Owners shall retain a complete copy of the submitted standard monitoring plan, including any modification required by the commissioner of the standard monitoring plan, for as long as the owner is required to retain the IDSE report under subdivision B-3-e(2)(d)(iii)((c))((iv)) of this section.

((b)) Owners shall monitor as indicated in the following table. Owners shall collect dual sample sets at each monitoring location. One sample in the dual sample set shall be analyzed for TTHM. The other sample in the dual sample set shall be analyzed for HAA5. Owners shall conduct one monitoring period during the peak historical month for TTHM levels or HAA5 levels or the month of warmest water temperature. Owners shall review available compliance, study, or operational data to determine the peak historical month for TTHM or HAA5 levels or warmest water temperature.

Source Water Type	Population Size Category	Monitoring Periods and Frequency of Sampling	Distribution System Monitoring Locations <sup>1</sup>				
			Total per monitoring period	Near Entry Points	Average Residence Time	High TTHM Locations	High HAA5 Locations
Surface water or groundwater under the direct influence of surface water.	Less than 500 consecutive waterworks	one (during peak historical month) <sup>2</sup>	2	4	-	4	-
	Less than 500 nonconsecutive waterworks		2	-	-	4	4
	500-3,300 consecutive waterworks	four (every 90 days)	2	4	-	4	-
	500-3,300 nonconsecutive waterworks		2	-	-	4	4
	3,301-9,999		4	-	4	2	4
	10,000-49,999		8	4	2	3	2

	50,000-249,999	six (every 60 days)	16	3	4	5	4
	250,000-999,999		24	4	6	8	6
	1,000,000-4,999,999		32	6	8	10	8
	Equal to or greater than 5,000,000		40	8	10	12	10
Ground-water	Less than 500 consecutive waterworks	one (during peak historical + month) <sup>2</sup>	2	1	-	1	-
	Less than 500 nonconsecutive waterworks		2	-	-	1	1
	500-9,999	four (every 90 days)	2	-	-	1	1
	10,000-99,999		6	1	1	2	2
	100,000-499,999		8	1	1	3	3
	Equal to or greater than 500,000		12	2	2	4	4

<sup>1</sup>A dual sample set (i.e., a TTHM and an HAA5 sample) shall be taken at each monitoring location during each monitoring period.

<sup>2</sup>The peak historical month is the month with the highest TTHM or HAA5 levels or the warmest water temperature.

((i)) Owners shall take samples at locations other than the existing monitoring locations used in subdivision B-3-c (1) of this section. Monitoring locations shall be distributed throughout the distribution system.

((ii)) If the number of entry points to the distribution system is fewer than the specified number of entry point monitoring locations, excess entry point samples shall be replaced equally at high TTHM and HAA5 locations. If there is an odd extra location number, the owner shall take a sample at a high TTHM location. If the number of entry points to the distribution system is more than the specified number of entry point monitoring locations, owners shall take samples at entry points to the distribution system having the highest annual water flows.

((iii)) The monitoring under subdivision B-3-c (2) (d) (iii) ((b)) of this section may not be reduced.

~~((c)) The IDSE report shall include the elements required in the following paragraphs. Owners shall submit the IDSE report to the commissioner according to the schedule in subdivision B 3 e (2) (c) of this section.~~

~~((ii)) The IDSE report shall include all TTHM and HAA5 analytical results from compliance monitoring required under subdivision B 3 e (1) of this section and all standard monitoring conducted during the period of the IDSE as individual analytical results and LRAAs presented in a tabular or spreadsheet format acceptable to the commissioner. If changed from the standard monitoring plan submitted under subdivision B 3 e (2) (d) (iii) ((a)) of this section, the report shall also include a schematic of the distribution system, the population served, and system type (surface water, groundwater under the direct influence of surface water or groundwater).~~

~~((iii)) The IDSE report shall include an explanation of any deviations from the approved standard monitoring plan.~~

~~((iii)) Owners shall recommend and justify the compliance monitoring locations to be used in accordance with subdivision B 3 e (3) of this section and timing based on the protocol in subdivision B 3 e (2) (e) of this section.~~

~~((iv)) Owners shall retain a complete copy of the IDSE report submitted under this section for 10 years after the date the report was submitted to the commissioner. If the commissioner modifies the LRAA monitoring requirements recommended in the IDSE report or if the commissioner approves alternative monitoring locations, the owner shall keep a copy of the commissioner's notification on file for 10 years after the date of the commissioner's notification. The owner shall make the IDSE report and any commissioner's notification available for review by the commissioner or the public.~~

~~(iv) System specific studies.~~

~~((a)) The system specific study plan shall be based on either existing monitoring results as required under subdivision B 3 e (2) (d) (iv) ((a)) or modeling as required under subdivision B 3 e (2) (d) (iv) ((a)) of this section. Owners shall prepare and submit the waterworks specific study plan to the commissioner according to the schedule in subdivision B 3 e (2) (e) of this section.~~

~~((ii)) Existing monitoring results. Owners may comply by submitting monitoring results collected before the waterworks is required to begin monitoring under subdivision B 3 e (2) (c) of this section. The monitoring results and analysis shall meet the criteria in subdivisions ((1)) and ((2)) as follows:~~

~~((1)) Minimum requirements.~~

~~((A)) TTHM and HAA5 results shall be based on samples collected and analyzed in accordance with 12VAC5-590-440. Samples shall be collected no earlier than five years prior to the study plan submission date.~~

~~((B)) The monitoring locations and frequency shall meet the conditions identified in the following table. Each location shall be sampled once during the peak historical month for TTHM levels or HAA5 levels or the month of warmest water temperature for every 12 months of data submitted for that location. Monitoring results shall include all compliance monitoring results in accordance with subdivision B 3 e (1) of this section plus additional monitoring results as necessary to meet minimum sample requirements.~~

System Type	Population Size Category	Number of Monitoring Locations	Number of Samples	
			TTHM	HAA5



Surface water or groundwater under the direct influence of surface water	Less than 500	3	3	3
	500-3,300	3	9	9
	3,301-9,999	6	36	36
	10,000-49,999	12	72	72
	50,000-249,999	24	144	144
	250,000-999,999	36	216	216
	1,000,000-4,999,999	48	288	288
	Equal to or greater than 5,000,000	60	360	360
Groundwater	Less than 500	3	3	3
	500-9,999	3	9	9
	10,000-99,999	12	48	48
	100,000-499,999	18	72	72
	Equal to or greater than 500,000	24	96	96

~~((2)) Reporting monitoring results. Owners shall report the following information:~~

~~((A)) Owners shall report previously collected monitoring results and certify that the reported monitoring results include all compliance and non-compliance results generated during the time period beginning with the first reported result and ending with the most recent results collected in accordance with subdivision B-3-c(1) of this section.~~

~~((B)) Owners shall certify that the samples were representative of the entire distribution system and that treatment, and distribution system have not changed significantly since the samples were collected.~~

~~((C)) The study monitoring plan shall include a schematic of the distribution system (including distribution system entry points and their sources, and storage facilities), with notes indicating the locations and dates of all completed or planned system specific study monitoring.~~

~~((D)) The system specific study plan shall specify the population served and system type (surface water, groundwater under the direct influence of surface water or groundwater).~~

~~((E)) Owners shall retain a complete copy of the system specific study plan submitted, including any modification requested by the commissioner of the system specific study plan, for as long as the owner is required to retain the IDSE report under subdivision B-3-c(2)(d)(iv)(b)(vii) of this section.~~

~~((F)) If previously collected data that fully meets the number of samples required under subdivision B-3-c(2)(d)(iv)(a)(i)(1)(b) of this section and the commissioner rejects some of the data, the owner shall either conduct additional monitoring to replace rejected data on a schedule the commissioner approves or conduct standard monitoring under subdivision B-3-c(2)(d)(iii) of this section.~~

~~((iii)) Modeling. Owners may comply through analysis of an extended period simulation hydraulic model. The extended period simulation hydraulic model and analysis shall meet the following criteria:~~

~~((1)) Minimum requirements.~~

~~((A)) The model shall simulate 24-hour variation in demand and show a consistently repeating 24-hour pattern of residence time.~~

~~((B)) The model shall represent the criteria listed in the following table:~~

-	75% of pipe volume;
-	50% of pipe length;
-	All pressure zones;
-	All 12-inch diameter and larger pipes;
-	All 8-inch and larger pipes that connect pressure zones, influence zones from different sources, storage facilities, major demand areas, pumps, and control valves, or are known or expected to be significant conveyors of water;
-	All 6-inch and larger pipes that connect remote areas of a distribution system to the main portion of the system;
-	All storage facilities with standard operations represented in the model; and
-	All active pump stations with controls represented in the model; and
-	All active control valves.

~~((C)) The model shall be calibrated, or have calibration plans, for the current configuration of the distribution system during the period of high TTHM formation potential. All storage facilities shall be evaluated as part of the calibration process. All required calibration shall be completed no later than 12 months after plan submission.~~

~~((2)) Reporting modeling. The system specific study plan shall include the following information:~~

~~((A)) Tabular or spreadsheet data demonstrating that the model meets requirements in subdivision B 3 e (2) (d) (iv) ((a)) ((iii)) ((1)) ((b)) of this section.~~

~~((B)) A description of all calibration activities undertaken, and if calibration is complete, a graph of predicted tank levels versus measured tank levels for the storage facility with the highest residence time in each pressure zone, and a time series graph of the residence time at the longest residence time storage facility in the distribution system showing the predictions for the entire simulation period (i.e., from time zero until the time it takes to for the model to reach a consistently repeating pattern of residence time).~~

~~((C)) Model output showing preliminary 24-hour average residence time predictions throughout the distribution system.~~

~~((D)) Timing and number of samples representative of the distribution system planned for at least one monitoring period of TTHM and HAA5 dual sample monitoring at a number of locations no less than would be required for the system under standard monitoring in subdivision B 3 e (2) (d) (iii) of this section during the historical month of high TTHM. These samples shall be taken at locations other than existing compliance monitoring locations listed in subdivision B 3 e (1) of this section.~~

~~((E)) Description of how all requirements will be completed no later than 12 months after owner submits the system specific study plan.~~

~~((F)) Schematic of the distribution system (including distribution system entry points and their sources, and storage facilities), with notes indicating the locations and dates of all completed system specific study monitoring (if calibration is complete) and all compliance monitoring listed in subdivision B 3 e (1) of this section.~~

~~((G)) Population served and system type (surface water, groundwater under the direct influence of surface water or groundwater).~~

~~((H)) Owners shall retain a complete copy of the system specific study plan submitted, including any modification recommended by the commissioner to the waterworks specific study plan, for as long as the owner is required to retain the IDSE report under subdivision B 3 e (2) (d) (iv) ((b)) ((vii)) of this section.~~

~~((3)) If an owner submits a model that does not fully meet the requirements under paragraph (iv) ((a)) ((ii)) of this section, the owners shall correct the deficiencies and respond to commissioner's inquiries concerning the model. If the owner fails to correct deficiencies or respond to inquiries to the commissioner's satisfaction, the owner shall conduct standard monitoring under subdivision B 3 e (2) (d) (iii) of this section.~~

~~((b)) The IDSE report shall include the elements required in the following paragraphs. Owners shall submit the IDSE report according to the schedule in subdivision B 3 e (2) (c) of this section.~~

~~((i)) The IDSE report shall include all TTHM and HAA5 analytical results from compliance monitoring in subdivision B 3 e (1) of this section and all system specific study monitoring conducted during the period of the system specific study presented in a tabular or spreadsheet format acceptable to the commissioner. If changed from the system specific study plan submitted under subdivision B 3 e (2) (d) (iv) ((a)) of this section, the IDSE report shall also include a schematic of the distribution system, the population served; and system type (surface water, groundwater under the direct influence of surface water or groundwater).~~

~~((ii)) Owners of waterworks using the modeling provision under subdivision B 3 e (2) (d) (iv) ((a)) ((iii)) of this section shall include final information for the elements described in subdivision B 3 e (2) (d) (iv) ((a)) ((ii)) ((2)) of this section, and a 24-hour time series graph of residence time for each LRAA compliance monitoring location selected.~~

~~((iii)) The owner shall recommend and justify LRAA compliance monitoring locations and timing based on the protocol in subdivision B 3 e (2) (e) of this section.~~

~~((iv)) The IDSE report shall include an explanation of any deviations from the waterworks approved system specific study plan.~~

~~((v)) The IDSE report shall include the basis (analytical and modeling results) and justification the owner used to select the recommended LRAA monitoring locations.~~

~~((vi)) The owner may submit the IDSE report in lieu of the system specific study plan on the schedule identified in subdivision B 3 e (2) (c) of this section for submission of the system specific study plan if the owner believes the necessary information has been obtained by the time that the waterworks specific study plan is due. If the owner elects this approach, the IDSE report shall also include all information required under subdivision B 3 e (2) (d) (iv) ((a)) of this section.~~

~~((vii)) The owner shall retain a complete copy of the IDSE report submitted under this subdivision for 10 years after the date submitted. If the commissioner modifies the LRAA monitoring requirements that the owner recommended in the IDSE report or if~~

the commissioner approves alternative monitoring locations, the owner shall keep a copy of the commissioner's notification on file for 10 years after the date of the commissioner's notification. The owner shall make the IDSE report and any notification from the commissioner available for review by the commissioner or the public.

(v) 40/30 certifications.

((a)) Eligibility. Waterworks are eligible for 40/30 certification if the waterworks had no TTHM or HAA5 monitoring violations under subdivision B 3 e (1) of this section and no individual sample exceeded 0.040 mg/L for TTHM or 0.030 mg/L for HAA5 during an eight consecutive calendar quarter period beginning no earlier than the date specified in the following table.

If the waterworks 40/30-Certification Is Due	Then the waterworks eligibility for 40/30 certification is based on eight consecutive calendar quarters of compliance monitoring under subdivision B 3 e (1) results beginning no earlier than <sup>4</sup>
October 1, 2006	January 2004
April 1, 2007	January 2004
October 1, 2007	January 2005
April 1, 2008	January 2005

<sup>4</sup>Unless the waterworks is on reduced monitoring under subdivision B 3 e (1) of this section and was not required to monitor during the specified period. If the owner did not monitor during the specified period, the owner shall base eligibility on compliance samples taken during the 12 months preceding the specified period.

((b)) Requirements for 40/30 certification:

((i)) Certify to the commissioner that every individual compliance sample taken under subdivision B 3 e (1) of this section during the periods specified in subdivision B 3 e (2) (d) (v) ((a)) of this section were less than or equal to 0.040 mg/L for TTHM and less than or equal to 0.030 mg/L for HAA5, and that the waterworks has not had any TTHM or HAA5 monitoring violations during the period specified in subdivision ((a)).

((ii)) The commissioner may require the owner to submit compliance monitoring results, distribution system schematics, and/or recommended LRAA compliance monitoring locations in addition to the certification. If an owner fails to submit the requested information, the commissioner may require standard monitoring under subdivision B 3 e (2) (d) (iii) of this section or a system specific study under subdivision B 3 e (2) (d) (iv) of this section.

((iii)) The commissioner may still require standard monitoring under subdivision B 3 e (2) (d) (iii) or a system specific study under subdivision B 3 e (2) (d) (iv) of this section even if the waterworks meet the criteria in subdivision B 3 e (2) (d) (v) ((a)) of this section.

((iv)) The owner shall retain a complete copy of the certification submitted under this subdivision for 10 years after the date that the owner submitted the certification. The owner shall make the certification, all data upon which the certification is based, and any notification from the commissioner available for review by the commissioner or the public.

(vi) Very small system waivers.

~~((a)) If the waterworks serves fewer than 500 people and has taken TTHM and HAA5 samples under subdivision B 3 e (1) of this section, the owner is not required to comply with this subdivision unless the commissioner notifies the owner to conduct standard monitoring under subdivision B 3 e (2) (d) (iii) or a system specific study under subdivision B 3 e (2) (d) (iv) of this section.~~

~~((b)) If the owner has not taken TTHM and HAA5 samples under subdivision B 3 e (1) of this section or if the commissioner notifies the owner to comply with this subdivision, the owner shall conduct standard monitoring under subdivision B 3 e (2) (d) (iii) of this section or a system specific study under subdivision B 3 e (2) (d) (iv) of this section.~~

~~(e) LRAA compliance monitoring location recommendations.~~

~~(i) The IDSE report shall include recommendations and justification for where and during what month(s) TTHM and HAA5 monitoring in accordance with subdivision B 3 e (3) of this section should be conducted. These recommendations shall be based on the criteria in the paragraphs in this section.~~

~~(ii) Owners shall select the number of monitoring locations specified in the following table. These recommended locations will be used as LRAA routine compliance monitoring locations, unless the commissioner requires different or additional locations. The locations should be distributed throughout the distribution system to the extent possible.~~

Source Water Type	Population Size Category	Monitoring Frequency <sup>1</sup>	Distribution System Monitoring Location			
			Total per monitoring period <sup>2</sup>	Highest TTHM Locations	Highest HAA5 Locations	Existing Compliance Locations in accordance with subdivision B 3 e (1)
Surface water or groundwater under the direct influence of surface water	Less than 500	per year	2	1	1	-
	500-3,300	per quarter	2	1	1	-
	3,301-9,999	per quarter	2	1	1	-
	10,000-49,999	per quarter	4	2	1	1
	50,000-249,999	per quarter	8	3	3	2
	250,000-999,999	per quarter	12	5	4	3
	1,000,000 - 4,999,999	per quarter	16	6	6	4

	Equal to or greater than 5,000,000	per quarter	20	8	7	5
Ground-water	Less than 500	per year	2	1	1	-
	500-9,999	per year	2	1	1	-
	10,000-99,999	per quarter	4	2	1	1
	100,000-499,999	per quarter	6	3	2	1
	Equal to or greater than 500,000	per quarter	8	3	3	2

<sup>1</sup>All owners shall monitor during month of highest DBP concentrations.

<sup>2</sup>Owners of waterworks on quarterly monitoring (except for surface water source or GUDI source waterworks serving 500-3,300) shall take dual sample sets every 90 days at each monitoring location. Groundwater source waterworks serving 500-9,999 (on annual monitoring) shall take dual sample sets annually at each monitoring location. Waterworks serving fewer than 500 and surface water source or GUDI source waterworks serving 500-3,300 shall take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations, respectively. Waterworks serving fewer than 500 shall sample annually and surface water source or GUDI source systems serving 500-3,300 shall sample every 90 days. Only one location with a dual sample set per monitoring period is needed if highest TTHM and HAA5 concentrations occur at the same location (and month, if monitoring annually).

~~(iii) Owners shall recommend LRAA compliance monitoring locations based on standard monitoring results, system specific study results, and compliance monitoring results under subdivision B 3 e (1) of this section. Owners shall follow the protocol in subdivision B 3 e (2) (e) (iii) ((a)) through ((h)) of this section. If required to monitor at more than eight locations, the owner shall repeat the protocol as necessary. If an owner does not have existing compliance monitoring results under subdivision B 3 e (1) of this section or if the owner does not have enough existing compliance monitoring results under subdivision B 3 e (1) of this section, the owner shall repeat the protocol, skipping the provisions of subdivision B 3 e (2) (e) (iii) ((c)) and ((g)) of this section as necessary, until the owner has identified the required total number of monitoring locations.~~

~~((a)) Location with the highest TTHM LRAA not previously selected as a LRAA monitoring location.~~

~~((b)) Location with the highest HAA5 LRAA not previously selected as a LRAA monitoring location.~~

~~((c)) Existing average residence time compliance monitoring location under subdivision B 3 e (1) of this section (maximum residence time compliance monitoring location for ground water systems) with the highest HAA5 LRAA not previously selected as a LRAA monitoring location.~~

~~((d)) Location with the highest TTHM LRAA not previously selected as a LRAA monitoring location.~~

~~((e)) Location with the highest TTHM LRAA not previously selected as a LRAA monitoring location.~~

~~((f)) Location with the highest HAA5 LRAA not previously selected as a LRAA monitoring location.~~

~~((g)) Existing average residence time compliance monitoring location under subdivision B 3 e (1) of this section (maximum residence time compliance monitoring location for ground water systems) with the highest TTHM LRAA not previously selected as a LRAA monitoring location.~~

~~((h)) Location with the highest HAA5 LRAA not previously selected as a LRAA monitoring location.~~

~~(iv) An owner may recommend locations other than those specified in subdivision B 3 e (2) (e) (iii) of this section if the owner includes a rationale for selecting other locations. If the commissioner approves the alternate locations, the owners shall monitor at these locations to determine compliance under subdivision B 3 e (3) of this section.~~

~~(v) The recommended schedule shall include LRAA monitoring during the peak historical month for TTHM and HAA5 concentration, unless the commissioner approves another month. Once the owner has identified the peak historical month, and if the owner is required to conduct routine monitoring at least quarterly, the owner shall schedule LRAA compliance monitoring at a regular frequency of every 90 days or fewer.~~

~~(f) The owner shall use only the analytical methods specified in 12VAC5-590-440, or otherwise approved by EPA for monitoring, to demonstrate compliance.~~

~~(g) IDSE results will not be used for the purpose of determining compliance with MCLs in Table 2.13.~~

~~(3) Locational running annual average monitoring requirements.~~

~~(a) This subdivision establishes monitoring and other requirements for achieving compliance with maximum contaminant levels based on locational running annual averages (LRAA) for total trihalomethanes (TTHM) and haloacetic acids (five) (HAA5), and for achieving compliance with maximum residual disinfectant residuals for chlorine and chloramines for certain consecutive waterworks.~~

~~(b) This subdivision applies to community waterworks or nontransient noncommunity waterworks that uses a primary or residual disinfectant other than ultraviolet light or delivers water that has been treated with a primary or residual disinfectant other than ultraviolet light.~~

~~(c) Owner shall comply on the schedule in the following table based on the type of waterworks:~~

Type of Waterworks	Waterworks shall comply with Locational Running Average monitoring by: <sup>3</sup>
Waterworks that are not part of a combined distribution system and waterworks that serve the largest population in the combined distribution system	
Waterworks serving equal to or greater than 100,000	April 1, 2012

Waterworks serving 50,000-99,999	October 1, 2012
Waterworks serving 10,000-49,999	October 1, 2013
Waterworks serving less than 10,000	October 1, 2013 if no Cryptosporidium monitoring is required under 12VAC5-590-420-B-3-a-(1)-(c) or October 1, 2014 if Cryptosporidium monitoring is required under 12VAC5-590-420-B-3-a-(1)-(c)
Other waterworks that are part of a combined distribution system	
Consecutive waterworks or wholesale waterworks	-at the same time as the waterworks with the earliest compliance date in the combined distribution system

<sup>1</sup>The commissioner may grant up to an additional 24 months for compliance with MCLs and operational evaluation levels if the waterworks require capital improvements to comply with an MCL.

~~(i) Waterworks monitoring frequency is specified in subdivision B-3-e-(3)-(d)-(ii) of this section.~~

~~((a)) Owners of waterworks required to conduct quarterly monitoring shall begin monitoring in the first full calendar quarter that includes the compliance date in the table in subdivision B-3-e-(3)-(c) of this section.~~

~~((b)) Owners of waterworks required to conduct monitoring at a frequency that is less than quarterly shall begin monitoring in the calendar month recommended in the IDSE report prepared under subdivision B-3-e-(2)-(d)-(iii) or subdivision B-3-e-(2)-(d)-(iv) of this section or the calendar month identified in the LRAA monitoring plan developed under subdivision B-3-e-(3)-(e) of this section no later than 12 months after the compliance date in the table in subdivision B-3-e-(3)-(c) of this section.~~

~~(ii) Owners of waterworks required to conduct quarterly monitoring shall make compliance calculations at the end of the fourth calendar quarter that follows the compliance date and at the end of each subsequent quarter (or earlier if the LRAA calculated based on fewer than four quarters of data would cause the MCL to be exceeded regardless of the monitoring results of subsequent quarters). Owners of waterworks required to conduct monitoring at a frequency that is less than quarterly shall make compliance calculations beginning with the first compliance sample taken after the compliance date.~~

~~(iii) For the purpose of the schedule in subdivision B-3-e-(3)-(c) of this section, the commissioner has determine that the combined distribution system does not include consecutive waterworks that receive water from a wholesale waterworks only on an emergency basis or receive less than 10% of their total water consumption from a wholesale waterworks. The commissioner has also determine that the combined distribution system does not include wholesale waterworks which deliver water to a consecutive waterworks only on an emergency basis or deliver less than 10% of the total water used by a consecutive waterworks.~~



(d) Routine monitoring.

(i) Owners submitting an IDSE report shall begin monitoring at the locations and months the owner recommended in the IDSE report submitted under subdivision B 3 e (2) (e) of this section following the schedule in subdivision B 3 e (3) (c) of this section, unless the commissioner requires other locations or additional locations after review. If the owner submitted a 40/30 certification under subdivision B 3 e (2) (d) (v) of this section or the waterworks qualified for a very small system waiver under subdivision B 3 e (2) (d) (vi) of this section or the waterworks is a nontransient noncommunity waterworks serving less than 10,000, the owner shall monitor at the location(s) and dates identified in the monitoring plan in subdivision B 3 j of this section, updated as required by subdivision B 3 e (3) (e) of this section.

(ii) Owners shall monitor at no fewer than the number of locations identified in the following table:

Source Water Type	Population Size Category	Monitoring Frequency <sup>1</sup>	Distribution System Monitoring Location Total per Monitoring Period <sup>2</sup>
Surface water or groundwater under the direct influence of surface water	Less than 500	per year	2
	500-3,300	per quarter	2
	3,301-9,999	per quarter	2
	10,000-49,999	per quarter	4
	50,000-249,999	per quarter	8
	250,000-999,999	per quarter	12
	1,000,000-4,999,999	per quarter	16
Groundwater	Equal to or greater than 5,000,000	per quarter	20
	Less than 500	per year	2
	500-9,999	per year	2
	10,000-99,999	per quarter	4
	100,000-499,999	per quarter	6
	Equal to or greater than 500,000	per quarter	8

<sup>1</sup>All owners shall monitor during month of highest DBP concentrations.

<sup>2</sup>Owners of waterworks on quarterly monitoring (except for surface water source or GUDI source waterworks serving 500-3,300) shall take dual sample sets every 90 days at each monitoring location. Groundwater source waterworks serving 500-9,999 (on annual monitoring) shall take dual sample sets annually at each monitoring location. Waterworks serving fewer than 500 and surface water source or GUDI source waterworks serving 500-3,300 shall take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations, respectively. Waterworks serving fewer than 500 shall sample annually and surface water source or GUDI source systems serving 500-3,300 shall sample every 90 days. Only one location with a dual sample set per

monitoring period is needed if highest TTHM and HAA5 concentrations occur at the same location (and month, if monitoring annually).

~~(iii) Owners of waterworks not using disinfection that begin using a disinfectant other than UV light after the dates in subdivision B 3 e (2) of this section for complying with the IDSE requirements shall consult with the commissioner to identify compliance monitoring locations. Owners shall then develop a monitoring plan under subdivision B 3 e (3) (e) of this section that includes those monitoring locations.~~

~~(iv) Owners shall use an approved method listed in 12VAC5-590-440 for TTHM and HAA5 analyses. Analyses shall be conducted by laboratories that have received certification by EPA or DCLS as specified in 12VAC5-590-440.~~

~~(e) Monitoring plan.~~

~~(i) Owners shall develop and implement a monitoring plan to be kept on file for review by the commissioner and the public. The monitoring plan shall be completed no later than the date the owner conducts the initial monitoring and contain:~~

~~((a)) Monitoring locations;~~

~~((b)) Monitoring dates; and~~

~~((c)) Compliance calculation procedures.~~

~~(ii) If the owner was not required to submit an IDSE report under either subdivision B 3 e (2) (d) (iii) or subdivision B 3 e (2) (d) (iv) of this section, and the waterworks did not have sufficient monitoring locations under subdivision B 3 e (1) of this section to identify the required number of LRAA compliance monitoring locations indicated in subdivision B 3 e (2) (e) (ii) of this section, the owner shall identify additional locations by alternating selection of locations representing high TTHM levels and high HAA5 levels until the required number of compliance monitoring locations have been identified. The owner shall also provide the rationale for identifying the locations as having high levels of TTHM or HAA5. If the waterworks has more monitoring locations under subdivision B 3 e (1) of this section than required for LRAA compliance monitoring in subdivision B 3 e (2) (e) (ii) of this section, the owner shall identify which locations the waterworks will use for LRAA compliance monitoring by alternating selection of locations representing high TTHM levels and high HAA5 levels until the required number of LRAA compliance monitoring locations have been identified.~~

~~(iii) Owners of waterworks using surface water or groundwater under the direct influence of surface water serving more than 3,300 people shall submit a copy of the monitoring plan to the commissioner prior to~~

~~the date the waterworks conducts the initial monitoring, unless the IDSE report submitted under subdivision B 3 e (2) of this section contains all the information required by this section.~~

~~(iv) Owners may revise the monitoring plan to reflect changes in treatment, distribution system operations and layout (including new service areas), or other factors that may affect TTHM or HAA5 formation, or for reasons approved by the commissioner, after consultation with the commissioner regarding the need for changes and the appropriateness of the changes. If the owner changes monitoring locations, the owner shall replace existing compliance monitoring locations with the lowest LRAA with new locations that reflect the current distribution system locations with expected high TTHM or HAA5 levels. The commissioner may also require modifications in the monitoring plan. Owners of waterworks using surface water or groundwater under the direct influence of surface water serving more than 3,300 people shall submit a copy of the~~

modified monitoring plan to the commissioner prior to the date the owner is required to comply with the revised monitoring plan.

(f) Reduced monitoring

(i) Owners may reduce monitoring to the level specified in the following table any time the LRAA is less than or equal to 0.040 mg/L for TTHM and less than or equal to 0.030 mg/L for HAA5 at all monitoring locations. Owners may only use data collected under the provisions of this subdivision or subdivision B 3 e (1) of this section to qualify for reduced monitoring. In addition, the source water annual average TOC level, before any treatment, shall be less than or equal to 4.0 mg/L at each treatment plant treating surface water or ground water under the direct influence of surface water, based on monitoring conducted under either subdivision B 3 e (1) (b) (vi) or B 3 i of this section.

Source Water Type	Population Size Category	Monitoring Frequency <sup>†</sup>	Distribution System Monitoring Location per Monitoring Period
Surface water or ground water under the direct influence of surface water	Less than 500	-	monitoring may not be reduced
	500-3,300	per year	1 TTHM and 1 HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement; 1 dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.
	3,301-9,999	per year	2 dual sample sets: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement
	10,000-49,999	per quarter	2 dual sample sets at the locations with the highest TTHM and highest HAA5 LRAAs
	50,000-249,999	per quarter	4 dual sample sets at the locations with the two highest TTHM and two highest HAA5 LRAAs
	250,000-999,999	per quarter	6 dual sample sets at the locations with the three highest TTHM and three highest HAA5 LRAAs
	1,000,000-4,999,999	per quarter	8 dual sample sets at the locations with the four highest TTHM and four highest HAA5 LRAAs
	Equal to or greater than 5,000,000	per quarter	10 dual sample sets at the locations with the five highest TTHM and five highest HAA5 LRAAs

Source Water Type	Population Size Category	Monitoring Frequency <sup>4</sup>	Distribution System Monitoring Location per Monitoring Period
Groundwater	Less than 500	every third year	1 TTHM and 1 HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement; 1 dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.
	500-9,999	per year	1 TTHM and 1 HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement; 1 dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.
	10,000-99,999	per year	2 dual sample sets: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement
	100,000-499,999	per quarter	2 dual sample sets; at the locations with the highest TTHM and highest HAA5 LRAAs
	Equal to or greater than 500,000	per quarter	4 dual sample sets at the locations with the two highest TTHM and two highest HAA5 LRAAs

<sup>4</sup>Owners of waterworks on quarterly monitoring shall take dual sample sets every 90 days.

(ii) owners may remain on reduced monitoring as long as the TTHM LRAA is less than or equal to 0.040 mg/L and the HAA5 LRAA is less than or equal to 0.030 mg/L at each monitoring location (for waterworks with quarterly reduced monitoring) or each TTHM sample is less than or equal to 0.060 mg/L and each HAA5 sample is less than or equal to 0.045 mg/L (for waterworks with annual or less frequent monitoring). In addition, the source water annual average TOC level, before any treatment, shall be less than or equal to 4.0 mg/L at each treatment plant treating surface water or ground water under the direct influence of surface water, based on monitoring conducted under either subdivision B 3 e (1) (b) (vi) or B 3 i of this section.

(iii) If the LRAA based on quarterly monitoring at any monitoring location exceeds either 0.040 mg/L for TTHM or 0.030 mg/L for HAA5 or if the annual (or less frequent) sample at any location exceeds either 0.060 mg/L for TTHM or 0.045 mg/L for HAA5,

or if the source water annual average TOC level, before any treatment, is greater than 4.0 mg/L at any treatment plant treating surface water or ground water under the direct influence of surface water, the owner shall resume routine monitoring under subdivision B 3 e (3) (d) of this section or begin increased monitoring if subdivision B 3 e (3) (g) of this section applies.

~~(iv) The commissioner may return the waterworks to routine monitoring at the commissioner's discretion.~~

~~(v) A waterworks may remain on reduced monitoring after the dates identified in subdivision B 3 e (3) (c) of this section for compliance with this section only if the waterworks qualifies for a 40/30 certification under subdivision B 3 e (2) (d) (v) of this section or has received a very small system waiver under subdivision B 3 e (2) (d) (vi) of this section, plus the waterworks meets the reduced monitoring criteria in subdivision B 3 e (3) (f) of this section, and the owner did not change or add monitoring locations from those used for compliance monitoring under subdivision B 3 e (1) of this section. If the monitoring locations under this subdivision differ from the monitoring locations under subdivision B 3 e (1) of this section, the owner may not remain on reduced monitoring after the dates identified in subdivision B 3 e (3) (c) of this section for compliance with this subdivision.~~

~~(vi) Owners shall use an approved method listed in 12VAC5-590-440 for TTHM and HAA5 analyses. Analyses shall be conducted by laboratories that have received certification by EPA or DCLS as specified in 12VAC5-590-440.~~

~~(g) Increased Monitoring~~

~~(i) Owners of waterworks required to monitor at a particular location annually or less frequently than annually under subdivision B 3 e (3) (d) or subdivision B 3 e (3) (f) of this section, shall increase monitoring to dual sample sets once per quarter (taken every 90 days) at all locations if a TTHM sample is greater than 0.080 mg/L or a HAA5 sample is greater than 0.060 mg/L at any location.~~

~~(ii) A waterworks is in violation of the MCL when the LRAA exceeds the MCLs in Table 2.13, calculated based on four consecutive quarters of monitoring (or the LRAA calculated based on fewer than four quarters of data if the MCL would be exceeded regardless of the monitoring results of subsequent quarters). Waterworks are in violation of the monitoring requirements for each quarter that a monitoring result would be used in calculating an LRAA if the owner fails to monitor.~~

~~(iii) Owners may return to routine monitoring once the waterworks has conducted increased monitoring for at least four consecutive quarters and the LRAA for every monitoring location is less than or equal to 0.060 mg/L for TTHM and less than or equal to 0.045 mg/L for HAA5.~~

~~(iv) Owners of waterworks on increased monitoring under subdivision e (1) in this section shall remain on increased monitoring until the waterworks qualify for a return to routine monitoring under subdivision B 3 e (3) (g) (iii) of this section. The owner shall conduct increased monitoring under subdivision B 3 e (3) (g) of this section at the monitoring locations in the monitoring plan developed under subdivision B 3 e (3) (e) of this section beginning at the date identified in subdivision B 3 e (3) (c) of this section for compliance with this subdivision and remain on increased monitoring until the waterworks qualifies for a return to routine monitoring under subdivision B 3 e (3) (g) (iii) of this section.~~

~~(v) Owners shall use an approved method listed in 12VAC5-590-440 for TTHM and HAA5 analyses. Analyses shall be conducted by laboratories that have received certification by EPA or DCLS as specified in 12VAC5-590-440.~~

f. Chlorite. Owners of community and nontransient noncommunity waterworks using chlorine dioxide, for disinfection or oxidation, shall conduct monitoring for chlorite.

(1) Routine monitoring.

(a) Daily monitoring. Owners shall take daily samples at the entrance to the distribution system. For any daily sample that exceeds the chlorite PMCL in Table 2.13, the owner shall take additional samples in the distribution system the following day at the locations required by subdivision B 3 f (1) (c) of this section, in addition to the sample required at the entrance to the distribution system.

(b) Monthly monitoring. Owners shall take a three-sample set each month in the distribution system. The owner shall take one sample at each of the following locations: near the first customer, at a location representative of average residence time, and at a location reflecting maximum residence time in the distribution system. Any additional routine sampling shall be conducted in the same manner (as three-sample sets, at the specified locations). The owner may use the results of additional monitoring conducted under subdivision B 3 f (1) (c) of this section to meet the requirement for monitoring in this paragraph.

(c) Additional monitoring requirements. On each day following a routine sample monitoring result that exceeds the chlorite PMCL in Table 2.13 at the entrance to the distribution system, the owner is required to take three chlorite distribution system samples at the following locations: as close to the first customer as possible, in a location representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

(2) Reduced monitoring.

(a) Chlorite monitoring at the entrance to the distribution system required by subdivision B 3 f (1) (a) of this section may not be reduced.

(b) Chlorite monitoring in the distribution system required by subdivision B 3 f (1) (b) of this section may be reduced to one three-sample set per quarter after one year of monitoring where no individual chlorite sample taken in the distribution system under subdivision B 3 f (1) (b) of this section has exceeded the chlorite PMCL in Table 2.13 and the owner has not been required to conduct monitoring under subdivision B 3 f (1) (c) of this section. The owner may remain on the reduced monitoring schedule until either any of the three individual chlorite samples taken quarterly in the distribution system under subdivision B 3 f (1) (b) of this section exceeds the chlorite PMCL or the owner is required to conduct monitoring under subdivision B 3 f (1) (c) of this section, at which time the owner shall revert to routine monitoring.

g. Bromate.

(1) The owner of a community or nontransient noncommunity waterworks treatment plant using ozone, for disinfection or oxidation, shall take one sample per month and analyze it for bromate. The owner shall take samples monthly at the entrance to the distribution system while the ozonation system is operating under normal conditions.

(2) Reduced monitoring.

(a) Until March 31, 2009, owners of waterworks required to analyze for bromate may reduce monitoring from monthly to quarterly, if the waterworks average source water bromide concentration is less than 0.05 mg/L based on representative monthly bromide measurements for one year. The owner may remain on reduced bromate monitoring until the running annual average source water bromide concentration, computed quarterly, is equal to or greater than 0.05 mg/L based on representative

monthly measurements. If the running annual average source water bromide concentration is equal to or greater than 0.05 mg/L, the owner shall resume routine monitoring required by subdivision B 3 g (1) of this section in the following month.

(b) Beginning April 1, 2009, owners may no longer use the provisions of subdivision B 3 g (2) (a) of this section to qualify for reduced monitoring. An owner required to analyze for bromate may reduce monitoring from monthly to quarterly, if the waterworks running annual average bromate concentration is equal to or less than 0.0025 mg/L based on monthly bromate measurements under subdivision B 3 g (1) of this section for the most recent four quarters, with samples analyzed in accordance with 12VAC5-590-440. If a waterworks has qualified for reduced bromate monitoring under subdivision B 3 g (2) (a) of this section, the owner may remain on reduced monitoring as long as the running annual average of quarterly bromate samples is equal to or less than 0.0025 mg/L based on samples analyzed in accordance with 12VAC5-590-440. If the running annual average bromate concentration is greater than 0.0025 mg/L, the owner shall resume routine monitoring required by subdivision B 3 g (1) of this section.

(3) Bromide. Owners of waterworks required to analyze for bromate may reduce bromate monitoring from monthly to once per quarter, if the owner demonstrates that the average source water bromide concentration is less than 0.05 mg/L based upon representative monthly measurements for one year. The owner shall continue bromide monitoring to remain on reduced bromate monitoring.

h. Monitoring requirements for disinfectant residuals.

(1) Chlorine and chloramines.

(a) Owners of waterworks that use chlorine or chloramines shall measure the residual disinfectant level in the distribution system at the same point in the distribution system and at the same time as total coliforms are sampled, as specified in subsection A. Owners of waterworks that use surface water or groundwater under the direct influence of surface water may use the results of residual disinfectant concentration sampling found in subdivision B 7 c (1) of this section in lieu of taking separate samples.

(b) Residual disinfectant level monitoring may not be reduced.

(2) Chlorine dioxide.

(a) Owners of waterworks that use chlorine dioxide for disinfection or oxidation shall take daily samples at the entrance to the distribution system. For any daily sample that exceeds the MRDL in Table 2.12, the owner shall take samples in the distribution system the following day at the locations required by subdivision B 3 h (2) (b) of this section, in addition to the sample required at the entrance to the distribution system.

(b) On each day following a routine sample monitoring result that exceeds the MRDL in Table 2.12, the owner is required to take three chlorine dioxide distribution system samples. If chlorine dioxide or chloramines are used to maintain a disinfectant residual in the distribution system, or if chlorine is used to maintain a disinfectant residual in the distribution system and there are no disinfection addition points after the entrance to the distribution system (i.e., no booster chlorination), the owner shall take three samples as close to the first customer as possible, at intervals of at least six hours. If chlorine is used to maintain a disinfectant residual in the distribution system and there are one or more disinfection addition points after the entrance to the distribution system (i.e., booster chlorination), the owner shall take one sample at each of the following locations: as close to the first customer as possible, in a location

representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

(e) Chlorine dioxide monitoring may not be reduced.

i. Monitoring requirements for disinfection byproduct precursors (DBPP).

(1) Owners of community or nontransient noncommunity waterworks using surface water or groundwater under the direct influence of surface water and using conventional filtration treatment (as defined in 12VAC5-590-10) shall monitor each treatment plant for TOC no later than the point of combined filter effluent turbidity monitoring and representative of the treated water. All owners required to monitor under subdivision (B 3 i (1)) shall also monitor for TOC in the source water prior to any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as paired samples. At the same time as the source water sample is taken, all owners shall monitor for alkalinity in the source water prior to any treatment. Owners shall take one paired sample and one source water alkalinity sample per month per plant at a time representative of normal operating conditions and influent water quality.

(2) Owners of community or nontransient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water with an average treated water TOC of less than 2.0 mg/L for two consecutive years, or less than 1.0 mg/L for one year, may reduce monitoring for both TOC and alkalinity to one paired sample and one source water alkalinity sample per plant per quarter. The owners shall revert to routine monitoring in the month following the quarter when the annual average treated water TOC equal to or greater than 2.0 mg/L.

j. The owner of each waterworks required to monitor under subdivision B 3 of this section shall develop and implement a monitoring plan. The owner shall maintain the plan and make it available for inspection by the commissioner and the general public no later than 30 days following the applicable compliance dates in subdivision B 3 a of this section. The owners of all community or nontransient noncommunity waterworks that use surface water or groundwater under the direct influence of surface water serving more than 3,300 people shall submit a copy of the monitoring plan to the commissioner no later than the date of the first report required under 12VAC5-590-530 A. The commissioner may also require the plan to be submitted by any other owner. After review, the commissioner may require changes in any plan elements. The plan shall include at least the following elements:

(1) Specific locations and schedules for collecting samples for any parameters included in subdivision B 3 of this section.

(2) How the owner will calculate compliance with PMCLs, MRDLs, and treatment techniques.

(3) The sampling plan for a consecutive waterworks shall reflect the entire consecutive distribution system.

4. Unregulated contaminants (UCs). Owners of all community and nontransient noncommunity waterworks shall sample for the contaminants listed in Table 2.6 and Table 2.7 as follows:

a. Table 2.6—Group A

(1) Owners of waterworks that use a surface water source in whole or in part shall sample at the entry points to the distribution system which is representative of each source, after treatment (hereafter called a sampling point). The minimum number of



samples is one year of consecutive quarterly samples per sampling point beginning in accordance with Table 2.8.

(2) Owners of waterworks that use groundwater shall sample at points of entry to the distribution system which is representative of each source (hereafter called a sampling point). The minimum number of samples is one sample per sampling point beginning in accordance with Table 2.8.

(3) The commissioner may require a confirmation sample for positive or negative results.

(4) Owners of waterworks serving less than 150 connections may inform the commissioner, in writing, that their waterworks is available for sampling instead of performing the required sampling.

(5) All waterworks required to sample under this section shall repeat the sampling at least every five years.

b. Table 2.6 — Group B and Table 2.7

(1) The owner of each community and nontransient noncommunity waterworks shall take four consecutive quarterly samples at the entry points to the distribution system which is representative of each source (hereafter called a sampling point) for each contaminant listed in Table 2.6 Group B and report the results to the commissioner. Monitoring shall be completed by December 31, 1995.

(2) The owner of each community and nontransient noncommunity waterworks shall take one sample at each sampling point for each contaminant listed in Table 2.7 and report the results to the commissioner. Monitoring shall be completed by December 31, 1995.

(3) The owner of each community and nontransient noncommunity waterworks may apply to the commissioner for a waiver from the monitoring requirements of subdivisions B 4 b (1) and (2) of this section for the contaminants listed in Table 2.6 Group B and Table 2.7.

(4) The commissioner may grant a waiver for the requirement of subdivision B 4 b (1) of this section based on the criteria specified in subdivision B 2 f of this section. The commissioner may grant a waiver from the requirement of subdivision B 4 b (2) of this section if previous analytical results indicate contamination would not occur, provided this data was collected after January 1, 1990.

(5) If the waterworks utilizes more than one source and the sources are combined before distribution, the owner shall sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

(6) The commissioner may require a confirmation sample for positive or negative results.

(7) Instead of performing the monitoring required by this section, the owner of a community waterworks or nontransient noncommunity waterworks serving fewer than 150 service connections may send a letter to the commissioner stating that the waterworks is available for sampling. This letter shall be sent to the commissioner by January 1, 1994. The owner shall not send such samples to the commissioner unless requested to do so by the commissioner.

(8) All waterworks required to sample under this subdivision shall repeat the sampling at least every five years.

5. Reserved.

6. Reserved.

7. Monitoring filtration and disinfection.

a. The owner of a waterworks that uses a surface water source or a groundwater source under the direct influence of surface water and provides filtration treatment shall monitor in accordance with this section beginning June 29, 1993, or when filtration is installed, whichever is later.

b. Turbidity measurements as required by 12VAC5-590-370 C shall be performed on representative samples of the filtered water every four hours (or more frequently) that the waterworks serves water to the public. An owner may substitute continuous turbidity monitoring for grab sample monitoring if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the commissioner. For any waterworks using slow sand filtration or filtration treatment other than conventional treatment, direct filtration, or diatomaceous earth filtration, the office may reduce the sampling frequency to once per day if it determines that less frequent monitoring is sufficient to indicate effective filtration performance. For waterworks serving 500 or fewer persons, the commissioner may reduce the turbidity sampling frequency to once per day, regardless of the type of filtration treatment used, if the commissioner determines that less frequent monitoring is sufficient to indicate effective filtration performance.

(1) In addition to the above, as of January 1, 2001, waterworks serving at least 10,000 people and as of January 1, 2005, waterworks serving less than 10,000 people supplied by surface water or groundwater under the direct influence of surface water using conventional filtration treatment or direct filtration shall conduct continuous monitoring of turbidity for each individual filter, using an approved method in 12VAC5-590-440. The turbidimeter shall be calibrated using the procedure specified by the manufacturer. The owner shall record the results of individual filter turbidity monitoring every 15 minutes.

(2) If there is a failure in the continuous turbidity monitoring equipment, the owner shall conduct grab sampling every four hours in lieu of continuous monitoring but for no more than five working days (for waterworks serving at least 10,000 people) or 14 days (for waterworks serving less than 10,000 people) following the failure of the equipment.

(3) If a waterworks serving less than 10,000 people consists of two or fewer filters, continuous monitoring of the combined filter effluent may be used in lieu of individual filter monitoring.

c. The residual disinfectant concentration of the water entering the distribution system shall be monitored continuously, and the lowest value shall be recorded each day, except that if there is a failure in the continuous monitoring equipment, grab sampling every four hours may be conducted in lieu of continuous monitoring, but for no more than five working days following the failure of the equipment, and owners of waterworks serving 3,300 or fewer persons may take grab samples in lieu of continuous monitoring on an ongoing basis at the frequencies each day prescribed below:

Table 2.5  
Grab Sample Monitoring Frequency

Waterworks Size By Population	Samples/Day <sup>†</sup>
500 or less	4
501 to 1,000	2

1,000 to 2,500	3
2,501 to 3,300	4

<sup>4</sup>The day's samples cannot be taken at the same time. The sampling intervals are subject to commissioner's review and approval. If at any time the residual disinfectant concentration falls below 0.2 mg/L in a waterworks using grab sampling in lieu of continuous monitoring, the waterworks owner shall take a grab sample every four hours until the residual disinfectant concentration is equal to or greater than 0.2 mg/L.

(1) The residual disinfectant concentration shall be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in subsection A of this section, except that the district engineer may allow an owner which uses both a surface water source or a groundwater source under direct influence of surface water, and a groundwater source to take disinfectant residual samples at points other than the total coliform sampling points if the division determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in 12VAC5-590-420 B may be measured in lieu of residual disinfectant concentration.

(2) If the commissioner determines, based on site-specific considerations, that a waterworks has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions and that the waterworks is providing adequate disinfection in the distribution system, the requirements of subdivision B 7 b (1) of this section do not apply to that waterworks.

d. The following information on the samples taken in the distribution system in conjunction with total coliform monitoring pursuant to 12VAC5-590-420 B shall be reported monthly to the district engineer by the owner:

- (1) Number of instances where the residual disinfectant concentration is measured;
- (2) Number of instances where the residual disinfectant concentration is not measured but HPC is measured;
- (3) Number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;
- (4) Number of instances where no residual disinfectant concentration is detected and where the HPC is greater than 500/mL;
- (5) Number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL;
- (6) For the current and previous month the waterworks serves water to the public, the value of "V" in percent in the following formula:

$$V = (c + d + e) / (a + b) \times 100$$

where

- a = the value in subdivision B 7 d (1) of this section;
- b = the value in subdivision B 7 d (2) of this section;
- c = the value in subdivision B 7 d (3) of this section;
- d = the value in subdivision B 7 d (4) of this section;
- e = the value in subdivision B 7 d (5) of this section;

(7) If the commissioner determines, based on site-specific considerations, that an owner has no means for having a sample transported and analyzed for HPC by a

~~certified laboratory within the requisite time and temperature conditions and that the waterworks is providing adequate disinfection in the distribution system, the requirements of subdivision B 7 c (1) of this section do not apply.~~

~~e. An owner need not report the data listed in 12VAC5-590-530 E 2 a if all data listed in 12VAC5-590-530 E 2 a through E 2 c remain on file at the waterworks and the district engineer determines that the owner has submitted all the information required by 12VAC5-590-530 E 2 a through c for at least 12 months.~~

~~8. Operational. Owners may be required by the commissioner to collect additional samples to provide quality control for any treatment processes that are employed.~~

~~C. Physical. All samples for turbidity analysis shall be taken at a representative entry point or points to the water distribution system unless otherwise specified. Turbidity samples shall be analyzed in accordance with 12VAC5-590-480 B 1 a, at least once per day at all waterworks that use surface water sources or groundwater sources under the direct influence of surface water.~~

~~D. Radiological. The location of sampling points, the radionuclides measured in community waterworks, the frequency, and the timing of sampling within each compliance period shall be established or approved by the commissioner. The commissioner may increase required monitoring where necessary to detect variations within the waterworks. Failure to comply with the sampling schedules in this section will require public notification pursuant to 12VAC5-590-540.~~

~~Community waterworks owners shall conduct monitoring to determine compliance with the PMCLs in Table 2.5 and 12VAC5-590-400 in accordance with this section.~~

~~1. Monitoring and compliance requirements for gross alpha particle activity, radium-226, radium-228, and uranium.~~

~~a. Community waterworks owners shall conduct initial monitoring to determine compliance with 12VAC5-590-400 B 2, B 3, and B 4 by December 31, 2007. For the purposes of monitoring for gross alpha particle activity, radium-226, radium-228, uranium, and beta particle and photon radioactivity in drinking water, "detection limit" is defined as in Appendix B of this chapter.~~

~~(1) Applicability and sampling location for existing community waterworks or sources. The owners of all existing community waterworks using ground water, surface water or waterworks using both ground and surface water shall sample at every entry point to the distribution system that is representative of all sources being used under normal operating conditions. The community waterworks owner shall take each sample at the same entry point unless conditions make another sampling point more representative of each source.~~

~~(2) Applicability and sampling location for new community waterworks or sources. All new community waterworks or community waterworks that use a new source of water shall begin to conduct initial monitoring for the new source within the first quarter after initiating use of the source. Community waterworks owners shall conduct more frequent monitoring when directed by the commissioner in the event of possible contamination or when changes in the distribution system or treatment processes occur which may increase the concentration of radioactivity in finished water.~~

~~b. Initial monitoring: Community waterworks owners shall conduct initial monitoring for gross alpha particle activity, radium-226, radium-228, and uranium as follows:~~

~~(1) Community waterworks without acceptable historical data, as defined below, shall collect four consecutive quarterly samples at all entry points before December 31, 2007.~~

(2) ~~Grandfathering of data: The commissioner may allow historical monitoring data collected at an entry point to satisfy the initial monitoring requirements for that entry point, for the following situations:~~

~~(a) To satisfy initial monitoring requirements, a community waterworks owner having only one entry point to the distribution system may use the monitoring data from the last compliance monitoring period that began between June 2000 and December 8, 2003.~~

~~(b) To satisfy initial monitoring requirements, a community waterworks owner with multiple entry points and having appropriate historical monitoring data for each entry point to the distribution system may use the monitoring data from the last compliance monitoring period that began between June 2000 and December 8, 2003.~~

~~(3) For gross alpha particle activity, uranium, radium-226, and radium-228 monitoring, the commissioner may waive the final two quarters of initial monitoring for an entry point if the results of the samples from the previous two quarters are below the method detection limit specified in Appendix B.~~

~~(4) If the average of the initial monitoring results for an entry point is above the PMCL, the community waterworks owner shall collect and analyze quarterly samples at that entry point until the owner has results from four consecutive quarters that are at or below the PMCL, unless the community waterworks owner enters into another schedule as part of a formal compliance agreement with the commissioner.~~

~~c. Reduced monitoring: The commissioner may allow community waterworks owners to reduce the future frequency of monitoring from once every three years to once every six or nine years at each entry point, based on the following criteria:~~

~~(1) If the average of the initial monitoring results for each contaminant (i.e., gross alpha particle activity, uranium, radium-226, or radium-228) is below the method detection limit specified in Appendix B, the community waterworks owner shall collect and analyze for that contaminant using at least one sample at that entry point every nine years.~~

~~(2) For gross alpha particle activity and uranium, if the average of the initial monitoring results for each contaminant is at or above the method detection limit specified in Appendix B but at or below 1/2 of the PMCL, the community waterworks owner shall collect and analyze for that contaminant using at least one sample at that entry point every six years. For combined radium-226 and radium-228, the analytical results shall be combined. If the average of the combined initial monitoring results for radium-226 and radium-228 is at or above the method detection limit specified in Appendix B but at or below 1/2 the PMCL, the community waterworks owner shall collect and analyze for that contaminant using at least one sample at that entry point every six years.~~

~~(3) For gross alpha particle activity and uranium, if the average of the initial monitoring results for each contaminant is above 1/2 the PMCL but at or below the PMCL, the community waterworks owner shall collect and analyze at least one sample at that entry point every three years. For combined radium-226 and radium-228, the analytical results shall be combined. If the average of the combined initial monitoring results for radium-226 and radium-228 is above 1/2 the PMCL but at or below the MPCL, the community waterworks owner shall collect and analyze at least one sample at that entry point every three years.~~

~~(4) Community waterworks owners shall use the samples collected during the reduced monitoring period to determine the monitoring frequency for subsequent monitoring periods (e.g., if a community waterworks entry point is on a nine-year monitoring~~

period, and the sample result is above 1/2 the PMCL, then the next monitoring period for that entry point is three years).

~~(5) If a community waterworks owner has a monitoring result that exceeds the PMCL while on reduced monitoring, the community waterworks owner shall collect and analyze quarterly samples at that entry point until the community waterworks owner has results from four consecutive quarters that are below the PMCL, unless the community waterworks enters into another schedule as part of a formal compliance agreement with the commissioner.~~

~~d. Compositing: To fulfill quarterly monitoring requirements for gross alpha particle activity, radium-226, radium-228, or uranium, a community waterworks owner may composite up to four consecutive quarterly samples from a single entry point if analysis is done within a year of the first sample. The commissioner will treat analytical results from the composited sample as the average analytical result to determine compliance with the PMCLs and the future monitoring frequency. If the analytical result from the composited sample is greater than 1/2 the PMCL, the commissioner may direct the community waterworks owner to take additional quarterly samples before allowing the community waterworks owner to sample under a reduced monitoring schedule.~~

~~e. A gross alpha particle activity measurement may be substituted for the required radium-226 measurement provided that the measured gross alpha particle activity does not exceed 5 pCi/L. A gross alpha particle activity measurement may be substituted for the required uranium measurement provided that the measured gross alpha particle activity does not exceed 15 pCi/L.~~

~~The gross alpha measurement shall have a confidence interval of 95% (1.65, where is the standard deviation of the net counting rate of the sample) for radium-226 and uranium. When a community waterworks owner uses a gross alpha particle activity measurement in lieu of a radium-226 and/or uranium measurement, the gross alpha particle activity analytical result will be used to determine the future monitoring frequency for radium-226 and/or uranium. If the gross alpha particle activity result is less than the detection limit as specified in Appendix B, 1/2 the detection limit will be used to determine compliance and the future monitoring frequency.~~

2. ~~Monitoring and compliance requirements for beta particle and photon radioactivity. To determine compliance with the maximum contaminant levels in 12VAC5-500-400 B-5 for beta particle and photon radioactivity, a community waterworks owner shall monitor at a frequency as follows:~~

~~a. Community waterworks owners (using surface or groundwater) designated by the commissioner as vulnerable shall sample for beta particle and photon radioactivity. Community waterworks owners shall collect quarterly samples for beta emitters and annual samples for tritium and strontium-90 at each entry point to the distribution system, beginning within one quarter after being notified by the commissioner. Community waterworks already designated by the commissioner shall continue to sample until the commissioner reviews and either reaffirms or removes the designation.~~

~~(1) If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity at an entry point has a running annual average (computed quarterly) less than or equal to 50 pCi/L (screening level), the commissioner may reduce the frequency of monitoring at that entry point to once every three years. Community waterworks owners shall collect all samples required in subdivision 2 a of this subsection during the reduced monitoring period.~~

~~(2) For community waterworks in the vicinity of a nuclear facility, the commissioner may allow the community waterworks owners to utilize environmental surveillance data collected by the nuclear facility in lieu of monitoring at the community waterworks' entry point(s), where the commissioner determines if such data is applicable to a particular community waterworks. In the event that there is a release from a nuclear facility, community waterworks owners which are using surveillance data shall begin monitoring at the community waterworks' entry point(s) in accordance with subdivision 2 a of this subsection.~~

~~b. Community waterworks owners (using surface or groundwater) designated by the commissioner as utilizing waters contaminated by effluents from nuclear facilities shall sample for beta particle and photon radioactivity. Community waterworks owners shall collect quarterly samples for beta emitters and iodine-131 and annual samples for tritium and strontium-90 at each entry point to the distribution system, beginning within one quarter after being notified by the commissioner. Owners of community waterworks already designated by the commissioner as using waters contaminated by effluents from nuclear facilities shall continue to sample until the commissioner reviews and either reaffirms or removes the designation.~~

~~(1) Quarterly monitoring for gross beta particle activity shall be based on the analysis of monthly samples or the analysis of a composite of three monthly samples. The former is recommended.~~

~~(2) For iodine-131, a composite of five consecutive daily samples shall be analyzed once each quarter. As directed by the commission, more frequent monitoring shall be conducted when iodine-131 is identified in the finished water.~~

~~(3) Annual monitoring for strontium-90 and tritium shall be conducted by means of the analysis of a composite of four consecutive quarterly samples or analysis of four quarterly samples. The latter procedure is recommended.~~

~~(4) If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity at a sampling point has a running annual average (computed quarterly) less than or equal to 15 pCi/L (screening level), the commissioner may reduce the frequency of monitoring at that sampling point to every three years. Community waterworks owners shall collect all samples required in subdivision 2 b of this subsection during the reduced monitoring period.~~

~~(5) For community waterworks in the vicinity of a nuclear facility, the commissioner may allow the community waterworks owner to utilize environmental surveillance data collected by the nuclear facility in lieu of the monitoring at the community waterworks' entry point(s), where the commissioner determines such data is applicable to a particular waterworks. In the event that there is a release from a nuclear facility, community waterworks owners which are using surveillance data shall begin monitoring at the community waterworks' entry point(s) in accordance with subdivision 2 b of this subsection.~~

~~c. Owners of community waterworks designated by the commissioner to monitor for beta particle and photon radioactivity cannot apply to the commissioner for a waiver from the monitoring frequencies specified in subdivision 2 a or 2 b of this subsection.~~

~~d. Community waterworks owners may analyze for naturally occurring potassium-40 beta particle activity from the same or equivalent sample used for the gross beta particle activity analysis. Community waterworks owners are allowed to subtract the potassium-40 beta particle activity value from the total gross beta particle activity value to determine if the screening level is exceeded. The potassium-40 beta particle activity~~

shall be calculated by multiplying elemental potassium concentrations (in mg/L) by a factor of 0.82.

e. If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity exceeds the appropriate screening level, an analysis of the sample shall be performed to identify the major radioactive constituents present in the sample and the appropriate doses shall be calculated and summed to determine compliance with 12VAC5-590-400 B-5 a, using the formula in 12VAC590-400 B-5 b. Doses shall also be calculated and combined for measured levels of tritium and strontium to determine compliance.

f. Community waterworks owners shall monitor monthly at the entry point(s) which exceed the maximum contaminant level in 12VAC5-590-400 B-5 beginning the month after the exceedance occurs. Community waterworks owners shall continue monthly monitoring until the community waterworks has established, by a rolling average of three monthly samples, that the PMCL is being met. Community waterworks owners who establish that the PMCL is being met shall return to quarterly monitoring until they meet the requirements set forth in subdivision 2 a (1) or 2 b (4) of this subsection.

### 3. General monitoring and compliance requirements for radionuclides.

a. The commissioner may require more frequent monitoring than specified in subdivisions 1 and 2 of this subsection, or may require confirmation samples at his discretion. The results of the initial and confirmation samples shall be averaged for use in compliance determinations.

b. Each community waterworks owner shall monitor at the time designated by the commissioner during each compliance period.

c. Compliance: Compliance with 12VAC5-590-400 B-2 through B-5 will be determined based on the analytical results(s) obtained at each entry point. If one entry point is in violation of a PMCL, the community waterworks is in violation of the PMCL.

(1) For community waterworks monitoring more than once per year, compliance with the PMCL is determined by a running annual average at each entry point. If the average of any entry point is greater than the PMCL, then the community waterworks is out of compliance with the PMCL.

(2) For community waterworks monitoring more than once per year, if any sample result will cause the running average to exceed the PMCL at any entry point, the community waterworks is out of compliance with the PMCL immediately.

(3) Community waterworks owners shall include all samples taken and analyzed under the provisions of this section in determining compliance, even if that number is greater than the minimum required.

(4) If a community waterworks owner does not collect all required samples when compliance is based on a running annual average of quarterly samples, compliance will be based on the running average of the samples collected.

(5) If a sample result is less than the method detection limit as specified in Appendix B, zero will be used to calculate the annual average, unless a gross alpha particle activity is being used in lieu of radium-226 and/or uranium. If the gross alpha particle activity result is less than the method detection limit as specified in Appendix B, 1/2 the method detection limit will be used to calculate the annual average.

d. The commissioner has the discretion to delete results of obvious sampling or analytic errors.



e. If the PMCL for radioactivity set forth in 12VAC5-590-400 B 2 through B 5 is exceeded, the owner of a community waterworks shall give notice to the commissioner pursuant to 12VAC5-590-530 and to the public as required by 12VAC5-590-540.

#### **12VAC5-590-372. Inorganic chemicals monitoring.**

A. ~~The owner of a Community-community and-or a~~ nontransient noncommunity waterworks ~~owners~~ shall conduct monitoring to determine compliance with the PMCLs and SMCLs listed in Table 340.1 in accordance with this section. ~~All-The owner of a~~ transient noncommunity waterworks ~~owners~~ shall conduct monitoring to determine compliance with the nitrate, nitrite, and nitrate-nitrite PMCLs listed in Table 340.1 in accordance with this section.

B. If a waterworks draws water from more than one source and the sources are combined before distribution, then the owner shall sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

C. When the results of sampling for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium exceed the applicable PMCL, the owner shall ~~take-collect~~ a confirmation sample, at the same sampling site, within two weeks of notification of the analytical results of the first sample.

#### D. Monitoring frequency.

1. Asbestos. The commissioner has granted a statewide waiver for asbestos. If the statewide waiver is removed or if ~~site-specific site-specific~~ waterworks conditions warrant monitoring for asbestos, then monitoring to determine compliance with the PMCL for asbestos specified in Table 340.1 shall be conducted as follows:

a. The owner of ~~each-a~~ community ~~and-or~~ nontransient noncommunity waterworks shall monitor for asbestos during the first three-year compliance period of each nine-year compliance cycle.

b. If the statewide waiver is removed, and the owner believes the waterworks is not vulnerable to asbestos contamination from either its source water or due to corrosion of ~~its~~ asbestos-cement pipe, then the owner may apply to the commissioner for a monitoring waiver for asbestos. If the commissioner grants the monitoring waiver, then the owner is not required to monitor.

c. The commissioner may grant a waiver based on a consideration of the following factors:

(1) Potential asbestos contamination of the water source; ~~and, and~~

(2) The use of asbestos-cement pipe for finished water distribution and the corrosive nature of the water.

d. A waiver remains in effect until the completion of the compliance period (i.e., three years).

e. The owner of a waterworks vulnerable to asbestos contamination due solely to corrosion of ~~its~~ asbestos-cement pipe shall ~~take-collect~~ one sample at a tap served by ~~the~~ asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

f. The owner of a waterworks vulnerable to asbestos contamination due to ~~its~~ source water shall monitor at ~~the~~ entry points.

g. The owner of a waterworks vulnerable to asbestos contamination due both to its source water and corrosion of ~~its~~ asbestos-cement pipe shall ~~take-collect~~ one sample at a tap served by ~~the~~ asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

h. The owner of a waterworks that exceeds the PMCL as determined in 12VAC5-590-382 A shall monitor quarterly beginning in the next quarter after the exceedance occurred.

i. The ~~commissioner department~~ may decrease the quarterly monitoring requirement to the frequency specified in subdivision D 1 a of this section provided the ~~commissioner department~~ has determined that the waterworks is reliably and consistently below the PMCL. In no case shall the commissioner make this determination unless the owner of a groundwater ~~source waterworks system takes collects~~ a minimum of two quarterly samples or the owner of a waterworks that uses a surface water source, in whole or in part, ~~takes collects~~ a minimum of four quarterly samples.

2. Antimony, arsenic, barium, beryllium, cadmium, chromium, cyanide (as free cyanide), fluoride, mercury, nickel, selenium, and thallium. Monitoring to determine compliance with the PMCL for these contaminants specified in Table 340.1 shall be conducted as follows:

a. The owner shall ~~take collect~~ one sample at each groundwater source entry point during each compliance period.

b. The owner shall ~~take collect~~ one sample annually at each surface water source ~~(in whole or in part)~~ entry point, in whole or in part.

c. The owner may apply to the ~~commissioner department~~ for a waiver from the monitoring frequencies specified in subdivisions D 2 a and D 2 b of this section.

(1) A condition of the waiver shall require that the owner ~~take collect~~ a minimum of one sample while the waiver is effective. The waiver remains in effect for one compliance cycle (i.e., nine years).

(2) The ~~commissioner department~~ may grant a waiver provided the owner has monitored surface water source ~~entry points, (in whole or in part.) entry points~~ annually for at least three years and has conducted a minimum of three rounds of monitoring at groundwater source entry points. At least one sample shall have been ~~taken collected~~ since January 1, 1990. The owner shall demonstrate that all previous analytical results were less than the PMCL. ~~A Waterworks waterworks~~ that uses a new water source ~~are is~~ not eligible for a waiver until three rounds of monitoring from the new source have been completed.

(3) In determining the appropriate reduced monitoring frequency, the ~~commissioner department~~ shall consider:

(a) Reported concentrations from all previous monitoring;

(b) The degree of variation in reported concentrations; and

(c) Other factors that may affect contaminant concentrations such as changes in groundwater pumping rates, changes in the waterworks configuration, changes in the waterworks operating procedures, or changes in stream flows or characteristics.

(4) A decision by the ~~commissioner department~~ to grant a waiver shall be made in writing and shall set forth the basis for the determination. The request for a waiver may be initiated by the ~~commissioner department~~ or upon an application by the owner. The owner shall specify the basis for the request. The ~~commissioner department~~ shall evaluate and, where appropriate, revise the determination of the appropriate monitoring frequency when the owner submits new monitoring data or when other data relevant to the appropriate monitoring frequency become available.

(5) No arsenic waivers shall be granted by the ~~commissioner department~~.

d. ~~Owners of~~The owner of a -waterworks that exceed the PMCLs as calculated in 12VAC5-590-382 shall monitor quarterly beginning in the next quarter after the exceedance occurred. The ~~commissioner department~~ may decrease the quarterly monitoring requirement to the frequencies specified in subdivision D 2 a, D 2 b, or D 2 c of this section provided a determination has been made that the analytical results are reliably and consistently below the PMCL. In no case may the ~~commissioner department~~ make this determination unless the owner ~~takes-collects~~ a minimum of two quarterly samples from each groundwater source entry point and a minimum of four quarterly samples from each surface water source ~~entry point, (in whole or in part)~~ entry point.

3. Nitrate and combined nitrate-nitrite as nitrogen. Monitoring to determine compliance with the PMCL for nitrate and combined nitrate-nitrite as nitrogen specified in Table 340.1 shall be conducted as follows:

a. The owner shall ~~take-collect~~ one sample annually at each groundwater source entry point.

b. The owner shall ~~take-collect~~ one sample quarterly at each surface water source ~~entry point, (in whole or in part)~~ entry point.

c. For groundwater source entry points at community and nontransient noncommunity waterworks, the repeat monitoring frequency shall be quarterly for at least one year following any one sample in which the concentration is greater than 50% of the PMCL. After four consecutive quarters of monitoring, the ~~commissioner department~~ may allow the owner to reduce the sampling frequency to annually after determining the results are reliably and consistently less than the PMCL.

d. For surface water source ~~(in whole or in part)~~ entry points, ~~in whole or in part,~~ the ~~commissioner department~~ may allow the owner to reduce the sampling frequency to annually if all analytical results from four consecutive quarters are less than 50% of the PMCL. The waterworks shall return to quarterly monitoring if the concentration found in any one sample is greater than or equal to 50% of the PMCL.

e. After any round of quarterly sampling is completed as required by subdivisions D 3 c and D 3 d of this section, the owner ~~that-who~~ is monitoring annually shall ~~take-collect~~ subsequent samples during the quarter that previously resulted in the highest analytical result.

f. No monitoring waivers shall be issued for nitrate or combined nitrate-nitrite as nitrogen.

4. Nitrite. Monitoring to determine compliance with the PMCL for nitrite specified in Table 340.1 shall be conducted as follows:

a. All owners shall ~~take-collect~~ one sample at each entry point during the initial compliance period.

b. After the initial sample, the owner of ~~any-a~~ waterworks where an analytical result for nitrite is less than 50% of the PMCL shall monitor at the frequency specified by the ~~commissioner department~~.

c. The repeat monitoring frequency for ~~any-an~~ owner shall be quarterly for at least one year following any one sample in which the concentration is greater than 50% of the PMCL. The ~~commissioner department~~ may allow an owner to reduce the sampling frequency to annually after determining the analysis results are reliably and consistently less than the PMCL.

~~d. Owners of waterworks that are~~ An owner who is ~~monitoring~~ annually shall ~~take collect~~ each subsequent sample during the ~~quarter(e) quarter~~ that previously resulted in the highest analytical result.

e. No monitoring waivers shall be issued for nitrite.

5. Aluminum, chloride, copper, corrosivity, fluoride, foaming agents (surfactants), iron, manganese, silver, sulfate, and zinc. Monitoring to determine compliance with the SMCL for these contaminants specified in Table 340.1 shall be conducted as follows:

a. The owner shall ~~take collect~~ one sample at each groundwater source entry point during each compliance period.

b. The owner shall ~~take collect~~ one sample annually at each surface water source entry point, ~~(in whole or in part) entry point.~~

#### **12VAC5-590-373. Organic chemicals monitoring.**

A. ~~Owners-The owner~~ of a community ~~and-or~~ nontransient noncommunity waterworks shall conduct monitoring to determine compliance with PMCLs listed in Table 340.2 in accordance with this section. Where two or more sources are combined before distribution, the owner shall sample at the entry point for the combined sources during periods of normal operation conditions.

1. ~~Owners-The owner~~ of a waterworks that uses groundwater shall collect a minimum of one sample at each entry point.

2. ~~The owner Owners~~ of a waterworks that uses surface water, in whole or in part, shall collect a minimum of one sample at each entry point.

B. During the initial compliance period and each subsequent compliance period, the owner shall monitor during four consecutive calendar quarters for each contaminant listed in Table 340.2. A minimum of one sample at each entry point shall be collected during each calendar quarter.

C. Reduced monitoring.

1. VOCs.

a. The requirement for four quarterly samples during the initial monitoring period as specified in subsection B of this section may not be reduced.

b. The ~~commissioner-department~~ may decrease the requirement for quarterly monitoring during subsequent compliance periods provided it has been determined that the analytical results are ~~reliably and~~ consistently ~~and-reliably~~ below the PMCL.

(1) In no case shall the ~~commissioner-department~~ make this determination unless the owner collects a minimum of two quarterly samples at each groundwater source entry point, or

(2) The owner collects a minimum of four quarterly samples at each surface water source ~~entry point, (in whole or in part.) entry point.~~

c. If the ~~commissioner-department~~ determines that the waterworks is ~~reliably and~~ consistently ~~and-reliably~~ below the PMCL, then the ~~commissioner-department~~ may allow the owner to monitor annually. ~~An owner who Owners that~~ monitors annually shall monitor during the quarter that previously yielded the highest analytical result.

d. For a groundwater ~~source waterworks system~~ only. -- After a minimum of three years of annual sampling, the ~~commissioner-department~~ may allow the owner of a ~~groundwater source waterworks~~ with no previous detection of any VOCs ~~contaminant~~ listed in Table 340.2 to ~~take collect~~ one sample during each compliance period.

e. ~~The owner Owners~~ of a groundwater ~~source waterworks~~ system that ~~have~~-has three consecutive annual samples with no detection of a contaminant may apply to the ~~commissioner department~~ for a waiver.

## 2. SOCs.

a. ~~The owner Owners~~ of a waterworks serving more than 3,300 persons that do not detect any SOCs listed in Table 340.2 in the initial compliance period may reduce the sampling frequency to a minimum of two quarterly samples in one year during each repeat compliance period.

b. ~~Owners-The owner~~ of a waterworks serving less than or equal to 3,300 persons that ~~does~~ not detect any SOCs listed in Table 340.2 in the initial compliance period may reduce the sampling frequency to a minimum of one sample during each repeat compliance period.

c. The ~~commissioner department~~ may decrease the requirement for quarterly monitoring during subsequent monitoring periods as specified in subsection B of this section provided the analytical results of the four quarterly samples required during the initial monitoring are ~~reliably and~~ consistently ~~and reliably~~ below the PMCL.

d. The ~~commissioner department~~ may reduce the increased monitoring required by subdivision D 1 of this section provided the ~~commissioner department~~ has determined that the analytical results are ~~reliably and~~ consistently ~~and reliably~~ below the PMCL. In no case shall the ~~commissioner department~~ make this latter determination unless:

(1) The owner collects a minimum of two quarterly samples at each groundwater source entry point.

(2) The owner collects a minimum of four quarterly samples at each surface water source ~~entry point, (in whole or in part) entry point.~~

e. If the ~~commissioner department~~ determines that the analytical results are ~~reliably and~~ consistently ~~and reliably~~ below the PMCL, the ~~commissioner department~~ may allow the owner to monitor annually. ~~An owner who Owners that~~ monitors annually shall monitor during the quarter that previously yielded the highest analytical result.

f. ~~The owner Owners~~ of a waterworks that ~~has~~ve three consecutive annual samples with no detection of a contaminant may apply to the ~~commissioner department~~ for a waiver for SOC monitoring by submitting a waiver application as specified in subdivisions E 1 b and E 2 b of this section. The waiver remains in effect for one compliance period (i.e., three years).

3. Return to ~~Compliance~~—compliance. ~~An owner Owners~~ of a waterworks that exceeds the PMCLs listed in Table 340.2 for VOCs or SOCs, as determined by 12VAC5-590-383, shall monitor quarterly. After a minimum of four consecutive quarterly samples that show the waterworks is in compliance as specified in 12VAC5-590-383 and the ~~commissioner department~~ determines that the analytical results are ~~reliably and~~ consistently ~~and reliably~~ below the PMCL, the owner may monitor at the frequency and time specified in subdivisions C 1 c and C 2 e of this section.

## D. Increased ~~Monitoring~~ monitoring.

1. If ~~the owner of~~ a waterworks that is on reduced monitoring detects a contaminant listed in Table 340.2 (see 12VAC5-590-383 A regarding confirmation samples), then the owner shall monitor quarterly at each sampling point where the contaminant was detected unless:

a. That contaminant was previously detected and the ~~commissioner department~~ determined it was ~~reliably and~~ consistently ~~and reliably~~ below the PMCL according to subdivisions C 1 b and C 2 d of this section;

b. Historical sampling data ~~does~~ not indicate a meaningful increase in the contaminant concentration; ~~and, and~~

c. The contaminant concentration does not exceed the PMCL.

2. Vinyl ~~Chloride~~chloride.

a. ~~An owner~~ Owners of a groundwater ~~source waterworkssystem~~ that has~~ve~~ detected one or more of the following two-carbon organic compounds: trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, 1,1,1-trichloroethane, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, or 1,1-dichloroethylene shall monitor quarterly for vinyl chloride. A vinyl chloride sample shall be collected at each sampling point at which one or more of the two-carbon organic compounds were detected. If the results of the first analysis do not detect vinyl chloride, then the ~~commissioner department~~ may reduce the quarterly monitoring frequency of vinyl chloride monitoring to one sample during each compliance period.

b. ~~An owner who is~~ Owners are required to monitor for vinyl chloride as specified by the ~~commissioner department~~ at each surface water source ~~entry point~~, (in whole or in part) ~~entry point~~.

3. If monitoring detects one or more of certain related contaminants (heptachlor and heptachlor epoxide), then subsequent monitoring shall analyze for all related contaminants.

4. For entry points sampled and analyzed for contaminants ~~listed on~~ in Table 340.2, the following detection limits apply:

a. A VOC is detected at a level equal to or greater than 0.0005 mg/L; and

b. A SOC is detected at a level equal to or greater than defined by EPA under 40 CFR 141.24 (h) (18) or by the ~~commissioner department~~.

E. Monitoring waivers.

1. Groundwater source entry points.

a. The owner of a waterworks that does not detect a VOC contaminant listed in Table 340.2 may apply to the ~~commissioner department~~ for a waiver from the subsequent compliance period requirements of subsection B, and subdivisions C 1 c, and C 1 d of this section after completing the initial monitoring. A waiver shall be effective for no more two compliance periods (i.e., six years).

b. The owner of a waterworks may apply to the ~~commissioner department~~ for a SOC monitoring waiver from the requirement of subsection B and subdivision C 2 of this section. The owner must reapply for a waiver for each subsequent compliance period (i.e. i.e., three years).

2. Surface water source ~~entry points~~, (in whole or in part) ~~entry points~~.

a. No VOC monitoring waivers shall be issued.

b. The owner of a waterworks that does not detect a SOC contaminant listed in Table 340.2 may apply to the ~~commissioner department~~ for a SOC monitoring waiver from the requirement of subsection B and subdivision C 2 of this section. The owner must reapply for a waiver for each subsequent compliance period (i.e., three years).

3. Monitoring waiver applications. The owner shall submit a monitoring waiver application for evaluation on a form approved by the department. The ~~commissioner department~~ may grant a waiver after an evaluation of the use, transport, storage, or disposal of any organic contaminant within the watershed or zone of influence of the source.

a. If an evaluation by the ~~commissioner department~~ reveals no previous use of the contaminants within the watershed or zone of influence, then a waiver may be granted.

b. If an evaluation by the ~~commissioner-department~~ reveals either previous use of the contaminants or that use is unknown, then the following factors shall be used to determine whether a waiver is granted:

(1) Previous analytical results.

(2) The proximity of the water source to land use activities that are potential point or ~~non-point~~ nonpoint sources of organic contamination and to potential conduits to groundwater. Point sources include spills and leaks of chemicals at or near a waterworks or at manufacturing, distribution, or storage facilities, or from hazardous or municipal waste landfills and other waste handling or treatment facilities. Nonpoint sources for SOCs include the use of pesticides to control insects and weed pests on agricultural areas, forest lands, home and ~~gardens-gardens~~, and other land application uses.

(3) The environmental persistence and transport of the contaminants listed in Table 340.2 ~~VOC and SOC~~.

(4) The implementation of wellhead protection measures by the owner.

(5) For groundwater well sources: well construction, well depth, soil type, geological conditions, and well structure integrity.

(6) Special factors.

(a) For VOCs. The number of persons served by the waterworks and the proximity of a smaller waterworks to a larger waterworks.

(b) For SOCs. Elevated nitrate levels at the waterworks' ~~supply-source~~ water.

(c) For SOCs. Use of PCBs in equipment used in the production, storage, or distribution of water (i.e., PCBs used in pumps, transformers, etc.).

c. ~~An Entry points~~entry point at which treatment has been installed to remove a-VOCs or SOCs ~~are-is~~ not eligible for a monitoring waiver for the VOCs or SOCs for which treatment has been installed.

d. All waterworks are granted a waiver from monitoring dioxin, endoathal, and glyphosate unless the ~~commissioner-department~~ determines that there is a source of these contaminants which poses a threat to ~~a drinking water-the~~ source water.

#### 4. Condition for waivers.

a. Groundwater source entry points.

(1) As a condition of the VOC waiver, the owner shall collect one sample at each entry point during the time the waiver is effective (i.e., one sample during two compliance periods or six years). Based on this data, the ~~commissioner-department~~ may reconfirm that the source is ~~non-susceptible~~ nonsusceptible. If the ~~commissioner-department~~ does not make this reconfirmation within three years of the initial determination, then the waiver is invalidated and the owner is required to sample annually.

(2) There are no conditions to SOC waivers.

b. Surface water source ~~entry points, (in whole or in part.)~~entry points. There are no conditions to VOC and SOC waivers for waterworks in regard to these entry points.

#### **12VAC5-590-374. ~~Disinfectant residuals~~Residual disinfectant, disinfection byproducts, and disinfection byproduct precursors monitoring.**

A. Unless otherwise noted, ~~an owners~~ of ~~all-a~~ waterworks that uses a chemical disinfectant shall comply with the requirements of this section as follows:

1. ~~The owner Owners~~ of a community or a nontransient noncommunity waterworks shall comply with this section.

2. ~~The owner of a Owners-of~~ transient noncommunity waterworks that uses any combination of a surface water source, a GUDI source, or a groundwater source and uses chlorine dioxide as a disinfectant or oxidant shall comply with all the requirements for chlorine dioxide in this section.

B. ~~The owner Owners~~ shall collect all samples during normal operating conditions.

1. Analysis under this section for disinfection byproducts (TTHM, HAA5, chlorite, and bromate) shall be conducted by a laboratory that has received certification by the DCLS except as noted in subdivisions B 2 and B 3 of this section.

2. Measurement under this section of daily chlorite samples at the entry point to the distribution system, disinfectant residuals (free chlorine, combined chlorine, total chlorine, and chlorine dioxide), alkalinity, TOC, SUVA (DOC and UV<sub>254</sub>), pH, and magnesium shall be made by a party approved by the commissioner department.

3. Residual disinfectant concentrations for free chlorine, combined chlorine, total chlorine, and chlorine dioxide shall be made using equipment deemed satisfactory by the commissioner department.

C. Monitoring plan. The owner of each waterworks required to monitor under this section shall develop and implement a monitoring plan. The owner shall maintain the plan and make it available for inspection by the commissioner department and the general public. The owners of all a community or a nontransient noncommunity waterworks that uses either a surface water source or a GUDI source source or both and serving more than 3,300 people shall submit a copy of the monitoring plan to the commissioner department no later than the date of the first report required under 12VAC5-590-531 A. The commissioner department may also require the plan to be submitted by any other owner. After evaluation, the commissioner department may require changes in any of the plan elements. The plan shall include at least the following:

1. Specific locations and schedules with monitoring dates for collecting samples for any parameters included in this section.

2. How the owner will calculate compliance with PMCLs, MRDLs, and treatment techniques.

3. The sampling plan for a consecutive waterworks shall reflect the entire consecutive distribution system.

D. Failure to monitor in accordance with the monitoring plan required under subsection C of this section is a monitoring violation. Failure to monitor shall be treated as a violation for the entire period covered by the annual average where compliance is based on a running annual average RAA of monthly or quarterly samples or averages, and the owner's failure to monitor makes it impossible to determine compliance with PMCLs or MRDLs.

E. ~~Owners-The owner~~ may use only data collected under the provisions of this section to qualify for reduced monitoring.

F. TTHM and HAA5 monitoring. ~~The owner of a Owners-of~~ community or a nontransient noncommunity waterworks shall conduct the locational running annual average (LRAA) monitoring for TTHM and HAA5 at the frequency given below, unless otherwise indicated.

1. This subdivision establishes monitoring and other requirements for achieving compliance with PMCLs based on the LRAA for TTHM and HAA5, and for achieving compliance with MRDLs for chlorine and chloramines for certain consecutive waterworks.

2. This subdivision applies to a community waterworks or a nontransient noncommunity waterworks that uses a primary or secondary disinfectant other than ultraviolet light or



delivers water that has been treated with a primary or secondary disinfectant other than ultraviolet light.

3. Routine monitoring.

a. If the waterworks is a nontransient noncommunity waterworks serving less than 10,000 people, then the owner shall monitor at the location or locations and dates identified in the monitoring plan in subsection C of this section, updated as required by subdivision F 3 e of this section.

b. The owner Owners shall monitor at no fewer than the number of locations identified in Table 374.1:

TABLE 374.1.  
Monitoring Frequency by Source Water Type for TTHM and HAA5.

SOURCE WATER TYPE	POPULATION SIZE CATEGORY	MONITORING FREQUENCY <sup>a</sup>	DISTRIBUTION SYSTEM MONITORING LOCATION TOTAL PER MONITORING PERIOD <sup>b</sup>
Surface water or GUDI Source	Less than 500	per year	2
	500-3,300	per quarter	2
	3,301-9,999	per quarter	2
	10,000-49,999	per quarter	4
	50,000-249,999	per quarter	8
	250,000-999,999	per quarter	12
	1,000,000-4,999,999	per quarter	16
	Equal to or greater than 5,000,000	per quarter	20
Groundwater	Less than 500	per year	2
	500-9,999	per year	2
	10,000-99,999	per quarter	4
	100,000-499,999	per quarter	6
	Equal to or greater than 500,000	per quarter	8

<sup>a</sup> All owners shall monitor during the month of highest DBP concentrations.

<sup>b</sup> ~~Owners-An owner of a waterworks on quarterly monitoring (except those using for either a surface water source or a GUDI source or both and waterworks serving 500-3,300 people) shall collect dual sample sets every 90 days at each monitoring location. A Groundwater groundwater source waterworkssystem serving 500-9,999 people (on annual monitoring) shall collect dual sample sets annually at each monitoring location. A Waterworks-waterworks~~

servicing fewer than 500 people and a waterworks using either a surface water source or a GUDI source or both and waterworks serving 500-3,300 people shall collect individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations, respectively. A Waterworks-waterworks serving fewer than 500 people shall sample annually, and a waterworks using either a surface water source or a GUDI source or both and waterworks serving 500-3,300 people shall sample every 90 days. For a waterworks serving fewer than 500 people, only one location with a dual sample set per monitoring period is needed if the highest TTHM and HAA5 concentrations occur at the same location (and month, if monitoring annually).

c. ~~The owner of a Owners of~~ waterworks not using disinfection ~~that and then~~ begin using a disinfectant other than UV light shall consult with the ~~commissioner department~~ to identify compliance monitoring locations. ~~The owner Owners~~ shall then develop a monitoring plan under subdivision F 3 e of this section ~~that to~~ includes those monitoring locations.

d. ~~The owner Owners~~ shall use an approved method listed in 12VAC5-590-440 for TTHM and HAA5 analyses. Analyses shall be conducted by laboratories that have received certification by EPA or DCLS as specified in 12VAC5-590-440.

e. ~~The owner Owners~~ may revise the monitoring plan to reflect changes in treatment, distribution system operations and layout (including new service areas), or other factors that may affect TTHM or HAA5 formation, or for reasons approved by the ~~commissioner department~~, after consultation with the ~~commissioner department~~ regarding the need for changes and the appropriateness of the changes. If the owner changes monitoring locations, ~~then~~ the owner shall replace existing compliance monitoring locations with the lowest LRAA with new locations that reflect the current distribution system locations with expected high TTHM or HAA5 levels. The ~~commissioner department~~ may also require modifications in the monitoring plan. ~~The owner Owners of a~~ waterworks using either a surface water source or a GUDI ~~sources source or both~~ and serving more than 3,300 people shall submit a copy of the modified monitoring plan to the ~~commissioner department prior to~~ before the date the owner is required to comply with the revised monitoring plan.

4. Reduced monitoring.

a. ~~The owner Owners~~ may reduce monitoring to the level specified in Table 374.2 any time the LRAA is less than or equal to 0.040 mg/L for TTHM and less than or equal to 0.030 mg/L for HAA5 at all monitoring locations. ~~An owner Owners~~ may only use data collected under the provisions of this section to qualify for reduced monitoring. In addition, the source water annual average TOC level, before any treatment, shall be less than or equal to 4.0 mg/L at each water treatment plant treating either a surface water source or a GUDI ~~sources source or both~~, based on monitoring conducted under subsection J of this section.

TABLE 374.2.  
Reduced Monitoring for TTHM and HAA5.

SOURCE WATER TYPE	POPULATION SIZE CATEGORY	MONITORING FREQUENCY <sup>a</sup>	DISTRIBUTION SYSTEM MONITORING LOCATION PER MONITORING PERIOD
	Less than 500		Monitoring may not be reduced.

TABLE 374.2.  
Reduced Monitoring for TTHM and HAA5.

<u>SOURCE WATER TYPE</u>	<u>POPULATION SIZE CATEGORY</u>	<u>MONITORING FREQUENCY<sup>a</sup></u>	<u>DISTRIBUTION SYSTEM MONITORING LOCATION PER MONITORING PERIOD</u>
<u>Surface water or GUDI Source</u>	<u>500-3,300</u>	<u>per year</u>	<u>One TTHM and one HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement; one dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.</u>
	<u>3,301-9,999</u>	<u>per year</u>	<u>Two dual sample sets: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement.</u>
	<u>10,000-49,999</u>	<u>per quarter</u>	<u>Two dual sample sets: at the locations with the highest TTHM and highest HAA5 LRAAs.</u>
	<u>50,000-249,999</u>	<u>per quarter</u>	<u>Four dual sample sets: at the locations with the two highest TTHM and two highest HAA5 LRAAs.</u>
	<u>250,000-999,999</u>	<u>per quarter</u>	<u>Six dual sample sets: at the locations with the three highest TTHM and three highest HAA5 LRAAs.</u>
	<u>1,000,000-4,999,999</u>	<u>per quarter</u>	<u>Eight dual sample sets: at the locations with the four highest TTHM and four highest HAA5 LRAAs.</u>
	<u>Equal to or greater than 5,000,000</u>	<u>per quarter</u>	<u>Ten dual sample sets: at the locations with the five highest TTHM and five highest HAA5 LRAAs.</u>
<u>Groundwater</u>	<u>Less than 500</u>	<u>every third year</u>	<u>One TTHM and one HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the</u>

**TABLE 374.2.**  
Reduced Monitoring for TTHM and HAA5.

<u>SOURCE WATER TYPE</u>	<u>POPULATION SIZE CATEGORY</u>	<u>MONITORING FREQUENCY<sup>a</sup></u>	<u>DISTRIBUTION SYSTEM MONITORING LOCATION PER MONITORING PERIOD</u>
			<u>location and during the quarter with the highest HAA5 single measurement; one dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.</u>
	<u>500-9,999</u>	<u>per year</u>	<u>One TTHM and one HAA5 sample: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement; one dual sample set per year if the highest TTHM and HAA5 measurements occurred at the same location and quarter.</u>
	<u>10,000-99,999</u>	<u>per year</u>	<u>Two dual sample sets: one at the location and during the quarter with the highest TTHM single measurement, one at the location and during the quarter with the highest HAA5 single measurement.</u>
	<u>100,000-499,999</u>	<u>per quarter</u>	<u>Two dual sample sets: at the locations with the highest TTHM and highest HAA5 LRAAs.</u>
	<u>Equal to or greater than 500,000</u>	<u>per quarter</u>	<u>Four dual sample sets: at the locations with the two highest TTHM and two highest HAA5 LRAAs.</u>

<sup>a</sup> Owners-An owner of a waterworks on quarterly monitoring shall collect dual sample sets every 90 days.

b. The owner Owners may remain on reduced monitoring as long as the TTHM LRAA is less than or equal to 0.040 mg/L and the HAA5 LRAA is less than or equal to 0.030 mg/L at each monitoring location (for waterworks with quarterly reduced monitoring). In addition, the source water annual average TOC level, before any treatment, shall be less than or equal to 4.0 mg/L at each water treatment plant treating either a surface water source or a GUDI source source or both, based on monitoring conducted under subsection J of this section.

c. If the LRAA based on quarterly monitoring at any monitoring location exceeds either 0.040 mg/L for TTHM or 0.030 mg/L for HAA5 or if the annual (or less frequent) sample at any location exceeds either 0.060 mg/L for TTHM or 0.045 mg/L for HAA5, or if the source water annual average TOC level, before any treatment, is greater than 4.0 mg/L at any water treatment plant treating either a surface water source or a GUDI source source or both, then the owner shall resume routine monitoring under subdivision F 3 of this section or begin increased monitoring if subdivision F 5 of this section applies.

d. ~~A Waterworks-waterworks~~ may return to routine monitoring at the ~~commissioner's department's~~ discretion.

5. Increased monitoring.

a. ~~The owner of a Owners-of~~ waterworks required to monitor at a particular location annually or less frequently than annually, under subdivision F 3 or F 4 of this section, shall increase monitoring to dual sample sets once per quarter (collected every 90 days) at all locations if a TTHM sample is greater than 0.080 mg/L or a HAA5 sample is greater than 0.060 mg/L at any location.

b. ~~The owner Owners~~ may return to routine monitoring once the waterworks has conducted increased monitoring for at least four consecutive quarters and the LRAA for every monitoring location is less than or equal to 0.060 mg/L for TTHM and less than or equal to 0.045 mg/L for HAA5.

G. Chlorite. ~~Owners-The owner of a community and-or a~~ nontransient noncommunity waterworks using chlorine dioxide, for disinfection or oxidation, shall conduct monitoring for chlorite.

1. Routine monitoring.

a. ~~Owners-The owner~~ shall collect daily samples at the entry point to the distribution system. For any daily sample that exceeds the chlorite PMCL listed in Table 340.6, the owner shall collect additional samples in the distribution system the following day at the locations required by subdivision G 1 c of this section, in addition to the sample required at the entrance to the distribution system.

b. ~~Owners-The owner~~ shall collect a three-sample set each month in the distribution system. The owner shall collect one sample at each of the following locations: near the first customer, at a location representative of average residence time, and at a location reflecting maximum residence time in the distribution system. Any additional routine sampling shall be conducted in the same manner (as three-sample sets, at the specified locations). The owner may use the results of additional monitoring conducted under subdivision G 1 c of this section to meet the requirement for monitoring in this paragraph.

c. On each day following a routine sample monitoring result that exceeds the chlorite PMCL listed in Table 340.6 at the entrance to the distribution system, the owner is required to collect three chlorite distribution system samples at the following locations: as close to the first customer as possible, in a location representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

2. Reduced monitoring.

a. Chlorite monitoring at the entrance to the distribution system required by subdivision G 1 a of this subsection may not be reduced.

b. Chlorite monitoring in the distribution system required by subdivision G 1 b of this section may be reduced to one three-sample set per quarter after one year of

monitoring where no individual chlorite sample collected in the distribution system under subdivision G 1 b of this section has exceeded the chlorite PMCL listed in Table 340.6 and the owner has not been required to conduct monitoring under subdivision G 1 c of this section. The owner may remain on the reduced monitoring schedule until either any of the three individual chlorite samples collected quarterly in the distribution system under subdivision G 1 b of this section exceeds the chlorite PMCL or the owner is required to conduct monitoring under subdivision G 1 c of this section, at which time the owner shall revert to routine monitoring.

#### H. Bromate.

1. The owner of a community or a nontransient noncommunity water treatment plant using ozone, for disinfection or oxidation, shall collect one sample per month and analyze it for bromate. The owner shall collect samples monthly at the entrance to the distribution system while the ozonation system is operating under normal conditions.

2. ~~The owner Owners~~ required to analyze for bromate may reduce monitoring from monthly to quarterly if the waterworks ~~running annual average~~RAA bromate concentration is less than or equal to 0.0025 mg/L based on monthly bromate measurements under subdivision H 1 of this section for the most recent four quarters. If a waterworks has qualified for reduced bromate monitoring under this subdivision, ~~then~~ the owner may remain on reduced monitoring as long as the ~~running annual average~~RAA of quarterly bromate samples is equal to or less than 0.0025 mg/L. If the ~~running annual average~~RAA bromate concentration is greater than 0.0025 mg/L, ~~then~~ the owner shall resume routine monitoring required by subdivision H 1 of this section.

#### I. Monitoring requirements for disinfectant residuals.

##### 1. Chlorine and chloramines.

a. ~~The owner Owners~~ of a waterworks that uses chlorine or chloramines shall measure the residual disinfectant level in the distribution system at the same point in the distribution system and at the same time as total coliform bacteria are sampled, as specified in 12VAC5-590-370 A and 12VAC5-590-380 D. ~~The owner Owners~~ of a waterworks ~~that use using either a surface water source or a GUDI sources- source or both~~ may use the results of the residual disinfectant concentration sampling found in 12VAC5-590-376 D ~~in lieu- instead~~ of collecting separate samples.

b. Residual disinfectant level monitoring may not be reduced.

##### 2. Chlorine dioxide.

a. ~~The owner Owners~~ of a waterworks that uses chlorine dioxide for disinfection or oxidation shall collect daily samples at the entrance to the distribution system. For any daily sample that exceeds the MRDL listed in Table 340.7, the owner shall collect samples in the distribution system the following day at the locations required by subdivision I 2 b of this section, in addition to the sample required at the entrance to the distribution system.

b. On each day following a routine sample monitoring result that exceeds the MRDL listed in Table 340.7, the owner is required to collect three chlorine dioxide distribution system samples. If chlorine dioxide or chloramines are used to maintain a disinfectant residual in the distribution system, or if chlorine is used to maintain a disinfectant residual in the distribution system and there is no rechlorination after the entry point, ~~then~~ the owner shall collect three samples as close to the first customer as possible, at intervals of at least six hours. If chlorine is used to maintain a disinfectant residual in the distribution system and there are one or more rechlorination points after the entry point, ~~then~~ the owner shall collect one sample at each of the following locations:

as close to the first customer as possible, in a location representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

c. Chlorine dioxide monitoring may not be reduced.

3. Ozone. Ozone residual levels shall be monitored continuously and recorded. A portable ozone meter is recommended as a backup.

4. Additional monitoring and reporting requirements are specified in 12VAC5-590-500 to demonstrate log inactivation or removal of Giardia lamblia, virus, and Cryptosporidium.

J. Monitoring requirements for disinfection byproduct precursors (DBPPs).

1. ~~Owners-The owner~~ of a community or a nontransient noncommunity waterworks using either a surface water source or a GUDI ~~sources- source or both~~ and using conventional filtration treatment, as defined in 12VAC5-590-10, shall monitor each water treatment plant for TOC no later than the point of combined filter effluent turbidity monitoring and representative of the treated water. ~~All-The owners-owner~~ shall also monitor for TOC in the source water ~~prior to before~~ any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as paired samples. At the same time as the source water sample is collected, ~~all-owners the owner~~ shall monitor for alkalinity in the source water ~~prior to before~~ any treatment. ~~The Owners owner~~ shall collect one paired sample and one source water alkalinity sample per month per water treatment plant at a time representative of normal operating conditions and influent water quality.

2. ~~Owners-The owner~~ of a community or a nontransient noncommunity waterworks that uses either a surface water source or a GUDI ~~sources- source or both~~ with an average treated water TOC of less than 2.0 mg/L for two consecutive years, or less than 1.0 mg/L for one year, may reduce monitoring for both TOC and alkalinity to one paired sample and one source water alkalinity sample per water treatment plant per quarter. The ~~owners owner~~ shall revert to routine monitoring in the month following the quarter when the annual average treated water TOC is equal to or greater than 2.0 mg/L.

#### **12VAC5-590-375. Lead and copper monitoring.**

A. The ~~owners-owner~~ of ~~all-a~~ community ~~and-or~~ a nontransient noncommunity waterworks shall monitor for lead and copper in tap water (subsection B of this section), water quality (corrosion) parameters in the distribution system and at entry points (subsection C of this section), and lead and copper in water supplies (subsection D of this section).

B. Monitoring requirements for lead and copper in tap water.

1. Sample site location.

a. By the ~~commissioner-determined~~ date determined by the department for commencement of monitoring under subdivision B 4 a of this section, ~~each-the~~ owner shall complete a materials evaluation of the distribution system ~~in-order~~ to identify a pool of targeted sampling sites that meets the requirements of this subdivision, and that is sufficiently large to ensure that the owner can collect the number of lead and copper tap samples required in subdivision B 3 of this section. All sites from which ~~first draw~~first-draw samples are collected shall be selected from this pool of targeted sampling sites. Sampling sites may not include faucets that have point-of-use or point-of-entry treatment devices designed to remove inorganic contaminants.

b. When the distribution system evaluation required in subdivision B 1 a of this section is insufficient to locate the requisite number of lead and copper sampling sites that meet the targeting criteria of this section, the owner shall review the sources of

information listed below ~~in order~~ to identify a sufficient number of sampling sites. In addition, the owner shall seek to collect such information where possible in the course of its normal operations (e.g., checking service line materials when reading water meters or performing maintenance activities):

(1) All plumbing codes, permits, and records in the files of the building department or departments that indicate the plumbing materials that are installed within publicly and privately owned structures connected to the distribution system;

(2) All inspections and records of the distribution system that indicate the material composition of the service connections that connect a structure to the distribution system; and

(3) All existing water quality information, which includes the results of all prior analyses of the waterworks or individual structures connected to the waterworks, indicating locations that may be particularly susceptible to high lead or copper concentrations.

c. The sampling sites selected for a community waterworks' sampling pool (tier 1 sampling sites) shall consist of single family structures that:

(1) Contain copper pipes with lead solder installed between January 1983 and April 1986 or contain lead pipes; or

(2) Are served by a lead service line.

NOTE: When multiple-family residences comprise at least 20% of the structures served by a waterworks, the owner may include these types of structures in the sampling pool.

d. The owner of ~~any a~~ community waterworks with insufficient tier 1 sampling sites shall complete the sampling pool with tier 2 sampling sites consisting of buildings, including multiple-family residences that:

(1) Contain copper pipes with lead solder installed between January 1983 and April 1986 or contain lead pipes; or

(2) Are served by a lead service line.

e. The owner of ~~any a~~ community waterworks with insufficient tier 1 and tier 2 sampling sites shall complete the sampling pool with tier 3 sampling sites, consisting of single family structures that contain copper pipes with lead solder installed before 1983. The owner of a community waterworks with insufficient tier 1, tier 2, and tier 3 sampling sites shall complete the sampling pool with representative sites throughout the distribution system. For the purpose of this subdivision, a representative site is a site in which the plumbing materials used at that site would be commonly found at other sites served by the waterworks.

f. The sampling sites selected for a nontransient noncommunity waterworks (tier 1 sampling sites) shall consist of buildings that:

(1) Contain copper pipes with lead solder installed between January 1983 and April 1986 or contain lead pipes; or

(2) Are served by a lead service line.

g. The owner of a nontransient noncommunity waterworks with insufficient tier 1 sites that meet the targeting criteria in subdivision B 1 f of this section shall complete the sampling pool with sampling sites that contain copper pipes with lead solder installed before 1983. If additional sites are needed to complete the sampling pool, the owner of a nontransient noncommunity waterworks shall use representative sites throughout the distribution system. For the purpose of this subdivision, a representative site is a



site in which the plumbing materials used at that site would be commonly found at other sites served by the waterworks.

h. The owner of ~~any-a~~ waterworks whose distribution system contains lead service lines shall draw 50% of the samples the owner collects during each monitoring period from sites that contain lead pipes, or copper pipes with lead solder, and 50% of the samples the owner collects from sites served by a lead service line. Any owner who cannot identify a sufficient number of sampling sites served by a lead service line shall collect ~~first draw~~first-draw tap samples from all of the sites identified as being served by ~~such these~~ lines.

## 2. Sample collection methods.

a. All tap samples for lead and copper, with the exception of lead service line samples collected under 12VAC5-590-405 C 4 and samples collected under subdivision B 2 e of this section, shall be ~~first draw~~first-draw samples.

b. Each first-draw tap sample for lead and copper shall be one liter in volume and have stood motionless in the plumbing system of each sampling site for at least six hours, ~~and is collected without flushing the tap.~~ ~~First draw~~First-draw samples from residential housing shall be collected from the cold-water kitchen tap or ~~from a~~ bathroom sink tap. First-draw samples from a nonresidential building shall be one liter in volume and shall be collected at an interior tap from which water is typically drawn for consumption. Non-first-draw samples collected ~~in lieu instead~~ of first-draw samples pursuant to subdivision B 2 e of this section shall be one liter in volume and shall be collected at an interior tap from which water is typically drawn for consumption. ~~First draw~~First-draw samples may be collected by the owner or the owner may allow residents to collect ~~first draw~~first-draw samples after instructing the residents of the sampling procedures specified in this subdivision. To avoid problems of residents handling nitric acid, acidification of ~~first draw~~first-draw samples may be done up to 14 days after the sample is collected. After acidification to resolubilize the metals, the sample must stand in the original container for the time specified in the approved EPA method before the sample can be analyzed. If an owner allows residents to perform sampling, ~~then~~ the owner may not challenge, based on alleged errors in sample collection, the accuracy of sampling results.

c. Each lead service line sample collected pursuant to 12VAC5-590-405 C 4 for the purpose of avoiding replacement shall be one liter in volume and have stood motionless in the lead service line for at least six hours. Lead service line samples shall be collected in one of the following three ways:

(1) At the tap after flushing the volume of water between the tap and the lead service line. The volume of water shall be calculated based on the interior diameter and length of the pipe between the tap and the lead service line;

(2) Tapping directly into the lead service line; or

(3) If the sampling site is a building constructed as a ~~single-family~~ single family residence, ~~then~~ allowing the water to run until there is a significant change in temperature that would be indicative of water that has been standing in the lead service line.

d. ~~An~~The owner shall collect each ~~first draw~~first-draw tap sample from the same sampling site from which the owner collected a previous sample. If, for any reason, the owner cannot gain entry to a sampling site ~~in order~~ to collect a follow-up tap sample, ~~then~~ the owner may collect the follow-up tap sample from another sampling site in the sampling pool as long as the new site meets the same targeting criteria and is within reasonable proximity of the original site.

e. The owner of a nontransient noncommunity waterworks, or a community waterworks that meets the criteria of 12VAC5-590-405 D 2 e (2) that does not have enough taps that can supply first-draw samples, as defined in subdivision B 2 b of this section, may apply to the ~~district engineer~~ commissioner department in writing to substitute non-first-draw samples. If approved by the ~~commissioner~~ department, ~~such then an~~ owners shall collect as many first-draw samples from appropriate taps as possible and identify sampling times and locations that would likely result in the longest standing time for the remaining sites.

3. Number of samples.

a. ~~Owners~~ The owner shall collect at least one sample during each monitoring period specified in subdivision B 4 of this section from the number of sites listed in the first column (standard monitoring) of ~~the table in subdivision B 3 c of this section Table 375.1.~~ The owner of a waterworks conducting reduced monitoring under subdivision B 4 d of this section shall collect at least one sample from the number of sites specified in the second column (reduced monitoring) of ~~the table in subdivision B 3 c of this section Table 375.1~~ during each monitoring period specified in subdivision B 4 d of this section. ~~Such reduced~~ Reduced monitoring sites shall be representative of the sites required for standard monitoring. The ~~commissioner department~~ may specify sampling locations when an owner is conducting reduced monitoring.

b. The owner of a waterworks that has fewer than five drinking water taps that are normally used for human consumption meeting the sample site criteria of subdivision B 1 of this section to reach the required number of sample sites listed in ~~the table in subdivision B 3 c of this section Table 375.1,~~ shall collect at least one sample from each tap and then shall collect additional samples from those taps on different days during the monitoring period to meet the required number of sites. Alternatively, the ~~commissioner department~~ may allow these owners to collect a number of samples less than the number of sites specified in ~~the table in subdivision B 3 c of this section Table 375.1,~~ provided that 100% of all taps that are normally used for human consumption are sampled. The ~~commissioner department~~ ~~must~~ shall approve this reduction of the minimum number of samples in writing based on a request from the owner or onsite verification by the ~~district engineer~~ designated department representative.

c. ~~The lead and copper tap sample table is as follows:~~

TABLE 375.1.

Tap Samples for Lead and Copper.

<del>System Size</del> <u>WATERWORKS SIZE</u> (Number of People Served)	<del>Number of Sites</del> <u>NUMBER OF SITES</u> (Standard Monitoring)	<del>Number of Sites</del> <u>NUMBER OF SITES</u> (Reduced Monitoring)
<del>greater</del> <u>Greater</u> than 100,000	100	50
10,001-100,000	60	30
3,301 to 10,000	40	20
501 to 3,300	20	10
101 to 500	10	5
<del>less</del> <u>Less</u> than or equal to 100	5	5

4. Timing of monitoring.

a. Initial tap sampling. The first six-month monitoring period for small (serving less than 3,300 population), ~~medium-size~~ medium (serving 3,301 to 50,000 population), and large waterworks (serving greater than 50,000 population) shall be established by the ~~commissioner~~ department.

(1) ~~The owner~~ Owners of ~~all~~ a large waterworks shall monitor during two consecutive six-month periods.

(2) ~~The owner~~ Owners of ~~all~~ a small ~~and or a~~ medium-size medium waterworks shall monitor during each six-month monitoring period until the waterworks exceeds the lead or copper action level and is therefore required to implement the corrosion control treatment requirements under 12VAC5-590-405 A 2, in which case the owner shall continue monitoring in accordance with subdivision B 4 b of this section, or the waterworks meets the lead and copper action levels during two consecutive six-month monitoring periods, in which case the owner may reduce monitoring in accordance with subdivision B 4 d of this section.

b. Monitoring after installation of corrosion control and ~~water supply (source water)~~ source water treatment.

(1) The owner of ~~any~~ a large waterworks that installs optimal corrosion control treatment pursuant to 12VAC5-590-405 A 2 d (4) shall monitor during two consecutive six-month monitoring periods by the date specified in 12VAC5-590-405 A 2 d (5).

(2) The owner of ~~any~~ a small or a ~~medium-size~~ medium waterworks that installs optimal corrosion control treatment pursuant to 12VAC5-590-405 A 2 e (5) shall monitor during two consecutive six-month monitoring periods by the date specified in ~~12VAC5-590-405 A 2 d (6)~~ 12VAC5-590-405 A 2 e (6).

(3) The owner of ~~any~~ a waterworks that installs source water treatment pursuant to 12VAC5-590-405 B 1 c shall monitor during two consecutive six-month monitoring periods by the date specified in 12VAC5-590-405 B 1 d.

c. Monitoring after the ~~commissioner~~ department specifies water quality parameter values for optimal corrosion control. After the ~~commissioner~~ department specifies the values for water quality control parameters under 12VAC5-590-405 A 1 f, the owner shall monitor during each subsequent six-month monitoring period, with the first monitoring period to begin on the date the ~~commissioner~~ department specifies the optimal values.

d. Reduced monitoring.

(1) The owner of a small or ~~medium-size~~ medium waterworks that meets the lead and copper action levels during each of two consecutive six-month monitoring periods may reduce the number of samples in accordance with subdivision B 3 of this section, and reduce the frequency of sampling to once per year. The owner of a small or a ~~medium water system~~ waterworks collecting fewer than five samples, as specified in subdivision B 3 b of this section, that meets the lead and copper action levels during each of two consecutive six-month monitoring periods may reduce the frequency of sampling to once per year. In no case may the owner reduce the number of samples required below the minimum of one sample per available tap. This sampling shall begin during the calendar year immediately following the end of the second consecutive six-month monitoring period.

(2) The owner of ~~any~~ a waterworks that meets the lead action level and maintains the range of values for the water quality control parameters reflecting optimal corrosion control treatment specified by the ~~commissioner~~ department under 12VAC5-590-405

A 1 f during each of two consecutive six-month monitoring periods may reduce the frequency of monitoring to once per year and to reduce the number of lead and copper samples in accordance with subdivision B 3 of this section if the owner receives written approval from the ~~commissioner~~department. This sampling shall begin during the calendar year immediately following the end of the second consecutive six-month monitoring period. The ~~commissioner~~department ~~must review~~ shall evaluate monitoring, treatment, and other relevant information submitted by the owner in accordance with ~~12VAC5-590-530 F~~ 12VAC5-590-532 and ~~must~~shall notify the owner in writing when a determination is made that the owner is eligible to commence reduced monitoring pursuant to this subdivision. The ~~commissioner~~department ~~must review~~shall evaluate, and where appropriate, revise ~~his~~the determination when the owner submits new monitoring or treatment data, or when other data relevant to the number and frequency of tap sampling becomes available.

(3) The owner of a small or ~~medium-size~~medium waterworks that meets the lead and copper action levels during three consecutive years of monitoring may reduce the frequency of monitoring for lead and copper from annually to once every three years. The owner of ~~any a~~waterworks that meets the lead action level and maintains the range of values for the water quality control parameters reflecting optimal corrosion control treatment specified by the ~~commissioner~~department under 12VAC5-590-405 A 1 f during three consecutive years of monitoring may reduce the frequency of monitoring from annually to once every three years if the owner receives written approval from the ~~commissioner~~department. Samples collected once every three years shall be collected no later than every third calendar year. The ~~commissioner~~department ~~must review~~ shall evaluate monitoring, treatment, and other relevant information submitted by the owner in accordance with ~~12VAC5-590-530 F~~ 12VAC5-590-532 and ~~must~~shall notify the owner in writing when a determination is made that the owner is eligible to commence reduced monitoring pursuant to this subdivision. The ~~commissioner~~department ~~must review~~shall evaluate, and where appropriate, revise ~~his~~the determination when the owner submits new monitoring or treatment data, or when other data relevant to the number and frequency of tap sampling becomes available.

(4) The owner of a waterworks that reduces the number and frequency of sampling shall collect these samples from representative sites included in the pool of targeted sampling sites identified in subdivision B 1 of this section. ~~The owner~~Owners sampling annually or less frequently shall conduct the lead and copper tap sampling during the months of June, July, August, or September. For a nontransient noncommunity waterworks that does not operate during the months of June through September, the ~~commissioner~~department shall designate an alternate monitoring period that represents a time of normal operation for the waterworks. This sampling shall begin in the calendar year immediately following the end of the second consecutive six-month monitoring period ~~of for~~the owners initiating annual monitoring, and during the three-year period following the end of the third consecutive calendar year of annual monitoring for the owners initiating triennial monitoring.

(5) The owner of ~~any a~~waterworks that demonstrates for two consecutive six-month monitoring periods that the tap water lead level computed under 12VAC5-590-385 C is less than or equal to 0.005 mg/L and the tap water copper level computed under 12VAC5-590-385 C is less than or equal to 0.65 mg/L may reduce the number of samples in accordance with subdivision B 3 of this section and reduce the frequency of sampling to once every three calendar years.

(6) The owner of a small or ~~medium-size~~ a medium waterworks subject to reduced monitoring that exceeds the lead or copper action level shall resume sampling in accordance with subdivision B 4 c of this section and collect the number of samples specified for standard monitoring under subdivision B 3 of this section. ~~Such~~ The owner shall also conduct water quality parameter monitoring in accordance with ~~subdivision C 2, 3, or 4~~ subdivisions C 2 through C 4 of this section (as appropriate) during the monitoring period in which the action level is exceeded. The owner of ~~any such a~~ waterworks may resume annual monitoring for lead and copper at the tap at the reduced number of sites specified in subdivision B 3 of this section after it has completed two subsequent consecutive six-month rounds of monitoring that meet the criteria of subdivision B 4 d (1) of this section or may resume triennial monitoring for lead and copper at the reduced number of sites after it demonstrates through subsequent rounds of monitoring that it meets the criteria of either subdivision B 4 d (3) or B 4 d (5) of this section.

(7) The owner of ~~any a~~ waterworks subject to the reduced monitoring frequency that fails to meet the lead action level during any four-month monitoring period or that fails to operate at or above the minimum value or within the range of values for the water quality parameters specified by the ~~commissioner department~~ under 12VAC5-590-405 A 1 f for more than nine days in any six-month period specified in subdivision C 4 of this section shall conduct tap water sampling for lead and copper at the frequency specified in subdivision B 4 c of this section, collect the number of samples specified for standard monitoring under subdivision B 3 of this section, and resume monitoring for water quality parameters within the distribution system in accordance with subdivision C 4 of this section. This standard tap water sampling shall begin no later than the six-month period beginning January 1 of the calendar year following the lead action level exceedance or water quality parameter excursion. The owner of such a waterworks may resume reduced monitoring for lead and copper at the tap and for water quality parameters within the distribution system under the following conditions:

(a) The owner may resume annual monitoring for lead and copper at the tap at the reduced number of sites specified in subdivision B 3 of this section after completion of two subsequent six-month rounds of monitoring that meet the criteria of subdivision B 4 d ~~2(2)~~ of this section and the owner has received written approval from the ~~commissioner department~~ that it is appropriate to resume reduced monitoring on an annual frequency. This sampling shall begin during the calendar year immediately following the end of the second consecutive six-month monitoring period.

(b) The owner may resume triennial monitoring for lead and copper at the tap at the reduced number of sites after demonstration through subsequent rounds of monitoring that it meets the criteria of either subdivision B 4 d (3) or B 4 d (5) of this section and the owner has received written approval from the ~~commissioner department~~ that it is appropriate to resume triennial monitoring.

(c) The owner may reduce the number of water quality parameter tap water samples required in accordance with subdivision C 5 a of this section and the frequency with which it collects ~~such these~~ samples in accordance with subdivision C 5 b of this section. The owner of such a waterworks may not resume triennial monitoring for water quality parameters at the tap until it demonstrates, in accordance with the requirements of subdivision C 5 b of this section, that it has requalified for triennial monitoring.

(8) The owner of ~~any a~~ waterworks subject to a reduced monitoring frequency under subdivision B 4 d of this section shall notify the ~~district engineer department~~ in writing in accordance with 12VAC5-590-530 ~~F 1 e~~ and 12VAC5-590-532 of any upcoming

long-term change in the treatment or addition of a new ~~water~~-source water as described in this section. The ~~commissioner department~~ must review shall evaluate and approve the addition of a new ~~water~~-source water or long-term change in the water treatment before it is implemented by the owner. The ~~commissioner department~~ may require the owner to resume sampling in accordance with subdivision B 4 c of this section and collect the number of samples specified for standard monitoring under subdivision B 3 of this section or take other appropriate steps such as increased water quality parameter monitoring or re-evaluation of its corrosion control treatment given the potentially different water quality considerations.

5. Additional monitoring by owner. The results of ~~any~~-monitoring conducted in addition to the minimum requirements of this section shall be considered by the owner and the ~~commissioner department~~ in making ~~any~~-determinations (i.e., calculating the 90th percentile lead or copper level) under 12VAC5-590-385 C.

6. Invalidation of lead or copper tap water samples. A sample invalidated under this subdivision does not count toward determining lead or copper 90th percentile levels under 12VAC5-590-385 C or toward meeting the minimum monitoring requirements of subdivision B 3 of this section.

a. The ~~commissioner department~~ may invalidate a lead or copper tap water sample if at least one of the following conditions is ~~met~~-met:

(1) The laboratory establishes that improper sample analysis caused erroneous results.

(2) The ~~commissioner department~~ determines that the sample was ~~taken~~-collected from a site that did not meet the site selection criteria of this section.

(3) The sample container was damaged in transit.

(4) There is substantial reason to believe that the sample was subject to tampering.

b. The owner shall report the results of all samples to the ~~district engineer~~ department and all supporting documentation for samples the owner believes should be invalidated.

c. To invalidate a sample under subdivision B 6 a of this section, the decision and the rationale for the decision shall be documented in writing. The ~~commissioner~~ department may not invalidate a sample solely on the grounds that a follow-up sample result is higher or lower than that of the original sample.

d. The owner shall collect a replacement samples for ~~any a~~ samples invalidated under this section if, after the invalidation of one or more samples, the owner has too few samples to meet the minimum requirements of subdivision B 3 of this section. ~~Any~~ Asuch replacement samples shall be ~~taken~~-collected as soon as possible, but no later than 20 days after the date the ~~commissioner department~~ invalidates the sample or by the end of the applicable monitoring period, whichever occurs later. Replacement samples ~~taken~~-collected after the end of the applicable monitoring period shall not also be used to meet the monitoring requirements of a subsequent monitoring period. The replacement samples shall be ~~taken~~-collected at the same locations as the invalidated samples or, if that is not possible, at locations other than those already used for sampling during the monitoring period.

7. Monitoring waivers for small waterworks. The owner of ~~any a~~ small waterworks that meets the criteria of this subdivision may apply to the ~~commissioner department~~ to reduce the frequency of monitoring for lead and copper to once every nine years (i.e., a full waiver) if the owner meets all of the materials criteria specified in subdivision B 7 a of this section and all of the monitoring criteria specified in subdivision B 7 b of this section. The owner

of ~~any a~~ small waterworks that meets the criteria in subdivisions B 7 a and B 7 b of this section only for lead, or only for copper, may apply to the ~~commissioner department~~ for a waiver to reduce the frequency of tap water monitoring to once every nine years for that contaminant only (i.e., a partial waiver).

a. ~~Materials criteria. The owner shall demonstrate that the distribution system and service lines and all drinking water supply plumbing~~ service lines and plumbing connected to the waterworks, including plumbing conveying drinking water within all residences and buildings connected to the waterworks, are free of lead-containing materials or copper-containing materials, as those terms are defined in this subdivision, as follows:

(1) Lead. To qualify for a full waiver, or a waiver of the tap water monitoring requirements for lead (i.e., a lead waiver), the owner shall provide certification and supporting documentation to the ~~commissioner department~~ that the waterworks is free of all lead-containing materials, as follows:

(a) It contains no plastic pipes that contain lead plasticizers, or plastic service lines that contain lead plasticizers; ~~and~~

~~(b) It is free of lead service lines, lead pipes, lead soldered pipe joints, and leaded brass or bronze alloy fittings and fixtures, unless such fittings and fixtures meet the specifications of any standard established pursuant to 42 USC § 300g-6(e) (SDWA § 1417(e)).~~

(b) Solders and flux contain no more than 0.2% lead; and

(c) The weighted average of wetted surface of pipes, pipe fittings, plumbing fittings, and plumbing fixtures contain no more than 0.25% lead.

(2) Copper. To qualify for a full waiver, or a waiver of the tap water monitoring requirements for copper (i.e., a copper waiver), the owner shall provide certification and supporting documentation to the ~~commissioner department~~ that the waterworks contains no copper pipes or copper service lines.

b. Monitoring criteria for waiver issuance. The owner shall have completed at least one six-month round of standard tap water monitoring for lead and copper at sites approved by the ~~commissioner department~~ and from the number of sites required by subdivision B 3 of this section and demonstrate that the 90th percentile levels for any and all rounds of monitoring conducted since the owner became free of all lead-containing or copper-containing materials, as appropriate, meet the following criteria:

(1) Lead levels. To qualify for a full waiver, or a lead waiver, the owner shall demonstrate that the 90th percentile lead level does not exceed 0.005 mg/L.

(2) Copper levels. To qualify for a full waiver, or a copper waiver, the owner shall demonstrate that the 90th percentile copper level does not exceed 0.65 mg/L.

c. ~~Commissioner Department~~ approval of waiver application. The ~~commissioner department~~ shall notify the owner of the waiver determination, in writing, setting forth the basis of ~~his the~~ decision and any condition of the waiver. As a condition of the waiver, the ~~commissioner department~~ may require the owner to perform specific activities (e.g., limited monitoring, periodic outreach to customers to remind them to avoid installation of materials that might void the waiver) to avoid the risk of lead or copper concentration of concern in tap water. The owner of a small waterworks shall continue monitoring for lead and copper at the tap as required by subdivisions B 4 a through B 4 d of this section, as appropriate, until it receives written notification from the ~~commissioner department~~ that the waiver has been approved.

d. Monitoring frequency for owners with waivers.

(1) ~~An-The~~ owner with a full waiver shall conduct tap water monitoring for lead and copper in accordance with subdivision B 4 d (4) of this section at the reduced number of sampling sites identified in subdivision B 3 of this section at least once every nine years and provide the materials certification specified in subdivision B 7 a of this section for both lead and copper to the ~~commissioner-department~~ along with the monitoring results. Samples collected every nine years shall be collected no later than every ninth calendar year.

(2) An owner with a partial waiver shall conduct tap water monitoring for the waived contaminant in accordance with subdivision B 4 d (4) of this section at the reduced number of sampling sites specified in subdivision B 3 of this section at least once every nine years and provide the materials certification specified in subdivision B 7 a of this section pertaining to the waived contaminant along with the monitoring results. ~~Such as~~ The owner also shall continue to monitor for the nonwaived contaminant in accordance with requirements of subdivisions B 4 a through B 4 d of this section, as appropriate.

(3) ~~Any-The~~ owner with a full or partial waiver shall notify the ~~district engineer department~~ in writing in accordance with ~~12VAC5-590-530 F 1 e~~ 12VAC5-590-532 B 3 of any upcoming long-term change in the treatment or addition of a new source water, as described in that section. The ~~commissioner-department~~ ~~must review~~ shall evaluate and approve the addition of a new source water or a long-term change in water treatment before it is implemented by the owner. The ~~commissioner-department~~ has the authority to require the owner to add or modify waiver conditions (e.g., require recertification that the waterworks is free of lead-containing or copper-containing materials; require additional round or rounds of monitoring), if it deems ~~such these~~ modifications are necessary to address treatment or source water changes at the waterworks.

(4) If an owner with a full or partial waiver becomes aware that it is no longer free of lead-containing or copper-containing materials, as appropriate, (e.g., as a result of new construction or repairs), then the owner shall notify the ~~district engineer department~~ in writing no later than 60 days after becoming aware of ~~such a the~~ change.

e. Continued eligibility. If the owner continues to satisfy the requirements of subdivision B 7 d of this section, then the waiver will be renewed automatically, unless any of the conditions listed in subdivisions B 7 e (1), B 7 e (2), or B 7 e (3) of this section occurs. ~~An-The~~ owner whose waiver has been revoked may reapply for a waiver ~~at such time as when it he~~ again meets the appropriate materials and monitoring criteria of subdivisions B 7 a and B 7 b of this section.

(1) A waterworks with a full waiver or a lead waiver no longer satisfies the materials criteria of subdivision B 7 a (1) of this section or has a 90th percentile lead level greater than 0.005 mg/L.

(2) A waterworks with a full waiver or a copper waiver no longer satisfies the materials criteria of subdivision B 7 a (2) of this section or has a 90th percentile copper level greater than 0.65 mg/L.

(3) The ~~commissioner-department~~ notifies the owner, in writing, that the waiver has been revoked, setting forth the basis of the decision.

f. Requirements following waiver revocation. A waterworks whose full or partial waiver has been revoked by the ~~commissioner-department~~ is subject to the corrosion control treatment and lead and copper tap water monitoring requirements, as follows:



(1) If the waterworks exceeds the lead or copper action level, then the owner shall implement corrosion control treatment in accordance with the deadlines specified in 12VAC5-590-405 A 2 e and any other applicable requirements of this section.

(2) If the waterworks meets both the lead and the copper action level, then the owner shall monitor for lead and copper at the tap no less frequently than once every three years using the reduced number of sample sites specified in subdivision B 3 of this section.

g. Pre-existing waivers. Waivers for small waterworks approved by the ~~commissioner~~ department in writing ~~prior to~~ before April 11, 2000, shall remain in effect under the following conditions:

(1) If the waterworks has demonstrated that it is both free of lead-containing and copper-containing materials, as required by subdivision B 7 a of this section and that its 90th percentile lead levels and 90th percentile copper levels meet the criteria of subdivision B 7 b of this section, then the waiver remains in effect so long as the owner continues to meet the waiver eligibility criteria of subdivision B 7 e of this section. The first round of tap water monitoring conducted pursuant to subdivision B 7 d of this section shall be completed no later than nine years after the last time the owner has monitored for lead and copper at the tap.

(2) If the waterworks has met the materials criteria of subdivision B 7 a of this section but has not met the monitoring criteria of subdivision B 7 b of this section, then the owner shall conduct one six-month round of standard tap water monitoring for lead and copper at sites approved by the ~~commissioner~~ department demonstrating that it meets the criteria of subdivision B 7 b of this section. Thereafter, the waiver shall remain in effect as long as the owner meets the continued eligibility criteria of subdivision B 7 e of this section. The first round of tap water monitoring conducted pursuant to subdivision B 7 d of this section shall be completed no later than nine years after the round of monitoring conducted pursuant to subdivision B 7 b of this section.

C. Monitoring requirements for water quality parameters. The owners of all large waterworks and all small and ~~medium-size~~ medium -waterworks that exceed the lead or copper action level shall monitor for water quality parameters in addition to lead and copper in accordance with this section.

1. General requirements.

a. Sample collection methods.

(1) Tap samples shall be representative of water quality throughout the distribution system taking into account the number of persons served, the different sources of water, the different treatment methods employed by the waterworks, and seasonal variability. Tap sampling under this section is not required to be conducted at taps targeted for lead and copper sampling under subdivision B 1 of this section. ~~Owners~~ An owner may find it convenient to conduct tap sampling for water quality parameters at sites approved for coliform sampling.

(2) Samples collected at the entry point or points to the distribution system shall be from locations representative of each source water after treatment. If a waterworks draws water from more than one source water and the source waters are combined before distribution, then the owner shall sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

b. Number of samples.

(1) ~~Owners~~The owner shall collect two tap samples from the standard monitoring number of sites given in Table 375.2 for applicable water quality parameters during each monitoring period specified under ~~subdivision~~ subdivisions C 2 through C 5 of this section ~~from the following number of sites.~~

TABLE 375.2.  
Water Quality Monitoring for Lead and Copper.

System WATERWORKS SIZE (Number of People Served)	NUMBER OF SITES FOR WATER QUALITY PARAMETERS	
	Number of Sites for Water Quality Parameters <u>STANDARD MONITORING</u>	<u>REDUCED MONITORING</u>
<del>greater</del> <u>Greater</u> than 100,000	25	<u>10</u>
10,001-100,000	10	<u>7</u>
3,301 to 10,000	3	<u>3</u>
501 to 3,300	2	<u>2</u>
101 to 500	1	<u>1</u>
<del>less</del> <u>Less</u> than or equal to 100	1	<u>1</u>

(2) Except as provided in subdivision C 3 c of this section, ~~owners~~the owner shall collect two samples for each applicable water quality parameter at each entry point to the distribution system during each monitoring period specified in subdivision C 2 of this section. During each monitoring period specified in ~~subdivision~~ subdivisions C 3 through C 5 of this section, ~~owners~~the owner shall collect one sample for each applicable water quality parameter at each entry point to the distribution system.

2. Initial sampling. The ~~owners~~owner of ~~all a~~ large waterworks shall measure the applicable water quality parameters as specified below at taps and at each entry point to the distribution system during each six-month monitoring period specified in subdivision B 4 a of this section. The ~~owners~~owner of ~~all a~~ small ~~and or medium size~~ medium waterworks shall measure the applicable water quality parameters at the locations specified below during each six-month monitoring period specified in subdivision B 4 a of this section during which the waterworks exceeds the lead or copper action level.

a. At taps:

- (1) pH;
- (2) Alkalinity;
- (3) Orthophosphate, when an inhibitor containing a phosphate compound is used;
- (4) Silica, when an inhibitor containing a silicate compound is used;
- (5) Calcium;

- (6) Conductivity; and
- (7) Water temperature.

b. At each entry point to the distribution system: all of the applicable parameters listed in subdivision C 2 a of this section.

3. Monitoring after installation of corrosion control. The owner of ~~any a~~ large waterworks ~~which that~~ installs optimal corrosion control treatment pursuant to 12VAC5-590-405 A 2 d (4) shall measure the water quality parameters at the locations and frequencies specified below during each six-month monitoring period specified in subdivision B 4 b (1) of this section. The owner of ~~any a~~ small or ~~medium-size a medium~~ -waterworks that installs optimal corrosion control treatment shall conduct ~~such~~ monitoring during each six-month monitoring period specified in subdivision B 4 b (2) of this section in which the waterworks exceeds the lead or copper action level.

a. At taps, two samples for:

- (1) pH;
- (2) Alkalinity;
- (3) Orthophosphate, when an inhibitor containing a phosphate compound is used;
- (4) Silica, when an inhibitor containing a silicate compound is used; and
- (5) Calcium, when calcium carbonate stabilization is used as part of corrosion control.

b. Except as provided in subdivision C 3 c of this section, at each entry point to the distribution system, at least one sample no less frequently than every two weeks (~~bi-weekly~~~~biweekly~~) for:

- (1) pH;
- (2) When alkalinity is adjusted as part of optimal corrosion control, a reading of the dosage rate of the chemical used to adjust ~~alkalinity, and the alkalinity and~~ the alkalinity concentration; and
- (3) When a corrosion inhibitor is used as part of optimal corrosion control, a reading of the dosage rate of the inhibitor ~~used, used~~ and the concentration of orthophosphate or silica (whichever is applicable).

c. The owner of ~~any a~~ groundwater ~~source waterworks system~~ may limit entry point sampling described in subdivision C 3 b of this section to those entry points that are representative of water quality and treatment conditions throughout the waterworks. If water from untreated ~~ground water groundwater~~ sources mixes with water from treated ~~ground water groundwater~~ sources, ~~then~~ the owner shall monitor for water quality parameters both at representative entry points receiving treatment and representative entry points receiving no treatment. ~~Prior to~~ Before the start of any monitoring under this subdivision, the owner shall provide to the ~~commissioner department~~ written information identifying the selected entry points and documentation, including information on seasonal variability, sufficient to demonstrate that the sites are representative of water quality and treatment conditions throughout the waterworks.

4. Monitoring after the ~~commissioner department~~ specifies water quality parameter values for optimal corrosion control. After the ~~commissioner department~~ specifies the values for applicable water quality control parameters reflecting optimal corrosion control treatment under 12VAC5-590-405 A 1 f, the ~~owners owner~~ of ~~all a~~ large waterworks shall measure the applicable water quality parameters in accordance with subdivision C 3 of this section and determine compliance with the requirements of 12VAC5-590-405 A 1 g every six months with the first six-month period to begin on either January 1 or July 1, whichever comes first, after the ~~commissioner department~~ specifies the optimal values under

12VAC5-590-405 A 1 f. The owner of ~~any-a~~ small or ~~medium-size~~ medium waterworks shall conduct ~~such~~ monitoring during each six-month monitoring period specified in this subdivision in which the waterworks exceeds the lead or copper action level. For the owner of ~~any-a~~ ~~such~~ small ~~and-or~~ medium-size a medium waterworks that is subject to a reduced monitoring frequency pursuant to subdivision B 4 d of this section at the time of the action level exceedance, the start of the applicable six-month period under this subdivision shall coincide with the start of the applicable monitoring period under subdivision B 4 d of this section. Compliance with the ~~commissioner~~department-designated optimal water quality parameter values shall be determined as specified under 12VAC5-590-405 A 1 g.

5. Reduced monitoring.

a. The owner of ~~any-a~~ waterworks that maintains the range of values for the water quality parameters reflecting optimal corrosion control treatment during each of two consecutive six-month monitoring periods under subdivision C 4 of this section shall continue monitoring at the entry point or points to the distribution system as specified in subdivision C 3 b of this section. The owner of ~~such~~ the waterworks may collect two tap samples for applicable water quality parameters from the ~~following~~ reduced number of sites during each six-month monitoring period shown in Table 375.2.

Size of Water System (Number of People Served)	Reduced Number of WQP Monitoring Sites
greater than 100,000	40
10,001 to 100,000	7
3,301 to 10,000	3
501 to 3,300	2
101 to 500	4
less than or equal to 100	4

b. The owner of ~~any-a~~ waterworks that maintains the range of values for the water quality parameters reflecting optimal corrosion control treatment specified by the ~~commissioner~~department under 12VAC5-590-405 A 1 f during three consecutive years of monitoring may reduce the frequency with which the owner collects the number of tap samples for applicable water quality parameters specified in subdivision C 5 of this section from every six months to annually. This sampling begins during the calendar year immediately following the end of the monitoring period in which the third consecutive year of six-month monitoring occurs. The owner of ~~any-a~~ waterworks that maintains the range of values for the water quality parameters reflecting optimal corrosion control treatment specified by the ~~commissioner~~department under 12VAC5-590-405 A 1 f during three consecutive years of annual monitoring under this subdivision may reduce the frequency with which it collects the number of tap samples for applicable water quality parameters specified in subdivision C 5 a of this section from annually to every three years. This sampling begins during the calendar year immediately following the end of the monitoring period in which the third consecutive year of six-month monitoring occurs.

c. The owner of a waterworks may reduce the frequency with which tap samples are collected for applicable water quality parameters specified in subdivision C 5 a of this

section to every three years if the owner demonstrates during two consecutive monitoring periods that the tap water lead level at the 90th percentile is less than or equal to the PQL for lead (0.005 mg/L), that the tap water copper level at the 90th percentile is less than or equal to 0.65 mg/L for copper, and that the owner also has maintained the range of values for water quality parameters reflecting optimal corrosion control treatment specified by the ~~commissioner~~ department under 12VAC5-590-405 A 1 f. Monitoring conducted every three years shall be done no later than every third calendar year.

d. The owner of a waterworks that conducts sampling annually shall collect these samples evenly throughout the year so as to reflect seasonal variability.

e. The owner of ~~any~~ a waterworks subject to the reduced monitoring frequency that fails to operate at or above the minimum value or within the range of values for the water quality parameters specified by the ~~commissioner~~ department under 12VAC5-590-405 A 1 f for more than nine days in any six-month period specified in 12VAC5-590-405 A 1 g shall resume distribution system tap water sampling in accordance with the number and frequency requirements in subdivision C 4 of this section. ~~Such an~~ An owner may resume annual monitoring for water quality parameters at the tap at the reduced number of sites specified in subdivision C 5 of this section after completion of two subsequent consecutive six-month rounds of monitoring that meet the criteria of that subdivision or may resume triennial monitoring for water quality parameters at the tap at the reduced number of sites after demonstration through subsequent rounds of monitoring that the criteria of either subdivision C 5 b or C 5 c of this section has been met.

6. Additional monitoring by owners. The results of any monitoring conducted in addition to the minimum requirements of this section shall be considered by the owner and the ~~commissioner~~ department in making any determinations under this section or 12VAC5-590-405 A 1.

D. Monitoring requirements for lead and copper in water supplies (source water).

1. Sample location, collection methods, and number of samples.

a. The owner of a waterworks that fails to meet the lead or copper action level on the basis of tap samples collected in accordance with subsection A of this section shall collect lead and copper ~~water supply~~ source water samples in accordance with the following requirements regarding sample location, number of samples, and collection methods:

(1) The owner of a waterworks served by groundwater sources shall ~~take collect~~ a minimum of one sample at every entry point to the distribution system ~~that is representative of each well after treatment (hereafter called a sampling point)~~. The owner shall ~~take collect~~ one sample at the same sampling point unless conditions make another sampling point more representative of each source water or water treatment plant.

(2) The owner of a waterworks served by surface water sources shall ~~take collect~~ a minimum of one sample at every entry point to the distribution system ~~after any application of treatment or in the distribution system at a point that is representative of each source after treatment (hereafter called a sampling point)~~. The owner shall ~~take collect~~ each sample at the same sampling point unless conditions make another sampling point more representative of each source water or water treatment plant. Note that for the purpose of this subdivision, a waterworks served by a surface water source includes waterworks served by a combination of surface water and ~~ground~~ groundwater sources.

(3) If a waterworks draws water from more than one source waters and the source waters are combined before distribution, then the owner shall collect samples at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all source waters being used).

(4) The ~~commissioner~~ department may reduce the total number of samples that must be analyzed by allowing the use of compositing. Compositing of samples shall be done by certified laboratory personnel. Composite samples from a maximum of five samples are allowed, provided that if the lead concentration in the composite sample is greater than or equal to 0.001 mg/L or the copper concentration is greater than or equal to 0.160 mg/L, then either a follow-up sample shall be collected and analyzed within 14 days at each sampling point included in the composite or if duplicates ~~of~~ or sufficient quantities from the original samples from each sampling point used in the composite are available, then the owner may use these instead of resampling.

b. Where the results of sampling indicate an exceedance of maximum permissible ~~water supply~~ source water levels established under 12VAC5-590-405 B 4, the ~~commissioner~~ department may require that one additional sample be collected as soon as possible after the initial sample was ~~taken~~ collected (but not to exceed two weeks) at the same sampling point. If a ~~commissioner required~~ confirmation sample required by the department is ~~taken~~ collected for lead or copper, then the results of the initial and confirmation sample shall be averaged in determining compliance with the ~~commissioner~~ department-specified maximum permissible levels. Any-A sample value below the method detection limit shall be considered to be zero. Any-A value above the method detection limit but below the PQL shall either be considered as the measured value or be considered one-half the PQL. The PQL for lead is equal to 0.005 mg/L, and the PQL for copper is equal to 0.050 mg/L.

2. Monitoring frequency after a waterworks exceeds a tap action level. The owner of any a waterworks ~~which that~~ exceeds the lead or copper action level at the tap shall collect one ~~water supply~~ source water sample from each entry point to the distribution system no later than six months after the end of the monitoring period during which the lead or copper action level was exceeded. For monitoring periods that are annual or less frequent, the end of the monitoring period is September 30 of the calendar year in which the sampling occurs, or if the ~~commissioner~~ department has established an alternate monitoring period, the last day of that period.

3. Monitoring frequency after installation of ~~water supply~~ source water treatment. The owner of any-a waterworks that installs ~~water supply~~ source water treatment pursuant to 12VAC5-590-405 B 1 c shall collect an additional source water ~~supply~~ sample from each entry point to the distribution system during two consecutive six-month monitoring periods by the deadline specified in 12VAC5-590-405 B 1 d.

4. Monitoring frequency after the ~~commissioner~~ department specifies maximum permissible ~~water supply~~ source water lead and copper levels or determines that ~~water supply~~ source water treatment is not needed.

a. ~~An-The~~ owner shall monitor at the frequency specified below in cases where the ~~commissioner~~ department specifies maximum permissible ~~water supply~~ source water lead and copper levels under 12VAC5-590-405 B 1 e or determines that the owner is not required to install ~~water supply~~ source water treatment under 12VAC5-590-405 B 2 b.

(1) The owner of a waterworks using only groundwater shall collect samples once during the three-year compliance period in effect when the applicable ~~commissioner~~ department determination under subdivision D 4 a of this section is made. The owner

~~Owners of such these waterworks~~ shall collect samples once during each subsequent compliance period. Triennial samples shall be collected every third calendar year.

(2) The owner of a waterworks using surface water (or a combination of surface ~~water~~ and groundwater ~~sources~~) shall collect samples once during each year, the first annual monitoring period to begin during the year in which the applicable ~~commissioner department~~ determination is made under subdivision D 4 a of this section.

b. ~~An-The~~ owner is not required to conduct ~~water-supply source water~~ sampling for lead or copper if the waterworks meets the action level for the specific contaminant in tap water samples during the entire ~~water-supply source water~~ sampling period applicable to the waterworks under subdivision D 4 a (1) or D 4 a (2) of this section.

5. Reduced monitoring frequency.

a. The owner of a waterworks using only groundwater may reduce the monitoring frequency for lead and copper in ~~water-supplies-source water~~ to once during each nine-year compliance cycle provided that the samples are collected no later than every ninth calendar year and if the owner meets one of the following criteria:

(1) The owner demonstrates that finished ~~drinking~~-water entering the distribution system has been maintained below the maximum permissible lead and copper concentrations specified by the ~~commissioner-department~~ under 12VAC5-590-405 B 1 e during at least three consecutive compliance periods under subdivision D 4 a of this section; or

(2) The ~~commissioner-department~~ has determined that ~~water-supply source water~~ treatment is not needed and the owner demonstrates that, during the last three consecutive compliance periods in which sampling was conducted under subdivision D 4 a of this section, the concentration of lead in the ~~water-supply source water~~ was less than or equal to 0.005 mg/L and the concentration of copper in the ~~water-supply source water~~ was less than or equal to 0.65 mg/L.

b. The owner of a waterworks using surface water (or a combination of surface ~~water~~ and ~~ground-waters groundwater sources~~) may reduce the monitoring frequency for lead and copper in ~~source waters supplies~~ to once during each nine-year compliance cycle provided that the samples are collected no later than every ninth calendar year and if the owner meets one of the following criteria:

(1) The owner demonstrates that finished ~~drinking~~-water entering the distribution system has been maintained below the maximum permissible lead and copper concentrations specified by the ~~commissioner-department~~ under 12VAC5-590-405 B 1 e for at least three consecutive years; or

(2) The ~~commissioner-department~~ has determined that ~~water-supply source water~~ treatment is not needed and the owner demonstrates that, during the last three consecutive years, the concentration of lead in the ~~water-supply source water~~ was less than or equal to 0.005 mg/L and the concentration of copper in the ~~water-supplysource water~~ was less than or equal to 0.65 mg/L.

c. ~~The owner~~ ~~Owners~~ of a waterworks that uses a new ~~water-supply-source water~~ is not eligible for reduced monitoring for lead or copper until concentrations in samples collected from the new ~~supply-source water~~ during three consecutive monitoring periods are below the maximum permissible lead and copper concentrations specified in 12VAC5-590-405 B 1 e.

**12VAC5-590-376. Surface water and GUDI sources treatment monitoring.**

A. The owner of a waterworks that uses either a surface water source or a GUDI source or both and provides filtration treatment shall monitor in accordance with this section.

B. Turbidity measurements shall be performed on representative samples of the filtered water every four hours (or more frequently) that the waterworks serves water to the public. ~~An~~The owner may substitute continuous turbidity monitoring for grab sample monitoring if ~~he~~ validates the continuous measurement for accuracy on a regular basis using a protocol approved by the ~~commissioner~~department. For ~~any~~a waterworks using slow sand filtration or filtration treatment other than conventional treatment, direct filtration, or diatomaceous earth filtration, the ~~commissioner~~department may reduce the sampling frequency to once per day if the ~~commissioner~~department determines that less frequent monitoring is sufficient to indicate effective filtration performance. For a waterworks serving 500 or fewer persons, the ~~commissioner~~department may reduce the turbidity sampling frequency to once per day, regardless of the type of filtration treatment used, if the ~~commissioner~~department determines that less frequent monitoring is sufficient to indicate effective filtration performance.

1. ~~Owners of~~ The owner of a waterworks supplied by either a surface water source or a GUDI source or both using conventional filtration treatment or direct filtration shall conduct continuous monitoring of turbidity for each individual filter. The turbidimeter shall be calibrated using the procedure specified by the turbidimeter manufacturer. The owner shall record the results of individual filter turbidity monitoring a minimum of every 15 minutes.
2. If there is a failure in the continuous turbidity monitoring equipment, then the owner shall conduct grab sampling every four hours ~~in lieu~~ instead of continuous monitoring but for no more than five working days (for a waterworks serving 10,000 or more persons) or 14 days (for a waterworks serving less than 10,000 persons) following the failure of the equipment.
3. If a waterworks serving less than 10,000 persons consists of two or fewer filters, continuous monitoring of the combined filter effluent may be used ~~in lieu~~ instead of individual filter monitoring.

C. The residual disinfectant concentration of the water entering the distribution system shall be monitored continuously, and the lowest and highest values shall be recorded each day. If there is a failure in the continuous monitoring equipment, then grab sampling every four hours shall be conducted ~~in lieu~~ instead of continuous monitoring, but for no more than five working days following the failure of the equipment. ~~The owner~~ Owners of a waterworks serving 3,300 or fewer persons may collect grab samples ~~in lieu~~ instead of continuous monitoring on an ongoing basis at the frequencies ~~each day~~ prescribed in Table 376.1.

1. The day's samples cannot be collected at the same time.
2. The sampling intervals are subject to ~~commissioner's~~ department's evaluation and approval.
3. If at any time the residual disinfectant concentration falls below 0.2 mg/L in a waterworks using grab sampling ~~in lieu~~ instead of continuous monitoring, then the owner shall collect a grab sample every four hours until the residual disinfectant concentration is equal to or greater than 0.2 mg/L.

Table 376.1.  
Grab Sample Monitoring Frequency.

WATERWORKS SIZE BY POPULATION	SAMPLES/DAY
500 or less	1
501 to 1,000	2
1,000 to 2,500	3



D. The residual disinfectant concentration shall be measured at least at the same points in the distribution system and at the same time as total coliform bacteria are sampled, as specified in 12VAC5-590-370 A and 12VAC5-590-380 D, except that the ~~commissioner~~ department may allow ~~an~~ the owner of a waterworks that uses a groundwater source along with either a surface water source or a GUDI source or both to collect disinfectant residual samples at points other than the total coliform sampling points if the ~~commissioner~~ department determines that these points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as HPC as specified in 12VAC5-590-395 A 2 a (3), may be measured ~~in lieu~~ instead of residual disinfectant concentration.

E. The following information on the samples collected in the distribution system in conjunction with total coliform monitoring pursuant to 12VAC5-590-395 A 2 shall be reported monthly to the department by the owner:

1. Number of instances where the residual disinfectant concentration is measured;
2. Number of instances where the residual disinfectant concentration is not measured but HPC is measured;
3. Number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;
4. Number of instances where no residual disinfectant concentration is detected and where the HPC is greater than 500/mL;
5. Number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL; and
6. For the current and previous month the waterworks serves water to the public, the value of "V" in percent in the following formula:

$$V = (c + d + e) / (a + b) \times 100$$

where

- a = the value in subdivision E 1 of this section;
- b = the value in subdivision E 2 of this section;
- c = the value in subdivision E 3 of this section;
- d = the value in subdivision E 4 of this section;
- e = the value in subdivision E 5 of this section.

#### **12VAC5-590-377. Physical constituent monitoring.**

A. Color, odor, pH, and total dissolved solids. Monitoring to determine compliance with the SMCLs for these constituents specified in Table 340.3 shall be conducted as follows:

1. The owner shall collect one sample at each groundwater source entry point during each compliance period.
2. The owner shall collect one sample annually at each surface water source ~~entry point,~~ ~~(in whole or in part)~~ entry point.

B. ~~On-site~~ Onsite daily turbidity measurements may be required to be performed on representative samples collected at each entry point ~~of for~~ groundwater sources not required to filter, ~~in order~~ to determine compliance set forth in 12VAC5-590-379 B. The turbidity monitoring requirements for a waterworks required to filter are specified in 12VAC5-590-376 B.

**12VAC5-590-378. Radiological monitoring.**

A. The location of sampling points, the radionuclides measured in community waterworks, the frequency, and the timing of sampling within each compliance period shall be established or approved by the ~~commissioner~~department. The ~~commissioner~~department may increase required monitoring where necessary to detect variations within the waterworks. Failure to comply with the sampling schedules in this section will require public notification pursuant to 12VAC5-590-540 A 3.

B. ~~An owner of a community~~ Community waterworks ~~owners~~ shall conduct monitoring to determine compliance with the PMCLs in Table 340.4 and 12VAC5-590-388 in accordance with this section.

1. Monitoring requirements for gross alpha particle activity, radium-226, radium-228, and uranium.

a. ~~Owners~~The owner shall conduct initial monitoring to determine compliance with the PMCLs listed in Table 340.4 for gross alpha particle activity, radium-226, radium-228, and uranium. For the purposes of monitoring for gross alpha particle activity, radium-226, radium-228, uranium, and beta particle and photon radioactivity in drinking water, "detection limit" is defined as specified in Table 378.1.

(1) Applicability and sampling location for ~~an~~ existing community waterworks or ~~its~~ sources. ~~The owner~~ Owners using groundwater, surface water, or both groundwater and surface water shall sample at every entry point to the distribution system that is representative of all sources being used under normal operating conditions. ~~Owners~~ The owner shall collect each sample at the same entry point unless conditions make another sampling point more representative of each source.

(2) Applicability and sampling location for ~~a~~ new community waterworks or ~~its~~ sources. ~~All~~A new community waterworks or a community waterworks that uses a new source of water shall begin to conduct initial monitoring for the new source within the first quarter after initiating use ~~of the source~~. ~~Owners~~The owner shall conduct more frequent monitoring when directed by the ~~commissioner~~department in the event of possible contamination or when changes in the distribution system or treatment processes occur that may increase the concentration of radioactivity in ~~the~~ finished water.

b. Initial monitoring: ~~Owners~~The owner shall conduct initial monitoring for gross alpha particle activity, radium-226, radium-228, and uranium as follows:

(1) ~~Owners~~The owner shall collect four consecutive quarterly samples at all entry points.

(2) For gross alpha particle activity, uranium, radium-226, and radium-228 monitoring, the ~~commissioner~~department may waive the final two quarters of initial monitoring for an entry point if the results of the samples from the previous two quarters are below the detection limit as defined by ~~and~~ as specified in Table 378.1.

(3) If the average of the initial monitoring results for an entry point is above the PMCL, ~~then~~ the owner shall collect and analyze quarterly samples at that entry point until the owner has results from four consecutive quarters that are at or below the PMCL, unless the owner enters into another schedule as part of a formal compliance agreement with the ~~commissioner~~department.

c. Reduced monitoring: The ~~commissioner~~department may allow ~~the owner~~ owners to reduce the future frequency of monitoring from once every three years to once every six or nine years at each entry point, based on the following criteria:

(1) If the average of the initial monitoring results for each contaminant (i.e., gross alpha particle activity, uranium, radium-226, or radium-228) is below the detection limit as specified in Table 378.1, then the owner shall collect and analyze for that contaminant using at least one sample at that entry point every nine years.

(2) For gross alpha particle activity, combined radium, and uranium, if the average of the initial monitoring results for each contaminant is at or above the detection limit as specified in Table 378.1, but at or below 1/2 of the PMCL, then the owner shall collect and analyze for that contaminant using at least one sample at that entry point every six years.

(3) For gross alpha particle activity, combined radium, and uranium, if the average of the initial monitoring results for each contaminant is above 1/2 the PMCL but at or below the PMCL, then the owner shall collect and analyze at least one sample at that entry point every three years.

(4) ~~The owner~~ Owners shall use the samples collected during the reduced monitoring period to determine the monitoring frequency for subsequent monitoring periods (e.g., if a waterworks' entry point is on a nine-year monitoring period, and the sample result is above 1/2 the PMCL, then the next monitoring period for that entry point is three years).

(5) If ~~an~~ the owner has a monitoring result that exceeds the PMCL while on reduced monitoring, then the owner he shall collect and analyze quarterly samples at that entry point until the ~~owner has~~ results from four consecutive quarters ~~that~~ are below the PMCL, unless the waterworks enters into another schedule as part of a formal compliance agreement with the ~~commissioner~~ department.

d. Compositing: To fulfill quarterly monitoring requirements for gross alpha particle activity, radium-226, radium-228, or uranium, ~~an~~ the owner may composite up to four consecutive quarterly samples from a single entry point if the analysis is done within a year of the first sample. The ~~commissioner~~ department will treat analytical results from the composited sample as the average analytical result to determine compliance with the PMCLs and the future monitoring frequency. If the analytical result from the composited sample is greater than 1/2 the PMCL, then the ~~commissioner~~ department may direct the owner to collect additional quarterly samples before allowing the owner to sample under a reduced monitoring schedule.

e. A gross alpha particle activity measurement may be substituted for the required radium-226 measurement provided that the measured gross alpha particle activity does not exceed 5 pCi/L. A gross alpha particle activity measurement may be substituted for the required uranium measurement provided that the measured gross alpha particle activity does not exceed 15 pCi/L. The gross alpha measurement shall have a confidence interval of 95% ( $1.65 \sigma$ , where  $\sigma$  is the standard deviation of the net counting rate of the sample) for radium-226 and uranium. When an owner uses a gross alpha particle activity measurement ~~in lieu~~ instead of a radium-226 or uranium measurement, the gross alpha particle activity analytical result will be used to determine the future monitoring frequency for radium-226 or uranium. If the gross alpha particle activity result is less than the detection limit as specified in Table 378.1, then 1/2 the detection limit will be used to determine compliance and the future monitoring frequency.

2. Monitoring requirements for beta particle and photon radioactivity. To determine compliance with the PMCL in Table 340.4 for beta particle and photon radioactivity, an owner shall monitor at a frequency as follows:

a. ~~Owners-The owner~~ (using surface ~~water~~ or groundwater ~~sources~~) designated by the ~~commissioner department~~ as vulnerable shall sample for beta particle and photon radioactivity. ~~The owner Owners~~ shall collect quarterly samples for beta emitters and annual samples for tritium and strontium-90 at each entry point to the distribution system, beginning within one quarter after being notified by the ~~commissioner department~~. ~~A Waterworks waterworks~~ already designated by the ~~commissioner department~~ shall continue to sample until the ~~commissioner department~~ evaluates and either reaffirms or removes the designation.

(1) If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity at an entry point has a ~~running annual average~~ RAA (computed quarterly) less than or equal to 50 pCi/L (screening level), ~~then the commissioner department~~ may reduce the frequency of monitoring at that entry point to once every three years. ~~Owners-The owner~~ shall collect all samples required in subdivision B 2 a of this section during the reduced monitoring period.

(2) For ~~a~~ waterworks in the vicinity of a nuclear facility, the ~~commissioner department~~ may allow ~~the owners the owner~~ to utilize environmental surveillance data collected by the nuclear facility ~~in lieu instead~~ of monitoring at the waterworks' entry point or points, where the ~~commissioner department~~ determines the data is applicable to a particular waterworks. In the event that there is a release from a nuclear facility, ~~the owner who is owners that are~~ using surveillance data shall begin monitoring at the waterworks' entry point or points in accordance with subdivision B 2 a of this section.

b. ~~Owners-The owner~~ (using either surface ~~water~~ or groundwater ~~or both~~) designated by the ~~commissioner department~~ as utilizing waters contaminated by effluents from nuclear facilities shall sample for beta particle and photon radioactivity. ~~Owners-The owner~~ shall collect quarterly samples for beta emitters and iodine-131 and annual samples for tritium and strontium-90 at each entry point to the distribution system, beginning within one quarter after being notified by the ~~commissioner department~~. ~~Owners-The owner~~ of a waterworks already designated by the ~~commissioner department~~ as using waters contaminated by effluents from nuclear facilities shall continue to sample until the ~~commissioner department~~ evaluates and either reaffirms or removes the designation.

(1) Quarterly monitoring for gross beta particle activity shall be based on the analysis of monthly samples or the analysis of a composite of three monthly samples. The former ~~procedure~~ is recommended.

(2) For iodine-131, a composite of five consecutive daily samples shall be analyzed once each quarter. As directed by the ~~commissioner department~~, more frequent monitoring shall be conducted when iodine-131 is identified in the finished water.

(3) Annual monitoring for strontium-90 and tritium shall be conducted by means of the analysis of a composite of four consecutive quarterly samples or analysis of four quarterly samples. The latter procedure is recommended.

(4) If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity at a sampling point has a ~~running annual average~~ RAA (computed quarterly) less than or equal to 15 pCi/L (screening level), ~~then the commissioner department~~ may reduce the frequency of monitoring at that sampling point to every three years. ~~The owner Owners~~ shall collect all samples required in subdivision B 2 b of this section during the reduced monitoring period.

(5) For ~~a~~ waterworks in the vicinity of a nuclear facility, the ~~commissioner department~~ may allow the owner to utilize environmental surveillance data collected by the nuclear facility ~~in lieu instead~~ of the monitoring at the waterworks' entry point or points, where

the ~~commissioner department~~ determines the data is applicable to a particular waterworks. In the event that there is a release from a nuclear facility, ~~the owner who is owners that are~~ using surveillance data shall begin monitoring at the waterworks' entry point or points in accordance with subdivision B 2 b of this section.

c. ~~The owner of a Owners of~~ waterworks designated by the ~~commissioner department~~ to monitor for beta particle and photon radioactivity cannot apply to the ~~commissioner department~~ for a waiver from the monitoring frequencies specified in subdivision B 2 a or B 2 b of this section.

d. ~~Owners-The owner~~ may analyze for naturally occurring potassium-40 beta particle activity from the same or equivalent sample used for the gross beta particle activity analysis. ~~The owner is Owners are~~ allowed to subtract the potassium-40 beta particle activity value from the total gross beta particle activity value to determine if the screening level is exceeded. The potassium-40 beta particle activity shall be calculated by multiplying elemental potassium concentrations (in mg/L) by a factor of 0.82.

e. If the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity exceeds the appropriate screening level, ~~then~~ an analysis of the sample shall be performed to identify the major radioactive constituents present in the sample and the appropriate doses shall be calculated and summed to determine compliance with the PMCL for beta particles and photon radioactivity. Doses shall also be calculated and combined for measured levels of tritium and strontium to determine compliance.

f. ~~The owner Owners~~ shall monitor monthly at the entry point or points that exceed the PMCLs listed in Table 340.4 beginning the month after the exceedance occurs. ~~The owner Owners~~ shall continue monthly monitoring until the waterworks has established, by a rolling average of three monthly samples, that the PMCL is being met. ~~The owner Owners~~ who establishes that the PMCL is being met shall return to quarterly monitoring until ~~they meet~~ the requirements set forth in subdivision B 2 a (1) or B 2 b (4) of this section ~~are met~~.

### 3. General monitoring requirements for radionuclides.

a. The ~~commissioner department~~ may require more frequent monitoring than specified in subdivisions B 1 and B 2 of this section, or may require confirmation samples at ~~his or her~~ the department's discretion. The results of the initial and confirmation samples shall be averaged for use in compliance determinations.

b. ~~Each-The~~ owner shall monitor at the time designated by the ~~commissioner department~~ during each compliance period.

c. The ~~commissioner department~~ has the discretion to delete results of obvious sampling or analytic errors.

d. Table 378.1 provides the minimum detection limits for radiological analyses.

TABLE 378.1.  
Minimum Detection Limits for Radiological Analyses.

<u>CONTAMINANT</u>	<u>DETECTION LIMIT</u> (pCi/L unless otherwise noted)
Gross alpha	<u>3</u>
Gross beta	<u>4</u>

Cesium-134	10
Iodine-131	1
Radium-226	1
Radium 228	1
Strontium-89	10
Strontium-90	2
Tritium	1,000
Uranium	1 (µg/L)

**12VAC5-590-379. Groundwater ~~waterworks-system~~ monitoring.**

A. General monitoring requirements.

1. ~~The owner of a~~ ~~Owners of~~ groundwater ~~system, waterworks,~~ including consecutive and wholesale waterworks, shall conduct monitoring in accordance with this section, except that requirements do not apply to waterworks that combine all of their groundwater ~~sources~~ with surface water ~~sources~~ or with groundwater under the direct influence of surface water ~~GUDI sources~~ ~~prior to~~ ~~before~~ treatment in accordance with ~~42VAC5-590-420~~ 12VAC5-590-395.
2. Source water monitoring ~~for by the owner~~ ~~owners of~~ a groundwater ~~system waterworks~~ that ~~does~~ not provide 4-log treatment of viruses for their groundwater sources before or at the first customer ~~are is~~ described in subsection B of this section.
3. ~~Owners of~~ ~~The owner of a~~ groundwater ~~waterworks-system~~ that provides at least 4-log treatment of viruses before or at the first customer ~~are is~~ required to conduct compliance monitoring in accordance with 12VAC5-590-421 C.
4. ~~Owners~~ ~~The owner of a~~ groundwater ~~waterworks-system~~ that ~~have has~~ confirmed fecal ~~E. coli~~ contamination, as determined by source water monitoring conducted under subsection B of this section or have been notified of a significant deficiency as described in 12VAC5-590-350 D, shall implement one or more of the corrective actions outlined in 12VAC5-590-421 A 1, as prescribed by the ~~commissioner~~ ~~department~~.
5. ~~Owners~~ ~~The owner of a~~ groundwater ~~waterworks-system~~ that ~~does~~ not provide 4-log treatment of viruses before or at the first customer, and ~~are is~~ not performing compliance monitoring, shall provide a triggered source water monitoring plans to the ~~commissioner~~ ~~department~~.
6. Any source water sample collected in accordance with this section shall be analyzed for E. coli using one of the analytical methods in 40 CFR 141.402(c).

B. Groundwater source microbial monitoring.

1. Triggered source water monitoring.
  - a. General requirements. ~~Groundwater waterworks owners~~ ~~The groundwater system owner~~ shall conduct triggered source water monitoring if both the conditions identified in subdivisions B 1 a (1) and B 1 a (2) of this section exist.
    - (1) The groundwater ~~waterworks-system owner~~ does not provide at least 4-log treatment of viruses before or at the first customer for each groundwater source; and
    - (2) The groundwater ~~waterworks-system~~ owner is notified that a sample collected under 12VAC5-590-370 A is total coliform-positive and the sample is not invalidated under 12VAC5-590-380 E.

b. Sampling requirements. ~~The Groundwater waterworks owners~~groundwater system owner shall collect, within 24 hours of notification of the total coliform-positive sample, one ~~groundwater~~ source ~~water~~ sample from each groundwater source in use at the time the total coliform-positive sample was collected under 12VAC5-590-370 A, except as provided in this subdivision ~~B-4-b~~.

(1) The ~~commissioner department~~ may extend the 24-hour time limit on a case-by-case basis if the owner cannot collect the ~~groundwater~~-source water sample within 24 hours due to circumstances beyond ~~his-the owner's~~ control. In the case of an extension, the ~~commissioner department~~ shall specify how much time the owner has to collect the sample.

(2) If approved by the ~~commissioner department, the owner of a waterworks owners of waterworks~~ with more than one groundwater source may meet the requirements of this subdivision ~~B-4~~ by sampling a representative groundwater source or sources. ~~The owner Owners~~ shall submit, for the ~~commissioner's department's~~ approval, a triggered source water monitoring plan that identifies one or more groundwater sources that are representative of each monitoring site in the waterworks' bacteriological sample siting report or that identifies groundwater sources that are hydro-geologically similar and clearly identifies which sources will be sampled.

(3) A groundwater system serving 1,000 people or fewer may use a triggered source water sample collected from a groundwater source to meet both the requirements of 12VAC5-590-380 and to satisfy the monitoring requirements of this subdivision ~~B-4~~ for a groundwater source.

c. Additional requirements.

(1) If an E. coli-positive triggered source water sample collected under this subdivision ~~B-4~~ is not invalidated under subdivision B 2 of this section, then the groundwater ~~waterworks-system~~ owner shall provide public notification and collect five additional source water samples from the same source within 24 hours of being notified of the E. coli-positive sample.

(a) If the E. coli-positive triggered source water sample is also used as a repeat sample, then an E. coli PMCL violation is incurred under 12VAC5-590-380 B 1 a.

(b) If a waterworks ~~takes~~ collects more than one repeat sample at the monitoring location required for triggered source water monitoring, then the number of additional source water samples required under subdivision B 1 c (1) of this section may be reduced by the number of repeat samples ~~taken~~ collected at that location that were not E. coli positive.

(2) If any of the five additional samples are E. coli positive, then the groundwater system owner shall comply with the treatment technique requirements of 12VAC5-590-421.

d. Consecutive and wholesale waterworks.

(1) A consecutive groundwater ~~waterworks-system~~ owner ~~that-who~~ has a total coliform-positive sample collected in accordance with 12VAC5-590-370 A shall notify the wholesale waterworks owner and the ~~district engineer~~ department within 24 hours of being notified of the total coliform-positive sample.

(2) ~~A-The~~ wholesale groundwater ~~waterworks-system~~ owner shall comply with the following:

(a) A wholesale groundwater ~~waterworks-system~~ owner ~~that-who~~ receives notice from a consecutive waterworks it serves that a sample collected in accordance with 12VAC5-590-370 A is total coliform-positive shall, within 24 hours of being notified,

collect a sample from its groundwater ~~source(s)~~ source or sources, as described in subdivision B 1 of this section.

(b) If the sample collected under this subdivision ~~B-4~~ is E. coli positive, then the wholesale groundwater system owner shall within 24 hours notify all consecutive waterworks served by that groundwater source of the E. coli positive source water ~~positive~~ sample as described in 12VAC5-590-540 and shall meet the requirements of subdivision B 1 c of this section.

e. Exception to the triggered source water monitoring requirements. A groundwater system owner is not required to comply with the source water monitoring requirements of this subdivision ~~B-4~~ if the ~~commissioner~~ department determines, and documents in writing, that:

(1) The total coliform-positive sample collected in accordance with 12VAC5-590-370 A is invalidated under 12VAC5-590-380 E.

(2) The total coliform-positive sample collected in accordance with 12VAC5-590-370 A is caused by a distribution system deficiency (sanitary defect).

(3) The total coliform-positive sample collected in accordance with 12VAC5-590-370 A was caused by distribution system conditions that will cause total coliform-positive samples.

2. Invalidation of an E. coli-positive groundwater source sample.

a. ~~A-The~~ groundwater ~~waterworks-system~~ owner may obtain the ~~commissioner's department's~~ invalidation of an E. coli-positive groundwater source sample collected under subdivision B 1 of this section only under the conditions specified in subdivisions B 2 a (1) and B 2 a (2) of this section:

(1) The groundwater ~~waterworks-system~~ owner provides the ~~commissioner department~~ with written notice from the laboratory that improper sample analysis occurred; or

(2) The ~~commissioner department~~ determines and documents in writing that there is substantial evidence that the E. coli-positive groundwater source sample is not related to source water quality.

b. If the ~~commissioner department~~ invalidates an E. coli-positive groundwater source sample, then the groundwater system owner shall collect another source water sample under subdivision B 1 of this section within 24 hours of being notified by the ~~commissioner department~~ of the invalidation decision and have it analyzed for E. coli.

3. Sampling location. All groundwater source samples required under subdivision B 1 of this section shall be collected at a location ~~prior to before~~ any treatment of the groundwater source unless otherwise approved by the ~~commissioner~~ department.

4. Public notification. The owner of a groundwater ~~waterworks-system~~ with a source water sample collected under this subsection that is E. coli positive and that is not invalidated under subdivision B 2 of this section, including consecutive waterworks served by the groundwater source, shall conduct public notification as required in 12VAC5-590-540 A 1.

5. Monitoring violations. Failure to meet the monitoring requirements of subdivision B 1 of this section is a violation and requires the groundwater ~~waterworks-system~~ owner to provide public notification as required in 12VAC5-590-540 A 3.

C. Monitoring requirements for source water.

1. The owner of ~~any-a~~ groundwater source utilizing chlorine disinfection or any other treatment or chemical addition that may alter or affect the bacteriological quality of the



source water shall collect source ~~water~~ samples for bacteriological analysis in accordance with this section.

2. All bacteriological samples under this section shall be collected from the source water ~~prior to before~~ any treatment or chemical addition.

a. The owner shall provide a suitable source water sample tap at each groundwater source.

b. If conditions ~~are such indicate~~ that it is not possible to install a source water sample tap, ~~then~~ an alternate sample location acceptable to the ~~commissioner department~~ may be utilized for this monitoring.

3. All samples shall be analyzed by a test method that will yield a Most Probable Number (MPN) result for both total coliforms and E. coli.

4. Number of samples.

a. The number of routine source water samples to be collected and the frequency of sampling shall be determined by the department. The department will notify the ~~waterworks~~ owner of the source water sampling requirements.

b. As a minimum, the owner shall collect source water samples in accordance with Table 379.1.

TABLE 379.1.

Monitoring Requirements for Source Water Samples.

<u>SOURCE TYPE</u>	<u>MINIMUM ROUTINE SOURCE WATER MONITORING FREQUENCY</u>	<u>PARAMETERS</u>
<u>Well located in non-karst geology</u>	<u>One sample per year</u>	<u>Total coliforms MPN and E coli MPN</u>
<u>Well located in karst geology</u>	<u>One sample per calendar quarter</u>	<u>Total coliforms MPN and E coli MPN</u>
<u>Spring</u>	<u>One sample per month</u>	<u>Total coliforms MPN and E coli MPN</u>

c. When a single sample result from ~~any a~~ groundwater source that requires a routine source water monitoring frequency of less than monthly indicates total coliforms in excess of 50 colonies/100 mL or the presence of E. coli, the owner shall collect one confirmation sample within seven calendar days after notification of the results.

d. The ~~commissioner department~~ may require that additional source water samples be collected and will establish the specific number of samples and the monitoring frequency.

**12VAC5-590-380. Bacteriological quality compliance.**

A. Analytical methodology.

1. ~~The standard sample volume for the coliform test shall consist of 100 milliliters, regardless of the analytical method used.~~

2. ~~Owners-The owner~~ needs only to determine the presence or absence of total coliforms and E. coli; ~~a determination of total coliform density is not required for routine bacteriological monitoring at entry points or distribution system locations.~~

3. The time from sample collection to initiation of test medium incubation shall not exceed 30 hours.

4. Owners are encouraged but not required to hold samples below 10°C during transit.

5. If water having residual chlorine (measured as free, combined, or total chlorine) is to be analyzed, sufficient sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) shall be added to the sample bottle before sterilization to neutralize any residual chlorine in the water sample.

B. PMCLs for microbial contaminants.

1. A waterworks is in compliance with the PMCL for E. coli unless any of the conditions identified in this subdivision occur. A violation may pose an acute risk to public health and is a Tier 1 condition requiring public notification as described in 12VAC5-590-540 A.1 when:

- a. A repeat sample following a total coliform-positive routine sample is E. coli positive;
- b. A repeat sample following an E. coli-positive routine sample is total coliform positive;
- c. The owner fails to ~~take~~collect all required repeat samples following an E. coli-positive routine sample; or
- d. The owner fails to test for E. coli when any repeat sample tests positive for total coliform.

2. Compliance shall be determined with the PMCL for E. coli for each monitoring period for which monitoring for total coliforms is required.

C. The best available technology, treatment techniques, or other means available for achieving compliance with the PMCL for E. coli shall be:

1. Protection of wells from contamination by coliforms by appropriate placement, ~~and construction, and maintenance of the wells~~;
2. Maintenance of a detectable disinfectant residual throughout the distribution system;
3. Proper maintenance of the distribution system including appropriate pipe replacement and repair procedures, water main flushing programs, proper operation and maintenance of storage tanks and reservoirs, continual maintenance of positive water pressure in all parts of the distribution system, and an approved cross-connection control program;
4. Filtration and disinfection of either surface water sources or ~~surface-influenced groundwater~~ GUDI sources or both; and
5. Disinfection of groundwater using strong oxidants such as chlorine, chlorine dioxide, or ozone.

D. A total coliform-positive result is indicative of a breakdown in the protective barriers and shall be cause for repeat monitoring and special follow-up action to locate and eliminate the cause of contamination.

1. For each routine sample found to be total coliform positive, the ~~waterworks~~ owner shall collect a set of three repeat samples within 24 hours of being notified of the positive result. The ~~commissioner department~~ may extend the 24-hour time limit on a case-by-case basis. For groundwater ~~waterworks~~systems, the requirements of 12VAC5-590-379 shall also apply, and all repeat samples must be analyzed for E. coli using one of the analytical methods in 40 CFR 141.402(c).

- a. The owner shall collect at least one repeat sample from the sampling tap where the original total coliform-positive sample was ~~taken~~collected, and at least one repeat sample at a tap within five service connections upstream and at least one repeat sample at a tap within five service connections downstream of the original sampling site. If a total coliform-positive sample is at the end of the distribution system or one

service connection away from the end of the distribution system, the owner must still ~~take~~ collect all required repeat samples.

b. The owner shall collect an additional set of repeat samples if one or more repeat samples in the current set of repeat samples is total coliform positive. The owner shall collect the additional set of repeat samples within 24 hours of being notified of the positive results, unless the ~~commissioner~~ department extends the limit as provided in this section. The owner shall continue to collect additional sets of repeat samples until either total coliforms are not detected in one complete set of repeat samples or the owner determines that a coliform treatment technique trigger specified in 12VAC5-590-392 B has been exceeded as a result of a repeat sample being total coliform positive and notifies the ~~appropriate ODW field office~~ department. If a trigger identified in 12VAC5-590-392 B is exceeded as a result of a routine sample being total coliform positive, ~~then on the~~ owner is required to conduct only one round of repeat monitoring for each total coliform-positive routine sample.

c. If the owner collects a routine sample before learning the results of the previous routine sample, and the sample is ~~taken~~ collected within five service connections of the initial routine sample, then the owner may count the subsequent sample as a repeat sample when the initial sample results are found to be total coliform positive.

d. If one or more repeat samples ~~taken~~ collected at the monitoring location required for triggered source water monitoring are E. coli positive, ~~then the~~ waterworks-owner has exceeded the E. coli PMCL and must comply with the groundwater system treatment technique requirements specified in 12VAC5-590-421.

e. If all repeat samples ~~taken~~ collected at the monitoring location required for triggered source water monitoring are E. coli negative, and a repeat sample ~~taken~~ collected at a monitoring location other than the one required for triggering source water monitoring is E. coli positive, then the ~~waterworks~~-owner has exceeded the E. coli PMCL. However, the owner is not required to collect five additional source water samples from the same source within 24 hours of learning the E. coli-positive result.

f. The ~~waterworks~~-owner shall collect all repeat samples on the same day, except the ~~commissioner~~ department may allow ~~the owner of~~ a waterworks with a single service connection to collect the required set of repeat samples over a three-day period or to collect a larger volume repeat sample in one or more sample containers of any size as long as the total volume collected is at least 300 ml.

g. If a repeat sample ~~taken~~ collected at the monitoring location required for triggered source water monitoring is E. coli positive, ~~then the~~ waterworks-owner has exceeded the E. coli PMCL and must collect five additional source water samples from the same source within 24 hours of learning the E. coli-positive result.

2. Results of all routine and repeat samples not invalidated by the ~~commissioner~~ department shall be used to determine compliance with the PMCL for E. coli and whether a treatment technique trigger specified in 12VAC5-590-392 B has been exceeded.

3. Special-~~purpose~~ samples, such as those ~~taken~~ collected to determine whether disinfection practices are sufficient following pipe placement, replacement, or repair, and samples ~~taken~~ collected before start-up of a seasonal waterworks, shall not be used to determine compliance. Repeat samples are not considered special-~~purpose~~ samples.

E. A total coliform-positive sample invalidated under this paragraph does not count towards meeting the minimum monitoring requirements of this section. To invalidate a total coliform-positive sample under this subsection, the written decision and rationale shall be ~~reviewed~~ ~~evaluated~~, approved, and signed by the ~~commissioner~~ department. The ~~commissioner~~ department shall make this document available to EPA and the public. The written documentation

shall state the specific cause of the total coliform-positive sample and what action the owner has taken, or will take, to correct this problem. The ~~commissioner-department~~ shall not invalidate a total coliform-positive sample solely on the grounds that all repeat samples are total coliform negative.

1. The ~~commissioner-department~~ may invalidate a total coliform-positive sample if any of the following conditions are met:

a. The laboratory establishes that improper sample analysis caused the total coliform-positive result;

b. The ~~commissioner-department~~, on the basis of the results of repeat samples collected as required by subdivision D 1 of this section, determines that the total coliform-positive sample resulted from a domestic or other ~~non-distribution non-distribution~~ non-distribution system plumbing problem. The ~~commissioner-department~~ cannot invalidate a sample on the basis of repeat sample results unless all repeat ~~sample(s) sample or samples~~ collected at the same tap as the original total coliform-positive sample are also total coliform positive, and all repeat samples collected at a location other than the original tap are total coliform negative (e.g., the ~~commissioner-department~~ cannot invalidate a total coliform-positive sample on the basis of repeat samples if all the repeat samples are total coliform negative, or if the waterworks has only one service connection); or

c. The ~~commissioner-department~~ has substantial grounds to believe that a total coliform-positive result is due to a circumstance or condition that does not reflect water quality in the distribution system. In this case, the ~~waterworks-owner~~ shall still collect all repeat samples required under subdivision D 1 of this section, and use them to determine whether a coliform treatment technique trigger in 12VAC5-590-392 B has been exceeded.

2. A laboratory must invalidate a sample because of sampling interference (i.e., turbid culture in absence of (i) gas production, or (ii) acid reaction; exhibition of confluent growth; or production of colonies too numerous to count). The ~~waterworks-owner's owner~~ shall collect a replacement sample from the same location within 24 hours, and have it analyzed for the presence of total coliforms. The ~~waterworks-owner~~ must continue to resample within 24 hours and have the samples analyzed until ~~they obtain~~ they obtain a valid result is obtained. The ~~commissioner-department~~ may waive the 24-hour time limit on a case-by-case basis.

#### F. Escherichia coli (E. coli).

1. If ~~any routine or repeat, sample or replacement sample~~ is total coliform positive, ~~then~~ the ~~waterworks-owner~~ shall analyze ~~that the~~ total coliform-positive culture medium to determine if E. coli are present. If E. coli are present, ~~then~~ the ~~waterworks-owner~~ shall notify the ~~appropriate ODW field office department~~ by the end of the day when the ~~waterworks-owner~~ is notified of the test result, unless the ~~ODW's field office department~~ is closed, in which case the ~~appropriate ODW field office department~~ must be notified before the end of the next business day.

2. The ~~commissioner-department~~ has the discretion to allow an ~~an waterworksowner~~, on a case-by-case basis, to forgo E. coli testing on a total coliform-positive sample if the owner assumes that the total coliform-positive sample is E. coli positive. Accordingly, the owner must notify the ~~appropriate ODW field office department~~ as specified in subdivision E1 of this subsection and the provisions of subdivision B 1 of this section apply.

#### G. Groundwater sources.

1. Groundwater sources shall be disinfected in accordance with ~~12VAC5-590-1000 when~~ the total coliform geometric mean of 20 or more raw water samples measured by a method

yielding a multiple-portion decimal dilution (MPN) result is greater than three. ~~12VAC5-590-421 A 1 d~~ when the results of the source water monitoring samples specified in 12VAC5-590-430 B 2 or 12VAC5-590-840 K 1 a indicate a total coliform concentration (geometric mean) of the 20 samples to be greater than 3 colonies/100 mL but less than 100 colonies/100 mL. The value 1.0 shall be used to represent a negative zero coliform result in the calculation of the geometric mean.

2. ~~Groundwater sources containing a total coliform geometric mean of 100 or more organisms per 100 milliliters or with more than 10% of these samples exceeding 100 organisms per 100 milliliters constitutes unacceptable contamination for disinfection treatment only.~~ source monitoring results conducted in accordance with 12VAC5-590-430 B 2 or 12VAC5-590-840 K 1 a that indicate a total coliform concentration equal to or greater than 100 colonies/100 ml constitutes contamination that is not treatable by single-barrier disinfection treatment alone.

3. Groundwater sources shall be disinfected in accordance the requirements of ~~12VAC5-590-1000~~ 12VAC5-590-421 A 1 d when the source water quality contributes to the waterworks' failure to meet the bacteriological PMCL specified in subsection B of this section.

4. ~~Groundwater sources shall be disinfected in accordance with 12VAC5-590-421 A 1 d when the results of source development samples specified in 12VAC5-590-840 B 11 indicate the presence of E. coli in two or more samples.~~

5. ~~Groundwater sources shall be disinfected in accordance with 12VAC5-590-421 A 1 d when the results of raw water monitoring conducted in accordance with 12VAC5-590-425 indicate the presence of E. coli in two or more samples during any running six month period.~~

4. If the results of the source water monitoring required by 12VAC5-590-379 C or 12VAC5-590-430 B 2 indicate the presence of E. coli in two or more samples collected during any running six-month period, then the owner shall:

- a. Issue a Tier 1 public notice in accordance with 12VAC5-590-540 A 1.
- b. Provide disinfection treatment to achieve a 4-log virus inactivation and removal as specified in 12VAC5-590-421 A 1 d.
- c. Conduct compliance monitoring as specified in 12VAC5-590-421 B and 12VAC5-590-421 C.

5. If the results of the source water monitoring required in 12VAC5-590-379 C indicate total coliform concentration in excess of 50 colonies/100 mL in three or more samples collected during any running ~~6~~ six-month period or the presence of E. coli in two or more samples collected during any running ~~6~~ six-month period, then the source shall be reevaluated for GUDI determination in accordance with 12VAC5-590-430.

6. The ~~commissioner~~ department may require that any groundwater source be disinfected in accordance with the requirements of 12VAC5-590-421 A 1 d.

H. ~~Groundwater systems conducting source water monitoring as described in 12VAC5-590-379 shall determine the presence or absence of E. coli. All samples shall be analyzed in accordance with 12VAC5-590-440 by the Division of Consolidated Laboratory Services (DCLS) or by a laboratory certified by DCLS for drinking water samples analyses.~~

#### **12VAC5-590-382. Inorganic chemicals compliance.**

A. When the results of sampling for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium exceed the

applicable PMCL, the owner shall collect a confirmation sample, at the same sampling point, within two weeks of notification of the analytical results of the first sample. The fluoride PMCL applies only to community waterworks.

1. The results of the initial and confirmation samples shall be averaged to determine compliance with subsection A of this section. The ~~commissioner~~ department has the discretion to delete results of obvious sampling errors.

2. Compliance with the PMCLs for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, and thallium listed in Table 340.1 shall be determined based on the analytical results obtained at each sampling point.

a. For ~~waterworks that are the owner who is~~ conducting monitoring more frequently than annually, compliance with the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium is determined by a ~~running annual average~~ RAA at each sampling point. If the average at any sampling point is greater than the PMCL, then the waterworks is out of compliance. If any single sample would cause the annual average to be exceeded, then the waterworks is out of compliance immediately. ~~Any~~ A sample below the method detection limit shall be calculated as zero for the purpose of determining the annual average. If ~~an~~ the owner fails to collect the required number of samples, ~~then~~ compliance (average concentration) shall be based on the total number of samples collected.

b. For ~~waterworks that are the owner who is~~ monitoring annually, or less frequently, the waterworks is out of compliance with the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium if the average of the original sample and a confirmation sample of a contaminant at any sampling point is greater than the PMCL. ~~Waterworks~~ The owner monitoring annually or less frequently whose sample results exceeds the PMCL shall begin quarterly sampling. The ~~waterworks owner~~ shall not be considered in violation of the PMCL until ~~the owner has completed~~ one year of quarterly sampling ~~has been completed and the RAA is exceeded~~. However, if the confirmation sample is not collected, the owner is in violation of the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium. If ~~an~~ the owner fails to collect the required number of samples, ~~then~~ compliance (average concentration) shall be based on the total number of samples collected.

B. Compliance with the PMCLs for nitrate and nitrite shall be determined based on the analytical results obtained at each sampling point. The waterworks is not out of compliance with the PMCL if the concentrations of these contaminants are equal to or below the PMCLs. Where nitrate or nitrite sample results exceed the PMCL, the owner shall collect a confirmation sample, from the same sampling point that exceeded the PMCL within 24 hours of the ~~waterworks' owner's~~ receipt of the analytical results of the first sample. The results of the initial and confirmation ~~sample~~ samples shall be averaged to determine compliance. ~~Owners~~ An owner unable to comply with the 24-hour sampling requirement shall immediately notify the consumers in the area served by the waterworks in accordance with 12VAC5-590-540 A 1. ~~Owners~~ The owner exercising this option shall ~~take collect~~ and analyze a confirmation sample within two weeks of notification of the analytical results of the first sample. The ~~commissioner~~ department may require more frequent monitoring. The ~~commissioner~~ department has the discretion to delete results of obvious sampling errors.

1. Nitrate nitrogen (NO<sub>3</sub>-N) levels not exceeding 20 mg/L may be allowed in a noncommunity waterworks if the owner:

- a. Demonstrates to the satisfaction of the ~~commissioner~~ department that this water will not be available to children under six months of age;
- b. Provides continuous posting of the fact that NO<sub>3</sub>-N levels exceed 10 mg/L and the potential health effects of exposure;
- c. Notifies health officials annually of NO<sub>3</sub>-N levels that exceed 10 mg/L; and
- d. The ~~commissioner~~ department shall determine that no adverse health effects will result.

2. Nitrite in water poses a significant health hazard. Water with nitrite-nitrogen concentrations over 1 mg/L should not be used for infant feedings.

C. Compliance with the SMCLs for aluminum, chloride, copper, corrosivity, fluoride, foaming agents, iron, manganese, silver, sulfate, or zinc shall be determined based on the analytical results obtained at each sampling point. When the result of a sample exceeds the applicable SMCL, the owner should collect a confirmation sample, at the same sampling point, within two weeks of notification of the analytical results of the first sample. The results of the initial and confirmation samples shall be averaged to determine compliance. If the average concentration level of any of these constituents exceeds the SMCL, then the ~~commissioner~~ department shall determine whether treatment for the constituents can be accomplished or more suitable ~~supplies~~ source waters are, or can be made, available. This determination shall be made as quickly as possible. If either of these alternatives is feasible, then corrective action shall be promptly ~~collected~~ implemented by the owner if deemed necessary by the ~~commissioner~~ department. Exceeding the fluoride SMCL requires annual public notice in accordance with ~~{See see~~ 12VAC5-590-540 G}.

#### **12VAC5-590-383. Organic chemicals compliance.**

A. When the results of sampling indicate positive results for contaminants listed in Table 340.2, the owner shall collect a confirmation sample, at the same sampling point, within two weeks of notification of the analytical results of the first sample.

B. The results of the initial and confirmation ~~sample~~ samples shall be averaged to determine the waterworks' compliance in accordance with subsection C of this section. The ~~commissioner~~ department has the discretion to delete results of obvious sampling errors.

C. Compliance with Table 340.2 shall be determined based on the analytical results obtained at each sampling point. ~~Any~~ A samples result below the detection limit shall be calculated as zero for the purposes of determining the annual average. If ~~an~~ the owner fails to collect the required number of samples, then compliance (average concentration) shall be based on the total number of samples collected.

1. For ~~waterworks that are the owner who is~~ conducting monitoring more frequently than annually, compliance is determined by a ~~running annual average~~ RAA of all samples collected at each sampling point. If the annual average of any sampling point is greater than the PMCL, then the waterworks is out of compliance. If the initial sample or a subsequent sample would cause the annual average to be exceeded, then the waterworks is out of compliance immediately. ~~Any~~ samples result below the detection limit shall be calculated as zero for purposes of determining the annual average.

2. If the owner is conducting monitoring ~~is conducted~~ annually, or less frequently, then the ~~waterworks owner~~ is not in violation if the average of the initial and confirmation ~~sample~~ samples is greater than the PMCL for that contaminant; however, the owner shall begin quarterly sampling. The ~~waterworks owner~~ will not be considered in violation of the PMCL

until ~~it has completed~~ one year of quarterly sampling ~~has been completed and the RAA is exceeded~~. If any sample will cause the ~~running annual average~~RAA to exceed the PMCL at any sampling point, ~~then~~ the waterworks is immediately out of compliance with the PMCL.

**12VAC5-590-384. Disinfectant residualsResidual disinfectant, disinfection byproducts, and disinfection byproduct precursor compliance.**

A. General requirements.

1. Where compliance is based on a ~~running annual average~~RAA of monthly or quarterly samples or averages and the owner fails to monitor for TTHM, HAA5, or bromate, this failure to monitor shall be treated as a monitoring violation for the entire period covered by the annual average. Where compliance is based on a ~~running annual average~~RAA of monthly or quarterly samples or averages and the ~~owners'~~owner's failure to monitor makes it impossible to determine compliance with MRDLs for chlorine and chloramines, this failure to monitor shall be treated as a monitoring violation for the entire period covered by the annual average.

2. All samples collected and analyzed under the provisions of this section shall be included in determining compliance, even if that number is greater than the minimum required.

3. ~~A waterworks~~The owner is in violation of the PMCL when the LRAA exceeds the PMCLs listed in Table 340.6, calculated based on four consecutive quarters of monitoring, or the LRAA calculated based on fewer than four quarters of data if the PMCL would be exceeded regardless of the monitoring results of subsequent quarters. ~~The owner is~~Waterworks are in violation of the monitoring requirements for each quarter that a monitoring result would be used in calculating ~~an~~the LRAA if the owner fails to monitor.

B. Disinfection byproducts.

1. TTHM and HAA5.

a. ~~Owners of~~The owner of a waterworks required to monitor quarterly shall calculate the LRAAs for TTHM and HAA5 using monitoring results collected under 12VAC5-590-374 F and determine that each LRAA does not exceed the PMCL in order to comply with the PMCLs listed in Table 340.6. If the owner fails to complete four consecutive quarters of monitoring, ~~then~~ the owner shall calculate compliance with the PMCL based on the average of the available data from the most recent four quarters. If the owner collects more than one sample per quarter at a monitoring location, ~~then~~ the owner shall average all samples collected in the quarter at that location to determine a quarterly average to be used in the LRAA calculation.

b. ~~Owners of~~The owner of a waterworks required to monitor ~~yearly~~annually or less frequently shall determine that each sample collected is less than the PMCL in order to determine compliance with the PMCLs listed in Table 340.6. If any sample result exceeds the PMCL, ~~then~~ the owner shall comply with the requirements of 12VAC5-590-374 F 5. If no sample result exceeds the PMCL, ~~then~~ the sample result for each monitoring location is considered the LRAA for that monitoring location.

c. ~~Waterworks are~~The owner is in violation of the monitoring requirements for each quarter that a monitoring result would be used in calculating an LRAA if the owner fails to monitor.

d. ~~A Waterworks~~waterworks ~~have~~has exceeded the operational evaluation level at any monitoring location where the sum of the two previous quarters' TTHM results plus twice the current quarter's TTHM result, divided by four to determine an average, exceeds 0.080 mg/L, or where the sum of the two previous quarters' HAA5 results plus



twice the current quarter's HAA5 result, divided by four to determine an average, exceeds 0.060 mg/L.

(1) ~~Owners~~The owner of a waterworks that exceeds the operational evaluation level shall conduct an operational evaluation and submit a written report of the evaluation to the ~~commissioner department~~ on a form approved by the department no later than 90 days after being notified of the analytical result that ~~causes~~caused the waterworks to exceed the operational evaluation level. The written report shall be made available to the public upon request.

(2) The operational evaluation report shall include an examination of the waterworks treatment and distribution operational practices, including source water conditions, storage tank operations, excess storage capacity, distribution system flushing, changes in source water or source water quality, and treatment changes or problems that may contribute to TTHM and HAA5 formation and what steps could be considered to minimize future exceedances.

(3) The owner may request and the ~~commissioner department~~ may allow the ~~waterworks owner~~ to limit the scope of the evaluation if the owner is able to identify the cause of the operational evaluation level exceedance. The request to limit the scope of the evaluation does not extend the schedule in subdivision B 1 d (1) of this section for submitting the written report. The ~~commissioner department~~ shall approve this limited scope of evaluation in writing and the owner shall keep that approval with the completed report.

2. Bromate. Compliance shall be based on a running annual arithmetic average, computed quarterly, of monthly samples ~~for, for months in which the owner collects more than one sample, the average of all samples collected during the month~~ collected by the owner as prescribed by 12VAC5-590-374 H. ~~For months in which the owner collects more than one sample, compliance is based on the average of all samples collected during the month.~~ If the average result of the samples covering any consecutive four-quarter period exceeds the PMCL listed in Table 340.6, then the ~~waterworks owner~~ is in violation of the PMCL and shall notify the public pursuant to 12VAC5-590-540 A 2, in addition to reporting to the ~~commissioner department~~ pursuant to 12VAC5-590-530 and 12VAC5-590-531. If ~~an~~the owner fails to complete 12 consecutive ~~months'~~months of monitoring, then compliance with the PMCL for the last four-quarter compliance period shall be based on ~~an~~the average of the available data.

3. Chlorite. Compliance shall be based on an arithmetic average of each ~~three~~three-sample set collected in the distribution system as prescribed by 12VAC5-590-374 G. If the arithmetic average of any ~~three~~three-sample set exceeds the PMCL listed in Table 340.6, then the ~~waterworks owner~~ is in violation of the PMCL and shall notify the public pursuant to 12VAC5-590-540 A 2, in addition to reporting to the ~~commissioner department~~ pursuant to 12VAC5-590-530 and 12VAC5-590-531.

#### C. ~~Residual disinfectant~~Disinfectant residuals.

##### 1. Chlorine and chloramines.

a. Compliance shall be based on a running annual arithmetic average, computed quarterly, of monthly averages of all samples collected by the owner under 12VAC5-590-374 I 1 a. If the average covering any consecutive four-quarter period exceeds the MRDL listed in Table 340.7, then the ~~waterworks owner~~ is in violation of the MRDL and shall notify the public pursuant to 12VAC5-590-540 A 2, in addition to reporting to the ~~commissioner department~~ pursuant to 12VAC5-590-530 and 12VAC5-590-531.

b. In cases where the owner ~~waterworks switch~~switches between the use of chlorine and chloramines for residual disinfection during the year, compliance shall be

determined by including together all monitoring results of both chlorine and chloramines in calculating compliance. Reports submitted pursuant to 12VAC5-590-530 and 12VAC5-590-531 shall clearly indicate which residual disinfectant was analyzed for each sample.

c. Notwithstanding the MRDLs listed in Table 340.7, operators may increase the residual disinfectant levels of chlorine or chloramines in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems caused by circumstances such as ~~distribution line~~ water main breaks in the distribution system, storm runoff events, source water contamination, or cross-connections.

#### 2. Chlorine dioxide.

a. Acute violations. Compliance shall be based on consecutive daily samples collected by the owner under 12VAC5-590-374 I 2 a. If any daily sample collected at the entrance to the distribution system exceeds the MRDL listed in Table 340.7, and on the following day one (or more) of the three samples collected in the distribution system exceed the MRDL, then the waterworks-owner is in violation of the MRDL and shall take immediate corrective action to lower the level of chlorine dioxide below the MRDL and shall notify the public pursuant to the procedures for Tier 1 conditions in 12VAC5-590-540 A 1 in addition to reporting to the ~~commissioner~~ department pursuant to 12VAC5-590-530 and 12VAC5-590-531. Failure to collect samples in the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system shall also be considered an MRDL violation, and the owner shall notify the public of the violation in accordance with the provisions for Tier 1 conditions in 12VAC5-590-540 A 1 in addition to reporting to the ~~commissioner~~ department pursuant to 12VAC5-590-530 and 12VAC5-590-531.

b. Non-acute violations. Compliance shall be based on consecutive daily samples collected by the owner under 12VAC5-590-374 I 2 a. If any two consecutive daily samples collected at the entrance to the distribution system exceed the MRDL listed in Table 340.7 and all distribution system samples collected are below the MRDL, then the waterworks-owner is in violation of the MRDL and shall take corrective action to lower the level of chlorine dioxide below the MRDL at the point of sampling and shall notify the public pursuant to the procedures for Tier 2 conditions in 12VAC5-590-540 A 2 in addition to reporting to the ~~commissioner~~ department pursuant to 12VAC5-590-530 and 12VAC5-590-531. Failure to monitor at the entrance to the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system is also an MRDL violation, and the owner shall notify the public of the violation in accordance with the provisions for Tier 2 conditions in 12VAC5-590-540 A 2 in addition to reporting to the ~~commissioner~~ department pursuant to 12VAC5-590-530 and 12VAC5-590-531.

#### D. Disinfection byproduct precursors (DBPPs).

1. Compliance shall be determined as specified by 12VAC5-590-411 A 3.

2. For the owner of a -waterworks required to meet Step 1 TOC removals, if the value calculated under 12VAC5-590-411 A 3 a (4) is less than 1.00, then the waterworks-owner is in violation of the treatment technique requirements and shall notify the public pursuant to 12VAC5-590-540 A 2 in addition to reporting to the ~~commissioner~~ department pursuant to 12VAC5-590-530 and 12VAC5-590-531.

**12VAC5-590-385. Lead and copper action level compliance.**

A. The lead action level is exceeded if the concentration of lead in more than 10% of tap water samples collected during any monitoring period conducted in accordance with 12VAC5-590-375 B is greater than 0.015 mg/L (i.e., if the 90th percentile lead level is greater than 0.015 mg/L).

B. The copper action level is exceeded if the concentration of copper in more than 10% of tap water samples collected during any monitoring period conducted in accordance with 12VAC5-590-375 B is greater than 1.3 mg/L (i.e., if the 90th percentile copper level is greater than 1.3 mg/L).

C. The 90th percentile lead and copper levels shall be computed as follows:

1. The results of all lead or copper samples taken during a monitoring period shall be placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Each sampling result shall be assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level shall be equal to the total number of samples taken.

2. The number of samples taken during the monitoring period shall be multiplied by 0.9.

3. The contaminant concentration in the numbered sample yielded by the calculation in subdivision C 2 of this section is the 90th percentile contaminant level.

4. For a waterworks serving fewer than 100 people, ~~and the owner collects that collect~~ five samples per monitoring period, the 90th percentile is computed by taking the average of the highest and second highest concentrations.

5. For ~~an the~~ owner ~~that who~~ has been allowed by the ~~commissioner department~~ to collect fewer than five samples in accordance with 12VAC5-590-375 B 3, the sample result with the highest concentration is considered the 90th percentile value.

**12VAC5-590-388. Radiological compliance.**

A. MCLGs for radionuclides are listed in Table 546.1 of 12VAC5-590-546 B.

B. PMCLs for radionuclides are applicable to community waterworks only and are listed in Table 340.4. Compliance with PMCLs will be determined based on the analytical results obtained at each entry point. If the sample result at one entry point is in violation of a exceeds the PMCL, then the owner waterworks is in violation of the PMCL.

1. For the owner waterworks who is monitoring more than once per year, compliance with the PMCL is determined by a ~~running annual average~~ RAA of the analytical results at each entry point. If the average result of at any entry point is greater than the PMCL, then the waterworks is out of compliance with the PMCL.

2. For the owner who is waterworks monitoring more than once per year, if any sample result will cause the ~~running average~~ RAA to exceed the PMCL at any entry point, then the waterworks is out of compliance with the PMCL immediately.

3. All samples collected and analyzed under the provisions 12VAC5-590-378 shall be included in determining compliance, even if that number is greater than the minimum required.

4. If ~~an the~~ owner does not collect all required samples when compliance is based on a ~~running annual average~~ RAA result of quarterly samples, then compliance will be based on the ~~running average~~ RAA result of the samples collected.

5. If a sample result is less than the detection limit as specified in Table 378.1, then zero will be used to calculate the ~~RAA~~ annual average, unless a gross alpha particle activity result is being used ~~in lieu instead~~ of radium-226 or uranium. If the gross alpha particle

activity result is less than the detection limit as specified in Table 378.1, ~~then 1/2~~one-half the detection limit will be used to calculate the RAA annual average.

C. Radiological (gross alpha, combined radium-226 and radium-228, uranium, and man-made radioactivity).

1. Compliance with the radiological PMCLs shall be based on the RAA annual average results. PMCLs are indicated in Table 340.4. Sampling for radiological analysis shall be in compliance with 12VAC5-590-378.

2. Compliance shall be determined by rounding off results to the same number of significant figures as the PMCL for the substance-radionuclide in question.

D. If a PMCL for radioactivity ~~set forth~~listed in Table 340.4 is exceeded, ~~then~~ the owner shall give notice to the ~~commissioner~~department pursuant to 12VAC5-590-530 and to the public as required by 12VAC5-590-540 A 2.

#### **12VAC5-590-390. Chemical and physical qualityPhysical constituent compliance.**

A. Necessary action for noncompliance.

1. Inorganic chemicals. See 12VAC5-590-530 B and 12VAC5-590-540.

2. Organic chemicals. See 12VAC5-590-530 B and 12VAC5-590-540.

3. Turbidity. See 12VAC5-590-530 B and 12VAC5-590-540.

A. Color, odor, pH, and total dissolved solids.

1. When the sampling results ~~of sampling~~ for color, odor, pH, or total dissolved solids exceed the applicable SMCL, the owner shall collect a confirmation sample, at the same sampling site, within two weeks of notification of the analytical results of the first sample.

2. The results of the initial and confirmation samples shall be averaged to determine compliance with 12VAC5-590-340 C. The ~~commissioner~~department has the discretion to void results of obvious sampling errors.

4-3. If the average concentration level of ~~a substance~~any contaminant of color, odor, pH, or total dissolved solids is greater than the ~~Secondary Maximum Contaminant Level~~ SMCL listed in Table 340.3, ~~then~~ the ~~division~~will ~~commissioner~~department shall determine whether treatment to remove ~~the substance that contaminant~~ can be accomplished or more suitable supplies of source water are, or can be made, available. This determination will be made as quickly as possible. If either of these alternatives is possible, corrective action shall be promptly taken by the owner if deemed necessary by the division.

B. Specific limits. No attempt has been made to prescribe specific limits for every contaminant that might enter a water supply or waterworks. Although the need exists for continued attention to the entry of chemical and physical substances into water, the limits are confined to substances recognized as being detrimental to the health or well-being of the consumer. Limits for innumerable substances would require an impossible burden of analytical examination. The specific limits included in these regulations are listed in Tables 2.2, 2.3, and 2.4. Turbidity in groundwater sources not required to filter shall not:

1. Interfere with disinfection throughout the distribution system;

2. Cause taste and odors upon disinfection; or

3. Cause consumers to question the safety of their drinking water.

#### **12VAC5-590-391. Treatment technique requirements.**

A. When it is not technically or economically feasible to monitor for a particular PMCL ~~or a~~ contaminant, one or more specific treatment techniques that lead to a reduction in the level of that contaminant shall be required. The application of that treatment technique ~~reduces~~ the contaminant in question to a concentration level that achieves compliance with this chapter.

B. Failure to continuously maintain the treatment technique is a violation of this chapter and public notification in accordance with 12VAC5-590-540 A 2 is required.

**12VAC5-590-392. Coliform treatment technique triggers and assessment requirements.**

A. Assessments shall be conducted in accordance with subsections C, ~~D,~~ and through E of this section after exceeding treatment technique triggers.

B. Treatment technique triggers.

1. Level 1 treatment technique triggers:

a. For ~~owners~~ the owner required to collect 40 or more samples per month, the number of total coliform-positive samples exceeds 5.0% of the number of samples collected for the month.

b. For ~~owners~~ the owner required to collect fewer than 40 samples per month, when there are two or more total coliform-positive samples in the same month.

c. The owner fails to collect every required repeat sample after any single total coliform-positive sample.

2. Level 2 treatment technique triggers:

a. An E. coli PMCL violation, as specified in 12VAC5-590-380 B 2.

b. A second Level 1 trigger occurs within a rolling 12-month period, unless the ~~commissioner~~ department has determined a likely reason for the first Level 1 treatment technique trigger and that the owner has corrected the problem.

C. Assessment requirements.

1. Level 1 and 2 assessments shall be conducted ~~in order~~ to identify the possible presence of sanitary defects and defects in the distribution system coliform monitoring practices. The owner shall be responsible for conducting Level 1 assessments. Level 2 assessments shall be conducted by the ~~commissioner~~ department.

2. When conducting Level 1 and Level 2 assessments, the assessor shall include:

a. ~~A review~~ An evaluation and identification of inadequacies in sample sites, sampling protocol, and sample processing;

b. ~~A review~~ An evaluation of atypical events that could affect distributed water quality or indicate that distributed water quality was impaired;

c. Evaluation of changes in distribution system maintenance and operation that could affect distributed water quality, including water storage;

d. Evaluation of source and treatment considerations that impact distributed water quality; and

e. Evaluation of existing water quality monitoring data.

3. Level 1 assessment.

a. The owner shall complete the assessment and document the assessment on ~~the Waterworks Level 1 Assessment form~~ a form approved by the department. The owner shall submit the assessment form, as soon as practical, but within 30 days after the owner learns that a trigger in subdivision B 1 of this section has been exceeded.

b. If the ~~commissioner~~ department ~~reviews~~ evaluates the completed Level 1 assessment and determines that the assessment is not sufficient, including any proposed timetable for any corrective actions, ~~then~~ the ~~commissioner~~ department shall consult with the owner. If the ~~commissioner~~ department requires revisions after the consultation, ~~then~~ the owner shall submit a revised assessment form to the ~~appropriate ODW field office~~ department on an agreed upon schedule not to exceed 30 days from the date of consultation.

c. Upon completion and submission of the assessment form by the owner, the ~~commissioner department~~ shall determine if the owner has identified a likely cause for the Level 1 trigger and, if so, confirm that the owner has corrected the problem or has included a schedule acceptable to the ~~commissioner department~~ for correcting the problem.

4. Level 2 assessment.

a. ~~ODW The department~~ will complete the assessment and document the assessment on the Waterworks Level 2 Assessment form on a form ~~developed approved~~ by the department. ~~ODW staff~~ The department will consult with the owner during the assessment and complete the assessment within 30 days upon learning ~~that a the~~ waterworks has exceeded any ~~of the~~ triggers in subdivision B 2 of this section.

b. The ~~commissioner department~~ will send to the owner the completed assessment form, which will describe any detected sanitary defects, corrective actions completed or needed and, if needed, a timetable to complete ~~the~~ corrective actions. The owner will return the form within seven days with signature that indicates concurrence with the listed actions needed and timetable to complete the corrective actions. If the owner does not concur with either an action or timetable to complete a corrective action, ~~then~~ the owner shall notify the ~~commissioner department~~, complete consultation with the ~~commissioner department~~, and develop a revised corrective action schedule. The owner shall submit the revised schedule to the ~~commissioner department~~ for ~~review~~ evaluation and approval within 30 days of the date of the consultation.

D. Corrective actions.

1. The owner shall correct sanitary defects found through either ~~the~~ Level 1 or ~~the~~ Level 2 assessment conducted under subsection C of this section.

2. The owner shall complete the corrective action or corrective actions in compliance with the timetable approved by the ~~commissioner department~~ in consultation with the owner. The owner shall notify the ~~appropriate ODW field office department~~ no later than seven days after each scheduled corrective action is completed.

E. Consultation.

1. At any time during the assessment or corrective action phase, either the owner or the ~~commissioner department~~ may request a consultation with the other party to determine the appropriate actions to be taken.

2. The owner may consult with the ~~commissioner department~~ on all relevant information that may impact the ability to comply with subsection D of this section.

F. Violations. Failure to conduct the required assessment or corrective actions in accordance with subsections C and D of this section, after exceeding a treatment technique trigger specified in subsection B of this section, is a treatment technique violation. The owner shall provide public notification as required under Tier 2 conditions specified in ~~42VAC5-590-540~~ 12VAC5-590-540 A 2.

**12VAC5-590-395. Surface water and GUDI sources, polymer, and recycle treatment techniques.**

A. Surface water and GUDI source treatment techniques.

1. The filtration and disinfection provisions of this section are required treatment techniques for ~~any a~~ waterworks supplied by ~~either~~ a surface water source ~~and~~ ~~waterworks supplied by or~~ a GUDI source ~~or both~~. ~~The~~ These treatment technique requirements are in ~~lieu place~~ of a PMCL for the following contaminants: Giardia lamblia, viruses, heterotrophic bacteria, Cryptosporidium, Legionella, and turbidity. ~~Each A~~ waterworks ~~with that uses either~~ a surface water source or a GUDI source ~~or both~~ shall

provide treatment of that source water that complies with these treatment technique requirements. See 12VAC5-590-401 for filtration log removal credits and required log inactivation for Cryptosporidium. See 12VAC5-590-500 for log removal credits and required log inactivation for Giardia lamblia and viruses. ~~The-These~~ treatment technique requirements consist of installing and properly operating water treatment processes that reliably achieve:

- a. At least 99.9% (3-log) removal or inactivation of Giardia lamblia between a point where the source water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer;
- b. At least 99.99% (4-log) removal or inactivation of viruses between a point where the source water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer; and
- c. At least 99% (2-log) removal of Cryptosporidium between a point where the source water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.

2. A waterworks that uses either a surface water source or a GUDI source or both is considered to be in compliance with the requirements of subdivision A 1 of this section if it meets the following disinfection and filtration requirements:

a. Disinfection requirements.

(1) The disinfection treatment shall be sufficient to ensure that the total treatment processes of that waterworks achieve at least 99.9% (3-log) inactivation or removal of Giardia lamblia and at least 99.99% (4-log) inactivation or removal of viruses. If any physical process can achieve at least a 3-log removal of Giardia lamblia but cannot adequately remove pathogens, then the disinfection treatment shall provide a second treatment barrier for Giardia lamblia, Legionella, heterotrophic bacteria, and viruses. The disinfection treatment shall be sufficient to assure at least a 0.5 log inactivation of Giardia lamblia.

(2) The residual disinfectant concentration in the water entering the distribution system shall not be less than 0.2 mg/L for more than four hours.

(3) The residual disinfectant concentration in the distribution system, measured as total chlorine, free chlorine, combined chlorine, or chlorine dioxide, shall not be undetectable in more than 5% of the samples each month, for any two consecutive months that the waterworks serves water to the public. If the ~~commissioner-department~~ determines that a waterworks is experiencing excessive coliform occurrences in its distribution system, then the ~~commissioner-department~~ may require the owner to maintain minimum chlorine residual levels of 0.2 mg/L or monochloramine levels of 0.5 mg/L throughout the distribution system. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/mL, measured as HPC, is deemed to have a detectable disinfectant residual for the purposes of determining compliance with this requirement. Thus, the value "V," in %, in the following formula shall not exceed 5% in one month, for any two consecutive months.

$$V = \left[ \frac{(c + d + e)}{(a + b)} \right] * 100$$

where:

a = number of instances where the residual disinfectant concentration is measured;

b = number of instances where the residual disinfectant concentration is not measured but HPC is measured;

c = number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;

d = number of instances where no residual disinfectant concentration is detected and where the HPC is greater than 500/mL; and

e = number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL.

(4) The ~~commissioner~~ department may determine that the HPC compliance requirements of subdivision A 2 a (3) of this section do not apply based on site-specific considerations or if an owner has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions and the waterworks is providing adequate disinfection in the distribution system.

b. Filtration requirements. ~~All~~ waterworks that uses either a surface water source or a GUDI source or both shall provide filtration treatment by using one of the following methods:

(1) Conventional filtration.

(a) Achieve a filtered water turbidity of less than or equal to 0.3 NTU in at least 95% of the measurements taken each month. Samples shall be representative of the waterworks' filtered water.

(b) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed one NTU, measured as specified in 12VAC5-590-440.

(c) A waterworks that uses lime softening may acidify representative samples ~~prior to~~ before analysis using a protocol approved by the ~~commissioner~~ department.

(d) Water treatment plants utilizing conventional or direct filtration with gravity- flow granular media filters are capable of producing filtered water with turbidity consistently less than 0.10 NTU. Therefore, for these types of water treatment plants, the operational goal for filter effluent turbidity for each filter, before any post-filtration chemical addition, shall be 0.10 NTU.

(2) Diatomaceous earth filtration.

(a) The turbidity level of representative samples of a waterworks' filtered water shall be less than or equal to one NTU in at least 95% of the measurements taken each month.

(b) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed five NTU.

(3) Slow sand filtration.

(a) The turbidity level of representative samples of a waterworks' filtered water shall be less than or equal to one NTU in at least 95% of the measurements taken each month, except that if the commissioner determines there is no significant interference with disinfection at a higher turbidity level, then the commissioner may substitute this higher turbidity limit for that waterworks.

(b) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed five NTU.

(4) Membrane filters, bag filters, and cartridge filters.

(a) The turbidity level of representative samples of a waterworks' filtered water shall be less than or equal to 0.3 NTU in at least 95% of the measurements taken each month, except that if the ~~commissioner~~ department determines there is no significant



interference with disinfection at a higher turbidity level, ~~then the commissioner department~~ may substitute this higher turbidity limit for that waterworks.

(b) Water treatment plants utilizing membrane filtration are capable of producing filtered water with turbidity consistently less than 0.05 NTU. Therefore, for these types of water treatment plants, the operational goal for filter effluent turbidity for each filter, before any post-filtration chemical addition, is 0.05 NTU.

(c) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed one NTU.

(5) ~~An~~The owner may use a filtration technology not listed in this section if the owner demonstrates to the satisfaction of the ~~commissioner department~~ by ~~full-scale pilot plant studies or challenge~~ full-scale, pilot-plant, or challenge studies, or by other approved means that the alternative filtration technology, in combination with disinfection, will meet the requirements of this section.

3. Once the ~~commissioner department~~ has determined that a waterworks ~~has utilizes~~ either a surface water source or ~~is~~a GUDI source or both (see 12VAC5-590-430), filtration and disinfection treatments are required. The owner shall install and have in operation treatment units that meet the requirements described in subdivisions A 1 and A 2 of this section no later than 18 months following the ~~commissioner's department's~~ determination. During the interim period, ~~and~~ until filtration and disinfection treatments ~~is-are~~ installed and in operation, the owner shall discontinue use of either the surface water source or GUDI source or both unless the source must remain in service because discontinuing the source is not a viable option, at which point the owner shall:

a. Issue a continuous boil water notice through the public notification procedure in 12VAC5-590-540 A 1 until ~~such time as~~ the required filtration and disinfection treatments ~~is-are~~ installed and ~~is-are~~ in operation;

b. Provide disinfection treatment to achieve a 4-log inactivation of virus during the interim period before ~~the~~ filtration ~~treatment~~ is installed. Monitoring equipment shall be installed that will ensure compliance with this requirement; and

c. Increase bacteriological sampling frequency in the distribution system. For ~~the waterworks owner that required to~~ collect routine distribution system bacteriological samples at a monthly frequency, the ~~waterworks owner~~ shall collect twice the number of samples required for that population each month. For ~~the waterworks owner that required to~~ collect routine bacteriological samples at a quarterly frequency, the ~~waterworks owner~~ shall increase the sampling frequency to monthly.

#### B. Polymer treatment techniques.

1. ~~Each~~The owner shall certify annually in writing to the ~~commissioner department~~ (using ~~third party~~ third-party or manufacturer's certification) that, when polymers containing acrylamide or epichlorohydrin are used by the waterworks, the combination (or product) of dose and monomer level does not exceed the following specified levels:

a. Acrylamide = 0.05% dosed at one ppm (or equivalent) of polymer.

b. Epichlorohydrin = 0.01% dosed at 20 ppm (or equivalent) of polymer.

2. Certifications may rely on ~~the~~ manufacturers or third parties, as approved by the ~~commissioner department~~.

#### C. Recycle treatment techniques.

1. If spent filter backwash water, thickener supernatant, or liquids from dewatering processes are recycled, in ~~any-a~~ waterworks supplied by either a surface water source ~~and waterworks supplied by or~~ a GUDI source or both that employ conventional filtration

or direct filtration treatment, then ~~they are the waterworks is~~ subject to the recycle treatment technique requirement described in subsection A.

2. Under this requirement, recycle flows shall be returned through all the processes of the treatment system, or an alternative location approved by the commissioner/department.

#### **12VAC5-590-400. Radiological quality. (Repealed)**

~~The effects of human radiation exposure are viewed as harmful, and any unnecessary exposure to ionizing radiation should be avoided.~~

~~A. Maximum contaminant level goals for radionuclides are listed in subsection A of Table 2.5 of 12VAC5-590-440.~~

~~B. Maximum contaminant levels for radionuclides are applicable to community waterworks only and are listed in this section and subsection B of Table 2.5.~~

~~1. (Reserved.)~~

~~2. PMCL for combined radium-226 and radium-228. The primary maximum contaminant level for combined radium-226 and radium-228 is 5 pCi/L. The combined radium-226 and radium-228 value is determined by the addition of the results of the analysis for radium-226 and the analysis for radium-228.~~

~~3. PMCL for gross alpha particle activity (excluding radon and uranium). The primary maximum contaminant level for gross alpha particle activity (including radium-226 but excluding radon and uranium) is 15 pCi/L.~~

~~4. PMCL for uranium. The primary maximum contaminant level for uranium is 30 µg/l.~~

~~5. PMCL for beta particle and photon radioactivity.~~

~~a. The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year (mrem/year).~~

~~b. Except for the radionuclides listed in schedule 1 of Table 2.5, the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents must be calculated on the basis of 2 liter per day drinking water intake using the 168-hour data list in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," NBS (National Bureau of Standards) Handbook 69 as amended August 1963, U.S. Department of Commerce. A copy of this document may be reviewed at the Virginia Department of Health Office of Drinking Water office in Richmond, Virginia. If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.~~

~~6. Compliance dates. Compliance dates for combined radium-226 and radium-228, gross alpha particle activity, gross beta particle and photon radioactivity, and uranium: community waterworks owners must comply with the PMCLs listed in subdivisions 2, 3, 4, and 5 of this subsection beginning December 8, 2003, and compliance shall be determined in accordance with the requirements of 12VAC5-590-370 D. Compliance with reporting requirements for the radionuclides under 12VAC5-590-545 and 12VAC5-590-540 is required on December 8, 2003.~~

#### **VAC5-590-401. Enhanced filtration and disinfection for Cryptosporidium treatment techniques.**

A. ~~All~~ waterworks using either a surface water source or a GUDI source or both shall comply with the requirements of this section based on their population or if the waterworks is a wholesaler, based on the population of the largest waterworks in the combined distribution system.

B. ~~Owners-The owner~~ shall conduct an initial and a second round of source water monitoring for each water treatment plant that treats either a surface water source or a GUDI source or both. This monitoring may include sampling for Cryptosporidium, E. coli, and turbidity to determine what level, if any, of additional Cryptosporidium treatment is required.

1. Initial round of source water monitoring. ~~Owners-The owner~~ shall conduct the following monitoring on the schedule in subdivision B 3 of this section unless ~~they meet~~ the monitoring avoidance criteria in subdivision B 4 of this section ~~are met~~.

a. ~~Owners-The owner~~ of a waterworks serving at least 10,000 people shall sample ~~their-the~~ source water for Cryptosporidium, E. coli, and turbidity at least monthly for 24 months.

b. ~~Owners-of the owner of a~~ waterworks serving fewer than 10,000 people:

(1) Shall sample ~~their-the~~ source water for E. coli at least once every two weeks for 12 months, or

(2) May avoid E. coli monitoring if the ~~waterworks-owner~~ notifies the ~~commissioner department~~ that ~~it-he~~ will monitor for Cryptosporidium as described in subdivision B 1 c of this section. The owner shall notify the ~~commissioner-department~~ no later than three months ~~prior to before~~ the date ~~the waterworkshe~~ is otherwise required to start E. coli monitoring.

c. ~~Owners-of~~The owner of a waterworks serving fewer than 10,000 people shall sample ~~their-the~~ source water for Cryptosporidium at least twice per month for 12 months or at least monthly for 24 months if ~~they meetthe meets~~ one of the following, based on monitoring conducted under subdivision B 1 b of this section:

(1) For a waterworks using ~~source water from a lake/reservoir-sources~~, the annual mean E. coli concentration is greater than 10 E. coli/100 mL.

(2) For a waterworks using ~~source water from a flowing stream-sources~~, the annual mean E. coli concentration is greater than 50 E. coli/100 mL.

(3) The waterworks does not conduct E. coli monitoring as described in subdivision B 1 b of this section.

(4) ~~The Waterworks-waterworks~~ using a GUDI source shall comply with the requirements of subdivision B 1 c of this section based on the E. coli level that applies to the nearest surface water body. If no surface water body is nearby, the waterworks shall comply based on the requirements that apply to a waterworks using ~~source water from a lake/reservoir-sources~~.

d. For ~~the~~ waterworks serving fewer than 10,000 people, the ~~commissioner department~~ may approve monitoring for an indicator other than E. coli under subdivision B 1 b (1) of this section. The ~~commissioner-department~~ also may approve an alternative to the E. coli concentration in subdivision B 1 c (1), B 1 c (2), or B 1 c (4) of this section to trigger Cryptosporidium monitoring. This approval by the ~~commissioner department~~ shall be provided to the ~~waterworks-owner~~ in writing and shall include the basis for the ~~commissioner's-department's~~ determination that the alternative indicator or trigger level will provide a more accurate identification of whether a waterworks will exceed the Bin 1 Cryptosporidium level in subdivision B 1 a of this section.

e. ~~The Waterworks-waterworks~~ may sample more frequently than required under this section if the sampling frequency is evenly spaced throughout the monitoring period.

2. Second round of source water monitoring: ~~Owners-The owner~~ shall conduct a second round of source water monitoring that meets the requirements for monitoring parameters, frequency, and duration described in subdivision B 1 of this section, unless ~~they meet~~ the

monitoring exemption criteria in subdivision B 4 of this section ~~are met. Owners-~~The owner shall conduct this monitoring on the schedule in subdivision B 3 of this section.

3. Monitoring schedule. ~~Owners-~~The owner shall begin the monitoring required in subdivisions B 1 and B 2 of this section no later than the month beginning with the date listed in Table 401.1:

TABLE 401.1.  
Source Water Monitoring Starting Dates.

<u>OWNERS OF WATERWORKS THAT SERVE...</u>	<u>SHALL BEGIN THE FIRST ROUND OF SOURCE WATER MONITORING NO LATER THAN THE MONTH BEGINNING...</u>	<u>AND SHALL BEGIN THE SECOND ROUND OF SOURCE WATER MONITORING NO LATER THAN THE MONTH BEGINNING...</u>
<u>At least 100,000 people</u>	<u>October 1, 2006</u>	<u>April 1, 2015</u>
<u>From 50,000 to 99,999 people</u>	<u>April 1, 2007</u>	<u>October 1, 2015</u>
<u>From 10,000 to 49,999 people</u>	<u>April 1, 2008</u>	<u>October 1, 2016</u>
<u>Fewer than 10,000 and monitor for E. coli</u>	<u>October 1, 2008</u>	<u>October 1, 2017</u>
<u>Fewer than 10,000 and monitor for Cryptosporidium<sup>a</sup></u>	<u>April 1, 2010</u>	<u>April 1, 2019</u>
<sup>a</sup> <u>Applies to a waterworks that meet the conditions of subdivision B 1 c of this section.</u>		

4. Monitoring avoidance.

a. ~~Owners are~~The owner is not required to conduct source water monitoring if the waterworks will provide a total of at least 5.5-log of treatment for Cryptosporidium, equivalent to meeting the treatment requirements of ~~Bin-bin~~ 4 in subdivision D 2 of this section.

b. If ~~an-the~~ owner chooses to provide the level of treatment in subdivision B 4 a of this section, rather than start source water monitoring, ~~then~~ the owner shall notify the ~~commissioner-department~~ in writing no later than the date the owner is otherwise required to submit a sampling schedule for monitoring under subdivision B 5 of this section. Alternatively, ~~an-the~~ owner may choose to stop sampling at any point after ~~the owner has initiated~~ initiating monitoring if the owner notifies the ~~commissioner-department~~ in writing that ~~it-he~~ will provide this level of treatment. ~~Owners-~~The owner shall install and operate technologies to provide this level of treatment by the applicable treatment compliance date in subdivision D 3 of this section.

5. Sampling schedules.

a. ~~Owners of~~The owner of a waterworks required to conduct source water monitoring in accordance with subsection B of this section shall submit a sampling schedule that specifies the calendar dates when the owner shall collect each required sample.

(1) ~~Owners-The owner~~ shall submit a sampling schedules to the ~~commissioner department~~ no later than three months ~~prior to before~~ the applicable date listed in subdivision B 3 of this section for each round of required monitoring.

(2) If the ~~commissioner department~~ does not respond to ~~an-the~~ owner regarding the sampling schedule, ~~then~~ the owner shall sample at the reported schedule.

b. ~~Owners-The owner~~ shall collect samples within two days before or two days after the dates indicated in ~~their-the~~ sampling schedule (i.e., within a five-day period around the schedule date) unless one of the conditions of this subdivision apply:-:

(1) If an extreme condition or situation exists that may pose danger to the sample collector, or that cannot be avoided and causes the owner to be unable to sample in the scheduled five-day period, ~~then~~ the owner shall sample as close to the scheduled date as is feasible unless the ~~commissioner department~~ approves an alternative sampling date. The owner shall submit an explanation for the delayed sampling date to the ~~commissioner department~~ concurrent with the shipment of the sample to the laboratory.

(2) If ~~thean~~ owner is unable to report a valid analytical result for a scheduled sampling date due to equipment failure, loss of or damage to the sample, failure to comply with the analytical method requirements, including the quality control requirements of 12VAC5-590-440, or the failure of an approved laboratory to analyze the sample, ~~then~~ the owner shall collect a replacement sample. The owner shall collect the replacement sample not later than 21 days after receiving information that an analytical result cannot be reported for the scheduled date unless the owner demonstrates that collecting a replacement sample within this time frame is not feasible or the ~~commissioner department~~ approves an alternative ~~re-sampling resampling~~ date. The owner shall submit an explanation for the delayed sampling date to the ~~commissioner department~~ concurrent with the shipment of the sample to the laboratory.

c. ~~Owners-The owner~~ of a waterworks that fails to meet the criteria of subdivision B 5 b of this section for any source water sample required under subsection B of this section shall revise ~~their-the~~ sampling schedules to add dates for collecting all missed samples. ~~Owners-The owner~~ shall submit the revised schedule to the ~~commissioner department~~ for approval ~~prior to before~~ ~~when~~ the owner begins collecting the missed samples.

#### 6. Sampling locations.

a. ~~Owners-The owner~~ of a waterworks required to conduct source water monitoring under subsection B of this section shall collect samples for each water treatment plant that treats ~~either~~ a surface water source or a GUDI source or both. Where multiple water treatment plants draw source water from the same influent, such as the same pipe or intake, the ~~commissioner department~~ may approve one set of monitoring results to be used to satisfy the requirements of subsection B of this section for all water treatment plants.

b. ~~Owners-An owner~~ shall collect source water samples ~~prior to before~~ chemical treatment, such as coagulants, oxidants, and disinfectants. However, the ~~commissioner department~~ may approve the collection of a source water sample after chemical treatment. To grant this approval, the ~~commissioner department~~ shall determine that collecting a sample ~~prior to before~~ chemical treatment is not feasible for the ~~waterworks-owner~~ and that the chemical treatment is unlikely to have a significant adverse effect on the analysis of the sample.

c. ~~Owners-The owner~~ of a waterworks that recycle filter backwash water shall collect source water samples ~~prior to before~~ the point of filter backwash water addition.

d. Bank filtration.

(1) ~~The Waterworks owner~~ that receives Cryptosporidium treatment credit for bank filtration under 12VAC5-590-395 A 2 b (1) shall collect source water samples ~~in from~~ the surface water ~~prior to before~~ bank filtration.

(2) ~~The Waterworks owner~~ that uses bank filtration as pretreatment to a water treatment plant shall collect source water samples from the well (i.e., after bank filtration). ~~The Use use~~ of bank filtration during monitoring shall be consistent with routine operational practice. ~~The Waterworks owner~~ collecting samples after a bank filtration process may not receive treatment credit for the bank filtration under subdivision E 4 c of this section.

e. Multiple sources. ~~Owners-The owner~~ of a waterworks that uses multiple ~~source waters sources~~, including multiple surface water sources and blended surface water and ~~ground water~~ groundwater sources, shall collect samples as specified in subdivision B 6 e (1) or B 6 e (2) of this section. The use of multiple sources ~~waters~~ during monitoring shall be consistent with routine operational practice.

(1) If a sampling tap is available where the source ~~waters~~ are combined ~~prior to before~~ treatment, ~~then the owners owner~~ shall collect samples from the tap.

(2) If a sampling tap ~~is not available~~ where the sources are combined ~~prior to before~~ treatment ~~is not available~~, ~~then owners the owner~~ shall collect samples at each source near the intake on the same day and shall follow either subdivision B 6 e (2) (a) or B 6 e (2) (b) of this section for sample analysis.

(a) ~~Owners-The owner~~ may composite samples from each source into one sample ~~prior to before~~ analysis. The volume of sample from each source shall be weighted according to the proportion of the source ~~water~~ in the total water treatment plant flow at the time the sample is collected.

(b) ~~Owners-The owner~~ may ~~analyze choose to have~~ samples ~~analyzed~~ from each source separately and calculate a weighted average of the analysis results for each sampling date. The weighted average shall be calculated by multiplying the analysis result for each source ~~water~~ by the fraction the source ~~water~~ contributed to ~~the~~ total water treatment plant flow at the time the sample was collected and then summing these values.

f. Additional requirements. ~~Owners-The owner~~ shall submit a description of ~~their the~~ sampling location or locations to the ~~commissioner department~~ at the same time as the sampling schedule required in subdivision B 3 of this section. This description shall address the position of the sampling location in relation to the waterworks' ~~source water source or source waters~~ and treatment processes, including pretreatment, points of chemical treatment, and filter backwash recycle. If the ~~commissioner department~~ does not respond to an owner regarding sampling location or locations, ~~then~~ the owner shall sample at the reported location or locations.

7. Analytical methods. All analytical methods shall be conducted in accordance with 12VAC5-590-440.

8. Approved laboratories.

a. Cryptosporidium. ~~The owner Owners~~ shall have Cryptosporidium samples analyzed by a laboratory that has received reciprocal certification approved under DCLS' Laboratory Certification Program for Analysis of Cryptosporidium in Water.

b. E. coli: ~~Any A~~ laboratory certified by DCLS for total coliform analysis under 12VAC5-590-440 is approved for E. coli analysis when the laboratory uses the same technique for E. coli that the laboratory uses under 12VAC5-590-440. Laboratories

shall use methods for enumeration of E. coli in source water approved in 12VAC5-590-440.

c. Turbidity: —Measurements of turbidity shall be made by a party approved by the ~~commissioner~~department.

9. Reporting of the source water results shall be in accordance with 12VAC5-590-531.

10. ~~Owners~~The owner of a waterworks treating either a surface water source or a GUDI ~~sources~~source or both that operates for only part of the year shall conduct source water monitoring in accordance with this section, but with the following modifications:

a. ~~Owners~~The owner shall sample ~~their~~the source water only during the months that the waterworks operates unless the ~~commissioner~~department specifies another monitoring period based on ~~the~~ waterworks operating practices.

b. ~~Owners~~The owner of a waterworks that operates less than six months per year and that monitor for Cryptosporidium shall collect at least six Cryptosporidium samples per year during each of two years of monitoring. Samples shall be evenly spaced throughout the period the waterworks operates.

11. New sources:

a. ~~Owners~~The owner of a waterworks that begins using either a new surface water source of surface water or a GUDI ~~sources~~source or both after the waterworks is required to begin monitoring under subdivision B 3 of this section and shall monitor the new source on a schedule approved by the ~~commissioner~~departmentapproves. Source water monitoring shall meet the requirements of this section. The owner shall also meet the bin classification and Cryptosporidium treatment requirements of subdivisions D 1 and D 2 of this section, for the new source on a schedule approved by the ~~commissioner~~department.

b. The requirements of this section apply to a waterworks using either a surface water source or a GUDI ~~sources~~source or both that begin operation after the monitoring start date applicable to the size of the waterworks ~~size~~under subdivision B 3 of this section.

c. The owner shall begin a second round of source water monitoring no later than six years following the initial bin classification under subdivision D 1 of this section.

12. Failure to collect any source water sample required under this section in accordance with the sampling schedule, sampling location, analytical method, approved laboratory, and reporting requirements of subdivisions B 5 through B 9 of this section is a monitoring violation.

13. Grandparenting monitoring data. ~~Owners~~The owner may use ~~(grandparenting)~~ monitoring data collected ~~prior to before~~the applicable monitoring start date in subdivision B 3 of this section to meet the initial source water monitoring requirements in subdivision B 1 of this section. Grandparented data may be substituted for an equivalent number of months at the end of the monitoring period. All data submitted under this subdivision shall meet the requirements in subdivisions B 13 a through B 13 h of this section and be approved by the ~~commissioner~~department:

a. ~~An~~The owner may grandparent Cryptosporidium samples to meet the requirements of this section when the owner does not have corresponding E. coli and turbidity samples. ~~A waterworks~~The owner that who grandparents Cryptosporidium samples without E. coli and turbidity samples is not required to collect E. coli and turbidity samples when the ~~waterworks~~owner completes the requirements for Cryptosporidium monitoring under this section.

b. ~~E. coli sample analysis.~~ The analysis of E. coli samples shall meet the analytical method and approved laboratory requirements of subdivisions B 7 and B 8 of this section.

c. ~~Cryptosporidium sample analysis.~~ The analysis of Cryptosporidium samples shall meet the requirements of subdivision B 8 of this section.

d. The sampling location shall meet the conditions in subdivision B 6 of this section.

e. Cryptosporidium sample collection intervals may vary for the conditions specified in subdivisions B 5 b (1) and B 5 b (2) of this section, if the owner provides documentation of the condition when reporting monitoring results.

(1) The ~~commissioner department~~ may approve grandparenting of previously collected data where there are time gaps in the sampling frequency, if the owner conducts additional monitoring the ~~commissioner department~~ specifies to ensure that the data used to comply with the initial source water monitoring requirements of subsection B of this section are seasonally representative and unbiased.

(2) ~~Owners-The owner~~ may grandparent previously collected data where the sampling frequency within each month varied. If the Cryptosporidium sampling frequency varied, ~~then owners-an owner~~ shall follow the monthly averaging procedure in subdivision D 1 a (5) of this section, when calculating the bin classification for a filtered waterworks.

f. ~~Reporting monitoring results for grandparenting. Owners that~~ The owner who requests to grandparent previously collected monitoring results shall report the following information by the applicable dates listed in the following subdivisions. ~~Owners-The owner~~ shall report this information to the ~~commissioner department~~.

(1) ~~Owners-The owner~~ shall report ~~that they intend the intent~~ to submit previously collected monitoring results for grandparenting. This report shall specify the number of previously collected results the owner shall submit, the dates of the first and last sample, and whether an owner shall conduct additional source water monitoring to meet the requirements in subsection B of this section. ~~Owners-The owner~~ shall report this information no later than the date the sampling schedule listed in subdivision B 3 of this section is required.

(2) ~~Owners-The owner~~ shall report ~~previously- previously~~ collected monitoring results for grandparenting no later than two months after the applicable date listed in subdivision B 3 of this section.

~~-(a) For each sample result, owners-the owner~~ shall report the applicable data elements in 12VAC5-590-531 A 5.

(b) ~~Owners-The owner~~ shall certify that the reported monitoring results include all results the waterworks generated during the time period beginning with the first reported result and ending with the final reported result. This applies to samples that were collected from the sampling location specified for source water monitoring under subdivision B 1 of this section, not spiked, and analyzed using the laboratory's routine process for the analytical methods listed in this section.

(c) ~~Owners-The owner~~ shall certify that the samples were representative of a waterworks' source waters and ~~that~~ the source waters ~~have-has~~ not changed. ~~Owners~~ The owner shall report a description of the sampling location or locations, which shall address the position of the sampling location in relation to the waterworks' ~~water~~ source ~~water~~ or source ~~waters~~ and treatment processes, including points of chemical addition and filter backwash recycle.

(d) For Cryptosporidium samples, the laboratory or laboratories that analyzed the samples shall provide a letter certifying that the quality control criteria specified in the



methods listed in subdivision B 8 of this section were met for each sample batch associated with the reported results. Alternatively, the laboratory may provide bench sheets and sample examination report forms for each field, matrix spike, initial precision and recovery (IPR), ongoing precision and recovery (OPR), and method blank sample associated with the reported results.

g. If the ~~commissioner department~~ determines that a previously collected data set submitted for grandparenting was generated during source water conditions that were not normal for the waterworks, such as a drought, the ~~commissioner department~~ may disapprove the data. Alternatively, the ~~commissioner department~~ may approve the previously collected data if the owner reports additional source water monitoring data, as determined by the ~~commissioner department~~, to ensure that the data set used under subdivision D 1 of this section represents average source water conditions for the waterworks.

h. If ~~an the~~ owner submits previously collected data that fully meets the number of samples required for ~~the~~ initial source water monitoring under subdivision B 1 of this section and some of the data are rejected due to not meeting the requirements of this section, ~~then~~ the owner shall conduct additional monitoring to replace rejected data on a schedule ~~approved by the commissioner approves department. Owners are~~ ~~The owner is~~ not required to begin this additional monitoring until two months after notification that data have been rejected and additional monitoring is necessary.

C. ~~Owners-The owner~~ of a waterworks that plan to make a significant change to ~~their-the~~ disinfection practice shall develop disinfection profiles and calculate disinfection benchmarks, as described in 12 VAC 5-590-500.

1. The owner shall notify the ~~commissioner department prior to before~~ changing the disinfection practice and shall include in this notice the following information:

- a. A completed disinfection profile and disinfection benchmark for Giardia lamblia and viruses;
- b. A description of the proposed change in disinfection practice; and
- c. An analysis of how the proposed change will affect the current level of disinfection.

2. Significant changes to ~~the~~ disinfection practice are defined as follows:

- a. Changes to the point of disinfection;
- b. Changes to the disinfectant or disinfectants used in the water treatment plant;
- c. Changes to the disinfection process; or
- d. Any other modification identified by the ~~commissioner department~~ as a significant change to disinfection practice.

D. ~~Owners-The owner~~ shall determine ~~their-the~~ Cryptosporidium treatment bin classification as described in subdivision D 1 of this section and provide additional treatment for Cryptosporidium, if required, as described in subdivision D 2 of this section. ~~Owners-The owner~~ shall implement Cryptosporidium treatment according to the schedule in subdivision D 3 of this section.

1. Bin classification for waterworks.

a. Following completion of the initial round of source water monitoring required under subdivision B 1 of this section, ~~owners-the owner~~ shall calculate an initial Cryptosporidium bin concentration for each water treatment plant for which monitoring was required. Calculation of the bin concentration shall use the Cryptosporidium results reported under subdivision B 1 of this section and shall follow these procedures:

(1) For ~~the owner waterworks that who collect-collects~~ a total of at least 48 samples, the bin concentration is equal to the arithmetic mean of all sample concentrations.

(2) For ~~the owner who waterworks that collect-collects~~ a total of at least 24 samples, but not more than 47 samples, the bin concentration is equal to the highest arithmetic mean of all sample concentrations in any 12 consecutive months during which Cryptosporidium samples were collected.

(3) For ~~the owner of a~~ waterworks that ~~serve-serves~~ fewer than 10,000 people and monitor for Cryptosporidium for only one year (i.e., collect 24 samples in 12 months), the bin concentration is equal to the arithmetic mean of all sample concentrations.

(4) For ~~water treatment plants that operate only part of the year and that monitor fewer than 12 months per year under subdivision B 1 of this section,~~ the bin concentration is equal to the highest arithmetic mean of all sample concentrations during any year of Cryptosporidium monitoring.

(5) If the monthly Cryptosporidium sampling frequency varies, ~~then owners-an owner~~ shall first calculate a monthly average for each month of monitoring. ~~The owner Owners~~ shall then use these monthly average concentrations, rather than individual sample concentrations, in the applicable calculation for bin classification in subdivisions D 1 a (1) through D 1 a (4) of this section.

b. ~~Owners-The. owner~~ shall determine ~~their-the~~ initial bin classification from Table 401.2 using the Cryptosporidium bin concentration calculated under subdivision D 1 a of this section:

TABLE 401.2.  
Bin Classification for Filtered Waterworks.

<u>FOR OWNERS OF WATERWORKS THAT ARE:</u>	<u>WITH A CRYPTOSPORIDIUM BIN CONCENTRATION OF<sup>a</sup> ...</u>	<u>THE BIN CLASSIFICATION IS...</u>
<u>...required to monitor for Cryptosporidium under subdivision B 1 of this section</u>	<u>Cryptosporidium less than 0.075 oocysts/L</u>	<u>Bin 1</u>
	<u>Cryptosporidium equal to or greater than 0.075 oocysts/L but less than 1.0 oocysts/L</u>	<u>Bin 2</u>
	<u>Cryptosporidium equal to or greater than 1.0 oocysts/L but less than 3.0 oocysts/L</u>	<u>Bin 3</u>
	<u>Cryptosporidium equal to or greater than 3.0 oocysts/L</u>	<u>Bin 4</u>
<u>...serving fewer than 10,000 people and NOT required to monitor for Cryptosporidium under subdivision B 1 c of this section</u>	<u>NA</u>	<u>Bin 1</u>

<sup>4a</sup> ~~§~~ Based on calculations in subdivision D 1 a or D 1 c of this section, as applicable.

c. Following completion of the second round of source water monitoring required under subdivision B 2 of this section, ~~owners—the owner~~ shall recalculate ~~their—the~~ Cryptosporidium bin concentration using the Cryptosporidium results reported under subdivision B 2 of this section and following the procedures in subdivisions D 1 a (1) through D 1 a (4) of this section. ~~Owners—The owner~~ shall then ~~re-determine~~ ~~redetermine~~ ~~their—the~~ bin classification using this bin concentration and Table 401.3.

d. Reporting of bin classifications.

(1) ~~Owners—The owner~~ shall report ~~their—the~~ initial bin classification under subdivision D 1 b of this section to the ~~commissioner—department~~ for approval no later than six months after the waterworks is required to complete ~~the~~ initial source water monitoring based on the schedule in subdivision B 3 of this section.

(2) ~~Owners—The owner~~ shall report ~~their—the~~ bin classification under subdivision D 1 c of this section to the ~~commissioner—department~~ for approval no later than six months after the owner is required to complete the second round of source water monitoring based on the schedule in subdivision D 1 a (3) of this section.

(3) The bin classification report to the ~~commissioner—department~~ shall include a summary of source water monitoring data and the calculation procedure used to determine bin classification.

e. Failure to comply with the conditions of subdivision D 1 d of this section is a violation of the treatment technique requirement.

2. Waterworks additional Cryptosporidium treatment requirements.

a. ~~A Waterworks—waterworks~~ shall provide the level of additional treatment for Cryptosporidium specified in this subdivision based on their bin classification as determined under subdivision D 1 of this section and according to the schedule in subdivision D 3 b of this section.

TABLE 401.3.  
Cryptosporidium Treatment Requirements.

IF THE WATERWORKS BIN CLASSIFICATION IS...	AND THE WATERWORKS USES THE FOLLOWING FILTRATION TREATMENT IN FULL COMPLIANCE WITH 12VAC5-590-395 A 1 AND 12VAC5-590-395 A 2, THEN THE ADDITIONAL CRYPTOSPORIDIUM TREATMENT REQUIREMENTS ARE...			
	Conventional filtration treatment (including softening)	Direct filtration	Slow sand or diatomaceous earth filtration	Alternative filtration technologies
Bin 1	No additional treatment	No additional treatment	No additional treatment	No additional treatment
Bin 2	1-log treatment	1.5-log treatment	1-log treatment	<sup>a</sup>

Bin 3	2-log treatment	2.5-log treatment	2-log treatment	b
Bin 4	2.5-log treatment	3-log treatment	2.5-log treatment	c
<p><sup>a</sup> As determined by the <del>commissioner</del> department such that the total Cryptosporidium removal and inactivation is at least 4.0-log.</p> <p><sup>b</sup> As determined by the <del>commissioner</del> department such that the total Cryptosporidium removal and inactivation is at least 5.0-log.</p> <p><sup>c</sup> As determined by the <del>commissioner</del> department such that the total Cryptosporidium removal and inactivation is at least 5.5-log.</p>				

b. Additional treatment.

(1) ~~Owners~~ The owner shall use one or more of the treatment and management options listed in subsection E of this section, termed the microbial toolbox, to comply with the additional Cryptosporidium treatment required in subdivision D 2 a of this section.

(2) ~~A Waterworks~~ waterworks classified in ~~Bin~~ bin 3 and ~~Bin~~ bin 4 shall achieve at least 1-log of the additional Cryptosporidium treatment required under subdivision D 2 a of this section using either one or a combination of the following: (i) bag filters, (ii) bank filtration, (iii) cartridge filters, (iv) chlorine dioxide, (v) membranes, (vi) ozone, or (vii) UV, as described in subdivisions E 3 through E 7 of this section.

c. Failure by a waterworks in any month to achieve treatment credit by meeting criteria in subdivisions E 3 through E 7 of this section for microbial toolbox options that is at least equal to the level of treatment required in subdivision D 2 a of this section is a violation of the treatment technique requirement.

d. If the ~~commissioner~~ department determines during a sanitary survey or an equivalent source water assessment that after ~~a waterworks~~ an owner completed the monitoring conducted under subdivision B 1 or B 2 of this section, significant changes occurred in the waterworks' watershed that could lead to increased contamination of the source water by Cryptosporidium, then the owner shall take actions specified by the ~~commissioner~~ department to address the contamination. These actions may include additional source water monitoring or implementing microbial toolbox options listed in subdivision E 2 of this section.

3. Schedule for compliance with Cryptosporidium treatment requirements.

a. Following the initial bin classification in accordance with subdivision D 1 b of this section, the ~~waterworks~~ owner shall provide the level of treatment for Cryptosporidium required under subdivision D 2 of this section according to the schedule in subdivision D 3 b of this section.

b. If the bin classification for a filtered waterworks changes following the second round of source water monitoring, as determined under subdivision D 1 c of this section, then the ~~waterworks~~ owner shall provide the level of treatment for Cryptosporidium required under subdivision D 2 of this section on a schedule approved by the ~~commissioner~~ department.

E. ~~Owners~~ The owner of a f waterworks required to provide additional treatment for Cryptosporidium shall implement microbial toolbox options that are designed and operated as described in subdivisions E 1 through E 7 of this section.

1. ~~Waterworks-The owner~~ receives the treatment credits listed in Table 401.4 by meeting the conditions for microbial toolbox options described in subdivisions E 3 through E 7 of this section. ~~Waterworks-The owner shall~~ apply these treatment credits to meet the treatment requirements in subdivision D 2 of this section.

2. Microbial Toolbox Summary Table: Options, Treatment Credits and Criteria

TABLE 401.4.

Microbial Toolbox Summary: Options, Treatment Credits and Criteria.

TOOLBOX OPTION	CRYPTOSPORIDIUM TREATMENT CREDIT WITH DESIGN AND IMPLEMENTATION CRITERIA
<u>Source Protection and Management Toolbox Options</u>	
<u>Alternative source/ intake management</u>	No prescribed credit. <del>Owners-The owner</del> may conduct simultaneous monitoring for treatment bin classification at <u>alternative intake locations or under alternative intake management strategies</u> . Specific criteria are in subdivision E 3 b of this section.
<del>Pre-Filtration</del> <u>Prefiltration</u> Toolbox Options	
<u>Presedimentation basin with coagulation</u>	0.5-log credit during any month that <u>presedimentation basins achieve a monthly mean reduction of 0.5-log or greater in turbidity or alternative performance criteria approved by the commissioner department</u> . To be eligible, basins shall be operated continuously with coagulant addition and all water treatment plant flow shall pass through basins. Specific criteria are in subdivision E 4 a of this section.
<u>Two-stage lime softening</u>	0.5-log credit for <u>two-stage softening where chemical addition and hardness precipitation occur in both stages</u> . All water treatment plant flow shall pass through both stages. <u>Single-stage softening is credited as equivalent to conventional treatment</u> . Specific criteria are in subdivision E 4 b of this section.
<u>Bank filtration</u>	0.5-log credit for 25-foot setback; 1.0-log credit for 50-foot setback; aquifer shall be <u>unconsolidated sand containing at least 10% fines</u> ; average turbidity in wells shall be less than 1 NTU. <del>A Waterworks-waterworks</del> using wells followed by filtration when conducting source water monitoring shall <u>sample the well to determine bin classification and are not eligible for additional credit</u> . Specific criteria are in subdivision E 4 c of this section.
<u>Treatment Performance Toolbox Options</u>	
<u>Combined filter performance</u>	0.5-log credit for <u>combined filter effluent turbidity less than or equal to 0.15 NTU in at least 95% of measurements each month</u> . Specific criteria are in subdivision E 5 a of this section.
<u>Individual filter performance</u>	0.5-log credit (in addition to 0.5-log combined filter performance credit) if <u>individual filter effluent turbidity is less</u>

	than or equal to 0.15 NTU in at least 95% of samples each month in each filter and is never greater than 0.3 NTU in two consecutive measurements in any filter. Specific criteria are in subdivision E 5 b of this section.
<u>Additional Filtration Toolbox Options</u>	
<u>Bag or cartridge filters (individual filters)</u>	Up to 2-log credit based on the removal efficiency demonstrated during challenge testing with a 1.0-log factor of safety. Specific criteria are in subdivision E 6 a of this section.
<u>Bag or cartridge filters (in series)</u>	Up to 2.5-log credit based on the removal efficiency demonstrated during challenge testing with a 0.5-log factor of safety. Specific criteria are in subdivision E 6 a of this section.
<u>Membrane filtration</u>	Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing. Specific criteria are in subdivision E 6 b of this section.
<u>Second stage filtration</u>	0.5-log credit for second separate granular media filtration stage if treatment train includes coagulation <del>prior to</del> before first filter. Specific criteria are in subdivision E 6 c of this section.
<u>Slow sand filters</u>	2.5-log credit as a secondary filtration step; 3.0-log credit as a primary filtration process. No prior chlorination for either option. Specific criteria are in subdivision E 6 d of this section.
<u>Inactivation Toolbox Options</u>	
<u>Chlorine dioxide</u>	Log credit based on measured CT in relation to Table 401.5. Specific criteria in subdivision E 7 b of this section.
<u>Ozone</u>	Log credit based on measured CT in relation to Table 401.6. Specific criteria in subdivision E 7 b of this section.
<u>UV</u>	Log credit based on validated UV dose in relation to Table 401.7; reactor validation testing required to establish UV dose and associated operating conditions. Specific criteria in subdivision E 7 c of this section.

### 3. Source toolbox components.

a. Reserved.

b. Alternative source.

(1) ~~An~~The owner may conduct source water monitoring that reflects a different intake location (either in the same source or for an alternate source) or a different procedure for the timing or level of withdrawal from the source (alternative source water monitoring). If the ~~commissioner~~ department approves, ~~then an~~the owner may determine the bin classification under subdivision D 1 of this section based on the alternative source water monitoring results.

(2) If ~~an~~the owner conducts alternative source water monitoring under subdivision E 3 b (1) of this section, ~~then~~ the owner shall also monitor the ~~if~~ current water treatment plant intake concurrently as described in subsection B of this section. "Plant intake" means the works or structures at the head of a conduit through which source water is diverted ~~from a source~~ (e.g., river or lake) into the water treatment plant.

(3) Alternative source ~~water~~ monitoring under subdivision E 3 b (1) of this section shall meet the requirements for source ~~water~~ monitoring to determine bin classification, as described in subdivisions B 1 through B 13 of this section. ~~Owners-The owner~~ shall report the alternative source monitoring results to the ~~commissionerdepartment~~, along with supporting information documenting the operating conditions under which the samples were collected.

(4) If ~~an-the~~ owner determines the bin classification under subdivision D 1 of this section using alternative source ~~water~~ monitoring results that reflect a different intake location or a different procedure for managing the timing or level of withdrawal from the source, ~~then~~ the owner shall relocate the intake or permanently adopt the withdrawal procedure, as applicable, no later than the applicable treatment compliance date in subdivision D 3 of this section.

#### 4. ~~Pre-filtration~~Prefiltration treatment toolbox components.

a. Presedimentation. ~~Waterworks-The owner receives~~ 0.5-log Cryptosporidium treatment credit for a presedimentation basin during any month the process meets the following criteria:

(1) The presedimentation basin shall be in continuous operation and shall treat the entire water treatment plant flow ~~taken from~~ at a ~~waterworks using~~ either a surface water source or a GUDI source or both.

(2) ~~The waterworks shall continuously add a~~ A coagulant shall be continuously added to the presedimentation basin.

(3) The presedimentation basin shall achieve the performance criteria in either of the following:

(a) Demonstrates at least 0.5-log mean reduction of influent turbidity. This reduction shall be determined using daily turbidity measurements in the presedimentation process influent and effluent and shall be calculated as follows:  $\log_{10}$  (monthly mean of daily influent turbidity) -  $\log_{10}$  (monthly mean of daily effluent turbidity).

(b) Complies with the performance criteria approved by the ~~commissionerdepartment~~ that demonstrate at least 0.5-log mean removal of micron-sized particulate material through the presedimentation process.

b. Two-stage lime softening. ~~Waterworks-The owner receives~~ an additional 0.5-log Cryptosporidium treatment credit for a two-stage lime softening plant if chemical addition and hardness precipitation occur in two separate and sequential softening stages ~~prior to before~~ filtration. Both softening stages shall treat the entire plant flow taken from either a surface water source or a GUDI source or both.

c. Bank filtration. ~~Waterworks-The owner receives~~ Cryptosporidium treatment credit for bank filtration that serves as pretreatment to a water filtration plant by meeting the criteria in this subdivision. ~~Waterworks-The owner using bank filtration when they begin upon beginning~~ -source water monitoring under subdivision B 1 of this section shall collect samples as described in subdivision B 6 d of this section and are not eligible for this credit.

(1) Wells with a ~~ground-water groundwater~~ flow path of at least 25 feet receive 0.5-log treatment credit, and ~~;~~ wells with a ~~ground-water groundwater~~ flow path of at least 50 feet receive 1.0-log treatment credit. The ~~ground-water groundwater~~ flow path shall be determined as specified in subdivision E 4 c (4) of this section.

(2) Only wells in granular aquifers are eligible for treatment credit. Granular aquifers are those comprised of sand, clay, silt, rock fragments, pebbles, or larger particles, and minor cement. ~~A waterworks~~The owner shall characterize the aquifer at the well

site to determine aquifer properties. ~~Owners-The owner~~ shall extract a core from the aquifer and demonstrate that, in at least 90% of the core length, grains less than 1.0 mm in diameter constitute at least 10% of the core material.

(3) Only horizontal and vertical wells are eligible for treatment credit.

(4) For vertical wells, the ~~ground-water groundwater~~ flow path is the measured distance from the edge of the surface water body under high flow conditions (determined by the 100-year floodplain elevation boundary or by the floodway, as defined in Federal Emergency Management Agency flood hazard maps) to the well screen. For horizontal wells, the ~~ground-water groundwater~~ flow path is the measured distance from the bed of the river under normal flow conditions to the closest horizontal well lateral screen.

(5) ~~Owners-The owner~~ shall monitor each wellhead for turbidity at least once every four hours while the bank filtration process is in operation. If monthly average turbidity levels, based on daily maximum values in the well, exceed 1 NTU, then the owner shall report this result to the ~~commissioner-department~~ and conduct an assessment within 30 days to determine the cause of the high turbidity levels in the well. If the ~~commissioner-department~~ determines that microbial removal has been compromised, then the ~~commissioner-department~~ may revoke treatment credit until the owner implements corrective actions approved by the ~~commissioner-department~~ to remediate the problem.

(6) Springs and infiltration galleries are not eligible for treatment credit under this section.

(7) Bank filtration demonstration of performance. The ~~commissioner-department~~ may approve Cryptosporidium treatment credit for bank filtration based on a demonstration-of-performance study that meets the criteria in this subdivision. This treatment credit may be greater than 1.0-log and may be awarded to bank filtration that does not meet the criteria in subdivisions E 4 c (1) through E 4 c (5) of this section.

(a) The study shall follow a protocol approved by the ~~commissioner-department~~ and shall involve the collection of data on the removal of Cryptosporidium or a surrogate for Cryptosporidium and related hydrogeologic and water quality parameters during the full range of operating conditions.

(b) The study shall include sampling both from the production well or wells and from monitoring wells that are screened and located along the shortest flow path between the surface water source and the production well or wells.

#### 5. Treatment performance toolbox components.

a. Combined filter performance. ~~Waterworks-The owner~~ using conventional filtration treatment or direct filtration treatment receives an additional 0.5-log Cryptosporidium treatment credit during any month the waterworks meets the criteria in this subdivision. Combined filter effluent (CFE) turbidity shall be less than or equal to 0.15 NTU in at least 95% of the measurements. Turbidity shall be measured as described in 12VAC5-590-376 B.

b. Individual filter performance. ~~Waterworks-The owner~~ using conventional filtration treatment or direct filtration treatment receives 0.5-log Cryptosporidium treatment credit, which can be in addition to the 0.5-log credit under subdivision E 5 a of this section, during any month the waterworks meets the criteria in this subdivision. Compliance with these criteria shall be based on individual filter turbidity monitoring as described in 12VAC5-590-376 B.

(1) The filtered water turbidity for each individual filter shall be less than or equal to 0.15 NTU in at least 95% of the measurements recorded each month.



(2) No individual filter may have a measured turbidity greater than 0.3 NTU in two consecutive measurements collected 15 minutes apart.

(3) ~~Any waterworks that~~ ~~The owner who~~ has received treatment credit for individual filter performance and fails to meet the requirements of subdivision E 5 b (1) or E 5 b (2) of this section during any month does not receive a treatment technique violation under subdivision D 2 c of this section if the ~~commissioner~~ ~~department~~ determines the following:

(a) The failure was due to unusual and short-term circumstances that could not reasonably be prevented through optimizing water treatment plant design, operation, and maintenance.

(b) The waterworks has experienced no more than two failures in ~~any~~ a calendar year.

6. Additional filtration toolbox components.

a. Bag and cartridge filters. ~~Waterworks~~ ~~The owner~~ receives Cryptosporidium treatment credit of up to 2.0-log for individual bag or cartridge filters and up to 2.5-log for bag or cartridge filters operated in series by meeting the criteria in subdivisions E 6 a (1) through E 6 a (10) of this section. To be eligible for this credit, ~~owners~~ ~~the owner~~ shall report the results of challenge testing that meets the requirements of subdivisions E 6 a (2) through E 6 a (9) of this section to the ~~commissioner~~ ~~department~~. The filters shall treat the entire water treatment plant flow taken from ~~either~~ a surface water source or a GUDI source or both.

(1) The Cryptosporidium treatment credit awarded to bag or cartridge filters shall be based on the removal efficiency demonstrated during challenge testing that is conducted according to the criteria in subdivisions E 6 a (2) through E 6 a (9) of this section. A factor of safety equal to 1-log for individual bag or cartridge filters and 0.5-log for bag or cartridge filters in series shall be applied to challenge testing results to determine removal credit. ~~Owners~~ ~~The owner~~ may use the results from challenge testing conducted ~~prior to~~ before January 5, 2006, if the prior testing was consistent with the criteria specified in subdivisions E 6 a (2) through E 6 a (9) of this section.

(2) Challenge testing shall be performed on full-scale bag or cartridge filters, and the associated filter housing or pressure vessel, that are identical in material and construction to the filters and housings the waterworks will use for removal of Cryptosporidium. Bag or cartridge filters shall be challenge tested in the same configuration that the waterworks will use, either as individual filters or as a series configuration of filters.

(3) Challenge testing shall be conducted using Cryptosporidium or a surrogate that is removed no more efficiently than Cryptosporidium. The microorganism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate shall be determined using a method capable of discreetly quantifying the specific microorganism or surrogate used in the test; gross measurements such as turbidity shall not be used.

(4) The maximum feed water concentration that can be used during a challenge test shall be based on the detection limit of the challenge particulate in the filtrate (i.e., filtrate detection limit) and shall be calculated using the following equation:

$$\text{Maximum Feed Concentration} = 1 \times 10^4 \times (\text{Filtrate Detection Limit})$$

(5) Challenge testing shall be conducted at the maximum design flow rate for the filter as specified by the manufacturer.

(6) Each filter evaluated shall be tested for a duration sufficient to reach 100% of the terminal pressure drop that establishes the maximum pressure drop under which the filter may be used to comply with the requirements of subdivision E 6 of this section.

(7) Removal efficiency of a filter shall be determined from the results of the challenge test and expressed in terms of log removal values using the following equation:

$$\text{LRV} = \text{LOG}_{10}(C_f) - \text{LOG}_{10}(C_p).$$

where LRV = log removal value demonstrated during challenge testing;  $C_f$  = the feed concentration measured during the challenge test; and  $C_p$  = the filtrate concentration measured during the challenge test. In applying this equation, the same units shall be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, then the term  $C_p$  shall be set equal to the detection limit.

(8) Each filter tested shall be challenged with the challenge particulate during three periods over the filtration cycle: within two hours of start-up of a new filter; when the pressure drop is between 45 % and 55% of the terminal pressure drop; and at the end of the cycle after the pressure drop has reached 100% of the terminal pressure drop. An LRV shall be calculated for each of these challenge periods for each filter tested. The LRV for the filter (LRV filter) shall be assigned the value of the minimum LRV observed during the three challenge periods for that filter.

(9) If fewer than 20 filters are tested, then the overall removal efficiency for the filter product line shall be set equal to the lowest LRV filter among the filters tested. If 20 or more filters are tested, then the overall removal efficiency for the filter product line shall be set equal to the 10th percentile of the set of LRV filter values for the various filters tested. The percentile is defined by  $(i/(n+1))$ , where  $i$  is the rank of  $n$  individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

(10) If a previously tested filter is modified in a manner that could change the removal efficiency of the filter product line, then challenge testing to demonstrate the removal efficiency of the modified filter shall be conducted and submitted to the ~~commissioner~~ department.

b. Membrane filtration.

(1) ~~Waterworks~~The owner receives Cryptosporidium treatment credit for membrane filtration that meets the criteria of this subdivision. Membrane cartridge filters that meet the definition of membrane filtration in 12VAC5-590-10 are eligible for this credit. The level of treatment credit ~~a waterworks~~the owner receives is equal to the lower of the values determined as follows:

(a) The removal efficiency demonstrated during challenge testing conducted under the conditions in subdivision E 6 b (2) of this section.

(b) The maximum removal efficiency that can be verified through direct integrity testing used with the membrane filtration process under the conditions in subdivision E 6 b (3) of this section.

(2) Challenge Testing. The membrane used by the waterworks shall undergo challenge testing to evaluate removal efficiency, and the owner shall report the results of the challenge testing to the department. Challenge testing shall be conducted according to the criteria in subdivisions E 6 b (2) (a) through E 6 b (2) (g) of this section. ~~Owners~~The owner may use data from the challenge testing conducted ~~prior to before~~ January 5, 2006, if the prior testing was consistent with the criteria-:

(a) Challenge testing shall be conducted on either a full-scale membrane module, identical in material and construction to the membrane modules used in the

waterworks' treatment facility, or a smaller-scale membrane module, identical in material and similar in construction to the full-scale module. A module is defined as the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet structure.

(b) Challenge testing shall be conducted using Cryptosporidium or a surrogate that is removed no more efficiently than Cryptosporidium. The organism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate, in both the feed and filtrate water, shall be determined using a method capable of discretely quantifying the specific challenge particulate used in the test; gross measurements such as turbidity shall not be used.

(c) The maximum feed water concentration that can be used during a challenge test is based on the detection limit of the challenge particulate in the filtrate and shall be determined according to the following equation:

Maximum Feed Concentration =  $3.16 \times 10^6 \times (\text{Filtrate Detection Limit})$

(d) Challenge testing shall be conducted under representative hydraulic conditions at the maximum design flux and maximum design process recovery specified by the manufacturer for the membrane module. Flux is defined as the throughput of a ~~pressure driven~~ pressure-driven membrane process expressed as flow per unit of membrane area. Recovery is defined as the volumetric percent of feed water that is converted to filtrate over the course of an operating cycle uninterrupted by events such as chemical cleaning or a solids removal process (i.e., backwashing).

(e) Removal efficiency of a membrane module shall be calculated from the challenge test results and expressed as a log removal value according to the following equation:

$$\text{LRV} = \text{LOG}_{10}(C_f) - \text{LOG}_{10}(C_p).$$

where LRV = log removal value demonstrated during the challenge test;  $C_f$  = the feed concentration measured during the challenge test; and  $C_p$  = the filtrate concentration measured during the challenge test. Equivalent units shall be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, then the term  $C_p$  is set equal to the detection limit for the purpose of calculating the LRV. An LRV shall be calculated for each membrane module evaluated during the challenge test.

(f) The removal efficiency of a membrane filtration process demonstrated during challenge testing shall be expressed as a log removal value ( $\text{LRV}_{\text{C-Test}}$ ). If fewer than 20 modules are tested, then  $\text{LRV}_{\text{C-Test}}$  is equal to the lowest of the representative LRVs among the modules tested. If 20 or more modules are tested, then  $\text{LRV}_{\text{C-Test}}$  is equal to the 10th percentile of the representative LRVs among the modules tested. The percentile is defined by  $(i/(n+1))$ , where  $i$  is the rank of  $n$  individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

(g) The challenge test shall establish a quality control release value (QCRV) for a nondestructive performance test that demonstrates the Cryptosporidium removal capability of the membrane filtration module. This performance test shall be applied to each production membrane module used by the waterworks that was not directly challenge tested ~~in order~~ to verify Cryptosporidium removal capability. Production modules that do not meet the established QCRV are not eligible for the treatment credit demonstrated during the challenge test.

(h) If a previously tested membrane is modified in a manner that could change the removal efficiency of the membrane or the applicability of the ~~non-destructive~~

nondestructive performance test and associated QCRV, then additional challenge testing to demonstrate the removal efficiency of, and determine a new QCRV for, the modified membrane shall be conducted and submitted to the commissioner/department.

(3) Direct integrity testing. ~~Owners-The owner~~ shall conduct direct integrity testing in a manner that demonstrates a removal efficiency equal to or greater than the removal credit awarded to the membrane filtration process and meets the requirements described in subdivisions E 6 b (3) (a) through E 6 b (3) (f) of this section. A direct integrity test is defined as a physical test applied to a membrane unit ~~in order~~ to identify and isolate integrity breaches (i.e., one or more leaks that could result in contamination of the filtrate).

(a) The direct integrity test shall be independently applied to each membrane unit in service. A membrane unit is defined as a group of membrane modules that share common valving that allows the unit to be isolated from the rest of the waterworks for the purpose of integrity testing or other maintenance.

(b) The direct integrity method shall have a resolution of three micrometers or less, where resolution is defined as the size of the smallest integrity breach that contributes to a response from the direct integrity test.

(c) The direct integrity test shall have a sensitivity sufficient to verify the log treatment credit awarded to the membrane filtration process by the commissioner/department, where sensitivity is defined as the maximum log removal value that can be reliably verified by a direct integrity test. Sensitivity shall be determined using the approach in either of the following as applicable to the type of direct integrity test the waterworks uses:

(i) For direct integrity tests that use an applied pressure or vacuum, the direct integrity test sensitivity shall be calculated according to the following equation:

$$\text{LRV}_{\text{DIT}} = \text{LOG}_{10}(\text{Q}_p / (\text{VCF} \times \text{Q}_{\text{breach}}))$$

where  $\text{LRV}_{\text{DIT}}$  = the sensitivity of the direct integrity test;

$\text{Q}_p$  = total design filtrate flow from the membrane unit;

$\text{Q}_{\text{breach}}$  = flow of water from an integrity breach associated with the smallest integrity test response that can be reliably measured; and

VCF = volumetric concentration factor. The volumetric concentration factor is the ratio of the suspended solids concentration on the high- pressure side of the membrane relative to that in the feed water.

(ii) For direct integrity tests that use a particulate or molecular marker, the direct integrity test sensitivity shall be calculated according to the following equation:

$$\text{LRV}_{\text{DIT}} = \text{LOG}_{10}(\text{C}_f) - \text{LOG}_{10}(\text{C}_p)$$

where  $\text{LRV}_{\text{DIT}}$  = the sensitivity of the direct integrity test;

$\text{C}_f$  = the typical feed concentration of the marker used in the test; and

$\text{C}_p$  = the filtrate concentration of the marker from an integral membrane unit.

(d) ~~Owners-The owner~~ shall establish a control limit within the sensitivity limits of the direct integrity test that is indicative of an integral membrane unit capable of meeting the removal credit awarded by the commissioner/department.

(e) If the result of a direct integrity test exceeds the control limit established under subdivision E 6 b (3) (d) of this section, then the ~~owners-owner~~ shall remove the membrane unit from service. ~~Owners-The owner~~ shall conduct a direct integrity test to verify any repairs, and may return the membrane unit to service only if the direct integrity test is within the established control limit.

(f) ~~Owners-The owner~~ shall conduct direct integrity testing on each membrane unit at a frequency of not less than once each day that the membrane unit is in operation. The ~~commissioner-department~~ may approve less frequent testing, based on demonstrated process reliability, the use of multiple barriers effective for Cryptosporidium, or reliable process safeguards.

(4) Indirect integrity monitoring. ~~Owners-The owner~~ shall conduct continuous indirect integrity monitoring on each membrane unit according to the criteria in subdivisions E 6 b (4) (a) through E 6 b (4) (e). Indirect integrity monitoring is defined as monitoring some aspect of filtrate water quality that is indicative of the removal of particulate matter. ~~A waterworks that~~ The owner who implements continuous direct integrity testing of membrane units in accordance with the criteria in subdivisions E 6 b (3) (a) through E 6 b (3) (f) of this section is not subject to the requirements for continuous indirect integrity monitoring. ~~Owners-The owner~~ shall submit a monthly report to the ~~commissioner-department~~ summarizing all continuous indirect integrity monitoring results triggering direct integrity testing and the corrective action that was taken in each case.

(a) Unless the ~~commissioner-department~~ approves an alternative parameter, continuous indirect integrity monitoring shall include continuous filtrate turbidity monitoring.

(b) Continuous monitoring shall be conducted at a frequency of no less than once every 15 minutes.

(c) Continuous monitoring shall be separately conducted on each membrane unit.

(d) If indirect integrity monitoring includes turbidity and if the filtrate turbidity readings are above 0.15 NTU for a period greater than 15 minutes (i.e., two consecutive 15-minute readings above 0.15 NTU), direct integrity testing shall immediately be performed on the associated membrane unit as specified in subdivisions E 6 b (3) (a) through E 6 b (3) (f) of this section.

(e) If indirect integrity monitoring includes ~~a-an~~ alternative parameter approved by the ~~commissioner-department~~ and if the alternative parameter exceeds a control limit approved by the ~~commissioner-department~~ for a period greater than 15 minutes, ~~then~~ direct integrity testing shall immediately be performed on the associated membrane units as specified in subdivisions E 6 b (3) (a) through E 6 b (3) (f) of this section.

c. Second stage filtration. ~~Waterworks-The owner receives~~ 0.5-log Cryptosporidium treatment credit for a separate second stage of filtration that consists of sand, dual media, GAC, or other fine grain media following granular media filtration if ~~approved by the commissioner-department. approves.~~ To be eligible for this credit, the first stage of filtration shall be preceded by a coagulation step and both filtration stages shall treat the entire water treatment treatment plant flow taken from ~~either~~ a surface water source or a GUDI source or both. A cap, such as GAC, on a single stage of filtration is not eligible for this credit. The ~~commissioner-department~~ shall approve the treatment credit based on an assessment of the design characteristics of the filtration process.

d. Slow sand filtration (as secondary filter). ~~Waterworks-The owner are-is~~ eligible to receive 2.5-log Cryptosporidium treatment credit for a slow sand filtration process that follows a separate stage of filtration if both filtration stages treat ~~the~~ entire water treatment plant flow taken from ~~either~~ a surface water source or a GUDI ground water ~~under the direct influence of surface water source or both~~ and no disinfectant-residual disinfectant is present in the influent water to the slow sand filtration process. The ~~commissioner-department~~ shall approve the treatment credit based on an assessment

of the design characteristics of the filtration process. This subdivision does not apply to treatment credit awarded to slow sand filtration used as a primary filtration process.

7. Inactivation toolbox components.

a. Calculation of CT values.

(1) CT is the product of the disinfectant contact time (T, in minutes) and disinfectant concentration (C, in milligrams per liter). ~~Owners-The owner~~ of a waterworks with treatment credit for chlorine dioxide or ozone under subdivision E 7 b of this section shall calculate CT at least once each day, with both C and T measured during peak hourly flow in accordance with the procedure listed in 12VAC5-590-500.

(2) ~~A Waterworks-waterworks~~ with several disinfection segments in sequence may calculate CT for each segment, where a disinfection segment is defined as a treatment unit process with a measurable residual disinfectant residual level and a liquid volume. Under this approach, ~~owners-the owner~~ shall add the Cryptosporidium CT values in each segment to determine the total CT for the treatment plant.

b. CT values for chlorine dioxide and ozone.

(1) ~~Waterworks-The owner~~ receives the Cryptosporidium treatment credit listed in Table 401.5 by meeting the corresponding chlorine dioxide CT value for the applicable water temperature, as described in subdivision E 7 a of this section.

TABLE 401.5.

CT Values (mg-min/L) for Cryptosporidium Inactivation by Chlorine Dioxide<sup>a</sup>

LOG CREDIT	WATER TEMPERATURE, °C					
	≤0.5	1	2	3	5	7
0.25	159	153	140	128	107	90
0.5	319	305	279	256	214	180
1.0	637	610	558	511	429	360
1.5	956	915	838	767	643	539
2.0	1275	1220	1117	1023	858	719
2.5	1594	1525	1396	1278	1072	899
3.0	1912	1830	1675	1534	1286	1079
LOG CREDIT	WATER TEMPERATURE, °C					
	10	15	20	25	30	
0.25	69	45	29	19	12	
0.5	138	89	58	38	24	
1.0	277	179	116	75	49	
1.5	415	268	174	113	73	
2.0	553	357	232	150	98	
2.5	691	447	289	188	122	

<u>3.0</u>	<u>830</u>	<u>536</u>	<u>347</u>	<u>226</u>	<u>147</u>	
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<sup>a</sup>~~Waterworks~~The owner may use this equation to determine log credit between the indicated values:

$$\text{Log credit} = (0.001506 \times (1.09116)^{\text{Temp}}) \times \text{CT}$$

(2) ~~The owner~~Waterworks receives the Cryptosporidium treatment credit listed in Table 401.6 by meeting the corresponding ozone CT values for the applicable water temperature, as described in subdivision E 7 a of this section.

TABLE 401.6.  
CT Values (mg-min/L) for Cryptosporidium Inactivation by Ozone<sup>a</sup>.

LOG CREDIT	WATER TEMPERATURE, °C										
	<u>≤0.5</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>5</u>	<u>7</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>
<u>0.25</u>	<u>6.0</u>	<u>5.8</u>	<u>5.2</u>	<u>4.8</u>	<u>4.0</u>	<u>3.3</u>	<u>2.5</u>	<u>1.6</u>	<u>1.0</u>	<u>0.6</u>	<u>0.39</u>
<u>0.5</u>	<u>12</u>	<u>12</u>	<u>10</u>	<u>9.5</u>	<u>7.9</u>	<u>6.5</u>	<u>4.9</u>	<u>3.1</u>	<u>2.0</u>	<u>1.2</u>	<u>0.78</u>
<u>1.0</u>	<u>24</u>	<u>23</u>	<u>21</u>	<u>19</u>	<u>16</u>	<u>13</u>	<u>9.9</u>	<u>6.2</u>	<u>3.9</u>	<u>2.5</u>	<u>1.6</u>
<u>1.5</u>	<u>36</u>	<u>35</u>	<u>31</u>	<u>29</u>	<u>24</u>	<u>20</u>	<u>15</u>	<u>9.3</u>	<u>5.9</u>	<u>3.7</u>	<u>2.4</u>
<u>2.0</u>	<u>48</u>	<u>46</u>	<u>42</u>	<u>38</u>	<u>32</u>	<u>26</u>	<u>20</u>	<u>12</u>	<u>7.8</u>	<u>4.9</u>	<u>3.1</u>
<u>2.5</u>	<u>60</u>	<u>58</u>	<u>52</u>	<u>48</u>	<u>40</u>	<u>33</u>	<u>25</u>	<u>16</u>	<u>9.8</u>	<u>6.2</u>	<u>3.9</u>
<u>3.0</u>	<u>72</u>	<u>69</u>	<u>63</u>	<u>57</u>	<u>47</u>	<u>39</u>	<u>30</u>	<u>19</u>	<u>12</u>	<u>7.4</u>	<u>4.7</u>

<sup>a</sup>~~Waterworks~~The owner may use this equation to determine log credit between the indicated values:

$$\text{Log credit} = (0.0397 \times (1.09757)^{\text{Temp}}) \times \text{CT}$$

c. Ultraviolet light. ~~The owner~~Waterworks receives Cryptosporidium, Giardia lamblia, and virus treatment credits for ultraviolet (UV) light reactors by achieving the corresponding UV dose values shown in subdivision E 7 c (1) of this section. ~~Waterworks~~The owner shall validate and monitor UV reactors as described in subdivisions E 7 c (2) and E 7 c (3) of this section to demonstrate that they are achieving a particular UV dose value for treatment credit.

(1) UV dose table. The treatment credits listed in Table 401.7 are for UV light at a wavelength of 254 nm as produced by a ~~low-pressure~~ low-pressure mercury vapor lamp. To receive treatment credit for other lamp types, ~~waterworks~~the owner shall demonstrate an equivalent germicidal dose through reactor validation testing, as described in subdivision E 7 c (2) of this section. The UV dose values listed in Table 401.7 are applicable only to post-filter applications of UV in filtered waterworks.

TABLE 401.7.  
UV Doses for Cryptosporidium, Giardia lamblia, and Virus Inactivation ~~Credit~~ Credit.

LOG CREDIT	CRYPTOSPORIDIUM UV DOSE (mJ/cm <sup>2</sup> )	GIARDIA LAMBLIA UV DOSE (mJ/cm <sup>2</sup> )	VIRUS UV DOSE (mJ/cm <sup>2</sup> )
<u>0.5</u>	<u>1.6</u>	<u>1.5</u>	<u>39</u>

<u>1.0</u>	<u>2.5</u>	<u>2.1</u>	<u>58</u>
<u>1.5</u>	<u>3.9</u>	<u>3.0</u>	<u>79</u>
<u>2.0</u>	<u>5.8</u>	<u>5.2</u>	<u>100</u>
<u>2.5</u>	<u>8.5</u>	<u>7.7</u>	<u>121</u>
<u>3.0</u>	<u>12</u>	<u>11</u>	<u>143</u>
<u>3.5</u>	<u>15</u>	<u>15</u>	<u>163</u>
<u>4.0</u>	<u>22</u>	<u>22</u>	<u>186</u>

(2) Reactor validation testing. ~~Waterworks-~~The owner shall use UV reactors that have undergone validation testing to determine the operating conditions under which the reactor delivers the UV dose required in subdivision E 7 c (1) of this section (i.e., validated operating conditions). These operating conditions shall include flow rate, UV intensity as measured by a UV sensor, and UV lamp status.

(a) When determining validated operating conditions, ~~owners-~~the owner shall account for the following factors: (i) UV absorbance of the water; (ii) lamp fouling and aging; (iii) measurement uncertainty of online sensors; (iv) UV dose distributions arising from the velocity profiles through the reactor; (v) failure of UV lamps or other critical waterworks components; and (vi) inlet and outlet piping or channel configurations of the UV reactor.

(b) Validation testing shall include the following: ~~full-scale~~full-scale testing of a reactor that conforms uniformly to the UV reactors used by the waterworks and inactivation of a test microorganism whose dose-response characteristics have been quantified with a ~~low-pressure~~low-pressure mercury vapor lamp.

(c) UV reactor validation testing shall be in accordance with EPA's recommended validation protocol for UV reactors, as described in EPA's "Ultraviolet Disinfection Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule," November 2006, EPA Office of Water. Alternative protocols may be considered for approval by the ~~commissioner-~~department on a case-by-case basis.

(d) Validation testing, whether on-site or off-site, shall be performed by a third party independent of the UV reactor manufacturer and the owner, to ensure that validation testing and data analysis are conducted in a technically sound manner without bias.

(e) To receive credit for lamp ~~types~~ other than ~~low-pressure~~low-pressure types, ~~waterworks-~~the owner shall demonstrate an equivalent germicidal dose through reactor validation testing.

(f) A validation report shall be submitted and approved by the ~~commissioner-~~department to receive disinfection credit.

(3) UV reactor monitoring.

(a) ~~Owners-~~The owner shall monitor ~~their-~~the UV reactors to determine if the reactors are operating within validated conditions, as determined under subdivision E 7 c (2) of this section. This monitoring shall include UV intensity as measured by a UV sensor, flow rate, lamp status, and other parameters the ~~commissioner-~~department designates based on UV reactor operation. ~~Owners-~~The owner shall verify the calibration of UV sensors and shall recalibrate sensors in accordance with a protocol ~~approved by the commissioner-~~department ~~approves~~.

(b) To receive treatment credit for UV light, ~~waterworks-~~The owner shall treat at least 95% of the water delivered to the public during each month by ~~the~~ UV reactors



operating within validated conditions for the required UV dose, as described in subdivisions E 7 c (1) and E 7 c (2) of this section. ~~Owners~~The owner shall demonstrate compliance with this condition by the monitoring required under subdivision E 7 c (3) (a) of this section.

F. ~~Owners~~The owner shall comply with the applicable recordkeeping and reporting requirements described in 12VAC5-590-530, 12VAC5-590-531, 12VAC5-590-550, and 12VAC5-590-570.

#### **12VAC5-590-405. Lead and copper treatment techniques.**

A. Lead and copper corrosion control techniques.

1. Corrosion control treatment requirements. The ~~owners~~owner of ~~all a~~ community ~~and or~~ a nontransient noncommunity waterworks shall install and operate optimum corrosion control treatment by completing the corrosion control treatment requirements described below which are applicable to ~~such these~~ ~~owners~~waterworks under subdivision A 2 of this section.

a. Owner's proposal regarding corrosion control treatment. Based upon the results of lead and copper tap monitoring and water quality parameter monitoring, the ~~owners~~owner of a small ~~and or~~ medium waterworks exceeding the lead or copper action level shall propose installation of one or more of the corrosion control treatments listed in subdivision A 1 c (1) of this section that the owner believes constitutes optimal corrosion control for that waterworks. The ~~commissioner~~department may require the owner to conduct additional water quality parameter monitoring in accordance with 12VAC5-590-375 C 2 to assist the ~~commissioner~~department in ~~reviewing~~evaluating the proposal.

b. Applicability of studies of corrosion control treatment—(applicable to small and medium waterworks). The ~~commissioner~~department may require the owner of ~~any a~~ small or medium waterworks that exceeds the lead or copper action level to perform corrosion control studies under subdivision A 1 c of this section to identify optimal corrosion control treatment for the waterworks.

c. Corrosion control studies.

(1) The owner of ~~any a~~ waterworks required by the ~~commissioner~~department to perform corrosion control studies shall evaluate the effectiveness of each of the following treatments, and, if appropriate, combinations of the following treatments to identify the optimal corrosion control treatment for that waterworks:

(a) Alkalinity and pH adjustment;

(b) Calcium hardness adjustment; and

(c) The addition of a phosphate-~~based~~ or silicate-~~based~~ ~~based~~ corrosion inhibitor at a concentration sufficient to maintain an effective corrosion inhibitor residual concentration in all test tap samples, such that a passivating film is formed on the interior walls of the pipe.

(2) The owner shall evaluate each of the corrosion control treatments using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other waterworks of similar size, water chemistry, and distribution system configuration.

(3) The owner shall measure the following water quality parameters in any tests conducted under subdivision A 1 c of this section before and after evaluating the corrosion control treatments listed ~~above~~ in subdivision A 1 c of this section:

(a) Lead;

- (b) Copper;
- (c) pH;
- (d) Alkalinity;
- (e) Calcium;
- (f) Conductivity;
- (g) Orthophosphate (when an inhibitor containing a phosphate compound is used);
- (h) Silicate (when an inhibitor containing a silicate compound is used); and
- (i) Water temperature.

(4) The owner shall identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with at least one of the following:

(a) Data and documentation showing that a particular corrosion control treatment has adversely affected other water treatment processes when used by another waterworks with comparable water quality characteristics; or

(b) Data and documentation demonstrating that the owner has previously attempted to evaluate a particular corrosion control treatment and has found that the treatment is ineffective or adversely affects other water quality treatment processes.

(5) The owner shall evaluate the effect of the chemicals used for corrosion control treatment on other water quality treatment processes.

(6) On the basis of an analysis of the data generated during each evaluation, the owner shall propose in writing to the ~~district engineer department~~ in writing, that the treatment option ~~resulting that from~~ the corrosion control studies ~~indicate~~ constitutes the optimal corrosion control treatment for that waterworks. The owner shall provide a rationale for ~~its-the~~ recommendation along with all supporting documentation specified in subdivisions A 1 c (1) through A 1 c (5) of this section.

d. Approval of optimal corrosion control treatment.

(1) Based upon consideration of available information including, where applicable, studies performed under subdivision A 1 c of this section and ~~an-the~~ owner's proposed treatment alternative, the ~~commissioner-department~~ shall either approve the corrosion control treatment option recommended by the owner, or designate alternative corrosion control treatment or treatments from among those listed in subdivision A 1 c (1) of this section. When approving optimal treatment, the ~~commissioner-department~~ shall consider the effects that additional corrosion control treatment will have on water quality parameters and on other water quality treatment processes.

(2) The ~~commissioner-department~~ shall notify the owner of ~~his-the~~ determination on optimal corrosion control treatment in writing and explain the basis for this determination. If the ~~commissioner-department~~ requests additional information to aid ~~a-review-an~~ evaluation, then the owner shall provide the information.

e. Installation of optimal corrosion control. ~~Each-The~~ owner shall properly install and operate throughout the waterworks the optimal corrosion control treatment approved by the ~~commissioner-department~~ under subdivision A 1 d of this section. ~~Also see 42VAC5-590-190. A construction permit is required prior-to-before~~ installation of any treatment, in accordance with 12VAC5-590-200.

f. ~~Commissioner's review~~ The ~~commissioner's-department's~~ evaluation of treatment and specification of the optimal water quality control parameters shall consist of the following:-

(1) The ~~commissioner-department~~ shall evaluate the results of all lead and copper tap samples and water quality parameter samples submitted by the owner and determine whether the owner has properly installed and operated the optimal corrosion control treatment approved by the ~~commissioner-department~~ under subdivision A 1 d of this section. Upon ~~reviewing-evaluating~~ the results of tap water and water quality parameter monitoring by the owner, both before and after the owner installs optimal corrosion control treatment, the ~~commissioner-department~~ shall designate:

(a) A minimum value or a range of values for pH measured at each entry point to the distribution system;

(b) A minimum pH value, measured in all tap samples. ~~Such~~ The value shall be equal to or greater than 7.0, unless the ~~commissioner-department~~ determines that meeting a pH level of 7.0 is not technologically feasible or is not necessary for the owner to optimize corrosion control;

(c) If a corrosion inhibitor is used, then a minimum concentration or a range of concentrations for the inhibitor, measured at each entry point to the distribution system and in all tap samples, that the ~~commissioner-department~~ determines is necessary to form a passivating film on the interior walls of the pipes of the distribution system;

(d) If alkalinity is adjusted as part of the optimal corrosion control treatment, then a minimum concentration or a range of concentrations for alkalinity, measured at each entry point to the distribution system and in all tap samples; or

(e) If calcium carbonate stabilization is used as part of the corrosion control, then a minimum concentration or a range of concentrations for calcium, measured in all tap samples.

(2) The values for the applicable water quality control parameters listed ~~above-in~~ subdivision A 1 c (3) of this section shall be those that the ~~commissioner-department~~ determines to reflect optimal corrosion control treatment for the waterworks. The ~~commissioner-department~~ may designate values for additional water quality control parameters determined by the ~~commissioner-department~~ to reflect optimal corrosion control for the waterworks. The ~~commissioner-department~~ shall notify the owner in writing of these determinations and explain the basis for ~~his-the~~ decisions.

g. Continued operation and monitoring. The ~~owners-of-all~~ owner of a waterworks optimizing corrosion control shall continue to operate and maintain optimal corrosion control treatment, including maintaining water quality parameters at or above the minimum values or within ranges designated by the ~~commissioner-department~~ under subdivision A 1 f of this section as verified by all samples collected under 12VAC5-590-375 C 4 through 12VAC5-590-375 C 6. Compliance with the requirements of this subdivision shall be determined every six months, as specified under 12VAC5-590-375 C 4. The ~~owner-of-a~~ waterworks is out of compliance with the requirements of this subdivision for a six-month period if excursions occur for any ~~commissionerdepartment~~-specified parameter on more than nine days during the period. An excursion occurs whenever the daily value for one or more of the water quality parameters measured at a sampling location is below the minimum value or outside the range designated by the ~~commissionerdepartment~~. ~~Daily values shall be calculated as follows.~~ The ~~commissioner-department~~ has discretion to delete results of obvious sampling errors. from this calculation. Daily values shall be calculated as follows:

(1) On days when more than one measurement for the water quality parameter is collected at the sampling location, the daily value shall be the average of all results

collected during the day regardless of whether they are collected through continuous monitoring, grab sampling, or a combination of both.

(2) On days when only one measurement for the water quality parameter is collected at the sampling location, the daily value shall be the result of that measurement.

(3) On days when no measurement is collected for the water quality parameter at the sampling location, the daily value shall be the daily value calculated on the most recent day on which the water quality parameter was measured at the sample site.

h. Modification of the ~~commissioner's department's~~ treatment decisions. Upon ~~his-the department's own~~ initiative or in response to a request by an owner or other interested party, the ~~commissioner department~~ may modify ~~his-the~~ determination of the optimal corrosion control treatment under subdivision A 1 d of this section or optimal water quality control parameters under subdivision A 1 f of this section. A request for modification by an owner or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The ~~commissioner department~~ may modify the determination where it is concluded that ~~such the~~ change is necessary to ensure that the waterworks continues to optimize corrosion control treatment. A revised determination shall be made in writing, set forth the new treatment requirements, explain the basis for the ~~commissioner's department's~~ decision, and provide an implementation schedule for completing the treatment modifications.

## 2. Corrosion control treatment steps.

a. ~~Owners-The owner~~ shall complete the applicable corrosion control treatment requirements described in subdivision A 1 of this section by the deadlines established in this subdivision.

(1) The owner of a large waterworks (serving > 50,000 persons) shall complete the corrosion control treatment steps specified in subdivision A 2 d of this section, unless the owner is deemed to have optimized corrosion control under subdivision A 2 b (2) or ~~subdivision A 2 b (3)~~ of this section.

(2) The owner of a small waterworks (serving ≤ 3300 persons) ~~and-or~~ a medium waterworks (serving >3,300 and ≤ 50,000 persons) shall complete the corrosion control treatment steps specified in subdivision A 2 e of this section, unless the owner is deemed to have optimized corrosion control under subdivisions A 2 b (1) through A 2 b (3) of this section.

b. ~~An-The~~ owner is deemed to have optimized corrosion control and is not required to complete the applicable corrosion control treatment steps identified in this subdivision if the waterworks satisfies one of the criteria specified in subdivisions A 2 b (1) through A 2 b (3) of this section. ~~Any-The~~ ~~such~~ owner deemed to have optimized corrosion control under this subdivision, and ~~which who~~ has treatment in place, shall continue to operate and maintain optimal corrosion control treatment and meet any requirements that the ~~commissioner department~~ determines appropriate to ensure optimal corrosion control treatment is maintained.

(1) The owner of a small or medium waterworks is deemed to have optimized corrosion control if the waterworks meets the lead and copper action levels during each of two consecutive six-month monitoring periods conducted in accordance with 12VAC5-590-375.

(2) ~~Any-The~~ owner may be deemed by the ~~commissioner department~~ to have optimized corrosion control treatment if the owner demonstrates to the satisfaction of the ~~commissioner department~~ that the owner has conducted activities equivalent to the corrosion control steps applicable to ~~such the~~ waterworks under this section. If the

~~commissioner department~~ makes this determination, then the owner shall be provided with a written notice explaining the basis for the decision and the notice shall specify the water quality control parameters representing optimal corrosion control in accordance with subdivision A 1 f of this section. ~~Waterworks owners~~ The owner ~~Owners~~ deemed to have optimized corrosion control under this subdivision shall operate in compliance with the ~~commissioner department-designated~~ designated optimal water quality control parameters in accordance with subdivision A 1 g and continue to conduct lead and copper tap and water quality parameter sampling in accordance with 12VAC5-590-375 B 4 c and 12VAC5-590-375 C 4, respectively. The owner shall provide the ~~commissioner department~~ with the following information ~~in order~~ to support a determination under this subdivision:

(a) The results of all test samples collected for each of the water quality parameters in subdivision A 1 c (3) of this section;

(b) A report explaining the test methods used by the owner to evaluate the corrosion control treatments listed in subdivision A 1 c (1) of this section, the results of all tests conducted, and the basis for the owner's selection of optimal corrosion control treatment;

(c) A report explaining how corrosion control has been installed and how it is being maintained to insure minimal lead and copper concentrations at consumers' taps; and

(d) The results of tap water samples collected in accordance with 12VAC5-590-375 B at least once every six months for one year after corrosion control treatment has been installed.

(3) ~~Any A~~ waterworks is deemed to have optimized corrosion control if the owner submits results of tap water monitoring conducted in accordance with 12VAC5-590-375 B and source water monitoring conducted in accordance with 12VAC5-590-375 D, ~~and which that demonstrates~~ for two consecutive six-month monitoring periods that the difference between the 90th percentile tap water lead level, computed under 12VAC5-590-385 C, and the highest source water lead concentration is less than the PQL for lead (0.005 mg/L).

(a) ~~Any The~~ owner ~~that who~~ submits monitoring results indicating that the highest source water lead level is below the method detection limit may also be deemed to have optimized corrosion control under this subdivision if the 90th percentile tap water lead level is less than or equal to the PQL for lead (0.005 mg/L) for two consecutive six-month monitoring periods.

(b) ~~Any The~~ owner deemed to have optimized corrosion control under this subdivision shall continue monitoring for lead and copper at the tap no less frequently than once every three calendar years using the reduced number of sites specified in 12VAC5-590-375 B 3 and collecting the samples at times and locations specified in 12VAC5-590-375 B 4 d (4).

(c) ~~Any The~~ owner deemed to have optimized corrosion control pursuant to this subdivision shall notify the ~~district engineer~~ department in writing pursuant to ~~12VAC5-590-530 F 4 c~~ 12VAC5-590-532 B 3 of any upcoming long-term change in treatment or addition of a new source water ~~source~~ as described in that subdivision. The ~~commissioner department~~ must review shall evaluate and approve the addition of a new source water ~~source~~ or long-term change in water treatment before it is implemented by the owner. The ~~commissioner department~~ may require the owner of ~~any a such~~ waterworks to conduct additional monitoring or to take other actions the ~~commissioner department~~ deems appropriate to ensure that minimum levels of corrosion control are being maintained in the distribution system.

(d) ~~An~~The owner is not deemed to have optimized corrosion control under this subdivision, and shall implement corrosion control treatment specified in subdivision A 2 b (3) (e) of this section, unless the copper action level is met.

(e) The owner of a waterworks triggered into corrosion control because the waterworks no longer is deemed to have optimized corrosion control under this subsection shall implement corrosion control treatment in accordance with the deadlines in subdivision A 2 e of this section. The owner of ~~any a such~~ large waterworks shall adhere to the schedule specified in subdivision A 2 e of this section for ~~medium-size systems~~ waterworks, with the time period for completing each step being triggered by the date the owner is no longer deemed to have optimized corrosion control treatment under this subsection.

c. The owner of ~~any a~~ small or medium waterworks that is required to complete the corrosion control steps due to the exceedance of the lead or copper action level may cease completing the treatment steps whenever the waterworks meets both action levels during each of two consecutive six-month monitoring periods conducted pursuant to 12VAC5-590-375 B 4 a and submits the results to the ~~district engineer department~~. If ~~any a such~~ waterworks thereafter exceeds the lead or copper action level during any monitoring period, the owner shall recommence completion of the applicable treatment steps, beginning with the first treatment step ~~which that~~ was not previously completed in its entirety. The ~~commissioner department~~ may require the owner to repeat treatment steps previously completed where the ~~commissioner department~~ determines that this is necessary to properly implement the treatment requirements of this section. The ~~commissioner department~~ shall notify the owner in writing of ~~such a the~~ determination and explain the basis for ~~his the~~ decision. The requirement for the owner of ~~any a~~ small or medium waterworks to implement corrosion control treatment steps in accordance with subdivision A 2 e of this section (including waterworks deemed to have optimized corrosion control under subdivision A 2 b (1) of this section) is triggered whenever ~~any a~~ small or medium waterworks exceeds the lead or copper action level.

d. Treatment steps and deadlines for large waterworks. Except as provided in subdivisions A 2 b (2) and A 2 b (3) of this section, ~~owners the owner of a~~ large waterworks shall complete the following corrosion control treatment steps (described in the referenced portions of subdivision A 1 of this section, 12VAC5-590-375 B, and 12VAC5-590-375 C):

(1) Step 1: The owner shall conduct initial monitoring (12VAC5-590-375 B 4 a and 12VAC5-590-375 C 2) during two consecutive six-month monitoring periods by a date specified by the ~~commissioner department~~.

(2) Step 2: The owner shall complete corrosion control studies (subdivision A 1 c of this section) and submit the study and recommendations to the ~~commissioner department~~ no later than 18 months after the date that initial monitoring is completed as specified in Step 1.

(3) Step 3: The ~~commissioner department~~ shall approve optimal corrosion control treatment (subdivision A 1 d) no later than 12 months following receipt of the corrosion control study required in Step 2.

(4) Step 4: The owner shall install optimal corrosion control treatment (subdivision A 1 e) no later than 24 months following the ~~commissioner's department's~~ approval of optimal corrosion control treatment specified in Step 3 (~~See 12VAC5-590-200~~).

(5) Step 5: The owner shall complete follow-up sampling (12VAC5-590-375 B 4 b and 12VAC5-590-375 C 3) no later than 12 months following the installation of optimal corrosion control treatment specified in Step 4.

(6) Step 6: The ~~commissioner-department~~ shall ~~review-evaluate the~~ installation of treatment and designate optimal water quality control parameters (subdivision A 1 f) no later than six months following completion of follow-up sampling specified in Step 5.

(7) Step 7: The owner shall operate the waterworks in compliance with the ~~commissioner-department~~-specified optimal water quality control parameters (subdivision A 1 g) and continue to conduct tap sampling (12VAC5-590-375 B 4 c and 12VAC5-590-375 C 4).

e. Treatment steps and deadlines for small and medium waterworks. Except as provided in subdivision A 2 b of this section, the owner owners of a small and-or medium waterworks shall complete the following corrosion control treatment steps (described in the referenced portions of subdivision A 1, 12VAC5-590-375 B<sub>1</sub> and 12VAC5-590-375 C):

(1) Step 1: The owner shall conduct initial tap sampling (12VAC5-590-375 B 4 a and 12VAC5-590-375 C 2) until the waterworks either exceeds the lead or copper action level or becomes eligible for reduced monitoring under 12VAC5-590-375 B 4 d. The owner of a waterworks exceeding the lead or copper action level shall propose optimal corrosion control treatment (subdivision A 1 a of this section) within six months after the end of the monitoring period during which it exceeds one of the action levels.

(2) Step 2: Within 12 months after the end of the monitoring period during which a waterworks exceeds the lead or copper action level, the ~~commissioner-department~~ may require the owner to perform corrosion control studies (subdivision A 1 b of this section). If the ~~commissioner-department~~ does not require the owner to perform ~~such these~~ studies, the ~~commissioner-department~~ shall specify optimal corrosion control treatment (subdivision A 1 d of this section) within the following timeframes:

(a) For a medium waterworks, within 18 months after the end of the monitoring period during which ~~such the~~ waterworks exceeds the lead or copper action level.

(b) For a small waterworks, within 24 months after the end of the monitoring period during which ~~such the~~ waterworks exceeds the lead or copper action level.

(3) Step 3: If the ~~commissioner-department~~ requires ~~an-the~~ owner to perform corrosion control studies under Step 2, then the owner shall complete the studies (subdivision A 1 c of this section) and submit the study and recommendations to the ~~commissioner-department~~ within 18 months after the ~~commissioner-department~~ requires that ~~such the~~ studies be conducted.

(4) Step 4: If the ~~waterworks-owner~~ has performed corrosion control studies under Step 2, then the ~~commissioner-department~~ shall designate optimal corrosion control treatment (subdivision A 1 d of this section) within six months after completion of Step 3.

(5) Step 5: The owner shall install optimal corrosion control treatment (subdivision A 1 e of this section) within 24 months after the ~~commissioner-department~~ designates such treatment. A construction permit is required prior to before installation of any treatment, in accordance with See 12VAC5-590-200.

(6) Step 6: The owner shall complete follow-up sampling (12VAC5-590-375 B 4 b and 12VAC5-590-375 C 3) within 36 months after the ~~commissioner-department~~ designates optimal corrosion control treatment.

(7) Step 7: The ~~commissioner department~~ shall ~~review evaluate~~ the owner's installation of treatment and designate optimal water quality control parameters (subdivision A 1 f of this section) within six months after completion of Step 6.

(8) Step 8: The owner shall operate the waterworks in compliance with the ~~commissioner department designated~~ ~~designated~~ optimal water quality control parameters (subdivision A 1 g of this section) and continue to conduct tap sampling (12VAC5-590-375 B 4 c and 12VAC5-590-375 C 4).

B. ~~Water supply (source water)~~ Source water treatment technique requirements for lead and copper. The owner of ~~any a~~ waterworks exceeding the lead or copper action level shall complete the applicable water supply source water monitoring and treatment requirements (described in the referenced portions of subdivision B 2 of this section, and in 12VAC5-590-375 B and 12VAC5-590-375 D) by the following deadlines:

1. Deadlines for completing water supply source water treatment steps.

a. Step 1: The owner of a waterworks exceeding the lead or copper action level shall complete lead and copper water supply source water monitoring (12VAC5-590-375 D 2) and ~~make submit~~ a treatment proposal to the ~~district engineer department~~ (subdivision B 2 a of this section) no later than 180 days after the end of the monitoring period during which the lead or copper action level was exceeded.

b. Step 2: The ~~commissioner department~~ shall make a determination regarding the need for water supply source water treatment (subdivision B 2 b of this section) within six months after submission of monitoring results under Step 1.

c. Step 3: If the ~~commissioner department~~ requires installation of water supply source water treatment, ~~then~~ the owner shall install the treatment (subdivision B 3 of this section) within 24 months after completion of Step 2.

d. Step 4: The owner shall complete follow-up tap water monitoring (12VAC5-590-375 B 4 b) and water supply source water lead and copper monitoring (12VAC5-590-375 D 3) within 36 months after completion of Step 2.

e. Step 5: The ~~commissioner department~~ shall ~~review evaluate~~ the owner's installation and operation of the water supply source water treatment and specify maximum permissible water supply source water lead and copper levels (subdivision B 4 of this section) within six months after completion of Step 4.

f. Step 6: The owner shall operate the waterworks in compliance with the ~~commissioner department~~-specified maximum permissible source water lead and copper ~~water supply~~ levels (subdivision B 4 of this section) and continue water supply source water monitoring (12VAC5-590-375 D 4).

2. Description of water supply source water treatment requirements.

a. Waterworks treatment recommendation. The owner of ~~any a~~ waterworks ~~which that~~ exceeds the lead or copper action level shall propose in writing to the ~~district engineer department~~, the installation and operation of one of the water supply source water treatments listed in subdivision B 2 b of this section. ~~An~~ ~~The~~ owner may propose that no treatment be installed based upon a demonstration that water supply source water treatment is not necessary to minimize lead and copper levels at ~~users'~~ consumers' taps.

b. ~~Commissioner's Department's~~ determination regarding water supply source water treatment. The ~~commissioner department~~ shall complete an evaluation of the results of all water supply source water samples submitted by the owner to determine whether water supply source water treatment is necessary to minimize lead or copper levels in water delivered to ~~users'~~ consumers' taps. If the ~~commissioner department~~ determines



that treatment is needed, ~~then~~ the ~~commissioner-department~~ shall either require installation and operation of the ~~water-supplysource water~~ treatment recommended by the owner or require the installation and operation of another ~~water-supplysource water~~ treatment from among the following: (i) ion exchange, (ii) reverse osmosis, (iii) lime softening, or (iv) coagulation/filtration. If the ~~commissioner-department~~ requests additional information to aid in the ~~reviewevaluation~~, ~~then~~ the owner shall provide the information by the date specified by the ~~commissioner-department~~ in the request. The ~~commissioner-department~~ shall notify the owner in writing of the determination and set forth the basis for the decision.

3. Installation of ~~water-supplysource water~~ treatment. ~~Each-The~~ owner shall properly install and operate the ~~water-supplysource water~~ treatment designated by the ~~commissioner department~~ under subdivision B 2 b of this section.

4. ~~Commissioner's-review~~ The ~~commissioner's-department's~~ evaluation of ~~water-supplysource water~~ treatment and specification of maximum permissible ~~water-supplysource water~~ lead and copper levels. The ~~commissioner-department~~ shall ~~review~~ evaluate the ~~water-supplysource water~~ samples ~~taken~~ collected by the owner both before and after the owner installs ~~water-supplysource water~~ treatment, and determine whether the owner has properly installed and operated the ~~water-supplysource water~~ treatment designated by the ~~commissionerdepartment~~. Based upon the ~~reviewevaluation~~, the ~~commissioner-department~~ shall designate the maximum permissible lead and copper concentrations for finished water entering the distribution system. ~~Such The~~ levels shall reflect the contaminant removal capability of the treatment properly operated and maintained. The ~~commissioner-department~~ shall notify the owner in writing and explain the basis for the decision.

5. Continued operation and maintenance. ~~Each-The~~ waterworks shall be operated to maintain lead and copper levels below the maximum permissible concentrations designated by the ~~commissioner-department~~ at each sampling point monitored in accordance with 12VAC5-590-375 D. The waterworks is out of compliance with this subdivision if the level of lead or copper at any sampling point is greater than the maximum permissible concentration designated by the ~~commissionerdepartment~~.

6. Modification of the ~~commissioner'sdepartment's~~ treatment decisions. Upon ~~the department's his own~~ initiative or in response to a request by an owner or other interested party, the ~~commissioner-department~~ may modify ~~his-the~~ determination of the ~~water-supplysource water~~ treatment under subdivision B 2 b of this section, or may modify the maximum permissible lead and copper concentrations for finished water entering the distribution system under subdivision B 4 of this section. A request for modification by an owner or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The ~~commissioner-department~~ may modify the determination where ~~he concludes the conclusion is made~~ that ~~such the~~ change is necessary to ensure that the waterworks continues to minimize lead and copper concentrations in ~~water-suppliesource waters~~. A revised determination shall be made in writing, set forth the new treatment requirements, explain the basis for the ~~commissioner's department's~~ decision, and provide an implementation schedule for completing the treatment modifications.

C. Lead service line replacement treatment technique requirements:

1. ~~Owners-The owner~~ of a waterworks that ~~fails~~ to meet the lead action level in tap samples ~~taken~~ collected pursuant to 12VAC5-590-375 B 4 b, after installing corrosion control or ~~water-supplysource water~~ treatment (whichever sampling occurs later), shall replace lead service lines in accordance with the requirements of this section. If ~~a-waterworksthe owner~~

is in violation of subdivision A 2 of this section or subsection B of this section for failure to install ~~water supply~~source water or corrosion control treatment, ~~then the commissioner~~department may require the owner to commence lead service line replacement under this section after the date by which the owner was required to conduct monitoring under 12VAC5-590-375 B 4 b has passed.

2. ~~An~~The owner shall replace annually at least 7.0% of the initial number of lead service lines in its distribution system. The initial number of lead service lines is the number of lead lines in place at the time the replacement program begins. The owner shall identify the initial number of lead service lines in its distribution system based upon a materials evaluation, including the evaluation required under 12VAC5-590-375 B 1. The first year of lead service line replacement shall begin on the first day following the end of the monitoring period in which the lead action level was exceeded under subdivision C 1 of this ~~subsection~~section. If monitoring is required annually or less frequently, ~~then~~ the end of the monitoring period is September 30 of the calendar year in which the sampling occurs. If the ~~commissioner~~department has established an alternate monitoring period, then the end of the monitoring period will be the last day of that period.

3. The owner of ~~any~~a waterworks resuming a lead service line replacement program after the cessation of the lead service line replacement program as allowed by subdivision C 7 of this section shall update the inventory of lead service lines to include those sites that were previously determined not to require replacement through the sampling provision under subdivision C 4 of this section. The owner shall then divide the updated number of remaining lead service lines by the number of remaining years in the program to determine the number of lines that must be replaced per year (7.0% lead service line replacement is based on a 15-year replacement program; so, for example, ~~owners~~the owner resuming lead service line replacement after previously conducting two years of replacement would divide the updated inventory by 13). For ~~those owners that~~the owner who have has completed a 15-year lead service line replacement program, the ~~commissioner~~department will determine a schedule for replacing or retesting lines that were previously tested out under the replacement program when the waterworks re-exceeds the lead action level.

4. ~~An~~The owner is not required to replace an individual lead service line if the lead concentration in all service line samples from that line, ~~taken~~collected pursuant to 12VAC5-590-375 B 2 c, is less than or equal to 0.015 mg/L.

5. ~~An~~The owner shall replace that portion of the lead service line that is owned by the waterworks. In cases where the ~~waterworks~~ owner does not own the entire lead service line, the ~~waterworks~~ owner shall notify the building owner, or the building owner's authorized agent, that the ~~waterworks~~ owner will replace that portion of the service line that is owned by the waterworks and shall offer to replace the building owner's portion of the line. The ~~waterworks~~ owner is not required to bear the cost of replacing the building owner's portion of the service line, nor is the ~~waterworks~~ owner required to replace the building owner's portion where the ~~waterworks~~ owner chooses not to pay the cost of replacing the building owner's portion of the line, or where replacing the building owner's portion would be precluded by state, local, or common law. ~~A~~The ~~waterworks~~ owner ~~that~~who does not replace the entire length of the service line also shall complete the following tasks:-

- a. At least 45 days ~~prior to~~before commencing with the partial replacement of a lead service line, the ~~waterworks~~ owner shall provide notice to the resident or residents of all buildings served by the line explaining that they may experience a temporary increase of lead levels in their drinking water, along with guidance on measures consumers can take to minimize their exposure to lead. The ~~commissioner~~department

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may allow the ~~waterworks~~ owner to provide notice under the previous sentence less than 45 days ~~prior to~~ before commencing partial lead service line replacement where ~~such~~ the replacement is in conjunction with emergency repairs. In addition, the ~~waterworks~~ owner shall inform the resident or residents served by the lead service line that the ~~waterworks~~ owner will, at the ~~waterworks~~ owner's expense, collect a sample from each partially ~~replaced~~ replaced lead service line that is representative of the water in the service line for analysis of lead content, as prescribed in 12VAC5-590-375 B 2 c, within 72 hours after the completion of the partial replacement of the lead service line. The ~~waterworks~~ owner shall collect the sample and report the results of the analysis to the building owner and resident or residents served by the service line within three business days of receiving the results. Mailed notices post-marked within three business days of receiving the results shall be considered on time.

b. The ~~waterworks~~ owner shall provide the information required by subdivision C 5 a of this section to the residents of individual dwellings by mail or by other methods approved by the ~~commissioner~~ department. In instances where multi-family dwellings are served by the service line, the ~~waterworks~~ owner shall have the option to post the information at a conspicuous location.

6. The ~~commissioner~~ department shall require ~~an~~ the owner to replace lead service lines on a shorter schedule than that required by this subsection, taking into account the number of lead service lines in the waterworks, where ~~such~~ a shorter replacement schedule is feasible. The ~~commissioner~~ department shall make this determination in writing and notify the owner of the findings within six months after the waterworks is triggered into lead service line replacement based on monitoring referenced in subdivision C 1 of this section.

7. ~~Any~~ The owner may cease replacing lead service lines whenever ~~first draw~~ first draw tap samples collected pursuant to 12VAC5-590-375 B 2 b meet the lead action level during each of two consecutive ~~six-month~~ monitoring periods and the owner submits the results to the ~~district engineer~~ department. If the ~~first draw~~ first draw tap samples collected in ~~any~~ a ~~such~~ waterworks thereafter exceeds the lead action level, ~~then~~ the owner shall recommence replacing lead service lines, pursuant to subdivision C 3 of this section.

8. To demonstrate compliance with subdivisions C 1 through C 5 of this section, an owner shall report to the ~~district engineer~~ department the information specified in ~~42VAC5-590-530 F 5~~ 12VAC5-590-532.

D. Lead public education requirements. The ~~waterworks~~ owner shall deliver a consumer notice of lead tap water monitoring results to all persons served by the ~~water system~~ waterworks at sites that are tested in accordance with subdivision D 4 of this section. The owner of a waterworks that exceeds the lead action level based on tap water samples collected in accordance with 12VAC5-590-375 B shall deliver the public education materials contained in ~~subdivisions~~ subdivision D 1 of this section in accordance with the requirements in subdivision D 2 of this section. The owner of a waterworks that exceeds the lead action level shall sample the tap water of any customer who requests it in accordance with subdivision D 3 of this section.

1. Content of written materials. The owner shall include the following text in all of the printed materials distributed through the lead public education program:

a. Community waterworks and nontransient noncommunity waterworks. ~~Owners~~ The ~~owner~~ owner of a community waterworks or a nontransient noncommunity waterworks shall include the following elements in printed materials (e.g., brochures and pamphlets) in the same order as listed below. In addition, the language specified in subdivisions D 1 a (1) through D 1 a (2) and in subdivision D 1 a (6) of this section shall be included in materials, exactly as written, except for the text in brackets for which the ~~waterworks~~ owner shall include system-specific information. Any additional information presented

by the owner shall be consistent with the information below and be in plain language that can be understood by the general public. The ~~commissioner department~~ may require the ~~waterworks~~ owner to obtain approval of the content of written material ~~prior to before~~ delivery.

(1) IMPORTANT INFORMATION ABOUT LEAD IN YOUR DRINKING WATER. ~~{INSERT NAME OF WATERWORKS}~~ (Insert name of waterworks) found elevated levels of lead in drinking water in some homes/buildings. Lead can cause serious health problems, especially for pregnant women and young children. Please read this information closely to see what you can do to reduce lead in your drinking water.

(2) Health effects of lead. Lead can cause serious health problems if too much enters your body from drinking water or other sources. It can cause damage to the brain and kidneys, and can interfere with the production of red blood cells that carry oxygen to all parts of your body. The greatest risk of lead exposure is to infants, young children, and pregnant women. Scientists have linked the effects of lead on the brain with lowered IQ in children. Adults with kidney problems and high blood pressure can be affected by low levels of lead more than healthy adults. Lead is stored in the bones, and it can be released later in life. During pregnancy, the child receives lead from the mother's bones, which may affect brain development.

(3) Sources of lead.

(a) Explain what lead is.

(b) Explain possible sources of lead in drinking water and how lead enters drinking water. Include information on home/building materials and services lines that may contain lead.

(c) Discuss other important sources of lead exposure in addition to drinking water (e.g., paint).

(4) Discuss the steps the consumer can take to reduce their exposure to lead in drinking water.

(a) Encourage running the water to flush out the lead.

(b) Explain concerns with using hot water from the tap and specifically caution against the use of hot water for preparing baby formula.

(c) Explain that boiling water does not reduce lead levels.

(d) Discuss other options consumers can take to reduce exposure to lead in drinking water, such as alternative sources or treatment of water.

(e) Suggest that parents have their child's blood tested for lead.

(5) Explain why there are elevated levels of lead in the waterworks' drinking water (if known) and what the ~~waterworks~~ owner is doing to reduce the lead levels in homes/buildings.

(6) For more information call us at ~~{INSERT WATERWORKS OWNER'S CONTACT PHONE NUMBER}~~, or ~~{IF APPLICABLE}~~ (insert owner's contact phone number), or if applicable, visit our website at ~~{INSERT WATERWORKS' WEBSITE HERE}~~ (insert waterworks' website URL here). For more information on reducing lead exposure around your home/building and the health effects of lead, visit EPA's website at <http://www.epa.gov/lead> or contact your health care provider.

b. In addition to including the elements specified in subdivision D 1 a of this section, the ~~owners of owner of a~~ community waterworks shall:

(1) Tell consumers how to get their water tested.

(2) Discuss lead in plumbing components and the difference between low lead and lead free. "Lead free" means: ~~(1i) When when~~ used with respect to solders and flux refers to solders and flux containing not more than 0.2% lead, and (2ii) ~~When when~~ used with respect to pipes, and pipe fittings, plumbing fittings, and plumbing fixtures refers to the weighted average of wetted surfaces of pipes, and pipe fittings, plumbing fittings, and plumbing fixtures containing not more than 8.0% 0.25% lead.

2. Delivery of public education materials.

a. The owner of ~~any a~~ waterworks serving a large proportion of non-English-speaking consumers, as determined by the ~~commissioner department~~, shall include in all public education materials information in the appropriate ~~language(s) language or languages~~ regarding the importance of the notice or contain a telephone number or address where persons served may contact the ~~water system waterworks~~ to obtain a translated copy of the public education materials or to request assistance in the appropriate language.

b. The owner of a community waterworks that exceeds the lead action level on the basis of tap water samples collected in accordance with 12VAC5-590-375 B, and that is not already conducting public education tasks, shall conduct the public education tasks under this subdivision within 60 days after the end of the monitoring period in which the exceedance occurred. For ~~a~~ waterworks that ~~are is~~ required to conduct monitoring annually or less frequently, the end of the monitoring period is September 30 of the calendar year in which the sampling occurs, or, if the ~~commissioner department~~ has established an alternate monitoring period, the last day of that period. These public education tasks include:

(1) Deliver printed materials meeting the content requirements of subdivision D 1 of this section to all bill paying customers.

(2) Contact customers who are most at risk by delivering education materials that meet the content requirements of subdivision D 1 of this section to the local health department even if they are not located within the ~~water system's waterworks'~~ service area, along with an informational notice that encourages distribution to all the organization's potentially affected customers or community ~~water system's users waterworks' consumers~~. The ~~waterworks~~ owner shall contact the local health department directly by phone or in person. The local health department may provide a specific list of additional community-based organizations serving target populations, which may include organizations outside the service area of the ~~water system waterworks~~. If ~~such these~~ lists are provided, ~~then~~ the ~~waterworks~~ owner shall deliver education materials that meet the content requirements of subdivision D 1 of this section to all organizations on the provided lists.

(3) Contact customers who are most at risk by delivering materials that meet the content requirements of subdivision D 1 of this section to the following organizations that are located within the ~~water system's waterworks'~~ service area, along with an informational notice that encourages distribution to all the organization's potentially affected customers or community ~~water system's waterworks' users~~: (i) public and private schools or school boards; (ii) Women, Infants, and Children (WIC) and Head Start programs; (iii) public and private hospitals and medical clinics; (iv) pediatricians; (v) family planning clinics; and (vi) local welfare agencies.

(4) Make a good faith effort to locate the following organizations within the service area and deliver materials that meet the content requirements of subdivision D 1 of this section to them, along with an informational notice that encourages distribution to all

potentially affected customers or ~~users~~ consumers. The good faith effort to contact at-risk customers may include requesting a specific contact list of these organizations from the local health department, even if the agencies are not located within the ~~water system's~~ waterworks' service area: (i) licensed childcare centers; (ii) public and private preschools; and (iii) obstetricians-gynecologists and midwives.

(5) No less often than quarterly, provide information on or in each water bill as long as the waterworks exceeds the action level for lead. The message on the water bill shall include the following statement exactly as written except for the text in brackets for which the owner shall include system-specific information: ~~[INSERT NAME OF WATERWORKS]~~ (Insert name of waterworks) found high levels of lead in drinking water in some homes. Lead can cause serious health problems. For more information please call ~~[INSERT NAME OF WATERWORKS]~~ or visit [IF APPLICABLE INSERT WATERWORKS' WEBSITE] ~~(Insert name of waterworks)~~ or (if applicable) visit our website at (Insert waterworks' website URL here). The message or delivery mechanism can be modified in consultation with the ~~commissioner~~ department; specifically, the ~~commissioner~~ department may allow a separate mailing of public education materials to customers if the ~~waterworks~~ owner cannot place the information on water bills.

(6) Post materials meeting the content requirements of subdivision D 1 of this section on the waterworks' website if the waterworks serves a population greater than 100,000 persons.

(7) Submit a press release to newspapers, television, and radio stations.

(8) In addition to the delivery requirements contained in subdivisions D 2 b (1) through D 2 b (7) of this section, the ~~owners~~ owner of a waterworks exceeding the lead action level shall implement at least three activities from one or more of the following categories: (i) public service announcements; (ii) paid advertisements; (iii) public area informational displays; (iv) e-mails to customers; (v) public meetings; (vi) household deliveries; (vii) targeted individual customer contact; (viii) direct material distribution to all multi-family homes and institutions; and (ix) other methods approved by the ~~commissioner~~ department. The educational content and selection of these activities shall be determined in consultation with the ~~district engineer~~ department.

(9) As long as a community ~~water system~~ waterworks exceeds the lead action level, the ~~waterworks~~ owner shall repeat the following public education activities:

(a) The ~~owner of a community water system~~ waterworks owner shall repeat the tasks contained in subdivisions D 2 b (1) through D 2 b (3); and D 2 b (8) of this section every 12 months.

(b) The ~~owner of a community water system~~ waterworks owner shall repeat tasks contained in subdivision D 2 b (5) of this section with each billing cycle.

(c) The owner of a community ~~water system~~ waterworks serving a population greater than 100,000 shall post and retain the material on a publicly accessible website pursuant to subdivision D 2 b (6) of this section.

(d) The ~~owner of a community water system~~ waterworks owner shall repeat the task in subdivision D 2 b (7) of this section twice every 12 months on a schedule agreed upon with the ~~commissioner~~ department.

(10) The ~~commissioner~~ department may allow the public education activities described in subdivision D 2 b of this section to extend beyond the 60-day requirement if needed for implementation purposes on a case-by-case basis; however, this extension must

be approved in writing by the ~~commissioner~~department in advance of the 60-day deadline.

c. The owner of a nontransient noncommunity waterworks that exceeds the lead action level on the basis of tap water samples collected in accordance with 12VAC5-590-375 B, and that is not already conducting public education tasks, shall conduct the public education tasks under this subdivision within 60 days after the end of the monitoring period in which the exceedance occurred. For a waterworks that ~~are~~is required to conduct monitoring annually or less frequently, the end of the monitoring period is September 30 of the calendar year in which the sampling occurs, or, if the ~~commissioner~~department has established an alternate monitoring period, the last day of that period. These public education tasks include:

(1) Post informational posters containing all of the public education elements contained in subdivision D 1 of this section in a public place or common area in each of the buildings served by the waterworks; and

(2) Distribute informational pamphlets or brochures on lead in drinking water containing all of the public education elements in subdivision D 1 of this section to each person served by the nontransient noncommunity waterworks. The ~~commissioner~~department may allow the owner to utilize electronic transmission ~~in lieu instead of~~, or combined with, printed materials as long as it achieves at least the same coverage.

(3) The owner of a nontransient noncommunity waterworks shall repeat the tasks contained in subdivisions D 2 c (1) through D 2 c (2) of this section at least once during each calendar year in which the waterworks exceeds the lead action level.

(4) The ~~commissioner~~department may allow the public education activities described in subdivision D 2 c of this section to extend beyond the 60-day requirement if needed for implementation purposes on a case-by-case basis; however, this extension must be approved in writing by the ~~commissioner~~department in advance of the 60-day deadline.

d. ~~An~~The owner may discontinue delivery of public education materials if the waterworks has met the lead action level during the most recent six-month monitoring period conducted pursuant to 12VAC5-590-375 B. The owner shall recommence public education in accordance with this subsection if the waterworks subsequently exceeds the lead action level during any monitoring period.

e. The owner of a community waterworks may apply to the ~~district engineer~~department, in writing, (unless the ~~commissioner~~department has waived the requirement for prior approval) to use only the text specified in subdivision D 1 a of this section ~~in lieu instead~~ of the text in subdivisions D 1 a through D 1 b of this section and to perform the tasks listed in subdivisions D 2 c (1) through D 2 c (2) of this section ~~in lieu instead~~ of the tasks in subdivisions D 2 b (1) through D 2 b (9) of this section if:

(1) The waterworks serves a facility, such as a prison or a hospital, where the population served is not capable of or is prevented from making improvements to plumbing or installing POU treatment devices; and

(2) The owner provides water as part of the cost of services provided and does not separately charge for water consumption.

f. The owner of a community waterworks serving 3,300 or fewer people may limit certain aspects ~~of their~~the public education programs as follows:

(1) With respect to the requirements of subdivision D 2 b (8) of this section, the owner of a waterworks serving 3,300 or fewer people shall implement at least one of the activities listed in that subdivision.

(2) With respect to the requirements of subdivision D 2 b (2) of this section, the owner of a waterworks serving 3,300 or fewer people may limit the distribution of the public education materials required under that subdivision to facilities and organizations served by the waterworks that are most likely to be visited regularly by pregnant women and children.

(3) With respect to the requirements of subdivision D 2 b (7) of this section, the ~~commissioner~~ department may waive this requirement for ~~systems~~ waterworks serving 3,300 or fewer persons as long as the owner distributes notices to every household served by the waterworks.

3. Supplemental monitoring and notification of results. The owner of a waterworks that fails to meet the lead action level on the basis of tap samples collected in accordance with 12VAC5-590-375 B shall offer to sample the tap water of any customer who requests it. The owner is not required to pay for collecting or analyzing the sample, nor is the owner required to collect and analyze the sample itself.

4. Notification of results. The ~~owners of a~~ owner of a community ~~waterworks and or a~~ nontransient noncommunity waterworks shall provide a notice of the individual tap results from lead tap water monitoring carried out under the requirements of 12VAC5-590-375 B to the persons served by the waterworks at the specific sampling site from which the sample was ~~taken~~ collected (e.g., the occupants of the residence or buildings where the tap was tested).

a. Timing of notification. ~~An~~ The owner shall provide this consumer notice as soon as practical, but no later than 30 days after the owner learns of the tap monitoring results.

b. Content. The consumer notice shall include the results of lead tap water monitoring for the tap that was tested, an explanation of the health effects of lead, list steps consumers can take to reduce exposure to lead in drinking water, and contact information for the waterworks. The notice shall also provide the ~~maximum~~ contaminant level goal MCLG and the action level for lead and the definitions for these two terms from 12VAC5-590-10.

c. Delivery. The consumer notice shall be provided to persons served at the tap that was tested, either by mail or by another method approved by the ~~commissioner~~ department. For example, the owner of a nontransient noncommunity waterworks may post the results on a bulletin board in the facility to allow ~~users~~ consumers to review the information. The owner shall provide the notice to customers at sample taps tested, including consumers who do not receive water bills.

#### **12VAC5-590-410. Determination of compliance. (Repealed.)**

~~For the purposes of determining compliance with a PMCL or action level, the following criteria shall be used:~~

~~A. Bacteriological results. Compliance with the PMCL for coliform bacteria shall be determined as specified in 12VAC5-590-380 B. Repeat samples shall be used as a basis for determining compliance with these regulations.~~

~~B. Inorganic chemicals.~~

~~1. Antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, and thallium. Where the results of sampling for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium exceed the PMCL, the owner~~



shall take a confirmation sample, at the same sampling point, within two weeks of notification of the analytical results of the first sample.

a. The results of the initial and confirmation samples shall be averaged to determine compliance with subdivision B 1 c of this subsection. The commissioner has the discretion to delete results of obvious sampling errors.

b. The commissioner may require more frequent monitoring.

c. Compliance with antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, and thallium in Table 2.2 of 12VAC5-590-440 shall be determined based on the analytical result(s) obtained at each sampling point.

(1) Owners that are conducting monitoring more frequently than annually, compliance with the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, and thallium is determined by a running annual average at each sampling point. If the average at any sampling point is greater than the PMCL, then the waterworks is out of compliance. If any one sample would cause the annual average to be exceeded, then the waterworks is out of compliance immediately. Any sample below the method detection limit shall be calculated at zero for the purpose of determining the annual average. If an owner fails to collect the required number of samples, compliance (average concentration) shall be based on the total number of samples collected.

(2) Owners that are monitoring annually, or less frequently, the waterworks is not out of compliance with the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, and thallium if the average of the original sample and a confirmation sample of a contaminant at any sampling point is greater than the PMCL. Owners of waterworks monitoring annually or less frequently whose sample result exceeds the PMCL shall begin quarterly sampling. The waterworks shall not be considered in violation of the PMCL until it has completed one year of quarterly sampling. However, if the confirmation sample is not collected, the waterworks is in violation of the PMCL for antimony, arsenic, asbestos, barium, beryllium, cadmium, cyanide (as free cyanide), chromium, fluoride, mercury, nickel, selenium, or thallium. If an owner fails to collect the required number of samples, compliance (average concentration) shall be based on the total number of samples collected.

2. Nitrate and nitrite. Compliance with the PMCL is determined based on one sample from each sampling point if the levels of these contaminants are below the PMCLs. Where nitrate or nitrite sample results exceed the PMCL, the owner shall take a confirmation sample from the same sampling point that exceeded the PMCL within 24 hours of the owner's receipt of the analytical results of the first sample. The results of the initial and confirmation sample shall be averaged to determine compliance with this subdivision. Owners unable to comply with the 24 hour sampling requirement shall immediately notify the consumers in the area served by the waterworks in accordance with 12VAC5-590-540. Owners exercising this option shall take and analyze a confirmation sample within two weeks of notification of the analytical results of the first sample. The commissioner may require more frequent monitoring. The commissioner has the discretion to delete results of obvious sampling errors.

#### C. Organic chemicals.

1. VOCs and SOCs. A confirmation sample shall be required for positive results for contaminants listed in Table 2.3. The commissioner has the discretion to delete results of obvious sampling errors from this calculation.

a. The results of the initial and confirmation sample shall be averaged to determine the waterworks' compliance in accordance with subdivision C 1 b of this subsection.

b. Compliance with Table 2.3 shall be determined based on the analytical results obtained at each sampling point. Any samples below the detection limit shall be calculated as zero for the purposes of determining the annual average. (Note: Refer to detection definition at 12VAC5-590-370 B 2 h.) If an owner fails to collect the required number of samples, compliance (average concentration) will be based on the total number of samples collected.

(1) Owners that are conducting monitoring more frequently than annually, compliance is determined by a running annual average of all samples taken at each sampling point. If the annual average of any sampling point is greater than the PMCL, then the waterworks is out of compliance. If the initial sample or a subsequent sample would cause the annual average to be exceeded, then the waterworks is out of compliance immediately. Any samples below the detection limit shall be calculated as zero for purposes of determining the annual average. (Note: Refer to detection definition at 12VAC5-590-370 B 2 h.)

(2) If monitoring is conducted annually, or less frequently, the waterworks is not in violation if the average of the initial and confirmation sample is greater than the PMCL for that contaminant; however, the owner shall begin quarterly sampling. The waterworks will not be considered in violation of the PMCL until the owner has completed one year of quarterly sampling. If any sample will cause the running annual average to exceed the PMCL at any sampling point, the waterworks is immediately out of compliance with the PMCL.

2. Disinfectant residuals, disinfection byproducts and disinfection byproduct precursors. Compliance with 12VAC5-590-370 B 3 a through B 3 k is as follows:

a. General requirements.

(1) Where compliance is based on a running annual average of monthly or quarterly samples or averages and the owner fails to monitor for TTHM, HAA5, or bromate, this failure to monitor will be treated as a monitoring violation for the entire period covered by the annual average. Where compliance is based on a running annual average of monthly or quarterly samples or averages and the owner's failure to monitor makes it impossible to determine compliance with MRDLs for chlorine and chloramines, this failure to monitor shall be treated as a monitoring violation for the entire period covered by the annual average.

(2) All samples taken and analyzed under subdivision C 2 of this section shall be included in determining compliance, even if that number is greater than the minimum required.

(3) If during the first year of monitoring under 12VAC5-590-370 B 3 b, any individual quarter's average will cause the running annual average of that waterworks to exceed the PMCL in Table 2.12 and Table 2.13, the waterworks is out of compliance at the end of that quarter.

b. Disinfection byproducts.

(1) TTHMs and HAA5.

(a) Running Annual Average. All waterworks using surface water or groundwater under the direct influence of surface water serving 10,000 or more persons shall comply with this section beginning January 1, 2002. All waterworks using surface water or groundwater under the direct influence of surface water serving less than 10,000 persons and all waterworks using groundwater not under the direct influence

of surface water shall comply with this section beginning January 1, 2004. All waterworks shall comply with this section until the dates listed in 12VAC5-590-370 B e (3) (e).

(i) For waterworks monitoring quarterly, compliance with PMCLs in Table 2.13 shall be based on a running annual arithmetic average, computed quarterly, of quarterly arithmetic averages of all samples collected by the owner as prescribed by 12VAC5-590-370 B 3 e (1).

(ii) For waterworks monitoring less frequently than quarterly, the owner demonstrates PMCL compliance if the average of samples taken that year under the provisions of 12VAC5-590-370 B 3 e (1) does not exceed the PMCLs in Table 2.13. If the average of these samples exceeds the PMCL, the owner shall increase monitoring to once per quarter per treatment plant and such a waterworks is not in violation of the PMCL until it has completed one year of quarterly monitoring, unless the result of fewer than four quarters of monitoring will cause the running annual average to exceed the PMCL, in which case the waterworks is in violation at the end of that quarter. Owners of waterworks required to increase monitoring frequency to quarterly monitoring shall calculate compliance by including the sample that triggered the increase monitoring plus the following three quarter of monitoring.

(iii) If the running annual arithmetic average of quarterly averages covering any consecutive four quarter period exceeds the PMCL in Table 2.12 and Table 2.13, the waterworks is in violation of the PMCL and the owner shall notify the public pursuant to 12VAC5-590-540 in addition to reporting to the commissioner pursuant to 12VAC5-590-530.

(iv) If an owner fails to complete four consecutive quarters of monitoring, compliance with the PMCL in Table 2.13 for the last four quarter compliance period shall be based on an average of the available data.

(b) Locational Running Annual Average (LRAA). All waterworks shall comply with this section beginning on the dates listed in 12VAC5-590-370 B e (3) (e).

(i) Owners of waterworks required to monitor quarterly shall calculate LRAAs for TTHM and HAA5 using monitoring results collected under 12VAC5-590-370 B 3 e (3) and determine that each LRAA does not exceed the PMCL in order to comply with PMCLs in Table 2.13. If the owner fails to complete four consecutive quarters of monitoring, the owner shall calculate compliance with the PMCL based on the average of the available data from the most recent four quarters. If the owner takes more than one sample per quarter at a monitoring location, the owner shall average all samples taken in the quarter at that location to determine a quarterly average to be used in the LRAA calculation.

(ii) Owners of waterworks required to monitor yearly or less frequently shall determine that each sample taken is less than the PMCL in order to determine compliance with PMCLs in Table 2.13. If any sample exceeds the PMCL, the owner shall comply with the requirements of 12VAC5-590-370 B 3 e (3) (g). If no sample exceeds the PMCL, the sample result for each monitoring location is considered the LRAA for that monitoring location.

(iii) Waterworks are in violation of the monitoring requirements for each quarter that a monitoring result would be used in calculating an LRAA if the owner fails to monitor.

(iv) Waterworks have exceeded the operational evaluation level at any monitoring location where the sum of the two previous quarters' TTHM results plus twice the current quarter's TTHM result, divided by four to determine an average, exceeds 0.080 mg/L, or where the sum of the two previous quarters' HAA5 results plus twice the

current quarter's HAA5 result, divided by four to determine an average, exceeds 0.060 mg/L.

~~((a)) Owners of waterworks that exceed the operational evaluation level shall conduct an operational evaluation and submit a written report of the evaluation to the commissioner no later than 90 days after being notified of the analytical result that causes the waterworks to exceed the operational evaluation level. The written report shall be made available to the public upon request.~~

~~((b)) The operational evaluation report shall include an examination of waterworks treatment and distribution operational practices, including storage tank operations, excess storage capacity, distribution system flushing, changes in sources or source water quality, and treatment changes or problems that may contribute to TTHM and HAA5 formation and what steps could be considered to minimize future exceedances.~~

~~((c)) The owner may request and the commissioner may allow waterworks to limit the scope of the evaluation if the owner is able to identify the cause of the operational evaluation level exceedance. The request to limit the scope of the evaluation does not extend the schedule in paragraph ((a)) of this section for submitting the written report. The commissioner shall approve this limited scope of evaluation in writing and the owner shall keep that approval with the completed report.~~

~~(2) Bromate. Compliance shall be based on a running annual arithmetic average, computed quarterly, of monthly samples (or, for months in which the waterworks takes more than one sample, the average of all samples taken during the month) collected by the owner as prescribed by 12VAC5-590-370 B 3 g. If the average of samples covering any consecutive four quarter period exceeds the PMCL in Table 2.13, the waterworks is in violation of the PMCL and the owner shall notify the public pursuant to 12VAC5-590-540, in addition to reporting to the commissioner pursuant to 12VAC5-590-530. If an owner fails to complete 12 consecutive months' monitoring, compliance with the PMCL for the last four quarter compliance period shall be based on an average of the available data.~~

~~(3) Chlorite. Compliance shall be based on an arithmetic average of each three sample set taken in the distribution system as prescribed by 12VAC5-590-370 B 3 f (1) (a), (b) and (c). If the arithmetic average of any three sample set exceeds the PMCL in Table 2.13, the waterworks is in violation of the PMCL and the owner shall notify the public pursuant to 12VAC5-590-540, in addition to reporting to the commissioner pursuant to 12VAC5-590-530.~~

~~e. Disinfectant residuals.~~

~~(1) Chlorine and chloramines.~~

~~(a) Compliance shall be based on a running annual arithmetic average, computed quarterly, of monthly averages of all samples collected by the waterworks under 12VAC5-590-370 B 3 h (1) (a). If the average covering any consecutive four quarter period exceeds the MRDL in Table 2.12, the waterworks is in violation of the MRDL and the owner shall notify the public pursuant to 12VAC5-590-540, in addition to reporting to the commissioner pursuant to 12VAC5-590-530.~~

~~(b) In cases where waterworks switch between the use of chlorine and chloramines for residual disinfection during the year, compliance shall be determined by including together all monitoring results of both chlorine and chloramines in calculating compliance. Reports submitted pursuant to 12VAC5-590-530 shall clearly indicate which residual disinfectant was analyzed for each sample.~~

~~(2) Chlorine dioxide.~~

~~(a) Acute violations. Compliance shall be based on consecutive daily samples collected by the owner under 12VAC5-590-370 B-3 h (2) (a). If any daily sample taken at the entrance to the distribution system exceeds the MRDL in Table 2.12, and on the following day one (or more) of the three samples taken in the distribution system exceed the MRDL, the waterworks is in violation of the MRDL and the owner shall take immediate corrective action to lower the level of chlorine dioxide below the MRDL and the owner shall notify the public pursuant to the procedures for Tier 1 conditions in 12VAC5-590-540 in addition to reporting to the commissioner in pursuant to 12VAC5-590-530. Failure to take samples in the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system will also be considered an MRDL violation and the owner shall notify the public of the violation in accordance with the provisions for Tier 1 conditions in 12VAC5-590-540 in addition to reporting to the commissioner in pursuant to 12VAC5-590-530.~~

~~(b) Nonacute violations. Compliance shall be based on consecutive daily samples collected by the owner under 12VAC5-590-370 B-3 h (2) (a). If any two consecutive daily samples taken at the entrance to the distribution system exceed the MRDL in Table 2.12 and all distribution system samples taken are below the MRDL, the waterworks is in violation of the MRDL and the owner shall take corrective action to lower the level of chlorine dioxide below the MRDL at the point of sampling and shall notify the public pursuant to the procedures for Tier 2 conditions in 12VAC5-590-540 in addition to reporting to the commissioner in pursuant to 12VAC5-590-530. Failure to monitor at the entrance to the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system is also an MRDL violation and the owner shall notify the public of the violation in accordance with the provisions for Tier 2 conditions in 12VAC5-590-540 in addition to reporting to the commissioner in pursuant to 12VAC5-590-530.~~

~~d. Disinfection byproduct precursors (DBPP). Compliance shall be determined as specified by 12VAC5-590-420 H-3. Owners may begin monitoring to determine whether Step 1 TOC removals can be met 12 months prior to the compliance date for the waterworks. This monitoring is not required and failure to monitor during this period is not a violation. However, any owner that does not monitor during this period, and then determines in the first 12 months after the compliance date that it is not able to meet the Step 1 requirements in 12VAC5-590-420 H-2 b and shall therefore apply for alternate minimum TOC removal (Step 2) requirements, is not eligible for retroactive approval of alternate minimum TOC removal (Step 2) requirements as allowed pursuant to 12VAC5-590-420 H-2 c and is in violation. Owners may apply for alternate minimum TOC removal (Step 2) requirements any time after the compliance date. For waterworks required to meet Step 1 TOC removals, if the value calculated under 12VAC5-590-420 H-3 a (4) is less than 1.00, the waterworks is in violation of the treatment technique requirements and the owner shall notify the public pursuant to 12VAC5-590-540 in addition to reporting to the commissioner pursuant to 12VAC5-90-530.~~

~~D. Radiological results (gross alpha, combined radium-226 and radium-228, uranium and man-made radioactivity). Compliance with the radiological PMCLs shall be in accordance with 12VAC5-590-370 D-3 c. PMCLs are indicated in subsection B of Table 2.5. Sampling for radiological analysis shall be in compliance with 12VAC5-590-370 D-1 and D-2. Furthermore, compliance shall be determined by rounding off results to the same number of significant figures as the PMCL for the substance in question.~~

~~E. Reserved.~~

F. Turbidity. The requirements in this subsection apply to filtered waterworks until June 29, 1993. The requirements in this section apply to unfiltered waterworks with surface water sources or groundwater sources under the direct influence of surface water that are required to install filtration equipment until June 29, 1993, or until filtration is installed, whichever is later. When a sample exceeds the PMCL for turbidity a confirmation sample shall be collected for analysis as soon as possible. In cases where a turbidimeter is required at the waterworks, the preferable resampling time is within one hour of the initial sampling. The repeat sample shall be the sample used for the purpose of calculating the monthly average. Compliance for public notification purposes shall be based on the monthly averages of the daily samples. However, public notification is also required if the average of samples taken on two consecutive days exceeds five NTU.

G. All analyses for PMCL and action level compliance determinations shall be consistent with current Environmental Protection Agency Regulations found at 40 CFR Part 141.

**12VAC5-590-411. Disinfection byproduct precursor, disinfection byproducts, and maximum residual disinfectant level treatment techniques.**

A. Treatment technique for control of disinfection byproduct precursors (DBPPs).

1. Applicability.

a. ~~The owner of a Community community waterworks and or a nontransient noncommunity waterworks owners~~ shall comply with treatment techniques for the control of DBPPs.

b. ~~A Waterworks waterworks~~ that uses ~~either a surface water source or a GUDI sources source or both~~ using conventional filtration treatment shall operate with enhanced coagulation or enhanced softening to achieve the TOC percentage removal levels specified in subdivision A 2 of this section, unless the waterworks meets at least one of the alternative compliance criteria listed in subdivision A 1 c or A 1 d of this section.

c. Alternative compliance criteria for enhanced coagulation and enhanced softening waterworks. ~~A Waterworks waterworks~~ that uses ~~either a surface water source or a GUDI sources source or both~~ provided with conventional filtration treatment may use the alternative compliance criteria in subdivisions A 1 c (1) through A 1 c (6) of this section to comply with this section ~~in lieu instead~~ of complying with subdivision A 2 of this section. ~~Owners-The owner~~ shall comply with monitoring requirements in 12VAC5-590-374 I.

(1) The waterworks' source water TOC level is less than 2.0 mg/L, calculated quarterly as a ~~running annual average~~ RAA.

(2) The waterworks' treated water TOC level is less than 2.0 mg/L, calculated quarterly as a ~~running annual average~~ RAA.

(3) The waterworks' source water TOC level is less than 4.0 mg/L, calculated quarterly as a ~~running annual average~~ RAA; the source water alkalinity is greater than 60 mg/L (as CaCO<sub>3</sub>), calculated quarterly as a ~~running annual average~~ RAA; and no TTHM and HAA5 LRAAs are greater than 0.040 mg/L and 0.030 mg/L, respectively.

(4) No TTHM and HAA5 LRAAs are greater than 0.040 mg/L and 0.030 mg/L, respectively, and the waterworks uses only chlorine for primary disinfection and ~~maintenance of maintains~~ a residual in the distribution system.

(5) The waterworks' source water SUVA, ~~prior to before~~ any treatment and measured monthly, is less than or equal to 2.0 ~~Liters-liters~~ per milligram-meter (L/mg-m), calculated quarterly as a ~~running annual average~~ RAA.

(6) The waterworks' finished water SUVA, measured monthly, is less than or equal to 2.0 L/mg-m. calculated quarterly as a ~~running annual average~~ RAA.

d. Additional alternative compliance criteria for softening waterworks. A ~~Waterworks waterworks~~ practicing enhanced softening that cannot achieve the TOC removals required by subdivision A 2 b of this section may use the alternative compliance criteria in subdivisions A 1 c (1) and A 1 c (2) ~~in lieu~~ instead of complying with subdivision A 2 of this section. ~~The Waterworks-waterworks~~ shall comply with monitoring requirements in 12VAC5-590-374 I.

(1) Softening that results in lowering the treated water alkalinity to less than 60 mg/L (as CaCO<sub>3</sub>), measured monthly and calculated quarterly as a ~~running annual average~~ RAA.

(2) Softening that results in removing at least 10 mg/L of magnesium hardness (as CaCO<sub>3</sub>), measured monthly and calculated quarterly as a ~~RAA an annual running average~~.

2. Enhanced coagulation and enhanced softening performance requirements.

a. A ~~Waterworks-waterworks~~ shall achieve the percentage reduction of TOC specified in subdivision A 2 b of this section between the source water and the combined filter effluent, unless the ~~commissioner-department~~ approves an owner's request for alternate minimum TOC removal (Step 2) requirements under subdivision A 2 c of this section.

Required Step 1 TOC reductions, indicated in Table 411.1, are based upon specified source water parameters. A ~~Waterworks-waterworks~~ practicing softening ~~are-is~~ required to meet the Step 1 TOC reductions in the far-right column (Source water alkalinity greater than 120 mg/L) for the specified source water TOC<sub>i</sub>.

b. Step 1 Required ~~Removal-removal~~ of TOC by "Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual," May 1999, EPA Office of Water.

TABLE 411.1.  
Required Percentage Removals of TOC<sup>a,b</sup>.

SOURCE WATER TOC, mg/L	SOURCE WATER ALKALINITY, mg/L as CaCO <sub>3</sub>		
	0-60	>60-120	>120 <sup>c</sup>
>2.0-4.0	35.0%	25.0%	15.0%
>4.0-8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

<sup>a</sup>~~Waterworks~~ A waterworks meeting at least one of the conditions in subdivisions A 1 c (1) through A 1 c (6) of this section ~~are-is~~ not required to operate with enhanced coagulation.

<sup>b</sup>~~Softening~~ A waterworks utilizing softening and meeting one of the alternative compliance criteria in subdivision A 1 d of this section ~~are-is~~ not required to operate with enhanced softening.

<sup>c</sup>~~Waterworks~~ A waterworks practicing softening shall meet the TOC removal requirements in this column.

c. A ~~Waterworks-waterworks~~ that uses either a surface water source or a GUDI ~~sources-source or both~~ with conventional treatment ~~waterworks~~ that cannot achieve

the Step 1 TOC removals required by subdivision A 2 b due to water quality parameters or operational constraints shall apply to the ~~commissioner~~department, within three months of failure to achieve the TOC removals required by subdivision A 2 b of this section, for approval of alternative minimum TOC (Step 2) removal requirements submitted by the owner. If the ~~commissioner~~department approves the alternative minimum TOC removal (Step 2) requirements, then the ~~commissioner~~department may make those requirements retroactive for the purposes of determining compliance. Until the ~~commissioner~~department approves the alternate minimum TOC removal (Step 2) requirements, the waterworks shall meet the Step 1 TOC removals contained in subdivision A 2 b of this section.

d. Alternate minimum TOC removal (Step 2) requirements. Applications, made to the ~~commissioner~~department by the owner of a owners-of waterworks using enhanced coagulation, for approval of alternative minimum TOC removal (Step 2) requirements under subdivision A 2 c of this section shall include, at a minimum, results of bench-scale or pilot-scale testing conducted under subdivision A 2 d (1) of this section. The submitted bench-scale or pilot-scale testing shall be used to determine the alternate enhanced coagulation level.

(1) Alternate enhanced coagulation level is defined as coagulation at a coagulant dose and pH as determined by the method described in subdivisions A 2 d (1) through A 2 d (5) of this section so that an incremental addition of 10 mg/L of alum (or equivalent amount of ferric salt) results in a TOC removal of equal to or less than 0.3 mg/L. The percentage removal of TOC at this point on the "TOC removal versus coagulant dose" curve is then defined as the minimum TOC removal required for the waterworks. Once approved by the ~~commissioner~~department, this minimum requirement supersedes the minimum TOC removal requirements listed in Table 411.1. This requirement shall be effective until such time as the ~~commissioner~~department approves a new value based on the results of a new bench-scale and pilot-scale test. Failure to achieve the alternative minimum TOC removal levels set by the ~~commissioner~~department is a violation of this ~~chapter~~section.

(2) Bench-scale or pilot-scale testing of enhanced coagulation shall be conducted by using representative water samples and adding 10 mg/L increments of alum (or equivalent amounts of ferric salt) until the pH is reduced to a level less than or equal to the enhanced coagulation Step 2 target pH shown in Table 411.2.

TABLE 411.2.  
Enhanced Coagulation.

ALKALINITY (mg/L as CaCO <sub>3</sub> )	TARGET pH
0-60	5.5
>60-120	6.3
>120-240	7.0
>240	7.5

(3) For source waters with alkalinities of less than 60 mg/L for which addition of small amounts of alum or equivalent addition of iron coagulant drives the pH below 5.5 before significant TOC removal occurs, the waterworks shall add necessary chemicals to maintain the pH between 5.3 and 5.7 in samples until the TOC removal of 0.3 mg/L per 10 mg/L alum added (or equivalent addition of iron coagulant) is reached.



(4) The waterworks may operate at any coagulant dose or pH necessary (consistent with other sections of this chapter) to achieve the minimum TOC percentage removal approved under subdivision A 2 c of this section.

(5) If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose at all dosages of alum (or equivalent addition of iron coagulant), then the water is deemed to contain TOC not amenable to enhanced coagulation. The owner may then apply to the ~~commissioner~~ department for a waiver of enhanced coagulation requirements.

### 3. Compliance calculations.

a. ~~A Waterworks~~ waterworks that uses either a surface water source or a GUDI ~~sources~~ source or both other than those identified in subdivision A 1 b or A 1 c of this section shall comply with requirements contained in subdivision A 2 b or A 2 c of this section. ~~Owners~~ The owner shall calculate compliance quarterly, beginning after the waterworks has collected 12 months of data, by determining an annual average using the following method:

(1) Determine actual monthly TOC percentage removal, equal to:

$[1 - (\text{treated water TOC} / \text{source water TOC})] \times 100$ .

(2) Determine the required monthly TOC percentage removal (from either Table 411.1 or from subdivision A 2 c of this section).

(3) Divide the value in subdivision A 3 a (1) of this section by the value in subdivision A 3 a (2) of this section.

(4) Add together the results of subdivision A 3 a (3) of this section for the last ~~twelve~~ 12 months and divide by ~~twelve~~ 12.

(5) If the value calculated in subdivision A 3 a (4) of this section is less than 1.00, then the waterworks is not in compliance with the TOC percentage removal requirements.

b. ~~Owners~~ The owner may use the provisions in subdivisions A 3 b (1) through A 3 b (5) of this section ~~in lieu~~ instead of the calculations in subdivisions A 3 a (1) through A 3 a (5) of this section to determine compliance with TOC percentage removal requirements.

(1) In any month that the waterworks' treated or source water TOC level is less than 2.0 mg/L, the waterworks may assign a monthly value of 1.0 (~~in lieu~~ instead of the value calculated in subdivision A 3 a (3) of this section) when calculating compliance under the provisions of subdivision A 3 a of this section.

(2) In any month that ~~a~~ the waterworks practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO<sub>3</sub>), the waterworks may assign a monthly value of 1.0 (~~in lieu~~ instead of the value calculated in subdivision A 3 a (3) of this section) when calculating compliance under the provisions of subdivision A 3 a of this section.

(3) In any month that the waterworks' source water SUVA, ~~prior to~~ before any treatment is equal to or less than 2.0 L/mg-m, the waterworks may assign a monthly value of 1.0 (~~in lieu~~ instead of the value calculated in subdivision A 3 a (3) of this section) when calculating compliance under the provisions of subdivision A 3 a of this section.

(4) In any month that the waterworks' finished water SUVA is equal to or less than 2.0 L/mg-m, the waterworks may assign a monthly value of 1.0 (~~in lieu~~ instead of the value calculated in subdivision A 3 a (3) of this section) when calculating compliance under the provisions of subdivision A 3 a of this section.

(5) In any month that ~~a~~ the waterworks practicing enhanced softening lowers the alkalinity below 60 mg/L (as CaCO<sub>3</sub>), the waterworks may assign a monthly value of

1.0 (~~in lieu instead~~ of the value calculated in subdivision A 3 a (3) of this section) when calculating compliance under the provisions of subdivision A 3 a of this section.

c. ~~A Waterworks~~ waterworks that uses ~~either a surface water source or a GUDI sources~~ source or both and using conventional treatment may also comply with the requirements of this section by meeting the criteria in subdivision A 1 b or A 1 c of this section.

4. Enhanced coagulation or enhanced softening is the treatment technique required to control the level of DBP precursors in ~~drinking water treatment and distribution systems~~ for waterworks using ~~either a surface water source or a GUDI sources~~ or both and using conventional treatment.

B. The best available technology, treatment techniques, or other means available for achieving compliance with the PMCLs for ~~disinfection byproducts~~ DBPs shown in Table 340.6 are listed below:

1. The best available technology, treatment techniques, or other means available for achieving compliance with the PMCLs for bromate and chlorite:

<u>DISINFECTION BYPRODUCT</u>	<u>BEST AVAILABLE TECHNOLOGY</u>
<u>Bromate</u>	<u>Control of ozone treatment process to reduce production of bromate.</u>
<u>Chlorite</u>	<u>Control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels</u>

2. The best available technology, treatment techniques, or other means available for achieving compliance with the ~~running annual average~~ RAA PMCLs for TTHM and HAA5:

<u>DISINFECTION BYPRODUCT</u>	<u>BEST AVAILABLE TECHNOLOGY</u>
<u>Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)</u>	<u>Enhanced coagulation or enhanced softening or GAC10, with chlorine as the primary and residual disinfectant</u>

3. The best available technology, treatment techniques, or other means available for achieving compliance with the LRAA PMCLs for TTHM and HAA5 for ~~all-a~~ waterworks that disinfects ~~their-its~~ source water:

<u>DISINFECTION BYPRODUCT</u>	<u>BEST AVAILABLE TECHNOLOGY</u>
<u>Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)</u>	<u>Enhanced coagulation or enhanced softening, plus GAC10; or nanofiltration with a molecular weight cutoff less than or equal to 1000 Daltons; or GAC20</u>

4. The best available technology, treatment techniques, or other means available for achieving compliance with the LRAA maximum contaminant levels for TTHM and HAA5 for ~~a~~ consecutive waterworks and applies only to the disinfected water that ~~a~~ consecutive waterworks buys or otherwise receives:

DISINFECTION BYPRODUCT	BEST AVAILABLE TECHNOLOGY
Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)	<p><del>A Waterworks-waterworks</del> serving equal to or greater than 10,000 <del>people</del>: Improved distribution system and storage tank management to reduce residence time, plus the use of chloramines for disinfectant residual maintenance</p> <p><del>A Waterworks-waterworks</del> serving less than 10,000 <del>people</del>: Improved distribution system and storage tank management to reduce residence time</p>

C. The best available technology, treatment techniques, or other means available for achieving compliance with the MRDLs identified in Table 340.7 is the control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels.

**12VAC5-590-415. Uncovered finished water storage.**

A. ~~A Waterworks-waterworks~~ with uncovered finished water storage facilities shall comply with the requirements to cover the facility as described in this section.

B. ~~Owners-The owner~~ shall immediately notify the ~~commissioner-department~~ of the use of each uncovered finished water storage facility.

C. All uncovered finished water storage facilities shall be covered, in compliance with a schedule approved by the ~~commissionerdepartment~~.

D. Failure to comply with the requirements of this section is a violation of the treatment technique requirement.

**12VAC5-590-420. Treatment technique requirement. (Repealed).**

~~This section establishes treatment technique requirements in lieu of maximum contaminant levels for specified contaminants. Failure to meet any requirement of this section after the applicable date specified is a treatment technique violation.~~

~~A. The filtration and disinfection provisions of this section are required treatment techniques for any waterworks supplied by a surface water source and waterworks supplied by a groundwater source under the direct influence of surface water. This section establishes treatment technique requirements in lieu of PMCL's for the following contaminants: Giardia lamblia, viruses, heterotrophic bacteria (HPC), Legionella, Cryptosporidium and turbidity. Each waterworks with a surface water source or a groundwater source under the direct influence of surface water shall provide treatment of that source water that complies with these treatment technique requirements. The treatment technique requirements consist of installing and properly operating water treatment processes which reliably achieve:~~

- ~~1. At least 99.9% (3-log) removal and/or inactivation of Giardia lamblia cysts between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer; and~~
- ~~2. At least 99.99% (4-log) removal and/or inactivation of viruses between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer; and~~
- ~~3. At least 99% (2-log) removal of Cryptosporidium between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.~~

~~B. A waterworks using a surface water source or a groundwater source under the direct influence of surface water is considered to be in compliance with the requirements of subsection A of this section if it meets the following disinfection filtration and enhanced filtration and disinfection for Cryptosporidium requirements:~~

~~1. Disinfection. Waterworks with a surface water source or a groundwater source under the direct influence of surface water shall provide disinfection treatment in accordance with this section.~~

~~a. The disinfection treatment shall be sufficient to ensure that the total treatment processes of that waterworks achieve at least 99.9% (3-log) inactivation and/or removal of Giardia lamblia cysts and at least 99.99% (4-log) inactivation and/or removal of viruses.~~

~~b. The residual disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/L for more than four hours.~~

~~c. The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide cannot be undetectable in more than 5.0% of the samples each month, for any two consecutive months that the waterworks serves water to the public. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/mL, measured as heterotrophic plate count (HPC) is deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement. Thus, the value "V" in percent in the following formula cannot exceed 5.0% in one month, for any two consecutive months.~~

$$V = (c + d + e) / (a + b) \times 100$$

~~a = number of instances where the residual disinfectant concentration is measured;~~

~~b = number of instances where the residual disinfectant concentration is not measured but HPC is measured;~~

~~c = number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;~~

~~d = number of instances where no residual disinfectant concentration is detected and where the HPC is greater than 500/mL; and~~

~~e = number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL.~~

~~d. The commissioner may determine, based on site specific considerations, that an owner has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions and the waterworks is providing adequate disinfection in the distribution system, that the requirements of subdivision B 1 c of this section does not apply.~~

~~2. Filtration. (Also see 12VAC5-590-880.) All waterworks that use a surface water source or a groundwater source under the direct influence of surface water shall provide filtration treatment by using one of the following methods:~~

~~a. Conventional filtration or direct filtration.~~

~~(1) Achieve a filtered water turbidity of less than or equal to 0.3 NTU in at least 95% of the measurements taken each month. Samples shall be representative of the waterworks' filtered water.~~

~~(2) The turbidity level of representative samples of a system's filtered water shall at no time exceed 1 NTU, measured as specified in 12VAC5-590-440.~~

~~(3) A system that uses lime softening may acidify representative samples prior to analysis using a protocol approved by the commissioner.~~

~~b. Slow sand filtration.~~

~~(1) The turbidity level of representative samples of a waterworks' filtered water shall be less than or equal to one NTU in at least 95% of the measurements taken each month, except that if the commissioner determines there is no significant interference with disinfection at a higher turbidity level, the commissioner may substitute this higher turbidity limit for that waterworks.~~

~~(2) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed five NTU.~~

~~c. Diatomaceous earth filtration.~~

~~(1) The turbidity level of representative samples of a waterworks' filtered water shall be less than or equal to one NTU in at least 95% of the measurements taken each month.~~

~~(2) The turbidity level of representative samples of a waterworks' filtered water shall at no time exceed five NTU.~~

~~d. Other filtration technologies. An owner may use a filtration technology not listed in subdivisions 2 a through c of this subsection if the owner demonstrates to the commissioner (by pilot plant studies or other means) that the alternative filtration technology, in combination with disinfection treatment, achieves 99.9% removal (3-log) and/or inactivation of Giardia lamblia cysts, 99.99% removal (4-log) and/or inactivation of viruses, and 99% removal (2-log) of Cryptosporidium oocysts. For an owner that makes this demonstration, a turbidity limit of representative samples of a waterworks' filtered water, not to exceed 0.3 NTU, shall be established by the commissioner, which the waterworks must meet at least 95% of the time. In addition, the commissioner shall establish a maximum turbidity limit of representative samples of a waterworks' filtered water, not to exceed 1 NTU that the waterworks must not exceed at any time. These turbidity limits shall consistently achieve the removal rates and/or inactivation rates stated in this subdivision.~~

~~e. Each waterworks using a surface water source or groundwater source under the direct influence of surface water shall be operated by licensed operators of the appropriate classification as per the Virginia Board for Waterworks and Wastewater Works Operators Regulations (18VAC155-20).~~

~~f. If the commissioner has determined that a waterworks has a surface water source or a groundwater source under the direct influence of surface water, filtration is required. The waterworks shall provide disinfection during the interim before filtration is installed as follows:~~

~~(1) The residual disinfectant concentration in the distribution system shall not be less than 2.0 mg/L for more than four hours.~~

~~(2) The owner shall issue continuing boil water notices through the public notification procedure in 12VAC5-590-540 until such time as the required filtration equipment is installed.~~

~~(3) As an alternative to subdivisions B f 2 (1) and (2) of this section, the owner may demonstrate that the source can meet the appropriate C-T values shown in Appendix L and be considered to satisfy the requirements for 99.9% removal of Giardia cysts and virus, respectively. In addition, the waterworks owner shall comply with the following:~~

~~(a) Justify that other alternative sources of supply meeting these regulations are not immediately available.~~

(b) Analysis of the source is performed quarterly for the contaminants listed in Tables 2.2, 2.3, and 2.4. The primary maximum contaminant levels shall not be exceeded.

(c) Daily turbidity monitoring and maintenance of the turbidity level not to exceed five NTU.

(d) MPN analysis of the raw water based on the minimum sample frequency chart below:

Population Served	Coliform Samples/Week
≤500	1
501 – 3,300	2
3,301 – 10,000	3
10,001 – 25,000	4
>25,000	5

Note: Shall be taken on separate days.

(e) Bacteriological sampling of the distribution system at a frequency of twice that required by Table 2.1.

3. Enhanced filtration and disinfection for Cryptosporidium — All waterworks using a surface water source or a groundwater source under the direct influence of surface water shall comply with the following requirements based on their population or if the waterworks is a wholesaler, based on the population of the largest waterworks in the combined distribution system:

a. Owners shall conduct an initial and a second round of source water monitoring for each plant that treats a surface water or groundwater under the direct influence of surface water source. This monitoring may include sampling for Cryptosporidium, E. coli, and turbidity to determine what level, if any, of additional Cryptosporidium treatment is required.

(1) Initial round of source water monitoring. Owners shall conduct the following monitoring on the schedule in subdivision B 3 a (3) of this section unless they meet the monitoring avoidance criteria in subdivision B 3 a (4) of this section.

(a) Owners of waterworks serving at least 10,000 people shall sample their source water for Cryptosporidium, E. coli, and turbidity at least monthly for 24 months.

(b) Owners of waterworks serving fewer than 10,000 people:

(i) shall sample their source water for E. coli at least once every two weeks for 12 months, or

(ii) may avoid E. coli monitoring if the waterworks notifies the commissioner that it will monitor for Cryptosporidium as described in paragraph (c) of this section. The owner shall notify the commissioner no later than three months prior to the date the waterworks is otherwise required to start E. coli monitoring.

(c) Owners of waterworks serving fewer than 10,000 people shall sample their source water for Cryptosporidium at least twice per month for 12 months or at least monthly for 24 months if they meet one of the following, based on monitoring conducted under subdivision B 3 a (1) (b) of this section:

(i) For waterworks using lake/reservoir sources, the annual mean E. coli concentration is greater than 10 E. coli/100 mL.

(ii) For waterworks using flowing stream sources, the annual mean E. coli concentration is greater than 50 E. coli/100 mL.

(iii) The waterworks does not conduct E. coli monitoring as described in paragraph (1) (b) of this section.

(iv) Waterworks using ground water under the direct influence of surface water shall comply with the requirements of subdivision B 3 a (1) (c) of this section based on the E. coli level that applies to the nearest surface water body. If no surface water body is nearby, the waterworks shall comply based on the requirements that apply to waterworks using lake/reservoir sources.

(d) For waterworks serving fewer than 10,000 people, the commissioner may approve monitoring for an indicator other than E. coli under subdivision B 3 a (1) (b) (i) of this section. The commissioner also may approve an alternative to the E. coli concentration in subdivision B 3 a (1) (c) (i), (ii) or (iv) of this section to trigger Cryptosporidium monitoring. This approval by the commissioner shall be provided to the waterworks in writing and shall include the basis for the commissioner's determination that the alternative indicator and/or trigger level will provide a more accurate identification of whether a waterworks will exceed the Bin 1 Cryptosporidium level in subdivision B 3 c (1) (a) of this section.

(e) Waterworks may sample more frequently than required under this section if the sampling frequency is evenly spaced throughout the monitoring period.

(2) Second round of source water monitoring: Owners shall conduct a second round of source water monitoring that meets the requirements for monitoring parameters, frequency, and duration described in subdivision B 3 a (1) of this section, unless they meet the monitoring exemption criteria in subdivision B 3 a (4) of this section. Owners shall conduct this monitoring on the schedule in subdivision B 3 a (3) of this section.

(3) Monitoring schedule. Owners shall begin the monitoring required in subdivisions B 3 a (1) and (2) of this section no later than the month beginning with the date listed in the following table:

Source Water Monitoring Starting Dates Table

Owners of waterworks that serve...	Shall begin the first round of source water monitoring no later than the month beginning...	And shall begin the second round of source water monitoring no later than the month beginning...
At least 100,000 people	October 1, 2006	April 1, 2015
From 50,000 to 99,999 people	April 1, 2007	October 1, 2015
From 10,000 to 49,999 people	April 1, 2008	October 1, 2016
Fewer than 10,000 and monitor for E. coli	October 1, 2008	October 1, 2017
Fewer than 10,000 and monitor for Cryptosporidium <sup>4</sup>	April 1, 2010	April 1, 2019

<sup>4</sup>Applies to waterworks that meet the conditions of subdivision B 3 a (1) (c) of this section.

(4) Monitoring avoidance.

(a) Owners are not required to conduct source water monitoring under subdivision C 3 a of this section if the waterworks will provide a total of at least 5.5 log of treatment for *Cryptosporidium*, equivalent to meeting the treatment requirements of Bin 4 in subdivision B 3 c (2) of this section.

(b) If an owner chooses to provide the level of treatment in subdivision B 3 a (1) (a) of this section, rather than start source water monitoring, the owners shall notify the commissioner in writing no later than the date the owner is otherwise required to submit a sampling schedule for monitoring under subdivision B 3 a (5) of this section. Alternatively, an owner may choose to stop sampling at any point after the owner has initiated monitoring if the owner notifies the commissioner in writing that it will provide this level of treatment. Owners shall install and operate technologies to provide this level of treatment by the applicable treatment compliance date in subdivision B 3 c (3).

(5) Sampling schedules.

(a) Owners of waterworks required to conduct source water monitoring in accordance with subdivision B 3 a shall submit a sampling schedule that specifies the calendar dates when the owner shall collect each required sample.

(i) Owners shall submit sampling schedules to the commissioner no later than three months prior to the applicable date listed in subdivision B 3 a (3) for each round of required monitoring.

(ii) If the commissioner does not respond to an owner regarding the sampling schedule, the owner shall sample at the reported schedule.

(b) Owners shall collect samples within two days before or two days after the dates indicated in their sampling schedule (i.e., within a five day period around the schedule date) unless one of the conditions of the following paragraphs apply.

(i) If an extreme condition or situation exists that may pose danger to the sample collector, or that cannot be avoided and causes the owner to be unable to sample in the scheduled five-day period, the owner shall sample as close to the scheduled date as is feasible unless the commissioner approves an alternative sampling date. The owner shall submit an explanation for the delayed sampling date to the commissioner concurrent with the shipment of the sample to the laboratory.

(ii) If an owner is unable to report a valid analytical result for a scheduled sampling date due to equipment failure, loss of or damage to the sample, failure to comply with the analytical method requirements, including the quality control requirements of 12VAC5-590-440, or the failure of an approved laboratory to analyze the sample, then the owner shall collect a replacement sample. The owner shall collect the replacement sample not later than 21 days after receiving information that an analytical result cannot be reported for the scheduled date unless the owner demonstrates that collecting a replacement sample within this time frame is not feasible or the commissioner approves an alternative resampling date. The owner shall submit an explanation for the delayed sampling date to the commissioner concurrent with the shipment of the sample to the laboratory.

(c) Owners of waterworks that fail to meet the criteria of subdivision B 3 a (5) (b) of this section for any source water sample required under subdivision B 3 a shall revise their sampling schedules to add dates for collecting all missed samples. Owners shall



submit the revised schedule to the commissioner for approval prior to when the owner begins collecting the missed samples.

~~(6) Sampling locations.~~

~~(a) Owners of waterworks required to conduct source water monitoring under subdivision B 3 a shall collect samples for each plant that treats a surface water or groundwater under the direct influence of surface water source. Where multiple plants draw water from the same influent, such as the same pipe or intake, the commissioner may approve one set of monitoring results to be used to satisfy the requirements subdivision B 3 a for all plants.~~

~~(b) Owners shall collect source water samples prior to chemical treatment, such as coagulants, oxidants and disinfectants. However, the commissioner may approve the collection of a source water sample after chemical treatment. To grant this approval, the commissioner shall determine that collecting a sample prior to chemical treatment is not feasible for the waterworks and that the chemical treatment is unlikely to have a significant adverse effect on the analysis of the sample.~~

~~(c) Owners of waterworks that recycle filter backwash water shall collect source water samples prior to the point of filter backwash water addition.~~

~~(d) Bank filtration.~~

~~(i) Waterworks that receive Cryptosporidium treatment credit for bank filtration under 12VAC5-590-420 B 2 d, shall collect source water samples in the surface water prior to bank filtration.~~

~~(ii) Waterworks that use bank filtration as pretreatment to a filtration plant shall collect source water samples from the well (i.e., after bank filtration). Use of bank filtration during monitoring shall be consistent with routine operational practice. Waterworks collecting samples after a bank filtration process may not receive treatment credit for the bank filtration under subdivision B 3 d (4) (c) of this section.~~

~~(e) Multiple sources. Owners of waterworks with plants that use multiple water sources, including multiple surface water sources and blended surface water and ground water sources shall collect samples as specified in subdivision B 3 a (6) (e) (i) or (ii) of this section. The use of multiple sources during monitoring shall be consistent with routine operational practice.~~

~~(i) If a sampling tap is available where the sources are combined prior to treatment, waterworks shall collect samples from the tap.~~

~~(ii) If a sampling tap where the sources are combined prior to treatment is not available, owners shall collect samples at each source near the intake on the same day and shall follow either subdivision B 3 a (6) (e) (ii) ((a)) or ((b)) of this section for sample analysis.~~

~~((a)) Owners may composite samples from each source into one sample prior to analysis. The volume of sample from each source shall be weighted according to the proportion of the source in the total plant flow at the time the sample is collected.~~

~~((b)) Owners may analyze samples from each source separately and calculate a weighted average of the analysis results for each sampling date. The weighted average shall be calculated by multiplying the analysis result for each source by the fraction the source contributed to total plant flow at the time the sample was collected and then summing these values.~~

~~(f) Additional Requirements. Owners shall submit a description of their sampling location(s) to the commissioner at the same time as the sampling schedule required in subdivision B 3 a (3) of this section. This description shall address the position of the sampling location in relation to the waterworks water source(s) and treatment~~

processes, including pretreatment, points of chemical treatment, and filter backwash recycle. If the commissioner does not respond to an owner regarding sampling location(s), the owner shall sample at the reported location(s).

~~(7) Analytical methods. All analytical methods shall be conducted in accordance with 12VAC5-590-440.~~

~~(8) Approved laboratories.~~

~~(a) Cryptosporidium. Owners shall have Cryptosporidium samples analyzed by a laboratory that is approved under EPA's Laboratory Quality Assurance Evaluation Program for Analysis of Cryptosporidium in Water or a laboratory that has been certified for Cryptosporidium analysis by an equivalent state laboratory certification program.~~

~~(b) E. coli. Any laboratory certified by the state for total coliform or fecal coliform analysis under 12VAC5-590-440 is approved for E. coli analysis when the laboratory uses the same technique for E. coli that the laboratory uses under 12VAC5-590-440. Laboratories shall use methods for enumeration of E. coli in source water approved in 12VAC5-590-440.~~

~~(c) Turbidity. Measurements of turbidity shall be made by a party approved by the commissioner.~~

~~(9) Reporting of the source water results shall be in accordance with 12VAC5-590-530.~~

~~(10) Plants operating only part of the year. Owners of waterworks treating surface water or groundwater under the direct influence of surface water that operates for only part of the year shall conduct source water monitoring in accordance with this section, but with the following modifications:~~

~~(a) Owners shall sample their source water only during the months that the plant operates unless the commissioner specifies another monitoring period based on plant operating practices.~~

~~(b) Owners of waterworks with plants that operate less than six months per year and that monitor for Cryptosporidium shall collect at least six Cryptosporidium samples per year during each of two years of monitoring. Samples shall be evenly spaced throughout the period the plant operates.~~

~~(11) New sources;~~

~~(a) Owners of waterworks that begin using a new source of surface water or groundwater under the direct influence of surface water after the waterworks is required to begin monitoring under subdivision B 3 a (3) of this section shall monitor the new source on a schedule the commissioner approves. Source water monitoring shall meet the requirements of this section. The owner shall also meet the bin classification and Cryptosporidium treatment requirements of subdivision B 3 c (1) and (2) of this section, for the new source on a schedule the commissioner approves.~~

~~(b) The requirements of this section apply to waterworks using surface water or groundwater under the direct influence of surface water that begin operation after the monitoring start date applicable to the waterworks size under subdivision B 3 a (3) of this section.~~

~~(c) The owner shall begin a second round of source water monitoring no later than six years following initial bin classification under in subdivision B 3 c (1) of this section.~~

~~(12) Failure to collect any source water sample required under this section in accordance with the sampling schedule, sampling location, analytical method,~~

approved laboratory, and reporting requirements of subdivision B 3 a (5), (6), (7), (8), or (9) of this section is a monitoring violation.

(13) Grandfathering monitoring data. Owners may use (grandfather) monitoring data collected prior to the applicable monitoring start date in subdivision B 3 a (3) of this section to meet the initial source water monitoring requirements in subdivision B 3 a (1) of this section. Grandfathered data may substitute for an equivalent number of months at the end of the monitoring period. All data submitted under this paragraph shall meet the requirements in (13) (a) through (h) listed below and be approved by the commissioner:

(a) An owner may grandfather Cryptosporidium samples to meet the requirements of this section when the owner does not have corresponding E. coli and turbidity samples. A waterworks that grandfathers Cryptosporidium samples without E. coli and turbidity samples is not required to collect E. coli and turbidity samples when the system completes the requirements for Cryptosporidium monitoring under this section.

(b) E. coli sample analysis. The analysis of E. coli samples shall meet the analytical method and approved laboratory requirements of subdivision B 3 a (7) and (8) of this section.

(c) Cryptosporidium sample analysis. The analysis of Cryptosporidium samples shall meet the requirements of subdivision B 3 a (8) of this section.

(d) Sampling location. The sampling location shall meet the conditions in subdivision B 3 a (6) of this section.

(e) Sampling frequency. Cryptosporidium samples were collected no less frequently than each calendar month on a regular schedule, beginning no earlier than January 1999. Sample collection intervals may vary for the conditions specified in subdivision B 3 a (5) (b) (i) and (ii) of this section, if the owner provides documentation of the condition when reporting monitoring results.

(i) The commissioner may approve grandfathering of previously collected data where there are time gaps in the sampling frequency if the owner conducts additional monitoring the commissioner specifies to ensure that the data used to comply with the initial source water monitoring requirements of subdivision B 3 a of this section are seasonally representative and unbiased.

(ii) Owners may grandfather previously collected data where the sampling frequency within each month varied. If the Cryptosporidium sampling frequency varied, owners shall follow the monthly averaging procedure in subdivision B 3 c (1) (a) (v) of this section, when calculating the bin classification for filtered systems.

(f) Reporting monitoring results for grandfathering. Owners that request to grandfather previously collected monitoring results shall report the following information by the applicable dates listed in the following paragraphs. Owners shall report this information to the commissioner.

(i) Owners shall report that they intend to submit previously collected monitoring results for grandfathering. This report shall specify the number of previously collected results the owner shall submit, the dates of the first and last sample, and whether an owner shall conduct additional source water monitoring to meet the requirements in subdivision B 3 a of this section. Owners shall report this information no later than the date the sampling schedule listed in subdivision B 3 a (3) of this section is required.

(ii) Owners shall report previously collected monitoring results for grandfathering, along with the associated documentation listed in paragraphs ((a)) through ((d)) listed

below, no later than two months after the applicable date listed in subdivision B 3 a (3) of this section.

~~((a)) For each sample result, owners shall report the applicable data elements in 12VAC5-590-530 E 1 c.~~

~~((b)) Owners shall certify that the reported monitoring results include all results the waterworks generated during the time period beginning with the first reported result and ending with the final reported result. This applies to samples that were collected from the sampling location specified for source water monitoring under subdivision B 3 a (13) (f) of this section, not spiked, and analyzed using the laboratory's routine process for the analytical methods listed in this section.~~

~~((c)) Owners shall certify that the samples were representative of a plant's source water(s) and the source water(s) have not changed. Owners shall report a description of the sampling location(s), which shall address the position of the sampling location in relation to the waterworks' water source(s) and treatment processes, including points of chemical addition and filter backwash recycle.~~

~~((d)) For Cryptosporidium samples, the laboratory or laboratories that analyzed the samples shall provide a letter certifying that the quality control criteria specified in the methods listed in subdivision B 3 a (8) of this section were met for each sample batch associated with the reported results. Alternatively, the laboratory may provide bench sheets and sample examination report forms for each field, matrix spike, IPR, OPR, and method blank sample associated with the reported results.~~

~~(g) If the commissioner determines that a previously collected data set submitted for grandfathering was generated during source water conditions that were not normal for the waterworks, such as a drought, the commissioner may disapprove the data. Alternatively, the commissioner may approve the previously collected data if the owner reports additional source water monitoring data, as determined by the commissioner, to ensure that the data set used under subdivision B 3 c (1) of this section represents average source water conditions for the waterworks.~~

~~(h) If an owner submits previously collected data that fully meets the number of samples required for initial source water monitoring under subdivision B 3 a (1) of this section and some of the data are rejected due to not meeting the requirements of this section, the owner shall conduct additional monitoring to replace rejected data on a schedule the commissioner approves. Owners are not required to begin this additional monitoring until two months after notification that data have been rejected and additional monitoring is necessary.~~

~~b. Owners of waterworks that plan to make a significant change to their disinfection practice shall develop disinfection profiles and calculate disinfection benchmarks, as described in subdivision B 3 a (1) and (2) below.~~

~~(1) Requirements when making a significant change in disinfection practice.~~

~~(a) Following the completion of initial source water monitoring under subdivision B 3 a (1) of this section, owners of waterworks that plan to make a significant change to its disinfection practice, as defined in subdivision B 3 b (1) (b) of this section, shall develop disinfection profiles and calculate disinfection benchmarks for Giardia lamblia and viruses as described in subdivision B 3 b (2) of this section. Prior to changing the disinfection practice, the owner shall notify the commissioner and shall include in this notice the information in subdivision B 3 b (1) a) (i) through (iii) of this section.~~

~~(i) A completed disinfection profile and disinfection benchmark for Giardia lamblia and viruses as described in subdivision B 3 b (2) of this section.~~

- ~~(ii) A description of the proposed change in disinfection practice.~~
- ~~(iii) An analysis of how the proposed change will affect the current level of disinfection.~~
- ~~(b) Significant changes to disinfection practice are defined as follows:~~
  - ~~(i) Changes to the point of disinfection;~~
  - ~~(ii) Changes to the disinfectant(s) used in the treatment plant;~~
  - ~~(iii) Changes to the disinfection process; or~~
  - ~~(iv) Any other modification identified by the commissioner as a significant change to disinfection practice.~~
- ~~(2) Developing the disinfection profile and benchmark.~~
  - ~~(a) Owners of waterworks required to develop disinfection profiles in accordance with subdivision B 3 b (1) of this section shall follow the requirements of this section. Owners shall monitor at least weekly for a period of 12 consecutive months to determine the total log inactivation for Giardia lamblia and viruses. If owners monitor more frequently, the monitoring frequency shall be evenly spaced. Owners of waterworks that operate for fewer than 12 months per year shall monitor weekly during the period of operation. Owners shall determine log inactivation for Giardia lamblia through the entire plant, based on CT99.9 values in Appendix L. Owners shall determine log inactivation for viruses through the entire treatment plant based on a protocol approved by the commissioner.~~
  - ~~(b) Owners of waterworks with a single point of disinfectant application prior to the entrance to the distribution system shall conduct the monitoring in subdivision B 3 b (2) (b) (i) through (iv) of this section. Owners of waterworks with more than one point of disinfectant application shall conduct the monitoring in subdivision B 3 b (2) (b) (i) through (iv) of this section for each disinfection segment. Owners shall monitor the parameters necessary to determine the total inactivation ratio, using analytical methods in Appendix L.~~
    - ~~(i) For waterworks using a disinfectant other than UV, the temperature of the disinfected water shall be measured at each residual disinfectant concentration sampling point during peak hourly flow or at an alternative location approved by the commissioner.~~
    - ~~(ii) For waterworks using chlorine, the pH of the disinfected water shall be measured at each chlorine residual disinfectant concentration sampling point during peak hourly flow or at an alternative location approved by the commissioner.~~
    - ~~(iii) The disinfectant contact time(s) (t) shall be determined during peak hourly flow.~~
    - ~~(iv) The residual disinfectant concentration(s) (C) of the water before or at the first customer and prior to each additional point of disinfectant application shall be measured during peak hourly flow.~~
  - ~~(c) In lieu of conducting new monitoring under subdivision B 3 b (2) (b) of this section, owners may elect to meet the requirements of subdivision B 3 b (2) (c) (i) or (ii) of this section.~~
  - ~~(i) Owners of waterworks that have at least one year of existing data that are substantially equivalent to data collected under the provisions of subdivision B 3 b (2) (b) of this section may use these data to develop disinfection profiles as specified in this section if the owner has neither made a significant change to its treatment practice nor changed sources since the data were collected. Owners may develop disinfection profiles using up to three years of existing data.~~

~~(ii) Owners may use disinfection profile(s) developed under 12VAC5-590-500 E-2 in lieu of developing a new profile if the owner has neither made a significant change to its treatment practice nor changed sources since the profile was developed. Owners that have not developed a virus profile under 12VAC5-590-500 E-2 shall develop a virus profile using the same monitoring data on which the Giardia lamblia profile is based.~~

~~(d) Owners of waterworks shall calculate the total inactivation ratio for Giardia lamblia as specified in subdivision B-3-b(2)(d)(i) through (iii) of this section.~~

~~(i) Owners of waterworks using only one point of disinfectant application may determine the total inactivation ratio for the disinfection segment based on either of the methods in subdivision B-3-b(2)(d)(i)((a)) or ((b)) of this section.~~

~~((a)) Determine one inactivation ratio (CTcalc/CT99.9) before or at the first customer during peak hourly flow.~~

~~((b)) Determine successive CTcalc/CT99.9 values, representing sequential inactivation ratios, between the point of disinfectant application and a point before or at the first customer during peak hourly flow. The owner shall calculate the total inactivation ratio by determining (CTcalc/CT99.9) for each sequence and then adding the (CTcalc/CT99.9) values together to determine ( $\Sigma$  (CTcalc/CT99.9)).~~

~~(ii) Owners of waterworks using more than one point of disinfectant application before the first customer shall determine the CT value of each disinfection segment immediately prior to the next point of disinfectant application, or for the final segment, before or at the first customer, during peak hourly flow. The (CTcalc/CT99.9) value of each segment and ( $\Sigma$  (CTcalc/CT99.9)) shall be calculated using the method in paragraph (i)((b)) of this section.~~

~~(iii) The owner shall determine the total logs of inactivation by multiplying the value calculated in subdivision B-3-b(2)(d)(i) or (ii) of this section by 3.0.~~

~~(iv) Owners shall calculate the log of inactivation for viruses using a protocol approved by the commissioner.~~

~~(e) Owners shall use the procedures specified in (i) and (ii) listed below to calculate a disinfection benchmark.~~

~~(i) For each year of profiling data collected and calculated under subdivision B-3-b(2)(a) through (d) of this section, owners shall determine the lowest mean monthly level of both Giardia lamblia and virus inactivation. Owners shall determine the mean Giardia lamblia and virus inactivation for each calendar month for each year of profiling data by dividing the sum of daily or weekly Giardia lamblia and virus log inactivation by the number of values calculated for that month.~~

~~(ii) The disinfection benchmark is the lowest monthly mean value (for waterworks with one year of profiling data) or the mean of the lowest monthly mean values (for waterworks with more than one year of profiling data) of Giardia lamblia and virus log inactivation in each year of profiling data.~~

~~c. Owners shall determine their Cryptosporidium treatment bin classification as described in subdivision B-3-c(1) and provide additional treatment for Cryptosporidium, if required, as described in subdivision B-3-c(2). Owners shall implement Cryptosporidium treatment according to the schedule in subdivision B-3-c(3).~~

~~(1) Bin classification for waterworks.~~

~~(a) Following completion of the initial round of source water monitoring required under subdivision B-3-a(1), owners shall calculate an initial Cryptosporidium bin~~

concentration for each plant for which monitoring was required. Calculation of the bin concentration shall use the Cryptosporidium results reported under subdivision B 3 a (1) and shall follow these procedures:

(i) For waterworks that collect a total of at least 48 samples, the bin concentration is equal to the arithmetic mean of all sample concentrations.

(ii) For waterworks that collect a total of at least 24 samples, but not more than 47 samples, the bin concentration is equal to the highest arithmetic mean of all sample concentrations in any 12 consecutive months during which Cryptosporidium samples were collected.

(iii) For waterworks that serve fewer than 10,000 people and monitor for Cryptosporidium for only one year (i.e., collect 24 samples in 12 months), the bin concentration is equal to the arithmetic mean of all sample concentrations.

(iv) For waterworks with plants operating only part of the year that monitor fewer than 12 months per year under subdivision B 3 a (1), the bin concentration is equal to the highest arithmetic mean of all sample concentrations during any year of Cryptosporidium monitoring.

(v) If the monthly Cryptosporidium sampling frequency varies, owners shall first calculate a monthly average for each month of monitoring. Owners shall then use these monthly average concentrations, rather than individual sample concentrations, in the applicable calculation for bin classification in subdivision B 3 c (1) (a) (i) through (iv) of this section.

(b) Owners shall determine their initial bin classification from the following table and using the Cryptosporidium bin concentration calculated under subdivision B 3 c (1) (a) of this section:

Bin Classification Table for Filtered Systems

For owners of waterworks that are:	with a Cryptosporidium bin concentration of <sup>1</sup> ...	The bin classification is...
...required to monitor for Cryptosporidium under subdivision B 3 a (1)	Cryptosporidium less than 0.075 oocysts/L	Bin 1
	Cryptosporidium equal to or greater than 0.075 oocysts/L but less than 1.0 oocysts/L	Bin 2
	Cryptosporidium equal to or greater than 1.0 oocysts/L but less than 3.0 oocysts/L	Bin 3
	Cryptosporidium equal to or greater than 3.0 oocysts/L	Bin 4
...serving fewer than 10,000 people and NOT required to monitor for Cryptosporidium under B 3 a (1)(e)	NA	Bin 1

<sup>1</sup>Based on calculations in subdivision B 3 c (1) (a) or (c) of this section, as applicable

(c) Following completion of the second round of source water monitoring required under subdivision B 3 a (2), owners shall recalculate their Cryptosporidium bin

concentration using the Cryptosporidium results reported under subdivision B 3 a (2) and following the procedures in subdivision B 3 c (1) (a)(i) through (iv) of this section. Owners shall then redetermine their bin classification using this bin concentration and the table in subdivision B 3 c (1) (b) of this section.

(d) Reporting of bin classifications

(i) Owners shall report their initial bin classification under subdivision B 3 c (1) (b) of this section to the commissioner for approval no later than six months after the waterworks is required to complete initial source water monitoring based on the schedule in subdivision B 3 a (3).

(ii) Owners shall report their bin classification under subdivision B 3 c (1) (c) of this section to the commissioner for approval no later than six months after the owner is required to complete the second round of source water monitoring based on the schedule in subdivision B 3 c (1) 3 a (3) of this section.

(iii) The bin classification report to the commissioner shall include a summary of source water monitoring data and the calculation procedure used to determine bin classification.

(e) Failure to comply with the conditions of subdivision B 3 c (1) (d) of this section is a violation of the treatment technique requirement.

(2) Waterworks additional Cryptosporidium treatment requirements.

(a) Waterworks shall provide the level of additional treatment for Cryptosporidium specified in this paragraph based on their bin classification as determined under subdivision B 3 c (1) of this section and according to the schedule in subdivision B 3 c (3) (b) of this section.

If the waterworks bin classification is...	And the waterworks uses the following filtration treatment in full compliance with 12VAC5-590-420 A and B, then the additional Cryptosporidium treatment requirements are...			
-	Conventional filtration treatment (including softening)	Direct filtration	Slow sand or diatomaceous earth filtration	Alternative filtration technologies
Bin 1	No additional treatment	No additional treatment	No additional treatment	No additional treatment
Bin 2	1-log treatment	1.5-log treatment	1-log treatment	(1)
Bin 3	2-log treatment	2.5-log treatment	2-log treatment	(2)
Bin 4	2.5-log treatment	3-log treatment	2.5-log treatment	(3)

<sup>1</sup>As determined by the commissioner such that the total Cryptosporidium removal and inactivation is at least 4.0-log



<sup>2</sup>As determined by the commissioner such that the total Cryptosporidium removal and inactivation is at least 5.0-log

<sup>3</sup>As determined by the commissioner such that the total Cryptosporidium removal and inactivation is at least 5.5-log

(b) Additional treatment

(i) Owners shall use one or more of the treatment and management options listed in subdivision B 3 d, termed the microbial toolbox, to comply with the additional Cryptosporidium treatment required in subdivision B 3 c (2) (a) of this section.

(ii) Waterworks classified in Bin 3 and Bin 4 shall achieve at least 1-log of the additional Cryptosporidium treatment required under subdivision B 3 c (2) (a) of this section using either one or a combination of the following: bag filters, bank filtration, cartridge filters, chlorine dioxide, membranes, ozone, or UV, as described in subdivision B 3 d (3) through (7) of this section.

(c) Failure by a waterworks in any month to achieve treatment credit by meeting criteria in subdivision B 3 d (3) through (7) of this section for microbial toolbox options that is at least equal to the level of treatment required in subdivision B 3 c (2) (a) of this section is a violation of the treatment technique requirement.

(d) If the commissioner determines during a sanitary survey or an equivalent source water assessment that after a waterworks completed the monitoring conducted under subdivision B 3 a (1) or (2) of this section, significant changes occurred in the waterworks' watershed that could lead to increased contamination of the source water by Cryptosporidium, the owner shall take actions specified by the commissioner to address the contamination. These actions may include additional source water monitoring and/or implementing microbial toolbox options listed in subdivision B 3 d (2) of this section.

(3) Schedule for compliance with Cryptosporidium treatment requirements.

(a) Following initial bin classification in accordance with subdivision B 3 c (1) (b) of this section, waterworks shall provide the level of treatment for Cryptosporidium required under subdivision B 3 c (2) of this section according to the schedule in subdivision B 3 c (3) (b) of this section.

(b) Cryptosporidium treatment compliance dates.

Cryptosporidium Treatment Compliance Dates Table

Waterworks that serve....	Shall comply with Cryptosporidium treatment requirements no later than <sup>4</sup> ....
At least 100,000 people	April 1, 2012
From 50,000 to 99,999 people	October 1, 2012
From 10,000 to 49,999 people	October 1, 2013
Fewer than 10,000 people	October 1, 2014

<sup>4</sup>The commissioner may allow up to an additional two years for complying with the treatment requirement for waterworks making capital improvements.

(e) If the bin classification for a filtered system changes following the second round of source water monitoring, as determined under subdivision B 3 c (1) (c) of this section,

the waterworks shall provide the level of treatment for Cryptosporidium required under subdivision B 3 c (2) of this section on a schedule the commissioner approves.

d. Owners of waterworks required to provide additional treatment for Cryptosporidium shall implement microbial toolbox options that are designed and operated as described in subdivision B 3 d (1) through (7) of this section.

(1) Waterworks receive the treatment credits listed in the table in subdivision B 3 d (2) of this section by meeting the conditions for microbial toolbox options described in subdivision B 3 d (3) through (7) of this section. Waterworks apply these treatment credits to meet the treatment requirements in subdivision B 3 c (2) of this section.

(2) Microbial Toolbox Summary Table: Options, Treatment Credits and Criteria  
 Microbial Toolbox Summary Table: Options, Treatment Credits and Criteria

Toolbox Option	Cryptosporidium treatment credit with design and implementation criteria
<b>Source Protection and Management Toolbox Options</b>	
Alternative source/ intake management	No prescribed credit. Owners may conduct simultaneous monitoring for treatment bin classification at alternative intake locations or under alternative intake management strategies. Specific criteria are in subdivision B 3 d (3) (b).
<b>Pre Filtration Toolbox Options</b>	
Presedimentation basin with coagulation	0.5-log credit during any month that presedimentation basins achieve a monthly mean reduction of 0.5-log or greater in turbidity or alternative performance criteria approved by the commissioner. To be eligible, basins shall be operated continuously with coagulant addition and all plant flow shall pass through basins. Specific criteria are in subdivision B 3 d (4) (a)
Two-stage lime softening	0.5-log credit for two-stage softening where chemical addition and hardness precipitation occur in both stages. All plant flow shall pass through both stages. Single-stage softening is credited as equivalent to conventional treatment. Specific criteria are in subdivision B 3 d (4) (b).
Bank filtration	0.5-log credit for 25-foot setback; 1.0-log credit for 50-foot setback; aquifer shall be unconsolidated sand containing at least 10% fines; average turbidity in wells shall be less than 1 NTU. Waterworks using wells followed by filtration when conducting source water monitoring shall sample the well to determine bin classification and are not eligible for additional credit. Specific criteria are in subdivision B 3 d (4) (c).
<b>Treatment Performance Toolbox Options</b>	
Combined filter performance	0.5-log credit for combined filter effluent turbidity less than or equal to 0.15 NTU in at least 95% of measurements each month. Specific criteria are in subdivision B 3 d (5) (a).
Individual filter performance	0.5-log credit (in addition to 0.5-log combined filter performance credit) if individual filter effluent turbidity is less than or equal to 0.15 NTU in at least 95% of samples each month in each filter

	and is never greater than 0.3 NTU in two consecutive measurements in any filter. Specific criteria are in subdivision B 3 d (5) (b).
<b>Additional Filtration Toolbox Options</b>	
Bag or cartridge filters (individual filters)	Up to 2-log credit based on the removal efficiency demonstrated during challenge testing with a 1.0 log factor of safety. Specific criteria are in subdivision B 3 d (6) (a).
Bag or cartridge filters (in series)	Up to 2.5-log credit based on the removal efficiency demonstrated during challenge testing with a 0.5 log factor of safety. Specific criteria are in subdivision B 3 d (6) (a).
Membrane filtration	Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing. Specific criteria are in subdivision B 3 d (6) (b).
Second stage filtration	0.5-log credit for second separate granular media filtration stage if treatment train includes coagulation prior to first filter. Specific criteria are in subdivision B 3 d (6) (c).
Slow sand filters	2.5-log credit as a secondary filtration step; 3.0-log credit as a primary filtration process. No prior chlorination for either option. Specific criteria are in subdivision B 3 d (6) (d).
<b>Inactivation Toolbox Options</b>	
Chlorine dioxide	Log credit based on measured CT in relation to CT table. Specific criteria in subdivision B 3 d (7) (b).
Ozone	Log credit based on measured CT in relation to CT table. Specific criteria in subdivision B 3 d (7) (b).
UV	Log credit based on validated UV dose in relation to UV dose table; reactor validation testing required to establish UV dose and associated operating conditions. Specific criteria in subdivision B 3 d (7) (d).

(3) Source toolbox components.

(a) Reserved

(b) Alternative source.

(i) An owner may conduct source water monitoring that reflects a different intake location (either in the same source or for an alternate source) or a different procedure for the timing or level of withdrawal from the source (alternative source monitoring). If the commissioner approves, an owner may determine the bin classification under subdivision B 3 c (1) of this section based on the alternative source monitoring results.

(ii) If an owner conducts alternative source monitoring under subdivision B 3 d (3) (b) (i) of this section, the owner shall also monitor their current plant intake concurrently as described in subdivision B 3 a of this section.

(iii) Alternative source monitoring under subdivision B 3 d (3) (b) (i) of this section shall meet the requirements for source monitoring to determine bin classification, as described in subdivision B 3 a (1) through (13) of this section. Owners shall report the alternative source monitoring results to the commissioner, along with supporting

information documenting the operating conditions under which the samples were collected.

(iv) If an owner determines the bin classification under subdivision B-3 c (1) of this section using alternative source monitoring results that reflect a different intake location or a different procedure for managing the timing or level of withdrawal from the source, the owner shall relocate the intake or permanently adopt the withdrawal procedure, as applicable, no later than the applicable treatment compliance date in subdivision B-3 c (3) of this section.

(4) Pre-filtration treatment toolbox components.

(a) Presedimentation. Waterworks receive 0.5-log Cryptosporidium treatment credit for a presedimentation basin during any month the process meets the following criteria:

(i) The presedimentation basin shall be in continuous operation and shall treat the entire plant flow taken from a surface water or groundwater under the direct influence of surface water source.

(ii) The waterworks shall continuously add a coagulant to the presedimentation basin.

(iii) The presedimentation basin shall achieve the performance criteria in either of the following:

((a)) Demonstrates at least 0.5-log mean reduction of influent turbidity. This reduction shall be determined using daily turbidity measurements in the presedimentation process influent and effluent and shall be calculated as follows:  $\log_{10}(\text{monthly mean of daily influent turbidity}) - \log_{10}(\text{monthly mean of daily effluent turbidity})$ .

((b)) Complies with performance criteria approved by the commissioner that demonstrate at least 0.5-log mean removal of micron-sized particulate material through the presedimentation process.

(b) Two-stage lime softening. Waterworks receive an additional 0.5-log Cryptosporidium treatment credit for a two-stage lime softening plant if chemical addition and hardness precipitation occur in two separate and sequential softening stages prior to filtration. Both softening stages shall treat the entire plant flow taken from a surface water or groundwater under the direct influence of ~~surface water~~ **source word m.**

(c) Bank filtration. Waterworks receive Cryptosporidium treatment credit for bank filtration that serves as pretreatment to a filtration plant by meeting the criteria in this paragraph. Waterworks using bank filtration when they begin source water monitoring under subdivision B-3 a (1) of this section shall collect samples as described in subdivision B-3 a (6) (d) of this section and are not eligible for this credit.

(i) Wells with a ground water flow path of at least 25 feet receive 0.5-log treatment credit; wells with a ground water flow path of at least 50 feet receive 1.0-log treatment credit. The ground water flow path shall be determined as specified in subdivision B-3 d (c) (iv) of this section.

(ii) Only wells in granular aquifers are eligible for treatment credit. Granular aquifers are those comprised of sand, clay, silt, rock fragments, pebbles or larger particles, and minor cement. A waterworks shall characterize the aquifer at the well site to determine aquifer properties. Owners shall extract a core from the aquifer and demonstrate that in at least 90% of the core length, grains less than 1.0 mm in diameter constitute at least 10% of the core material.

(iii) Only horizontal and vertical wells are eligible for treatment credit.

~~(iv) For vertical wells, the ground water flow path is the measured distance from the edge of the surface water body under high flow conditions (determined by the 100-year floodplain elevation boundary or by the floodway, as defined in Federal Emergency Management Agency flood hazard maps) to the well screen. For horizontal wells, the ground water flow path is the measured distance from the bed of the river under normal flow conditions to the closest horizontal well lateral screen.~~

~~(v) Owners shall monitor each wellhead for turbidity at least once every four hours while the bank filtration process is in operation. If monthly average turbidity levels, based on daily maximum values in the well, exceed 1 NTU, the owner shall report this result to the commissioner and conduct an assessment within 30 days to determine the cause of the high turbidity levels in the well. If the commissioner determines that microbial removal has been compromised, the commissioner may revoke treatment credit until the owner implements corrective actions approved by the commissioner to remediate the problem.~~

~~(vi) Springs and infiltration galleries are not eligible for treatment credit under this section.~~

~~(vii) Bank filtration demonstration of performance. The commissioner may approve Cryptosporidium treatment credit for bank filtration based on a demonstration of performance study that meets the criteria in this paragraph. This treatment credit may be greater than 1.0 log and may be awarded to bank filtration that does not meet the criteria in subdivision B 3 d (4) (c) (i) through (v) of this section.~~

~~((a)) The study shall follow a protocol approved by the commissioner and shall involve the collection of data on the removal of Cryptosporidium or a surrogate for Cryptosporidium and related hydrogeologic and water quality parameters during the full range of operating conditions.~~

~~((b)) The study shall include sampling both from the production well(s) and from monitoring wells that are screened and located along the shortest flow path between the surface water source and the production well(s).~~

~~(5) Treatment performance toolbox components.~~

~~(a) Combined filter performance. Waterworks using conventional filtration treatment or direct filtration treatment receive an additional 0.5 log Cryptosporidium treatment credit during any month the waterworks meets the criteria in this paragraph. Combined filter effluent (CFE) turbidity shall be less than or equal to 0.15 NTU in at least 95% of the measurements. Turbidity shall be measured as described in 12VAC5-590-370 B 7 b and 12VAC5-590-370 E.~~

~~(b) Individual filter performance. Waterworks using conventional filtration treatment or direct filtration treatment receive 0.5 log Cryptosporidium treatment credit, which can be in addition to the 0.5 log credit under subdivision B 3 d (5) (a) of this section, during any month the waterworks meets the criteria in this paragraph. Compliance with these criteria shall be based on individual filter turbidity monitoring as described in 12VAC5-590-370 B 7 b (1).~~

~~(i) The filtered water turbidity for each individual filter shall be less than or equal to 0.15 NTU in at least 95% of the measurements recorded each month.~~

~~(ii) No individual filter may have a measured turbidity greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart.~~

~~(iii) Any waterworks that has received treatment credit for individual filter performance and fails to meet the requirements of subdivision B 3 d (5) (b) (i) or (ii) of this section~~

during any month does not receive a treatment technique violation under subdivision B-3-c(2)(c) if the commissioner determines the following:

~~((a)) The failure was due to unusual and short term circumstances that could not reasonably be prevented through optimizing treatment plant design, operation, and maintenance.~~

~~((b)) The waterworks has experienced no more than two such failures in any calendar year.~~

~~(6) Additional filtration toolbox components.~~

~~(a) Bag and cartridge filters. Waterworks receive Cryptosporidium treatment credit of up to 2.0-log for individual bag or cartridge filters and up to 2.5-log for bag or cartridge filters operated in series by meeting the criteria in subdivision B-3-d(6)(a)(i) through (x) of this section. To be eligible for this credit, owners shall report the results of challenge testing that meets the requirements of subdivision B-3-d(6)(a)(ii) through (ix) of this section to the commissioner. The filters shall treat the entire plant flow taken from a surface water or groundwater under the direct influence of surface water source.~~

~~(i) The Cryptosporidium treatment credit awarded to bag or cartridge filters shall be based on the removal efficiency demonstrated during challenge testing that is conducted according to the criteria in subdivision B-3-d(6)(a)(ii) through (ix) of this section. A factor of safety equal to 1-log for individual bag or cartridge filters and 0.5-log for bag or cartridge filters in series shall be applied to challenge testing results to determine removal credit. Owners may use results from challenge testing conducted prior to January 5, 2006, if the prior testing was consistent with the criteria specified in subdivision B-3-d(6)(a)(ii) through (ix) of this section.~~

~~(ii) Challenge testing shall be performed on full-scale bag or cartridge filters, and the associated filter housing or pressure vessel, that are identical in material and construction to the filters and housings the waterworks will use for removal of Cryptosporidium. Bag or cartridge filters shall be challenge tested in the same configuration that the waterworks will use, either as individual filters or as a series configuration of filters.~~

~~(iii) Challenge testing shall be conducted using Cryptosporidium or a surrogate that is removed no more efficiently than Cryptosporidium. The microorganism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate shall be determined using a method capable of discreetly quantifying the specific microorganism or surrogate used in the test; gross measurements such as turbidity shall not be used.~~

~~(iv) The maximum feed water concentration that can be used during a challenge test shall be based on the detection limit of the challenge particulate in the filtrate (i.e., filtrate detection limit) and shall be calculated using the following equation:~~

~~Maximum Feed Concentration =  $1 \times 10^4 \times$  (Filtrate Detection Limit)~~

~~(v) Challenge testing shall be conducted at the maximum design flow rate for the filter as specified by the manufacturer.~~

~~(vi) Each filter evaluated shall be tested for a duration sufficient to reach 100% of the terminal pressure drop, which establishes the maximum pressure drop under which the filter may be used to comply with the requirements of subdivision B-3-d(6)(a) of this section.~~

~~(vii) Removal efficiency of a filter shall be determined from the results of the challenge test and expressed in terms of log removal values using the following equation:~~

$$LRV = \text{LOG}_{10}(C_i) - \text{LOG}_{10}(C_p)$$

where LRV = log-removal value demonstrated during challenge testing;  $C_i$  = the feed concentration measured during the challenge test; and  $C_p$  = the filtrate concentration measured during the challenge test. In applying this equation, the same units shall be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, then the term  $C_p$  shall be set equal to the detection limit.

(viii) Each filter tested shall be challenged with the challenge particulate during three periods over the filtration cycle: within two hours of start-up of a new filter; when the pressure drop is between 45 and 55% of the terminal pressure drop; and at the end of the cycle after the pressure drop has reached 100% of the terminal pressure drop. An LRV shall be calculated for each of these challenge periods for each filter tested. The LRV for the filter (LRV<sub>filter</sub>) shall be assigned the value of the minimum LRV observed during the three challenge periods for that filter.

(ix) If fewer than 20 filters are tested, the overall removal efficiency for the filter product line shall be set equal to the lowest LRV filter among the filters tested. If 20 or more filters are tested, the overall removal efficiency for the filter product line shall be set equal to the 10th percentile of the set of LRV<sub>filter</sub> values for the various filters tested. The percentile is defined by  $(i/(n+1))$  where  $i$  is the rank of  $n$  individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

(x) If a previously tested filter is modified in a manner that could change the removal efficiency of the filter product line, challenge testing to demonstrate the removal efficiency of the modified filter shall be conducted and submitted to the commissioner.

~~(b) Membrane filtration:~~

~~(i) Waterworks receive Cryptosporidium treatment credit for membrane filtration that meets the criteria of this paragraph. Membrane cartridge filters that meet the definition of membrane filtration in 12VAC5-590-10 are eligible for this credit. The level of treatment credit a waterworks receives is equal to the lower of the values determined as follows:~~

~~((a)) The removal efficiency demonstrated during challenge testing conducted under the conditions in subdivision B-3 d (6) (b) (ii) of this section.~~

~~((b)) The maximum removal efficiency that can be verified through direct integrity testing used with the membrane filtration process under the conditions in subdivision B-3 d (6) (b) (iii) of this section.~~

~~(ii) Challenge Testing. The membrane used by the waterworks shall undergo challenge testing to evaluate removal efficiency, and the owner shall report the results of challenge testing to the commissioner. Challenge testing shall be conducted according to the criteria in paragraphs ((a)) through ((g)) of this section as follows (owners may use data from challenge testing conducted prior to January 5, 2006, if the prior testing was consistent with the criteria):~~

~~((a)) Challenge testing shall be conducted on either a full-scale membrane module, identical in material and construction to the membrane modules used in the waterworks' treatment facility, or a smaller scale membrane module, identical in material and similar in construction to the full-scale module. A module is defined as the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet structure.~~

~~((b)) Challenge testing shall be conducted using Cryptosporidium oocysts or a surrogate that is removed no more efficiently than Cryptosporidium oocysts. The~~

organism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate, in both the feed and filtrate water, shall be determined using a method capable of discretely quantifying the specific challenge particulate used in the test; gross measurements such as turbidity shall not be used.

((c)) The maximum feed water concentration that can be used during a challenge test is based on the detection limit of the challenge particulate in the filtrate and shall be determined according to the following equation:

$$\text{Maximum Feed Concentration} = 3.16 \times 10^6 \times (\text{Filtrate Detection Limit})$$

((d)) Challenge testing shall be conducted under representative hydraulic conditions at the maximum design flux and maximum design process recovery specified by the manufacturer for the membrane module. Flux is defined as the throughput of a pressure driven membrane process expressed as flow per unit of membrane area. Recovery is defined as the volumetric percent of feed water that is converted to filtrate over the course of an operating cycle uninterrupted by events such as chemical cleaning or a solids removal process (i.e., backwashing).

((e)) Removal efficiency of a membrane module shall be calculated from the challenge test results and expressed as a log removal value according to the following equation:

$$\text{LRV} = \text{LOG}_{10}(C_i) - \text{LOG}_{10}(C_p)$$

where LRV = log removal value demonstrated during the challenge test;  $C_i$  = the feed concentration measured during the challenge test; and  $C_p$  = the filtrate concentration measured during the challenge test. Equivalent units shall be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, the term  $C_p$  is set equal to the detection limit for the purpose of calculating the LRV. An LRV shall be calculated for each membrane module evaluated during the challenge test.

((f)) The removal efficiency of a membrane filtration process demonstrated during challenge testing shall be expressed as a log removal value ( $\text{LRV}_{\text{C-Test}}$ ). If fewer than 20 modules are tested, then  $\text{LRV}_{\text{C-Test}}$  is equal to the lowest of the representative LRVs among the modules tested. If 20 or more modules are tested, then  $\text{LRV}_{\text{C-Test}}$  is equal to the 10th percentile of the representative LRVs among the modules tested. The percentile is defined by  $(i/(n+1))$  where  $i$  is the rank of  $n$  individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

((g)) The challenge test shall establish a quality control release value (QCRV) for a nondestructive performance test that demonstrates the *Cryptosporidium* removal capability of the membrane filtration module. This performance test shall be applied to each production membrane module used by the waterworks that was not directly challenge tested in order to verify *Cryptosporidium* removal capability. Production modules that do not meet the established QCRV are not eligible for the treatment credit demonstrated during the challenge test.

((h)) If a previously tested membrane is modified in a manner that could change the removal efficiency of the membrane or the applicability of the non-destructive performance test and associated QCRV, additional challenge testing to demonstrate the removal efficiency of, and determine a new QCRV for, the modified membrane shall be conducted and submitted to the commissioner.

((iii)) Direct integrity testing. Owners shall conduct direct integrity testing in a manner that demonstrates a removal efficiency equal to or greater than the removal credit



awarded to the membrane filtration process and meets the requirements described in subdivision B 3 d 6 (b) (iii) ((a)) through ((f)) of this section. A direct integrity test is defined as a physical test applied to a membrane unit in order to identify and isolate integrity breaches (i.e., one or more leaks that could result in contamination of the filtrate).

((a)) The direct integrity test shall be independently applied to each membrane unit in service. A membrane unit is defined as a group of membrane modules that share common valving that allows the unit to be isolated from the rest of the system for the purpose of integrity testing or other maintenance.

((b)) The direct integrity method shall have a resolution of three micrometers or less, where resolution is defined as the size of the smallest integrity breach that contributes to a response from the direct integrity test.

((c)) The direct integrity test shall have a sensitivity sufficient to verify the log treatment credit awarded to the membrane filtration process by the commissioner, where sensitivity is defined as the maximum log removal value that can be reliably verified by a direct integrity test. Sensitivity shall be determined using the approach in either of the following as applicable to the type of direct integrity test the waterworks uses:

((i)) For direct integrity tests that use an applied pressure or vacuum, the direct integrity test sensitivity shall be calculated according to the following equation:

$$LRV_{DIT} = \text{LOG}_{10}(Q_p / (VCF \times Q_{\text{breach}}))$$

where  $LRV_{DIT}$  = the sensitivity of the direct integrity test;

$Q_p$  = total design filtrate flow from the membrane unit;

$Q_{\text{breach}}$  = flow of water from an integrity breach associated with the smallest integrity test response that can be reliably measured, and

$VCF$  = volumetric concentration factor. The volumetric concentration factor is the ratio of the suspended solids concentration on the high pressure side of the membrane relative to that in the feed water.

((ii)) For direct integrity tests that use a particulate or molecular marker, the direct integrity test sensitivity shall be calculated according to the following equation:

$$LRV_{DIT} = \text{LOG}_{10}(C_i) - \text{LOG}_{10}(C_p)$$

where  $LRV_{DIT}$  = the sensitivity of the direct integrity test;

$C_i$  = the typical feed concentration of the marker used in the test; and

$C_p$  = the filtrate concentration of the marker from an integral membrane unit.

((d)) Owners shall establish a control limit within the sensitivity limits of the direct integrity test that is indicative of an integral membrane unit capable of meeting the removal credit awarded by the commissioner.

((e)) If the result of a direct integrity test exceeds the control limit established under subdivision B 3 d 6 (b) (iii) ((d)) of this section, the owners shall remove the membrane unit from service. Owners shall conduct a direct integrity test to verify any repairs, and may return the membrane unit to service only if the direct integrity test is within the established control limit.

((f)) Owners shall conduct direct integrity testing on each membrane unit at a frequency of not less than once each day that the membrane unit is in operation. The commissioner may approve less frequent testing, based on demonstrated process reliability, the use of multiple barriers effective for *Cryptosporidium*, or reliable process safeguards.

~~(iv) Indirect integrity monitoring. Owners shall conduct continuous indirect integrity monitoring on each membrane unit according to the criteria in ((a)) through ((e)). Indirect integrity monitoring is defined as monitoring some aspect of filtrate water quality that is indicative of the removal of particulate matter. A waterworks that implements continuous direct integrity testing of membrane units in accordance with the criteria in B 3 d (6) (b) (iv) (iii) ((a)) through ((f)) of this section is not subject to the requirements for continuous indirect integrity monitoring. Owners shall submit a monthly report to the commissioner summarizing all continuous indirect integrity monitoring results triggering direct integrity testing and the corrective action that was taken in each case.~~

~~((a)) Unless the commissioner approves an alternative parameter, continuous indirect integrity monitoring shall include continuous filtrate turbidity monitoring.~~

~~((b)) Continuous monitoring shall be conducted at a frequency of no less than once every 15 minutes.~~

~~((c)) Continuous monitoring shall be separately conducted on each membrane unit.~~

~~((d)) If indirect integrity monitoring includes turbidity and if the filtrate turbidity readings are above 0.15 NTU for a period greater than 15 minutes (i.e., two consecutive 15-minute readings above 0.15 NTU), direct integrity testing shall immediately be performed on the associated membrane unit as specified in subdivision B 3 d (6) (b) (iii) ((a)) through ((f)) of this section.~~

~~((e)) If indirect integrity monitoring includes an alternative parameter approved by the commissioner and if the alternative parameter exceeds a control limit approved by the commissioner for a period greater than 15 minutes, direct integrity testing shall immediately be performed on the associated membrane units as specified in subdivision B 3 d (6) (b) (iii) ((a)) through ((f)) of this section.~~

~~(c) Second stage filtration. Waterworks receive 0.5-log Cryptosporidium treatment credit for a separate second stage of filtration that consists of sand, dual media, GAC, or other fine grain media following granular media filtration if the commissioner approves. To be eligible for this credit, the first stage of filtration shall be preceded by a coagulation step and both filtration stages shall treat the entire plant flow taken from a surface water or groundwater under the direct influence of surface water source. A cap, such as GAC, on a single stage of filtration is not eligible for this credit. The commissioner shall approve the treatment credit based on an assessment of the design characteristics of the filtration process.~~

~~(d) Slow sand filtration (as secondary filter). Waterworks are eligible to receive 2.5-log Cryptosporidium treatment credit for a slow sand filtration process that follows a separate stage of filtration if both filtration stages treat entire plant flow taken from a surface water or ground water under the direct influence of surface water source and no disinfectant residual is present in the influent water to the slow sand filtration process. The commissioner shall approve the treatment credit based on an assessment of the design characteristics of the filtration process. This paragraph does not apply to treatment credit awarded to slow sand filtration used as a primary filtration process.~~

~~(7) Inactivation toolbox components.~~

~~(a) Calculation of CT values~~

~~(i) CT is the product of the disinfectant contact time (T, in minutes) and disinfectant concentration (C, in milligrams per liter). Owners of waterworks with treatment credit for chlorine dioxide or ozone under subdivision B 3 d (7) (b) of this section shall~~

calculate CT at least once each day, with both C and T measured during peak hourly flow in accordance with the procedure listed in Appendix L.

(ii) Waterworks with several disinfection segments in sequence may calculate CT for each segment, where a disinfection segment is defined as a treatment unit process with a measurable disinfectant residual level and a liquid volume. Under this approach, owners shall add the Cryptosporidium CT values in each segment to determine the total CT for the treatment plant.

(b) CT values for chlorine dioxide and ozone.

(i) Waterworks receive the Cryptosporidium treatment credit listed in the following table by meeting the corresponding chlorine dioxide CT value for the applicable water temperature, as described in subdivision B 3 d (7) (a) of this section.

CT Values (mg-min/L) for Cryptosporidium Inactivation by Chlorine Dioxide<sup>1</sup>

Log credit	Water Temperature, °C										
	Less than or equal to 0.5	4	2	3	5	7	10	15	20	25	30
0.25	159	153	140	128	107	90	69	45	29	19	12
0.5	319	305	279	256	214	180	138	89	58	38	24
1.0	637	610	558	511	429	360	277	179	116	75	49
1.5	956	915	838	767	643	539	415	268	174	113	73
2.0	1275	1220	1117	1023	858	719	553	357	232	150	98
2.5	1594	1525	1396	1278	1072	899	694	447	289	188	122
3.0	1912	1830	1675	1534	1286	1079	830	536	347	226	147

<sup>1</sup>Waterworks may use this equation to determine log credit between the indicated values:

$$\text{Log credit} = (0.001506 \times (1.09116)^{\text{Temp}}) \times \text{CT}$$

(ii) Waterworks receive the Cryptosporidium treatment credit listed in the following table by meeting the corresponding ozone CT values for the applicable water temperature, as described in subdivision B 3 d (7) (a) of this section.

CT Values (mg-min/L) for Cryptosporidium Inactivation by Ozone<sup>1</sup>

Log credit	Water Temperature, °C										
	Less than or equal to 0.5	4	2	3	5	7	10	15	20	25	30

0.25	6.0	5.8	5.2	4.8	4.0	3.3	2.5	1.6	1.0	0.6	0.39
0.5	12	12	10	9.5	7.9	6.5	4.9	3.1	2.0	1.2	0.78
1.0	24	23	21	19	16	13	9.9	6.2	3.9	2.5	1.6
1.5	36	35	34	29	24	20	15	9.3	5.9	3.7	2.4
2.0	48	46	42	38	32	26	20	12	7.8	4.9	3.1
2.5	60	58	52	48	40	33	25	16	9.8	6.2	3.9
3.0	72	69	63	57	47	39	30	19	12	7.4	4.7

<sup>1</sup>Waterworks may use this equation to determine log credit between the indicated values:

$$\text{Log credit} = (0.0397 \times (1.09757)^{\text{Temp}}) \times \text{CT}$$

(e) Ultraviolet light. Waterworks receive Cryptosporidium, Giardia lamblia, and virus treatment credits for ultraviolet (UV) light reactors by achieving the corresponding UV dose values shown in subdivision B 3 d (7) (c) (i) of this section. Waterworks shall validate and monitor UV reactors as described in subdivision B 3 d (7) (c) (ii) and (iii) of this section to demonstrate that they are achieving a particular UV dose value for treatment credit.

(i) UV dose table. The treatment credits listed in this table are for UV light at a wavelength of 254 nm as produced by a low pressure mercury vapor lamp. To receive treatment credit for other lamp types, waterworks shall demonstrate an equivalent germicidal dose through reactor validation testing, as described in subdivision B 3 d (7) (c) (ii) of this section. The UV dose values in this table are applicable only to post-filter applications of UV in filtered systems.

UV dose table for Cryptosporidium, Giardia lamblia, and virus inactivation credit

Log credit	Cryptosporidium UV dose (mJ/cm <sup>2</sup> )	Giardia lamblia UV dose (mJ/cm <sup>2</sup> )	Virus UV dose (mJ/cm <sup>2</sup> )
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

(ii) Reactor validation testing. Waterworks shall use UV reactors that have undergone validation testing to determine the operating conditions under which the reactor delivers the UV dose required in subdivision B 3 d (7) (c) (i) of this section (i.e., validated operating conditions). These operating conditions shall include flow rate, UV intensity as measured by a UV sensor, and UV lamp status.

~~((a)) When determining validated operating conditions, owners shall account for the following factors: UV absorbance of the water; lamp fouling and aging; measurement uncertainty of online sensors; UV dose distributions arising from the velocity profiles through the reactor; failure of UV lamps or other critical waterworks components; and inlet and outlet piping or channel configurations of the UV reactor.~~

~~((b)) Validation testing shall include the following: full scale testing of a reactor that conforms uniformly to the UV reactors used by the waterworks and inactivation of a test microorganism whose dose response characteristics have been quantified with a low pressure mercury vapor lamp.~~

~~((iii)) Reactor monitoring.~~

~~((a)) Owners shall monitor their UV reactors to determine if the reactors are operating within validated conditions, as determined under subdivision B 3 d (7) (c) (ii) of this section. This monitoring shall include UV intensity as measured by a UV sensor, flow rate, lamp status, and other parameters the commissioner designates based on UV reactor operation. Owners shall verify the calibration of UV sensors and shall recalibrate sensors in accordance with a protocol the commissioner approves.~~

~~((b)) To receive treatment credit for UV light, waterworks shall treat at least 95% of the water delivered to the public during each month by UV reactors operating within validated conditions for the required UV dose, as described in subdivision B 3 d (7) (c) (i) and (ii) of this section. Owners shall demonstrate compliance with this condition by the monitoring required under subdivision B 3 d (7) (c) (iii)(a) of this section.~~

~~e. Owners shall comply with the applicable recordkeeping and reporting requirements described in 12VAC5-590-530 and 12VAC5-590-550.~~

~~C. Reserved.~~

~~D. Reserved.~~

~~E. Reserved.~~

~~F. Reserved.~~

~~G. Beginning January 1, 1993, each owner shall certify annually in writing to the commissioner (using third party or manufacturer's certification) that, when polymers containing acrylamide or epichlorohydrin are used by the waterworks in drinking water systems, the combination (or product) of dose and monomer level does not exceed the following specified levels: Acrylamide = 0.05% dosed at 1 ppm (or equivalent) of polymer. Epichlorohydrin = 0.01% dosed at 20 ppm (or equivalent) of polymer. Certifications may rely on manufacturers or third parties, as approved by the commissioner.~~

~~H. Treatment technique for control of disinfection byproduct (DBPP) precursors.~~

~~1. Applicability.~~

~~a. Waterworks that use surface water or groundwater under the direct influence of surface water using conventional filtration treatment shall operate with enhanced coagulation or enhanced softening to achieve the TQC percent removal levels specified in subdivision H 2 of this section unless the waterworks meets at least one of the alternative compliance criteria listed in subdivision H 1 b or c of this section.~~

~~b. Alternative compliance criteria for enhanced coagulation and enhanced softening waterworks. Owners of waterworks that use surface water or groundwater under the direct influence of surface water provided with conventional filtration treatment may use the alternative compliance criteria in subdivisions H 1 b (1) through (6) of this section to comply with this section in lieu of complying with subdivision H 2 of this~~

section. Owners shall still comply with monitoring requirements in 12VAC5-590-370-B 3+.

(1) The waterworks' source water TOC level, measured according to 12VAC5-590-440, is less than 2.0 mg/L, calculated quarterly as a running annual average.

(2) The waterworks' treated water TOC level, measured according to 12VAC5-590-440, is less than 2.0 mg/L, calculated quarterly as a running annual average.

(3) The waterworks' source water TOC level, measured according to 12VAC5-590-440, is less than 4.0 mg/L, calculated quarterly as a running annual average; the source water alkalinity, measured according to 12VAC5-590-440, is greater than 60 mg/L (as CaCO<sub>3</sub>), calculated quarterly as a running annual average; and either the TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively; or prior to the effective date for compliance in 12VAC590-370-B 3 a, the owner has made a clear and irrevocable financial commitment not later than the effective date for compliance in 12VAC590-370-B 3 a to use of technologies that will limit the levels of TTHMs and HAA5 to no more than 0.040 mg/L and 0.030 mg/L, respectively. Owners shall submit evidence of a clear and irrevocable financial commitment, in addition to a schedule containing milestones and periodic progress reports for installation and operation of appropriate technologies, to the commissioner for approval not later than the effective date for compliance in 12VAC590-370-B 3 a. These technologies shall be installed and operating not later than June 30, 2005. Failure to install and operate these technologies by the date in the approved schedule will constitute a violation of these regulations.

(4) The TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively, and the waterworks uses only chlorine for primary disinfection and maintenance of a residual in the distribution system.

(5) The waterworks' source water SUVA, prior to any treatment and measured monthly according to 12VAC5-590-440, is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average.

(6) The waterworks' finished water SUVA, measured monthly according to 12VAC5-590-440, is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average.

c. Additional alternative compliance criteria for softening waterworks. Waterworks practicing enhanced softening that cannot achieve the TOC removals required by subdivision H 2 b of this section may use the alternative compliance criteria in subdivisions H 1 c (1) and (2) of this section in lieu of complying with subdivision H 2 of this section. Owners shall still comply with monitoring requirements in 12VAC5-590-370-B 3 i.

(1) Softening that results in lowering the treated water alkalinity to less than 60 mg/L (as CaCO<sub>3</sub>), measured monthly according to 12VAC5-590-440 and calculated quarterly as a running annual average.

(2) Softening that results in removing at least 10 mg/L of magnesium hardness (as CaCO<sub>3</sub>), measured monthly according to 12VAC5-590-440 and calculated quarterly as a running annual average.

## 2. Enhanced coagulation and enhanced softening performance requirements.

a. Waterworks shall achieve the percent reduction of TOC specified in subdivision H 2 b of this section between the source water and the combined filter effluent, unless the commissioner approves a waterworks' request for alternate minimum TOC removal (Step 2) requirements under subdivision H 2 c of this section.

b. Required Step 1 TOC reductions, indicated in the following table, are based upon specified source water parameters measured in accordance with 12VAC5-590-440. Waterworks practicing softening are required to meet the Step 1 TOC reductions in the far-right column (Source water alkalinity greater than 120 mg/L) for the specified source water TOC:

Step 1 Required Removal of TOC by Enhanced Coagulation and Enhanced Softening for Community or Nontransient Noncommunity Waterworks That Use Surface Water or Groundwater Under the Direct Influence of Surface Water Using Conventional Treatment<sup>1-2</sup>

Source water TOC mg/L	Source water alkalinity, mg/L as CaCO <sub>3</sub>		
	0-60	greater than 60-120	greater than 120 <sup>3</sup>
greater than 2.0 - 4.0	35.0%	25.0%	15.0%
greater than 4.0 - 8.0	45.0%	35.0%	25.0%
greater than 8.0	50.0%	40.0%	30.0%

<sup>1</sup>Waterworks meeting at least one of the conditions in subdivisions H 1 b (1) through (6) of this section are not required to operate with enhanced coagulation.

<sup>2</sup>Softening waterworks meeting one of the alternative compliance criteria in subdivision H 1 c of this section are not required to operate with enhanced softening.

<sup>3</sup>Waterworks practicing softening shall meet the TOC removal requirements in this column.

e. Waterworks that use surface water or groundwater under the direct influence of surface water with conventional treatment systems that cannot achieve the Step 1 TOC removals required by subdivision H 2 b of this section due to water quality parameters or operational constraints shall apply to the commissioner, within three months of failure to achieve the TOC removals required by subdivision H 2 b of this section, for approval of alternative minimum TOC (Step 2) removal requirements submitted by the waterworks. If the commissioner approves the alternative minimum TOC removal (Step 2) requirements, the commissioner may make those requirements retroactive for the purposes of determining compliance. Until the commissioner approves the alternate minimum TOC removal (Step 2) requirements, the owner shall meet the Step 1 TOC removals contained in subdivision H 2 b of this section.

d. Alternate minimum TOC removal (Step 2) requirements. Applications, made to the commissioner by waterworks using enhanced coagulation, for approval of alternative minimum TOC removal (Step 2) requirements under subdivision H 2 c of this section shall include, at a minimum, results of bench or pilot scale testing conducted under subdivision H 2 d (1) of this section. The submitted bench or pilot scale testing shall be used to determine the alternate enhanced coagulation level.

(1) Alternate enhanced coagulation level is defined as coagulation at a coagulant dose and pH as determined by the method described in subdivisions H 2 d (1) through (5) of this section such that an incremental addition of 10 mg/L of alum (or equivalent amount of ferric salt) results in a TOC removal of equal to or less than 0.3 mg/L. The percent removal of TOC at this point on the "TOC removal versus coagulant dose" curve is then defined as the minimum TOC removal required for the waterworks. Once approved by the commissioner, this minimum requirement supersedes the minimum TOC removal required by the table in subdivision H 2 b of this section. This requirement will be effective until such time as the commissioner approves a new value

based on the results of a new bench and pilot scale test. Failure to achieve the alternative minimum TOC removal levels set by the commissioner is a violation of these regulations.

(2) Bench or pilot scale testing of enhanced coagulation shall be conducted by using representative water samples and adding 10 mg/L increments of alum (or equivalent amounts of ferric salt) until the pH is reduced to a level less than or equal to the enhanced coagulation Step 2 target pH shown in the following table:

Enhanced Coagulation Step 2 Target pH

Alkalinity (mg/L as CaCO <sub>3</sub> )	Target pH
0-60	5.5
greater than 60-120	6.3
greater than 120-240	7.0
greater than 240	7.5

(3) For waters with alkalinities of less than 60 mg/L for which addition of small amounts of alum or equivalent addition of iron coagulant drives the pH below 5.5 before significant TOC removal occurs, the owner shall add necessary chemicals to maintain the pH between 5.3 and 5.7 in samples until the TOC removal of 0.3 mg/L per 10 mg/L alum added (or equivalent addition of iron coagulant) is reached.

(4) The owner may operate at any coagulant dose or pH necessary (consistent with other sections of these regulations) to achieve the minimum TOC percent removal approved under subdivision H 2 c of this section.

(5) If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose at all dosages of alum (or equivalent addition of iron coagulant), the water is deemed to contain TOC not amenable to enhanced coagulation. The waterworks may then apply to the commissioner for a waiver of enhanced coagulation requirements.

### 3. Compliance calculations.

a. Owners of waterworks that use surface water or groundwater under the direct influence of surface water other than those identified in subdivision H 1 b or H 1 c of this section shall comply with requirements contained in subdivision H 2 b or H 2 c of this section. Owners shall calculate compliance quarterly, beginning after the waterworks has collected 12 months of data, by determining an annual average using the following method:

(1) Determine actual monthly TOC percent removal, equal to:

$$-(1 - (\text{treated water TOC} / \text{source water TOC})) \times 100$$

(2) Determine the required monthly TOC percent removal (from either the table in subdivision H 2 b of this section or from subdivision H 2 c of this section).

(3) Divide the value in subdivision H 3 a (1) of this section by the value in subdivision H 3 a (2) of this section.

(4) Add together the results of subdivision H 3 a (3) of this section for the last 12 months and divide by 12.

(5) If the value calculated in subdivision H 3 a (4) of this section is less than 1.00, the waterworks is not in compliance with the TOC percent removal requirements.



b. Owners may use the provisions in subdivisions H 3 b (1) through (5) of this section in lieu of the calculations in subdivisions H 3 a (1) through (5) of this section to determine compliance with TOC percent removal requirements.

(1) In any month that the waterworks' treated or source water TOC level, measured according to 12VAC5-590-440, is less than 2.0 mg/L, the owner may assign a monthly value of 1.0 (in lieu of the value calculated in subdivision H 3 a (3) of this section) when calculating compliance under the provisions of subdivision H 3 a of this section.

(2) In any month that a waterworks practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO<sub>3</sub>), the waterworks may assign a monthly value of 1.0 (in lieu of the value calculated in subdivision H 3 a (3) of this section) when calculating compliance under the provisions of subdivision H 3 a of this section.

(3) In any month that the waterworks' source water SUVA, prior to any treatment and measured according to 12VAC5-590-440, is equal to or less than 2.0 L/mg-m, the owner may assign a monthly value of 1.0 (in lieu of the value calculated in subdivision H 3 a (3) of this section) when calculating compliance under the provisions of subdivision H 3 a of this section.

(4) In any month that the waterworks' finished water SUVA, measured according to 12VAC5-590-440, is equal to or less than 2.0 L/mg-m, the owner may assign a monthly value of 1.0 (in lieu of the value calculated in subdivision H 3 a (3) of this section) when calculating compliance under the provisions of subdivision H 3 a of this section.

(5) In any month that a waterworks practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO<sub>3</sub>), the owner may assign a monthly value of 1.0 (in lieu of the value calculated in subdivision H 3 a (3) of this section) when calculating compliance under the provisions of subdivision H 3 a of this section.

c. Waterworks that use surface water or groundwater under the direct influence of surface water and using conventional treatment may also comply with the requirements of this section by meeting the criteria in subdivision H 1 b or c of this section.

4. Enhanced coagulation or enhanced softening is the treatment technique required to control the level of DBP precursors in drinking water treatment and distribution systems for waterworks using surface water or groundwater under the direct influence of surface water and using conventional treatment.

1. The best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for disinfection byproducts show in Table 2.13 are listed below:

1. The best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for bromate and chlorite:

Disinfection byproduct	Best available technology
Bromate	Control of ozone treatment process to reduce production of bromate.
Chlorite	Control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels

2. The best technology, treatment techniques, or other means available for achieving compliance with the running annual average maximum contaminant levels for TTHM and HAA5:

Disinfection byproduct	Best available technology
Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)	Enhanced coagulation or enhanced softening or GAC10, with chlorine as the primary and residual disinfectant

3. The best technology, treatment techniques, or other means available for achieving compliance with the locational running annual average maximum contaminant levels for TTHM and HAA5 for all systems that disinfect their source water:

Disinfection byproduct	Best available technology
Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)	Enhanced coagulation or enhanced softening, plus GAC10; or nanofiltration with a molecular weight cutoff less than or equal to 1000 Daltons; or GAC20

4. The best technology, treatment techniques, or other means available for achieving compliance with the locational running annual average maximum contaminant levels for TTHM and HAA5 for consecutive waterworks and applies only to the disinfected water that consecutive waterworks buy or otherwise receive:

Disinfection byproduct	Best available technology
Total trihalomethanes (TTHM) and Haloacetic acids (five) (HAA5)	Waterworks serving equal to or greater than 10,000: Improved distribution system and storage tank management to reduce residence time, plus the use of chloramines for disinfectant residual maintenance  Waterworks serving less than 10,000: Improved distribution system and storage tank management to reduce residence time

J. The best technology, treatment techniques, or other means available for achieving compliance with the maximum residual disinfectant levels identified in Table 2.12 is the control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels.

K. If spent filter backwash water, thickener supernatant, or liquids from dewatering processes are recycled, in any waterworks supplied by a surface water source and waterworks supplied by a groundwater source under the direct influence of surface water that employ conventional filtration or direct filtration treatment, then they are subject to the recycle treatment technique requirement. Under this requirement recycle flows shall be returned through all the processes of the treatment system, or an alternative location approved by the state, by June 8, 2004.

L. Waterworks with uncovered finished water storage facilities shall comply with the requirements to cover the facility or treat the discharge from the facility as described in this paragraph.

1. Waterworks using uncovered finished water storage facilities shall comply with the conditions of this section.

2. Owners shall notify the commissioner of the use of each uncovered finished water storage facility no later than April 1, 2008.

3. Owners shall meet the conditions of subdivision L 3 a or b of this section for each uncovered finished water storage facility or be in compliance with a State approved schedule to meet these conditions no later than April 1, 2009.

a. All uncovered finished water storage facilities shall be covered.

b. ~~Waterworks shall treat the discharge from the uncovered finished water storage facility to the distribution system to achieve inactivation and/or removal of at least 4-log virus, 3-log Giardia lamblia, and 2-log Cryptosporidium using a protocol approved by the commissioner.~~

4. ~~Failure to comply with the requirements of this section is a violation of the treatment technique requirement.~~

**12VAC5-590-421. Groundwater system treatment techniques.**

A. ~~Owners-The owner~~ of a groundwater systems that (i) ~~have-has a~~ confirmed E. coli contamination as described in 12VAC5-590-379 B or (ii) ~~have-has~~ been notified in writing of a significant deficiency as described in 12VAC5-590-350 D shall meet the requirements of this section. Failure to meet any requirement of this section after the applicable time period specified is a treatment technique violation.

1. ~~Owners-The owner~~ of groundwater systems meeting either one of the conditions in clause (i) or (ii) above shall implement one or more of the following corrective actions:

- a. Correct all significant deficiencies;
- b. Provide an alternate source of water;
- c. Eliminate the source of contamination; or
- d. Provide treatment of the groundwater source that reliably achieves at least 4-log treatment of viruses before or at the first ~~consumer~~customer.

2. Unless the ~~ODW department~~ directs the ~~groundwater system~~ owner to implement a specific corrective action, the ~~groundwater system~~ owner shall consult with the ~~ODW department~~ regarding the appropriate corrective action within 30 days of receiving written notification from the ~~commissioner department~~ or the laboratory. This consultation may take the form of a telephone conversation, ~~electronic mail e-mail~~, meeting, or other mechanism agreed to by the ~~ODW department~~.

3. Within 45 days of receiving this notification, the ~~groundwater system~~ owner shall submit a written Corrective Action Plan (CAP) to the ~~commissioner department~~ that satisfactorily addresses the deficiency. The CAP shall include a schedule for completing individual actions, and ~~it~~ shall include one or more of the corrective actions in subdivision A 1 of this section. Approval of the CAP by the ~~commissioner department~~ constitutes an approved CAP.

4. Within 120 days of receiving written notification from the ~~commissioner department~~ or the laboratory, the ~~groundwater system~~ owner shall either:

- a. Have a completed corrective ~~action~~actions in accordance with the ~~commissioner department~~approved CAP including ~~commissioner department~~specified interim measures; or
- b. Be in compliance with a ~~commissioner department~~approved CAP and schedule ~~subject to the conditions specified in subdivisions 4 b 1 and 2 of this subsection.~~

(1) Any subsequent modifications to a ~~commissioner department~~approved CAP and schedule shall also be approved by the ~~commissioner department~~.

(2) If the ~~commissioner department~~ specifies interim measures for protection of the public health pending the ~~commissioner's department's~~ approval of the CAP and schedule or pending completion of the CAP, ~~then~~ the ~~groundwater system~~ owner shall comply with these interim measures as well as with any schedule specified by the ~~commissioner department~~.

5. When a significant deficiency is identified at a waterworks that uses both a groundwater and a surface water or a GUDI source, the owner shall comply with this

section unless the ~~commissioner~~ department has determined that the significant deficiency is in a portion of the distribution system that is served solely by the surface water or ~~a~~ the GUDI source.

B. ~~Owners~~ The owner of a groundwater systems that provides at least 4-log treatment of viruses before or at the first customer shall conduct compliance monitoring to demonstrate treatment effectiveness, in accordance with subsection C of this section. ~~Owners~~ The owner shall also conduct source water monitoring in accordance with 12VAC5-590-379 C.

1. Existing groundwater sources. A groundwater system that is not required to meet the source water monitoring requirements of 12VAC5-590-379 for any groundwater source(s) because the owner has been notified by the ODW that the groundwater system provides at least 4-log treatment of viruses before or at the first customer for any groundwater source(s) shall comply with the following:

a. ~~The groundwater system owner shall have written approval from the ODW that the groundwater system provides at least 4-log treatment of viruses before or at the first customer served by the groundwater source.~~

b. ~~The groundwater system owner shall conduct compliance monitoring as required by subsection C of this section within 30 days of placing the source in service.~~

2. New groundwater sources. ~~A groundwater system owner that places a new groundwater source into service shall meet the requirements of subdivisions 1 a and b of this subsection and conduct raw water monitoring in accordance with 12VAC5-590-425. The groundwater system owner shall provide engineering, operational, or other information as required by the ODW department to complete a determination of virus treatment effectiveness.~~

C. ~~The owner of a groundwater system subject to the requirements of subsection B of this section that provides at least 4-log treatment of viruses shall monitor the effectiveness and reliability of treatment for that groundwater source before or at the first customer as follows:~~

1. Chemical disinfection.

a. ~~The owner of a groundwater system that who~~ serves greater than 3,300 people shall continuously monitor and record the residual disinfectant concentration using analytical methods specified in ~~40 CFR 141.74 (a)(2)~~ 12VAC5-590-440 at a location approved by the ODW department and shall record the lowest residual disinfectant concentration each day that water from the groundwater source is served to the public. ~~The groundwater system owner shall maintain at least the ODW-determined department-determined~~ residual disinfectant concentration every day the groundwater system serves water from the groundwater source to the public. If there is a failure in the continuous monitoring equipment, the ~~groundwater system~~ owner shall conduct grab sampling every four hours until the continuous monitoring equipment is returned to service. The system shall resume continuous residual disinfectant monitoring within 14 days.

b. ~~The owner of a groundwater system that who~~ serves 3,300 or fewer people shall monitor the residual disinfectant concentration using analytical methods specified in ~~40 CFR 141.74 (a)(2)~~ 12VAC5-590-440 at a location approved by the ODW department and record the residual disinfection concentration each day that water from the groundwater source is served to the public. ~~The groundwater system owner shall maintain the ODW-determined department-determined~~ residual disinfectant concentration every day the groundwater system serves water from the groundwater source to the public. ~~The groundwater system owner shall take collect~~ a daily grab sample during the hour of peak flow or at another time specified by the ~~ODW department~~. If any daily grab sample measurement falls below the ~~ODW-determined department-determined~~ residual disinfectant concentration, the ~~groundwater system~~

~~source waterworks~~ owner shall ~~take collect~~ follow-up samples every four hours until the residual disinfectant concentration is restored to the ~~ODW-determined department-determined~~ level. ~~A. The owner who~~ groundwater system that serves 3,300 or fewer people may monitor continuously to meet the requirements of this subsection.

~~c. When the disinfection treatment is required based on confirmed E. coli contamination in the source water, the requirements in this section apply. When the disinfection treatment is required for any other reason or provided voluntarily by the owner, the department will determine the frequency of residual disinfectant residual monitoring.~~

~~ed.~~ Failure to maintain the ~~ODW-specified department-specified~~ minimum residual disinfectant concentration for a period of more than four hours is a violation of the treatment technique requirement.

2. ~~A groundwater system owner that~~ The owner who uses ~~an a~~ ODW-approved ~~department-approved~~ alternative treatment to meet the requirements of this section by providing at least 4-log treatment of viruses before or at the first customer shall:

a. Monitor the alternative treatment in accordance with all ~~ODW-specified department-specified~~ monitoring requirements; and

b. Operate the alternative treatment in accordance with all ~~ODW-specified department-specified~~ compliance requirements necessary to achieve at least 4-log treatment of viruses.

3. Failure to meet the monitoring requirements of subsection C of this section is a violation and requires the ~~groundwater system~~ owner to provide public notification as required in 12VAC5-590-540 A 3.

D. Discontinuing compliance monitoring or treatment.

1. ~~A. The owner groundwater system owner~~ may discontinue compliance monitoring if the ~~ODW department~~ determines and documents in writing that compliance monitoring is no longer necessary for that groundwater source. ~~Owners of groundwater systems that have~~ The owner who has ~~ODW department~~ approval to discontinue compliance monitoring shall be subject to the triggered source water monitoring requirements of 12VAC5-590-379 B 1.

2. ~~A. The owner groundwater system owner who is~~ discontinuing compliance monitoring is still subject to the requirements of 12VAC5-590-380 G.

3. ~~The owner Owners of waterworks with groundwater sources that have who has~~ been required by the ~~commissioner department~~ to provide at least 4-log treatment of viruses shall not discontinue treatment or monitoring.

**12VAC5-590-425. Raw water monitoring requirements for groundwater sources. (Repealed.)**

~~A. The owner of any groundwater source utilizing chlorine disinfection or any other treatment or chemical addition that may alter or affect the bacteriological quality of the raw water shall collect source samples for bacteriological analysis in accordance with this section.~~

~~B. All bacteriological samples under this section shall be collected from the raw water prior to any treatment or chemical addition.~~

~~1. The owner shall provide a suitable raw water sample tap at each groundwater source.~~

~~2. If conditions are such that it is not possible to install a raw water sample tap, an alternate sample location acceptable to the commissioner may be utilized for this monitoring.~~

C. All samples shall be analyzed in accordance with 12VAC5-590-440 by the DCLS or by a laboratory certified by DCLS for drinking water samples and by a test method that will yield a Most Probable Number (MPN) result for both total coliforms and E. coli.

D. Number of samples.

1. The number of routine raw water samples to be collected and the frequency of sampling shall be determined by the district engineer. The district engineer will notify the waterworks owner of the raw water sampling requirements.

2. As a minimum, the owner shall collect raw water samples in accordance with the following table:

Source Type	Minimum Routine Raw Water Monitoring Frequency	Parameters
Well located in non-karst geology	One sample per year	Total coliforms MPN and E coli MPN
Well located in karst geology	One sample per calendar quarter	Total coliforms MPN and E coli MPN
Spring	One sample per month	Total coliforms MPN and E coli MPN

3. When a single sample result from any groundwater source that requires a routine raw water monitoring frequency of less than monthly indicates total coliforms in excess of 50 colonies per 100 mL or the presence of E. coli, the owner shall collect one confirmation sample within 10 calendar days of notification of the results. The district engineer may require that additional samples be collected and will establish the specific number of samples and the monitoring frequency.

E. If the results of the raw water monitoring required by this section indicate total coliforms in excess of 50 colonies per 100 ml in two or more samples collected during any running six-month period or the presence of E. coli in two or more samples collected during any running six-month period, the waterworks owner shall provide all necessary information required in 12VAC5-590-430 to the district engineer and the commissioner will make a GUDI determination for the groundwater source.

F. If the results of the raw water monitoring required by this section indicate the presence of E. coli in two or more samples collected during any running six-month period, the waterworks owner shall:

1. Issue a Tier 1 public notice in accordance with 12VAC5-590-540 A 1.
2. Provide disinfection treatment to achieve a 4 log virus inactivation as specified in 12VAC5-590-421 A 1 d.
3. Conduct compliance monitoring as specified in 12VAC5-590-421 C 1.

**12VAC5-590-430. Determination of surface water influence of groundwater sources.**

A. All waterworks' groundwater sources utilized by a waterworks, such as including wells, springs, and infiltration galleries, shall be evaluated by the division department and a determination of surface water influence shall be made by the commissioner department to determine surface water influence. The waterworks owner shall provide to the division department all necessary information to make this determination in accordance with the following three-step procedure described in subsection B of this section.

B. The groundwater source shall be evaluated and subjected to all the criteria in a stepwise fashion. Once the ~~commissioner department~~ has made a determination with regard to surface water influence, ~~has been made~~ it is not necessary to continue to the next step:

1. Step ~~one~~– 1. Evaluation of source history, construction, and location.

~~a. The source is not surface influenced if the division has previously determined that disinfection treatment is not required (see 12VAC5-590-380 G).~~

~~b. a. The source is surface influenced under the direct influence of surface water if it has been directly associated with a biological waterborne disease outbreak, such as Giardiasis, or if it has been directly associated with chemical contamination from the surface.~~

~~c. For all sources consisting of a spring, infiltration gallery, wells located in Karstian geology, or not classified as either 12VAC5-590-430 A 1 or 2 the determination shall proceed to step two.~~

b. The source is under the direct influence of surface water if there are any demonstrated or known direct connections between the source to surface water via surface water bodies, sinkholes, troughs, drainage ways, or other geologic features.

c. The source is under the direct influence of surface water if a sanitary survey reveals, or there is other evidence to indicate, that surface water is directly entering the source.

d. If the ~~commissioner department~~ has not determined that the source is influenced by surface water based upon the criteria in subdivisions B 1 a through B 1 c of this section, then the source evaluation proceeds to ~~step-Step two~~2.

2. Step ~~two~~– 2. source physiology and geology Microbiological water quality.

a. The owner shall collect a series of bacteriological samples directly from the source ~~prior to before~~ any treatment. The specific number of samples to be collected, the sampling frequency, and the duration of sampling shall be determined by the ~~commissioner department~~.

(1) At a minimum, a series of 20 samples collected on a weekly frequency is required. Sample collection may be adjusted within the week to collect samples immediately following rainfall events, whenever possible.

(2) All bacteriological analyses shall be performed in accordance with 12VAC5-590-440 by the DCLS or by a laboratory certified by the DCLS for drinking water samples and by a test method that will yield both total coliform concentration and E. coli concentration.

(3) The ~~commissioner department~~ may utilize bacteriological results from source water samples collected in accordance with 12VAC5-590-379 C if the sample results cover at least a ~~20-week~~ 20-week period that includes multiple significant rainfall events for this ~~step-Step two-2~~ evaluation.

b. The total coliform concentration sample results shall be evaluated as follows:

(1) If the results of the total coliform concentration samples indicate three or more samples with total coliform greater than 100 colonies/100 ml, then the source evaluation proceeds to ~~step-Step 3~~3.

(2) If the results of the total coliform concentration samples indicate a geometric mean equal to or greater than 100 colonies/100 ml, then the requirements of 12VAC5-590-380 G 2 will apply.

c. The E. coli concentration samples shall be evaluated as follows:

(1) If the results of the E. coli concentration samples indicate greater than or equal to five E. coli per 100 ml in three or more samples, then the source evaluation proceeds to ~~step-Step three3.~~

(2) If the results of the E. coli concentration samples indicate the presence of E. coli in five or more samples, then the source evaluation proceeds to ~~step-Step three3.~~

~~a. The source is not surface influenced if it consists of a properly constructed Class I or Class II well in non-Karstian geologic provinces of the state, with no history of turbidity fluctuations, and that have been determined by the division to be adequately treated by disinfection alone (12VAC5-590-380 G).~~

~~b. The source is surface influenced if a sanitary survey reveals that surface water may directly enter the source either through structural defects or through nearby surface water bodies, sinkholes, troughs, drainage ways, or other suspect geological features.~~

~~c. The determination for sources consisting of a spring, infiltration gallery, wells located in Karstian geology or otherwise not classified under 12VAC5-590-430 B 1 or 2 shall proceed to step three.~~

3. Step ~~three~~ water quality 3. additional-Additional water quality monitoring.

~~a. The source is not surface influenced if the total coliform concentrations of the raw water as measured by the multiple-portion decimal dilution (MPN) method is less than 100 organisms/100 mL based on a geometric mean of 20 or more samples over a period of six months with no more than 10% of these samples exceeding 100 organisms/100 mL; and having no record or confirmed fecal coliform contamination.~~

a. The owner shall prepare and submit a written source water monitoring plan to the department for approval detailing additional water quality samples to be collected directly from the source ~~prior to before~~ any treatment, and if applicable from a nearby surface water source. The monitoring plan shall include the following:

(1) The specific parameters to be monitored.

(2) The monitoring frequency for each parameter.

(3) The duration of monitoring.

~~b. The source is surface influenced if:~~

~~(1) The source turbidity, temperature, pH, or conductivity fluctuate following climatic events or fluctuate relative to nearby surface bodies of water, or~~

~~(2) The source exhibits the presence of diatoms, rotifers, coccidia, plant debris, insect parts, or Giardia cysts as identified by particulate analysis.~~

b. The source water monitoring plan shall include Microscopic Particulate Analysis (MPA).

(1) A minimum of four source water MPA tests is required, two to be conducted during a wet period and two to be conducted during a dry period. All MPA tests shall be collected at least 60 days apart.

(2) All MPA tests shall be performed by a laboratory approved by the ~~commissioner~~ department and shall include both Giardia lamblia and Cryptosporidium.

(3) All MPA testing and reporting of results shall be in accordance with the EPA "Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)", dated October 1992, Environmental Services Division.



c. The source water monitoring plan shall include monitoring of ~~the source water~~ physical parameters such as temperature, pH, turbidity, conductivity, and other parameters.

(1) If a surface water source is located near the groundwater source being evaluated, ~~then~~ monitoring of the nearby surface water source is required, using the same physical parameters and frequency as the groundwater source.

(2) Records of rainfall and other climatological events shall be maintained and reported with the physical parameter results.

d. The owner shall provide the department with all of the monitoring results required in the approved monitoring plan. Results of all MPA tests shall be reported within 10 days of receipt by the owner. If any MPA result indicates the presence of Giardia lamblia or Cryptosporidium, ~~then~~ the owner shall notify the department within 24 hours of receipt. The results of the physical parameter monitoring shall be provided along with applicable rainfall ~~or~~ climatological data to the department in a summary report.

e. The additional water quality monitoring results shall be evaluated as follows:

(1) The source is under the direct influence of surface water if any single MPA test result indicates a score of equal to or greater than 20.

(2) The source is under the direct influence of surface water if any two MPA test results indicate a score of equal to or greater than 15.

(3) The source is under the direct influence of surface water if the results of physical parameter monitoring indicate a correlation between fluctuations in the groundwater source in direct response to a rainfall or other climatological events.

(4) The source is under the direct influence of surface water if the results of physical parameter monitoring indicate a direct correlation between the groundwater source being evaluated and the physical parameters of a nearby surface water source.

(5) The source is a groundwater source and is not under the direct influence of surface water if: (i) ~~All~~ MPA test results indicate a score of equal to or less than 9, ~~and~~ (ii) ~~There~~ there are no fluctuations in source water monitored physical parameters in direct response to a rainfall or other climatological events, and (iii) ~~There~~ there is no direct correlation in the monitored physical parameters between the groundwater source being evaluated and a nearby surface water source.

f. If the ~~commissioner~~ department has not determined that the source is under the direct influence of surface water based upon the criteria in subdivisions B 3 e (1) through B 3 e (4) of this section, and if at least one of the MPA test results indicate a score of greater than 9 but less than 15, ~~then~~ the ~~commissioner~~ department shall evaluate all available water quality monitoring data, source construction, location, geology, and any other relevant factors, ~~and the commissioner shall to~~ determine that either:

(1) The source is a groundwater source and is not under the direct influence of surface water; or

(2) The source is at risk and requires continued source water monitoring as prescribed by the ~~commissioner~~ department.

C. If the source is subject to the requirements of subdivision B 3 of this section, ~~then~~ the owner shall perform the following interim measures until the ~~commissioner~~ department has made a final GUDI determination:

1. Provide disinfection treatment to achieve a 4-log inactivation of virus in accordance with 12VAC5-590-421 A 1 d;

2. Conduct compliance monitoring in accordance with 12VAC5-590-421 C 1;

3. If the disinfection treatment required in subdivision C 1 of this section has to be installed, ~~then the owner shall issue a public notice in accordance with 12VAC5-590-540 A 1 advising consumers to boil the water before using it for human consumption. with continuous boil water advisory in accordance with 12VAC5-590-540 A 1.~~ The boil water notice shall remain in effect until the disinfection treatment is installed and in operation.

4. The ~~commissioner~~ department may require that the owner perform additional interim measures if deemed necessary to protect public health.

D. If the total coliform concentration criteria in subdivision B 2 b of this section or the E. coli concentration criteria in subdivision B 2 c of this section are exceeded or if the ~~commissioner~~ department has declared the source to be GUDI, ~~then the owner may propose either mitigation measures and/or or a plan to correct deficiencies, or both.~~

1. Any proposed mitigation measures or corrective actions must be detailed in a report submitted to the department for approval. The report shall be prepared by a professional engineer licensed in Virginia, a professional geologist licensed in Virginia, or other licensed professional approved by the ~~field office~~ department. The report shall include:

a. A description of the proposed mitigation or corrective action activities such as the repair of structural defects, elimination of sources of contamination in proximity to the source, implementation of source water protection measures, or other mitigation or corrective action activities.

b. Specific milestones and milestone completion dates.

c. A follow-up source water monitoring plan to be implemented upon completion of the mitigation measures or of the corrective actions.

2. If the source must remain in operation during the period of time that the mitigation or corrective action activities are implemented and evaluated, ~~then the commissioner~~ department may require that the owner implement the interim measures described in 12VAC5-590-395 A 3 or subdivisions C 1 through C 4 of this section.

3. A final summary report, detailing ~~either the mitigation measures or and/or the corrective actions or both that are completed~~, the results of the follow-up monitoring, conclusions, recommendations and all other supporting data, shall be submitted to the ~~field office~~ department for approval.

a. The final summary report shall be prepared by a professional engineer licensed in Virginia, a professional geologist licensed in Virginia, or other licensed professional approved by the department.

b. Upon evaluation of the final report and supporting data, the ~~commissioner~~ department will make a GUDI determination.

E. For any source previously determined to be a groundwater source and not under the direct influence of surface water, the ~~commissioner~~ department may:

1. Require that the source be re-evaluated in accordance with procedures contained in ~~this chapter~~ section, or

2. Waive any additional re-evaluation under this section.

#### **12VAC5-590-440. Analytical methods.**

A. All drinking water analyses for compliance ~~with primary and secondary maximum contaminant levels or action levels purposes shall have been~~ performed by analytical methods that are consistent with current U.S. Environmental Protection Agency-EPA regulations found at 40 CFR Part 141 and 40 CFR Part 143 as well as 40 CFR Part 136, if applicable. ~~Standards for laboratories~~ Laboratories seeking certification to perform drinking water analyses ~~shall comply~~

with all are found in the Regulations for the Certification of Laboratories analyzing Drinking Water (1VAC30-41) and other applicable regulations promulgated by the Department of General Services, Division of Consolidated Laboratory Services DCLS.

B. For the purposes of determining compliance, the commissioner department will only accept results from samples that have been handled, processed, and documented in accordance with DCLS regulations for the certification for laboratories analyzing drinking water found in 1VAC30-41.

C. Testing for alkalinity, calcium, conductivity, disinfectant residual, orthophosphate, pH, silica, temperature, and turbidity, TOC, DOC, SUVA, and UV254 for compliance purposes may be performed by any person or party acceptable to the commissioner department, in accordance with 1VAC30-41 the Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017, American Water Works Association/American Public Health Association/Water Environment Federation or other methods specified in 40 CFR Part 141.

Table 2.2 — Inorganic Chemicals.

Substance	Primary Maximum Contaminant Level (mg/L)
Antimony	0.006
Arsenic (As)	0.010***
Asbestos	7 Million Fibers/Liter (longer than 10 um)
Barium (Ba)	2
Beryllium	0.004
Cadmium (Cd)	0.005
Chromium (Cr)	0.1
Cyanide (as free Cyanide)	0.2
Fluoride (F)	4.0 #
Mercury (Hg)	0.002
Nickel	No Limits Designated
Nitrate (as N)	10**
Nitrite (as N)	1
Total Nitrate and Nitrite (as N)	10
Selenium (Se)	0.05
Thallium	0.002
Substance	Secondary Maximum Contaminant Level (mg/L)
Chloride (Cl)	250.0
Copper (Cu)	1.0
Corrosivity	Noncorrosive, See Appendix B

Fluoride	2.0
Foaming Agents	0.5*
Iron (Fe)	0.3
Manganese (Mn)	0.05
Sodium (Na)	No Limits Designated
Sulfate (SO <sub>4</sub> )	250.0
Zinc (Zn)	5.0
Substance	Action Level (mg/L)
Lead (Pb)	0.015
Copper (Cu)	1.3

# Note. For artificially fluoridated waterworks the minimum concentration of fluoride should be 0.8 mg/L and the maximum should be 1.0 mg/L. The optimum control limit is 0.9 mg/L. (See Appendix B)

\*Note. Concentration reported in terms of Methylene Blue Active Substances.

\*\*Note. See Appendix B for Exception Regarding Noncommunity Waterworks.

\*\*\*Note. The PMCL for arsenic is 0.010 mg/L for community and nontransient noncommunity waterworks effective January 23, 2006. Arsenic sampling results shall be reported to the nearest 0.001 mg/L.

Table 2.3 — Organic Chemicals.

Substance	Primary Maximum Contaminant Levels (mg/L)
VOC	
1. Vinyl Chloride	0.002
2. Benzene	0.005
3. Carbon Tetrachloride	0.005
4. 1,2-Dichloroethane	0.005
5. Trichloroethylene (TCE)	0.005
6. 1,1-Dichloroethylene	0.007
7. 1,1,1-Trichloroethane	0.2
8. para-Dichlorobenzene	0.075
9. cis-1,2-Dichloroethylene	0.07
10. 1,2-Dichloropropane	0.005
11. Ethylbenzene	0.7

12. Monochlorobenzene	0.1
13. o-Dichlorobenzene	0.6
14. Styrene	0.1
15. Tetrachloroethylene	0.005
16. Toluene	1
17. trans-1,2-Dichloroethylene	0.1
18. Xylene (total)	10
19. Dichloromethane	0.005
20. 1,2,4-Trichlorobenzene	0.07
21. 1,1,2-Trichloroethane	0.05
SOC	
1. Alachlor	0.002
2. Atrazine	0.003
3. Carbofuran	0.04
4. Chlordane	0.002
5. Heptachlor	0.0004
6. Heptachlor epoxide	0.0002
7. Polychlorinated biphenyls (PCBs)	0.0005
8. Dibromochloropropane (DBCP)	0.0002
9. Ethylene dibromide (EDB)	0.00005
10. Lindane	0.0002
11. Methoxychlor	0.04
12. Toxaphene	0.003
13. 4-Dichlorophenoxyacetic Acid (2,4-D)	0.07
14. 2,4,5-Trichlorophenoxypropionic Acid (2,4,5-TP or Silvex)	0.05
15. Reserved	-
16. Reserved	-
17. Reserved	-
18. Pentachlorophenol	0.001
19. Benzo(a)pyrene	0.0002
20. Dalapon	0.2
21. Di(2-ethylhexyl)adipate	0.4

22. Di(2-ethylhexyl)phthalate	0.006
23. Dinoseb	0.007
24. Diquat	0.02
25. Endothall	0.4
26. Endrin	0.002
27. Glyphosate	0.7
28. Hexachlorobenzene	0.004
29. Hexachlorocyclopentadiene	0.05
30. Oxamyl (Vydate)	0.2
31. Picloram	0.5
32. Simazine	0.004
33. 2,3,7,8-TCDD (Dioxin)	$3 \times 10^{-8}$

Table 2.4 — Physical Quality.

Parameter	Maximum Contaminant Level	Concentration
Color	Secondary	15 Color Units
Odor	Secondary	3 Threshold odor numbers
pH	Secondary	6.5-8.5
Total Dissolved	Secondary	500 mg/L Solids (TDS)
Turbidity	Primary	*1 Turbidity Unit
* See Appendix B for operational requirements.		

Table 2.5 — Radiological Quality.

A. Maximum Contaminant Level Goals for Radionuclides	
Substance	MCLG
1. Combined radium-226 and radium-228	Zero
2. Gross alpha particle activity (excluding Radon and uranium)	Zero
3. Beta particle and photon radioactivity	Zero
4. Uranium	Zero
B. Primary Maximum Contaminant Levels for Radionuclides	
Substance	Primary Maximum Contaminant Level

1. Combined radium 226 and radium 228	5 pCi/L
2. Gross Alpha Activity (excluding Radon and Uranium)	15 pCi/L
3. Uranium	30 µg/L
Primary Maximum Contaminant Levels for Beta Particle and Photon Radioactivity from Man-Made Radionuclides	
1. The average annual concentration of Beta particle and Photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year.	
2. Except for the radionuclides listed in Schedule I, the concentration of man-made radionuclides causing 4 MREM total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168 hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure," MBS Handbook 69 as amended August 1963, U.S. Department of Commerce. If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ exceed 4 millirem/year.	
Schedule I	
Average annual concentrations assumed to produce a total body organ dose of 4 mrem/year.	
Radionuclide	Critical Organ
Tritium	Total Body
Strontium-90	Bone Marrow
* See Appendix B	-
	pCi/liter
	20,000
	8
	-

Table 2.6 — Unregulated Contaminant Organics to be Monitored.

Group A	
1. Chloroform	12. Chloromethane
2. Bromodichloromethane	13. Bromoethane
3. Chlorodibromomethane	14. 1,2,3-Trichloropropane
4. Bromoform	15. 1,1,1,2-Tetrachloroethane
5. Chlorobenzene	16. Chloroethane
6. m-Dichlorobenzene	17. 2,2-Dichloropropane
7. Dibromomethane	18. o-Chlorotoluene
8. 1,1-Dichloropropene	19. p-Chlorotoluene
9. 1,1-Dichloroethane	20. Bromobenzene
10. 1,1,2,2-Tetrachloroethane	21. 1,3-Dichloropropene

11. 1,3-Dichloropropane	-
<b>Group B</b>	
1. Aldrin	8. Metoachlor
2. Butachlor	9. Metribuzin
3. Carbaryl	10. Propachlor
4. Dicamba	11. Aldicarb
5. Dieldrin	12. Aldicarb sulfone
6. Methomyl	13. Aldicarb sulfoxide
7. 3-Hyposycarbofuran	-

Table 2.7 — Reserved

Table 2.8 — Organic Chemical Monitoring Implementation Schedule.

Number of Persons Served	Monitoring to Begin During the Quarter that Begins
Over 10,000	January 1, 1988
3,300 to 10,000	January 1, 1989
less than 3,300	January 1, 1991

Table 2.9 — PMCL Effective Dates.

Table 2.3, Organics Chemicals, VOC 1 through 8 (Phase I)	January 9, 1989
Total Trihalomethanes and Fluoride	July 1, 1991
Table 2.3, Organics Chemicals, VOC 9 through 18 and SOC 1 through 14 (Phase II VOCs and SOCs)	July 30, 1992
Asbestos, Cadmium, Chromium, Mercury, Nitrate, Nitrite, Total Nitrate+Nitrite, Selenium (Phase II IOCs)	July 30, 1992
Table 2.3, Organics Chemicals, SOC 15 through 18 and Table 2.2, Inorganic Chemicals, Barium (Phase II SOCs and IOCs)	January 1, 1993
Table 2.3, Organics Chemicals, VOC 19 through 21, SOC 19 through 33 and Table 2.2, Inorganic Chemicals; antimony, beryllium, cyanide (as free cyanide), nickel, and thallium	January 17, 1994
Uranium	December 8, 2003
E. coli	April 1, 2016

Table 2.10 — Maximum Contaminant Level Goals for Microbiological Contaminants.



Contaminant	MCLG
Giardia lamblia	Zero
Viruses	Zero
Legionella	Zero
Cryptosporidium	Zero
Escherichia coli (E. coli)	Zero

Table 2.11 — Maximum Contaminant Level Goals for Disinfection Byproducts.

Disinfection byproduct	MCLG (mg/L)
Bromate	Zero
Bromodichloromethane	Zero
Bromoform	Zero
Chlorite	0.8
Chloroform	0.07
Dibromochloromethane	0.06
Dichloroacetic acid	Zero
Monochloroacetic acid	0.07
Trichloroacetic acid	0.02

Table 2.12 — Maximum Residual Disinfectant Level Goals (MRDLG) and Maximum Residual Disinfectant Levels (MRDL) for Disinfectants

Disinfectant residual	MRDLG (mg/L)	MRDL (mg/L)
Chlorine	4 (as Cl <sub>2</sub> )	4.0 (as Cl <sub>2</sub> )
Chloramines	4 (as Cl <sub>2</sub> )	4.0 (as Cl <sub>2</sub> )
Chlorine dioxide	0.8 (as ClO <sub>2</sub> )	0.8 (as ClO <sub>2</sub> )

Notwithstanding the MRDLs in Table 2.12, owners may increase residual disinfectant levels in the distribution system of chlorine or chloramines (but not chlorine dioxide) to a level and for a time necessary to protect public health, to address specific microbiological contamination problems caused by circumstances such as, but not limited to, distribution line breaks, storm run-off events, source water contamination events, or cross-connection events.

Table 2.13 — Primary Maximum Contaminant Levels (PMCL) for Disinfection Byproducts

Disinfection byproduct	PMCL (mg/L)
Total trihalomethanes (TTHM)	0.080
Haloacetic Acids (five) (HAA5)	0.060

Bromate	0.010
Chlorite	1.0

Article 3  
Operation of Waterworks

**12VAC5-590-450. General. Facility and personnel management.**

Waterworks operation comprises the constant ~~operation oversight~~ and management of ~~the~~ facilities and personnel. Consideration ~~must~~ shall be given to such factors as ~~the competent competency of personnel;~~ standards of water quality, including drinking water standards; ~~water treatment plant maintenance and cleanliness;~~ analytical laboratory control; ~~and the operation and maintenance of plant equipment, plant records and safety~~ the facilities, including water treatment plant equipment and distribution system equipment and piping. As the ~~degree of complexity of water treatment~~ the waterworks increases, ~~so does~~ does the expertise and skill required to produce a high quality water also increases of the operating staff.

**12VAC5-590-460. Personnel. (Repealed.)**

~~The operation of waterworks, both small and large, must rest in the hands of qualified persons. The number of such employees in a waterworks system depends principally upon the size, the quality of the raw water, and the type of treatment processes used.~~

~~A. Waterworks operators designated by the waterworks owner to be in responsible charge must possess a valid waterworks operator license issued by the Board for Waterworks and Wastewater Works Operators and Onsite Sewage Professionals, Department of Professional and Occupational Regulation, in accordance with that board's regulations (18VAC160-20-10 et seq.) and Chapters 1, 2, 3, and 23 of Title 54.1 of the Code of Virginia. The license must be of a classification equal to or higher than that of the waterworks. Additional operating personnel at the waterworks must also be licensed as specified below.~~

~~B. The number and class of operators in attendance and additional operating personnel are a minimum to meet the requirements of protection of the public health of the consumer and safety of the operating personnel. The classification of operators and additional operating personnel in attendance must conform with Table 2.9.~~

~~1. The owner shall designate one or more properly licensed operators to be in responsible charge of the waterworks at all times. When no designated operator is on duty or in communication with the operating personnel in attendance at the waterworks, a substitute operator shall be designated by the owner. The substitute operator shall possess a valid operator license of a classification equal to or greater than that of the waterworks.~~

~~2. All waterworks having design capacity of 2.0 mgd or higher and employing filtration must have a minimum of two operating personnel on duty whenever the plant is in operation. All other waterworks employing filtration must have a minimum of one operating person on duty whenever the plant is in operation.~~

~~3. Waterworks designed for softening only and utilizing chemical precipitation:~~

~~a. Waterworks having a design capacity of 2.0 mgd or higher must have a minimum of two operating personnel in attendance at all times the plant is in operation; and~~

~~b. All other waterworks must have a minimum of one operator operating person in attendance at all times the treatment plant is in operation.~~

~~4. Waterworks utilizing iron and manganese removal by precipitation and having a design capacity of 0.5 mgd or higher must have a minimum of one operating person on duty at all times the treatment plant is in operation.~~

5. Waterworks providing treatment or no treatment and serving 400 or more persons and not previously covered will require daily attendance at each treatment facility by an operating person for sufficient time to insure proper operation of the facility and protection of the public health, as determined by the division.

TABLE 2.9  
 MINIMUM CLASSIFICATION FOR WATERWORKS OPERATIONS  
 ADDITIONAL OPERATING PERSONNEL

PLANT CLASSIFICATION	PLANT CAPACITY (MGC)	EQUIVALENT POPULATION SERVED	TREATMENT	OPERATOR-IN-RESPONSIBLE CHARGE (CLASS)	SHIFT SUPERVISOR (CLASS)	OTHERS
CLASS I	15.0 or more	150,000	Conventional filtration or filter rate more than 2 gpm/ft <sup>2</sup>	I	I	II, III, IV Trainee*
CLASS I	5.0 but less than 15.0	50,000 but less than 150,000	Conventional filtration filter rate more than 2 gpm/ft <sup>2</sup>	I	II	II, III, IV Trainee*
CLASS II	Less than 5.0	Less than 50,000	Filtering rater greater than 2 gpm/ft <sup>2</sup>	II	II	III, IV Trainee*
CLASS II	0.5 but less than 5.0	5,000 but less than 50,000	Conventional filtration	II	III	III, IV Trainee*
CLASS III	Less than 0.5	Less than 5,000	Conventional filtration	III	III	IV or Trainee*
CLASS III	5,000 or more	-	Approved treatment other than conventional filtration and fluoridation	III	IV	IV or Trainee*

CLASS III	Sufficient persons or connections to be classified as a Public Water supply	-	Not under higher classifications but using fluoridation	III	IV	Trainee*
CLASS IV	Less than 5,000	-	Approved treatment other than conventional filtration and fluoridation or no treatment serving 400 or more persons	IV	IV	Trainee*

\* Trainees should meet basic prerequisites for operators with the exception of experience and have potential for licensing wherever listed in these guidelines. Owner must provide a qualified substitute operator when only one operator is normally employed. The substitute must have the same class license as the operator.

**12VAC5-590-461. Classification of waterworks, operator requirements, and operator attendance.**

A. Classification of waterworks. All community and NTNC waterworks, including consecutive waterworks, fitting the classification protocol in this subsection shall be designated as classified waterworks. The commissioner retains the discretion to assign the classification of the waterworks or treatment facility either higher or lower. Those community and NTNC waterworks failing to fall within one of the classifications listed below shall be designated an unclassified waterworks unless specified otherwise by the commissioner. Normally, a TNC waterworks shall not be classified and shall not be required to have an operator, unless the commissioner determines that it is necessary to ensure satisfactory operation of the ~~installed~~ treatment. ~~installed~~. If a waterworks consists of multiple treatment facilities, then these facilities may be individually classified for the purpose of determining the operator requirements.

1. Class 1 shall mean:

- a. ~~A Waterworks-waterworks~~ or a water treatment plant serving 50,000 or more persons; or having a water treatment plant capacity of 5.0 MGD or more and employing conventional filtration or chemical coagulation in combination with membrane filtration; or
- b. The waterworks is designated by the commissioner to be a Class 1 waterworks.

2. Class 2 shall mean:

a. ~~A Waterworks-waterworks~~ or a water treatment plant serving 5,000 or more persons but fewer than 50,000 persons, or having a water treatment plant capacity of 0.5 MGD or more but less than 5.0 MGD, whichever range applies, and employing rapid rate conventional filtration (see 12VAC5-590-874), ~~or~~ chemical coagulation in combination with membrane filtration; or

b. ~~A Waterworks-waterworks~~ or a water treatment plant serving fewer than 50,000 persons or having a water treatment plant capacity of less than 5.0 MGD and employing high rate conventional filtration (see 12VAC5-590-874); or

c. The waterworks is designated by the commissioner to be a Class 2 waterworks.

3. Class 3 shall mean:

a. ~~A Waterworks-waterworks~~ or a water treatment plant serving fewer than 5,000 persons or having a water treatment plant capacity less than 0.5 MGD, whichever is greater, and employing conventional filtration or chemical coagulation in combination with membrane filtration; or

b. ~~A Waterworks-waterworks~~ or a water treatment plant serving 5,000 or more persons or having a water treatment plant capacity of 0.5 MGD or more, whichever is greater, and employing one or more of the following: disinfection other than with hypochlorination; caustic soda feed; iron and manganese removal; ion exchange; slow sand filtration; aeration; re-chlorination other than with hypochlorination; activated carbon contactors; membrane or other filtration technologies without chemical coagulation; and fluoridation with a saturator or acid feed; or

c. ~~A Waterworks-waterworks~~ or a water treatment plant employing fluoridation with other than a saturator not considered a Class 1 or Class 2 waterworks; or

d. The waterworks is designated by the commissioner to be a Class 3 waterworks.

4. Class 4 shall mean:

a. ~~A Waterworks-waterworks~~ or a water treatment plant serving fewer than 5,000 persons or having a water treatment plant capacity of less than 0.5 MGD, and employing one or more of the following: disinfection other than with hypochlorination; caustic soda feed; iron and manganese removal; ion exchange; slow sand filtration; aeration; re-chlorination other than with hypochlorination; activated carbon contactors; membrane or other filtration technologies without chemical coagulation; and fluoridation with a saturator; or

b. The waterworks is designated by the commissioner to be a Class 4 waterworks.

5. Class 5 shall mean:

a. A waterworks serving 400 or more persons that:

(1) Provides no treatment; or

(2) Employs one or more of the following treatment processes:

(a) Hypochlorination for disinfection; or

(b) Corrosion control with calcite or magnesium oxide contactors or solution feed except with caustic soda; or

(c) Sequestration by solution feed.

b. The waterworks is designated by the commissioner to be a Class 5 waterworks.

6. Class 6 shall mean:

a. ~~A Waterworks-waterworks~~ serving fewer than 400 persons that:

(1) Provides no treatment; or

(2) Employs one or more of the following treatment processes:

(a) Hypochlorination for disinfection; or

(b) Corrosion control with calcite or magnesium oxide contactors or solution feed except with caustic ~~soda~~; or

(c) Sequestration by solution feed.

b. The waterworks is designated by the commissioner to be a Class 6 waterworks.

B. Operator requirements. The operation of all waterworks must rest in the hands of qualified staff. The number and qualifications of persons constituting the operating staff at a waterworks depend principally upon the capacity of the waterworks, the number of persons served by the waterworks, and the complexity of the treatment process or processes. If a classified waterworks or water treatment plant is without a required operator, then the owner shall notify the department as soon as ~~reasonably~~ practical but no later than 24 hours of such an occurrence.

21. The operator attendance requirements specified in subsection C of this section are a minimum to protect the health of the consumer and safety of the operating staff. The ~~commissioner-department~~ may increase the required operating attendance when appropriate to protect human health.

32. ~~All~~ A classified waterworks shall be operated by an operator having a valid license issued by the Commonwealth of Virginia (DPOR, 18VAC160-20-10) with a classification equal to or higher than the classification of the waterworks or water treatment plant being operated. (See definition of operator in 12VAC5-590-10).

43. Operators are not required at unclassified waterworks.

C. Minimum operator attendance at classified waterworks. For the purpose of this section and 12VAC5-590-570, all classified waterworks or individual water treatment plants shall maintain the minimum operator attendance as follows:-:

1. Class 1. ~~The Waterworks-waterworks~~ shall have a minimum of two operating staff in attendance whenever the water treatment plant is in operation; at least one of the operating staff must be an operator.

2. Class 2. ~~The Waterworks-waterworks~~ shall have a minimum of one operator in attendance whenever the water treatment plant is in operation.

3. Class 3. ~~The Waterworks-waterworks~~ employing conventional filtration or chemical coagulation in combination with membrane filtration shall have a minimum of one operator in attendance whenever the water treatment plant is in operation. All other treatment facilities may have operator attendance similar to a Class 4 waterworks.

4. Class 4. ~~The Waterworks-waterworks~~ shall be attended by an operator at least three days per week, except that water treatment plants employing membrane filters treating surface waters ~~sources~~ or GUDI sources shall be attended by an operator daily. The attendance shall be for sufficient time to perform the necessary operations, monitoring, and maintenance.

5. Class 5 and Class 6.

a. Where no treatment is provided, the waterworks shall be attended by an operator at least twice a month.

b. When treatment is provided, the waterworks shall be attended by an operator at least once per week.

c. The attendance shall be for sufficient time to perform the necessary operations, monitoring, and maintenance.

D. Operator attendance alternatives.

1. Increased staffing attendance may be required by the commissioner on a case-by-case basis in order to protect public health, ~~taking into consideration operational history and treatment processes employed.~~

2. Reduced operator attendance for Class 3 ~~through ,4, 5 and~~ Class 6 waterworks may be considered by the commissioner on a case-by-case basis.

3. ~~When requiring increased operator attendance, or considering reduced operator attendance, the commissioner will consider the following criteria, which includes: Evaluation criteria shall include, but are not limited to, the following:~~

- a. Operational history;
- b. Type of treatment;
- c. Facility capacity and hours of operation;
- d. Population served;
- e. Type and reliability of remote monitoring controls, alarms, and communications;
- f. Reliable staff communications; and
- g. Emergency response plans and procedures.

**12VAC5-590-470. Waterworks appearance condition.**

~~The general appearance and state of cleanliness of a waterworks can greatly influence the attitude of the public toward a utility and can actually promote public health. A community without confidence in its public water supply will often resort to the use of water from questionable or polluted sources; therefore, the The waterworks must shall be maintained in a clean and orderly condition to achieve this goal.~~

**12VAC5-590-475. Removal of wells from service.**

A. Temporary inactivation.

1. ~~Any A~~ water well temporarily inactivated shall be sealed with a watertight cap or well-head seal.
2. The well shall be maintained so that it will not be a source or channel ~~of for~~ contamination during temporary inactivation.
3. The well-head shall be visually inspected and ~~observations~~ documented to verify adequate sanitary integrity on a quarterly basis.
4. The well lot shall be maintained.

B. Permanent abandonment.

1. Well abandonment shall be supervised by a certified water well systems provider.
2. All well abandonments shall be documented on a Uniform Water Well Completion Report, Form GW-2, and submitted to the department within 30 days of completing the physical abandonment.
3. Groundwater wells that are abandoned shall be sealed by methods that will restore to the fullest extent possible the controlling geological conditions that existed before the wells were constructed.
4. Casing and screen materials may be salvaged.
5. The well shall be checked from land surface to the entire depth of the well before it is sealed to ascertain freedom from obstructions that may interfere with sealing operations. ~~Sufficient effort~~ Effort shall be made to remove or clear any obstacles that may prohibit sealing by grouting the complete well depth.
6. The well shall be thoroughly chlorinated ~~prior to before~~ sealing.

7. Bored wells and uncased wells shall be backfilled with clean fill to the water level. A two-foot-thick bentonite grout plug shall be placed immediately above the water level. Clean fill shall be placed on top of the bentonite grout plug and brought up to at least five feet from the ground surface. The top five feet of the well casing, if present, shall be removed from the bore hole. If an open annular space is present around the well casing, then the annular space shall be filled with bentonite grout to the maximum depth possible, but less than or equal to 20 feet. A one-foot-thick cement or bentonite grout plug that completely fills the bore void space shall be placed a minimum of five feet from the ground surface. As an alternative, bored wells and uncased wells may be completely filled with concrete, sand-cement, bentonite-cement, or neat cement grout, to within a minimum of five feet from the ground surface by introduction through a pipe initially extending to the bottom of the well. The pipe shall be raised, but remain submerged in grout or concrete, as the well is filled. The remaining space shall be filled with clean fill ~~which that~~ is mounded a minimum of one foot above the surrounding ground surface.

8. Non-bored wells constructed in unconsolidated formations shall be completely filled with concrete, sand-cement, bentonite-cement, or neat cement grout to within a minimum of five feet from the ground surface by introduction through a pipe initially extending to the bottom of the well. The pipe shall be raised, but remain submerged in grout or concrete, as the well is filled. The remaining space shall be filled with clean fill ~~which that~~ is mounded a minimum of one foot above the surrounding ground surface.

9. Wells constructed in consolidated rock formations or which penetrate zones of consolidated rock may be filled with sand or gravel opposite the zones of consolidated rock. The top of the sand or gravel fill shall be at least five feet below the top of the consolidated rock and at least 20 feet below land surface. The remainder of the well shall be filled with concrete, sand-cement, bentonite-cement, or neat cement grout to within a minimum of five feet from the ground surface by introduction through a pipe initially extending to the bottom of the well. The pipe shall be raised, but remain submerged in grout or concrete, as the well is filled. The remaining space shall be filled with clean fill ~~which that~~ is mounded a minimum of one foot above the surrounding ground surface.

10. The location of the well shall be permanently documented for future ~~location reference~~.

#### **12VAC5-590-476. Reactivation of wells.**

A. The owner shall notify the department of the intent to reactivate a well.

B. ~~Prior to Before~~ bringing the well into service, it ~~shall~~ be pumped to waste (purged) for a minimum of five well volumes, ~~and but~~ no less than 30 minutes. The purged well water shall be discharged in a manner so that it will not return to the well, directly or indirectly, during the pumping period.

C. After the well is pumped, water quality samples shall be collected. If the well has been inactive for less than one year, then two samples shall be collected at least 30 minutes apart and tested for the presence of E. coli. If the well has been inactive for one or more years, ~~then the well~~ it shall be tested for total coliform density (MPN), nitrate, and if determined by the ~~commissioner~~ department, inorganics, VOCs, SOCs, and radionuclides. Satisfactory test results shall be obtained ~~prior to before~~ placing the well in service.

D. A well yield and drawdown test may be required by the ~~commissioner department~~ ~~prior to before~~ bringing the well into service. The test shall be performed in accordance with 12VAC5-590-840 H, as applicable.

E. A well may be activated for emergency use ~~prior to before~~ receipt of satisfactory monitoring results, ~~even~~ if public health and safety are ~~unknowns and may be~~ at risk, as determined by the ~~commissioner~~ department. ~~However, in~~ these circumstances, a special water advisory shall be



approved by the ~~commissioner department~~ and issued by the waterworks at the same time the well is activated.

**12VAC5-590-480. Analytical laboratory control-Operational control testing and monitoring.**

A. ~~Analyses~~ Water analyses and tests performed at waterworks are ~~made-conducted~~ for four main purposes: ~~(i) to ensure compliance; (ii) to control water treatment plant operation; (iii) to record water treatment plant performance; and (iv) to improve plant performance, and to undertake fundamental research of value to the plant and to the profession in general provide information for improving water treatment plant performance.~~ Tests designed to control operation ~~should~~ shall present evidence that:

1. ~~The water has been properly prepared for each major key step in the treatment process;~~2. Each key process, such as mixing, coagulation, sedimentation, filtration, softening, iron and manganese removal, disinfection, and taste and odor control ~~has proceeded according to plan~~ is effective; and
3. The finished product is clean, is free from objectionable taste or and odor, is free from undesirable chemical characteristics, and is safe for human consumption.

B. ~~Laboratory analyses shall conform with the most current edition available of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation, or analytical methods approved by the division. Testing for regulatory compliance purposes shall use an EPA-approved analytical method found in 40 CFR Parts 141 and 143. Instruments used for operational control purposes must be calibrated in accordance with manufacturer's-the manufacturers' instructions. Calibrations shall be documented in a manner acceptable to the commissioner department.~~

C. Ample laboratory space shall be provided for all required laboratory analyses as specified in 12VAC5-590-760.

1. Chemical. The analyses listed below are the minimum required. Additional testing may be required by the division.
  - a. ~~Waterworks utilizing treatment for turbidity removal shall provide equipment for the analysis of pH, alkalinity, hardness, turbidity, water temperature and coagulation dosage. An electric pH meter must be provided; however, a color comparator may be used as a back-up unit. Turbidities must be determined by the use of a nephelometer. Minimum equipment for coagulation control shall be a multiple jar stirring machine.~~
  - b. ~~Waterworks providing softening only and utilizing chemical precipitation shall provide equipment for analysis of pH utilizing an electric pH meter, alkalinity, hardness, water temperature, and chemical dosage for precipitation utilizing a multiple jar stirring machine.~~
  - c. ~~Waterworks providing iron and manganese removal by chemical precipitation shall provide equipment for analysis of pH, alkalinity, iron, manganese, and water temperature.~~
  - d. ~~Waterworks providing fluoridation shall provide equipment for analysis of the fluoride ion concentration and water temperature.~~
  - e. ~~Waterworks providing chlorination or rechlorination shall provide equipment for the analysis of chlorine residual and temperature.~~
  - f. ~~Waterworks providing iron and manganese removal by ion exchange and or softening by ion exchange shall provide equipment for the analysis of iron and manganese, or hardness.~~

2. Bacteriological. Only results of bacteriological analyses performed by the Division of Consolidated Laboratory Services, or by laboratories and laboratory personnel certified by the Division of Consolidated Laboratory Services will be acceptable.

a. The number and frequency of bacteriological sampling shall comply with Article 1 of Part II. Additional analyses may be necessary when deemed so by the division.

b. Waterworks having a rated capacity of 3.0 mgd or more or serving an equivalent of 30,000 persons or more shall provide laboratory space and equipment for routine bacteriological analysis.

c. Bacteriological sampling in accordance with Article 1 of Part II is required by all waterworks.

D. Required waterworks on-site laboratory analyses. The analyses listed in this subsection are the minimum required. Additional testing may be required by the ~~commissioner~~ department.

1. ~~Owners~~ An owner of a waterworks employing chemical coagulation or lime softening in combination with any filtration treatment for turbidity removal or TOC reduction shall provide equipment for the analysis of pH, alkalinity, hardness, turbidity, water temperature, and coagulant dosage. A calibrated electric pH meter must be provided; however, a color comparator may be used as a back-up unit. Turbidities must be determined by the use of a calibrated turbidimeter. ~~Minimum equipment for coagulation control shall be a multiple jar stirring machine.~~

2. ~~Owners~~ An owner of a waterworks employing membrane filtration without chemical coagulation or lime softening shall provide equipment for the analysis of turbidity and temperature. Turbidities shall be determined by the use of a calibrated turbidimeter.

3. ~~Owners~~ An owner of a waterworks employing softening only and utilizing chemical precipitation shall provide equipment for the analysis of pH utilizing a calibrated electric pH meter, alkalinity, hardness, water temperature, and chemical dosage for precipitation utilizing a multiple jar stirring machine.

4. ~~Owners~~ An owner of a waterworks employing iron and manganese removal by chemical precipitation shall provide equipment for the analysis of pH, alkalinity, iron, manganese, and water temperature.

5. ~~Owners~~ An owner of a waterworks employing fluoridation shall provide equipment for the analysis of the fluoride ion concentration and water temperature.

6. ~~Owners~~ An owner of a waterworks employing chlorination, re-chlorination, chloramination, or re-chloramination shall provide equipment for the analysis of the appropriate chlorine residual measurement and temperature.

7. ~~Owners~~ An owner of a waterworks employing iron and manganese removal by ion exchange or softening by ion exchange shall provide equipment for the analysis of iron and manganese.

E. Process control instruments, monitors, gauges, and controllers, including reading, recording, and alarm features, required in Part III, Manual of Practice, shall be maintained fully operational and calibrated in accordance with the ~~manufacturer's~~ manufacturers' instructions.

1. ~~Owners~~ An owner of waterworks employing UV for inactivation credit shall perform UV sensor calibration checks. Calibrations and instrument checks shall be documented in a manner acceptable to the ~~commissioner~~ department. All UV sensors shall be verified calibrated with a reference UV sensor at least monthly. It is also recommended that off-line/standby sensors be calibrated at the same time. At least one reference sensor for calibration of on-line sensors shall be provided. The reference UV sensor shall be calibrated at least yearly at a qualified facility, usually the manufacturer. Ultraviolet transmittance (UVT) analyzer calibration is required when used as a control instrument.

The UVT analyzer shall be calibrated at least weekly by comparing on-line measurements to a bench top spectrophotometer that is calibrated in accordance with manufacturer's instructions. ~~In lieu~~ **Instead** of an online UVT analyzer, a bench top spectrophotometer may be utilized to determine UV transmittance at least every four hours.

2. ~~The An owner of a waterworks~~ employing ozone for inactivation credit shall perform calibration checks on continuous, online ozone residual monitors at least weekly, during peak hourly flow. Inactivation credits for a multiple chamber contactor shall be based on only the chambers that have a measured ozone residual > 0.02 mg/L or higher, depending on residual analysis instrumentation.

#### **12VAC5-590-490. Adequate treatment.**

A. Adequate treatment is any one or any combination of the controlled processes of coagulation, sedimentation, absorption, filtration, disinfection, or other processes that produce a water consistently meeting the requirements of this chapter. The concept of adequate treatment also includes processes that are appropriate to (i) the source of supply water; (ii) waterworks that are of adequate capacity to meet maximum demands without creating health hazards, and that are located, designed, and constructed to eliminate or prevent cross-connections; and (iii) the conscientious operation by well-trained and competent personnel whose qualifications are commensurate with the responsibilities of the position and acceptable to the ~~division commissioner department~~.

B. ~~All A~~ waterworks shall provide adequate treatment and when ~~needed~~ **required** and in accordance with 12VAC5-590-680 to ensure the production of ~~pure~~ potable water.

#### **12VAC5-590-500. Disinfection by chlorination criteria, determination of CT, disinfection profiles, and disinfection benchmarks for Giardia and virus inactivation.**

A. ~~All A water supplies derived from waterworks utilizing~~ surface water sources, or GUDI sources, in whole or in part, shall be disinfected in accordance with subsection C of this section, and 12VAC5-590-1000 until June 29, 1993. It is recommended that a chlorine residual be maintained. Beginning June 29, 1993, every owner of a waterworks shall comply with the disinfection requirements of 12VAC5-590-420.

B. Owners of waterworks utilizing surface waters as a water supply shall practice prechlorination. The requirement for prechlorination may be waived by the commissioner when warranted.

C. Owners of waterworks utilizing groundwater as a water supply that has been determined by the commissioner to be under the direct influence of surface water, as provided in 12VAC5-590-430, will be required to disinfect. If the commissioner determines that the groundwater supply is surface influenced, the owner shall provide disinfection during the interim before filtration is installed in accordance with 12VAC5-590-420-B 2 f. If filtration is installed prior to June 29, 1993, the owner shall comply with the disinfection requirements of 12VAC5-590-1000 until June 29, 1993. By June 29, 1993, all owners of waterworks using a groundwater source determined to be under the direct influence of surface water shall comply with the disinfection requirements of 12VAC5-590-420.

D. ~~The Owners owner of a groundwater system~~ systems ~~source waterworks~~ subject to the requirements of 12VAC5-590-421 A 1 d shall provide a primary disinfection treatment by means of one of the following:

1. A disinfectant residual concentration (C) and contact time (T) to achieve a 4-log **removal or** inactivation of viruses. CT shall be calculated in accordance with ~~Appendix L~~ subsections C and D of this section, which contains information on calculation methods and contact tank baffling factors.

2. UV treatment to achieve a 4-log ~~removal~~ or inactivation of viruses. Log inactivation shall be determined in accordance with 12VAC5-590-401 E 7 c. A secondary disinfection residual in the distribution system may be required by the ~~commissioner~~department.

~~E. Disinfection profile data and disinfection benchmark data-~~

~~1. The owner of any waterworks that has disinfection profile data shall retain this data in graphic form, as a spreadsheet, or in some other format acceptable to the commissioner for review as part of sanitary surveys conducted by the commissioner. Appendix L lists the procedure for developing a disinfection profile.~~

~~2. Disinfection benchmarking.~~

~~a. The owner of any waterworks that has developed a disinfection profile and that decides to make a significant change to its disinfection practice shall consult with the commissioner prior to making such change. Significant changes to disinfection practice are:~~

- ~~(1) Changes to the point of disinfection;~~
- ~~(2) Changes to the disinfectants used in the treatment plant;~~
- ~~(3) Changes to the disinfection process; and~~
- ~~(4) Any other modification identified by the commissioner.~~

~~b. The owner of any waterworks that is modifying its disinfection practice shall calculate its disinfection benchmark using the following procedure:~~

~~(1) For each year of profiling data collected, the owner shall determine the lowest average monthly Giardia lamblia inactivation in each year of profiling data. The owner shall determine the average Giardia lamblia inactivation for each calendar month for each year of profiling data by dividing the sum of daily (or weekly) Giardia lamblia inactivation by the number of values calculated for that month.~~

~~(2) The disinfection benchmark is the lowest monthly average value (for waterworks with one year of profiling data) or average of lowest monthly average values (for waterworks with more than one year of profiling data) of the monthly logs of Giardia lamblia inactivation in each year of profiling data.~~

~~(3) The owner of a waterworks that uses either chloramines or ozone for primary disinfection shall also calculate the disinfection benchmark for viruses using a method approved by the commissioner.~~

~~c. The owner shall submit the following information to the commissioner as part of the waterworks' consultation process.~~

- ~~(1) A description of the proposed change;~~
- ~~(2) The disinfection profile for Giardia lamblia (and, if necessary, viruses) and benchmark listed in subdivision E 2 b of this section;~~
- ~~(3) An analysis of how the proposed change will affect the current levels of disinfection; and~~
- ~~(4) Any additional information to justify the change.~~

C. Disinfection criteria.

1. An ~~Owners-owner~~ of a waterworks utilizing surface water sources in whole or in part, or GUDI sources, shall provide a minimum 3-log (99.9%) removal of Giardia cysts and a 4-log (99.99%) removal of viruses, respectively.

2. Additional inactivation levels that must be achieved by disinfection shall be in accordance with Table 500.1 for waterworks employing the filtration processes listed.

TABLE 500.1.

Maximum Log Removal Credits for Various Filtration Technologies and the Resulting Minimum Required Logs of Inactivation by Disinfection

FILTRATION PROCESS <sup>a</sup>	MAXIMUM LOG REMOVAL CREDITS FOR FILTRATION		ADDITIONAL LOG INACTIVATION REQUIRED BY DISINFECTION	
	Giardia lamblia	Viruses	Giardia lamblia	Viruses
Conventional	2.5	2.0	0.5	2.0
Direct	2.0	1.0	1.0	3.0
Pre-engineered package	2.5	Zero	0.5	4.0
Diatomaceous Earth	2.0	1.0	1.0	3.0
Slow Sand	2.0	2.0	1.0	2.0
Ultrafiltration or Microfiltration Membrane	3.0	Zero	0.5	4.0
Bag or Cartridge	2.0	Zero	1.0	4.0

<sup>a</sup> Refer to Part III of this ~~Chapter~~ chapter for further description of the filtration processes.

D. A disinfection profile shall be developed in accordance with the procedures in subdivisions D 1 through D 3.

1. ~~Owners~~An owner shall monitor at least weekly for a period of 12 consecutive months to determine the total log inactivation for Giardia lamblia and viruses. If ~~an owners-owner~~ monitors more frequently, then the monitoring frequency shall be evenly spaced. An owner ~~Owners~~ of a waterworks that operates for fewer than 12 months per year shall monitor weekly during the period of operation.

2. An owner of a ~~Owners~~ waterworks with a single point of disinfectant application ~~prior to before~~ the entrance to the distribution system, or with more than one point of disinfectant application, shall conduct the monitoring in subdivisions D 2 a through D 2 e of this section.

a. For a waterworks using a disinfectant other than UV, the temperature of the disinfected water shall be measured at each residual disinfectant concentration sampling point during peak hourly flow or at an alternative location approved by the ~~commissioner~~ department.

b. For a waterworks using chlorine, the pH of the disinfected water shall be measured at each chlorine residual disinfectant concentration sampling point during peak hourly flow or at an alternative location approved by the ~~commissioner~~ department.

c. The residual disinfectant concentration (C) of the water before or at the first customer, and ~~prior to before~~ each additional point of disinfectant application, shall be measured at peak hourly flow.

d. The disinfectant contact times (T) of the water before or at the first customer, and ~~prior to before~~ each additional point of disinfectant application, shall be determined during peak hourly flow. The disinfectant contact time to be used for calculating CT is T<sub>10</sub>, which is the detention time at which 90 ~~percent~~% of the water passing through a unit is retained within that unit. T<sub>10</sub> shall be determined either by calculations that involve the theoretical hydraulic detention time and baffling factors that account for the

degree of short-circuiting that might be expected through any given unit, or by tracer studies. The baffling factors listed in Table 500.15 shall be used in determining contact time if tracer studies are not performed.

e. Inactivation credits for ozone contactors will be based on only the chambers that have a measured ozone residual. A minimum of two dedicated on-line monitors per ozone contactor shall be installed at locations suited to the CT calculation method used. Ozone residual levels shall be monitored continuously and recorded. Methods for computing log inactivation of Giardia lamblia and virus shall be approved by the commissioner department. Tracer studies shall be required to verify  $T_{10}$  values prior to before receiving inactivation credit.

3. ~~In lieu~~ Instead of conducting new monitoring under subdivision D 2 of this section, an owners may elect to meet the requirements of subdivision D 3 a or D 3 b of this section.

a. ~~Owners-An owner that who have has~~ at least one year of existing data that are substantially equivalent to data collected under the provisions of subdivision D 3 of this section shall use these data to develop disinfection profiles, if the owner has neither made a significant change to ~~its the~~ treatment practice nor changed sources since the data were collected. ~~Owners-An owner~~ may develop a disinfection profiles using up to three years of existing data.

b. ~~Owners-An owner~~ may use a disinfection profiles developed previously in accordance with the procedures in- subdivisions D 1 through D 3 of this section, if the owner has neither made a change to ~~its the~~ treatment practice nor changed sources since the profile was developed. ~~Owners that have An owner who has-not~~ developed a virus profile shall develop a virus disinfection profile using the same monitoring data on which the Giardia lamblia profile is based.

E. ~~Owners of waterworks An owner~~ shall calculate the total inactivation ratio for Giardia lamblia and viruses as specified in ~~subdivision E subdivisions E~~ 1 through E 4 of this subsection, based on  $CT_{99.9}$  (3-log) values for Giardia lamblia in Tables 500.2 through 500.4413. Note that the 3-log values in Tables 500.2 through 500.14 also achieve a 4-log virus inactivation. pH and temperature values between the indicated values in Tables 500.2 through 500.43-14 shall be determined by linear interpolation, or the CT value at the lower temperature and at the higher pH shall be used. All parameters necessary to determine the total inactivation ratio shall be monitored during peak hourly flow.

1. ~~Owners of waterworks An owner~~ using only one point of disinfectant application shall determine the total inactivation ratio for the disinfection segment based on either of the following methods:

a. Determine one inactivation ratio ( $CT_{calc}/CT_{99.9}$ ) before or at the first customer during peak hourly flow.

b. Determine successive  $CT_{calc}/CT_{99.9}$  values, representing sequential inactivation ratios, between the point of disinfectant application and a point before or at the first customer during peak hourly flow. The owner shall calculate the total inactivation ratio by determining ( $CT_{calc}/CT_{99.9}$ ) for each sequence and then adding the ( $CT_{calc}/CT_{99.9}$ ) values together to determine total inactivation ( $\Sigma (CT_{calc}/CT_{99.9})$ ).

2. ~~Owners of waterworks An owner~~ using more than one point of disinfectant application before the first customer shall determine the CT value of each disinfection segment immediately ~~prior to before~~ the next point of disinfectant application, or for the final segment before or at the first customer, during peak hourly flow. The ( $CT_{calc}/CT_{99.9}$ ) value of each segment and ( $\Sigma (CT_{calc}/CT_{99.9})$ ) shall be calculated using the method in subdivision E 1 a or E 1 b of this subsection.

3. The owner shall determine the total logs of inactivation of Giardia lamblia by multiplying the value calculated in subdivision E 1 a or E 1 b of this subsection by 3.0.

4. The owner shall determine the total logs of inactivation of viruses by multiplying the value calculated in subdivision E 1 a or E 1 b of this subsection by 4.0.

F. A disinfection benchmark shall be calculated following the procedures in subdivisions F 1 through F 3 of this subsection:

1. For each year of profiling data collected and calculated, ~~owners~~ an owner shall determine the lowest mean monthly level of both Giardia lamblia and virus inactivation. ~~Owners~~ The owner shall determine the mean Giardia lamblia and virus inactivation for each calendar month for each year of profiling data by dividing the sum of daily or weekly Giardia lamblia and virus log inactivation by the number of values calculated for that month.

2. The disinfection benchmark is the lowest monthly mean value (for waterworks with one year of profiling data) or the mean of the lowest monthly mean values (for waterworks with more than one year of profiling data) of Giardia lamblia and virus log inactivation in each year of profiling data.

3. An owner of a ~~Waterworks~~ waterworks using chloramines, ozone, or chlorine dioxide for primary disinfection shall calculate the disinfection benchmark for viruses from the data collected, in the same manner used to calculate the Giardia lamblia disinfection benchmark.

G. The owner shall retain the disinfection profile in graphic form, as a spreadsheet, or in some other format acceptable to the ~~commissioner~~ department for evaluation as part of sanitary surveys conducted by the ~~commissioner~~ department.

H. ~~Prior to~~ Before making a significant change to the waterworks disinfection practice, the owner shall review the disinfection benchmark and consult with the ~~commissioner~~ department.

1. Significant changes to disinfection practice are: (i) ~~Changes~~ changes to the point of disinfectant application; (ii) ~~Changes~~ changes to the disinfectants used in the treatment plant; (iii) ~~Changes~~ changes to the disinfection process; and (iv) ~~Any~~ any other modification identified by the ~~commissioner~~ department.

2. The owner shall submit the following information to the ~~commissioner~~ department as part of the consultation process: (i) ~~A~~ a description of the proposed change; (ii) ~~The~~ the disinfection profile and benchmarks established for Giardia lamblia and, if necessary, viruses; (iii) ~~An~~ an analysis of how the proposed change will affect the current levels of disinfection; and (iv) any additional information to justify the change.

TABLE 500.2.

CT Values for 3-Log Inactivation of Giardia lamblia by Free Chlorine at Less than 0.5°C.

FREE RESIDUAL (mg/L)	pH						
	≤6.0	6.5	7.0	7.5	8.0	8.5	≤9.0
≤0.4	137	163	195	237	277	329	390
0.6	141	168	200	239	286	342	407
0.8	145	172	205	246	295	354	422
1.0	148	176	210	253	304	365	437

<u>1.2</u>	<u>152</u>	<u>180</u>	<u>215</u>	<u>259</u>	<u>313</u>	<u>376</u>	<u>451</u>
<u>1.4</u>	<u>155</u>	<u>184</u>	<u>221</u>	<u>266</u>	<u>321</u>	<u>387</u>	<u>464</u>
<u>1.6</u>	<u>157</u>	<u>189</u>	<u>226</u>	<u>273</u>	<u>329</u>	<u>397</u>	<u>477</u>
<u>1.8</u>	<u>162</u>	<u>193</u>	<u>231</u>	<u>279</u>	<u>338</u>	<u>407</u>	<u>489</u>
<u>2.0</u>	<u>165</u>	<u>197</u>	<u>236</u>	<u>286</u>	<u>346</u>	<u>417</u>	<u>500</u>
<u>2.2</u>	<u>169</u>	<u>201</u>	<u>242</u>	<u>297</u>	<u>353</u>	<u>426</u>	<u>511</u>
<u>2.4</u>	<u>172</u>	<u>205</u>	<u>247</u>	<u>298</u>	<u>361</u>	<u>435</u>	<u>522</u>
<u>2.6</u>	<u>175</u>	<u>209</u>	<u>252</u>	<u>304</u>	<u>368</u>	<u>444</u>	<u>533</u>
<u>2.8</u>	<u>178</u>	<u>213</u>	<u>257</u>	<u>310</u>	<u>375</u>	<u>452</u>	<u>543</u>
<u>3.0</u>	<u>181</u>	<u>217</u>	<u>261</u>	<u>316</u>	<u>382</u>	<u>460</u>	<u>552</u>

TABLE 500.3.  
CT Values for 3-Log Inactivation of *Giardia lamblia* by Free Chlorine at 5°C.

FREE RESIDUAL (mg/L)	pH						
	≤6.0	6.5	7.0	7.5	8.0	8.5	≤9.0
<u>≤0.4</u>	<u>97</u>	<u>117</u>	<u>139</u>	<u>166</u>	<u>198</u>	<u>236</u>	<u>279</u>
<u>0.6</u>	<u>100</u>	<u>120</u>	<u>143</u>	<u>171</u>	<u>204</u>	<u>244</u>	<u>291</u>
<u>0.8</u>	<u>103</u>	<u>122</u>	<u>146</u>	<u>175</u>	<u>210</u>	<u>252</u>	<u>301</u>
<u>1.0</u>	<u>105</u>	<u>125</u>	<u>149</u>	<u>179</u>	<u>216</u>	<u>260</u>	<u>312</u>
<u>1.2</u>	<u>107</u>	<u>127</u>	<u>152</u>	<u>183</u>	<u>221</u>	<u>267</u>	<u>320</u>
<u>1.4</u>	<u>109</u>	<u>130</u>	<u>155</u>	<u>187</u>	<u>227</u>	<u>274</u>	<u>329</u>
<u>1.6</u>	<u>111</u>	<u>132</u>	<u>158</u>	<u>192</u>	<u>232</u>	<u>281</u>	<u>337</u>
<u>1.8</u>	<u>114</u>	<u>135</u>	<u>162</u>	<u>196</u>	<u>238</u>	<u>287</u>	<u>345</u>
<u>2.0</u>	<u>116</u>	<u>138</u>	<u>165</u>	<u>200</u>	<u>243</u>	<u>294</u>	<u>353</u>
<u>2.2</u>	<u>118</u>	<u>140</u>	<u>169</u>	<u>204</u>	<u>248</u>	<u>300</u>	<u>361</u>
<u>2.4</u>	<u>120</u>	<u>143</u>	<u>172</u>	<u>209</u>	<u>253</u>	<u>306</u>	<u>368</u>
<u>2.6</u>	<u>122</u>	<u>146</u>	<u>175</u>	<u>213</u>	<u>258</u>	<u>312</u>	<u>375</u>
<u>2.8</u>	<u>124</u>	<u>148</u>	<u>178</u>	<u>217</u>	<u>263</u>	<u>318</u>	<u>382</u>
<u>3.0</u>	<u>126</u>	<u>151</u>	<u>182</u>	<u>221</u>	<u>268</u>	<u>324</u>	<u>389</u>



**TABLE 500.4.**  
**CT Values for 3-Log Inactivation of Giardia lamblia by Free Chlorine at 10°C.**

FREE RESIDUAL (mg/L)	pH						
	≤6.0	6.5	7.0	7.5	8.0	8.5	≤9.0
≤0.4	73	88	104	125	149	177	209
0.6	75	90	107	128	153	183	218
0.8	78	92	110	131	158	189	226
1.0	79	94	112	134	162	195	234
1.2	80	95	114	137	166	200	240
1.4	82	98	116	140	170	206	247
1.6	83	99	119	144	174	211	253
1.8	86	101	122	147	179	215	259
2.0	87	104	124	150	182	221	265
2.2	89	105	127	153	186	225	271
2.4	90	107	129	157	190	230	276
2.6	92	110	131	160	194	234	281
2.8	93	111	134	163	197	239	287
3.0	95	113	137	166	201	243	292

**TABLE 500.5.**  
**CT Values for 3-Log Inactivation of Giardia lamblia by Free Chlorine at 15°C.**

FREE RESIDUAL (mg/L)	pH						
	≤6.0	6.5	7.0	7.5	8.0	8.5	≤9.0
≤0.4	49	59	70	83	99	118	140
0.6	50	60	72	86	102	122	146
0.8	52	61	73	88	105	126	151
1.0	53	63	75	90	108	130	156
1.2	54	64	76	92	111	134	160
1.4	55	65	78	94	114	137	165
1.6	56	66	79	96	116	141	169

<u>1.8</u>	<u>57</u>	<u>68</u>	<u>81</u>	<u>98</u>	<u>119</u>	<u>144</u>	<u>173</u>
<u>2.0</u>	<u>58</u>	<u>69</u>	<u>83</u>	<u>100</u>	<u>122</u>	<u>147</u>	<u>177</u>
<u>2.2</u>	<u>59</u>	<u>70</u>	<u>85</u>	<u>102</u>	<u>124</u>	<u>150</u>	<u>181</u>
<u>2.4</u>	<u>60</u>	<u>72</u>	<u>86</u>	<u>105</u>	<u>127</u>	<u>153</u>	<u>184</u>
<u>2.6</u>	<u>61</u>	<u>73</u>	<u>88</u>	<u>107</u>	<u>129</u>	<u>156</u>	<u>188</u>
<u>2.8</u>	<u>62</u>	<u>74</u>	<u>89</u>	<u>109</u>	<u>132</u>	<u>159</u>	<u>191</u>
<u>3.0</u>	<u>63</u>	<u>76</u>	<u>91</u>	<u>111</u>	<u>134</u>	<u>162</u>	<u>195</u>

TABLE 500.6.  
CT Values for 3-Log Inactivation of *Giardia lamblia* by Free Chlorine at 20°C.

FREE RESIDUAL (mg/L)	pH						
	≤6.0	6.5	7.0	7.5	8.0	8.5	≤9.0
≤0.4	36	44	52	62	74	89	105
0.6	38	45	54	64	77	92	109
0.8	39	46	55	66	79	95	113
1.0	39	47	56	67	81	98	117
1.2	40	48	57	69	83	100	120
1.4	41	49	58	70	85	103	123
1.6	42	50	59	72	87	105	126
1.8	43	51	61	74	89	108	129
2.0	44	52	62	75	91	110	132
2.2	44	53	63	77	93	113	135
2.4	45	54	65	78	95	115	138
2.6	46	55	66	80	97	117	141
2.8	47	56	67	81	99	119	143
3.0	47	57	68	83	101	122	146

TABLE 500.7.  
CT Values for 3-Log Inactivation of *Giardia lamblia* by Free Chlorine at 25°C and Higher.

	pH
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<u>2</u>	<u>1.4</u>	<u>1.2</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	-
<u>3</u>	<u>2.4</u>	<u>2.2</u>	<u>2.0</u>	<u>1.8</u>	<u>1.6</u>	<u>1.4</u>	<u>1.2</u>	<u>1.0</u>	<u>1.0</u>	-
<u>4</u>	<u>3.4</u>	<u>3.2</u>	<u>3.0</u>	<u>2.8</u>	<u>2.6</u>	<u>2.4</u>	<u>2.2</u>	<u>2.0</u>	<u>2.0</u>	-

TABLE 500.9.

CT Values for Inactivation of *Giardia lamblia* by Chlorine Dioxide, pH 6.0-9.0.

LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	1	2	3	4	5	6	7	8	9
<u>0.5</u>	<u>10.0</u>	<u>8.6</u>	<u>7.2</u>	<u>5.7</u>	<u>4.3</u>	<u>4.2</u>	<u>4.2</u>	<u>4.1</u>	<u>4.1</u>
<u>1</u>	<u>21.0</u>	<u>17.9</u>	<u>14.9</u>	<u>11.8</u>	<u>8.7</u>	<u>8.5</u>	<u>8.3</u>	<u>8.1</u>	<u>7.9</u>
<u>1.5</u>	<u>32.0</u>	<u>27.3</u>	<u>22.5</u>	<u>17.8</u>	<u>13.0</u>	<u>12.8</u>	<u>12.6</u>	<u>12.4</u>	<u>12.2</u>
<u>2</u>	<u>42.0</u>	<u>35.8</u>	<u>29.5</u>	<u>23.3</u>	<u>17.0</u>	<u>16.6</u>	<u>16.2</u>	<u>15.8</u>	<u>15.4</u>
<u>2.5</u>	<u>52.0</u>	<u>44.5</u>	<u>37.0</u>	<u>29.5</u>	<u>22.0</u>	<u>21.4</u>	<u>20.8</u>	<u>20.2</u>	<u>19.6</u>
<u>3</u>	<u>63.0</u>	<u>53.8</u>	<u>44.5</u>	<u>35.3</u>	<u>26.0</u>	<u>25.4</u>	<u>24.8</u>	<u>24.2</u>	<u>23.6</u>
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	10	11	12	13	14	15	16	17	18
<u>0.5</u>	<u>4.0</u>	<u>3.8</u>	<u>3.7</u>	<u>3.5</u>	<u>3.4</u>	<u>3.2</u>	<u>3.1</u>	<u>2.9</u>	<u>2.8</u>
<u>1</u>	<u>7.7</u>	<u>7.4</u>	<u>7.1</u>	<u>6.9</u>	<u>6.6</u>	<u>6.3</u>	<u>6.0</u>	<u>5.8</u>	<u>5.5</u>
<u>1.5</u>	<u>12.0</u>	<u>11.6</u>	<u>11.2</u>	<u>10.8</u>	<u>10.4</u>	<u>10.0</u>	<u>9.5</u>	<u>9.0</u>	<u>8.5</u>
<u>2</u>	<u>15.0</u>	<u>14.6</u>	<u>14.2</u>	<u>13.8</u>	<u>13.4</u>	<u>13.0</u>	<u>12.4</u>	<u>11.8</u>	<u>11.2</u>
<u>2.5</u>	<u>19.0</u>	<u>3.8</u>	<u>3.7</u>	<u>3.5</u>	<u>3.4</u>	<u>3.2</u>	<u>3.1</u>	<u>2.9</u>	<u>2.8</u>
<u>3</u>	<u>23.0</u>	<u>7.4</u>	<u>7.1</u>	<u>6.9</u>	<u>6.6</u>	<u>6.3</u>	<u>6.0</u>	<u>5.8</u>	<u>5.5</u>
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	19	20	21	22	23	24	25	-	-
<u>0.5</u>	<u>2.6</u>	<u>2.5</u>	<u>2.4</u>	<u>2.3</u>	<u>2.2</u>	<u>2.1</u>	<u>2.0</u>	-	-
<u>1</u>	<u>5.3</u>	<u>5.0</u>	<u>4.7</u>	<u>4.5</u>	<u>4.2</u>	<u>4.0</u>	<u>3.7</u>	-	-
<u>1.5</u>	<u>8.0</u>	<u>7.5</u>	<u>7.1</u>	<u>6.7</u>	<u>6.3</u>	<u>5.9</u>	<u>5.5</u>	-	-
<u>2</u>	<u>10.6</u>	<u>10.0</u>	<u>9.5</u>	<u>8.9</u>	<u>8.4</u>	<u>7.8</u>	<u>7.3</u>	-	-
<u>2.5</u>	<u>2.6</u>	<u>2.5</u>	<u>12.2</u>	<u>11.4</u>	<u>10.6</u>	<u>9.8</u>	<u>9.0</u>	-	-
<u>3</u>	<u>5.3</u>	<u>5.0</u>	<u>14.2</u>	<u>13.4</u>	<u>12.6</u>	<u>11.8</u>	<u>11.0</u>	-	-

TABLE 500.10.

CT Values for Inactivation of Virus by Chlorine Dioxide, pH 6.0-9.0.

LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	1	2	3	4	5	6	7	8	9
2	8.4	7.7	7.0	6.3	5.6	5.3	5.0	4.8	4.5
3	25.6	23.5	21.4	19.2	17.1	16.2	15.4	14.5	13.7
4	50.1	45.9	41.8	37.6	33.4	31.7	30.1	28.4	26.8
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	10	11	12	13	14	15	16	17	18
2	4.2	3.9	3.6	3.4	3.1	2.8	2.7	2.5	2.4
3	12.8	12.0	11.1	10.3	9.4	8.6	8.2	7.7	7.3
4	25.1	23.4	21.7	20.1	18.4	16.7	15.9	15.0	14.2
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	19	20	21	22	23	24	25	-	
2	2.2	2.1	2.0	1.8	1.7	1.5	1.4	-	
3	6.8	6.4	6.0	5.6	5.1	4.7	4.3	-	
4	13.3	12.5	11.7	10.9	10.0	9.2	8.4	-	

TABLE 500.11.

CT Values for Inactivation of Giardia lamblia by Chloramines, pH 6.0-9.0.

LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	1	2	3	4	5	6	7	8	9
0.5	635	568	500	433	365	354	343	332	321
1	1,270	1,136	1,003	869	735	711	687	663	639
1.5	1,900	1,700	1,500	1,300	1,100	1,066	1,032	998	964
2	2,535	2,269	2,003	1,736	1,470	1,422	1,374	1,326	1,278
2.5	3,170	2,835	2,500	2,165	1,830	1,772	1,714	1,656	1,598
3	3,800	3,400	3,000	2,600	2,200	2,130	2,060	1,990	1,920
	WATER TEMPERATURE (°C)								

LOG INACTIVATIO N CREDIT	10	11	12	13	14	15	16	17	18
0.5	310	298	286	274	262	250	237	224	211
1	615	592	569	546	523	500	474	448	422
1.5	930	894	858	822	786	750	710	670	630
2	$\frac{1,23}{0}$	$\frac{1,18}{4}$	$\frac{1,13}{8}$	$\frac{1,09}{2}$	$\frac{1,04}{6}$	$\frac{1,00}{0}$	947	894	841
2.5	$\frac{1,54}{0}$	$\frac{1,48}{2}$	$\frac{1,42}{4}$	$\frac{1,36}{6}$	$\frac{1,30}{8}$	$\frac{1,25}{0}$	$\frac{1,18}{3}$	$\frac{1,11}{6}$	$\frac{1,04}{9}$
3	$\frac{1,85}{0}$	$\frac{1,78}{0}$	$\frac{1,71}{0}$	$\frac{1,64}{0}$	$\frac{1,57}{0}$	$\frac{1,50}{0}$	$\frac{1,42}{0}$	$\frac{1,34}{0}$	$\frac{1,26}{0}$
LOG INACTIVATIO N CREDIT	WATER TEMPERATURE (°C)								
	19	20	21	22	23	24	25		
0.5	198	185	173	161	149	137	125		
1	396	370	346	322	298	274	250		
1.5	590	550	515	480	445	410	375		
2	788	735	688	641	594	547	500		
2.5	982	915	857	799	741	683	625		
3	$\frac{1,18}{0}$	$\frac{1,10}{0}$	$\frac{1,03}{0}$	960	890	820	750		

TABLE 500.12.

CT Values for Inactivation of Virus by Chloramines, pH 6.0-9.0.

LOG INACTIVATIO N CREDIT	WATER TEMPERATURE (°C)								
	1	2	3	4	5	6	7	8	9
2	$\frac{1,24}{3}$	$\frac{1,14}{7}$	$\frac{1,05}{0}$	954	857	814	771	729	686
3	$\frac{2,06}{3}$	$\frac{1,90}{3}$	$\frac{1,74}{3}$	$\frac{1,58}{3}$	$\frac{1,42}{3}$	$\frac{1,35}{2}$	$\frac{1,28}{1}$	$\frac{1,20}{9}$	$\frac{1,13}{8}$
4	$\frac{2,88}{3}$	$\frac{2,65}{9}$	$\frac{2,43}{6}$	$\frac{2,21}{2}$	$\frac{1,98}{8}$	$\frac{1,88}{9}$	$\frac{1,78}{9}$	$\frac{1,69}{0}$	$\frac{1,59}{0}$
LOG INACTIVATIO N CREDIT	WATER TEMPERATURE (°C)								
	10	11	12	13	14	15	16	17	18
2	643	600	557	514	471	428	407	385	364

3	<u>1.06</u> <u>7</u>	<u>996</u>	<u>925</u>	<u>854</u>	<u>783</u>	<u>712</u>	<u>676</u>	<u>641</u>	<u>605</u>
4	<u>1.49</u> <u>1</u>	<u>139</u> <u>2</u>	<u>129</u> <u>2</u>	<u>119</u> <u>3</u>	<u>1.09</u> <u>3</u>	<u>994</u>	<u>944</u>	<u>895</u>	<u>845</u>
<u>LOG</u> <u>INACTIVATION</u> <u>CREDIT</u>	<u>WATER TEMPERATURE (°C)</u>								
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	-	-
<u>2</u>	<u>342</u>	<u>321</u>	<u>300</u>	<u>278</u>	<u>257</u>	<u>235</u>	<u>214</u>	-	-
<u>3</u>	<u>570</u>	<u>534</u>	<u>498</u>	<u>463</u>	<u>427</u>	<u>392</u>	<u>356</u>	-	-
<u>4</u>	<u>796</u>	<u>746</u>	<u>696</u>	<u>646</u>	<u>597</u>	<u>547</u>	<u>497</u>	-	-

TABLE 500.13.

CT Values for Inactivation of Giardia lamblia by Ozone.

<u>LOG</u> <u>INACTIVATION</u> <u>CREDIT</u>	<u>WATER TEMPERATURE (°C)</u>								
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
<u>0.5</u>	<u>0.48</u>	<u>0.44</u>	<u>0.40</u>	<u>0.36</u>	<u>0.32</u>	<u>0.30</u>	<u>0.28</u>	<u>0.27</u>	<u>0.25</u>
<u>1</u>	<u>0.97</u>	<u>0.89</u>	<u>0.80</u>	<u>0.72</u>	<u>0.63</u>	<u>0.60</u>	<u>0.57</u>	<u>0.54</u>	<u>0.51</u>
<u>1.5</u>	<u>1.50</u>	<u>1.36</u>	<u>1.23</u>	<u>1.09</u>	<u>0.95</u>	<u>0.90</u>	<u>0.86</u>	<u>0.81</u>	<u>0.77</u>
<u>2</u>	<u>1.90</u>	<u>1.75</u>	<u>1.60</u>	<u>1.45</u>	<u>1.30</u>	<u>1.23</u>	<u>1.16</u>	<u>1.09</u>	<u>1.02</u>
<u>2.5</u>	<u>2.40</u>	<u>2.20</u>	<u>2.00</u>	<u>1.80</u>	<u>1.60</u>	<u>1.52</u>	<u>1.44</u>	<u>1.36</u>	<u>1.28</u>
<u>3</u>	<u>2.90</u>	<u>2.65</u>	<u>2.40</u>	<u>2.15</u>	<u>1.90</u>	<u>1.81</u>	<u>1.71</u>	<u>1.62</u>	<u>1.52</u>
<u>LOG</u> <u>INACTIVATION</u> <u>CREDIT</u>	<u>WATER TEMPERATURE (°C)</u>								
	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>
<u>0.5</u>	<u>0.23</u>	<u>0.22</u>	<u>0.20</u>	<u>0.19</u>	<u>0.17</u>	<u>0.16</u>	<u>0.15</u>	<u>0.14</u>	<u>0.14</u>
<u>1</u>	<u>0.48</u>	<u>0.45</u>	<u>0.42</u>	<u>0.38</u>	<u>0.35</u>	<u>0.32</u>	<u>0.30</u>	<u>0.29</u>	<u>0.27</u>
<u>1.5</u>	<u>0.72</u>	<u>0.67</u>	<u>0.62</u>	<u>0.58</u>	<u>0.53</u>	<u>0.48</u>	<u>0.46</u>	<u>0.43</u>	<u>0.41</u>
<u>2</u>	<u>0.95</u>	<u>0.89</u>	<u>0.82</u>	<u>0.76</u>	<u>0.69</u>	<u>0.63</u>	<u>0.60</u>	<u>0.57</u>	<u>0.54</u>
<u>2.5</u>	<u>1.20</u>	<u>1.12</u>	<u>1.04</u>	<u>0.95</u>	<u>0.87</u>	<u>0.79</u>	<u>0.75</u>	<u>0.71</u>	<u>0.68</u>
<u>3</u>	<u>1.43</u>	<u>1.33</u>	<u>1.24</u>	<u>1.14</u>	<u>1.05</u>	<u>0.95</u>	<u>0.90</u>	<u>0.86</u>	<u>0.81</u>
<u>LOG</u> <u>INACTIVATION</u> <u>CREDIT</u>	<u>WATER TEMPERATURE (°C)</u>								
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	-	-
<u>0.5</u>	<u>0.13</u>	<u>0.12</u>	<u>0.11</u>	<u>0.10</u>	<u>0.10</u>	<u>0.09</u>	<u>0.08</u>	-	-
<u>1</u>	<u>0.26</u>	<u>0.24</u>	<u>0.22</u>	<u>0.21</u>	<u>0.19</u>	<u>0.18</u>	<u>0.16</u>	-	-

<u>1.5</u>	<u>0.38</u>	<u>0.36</u>	<u>0.34</u>	<u>0.31</u>	<u>0.29</u>	<u>0.26</u>	<u>0.24</u>	-	-
<u>2</u>	<u>0.51</u>	<u>0.48</u>	<u>0.45</u>	<u>0.42</u>	<u>0.38</u>	<u>0.35</u>	<u>0.32</u>	-	-
<u>2.5</u>	<u>0.64</u>	<u>0.60</u>	<u>0.56</u>	<u>0.52</u>	<u>0.48</u>	<u>0.44</u>	<u>0.40</u>	-	-
<u>3</u>	<u>0.13</u>	<u>0.12</u>	<u>0.11</u>	<u>0.10</u>	<u>0.10</u>	<u>0.09</u>	<u>0.08</u>		

TABLE 500.14.

CT Values for Inactivation of Virus by Ozone.

LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	1	2	3	4	5	6	7	8	9
<u>2</u>	<u>0.90</u>	<u>0.83</u>	<u>0.75</u>	<u>0.68</u>	<u>0.60</u>	<u>0.58</u>	<u>0.56</u>	<u>0.54</u>	<u>0.52</u>
<u>3</u>	<u>1.40</u>	<u>1.28</u>	<u>1.15</u>	<u>1.03</u>	<u>0.90</u>	<u>0.88</u>	<u>0.86</u>	<u>0.84</u>	<u>0.82</u>
<u>4</u>	<u>1.80</u>	<u>1.65</u>	<u>1.50</u>	<u>1.35</u>	<u>1.20</u>	<u>1.16</u>	<u>1.12</u>	<u>1.08</u>	<u>1.04</u>
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	10	11	12	13	14	15	16	17	18
<u>2</u>	<u>0.50</u>	<u>0.46</u>	<u>0.42</u>	<u>0.38</u>	<u>0.34</u>	<u>0.30</u>	<u>0.29</u>	<u>0.28</u>	<u>0.27</u>
<u>3</u>	<u>0.80</u>	<u>0.74</u>	<u>0.68</u>	<u>0.62</u>	<u>0.56</u>	<u>0.50</u>	<u>0.48</u>	<u>0.46</u>	<u>0.44</u>
<u>4</u>	<u>1.00</u>	<u>0.92</u>	<u>0.84</u>	<u>0.76</u>	<u>0.68</u>	<u>0.60</u>	<u>0.58</u>	<u>0.56</u>	<u>0.54</u>
LOG INACTIVATION CREDIT	WATER TEMPERATURE (°C)								
	19	20	21	22	23	24	25	-	-
<u>2</u>	<u>0.26</u>	<u>0.25</u>	<u>0.23</u>	<u>0.21</u>	<u>0.19</u>	<u>0.17</u>	<u>0.15</u>	-	-
<u>3</u>	<u>0.42</u>	<u>0.40</u>	<u>0.37</u>	<u>0.34</u>	<u>0.31</u>	<u>0.28</u>	<u>0.25</u>	-	-
<u>4</u>	<u>0.52</u>	<u>0.50</u>	<u>0.46</u>	<u>0.42</u>	<u>0.38</u>	<u>0.34</u>	<u>0.30</u>	-	-

TABLE 500.15.

Baffling Classifications.

BAFFLING CONDITION	$T_{10}/T$	BAFFLING DESCRIPTION
<u>Unbaffled (mixed flow)</u>	<u>0.1</u>	<u>None, agitated basin, very low length-to-width ratio, high inlet and outlet flow velocities</u>
<u>Poor</u>	<u>0.3</u>	<u>Single or multiple unbaffled inlets and outlets, no intra-basin baffles</u>
<u>Average</u>	<u>0.5</u>	<u>Baffled inlet or outlet with some intra-basin baffles</u>



<u>Superior</u>	<u>0.7</u>	<u>Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir or perforated launders</u>
<sup>a</sup> At perfect plug flow conditions, T <sub>10</sub> is equal to T.		

**12VAC5-590-505. Emergency management plan for extended power outages.**

A. ~~Each~~The owner of ~~each~~a community waterworks (including consecutive waterworks) shall develop and maintain an emergency management plan for extended power outages.

B. ~~Each~~The plan shall be kept current and shall be ~~kept retained~~at a location that is readily accessible to the owner in the event of an extended power outage.

C. ~~Each~~The owner of ~~each~~a community waterworks shall certify in writing to the ~~appropriate field office of the Office of Drinking Water in the Department of Health~~department that the waterworks plan has ~~been~~ completed such plan.

D. ~~Each~~The plan shall address the following where applicable:

1. Identification of the criteria (events, duration of power outage, etc.) that will initiate activation of the plan.
2. How the ~~community waterworks~~ owner will respond to an extended power outage ~~for~~ lasting a minimum of five days.
3. Procedures for obtaining and distributing potable water in the event that ~~the~~ primary source(s) ~~becomes~~ source or sources become unavailable.
4. Notification procedures and example notices to the public and media (local radio stations, television stations, local newspapers, etc.) including conservation notices and boil water advisories.
5. Emergency disinfection procedures for ~~the~~ distribution ~~system(s)~~system and storage ~~tank(s)~~ tank or tanks.
6. The ~~telephone number of~~ point of contact for the ~~appropriate ODW field office of the Office of Drinking Water in the Virginia Department of Health~~department.
7. The ~~names and telephone numbers of~~ points of contact for the waterworks personnel who should be notified.
8. The ~~name and telephone number of~~ point of contact for the Local Emergency Coordinator designated by the Virginia Department of Emergency Management.
9. The ~~names and telephone numbers of~~ points of contact for the electric power, natural gas, and propane distributors, or other energy supplier to the waterworks.

**12VAC5-590-510. Acceptable operating practices.**

A. This section is not intended to be all inclusive but reflects the concern for the public health significance of certain practices related to ~~treatment plant~~ waterworks operation.

~~B. Waterworks designed for bacteria and turbidity removal shall not be operated without adequate chemical coagulation as determined by the division.~~

B. Filter operation.

1. Gravity flow granular media filters designed for pathogen and turbidity removal shall not be operated without adequate chemical coagulation as determined by the commissionerdepartment

~~2. A Waterworks-waterworks utilizing gravity flow granular media filtration shall not vary the rate of filtration through any single filter above its design capacity unless approved by the commissionerdepartment.~~

~~3. Gravity flow granular media filters equipped with filter-to-waste facilities shall not be returned to service after backwashing until a thorough rinsing period has occurred so that the filter-to-waste water has a turbidity less than or equal to 0.3 NTU.~~

~~4. All micro-microfiltration and ultra-filtration ultrafiltration technologies employed for pathogen removal shall demonstrate removal efficiency equal to the removal (log inactivation) credit given in Table 500.1 in 12VAC5-590-500 C 2. A direct integrity test acceptable to the commissioner-department shall be conducted and include the following:~~

~~a. The direct integrity test capability shall be provided for each filter unit, and~~

~~b. The direct integrity test shall be conducted at least daily for each day the filtration unit is in operation.~~

~~C. Waterworks utilizing filtration in the treatment process shall not vary the rate of filtration through any single filtering unit above its design capacity unless approved by the division.~~

~~D. Filtering units equipped with rewash facilities shall not be returned to service after backwashing until being thoroughly rewash.~~

~~E. C. All waterworks shall provide a minimum working pressure of 20 psi-gauge (psig) at all service connections.~~

~~D. The board recommends that all community waterworks in the Commonwealth deliver the optimum fluoride ion concentration, as determined by the U.S. Department of Health and Human Services.~~

~~E. At least 90 days before permanently ceasing operation of a fluoride feed system, or as soon as practical, a waterworks owner shall provide written notice to the commissioner of the intent to discontinue fluoridation at the waterworks.~~

~~E. As soon as practical, a waterworks owner the owner of a community waterworks shall provide written notice to the commissioner about the intent to permanently cease a program to deliver the optimum fluoride ion concentration to the waterworks' consumers.~~

#### **12VAC5-590-515. Use of chemicals.**

~~A. All chemicals used in water treatment shall be compliant with NSF/ANSI Standard 60. These chemicals shall include, but are not limited to the following:~~

~~1. Corrosion and scale inhibitors;~~

~~2. Coagulants and flocculants;~~

~~3. Disinfectants and oxidants;~~

~~4. pH adjustment chemicals;~~

~~5. Regenerate-Regenerating agents; and~~

~~6. Membrane cleaning compounds.~~

~~B. Chemical containers shall bear ~~a-the~~ proper certification ~~ark-mark~~ and identification consistent with the Safety Data Sheet for the chemical used.~~

~~C. The owner shall maintain documentation verifying that all chemicals meet NSF/ANSI Standard 60 certification requirements.~~

#### **12VAC5-590-520. Waterworks expansion capacity.**

~~A. At such time as the water production of a community waterworks reaches 80% of the rated capacity of the waterworks for any consecutive three-month period, the owner shall cause plans and specifications to be developed for expansion of the waterworks to include a schedule for construction; however, if it can be shown by the owner that growth within the service area is limited~~

and will not exceed the rated capacity of the waterworks or if unusual transient conditions caused production to reach the 80% level, preparation of plans and specifications for expansion will no longer be required.

A. When the water production of a community waterworks reaches 80% of the permitted capacity for any consecutive three-month period, the owner shall prepare and submit a written plan within 30 days of notification by the department to address capacity needs. This plan shall be evaluated by the department and corrective actions shall be approved by the commissioner.

~~B. All waterworks shall provide metering of total water production.~~

B. The commissioner may require the owner to reevaluate a well the source water capacity of a well by conducting a yield and drawdown test in accordance with 12VAC5-590-840 H when the well has demonstrated declining yield.

#### **12VAC5-590-530. Reporting.**

A. The results of any all required monitoring activity shall be reported by the owner (or their authorized agent) to the ODW department no later than (i) the 10th day of the month following the month during which the test results were received, or (ii) the 10th day following the end of the monitoring period, whichever is shorter, unless stipulated otherwise by the commissioner department. The results of any required monitoring activity shall be reported by the owner (or their authorized agent) in a format and method prescribed by the commissioner department. For routine compliance samples analyzed for contaminants listed in Tables 340.1 through Table 340.7, the owner shall request that the certified analytical laboratory performing the analyses provide the data electronically to the department as per the requirements of this section.

B. It shall be the duty and responsibility of an owner to report to the ODW department in the most expeditious manner (usually by telephone) under the following circumstances. If it is done by telephone a confirming report shall be mailed for circumstances identified in subsections C through J of this section. The owner shall Contact-contact the department for the acceptable notification method. The official laboratory data report shall be sent to the department as soon as practical.

#### 4. C. Bacteriological examination reporting.

~~a. 1.~~ When a bacteriological examination shows that samples are required (see 12VAC5-590-380 D), the owner shall collect the repeat samples within 24 hours of being notified of the positive result and shall report the repeat sample results to the appropriate ODW field office department.

~~b. 2.~~ Microbial contamination, as evidenced by one or more routine distribution system water samples indicating the presence of E. coli or waterborne pathogens, shall be reported by the owner to the appropriate ODW field office department by the end of the day when the owner was notified of the test result, unless ODW's field office the department is closed, in which case ODW the department shall be notified before the end of the next business day.

~~c. 3.~~ An E. coli PMCL violation shall be reported by the owner to the appropriate ODW field office department by the end of the day when the owner was notified of the test result, unless the ODW field office department is closed, in which case ODW the department shall be notified before the end of the next business day.

~~d. 4.~~ Any An owner who has failed to comply with the monitoring requirements of 12VAC5-590-370 shall report the monitoring violation to the appropriate ODW field office department in writing within 10 days after the owner discovers the violation and shall notify the public in accordance with 12VAC5-590-540 A 3.

~~2.~~ When the daily average of turbidity testing exceeds 5.0 NTU a report shall be made within 48 hours

D. Turbidity reporting. For a waterworks required to filter for pathogen and turbidity removal, a report shall be made within 24 hours to the department if the filtered water turbidity measurement exceeds the following concentrations based on the filtration treatment type:

1. Conventional filtration - one NTU.
2. Diatomaceous earth filtration - five NTU.
3. Slow sand filtration - five NTU.
4. Membrane, bag, and cartridge ~~filters~~ filtration - one NTU.

E. PMCL exceedance.

~~3.~~ 1. When a PMCL of an inorganic or organic chemical is exceeded for a single sample, the owner shall report ~~same~~ the exceedance within seven days. If ~~any one~~ a sample result would cause the compliance average to be exceeded, then the owner shall report ~~same~~ in the sample result, in context with the compliance average, to the department within 48 hours.

4. 2. When the average value of the samples collected pursuant to ~~12VAC5-590-410~~ 12VAC5-590-382 and 12VAC5-590-383 exceeds the PMCL of ~~any organic inorganic or inorganic organic~~ chemical, the owner shall report ~~same~~ the exceedance to the department within 48 hours.

~~5.~~ 3. When the ~~maximum contaminant level~~ PMCL for a radionuclides has been exceeded as determined by Table ~~2-5~~ 340.4, the results shall be reported to the department within 48 hours.

~~6.~~ F. The owner shall report to the ~~district engineer~~ department within 48 hours of the failure to comply with the monitoring and sanitary survey requirements of this chapter.

~~7.~~ G. The owner shall report to the ~~district engineer~~ department within 48 hours of the failure to comply with the requirements of ~~any~~ the schedule prescribed pursuant to a variance or exemption.

~~8.~~ H. The owner shall report a Tier 1 violation or situation, as described in 12VAC5-590-540 A 1, to the ~~district engineer~~ department as soon as practical, but no later than 24 hours after the owner learns of the Tier 1 violation or situation. At the same time the report is made, the owner shall consult with the ~~field office~~ department to determine the need for any additional actions to address the violation or situation.

~~9.~~ The owner shall report a violation of treatment technique requirement resulting from a single exceedance of the maximum allowable turbidity limit, as described in 12VAC5-590-420 B 2 a (2), B 2 a (3), B 2 b (2), B 2 c (2), and B 2 d, to the district engineer as soon as practical, but no later than 24 hours after the owner learns of the violation. At the same time the report is made, the owner shall consult with the field office to determine the need for any additional actions to address the violation or situation.

~~C.~~ I. Reporting requirements for coliform treatment technique violations.

1. Any owner who has violated the treatment technique required in 12VAC5-590-392 B shall report the violation to the ~~appropriate ODW field office~~ department no later than the end of the next business day after learning of the violation and shall notify the public in accordance with 12VAC5-590-540 A 2.

2. Any owner who is required to conduct an assessment under 12VAC5-590-392 C shall submit the assessment report within 30 days to the ~~appropriate ODW field office~~ department.

3. The owner shall notify the ~~appropriate ODW field office~~ department in writing after each scheduled corrective action is completed for corrections that were not completed by the

time of submission of the assessment form under the requirements of 12VAC5-590-392 C.

~~D. J. The owner of a seasonal waterworks shall submit the certification of completion of the approved start-up procedure on a form approved by to the commissioner department prior to before serving water on a form approved by the department.~~

~~E. Reporting requirements for filtration treatment and disinfection treatment.~~

~~1. The owner of a waterworks that provides filtration treatment shall report monthly to the commissioner the following specified information beginning June 29, 1993, or when filtration is installed, whichever is later.~~

~~a. Turbidity measurements as required by 12VAC5-590-370 B 7 a shall be reported within 10 days after the end of each month the waterworks serves water to the public. Information that shall be reported includes:~~

~~(1) The total number of filtered water turbidity measurements taken during the month.~~

~~(2) The number and percentage of filtered water turbidity measurements taken during the month which are less than or equal to the turbidity limits specified in 12VAC5-590-420 B 2 for the filtration technology being used.~~

~~(3) The date and value of any turbidity measurements taken during the month which exceed 5.0 NTU.~~

~~b. The owner of a waterworks using surface water or groundwater under the direct influence of surface water that provides conventional filtration treatment or direct filtration shall report monthly to the commissioner the information specified in subdivisions E 1 a (1) and (2) of this section. Also, the owner of a waterworks that provides filtration approved under 12VAC5-590-420 B 2 d shall report monthly to the commissioner the information specified in subdivision E 1 a (1) of this section.~~

~~(1) Turbidity measurements as required by 12VAC5-590-420 B 2 a (3) shall be reported within 10 days after the end of each month the system serves water to the public. Information that shall be reported includes:~~

~~(a) The total number of filtered water turbidity measurements taken during the month.~~

~~(b) The number and percentage of filtered water turbidity measurements taken during the month that are less than or equal to the turbidity limits specified in 12VAC5-590-420 B 2 a (3) or 12VAC5-590-420 B 2 d.~~

~~(c) The date and value of any turbidity measurements taken during the month that exceed 1.0 NTU for systems using conventional filtration treatment or direct filtration, or that exceed the maximum level set by the commissioner under 12VAC590-420 B 2 d.~~

~~(2) The owner shall maintain the results of individual filter monitoring taken under 12VAC5-590-370 B 7 b (1) for at least three years. The owner shall report that he has conducted individual filter turbidity monitoring under 12VAC5-590-370 B 7 b (1) within 10 days after the end of each month the waterworks serves water to the public. Owners shall report individual filter turbidity measurement results taken under 12VAC5-590-370 B 7 b (1) within 10 days after the end of each month the waterworks serves water to the public only if measurements demonstrate one or more of the conditions in subdivisions E 1 b (2) (a) or (b) of this section. The owners of waterworks that use lime softening may apply to the commissioner for alternative exceedance levels for the levels specified in subdivisions E 1 b (2) (a) or (b) of this section if they can demonstrate that higher turbidity levels in individual filters are due to lime carryover only and not due to degraded filter performance.~~

(a) For waterworks serving 10,000 or more people:

(i) For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the owner shall either produce a filter profile for the filter within seven days of the exceedance (if the owner is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

(ii) For any individual filter that has a measured turbidity level of greater than 0.5 NTU in two consecutive measurements taken 15 minutes apart at the end of the first four hours of continuous filter operation after the filter has been backwashed or otherwise taken offline, the owner shall report the filter number, the turbidity, and the date, or dates, on which the exceedance occurred. In addition, the owner shall either produce a filter profile for the filter within seven days of the exceedance (if the owner is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

(iii) For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of three consecutive months, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the owner shall conduct a self-assessment of the filter within 14 days of the exceedance and report that the self-assessment was conducted. The self-assessment shall consist of at least the following components: assessment of filter performance; development of a filter profile; identification and prioritization of factors limiting filter performance; assessment of the applicability of corrections; and preparation of a filter self-assessment report.

(iv) For any individual filter that has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of two consecutive months, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the owner shall arrange for the conduct of a comprehensive performance evaluation by the commissioner or a third party approved by the commissioner no later than 30 days following the exceedance and have the evaluation completed and submitted to the commissioner no later than 90 days following the exceedance.

(b) For waterworks serving less than 10,000 people:

(i) For any individual filter (or the turbidity of combined filter effluent for systems with two filters that monitor combined filter effluent in lieu of individual filters) that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart, the owner shall report the filter number(s), the turbidity measurement(s), and the date, or dates, on which the exceedance occurred and the cause (if known) for the exceedance(s).

(ii) For any individual filter (or the turbidity of combined filter effluent for systems with two filters that monitor combined filter effluent in lieu of individual filters) that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of three consecutive months, the owner shall conduct a self-assessment of the filter(s) within 14 days of the day the filter exceeded 1.0 NTU unless a comprehensive performance evaluation as specified in clause (iii) of this subdivision was required. Owners of waterworks with two filters that monitor the combined filter effluent in lieu of individual filters shall conduct a self

assessment on both filters. The self-assessment shall be reported to the commissioner and consist of at least the following components: date self-assessment was triggered; date the self-assessment was completed; assessment of filter performance; development of a filter profile; identification and prioritization of factors limiting filter performance; assessment of the applicability of corrections; and preparation of a filter self-assessment report. The self-assessment shall be submitted within 10 days after the end of the month or 14 days after the self-assessment was triggered only if it was triggered during the last four days of the month.

(iii) For any individual filter (or the turbidity of combined filter effluent for systems with two filters that monitor combined filter effluent in lieu of individual filters) that has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of two consecutive months, the owner shall arrange for a comprehensive performance evaluation by the commissioner or a third party approved by the commissioner no later than 60 days following the day the filter exceeded 2.0 NTU in two consecutive months. The owner shall report within 10 days after the end of the month that a comprehensive performance evaluation is required and the date that it was triggered. If a comprehensive performance evaluation has been completed by the commissioner or a third party approved by the commissioner within the 12 prior months or the owner and the commissioner are jointly participating in an ongoing Comprehensive Technical Assistance project at the waterworks, a new comprehensive performance evaluation is not required. If conducted, a comprehensive performance evaluation shall be completed and submitted to the commissioner no later than 120 days following the day the filter exceeded 2.0 NTU in two consecutive measurements for the second straight month.

c. Reporting source water monitoring results.

(1) Owners shall report results from the source water monitoring required in 12VAC5-590-420 B 3 a no later than 10 days after the end of the first month following the month when the sample is collected.

(2) Owners shall report the applicable information in subdivisions (a) and (b) as follows for the source water monitoring required in 12VAC5-590-420 B 3 a.

(a) Owners shall report the following data elements for each Cryptosporidium analysis:

Data element
PWS ID
Facility ID
Sample collection date
Sample type (field or matrix spike)
Sample volume filtered (L), to nearest ¼ L
Was 100% of filtered volume examined
Number of oocysts counted

(i) For matrix spike samples, the owner shall also report the sample volume spiked and estimated number of oocysts spiked. These data are not required for field samples.

(ii) For samples in which less than 10 L is filtered or less than 100% of the sample volume is examined, the owner shall also report the number of filters used and the packed pellet volume.

(iii) For samples in which less than 100% of sample volume is examined, the owner shall also report the volume of resuspended concentrate and volume of this resuspension processed through immunomagnetic separation.

(b) Owners shall report the following data elements for each E. coli analysis:

Data element
1. PWS ID
2. Facility ID
3. Sample collection date
4. Analytical method number
5. Method type
6. Source type (flowing stream, lake/reservoir, GUDI)
7. E. coli/100 mL
8. Turbidity <sup>a</sup>

<sup>a</sup>Owners of waterworks serving fewer than 10,000 people that are not required to monitor for turbidity under in 12VAC5-590-420 B 3 a are not required to report turbidity with their E. coli results.

2. Disinfection information specified below shall be reported to the district engineer within 10 days after the end of each month the waterworks serves water to the public. Information that shall be reported includes:

- a. For each day, the lowest measurement of residual disinfectant concentration in mg/L in water entering the distribution system.
- b. The date and duration of each period when the residual disinfectant concentration in water entering the distribution system fell below 0.2 mg/L and when the district engineer was notified of the occurrence.
- c. The following information on the samples taken in the distribution system in conjunction with total coliform monitoring pursuant to 12VAC5-590-420 B.
  - (1) Number of instances where the residual disinfectant concentration is measured;
  - (2) Number of instances where the residual disinfectant concentration is not measured but HPC is measured;
  - (3) Number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;
  - (4) Number of instances where no residual disinfectant concentration is detected and where HPC is greater than 500/mL;
  - (5) Number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL;
  - (6) For the current and previous month the system serves water to the public, the value of "V" in percent in the following formula:

$$V = \frac{c + d + e}{c + d + e} \times 100$$



a + b

a = the value in subdivision E 2 c (1) of this section

b = the value in subdivision E 2 c (2) of this section

c = the value in subdivision E 2 c (3) of this section

d = the value in subdivision E 2 c (4) of this section

e = the value in subdivision E 2 c (5) of this section

(7) If the division determines, based on site specific considerations, that a waterworks owner has no means for having a sample transported and analyzed for HPC by a certified laboratory within the requisite time and temperature conditions and that the waterworks is providing adequate disinfection in the distribution system, the requirements of subdivision E 2 c (1) through (6) of this section do not apply.

d. An owner need not report the data listed in subdivision E 2 a of this section if all data listed in subdivisions E 2 a through c of this section remain on file at the waterworks and the commissioner determines that the owner has submitted all of the information required by subdivisions E 2 a through c of this section for the last 12 months.

3. If at any time the chlorine residual falls below 0.2 mg/L in the water entering the distribution system, the owner shall notify the district engineer as soon as possible, but no later than by the end of the next business day. The owner also shall notify the district engineer by the end of the next business day whether or not the residual was restored to at least 0.2 mg/L within four hours.

F. Reporting requirements for lead and copper. All owners shall report all of the following information to the district engineer in accordance with this subsection.

1. Reporting requirements for tap water monitoring for lead and copper and for water quality parameter monitoring.

a. Except as provided in subdivision F 1 a (7) of this section, an owner shall report the information specified below for all tap water samples specified in 12VAC5-590-375 B and for all water quality parameter samples specified in 12VAC5-590-375 C within the first 10 days following the end of each applicable monitoring period specified in 12VAC5-590-375 B and 12VAC5-590-375 C (i.e., every six months, annually, every three years, or every nine years). For monitoring periods with a duration less than six months, the end of the monitoring period is the last date samples can be collected during the period as specified in 12VAC5-590-375 B and C.

(1) The results of all tap samples for lead and copper including location or a location site code and the criteria under 12VAC5-590-375 B 1 c through 12VAC5-590-375 B 1 f or 12VAC5-590-375 C under which the site was selected for the waterworks' sampling pool.

(2) Documentation for each tap water lead or copper sample for which the owner requests invalidation pursuant to 12VAC5-590-375 B 6.

(3) The 90th percentile lead and copper concentrations measured from among all lead and copper tap water samples collected during each monitoring period (calculated in accordance with 12VAC5-590-385 C) unless the district engineer calculates the 90th percentile lead and copper levels under subdivision F 8 of this section.

(4) With the exception of initial tap sampling conducted pursuant to 12VAC5-590-375 B 4 a, the owner shall designate any site that was not sampled during previous monitoring periods, and include an explanation of why sampling sites have changed.

~~(5) The results of all tap samples for pH, and where applicable, alkalinity, calcium, conductivity, temperature, and orthophosphate or silica collected under 12VAC5-590-375 C 2 through 12VAC5-590-375 C 5.~~

~~(6) The results of all samples collected at the entry point(s) to the distribution system for applicable water quality parameters under 12VAC5-590-375 C 2 through 12VAC5-590-375 C 5.~~

~~(7) The owner shall report the results of all water quality parameter samples collected under 12VAC5-590-375 C 3 through 12VAC5-590-375 C 6 during each six month monitoring period specified in 12VAC5-590-375 C 4 within the first ten days following the end of the monitoring period unless the commissioner has specified a more frequent reporting requirement.~~

~~b. The owner of a nontransient noncommunity waterworks, or a community waterworks meeting the criteria of 12VAC5-590-405 D 2 c, that does not have enough taps that can provide first draw samples, must either:~~

~~(1) Provide written documentation to the commissioner identifying standing times and locations for enough non first draw samples to make up the sampling pool under 12VAC5-590-375 B 2 e by the start of the first applicable monitoring period under 12VAC5-590-375 B 4, unless the commissioner has waived prior approval of non first draw sample sites selected by the owner pursuant to 12VAC5-590-375 B 2 e; or~~

~~(2) If the commissioner has waived prior approval of non first draw sample sites selected by the owner, identify, in writing, each site that did not meet the six hour minimum standing time and the length of standing time for that particular substitute sample collected pursuant to 12VAC5-590-375 B 2 e and include this information with the lead and copper sample results required to be submitted pursuant to subdivision F 1 a (1) of this section.~~

~~c. At a time specified by the commissioner, or if no specific time is designated by the commissioner, then as early as possible prior to the addition of a new source or any long term change in water treatment, an owner deemed to have optimized corrosion control under 12VAC5-590-405 A 2 b (3); an owner subject to reduced monitoring pursuant to 12VAC5-590-375 B 4 d; or an owner subject to a monitoring waiver pursuant to 12VAC5-590-375 B 7, shall submit written documentation to the district engineer describing the change or addition. The district engineer must review and the commissioner must approve the addition of a new source or a long term change in treatment before it is implemented by the owner. Examples of long term treatment changes include the addition of a new treatment process or modification of an existing treatment process. Examples of modification include switching secondary disinfectants, switching coagulants (e.g., alum to ferric chloride), switching corrosion inhibitor products (e.g., orthophosphate to blended phosphate). Long term changes can include dose changes to existing chemicals if the waterworks is planning long term changes to its finished water pH or residual inhibitor concentration. Long term treatment changes would not include chemical dose fluctuations associated with daily raw water quality changes.~~

~~d. The owner of any small waterworks applying for a monitoring waiver under 12VAC5-590-375 B 7 or subject to a waiver granted pursuant to 12VAC5-590-375 B 7 c, shall provide the following information to the commissioner in writing by the specified deadline:~~

~~(1) By the start of the first applicable monitoring period in 12VAC5-590-375 B 4, the owner of any small waterworks applying for a monitoring waiver shall provide the~~

documentation required to demonstrate that it meets the waiver criteria of 12VAC5-590-375 B 7 a and 12VAC5-590-375 B 7 b.

~~(2) No later than nine years after the monitoring previously conducted pursuant to 12VAC5-590-375 B 7 b or 12VAC5-590-375 B 7 d (1), the owner of each small waterworks desiring to maintain its monitoring waiver shall provide the information required by 12VAC5-590-375 B 7 d (1) and 12VAC5-590-375 B 7 d (2).~~

~~(3) No later than 60 days after becoming aware that it is no longer free of lead-containing or copper-containing material, the owner of each small waterworks with a monitoring waiver shall provide written notification to the district engineer, setting forth the circumstances resulting in the lead-containing or copper-containing materials being introduced into the waterworks and what corrective action, if any, the owner plans to take to remove these materials.~~

~~e. The owner of each groundwater source waterworks that limits water quality parameter monitoring to a subset of entry points under 12VAC5-590-375 C 3 c shall provide, by the commencement of such monitoring, written correspondence to the district engineer that identifies the selected entry points and includes information sufficient to demonstrate that the sites are representative of water quality and treatment conditions throughout the waterworks.~~

~~2. Water supply (source water) monitoring reporting requirements.~~

~~a. An owner shall report the sampling results for all source water samples collected in accordance with 12VAC5-590-375 D within the first 10 days following the end of each source water monitoring period (i.e., annually, per compliance period, per compliance cycle) specified in 12VAC5-590-375 D.~~

~~b. With the exception of the first round of source water sampling conducted pursuant to 12VAC5-590-375 D 2, the owner shall specify any site which was not sampled during previous monitoring periods, and include an explanation of why the sampling point has changed.~~

~~3. Corrosion control treatment reporting requirements. By the applicable dates under 12VAC5-590-405 A 2 a, owners shall report the following information:~~

~~a. For owners demonstrating that they have already optimized corrosion control, information required in 12VAC5-590-405 A 2 b (2) or 12VAC5-590-405 A 2 b (3).~~

~~b. For owners required to optimize corrosion control, the owner's recommendation regarding optimal corrosion control treatment under 12VAC5-590-405 A 1 a.~~

~~c. For owners required to evaluate the effectiveness of corrosion control treatments under 12VAC5-590-405 A 1 c, the information required by that subdivision.~~

~~d. For owners required to install optimal corrosion control designated by the commissioner under 12VAC5-590-405 A 1 d, a letter certifying that the owner has completed installing that treatment.~~

~~4. Water supply source water treatment reporting requirements. By the applicable dates in 12VAC5-590-405 B, owners shall provide the following information to the district engineer:~~

~~a. If required under 12VAC5-590-405 B 2 a, the owner's recommendation regarding source water treatment;~~

~~b. For owners required to install source water treatment under 12VAC5-590-405 B 2 b, a letter certifying that the owner has completed installing the treatment designated by the commissioner within 24 months after the commissioner designated the treatment.~~

5. Lead service line replacement reporting requirements. Owners shall report the following information to the district engineer to demonstrate compliance with the requirements of 12VAC5-590-405 C:

a. No later than 12 months after the end of a monitoring period in which a waterworks exceeds the lead action level in sampling referred to in 12VAC5-590-405 C 1, the owner shall submit written documentation to the district engineer of the materials evaluation conducted as required in 12VAC5-590-375 B 1, to identify the initial number of lead service lines in the distribution system at the time the waterworks exceeds the lead action level, and provide the owner's schedule for annually replacing at least 7.0% of the initial number of lead service lines in its distribution system.

b. No later than 12 months after the end of a monitoring period in which a waterworks exceeds the lead action level in sampling referred to in 12VAC5-590-405 C 1, and every 12 months thereafter, the owner shall demonstrate to the district engineer in writing that the owner has either:

(1) Replaced in the previous 12 months at least 7.0% of the initial lead service lines (or a greater number of lines specified by the commissioner under 12VAC5-590-405 C 6) in the distribution system, or

(2) Conducted sampling that demonstrates that the lead concentration in all service line samples from an individual line(s), taken pursuant to 12VAC5-590-375 B 2 c, is less than or equal to 0.015 mg/L. In such cases, the total number of lines replaced and/or which meet the criteria in 12VAC5-590-405 C 4 shall equal at least 7.0% of the initial number of lead lines identified under subdivision F 5 a of this section (or the percentage specified by the commissioner under 12VAC5-590-405 C 6).

c. The annual letter submitted to the district engineer under subdivision F 5 b of this section shall contain the following information:

(1) The number of lead service lines scheduled to be replaced during the previous year of the waterworks' replacement schedule;

(2) The number and location of each lead service line replaced during the previous year of the waterworks' replacement schedule;

(3) If measured, the water lead concentration and location of each lead service line sampled, the sampling method, and the date of sampling.

d. The owner of any waterworks that collects lead service line samples following partial lead service line replacement required by 12VAC5-590-405 C shall report the results to the district engineer within the first ten days of the month following the month in which the owner receives the laboratory results, or as specified by the commissioner. Owners shall also report any additional information as specified by the commissioner, and in a time and manner prescribed by the commissioner, to verify that all partial lead service line replacement activities have taken place.

6. Public education program reporting requirements. Owners shall report the following information to the district engineer to demonstrate compliance with the requirements of 12VAC5-590-405 D:

a. The owner of any waterworks that is subject to the public education requirements in 12VAC5-590-405 D shall, within 10 days after the end of each period in which the owner is required to perform public education tasks in accordance with 12VAC5-590-405 D 2, send written notice to the district engineer that contains:

(1) A demonstration that the owner has delivered the public education materials that meet the content requirements of 12VAC5-590-405 D 1 and the delivery requirements of 12VAC5-590-405 D 2, and

~~(2) A list of all the newspapers, radio stations, television stations, and facilities and organizations to which the owner delivered public education materials during the period in which the owner was required to perform public education tasks.~~

~~b. Unless required by the commissioner, an owner who previously has submitted the information required by subdivision F 6 a (2) of this section need not resubmit the information required by subdivision F 6 a (2) of this section, as long as there has been no changes in the distribution list and the owner certifies that the public education materials were distributed to the same list submitted previously.~~

~~c. No later than three months following the end of the monitoring period, the owner shall mail a sample copy of the consumer notification of tap results to the district engineer along with a certification that the notification has been distributed in a manner consistent with the requirements of 12VAC5-590-405 D 4.~~

~~7. Reporting of additional monitoring data. The owner of any waterworks which collects sampling data in addition to that required by 12VAC5-590-375 shall report the results to the district engineer within the first 10 days following the end of the applicable monitoring period under 12VAC5-590-375 B, 12VAC5-590-375 C, and 12VAC5-590-375 D during which the samples are collected.~~

~~8. Reporting of the 90th percentile lead and copper concentrations where the district engineer calculates a waterworks' 90th percentile concentrations. An owner is not required to report the 90th percentile lead and copper concentrations measured from among all lead and copper tap samples collected during each monitoring period, as required by subdivision F 1 a (4) of this section if:~~

~~a. The commissioner has previously notified the owner that the district engineer will calculate the waterworks' 90th percentile lead and copper concentrations, based on the lead and copper tap results submitted pursuant to subdivision F 8 b (1) of this section, and has specified a date before the end of the applicable monitoring period by which the owner shall provide the results of the lead and copper tap water samples;~~

~~b. The owner has provided the following information to the district engineer by the date specified in subdivision F 8 a of this section:~~

~~(1) The results of all tap samples for lead and copper including the location of each site and the criteria under 12VAC5-590-375 B 1 c through 12VAC5-590-375 B 1 f or 12VAC5-590-375 B 1 g under which the site was selected for the waterworks sampling pool, pursuant to subdivision F 1 a (1) of this section;~~

~~(2) An identification of sampling sites utilized during the current monitoring period that were not sampled during the previous monitoring periods, and an explanation why sampling sites have changed; and~~

~~(3) The district engineer has provided the results of the 90th percentile lead and copper calculations, in writing, to the owner before the end of the monitoring period.~~

~~G. Reporting requirements for disinfection byproducts. Owners shall report the following information in accordance with subsection A of this section. (The district engineer may choose to perform calculations and determine whether the PMCL was violated, in lieu of having the owner report that information):~~

~~1. Running Annual Average Reporting:~~

~~a. The owner of a waterworks monitoring for TTHM and HAA5 under the requirements of 12VAC5-590-370 B 3 e (1) on a quarterly or more frequent basis shall report:~~

~~(1) The number of samples taken during the last quarter.~~

~~(2) The location, date, and result of each sample taken during the last quarter.~~

- (3) The arithmetic average of all samples taken in the last quarter.
- (4) The annual arithmetic average of the quarterly arithmetic averages of this section for the last four quarters.
- (5) Whether, based on 12VAC5-590-410 C 2 b (1) (a), the PMCL was violated.
- b. The owner of a waterworks monitoring for TTHMs and HAA5 under the requirements of 12VAC5-590-370 B 3 e (1) less frequently than quarterly (but at least annually) shall report:
  - (1) The number of samples taken during the last year.
  - (2) The location, date, and result of each sample taken during the last monitoring period.
  - (3) The arithmetic average of all samples taken over the last year.
  - (4) Whether, based on 12VAC5-590-410 C 2 b (1) (a) the PMCL was violated.
- c. The owner of a waterworks monitoring for TTHMs and HAA5 under the requirements of 12VAC5-590-370 B 3 e (1) less frequently than annually shall report:
  - (1) The location, date, and result of the last sample taken.
  - (2) Whether, based on 12VAC5-590-410 C 2 b (1) (a), the PMCL was violated.

2. Locational Running Annual Average (LRAA) Reporting:

- a. Owners shall report the following information for each monitoring location to the commissioner:
  - (1) Number of samples taken during the last quarter.
  - (2) Date and results of each sample taken during the last quarter.
  - (3) Arithmetic average of quarterly results for the last four quarters for each LRAA, beginning at the end of the fourth calendar quarter that follows the compliance date and at the end of each subsequent quarter. If the LRAA calculated based on fewer than four quarters of data would cause the PMCL to be exceeded regardless of the monitoring results of subsequent quarters, the owner shall report this information to the commissioner as part of the first report due following the compliance date or anytime thereafter that this determination is made. If the owner is required to conduct monitoring at a frequency that is less than quarterly, the owner shall make compliance calculations beginning with the first compliance sample taken after the compliance date, unless the owner is required to conduct increased monitoring under 12VAC5-590-370 B 3 e (3) (g).
  - (4) Whether, based on Table 2.13, the PMCL was violated at any monitoring location.
  - (5) Any operational evaluation levels, under 12VAC5-590-410 C 2 b (1) (b) (iv), that were exceeded during the quarter and, if so, the location and date, and the calculated TTHM and HAA5 levels.
- b. Owners of waterworks using surface water or GUDI seeking to qualify for or remain on reduced TTHM/HAA5 monitoring shall report the following source water TOC information for each treatment plant that treats surface water or ground water under the direct influence of surface water to the commissioner within 10 days of the end of any quarter in which monitoring is required:
  - (1) The number of source water TOC samples taken each month during last quarter.
  - (2) The date and result of each sample taken during last quarter.
  - (3) The quarterly average of monthly samples taken during last quarter or the result of the quarterly sample.

~~(4) The running annual average (RAA) of quarterly averages from the past four quarters.~~

~~(5) Whether the RAA exceeded 4.0 mg/L.~~

~~3. The owner of a waterworks monitoring for chlorite under the requirements of 12VAC5-590-370 B 3 f shall report:~~

~~a. The number of entry point samples taken each month for the last three months.~~

~~b. The location, date, and result of each sample (both entry point and distribution system) taken during the last quarter.~~

~~c. For each month in the reporting period, the arithmetic average of all samples taken in each three sample set taken in the distribution system.~~

~~d. Whether, based on 12VAC5-590-410 C 2 b, the PMCL was violated, in which month and how many times it was violated each month.~~

~~4. The owner of a waterworks monitoring for bromate under the requirements of 12VAC5-590-370 B 3 g shall report:~~

~~a. The number of samples taken during the last quarter.~~

~~b. The location, date, and result of each sample taken during the last quarter.~~

~~c. The arithmetic average of the monthly arithmetic averages of all samples taken in the last year.~~

~~d. Whether, based on 12VAC5-590-410 C 2 b, the PMCL was violated.~~

~~H. Reporting requirements for disinfectants. Owners shall report the information specified below in accordance with subsection A of this section. (The district engineer may choose to perform calculations and determine whether the MRDL was violated, in lieu of having the owner report that information):~~

~~1. The owner of a waterworks monitoring for chlorine or chloramines under the requirements of 12VAC5-590-370 B 3 h shall report:~~

~~a. The number of samples taken during each month of the last quarter.~~

~~b. The monthly arithmetic average of all samples taken in each month for the last 12 months.~~

~~c. The arithmetic average of all monthly averages for the last 12 months.~~

~~d. Whether, based on 12VAC5-590-410 C 2 c, the MRDL was violated.~~

~~2. The owner of a waterworks monitoring for chlorine dioxide under the requirements of 12VAC5-590-370 B 3 h shall report:~~

~~a. The dates, results, and locations of samples taken during the last quarter.~~

~~b. Whether, based on 12VAC5-590-410 C 2 c, the MRDL was violated.~~

~~c. Whether the MRDL was exceeded in any two consecutive daily samples and whether the resulting violation was acute or nonacute.~~

~~I. Reporting requirements for disinfection byproduct precursors and enhanced coagulation or enhanced softening. Owners shall report the following information in accordance with subsection A of this section. (The district engineer may choose to perform calculations and determine whether the treatment technique was met, in lieu of having the owner report that information):~~

~~1. The owner of a waterworks monitoring monthly or quarterly for TOC under the requirements of 12VAC5-590-370 B 3 i and required to meet the enhanced coagulation or enhanced softening requirements in 12VAC5-590-420 H 2 b or c shall report:~~

~~a. The number of paired (source water and treated water) samples taken during the last quarter.~~

b. The location, date, and results of each paired sample and associated alkalinity taken during the last quarter.

c. For each month in the reporting period that paired samples were taken, the arithmetic average of the percent reduction of TOC for each paired sample and the required TOC percent removal.

d. Calculations for determining compliance with the TOC percent removal requirements, as provided in 12VAC5-590-420 H 3 a.

e. Whether the system is in compliance with the enhanced coagulation or enhanced softening percent removal requirements in 12VAC5-590-420 H 2 a for the last four quarters.

2. The owner of a waterworks monitoring monthly or quarterly for TOC under the requirements of 12VAC5-590-370 B 3 i and meeting one or more of the alternative compliance criteria in 12VAC5-590-420 H 1 b or c shall report:

a. The alternative compliance criterion that the system is using.

b. The number of paired samples taken during the last quarter.

c. The location, date, and result of each paired sample and associated alkalinity taken during the last quarter.

d. The running annual arithmetic average based on monthly averages (or quarterly samples) of source water TOC for systems meeting a criterion in 12VAC5-590-420 H 1 b (1) or (3) or of treated water TOC for systems meeting the criterion in 12VAC5-590-420 H 1 b (2).

e. The running annual arithmetic average based on monthly averages (or quarterly samples) of source water SUVA for systems meeting the criterion in 12VAC5-590-420 H 1 b (5) or of treated water SUVA for systems meeting the criterion in 12VAC5-590-420 H 1 b (6).

f. The running annual average of source water alkalinity for systems meeting the criterion in 12VAC5-590-420 H 1 b (3) and of treated water alkalinity for systems meeting the criterion in 12VAC5-590-420 H 1 c (1).

g. The running annual average for both TTHM and HAA5 for systems meeting the criterion in 12VAC5-590-420 H 1 b (3) or (4).

h. The running annual average of the amount of magnesium hardness removal (as  $\text{CaCO}_3$ , in mg/L) for systems meeting the criterion in 12VAC5-590-420 H 1 c (2).

i. Whether the system is in compliance with the particular alternative compliance criterion in 12VAC5-590-420 H 1 b or c.

J. Reporting of analytical results to the district engineer will not be required in instances where the state laboratory performs the analysis and reports same to the district engineer.

K. Recycle flow reporting requirements. The owner of any waterworks supplied by a surface water source and waterworks supplied by a groundwater source under the direct influence of surface water that employs conventional filtration or direct filtration treatment shall notify the commissioner in writing by December 8, 2003, if the system recycles spent filter backwash water, thickener supernatant, or liquids from dewatering processes. This notification shall include, as a minimum:

1. A plant schematic showing the origin of all flows that are recycled, including but not limited to spent filter backwash water, thickener supernatant, and liquids from dewatering processes. The schematic shall also specify the hydraulic conveyance used to transport all recycle flows and the location where recycle flows are reintroduced back into the treatment plant.



2. Typical recycle flow in gallons per minute (gpm), the highest observed plant flow experienced in the previous year (gpm), design flow for the treatment plant (gpm), and state approved operating capacity for the plant.

~~L. Reporting of requirements for enhanced treatment for cryptosporidium.~~

~~1. Owners shall report sampling schedules under 12VAC5-590-420 B 3 a (5) and source water monitoring results under subsection E 1 c of this section unless they notify the commissioner that they will not conduct source water monitoring due to meeting the criteria of 12VAC5-590-420 B 3 a (4).~~

~~2. Owners shall report the use of uncovered finished water storage facilities to the commissioner as described in 12VAC5-590-420 L.~~

~~3. Owners of waterworks that provide filtration shall report their Cryptosporidium bin classification as described in 12VAC-590-420 B 3 c.~~

~~4. Owners shall report disinfection profiles and benchmarks to the commissioner as described in 12VAC5-590-420 B 3 b (1) through (2) prior to making a significant change in disinfection practice.~~

~~5. Owners shall report to the commissioner in accordance with the following table for any microbial toolbox options used to comply with treatment requirements under 12VAC5-590-420 B 3 c (2). Alternatively, the commissioner may approve a waterworks to certify operation within required parameters for treatment credit rather than reporting monthly operational data for toolbox options.~~

~~Microbial Toolbox Reporting Requirements~~

<del>Toolbox option</del>	<del>Owners shall submit the following information</del>	<del>On the following schedule</del>
<del>Alternative source/intake management</del>	<del>Verification that waterworks has relocated the intake or adopted the intake withdrawal procedure reflected in monitoring results</del>	<del>No later than the applicable treatment compliance date in 12VAC5-590-420 B 3 c (3).</del>
<del>Presedimentation</del>	<del>Monthly verification of the following: (i) Continuous basin operation (ii) Treatment of 100% of the flow (iii) Continuous addition of a coagulant (iv) At least 0.5 log mean reduction of influent turbidity or compliance with alternative performance criteria approved by the commissioner</del>	<del>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B 3 c (3).</del>
<del>Two stage lime softening</del>	<del>Monthly verification of the following: (i) Chemical addition and hardness precipitation occurred in two separate and sequential softening stages prior to filtration</del>	<del>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment</del>

	(ii) Both stages treated 100% of the plant flow	compliance date in 42VAC5-590-420 B 3 c (3).
Bank filtration	Initial demonstration of the following: (i) Unconsolidated, predominantly sandy aquifer (ii) Setback distance of at least 25 ft. (0.5-log credit) or 50 ft. (1.0-log credit)	No later than the applicable treatment compliance date in 42VAC5-590-420 B 3 c (3).
	If monthly average of daily max turbidity is greater than 1.0 NTU then system shall report result and submit an assessment of the cause	Report within 30 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 42VAC5-590-420 B 3 c (3).
Combined filter performance	Monthly verification of combined filter effluent (CFE) turbidity levels less than or equal to 0.15 NTU in at least 95% of the four-hour CFE measurements taken each month	Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 42VAC5-590-420 B 3 c (3).
Individual filter performance	Monthly verification of the following: (i) Individual filter effluent (IFE) turbidity levels less than or equal to 0.15 NTU in at least 95% of samples each month in each filter (ii) No individual filter greater than 0.3 NTU in two consecutive readings 15 minutes apart	Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 42VAC5-590-420 B 3 c (3).
Demonstration of performance	Results from testing following a protocol approved by the commissioner	No later than the applicable treatment compliance date in 42VAC5-590-420 B 3 c (3).
	(ii) As required by the commissioner, monthly verification of operation within conditions of commissioner approval for demonstration of performance credit	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment

		compliance date in 12VAC5-590-420 B-3-c (3).
Bag filters and cartridge filters	Demonstration that the following criteria are met: (i) Process meets the definition of bag or cartridge filtration (ii) Removal efficiency established through challenge testing that meets criteria in 12VAC5-590-420 B-3-d (6) (a)	No later than the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
	Monthly verification that 100% of plant flow was filtered	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
Membrane filtration	Results of verification testing demonstrating the following: (i) Removal efficiency established through challenge testing that meets criteria in subsection J of this section (ii) Integrity test method and parameters, including resolution, sensitivity, test frequency, control limits, and associated baseline	No later than the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
	Monthly report summarizing the following: (i) All direct integrity tests above the control limit (ii) If applicable, any turbidity or alternative indirect integrity monitoring approved by the commissioner results triggering direct integrity testing and the corrective action that was taken	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
Second stage filtration	Monthly verification that 100% of flow was filtered through both stages and that first stage was preceded by a coagulation step	Within 10 days following the month in which monitoring was conducted, beginning on

		the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
Slow sand filtration (as secondary filter)	Monthly verification that both a slow sand filter and a preceding separate stage of filtration treated 100% of flow from surface water or groundwater under the direct influence of surface water sources	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
Chlorine dioxide	Summary of CT values for each day as described in 12VAC5-590-420 B-3 d (7)(b)(i)	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
Ozone	Summary of CT values for each day as described in 12VAC5-590-420 B-3 d (7)(b)(ii)	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
UV	Validation test results demonstrating operating conditions that achieve required UV dose	No later than the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).
	Monthly report summarizing the percentage of water entering the distribution system that was not treated by UV reactors operating within validated conditions for the required dose as specified in 12VAC5-590-420 B-3 d (7) (c)	Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-420 B-3-c (3).

MK. Reporting requirements for groundwater systems. ~~An owner~~ ~~Owners of groundwater systems~~ shall report the following information in accordance with subsection A of this section:

1. ~~An owner~~ ~~Owners of groundwater systems~~ conducting compliance monitoring as required by 12VAC5-590-421 C shall notify the ~~ODW department~~ as soon as ~~possible~~ ~~practical~~ ~~any time~~ ~~whenever~~ the groundwater system fails to meet the ~~ODW department~~

specified minimum residual disinfectant concentration for more than four hours, but no later than the next business day.

2. ~~An owner~~ ~~Owners of groundwater systems that are~~ required to conduct corrective action as described in 12VAC5-590-421 A shall notify the ~~ODW department~~ within 30 days of completion of corrective action.

3. ~~An owner~~ ~~Owners of groundwater systems~~ subject to the source water monitoring requirements of 12VAC5-590-379 that do not conduct this monitoring under the provision of 12VAC5-590-380 E, shall provide documentation to the ~~ODW department~~ within 30 days of the collection that the sample met the criteria defined in 12VAC5-590-380 E.

~~N. Information to be included on the operation monthly report shall be determined by the commissioner for each waterworks on an individual basis. Appendix G contains suggested monthly operation report requirements.~~

**12VAC5-590-531. Reporting requirements for filtration treatment and disinfection treatment.**

A. The owner of a waterworks using either a surface water source or a GUDI source or both shall report monthly to the department the following specified information-:

1. Turbidity measurements as required by 12VAC5-590-376 B shall be reported within ~~ten~~ 10 days after the end of each month the waterworks serves water to the public. Information that shall be reported includes:

a. The total number of filtered water turbidity measurements collected during the month.

b. The number and percentage of filtered water turbidity measurements collected during the month that are less than or equal to the turbidity limits specified in 12VAC5-590-395 A 2 b for the filtration technology being used.

c. The ~~owners~~ owner of a waterworks that uses lime softening may apply to the ~~commissioner~~ department for alternative exceedance levels for the levels specified in subdivision A 1 b of this section if ~~they~~ he can demonstrate that higher turbidity levels in individual filters are due to lime carryover only and not due to degraded filter performance.

2. The owner of a waterworks with combined distribution systems serving at least 10,000 persons using either a surface water source or a GUDI source or both that provides conventional filtration treatment or direct filtration shall report monthly to the ~~commissioner~~ department the information specified in subdivisions A 2 a and A 2 b of this section. Also, the owner of a waterworks that provides filtration approved under 12VAC5-590-395 A 2 b shall report monthly to the department the information specified in subdivisions A 2 a and A 2 b of this section.

a. Turbidity measurements collected to meet 12VAC5-590-395 A 2 b shall be reported within 10 days after the end of each month the waterworks serves water to the public. Information that shall be reported includes:

(1) The total number of filtered water turbidity measurements collected during the month.

(2) The number and percentage of filtered water turbidity measurements collected during the month that are less than or equal to the turbidity limits specified in 12VAC5-590-395 A 2 b.

(3) The date and value of any turbidity measurements collected during the month that exceed 1 NTU for waterworks using conventional filtration treatment or direct filtration.

or that exceed the maximum level set by the ~~commissioner~~ department under 12VAC5-590-395 A 2 b.

b. The owner shall maintain the results of individual filter monitoring collected under 12VAC5-590-376 B for at least three years. The owner shall report the completion of individual filter turbidity monitoring under 12VAC5-590-376 B within ~~ten~~ 10 days after the end of each month the waterworks serves water to the public. ~~Owners~~ The owner shall report individual filter turbidity measurement results collected under 12VAC5-590-376 B within ~~ten~~ 10 days after the end of each month the waterworks serves water to the public only if measurements demonstrate one or more of the conditions in 12VAC5-590-395 A 2 b. The owner of a ~~Owners of~~ waterworks that uses lime softening may apply to the ~~commissioner~~ department for alternative exceedance levels for the levels specified in 12VAC5-590-395 A 2 b if ~~they~~ he can demonstrate that higher turbidity levels in individual filters are due to lime carryover only and not due to degraded filter performance.

3. For a waterworks with combined distribution systems serving 10,000 or more persons:

a. For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements collected 15 minutes apart, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the owner shall either produce a filter profile for the filter within seven days of the exceedance (if the owner is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

b. For any individual filter that has a measured turbidity level of greater than 0.5 NTU in two consecutive measurements collected 15 minutes apart at the end of the first four hours of continuous filter operation after the filter has been backwashed or otherwise taken offline, the owner shall report the filter number, the turbidity, and the date, or dates, on which the exceedance occurred. In addition, the owner shall either produce a filter profile for the filter within seven days of the exceedance (if the owner is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

c. For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements collected 15 minutes apart at any time in each of three consecutive months, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the waterworks shall conduct a self-assessment of the filter within 14 days of the exceedance and report that the self-assessment was conducted. The self-assessment shall consist of at least the following components: assessment of filter performance; development of a filter profile; identification and prioritization of factors limiting filter performance; assessment of the applicability of corrections; and preparation of a filter self-assessment report.

d. For any individual filter that has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements collected 15 minutes apart at any time in each of two consecutive months, the owner shall report the filter number, the turbidity measurement, and the date, or dates, on which the exceedance occurred. In addition, the owner shall arrange for the conduct of a comprehensive performance evaluation (CPE) by the ~~commissioner~~ department or a third party approved by the ~~commissioner~~ department no later than 30 days following the exceedance and have the evaluation completed and submitted to the ~~commissioner~~ department no later than 90 days following the exceedance. A CPE means a thorough evaluation and analysis of a water

treatment plant's performance-based capabilities and associated administrative, operational, and maintenance practices. A CPE is conducted to identify factors that may be adversely impacting a water treatment plant's capability to achieve compliance, and emphasizes approaches that can be implemented without significant capital improvements.

4. For a waterworks with combined distribution systems serving less than 10,000 persons:

a. For any individual filter (or the turbidity of combined filter effluent for waterworks with two filters that monitor combined filter effluent ~~in lieu~~ instead of individual filters) that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements collected 15 minutes apart, the owner shall report the filter number or numbers, the turbidity measurements, and the date, or dates, on which the exceedance occurred and the cause (if known) for the exceedances.

b. For any individual filter (or the turbidity of combined filter effluent for a waterworks with two filters that monitor combined filter effluent ~~in lieu~~ instead of individual filters) that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements collected 15 minutes apart at any time in each of three consecutive months, the owner shall conduct a self-assessment of the filter or filters within 14 days of the day the filter exceeded 1.0 NTU unless a ~~comprehensive performance evaluation~~CPE as specified in subdivision A 4 c of this section was required. A ~~Waterworks-waterworks~~ with two filters that monitor the combined filter effluent ~~in lieu~~ instead of individual filters shall conduct a self-assessment on both filters. The self-assessment shall be reported to the ~~commissioner department~~ and consist of at least the following components: (i) date the self-assessment was triggered; (ii) date the self-assessment was completed; (iii) an assessment of filter performance; (iv) development of a filter profile; (v) identification and prioritization of factors limiting filter performance; (vi) assessment of the applicability of corrections; and (vii) preparation of a filter self-assessment report. The self-assessment shall be submitted within 10 days after the end of the month or 14 days after the self-assessment was triggered only if it was triggered during the last four days of the month.

c. For any individual filter (or the turbidity of combined filter effluent for a waterworks with two filters that monitor combined filter effluent ~~in lieu~~ instead of individual filters) that has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements collected 15 minutes apart at any time in each of two consecutive months, the owner shall arrange for a CPE, as defined in subdivision A 3 d of this section, by the ~~commissioner department~~ or a third party approved by the ~~commissioner department~~ no later than 60 days following the day the filter exceeded 2.0 NTU in two consecutive months. The owner shall report within ~~ten~~ 10 days after the end of the month that a ~~comprehensive performance evaluation~~CPE is required and the date that it was triggered. If a ~~comprehensive performance evaluation~~CPE has been completed by the ~~commissioner department~~ or a third party approved by the ~~commissioner department~~ within the 12 prior months or the owner and the ~~commissioner department~~ are jointly participating in an ongoing comprehensive technical assistance project at the waterworks, then a new ~~comprehensive performance evaluation~~CPE is not required. If conducted, a ~~comprehensive performance evaluation~~CPE shall be completed and submitted to the ~~commissioner department~~ no later than 120 days following the day the filter exceeded 2.0 NTU in two consecutive measurements for the second straight month.

5. Reporting Cryptosporidium monitoring results.

a. ~~The owner Owners~~ shall report results from the source water monitoring required in 12VAC5-590-401 B no later than 10 days after the end of the first month following the month when the sample is collected.

b. ~~The owner Owners~~ shall report the following data elements for each Cryptosporidium analysis:

(1) PWS ID;

(2) Facility ID;

(3) Sample collection date;

(4) Sample type (field or matrix spike);

(5) Sample volume filtered (L), to nearest 1/4 L;

(6) Was 100% of filtered volume examined; and

(7) Number of oocysts counted.

c. Quality control for Cryptosporidium analysis.

(1) For matrix spike samples, the owner shall also report the sample volume spiked and ~~the~~ estimated number of oocysts spiked. These data are not required for field samples.

(2) For samples in which less than 10 L is filtered or less than 100% of the sample volume is examined, the owner shall also report the number of filters used and the packed pellet volume.

(3) For samples in which less than 100% of ~~the~~ sample volume is examined, the owner shall also report the volume of re-suspended concentrate and volume of this re-suspension processed through immunomagnetic separation.

d. ~~The owner Owners~~ shall report the following data elements for each E. coli analysis:

(1) PWS ID;

(2) Facility ID;

(3) Sample collection date;

(4) Analytical method number;

(5) Method type;

(6) Source type (flowing stream, lake ~~or~~ reservoir, GUDI source);

(7) E. coli/100 mL; and

(8) Turbidity.

e. ~~The owner of a Owners-of~~ waterworks serving fewer than 10,000 persons, ~~that are~~ and not required to monitor for turbidity under ~~in-12VAC5-590-401 B, are-is~~ not required to report turbidity with their E. coli results.

#### B. Reporting of requirements for enhanced treatment for Cryptosporidium.

1. ~~Owners-The owner~~ shall report sampling schedules under 12VAC5-590-401 B and source water monitoring results under 12VAC5-590-531 A 5, unless ~~they-the owner~~ notifies the ~~commissioner-department~~ that ~~they-he~~ will not conduct source water monitoring due to meeting the criteria of 12VAC5-590-401 B 4.

2. ~~Owners-The owner~~ shall report the use of uncovered finished water storage facilities to the ~~commissioner-department~~ as described in 12VAC5-590-415.

3. ~~OwnersThe owner of a -of~~ waterworks that provide filtration shall report their Cryptosporidium bin classification as described in 12VAC5-590-401 D.



4. ~~Owners~~—The owner shall report disinfection profiles and benchmarks to the ~~commissioner-department~~ as described in 12VAC5-590-401 C 1 and VAC5-590-401 C 2 ~~prior to before~~ making a significant change in disinfection practice.

5. ~~Owners~~—The owner shall report to the ~~commissioner-department~~ in accordance with Table 531.1 for any microbial toolbox options used to comply with treatment requirements under 12VAC5-590-401 D 2. Alternatively, the ~~commissioner-department~~ may approve a waterworks to certify operation within required parameters for treatment credit rather than reporting monthly operational data for toolbox options.

TABLE 531.1.  
Microbial Toolbox Reporting Requirements.

TOOLBOX OPTION	OWNERS SHALL SUBMIT THE FOLLOWING INFORMATION:	ON THE FOLLOWING SCHEDULE:
<u>Alternative source/intake management</u>	<u>Verification that the waterworks has relocated the intake or adopted the intake withdrawal procedure reflected in monitoring results.</u>	<u>No later than the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Presedimentation</u>	<u>Monthly verification of the following: (i) Continuous basin operation; (ii) Treatment of 100% of the flow; (iii) Continuous addition of a coagulant; and (iv) At least 0.5-log mean reduction of influent turbidity or compliance with alternative performance criteria approved by the <del>commissioner</del>department.</u>	<u>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Two-stage lime softening</u>	<u>Monthly verification of the following: (i) Chemical addition and hardness precipitation occurred in two separate and sequential softening stages <del>prior to before</del> filtration; and, (ii) Both stages treated 100% of the water treatment plant flow.</u>	<u>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Bank filtration</u>	<u>Initial demonstration of the following: (i) Unconsolidated, predominantly sandy aquifer; and, (ii) Setback distance of at least 25 ft. (0.5-log credit) or 50 ft. (1.0-log credit).</u>	<u>No later than the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
	<u>If monthly average of daily maximum turbidity is greater than 1 NTU, then the waterworks shall report the result and submit an assessment of the cause.</u>	<u>Report within 30 days following the month in which the monitoring was conducted, beginning on the</u>

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		<u>applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Combined filter performance</u>	<u>Monthly verification of combined filter effluent (CFE) turbidity levels less than or equal to 0.15 NTU in at least 95% of the four-hour CFE measurements collected each month.</u>	<u>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Individual filter performance</u>	<u>Monthly verification of the following:</u> <u>(i) Individual filter effluent turbidity levels less than or equal to 0.15 NTU in at least 95% of samples each month in each filter; and;</u> <u>(ii) No individual filter greater than 0.3 NTU in two consecutive readings 15 minutes apart.</u>	<u>Monthly reporting within 10 days following the month in which the monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Demonstration of performance</u>	<u>Results from testing following a protocol approved by the <del>commissioner</del>department.</u>	<u>No later than the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
	<u>As required by the <del>commissioner</del>department, monthly verification of operation within conditions of <del>commissioner</del>the department's approval for demonstration of performance credit.</u>	<u>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Bag filters and cartridge filters</u>	<u>Demonstration that the following criteria are met:</u> <u>(i) Process meets the definition of bag or cartridge filtration; and;</u> <u>(ii) Removal efficiency established through challenge testing that meets criteria in 12VAC5-590-401 E 6 a.</u>	<u>No later than the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
	<u>Monthly verification that 100% of the water treatment plant flow was filtered.</u>	<u>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
<u>Membrane filtration</u>	<u>Results of verification testing demonstrating the following:</u>	<u>No later than the applicable treatment</u>

	<p>(i) Removal efficiency established through challenge testing that meets criteria in <del>subsection-subdivision</del> <u>B 5</u> of this section; and;</p> <p>(ii) Integrity test method and parameters, including resolution, sensitivity, test frequency, control limits, and associated baseline.</p>	<p>compliance date in <u>12VAC5-590-401 D 3.</u></p>
	<p>Monthly report summarizing the following:</p> <p>(i) All direct integrity tests above the control limit; and;</p> <p>(ii) If applicable, any turbidity or alternative indirect integrity monitoring approved by the <del>commissioner</del> <u>department that results in triggering direct integrity testing and the corrective action that was taken.</u></p>	<p>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in <u>12VAC5-590-401 D 3.</u></p>
<p><u>Second stage filtration</u></p>	<p>Monthly verification that 100% of flow was filtered through both stages and that first stage was preceded by a <u>coagulation step.</u></p>	<p>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in <u>12VAC5-590-401 D 3.</u></p>
<p><u>Slow sand filtration (as secondary filter)</u></p>	<p>Monthly verification that both a slow sand filter and a preceding separate stage of filtration treated 100% of flow from surface water or groundwater under the direct influence of surface water.</p>	<p>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in <u>12VAC5-590-401 D 3.</u></p>
<p><u>Chlorine dioxide</u></p>	<p>Summary of CT values for each day as described in <u>12VAC5-590-401 E 7 b (1).</u></p>	<p>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in <u>12VAC5-590-401 D 3.</u></p>
<p><u>Ozone</u></p>	<p>Summary of CT values for each day as described in <u>12VAC5-590-401 E 7 b (2).</u></p>	<p>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in <u>12VAC5-590-401D 3.</u></p>

<u>UV</u>	<u>Validation test results demonstrating operating conditions that achieve required UV dose.</u>	<u>No later than the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>
	<u>Monthly report summarizing the percentage of water entering the distribution system that was not treated by UV reactors operating within validated conditions for the required dose as specified in 12VAC5-590-401 E 7 c (1).</u>	<u>Within 10 days following the month in which monitoring was conducted, beginning on the applicable treatment compliance date in 12VAC5-590-401 D 3.</u>

C. Disinfection information specified below shall be reported to the department within ~~ten~~ 10 days after the end of each month the waterworks serves water to the public. Information that shall be reported includes:

1. For each day, the lowest measurement of residual disinfectant concentration in mg/L in water entering the distribution system.
2. The date and duration of each period when the residual disinfectant concentration in water entering the distribution system fell below 0.2 mg/L and when the department was notified of the occurrence.
3. The following information on the samples collected in the distribution system in conjunction with total coliform monitoring pursuant to 12VAC5-590-395 A 2.
  - a. Number of instances where the residual disinfectant concentration is measured;
  - b. Number of instances where the residual disinfectant concentration is not measured but HPC is measured;
  - c. Number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;
  - d. Number of instances where no residual disinfectant concentration is detected and where HPC is greater than 500/mL;
  - e. Number of instances where the residual disinfectant concentration is not measured and HPC is greater than 500/mL; and
  - f. For the current and previous month the waterworks serves water to the public, the value of "V", in %, in the following formula:

$$V = \left[ \frac{(c+d+e)}{(a+b)} \right] * 100$$

- a = the value in subdivision C 3 a of this section
- b = the value in subdivision C 3 b of this section
- c = the value in subdivision C 3 c of this section
- d = the value in subdivision C 3 d of this section
- e = the value in subdivision C 3 e of this section

g. The ~~commissioner~~ department may determine that, based on site-specific considerations, if an owner has no means for having a sample transported and

analyzed for HPC by a certified laboratory under the requisite time and temperature conditions and the waterworks is providing adequate disinfection in the distribution system, the HPC compliance requirements of subdivisions C 3 a through C 3 f of this section do not apply.

4. An owner need not report the data listed in subdivision C1 of this section if all data listed in subdivisions C 1 through C 3 of this section remain on file at the waterworks and the ~~commissioner~~ department determines that the owner has submitted all of the information required by subdivisions C 1 through C 3 of this section for the last 12 months.

5. ~~A Waterworks~~ waterworks using disinfection oxidants other than free chlorine after filtration shall continue to record disinfection profile measurements and incorporate log inactivation computations into their Monthly Operation Reports, as described in 12VAC5-590-570.

D. Reporting requirements for disinfection byproducts. ~~The owner~~ Owners shall report the following information to the department in accordance with 12VAC5-590-530. The ~~commissioner~~ department may choose to perform calculations and determine whether the PMCL was violated, ~~in lieu~~ instead of having the owner report that information.

1. Locational Running Annual Average (LRAA) Reporting:

a. ~~The owner~~ Owners shall report the following information for each monitoring location to the ~~commissioner~~ department:

(1) Number of samples collected during the last quarter.

(2) Date and results of each sample collected during the last quarter.

(3) Arithmetic average of quarterly results for the last four quarters for each LRAA, beginning at the end of the fourth calendar quarter that follows the compliance date and at the end of each subsequent quarter. If the LRAA calculated based on fewer than four quarters of data would cause the PMCL to be exceeded regardless of the monitoring results of subsequent quarters, the owner shall report this information to the ~~commissioner~~ department as part of the first report due following the compliance date or anytime thereafter that this determination is made. If the owner is required to conduct monitoring at a frequency that is less than quarterly, then the owner shall make compliance calculations beginning with the first compliance sample collected after the compliance date, unless the owner is required to conduct increased monitoring under 12VAC5-590-374 F 5.

(4) Whether, based on 12VAC5-590-384 B 1, the PMCL was violated at any monitoring location.

(5) Any operational evaluation levels, under 12VAC5-590-384 B 1 d, that were exceeded during the quarter and, if so, the location and date, and the calculated TTHM and HAA5 levels.

b. ~~Owners~~ The owner of a waterworks using either a surface water source or a GUDI source or both seeking to qualify for or remain on reduced TTHM/ and HAA5 monitoring shall report the following source water TOC information for each water treatment plant that treats surface water or ground water under the direct influence of surface water to the ~~commissioner~~ department within 10 days of the end of any quarter in which monitoring is required:

(1) The number of source water TOC samples collected each month during last quarter.

(2) The date and result of each sample collected during last quarter.

(3) The quarterly average of monthly samples collected during last quarter or the result of the quarterly sample.

(4) The ~~running annual average (RAA)~~ of quarterly averages from the past four quarters.

(5) Whether the RAA exceeded 4.0 mg/L.

2. The owner of a waterworks monitoring for chlorite under the requirements of 12VAC5-590-374 G shall report:

a. The number of entry point samples collected each month for the last three months.

b. The location, date, and result of each sample (both entry point and distribution system) collected during the last quarter.

c. For each month in the reporting period, the arithmetic average of all samples collected in each three-sample set collected in the distribution system.

d. Whether, based on 12VAC5-590-384 B 3, the PMCL was violated, in which month and how many times it was violated each month.

3. The owner of a waterworks monitoring for bromate under the requirements of 12VAC5-590-374 H shall report:

a. The number of samples collected during the last quarter.

b. The location, date, and result of each sample collected during the last quarter.

c. The arithmetic average of the monthly arithmetic averages of all samples collected in the last year.

d. Whether, based on 12VAC5-590-384 B 2, the PMCL was violated.

E. Reporting requirements for disinfectants. ~~Owners~~The owner shall report the information specified below to the department in accordance with 12VAC5-590-530 within 10 days after the end of each monitoring period in which samples were collected. (The ~~commissioner~~department may choose to perform calculations and determine whether the MRDL was violated, ~~in lieu~~ instead of having the owner report that information):

1. The owner of a waterworks monitoring for chlorine or chloramines under the requirements of 12VAC5-590-374 I 1 shall report:

a. The number of samples collected during each month of the last quarter.

b. The monthly arithmetic average of all samples collected in each month for the last 12 months.

c. The arithmetic average of all monthly averages for the last 12 months.

d. Whether, based on 12VAC5-590-384 C 1, the MRDL was violated.

2. The owner of a waterworks monitoring for chlorine dioxide under the requirements of 12VAC5-590-374 I 2 shall report:

a. The dates, results, and locations of samples collected during the last quarter.

b. Whether, based on 12VAC5-590-384 C 2, the MRDL was violated.

c. Whether the MRDL was exceeded in any two consecutive daily samples and whether the resulting violation was acute or nonacute.

F. Reporting requirements for disinfection byproduct precursors and enhanced coagulation or enhanced softening. ~~The owner~~ Owners shall report the following information to the department within 10 days after the end of each monitoring period in which the samples were collected in accordance with subsection A of this section. (The ~~commissioner~~department may choose to perform calculations and determine whether the treatment technique was met, ~~in lieu~~ instead of having the owner report that information):

1. The owner of a waterworks monitoring monthly or quarterly for TOC under the requirements of 12VAC5-590-374 J and required to meet the enhanced coagulation or enhanced softening requirements in 12VAC5-590-411 A 2 shall report:

- a. The number of paired (source water and treated water) samples collected during the last quarter.
- b. The location, date, and results of each paired sample and associated alkalinity collected during the last quarter.
- c. For each month in the reporting period that paired samples were collected, the arithmetic average of the percent reduction of TOC for each paired sample and the required TOC percent removal.
- d. Calculations for determining compliance with the TOC percentage removal requirements, as provided in 12VAC5-590-411 A 3.
- e. Whether the waterworks is in compliance with the enhanced coagulation or enhanced softening percent removal requirements in 12VAC5-590-411 A 2 for the last four quarters.

2. The owner of a waterworks monitoring monthly or quarterly for TOC under the requirements of 12VAC5-590-374 J and meeting one or more of the alternative compliance criteria in 12VAC5-590-411 A 1 b or 12VAC5-590-411 A 1 c shall report:

- a. The alternative compliance criterion that the waterworks is using.
- b. The number of paired samples collected during the last quarter.
- c. The location, date, and result of each paired sample and associated alkalinity collected during the last quarter.
- d. The running annual arithmetic average based on monthly averages (or quarterly samples) of source water TOC for a waterworks meeting a criterion in 12VAC5-590-411 A 1 c (1) or 12VAC5-590-411 A 1 c (3) or of treated water TOC for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (2).
- e. The running annual arithmetic average based on monthly averages (or quarterly samples) of source water SUVA for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (5) or of treated water SUVA for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (6).
- f. The ~~running annual average~~ RAA of source water alkalinity for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (3) and of treated water alkalinity for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (1).
- g. The ~~running annual average~~ RAA for both TTHM and HAA5 for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (3) or 12VAC5-590-411 A 1 c (4).
- h. The ~~running annual average~~ RAA of the amount of magnesium hardness removal (as CaCO<sub>3</sub>, in mg/L) for a waterworks meeting the criterion in 12VAC5-590-411 A 1 c (2).
- i. Whether the waterworks is in compliance with the particular alternative compliance criterion in 12VAC5-590-411 A 1 b or 12VAC5-590-411 A 1 c.

G. Additional reporting requirements. The owner shall report the following incidents within 24 hours to the department:

1. A waterborne disease outbreak that is potentially attributable to that waterworks.
2. Chlorine residual of below 0.2 mg/L in the water entering the distribution system. The owner also shall notify the department by the end of the next business day whether or not the residual was restored to at least 0.2 mg/L within four hours.

**12VAC5-590-532. Reporting requirements for lead and copper.**

A. ~~All~~ ~~An owner owners~~ shall report all of the following information to the department in accordance with this subsection.

B. Reporting requirements for tap water monitoring for lead and copper and for water quality parameter monitoring.

1. Except as provided in subdivision B 1 g of this section, an owner shall report the information specified below for all tap water samples specified in 12VAC5-590-375 B and for all water quality parameter samples specified in 12VAC5-590-375 C within the first 10 days following the end of each applicable monitoring period specified in 12VAC5-590-375 B and 12VAC5-590-375 C (i.e., every six months, annually, every three years, or every nine years). For monitoring periods with a duration less than six months, the end of the monitoring period is the last date samples can be collected during the period as specified in 12VAC5-590-375 B and 12VAC5-590-375 C.

a. The results of all tap samples for lead and copper including location or a location site code and the criteria under 12VAC5-590-375 B 1 c through 12VAC5-590-375 B 1 f or 12VAC5-590-375 C under which the site was selected for the waterworks' sampling pool.

b. Documentation for each tap water lead or copper sample for which the owner requests invalidation pursuant to 12VAC5-590-375 B 6.

c. The 90th percentile lead and copper concentrations measured from among all lead and copper tap water samples collected during each monitoring period (calculated in accordance with 12VAC5-590-385 C) unless the ~~commissioner~~ department calculates the 90th percentile lead and copper levels under ~~Subsection-subsection I~~ of this section.

d. With the exception of initial tap sampling conducted pursuant to 12VAC5-590-375 B 4 a, the owner shall designate any site that was not sampled during previous monitoring periods, and include an explanation of why sampling sites have changed.

e. The results of all tap samples for pH, and where applicable, alkalinity, calcium, conductivity, temperature, and orthophosphate or silica collected under 12VAC5-590-375 C 2 through 12VAC5-590-375 C 5.

f. The results of all samples collected at the entry point or points to the distribution system for applicable water quality parameters under 12VAC5-590-375 C 2 through 12VAC5-590-375 C 5.

g. The owner shall report the results of all water quality parameter samples collected under 12VAC5-590-375 C 3 through 12VAC5-590-375 C 6 during each six-month monitoring period specified in 12VAC5-590-375 C 4 within the first ~~ten~~ 10 days following the end of the monitoring period, unless the ~~commissioner~~ department has specified a more frequent reporting requirement.

2. The owner of a nontransient noncommunity waterworks, or a community waterworks meeting the criteria of 12VAC5-590-405 D 2 e, that does not have enough taps that can provide first-draw samples, must either:

a. Provide written documentation to the ~~commissioner~~ department identifying standing times and locations for enough non-first-draw samples to make up the sampling pool under 12VAC5-590-375 B 2 e by the start of the first applicable monitoring period under 12VAC5-590-375 B 4, unless the ~~commissioner~~ department has waived prior approval of non-first-draw sample sites selected by the owner pursuant to 12VAC5-590-375 B 2 e; or



b. If the ~~commissioner~~ department has waived prior approval of non-first-draw sample sites selected by the owner, then the owner shall identify, in writing, each site that did not meet the ~~six hours~~ six-hour minimum standing time and the length of standing time for that particular substitute sample collected pursuant to 12VAC5-590-375 B 2 e and include this information with the lead and copper sample results required to be submitted pursuant to subsection B of this section.

3. At a time specified by the ~~commissioner~~ department, or if no specific time is designated by the ~~commissioner~~ department, then as early as ~~possible~~ practical prior to before the addition of a new source or any long-term change in water treatment, an owner (i) deemed to have optimized corrosion control under 12VAC5-590-405 A 2 b (3); ~~an owner~~ (ii) subject to reduced monitoring pursuant to 12VAC5-590-375 B 4 d; or (iii) ~~an owner~~ subject to a monitoring waiver pursuant to 12VAC5-590-375 B 7, shall submit written documentation to the department describing the change or addition. The ~~commissioner~~ department must approve the addition of a new source or a long-term change in treatment before it is implemented by the owner. Examples of long-term treatment changes include the addition of a new treatment process or modification of an existing treatment process. Examples of modification include switching secondary disinfectants, switching coagulants (e.g., alum to ferric chloride), switching corrosion inhibitor products (e.g., orthophosphate to blended phosphate). Long-term changes can include dose changes to existing chemicals if the waterworks is planning long-term changes to its finished water pH or residual inhibitor concentration. Long-term treatment changes would not include chemical dose fluctuations associated with daily source water quality changes.

4. The owner of ~~any~~ a small waterworks applying for a monitoring waiver under 12VAC5-590-375 B 7 or subject to a waiver granted pursuant to 12VAC5-590-375 B 7 c, shall provide the following information to the ~~commissioner~~ department in writing by the specified deadline:

a. By the start of the first applicable monitoring period in 12VAC5-590-375 B 4, the owner of ~~any~~ a small waterworks applying for a monitoring waiver shall provide the documentation required to demonstrate that ~~it meets~~ the waiver criteria of 12VAC5-590-375 B 7 a and 12VAC5-590-375 B 7 b ~~have been met~~.

b. No later than nine years after the monitoring previously conducted pursuant to 12VAC5-590-375 B 7 b or 12VAC5-590-375 B 7 d (1), the owner of ~~each~~ a small waterworks desiring to maintain its monitoring waiver shall provide the information required by 12VAC5-590-375 B 7 d (1) and 12VAC5-590-375 B 7 d (2).

c. No later than 60 days after becoming aware that it is no longer free of lead-containing or copper-containing material, the owner of ~~each~~ a small waterworks with a monitoring waiver shall provide written notification to the department, setting forth the circumstances resulting in the lead-containing or copper-containing materials being introduced into the waterworks and what corrective action, if any, the owner plans to take to remove these materials.

5. The owner of ~~each~~ a groundwater ~~system~~ ~~source waterworks~~ that limits water quality parameter monitoring to a subset of entry points under 12VAC5-590-375 C 3 c shall provide, by the commencement of the monitoring, written correspondence to the department that identifies the selected entry points and includes information sufficient to demonstrate that the sites are representative of water quality and treatment conditions throughout the waterworks.

#### C. Source water monitoring reporting requirements.

1. An owner shall report the sampling results for all source water samples collected in accordance with 12VAC5-590-375 D within the first 10 days following the end of each

source water monitoring period (i.e., annually, per compliance period, per compliance cycle) specified in 12VAC5-590-375 D.

2. With the exception of the first round of source water sampling conducted pursuant to 12VAC5-590-375 D 2, the owner shall specify any site that was not sampled during previous monitoring periods, and include an explanation of why the sampling point has changed.

D. Corrosion control treatment reporting requirements. By the applicable dates under 12VAC5-590-405 A 2 a, ~~an owner owners~~ shall report the following information:

1. For ~~the owner owners~~ demonstrating that ~~they have~~ ~~he has~~ already optimized corrosion control, information required in 12VAC5-590-405 A 2 b (2) or 12VAC5-590-405 A 2 b (3).

2. For ~~the owner owners~~ required to optimize corrosion control, the owner's recommendation regarding optimal corrosion control treatment under 12VAC5-590-405 A 1 a.

3. For ~~the owner owners~~ required to evaluate the effectiveness of corrosion control treatments, ~~the information required~~ under 12VAC5-590-405 A 1 c.; ~~the information required by that subdivision.~~

4. For ~~the owner owners~~ required to install optimal corrosion control designated by the ~~commissioner department~~ under 12VAC5-590-405 A 1 d, a letter certifying that the owner has completed installing that treatment.

E. Source water treatment reporting requirements. By the applicable dates in 12VAC5-590-405 B, ~~an owner owners~~ shall provide the following information to the department:

1. If required under 12VAC5-590-405 B 2 a, the owner's recommendation regarding source water treatment; or

2. For ~~an owner owners~~ required to install source water treatment under 12VAC5-590-405 B 2 b, a letter certifying that the owner has completed installing the treatment designated by the ~~commissioner department~~ within 24 months after the ~~commissioner department~~ designated the treatment.

F. Lead service line replacement reporting requirements. ~~Owners-An owner~~ shall report the following information to the department to demonstrate compliance with the requirements of 12VAC5-590-405 C:

1. No later than 12 months after the end of a monitoring period in which a waterworks exceeds the lead action level in sampling referred to in 12VAC5-590-405 C 1, the owner shall submit written documentation to the department of the materials evaluation conducted as required in 12VAC5-590-375 B 1, to identify the initial number of lead service lines in the distribution system at the time the waterworks exceeds the lead action level, and provide the owner's schedule for annually replacing at least 7.0% of the initial number of lead service lines in its distribution system.

2. No later than 12 months after the end of a monitoring period in which a waterworks exceeds the lead action level in sampling referred to in 12VAC5-590-405 C 1, and every 12 months thereafter, the owner shall demonstrate to the department in writing that the owner has either:

a. Replaced in the previous 12 months at least 7.0% of the initial lead service lines (or a greater number of lines specified by the ~~commissioner department~~ under 12VAC5-590-405 C 6) in the distribution system; or

b. Conducted sampling that demonstrates that the lead concentration in all service line samples from an individual line or lines, collected pursuant to 12VAC5-590-375 B 2 c, is less than or equal to 0.015 mg/L. In these cases, the total number of lines replaced

and/or which that meet the criteria in 12VAC5-590-405 C 4 shall equal at least 7.0% of the initial number of lead lines identified under subdivision F 1 of this section (or the percentage specified by the commissioner department under 12VAC5-590-405 C 6).

3. The annual letter submitted to the department under subdivision F 2 of this section shall contain the following information:

a. The number of lead service lines scheduled to be replaced during the previous year of the waterworks' replacement schedule;

b. The number and location of each lead service line replaced during the previous year of the waterworks' replacement schedule; and

c. If measured, the water lead concentration and location of each lead service line sampled, the sampling method, and the date of sampling.

4. The owner of any-a waterworks that collects lead service line samples following partial lead service line replacement required by 12VAC5-590-405 C shall report the results to the department within the first 10 days of the month following the month in which the owner receives the laboratory results, or as specified by the commissioner department. The owner Owners shall also report any additional information as specified by the commissioner department, and in a time and manner prescribed by the commissioner department, to verify that all partial lead service line replacement activities have taken place.

G. Public education program reporting requirements. Owners—An owner shall report the following information to the department to demonstrate compliance with the requirements of 12VAC5-590-405 D.

1. The owner of any-a waterworks that is subject to the public education requirements in 12VAC5-590-405 D shall, within 10 days after the end of each period in which the owner is required to perform public education tasks in accordance with 12VAC5-590-405 D 2, send written notice to the department that contains:

a. A demonstration that the owner has delivered the public education materials that meet the content requirements of 12VAC5-590-405 D 1 and the delivery requirements of 12VAC5-590-405 D 2; and

b. A list of all the newspapers, radio stations, television stations, and facilities and organizations to which the owner delivered public education materials during the period in which the owner was required to perform public education tasks.

2. Unless required by the commissioner department, an owner who previously has submitted the information required by subdivision G 1 b of this section need not resubmit the information required by subdivision G 1 b of this section, as long as there has been no changes in the distribution list and the owner certifies that the public education materials were distributed to the same list submitted previously.

3. No later than three months following the end of the monitoring period, the owner shall mail a sample copy of the consumer notification of tap results to the department along with a certification that the notification has been distributed in a manner consistent with the requirements of 12VAC5-590-405 D 4.

H. Reporting of additional monitoring data. The owner of any-a waterworks that collects sampling data in addition to that required by 12VAC5-590-375 shall report the results to the department within the first 10 days following the end of the applicable monitoring period under 12VAC5-590-375 B, 12VAC5-590-375 C, and 12VAC5-590-375 D during which the samples are collected.

I. Reporting of the 90th percentile lead and copper concentrations where the commissioner department calculates a waterworks' 90th percentile concentrations. An owner is not required to

report the 90th percentile lead and copper concentrations measured from among all lead and copper tap samples collected during each monitoring period, as required by subdivision B 1 d of this section if:

1. The ~~commissioner~~ department has previously notified the owner that the department will calculate the waterworks' 90th percentile lead and copper concentrations, based on the lead and copper tap results submitted pursuant to subdivision I 2 a of this section, and has specified a date before the end of the applicable monitoring period by which the owner shall provide the results of the lead and copper tap water samples;

2. The owner has provided the following information to the department by the date specified in subdivision I 1 of this section:

a. The results of all tap samples for lead and copper including the location of each site and the criteria under 12VAC5-590-375 B 1 c through 12VAC5-590-375 B 1 f or 12VAC5-590-375 B 1 g under which the site was selected for the waterworks sampling pool, pursuant to subdivision B 1 a of this section;

b. An identification of sampling sites utilized during the current monitoring period that were not sampled during the previous monitoring periods, and an explanation why sampling sites have changed; and

c. The ~~commissioner~~ department has provided the results of the 90th percentile lead and copper calculations, in writing, to the owner before the end of the monitoring period.

#### **12VAC5-590-540. Public notices.**

A. ~~All owners~~An owner shall give public notice to (i) persons served by the waterworks and (ii) the owner of any consecutive waterworks to which it sells or otherwise provides water under the following circumstances.

1. Tier 1.

a. When E. coli are present in the distribution system, or when the waterworks fails to test for E. coli when any repeat sample tests positive for total coliform;

b. Violation of the PMCL for E.coli;

c. Violation of the PMCL for nitrate, nitrite, or total nitrate and nitrite;

d. Failure to ~~take~~collect a confirmation sample within 24 hours of the waterworks receipt of the first sample showing an exceedance of the nitrate or nitrite PMCL;

e. Exceedance of the nitrate PMCL by a noncommunity waterworks, where permitted to exceed the PMCL by the ~~commissioner~~department;

f. Violation of the MRDL for chlorine dioxide when one or more samples ~~taken~~collected in the distribution system the day following an exceedance of the MRDL at the entry point ~~of to~~ the distribution system exceed the MRDL;

g. Failure to monitor chlorine dioxide residuals in the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system;

h. Violation of the treatment technique requirements for filtration and disinfection resulting from a single exceedance of the maximum allowable turbidity limit, where the ~~commissioner~~department determines after consultation that a Tier 1 notice is required;

i. Failure to consult with the ~~commissioner~~department within 24 hours after the owner learns of the violation of the treatment technique requirements for filtration and

disinfection resulting from a single exceedance of the maximum allowable turbidity limit;

j. Occurrence of a waterborne disease outbreak or other waterborne emergency (such as a failure or significant interruption in key water treatment processes, a natural disaster that disrupts the water supply or distribution system, or a chemical spill or unexpected loading of possible pathogens into the source water that significantly increases the potential for drinking water contamination);

k. Detection of E. coli in groundwater source samples; or

l. Other violations or situations with significant potential to have serious adverse effects on human health as a result of short-term exposure, as determined by the ~~commissioner~~ department on a case-by-case basis.

2. Tier 2.

a. All violations of the PMCL, MRDL, and treatment technique requirements, except where a Tier 1 public notice is required or where the ~~commissioner~~ department determines that a Tier 1 notice is required instead per subdivision A 1 l of this ~~subsection~~ section;

b. Violations of the monitoring and testing procedure requirements, where the ~~commissioner~~ department determines that a Tier 2 rather than a Tier 3 public notice is required instead, taking into account potential health impacts and persistence of the violation;

c. Failure to comply with the terms and conditions of any variance or exemption in place; or

d. Failure to take corrective action or failure to maintain at least ~~four~~4-log treatment of viruses (using inactivation, removal, or an approved combination of ~~four~~4-log virus inactivation and removal) before or at the first customer under the treatment technique requirements for waterworks with groundwater sources.

3. Tier 3.

a. Monitoring violations, except where a Tier 1 public notice is required per subdivisions A 1 d and A 1 g of this ~~subsection~~ section, or where the ~~commissioner~~ department determines that a Tier 2 public notice is required instead per subdivision A 2 b of this ~~subsection~~ section;

b. Failure to comply with a testing procedure, except where a Tier 1 notice is required per subdivision A 1 b of this ~~subsection~~ section, or where the commissioner determines that a Tier 2 notice is required instead per subdivision A 2 b of this ~~subsection~~ section;

c. Operation under a variance or an exemption to a PMCL or treatment technique requirement;

d. Availability of unregulated contaminant monitoring results; or

e. Exceedance of the fluoride ~~secondary maximum contaminant level (SMCL); and SMCL.~~

f. ~~Reporting and recordkeeping violations specified in 12VAC5-590-530 B, C, and D, and 12VAC5-590-550 L.~~

4. The ~~commissioner~~ department may require public notice for violations or other situations not listed in this section, or may require a higher tier of public notice for specific violations and situations listed in this section.

a. The content and extent of distribution of these public notices shall be determined by the ~~commissioner~~ department.

b. The owner shall provide the public notice certification required in ~~42VAC5-590-540 N~~ subsection N of this section.

~~c. Within 90 days of initiating or permanently ceasing a program to deliver the optimum fluoride ion concentration, a waterworks-an owner shall provide written notice to the waterworks' consumers. Notice to the consumers shall be consistent with 12VAC5-590-540 C 2 d, or as allowed in 12VAC5-590-545 C. At least 90 days before permanently ceasing operation of a fluoride feed system, or as soon as practical, a waterworks owner shall provide written notice to the waterworks' consumers of the intent to discontinue fluoridation. Notice to consumers shall be approved by the commissioner prior to delivery and performed in a manner that is consistent with 12VAC5-590-540 C 2 d. The owner shall provide a public notice of the waterworks' intent to discontinue fluoridation in accordance with 12VAC5-590-540-D. The contents of this notice shall be approved by the commissioner at least 90 days before ceasing operation of the fluoridation feed system.~~

B. If a waterworks has a violation, failure, exceedance, or situation in a portion of the distribution system that is physically or hydraulically isolated from other parts of the distribution system, the ~~commissioner~~ department may allow the owner to limit distribution of the public notice to only those persons served by that portion of the waterworks ~~which~~ that is out of compliance. The decision granting limited distribution of the public notice shall be issued in writing.

C. Public notice distribution requirements.

1. For Tier 1 violations, exceedances, or situations, the owner shall:

a. Provide a public notice as soon as practical but no later than 24 hours after the owner learns of the violation, exceedance, or situation;

b. Initiate consultation with the ~~commissioner~~ department as soon as practical, but no later than 24 hours after the owner learns of the violation, exceedance, or situation, to determine additional public notice requirements;

c. Comply with any additional public notice requirements, including any repeat notices or direction on the duration of the posted notices, that are established as a result of the consultation with the ~~commissioner~~ department. ~~Such~~ These requirements may include the timing, form, manner, frequency, and content of repeat notices (if any) and other actions designed to reach all persons served; and

d. Provide the public notice in a form and manner reasonably calculated to reach all persons served. The form and manner shall fit the specific situation, and shall be designed to reach residential, transient, and ~~non-transient~~ nontransient users of the waterworks. ~~In order to~~ To reach all persons served, owners shall use, at a minimum, one or more of the following forms of delivery:

(1) Appropriate broadcast media (such as radio and television);

(2) Posting of the public notice in conspicuous locations throughout the area served by the waterworks;

(3) Hand delivery of the public notice to persons served by the ~~water system~~ waterworks; or

(4) Another delivery method approved in writing by the ~~commissioner~~ department.

2. For Tier 2 violations, exceedances, or situations, the owner shall:

a. Provide the public notice as soon as practical, but no later than 30 days after the owner learns of the violation, exceedance, or situation. The ~~commissioner~~ department may allow, on a case-by-case determination, additional time for the initial notice of up to three months from the date the owner learns of the violation, exceedance, or

situation; however, the ~~commissioner~~ department shall not grant an extension to the 30-day deadline for any unresolved violation, ~~exceedance, or situation~~.

b. Repeat the public notice every three months as long as the violation, exceedance, or situation persists, unless the ~~commissioner~~ department determines that appropriate circumstances warrant a different repeat notice frequency. In no circumstance shall the repeat notice be given less frequently than once per year. Repeat notice frequency less than every three months shall not be allowed for (i) a violation as specified in 12VAC5-590-380 B and 12VAC5-590-392 F; (ii) a treatment technique violation for filtration and disinfection; and (iii) other ongoing violations, exceedances, or situations.

c. Consult with the ~~commissioner~~ department as soon as practical but no later than 24 hours after the owner learns of a violation of the treatment technique requirements for filtration and disinfection resulting from a single exceedance of the maximum allowable turbidity limit to determine whether a Tier 1 public notice is required to protect public health. If consultation does not take place within the 24-hour period, ~~then~~ the owner shall distribute a Tier 1 public notice of the violation within the next 24 hours (i.e., no later than 48 hours after the owner learns of the violation).

d. Provide the initial public notice and any repeat notices in a form and manner that is reasonably calculated to reach persons served in the required time period.

(1) For a community waterworks, the owner shall:

(a) Mail or otherwise directly deliver the public notice to each customer receiving a bill and to other service connections to which water is delivered by the waterworks; and

(b) Use any other distribution method reasonably calculated to reach other persons regularly served by the waterworks, if they would not normally be reached by the notice required in subdivision C 2 d (1) (a) of this ~~subsection~~ section. ~~Such-These~~ persons may include those who do not pay water bills or do not have service connection addresses (e.g., house renters, apartment dwellers, university students, nursing home patients, prison inmates, etc.). Other methods may include: ~~Publication~~ (i) publication in a local newspaper; (ii) delivery of multiple copies for distribution by customers that provide their drinking water to others (e.g., apartment building owners or large private employers); (iii) posting in public places served by the ~~system~~ waterworks or on the Internet; or (iv) delivery to community organizations.

(2) For a noncommunity waterworks, the owner shall:

(a) Post the public notice in conspicuous locations throughout the distribution system frequented by persons served by the waterworks, or by mail or direct delivery to each customer and service connection (where known); and

(b) Use any other method reasonably calculated to reach other persons served by the system if they would not normally be reached by the notice required in subdivision C 2 d (2) (a) of this ~~subsection~~ section. ~~Such-These~~ persons may include those served who may not see a posted notice because the posted notice is not in a location they routinely pass by. Other methods may include (i) publication in a local newspaper or newsletter distributed to customers; (ii) use of e-mail to notify employees or students; or (iii) delivery of multiple copies in central locations (e.g., community centers).

e. Maintain a posted public notice in place for as long as the violation, exceedance, or situation persists, but in no case for less than seven days, even if the violation, exceedance, or situation is resolved.

3. For Tier 3 violations, exceedances, or situations, the owner shall:

a. Provide the public notice not later than one year after the owner learns of the violation, exceedance, or situation, or begins operating under a variance or exemption.

b. Repeat the public notice annually for as long as the violation, exceedance, variance, exemption, or other situation persists.

c. Maintain a posted public notice in place for as long as the violation, exceedance, variance, exemption, or other situation persists, but in no case less than seven days even if the violation, exceedance, or situation is resolved.

d. Instead of individual Tier 3 public notices, the owner may use an annual report detailing all violations, exceedances, and situations that occurred during the previous ~~twelve-12~~ months, as long as the timing requirements of subdivision C 3 a of this ~~subsection~~ section are met. For a community waterworks, the Consumer Confidence Report (CCR) may be used as a vehicle for the initial Tier 3 public notice and all required repeat notices, provided that:

(1) The CCR is provided to persons served by the waterworks no later than 12 months after the owner learns of the violation, exceedance, or other situation.

(2) The Tier 3 public notice contained in the CCR meets the content requirements in subsection ~~E D~~ of this section.

(3) The CCR is distributed in a manner meeting the delivery requirements in subdivision ~~D 3 e C 3 e (1)~~ of this section.

e. For a community waterworks, the owner shall:

(1) Mail or otherwise directly deliver the public notice to each customer receiving a bill and to other service connections to which water is delivered by the waterworks; and

(2) Use any other method reasonably calculated to reach other persons regularly served by the system waterworks, if they would not normally be reached by the notice required in subdivision C 3 e (1) of this ~~subsection~~ section. ~~Such-These~~ persons may include those who do not pay water bills or do not have service connection addresses (e.g., house renters, apartment dwellers, university students, nursing home patients, prison inmates, etc.). Other methods may include (i) publication in a local newspaper, (ii) delivery of multiple copies for distribution by customers that provide their drinking water to others (e.g., apartment building owners or large private employers), (iii) posting in public places or on the Internet, or (iv) delivery to community organizations.

f. For a noncommunity waterworks, the owner shall:

(1) Post the public notice in conspicuous locations throughout the distribution system frequented by persons served by the waterworks, or by mail or direct delivery to each customer and service connection (where known); and

(2) Use any other method reasonably calculated to reach other persons served by the system, if they would not normally be reached by the notice required in subdivision 3 f (1) of this subsection. ~~Such-These~~ persons may include those who may not see a posted notice because the notice is not in a location they routinely pass by. Other methods may include: ~~Publication-(i) publication~~ in a local newspaper or newsletter distributed to customers; ~~-(ii) use of Ee-mail to notify employees or students; - or;~~ (iii) delivery of multiple copies in central locations (e.g., community centers).

#### D. Public notice contents.

1. Each public notice for PMCL, MRDL, and TT violations and other situations requiring a public notice shall include the following elements:

a. A description of the violation, exceedance, or situation, including the contaminant or contaminants ~~contaminant(e)~~ of concern, and (as applicable) the contaminant level(s) ~~level or levels~~;

b. When the violation, exceedance, or situation occurred;



- c. Any potential adverse health effects from the violation, exceedance, or situation, including the standard language under subdivision 5 a or 5 b of this subsection, whichever is applicable;
  - d. The population at risk, including subpopulations particularly vulnerable if exposed to the contaminant in their drinking water;
  - e. Whether alternative water supplies should be used;
  - f. What actions consumers should take, including when they should seek medical help, if known;
  - g. What the owner is doing to correct the violation, exceedance, or situation;
  - h. When the owner expects the waterworks to return to compliance or resolve the situation;
  - i. The name, business address, and phone number of the owner, operator, or designee as a source of additional information concerning the notice; and
  - j. A statement to encourage the notice recipient to distribute the public notice to other persons served, using the standard language under subdivision 5 c of this subsection, where applicable.
2. Each public notice for a waterworks that has been granted a variance or an exemption shall include the following elements:
- a. An explanation of the reasons for the variance or exemption;
  - b. The date on which the variance or exemption was issued;
  - c. A brief status report on the steps the owner is taking to install treatment, find alternative sources of source water, or otherwise comply with the terms and schedules of the variance or exemption; and
  - d. A notice of any opportunity for public input in the ~~review~~-evaluation of the variance or exemption.
3. Each public notice for a waterworks that violates the conditions of a variance or an exemption shall contain the ~~ten-10~~ elements listed in subdivision D\_1 of this ~~subsection~~ section.
4. Each public notice shall:
- a. Be displayed in a conspicuous way when printed or posted;
  - b. Not contain overly technical language or very small print;
  - c. Not be formatted in a way that defeats the purpose of the notice;
  - d. Not contain language ~~which~~that nullifies the purpose of the notice;
  - e. Contain information in the appropriate ~~language(s)~~language or languages, for waterworks serving a large proportion of non-English-~~speaking~~ speaking consumers, regarding the importance of the notice or contain a telephone number or address where persons served may contact the owner to obtain a translated copy of the notice or to request assistance in the appropriate language.
5. The public notice shall include the following standard language:
- a. For PMCL or MRDL violations, treatment technique violations, and violations of the condition of a variance or an exemption, ~~-- use~~ standard health effects language as specified in ~~Appendix O-12VAC5-590-546~~ corresponding to each PMCL, MRDL, and treatment technique violation and for each violation of a condition of a variance or an exemption. For violation of the treatment technique requirement, the public notice shall also include one or both of the following statements, as appropriate:
    - (1) We failed to conduct the required assessment.

(2) We failed to correct all sanitary defects that were identified during the assessment.

b. For monitoring and testing procedure violations including failure to monitor for total coliform bacteria or E. coli ~~prior to before~~ serving water from a seasonal waterworks, ~~-use~~ standard language as specified below, including the language necessary to fill in the blanks:

We are required to monitor your drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not your drinking water meets health standards. During (compliance period), we (did not monitor or test or did not complete all monitoring or testing) for (~~contaminant or contaminants~~ ~~contaminant(s)~~), and therefore cannot be sure of the quality of your drinking water during that time.

c. For all public notices, ~~-- use~~ standard language (where applicable), as specified below:

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (~~e.g., for example,~~ people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

d. For total coliform bacteria treatment technique violations, the public notice shall include the following statement: We found coliforms indicating the need to look for potential problems in our waterworks. When this occurs, we are required to conduct assessments to identify problems and correct any problems that are found. The public notice shall also include the following statements, as appropriate:

(1) We failed to conduct the required assessment.

(2) We failed to correct all sanitary defects that were identified during the assessment.

e. For E. coli treatment technique violations, the public notice shall include the following statement: "We violated the standard for E. coli, indicating the need to look for potential problems in our waterworks. When this occurs, we are required to conduct a detailed assessment to identify problems and to correct any problems that are found." The public notice shall also include the following statements, as appropriate:

(1) We failed to conduct the required assessment.

(2) We failed to correct all sanitary defects that were identified during the assessment.

E. Public notice to new billing units or customers.

1. For a community waterworks, the owner shall give a copy of the most recent public notice for any continuing violation, ~~exceedance, variance, or~~ exemption, or other ongoing situations requiring a public notice to all new billing units or new customers ~~prior to before~~ or at the time service begins.

2. For a noncommunity waterworks, the owner shall continuously post the public notice in conspicuous locations ~~in order to~~ inform new consumers of any continuing violation, ~~exceedance, variance, or~~ exemption, or other situation requiring a public notice for as long as the violation, ~~exceedance,~~ variance, exemption, or other situation persists.

F. Special notice of the availability of unregulated contaminant monitoring results.

1. The owner of a community waterworks or ~~a non-transient nontransient~~ noncommunity waterworks shall notify persons served by the ~~system waterworks~~ of the availability of the results of ~~such~~ the sampling no later than 12 months after the monitoring results are known.

2. The special notice shall meet the requirements ~~for of~~ a Tier 3 public notice and shall identify a person and telephone number to contact for information on the monitoring results.

G. Special notice for exceedance of the SMCL for fluoride.

1. ~~A Community~~ community waterworks that exceed the SMCL of 2 mg/L, but do not exceed the PMCL of 4 mg/L for fluoride, shall provide public notice to persons served as soon as practical but no later than 12 months from the day the owner learns of the exceedance.

2. A copy of the notice shall be sent to all new billing units and new customers at the time service begins and to the ~~district engineer~~ department.

3. The owner shall repeat the notice at least annually for as long as the SMCL is exceeded.

4. If the public notice is posted, then the notice shall remain in place for as long as the SMCL is exceeded, but in no case less than seven days even if the exceedance is eliminated.

5. On a case-by-case basis, the ~~commissioner~~ department may require an initial notice sooner than 12 months and repeat notices more frequently than annually.

6. The form and manner of the public notice (including repeat notices) shall meet the requirements ~~for of~~ a Tier 3 public notice.

7. The public notice shall contain the following language, including the language necessary to fill in the blanks:

This is an alert about your drinking water and a cosmetic dental problem that might affect children under nine years of age. At low levels, fluoride can help prevent cavities, but children drinking water containing more than 2 milligrams per liter (mg/L) of fluoride may develop cosmetic discoloration of their permanent teeth (dental fluorosis). The drinking water provided by your community waterworks (name) has a fluoride concentration of (insert value) mg/L. Dental fluorosis, in its moderate or severe forms, may result in a brown staining and/or pitting of the permanent teeth. This problem occurs only in developing teeth, before they erupt from the gums. Children under nine should be provided with alternative sources of drinking water or water that has been treated to remove the excess fluoride to avoid the possibility of staining and pitting of their permanent teeth. You may also want to contact your dentist about proper use by young children of fluoride-containing products by young children. Older children and adults may safely drink the water. Drinking water containing more than 4 mg/L of fluoride (the U.S. Environmental Protection Agency's drinking water standard) can increase your risk of developing bone disease. Your drinking water does not contain more than 4 mg/L of fluoride, but we are required to notify you when we discover that the fluoride levels in your drinking water exceed 2 mg/L because of this cosmetic dental problem. For more information, please call (name of water system contact) of (name of community waterworks) at (phone number). Some home water treatment units are also available to remove fluoride from drinking water. To learn more about available home water treatment units, you may call NSF International at ~~1-877-NSF-HELP~~ 1-877-867-3435 or email info@nsf.org.

H. Special notice for nitrate exceedances above PMCL by a noncommunity waterworks.

1. The owner of a noncommunity waterworks granted permission by the ~~commissioner~~ department to exceed the nitrate PMCL shall provide public notice to persons served meeting the requirements ~~for of~~ a Tier 1 notice.

2. The public notice shall be posted continuously and shall indicate the fact that nitrate levels exceed 10 mg/L and the potential health effects of exposure, meeting the requirements ~~for of~~ Tier 1 public notice delivery and content.

I. Special notice for repeated failure to conduct sampling of the source water for Cryptosporidium.

1. An owner who is required to sample source water shall provide public notice to persons served when he has failed to collect any three months of required samples. The form and manner of the public notice shall satisfy the requirements of a Tier 2 notice, and the notice shall be repeated in accordance with the requirements of a Tier 2 notice.

2. The notice shall contain the following language, including the language to fill in the blanks:

We are required to monitor the source of your drinking water for Cryptosporidium. Results of the monitoring are to be used to determine whether water treatment at the [blank – fill in treatment plant name] is sufficient to adequately remove Cryptosporidium from your drinking water. We are required to complete this monitoring and make this determination by [blank – fill in required bin determination date]. We "did not monitor" or "did not complete all monitoring or testing" on schedule and, therefore, we may not be able to determine by the required date what treatment modifications, if any, shall be made to ensure adequate Cryptosporidium removal. Missing this deadline may, in turn, jeopardize our ability to have the required treatment modifications, if any, completed by the deadline required, [blank – fill in date].

For more information, please call [blank – fill in name of waterworks contact] of [blank – fill in name of waterworks] at [blank – fill in phone number].

3. The notice shall contain a description of what the owner is doing to correct the violation and when the owner expects the waterworks to return to compliance or resolve the situation.

J. Special notice for failure to determine bin classification or mean Cryptosporidium level.

1. An owner who is required to determine a bin classification or to determine mean Cryptosporidium level shall provide public notice to persons served when the determination has not been made as required. The form and manner of the public notice shall satisfy the requirements of a Tier 2 notice, and the notice shall be repeated in accordance with the requirements of a Tier 2 notice. However, a public notice is not required if the owner is complying with a schedule to address the violation approved by the ODW department.

2. The notice shall contain the following language, including the language to fill in the blanks:

We are required to monitor the source of your drinking water for Cryptosporidium in order to determine by [blank – fill in date] whether water treatment at the [blank – fill in treatment plant name] is sufficient to adequately remove Cryptosporidium from you drinking water. We have not made this determination by the required date. Our failure to do this may jeopardize our ability to have the required treatment modifications, if any, completed by the required deadline of [blank – fill in date]. For more information, please call [blank – fill in name of waterworks contact] of [blank – fill in name of waterworks] at [blank – fill in telephone number].

3. The notice shall contain a description of what the owner is doing to correct the violation and when the owner expects the waterworks to return to compliance or resolve the situation.

K. Special notice for significant deficiencies by a noncommunity groundwater systems.

1. Any owner of a noncommunity groundwater system who has not corrected a significant deficiency within one year of being notified by the ODW department shall provide public notice to the consumers.

2. The form and manner of the public notice shall satisfy the requirements of a Tier 2 notice.

3. The owner shall continue to notify the public annually until the requirements of 12VAC5-590-421 have been satisfied. The notice shall include:

a. The nature of the significant deficiency and the date it was identified by the ~~ODW~~ department; and

b. The ~~ODW~~ department approved plan and schedule for correcting the significant deficiency including interim measures, progress to date, and which of the interim measures have been completed.

4. For a noncommunity groundwater systems with a large proportion of non-English-~~speaking speaking~~ consumers, the notice shall contain information in the appropriate language or languages regarding the importance of the notice or contain a telephone number or address where the consumers may contact the owner to obtain a translated copy of the notice or assistance with the appropriate language.

5. If directed by the ~~ODW~~ department, the owner of a noncommunity groundwater system with significant deficiencies that have been corrected shall inform the consumers of the significant deficiencies, how the deficiencies were corrected, and the date or dates of correction.

L. The ~~district engineer~~ commissioner department may give notice to the public required by this section on behalf of the owner as long as the notice if the district engineer commissioner complies with the requirements of this section. However, the owner remains legally responsible for ensuring that the requirements of this section are met.

M. The ~~commissioner department~~ may require an owner to provide public notice for significant changes in water quality.

N. Within 10 days of completion of each initial and repeat public notice, the owner shall provide the ~~district engineer department~~ with the following:

1. A certification that he has fully complied with the public notice requirements; and

2. A representative copy of each type of notice that was distributed, published, posted, and made available to the persons served by the waterworks and to the media.

~~NO~~. The owner shall maintain copies of each public notice and certification for at least three years after issuance.

#### **12VAC5-590-545. Consumer confidence reports.**

A. Purpose and applicability.

1. ~~Each-The owner of a~~ community waterworks ~~owner~~ shall deliver to his customers an annual report that contains information on the quality of the water delivered by the waterworks and characterizes the risks, if any, from exposure to contaminants detected in the drinking water.

2. For the purpose of this section, customers are defined as billing units or service connections to which water is delivered by a community waterworks.

3. For the purpose of this section, a contaminant is detected when the laboratory reports the contaminant level as a measured level and not as nondetected (ND) or less than (<) a certain level. The owner shall utilize a laboratory that complies with ~~12VAC5-590-340, and the laboratory's analytical and reporting procedures shall have been in accordance with 12VAC5-590-440; laboratory certification requirements of the Commonwealth of Virginia, Department of General Services, Division of Consolidated Laboratory Services; and consistent with current U. S. Environmental Protection Agency regulations found at 40 CFR Part 144. 12VAC5-590-440.~~

B. Effective dates.

1. ~~The owner of an Each~~-existing community waterworks ~~owner~~ shall deliver his report by July 1 annually.
2. The owner of a new community waterworks shall deliver his first report by July 1 of the year after its first full calendar year in operation and annually thereafter.
3. The owner of a community waterworks that sells water to a consecutive waterworks shall deliver the applicable information necessary to comply with the requirements contained in this section to the consecutive waterworks by April 1 annually, or on a date mutually agreed upon by the seller and the purchaser and specifically included in a contract between the parties.

C. Content.

1. ~~Each~~~~The owner of a~~ community waterworks ~~owner~~ shall provide his customers an annual report that contains the information on the source of the water delivered as follows:
  - a. Each report shall identify the source or sources of the water delivered by the community waterworks by providing information on:
    - (1) The type of the source water (e.g., surface water, ground-water); and
    - (2) The commonly used name, if any, and location of the body or bodies of the source water.
  - b. Where a source water assessment has been completed, the report shall:
    - (1) Notify consumers of the availability of the assessment;
    - (2) Describe the means to obtain the assessment; and
    - (3) Include a brief summary of the waterworks' susceptibility to potential sources of contamination.
  - c. The owner ~~should~~ is encouraged to highlight in the report significant sources of contamination in the source water area if ~~such~~ the information is readily available.
2. For the purpose of compliance with this section, ~~each~~~~the~~ report shall include the following definitions:
  - a. "Maximum contaminant level goal" or "MCLG" means the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
  - b. "Maximum contaminant level" or "MCL" means the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
  - c. ~~A~~~~The~~ report for a community waterworks operating under a variance or an exemption issued by the ~~commissioner~~~~department~~ under 12VAC5-590-140 and 12VAC5-590-150 shall include the following definition: "Variances and exemptions" means state or EPA permission not to meet an MCL or a treatment technique under certain conditions.
  - d. ~~A~~~~The~~ report that contains data on contaminants that EPA regulates using any of the following terms shall include the applicable definitions:
    - (1) "Treatment technique" means a required process intended to reduce the level of a contaminant in drinking water.
    - (2) "Action level" means the concentration of a contaminant that, if exceeded, triggers treatment or other requirements that an owner shall follow.
    - (3) "Maximum residual disinfectant level goal" or "MRDLG" means the level of a drinking water disinfectant below which there is no known or expected risk to health.

MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

(4) "Maximum residual disinfectant level" or "MRDL" means the highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for the control of microbial contaminants.

(5) "Level 1 assessment" means a study of the waterworks to identify potential problems and determine, if possible, why total coliform bacteria have been found in our waterworks.

(6) "Level 2 assessment" means a very detailed study of the waterworks to identify potential problems and determine, if possible, why an E. coli PMCL violation has occurred and why total coliform bacteria have been found in our waterworks on multiple occasions.

### 3. Information on detected contaminants.

a. This section specifies the requirements for information to be included in ~~each~~the report for ~~the following contaminants:~~

~~(1) Contaminants subject to a PMCL, action level, maximum residual disinfectant level, or treatment technique as specified in 12VAC5-590-370;~~

~~(2) Unregulated contaminants subject to monitoring as specified in 12VAC5-590-370; and~~

~~(3) Disinfection byproducts or microbial contaminants,, except as provided under subdivision 5 a of this subsection, and which are detected in the finished water contaminants subject to a PMCL, action level, MRDL, or treatment technique as specified in 12VAC5-590-340.~~

b. The data relating to these contaminants shall be displayed in one table or in several adjacent tables. Any additional monitoring results that an owner of a community waterworks ~~owner~~ chooses to include in the report shall be displayed separately.

c. The data shall be derived from data collected to comply with EPA and state monitoring and analytical requirements during the calendar year preceding the year the report is due, except that where an owner is allowed to monitor for contaminants specified in subdivision C 3 a (1) and 3 a (3) of this ~~subsection~~section less often than once a year, the table or tables shall include the date and results of the most recent sampling, and the report shall include a brief statement indicating that the data presented in the report are from the most recent testing done in accordance with the regulations. No data older than five years need be included.

d. For detected contaminants subject to a PMCL, action level, MRDL, or treatment technique as specified in ~~12VAC5-590-370 and listed in Tables 2.1, 2.2 (Primary Maximum Contaminant Levels only), 2.3, 2.4 (Primary Maximum Contaminant Levels only), and 2.5 listed in Tables 340.1 through 340.7,~~

(1) The PMCL for that contaminant expressed as a number equal to or greater than 1.0 as provided in ~~Appendix O, with an exception for beta/photon emitters. When the detected level of beta/photon emitters has been reported in the units of pCi/L and does not exceed 50 pCi/L, the report may list the PMCL as 50 pCi/L. In this case, the owner shall include in the report the following footnote: The PMCL for beta particles is 4 mrem/year. EPA considers 50 pCi/L to be the level of concern for beta particles~~ 12VAC5-590-546;

(2) The MCLG for that contaminant expressed in the same units as the PMCL as provided in ~~Appendix O~~ 12VAC5-590-546;

(3) If there is no PMCL for a detected contaminant, then the table shall indicate that there is a treatment technique, or specify the action level, applicable to that contaminant, and the report shall include the definitions for either treatment technique and/or action level or both, as appropriate, specified in subdivision C 3 d of this ~~subsection~~section;

(4) For contaminants subject to a PMCL, except turbidity and E. coli, the highest contaminant level used to determine compliance and the range of detected levels is as follows:

(a) When compliance with the PMCL is determined annually or less frequently, the highest detected level at any sampling point and the range of detected levels expressed in the same units as the PMCL.

(b) When compliance with the PMCL is determined by calculating a ~~running annual average- RAA~~ of all samples ~~taken~~collected at a sampling point, the highest average of any of the sampling points and the range of all sampling points expressed in the same units as the PMCL. For the PMCLs for TTHM and HAA5, the owner shall include the highest ~~locational running annual average- LRAA~~ and the range of individual sample results for all sampling points expressed in the same units as the PMCL. If more than one location exceeds the TTHM or HAA5 PMCL, then the owner shall include the ~~locational running annual averages- LRAAs~~ for all locations that exceed the PMCL.

(c) When compliance with the PMCL is determined on a ~~systemwide~~system-wide basis by calculating a ~~running annual average- RAA~~ of all samples at all sampling points, the average and range of detection expressed in the same units as the PMCL. The range of detection for TTHM and HAA5 shall include the individual sample results ~~for the IDSE conducted under 12VAC5-590-370 B 3 e (2) for the calendar year that the IDSE samples were taken for the purpose of establishing the monitoring locations for EPA's "Stage 2 Disinfectants and Disinfection Byproducts Rule."~~ initial distribution system evaluation.

(5) For turbidity, the highest single measurement and the lowest monthly percentage of combined filter samples meeting the turbidity limits specified in ~~12VAC5-590-420~~12VAC5-590-395 A 2 b for the filtration technology being used. The report should include an explanation of the reasons for measuring turbidity;

(6) For lead and copper, the 90th percentile value of the most recent round of sampling and the number of sampling sites exceeding the action level;

(7) For E. coli, the total number of positive samples;

(8) The likely source or sources of the detected contaminants. Specific information regarding contaminants may be available in sanitary surveys and source water assessments, and should be used when available to the owner. If the owner lacks specific information on the likely source, then the report shall include one or more of the typical sources for that contaminant listed in ~~Appendix Q~~12VAC5-590-546 that are most applicable to the system.

e. If the owner of a community waterworks ~~owner~~ distributes water to his customers from multiple hydraulically independent distribution systems that are fed by different ~~raw water sources~~source waters, then:

(1) The table shall contain a separate column for each service area and the report shall identify each separate distribution system; or

(2) The owner shall produce a separate report tailored to include data for each service area.



f. The table or tables shall clearly identify any data indicating violations of PMCLs, MRDLs, or treatment techniques and the report shall contain a clear and readily understandable explanation of the violation including:

- (1) The length of the violation;
- (2) The potential adverse health effects using the relevant language of ~~Appendix~~ 12VAC5-590-546; and
- (3) Actions taken by the ~~waterworks~~ owner to address the violation.

~~g. For detected unregulated contaminants subject to monitoring as specified in 12VAC5-590-370 and listed in Tables 2.6 and 2.7, for which monitoring is required, the table or tables shall contain the average and range at which the contaminant was detected. The report may include a brief explanation of the reasons for monitoring for unregulated contaminants.~~

4. Information on Cryptosporidium, radon, and other contaminants:

a. If the owner has performed any monitoring for Cryptosporidium, which indicates that Cryptosporidium may be present in the source water or the finished water, then the report shall include:

- (1) A summary of the results of the monitoring; and
- (2) An explanation of the significance of the results.

b. If the owner has performed any monitoring for radon, which indicates that radon may be present in the finished water, then the report shall include:

- (1) The results of the monitoring; and
- (2) An explanation of the significance of the results.

c. If the owner has performed additional monitoring that indicates the presence of other contaminants in the finished water, then the report should include any results that may indicate a health concern, as determined by the commissioner. Detections above a proposed MCL or health advisory level may indicate possible health concerns. For ~~such~~ these contaminants, the report should include:

- (1) The results of the monitoring; and
- (2) An explanation of the significance of the results noting the existence of a health advisory or a proposed regulation.

5. Compliance with other regulations.

~~a.~~ In addition to the requirements of subdivision C 3 f of this ~~subsection~~ section, the report shall note any violation that occurred during the year covered by the report of a requirement listed below.

~~(1)~~a. Monitoring and reporting of compliance data;

~~(2)~~b. Filtration and disinfection prescribed by ~~42VAC5-590-420~~12VAC5-590-395. For ~~an owner~~ owners who ~~have~~ has failed to install adequate filtration or disinfection equipment or processes, or ~~have~~ has had a failure of such equipment or processes ~~which~~ that constitutes a violation, the report shall include the following language as part of the explanation of potential adverse health effects: Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites, which can cause symptoms such as nausea, cramps, diarrhea, and associated headaches;

~~(3)~~c. Lead and copper control requirements prescribed by ~~42VAC5-590-370~~12VAC5-590-375. For ~~an owner~~ owners who ~~fails~~ to take one or more of the prescribed actions,

the report shall include the applicable language of ~~Appendix O~~ 12VAC5-590-546 for lead, copper, or both;

~~(4)d.~~ Treatment techniques for Acrylamide~~acrylamide~~ and Epichlorohydrin~~epichlorohydrin~~ prescribed by ~~12VAC5-590-420 G~~ 12VAC5-590-395 B. For ~~an owner~~ ~~owners~~ who violates the requirements of that section, the report shall include the relevant language from ~~Appendix O~~; 12VAC5-590-546;

~~(5)e.~~ Recordkeeping of compliance data;

~~(6)f.~~ Special monitoring requirements for ~~unregulated contaminants prescribed by 12VAC5-590-370 B 4~~ and for sodium; ~~and~~

~~(7)g.~~ Violation of the terms of a variance, an exemption, or an administrative or judicial order.

b. The report shall contain:

(1) A clear and readily understandable explanation of the violation;

(2) Any potential adverse health effects; and

(3) The steps the owner has taken to correct the violation.

c. For community groundwater systems, the following shall be included:

(1) A significant deficiency that is uncorrected at the time of the report, or;

(2) An E. coli positive groundwater source sample that is not invalidated at the time of the report.

d. The owner of a community groundwater system shall report annually the information in subdivision 5 c of this subsection until the ODW determines that the significant deficiency or the E. coli positive source water sample has been satisfactorily addressed. The report shall include the following information:

(1) The nature of the significant deficiency or the source of the E. coli contamination and the date the significant deficiency was identified by the ODW or the date or dates of the E. coli positive source samples.

(2) If the E. coli contamination has been addressed in accordance with 12VAC5-590-424 and the date of such action.

(3) The ODW approved plan and schedule for correcting the significant deficiency or E. coli contamination including interim measures, progress to date, and which interim measures have been completed.

(4) In communities with a large portion of non English speaking consumers, the notice shall contain information in the appropriate language or languages regarding the importance of the notice or contain a telephone number or address where the consumers may contact the owner to obtain a translated copy of the notice or assistance with the appropriate language.

(5) For E. coli contamination, the potential health effects language shall be included.

e. If directed by the ODW, the owner of a community groundwater system with significant deficiencies that have been corrected at the time of the report shall inform his consumers of the significant deficiencies, how the deficiencies were corrected, and the date or dates of correction under subdivisions 5 d (1) through (4) of this subsection.

6. Variances and exemptions. If a ~~system~~ ~~waterworks~~ is operating under the terms of a variance or an exemption issued by the commissioner under 12VAC5-590-140 and 12VAC5-590-150, ~~then~~ the report shall contain:

a. An explanation of the reasons for the variance or exemption;

b. The date on which the variance or exemption was issued;

- c. A brief status report on the steps the owner is taking to install treatment, find alternative sources of source water, or otherwise comply with the terms and schedules of the variance or exemption; and
- d. A notice of any opportunity for public input in the review-evaluation or renewal of the variance or exemption.

7. Additional information.

a. The report shall contain a brief explanation regarding contaminants, which may reasonably be expected to be found in drinking water including bottled water. This explanation shall include the exact language of subdivisions 7 a (1), 7 a (2), and 7 a (3) of this subsection or the owner shall use his own comparable language following approval by the commissioner~~department~~. The report also shall include the exact language of subdivision 7 a (4) of this subsection.

(1) The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

(2) Contaminants that may be present in source water include: (i) microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife; (ii) inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming; (iii) pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses; (iv) organic chemical contaminants, including SOCs and VOCs, ~~synthetic and volatile organic chemicals~~, which are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems; and (v) radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

(3) ~~In order to~~ To ensure that tap water is safe to drink, EPA prescribes regulations that limit the amount of certain contaminants in the water provided by public ~~water systems~~waterworks. The U.S. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water, which must provide the same protection for public health.

(4) Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the ~~Environmental Protection Agency's~~ EPA's Safe Drinking Water Hotline (800-426-4791).

(5) Notice about initiating or permanently ceasing a program to deliver the optimum fluoride ion concentration may be included in the CCR if the CCR delivery occurs earlier than the public notice specified in 12VAC5-590-540 A 4 c. The intent to permanently discontinue fluoridation may be included in the CCR if it occurs earlier than the public notice specified in 12VAC5-590-540 A 4 c.

b. The report shall include the telephone number of the owner, operator, or designee of the community waterworks as a source of additional information concerning the report.

c. In communities with a large proportion of non-English-speaking residents, as determined by the ~~commissioner~~department, the report shall contain information in the appropriate language or languages regarding the importance of the report or contain a telephone number or address where ~~such~~the residents may contact the ~~system waterworks~~ to obtain a translated copy of the report or assistance in the appropriate language.

d. The report shall include the following information about opportunities for public participation in decisions that may affect the quality of the drinking water. The ~~waterworks~~owner should consider including the following additional relevant information:

(1) The time and place of regularly scheduled board meetings of the governing body ~~which that~~ has authority over the waterworks; ~~and~~

(2) If regularly scheduled board meetings are not held, ~~then~~ the name and telephone number of a waterworks representative who has operational or managerial authority over the waterworks.

e. The owner may include ~~such~~additional information as he deems necessary for public education consistent with, and not detracting from, the purpose of the report.

f. For a community groundwater systems:

(1) Where there is ~~any-a~~ significant deficiency that is uncorrected at the time of the report or ~~any-an~~ E. coli-positive ~~positive groundwater~~source water sample that is not invalidated in accordance with 12VAC5-590-380 at the time of the report, the owner shall report the following:

(a) The nature of the significant deficiency or the source water, if known, of the E. coli contamination;

(b) The date the significant deficiency was identified by the department or the date or dates of the E. coli-positive ~~positive groundwater~~source water samples;

(c) If the E. coli contamination has been addressed in accordance with 12VAC5-590-421 and the date of the action;

(d)The department- approved plan and schedule, including interim measures, progress to date, and which interim measures have been completed, for correcting the significant deficiency or E. coli contamination; and

(e) The potential health effects language in 12VAC5-590-546 for an E. coli-positive ~~positive~~source water sample that is not invalidated in accordance with 12VAC5-590-380.

(2) If directed by the ~~commissioner~~department, where there are significant deficiencies that have been corrected at the time of the report, ~~then~~ the owner shall report the significant deficiencies, how the deficiencies were corrected, and the date or dates of correction.

#### D. Additional health information.

1. All reports shall prominently display the following language: Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer who are undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. ~~EPA/CDC~~ EPA/Center for Disease Control (CDC) guidelines on appropriate means to

lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

2. Any ~~waterworks~~ owner who detects arsenic at levels above 0.005 mg/L, but equal to or below the PMCL of 0.010 mg/L, shall include in his report the following informational statement about arsenic: While your drinking water meets EPA's standard for arsenic, it does contain low levels of arsenic. EPA's standard balances the current understanding of arsenic's possible health effects against the cost of removing arsenic from drinking water. EPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

~~In lieu~~ Instead of the statement required in this subdivision, the ~~waterworks~~ owner may include his own educational statement after receiving approval from the ~~commissioner~~ department.

3. A ~~waterworks~~ owner who detects arsenic levels above 0.010 mg/L shall include the ~~health effects language contained in Appendix O.~~

4. An owner who detects nitrate at levels above 5 mg/L, but below the PMCL, shall include in his report the following informational statement about the impacts of nitrate on children: Nitrate in drinking water at levels above 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity. If you are caring for an infant, then you should ask advice from your health care provider.

~~In lieu~~ Instead of the statement required in this subdivision, the ~~waterworks~~ owner may include his own educational statement after receiving approval from the ~~commissioner~~ department.

5. All reports shall prominently display the following language: "If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. (Name of Utility) is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to two minutes before using water for drinking or cooking. If you are concerned about lead in your water, then you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (800-426-4791).

~~In lieu~~ Instead of the statement required in this subdivision, the owner may include his own educational statement after receiving approval from the ~~commissioner~~ department.

6. ~~Community waterworks owners who detect TTHM above 0.080 mg/L, but below the PMCL, as an annual average shall include health effects language prescribed by paragraph 82 of Appendix O.~~

E. ~~The owner of a Community~~ community waterworks ~~owners~~ required to complete a Level 1 or a Level 2 assessment that is not due to an E. coli PMCL violation shall include in the report the text specified in subdivisions E 1, ~~E 2,~~ and through E 3 of this section, as appropriate, filling in the blanks accordingly, and shall include in the report the text specified in subdivision E 4 of this section, if appropriate.

1. Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, waterborne pathogens may be present or that a potential pathway exists through which contamination may enter the drinking water

distribution system. We found coliforms indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct assessments to identify problems and to correct any problems that are found.

2. During the past year, we were required to conduct (insert the number of Level 1 assessments) Level 1 assessments. (insert the number of Level 1 assessments) Level 1 assessments were completed. In addition, we were required to ~~take-collect~~ (insert the number of corrective actions) corrective actions and we completed (insert the number of corrective actions) of these actions.

3. During the past year (insert the number of Level 2 assessments) Level 2 assessments were required to be completed for our waterworks. (insert the number of Level 2 assessments) Level 2 assessments were completed. In addition, we were required to ~~take collect~~ (insert the number of corrective actions) corrective actions and we completed (insert the number of corrective actions) of these actions.

4. Any owner who failed to complete all of the required assessments or correct all identified sanitary defects shall also include one or both of the following statements, as appropriate:

a. During the past year, we failed to conduct all of the required assessments.

b. During the past year, we failed to correct all identified sanitary defects that were found during the assessments.

F. ~~The owner of a Community community~~ waterworks ~~owners~~ required to conduct Level 2 assessments due to an E. coli PMCL violation shall include in the report the text specified in subdivisions F 1 and F 2 of this section, filling in the blanks accordingly, and shall include in the report the text specified in subdivision F 3 of this section, if appropriate.

1. E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely compromised immune systems. We found E. coli, indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct assessments to identify problems and to correct any problems that are found.

2. We were required to complete a Level 2 assessment because we found E. coli in our waterworks. In addition, we were required to ~~take-collect~~ (insert number of corrective actions) corrective actions and we completed (insert number of corrective actions) of these actions.

3. Any owner who has failed to complete the required assessment or correct all identified sanitary defects shall also include one or both of the following statements, as appropriate:

a. We failed to conduct the required assessment.

b. We failed to correct all sanitary defects that were identified during the assessment that we conducted.

4. If ~~a waterworks detects~~ E. coli is detected in a waterworks and ~~has violated~~ the E. coli PMCL is violated, in addition to completing the table as specified in subdivision C 3 d of this section, the owner shall include one or more of the following statements to describe any noncompliance, as applicable:

a. We had an E. coli-positive repeat sample following a total coliform-positive routine sample.

b. We had a total coliform-positive repeat sample following an E. coli-positive routine sample.

c. We failed to ~~take collect~~ all the required repeat samples following an E. coli-positive routine sample.

d. We failed to test for E. coli when any repeat sample tested positive for total coliform.

5. If ~~a waterworks detects~~ E. coli is detected in a waterworks and ~~has not violated~~ the E. coli PMCL is not violated, in addition to completing the table as specified in subdivision C 3 d of this section, the owner may include a statement that explains that although ~~they have detected~~ E. coli was detected, they are he is not in violation of the E. coli PMCL.

G. Report delivery and recordkeeping.

1. ~~Each~~ The owner of a community waterworks ~~owner~~ shall mail or otherwise directly deliver one copy of the report to each customer, except as follows:

a. ~~Owners~~ The owner of community waterworks serving fewer than 10,000 persons shall have the option to either mail (or otherwise directly deliver) a copy of the report to each customer or publish the report in a local newspaper or newspapers of general circulation serving the area in which the waterworks is located by July 1 of each year; and

b. If the owner chooses to publish the report, then the owner shall inform customers, either in the newspaper in which the report is to be published or by other means approved by the ~~commissioner~~ department, that a copy of the report will not be mailed to them and that a copy of the report will be made available to the public upon request.

2. The owner of a Community-community waterworks ~~owners~~ shall make a good faith effort to deliver the report to the consumers who are served by the waterworks but are not bill paying customers, such as renters or workers. This good faith effort shall include at least one, and preferably two or more, of the following methods appropriate to the particular waterworks:

a. Posting the reports on the Internet;

b. Mailing to postal patrons in metropolitan areas;

c. Advertising the availability of the report in the news media;

d. Publication in a local newspaper;

e. Posting in public places such as libraries, community centers, and public buildings;

f. Delivery of multiple copies for distribution by single-biller customers such as apartment buildings or large private employers;

g. Delivery to community organizations; or

h. Other methods as approved by the ~~commissioner~~ department.

3. No later than July 1 of each year, the owner of a community waterworks ~~owners~~ shall deliver a copy of the report to the ~~district engineer~~ department, followed within three months by a certification that the report has been distributed to customers and that the information in the report is correct and consistent with the compliance monitoring data previously submitted to the ~~commissioner~~ department.

4. No later than July 1 of each year, the owner of a community waterworks ~~owners~~ shall deliver the report to any other agency or clearinghouse specified by the ~~commissioner~~ department.

5. The owner of a Community-community waterworks ~~owners~~ shall make the report available to the public upon request.

6. The owner of ~~each a~~ community waterworks serving 100,000 or more persons shall post the current year's report to a publicly accessible site on the Internet.

7. The owner of a Community community waterworks owners shall retain copies of the report for no less than three years.

**12VAC5-590-546. Regulated contaminants for the consumer confidence reports and public notification.**

A. Public notices and consumer confidence reports (CCRs) shall contain the appropriate mandatory language and information listed, as required by 12VAC5-590-540 and 12VAC5-590-545.

B. Information on regulated contaminants is presented in Table 546.1.

TABLE 546.1.

Content Requirements of Consumer Confidence Reports and Public Notices.

CONTAMINANT (UNITS)	TRADITIONAL PMCL IN MG/L	TO CONVERT FOR CCR, MULTIPLY BY	PMCL IN CCR UNITS	MCLG	MAJOR SOURCES IN DRINKING WATER	HEALTH EFFECTS LANGUAGE
<b>Microbiological Contaminants</b>						
(1) Total Coliform Bacteria		11		n/a	Naturally present in the environment	Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially-harmful, waterborne pathogens may be present or that a potential pathway exists through which contamination may enter the waterworks.
(2) E. coli	PMCL: In compliance unless (i) the waterworks has an E. coli-positive repeat sample following a total coliform-positive routine sample; (ii) the waterworks has a total coliform-positive repeat sample following an E. coli-positive routine sample; (iii) the waterworks owner fails to			0	Human and animal fecal waste	E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects, such as

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	<u>collect all required repeat samples following an E. coli positive routine sample; or (iv) the waterworks owner fails to test for E. coli when any repeat sample tests positive for total coliform.</u>				<u>diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely-compromised immune systems.</u>
<u>(3) E. coli</u>	<u>TT</u>			<u>n/a</u>	<u>Human and animal fecal waste</u>  <u>E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely compromised immune system.</u>
<u>(4) Source water fecal indicator (E. coli)</u>	<u>TT</u>		<u>TT</u>	<u>0 for E. coli</u>	<u>Fecal indicators are microbes whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short term health effects, such as diarrhea, cramps, nausea, headaches,</u>

						<p>or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune system.</p>
<p>(5) Groundwater rule TT violations other than source water fecal indicator E. coli above<sup>a</sup></p>	TT			TT		<p>Inadequately treated or inadequately protected water may contain disease-causing organisms. These organisms can cause symptoms such as diarrhea, nausea, cramps, and associated headaches.</p>
<p>(6) Turbidity</p>	TT		TT	n/a	Soil runoff	<p>Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches.</p>
<p>(7) Giardia lamblia, viruses, Hetrotropic plate</p>	TT <sup>c</sup>		n/a	0	n/a	<p>Inadequately treated water may contain disease-causing organisms. These</p>

<u>count, Legionella, Cryptosporidium<sup>a</sup></u>						<u>organisms include bacteria, viruses, and parasites which can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.</u>
<b>Radioactive Contaminants</b>						
<u>(8) Beta/photon emitters (mrem/yr)</u>	<u>4 mrem/yr</u>		<u>4</u>	<u>0</u>	<u>Decay of natural and man-made deposits</u>	<u>Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
<u>(9) Alpha emitters (pCi/L)</u>	<u>15 pCi/L</u>		<u>15</u>	<u>0</u>	<u>Erosion of natural deposits</u>	<u>Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
<u>(10) Combined radium (pCi/L)</u>	<u>5 pCi/L</u>		<u>5</u>	<u>0</u>	<u>Erosion of natural deposits</u>	<u>Some people who drink water containing radium-226 or radium-228 in excess of the PMCL over many years may have</u>

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						an increased risk of getting cancer.
(11) Uranium (ppb)	30 µg/L		30	0	Erosion of natural deposits	Some people who drink water containing uranium in excess of the PMCL over many years may have an increased risk of getting cancer and kidney toxicity.
<b>Inorganic Contaminants</b>						
(12) Antimony (ppb)	0.006	1000	6	6	Discharge from petroleum refineries; fire retardants; ceramics; electronics ; solder	Some people who drink water containing antimony well in excess of the PMCL over many years could experience increases in blood cholesterol and decreases in blood sugar.
(13) Arsenic (ppb)	0.010	1000	10.	0	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes	Some people who drink water containing arsenic in excess of the PMCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.
(14) Asbestos (MFL)	7 MFL		7	7	Decay of asbestos cement water mains; Erosion of natural deposits	Some people who drink water containing asbestos in excess of the PMCL over many years may have an increased risk of developing

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						benign intestinal polyps.
(15) Barium (ppm)	<u>2</u>		<u>2</u>	<u>2</u>	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits	Some people who drink water containing barium in excess of the PMCL over many years could experience an increase in their blood pressure.
(16) Beryllium (ppb)	<u>0.004</u>	<u>1000</u>	<u>4</u>	<u>4</u>	Discharge from metal refineries and coal-burning factories; Discharge from electrical, aerospace, and defense industries	Some people who drink water containing beryllium well in excess of the PMCL over many years could develop intestinal lesions.
(17) Cadmium (ppb)	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>5</u>	Corrosion of galvanized pipes; Erosion of natural deposits; Discharge from metal refineries; Run-off from waste batteries and paints	Some people who drink water containing cadmium in excess of the PMCL over many years could experience kidney damage.
(18) Chromium (ppb)	<u>0.1</u>	<u>1000</u>	<u>100</u>	<u>100</u>	Discharge from steel and pulp mills; Erosion of natural deposits	Some people who drink water containing chromium well in excess of the PMCL over many years could experience allergic dermatitis.

<u>(19) Copper (ppm)</u>	<u>AL=1.3</u>		<u>AL=1.3</u>	<u>1.3</u>	<u>Corrosion of household plumbing systems; Erosion of natural deposits</u>	<u>Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.</u>
<u>(20) Cyanide (ppb)</u>	<u>0.2</u>	<u>1000</u>	<u>200</u>	<u>200</u>	<u>Discharge from steel/metal factories; Discharge from plastic and fertilizer factories</u>	<u>Some people who drink water containing cyanide well in excess of the PMCL over many years could experience nerve damage or problems with their thyroid.</u>
<u>(21) Fluoride (ppm)</u>	<u>4</u>		<u>4</u>	<u>4</u>	<u>Erosion of natural deposits; Water additive which promotes strong teeth; Discharge from fertilizer and aluminum factories</u>	<u>Some people who drink water containing fluoride in excess of the PMCL over many years could get bone disease, including pain and tenderness of the bones. Fluoride in drinking water at half the PMCL or more may cause mottling of children's teeth.</u>

						usually in children less than nine years old. Mottling, also known as dental fluorosis, may include brown staining and/or pitting of the teeth, and occurs only in developing teeth before they erupt from the gums.
(22) Lead (ppb)	AL=0.015	1000	AL=15	0	Corrosion of household plumbing systems; Erosion of natural deposits	Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.
(23) Mercury [inorganic] (ppb)	0.002	1000	2	2	Erosion of natural deposits; Discharge from refineries and factories; Runoff from landfills; Runoff from cropland	Some people who drink water containing inorganic mercury well in excess of the PMCL over many years could experience kidney damage.
(24) Nitrate (ppm)	10		10	10	Runoff from fertilizer	Infants below the age of six months who drink water

					<u>use;</u> <u>Leaching from septic tanks,</u> <u>sewage;</u> <u>Erosion of natural deposits</u>	<u>containing nitrate in excess of the PMCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.</u>
(25) Nitrite (ppm)	<u>1</u>		<u>1</u>	<u>1</u>	<u>Runoff from fertilizer use;</u> <u>Leaching from septic tanks,</u> <u>sewage;</u> <u>Erosion of natural deposits</u>	<u>Infants below the age of six months who drink water containing nitrite in excess of the PMCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.</u>
(26) Total Nitrate and Nitrite	<u>10</u>		<u>n/a</u>	<u>10</u>	<u>n/a</u>	<u>Infants below the age of six months who drink water containing nitrate and nitrite in excess of the PMCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.</u>
(27) Selenium (ppb)	<u>0.05</u>	<u>1000</u>	<u>50</u>	<u>50</u>	<u>Discharge from petroleum and metal refineries;</u> <u>Erosion of natural deposits;</u> <u>Discharge from mines</u>	<u>Selenium is an essential nutrient. However, some people who drink water containing selenium in excess of the PMCL over many years could experience hair or fingernail losses, numbness in</u>



						fingers or toes, or problems with their circulation.
(28) Thallium (ppb)	0.002	1000	2	0.5	Leaching from ore-processing sites; Discharge from electronics, glass, and drug factories	Some people who drink water containing thallium in excess of the PMCL over many years could experience hair loss, changes in their blood, or problems with their kidneys, intestines, or liver.
<u>Synthetic Organic Chemicals Contaminants</u> including Pesticides and Herbicides						
(29) 2,4-D (ppb)	0.07	1000	70	70	Runoff from herbicides used on row crops	Some people who drink water containing the weed killer 2,4-D well in excess of the PMCL over many years could experience problems with their kidneys, liver, or adrenal glands.
(30) 2,4,5-TP [Silvex] (ppb)	0.05	1000	50	50	Residue of banned herbicide	Some people who drink water containing silvex in excess of the PMCL over many years could experience liver problems.
(31) Acrylamide	11		11	0	Added to water during sewage/wastewater treatment	Some people who drink water containing high levels of acrylamide over a long period of time could have problems with their nervous system or blood, and may have an increased risk of getting cancer.

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(32) Alachlor (ppb)	<u>0.002</u>	<u>1000</u>	<u>2</u>	<u>0</u>	Runoff from herbicide used on row crops	Some people who drink water containing alachlor in excess of the PMCL over many years could have problems with their eyes, liver, kidneys, or spleen, or experience anemia, and may have an increased risk of getting cancer.
(33) Atrazine (ppb)	<u>0.003</u>	<u>1000</u>	<u>3</u>	<u>3</u>	Runoff from herbicide used on row crops	Some people who drink water containing the atrazine well in excess of the PMCL over many years could experience problems with their cardiovascular system or reproductive difficulties.
(34) Benzo(a)pyrene[P AH]	<u>0.0002</u>	<u>1,000,000</u>	<u>200</u>	<u>0</u>	Leaching from linings of water storage tanks and distribution lines	Some people who drink water containing benzo(a)pyrene in excess of the PMCL over many years could experience reproductive difficulties and may have an increased risk of getting cancer.
(35) Carbofuran (ppb)	<u>0.04</u>	<u>1000</u>	<u>40</u>	<u>40</u>	Leaching of soil fumigant used on rice and alfalfa	Some people who drink water containing carbofuran in excess of the PMCL over many years could experience problems with their

						<u>blood, or nervous or reproductive systems.</u>
<u>(36) Chlordane (ppb)</u>	<u>0.002</u>	<u>1000</u>	<u>2</u>	<u>0</u>	<u>Residue of banned termiticide</u>	<u>Some people who drink water containing chlordane in excess of the PMCL over many years could experience problems with their liver or nervous system, and may have an increased risk of getting cancer.</u>
<u>(37) Dalapon (ppb)</u>	<u>0.2</u>	<u>1000</u>	<u>200</u>	<u>200</u>	<u>Runoff from herbicide used on rights of way</u>	<u>Some people who drink water containing dalapon well in excess of the PMCL over many years could experience minor kidney changes.</u>
<u>(38) Di(2-ethylhexyl) adipate (ppb)</u>	<u>0.4</u>	<u>1000</u>	<u>400</u>	<u>400</u>	<u>Discharge from chemical factories</u>	<u>Some people who drink water containing di(2-ethylhexyl)adipate well in excess of the PMCL over many years could experience toxic effects, such as weight loss, liver enlargement or possible reproductive difficulties.</u>
<u>(39) Di(2-ethylhexyl)phthalate (ppb)</u>	<u>0.006</u>	<u>1000</u>	<u>6</u>	<u>0</u>	<u>Discharge from rubber and chemical factories</u>	<u>Some people who drink water containing di(2-ethylhexyl)phthalate in excess of the PMCL over many years may have problems with their liver, or</u>

						experience reproductive difficulties, and may have an increased risk of getting cancer.
(40) Dibromochloropropane (ppt)	0.0002	1,000,000	200	0	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	Some people who drink water containing DBCP well in excess of the PMCL over many years could experience reproductive problems and may have an increased risk of getting cancer.
(41) Dinoseb (ppb)	0.007	1000	7	7	Runoff from herbicide used on soybeans and vegetables	Some people who drink water containing dinoseb well in excess of the PMCL over many years could experience reproductive difficulties.
(42) Diquat (ppb)	0.02	1000	20	20	Runoff from herbicide use	Some people who drink water containing diquat in excess of the PMCL over many years could get cataracts.
(43) Dioxin [2,3,7,8-TCDD] (ppq)	0.00000003	1,000,000,000	30	0	Emissions from waste incineration and other combustion; Discharge from chemical factories	Some people who drink water containing dioxin in excess of the PMCL over many years could experience reproductive difficulties and may have an increased risk of getting cancer.
(44) Endothall (ppb)	0.1	1000	100	100	Runoff from	Some people who drink water

					herbicide use	containing endothall in excess of the PMCL over many years could experience problems with their stomach or intestines.
(45) Endrin (ppb)	0.002	1000	2	2	Runoff of banned insecticide	Some people who drink water containing endrin in excess of the PMCL over many years could experience liver problems.
(46) Epichlorohydrin	TT		TT	0	Discharge from industrial chemical factories: An impurity of some water treatment chemicals	Some people who drink water containing high levels of epichlorohydrin over a long period of time could experience stomach problems, and may have an increased risk of getting cancer.
(47) Ethylene dibromide (ppt)	0.00005	1,000,000	50	0	Discharge from petroleum refineries	Some people who drink water containing ethylene dibromide in excess of the PMCL over many years could experience problems with their liver, stomach, reproductive system, or kidneys, and may have an increased risk of getting cancer.

(48) Glyphosate (ppb)	0.7	1000	700	700	Runoff from herbicide use	Some people who drink water containing glyphosate in excess of the PMCL over many years could experience problems with their kidneys or reproductive difficulties.
(49) Heptachlor (ppt)	0.0004	1,000,000	400	0	Residue of banned pesticide	Some people who drink water containing heptachlor in excess of the PMCL over many years could experience liver damage and may have an increased risk of getting cancer.
(50) Heptachlor epoxide (ppt)	0.0002	1,000,000	200	0	Breakdown of heptachlor	Some people who drink water containing heptachlor epoxide in excess of the PMCL over many years could experience liver damage, and may have an increased risk of getting cancer.
(51) Hexachlorobenzene (ppb)	0.001	1000	1	0	Discharge from metal refineries and agricultural chemical factories	Some people who drink water containing hexachlorobenzene in excess of the PMCL over many years could experience problems with their liver or kidneys or adverse reproductive effects, and may

						have an increased risk of getting cancer.
(52) Hexachlorocyclopentadiene (ppb)	0.05	1000	50	50	Discharge from chemical factories	Some people who drink water containing hexachlorocyclopentadiene well in excess of the PMCL over many years could experience problems with their stomach or kidneys.
(53) Lindane (ppt)	0.0002	1,000,000	200	200	Runoff/leaching from insecticide used on cattle, lumber, gardens	Some people who drink water containing lindane in excess of the PMCL over many years could experience problems with their kidneys or liver.
(54) Methoxychlor (ppb)	0.04	1000	40	40	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	Some people who drink water containing methoxychlor in excess of the PMCL over many years could experience reproductive difficulties.
(55) Oxamyl [Vydate] (ppb)	0.2	1000	200	200	Runoff/leaching from insecticide used on apples, potatoes and tomatoes	Some people who drink water containing ethylene oxamyl in excess of the PMCL over many years could experience slight nervous system effects.
(56) PCBs [Polychlorinated biphenyls] (ppt)	0.0005	1,000,000	500	0	Runoff from landfills; Discharge	Some people who drink water containing PCBs in excess of the

						of waste chemicals	PMCL over many years could experience changes in their skin, problems with their thymus gland, immune deficiencies, or reproductive or nervous system difficulties, and may have an increased risk of getting cancer.
(57) Pentachlorophenol (ppb)	0.001	1000	1	0		Discharge from wood preserving factories	Some people who drink water containing pentachlorophenol in excess of the PMCL over many years could experience problems with their liver or kidneys, and may have an increased risk of getting cancer.
(58) Picloram (ppb)	0.5	1000	500	500		Herbicide runoff	Some people who drink water containing picloram in excess of the PMCL over many years could experience problems with their liver.
(59) Simazine (ppb)	0.004	1000	4	4		Herbicide runoff	Some people who drink water containing simazine in excess of the PMCL over many years could experience problems with their blood.
(60) Toxaphene (ppb)	0.003	1000	3	0		Runoff/leaching from	Some people who drink water containing



					insecticide used on cotton and cattle	toxaphene in excess of the PMCL over many years could experience problems with their thyroid, kidneys, or liver and may have an increased risk of getting cancer.
Volatile Organic <del>Chemicals</del> Contaminants						
(61) Benzene (ppb)	0.005	1000	5	0	Discharge from factories; Leaching from gas storage tanks and landfills	Some people who drink water containing benzene in excess of the PMCL over many years could experience anemia or a decrease in blood platelets, and may have an increased risk of getting cancer.
(62) Carbon tetrachloride (ppb)	0.005	1000	5	0	Discharge from chemical plants and other industrial activities	Some people who drink water containing carbon tetrachloride in excess of the PMCL over many years could experience problems with their liver and may have an increased risk of getting cancer.
(63) Chlorobenzene (ppb)	0.1	1000	100	100	Discharge from chemical and agricultural chemical factories	Some people who drink water containing chlorobenzene in excess of the PMCL over many years could experience problems with their liver or kidneys.

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(64) <u>o-Dichlorobenzene (ppb)</u>	<u>0.6</u>	<u>1000</u>	<u>600</u>	<u>600</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing o-dichlorobenzene well in excess of the PMCL over many years could experience problems with their liver, kidneys, or spleen, or changes in their blood.</u>
(65) <u>p-Dichlorobenzene (ppb)</u>	<u>0.075</u>	<u>1000</u>	<u>75</u>	<u>75</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing p-dichlorobenzene in excess of the PMCL over many years could experience anemia, damage to their liver, kidneys, or circulatory systems.</u>
(66) <u>1,2-Dichloroethane (ppb)</u>	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>0</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing 1,2-dichloroethane in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
(67) <u>1,1-Dichloroethylene (ppb)</u>	<u>0.007</u>	<u>1000</u>	<u>7</u>	<u>7</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing 1,1-dichloroethylene in excess of the PMCL over many years could experience problems with their liver.</u>
(68) <u>cis-1,2-Dichloroethylene (ppb)</u>	<u>0.07</u>	<u>1000</u>	<u>70</u>	<u>70</u>	<u>Discharge from industrial</u>	<u>Some people who drink water containing cis-1,2-</u>

					<u>chemical factories</u>	<u>dichloroethylene in excess of the PMCL over many years could experience problems with their liver.</u>
<u>(69) trans-1,2-Dichloroethylene (ppb)</u>	<u>0.1</u>	<u>1000</u>	<u>100</u>	<u>100</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing trans-1,2-dichloroethylene well in excess of the PMCL over many years could experience problems with their liver.</u>
<u>(70) Dichloromethane (ppb)</u>	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>0</u>	<u>Discharge from pharmaceutical and chemical factories</u>	<u>Some people who drink water containing dichloromethane in excess of the PMCL over many years could have liver problems and may have an increased risk of getting cancer.</u>
<u>(71) 1,2-Dichloropropane (ppb)</u>	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>0</u>	<u>Discharge from industrial chemical factories</u>	<u>Some people who drink water containing 1,2-dichloropropane in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
<u>(72) Ethylbenzene (ppb)</u>	<u>0.7</u>	<u>1000</u>	<u>700</u>	<u>700</u>	<u>Discharge from petroleum refineries</u>	<u>Some people who drink water containing ethylbenzene well in excess of the PMCL over many years could experience problems with their liver or kidneys.</u>

(73) Styrene (ppb)	<u>0.1</u>	<u>1000</u>	<u>100</u>	<u>100</u>	<u>Discharge from rubber and plastic factories: Leaching from landfills</u>	<u>Some people who drink water containing styrene well in excess of the PMCL over many years could experience problems with their liver, kidneys, or circulatory system.</u>
(74) Tetrachloroethylene (ppb)	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>0</u>	<u>Discharge from factories and dry cleaners</u>	<u>Some people who drink water containing tetrachloroethylene in excess of the PMCL over many years could have problems with their liver, and may have an increased risk of getting cancer.</u>
(75) 1,2,4-Trichlorobenzene (ppb)	<u>0.07</u>	<u>1000</u>	<u>70</u>	<u>70</u>	<u>Discharge from textile-finishing factories</u>	<u>Some people who drink water containing 1,2,4-trichlorobenzene well in excess of the PMCL over many years could experience changes in their adrenal glands.</u>
(76) 1,1,1,-Trichloroethane (ppb)	<u>0.2</u>	<u>1000</u>	<u>200</u>	<u>200</u>	<u>Discharge from metal degreasing sites and other factories</u>	<u>Some people who drink water containing 1,1,1-trichloroethane in excess of the PMCL over many years could experience problems with their liver, nervous system, or circulatory system.</u>
(77) 1,1,2-Trichloroethane (ppb)	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>3</u>	<u>Discharge from industrial</u>	<u>Some people who drink water containing 1,1,2-trichloroethane</u>

					<u>chemical factories</u>	<u>well in excess of the PMCL over many years could have problems with their liver, kidneys, or immune systems.</u>
<u>(78) Trichloroethylene (ppb)</u>	<u>0.005</u>	<u>1000</u>	<u>5</u>	<u>0</u>	<u>Discharge from metal degreasing sites and other factories</u>	<u>Some people who drink water containing trichloroethylene in excess of the PMCL over many years could experience problems with their liver and may have an increased risk of getting cancer.</u>
<u>(79) Toluene (ppm)</u>	<u>1</u>		<u>1</u>	<u>1</u>	<u>Discharge from petroleum factories</u>	<u>Some people who drink water containing toluene well in excess of the PMCL over many years could have problems with their nervous system, kidneys, or liver.</u>
<u>(80) Vinyl Chloride (ppb)</u>	<u>0.002</u>	<u>1000</u>	<u>2</u>	<u>0</u>	<u>Leaching from PVC piping; Discharge from plastic factories</u>	<u>Some people who drink water containing vinyl chloride in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
<u>(81) Xylenes (ppm)</u>	<u>10</u>		<u>10</u>	<u>10</u>	<u>Discharge from petroleum factories; Discharge from chemical factories</u>	<u>Some people who drink water containing xylenes in excess of the PMCL over many years could experience damage to their nervous system.</u>
<u>Disinfection ByProducts, Precursors, and Residuals</u>						

(82) TTHM [total trihalomethanes] (ppb)	<u>0.080</u>	<u>1000</u>	<u>80</u>	<u>n/a</u>	<u>Byproduct of drinking water disinfection</u>	<u>Some people who drink water containing trihalomethanes in excess of the PMCL over many years could experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.</u>
(83) Haloacetic acids (HAA) (ppb)	<u>0.060</u>	<u>1000</u>	<u>60</u>	<u>n/a</u>	<u>Byproduct of drinking water disinfection</u>	<u>Some people who drink water containing haloacetic acids in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
(84) Bromate (ppb)	<u>0.010</u>	<u>1000</u>	<u>10</u>	<u>0</u>	<u>Byproduct of drinking water disinfection</u>	<u>Some people who drink water containing bromate in excess of the PMCL over many years may have an increased risk of getting cancer.</u>
(85) Chloramines (ppm)	<u>MRDL =4.0</u>		<u>MRDL= 4.0</u>	<u>MRDLG =4</u>	<u>Water additive used to control microbes</u>	<u>Some people who use water containing chloramines well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chloramines well in excess of the MRDL could experience</u>

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						<u>stomach discomfort or anemia.</u>
<u>(86) Chlorine (ppm)</u>	<u>MRDL</u> <u>=4.0</u>		<u>MRDL=</u> <u>4.0</u>	<u>MRDLG</u> <u>=4</u>	<u>Water additive used to control microbes</u>	<u>Some people who use water containing chlorine well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chlorine well in excess of the MRDL could experience stomach discomfort.</u>
<u>(87) Chlorine dioxide (ppb)<sup>b</sup></u>	<u>MRDL</u> <u>=0.8</u>	<u>1000</u>	<u>MRDL=</u> <u>800</u>	<u>MRDLG</u> <u>=800</u>	<u>Water additive used to control microbes</u>	<u>Some infants and young children who drink water containing chlorine dioxide in excess of the MRDL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorine dioxide in excess of the MRDL. Some people may experience anemia.</u>
<u>(88) Chlorine dioxide, where any two consecutive daily samples collected at the entrance to the distribution system are above the MRDL.<sup>a</sup></u>	<u>MRDL</u> <u>=0.8</u>			<u>MRDLG</u> <u>=0.8</u>		<u>The chlorine dioxide violations reported today are the result of exceedances at the treatment facility only, not within the distribution system which delivers</u>

						<u>water to consumers.</u> <u>Continued compliance with chlorine dioxide levels within the distribution system minimizes the potential risk of these violations to consumers.</u>
<u>(89) Chlorine dioxide, where one or more distribution system samples are above the MRDL.<sup>a</sup></u>	<u>MRDL =0.8</u>			<u>MRDLG =0.8</u>		<u>The chlorine dioxide violations reported today include exceedances of the EPA standard within the distribution system which delivers water to consumers. Violations of the chlorine dioxide standard within the distribution system may harm human health based on short-term exposures. Certain groups, including fetuses, infants, and young children, may be especially susceptible to nervous system effects from excessive chlorine dioxide exposure.</u>
<u>(90) Chlorite (ppm)</u>	<u>1.0</u>		<u>1.0</u>	<u>0.8</u>	<u>By-product of drinking water disinfection</u>	<u>Some infants and young children who drink water containing chlorite in excess of the PMCL could experience nervous system effects. Similar effects may occur</u>



						in fetuses of pregnant women who drink water containing chlorite in excess of the PMCL. Some people may experience anemia.
(91) Total organic carbon (ppm)	II		II	n/a	Naturally present in the environment	Total organic carbon (TOC) has no health effects. However, total organic carbon provides a medium for the formation of disinfection byproducts. These byproducts include trihalomethanes (THMs) and haloacetic acids (HAAs). Drinking water containing these byproducts in excess of the PMCL may lead to adverse health effects, liver or kidney problems, or nervous systems effects, and may lead to an increased risk of getting cancer.

<sup>a</sup> This information is for public notification purposes only.

<sup>b</sup> This information is for the ~~CCR Consumer Confidence Report~~ purposes only.

<sup>c</sup> Violations of the treatment technique requirements for filtration and disinfection that involve turbidity exceedances may use the health effects language for turbidity instead.

**12VAC5-590-550. Recordkeeping.**

A. ~~All The owner owners~~ shall maintain all of the waterworks records in accordance with the Records Retention and Disposition Schedule of the Library of Virginia, General Schedule No. 7 for public utility records of county and municipal governments.

B. ~~All The owners owner~~ shall retain at ~~their the~~ waterworks or at a convenient location near ~~their the~~ waterworks the following records for ~~the minimum~~ not less than the time periods specified:

~~A.~~ ~~Records of microbiological~~ 1. Microbiological analyses and turbidity analyses, including records of any repeat samples ~~taken collected~~ and meeting the criteria for an extension of the 24-hour period for collecting repeat samples as required under 12VAC5-590-380 -- Five years.

~~B~~2. Chemical ~~Analyses-analyses~~ -- 10 years.

3. The following information shall be provided for subdivisions B 1 and B 2 of this section:

a. ~~Date, place, and time of sampling as well as the name of the person who collected the sample;~~

b. ~~Identification of sample (e.g., routine, check-repeat, confirmation sample, source water, other);~~

c. ~~Date of analysis;~~

d. ~~Laboratory and/or person responsible for performing analysis;~~

e. ~~Analytical method/technique used; and, and~~

f. ~~Results of the analysis.~~

~~C~~4. Individual filter monitoring required under ~~42VAC5-590-530 E 1 b (2) -- 12VAC5-590-531 A 2 b --~~ Three years.

~~D~~5. Results of ~~Disinfection-disinfection Profile-profile~~ including raw data and analysis -- Indefinitely.

~~E~~6. Disinfection ~~Benchmarking-benchmarking~~ including raw data and analysis -- Indefinitely.

F. The following information shall be provided for subsections A and B of this section:

1. ~~Date, place, and time of sampling as well as the name of the person who collected the sample;~~

2. ~~Identification of sample (e.g., routine, check sample, raw water, other);~~

3. ~~Date of analysis;~~

4. ~~Laboratory and/or person responsible for performing analysis;~~

5. ~~Analytical method/technique used; and~~

6. ~~Results of the analysis.~~

~~G~~7. Original records of all sampling data and analyses, reports, surveys, letters, evaluations, schedules, ~~commissioner-department~~ determinations, and any other information required by 12VAC5-590-405 A 1 and 2, B, C, and D; and 12VAC5-590-375 B, C, and D 12VAC5-590-405 A 2, 12VAC5-590-405 B, 12VAC5-590-405 C, and 12VAC5-590-405 D, pertaining to lead and copper. ~~Each waterworks owner shall retain the records required by this section for no fewer than 12 -- 12 years.~~

~~H~~8. ~~Owners shall keep results~~ Results from the initial round of source water monitoring under 12VAC5-590-420 B 3 a (1) 12VAC5-590-401 B 1 and the second round of source water monitoring under 12VAC5-590-420 B 3 a (2) 12VAC5-590-401 B 2 until three years after bin classification under 12VAC5-590-420 B 3 c (1) 12VAC5-590-401 D 1 for the particular round of monitoring.

~~I.~~ ~~Owners shall keep any~~ 9. Any notification to the ~~commissioner-department~~ that they will not conduct source water monitoring will not be conducted due to meeting the criteria of 12VAC5-590-420 B 3 a (4) for three 12VAC5-590-401 B 4 -- Three years.

~~J~~10. ~~Owners shall keep the results~~ Results of treatment monitoring associated with microbial toolbox options under 12VAC5-590-420 B 3 d (3) through (7) 12VAC5-590-401 E 3 through 12VAC5-590-401 E 7 and with uncovered finished water reservoirs under 12VAC5-590-420 L 12VAC5-590-415, as applicable, for three -- Three years.

~~K~~11. Action taken to correct violations of ~~these regulations — three~~ this chapter -- Three years after last action with respect to violation involved.

~~L~~12. ~~Owners~~ The owner shall retain completed assessment forms for all Level 1 and Level 2 assessments conducted in accordance with 12VAC5-590-392 C, regardless of who conducts the assessment, and documentation of corrective actions completed as a result of those assessments, or other available summary documentation of the sanitary defects and correction actions taken under 12VAC5-590-392 D for a period not less than five years after completion of the assessment or corrective action, whichever is later.

~~M~~13. Copies of reports, summaries, or communications relating to any sanitary surveys performed -- 10 years following inspection.

~~N~~14. Variance or exemptions granted (and records related thereto) -- ~~five~~ Five years following expiration of the variance or exemption.

~~O~~15. Cross-connection control program records -- 10 years.

~~P~~16. ~~Owners of~~ The owner of a waterworks that recycles flow, as stipulated in ~~12VAC5-590-420 K~~ 12VAC5-590-395 C, shall collect and retain on file the recycle flow information for review and evaluation by the ~~district engineer beginning June 8, 2004~~ commissioner department. This information shall be retained for a minimum of 10 years. Information shall include, as a minimum:

4a. Copy of the recycle notification submitted to the ~~district engineer under 12VAC5-590-530 K~~ department.

2b. List of all recycle flows and the frequency with which they are returned.

3c. Average and maximum backwash flow rate through the filters and the average and maximum duration of the filter backwash process, in minutes.

4d. Typical filter run length and a written summary of how the filter run length is determined.

5e. The type of treatment provided for the recycle flow.

6f. Data on the physical dimensions of the equalization and/or treatment units, typical and maximum hydraulic loading rates, type of treatment chemicals used, average dose, frequency of use, and frequency at which solids are removed, if applicable.

~~Q~~17. Copies of monitoring plans developed pursuant to these regulations shall be kept for the same period of time as the records of analyses taken under the plan are required to be kept under subsection A or B of this section, except as specified elsewhere in this chapter.

~~R~~18. ~~All owners~~ The owner shall retain the following additional records:

4a. Plant operational records -- 5 years after the end of the calendar year;

2b. ~~Water well completion reports.~~ Current organizational/staffing chart;

3c. Record (As-built) engineering plans and specifications of facilities -- Retain for the life of the facility;

d. Equipment manuals for items in use -- Retain for the life of the equipment or facility;

4e. Shop drawings of major equipment, in use -- Retain for the life of the equipment;

f. Current list or chart of required laboratory tests with test frequencies and sampling locations;

g. Current preventive maintenance schedule;

5h. ~~Records of equipment repair or replacement.~~ of equipment in use -- Retain for the life of the equipment;

6i. Updated map of water distribution system; and

7j. All accident reports. – Three years

SC. Additional recordkeeping requirements for groundwater systems. ~~Owners of The owner of a~~ waterworks with groundwater sources shall maintain the following records.

1. ~~Records of corrective~~ Corrective actions – 10 years.
2. ~~Records of public~~ Public notification as required by 12VAC5-590-540 – Three years.
3. ~~Records of invalidation~~ Invalidation of groundwater source samples – Five years.
4. For consecutive waterworks, ~~records of~~ notification to the wholesale waterworks of coliform-positive samples – Five years.
5. For ~~a~~ waterworks required to conduct compliance monitoring:
  - a. ~~Records of the ODW-Department~~-specified minimum disinfectant residual – 10 years.
  - b. ~~Records of the lowest~~ Lowest daily residual disinfectant concentration – Five years.
  - c. ~~Records of the dates~~ Dates and duration of any failure to maintain the ~~ODW department~~-specified minimum residual disinfectant concentration for a period of more than four hours – Five years.
  - d. ~~Records of any ODW-Department~~-specified compliance parameters for alternative treatment and records of the date and duration of any failure to meet the alternative treatment operating requirements for more than four hours – Five years.
  - e. ~~For waterworks required to conduct compliance monitoring:~~
    - (1) ~~The department-specified minimum disinfectant residual – 10 years.~~
    - (2) ~~The lowest daily residual disinfectant concentration – Five years.~~
    - (3) ~~The dates and duration of any failure to maintain the department-specified minimum residual disinfectant concentration for a period of more than four hours – Five years.~~
    - (4) ~~The department-specified compliance parameters for alternative treatment and records of the date and duration of any failure to meet the alternative treatment operating requirements for more than four hours – Five years.~~

#### **12VAC5-590-560. Safety.**

~~Since its trained personnel is the waterworks' most important asset, an important phase of waterworks operation is the protection of personnel through an active safety program; therefore, it is strongly recommended that every waterworks institute a safety program. The owner of a~~ waterworks shall institute a safety program to inform personnel of the known hazards, preventive measures, and emergency procedures ~~from-pertaining to~~ the operation of the waterworks in accordance with VOSH requirements.

#### **12VAC5-590-565. Source ~~Water-water~~ Protectionprotection.**

A. ~~A waterworks owned by a county, city, or town~~ Counties, cities, and towns that are ~~waterworks owners~~ may exercise ~~their-the~~ authority pursuant to §15.2-2109 of the Code of Virginia to protect ~~their-the~~ waterworks from pollution or injury.

B. ~~Any-The owner of a~~ waterworks with a drinking water reservoir may establish a buffer around the intake to limit such uses as body contact recreation and boats powered by engines, pursuant to a plan acceptable to the ~~waterworks owner and the commissioner~~department.

C. ~~The owner of a~~ Waterworks-waterworks owners should develop a source water protection plans for all ~~their-the~~ sources and report ongoing or completed protection initiatives to the ~~commissioner~~department.

**12VAC5-590-570. Operational report forms, reporting requirements.**

All waterworks required to report information to the department shall use the forms approved by the division:

A. Monthly operational reports.

1. ~~All~~ A classified waterworks ~~are~~ ~~is~~ required to report monthly information to the department no later than the 10th of the month following the month during which the monitoring period occurred.
2. ~~All~~ A classified waterworks using conventional filtration shall report using the ~~Monthly monthly Operating-operating Report-report~~ (MOR) form approved by the department. All other classified waterworks shall report the required information specified in Tables 570.1 through 570.13, based on the treatment processes employed. Monitoring data shall be collected for each day ~~the operating staff attend to the operation of~~ the facilities.
3. ~~In order to~~ ~~To~~ determine if a waterworks using UV reactor systems ~~are~~ ~~is~~ operating within validated conditions designed in accordance with 12VAC5-590-1005, the following parameters shall be monitored and reported: (i) on/off status for each reactor; (ii) flow rate through reactor train; (iii) UV intensity as measured by a UV sensor; (iv) lamp status; (v) lamp age; and UV transmittance. The operational set points shall be reported if set point control is used. The calculated UV dose shall be reported if other than a set point control is used.
4. ~~All~~ ~~An~~ unclassified waterworks ~~are~~ ~~is~~ required to report quarterly the following information ~~specified in Table 570.1, where applicable,~~ to the department no later than the 10th of the month following the calendar quarter during which the monitoring period occurred.
5. ~~All~~ ~~An~~ unclassified waterworks that ~~are~~ ~~is~~ using any of the treatment processes described in Tables 570.2 through 570.13 ~~are~~ ~~is~~ required to report no later than the 10th of the month following the calendar month during which the monitoring occurred. The report shall contain the required information specified in Tables 570.1 through 570.13 based on the treatment processes employed. The monitoring data shall be collected at a minimum frequency as established by the department.
6. The ~~commissioner~~ ~~department~~ may vary the reporting requirements on a case-by-case basis.

Table 570.1.  
Baseline Data -- All Waterworks.

<u>PWSID No.</u>
<u>System Name</u>
<u>Reporting month and year (reporting quarter and year<sup>a</sup>)</u>
<u>Location (county)</u>
<u>Number of connections, monthly average (maximum for reporting period<sup>a</sup>)</u>
<u>Population served, monthly average (quarterly average and maximum day<sup>a</sup>)</u>
<u>Total source water withdrawn, gpd</u>
<u>Total source water treated, gpd</u>
<u>Total finished water produced, gal/month (for each Entry Point)</u>

and/or
Total water purchased, gal/month (at each consecutive connection)
Operator Name (printed and signature)
Operator Classification (Class 1 – 6)
Operator DPOR Certification No.
Name and contact information of the emergency contact person (text, voice phone number)
<sup>a</sup> Required for an unclassified waterworks.

Table 570.2.  
Chlorine Disinfection.

Chlorine compound used (chlorine gas, calcium hypochlorite, or sodium hypochlorite)
Amount of chlorine compound used at each application point, lb/day
Residual disinfectant concentration (measured as total chlorine, free chlorine, combined chlorine, or chlorine dioxide) at <u>Entry-entry Pointpoint</u> , mg/L
Chlorite concentration (if chlorine dioxide is used), daily measurement at <u>Entry-entry Pointpoint</u> , mg/L

Table 570.3.  
Chlorine Residual in the Distribution System.

Chlorine compound used (chlorine gas, calcium hypochlorite or sodium hypochlorite)
Residual disinfectant concentration, measured as total chlorine, free chlorine, combined chlorine, or chlorine dioxide, mg/L (Collected with each total coliform bacteria sample, in accordance with approved sampling plan).

Table 570.4.  
Re-Chlorination in Distribution System.

Chlorine compound used (chlorine gas, calcium hypochlorite, or sodium hypochlorite)
Amount of chlorine compound used at each application point, lb/day
Free chlorine residual concentration before re-chlorination, mg/L
Free chlorine residual concentration after re-chlorination, mg/L
Free chlorine residual, mg/L (measured and reported with each total coliform bacteria sample, in accordance with approved sampling plan.)

Table 570.5.  
Iron and Manganese Treatment by Oxidation, Detention, and Filtration.

<u>Source water iron and manganese concentrations, mg/L (each source)</u>
<u>Oxidant amount used, lb/day</u>
<u>Finished water iron and manganese concentrations, mg/L (each filter)</u>
<u>Finished water pH (each filter)</u>
<u>Filter hours between backwash (each filter)</u>

Table 570.6.  
Iron and Manganese Treatment by Ion Exchange.

<u>Ion exchange material (type, manufacturer, and product name)</u>
<u>Source water iron and manganese concentrations, mg/L (each source)</u>
<u>Finished water iron and manganese concentrations, mg/L (each unit softener)</u>
<u>Finished water pH (each unit softener)</u>
<u>Head Loss, psi (each unit softener)</u>
<u>Regeneration date and method (each unit softener)</u>
<u>Backwash date and duration of washing (each unit softener)</u>
<u>Backwash rate, gpm (each unit softener)</u>

Table 570.7.  
Sequestration of Iron and Manganese.

<u>Chemical used (manufacturer and product name)</u>
<u>Quantity used, lb/day (average)</u>
<u>Source water iron and manganese concentrations, mg/L (each source)</u>
<u>Finished water (<del>Entry-entry Pointpoint</del>) iron and manganese concentrations, mg/L</u>
<u>Finished water (<del>Entry-entry Pointpoint</del>) treatment chemical concentration, mg/L</u>
<u>Treatment chemical residual concentration, mg/L</u> <u>(Value at distal end of distribution system. Report at same frequency as free chlorine residual testing.)</u>

Table 570.8.  
pH Adjustment or Corrosion Control by Chemical Addition.

<u>Chemical used (manufacturer and product name)</u>
<u>Quantity used, lb/day (average)</u>

Source water pH
Finished water ( <del>Entry-entry Pointpoint</del> ) pH
Finished water ( <del>Entry-entry Pointpoint</del> ) treatment chemical concentration, mg/L (if required water quality parameter for compliance with lead and copper)

Table 570.9.  
Cation Exchange Softening.

Cation exchange material (type, manufacturer, and product name)
Regeneration date and method (each unit)
Backwashing date and duration of washing (each unit)
Softener influent hardness, mg/L as CaCO <sub>3</sub> (each source)
Softener effluent hardness, mg/L as CaCO <sub>3</sub> (each unit)
Stabilization chemical type, weight, daily dosage
Finished water ( <del>Entry-entry Pointpoint</del> ) pH
Finished water ( <del>Entry-entry Pointpoint</del> ) alkalinity, mg/L
Finished water ( <del>Entry-entry Pointpoint</del> ) hardness, as CaCO <sub>3</sub>

Table 570.10.  
Fluoridation.

Chemical used (manufacturer and product name)
Fluoride used, lb/day
Fluoride dosage, mg/L (daily)
Water treated, MGD
Finished water ( <del>Entry-entry Pointpoint</del> ) fluoride concentration, mg/L (maximum, minimum, and average)

Table 570.11.  
Microfiltration or Ultrafiltration.

Hours unit in operation
Source water flow, gpd
Filtrate volume, gpd
Recirculated during suspension mode (volume or % of feed flow, per day)



<u>Waste volume, gpd</u>
<u>Maximum stabilized flux, gpd/ft<sup>2</sup></u>
<u>Source water turbidity, NTU bench test (daily)</u>
<u>Source water turbidity, NTU in line (collected at same time as bench test)</u>
<u>Source water turbidity, NTU in-line (maximum daily))</u>
<u>Source water alkalinity, mg/L as CaCO<sub>3</sub> (daily)</u>
<u>Source water hardness, mg/L as CaCO<sub>3</sub> (daily)</u>
<u>Source water temperature, °C (daily)</u>
<u>Source water pH (daily)</u>
<u>Filtered water turbidity, NTU bench test (daily)</u>
<u>Filtered water turbidity, NTU in line (collected at same time as bench test)</u>
<u>Filtered water turbidity, NTU in-line (maximum daily)</u>
<u>Pressure loss across pre-filter, psi (daily)</u> <u>(if pre-filters are automatically cleaned, reporting is not required)</u>
<u>Number of membrane modules in use (daily)</u>
<u>Direct integrity test start time (daily)</u>
<u>Direct integrity test starting pressure, psi (each membrane unit, daily)</u>
<u>Direct integrity test final pressure, psi (daily)</u>
<u>Direct integrity test duration, minutes (daily)</u>
<u>Direct integrity test pressure decay rate, psi/minute (daily)</u>
<u>Direct integrity test Log Removal Value (daily)</u>
<u>Trans-membrane pressure, psi (daily)</u>
<u>Trans-membrane pressure <del>prior to</del> before clean-in-place, psi</u>
<u>Trans-membrane pressure after clean-in-place, psi</u>
<u>Cleaning solution used (<del>Manufacturer-manufacturer</del> and product name)</u>
<u>pH of rinse water after clean-in-place</u>
<u>Calibrations completed (<del>Itemized-itemized</del> instruments with dates completed)</u>
<u>Module repairs/replacements (<del>Itemized-itemized</del> with dates repairs/replacements)</u>
<u>Entry point <del>Log-log</del> inactivation of Giardia by disinfection (daily)</u>

Table 570.12.  
Reverse Osmosis.

<u>Hours unit in operation</u>
<u>Pre-filter inlet pressure, psi (daily)</u>
<u>Pre-filter outlet pressure, psi (daily)</u>
<u>RO Inlet pressure, psi (daily) (daily)</u>
<u>RO outlet pressure, psi (daily)</u>
<u>Total permeate flow, gpd</u>
<u>Concentrate flow (bypass), gpd</u>
<u>Finished water flow, gpd</u>
<u>Total finished water (<del>Entry entry Pointpoint</del>) flow, gpd</u>
<u>Pre RO TDS, mg/L (daily)</u>
<u>Post RO TDS, mg/L (daily)</u>
<u>Pre RO turbidity, NTU (daily)</u>
<u>Post RO turbidity, NTU</u>
<u>Pre RO conductivity, <math>\mu</math>S/cm (daily)</u>
<u>Post RO conductivity, <math>\mu</math>S/cm (daily)</u>
<u>Finished water conductivity, <math>\mu</math>S/cm (daily)</u>
<u>Source water pH (daily)</u>
<u>Permeate pH (daily)</u>
<u>Finished water (<del>Entry entry Pointpoint</del>) pH (daily)</u>
<u>Module repairs/replacements (<del>Itemized-itemized</del> with dates of repairs/replacements)</u>

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Table 570.13.  
UV Disinfection.

<u>Total run time, hours (per unit)</u>
<u>Lamp status for each reactor train</u>
<u>Lamp age for each reactor train</u>
<u>Total production, MGD or gpd</u>

<u>Flow Rates, minimum, maximum and average, MGD or gpd for each reactor train</u>
<u>To receive disinfection credit, the following shall also be reported:</u>
<u>Number of off-specification events</u>
<u>Total off-specification volume, gal</u>
<u>Percent off-specification volume,</u>
<u>UV Intensity setpoint, W/m<sup>2</sup> (if using intensity setpoint approach, daily)</u>
<u>UV Intensity for each reactor, minimum, W/m<sup>2</sup> (if using intensity setpoint approach, daily)</u>
<u>UV Intensity sensor calibration date(s) for each reactor</u>
<u>Required dose, mJ/cm<sup>2</sup> (if using calculated dose approach)</u>
<u>UV Transmittance (UVT) for each reactor, daily percentage (if using calculated dose approach)</u>
<u>Calculated dose for each reactor, daily minimum, mJ/cm<sup>2</sup> (if using calculated dose approach)</u>
<u>Validated dose for each reactor, daily minimum, mJ/cm<sup>2</sup> (if using calculated dose approach)</u>
<u>UVT analyzer calibration date(s) (if using calculated dose approach)</u>
<u>UV intensity sensor correction factor</u>

B. The owner shall report the following incidents within 24 hours to the department:

1. Water pressure below the 20 psi minimum required in the distribution system, including zero or negative pressure. Examples of these events include treatment plant or pump station shutdowns due to equipment failure, power outages, emptying of storage tanks, and draining of the **distribution** system during fire flow events.
2. Flooding of clearwells.
3. Flooding of groundwater wells.
4. Any other situation that occurs with the waterworks that presents or may present an imminent and substantial threat to public health.

#### Article 4

##### Cross Connection Control and Backflow Prevention in Waterworks

#### **12VAC5-590-580. General requirements for cross-connection control and backflow prevention.**

A. The purpose of this article is to require as a condition for the issuance and continued use of the operation permit for the waterworks that each owner of a waterworks. Every owner shall establish and enforce a program of cross-connection control and backflow prevention for each waterworks cross-connection control program (CCCP) in accordance with 12VAC5-590-360. The goal of the CCCP is to prevent the intrusion of contamination into the distribution system via cross-connections and backflow. The cross-connection control and backflow prevention program shall be approved by the division prior to issuance of the operation permit (see Appendix I).

B. The owner shall not install or allow to be installed a water service connection to any premises where ~~cross-connections to a waterworks or a consumer's water system exist, or auxiliary water system is known to exist,~~ unless the cross-connections are adequately safeguarded to the satisfaction of the owner and the ~~commissioner~~department.

C. The owner shall not install, maintain, or allow to be installed any connection whereby water from an auxiliary water system may enter a waterworks or consumer's water system, unless the auxiliary water system, and the method of connection, and use of such system shall have been approved by the owner and the ~~commissioner~~department.

~~C-D.~~ The owner, in accordance with 12VAC5-590-510 C, shall maintain acceptable working pressures in the distribution system to reduce the potential for backflow to occur.

**12VAC5-590-590. Cross connections. (Repealed.)**

~~A. The purveyor shall not install, maintain, or allow to be installed a water service connection to any premises where cross connections to a waterworks or a consumer's water system may exist unless such cross connections are abated or controlled to the satisfaction of the water purveyor or the division.~~

~~B. The purveyor shall not install, maintain, or allow to be installed any connection whereby water from an auxiliary water system may enter a waterworks or consumer's water system unless the auxiliary water system and the method of connection and use of such system shall have been approved by the water purveyor and by the division.~~

**12VAC5-590-600. Responsibilities CCCP responsibilities.**

~~A. General. Effective cross connection control requires the cooperation of the water purveyor, the building official, the consumer, the Virginia Department of Health, and the backflow prevention device tester.~~

~~B. Water purveyor.~~

~~1. The purveyor shall establish or cause to be established and operate a cross connection control and backflow prevention program. The owner shall establish and operate a CCCP consistent with the extent of the distribution system and the type of consumer served. This program shall include at least one designated individual who shall be responsible for the inspection of the waterworks for cross connection and backflow prevention control assigned by the owner to be in charge of the CCCP. Requirements for this position shall include training and experience in cross-connection control programs. This program shall be carried out in accordance with the Uniform Statewide Building Code and shall be a continuing program.~~

~~2. Suggested elements of this program are contained in Appendix I. The purveyor has full responsibility for water quality and for the construction, maintenance, and operation of the waterworks beginning at the water source and ending at the service connection.~~

~~3. The purveyor shall have thorough inspections and operational tests made at least annually of backflow prevention devices which are required and installed at the service connection.~~

B. The owner shall establish appropriate ~~procedures policies~~ to complete assessments of consumers' water systems, and shall determine both the degree of hazard and the appropriateness of existing safeguards.

C. The owner shall establish procedures for completing operational tests ~~or other operation evaluational procedures as appropriate~~ at least annually for testable backflow prevention assemblies, devices, and methods that provide containment and after installation, relocation, or repairs.

D. ~~In lieu~~Instead of annual assessments and operational tests, the ~~The~~owner may shall provide a public education program to residential ~~consumers~~, and commercial consumers whose

premise plumbing water supply system is similar in use, size, and complexity to a residential system, is not complex and where there are no known or suspected high hazards as identified in Table 630.1.

1. The public education program shall be designed to prompt consumer self-assessments, increase the awareness of cross- connections, and inform the consumer of the public health hazards of backflow.

2. The CCCP public education program shall describe, at a minimum:

a. Causes of backflow;

b. Hazards and health effects of cross connections and backflow;

c. Resources available to identify actual or potential cross connections;

d. Safeguards to use to eliminate or reduce the hazards at the point-of-use; and

e. Sources for additional information.

4. In the event of backflow of pollution or contamination into the waterworks, the purveyor shall promptly take or cause corrective action, to confine and eliminate the pollution or contamination. The purveyor shall immediately notify the division when backflow occurs.

~~E. In the event of backflow of contaminants into the waterworks, the owner shall promptly take or cause corrective action to confine and eliminate the contamination. The owner shall report the event to the department within one business day, in the most expeditious manner. The owner shall submit a written report by the 10th day of the month following the month during which backflow occurred addressing the incident, its causes and effects, and safeguards required or other action taken. The owner shall discontinue or refuse water service to the consumer, to ensure that the waterworks is adequately protected from cross connections and backflow, if any of the following conditions occur:~~

1. A required backflow prevention assembly ~~or backflow elimination method~~ is not installed, tested, and maintained in accordance with the applicable sections of this chapter;

2. A required backflow prevention assembly ~~or backflow elimination method~~ is inoperable ~~or has been removed or bypassed; or~~

3. An unprotected or inadequately protected cross connection is known to exist on the premises and the owner has determined that there is inadequate backflow prevention at the service connection.

~~F. In the event of backflow of contaminants into the waterworks, the owner shall promptly take or cause corrective action to confine and eliminate the contamination. The owner shall report the event to the department within one business day, in the most expeditious manner. The owner shall submit a written report by the 10th day of the month following the month during which backflow occurred addressing the incident, its causes and effects, and safeguards required or other action taken.~~

~~G. F.~~ The owner shall maintain an inventory ~~and records of testing, repairs, and maintenance~~ of all ~~backflow prevention~~ assemblies, ~~backflow elimination~~ methods, and ~~backflow prevention~~ devices required and installed under 12VAC5-590-610.

~~H. G.~~ The owner shall maintain records related to the CCCP implementation, and any other records required by the ~~commissioner department~~ in accordance with 12VAC5-590-550.

5. The purveyor shall take positive action to ensure that the waterworks is adequately protected at all times. If a cross connection exists or backflow occurs into a consumer's water system or if the pressure in the waterworks is lowered below 10 psi gauge, the purveyor may discontinue the water service to the consumer and water service shall not

be restored until the deficiencies have been corrected or eliminated to the satisfaction of the purveyor.

**12VAC5-590-610. Containment policy of backflow.**

A. An approved backflow prevention device Backflow prevention assemblies or backflow elimination methods shall be installed ~~(i)(1)~~ at each the service connection to a consumer's water system where, in the judgment of the water purveyor or the division, a health, pollution, or system hazard to the waterworks exists. B. When, as a matter of practicality, the backflow prevention device cannot be installed at the service connection, the device may be or ~~(ii)(2)~~ located downstream of the service connection but ~~prior to before~~ any unprotected takeoffs, ~~unless point-of-use isolation protection is provided using appropriate backflow prevention assemblies or backflow elimination methods complying with the USBC.~~

B. Where the consumer's water supply system is not intricate or complex and where actual or potential cross-connection hazards can be eliminated or reduced, point-of-use isolation protection by application of appropriate backflow prevention assemblies, backflow prevention devices or backflow elimination methods complying with the USBC, may be used instead ~~the~~ of containment.

C. A backflow prevention device assembly or backflow elimination method shall be installed at each service connection to a consumer's water system serving premises where the following conditions exist:

1. ~~Premises on which any A~~ substance is handled in such a manner as to create an actual or potential hazard to a waterworks, (this shall include premises having sources or systems containing ~~including~~ process fluids or ~~used~~ waters originating from a waterworks which are no longer under the control of the ~~water purveyor owner~~ connected to the consumer's water supply system;

2. ~~Premises having~~ There exists internal cross connections that, in the judgment of the ~~water purveyor owner~~ or the division ~~commissioner~~ department, may not be easily correctable or have intricate or complex plumbing arrangements ~~which that~~ make it impracticable to determine whether or not cross connections exist;

3. ~~Premises where, because of~~ There are security requirements or other prohibitions or restrictions, ~~it is impossible or impractical to make a complete cross-connection survey that prevent the assessment of all potential cross-connections that may impair the quality of the water delivered;~~

4. ~~Premises having~~ There is a repeated history of cross connections being established or reestablished;

5. ~~Premises having fire protection systems utilizing combinations of sprinklers, fire loops, storage tanks, pumps, antifreeze protection, or auxiliary water sources including siamese connections (fire loops and sprinkler systems with openings not subject to flooding, and containing no antifreeze or other chemicals, no separate fire protection storage, or auxiliary sources, will not normally require backflow prevention); and~~

5. There are fire protection systems, lawn sprinkler systems, or irrigation systems. ~~that are connected directly to the waterworks with a separate service connection;~~ These systems may have the required approved backflow prevention assembly installed at their downstream connection or takeoff point, but under this scenario the waterworks owner shall ~~has authority to ensure that the operational testing(e)~~ required by these regulations are completed (see 12VAC5-590-600 C) and the inventory and recordkeeping as required for a containment device (see 12VAC5-590-600 G); and

6. ~~Other premises specified by the division or the purveyor when cause can be shown that a potential cross-connection hazard not enumerated above exists~~

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6. Cause can be shown by the ~~commissioner department~~ or owner that a potential cross connection hazard exists.

~~D. D. Premises~~ ~~C. The owner shall ensure that premises having booster pumps or fire pumps connected to the waterworks shall be equipped with a low pressure regulating or cutoff device to shut off the booster pump when the pressure in the waterworks drops to a minimum of 10 psi gauge control devices to prevent a reduction of pump suction line pressure to less than 20 psig.~~

~~E. E. An approved~~ ~~D. A backflow prevention device assembly or backflow elimination method shall be installed at;~~ ~~each service connection to a consumer's water system serving; but not necessarily limited to;~~ ~~monitored at~~ the following types of facilities, ~~including~~:

1. Hospitals, mortuaries, clinics, veterinary establishments, nursing homes, and medical buildings;
2. Laboratories;
3. Piers, docks, and waterfront facilities;
4. Sewage treatment plants, sewage pumping stations, or storm water pumping stations;
5. Food and beverage processing plants;
6. Chemical plants, dyeing plants, and pharmaceutical plants;
7. Metal plating industries;
8. Petroleum or natural gas processing or storage plants;
9. Radioactive materials processing plants or nuclear reactors;
10. Car washes and laundries;
11. Lawn sprinkler systems, and irrigation systems;
12. Fire service systems;

11. Buildings with commercial, industrial, or institutional occupants served through a master meter;

12. Water loading facilities;

13. Slaughter houses and poultry processing plants;
14. Farms where the water is used for other than household purposes;
15. Commercial greenhouses and nurseries;
16. Health clubs with swimming pools, therapeutic baths, hot tubs, or saunas;
17. Paper and paper products plants and printing plants;
18. Pesticide or exterminating companies and their vehicles with storage or mixing tanks;
19. Facilities that blend, store, package, transport, or treat chemicals, and their related vehicles;

~~18. Agricultural and Lawn care companies and their vehicles with storage or mixing tanks;~~

20. Schools or colleges with laboratory facilities; ~~and~~

21. Multi-story office and/or commercial buildings with four or more stories, including residential buildings classified by the USBC as commercial; Highrise buildings (four or more stories); ~~and~~

21. Multiuse commercial, office, or warehouse facilities; ~~and~~

22. Others specified by the purveyor owner or the division ~~commissioner department~~ when reasonable cause can be shown for a potential backflow or cross connection hazard.

~~E. F. All temporary or emergency service connections shall be protected where reasonable cause can be shown for a potential backflow or cross-connection hazard. Devices-Backflow~~

prevention assemblies or backflow elimination methods used shall be appropriately certified or approved to match the requirements of this section.

**12VAC5-590-620. Type of protection required. (Repealed.)**

The type of protection required shall depend on the degree of hazard which exists or may exist and on the method of potential backflow. Backflow occurs either by back pressure or by back siphonage.

The degree of hazard, either high, moderate, or low, is based on the nature of the contaminant; the potential of the health hazard; the probability of the backflow occurrence; and the effect on waterworks structures, equipment, and appurtenances used in the storage, collection, purification, treatment, and distribution of pure water.

Table 2.10 shall be used as a guide to determine the degree of hazard for any situation.

A. Air gaps give the highest degree of protection and shall be used whenever practical to do so in high hazard situations subject to back pressure.

B. An air gap separation and a reduced pressure principle backflow prevention device will protect against back pressure when operating properly. Vacuum breakers will not protect against back pressure, but will protect against back siphonage when operating properly.

C. Backflow prevention devices consisting of dual independent check valves with or without an intermediate atmospheric vent shall only be used in low hazard situations.

D. Barometric loops are not acceptable.

E. An interchangeable connection or change-over device has limitations which prevent its use where back pressure is present or may occur, the auxiliary supply is not an approved source, or the waterworks line pressure is less than 20 psi. Since this type connection is one of the easiest to bypass, the use of this type device will be approved only as a temporary and continuously supervised arrangement. In most instances, an approved device or method must be included and approved by the purveyor and division.

**12VAC5-590-630. Backflow prevention assemblies, devices, and backflow elimination methods for containment.**

A. Any backflow prevention assembly or device or backflow elimination method shall be of the approved type and shall comply with the Uniform Statewide Building Code USBC.

B. Any backflow prevention device shall be installed in a manner approved by the water purveyor and in accordance with the Uniform Statewide Building Code.

**B. General Safeguards**

1. The backflow prevention assembly or device or backflow elimination method used shall depend on the degree of hazard that exists or may exist. The safeguard shall ensure maintenance of the distribution system water quality and its usefulness.

2. The degree of hazard, either high or low, is based on (i) the nature of the contaminant; (ii) the potential of the health hazard; (iii) the potential method of backflow (either by backpressure or by backsiphonage); and (iv) the potential effect on waterworks structures, equipment, and appurtenances used in the storage, collection, purification, treatment, and distribution of potable water. Table 630.1 shall be used as a guide to determine the degree of hazard for any situation.

Table 630.1.

Determination of Degree of Hazard.

Cross connections that meet or may meet the following conditions shall be rated at the corresponding degree of hazard.



High Hazard	Low Hazard
The contaminant would be toxic, poisonous, noxious, <del>or unhealthy, or of questionable-unknown</del> quality.	The contaminant would only degrade the quality of the water aesthetically or impair the usefulness of the water.
A health hazard would exist.	A health hazard would not exist.
The contaminant would disrupt the service of piped water for human consumption.	The contaminant would not disrupt service of piped water for human consumption.
<del>High probability that</del> Backflow would be by either backpressure or backsiphonage.	<del>Low probability that</del> Backflow would occur by backsiphonage.
Examples: <del>-</del> sewage, used water, nonpotable water, auxiliary water systems, and mixtures of water and other liquids, gases, or other toxic or hazardous chemicals.	Examples: <del>-</del> food residuals, nontoxic chemicals, and nonhazardous chemicals.

-

3. The USBC ~~and the manufacturers specifications~~ shall be used to determine ~~the appropriateness of the backflow prevention assembly and-or~~ device application for containment.

~~C. Existing backflow prevention devices approved by the purveyor and the division prior to the effective date of this chapter shall, except for inspection, testing, and maintenance requirements, be excluded from the requirements of 12VAC5-590-600 A and B if the water purveyor and the division are assured that the devices will protect the waterworks.~~

C. Backflow prevention devices or assemblies with openings, outlets, or vents that are designed to operate or open during backflow prevention shall not be installed:

- 1) In areas subject to flooding or in pits.
- 2) In areas with atmospheric conditions that represent a contamination threat to the potable water supply, ~~or-and shall be installed in a free atmosphere. They shall not be installed~~
- 3) ~~In such a manner as to be able to be bypassed. facilitate bypassing.~~

~~D. Persons testing and repairing backflow prevention assemblies shall be certified to do so by the DPOR, Virginia Board for Contractors, under the Tradesman Regulations.~~

~~D. Starting January 1, 2022, persons testing and repairing backflow prevention assemblies and devices shall be certified by a Commonwealth of Virginia tradesman certification program (identified by DPOR as backflow prevention device workers). Until January 1, 2022, persons testing and repairing backflow prevention assemblies and devices shall be qualified to perform such work as demonstrated by possessing a certification or license from a local or state agency having legal authority or shall possess a certificate of completion of applicable vocational training acceptable to the owner.~~

TABLE 2.10- DETERMINATION OF DEGREE OF HAZARD	
Premises with one or more of the following conditions shall be rated at the corresponding degree of hazard.	
High Hazard	The contaminant would be toxic, poisonous, noxious or unhealthy.
-	A health hazard would exist.

-	A high probability exists of a backflow occurrence either by back pressure or by back siphonage.
-	The contaminant would disrupt the service of piped water for human consumption.
-	Examples – sewage, used water, nonpotable water, auxiliary water systems, toxic or hazardous chemicals, etc.
Moderate Hazard	The contaminant would only degrade the quality of the water aesthetically or impair the usefulness of the water.
-	A health hazard would not exist.
-	A moderate probability exists of a backflow occurrence either by back pressure or by back siphonage.
-	The contaminant would not seriously disrupt service of piped water for human consumption.
-	Examples – food stuff, nontoxic chemicals, nonhazardous chemicals, etc.
Low Hazard	The contaminant would only degrade the quality of the water aesthetically.
-	A health hazard would not exist.
-	A low probability exists of the occurrence of backflow primarily by back siphonage.
-	The contaminant would not disrupt service of piped water.
-	Examples – food stuff, nontoxic chemicals, nonhazardous, chemicals, etc.

**Part III**  
**Manual of Practice for Waterworks Design**

Article 4  
General

**12VAC5-590-640. General design considerations.**

A. Waterworks shall conform with to the Public Water Supply Law, Article 2 of Chapter 6 of Title 32.1 of the Code of Virginia. ~~The engineer shall confer with the division before proceeding with the detailed designs. The engineering report and preliminary plan shall include plant site selection. Ordinarily, Community waterworks shall be designed to provide for the estimated population water demand 10 to 30 years hence under predicted growth conditions. All waterworks shall be designed so that they can readily be increased in capacity except where circumstances preclude the probability of expansion. Expansion by modular steps should be considered. Operation and maintenance manuals are required for treatment facilities and pumping facilities.~~

B. Waterworks design shall be based on sound engineering practice substantiated in the engineer's design and approved by the commissioner. Historical data or typical usage figures of waterworks with similar service area characteristics, and appropriate peaking factors, shall be used to support the design. USBC and design standards may be referenced for noncommunity waterworks, as appropriate.

1. Community waterworks shall be designed to meet or exceed the estimated maximum daily water demand of the service area at the design year. The design shall account for diurnal demand patterns, and special demands placed on the waterworks such as firefighting, industrial use, and wholesale customers.

2. Noncommunity waterworks shall be designed to meet or exceed the peak hour demand of the proposed services. ~~Either Pump-pump capacity and/or~~ storage capacity or both may be utilized to meet the peak hour demand.

3. Effective storage.

a. Community waterworks shall provide sufficient finished water effective storage to enable the waterworks to meet the estimated maximum daily water demand at the design year. Compliance with this requirement is normally determined by the use of a hydraulic model. In the absence of a hydraulic model, effective storage shall be a minimum of one-half of estimated maximum daily water demand of the waterworks at the design year.

b. There is no minimum finished water effective storage requirement for noncommunity waterworks.

c. Effective storage of atmospheric storage tanks shall be the volume available to store finished water in atmospheric reservoirs or tanks, measured as the difference between the overflow elevation, or the normal maximum operating level, and the minimum storage elevation. For atmospheric tanks that use a portion of their volume to generate distribution system pressure, the minimum storage elevation is that elevation of water in the tank that can provide a minimum pressure of 20 psi throughout that tank's service area under distribution system-wide maximum daily water demand.

d. Effective storage of pressure storage tanks shall be one-third of the nominal pressure vessel storage capacity.

C. Waterworks shall be designed to provide a minimum residual pressure of 20 psig at all service connections. Design shall be based on the most restrictive conditions, defaulting to the greater of peak hour demand or maximum daily water demand plus applicable fire flows. Fire flow design values shall be identified by the engineer after coordination among the owner, local and state building officials, and fire officials. Distribution system hydraulic modeling may be used to demonstrate compliance with this requirement.

D. Materials used in the construction of waterworks that are in contact with the product water shall comply with NSF/ANSI Standard 61 or an approved equivalent.

**12VAC5-590-650. Objectives of a waterworks. (Repealed.)**

A. The objectives of a waterworks are:

1. The production of pure water; and
2. The production of water appealing to the consumer.

B. To reach the objectives of a waterworks, finished water quality shall conform with Article 4 of Part II of this chapter.

**12VAC5-590-660. Site location.**

A. Wells and water treatment plants shall be located above the projected ~~400-year~~100-year flood-plain elevation. Lower elevations may be considered if it can be adequately shown that the wells or treatment plants can be protected from flooding. Site grading and adequate drainage shall be provided. Springs subject to flooding shall not be approved. See 12VAC5-590-840 E for additional well location requirements.

B. The waterworks pumping and treatment facilities shall be readily accessible in all seasons. Access roads shall be provided.

~~C. Consideration should be given to Functional aspects of the site shall be considered in design, including the convenience of transportation facilities to the plant site and also to the availability of electric power from more than one source of outside power.~~

**12VAC5-590-670. Site size.**

~~A. The area reserved around a well or spring site shall conform with 12VAC5-590-820, 12VAC5-590-830, and to 12VAC5-590-840 D and 12VAC5-590-840 E.~~

~~B. The treatment plant site shall be of ample size to accommodate expansion, and ample space shall be provided at the treatment site for adequate disposal-handling of treatment plant wastes residuals.~~

~~C. The disposal of water treatment plant wastes residuals shall conform to the State Water Control Law, Chapter 3.1 of Title 62.1 of the Code of Virginia.~~

**12VAC5-590-680. Treatment process selection and best available technology.**

~~A. The following shall be considered when selecting treatment processes to achieve treatment goals: (i) ~~The~~ the quality and variability of the source water, and (ii) ~~Possible~~ possible future changes in the quality and quantity of the source water.~~

~~A. The quality and variability of the source water.~~

~~B. Possible future changes in the quality of the source.~~

~~C. Water quality goals, including the growing desire of the public for better water.~~

~~D. When removal of contaminants for which BAT has been specified is necessary, processes classified as BAT shall be employed.~~

~~E. When treatment technique requirements have been established in lieu of MCLs, processes specified by such requirements shall be employed.~~

~~F. POE or POU devices shall not be utilized for long term compliance with PMCLs. Such devices may be considered for short term, interim use, as a condition of a variance or exemption issued by the commissioner.~~

~~B. The design shall employ best available technologies (BAT) for achieving compliance with the PMCLs for organic chemicals listed in 40 CFR 141.61, and BAT for achieving compliance with the PMCLs for inorganic chemicals listed in 40 CFR 141.62.~~

~~C. The design shall employ BAT for achieving compliance with the PMCLs for radionuclides listed in 40 CFR 141.66, including radium-226, radium-228, uranium, gross alpha particle activity, beta particle and photon radioactivity. The design shall consider the system size and use limitations for specific technologies listed in 40 CFR 141.66.~~

~~D. Alternative technologies may be employed when approved by the commissioner.~~

~~E. When treatment technique requirements have been established in lieu instead of PMCLs or Action Levels, the design shall employ processes specified by these requirements.~~

~~F. POU devices shall not be used to achieve compliance with the treatment technique for microbial contaminants. POE or POU devices may be considered for short-term interim use, when approved as a condition of a variance or exemption issued by the commissioner.~~

~~G. For softening, TDS removal, organics removal, and other treatment purposes, the use of reverse osmosis and nanofiltration shall be in accordance with ANSI/AWWA Standard B114-16, or as allowed by the commissioner on a case-by-case basis.~~

**12VAC5-590-690. Capacity of waterworks. (Repealed.)**

~~The design capacity of the waterworks shall exceed the maximum daily water demand of the system. Waterworks shall normally be designed on the following basis of water consumption. If deviations are made, they shall be based on sound engineering knowledge substantiated in the designer's report and approved by the division.~~

A. Daily water consumption rates (annual daily water demand):

Dwellings, per person	100 gpd
High schools with showers, per person	16 gpd
Elementary schools without showers, per person	10 gpd
Boarding schools, per person	75 gpd
Motels at 65 gallons per person, minimum per room	130 gpd
Trailer courts at three persons per trailer, per trailer	300 gpd
Restaurants, per seat	50 gpd
Interstate or through highway restaurants, per seat	180 gpd
Interstate rest areas, per person	5 gpd
Service stations, per vehicle served	10 gpd
Factories, per person, per eight hour shift	15-35 gpd
Shopping centers, per 1,000 sq.ft. of ultimate floor space	200-300 gpd
Hospitals, per bed	300 gpd
Nursing homes, per bed	200 gpd
Home for the aged, per bed	100 gpd
Doctor's office in medical center	500 gpd
Laundromats, 9 to 12# machines, per machine	500 gpd
Community colleges per student and faculty member	15 gpd
Swimming pools, per swimmer	10 gpd
Theaters, drive-in type, per car	5 gpd
Theaters, auditorium type, per seat	5 gpd
Picnic areas, per person	5 gpd
Camps, resort, day and night with limited plumbing, per camp site	50 gpd
Picnic areas, per person	5 gpd
Luxury Camps with flush toilets, per camp site	100 gpd

B. Minimum acceptable effective finished water storage for human consumption shall not be less than 200 gallons per equivalent residential connection at minimum pressure.

C. All waterworks shall provide at least a minimum working (under flow) pressure of 20 psi at the service connection based on the greater of maximum hour or maximum day plus applicable fire flows. Applicable fire flows shall be selected by coordination between the water supply owner, design consultant, local officials and local fire marshal. When the number of residential units is less than 1,000, the formula  $Q=11.4N^{0.544}$ , is acceptable for estimating maximum hour domestic demand flow, where Q=total gallons per minute and N=total number of residential units. The division can require a higher design pressure if indicated by site conditions.

D. A waterworks utilizing wells as the sole source of supply shall provide source capacity of a minimum of 0.5 gallons per minute per equivalent residential connection.

E. Waterworks serving 50 or more residential connections with wells as the source of supply shall provide at least two water sources that do not hydraulically interfere with another source of public water supply. Consideration shall be given to requiring each source to be of a minimum yield so its reliability is realistic. The secondary well should be rated at 20% of the waterworks capacity as a minimum.

F. Waterworks serving less than 50 residential connections with wells as the source of supply shall provide or have access to an auxiliary pump stored or stocked locally or they shall provide 48 hours of total effective storage volume based on water usage.

**12VAC5-590-700. Metering total water production.**

A. ~~Waterworks providing chlorination only shall meter the water prior to treatment. The design of all community and nontransient noncommunity waterworks shall provide metering of total water production.~~

B. ~~The design of all nontransient noncommunity waterworks that provide treatment or have a design capacity of produce greater than 300,000 gallons per month shall provide metering of total water production.~~

C. ~~The design of all transient noncommunity waterworks that provide treatment or have a design capacity of greater than 300,000 gallons per month shall provide metering of total water production.~~

D. ~~If the waterworks treatment process or processes result in a waste flow, including filter backwash, ion exchange regenerate, or residual solids, then the design shall provide metering of total source water withdrawn and finished water produced. The design of all transient noncommunity waterworks that produce greater than 300,000 gallons per month shall provide metering of total water production.~~

E. ~~Metering of total water production at waterworks that do not meet the conditions found in subsections A through D of this section should be provided is encouraged.~~

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B. ~~Waterworks providing iron or manganese removal, or both, shall meter the water prior to treatment. Metering of total water production at waterworks that do not meet the conditions found in subsections A through D of this section is encouraged.~~

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C. ~~Waterworks providing softening by ion exchange, shall meter all water treated and total water delivered to the distribution system. D. Waterworks providing turbidity removal or softening by precipitation, or both, shall meter the water prior to and subsequent to treatment.~~

E. All waterworks shall provide metering of total water production.

**12VAC5-590-710. Site layout. (Repealed.)**

A. Functional aspects of site layout shall be considered.

B. Site grading shall be provided.

C. Adequate site drainage shall be provided.

D. Walks shall be provided.

E. Access roads shall be provided.

F. Driveways shall be provided.

**12VAC5-590-720. Building layout design and construction.**

A. Adequate ventilation shall be provided.

B. Adequate lighting shall be provided.

~~C. Adequate heating shall be provided.~~

~~D. Adequate drainage shall be provided.~~

~~E. Adequate dehumidification equipment shall be provided.~~

~~F. Accessibility of equipment for operation, servicing, and removal shall be provided.~~

~~G. Flexibility of operation shall be provided.~~

~~H. Safety precautions shall be considered. Reference the applicable health and safety standards of the Virginia Department of Labor and Industry for the appropriate requirements.~~

~~I. Convenience of operation shall be considered.~~

~~J. Separate rooms for chemical storage and feed equipment to reduce dust problems shall be considered.~~

~~K. Sanitary facilities shall be provided at all waterworks installations requiring an operator in attendance at all times during operation.~~

~~L. A. In accordance with the USBC, Chapter 6 (§ 36.97 et seq.) of Title 36 of the Code of Virginia, and the Statewide Fire Prevention Code (§ 27.94 et seq.) of Title 27 of the Code of Virginia, all waterworks building design and construction shall include necessary features that will assure a functional and safe environment, including ~~but not limited to:~~ adequate ventilation, lighting, heating, drainage, dehumidification, and accessibility to equipment for operation and maintenance.~~

~~B. Consistent with subdivision A of this section, the waterworks building design and layout shall incorporate safety provisions to protect waterworks operators and other personnel, in accordance with Article 1 (§ 40.1-22) of Chapter 3 of Title 40.1 of the Code of Virginia. These provisions must comply with OSHA standards and regulations under Title 29, Section 651 et seq. of the U.S. Code, and shall include but not be limited to: separation of incompatible chemicals, confined space entry, handrails and guards, ladders, lighting, warning signs, smoke detectors, chlorine leak detectors, protective equipment, safety showers, eye washes, and fire extinguishers.~~

~~C. Positive identification of the contents of a piping system shall be by lettered legend giving the name of the contents. Arrows ~~should~~ shall be used to indicate the direction of flow. Legends shall be applied close to valves, adjacent to changes in direction and branches, where pipes pass through walls and floors, and at frequent intervals on straight pipe runs. The lettering shall be of such color, size, and location so as to be clearly visible and readable.~~

~~M. No conduit or basin containing filtered water shall have a common division wall with another conduit or basin.~~ ~~D. Common division walls between basins or conduits containing nonpotable water and potable water are prohibited.~~ Vertical double division walls, where separated sufficiently to permit ready access for inspection, are permissible where the division walls are monolithic in construction and are properly keyed into their footings or are cast monolithically with their footings.

~~E. Shop space and storage requirements shall be provided.~~

~~F. Wherever pipes pass through walls of concrete structures, extra wall castings to facilitate expansion and future uses shall be provided.~~

#### **12VAC5-590-725. Automated monitoring and control systems.**

The design of computers, including Supervisory Control and Data Acquisition (SCADA) systems, if used to monitor and control water treatment and distribution system facilities, shall meet the following general requirements:

##### 1. Data security.

a. Automated systems used to display and record data or control functions that are connected to the internet shall be secure.

b. Backup power supply shall be provided to allow orderly shutdown of the computer system and prevent corruption of data. The protection shall also power associated communications equipment.

c. Adequate hardware shall be in place to allow a high degree of SCADA and computer system reliability and data security.

d. Adequate hardware and **associated** facilities shall be provided for data archiving.

2. Equipment protection. SCADA and computer systems shall have adequate protection from voltage surges and spikes on the power supply, external data links, and environmental conditions.

3. Data displaying and recording.

a. SCADA and computer systems used to meet the continuous recording requirements of this chapter shall record an observation on a minimum frequency of once per 15 minutes, unless a greater recording frequency is required.

b. SCADA and computer systems used to meet the indicating and recording requirements of this chapter shall provide displays that show a minimum 24-hour trend of results for each parameter. The display panel or panels shall be located in an area where it can be routinely viewed by the waterworks operators.

c. SCADA and computer systems used to meet the indicating and recording requirements of this chapter shall monitor the values and provide alerts for the operator by visual display and audible alarms. Alarm conditions shall be recorded into an alarm log.

4. Waterworks pumps, chemical feeders, and other essential electrical equipment controlled through a SCADA or an automated control system shall have the capability for independent manual operation. Where a high degree of reliability is required, a backup control system shall be provided.

**12VAC5-590-730. ~~Standby power capability. Alternate power sources.~~**

~~Standby power capability may be required by the division so that water may be treated or pumped, or both, to the distribution system in order to maintain a minimum level of service during an emergency.~~

~~A. An emergency management plan for extended power outages shall be developed for each community waterworks as specified in 12VAC5-590-505.~~

~~B. Alternative power sources at all waterworks shall be considered in **the** design, in order to maintain a minimum level of service during an electrical power outage.~~

**12VAC5-590-740. ~~Maintenance and servicing of equipment. (Repealed.)~~**

~~Adequate facilities must be provided for the maintenance and servicing of automatic equipment.~~

**12VAC5-590-750. ~~Shop space and storage. (Repealed.)~~**

~~Adequate facilities should be included for shop space and storage consistent with the designed facilities.~~

**12VAC5-590-760. ~~Laboratory facilities.~~**

~~Laboratory equipment and facilities shall be compatible with the raw water source, intended design of the water treatment plant, and the complexity of the water treatment involved.~~

~~A. Testing equipment provided shall be adequate for the purpose intended and recognized procedures must be utilized. The design of laboratory facilities shall be compatible with the equipment provided, the water supply, and the design and complexity of the water treatment.~~



B. ~~Sufficient~~ The design of community and nontransient noncommunity waterworks shall provide for adequate floor and bench space, adequate ventilation, adequate light, storage room, laboratory sink, and auxiliary facilities shall be provided. Office space is not included in the following specified laboratory sizes: adequate separation of incompatible activities, adequate environmental ~~control controls~~, and auxiliary facilities sufficient to carry out reliable testing.

1. ~~Waterworks providing iron or manganese removal, or softening by ion exchange should provide a laboratory with a minimum of 64 square feet of floor area and 20 square feet of bench area.~~

2. ~~Waterworks providing turbidity removal or softening by precipitation, or both, should provide a laboratory with a minimum of 200 square feet of floor area and 65 square feet of bench area.~~

3. ~~Waterworks providing turbidity removal or softening by precipitation, or both, and in-plant bacteriological analysis should provide a laboratory with a minimum of 300 square feet of floor area and 100 square feet of bench area.~~

C. ~~When a bacteriological laboratory is required a separate room of adequate space shall be provided. Certified analytical laboratory facilities analyzing drinking water shall comply with 1VAC30-41.~~

**12VAC5-590-770. ~~Sample taps~~ Sampling and monitoring equipment.**

A. ~~Sample taps shall be provided so that water samples can be obtained from each water source water and each entry point to the distribution system. At waterworks providing treatment, sample taps shall be provided from each unit operation of treatment, with the taps being located at the master control sink in the laboratory. Taps shall be consistent with sampling needs and shall not be of the petcock type at the entrance and exit of each unit treatment process and at the entry point to the distribution system.~~

1. ~~For surface water treatment plants, a master control sink shall monitor source water, chemically treated water, settled water, combined filter water, and at the entry point to the distribution system.~~

2. ~~All sample taps shall discharge in the downward direction and be provided with a suitable air gap to prevent ~~cross-connection~~ cross connection.~~

B. ~~Continuous monitoring instrumentation shall have electronic sensors that continuously read the parameter and shall display results in real time. Continuous recording equipment shall be provided with the monitoring instrument to store in memory or print one data point at least every 15 minutes. Each result shall be a single result at that time; if signal averaging is applied, the averaging period shall not exceed 30 seconds. The recording equipment shall be capable of producing a paper copy (or equivalent electronic file) showing daily trends, including maximum, minimum, and average values.~~

**12VAC5-590-780. ~~Wall castings. (Repealed)~~**

~~Consideration shall be given to providing extra wall castings built into the structure to facilitate expansion and future uses wherever pipes pass through walls of concrete structures.~~

**12VAC5-590-790. ~~Water supply service~~ Process water.**

~~The water supply service for treatment facilities shall be taken from a point after there has been thorough mixing of all chemicals added to the water. ~~The p~~Process water shall be taken from the finished water ~~after thorough mixing of all added chemicals have been achieved~~ added. An approved backflow ~~prevention assembly or or backsiphonage prevention~~ device shall be installed on the process water supply pipe ~~prior to before~~ connection to the treatment process or equipment.~~

**12VAC5-590-800. Disinfection. (Repealed.)**

All pipes, tanks, and equipment which can convey or store potable water shall be disinfected prior to being placed in service. Plans and specifications shall outline the procedures and include the disinfectant dosage, contact time, and method of testing the results of the procedure.

1. Forms of chlorine for disinfection.

a. Liquid chlorine. The use of liquid chlorine shall be acceptable only when suitable equipment is available and only under the direction of a person trained to handle liquid chlorine. Emergency handling equipment shall be provided.

It will normally require 4.2 lbs. of liquid chlorine (supplied under pressure in steel containers) to produce a concentration of 50 mg/L of available chlorine in 10,000 gallons of water.

b. Calcium hypochlorite. Granular and tablet forms are available (both with 65% available chlorine). It will normally require 6.5 lbs. of calcium hypochlorite to produce a concentration of 50 mg/L of available chlorine in 10,000 gallons of water.

c. Sodium hypochlorite. This is supplied in strengths of 5.25% to 16% available chlorine. The required amount of sodium hypochlorite to produce a 50 mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula:

$$\frac{50}{\% \text{ available chlorine}}$$

2. Methods of disinfection other than chlorination may be considered by the division on a case by case basis.

3. Testing of water following disinfection:

a. All chlorine residual determinations shall be made using only those methods approved by the division; and

b. Two water samples for bacteriological analysis must be collected at least 24 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no coliform contamination before the pipe, tanks, or equipment can be utilized as part of the waterworks. If contamination is indicated, then the disinfection procedure must be repeated.

**12VAC5-590-810. Paints, coatings, sealers, or liners Components, materials, and products.**

Paints, coatings, sealers or liners which contact raw, partially treated, or potable water and are used in pipes, tanks, or equipment which can convey or store these waters shall be approved by the division before application. All components, materials and products that will be in contact with source water, partially treated water, finished water, or water treatment chemicals shall comply with NSF/ANSI Standard 61.

Article 2  
Source Development

**12VAC5-590-820. General New water source selection and sampling.**

A. Preference shall be given to the best available sources of supply which that present minimal risks of contamination from wastewater point and nonpoint pollution sources, which that contain a minimum of impurities that may be hazardous to health, and that give the greatest potential of ensuring a sufficient quantity of potable water.

B. In all cases, sources shall be selected and maintained on a basis which that will assure that the water is continuously amenable to available treatment processes. In selecting the source of water to be developed, the designing engineer must owner shall prove to the satisfaction of the

commissioner that the water which is to be delivered to the consumers shall comply with all applicable PMCLs of the board with respect to bacteriological, physical, chemical and radiological qualities to be delivered to the consumers will comply with 12VAC5-590-340.

C. All water samples for bacteriological, chemical, physical, and radiological analyses must ~~shall~~ be submitted to the Commonwealth of Virginia, Department of General Services, Division of Consolidated Laboratory Services DCLS or to a testing laboratory certified by the Division of Consolidated Laboratory Services DCLS. All bacteriological analyses must be performed at laboratories in accordance with analysis ~~12VAC5-590-370~~ A and ~~12VAC5-590-480~~ B-2 Analytical methods shall be in accordance with 12VAC5-590-440.

**12VAC5-590-830. Surface water sources; quantity; quality; development structures.**

A. A surface water source includes all tributary streams and drainage basins, natural lakes, and artificial reservoirs or impoundments above the point of water supply intake.

1. The quantity of water at the source shall:

- a. Be adequate to supply the water demand of the service area;
- b. Provide a reasonable surplus for anticipated growth; and
- c. Be adequate to compensate for all losses, including evaporation, seepage, flow by requirements, etc.

2. The safe yield of the source shall be determined as follows:

- a. Simple intake (free-flowing stream). The safe yield is defined as the minimum withdrawal rate available during a day and recurring every 30 years (30-year one day low flow). To generate the report for this, data is to be used to illustrate the worst drought of record in Virginia since 1930. If actual gauge records are not available for this, gauges are to be correlated from similar watersheds and numbers are to be synthesized; and
- b. Complex intake (impoundments in conjunction with streams). The safe yield is defined as the minimum withdrawal rate available to withstand the worst drought of record in Virginia since 1930. If actual gauge records are not available, correlation is to be made with a similar watershed and numbers synthesized in order to develop the report.

Note: Local governments may request this aid from the State Water Control Board (SWCB) by contacting either the Health Department's Office of Water Programs or the SWCB's headquarters office in Richmond.

B. The owner shall conduct, or have conducted, a sanitary survey and a study an assessment of the factors, both natural and man-made, which that will affect the quality of the water at the source and quantity of the source water supply. The results of the sanitary survey assessment shall be submitted to the division department with the design. Such survey and study The assessment shall include, but shall not be limited to:

1. Obtaining samples over a sufficient period of time acceptable to the commissioner, to assess the bacteriological, physical, chemical, and radiological characteristics of the source water supply;
2. Determining future uses and effects of impoundments or reservoirs;
3. Determining the degree of control over the watershed that may be exercised by the owner; and
4. Locating potential sources of pollution within 5 miles upstream from the surface water intake; and

45. Assessing ~~the~~ degree of hazard to the source by possible spillage surface source water supply resulting from a potential release of materials that may be toxic, harmful, or detrimental to treatment processes.

C. ~~Intake~~ Surface water intake structures shall provide for:

1. Withdrawal of water from at least three levels in impoundments or reservoirs. Withdrawal of water from more than one level may be required in run-of-the-stream intakes if the quality varies with depth;
2. Separate facilities for release of less desirable water held in storage at impoundments or reservoirs;
3. Screens on intake ports with provisions for adequate cleaning. Screen opening size and velocity may be restricted by federal or state permit;
4. Prevention of flooding of access walkways and control valves of intakes on multiple purpose reservoirs; and
5. ~~Velocity of flow through~~ Flow velocity through the inlet structure such so that frazil ice will be held to a minimum.

~~D. A detention reservoir is a structure into which water is stored for pretreatment to improve water quality prior to other treatment. Where a detention reservoir is required, the development shall assure that:~~

1. ~~Water quality is protected by controlling runoff into reservoir;~~
2. ~~Dikes are structurally sound and protected against wind action and erosion;~~
3. ~~Point of influent flow is separated from the point of withdrawal; and~~
4. ~~Sufficient detention time is provided in the reservoir as recommended by the designer and approved by the division.~~

~~E. In order to protect the public health and guarantee a supply of pure water, terminal reservoirs shall not be utilized for body contact recreation and boats powered by gasoline engines. Large terminal reservoirs may be used for body contact recreation and boats powered by gasoline engines provided a buffer zone acceptable to the division and water purveyor is furnished. Site preparation shall include but not be limited to the removal of brush and trees to the high water elevation, and protection from floods during construction.~~

#### **12VAC5-590-840. Groundwater sources.**

A. A groundwater source includes all water obtained from drilled wells and springs. Wells and springs ~~should~~ shall be protected from contamination during construction. All ~~public water supply wells intended to serve a waterworks~~ shall be constructed by registered Virginia contractors at certified water well system provider. All wells shall be constructed in a manner to protect groundwater resources by preventing contaminated water or water having undesirable physical, chemical, or radiological characteristics from entering ~~potable water~~ aquifers.

B. All wells located within the Eastern Virginia or the Eastern Shore Groundwater Management Areas (GWMA) shall be constructed in a manner to protect groundwater resources by preventing blending or cross contamination of the aquifers.

1. Wells shall not be constructed with screens in multiple aquifers.
2. Geophysical logging and formation sampling shall be required for all wells during construction, in addition to submitting a Form GW-2.
3. Observation and production wells shall be constructed with gravel packs and grout in a manner that prevents movement between aquifers. Gravel pack shall be terminated close to the top of the well screens and shall not extend above the top of the screened aquifer. The remainder of the annular space shall be filled with grout material.

4. Pump intake setting shall be documented and the pump intake shall not be set below the top of a confined aquifer or the bottom of an unconfined aquifer that supplies water to the well.

C. All groundwater sources must be analyzed for chemical, physical, radiological, and bacteriological quality ~~in order to determine treatment requirements as described in 12VAC5-590-840 K.~~ Groundwater containing total coliform concentrations of less than 100 and more than three organisms per 100 milliliters based on the geometric mean of 20 or more samples shall be disinfected. Groundwater containing total coliform concentrations of 100 or more organisms per 100 milliliters based on the geometric mean of 20 or more samples constitutes unacceptable contamination for disinfection only. Groundwater with widely fluctuating or increasing bacteriological results may be determined by the division to be unsuitable for disinfection treatment alone.

The class of well to be constructed shall be determined by the division. All well lot, well location, and well construction requirements contained in this section may be varied by the division as specific geologic and site conditions dictate.

1. Minimum well lot D. ~~Community waterworks' wells~~ Wells intended for use as a community waterworks shall be located on a well lot meeting the following minimum requirements:

~~a.~~ 1. The well lot shall provide a distance of at least 50 feet from the well to all property lines of the well lot. Larger well lots may be required under certain conditions. Fencing of the well lot may be required under certain conditions;

2. The owner shall consider the need for a larger well lot for future expansion, the need to provide security measures such as lot fencing, and ~~the need to establish~~ establishing additional well lots for future use;

~~b.~~ 3. If the well lot does not adjoin a public road, ~~then~~ an all-weather access road shall be provided and an access easement recorded as part of the well lot;

~~c.~~ 4. The well lot shall be graded to divert surface runoff away from the well and to prevent ponding on the well lot;

~~d.~~ 5. The well lot or lots ~~must~~ and access to the lot or lots shall be located by a survey, and a final plat plan and dedication document prepared and recorded as described in 12VAC5-590-200. The final plat plan must agree with the preliminary plat plan with respect to size and boundaries of the lot or lots selected for well or wells. One of the following must be submitted:

(1) A copy of the plat plan showing that it has been duly recorded and signed by the clerk of the circuit court for the jurisdiction where the well is located and giving the deed book and page number and date of recording will be required before a construction permit can be issued or

(2) If the well lot is identified on a recorded plan of the subdivision as a well lot, then this is acceptable, if recorded as indicated in subdivision A 1 d (1) above; and

e. In addition, a dedication document duly recorded with the clerk of the circuit court must be furnished stating that the well lot shall be used only for waterworks appurtenances as long as this lot is utilized as part of a waterworks.

2. E. Minimum well location requirements:

~~a.~~ 1. The horizontal distance from the well to any septic tank, ~~purification-sanitary drain~~ field, pit privy, cesspool, barnyard, ~~hog~~ animal feed lot, cemetery, geothermal well or source of similar contamination, ~~as well as~~ and all surface runoff from ~~such~~ actual or potential sources of contamination, shall be at least 50 feet;

~~b. 2. The horizontal distances from the well to any pipe carrying sewage or pipe in which sewage can back up shall be at least 50 feet; and,~~

~~e. The horizontal distance from the well to any petroleum or chemical storage tank or pipe line or similar source of contamination shall be at least 50 feet, except that where plastic type well casing is used, the separation distance shall be at least 100 feet. This 100-foot separation may be obtained by an enlarged well lot, easements, deed restrictions, or other equivalent legal means.~~

3. A minimum separation distance of 50 feet shall be maintained between a fuel storage tank and a well; however, a lesser distance may be allowed- if the ~~storage~~ fuel is propane or natural gas, or if it is liquid fuel meeting the following requirements:

a. Liquid fuel tanks shall be located above grade.

b. Liquid fuel tanks shall be double-walled with an inner wall leak-detection alarm, or single-walled with a full-capacity containment system constructed of compatible material.

c. The liquid fuel line shall be located above grade, or enclosed in a protective casing if below grade, and the liquid fuel tank shall be provided with a paved and curbed parking pad at the tank filling location.

4. The commissioner shall require a spill response plan if the fuel is stored within 50 ft of the well.

F. The class of well to be constructed shall be determined by the commissioner. A Form GW-2 shall be completed and submitted to the department with the project documents, in accordance with procedures in 12VAC5-590-200.

31. Minimum construction requirements for Class I wells:

a. The well shall be drilled and cased to a depth sufficient to exclude undesirable groundwater, but in no case shall the casing this depth be less than 100 feet in depth; below finished grade.

b. The diameter of the drill hole to the depth required above shall be at least three inches greater than the outside diameter of the couplings of the casing to be used; and,

c. For wells constructed in consolidated formations, the lower end of the casing shall terminate in solid rock or other impervious formation when practical to do so.

~~e. d.~~ The annular space around the casing shall be grouted to a depth of at least 100 feet in a manner satisfactory to the ~~division~~ commissioner. When the outer casing cannot be removed, the annular spacing between the drill hole and the outer casing shall also be sealed in a manner approved by the ~~division~~ commissioner.

42. Minimum construction requirements for Class II wells. This classification includes two types of construction, either of which is acceptable:

a. Type A wells in which the annular space around the casing is grouted a minimum of 20 feet from the surface:

(1) The well shall be drilled and cased to a depth of at least 100 feet; and

(2) The cased drill hole shall pass through at least the first 50 feet of unconsolidated formation such as caving sand, gravel or other material that will collapse against the casing;

b. Type B wells in which the annular space around the casing is grouted:

(1) ~~a.~~ The well shall be drilled and cased to a depth sufficient to exclude undesirable groundwater, but in no case shall ~~the casing be less than 50 feet in length; this depth be less than 50 feet below finished grade.~~

(2) ~~b.~~ The diameter of ~~the drill hole to the depth required above~~ shall be at least three inches greater than the outside diameter of the couplings of the casing to be used.

(3) ~~The c.~~ For wells constructed in consolidated formations, the lower end of the enlarged portion of the drill hole should terminate in solid rock or other impervious formation when practical to do so; ~~and.~~

(4) ~~d.~~ The annular space around the casing shall be grouted to a depth of at least 50 feet in a manner satisfactory to the ~~division commissioner.~~ When the outer casing cannot be removed, the annular spacing between the drill hole and the outer casing shall be sealed in a manner approved by the ~~division commissioner.~~

**B. General well development requirements G. Well construction materials and development:**

1. Water used in well construction shall be from a ~~satisfactory~~ potable water source or from the well under construction.

2. Casing and liner pipe:

a. ~~Shall be metallic pipe meeting ASTM, ANSI, AWWA or API~~ Steel casing and liner pipe shall meet ASTM, NSF/ANSI, or AWWA specifications and standards applicable to wells. Dimensions shall conform to the following table: Steel pipe dimensions shall conform to Table 840.1.

Table-TABLE 840.1.  
Steel Well Casing Pipe.

STEEL PIPES					
SIZE (inches)	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	External	Internal		Plain Ends	With Threads and Couplings
4 <del>id</del>	4.5	4.026	0.237	10.79	11.0 ÷
6 <del>id</del>	6.625	6.065	0.280	18.97	19.18 ÷
8	8.625	7.981	0.322	28.55	29.35 ÷
10	10.750	10.020	0.365	40.48	41.85
12	12.750	12.000	0.375	49.56	51.15
14 <del>od</del>	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	<del>65.30</del>
18	18.000	17.250	0.375	70.59	<del>73.00</del>
20	20.000	19.250	0.375	78.60	<del>81.00 ÷</del>
22	22.000	21.000	0.500	114.81	
24	24.000	23.000	0.500	125.49	

26	26.000	25.000	0.500	136.17	
28	28.000	27.000	0.500	146.85	
30	30.000	29.000	0.500	157.53	
32	32.000	31.000	0.500	168.21	
34	34.000	33.000	0.500	178.89	
36	36.000	35.000	0.500	189.57	

b. Plastic pipes may be approved following investigation by the division. The casing shall be PVC type 1120 (cell identification 12454), NSF approved for well casings meeting appropriate ASTM, ANSI, AWWA or API specifications and used to depths in conformance with the information contained in the following tables: Plastic well casing shall be PVC meeting ASTM F480, NSF/ANSI Standard 61, or AWWA Standard A100. Depths shall not exceed the published resistance to hydraulic collapse pressure of the PVC casing, taking into account the installation techniques and grouting methods. Well casing wall thickness shall be sufficient to withstand anticipated formation and hydrostatic pressures and mechanical forces imposed during installation, well development, and use. PVC well casing shall meet the requirements of ASTM, NSF/ANSI, and AWWA, as applicable.

Maximum Allowable Depths of Installation of Polyvinyl Chloride (PVC) Thermoplastic Water Well Casing Type 1120 (12454)									
Schedule Number	Nominal Diameter of PVC 1120								
	2	2.5	3	3.5	4	5	6	8	10
40-	560'	740'	485'	265'	201'	149'	113'	99'	74'
80-	1750'	2040'	1380'	1085'	912'	64-	395'	400'	340'

SDR No.	All Diameters of PVC 1120
SDR 41	25
SDR 32.5	50'
SDR 26	108'
SDR 24	212'
SDR 17	413
SDR 13.5	868'

c. ~~Heavy weight~~ **Heavyweight** casing pipe may be required under certain geologic and hydrostatic conditions; ~~and~~

d. Where corrosive conditions exist, materials such as coated casings, stainless steel, bronze, or plastic may be used as casings or linings subject to approval by the ~~division~~ commissioner, and meeting the requirements of NSF/ANSI Standard 61.



3. Packers or other well construction materials shall be of a material that will not impart taste, odors, toxic substances, or bacterial contamination to the water in the well. No lead is to be used in packers, flux, piping, etc.

4. Screens, where required, shall:

- a. Be constructed of material ~~which that~~ will not be damaged by chemical action of groundwater or future cleaning operations;
- b. Have size of openings to be based on sieve analysis of the formation to be screened, and ~~should shall~~ be adequate to pass flows at a velocity of 0.1 ~~feet per second ft/sec~~ or less; and
- c. Be installed so that exposure above the pumping level will not occur.

~~5. A water well completion report shall:~~

- ~~a. Be submitted to the division, the State Water Control Board and the owner; and~~
- ~~b. Provide all data requested on the most recent well completion form.~~

~~6. The yield and drawdown test data over a 48-hour minimum period shall be provided; however, in those areas where geologic conditions warrant, the required test period may be varied by the division.~~

~~7. Chemical conditioning shall be included in specifications as to method, equipment, chemicals, testing for residual chemicals, disposal of waste, and inhibitors used.~~

~~8. 5. Grouting requirements.~~

~~a. Neat cement grout is normally required and shall consist of cement (API Spec. 10, Class G cement or Class B similar to ASTM C150 TYPE II) shall consist of Portland cement and water with not more than six gallons of water per 94-pound sack of cement, and shall be in place within 48 hours of well construction. A maximum of 6.0%, by weight, bentonite and 2.0%, by weight, calcium chloride, may be added. NOTE: When exceptional conditions require the use of a less fluid grout to bridge voids, a mixture of cement (ASTM C150 TYPE II), sand and water in the proportion of not more than two parts by weight of sand to one part of cement with not more than six gallons of clean water per 94 pound sack of cement may be used if approved by the division; Other grout mixes may be approved by the commissioner where special conditions warrant.~~

~~b. Application.~~

~~(1) Grout shall be installed by means of continuous pressure grouting from the bottom of the annular opening upward in one continuous operation until the annular opening is filled.~~

~~(2) Sufficient annular opening shall be provided to permit a minimum of ~~1-1/2~~ 1-1/2 inches of grout around the protective casing, including couplings, if used.~~

~~(3) ~~Prior to Before~~ grouting, bentonite, Aquagel, or similar approved materials may be added to the annular opening, in the manner indicated for grouting; and wells suitable fill material such as bentonite, low-strength cement/sand mix, or similar materials that have been approved by the commissioner shall be added to the annular opening below the grout zone to seal and stabilize these areas. ~~In lieu~~ Instead of this requirement, the casing may be grouted for its entire depth.~~

~~c. ~~Protective casing~~ Casing shall be provided with sufficient centralizers attached to the casing to permit allow unobstructed flow and uniform thickness of the grout.~~

~~d. Where plastic well casing is used, the heat of hydration of cement mixtures and the collapse of the casing shall be taken into consideration ~~Department of Environmental~~~~

Quality (DEQ) when choosing grout composition and placement in accordance with Department of Environmental Quality (DEQ) guidelines..

9. Plumbness and alignment:

- a. ~~Every well shall be tested for plumbness and alignment;~~
- b. ~~The test method shall be clearly stated in specifications; and~~
- c. ~~Excessive kinks and bends shall not be acceptable.~~

10. 6. To prevent tampering and contamination of the water source, unused wells shall be capped and locked. Watertight welded metal plates, set screw caps, or screw-on caps are acceptable for temporarily capping a well until the pumping equipment is installed.

H. A well yield and drawdown test shall be performed in accordance with requirements of this subsection. The commissioner may require additional pumping wells, observation wells, or longer duration tests where site conditions warrant.

1. The yield and drawdown test duration shall be a minimum of 48 hours. Data to be collected during the yield and drawdown test shall be recorded on the Well Yield and Recovery Report form provided by the department. When the ~~source water supply~~ requirements for a noncommunity waterworks are determined to be three gpm or less over normal hours of operation, the 48-hour minimum drawdown test may be reduced to no less than 12 hours. Any reduction shall be approved by the commissioner ~~prior to before~~ conducting the test.

2. Discharge from the pumping well shall be conveyed away from the test site to avoid recharge.

3. Where multiple wells are ~~intended to be~~ used, the location and geology of each well in the vicinity shall be evaluated. The commissioner shall require that:

- a. The yield and drawdown test be performed simultaneously on ~~the~~ multiple wells, or
- b. During the yield and drawdown test of the pumping well, the water levels of the neighboring wells shall be monitored. If the water level of the neighboring wells declines in response to the pumping well, then additional evaluation shall be required by a Professional Engineer or a Professional Geologist with experience in groundwater source evaluations.

4. The commissioner may consider alternative testing methods and analyses as proposed by Professional Engineers or Professional Geologists with experience in groundwater source evaluations. Where geological conditions exist that prohibit an accurate determination of well yield using methods prescribed in this subsection, additional testing procedures shall be required on an individual basis ~~and approved~~ by the commissioner.

5. When a aquifer test is required by the DEQ for a well located in a GWMA, the yield and drawdown test may be incorporated into the aquifer test plan protocol, if approved by the commissioner ~~prior to before~~ conducting the test.

I. Well appurtenances.

1. A sanitary seal shall be provided on the top of the well casing, or a watertight well cap shall be provided when a pitless adapter is installed.

2. The well casing shall extend at least 12 inches above the concrete floor or apron.

3. Where aprons are used, they shall be centered on the well and measure at least 6 ft by ~~6 ft by 6 inches thick~~.

4. Provisions shall be made for venting the well casing to the atmosphere. Where vertical turbine pumps are used, vents into the side of the casing may be necessary to provide adequate venting.

5. Each well casing shall be provided with equipment and appurtenances for measuring the water level elevation in the well. Corrosion-resistant materials shall be used. Where necessary, the appurtenances shall be attached firmly to the drop pipe or pump column and in a manner as to prevent entrance of foreign materials.

6. All pitless well units, adapters, and watertight caps shall be listed by the Water Systems Council as certified products, or as approved by the commissioner.

J. Every new, modified, or reconditioned groundwater well or spring shall be disinfected after placement of the final pumping equipment. Wells shall be disinfected in accordance with AWWA Standard C654-13.

K. Water quality tests.

Water quality sampling and analysis shall be conducted for every new, modified, or reconditioned well or spring to determine what treatment, if any, is required. All samples shall be analyzed by DCLS or a testing laboratory certified by DCLS. Water quality analytical methods shall conform to requirements contained in 12VAC5-590-440.

11-1. Bacteriological quality:

~~a. Every new, modified, or reconditioned groundwater source shall be disinfected after placement of the final pumping equipment; and~~

~~b. A series of nine consecutive negative samples for bacteriological examination or a series of 20 or more samples for most probable number (MPN) examination is required.~~

a. Bacteriological samples for new or deepened wells shall consist of a series of 20 samples collected at a minimum of 30-minute intervals during the last 10 hours of the yield and drawdown test. These samples shall be analyzed for both total coliform density and E. coli density. See 12VAC5-590-380 G for groundwater disinfection treatment requirements, and 12VAC5-590-430 for surface water influence determinations.

b. Bacteriological samples for modified or reconditioned wells shall consist of two samples collected at least 30 minutes apart, at a minimum, while the pump is in continuous operation. These samples shall be analyzed for both total coliform density and E. coli density. More samples may be required by the commissioner, depending on the work performed.

~~12. Samples for chemical, physical and radiological analyses shall be submitted on every new, modified, or reconditioned well. The sample must be collected near the end of the pumping test and after the well water has cleared.~~

2. Samples for new wells shall be collected for chemical, physical, and radiological contaminants listed in Tables 340.1 through 340.4. SOC tests may be waived by the commissioner if supported by the source water assessment of vulnerability to contamination. Chemical sampling analysis for transient noncommunity waterworks may be limited to nitrate and nitrite only. Samples shall be collected at the end of the yield and drawdown test and after the well water has ~~shown no further change in the clarity of the water~~ cleared. Chemical, physical, and radiological constituent testing for modified or reconditioned wells shall be determined on an individual basis by the commissioner. -

13- L. Observation wells:

~~a. 1. Shall be constructed in accordance with the requirements for permanent wells if they are to remain in service after completion of the groundwater study; and of DEQ if they are constructed in a GWMA. Otherwise, they shall be constructed in accordance with ~~12VAC5-590-630- 12VAC5-630~~ if they are to remain in service as observation wells after completion of the groundwater study.~~

b. 2. Shall be protected at the upper terminal to preclude the entrance of contamination.

14. Well abandonment:

a. ~~Observation wells and groundwater sources which are not in use shall be sealed by methods which will restore the controlling geological conditions which existed before they were constructed;~~

b. ~~Temporary abandonment.~~

(1) ~~Any water well temporarily removed from service, or completed but not put into service, shall be sealed with a watertight cap or well head seal.~~

(2) ~~Such well shall be so maintained that it will not be a source or channel of contamination during temporary abandonment; and~~

c. ~~Permanent abandonment.~~

(1) ~~All casing and screen materials may be salvaged.~~

(2) ~~The well shall be checked from land surface to the entire depth of the well before it is plugged to ascertain freedom from obstructions that may interfere with plugging (sealing) operations.~~

(3) ~~The well shall be thoroughly chlorinated prior to plugging (sealing).~~

(4) ~~Bored wells shall be completely filled with cement grout or dry clay compacted in place.~~

(5) ~~Wells constructed in unconsolidated formations shall be completely filled with cement grout or clay slurry by introduction through a pipe initially extending to the bottom of the well. Such pipe shall be raised, but remain submerged in grout, as the well is filled.~~

(6) ~~Wells constructed in consolidated rock formations or which penetrate zones of consolidated rock may be filled with sand or gravel opposite the zones of consolidated rock. The top of the sand or gravel fill shall be at least five feet below the top of the consolidated rock. The remainder of the well shall be filled with sand cement grout only.~~

15. M. Sealing of select zones. All zones containing water of undesirable quality or zones to be protected but excluded from final well completion shall be grouted from a point at least five feet above the zone to a point at least five feet below the zone.

C. Special requirements for various groundwater sources:

4. N. Gravel packed wells:

a. 1. The gravel utilized shall be free of foreign material, properly sized, washed, and then disinfected ~~prior to before~~ or during placement;

b. 2. The gravel refill pipes, when used, shall be incorporated within the pump foundation or concrete apron and terminated with screwed or welded caps at least 12 inches above the ~~pumphouse pump house~~ floor or concrete apron;

c. 3. ~~Gravel.~~ The gravel refill pipes in the grouted annular opening shall be surrounded by a minimum of 1-½ inches of grout;

d. 4. ~~Means.~~ A means for the prevention of leakage of grout into the gravel pack of the screen shall be provided; ~~and~~

e. 5. The minimum protective casing and grouted depth shall be acceptable to the ~~division commissioner.~~

6. Wells located in a GWMA shall have gravel packing installed in accordance with 12 VAC5-590-840 B 3.

2. O. Radial water collectors will collector systems shall be considered on an individual basis by the division commissioner.

~~3. Multiple aquifer wells. The annular space between producing aquifers should be grouted to prevent the mixing of waters of different qualities (see subdivision B 15). An approved bentonite material specifically manufactured as a grout may be considered.~~

4. P. Flowing artesian wells located outside a GWMA will be considered on an individual basis by the division an individual basis by the commissioner.

1. The well shall be equipped with a pitless adapter specifically designed for pressurized artesian wells.

2. Special well construction, casing, and sealing may need to be considered for flowing artesian wells.

Q. Capacity determination of wells used for community waterworks shall meet the daily water demand..

1. Capacity of wells located in consolidated rock formations shall be determined by the well sustainable yield and the actual installed (production) well pump capacity, whichever value is less. The sustainable yield shall be calculated as follows:

(A x 1440 min/day) / 1.8 = gpd well sustainable yield, where A = well yield (gpm)

determined by the yield and drawdown test conducted in accordance with 12VAC5-590-840 H.

2. Capacity of wells located in unconsolidated formations shall be determined by the well yield and the actual installed (production) well pump capacity, whichever value is less.

R. Waterworks serving 50 or more residential connections employing only wells as-providing the source water supply shall include at least two wells. If only two wells are provided, then the second well shall be rated for at least 30% of the waterworks' permit capacity.

S. The owner of a waterworks serving less than 50 residential connections with a single well as-providing the source water supply shall provide or have ready access to a replacement pump and other components and materials needed for pump replacement. In-lieu Instead of this requirement, the owner may provide 48 hours of total finished water storage volume based on the maximum daily water demand.

5. Springs:

~~a. Springs may be considered only when it is not possible to develop an acceptable well or other source;~~

~~b. Springs may be approved only after an extensive sanitary survey and bacteriological, turbidity, chemical, and flow data over a time period sufficient to establish year-round quality and quantity. The amount of land required for protection of the spring shall be determined by the division on a case by case basis;~~

~~c. Springs shall be considered as surface water sources if they are influenced by surface conditions. Indicators of such influence include turbidity, bacteriological, and chemical quality that varies with surface conditions;~~

~~d. Springs shall be protected from entry of surface water;~~

~~e. Springs shall be housed in a permanent structure; and~~

~~f. Springs shall be continuously chlorinated.~~

T. Springs.

1. The water quality of spring sources shall be established by obtaining samples over a period of time, agreeable to the commissioner, to assess the bacteriological, physical, chemical, and radiological characteristics.

2. Springs shall be housed in a permanent structure and protected from entry of surface water.

3. The amount of land required for protection of the spring source shall be determined by the owner and approved by the commissioner.

4. The design of spring sources shall provide for continuous disinfection.

5. The capacity of spring sources shall be determined using actual flow data.

a. Sufficient daily flow data shall be collected to conduct a frequency distribution analysis. The capacity of a spring source is defined as the low flow rate for one day with a projected recurrence period of 30 years (30-year~~30-year~~ 1-day low flow).

b. The Log-Pearson Type III method of frequency distribution analysis shall be used to make the determination, with a minimum of 1000 daily flow measurements.

c. If sufficient data is not available to conduct the analysis specified in this subsection, ~~then~~ the lowest recorded daily flow rate may be considered to be the spring capacity. Sufficient flow records shall be available to capture the spring flow during drought conditions, and shall be acceptable to the commissioner.

Article 3  
Processes and Devices

**12VAC5-590-850. General Appropriate treatment.**

A. The design of ~~water treatment processes and devices~~ facilities shall depend upon the evaluation of the nature and quality of the particular ~~source~~ water to be treated and the ~~desired required~~ quality of the finished water as set forth in Article 4 of Part II, Drinking Water Standards, and Article 2 of Part III, Source Development. All surface water shall receive treatment by chemical addition, for coagulation, flocculation, clarification, filtration, and disinfection unless otherwise approved by the division. Some types of treatment processes may require ~~precipitation~~. Operation and maintenance manuals are required. Treatment process selection shall follow the requirements of 12VAC5-590-680.

B. The design of water treatment facilities shall address safety considerations as required in 12VAC5-590-560.

**12VAC5-590-860. Chemical application.**

Only chemicals authorized in the construction permit or subsequently authorized by the division and in compliance with National Sanitation Foundation Standards 60 and 61 shall be used to treat drinking water or as an additive to drinking water.

A. Plans and specifications shall be submitted for ~~review~~ evaluation and approval, as provided for ~~required~~ in Part I, and shall include:

1. Descriptions of feed equipment, including maximum and minimum feed ranges;
2. Location of feeders, piping layout, and points of application;
3. ~~Storage~~ Chemical storage and handling facilities;
4. Specifications for chemicals to be used;
5. Operating and control ~~procedures~~ features; and
6. Descriptions of testing equipment and procedures.

B. Chemicals shall be applied to the water at such points and by such means as to:

1. Assure maximum efficiency of treatment;
2. Provide maximum protection to the consumer;
3. Provide maximum safety to operators;

4. Assure satisfactory mixing of the chemicals with the water;
5. Provide maximum flexibility of operation through various points of application, when appropriate;
6. Prevent backflow or ~~back siphonage~~ backsiphonage between multiple points of feed through common manifolds; and
7. Provide for the application of pH-affecting chemicals to the ~~raw source water~~ supply ~~before prior to~~ the addition of the coagulant in turbidity removal processes.

C. Feed equipment.

1. Where chemical feed is necessary for the treatment of the source water supply, such as chlorination, coagulation, or other essential processes: ~~a. A minimum of two feeders shall be provided; and b. A standby unit or combination of units of sufficient capacity, a standby feeder or combination of feeders shall be available to replace provide the required chemical dose with the largest unit during shutdowns feeder out of service.~~
2. Feeders shall be of such design and capacity to meet the following requirements:
  - a. Feeders shall be able to supply ~~at all times~~ the necessary amounts of chemical at an accurate rate throughout the range of feed; at all times.
  - b. Proportioning of chemical feed to the rate of flow shall be provided where the water flow is not constant; or where specifically required by the commissioner.
  - c. Positive displacement type solution feed pumps, or gravity feed through ~~rotometers~~ rotameters, shall be used to feed liquid chemicals, but should not normally be used to feed chemical slurries; and.
  - d. ~~Chemical solutions shall be prevented from being siphoned into the water supply by:~~
    - (1) ~~Providing vacuum relief;~~
    - (2) ~~Providing a suitable air gap, or~~
    - (3) ~~Other approved devices or piping arrangements;~~
  - e. ~~The service water supply shall be protected from contamination by chemical solutions by:~~
    - (1) ~~Equipping the supply line with backflow or back siphonage prevention devices or~~
    - (2) ~~Providing an air gap between supply line and solution tank;~~
  - f. ~~Chemical contact materials and surfaces shall be resistant to the aggressiveness of the chemical solution;~~
  - g. ~~Dry chemical feeders shall:~~
    - (1) ~~Measure chemicals volumetrically or gravimetrically;~~
    - (2) ~~Provide effective solution of the chemical in the solution pot;~~
    - (3) ~~Preferably provide Provide~~ gravity feed from solution pots; and
    - (4) ~~Completely enclose chemicals to prevent emission of dust to the operation room;~~
  - h. ~~No direct connection may shall exist between any sewer and a drain or overflow from the feeder or solution chamber or tank; and.~~
  - i. ~~A separate chemical waste tank should be considered.~~
3. Chemical feed equipment:
  - a. Shall be located near points of application to minimize length of feed lines;
  - b. Shall be readily accessible for servicing and repair, and observation of operation; and

c. Shall be located within a and protective curbing ~~curbing provided~~ so that chemicals resulting from equipment failure, spillage, or accidental drainage shall not enter the water in conduits or treatment or storage basins.

4. Control:

a. Feeders ~~may shall~~ be capable of both manual or automatic control manually or automatically controlled with the automatic control reverting to manual control as necessary;

b. ~~The feeders~~ Feeders shall be manually started following shutdown, unless otherwise approved by the ~~division~~ commissioner; and

c. Automatic chemical dose ~~or controls with~~ residual analyzers ~~may be approved for use and~~ shall provide alarms for critical values, and shall include indicating and recording charts equipment.

5. Solution tanks. All solution tanks shall be manufactured of materials suitable ~~as a for~~ food contact surface; or that meet the requirements of 12VAC5-590-810.

a. Means shall be provided to maintain uniform strength of solution, consistent with the nature of the chemical solution. Continuous agitation ~~is necessary shall be provided~~ to maintain slurries in suspension;

b. ~~Two solution tanks of specific capacity may be required for a chemical to assure continuity of chemical application during servicing;~~ Solution tanks shall be of sufficient number and capacity to assure continuous chemical application during tank servicing, and the access openings shall be curbed and fitted with tight covers.

c. Each tank exceeding 30 gallons in capacity or fixed in place shall be provided with a drain unless other means of dewatering the tank are provided.

(1) ~~No direct~~ Direct connection between any tank or drain and a sewer ~~shall be permitted is prohibited.~~

(2) All drains shall terminate at least two pipe diameters, but not less than two inches, above the rim of the receiving sump, conduit, or waste receptacle;

d. Means shall be provided to indicate the solution level in the tank;

e. ~~Make-up~~ Process water shall enter the tank above the rim at a distance of two pipe diameters but not less than two inches;

f. Chemical solutions shall be kept covered.

(1) ~~Polyphosphate solutions shall be disinfected by carrying a chlorine residual when added to unchlorinated water.~~

(2) ~~Large tanks with access openings shall have such openings curbed and fitted with tight covers;~~

g. ~~Subsurface locations for~~ Buried or subsurface chemical storage or solution tanks shall: are prohibited.

(1) ~~Be free from sources of possible contamination;~~

(2) ~~Assure positive drainage for groundwaters, accumulated water, chemical spills, and overflows; and~~

h. Overflow pipes, when provided, shall:

(1) ~~Be turned downward, with end screened and when located outside, be provided with an appropriately sized screened end to prevent entry of insects and small animals;~~

(2) Have free discharge;

(3) Be located where noticeable; and



(4) Be directed so as not to contaminate the water or be a hazard to operating personnel.

6. Weighing scales:

a. Shall be provided for weighing cylinders at all water treatment plants utilizing chlorine gas; for large water treatment plants, indicating and recording type are desirable;

b. Shall be ~~required for fluoride solution~~ provided for fluorosilicic acid feed systems in conjunction with a ~~loss-of-weight~~ loss-of-weight recorder;

c. ~~Should be required~~ Shall be considered for volumetric dry chemical feeders; and

d. Shall be accurate to measure increments of 0.5% of load.

7. Feed lines:

a. Shall be as short as possible in length of run and be:

(1) Of durable, corrosion-~~resistant~~ resistant material;

(2) Easily accessible throughout the entire length;

(3) Protected against freezing; and

(4) Readily cleanable.

b. Shall slope upward from chemical source to feeder, when conveying gases;

c. Shall introduce corrosive chemicals in ~~such a~~ manner as to minimize potential for corrosion;

d. Shall be designed consistent with scale forming solids depositing properties of the water, chemical solution, or mixture conveyed;

e. Shall not carry chlorine gas beyond the chlorine feeder room unless the chlorine is under vacuum; and

f. Shall be designed so that liquid alum does not mix with water ~~prior to~~ before the point of application.

8. ~~Service water supply~~ Process water.

a. Water used for dissolving dry chemicals, diluting liquid chemicals, or operating chemical feeders shall be:

(1) ~~Only from~~ From a safe, approved source;

(2) Protected from contamination by appropriate means;

(3) Ample in supply and adequate in pressure;

(4) Provided with means for measurement when preparing specific solution concentrations by dilution; and

(5) Properly treated for hardness when necessary.

b. Where a booster pump is required, ~~duplicate equipment~~ a spare pump shall be provided ~~and, when necessary, standby power~~.

c. Backflow prevention shall be achieved by appropriate means such as:

(1) An air gap between the fill pipe and overflow rim of the solution or dissolving tank, and equivalent to two pipe diameters but not less than two inches;

(2) An approved reduced pressure zone backflow preventer, consistent with the degree of hazard, aggressiveness of chemical solution, back pressure sustained, location, and available means for maintaining and testing the device; or

(3) A satisfactory vacuum relief device.

D. Chemicals.

1. Quality.a. Chemical containers shall be fully labeled to include:

- (1) Chemical name, purity and concentration;
- (2) Supplier name and address;
- (3) Precautions in handling; and
- (4) Requirements of Virginia Department of Labor and Industry, Virginia Occupational Safety and Health Standards for General Industry, section 1910.1200(f).

b. Chemicals shall meet American Water Works Association standards, where applicable, and be stamped or certified accordingly.

c. Provisions may be required for assay of the chemicals delivered where the quality is in doubt.

d. Chemicals having a distinguishing color may be used, providing the coloring material is not toxic in concentrations used and will not impart taste, odor, or color to the water supply.

21. Storage.

a. Space shall be provided where at least 30 days of chemical supply can be stored, in dry storage conditions based on the average dose and average annual water treatment plant flow rate. Storage shall be at a location that is convenient for efficient handling unless local suppliers and safety. Lesser storage capacity may be approved if the owner can demonstrate that the local suppliers or other conditions indicate lesser storage is adequate will provide an uninterrupted source of chemicals.

b. Cylinders of chlorine gas shall be:

- (1) Isolated from operating areas;
- (2) Restrained in position to prevent upset; and
- (3) Stored in rooms separate from ammonia storage.

c. Liquid chemical storage tanks shall:

- (1) Have a liquid level indicator; and
- (2) Have an overflow and a receiving basin or drain capable of receiving accidental spills or overflows.

d. Special precautions shall be taken with: ~~(1) Sodium~~ sodium chlorite, to eliminate any danger of explosion; and

~~(2) e. Activated carbon, which is a potentially combustible material, requiring isolated, fireproof storage and explosion-proof electrical outlets, lights, and motors in areas of dry handling. Special precautions shall be taken in areas where activated carbon is stored and fed.~~

(1) Isolated, cool, and dry areas free from sources of ignition shall be provided for activated carbon storage.

(2) Electrical equipment, devices, and materials shall comply with local codes.

(3) Ventilation in these hazardous areas shall be ~~local~~-localized so as not to cause dust or material to be drawn into other nonhazardous areas.

(4) Activated carbon shall not be stored with strong oxidants such as ozone, liquid chlorine (i.e., compressed chlorine gas), and permanganate. ~~Liquid chlorine means liquefied, compressed chlorine gas.~~

e. Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved covered storage unit.

fg. Solution storage or day tanks supplying feeders directly should have sufficient capacity for one day of operation.

gh. Acid storage tanks shall be vented to the outside atmosphere, but not through vents in common with day tanks.

32. Handling.

a. Provisions shall be made for measuring quantities of chemicals used to prepare feed solutions.

b. Storage tanks and pipelines for liquid chemicals shall be specific to the chemicals and not for alternates.

c. Chemicals that are incompatible shall not be fed, stored, or handled together.

d. Provisions shall be made for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers ~~in such a way as to minimize~~ to mitigate the quantity of dust ~~which that~~ may enter the room in which the equipment is installed. Control shall be provided by use of:

(1) Vacuum pneumatic equipment or closed conveyor systems;

(2) Facilities for emptying shipping containers in special enclosures; or

(3) Exhaust fans and dust filters ~~which that~~ put the hoppers or bins under negative pressure.

e. Precautions shall be taken with electrical equipment to prevent explosions, ~~particularly in the use of sodium chlorite and activated carbon~~ and other hazards.

f. Acids shall:

(1) Be kept in closed, ~~acid-resistant~~ acid-resistant shipping containers or storage units; and

(2) Not be handled in open vessels, but should be pumped in undiluted form from original containers, through a suitable hose, to the point of treatment or to a covered day tank.

g. Carts, elevators, and other appropriate means shall be provided for lifting chemical containers to ~~minimize~~ mitigate excessive lifting by operators.

h. Provisions shall be made for disposing of empty containers by an approved procedure ~~which that~~ will ~~minimize~~ mitigate exposure to the chemical.

E. Housing.

1. Structures, rooms, and areas accommodating chemical feed equipment shall provide convenient access for servicing, repair, and observation of operation.

2. Floor surfaces shall be smooth and impervious, slip-proof, and well drained ~~with a slope of  $\frac{1}{8}$  inch per foot, minimum.~~

3. Open basins, tanks, and conduits shall be protected from chemical spills or accidental drainage.

F. Operator safety. Safety provisions shall protect people at the waterworks from chemical exposures in accordance with VOSH requirements.

1. Gases from feeders, storage, and equipment exhausts shall be conveyed to the outside atmosphere, above grade and remote from air intakes.

2. See 12VAC5-590-1000 and 12VAC5-590-1001 for special provisions for handling and storing chlorine.

3. A plastic bottle of hydrochloric acid (muriatic acid in commercial form) shall be available for ammonia leak detection where ammonia gas is used or stored.

4. At least one pair of rubber gloves with long gauntlets, a dust respirator of a type approved by the Virginia Occupational Safety and Health Standards for General Industry, Section 1910.134 that meets the VOSH Standards for toxic dusts, and an apron or other protective clothing shall be provided for each operator in any shift who will handle dry chemicals.

~~5. Rubber gloves, clothing protection, and goggles shall be provided for each operator preparing chemical solutions.~~

~~6. Facilities such as emergency eye wash and showers shall be provided for washing of the face, gloves, and protective equipment.~~

~~7. See 12VAC5-590-1000 E.~~

**12VAC5-590-865. Conventional filtration treatment.**

A. Conventional filtration treatment is generally used for surface water supplies. It is defined as a series of four processes: coagulation, flocculation, sedimentation, and filtration. The specific design parameters shall consider the water supply characteristics and variability in quality due to seasonal and climatic events.

B. Conventional filtration treatment plants shall provide staged, multiple treatment process units, to allow individual units to be taken out of service without disrupting operation.

C. The commissioner may require presedimentation of waters containing high turbidity or organics (as measured by total organic carbon).

1. Presedimentation basins utilizing a coagulant feed shall have hoppers or shall be provided with continuous sludge removal equipment. The minimum hydraulic detention time shall be three hours. The commissioner may require greater detention times depending on the source water quality and the level of pretreatment required.

2. Presedimentation basins without coagulant feed shall provide a minimum hydraulic detention time of 24 hours. The design shall address future needs for solids removal and handling.

3. Incoming water shall be dispersed across the full width of the line of travel as quickly as possible; short circuiting shall be minimized. The commissioner may require baffling on large basins.

4. Provisions for bypassing presedimentation basins shall be provided.

5. Surface runoff shall be prevented from entering presedimentation basins or reservoirs.

6. Dikes shall be structurally sound and protected against wind action and erosion.

**12VAC5-590-870. Mixing and sedimentation. (Repealed.)**

~~A. Plants designed for processing surface waters shall:~~

~~1. Provide multiple units for coagulation, flocculation, and sedimentation at plants having a rated capacity greater than 100 gallons per minute;~~

~~2. Permit operation of flocculation basins in series or parallel;~~

~~3. Be constructed to permit units to be taken out of service without disrupting operation; and~~

~~4. Provide multiple stage treatment facilities when required by the division.~~

~~B. Water containing high turbidity or coliform organisms may require pretreatment, usually sedimentation, either with or without the addition of chemicals. When pretreatment is used, the following requirements must be met:~~

~~1. Presedimentation basins utilizing a coagulant shall have hoppers or shall be equipped with continuous sludge removal apparatus;~~

2. Incoming water shall be dispersed across the full width of the line of travel as quickly as possible; short circuiting must be prevented;
3. Provisions for bypassing sedimentation basins shall be included; and
4. Three hours detention is the minimum period required. Greater detention may be required depending on raw water quality.

C. Flash mixing is the rapid dispersion of chemicals throughout the water to be treated, usually by violent agitation, to enhance coagulation.

1. Turbidity removal plants other than those of the solids contact type shall provide flash mixing facilities.
2. Basins shall be equipped with mechanical mixing devices; other arrangements, such as baffling, may be acceptable only under special conditions. Where mechanical mixing devices are utilized, duplicate units or spare mixing equipment shall be provided.
3. Design parameters:
  - a. The detention period shall not be less than 10 seconds;
  - b. The design of the flash mixing unit should be based upon the mean temporal velocity gradient  $G$  (expressed as units of  $\text{seconds}^{-1}$ ). Typical values for  $G$  and  $T$  are:

T (seconds)	G ( $\text{seconds}^{-1}$ )
20	1,000
30	900
40	700
Longer time	700

For optimization, the engineer should determine the appropriate  $G$  value and detention time through experimentation;

- c. The point of application of the coagulant shall be at the point of maximum mixing intensity;
  - d. The physical configuration of the mixing basin shall be designed to eliminate vortexing; and
  - e. Flash mix units should be designed to allow speed variation throughout at a range of one to three.
4. Properly designed static mixers may be utilized.

D. Flocculation mixing is the agitation of treated water at low velocity gradients for sufficient time to agglomerate coagulated particles.

1. Basin inlet and outlet design shall prevent short circuiting and destruction of floc. A drain and overflow shall be provided. Multiple units shall be provided for continuous operability and each basin shall be designed so that individual basins may be isolated without disrupting plant operation.
2. Design parameters:
  - a. The minimum detention time shall be 30 minutes;
  - b. The design of the flocculation units shall be based upon the value of  $GT$  (mean temporal velocity gradient in  $\text{seconds}^{-1}$ )  $\times$  (detention time in seconds) which is ordinarily in the range of 20,000 to 200,000. The engineer should establish the value of  $GT$  through experimentation;

c. Variable speed drive units shall be designed to provide speed variations throughout a range of four to one;

d. To control short-circuiting in mechanical flocculators, at least three successive compartments should be provided. In addition, special attention should be given to the ports between compartments to further suppress short circuiting;

e. To accomplish maximum power input and reduce particle shearing, tapered flocculation should be provided;

f. In basins utilizing vertical shaft flocculators, wing walls, or stators shall be provided to prevent vortexing; and

g. The flocculation basins must be so designed that individual basins may be isolated without disrupting plant operation.

3. Flocculation and sedimentation basins shall be as close together as possible. The velocity gradient of the flocculated water through pipes or conduits to settling basins shall not be greater than the velocity gradient utilized in flocculating the water. Where velocity gradient is not used as a design parameter, the linear velocity in pipes and conduits from the flocculators to the settling basin shall not exceed 0.5 feet per second. Allowances must be made to minimize turbulence at bends and changes in direction.

4. Baffling may be used to provide for flocculation in small plants only after consultation with the division. The design should be such that the velocity gradients noted above may be maintained. Turbidity removal plants other than solids contact shall provide flocculation basins.

5. Safety. Guard rails and adequate lighting shall be provided.

E. Sedimentation shall follow flocculation/mixing. The detention time for effective clarification is dependent upon a number of factors relating to basin design and the nature of the raw water. The number of basins required is dependent upon the plant size, turbidity, color, colloidal matter, and taste and odor causing compounds to be removed.

1. Plants utilizing rapid rate gravity filters in conjunction with conventional sedimentation shall provide a minimum of four hours effective settling (detention) time. Effective settling time shall be calculated using the volume of the basins from the stilling wall to the submerged effluent orifice or weir.

2. Inlets shall be designed to distribute the water equally and at uniform velocities. Open ports, submerged ports, stilling walls, and similar entrance arrangements are required. Where stilling walls are not provided, a baffle shall be constructed across the basin close to the inlet and shall project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin.

3. Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short circuiting. The use of submerged orifices or submerged weirs is required. The maximum velocity gradient in pipes and conduits from the settling basins to the filters shall not exceed that used in flocculation. Where velocity gradient is not used as a parameter the linear velocity in pipes and conduits from settling basins shall not exceed 1.0 foot per second.

4. Rectangular sedimentation basins should be designed with a length to width ratio of at least four to one. Surface overflow rates should be within the range of 0.25 to 0.38 gallons per minute per square foot in processes utilizing flocculation, the lower limit being utilized for cold waters and the higher limit being applied to warm waters.

5. The circular clarifiers of the center feed, peripheral feed, and spiral flow type will be considered on an individual basis.

~~6. Basins shall be provided with a means for dewatering. Basin bottoms shall slope toward the drain not less than one foot in twelve feet unless mechanical sludge collection equipment is provided.~~

~~7. Superstructures are acceptable at specific plant locations where necessary. In areas where settling basins are subject to high and frequent cross winds, consideration should be given to the provision of windbreaks.~~

~~8. The velocity through settling basins shall not exceed 1.0 foot per minute. The basins shall be designed to minimize short-circuiting. Baffles shall be provided as necessary to minimize short-circuiting.~~

~~9. An overflow weir (or pipe) shall be installed which will establish the maximum water level desired on top of the filters. It shall discharge with a free fall at a location where the discharge will be noted.~~

~~10. Permanent ladders or handholds shall be provided for safety on the inside walls of basins above the water level. Guard rails shall be included. Flushing lines or hydrants shall not include interconnection of the potable water with nonpotable water.~~

~~11. For plants having a capacity of 100 gallons per minute or more, multiple basins are required and shall be so designed that individual basins may be isolated without disrupting plant operation.~~

~~12. Mechanical sludge collecting equipment shall be considered for all plants with a capacity of 100 gallons per minute or more.~~

~~13. Facilities are required by the State Water Control Board for disposal of sludge (see 12VAC5-590-990). Provision shall be made for the operator to observe or sample sludge being withdrawn from unit.~~

~~F. Units that combine softening and clarification are acceptable where water characteristics are not variable and flow rates are uniform. Before solids contact units are considered as clarifiers without softening, specific approval of the division shall be obtained. Clarifiers shall be designed for the maximum uniform rate and shall be adjustable to changes in flow which are less than the design rate and for changes in water characteristics. A minimum of two units is required.~~

~~1. A representative of the manufacturer shall supervise the installation and initial operation of each unit.~~

~~2. The following equipment shall be provided for plant operation:~~

~~a. Complete outfit of tools and accessories; and~~

~~b. Adequate piping with suitable sampling taps so located as to permit the collection of samples of water from critical portions of the units.~~

~~3. Chemical feed requirements are those listed in 12VAC5-590-860.~~

~~4. Mixing devices shall be constructed to:~~

~~a. Provide good mixing of the raw water with previously formed sludge particles; and~~

~~b. Prevent deposition of solids in the mixing zone.~~

~~5. Flocculation equipment:~~

~~a. Shall be adjustable;~~

~~b. Shall insure that coagulation occurs in a separate chamber or baffled zone within the unit; and~~

~~c. Shall provide a flocculation and mixing period of at least 30 minutes.~~

~~6. The sludge equipment shall provide either internal or external sludge concentrators in order to obtain a concentrated sludge with a minimum of waste water.~~

~~7. Sludge removal design shall provide that:~~

- a. Sludge pipes shall be not less than three inches in diameter and so arranged as to facilitate cleaning;
  - b. Entrance to sludge withdrawal piping will prevent clogging;
  - c. Valves are located outside the tank for accessibility;
  - d. The operator may observe or sample sludge being withdrawn from the unit; and
  - e. A timeclock with proportional timer shall be provided for automatic blowoff.
8. Cross connections:
- a. Blowoff outlets and drains shall terminate and discharge at a place satisfactory to the division; and
  - b. Cross connection control shall be included for the potable water mains used to backflush sludge lines.
9. The detention time shall be established on basis of the raw water characteristics and other local conditions that affect the operation of the unit. Based on design flow rates, the minimum detention time shall be:
- a. Two hours for suspended solids contact clarifiers; and
  - b. One hour for the suspended solids contact softeners.
10. Softening units should be designed so that continuous slurry concentrates of 1.0% or more, by weight, can be satisfactorily maintained.
11. Water losses:
- a. Solids contact units shall be provided with suitable controls for sludge withdrawal;
  - b. Total water losses should not exceed:
    - (1) Five percent for clarifiers; and
    - (2) Three percent for softening units; and
  - c. The solids concentration of sludges bled to waste should be:
    - (1) Three percent by weight for clarifiers;
    - (2) Five percent by weight for softeners.
12. Units used as clarifiers should be equipped with orifices. Units used for softening should be equipped with either overflow weirs or orifices. Weirs shall be:
- a. Adjustable;
  - b. At least equivalent in length to the perimeter of the tank; and
  - c. Constructed so that surface water does not travel over 10 feet horizontally to the collection trough.
13. Weir loading:
- a. Weir loading shall not exceed 20 gallons per minute per foot of weir length for units used as softeners; and
  - b. Orifices shall produce uniform rising rates over the entire area of the tank and shall provide for an exit velocity not to exceed 1.0 foot per second.
14. Upflow rates shall not:
- a. Exceed 1.75 gpm/ft<sup>2</sup> of area at the slurry separation line for units used as softeners; or
  - b. Exceed 1.0 gpm/ft<sup>2</sup> of area at the sludge separation line for units used as clarifiers.
15. Consideration shall be given to providing a superstructure to enclose the solids contact unit, to enhance the treatment process, and for the protection of piping and associated sampling valves.



**12VAC5-590-871. Coagulation and flocculation.**

A. Rapid mixing is the rapid dispersion of chemicals throughout the water to be treated, usually by violent agitation, to promote coagulation.

1. Rapid mix basins or in-line static mixers shall be provided.
2. Basins shall be equipped with mechanical mixing devices. Other arrangements, such as baffling, may be acceptable under special conditions and only when approved by the commissioner. Where mechanical mixing devices are utilized, duplicate units or spare mixing equipment shall be provided.
3. Rapid mix basins with mechanical mixers should be based upon the mean temporal velocity gradient "G" (expressed as units of seconds<sup>-1</sup>). The owner's engineer shall submit the basis for the selected velocity gradient considering the chemicals to be added and water temperature. Typical values for G and T are:

TABLE 871.1.  
Rapid Mix Basin GT Values.

<u>T (seconds)</u>	<u>G (seconds<sup>-1</sup>)</u>
<u>20</u>	<u>1,000</u>
<u>30</u>	<u>900</u>
<u>40</u>	<u>700</u>
<u>60</u>	<u>600</u>

- a. The point of application of the coagulant shall be at the point of maximum mixing intensity;
- b. The physical configuration of the mixing basin shall be designed to eliminate vortexing; and
- c. Mechanical mixers should be designed to allow speed variation with a highest speed of at least three times the lowest speed.

B. Flocculation mixing is the agitation of treated water at low velocity gradients for sufficient time to agglomerate coagulated particles.

1. Basin inlet and outlet design shall prevent short circuiting and destruction of floc. A drain and overflow shall be provided. Multiple units shall be provided for continuous operability, and each basin shall be designed so that individual basins may be isolated without disrupting plant operation. Basins shall be arranged to allow for either series or parallel operation.
2. Design parameters:
  - a. The minimum detention time shall be 30 minutes for water treatment plants employing rapid rate gravity filters, and 20 minutes for water treatment plants using high rate gravity filters. Basin flow-through velocity should not be less than 0.5 ft/min or greater than 1.5 ft/min.
  - b. The design of the flocculation units shall be based upon the value of GT, which is ordinarily in the range of 20,000 to 200,000. The owner's engineer should establish the value of GT through experimentation.
  - c. Agitators shall be driven by variable speed drive units with peripheral tip speed of the paddles ranging from 0.5 ft/sec to 3.0 ft/sec.

d. To control short circuiting in mechanical flocculators, at least three successive compartments should be provided. In addition, special attention should be given to the ports between compartments to further suppress short circuiting.

e. To accomplish maximum power input and reduce particle shearing, tapered flocculation should be provided.

f. In basins utilizing vertical shaft flocculators, wing walls or stators shall be provided to prevent vortexing.

3. Flocculation and sedimentation basins shall be as close together as possible. The velocity gradient of the flocculated water through pipes or conduits to settling basins shall not be greater than the velocity gradient utilized in flocculating the water. Where velocity gradient is not used as a design parameter, the linear velocity in pipes and conduits from the flocculators to the settling basin shall not exceed 0.5 ft/sec unless otherwise approved by the commissioner. Allowances shall be made to minimize turbulence at bends and changes in direction.

4. Baffling may be used for flocculation in small water treatment plants only when approved by the commissioner. The design should allow the velocity gradients noted in subdivision B 3 of this subsection to be maintained.

#### **12VAC5-590-872. Sedimentation.**

A. The water treatment plant capacity, source water quality, and filtration process used shall be considered in determining the number and design of sedimentation basins.

B. The minimum settling time shall be four hours for water treatment plants employing rapid rate gravity filters, and a minimum of three hours for water treatment plants using high rate gravity filters. Reduced settling times may be approved by the commissioner where effective settling is demonstrated. Effective settling time shall be calculated using the volume of the basins from the stilling wall to the submerged effluent orifice or weir, including the volume under launders or finger weirs.

C. Inlets shall be designed to distribute the water equally and at uniform velocities. Open ports, submerged ports, stilling walls, and similar entrance arrangements are required. Port velocities should be in the range of 0.5 ft/sec to 1.5 ft/sec. Where stilling walls are not provided, a baffle shall be constructed across the basin close to the inlet and shall project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin.

D. Outlet weirs or submerged orifices shall be designed to maintain settling velocities in the basin and minimize short circuiting. Outlet weirs and submerged orifices shall be designed as follows:

1. The rate of flow over the outlet weir shall not exceed 20,000 gpd/ft of the outlet launder.
2. Submerged orifices shall not be located lower than 3 ft below the normal water surface.
3. The entrance velocity through the submerged orifices shall not exceed 0.5 ft/sec.

E. The linear velocity in pipes and conduits from settling basins shall not exceed 1.0 ft/sec.

F. Rectangular sedimentation basins shall be designed with a length-to-width ratio of at least 4:1.

G. Surface overflow rates shall be within the range of 0.25 gpm/ft<sup>2</sup> to 0.38 gpm/ft<sup>2</sup> in water treatment plants using rapid rate filters, and a maximum of 0.5 gpm/ft<sup>2</sup> for water treatment plants using high rate filters. Increased surface overflow rates and reduced settling times may be approved by the commissioner where effective settling is demonstrated. The length and area between launders and finger weirs may be included in determining length-to-width ratio and overflow rates.

H. Basins shall be provided with a means for dewatering. Basin bottoms shall slope toward the drain not less than one foot in 12 feet unless mechanical sludge collection equipment is provided.

I. In areas where settling basins are subject to high and frequent cross winds, windbreaks shall be considered. Covers or enclosures shall be considered in locations subject to freezing.

J. The velocity through settling basins shall not exceed 1.0 ft/min. The basins shall be designed to minimize short circuiting. Baffles shall be provided as necessary to minimize short circuiting.

K. Multiple basins shall be provided for continuous operability and each basin shall be designed so that individual basins may be isolated without disrupting plant operation.

L. Mechanical sludge collecting equipment shall be considered for all plants.

M. Sedimentation basins with tube or plate settlers shall meet the following design requirements:

1. Inlet and outlets shall be designed to maintain velocities suitable for settling in the basin and minimize short circuiting. Plate units shall be designed to ensure even flow distribution across the units.

2. Drain piping from the settler units shall be sized to facilitate a quick flush of the basin and to prevent flooding other portions of the plant.

3. Where units are located outdoors, adequate freeboard shall be provided above the top of the settlers to prevent freezing.

4. The maximum loading for tube settlers shall be 2 gpm/ft<sup>2</sup> of cross-sectional area unless higher rates are demonstrated through pilot plant or in-plant demonstration studies.

5. The maximum loading for plate settlers shall be 0.5 gpm/ft<sup>2</sup> based upon 80% of the projected horizontal plate area.

6. Flushing lines shall be provided to facilitate maintenance and shall be properly protected against backflow or backsiphonage.

**12VAC5-590-873. Solids contact treatment units.**

A. Solids contact units shall be acceptable for combined flocculation and clarification where source water characteristics are not variable and flow rates are uniform. When approved, these units shall be designed for the maximum uniform rate and shall be adjustable to changes in flow that are less than the design rate and for changes in water characteristics.

B. A minimum of two units shall be provided.

C. A rapid mix device designed in accordance with 12VAC5-590-871 A shall be provided. Mixing devices shall be constructed to:

1. Provide good mixing of the source water with previously formed sludge particles; and

2. Prevent deposition of solids in the mixing zone.

D. Flocculation equipment designed in accordance with 12VAC5-590-871 B shall:

1. Be equipped with an adjustable drive mechanism;

2. Insure that coagulation occurs in a separate chamber or baffled zone within the unit; and

3. Provide a flocculation period of at least 20 minutes.

E. The sludge equipment shall provide either internal or external sludge concentrators in order to obtain a concentrated sludge with a minimum of waste water. Sludge removal systems shall provide:

1. Sludge pipe sizes of not less than three inches in diameter;

2. Piping arrangements to prevent clogging and to facilitate cleaning;
3. Valves that are located outside the tank for accessibility;
4. A means to observe or sample sludge being withdrawn from the unit;
5. A time clock with proportional timer with automatic ~~blow-off~~blowoff; and
6. Suitable controls for sludge withdrawal.

F. Cross connections.

1. ~~Blow-off-Blowoff~~ outlets and drains shall terminate and discharge at a place satisfactory to the commissioner; and
2. Cross connection control shall be included for the potable water mains used to flush sludge lines.

G. The detention time shall be established on the basis of the source water characteristics and other local conditions that affect the operation of the unit. The minimum detention time shall be two hours for suspended solids contact clarifiers.

H. Orifices shall produce uniform rising rates over the entire area of the tank and shall provide for an exit velocity not to exceed 1.0 ft/sec.

I. Upflow rates shall not exceed 1.0 gpm/ft<sup>2</sup> of area at the sludge separation line.

**12VAC5-590-874. Gravity filtration.**

A. At least two gravity filter units shall be provided in conventional filtration treatment plants and direct filtration treatment plants.

B. Filter loading rates shall not exceed 2.0 gpm/ft<sup>2</sup> of filter area for rapid rate filters, and shall not exceed 4.0 gpm/ft<sup>2</sup> for high rate filters, during normal operation. Alternative loading rates may be approved by the commissioner when effective filtration is demonstrated.

C. The filter structure shall be so designed as to comply with the following:

1. The walls within the filter shall be vertical;
2. The filter walls shall not protrude into the filter media;
3. There shall be no common wall between filtered or finished water and any lesser quality water;
4. The filter shall be covered by a superstructure if determined necessary under local climatic conditions;
5. There shall be head room to allow normal inspection and operation;
6. A curb at least four inches high shall surround each filter to prevent floor drainage into the filter;
7. The maximum velocity gradient of treated water in pipes and conduits to the filters shall not exceed that used in flocculation. Where velocity gradient is not used as a design parameter, the linear velocity in pipes and conduits from settling basins to filters shall not exceed 1.0 ft/sec;
8. Influent pipes or conduits, where solids loading is heavy, shall be straight and equipped with cleanouts;
9. Backwash water drain capacity shall be sufficient to carry the maximum flow;
10. Access in the form of walkways not less than 24 inches in width shall be provided to each filter; and
11. The normal operating water surface on a filter shall be at the same hydraulic grade level as the sedimentation basin, if no intermediate treatment process is provided.

D. Backwash water troughs shall be so designed as to provide:

1. Bottom elevation of the trough above the maximum level of expanded media during backwashing;
2. At least a ~~two-inch~~ ~~two-inch~~ freeboard inside the trough at the maximum rate of wash;
3. A level top or edge;
4. Spacing so that each trough serves an equal area of each filter; and
5. Maximum horizontal travel of suspended particles to reach the trough not to exceed 3.0 ft.

E. Filter media shall be free from detrimental chemical or bacterial contaminants. Acceptable filter media shall include anthracite coal, silica sand, garnet sand, and GAC. Other natural or synthetic media may be approved by the commissioner when pilot-scale or full-scale demonstration studies demonstrate that the media is capable of meeting the filter effluent turbidity treatment technique requirements in Part II of this chapter.

1. Filters may be of single media, dual media, or ~~multi-media~~ ~~multimedia~~ design depending upon the water to be treated and the specific filtration process employed. A total media depth of not less than 27 inches shall be provided after cleaning and scraping.

2. Types of filter media:

a. Anthracite coal. A sieve analysis shall be provided. Anthracite media shall have:

(1) An effective size ~~of from~~ 0.45 mm to 0.55 mm with a uniformity coefficient ~~of not~~ greater than 1.65 when used alone.

(2) An effective size ~~of from~~ 0.8 mm to 1.2 mm with a uniformity coefficient ~~of not~~ greater than 1.85 when used in dual or ~~multi-media~~ ~~multimedia~~ filters.

b. Silica sand. A sieve analysis shall be provided. The media shall be clean silica sand having an effective size ~~of from~~ 0.35 mm to 0.55 mm and a uniformity coefficient not greater than 1.65.

c. Garnet sand. A sieve analysis shall be provided. The media shall have an effective size ~~of from~~ 0.15 mm to 0.35 mm.

d. Granular activated carbon (GAC) may be used as a media for filtration. The commissioner may require pilot studies where precursor or organics removal is a treatment objective. The design shall include the following:

(1) GAC media shall meet the basic specifications for filter media contained in this section, except the uniformity coefficient shall not be greater than 2.0. The commissioner may allow larger size media based upon pilot-scale or full-scale demonstration testing. The commissioner may require that a layer of sand media be placed below the GAC.

(2) Provisions shall be made for periodic treatment of GAC filter material for ~~the~~ control of bacteria and other growths.

(3) Provisions shall be made for GAC media replacement or regeneration.

(4) Only materials suitable for use with GAC media filters shall be utilized.

F. Support media.

1. Sand. A sieve analysis shall be provided. A three inch layer of sand shall be used as a supporting media for the filter media where supporting gravel is used and shall have an effective size ~~of from~~ 0.8 mm to 2.0 mm and a uniformity coefficient not greater than 1.7.

2. Gravel, when used as the supporting media, shall consist of hard, rounded particles and shall not include flat or elongated particles. The coarsest gravel shall be ~~2 1/2~~ 2-1/2 inches in size when the gravel rests directly on the strainer system, and shall extend above the top of the perforated laterals or strainer nozzles. Not less than four layers of gravel

shall be provided in accordance with the size and depth distribution specified in Table 874.1.

3. Changes of gravel depths and sizes may be considered by the commissioner where proprietary filter bottoms are proposed.

TABLE 874.1.

Gravity Filter Gravel Support Bed.

<u>SIZE</u>	<u>DEPTH</u>
<u>2- 1/2 to 1- 1/2 inches</u>	<u>5 to 8 inches</u>
<u>1- 1/2 to 3/4 inches</u>	<u>3 to 5 inches</u>
<u>3/4 to 1/2 inches</u>	<u>3 to 5 inches</u>
<u>1/2 to 3/16 inches</u>	<u>2 to 3 inches</u>
<u>3/16 to 3/32 inches</u>	<u>2 to 3 inches</u>

G. Filter bottoms and strainer systems. The commissioner may allow deviations from requirements of this subdivision for high rate filters and for proprietary filter bottoms. Porous plate bottoms shall not be used where iron or manganese or hard water may result in clogging. The design of manifold-type manifold-type collection systems shall:

1. Minimize loss of head in the manifold and laterals;
2. Assure even distribution of backwash water and an even rate of filtration over the entire area of the filter;
3. Provide a ratio of the area of the final openings of the strainer systems to the area of the filter of about 0.003;
4. Provide a total cross-sectional area of the laterals at about twice the total area at the final openings; and
5. Provide a manifold that has a cross-sectional area which is ~~4~~ 1-1/2 to two times the total area of the laterals.

H. Surface wash or air scouring of filters shall be provided.

1. All rotary surface wash devices shall be designed with:
  - a. Provisions for water pressures of at least 45 psi;
  - b. A vacuum breaker or other device or assembly to prevent backsiphonage;
  - c. Adequate surface wash water to provide 0.5 gpm/ft<sup>2</sup> to 1.0 gpm/ft<sup>2</sup> of filter area.
2. Air scouring shall provide for:
  - a. An air flow rate of three to five scfm/ft<sup>2</sup> of filter area when air is introduced in the underdrain. A lower air flow rate shall be used when the air scour distribution system is placed above the underdrain.
  - b. A method for avoiding loss of filter media during backwashing.
  - c. A fluidization backwash following air scour sufficient to re-stratify the filter media. The backwash water delivery system shall be in accordance with this section except the rate of flow should not exceed 8.0 gpm/ft<sup>2</sup> unless operating experience demonstrates that a higher rate is necessary to remove scoured particles from the filter media.

I. Turbidity monitoring.

1. Indicating and recording turbidimeters meeting the requirements of 12VAC5-590-770 B shall be provided for:

- a. The source water;
- b. The settled water from each sedimentation basin;
- c. The filter effluent from each filter; and
- d. The combined filter effluent.

2. Finished water indicating and recording turbidimeters shall be considered if chemical pH adjustment occurs following filtration.

3. The location of the turbidity sample tap shall allow turbidity to be monitored for both the filtered water and the filter-to-waste water.

4. The design may incorporate an operator selected filter effluent high turbidity alarm.

#### J. Appurtenances.

1. A sampling tap shall be placed between each filter and the effluent rate-of-flow controller to sample filtered water and filter-to-waste water. The location of sample taps shall allow turbidity to be monitored of both the filtered water and the filter-to-waste water.

2. Indicating and recording loss-of-head gauges shall be provided on all filters having a capacity of greater than 100 gpm. An indicating ~~loss-of-head~~ loss-of-head gauge shall be provided on all filters having a capacity of 100 gpm or less.

3. Indicating and recording rate-of-flow gauges shall be provided on all filters having a capacity of greater than 100 gpm. An indicating and totalizing water meter may be used ~~in-lieu~~ instead of an indicating and recording gauge on filters having a capacity of 100 ~~gallons per minute~~ gpm or less.

4. Effluent rate-of-flow controllers of the direct acting, indirect acting, or constant rate types shall be provided on each filter.

a. All control devices used shall incorporate an auxiliary shutoff valve in the filter effluent line. Indirect and direct acting effluent rate-of-flow control devices shall start operation from the closed position. Failure of indirect acting controllers shall not result in any increase in the rate of flow.

b. Filter effluent rate-of-flow control that simply maintains a constant water level on the filter is prohibited.

c. Control devices shall be configured to prevent exceeding the design filter hydraulic loading rate when any filter is taken out of service.

5. Provisions for draining the filter-to-waste (rewash) with appropriate backflow prevention and rate control shall be provided on each filter. The filter-to-waste design flow rate shall be equal to the filtration rate.

6. A high pressure hose and hose rack shall be provided to allow washing down filter walls.

#### K. Backwash provisions.

1. Filtered or finished water shall be applied uniformly across the filter in an upflow direction to provide at least 50% media expansion during all operating conditions. This will normally require backwash flow rates of up to 20 gpm/ft<sup>2</sup> depending on media size, media specific gravity, uniformity coefficient, and water temperature.

2. The backwash water shall be provided at the required rate by backwash pumps, backwash water tanks, the high service main, or a combination of these methods. Consideration should be given to including provisions to obtain backwash water from the distribution system or other sources; and to supply backwash water during plant start-up or during catastrophic events.

3. At least two backwash water pumps shall be installed unless an alternate means of obtaining backwash water is available.

4. The volume of backwash water provided shall be sufficient to backwash one filter at the design backwash flow rate and duration during the warmest water temperature. This backwash water volume shall be in addition to any other water storage requirements.

5. A backwash water controller or valve shall be provided on the main backwash water supply line to obtain the desired rate of filter wash with the backwash water valves on the individual filters open wide.

6. Consideration shall be given to provide for seasonal adjustments of the backwash flow rate, to ensure proper backwashing while preventing media loss, and to conserve water.

7. The rate-of-flow indicator on the main backwash water supply line shall be located so that it may easily be read by the operator during the backwashing process.

8. Where backwash water pumps are provided, a means for air release shall be installed between the backwash water pump and the backwash water valve.

L. Other design considerations.

1. Roof drains shall not discharge into the filter or basins and conduits preceding the filters.

2. Provision shall be made for continuous operation of all other filtering units while one filtering unit is out of operation.

3. High rate filtration shall be provided with precise coagulation control. A multiple six-gang stirring machine for performing jar tests shall be provided in addition to one or more of the following means of controlling the coagulation process:

a. Zeta potential, as measured by microelectrophoresis.

b. Pilot filters. Where dual pilot filters are used, two units shall be provided. Each pilot filter shall consist of a small filter (about six inches in diameter) containing the same type and depth of media as the plant filters. The pilot filter shall be equipped with recording turbidimeters on the effluent to measure the filterability of the water as reflected by turbidity monitoring.

c. Streaming current monitor, defined as a continuous sampling instrument that measures the electric current generated when water flows past suspended particles contained in the water.

4. High rate filtration shall be provided with indicating and recording pH monitoring equipment for:

(1) The source water;

(2) The rapid mix effluent; and

(3) The finished water leaving the treatment plant.

**12VAC5-590-875. Direct filtration.**

A. Direct filtration is defined as a series of treatment processes including coagulation and filtration, but excluding sedimentation. Direct filtration shall be considered only for treatment of high quality and seasonally consistent surface water supplies or GUDI water supplies.

B. An in-plant demonstration study or pilot study shall be required to demonstrate acceptable performance of direct filtration. The study shall be conducted over a sufficient time to treat all expected source water conditions throughout the year. The pilot plant filter shall be of a similar type and operated in the same manner as proposed for full-scale operation.

C. The commissioner may require presedimentation meeting the requirements of 12VAC5-590-865 C to be provided prior to direct filtration treatment plants.



D. Rapid mix coagulation and flocculation shall be provided, meeting the requirements of 12VAC5-590-871.

E. Filters shall be dual media or multimedia gravity filters. Design of filtration units shall meet requirements for rapid rate or high rate gravity filters in 12VAC5-590-874, including filter structure, filter media, support gravel, backwash provisions, rate-of-flow control, surface wash, or air scour. Alternative designs may be considered by the commissioner.

F. Turbidity monitoring.

1. Indicating and recording turbidimeters meeting the requirements of 12VAC5-590-770 B shall be provided for:

- a. The source water;
- b. The filter effluent from each filter; and
- c. The combined filter effluent.

2. Finished water indicating and recording turbidimeters shall be considered if chemical softening occurs following filtration.

G. Where automatic unit process control is provided, manual override of all automatic features shall be provided.

1. Automatic startup of treatment plant unit processes is prohibited.
2. Valve actuators shall be provided with manual override capability.

H. The plant design should allow for the future installation of sedimentation basins.

#### **12VAC5-590-880. Filtration Diatomaceous earth filtration.**

A. Rapid rate gravity filters acceptable for the treatment of water from surface water sources or groundwater sources under the direct influence of surface water:

1. Pretreatment is required where rapid rate gravity filters are utilized. Pretreatment shall include but not be limited to disinfection, coagulation, flocculation, and sedimentation.

2. At least two filtering units shall be provided at plants having a rated capacity of more than 100 gpm and less than 2 MGD. The total number of filters necessary at plants having a rated capacity equal to or greater than 2 MGD may be estimated utilizing the following formula:

$$N = 2.7 (Q)^{0.5}$$

(Formula as per Morrell and Wallace from Hardenbergh and Redie's "WATER SUPPLY AND WASTE DISPOSAL 1960").

Where N equals number of filter units and Q equals plant capacity in million gallons per day.

3. The design rate of filtration shall be two gallons per minute per square foot of filter area.

4. The filter structure shall be so designed as to comply with the following requirements:

- a. The walls within the filter shall be vertical;
- b. The filter walls shall not protrude into the filter media;
- c. The filter shall be covered by a superstructure if determined necessary under local climatic conditions;
- d. There shall be head room to permit normal inspection and operation;
- e. The filter shall have a minimum depth of 8½ feet as measured from the normal operating water surface to the bottom of the underdrainage system;

- f. A minimum water depth of three feet as measured from the normal operating water surface to the surface of the filter sand;
- g. There shall be a water seal on the effluent line to prevent backflow of air to the filters;
- h. A curb at least four inches high shall surround each filter to prevent floor drainage into the filter;
- i. A hand rail shall enclose each filter or filter bank;
- j. The maximum velocity gradient of treated water in pipes and conduits to the filters shall not exceed that used in flocculation. Where velocity gradient is not used as a parameter, the linear velocity in pipes and conduits from settling basins to filters shall not exceed 1.0 foot per second;
- k. Influent pipes or conduits where solids loading is heavy, or following lime soda softening, shall be straight and equipped with cleanouts.
- l. Washwater drain capacity shall be sufficient to carry the maximum flow;
- m. Access in the form of walkways not less than 24 inches in width shall be provided to each filter; and
- n. The normal operating water surface on a filter shall be at the same hydraulic grade level as the sedimentation basin.

5. Washwater troughs shall be so designed as to provide:

- a. Bottom elevation of the trough above the maximum level of expanded media during washing;
- b. A top elevation of the trough above the filter surface, not to exceed 30 inches;
- c. A two inch freeboard at the maximum rate of wash;
- d. A level top or edge;
- e. Spacing so that each trough serves the same number of square feet of filter area; and
- f. Maximum horizontal travel of suspended particles to reach trough not to exceed three feet.

6. Filter material.

- a. Sand - A sieve analysis shall be provided by the design engineer. The media shall be clean silica sand having:
  - (1) A depth of not less than 27 inches and generally not more than 30 inches after cleaning and scraping; and
  - (2) An effective size of from 0.35mm to 0.5mm, depending upon the quality of the raw water and a uniformity coefficient not greater than 1.6.
- b. Supporting media for the filter sand - A sieve analysis shall be provided by the design engineer. A three inch layer of torpedo sand shall be used as a supporting media for the filter sand; such torpedo sand shall have:
  - (1) An effective size of 0.8mm to 2.0mm; and
  - (2) A uniformity coefficient not greater than 1.7.
- c. Anthracite - A sieve analysis shall be provided by the design engineer. Clean crushed anthracite or a combination of sand and anthracite may be considered on the basis of data specific to the project; this media shall have:
  - (1) An effective size from 0.45mm to 0.8mm; and
  - (2) A uniformity coefficient not greater than 1.7.

d. Gravel, when used as the supporting media, shall consist of hard, rounded particles and shall not include flat or elongated particles. The coarsest gravel shall be 2 1/2 inches in size when the gravel rests directly on the strainer system, and must extend above the top of the perforated laterals or strainer nozzles. Not less than four layers of gravel shall be provided in accordance with the following size and depth distribution:

SIZE	DEPTH
2-1/2 to 1-1/2 inches	5 to 8 inches
1-1/2 to 3/4 inches	3 to 5 inches
3/4 to 1/2 inches	3 to 5 inches
1/2 to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

Reduction of gravel depths may be considered upon application to the division where proprietary filter bottoms are proposed.

e. Granular activated carbon – See 12VAC5-590-960 B 6.

7. Porous plate bottoms shall not be used where iron or manganese may clog them or with waters softened by lime. The design of manifold type collection systems shall be such as to:

- a. Minimize loss of head in the manifold and laterals;
- b. Assure even distribution of washwater and an even rate of filtration over the entire area of the filter;
- c. Provide a ratio of the area of the final openings of the strainer systems to the area of the filter of about 0.003;
- d. Provide a total cross sectional area of the laterals at about twice the total area at the final openings; and
- e. Provide a manifold which has a cross sectional area which is 1 1/2 to two times the total area of the laterals.

8. Surface wash facilities are required. Revolving type surface washers shall be provided; however, other types may be considered. All rotary surface wash devices shall be designed with:

- a. Provisions for water pressures of 45 to 100 psi;
- b. A vacuum breaker or other device to prevent backsiphonage;
- c. Provisions for adequate surface wash water to provide 0.5 to one gallon per minute per square foot of filter area; and
- d. Air washing may be considered.

9. The following shall be provided for every filter:

- a. A sampling tap shall be placed between the filter and the effluent rate of flow controller and shall be equipped with an auxiliary spigot at the point of connection to the effluent line;
- b. Indicating and recording loss of head gauges shall be required on all filters having a capacity of greater than 100 gallons per minute. An indicating loss of head gauge shall be required on all filters having a capacity of 100 gallons per minute or less;
- c. Indicating and recording rate of flow gauges shall be required on all filters having a capacity of greater than 100 gallons per minute. An indicating and totalizing water

meter may be used in lieu of an indicating and recording gauge on filters having a capacity of 100 gallons per minute or less;

d. ~~Effluent rate of flow controllers of the direct acting, indirect acting, constant rate, or declining rate types shall be required on each filter. All control devices used must incorporate an auxiliary shutoff valve in the filter effluent line. Indirect and direct acting effluent rate of flow control devices shall start operation from the closed position; Failure of indirect acting controllers shall not result in any increase in the rate of flow, at the time of failure;~~

e. ~~Provisions for draining the filter to waste (rewash) with appropriate measure for backflow prevention are required;~~

f. ~~Hose bibb, hose, and suitable rack for storage of hoses are required; and~~

g. ~~Indicating and recording turbidimeters on filter effluent with automatic high turbidity alarm are required at all plants having a capacity of 10 MGD or more.~~

10. ~~Provisions shall be made for washing filters (backwashing) as follows:~~

a. ~~A minimum rate of 15 gallons per square foot per minute, consistent with water temperatures and specific gravity of the filter media; a rate of 20 gallons per square foot per minute or more is recommended to provide for adequate expansion of the filter media;~~

b. ~~Filtered water shall be provided at the required rate by washwater tanks, a washwater pump, from the high service main, or a combination of these;~~

c. ~~Washwater pumps shall be in duplicate unless an alternate means of obtaining washwater is available;~~

d. ~~The volume of washwater shall provide for not less than 15 minutes wash of one filter at the design rate of wash;~~

e. ~~A washwater controller or valve shall be provided on the main washwater line to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide;~~

f. ~~The rate of flow indicator on the main washwater line shall be located so that it can be easily read by the operator during the washing process; and~~

g. ~~Where backwash pumps are provided, a means for air release must be provided between the backwash pump and the washwater valve.~~

11. ~~Miscellaneous:~~

a. ~~Roof drains shall not discharge into the filter or basins and conduits preceding the filters;~~

b. ~~Provisions must be made for continuous operation of all other filtering units while one filtering unit is out of operation; and~~

c. ~~Automatic startup of filtering units is prohibited.~~

~~B. High rate gravity filters are acceptable for the treatment of water from surface water sources or groundwater sources under the direct influence of surface water. See 12VAC5-590-890 for design requirements.~~

~~C. Slow sand gravity filters are acceptable for the treatment of water from certain surface water sources or certain groundwater sources under the direct influence of surface water.~~

~~1. Source restrictions. Raw water quality for application to a slow sand filter without pretreatment shall meet the following requirements:~~

a. ~~Not exceed a turbidity level of 5 NTU monthly average or 30 NTU peak day over a one-year period;~~

- b. Not exceed 800 total coliforms in 80% of a minimum of 50 samples taken over a minimum of a 52 week period;
  - c. Not exceed an apparent color level of 15 CU monthly average over a one year period; and
  - d. Groundwater sources under the direct influence of surface water shall pilot test to determine if the water contains sufficient nutrients for slow sand filtration to be a viable option.
2. Pretreatment. Raw waters that cannot meet the criteria listed in 12VAC5-590-880 C 1 a through c shall be treated to that quality prior to application to a slow sand gravity filter.
- a. Presedimentation may be an appropriate pretreatment depending on the size and specific gravity of the turbidity particles.
  - b. Coarse media filtration of either a horizontal or vertical flow configuration may be appropriate for reducing levels of smaller size particles. Normally such roughing filters would be designed to accommodate periodic media removal, cleaning, and replacement.
  - c. Chemical flocculation and coagulation is normally not appropriate pretreatment for slow sand gravity filters.
  - d. Preoxidation is normally not appropriate pretreatment for slow sand gravity filters.
3. Number of filters. At least two filters shall be provided. In all cases the filters shall be capable of meeting the design maximum daily water demand with one filter out of service.
4. Filter media. Sand shall be clean silica sand that meets the following criteria:
- a. The effective size shall be between 0.15 mm and 0.35 mm.
  - b. The uniformity coefficient shall not exceed 2.5.
  - c. The sand depth shall not exceed 55 inches. A minimum depth of 30 inches is required for normal operation.
5. Supporting media. Gravel shall meet the requirements of 12VAC5-590-880 A 6 d.
6. Structural details.
- a. Sufficient head room shall be provided for normal movement on the filter by operating personnel for periodic sand removal operations.
  - b. Adequate manholes and access ports shall be provided for moving sand off and onto the filter.
  - c. There shall be no common wall between finished water and any lesser quality water.
  - d. Consideration should be given to providing facilities for dirty sand storage and washing, as well as for clean sand storage.
  - e. All slow sand filters should be covered.
7. Hydraulic design.
- a. Filter to waste shall be provided for all slow sand filters.
  - b. Water entering the filter shall be distributed in a manner such that the surface of the filter shall not be disturbed in any way.
  - c. The nominal rate of filtration may range from 45 to 150 gpd/ft<sup>2</sup> (0.031 to 0.10 gpm/ft<sup>2</sup>) of sand area.
  - d. The minimum depth of water over the filters shall be three feet. The maximum depth of water over the filters shall not exceed five feet. An overflow capable of handling the maximum flow to the filter shall be provided at the maximum filter water level.

e. Underdrains shall be provided to assure an even rate of filtration across the filter surface. The maximum velocity of water in the lateral underdrains shall be 1.0 ft/sec. The underdrain spacing shall not exceed 12 feet.

f. Each filter shall be capable of being filled with water from the bottom up.

g. Each filter shall be equipped with a loss of head gauge; a rate of flow control device such as an orifice, weir, or butterfly valve; a weir or effluent pipe designed to assure that the water level over the filter never drops below the sand surface; and filtered water sample taps.

8. Performance report. At the conclusion of at least 12 months but no more than 18 months operation of the full scale plant an engineering report shall be submitted to the division that summarizes operating conditions and establishes optimum filter curing time, optimum filter run times, raw and finished water bacteriological and turbidity data, and any other pertinent factors.

~~D. A.~~ Diatomaceous earth filtration is essentially a straining process. The use of these filters is acceptable for application to surface waters or groundwaters under the direct influence of surface water shall be limited to treatment of either a surface ~~waters~~ water source or a GUDI source or both water supplies with low turbidity and low bacterial contamination, and may be used for iron removal for groundwaters from groundwater.

1. Source restrictions. Raw water quality for application to a diatomaceous earth filter without pretreatment shall meet the following requirements:

a. Bacteria shall not exceed 50 total coliforms in any sample.

b. Color shall not exceed 15 apparent CU units in any sample.

c. Turbidity shall not exceed 5 NTU in any sample.

2. Pretreatment. If the raw water can be treated to meet the above source restrictions diatomaceous earth filtration may be utilized.

~~3. B.~~ Pilot plant study. Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated.

a. Conditions of the the study, such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, and other relative information shall be approved by the division prior to the study.

b. Satisfactory pilot plant results shall be obtained prior to submission of final construction plans and specifications.

c. The pilot plant study shall demonstrate the ability of the system to meet applicable drinking water standards at all times.

4. ~~C.~~ Types of filters. Pressure or vacuum diatomaceous earth filtration units will be considered for approval.

~~5. D.~~ Treated water storage. Treated water storage capacity in excess of normal requirements shall be provided to:

a. 1. Allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate, and

b. 2. Guarantee continuity of service during adverse raw source water conditions without bypassing the system.

6. ~~E.~~ Number of units. At least two filtering units shall be provided at plants having a rated capacity of more than 100 gpm.

7. ~~F.~~ Precoat.

a. 1. Application. A uniform precoat shall be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing a filter-to-waste or recirculation system.

b. 2. Quantity. Diatomaceous earth in the amount of 0.2 lb/ft<sup>2</sup> of filter area ~~or an amount sufficient to apply a minimum of  $\frac{1}{16}$  inch coating shall be used with recirculation.~~

8. G. Body feed. A body feed system to apply additional amounts of diatomaceous earth slurry during the filter run is required.

a. 1. Quantity. Rate of body feed is dependent on ~~raw source~~ water quality and characteristics and must be determined in the pilot plant study.

b. 2. Adequate accessibility to the feed system and slurry lines is required.

c. 3. Continuous mixing of the body feed slurry is required.

d. 4. Consideration should be given to providing a coagulant coating (alum or suitable polymer) of the body feed.

9. Filtration.

a. H. Rate of filtration. The ~~recommended nominal rate is 1.0 gpm/ft<sup>2</sup> of filter area and~~ hydraulic loading rate shall not exceed 1.5 gpm/ft<sup>2</sup> of filter area. The filtration rate shall be controlled.

b. I. Head loss. The head loss shall not exceed 30 psi for pressure diatomaceous earth filters, or a vacuum of 15 inches of mercury for a vacuum system.

c. J. Recirculation. A recirculation or holding pump shall be employed to maintain a differential pressure across the filter when the unit is not in operation ~~in order~~ to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of 0.1 gpm/ft<sup>2</sup> filter area shall be provided.

d. K. Septum or filter element. The filter elements shall be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and shall be spaced ~~such so~~ that no less than one inch is provided between elements or between any element and a wall. Means shall be provided to check the ~~septum(s)~~ septum or septums for cleanliness or damage. Consideration should be given to providing septum assemblies where an individual ~~septums-septum~~ septum can be removed, cleaned, repaired, and replaced.

e. L. Inlet design. The filter influent shall be designed to prevent scour of the diatomaceous ~~each earth~~ from the filter element.

10. M. Backwash. Provision shall be made for periodic backwashing of the filter. A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided.

14. N. Appurtenances. The following shall be provided for every filter:

a. 1. Sampling taps for ~~raw source~~ and filtered water;

b. 2. ~~Loss of head~~ A loss-of-head or a differential pressure gauge;

c. 3. ~~Rate of flow~~ A rate-of-flow indicator, preferable with totalizer; and

d. 4. A throttling valve used to reduce rates below normal during adverse ~~raw source~~ water conditions.

12. Monitoring. Turbidity monitoring is required for filter effluent. The monitoring may be ~~done by recorder or daily periodic measurements.~~

O. Turbidity monitoring. Indicating and recording turbidimeters meeting requirements of 12VAC5-590-770 B shall be provided for:

1. The source water;

2. The effluent from each filter unit; and

3. The combined filter effluent.

P. An operation and maintenance manual shall be provided for all diatomaceous earth filtration units. The manual shall include the following:

1. A detailed description of the treatment units and the control of each unit for optimal performance;
2. A preventative maintenance schedule;
3. The manual adjustment and override procedures for all automatic control features; and
4. A troubleshooting guide for typical problems.

Q. The owner shall require the equipment manufacturer to provide ~~on-site start-up~~ onsite start-up and follow-up training.

E. Direct filtration:

~~1. General. Direct filtration refers to the filtration of high quality and seasonally consistent raw water without prior sedimentation. Design shall be preceded by a pilot study acceptable to the division. An in-plant demonstration study may be appropriate where a conventional treatment plant is to be converted to direct filtration.~~

~~2. Preliminary engineering report. A report shall be prepared and submitted to the division which included the following specific items, in addition to those listed in 12VAC5-590-200 C:~~

~~a. Historical summary of meteorological conditions.~~

~~b. Historical summary of raw water quality covering a period of at least one year with special reference to fluctuation in quality and possible sources of contamination. The following raw water parameters should be evaluated:~~

~~(1) Apparent color~~

~~(2) Turbidity~~

~~(3) Bacterial concentration~~

~~(4) Microscopic biological organisms~~

~~(5) Temperature~~

~~(6) Total solids~~

~~(7) General inorganic and organic chemical characteristics~~

~~(8) Additional parameters as required by the division.~~

~~c. Description of the pilot plant study methods and work to be done.~~

~~3. The pilot plant or in-plant demonstration study shall be conducted over a sufficient time to treat all expected raw water conditions throughout the year. The pilot plant filter shall be of a similar type and operated in the same manner as proposed for full-scale operation. The following items, as a minimum, shall be addressed:~~

~~a. Chemical mixing conditions including shear gradients and detention periods.~~

~~b. Chemical feed rates.~~

~~c. Use of various coagulant and filtration aids including polymers.~~

~~d. Flocculation conditions and contact time necessary for optimum filtration for each coagulant proposed.~~

~~e. Filtration rates.~~

~~f. Filter gradation, types of media, and depth of media.~~

~~g. Filter breakthrough conditions and backwash requirements.~~

~~4. Final engineering report. A final report including the engineer's design recommendation shall be prepared and submitted prior to the submission of plans and specifications.~~



5. Treatment facilities.

a. Flash mixing and flocculation. The design shall be based on the results of the pilot plant or in-plant demonstration study and the requirements in 12VAC5-590-870-C and D.

b. Filtration. Filters shall be dual-media or multimedia gravity filters. The final design shall be based on the results of the pilot plant or in-plant demonstration study and the requirements in 12VAC5-590-890. Turbidity at the sand-coal interface of each filter shall be monitored by indicating and recording equipment.

6. Plant siting. The plant design should allow for the future installation of sedimentation basing.

F. Rapid rate pressure filters.

The use of these filters may be considered for iron and manganese and other clarification processes. Pressure filters shall not be used in the filtration of polluted water, water from surface water sources, groundwater under the direct influence of surface water, or following lime soda softening.

1. Minimum criteria relative to number, rate of filtration, structural details and hydraulics, filter media, etc. provided for rapid rate gravity filters also apply to pressure filters where appropriate.

2. The normal rate of filtration shall be 3 gpm/ft<sup>2</sup> of filter area.

3. The filters shall be designed to provide:

a. Loss of head gauges on the inlet and outlet pipes of each filter;

b. An easily readable meter or flow indicator on each battery of filters. A flow indicator is recommended for each filtering unit;

c. Filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes;

d. Minimum sidewall shell height of five feet. A corresponding reduction in sidewall height is acceptable where proprietary bottoms permit reduction of the gravel depth;

e. The top of the washwater collection trough to be at least 18 inches above the surface of sand;

f. The underdrain system to collect efficiently the filtered water and to distribute the backwash water at a rate not less than 15 gpm/ft<sup>2</sup> of filter area;

g. Location of flow indicators and controls that is easily readable while operating the control valves;

h. Air release valve on the highest point of each filter;

i. Accessible manhole to facilitate inspections and repairs;

j. Means to observe the wastewater during backwashing; and

k. Construction to prevent cross connection.

**12VAC5-590-881. Slow sand filtration.**

A. Slow sand filters shall be approved only after a pilot study demonstrates that the water supply contains sufficient nutrients for use of this treatment technology.

B. At least two filters shall be provided. In all cases, the filters shall be capable of meeting the design maximum daily water demand with one filter out of service.

C. Sand shall be clean silica sand that meets the following criteria:

1. The effective size shall be between 0.15 mm and 0.35 mm;

2. The uniformity coefficient shall not exceed 2.5; and

3. The sand depth shall not exceed 55 inches. A minimum depth of 30 inches is required for normal operation.

D. Supporting media gravel shall meet the requirements of 12VAC5-590-874 F.

E. Structural details.

1. All slow sand filters shall be covered.

2. Sufficient head room shall be provided for normal movement on the filter by operating personnel for periodic sand removal operations.

3. Adequate manholes and access ports shall be provided for moving sand off and onto the filter.

4. There shall be no common wall between the finished water and any water of any lesser quality ~~water~~.

5. All filters shall be protected from freezing.

F. General design requirements.

1. Filter to waste shall be provided for all slow sand filters.

2. Water entering the filter shall be distributed in a manner so that the surface of the filter shall not be disturbed in any way.

3. The nominal rate of filtration range shall be from 45 gpd/ft<sup>2</sup> to 150 gpd/ft<sup>2</sup> (0.031 gpm/ft<sup>2</sup> to 0.10 gpm/ft<sup>2</sup>) of sand area.

4. The minimum depth of water over the filters shall be three feet. The maximum depth of water over the filters shall not exceed five feet. An overflow capable of handling the maximum flow to the filter shall be provided at the maximum filter water level.

5. Underdrains shall be provided to assure an even rate of filtration across the filter surface. The maximum velocity of water in the lateral underdrains shall be 0.75 ft/sec. The underdrain spacing shall not exceed three feet.

6. Each filter shall be capable of being filled with water from the bottom up.

7. Each filter shall be equipped with: a loss-of-head gauge; a rate-of-flow control device such as an orifice, weir, or butterfly valve; a weir or effluent pipe designed to assure that the water level over the filter never drops below the sand surface; and filtered water sample taps.

8. Monitoring, indicating, and recording turbidimeters meeting the requirements of 12VAC5-590-770 B shall be provided for:

a. The source water;

b. The filter effluent from each filter unit; and

c. The combined filter effluent.

9. The filters shall be designed to operate to waste after scraping or replacement of the sand, until the ripening process is complete and the turbidity meets the requirements of 12VAC5-590-395 A 2 b (3).

#### **12VAC5-590-882. Membrane filtration.**

A. Applicability. This section pertains to the use of membrane filtration as follows: ~~to provide for pathogen and turbidity removal. The design requirements when using this technology for other purposes, such as for softening or organics removal, shall be established by the commissioner on an individual basis.~~

1. For pathogen with turbidity log removal credits in accordance with Table 500.1 in 12VAC5-590-500, the use of microfiltration and ultrafiltration are allowed.

2. For softening, TDS removal, organics removal, and other treatment purposes, reverse osmosis and nanofiltration are allowed in accordance with 12VAC5-590-680 G.

B. Membrane filtration systems shall meet all requirements contained in 12VAC5-590-401 E 6 b to be granted removal credit for Giardia lamblia and Cryptosporidium.

C. A demonstration study shall be conducted on the water to be treated ~~prior to~~ before the installation of a membrane filtration system, unless the owner can demonstrate to the satisfaction of the commissioner that the ~~supply-source~~ water quality range over all four seasons of a year will be adequately treated by the proposed design.

D. All membrane treatment units for pathogen and turbidity removal shall employ microfiltration or ultrafiltration using hollow fiber, positive ~~pressure-driven~~ pressure-driven membrane filtration technology. They may employ either an inside-to-outside or outside-to-inside flow direction.

E. The number of membrane units shall be a function of the overall treatment facility capacity, waterworks capacity, and water demand. Multiple membrane units shall be provided where the treatment facility design capacity exceeds 0.5 MGD.

F. Approved materials and chemicals.

1. All membrane materials, ~~and~~ associated piping, ~~and other~~ components, ~~etc.~~ in contact with the water shall be in accordance with 12VAC5-590-810.

2. Chemicals used in any membrane cleaning process shall be in accordance with 12VAC5-590-515.

G. Turbidity monitoring. Continuous indicating and recording equipment meeting the requirements of 12VAC5-590-770 B shall be provided for the following locations:

1. Source water;

2. Pretreated water, such as by coagulation, flocculation, and sedimentation (if applicable);

3. Filtrate from each membrane unit; and

4. Combined filter effluent, where more than one membrane unit is installed.

H. Indicating and recording equipment for entry point chlorine residual monitoring shall be provided. Indicating and recording equipment for filtered water temperature monitoring shall be provided.

I. Pressure monitoring:

1. Indicating equipment shall be provided for monitoring ~~the~~ pressure drop across any prefilter.

2. Indicating and recording equipment shall be provided for monitoring ~~the~~ pressure drop across membrane modules, i.e., transmembrane pressure.

3. Integrity monitoring. Indicating and recording equipment for direct integrity test monitoring shall be provided and shall document the date, time, and results of every test performed on each unit.

J. Flow measurement. Equipment shall be provided for measuring or calculating the following flows:

1. Source water, gpm and totalized;

2. Filtrate from each unit, gpm and totalized;

3. Flux from each unit, gpd/sf;

4. Recirculation to each unit, gpd or percent of feed flow, if applicable;

5. Entry point, gpm and totalized; and

6. Waste.

K. An alarm system shall be provided that will report alarm conditions and shut down the treatment plant and entry point flow as necessary.

1. All alarms shall be reported to a location manned 24 hours per day or to a person on-call and shall report alarm conditions audio-visually at the water treatment plant.

2. At a minimum, the following points shall be monitored by the alarm system. Alarm and shut down set point conditions will be determined by the commissioner on an individual basis.

a. Feed water flow;

b. Feed water turbidity, if required by the commissioner;

c. Filtrate turbidity from each unit exceeding operational control criteria;

d. Membrane direct integrity test initiation, failure, and exceeding operational control criteria; and

e. Entry point disinfectant residual.

L. Sample taps shall be provided to monitor the following:

1. Source water;

2. Source water storage tank effluent;

3. Feed water after prefiltration;

4. Filtrate from each membrane unit;

5. Combined filtrate from all units;

6. Entry point; and

7. Additional sample taps to monitor the presence of cleaning solutions used in either the backwash or cleaning operations.

M. Equipment shall be provided, using variable frequency drive or other suitable means, to adjust the feed pump output in order not to exceed the design flux in the event modules are taken off line.

N. Pressure gauges.

1. A portable, pocket-type pressure gauge, of the correct range and accuracy for the application and with the capability of being calibrated, shall be provided to check the pressure readings of the pressure transducers installed on the membrane units.

2. At each location of a pressure transducer, a ~~3/4~~-1/4-inch diameter pressure gauge with American National Standard Taper Threads (NPT) connection shall be provided to facilitate the connection of a portable, pocket-type test gauge.

O. Clean-in-place systems, including tanks, piping, all joints, and valves shall be compatible with the cleaning solution and shall be corrosion resistant.

P. An operation and maintenance manual shall be provided for all membrane filtration treatment units. The operation and maintenance manual shall include the following:

1. A maintenance schedule for each piece of equipment.

2. Operation procedures, including software user instructions.

3. A trouble shooting guide.

4. Identification of specific proprietary equipment or software not available to the owner or operator.

5. A service call number.

6. DIT requirements.

7. Chemical cleaning instructions.

8. A detailed description of the treatment units and ~~the~~ control of each unit for optimal performance.

Q. A means shall be provided to isolate a compromised module or fiber or both. A means to visually inspect modules while simultaneously conducting the DIT shall be provided. Alternatively, sonic testing equipment ~~providing that provides~~ a relative accelerometer reading shall be provided where visual inspection cannot be performed.

Statutory Authority

**12VAC5-590-883. Bag and cartridge filtration.**

A. Bag or cartridge filtration shall be limited to treating ~~either a surface water source or a GUDI sources-source or both~~ with low turbidity.

B. A pilot plant study shall be conducted on the water to be treated ~~prior to~~ before the installation of a bag or cartridge filter system.

C. Bag and cartridge filtration systems shall be granted removal credit for Giardia lamblia and Cryptosporidium in accordance with 12VAC5-590-401 E 6 a, provided that ~~it-they~~ meets the requirements of this section.

D. General design requirements.

1. All system components such as housing, bags, cartridges, gaskets, O-rings, ~~and other components etc.~~ in contact with water shall be in accordance with 12VAC5-590-810. All cartridge filter housing shall be certified by the 2017 ASME Boiler and Pressure Vessel Code (BPVC), July 1, 2017 ASME certification program for pressure vessels, and stamped with a "U" or "U2" certification mark.

2. Indicating and recording turbidimeters meeting requirements of 12VAC5-590-770 B shall be provided for the source water and the combined filter effluent. The commissioner may require indicating and recording effluent turbidimeters for each filter unit.

3. The maximum flux rate across the final filter shall not exceed 0.2 gpm/ft<sup>2</sup>.

4. Maximum differential pressure across the cartridge filter shall not exceed 20 psi.

5. Pressure gauges and sampling taps shall be provided before and after each bag or cartridge filter.

6. Provisions to accomplish filter to waste shall be provided.

7. Automatic startup of bag or cartridge filters is prohibited.

8. An alarm system shall be provided that will report alarm conditions and shut down the treatment plant and entry point flow.

a. All alarms shall be reported to a location manned 24 hours per day or to a person on-call and shall report alarm conditions audio-visually at the water treatment plant.

b. The following shall be monitored by the alarm system:

(1) Source water turbidity;

(2) Feed water flow;

(3) If applicable, filtrate turbidity from each unit exceeding operational control criteria;

(4) Combined filter effluent turbidity exceeding operational control criteria;

(5) Differential pressure at each unit; and

(6) Entry point disinfectant residual.

9. At least two filtering units shall be provided at plants having a rated capacity of greater than 100 gpm.

E. Operation and maintenance documents shall be provided for all bag or cartridge filter units and shall include:

1. Detailed description of the bag or cartridge treatment units and the control of each unit for optimal performance.
2. ~~Procedure-~~ Procedural criteria (such as pressure differential, turbidity, and other parameters etc.) and expected frequency of bag or cartridge filter replacement.
3. A preventative maintenance schedule.
4. Manual adjustment and override procedures for any automatic control features.
5. Troubleshooting guide for typical problems.

F. The owner shall require the equipment manufacturer to provide ~~on-site onsite~~ start-up and follow-up training.

**12VAC5-590-890. High rate treatment processes. (Repealed.)**

~~A. General.~~

~~High rate treatment processes are characterized by:~~

- ~~1. Precise coagulation control;~~
- ~~2. Turbidity monitoring throughout the process;~~
- ~~3. pH monitoring throughout the process;~~
- ~~4. Reduced flocculation time;~~
- ~~5. Reduced sedimentation time;~~
- ~~6. Use of multimedia filters incorporating anthracite and silica or other types of filter materials; and~~
- ~~7. Filter rates greater than two gallons per minute per square foot of filter area and not exceeding four gallons per minute per square foot of filter area.~~

~~B. Instrumentation.~~

- ~~1. The coagulation process shall be controlled by:
  - ~~a. Zeta potential shall be measured by microelectrophoresis;~~
  - ~~b. Dual pilot filters shall be required. The pilot filter shall consist of a small filter (about six inches in diameter) containing the same type and depth of media as the plant filters, and which is operated in the same manner as the larger plant units except that the plant raw water after the treatment chemicals have been added rather than the coagulated and settled water is applied to the pilot filter. The pilot filter shall be equipped with recording turbidimeters on the effluent to measure the filterability of the water as reflected by turbidity monitoring. Departures from these standards using proprietary pilot filters may be considered;~~
  - ~~c. Streaming current monitor—a continuous sampling instrument which measures the electric current generated when water flows past suspended particles contained in the water; and~~
  - ~~d. In addition to one of the above devices, a multiple six-gang stirring machine for performing jar tests shall be provided.~~~~
- ~~2. Indicating and recording turbidity monitoring shall be provided for monitoring the turbidity of:
  - ~~a. The raw water;~~
  - ~~b. Settled water from each sedimentation basin;~~
  - ~~c. Filter effluent from each filter; and~~~~

d. Finished water leaving the treatment plant.

3. Indicating and recording pH monitoring equipment shall be provided for monitoring:

a. The raw water;

b. The flash mix effluent; and

c. The finished water leaving the treatment plant.

C. Unit processes:

1. Flash mix facilities shall conform with 12VAC5-590-870 C.

2. Flocculation design shall comply with 12VAC5-590-870 D, except the minimum detention time shall be 20 minutes.

3. Sedimentation design shall comply with 12VAC5-590-870 E, except the minimum effective detention time shall be three hours.

4. Filtration:

a. The maximum rate of filtration shall not exceed four gallons per minute per square foot of filter area.

b. Number of filter units. At least two units shall be provided at plants having a rated capacity less than two million gallons per day. The total number of filters necessary at plants having a rated capacity equal to or greater than two million gallons per day may be estimated using the following formula:

$$N = 1.35 (Q)^{0.5}$$

(Based upon the formula as per Morrell and Wallace from Hardenbergh and Redie's "WATER SUPPLY AND WASTE DISPOSAL 1960" and modified for the high rate process).

Where N equals the number of filter units, Q equals the plant capacity in million gallons per day.

c. Filters incorporated in the high rate treatment process shall be of the dual media or multimedia type. The media shall consist of anthracite, silica sand, or other suitable filter materials. Both dual media and mixed media filters will be considered. Since filter media designs utilized in the high rate treatment process are generally proprietary in nature, no attempt will be made to set standards for the minimum filter media depth, the effective size and uniformity coefficient of the filter media, or the specific gravity. However, beds having a minimum total depth of 27 inches of filter media with a minimum of 10 inches of fine sand will be considered. Other proposals for high rate processes shall be considered individually by the division.

d. Structural details and hydraulics - see 12VAC5-590-880 A 4.

e. Washwater trough - see 12VAC5-590-880 A 5.

f. Filter bottoms and strainers - see 12VAC5-590-880 A 7.

g. Surface wash - see 12VAC5-590-880 A 8.

h. Appurtenances - see 12VAC5-590-880 A 9.

i. Backwash - see 12VAC5-590-880 A 10.

j. Miscellaneous - see 12VAC5-590-880 A 11.

5. Chemical application:

a. Suitable equipment for application of filter aids (polymers) to the influent of the filters shall be provided.

b. See 12VAC5-590-860.

**12VAC5-590-895. Pre-engineered package treatment units.**

A. Pre-engineered package treatment units are defined as pre-designed, factory built, and transported virtually assembled to the operation site. The provisions of 12VAC5-590-290 shall apply.

B. General design considerations.

1. A rapid mix unit process shall be provided. The design shall meet requirements of 12VAC5-590-871 A.

2. Flocculation units shall meet requirements of 12VAC5-590-871 B or as identified and justified in the approved PER.

3. Sedimentation units shall meet requirements of 12VAC5-590-872 or as identified and justified in the approved PER.

4. Filters shall be dual media or multimedia gravity filters. Design of filtration units shall meet the requirements of 12VAC5-590-874 or as identified and justified in the approved PER.

5. Indicating and recording turbidimeters meeting requirements of 12VAC5-590-770 B shall be provided for the:

- a. source water;
- b. applied water to each filter;
- c. filter effluent from each filter; and
- d. combined filter effluent.

6. Sufficient overflows and drains shall be provided to maintain a maximum water level within the plant, including the depth of water over the filters, and to facilitate complete draining of the package unit.

7. Where automatic unit process control is provided, operator adjustment of chemical feed rates, times, and sequences shall be provided as well as a manual override of all automatic features.

- a. Automatic startup of water treatment unit processes is prohibited.
- b. Valve actuators shall be provided with manual override capability.

8. Treatment units installed at ground level shall be provided with stairways, walkways, or other suitable means to allow access for operation and maintenance and observation of all treatment process units. Filters shall be adequately accessible to facilitate evaluation of the entire filter bed for media condition and placement, fluidization during backwashing, and evaluation of compaction during filtration.

C. An operation and maintenance manual shall be provided for all pre-engineered package treatment units. The operation and maintenance manual shall include the following:

- 1. A detailed description of the treatment units and the control of each unit for optimal performance.
- 2. A preventative maintenance schedule.
- 3. Manual adjustment and override procedures for any automatic control features.
- 4. A troubleshooting guide for typical problems.

D. The owner shall require the equipment manufacturer to provide onsite start-up and follow-up training.

**12VAC5-590-900. Softening Cation exchange softening.**

~~Softening shall not be used as the sole treatment method for surface waters or bacteriologically contaminated groundwater. The softening process design selected shall be~~



based upon the mineral qualities of the raw source water and the desired finished water quality in conjunction with requirements for disposal of sludge or brine water, cost of the plant, cost of the chemicals, and the plant location.

~~A. Lime, excess lime, and excess lime soda processes. The applicable design standards for mixing, flocculation, and sedimentation are the same for the lime, excess lime, and excess lime soda processes as for conventional clarification except that the minimum flash mix time is five minutes, flocculation time is 40 minutes, and settling time is two hours. Where softening is included as a treatment process in conjunction with clarification, the greater detention time criteria shall govern. For criteria pertaining to softening with solids contact units, see [12VAC5-590-870](#).~~  
F.

- ~~1. Mechanical sludge removal equipment shall be provided in the sedimentation basin.~~
- ~~2. Determinations shall be made of the CO<sub>2</sub> content of the raw water. When concentrations exceed 10 milligrams per liter, the economics of removal by aeration as opposed to removal with lime should be considered.~~
- ~~3. Equipment for stabilization of water softened by the excess lime and excess lime soda processes is required.~~
- ~~4. Staging shall be considered when the excess lime soda process is employed.~~
- ~~5. Provision shall be included for proper disposal of softening sludges.~~
- ~~6. The use of excess lime shall not be considered an acceptable substitution for chlorination.~~

~~B. Cation exchange process.~~

~~A. Iron, manganese, or a combination of the two, in the oxidized state or unoxidized state, should shall not exceed 0.3 milligrams per liter mg/L in the water as applied to the cation exchange material. Pretreatment shall should be required when the content of iron, manganese, or a combination of the two, is one milligram per liter 1.0 mg/L or more.~~

~~1. B. The units may shall be of pressure or gravity type, or of either an upflow or downflow design, using automatic or manual regeneration. Automatic regeneration is suggested recommended for small plants.~~

~~2. C. The design capacity for hardness removal should shall not exceed 20,000 grains/ft<sup>3</sup> per cubic foot when the resin is regenerated with 0.3 pounds of salt per kilograin of hardness removed.~~

~~3. D. The depth of the cation exchange material should shall not be less than three feet.~~

~~4. E. The hydraulic loading rate of softening should not exceed seven gallons per square foot per minute 7 gpm/ft<sup>2</sup> and the backwash rate should be six to eight gallons per square foot per minute 6-8 gpm/ft<sup>2</sup>.~~

~~5. F. The freeboard shall depend upon the specific gravity of the media and the direction of the water flow.~~

~~6. G. The bottoms, strainer systems, and support for the cation exchange material shall conform to criteria provided for rapid rate gravity filters; see also [12VAC5-590-874](#).~~

~~7. H. Facilities shall be included for even distribution of brine over the entire surface of both upflow and downflow units. Backwash, rinse, and air relief discharge pipes shall be installed in such a manner as to prevent any possibility of backsiphonage.~~

~~8. I. A bypass shall be provided around softening the cation exchange units to produce a blended water of desirable hardness. Meters shall be installed to measure total water delivered to the distribution system and on each softener unit. An automatic proportioning or regulating device and shutoff valve should be provided on the bypass line. In some installations, it may be necessary to treat the bypassed water to obtain acceptable levels of iron and manganese in the finished water.~~

9. J. Waters having turbidity of five units NTUs or more turbidity shall not be applied directly to the cation exchange softener. Silica gel materials should be used for water having a pH above 8.4 and should not be used when iron is present. When the applied water contains a chlorine residual, the cation exchange material shall be a type that is not damaged by residual chlorine. Phenolic resin shall not be used.

10. K. ~~Smooth nose sampling~~ Sampling taps shall be provided for the collection of representative samples for both bacteriological and chemical analyses. The taps shall be located to provide for sampling of the softener influent, softener effluent, and the blended water. The sampling taps for the blended water shall be at least 20 ~~feet-~~ ft downstream from the point of blending.

11. L. Brine measuring or ~~salt-dissolving~~ salt-dissolving tanks and wet salt storage facilities shall be covered. The makeup water inlet shall have a free fall discharge of two pipe diameters but not less than two inches above the maximum liquid level of the unit or be protected from backsiphonage. Water for filling the tank should be distributed over the entire surface by pipes above the maximum brine level in the tank. The salt shall be supported on graduated layers of gravel under which is a suitable means of collecting the brine. Wet salt storage basins must be equipped with manhole or hatchway openings having raised curbs and watertight covers ~~having~~ with overhanging edges similar to those required for finished water reservoirs. Overflows, where provided, shall be turned down, have a proper free fall discharge and be protected with noncorrodible screens or self-closing flap valves.

12. M. Wet salt storage basins shall have sufficient capacity to store at least a ~~30-days-~~ 30-day operating supply.

13. N. Stabilization of the finished water for corrosion control ~~shall be provided~~ shall be considered.

14. O. Suitable disposal must be provided for the brine waste.

15. P. Pipes and contact materials shall be resistant to the aggressiveness of the salt.

16. ~~Salt storage tanks and feed equipment should be enclosed and separated from other operating areas in order to prevent damage to equipment.~~

**12VAC5-590-910. Aeration. (Also see 12VAC5-590-970.)**

A. Aeration treatment ~~devices as described herein may be used~~ is acceptable for oxidation, separation of gases, or for taste and odor control. General design requirements include the following:

A. Natural draft aeration.

The design of natural draft aeration shall provide the following:

1. The water shall be distributed uniformly onto the top tray;
2. The water shall be discharged through a series of three or more trays with the separation of trays not less than six inches;
3. The trays shall be loaded at a rate ranging from one gallon per minute to five gallons per minute for each square foot of total tray area;
4. The trays shall have slotted, woven wire cloth, or perforated bottoms;
5. The perforations shall be 3/16 to 1/2 inches in diameter and spaced one to three inches on centers when perforations are used;
6. Eight to 12 inches of inert media shall be used, such as coke or limestone which shall be two to six inches in size, and will not readily disintegrate due to freezing cycles;
7. The aerated water shall receive disinfection treatment; and

8. The trays shall be designed using materials resisting deterioration with consideration being given to corrosion, slime, and algae control.

~~B. Forced or induced draft aeration devices shall be designed to:~~

- ~~1. Provide an adequate liquid distribution and countercurrent of air through the enclosed aeration column;~~
- ~~2. Be insectproof and lightproof;~~
- ~~3. Be such that air introduced into column shall be screened through insect proof screen and be as free of dust as possible;~~
- ~~4. Ensure that water outlet is adequately sealed to prevent unwanted loss of air; and~~
- ~~5. Ensure that the sections of the aerator can be easily reached and removed for maintenance.~~

~~C. Pressure aeration may be used for oxidation purposes if a pilot plant study indicates the method is applicable; it is not acceptable for removal of dissolved gases. Filters following pressure aeration shall have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to:~~

- ~~1. Give thorough mixing of compressed air with the water being treated; and~~
- ~~2. Provide screened and filtered air, free of obnoxious fumes, dust, dirt, and other contaminants.~~

~~1. The aerated water shall be chlorinated following aeration.~~

~~2. The equipment shall incorporate materials resistant to deterioration and corrosion, and shall be designed to eliminate the potential for fouling problems from calcium carbonate and iron precipitation, and from algae, slime, and bacteriological growth. Disinfection capability shall be provided ~~prior to before~~ the aeration treatment units.~~

~~3. The equipment shall be easily accessed and serviced.~~

~~4. The air introduced into the treatment units shall be filtered, and shall be free of insects, obnoxious fumes, dust, dirt, and other contaminants. If blowers are located inside a building, ~~then~~ the air intakes shall extend to the outside and be furnished with appropriate air filters.~~

~~5. Air exhaust outlets shall be located to avoid induced contaminants, particularly at or near occupied areas or blower intakes.~~

~~6. Duplicate blowers, motors, or multiple treatment units shall be required for treatment processes designed to meet the drinking water quality standards in 12 VAC5-590-340.~~

~~B. Natural, forced, or induced draft aeration units shall be designed to provide an adequate liquid distribution and countercurrent of air through the enclosed aeration column, and adequately seal the water outlet to prevent unwanted loss of air.~~

~~C. Pressure aeration means the injection of compressed air into the water to be treated, typically for oxidation. Pressure aeration shall not be approved for removal of dissolved gases. Filters following pressure aeration shall have adequate exhaust devices for the release of air. Pressure aeration devices shall be designed to provide thorough mixing of compressed air with the water being treated.~~

~~D. Packed ~~Tower-tower~~ Aeration-aeration (Air-air Strippingstripping) is suitable for removing VOCs, ~~volatile organic chemicals~~, trihalomethanes, carbon dioxide, and radon.~~

- ~~1. Justification shall be provided for the selected design parameters (e.g., height and diameter of the unit, air-to-water ratio, packing depth, surface loading rate, and other features etc.). The design shall consider the effects of temperature change and the~~

resulting impact in contaminant removal efficiency. Pilot plant studies may be required to substantiate the design.

2. The packing material used shall be resistant to the aggressiveness of the water, dissolved gases, and cleaning materials, and shall meet requirements of 12VAC5-590-810.

3. Water shall be evenly distributed at the top of the tower using spray nozzles or ~~orifice type- orifice-type~~ distributor trays that will prevent short circuiting. A mist eliminator above the water distribution system may be required.

4. A means to allow for discharge and wasting of water or chemicals used to clean the tower shall be provided.

5. Sample taps shall be provided in the influent and effluent piping.

6. The design shall prevent freezing of the influent riser and effluent piping.

7. An overflow pipe discharging 12 to - 24 inches above the ground and over a drainage inlet structure or splash pad shall be provided.

8. A sufficient number of access ports with a minimum diameter of 24 inches shall be provided to facilitate inspection, media replacement, media cleaning, and maintenance of the unit interior.

9. A positive air flow sensing device and a pressure gauge shall be installed on the air influent line. If the aeration unit is designed to remove a contaminant with a PMCL, then the positive air flow sensing device shall be an integral part of an automatic control system that will turn off the influent water if positive air flow is not detected.

~~D.E. Other methods of aeration may be used if applicable to the treatment needs. Such methods include, but are not restricted to, spraying, diffused air, and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated and are subject to the approval of the division commissioner.~~

~~E. Aerators that discharge through the atmosphere should be protected from wind by being placed in a louvered enclosure designed to provide easy access to the interior.~~

~~F. Aerators that are used for oxidation or removal of dissolved gases from waters that will be given no further treatment other than chlorination shall be protected from contamination from insects and birds.~~

~~G. Ventilation shall be provided to prevent the accumulation of released gases in the building housing the treatment facilities.~~

#### **12VAC5-590-920. Iron and manganese control.**

A. Iron and manganese control, as used in this section herein, refers solely to treatment processes designed specifically for this purpose. The treatment process used will depend upon the character of the raw source water. The selection of one or more treatment processes shall meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated, and receive the approval of the division commissioner. The commissioner may require that pilot studies be conducted.

It may be necessary to operate a pilot plant in order to gather all information pertinent to the design.

A. ~~Removal~~ B. Iron and manganese removal by oxidation, ~~detention~~, and filtration.

1. Oxidation may be by aeration or by chemical oxidation with shall be accomplished by aeration, or by chemicals such as chlorine or potassium permanganate, sodium permanganate, or a combination thereof.

~~2. A minimum detention of 30 minutes shall be provided following oxidation by aeration in order to insure that the oxidation reactions are as complete as possible. This minimum detention time shall be reduced only when a pilot plant using the water under study demonstrates a lesser detention time. The detention basin shall be designed as a holding tank with no provision for sludge collection but with sufficient baffling to prevent short circuiting. Sedimentation basins shall be provided when treating water with high iron or manganese content or where chemical coagulation is used to reduce the load on the filters. The detention time shall be in a range of one to four hours where sedimentation is necessary prior to filtration. Pilot studies should be made of the water to determine the necessary detention time.~~

~~3. Filtration – see 12VAC5-590-880.~~

~~B. Removal by lime-soda process – see 12VAC5-590-900 A.~~

2. The design shall consider:

a. pH adjustment to promote rapid oxidation;

b. A pre-settling tank located ahead of the filters to remove oxidized iron and increase filter run times;

c. A manganese-oxide coating on the filter media, such as manganese greensand. The total depth of media shall not be less than 30 inches. Media shall have an effective size ~~from 0.3 mm to--~~ 0.35 mm and a uniformity coefficient of no more than 1.6. Following initial placement of the media, care shall be taken to remove fines by backwashing and skimming the surface; and

d. An anthracite cap layer over the manganese-oxide coated media, having a depth of 6 – 18 inches.

3. Aeration shall be designed in accordance with 12VAC5-590-910.

4. Flow proportional chemical feeders shall be provided, and the feed rate shall be adequately controlled by using feeders that are paced by water meters to prevent an over-dosage of chemical. A flow switch in place of a flow proportional feeder may be permissible.

5. Sample taps shall be provided ~~prior to~~ before the application of the oxidant, immediately ahead of filtration, and at the filter effluent.

6. Pressure filters shall include provisions for:

a. Pressure gauges on the inlet and outlet pipes of each filter, or a differential pressure gauge on each filter;

b. An easily readable meter or flow indicator on each battery of filters. A flow indicator is recommended for each filtering unit;

c. Filtration, backwashing, and filter-to-waste of each filter individually:

(1) Backwash water shall be evenly distributed in an adequate quantity to achieve at least a 30% media bed expansion during backwashing. The backwash rate shall be based on the media.

(2) The top of the backwash water collection trough shall be at least 18 inches above the media surface;

(3) An underdrain system to efficiently collect the filtered water and to distribute an adequate quantity of backwash water to achieve at least a 30% media bed expansion during backwashing;

d. ~~Location of flow~~ Flow indicators and controls are located so that they ~~that is~~ are easily readable while operating the control valves;

- e. An air release valve on the highest point of each filter;
- f. An accessible manhole to facilitate inspections and repairs for filters greater than 36 inches in diameter;
- g. A means to observe the wastewater during backwashing; and
- h. Construction to prevent cross connection.

C. Removal by units using continuous potassium permanganate regeneration-

1. This process consists of a continuous feed of potassium permanganate to the influent of a manganese greensand filter. Positive displacement type feeders shall be provided, and the feed rate shall be adequately controlled by using feeders which are paced by water meters or ratio type feeders (which are a combination type feeder and flow meter) to prevent an overdosage of potassium permanganate.

- 1. The permanganate shall be applied following pH affecting chemicals.
- 2. Other oxidizing agents or processes such as chlorination or aeration may be used prior to the permanganate feed to reduce the cost of the chemical.
- 3. The normal filtration rate is three gallons per minute per square foot. Lower filtration rates may be required or higher filtration rates may be permitted if justified by field studies and approved by the division
- 4. The normal wash rate is eight to 12 gallons per minute per square foot.
- 5. Air washing may be provided.
- 6. Sample taps shall be provided.
  - a. Prior to application of permanganate;
  - b. Immediately ahead of filtration;
  - c. At a point between the anthracite coal media and the manganese treated greensand;
  - d. Halfway down the manganese treated greensand; and
  - e. For filter effluent.

D. Removal by ion exchange. This process of iron and manganese removal may not be acceptable for waters containing high concentrations (more than 1.0 milligrams per liter) of iron, manganese, or combination thereof. Applications may be limited based on the media used. This process may not be acceptable where either the raw water or wash water contains dissolved oxygen. (See 12VAC5-590-900 B for general cation exchange information.)

C. Iron and manganese removal by ion exchange shall only be approved for removing low concentrations (less than 0.5 mg/L) of combined iron and manganese. The commissioner may require pilot studies be conducted to determine post-exchange pH/alkalinity adjustment. See 12VAC5-590-900 for general ion exchange design requirements.

E. D. Sequestering --see 12VAC5-590-950 E iron and manganese.

- 1. Sequestration with polyphosphates shall be considered for polishing filtered water; however, it shall not be used where residual iron, manganese, or combination thereof exceeds 1.0 mg/L.
- 2. Phosphate feed rates shall be determined by the product manufacturer and shall not exceed 10 mg/L.
- 3. Feed equipment shall be in accordance with the requirements of 12VAC5-590-860.
- 4. Stock phosphate solution shall be disinfected in accordance with the manufacturer's recommendations unless the phosphate solution is fed directly from the covered shipping container.

5. Sodium silicate or other silicate-based chemicals for the sequestration of iron and manganese shall be approved by the commissioner on an individual basis. Operational data from actual full-scale facilities treating waters of similar quality or pilot tests may be required.

~~F.~~ E. Sampling taps shall be provided for control purposes. Taps shall be located on each raw source water source, each treatment unit influent, and each treatment unit effluent.

~~G. Testing equipment shall be provided for all plants.~~ F. Iron and manganese testing equipment shall be provided. The Iron testing equipment shall have the capacity to accurately measure the iron content to a minimum of 0.1 milligrams per liter and to indicate manganese removal. be capable of accurately measuring iron concentration as low as 0.1 mg/L. Manganese testing equipment shall be capable of accurately measuring manganese concentration as low as 0.05 mg/L.

G. The commissioner may approve proprietary treatment processes for the removal of iron and manganese on an individual basis. Operational data from actual full-scale facilities treating waters of similar quality or pilot tests may be required. The provisions of 12VAC5-590-290 may apply.

#### **12VAC5-590-930. Fluoridation.**

~~Where practicable and feasible, the board may require owners of waterworks to provide artificial fluoridation so as to bring the fluoride ion concentration to the optimum level as set forth in Article 1 of Part II.~~

~~A. The board recommends that all community waterworks in Virginia be optimally fluoridated. Prior to the issuance of a permit for fluoridation, plans, specifications, operating procedures, and methods of supervision shall be submitted to the division. These shall be in conformity with requirements to be determined for each individual installation by the division. Fluoridation feed systems shall be designed to deliver the optimum fluoride ion concentration of 0.7 mg/L as determined by the U.S. Department of Health and Human Services.~~

~~B. Fluoride compounds. Commercial sodium fluoride, sodium silicofluoride fluorosilicate (also called sodium silicofluoride), and fluorosilicic acid (also called hydrofluorosilicic acid) shall conform to the applicable AWWA standards or NSF/ANSI standard Standard 60, as appropriate. Use of other chemicals which may be made available must be approved by the division.~~

~~C. Fluoride compound storage. Fluoride chemicals shall be isolated from other chemicals to prevent cross contamination. Compounds shall be stored in covered or unopened shipping containers in a separate room (except sodium fluoride saturators) with the chemical feeder. The room must be provided with mechanical ventilation to the outside of the building.~~

~~D. Chemical feed installations.~~

~~1. Chemical feed installations shall conform to 12VAC5-590-860.~~

~~2-1. Scales and loss-of-weight loss-of-weight recorders for dry chemical feeders and hydrofluorosilicic acid feeders shall be provided.~~

~~3- Feeders 2. Fluoride metering pumps shall have an accuracy so that the actual feed rate will be within 5.0% of the intended feed rate.~~

~~3. The point of application shall be so located to provide adequate mixing.~~

~~4. The point of application of hydrofluorosilicic acid, if into a pipe, shall be so located as to provide adequate mixing.~~

~~5-4. All fluoride feed lines shall be provided with adequate antisiphon anti-siphon devices.~~

~~5. Design of fluoride saturators shall consider:~~

~~a. The source water hardness. The water applied to the sodium fluoride saturator feeders shall be softened if the hardness exceeds 50 mg/L.~~

b. The fluoride source. Use only sodium fluoride in saturators.

c. A flow restrictor with a maximum flow of 2.0 gpm on all upflow saturators.

~~6. The water applied to sodium fluoride saturator feeders shall be softened if hardness exceeds 75 milligrams per liter.~~

~~7. Unless otherwise approved, fluoride shall be applied to the raw water with the feeder paced by the raw water meter.~~

6. Adequate fluoride feed rate control and mixing shall be provided.

~~87. Provisions shall be made for venting hydrofluosilicic/fluorosilicic acid carboys to the outside of the building when the carboys are in use.~~

E. Suitable protective equipment shall be provided which includes gloves, aprons, dust mask, and goggles.

F. Suitable equipment shall be provided for ~~wet mopping~~ wet mopping and hosing dust that might accumulate in the plant. Dry feeders shall be equipped with bag loading hoppers.

G. Equipment shall be provided for measuring the quantity of fluoride ion in the water. Testing equipment shall be colorimetric or electrode type as approved by the ~~division~~ commissioner.

~~H. At least 90 days prior to permanent ceasing operation of a fluoride feed system, or as soon as practical, a waterworks owner should provide written notice to the commissioner and the waterworks' customers of the intent to discontinue fluoridation at the waterworks. Notice to consumers shall be in a form and manner that is consistent with the requirements in 12VAC5-590-540-C 2.~~

#### **12VAC5-590-940. Fluoride removal.**

A. Fluoride removal may be accomplished by blending with a different quality water or by removal treatment. Where fluoride removal is required, the treatment units shall be designed to achieve a finished water fluoride concentration that is below the SMCL.

~~A. B. Blending. Blended water must shall~~ result in all water delivered to the distribution system being of the same quality.

~~B. C. Treatment.~~

~~1. Chemical feed shall conform to 12VAC5-590-860.~~

~~2. 1. Treatment includes use of shall include, but not be limited to, ion exchange, activated alumina, bone char, reverse osmosis, or electrodialysis. Other processes may be utilized if they adequately defluoridate. The selected design is to shall be supported by pilot studies; unless at least two pilot studies, or two prototype plants, have demonstrated that the selected design is feasible. Such/These studies or prototypes should/shall be for waters having characteristics similar to the water that is to be treated.~~

~~3. Raw water/2. Water pH shall be adjustable to an optimum level to achieve the best fluoride removal.~~

~~4. 3. With any one unit out of service, the remaining unit or units must shall be capable of handling peak day flows treating the maximum plant flow rate.~~

~~5. 4. Filter clogging constituents such as iron having a concentration greater than 1.0 milligrams per liter should/mg/L shall be removed prior to before defluoridation/fluoride removal. If applicable, chlorination is to be applied after defluoridation.~~

~~6. 5. Test equipment must shall be provided and must be accurate to at least 0.1 milligrams per liter mg/L.~~

~~7. 6. An operation and maintenance (O & M) manual must shall be provided.~~



**12VAC5-590-950. Stabilization Corrosion control or stabilization.**

~~A. Water that is unstable due either to natural causes or to the treatment given-applied to the water should shall be stabilized. Water treated with excess lime for softening or manganese removal shall be treated by carbon dioxide or acid.~~

~~A. Carbon dioxide addition.~~

~~1. The recarbonation chamber design should provide:~~

- ~~a. A detention time of three to 10-20 minutes;~~
- ~~b. A depth of about eight feet; and~~
- ~~c. A reaction tank with a detention time of 20 minutes.~~

~~2. Adequate precautions shall be taken to prevent the possibility of carbon monoxide entering the plant from the recarbonation and reaction chamber.~~

~~B. Sulfuric acid.~~

~~1. Feed equipment for sulfuric acid shall conform to [12VAC5-590-860](#).~~

~~2. Adequate precautions shall be taken for safety.~~

~~C. Removal of free carbon dioxide. Carbon dioxide may be removed by an alkali, following aeration. The addition of an alkali following aeration may not be necessary when the alkalinity of the aerated water is greater than 80 milligrams per liter.~~

~~D. Deposition of calcium carbonate film. The desired calcium carbonate film may be obtained by using either soda ash or caustic soda when the alkalinity of the water exceeds about 35 milligrams per liter/mg/L. Soft waters should be treated with lime to provide the required calcium. Soft waters which-that also have a low carbon dioxide content may need a mixture of lime and soda ash to provide both calcium and carbonate for the calcium carbonate film.~~

~~E. Polyphosphates. Polyphosphates are applicable for sequestering dissolved minerals.~~

~~C. Phosphates or other corrosion inhibitors may be used for corrosion control when applied in accordance with the manufacturer's recommendations, and meeting the requirements of [12VAC5-590-515](#). Stock phosphate solution shall be disinfected in accordance with the manufacturer's recommendations unless the phosphate solution is fed directly from the covered shipping container.~~

~~1. Feed equipment shall conform to [12VAC5-590-860](#).~~

~~2. Phosphate chemicals shall be food grade.~~

~~3. Stock phosphate solution shall be kept covered and disinfected by carrying approximately 10 milligrams per liter chlorine residual.~~

~~4. Satisfactory chlorine residuals should be maintained in the distribution system when phosphates are used.~~

~~F. Under some conditions, softening plants can be designed using split treatment in which raw water is blended with softened water to partially stabilize the water. Treatment plants designed to utilize split treatment should, in most cases, also contain facilities for further stabilization by other means.~~

~~G. Water unstable due to biochemical action in the distribution system. Residual chlorine throughout the distribution systems may be used to prevent corrosion due to decomposition of organic matter (especially in dead-ended mains), the biochemical action within tubercles and the reduction of sulfates to sulfides.~~

~~H. Cathodic protection may be used to prevent or minimize shall be acceptable for preventing or reducing corrosion of the inner surfaces of water storage tanks and standpipes and the outer surfaces surface of metal conduits/pipe.~~

~~4E.~~ Laboratory equipment shall be provided for determining the effectiveness of stabilization treatment and ~~the~~ concentration of chemicals in the treated water.

**12VAC5-590-960. Taste and odor control.**

~~Tastes and odors found in water are primarily organic in nature. Since the presence of taste and odor problems in a water supply suggests to the consumer that the water may contain potentially toxic agents, expenditures are justified to improve the aesthetic quality of the water and maintain the consumers' confidence in the water utility.~~

~~A. Source treatment. Taste and odor problems in raw surface water sources are most frequently caused by the presence of plankton, or more specifically, algae. The treatment methods and dosages listed below have been found effective in some applications.~~

~~1. The continuous or periodic treatment of raw water source waters with copper sulfate and other copper compounds to kill algae or other growths shall be controlled to prevent a copper concentration in excess of 1.0 milligrams per liter mg/L, as copper, in the finished water leaving the treatment plant.~~

~~B. Surface water aerators or diffused aeration systems shall be acceptable for de-stratifying reservoirs, reducing or eliminating seasonal turnover, and the releasing of compounds in the anaerobic or anoxic zones.~~

~~C. Addition of chemical oxidants at the source water intake, in the source water pump station discharge line, at the head of the treatment plant, or within the treatment train shall be acceptable for treating tastes and odors. Effective oxidants include chlorine, chlorine dioxide, potassium permanganate, and ozone. If breakpoint chlorination is proposed, then the actual breakpoint of the water shall be determined accurately. "Breakpoint chlorination" means the addition of chlorine to water until the chlorine demand has been satisfied, chlorine and ammonia nitrogen reactions are near completion, and further additions of chlorine result in a free residual chlorine that is directly proportional to the amount of chlorine added.~~

~~2. The periodic treatment of the shallow areas of a reservoir with an activated carbon dosage of 0.2 to 0.5 pounds per 1,000 square feet of water surface has been found effective in some applications.~~

~~3. A potassium permanganate dosage from 0.4 to 4.0 milligrams per liter has been found effective in some applications.~~

~~4. 3. Chlorine dosages that produce 0.2 to 1.0 milligrams per liter of free chlorine in the treated water have been found effective in some applications. Prior to treatment, this treatment method should be evaluated to determine that it will not cause any objectionable tastes or odors in the treated water.~~

~~B. Treatment methods. The waterworks shall be designed to produce high quality water regardless of any changes or emergencies that may arise with the raw water source. Provisions to handle taste and odor problems should be included in all designs regardless of the anticipated raw water quality.~~

~~1. Provisions shall be included in the design of the treatment plant to add chlorine or other approved oxidizing chemicals at the reservoir or at the head of the treatment plant. If breakpoint chlorination is proposed to treat taste and odor problems, extreme caution is warranted to insure that the actual breakpoint of the water is determined accurately. Dechlorination may be required if deemed necessary.~~

~~2. Chlorine dioxide can be utilized to treat any taste and odor problems susceptible to oxidation.~~

~~3. Potassium permanganate has oxidizing capabilities that can be utilized to treat taste and odor problems. It is normally fed to the raw water during the flash mix operation in a~~

dosage such that the pink color formed during its solution travels only 1/2 to 2/3 of the length of the sedimentation basins.

4. Aeration has been used successfully to treat tastes and odors attributed to volatile organic matter but has shown limited success in treating tastes and odors associated with dissolved and suspended organic matter. Aeration facilities shall be designed in accordance with the provisions of [12VAC5-590-910](#).

5. When taste and odor problems are anticipated on an intermittent basis, treatment facilities shall be included in the water treatment plant design for the addition of powdered activated carbon. The dosage of powdered activated carbon required to treat taste and odor problems will vary with each individual raw water, and extensive lab work should be undertaken to ascertain that the carbon feed equipment is properly sized. The carbon feed equipment shall be capable of adding at least 40 milligrams per liter of powdered activated carbon regardless of the anticipated raw water quality. In the water treatment plant design, facilities should be provided to add powdered activated carbon to the flash mixer, to the flocculation basins, at the midpoint of sedimentation basins, and to the conduits leading to the filters.

The carbon can be added as a premixed slurry, or by means of a dry feed machine as long as it is assured that the carbon is properly wetted. All mechanisms for handling dry carbon should be tightly sealed and dust collection is required on all installations. The feed machine hopper wall should be on at least a 60 degree angle to the horizontal.

The carbon feed lines to the application points should be sized to handle the carbon suspension and should be equipped with flushing provisions.

D. Powdered activated carbon (PAC).— When taste and odor problems are anticipated on an intermittent basis, the addition of PAC shall be considered, and a pilot study shall be conducted to determine the optimum dosage. Multiple PAC feed locations shall be evaluated to provide maximum contact time, including the rapid mixer, the flocculation basins, and at the midpoint of the sedimentation basins.

1. PAC shall not be applied near the point of chlorine or other oxidant application.

2. Continuous agitation or re-suspension equipment shall be required to keep the PAC from depositing in the slurry/storage tank.

3. All mechanisms for handling dry PAC shall be tightly sealed. Dust collection is required ~~on~~ at all installations.

4. The PAC feed lines to the application points shall be sized to handle the PAC suspension and should be equipped with flushing provisions.

6. Granular activated carbon units may be used in place of filters described in [12VAC5-590-880](#) with appropriate pretreatment described in [12VAC5-590-870](#). Rates of flow shall be consistent with the type and intensity of the problem. The design of the facilities must be supported by the results of pilot plant studies

E. GAC media shall be acceptable in conventional gravity filters or in separate contactors to reduce taste and odor.

F. Ozonation shall be acceptable for taste and odor control.

**12VAC5-590-970. Removal of volatile synthetic organic chemicals (VOCs). (Repealed.)**

Appropriate processes or technologies (either specified as BAT in Appendix N or a division-approved alternative, such as other aeration techniques) that treat all the water in the waterworks shall be applied to achieve compliance. The selected design is to be supported by pilot studies unless at least two pilot studies, or two prototype plants, have demonstrated that the selected

design is feasible. Such studies or prototypes shall be for waters having characteristics similar to the water that is to be treated.

A. Granular Activated Carbon (GAC). As in taste and odor control, GAC units may be used with appropriate pretreatment described in 12VAC5-590-870 B. The elements of a GAC system include carbon contactors, a carbon storage and transfer system, a regeneration system and a control system.

The selected GAC shall meet AWWA Standards. Multiple units shall be provided to process at least the peak day flow rate with one unit out of service. As carbon is corrosive, the use of noncorrosive piping and storage materials is mandatory.

B. Packed tower aeration. (Also see 12VAC5-590-910.)

1. Usually more efficient than other types of waterfall (natural) aeration.
2. With one unit out of service, the remaining unit(s) must be capable of handling peak day flows.

#### **12VAC5-590-975. Removal of radionuclides.**

A. Processes for the removal of radionuclides specified as BAT are identified in 40 CFR 141.66. The specific process and equipment proposed for removal of radionuclides shall, to the satisfaction of the commissioner, have a demonstrated history of successful performance with similar water quality characteristics and performance requirements. Otherwise, the procedures of 12VAC5-590-290 shall apply.

B. When manganese greensand filter systems are utilized, the design shall meet the requirements of 12VAC5-590-920 B. In addition, a chemical contact tank with a minimum detention time of 30 minutes shall be provided. Laboratory or pilot studies may be required to demonstrate compliance with the radium standard when using a filtering treatment system for groundwater with total radium greater than 10 pCi/L.

C. Waste handling, disposal, and permitting shall be given special consideration early in the design process.

D. Occupational exposure shall be considered in the project design.

E. Provisions for operational control monitoring of the radionuclides requiring removal or ~~an~~ of acceptable ~~surrogate surrogates~~ shall be included in the project design.

#### **12VAC5-590-980. Microscreening. (Repealed.)**

A microscreen is a mechanical supplement to treatment capable of removing suspended matter from water by straining. It shall not be used as a substitute for clarification or filtration.

A. The design of microscreening facilities shall give due consideration to:

1. A sanitary survey and chemical and biological evaluation;
2. The nature of suspended matter to be removed;
3. The corrosiveness of water;
4. The effect of chlorination when required as pretreatment; and
5. Control of the hydraulic capacity of the microscreen.

B. The design shall provide:

1. For durable, corrosion resistant screens;
2. A bypass and cleaning arrangement;
3. Duplicate units for continuous operation;
4. Protection against back siphonage when potable water is used for washing; and
5. Proper disposal of wash water.

#### **12VAC5-590-985. GAC contactors.**

A. GAC contactors may be used to adsorb natural organic compounds, taste and odor compounds, and SOCs. ~~synthetic organic chemicals.~~ The most common applications of GAC contactors in drinking water treatment plants are (4i) post-filtration adsorption and (2ii) filtration-adsorption, in which some or all of the filter media in a granular media filter is replaced with GAC.

##### B. General requirements.

1. A demonstration study using bench-scale or pilot-scale ~~scale~~ tests shall be conducted to determine the GAC media effectiveness, adsorption efficiency, and regeneration frequency.
2. GAC contactors shall be sized for the optimum empty bed contact time.
3. A minimum of two contactor units shall be provided.
4. Bypassing the GAC facility may be permissible under certain circumstances to accommodate seasonal water quality fluctuations and allow for blending water.

##### C. Hydraulic configuration.

1. Pressure vessel installation may be configured in parallel or in series.
2. For pressure contactors, pre-filter and post-filter pressure gauges shall be installed at each individual contactor unit.
3. The rate of flow through the contactors shall be controlled either manually or automatically to ensure equal flow through each contactor.

##### D. Design details.

1. For pressure contactors, the maximum pressure loss through the vessels shall be as determined by the product manufacturer.
2. Sample taps, isolation valves, and bypass piping shall be provided before and after each individual contactor unit.
3. Pipes, tanks, and appurtenances shall be corrosion resistant.
4. The GAC facility shall provide the ability to filter-to-waste to prevent carbon fines in the effluent water.
5. Unless otherwise approved by the commissioner, disinfection shall be accomplished following the GAC contactors.
6. If backwashing of GAC specific units is required, then unchlorinated filtered water shall be used.
7. Turbidity monitoring of contactor effluent shall be considered.
8. The facility design shall include provisions for spent carbon disposal, GAC delivery, and storage.

#### **12VAC5-590-990. Waterworks waste.**

A. With the exception of sanitary sewage and flows recycled through the water treatment system, the wastes generated during the operation of water filtration plants constitute industrial wastes and are subject to the State Water Control Law (Chapter 3.1 (§ 62.1-44.2 et seq.) of Title 62.1 of the Code of Virginia).

Industrial wastes generated by water treatment facilities include, but are not limited to, the following:

1. Filter backwash water;
2. Coagulant ~~sludges~~ residuals;
3. Softening ~~sludges~~ residuals;
4. Microscreening sludges;

~~5.~~ 4. Iron and manganese ~~sludges~~ residuals

~~6.~~ 5. ~~Sludges~~ Settled solids from presedimentation units; and

~~7.~~ 6. Brine wastes.

B. After receipt ~~and review~~ of plans and specifications from the consulting engineer for the water treatment facilities, the ~~division commissioner~~ will advise the State Water Control Board of any proposal to treat and discharge industrial wastes into state waters. The ~~division commissioner~~ will submit to the State Water Control Board a letter report to include the following:

1. Capacity of the proposed treatment facilities;
2. Location of the proposed facilities;
3. Proposed final disposition of the treated waste effluent;
4. Name and address of the consulting engineer; and
5. Name and address of the owner.

C. Except for recycle flows as described in ~~12VAC5-590-420 K, 12VAC5-590-395 C,~~ the State Water Control Board will then deal directly with the ~~consulting engineer~~ owner in reference to the final disposal of these wastes ~~and~~.

D. The sanitary wastes from water treatment plants must receive treatment. Wastes from these facilities ~~must~~ shall be discharged either directly to a sanitary sewer system or to an ~~approved~~ individual waste disposal facility providing suitable treatment approved by the State Water Control Board.

#### **12VAC5-590-1000. Disinfection.**

A. ~~Objective. To~~ The objective of disinfection is to prevent the occurrence of waterborne diseases from the consumption of drinking water.

~~B. Methods. Disinfection shall be accomplished by the application of chlorine. The specific chlorine compound shall be selected on the basis of water flow rates, application rates, pH of the water, cost of equipment and chemicals, availability of disinfectant, and reliability of feed equipment. Alternate chemicals and methods for disinfection are to be handled as unconventional and the procedures of 12VAC5-590-300 apply.~~

B. Primary disinfection shall be provided for all surface water sources, all spring sources, all GUDI sources, and all well sources determined to be of questionable bacteriological quality as required by the commissioner. Consideration shall be given to minimizing the formation of disinfection byproducts when designing a disinfection process. Waterworks with groundwater sources requiring disinfection under this section shall meet the requirement of 12VAC5-590-421 A 1 d.

C. All pipes, tanks, and equipment that convey, store, or treat potable water shall be disinfected with chlorine ~~prior to~~ before being placed in service, in accordance with the following AWWA Standards, where applicable: C651-14, C652-11, and C653-13.

D. All disinfectant residual determinations shall be made using methods identified in 12VAC5-590-440.

1. The project documents shall outline the procedures and include the disinfectant dosage, contact time, and method of testing the results of the procedure.

2. Methods of disinfection other than chlorination may be considered by the commissioner on a individual basis.

C. Equipment.

1. Solution feed vacuum type gas chlorinators are generally preferred. The use of hypochlorite feeders of the positive displacement type may be considered for small installations.

2. Chlorinator capacities will vary, depending on the use and point of application of the chlorine and the raw water quality. Chlorination capacity shall be such that a minimum dosage of 15 milligrams per liter may be fed at all times.

3. Standby chlorination equipment shall be provided and chlorination capacities shall comply with 12VAC5-590-1000 C-2 with any unit out of operation for repairs. Spare parts shall be available for all chlorinators to replace parts which are subject to wear and breakage. All chlorinators shall be properly maintained and operated.

4. An ample supply of potable water shall be available for operating the chlorinator. Where a booster pump is required, duplicate equipment shall be provided, and, when necessary, standby power as well. Equipment for backflow prevention shall be provided. A pressure gauge shall be provided on each chlorinator water supply line.

5. Scales for weighing cylinders shall be provided at all waterworks using chlorine gas. At large waterworks, scales of the indicating and recording type are recommended. Scales shall be recessed unless they are of the low platform type.

6. Where manifolding of several cylinders is required to evaporate sufficient chlorine, consideration shall be given to the installation of gas evaporators.

7. A bottle of ammonia hydroxide solution shall be available for detecting chlorine gas leaks. Consideration shall also be given to the provision of caustic soda solution reaction tanks for absorbing the contents of leaking one-ton cylinders where such cylinders are in use. At large installations, consideration should be given to the installation of automatic gas detection and related alarm equipment. Emergency cylinder repair kits shall be provided.

8. Piping and connections for chlorine gas.

a. Piping arrangements should be as simple as possible. Pressure gauges shall be installed on the piping to each chlorinator. The number of screwed or flanged joints should be held to a minimum. Piping systems should be well supported and adequately sloped to allow drainage; low spots should be avoided. Suitable allowance should be provided for pipe expansion due to changes in temperature. Liquid chlorine has a high coefficient of thermal expansion. If liquid chlorine (containing no gas bubbles) is trapped between two valves, high pressure will develop upon increase in the temperature of the chlorine. This pressure may lead to hydrostatic rupture of the line. The effects of possible rupture should be considered in the design of any piping system. Where such rupture would present an undue hazard to personnel or equipment by allowing large quantities of chlorine to escape, protection of the system against hydrostatic pressure should be provided.

b. Condensation or reliquefaction of chlorine may occur in chlorine gas lines which pass through areas where the temperature is below the temperature pressure equilibrium indicated in the vapor pressure curve. Where adequate superheat is not provided by a vaporizer, condensation can be prevented by reducing the pressure with a pressure reducing valve.

c. It is recommended that joints in chlorine piping be flanged or welded. If threaded joints are used, extreme care should be taken to obtain clean, sharp threads. A lubricating pipe dope suitable for chlorine should be used. All threading oil must be thoroughly cleaned from the pipe. For permanent joints, linseed oil and graphite, glycerine or Teflon tape may be used. If Teflon tape is used, all remnants must be removed before joints are remade.

d. Fittings and appurtenances must be suitable for handling dry chlorine.

9. Chlorine solution is very corrosive to all of the common construction metals. At low pressures, chlorine solution can be handled in chemical stoneware, glass or porcelain equipment, and by certain alloys. Hard rubber, unplasticized polyvinylchloride, glassfiber reinforced polyester, polyvinylidene chloride, and fully halogenated fluorocarbon resins have been used successfully. Low molecular weight polyethylene, fiber reinforced rubber hose, and wrapped rubber hose have been used successfully for small capacity chlorinators. All of these materials must be selected with great care. For higher pressures, combinations using resistant lining materials (rubber, kynar, saran, Teflon, etc.) with the common metals for strength should be used.

Titanium may be used with chlorine solution, but must not be used with chlorine gas. Tantalum is inert to chlorine solution at temperatures up to 300°F. Hastelloy Alloy C® and Monel Alloy® are widely used. Platinum and silver find special applications. In general, operations involving chlorine solution require individual study.

Chlorine and equipment suppliers shall make recommendations only after careful survey of all factors involved.

10. Chlorine solution and hypochlorite solution piping shall be arranged such that prechlorination or postchlorination may be accomplished by any or all chlorinators.

#### D. Engineering design:

1. Any building to house chlorine equipment or containers should be designed and constructed to protect all elements of the chlorine system from fire hazards. If flammable materials are stored or processed in the same building, a fire wall should be erected to separate the two areas. Fire resistive construction is recommended.

If gas chlorination equipment and chlorine cylinders are to be in a building used for other purposes, a gas tight partition shall separate this room from any other portion of the building. Doors to this room shall open only to the outside of the building, and shall be equipped with panic hardware. Such rooms shall be at ground level, and should be separated from the feed area.

At least two means of exit should be considered from each separate room or building in which chlorine is stored, handled, or used. All exit doors shall open outward.

A clear glass, gas tight window shall be installed in an interior wall of the chlorinator room to permit the chlorinators to be viewed without entering the room.

Feed lines shall not carry chlorine gas beyond the chlorine feeder room unless the chlorine is under vacuum.

2. Chlorinator rooms shall be provided with a means of heating so that a temperature of at least 60°F can be maintained, but the room should be protected from excess heat. Cylinders shall be kept at essentially room temperature for at least 24 hours prior to use unless an evaporator is employed.

3. Forced, mechanical ventilation which will provide one complete air change per minute shall be installed in all chlorine feed rooms and rooms where chlorine cylinders are stored. The entrance to the air exhaust duct from the room shall be near the floor and the point of discharge shall be located so as not to contaminate the air inlet to any building or inhabited areas. Air inlets shall be located so as to provide cross ventilation with air and at such temperature that will not adversely affect the chlorination equipment. The vent hose shall run without traps from the chlorinator and shall discharge to the outside atmosphere above grade.

4. The electrical controls for the fans and lights shall be such that they will automatically operate when the door is opened and can be manually operated from the outside without opening the door.



~~E. Respiratory protection. The use of self-contained breathing apparatus (SCBA) in compliance with OSHA Respiratory Protection Standard 1910.134, "VIRGINIA OSHA STANDARDS" for General Industry, is required whenever anyone is dealing with an accidental release of chlorine. All waterworks that use chlorine gas at their treatment facility shall maintain a respiratory protection plan including emergency procedures, evacuation plans, designated SCBA personnel and any special site specific requirements. All respiratory protection devices shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture or damaging chemicals; and in a location remote from the chlorine area.~~

~~F. Application of chlorine.~~

~~1. Provisions shall be made to ensure uniform mixing of the chlorine solution or hypochlorite solution with the water near the point of application.~~

~~2. Residual and contact time.~~

~~a. Waterworks with surface water sources shall provide a minimum residual (C) and contact time (T) as calculated in accordance with Appendix L. Appendix L contains information on CT calculations and methods, as well as information on contact tank baffling arrangements.~~

~~b. Waterworks with groundwater sources shall provide a minimum 30 minute hydraulic detention period (based on design flow) for chlorine contact.~~

~~G. Evaluation of effectiveness.~~

~~1. Sampling—see 12VAC5-590-770.~~

~~2. Equipment shall be provided for measuring chlorine residual employing any method listed in the most recent edition of "Standard Methods for the Examination of Water and Wastewater."~~

~~The equipment should enable residual chlorine measurement to the nearest 0.1 milligram per liter in the range below 0.5 milligram per liter, and to an accuracy of approximately 25% above 0.5 milligram per liter. The installation of continuous automatic chlorine residual analyzers recording and proportioning systems may be required on large installations.~~

**12VAC5-590-1001. Chlorination.**

A. General design requirements.

1. Chlorine feed capacity shall be capable of meeting the disinfection requirements under all operating conditions.

a. Chlorine feed systems for primary disinfection ~~of- at a waterworks using either a surface water source sources- or a GUDI sources-source or both~~ shall provide sufficient capacity to achieve the required microbial log inactivation specified in Table 500.1.

b. Chlorine feed systems for primary disinfection ~~of- at a waterworks using groundwater sources~~ shall provide sufficient capacity to achieve 4-log virus inactivation and removal.

c. Chlorine feed systems for secondary disinfection at a waterworks shall provide sufficient capacity to achieve a minimum chlorine residual at the entry point of 0.2 mg/L for more than 4 hours.

2. Chlorine feed systems for disinfection ~~of- at a waterworks using either a surface water sources- source or a GUDI sources-source or both~~ shall be sized to deliver the required dose with the largest unit out of operation. Small hypochlorination installations for groundwater source waterworks shall have a spare metering pump, unless it can be demonstrated to the satisfaction of the commissioner that spare equipment is readily available from a local supplier. Spare parts shall be available for all chlorinators to replace parts that are subject to wear and breakage.

3. Consideration shall be given to providing multiple chlorine feed points at all waterworks. For conventional filtration treatment plants, chlorine feed points shall be provided for the source water, applied water to the filters, and filter effluent.

4. The ~~water supply piping~~ providing finished water for preparing the chlorine solution ~~water supply piping~~ shall be designed to prevent contamination of the "bulk treated" finished water supply.

a. At all facilities treating surface water, pre-filtration and post-filtration disinfection systems shall operate independently of each other to prevent possible siphoning of partially treated water into the clearwell.

b. The water piping supply to each ejector shall have a separate shut-off shutoff valve. A master shut-off shutoff valve is prohibited.

5. Provisions shall be made to ensure uniform mixing of the chlorine with the water near the point of application.

6. Residual and contact time.

a. ~~The Owners-~~ owner of a waterworks ~~with-using either a surface water sources source or a GUDI sources- source or both~~ shall provide a minimum residual (C) and contact time (T) as calculated in accordance with 12VAC5-590-500.

b. ~~Owners-The owner of a waterworks with-using a groundwater sources that are-is~~ required to disinfect shall provide a minimum residual (C) and contact time (T) to achieve ~~four~~4-log virus inactivation and removal of virus, based on maximum design flow rate. Provisions shall be made to prevent short circuiting. The contact basin shall be designed utilizing the appropriate baffle factors referenced in Table 500.15 of 12VAC5-590-500.

7. Automatic proportioning chlorinators shall be provided where the rate of flow is not reasonably constant.

8. Equipment shall be provided for measuring the chlorine residual, employing any method specified in 12VAC5-590-440. The equipment shall be capable of a residual chlorine measurement to the nearest 0.1 mg/L.

9. Continuous chlorine residual analyzers shall be provided at all waterworks that are required to filter and that serve 3,300 or more persons, or at any waterworks required by the commissioner. Where a continuous chlorine residual ~~analyzers are provided~~ analyzer is provided, the commissioner may require that the design incorporate an operator-selected high or low chlorine residual alarm.

B. Gas chlorine feed systems.

1. Equipment.

a. An ample supply of potable water shall be available for operating the chlorinator. Where a booster pump is required, duplicate equipment shall be provided, and, when necessary, standby power as well. Equipment for backflow prevention shall be provided. A pressure gauge shall be provided on each chlorinator ~~mixing water-supply line piping~~.

b. Scales for weighing cylinders shall be provided at all waterworks using chlorine gas. At large waterworks, scales of the indicating and recording type shall be considered. Scales shall be recessed unless they are of the ~~low platform~~ low-platform type.

c. Where a manifold of several cylinders is required to evaporate sufficient chlorine, consideration shall be given to the installation of gas evaporators.

d. Automatic switch-over of chlorine cylinders shall be provided to assure continuous disinfection.

2. Chlorine gas leak detection.

- a. Automatic chlorine gas leak detection, with strategically located sensors, and related alarm equipment, shall be provided for all installations.
- b. A bottle of ammonia hydroxide solution shall be provided for detecting chlorine gas leaks.

3. Emergency cylinder repair kits shall be provided.

4. Consideration shall be given to the provision of caustic soda solution reaction tanks for absorbing the contents of leaking one-ton cylinders where the cylinders are in use.

5. Piping and connections for chlorine gas.

- a. Pressure gauges shall be installed on the piping to each chlorinator. Piping systems shall be well supported and adequately sloped to allow drainage. Suitable allowance shall be made for pipe expansion due to changes in temperature.
- b. Fittings and appurtenances shall be suitable for handling dry chlorine.

6. Building design.

a. Any building to house chlorine equipment or containers shall be designed and constructed to protect all ~~elements~~ ~~components~~ of the chlorine system from fire hazards. See [12VAC5-590-720](#).

b. If gas chlorination equipment and chlorine cylinders are to be in a building used for other purposes, a ~~gas-tight~~ ~~gas-tight~~ partition shall separate this room from any other portion of the building. Doors to this room shall open only to the outside of the building, and shall be equipped with panic hardware. These rooms shall be at ground level, and should be separated from the feed area.

c. At least two means of exit shall be considered from each separate room or building in which chlorine is stored, handled, or used. All exit doors shall open outward.

d. A clear glass, ~~gas-tight~~ ~~gas-tight~~ window shall be installed in an interior wall of the chlorinator room to permit the chlorinators to be viewed without entering the room.

e. Feed lines shall not carry chlorine gas beyond the chlorine feeder room unless the chlorine is under vacuum.

f. Chlorinator rooms shall be provided with a means of heating so that a temperature of at least 60°F can be maintained, but the room should be protected from excess heat. Cylinders shall be kept at essentially room temperature for at least 24 hours ~~prior~~ ~~to before~~ use unless an evaporator is employed.

g. Forced, mechanical ventilation that provides one complete air change per minute shall be installed in all chlorine feed rooms and rooms where chlorine cylinders are stored. The inlet to the air exhaust duct from the room shall be near the floor, and the point of discharge shall be located so as not to contaminate the air inlet to any building or inhabited areas. Air inlets shall be located so as to provide cross ventilation with air and at a temperature that will not adversely affect the chlorination equipment. The vent hose shall run without traps from the chlorinator and shall discharge to the outside atmosphere above grade.

h. The electrical controls for the fans and lights shall automatically operate when the door is opened and can be manually operated from the outside without opening the door.

C. Calcium hypochlorite and sodium hypochlorite feed systems.

1. Both calcium hypochlorite and sodium hypochlorite shall be acceptable for disinfection.

2. Hypochlorite solution feeders of the positive displacement type shall be provided.

3. Adequate mixing of ~~the~~ calcium hypochlorite or sodium hypochlorite solutions shall be provided.

4. Special design considerations for bulk delivery systems:

a. Bulk sodium hypochlorite storage tanks shall be constructed of corrosion-proof materials. Pumps, piping, materials, and appurtenances exposed to ~~the sodium~~ hypochlorite shall be suitable for such use.

b. Sodium hypochlorite storage facilities shall be designed to keep ambient temperature and lighting low. Sodium hypochlorite fumes are corrosive and tanks shall be vented to the outside. Tanks shall be designed for ease of filling, draining, and transfer of contents.

c. Piping, valves, pumps, and pipe accessories shall be ~~se~~-designed and ~~sloped~~ configured so as not to allow accumulation of ~~gasses-gases~~ that could cause air locking or loss of prime in chemical feed piping or pumps.

d. The design shall provide a system of local or general exhaust features to keep employee exposures below the airborne exposure limits, as described in the Safety Data Sheet for the chemical used, in accordance with OSHA 29 CFR § 1910.1200 (g). Local exhaust ventilation is generally preferred because it controls contaminant emissions at the source and thus, preventing dispersion into the general work area which could result in corrosion/exposure. Exhaust equipment and accessories shall be corrosion proof.

e. An eye wash fountain and quick-drench facilities in the immediate work area shall be provided.

#### **12VAC5-590-1002. Chloramination.**

A. Chloramines shall be acceptable for secondary disinfection. Chloramines are formed by the reaction of ammonia and chlorine. Multiple chemical species may be created~~;~~; however, monochloramine is the desired form.

B. The process shall be controlled to minimize formation of dichloramine and nitrogen trichloride, which can create objectionable taste and odors. Control should be sufficient to limit free ammonia leaving the chloramination facility to no more than 0.1 mg/L as nitrogen.

C. pH adjustment facilities shall be provided to maintain pH in the range of 7 ~~to~~ 8.

D. When use of chloramines is proposed, the potential increase of lead leaching within the distribution system shall be considered. Additional distribution system monitoring may be required by the commissioner.

E. The owner shall inform the public ~~prior to~~ before initiating any disinfection process involving chloramines, as directed by the commissioner.

#### **12VAC5-590-1003. Chlorine dioxide addition.**

A. Chlorine dioxide may be considered as a pre-oxidant to control tastes and odors, reduce color, oxidize iron and manganese, and reduce disinfection byproduct precursors. Chlorine dioxide may be used for primary disinfection. Where chlorine dioxide is used, consideration shall be given to ~~the~~ formation of the byproducts chlorite and chlorate.

B. Chlorine dioxide is generated ~~on-site~~ onsite from sodium chlorite and either chlorine gas or hypochlorite solution. Chlorine dioxide generation equipment shall be factory assembled, pre-engineered units with a minimum efficiency of 95%. The excess free chlorine shall not exceed 3.0% of the theoretical stoichiometric concentration required.

C. The owner shall inform the public ~~prior to~~ before using chlorine dioxide, as directed by the commissioner.

#### **12VAC5-590-1004. Ozonation.**

A. Ozone may be considered as a pre-oxidant to control tastes and odors, reduce color, oxidize iron and manganese, reduce disinfection byproduct precursors, and used for primary disinfection. Where ozone is used, consideration shall be given to the level of bromide and formation of brominated byproducts.

B. Ozone systems are typically comprised of four basic subsystems: ozone generation, feed gas preparation, ozone contactors, and off-gas disposal.

C. The PER shall evaluate water and gas flow rates, oxygen source, generator selection and sizing, contactor design, treatment process location, exhaust gas collection and destruction, and operator requirements.

D. Treatability studies using bench-scale or pilot-scale ~~scale~~ tests may be required as part of the PER to address the following:

1. Alternate points of ozone application;
2. Ozone demand tests, applied dose, transferred dose, and decay rates; and
3. Ozone byproducts, including bromide/bromate analyses.

E. Ozone systems shall be granted disinfection credit for Giardia lamblia, Cryptosporidium, and viruses, in accordance with 12VAC5-590-401 E 7 and 12VAC5-590-500, provided that they meet the requirements of this section.

1. Ozone residual levels shall be monitored continuously and recorded. For waterworks that claim inactivation credit for ozone, a minimum of two dedicated, on-line monitors per ozone contactor shall be provided. The location of the monitors shall be acceptable to the commissioner. A portable ozone monitor shall be provided as a ~~back-up~~ backup.

2. Ozone systems using multiple, consecutive contact chambers, with gaseous ozone injected in the initial chambers, shall be designed to measure ~~the ozone oxide~~ residual and compute log inactivation of Giardia and virus using the  $C_{\text{effluent}} T_{10}$  Method or the Log Integration  $CT_{10}$  Method, as described in the "Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual," EPA Office of Water (4606), EPA 815-R-09-016, April 2010."

3. ~~Sample Sampling~~ lines shall be designed to minimize the reaction time (typically less than 10 seconds conveyance time).

F. Alarms shall be provided for ozone process control safety. Automatic shutdown features shall be considered.

#### **12VAC5-590-1005. Ultraviolet light (UV) disinfection.**

A. All UV reactors shall conform to NSF/ANSI standards.

B. Each reactor train shall be equipped with an individual flow meter, or a single flow meter in conjunction with differential pressure sensors in each treatment train. Reactors shall be sized to treat the design flow.

C. Hydraulic design shall ensure that lamps are submerged, and that the entrance of air, negative pressure, or pressure surges in the reactors is prevented. Open channel flow reactors are prohibited.

D. A pressure gauge shall be provided upstream of each reactor. The design shall ensure that the reactor's maximum rated pressure cannot be exceeded.

E. Water quality parameters that may affect UV disinfection system performance shall be evaluated, including calcium, iron, manganese, hardness, and alkalinity. Pretreatment shall be considered for water quality parameters that may result in lamp sleeve fouling.

F. A building to enclose and protect all UV equipment shall be provided. Adequate space between control panels, power supply, and the reactor equipment shall be provided to allow for routine operation and maintenance, including removing lamp and wiper assemblies and for off-line chemical cleaning of reactor lamps.

G. An operation and maintenance manual shall be provided for all UV reactors.

H. UV systems may be used for primary disinfection and shall be granted log inactivation credit for Giardia lamblia, Cryptosporidium, and viruses in accordance with Table 401.7, provided that they meet the requirements of 12VAC5-590-401 E 7 c and this subsection.

1. Only UV reactors that have undergone independent, third-party oversight of the validation testing on a fully assembled system to determine the operating conditions under which the reactors deliver the required UV dose shall be considered for log inactivation credit.

2. The dose-monitoring strategy shall be either the UV intensity set point approach or the calculated dose approach as described in the "Ultraviolet Disinfection Guidance Manual For The Final Long Term 2 Enhanced Surface Water Treatment Rule," Office of Water (4601), EPA 815-R-06-007, November 2006. The dose-monitoring strategy shall be demonstrated through the UV reactor validation testing.

3. At least two reactors shall be provided. Reactors shall be sized to treat the design flow with the largest reactor out of service.

4. Continuous monitoring sensors shall be provided to measure UV intensity. A continuous sensor shall also be provided to measure UVT if the calculated dose approach is utilized.

a. The number of sensors provided shall be the same as that used in validation testing of the reactor.

b. Output from a continuous UVT analyzer shall be capable of being input directly into a control loop for each UV reactor, a SCADA system, or both. A bench-top ~~top~~ spectrophotometer may be provided ~~in lieu~~ instead of a continuous UVT analyzer.

c. All signals from ~~the~~ sensors shall be displayed for operator response and for recordation.

d. At least one reference sensor for calibration of on-line UV intensity sensors shall be provided. Reference sensors shall be capable of calibration against a traceable standard.

e. Continuous recording equipment shall be provided with the monitoring sensors to store in memory or print one data point at least every 4 hours.

5. A means of flow distribution and control among multiple reactors shall be provided. The hydraulic flow profiles and piping configuration shall be identical to or more protective than that tested during equipment validation.

a. For ~~on-site~~onsite validation, the inlet and outlet piping configuration for the UV facility shall be designed according to ~~the~~ manufacturer's recommendations and to accommodate any site-specific constraints.

b. To avoid jetting flow and swirling flow, consideration shall be given to exclude expansions for at least ~~ten~~(10)-pipe diameters upstream of the reactor and to exclude out-of-plane ~~90 degree bends~~90-degree bends in ~~series~~series.

c. Each UV reactor shall be capable of being isolated and removed from service. Isolation valves upstream and downstream of each reactor, a drain, and sample taps for each reactor treatment train shall be provided. If the isolation valves are also used for flow control, ~~then~~ the flow control valve shall be located downstream of the UV reactor to limit the disturbance of the flow entering the UV reactor. Bypass piping shall not be allowed.

d. The lateral piping for each UV reactor train shall be sized and configured to provide approximately equal head loss through each UV reactor train over the validated range of flow rates.

6. The control system shall be capable of meeting the monitoring and reporting requirements in 12VAC5-590-401 and 12VAC5-590-570.

7. Automatic shutdown capability under critical alarm conditions shall be provided, including: lamp/ballast failure, low liquid level, ~~and~~ and high temperature. Alarms shall be provided for low UV validated dose, low UV intensity, low UV transmittance, high flow rate, and mechanical wiper failure.

8. Ground-fault circuit interrupters shall be provided for all lamps. ~~Back-up~~Backup power shall be considered.

9. The owner shall develop a start-up plan and submit the plan to ~~ODW~~ the department for approval. The plan shall include functional testing, determination of validated operating conditions and control settings, performance testing, development of an operation and maintenance manual, and inspection schedules.

1. UV systems not intended for primary disinfection may be used provided that they meet the requirements of this subsection.

1. Continuous sensors to measure UV intensity shall be considered.

2. Each UV reactor shall be capable of being isolated, ~~and~~ removed from service, and be provided with bypass piping.

3. Automatic shutdown capabilities shall be provided in the event of lamp/ballast failure.

#### Article 4 Pumping Facilities

##### **12VAC5-590-1010. General Basic pumping facility design criteria.**

Pumping facilities shall be designed to maintain the sanitary quality of pumped water. All pumps shall be accessible for servicing and repair.

##### **12VAC5-590-1020. Location.**

A. The pumping station shall be located so that the proposed site will meet the requirements of the sanitary protection of the water quality and the hydraulics of the system and be protected against interruption of service by fire, flood, or any other hazard to meet the hydraulic needs of the distribution system, preserve the quality of the water pumped, and shall consider the availability of a power or a fuel supply.

B. The station shall be:

1. Elevated to a minimum of one foot above the 100-year flood elevation or protected to such that elevation;

2. Accessible at all times unless permitted ~~allowed~~ to be out of service for a period of inaccessibility by the commissioner;

3. Graded around the station so as to lead surface drainage away from the station; and

4. Protected to prevent vandalism and entrance by animals or unauthorized persons;

5. Located with respect to availability of a power or a fuel supply.

##### **12VAC5-590-1030. Groundwater facilities. (Repealed.)**

Where pumping facilities are used, wells and springs shall be vented by properly hooded and screened pipe extending at least 12 inches above the pump floor or ground surface. Where

necessary, provisions shall be made for lubricating the pump from a point at least six inches above the top of the well cover by means which will prevent contamination of the water supply.

A. General well appurtenances.

The following well appurtenances are required:

1. A sanitary seal shall be provided on the top of the well casing;
2. A properly screened vent with the end elbowed downward shall be provided for the well casing;
3. A sampling tap shall be provided for raw water sampling which discharges in a downward direction and away from the well casing;
4. Adequate control switches, etc., for the pumping equipment shall be provided;
5. A water meter is required to determine water production for each well and the meter shall be located upstream of the well blow-off;
6. The well casing shall extend at least 12 inches above the concrete floor or apron surrounding the well;
7. Adequate support for the well pump and drop pipe shall be provided; and
8. Each well casing shall be equipped with a drawdown gauge, airline, and appurtenances for measuring the change in the elevation of the water level in the well.

B. Drilled wells with the prime mover mounted on the casing shall:

1. Have the casing extend 12 inches above the floor, and be equipped with a flange or suitable sanitary seal;
2. Have the casing firmly connected to the pump structure or have the casing inserted into a recess extending at least one inch into the base of the pump if a watertight connection is not provided;
3. Have the base of the pump not less than 12 inches above the pump room floor or apron; and
4. Have the pump foundation and base designed to prevent water from coming into contact with the joint between the casing and the prime mover.

C. Submersible pumps. Where a submersible pump is used, the top of the casing shall be effectively sealed against entrance of water under all conditions of vibration or movement of conductors or cables and shall have a gooseneck vent with a screen covered opening.

D. Discharge piping. The discharge piping shall be provided with separate means to pump (blowoff) water of unsatisfactory quality to a point away from the groundwater source but shall not be directly connected to a sewer. The discharge line shall:

1. Have control valves located above the pump floor;
2. Be protected against freezing;
3. Be valved to permit testing and control of each well;
4. Have watertight joints;
5. Have all exposed valves protected; and
6. Have erosion protection at the point of waste discharge.

E. General well pump house construction requirements.

1. The well pump house floor or apron surrounding the well shall:
  - a. Be of good quality concrete with adequate reinforcement;
  - b. Be a minimum of six inches in thickness;
  - c. Extend a minimum of three feet in all directions from the well; and



~~d. Slope at least ¼ inch per foot towards a screened four inch floor drain to atmosphere.~~

~~2. Well houses or well pump stations in pits are prohibited.~~

~~3. Well pump stations housing chlorination equipment shall meet the requirements of 12VAC5-590-1000.~~

#### **12VAC5-590-1040. Pump stations.**

~~A. Pump stations associated with surface water sources, treatment facilities, and finished water shall:~~

~~1. Have adequate space for the installation of additional units if needed and for the safe servicing of all equipment;~~

~~2. Be of durable construction, fire and weather resistant, and furnished with outward opening doors;~~

~~3. Have the floor elevation at least six inches above the finished grade, if possible;~~

~~4. Have the underground structure waterproofed;~~

~~5. Have all floors drained without impairing the quality of water being handled, and, if equipment is contained on the floor, the floor shall slope at least  $\frac{1}{8}$  inch in every foot to the point of discharge; and~~

~~6. Provide suitable outlet for drainage from pump glands without discharging onto the floor.~~

~~B. Suction wells. Suction wells shall:~~

~~1. Be watertight;~~

~~2. Have floors sloped to permit removal of water and entrained solids; and~~

~~3. Be covered or otherwise protected against contamination, including contamination by pump lubricants.~~

~~C. Equipment servicing in pump stations.~~

~~1. Craneways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors, or other heavy equipment shall be provided.~~

~~2. Walkways shall be provided to lubrication points of equipment if these are located at intermediate points between floors.~~

~~3. Openings in floors, roofs, or wherever else needed for removal of heavy or bulky equipment shall be provided.~~

~~4. A convenient tool board or other facilities shall be provided as needed for proper maintenance of the equipment.~~

~~D. Stairways and ladders. Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They shall have risers not exceeding nine inches and treads wide enough for safety. Where ladders are used, intermediate landings should be provided if the vertical distance exceeds 10 feet. Stairways and ladders shall:~~

~~1. Be provided between all floors and in pits or compartments which must be entered and;~~

~~2. Have handrails on both sides and treads of nonslip material.~~

~~E. Heating. In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process. Provision shall be made for adequate heating for the comfort of the operator and the safe and efficient operation of the equipment.~~

~~F. Ventilation. Adequate ventilation shall be provided for all pumping stations. Forced draft ventilation of at least six changes of air per hour (continuous operation) shall be provided for:~~

~~1. All rooms, compartments, pits and other enclosures below the grade floor; and~~

~~2. Any area where an unsafe atmosphere may develop or where excessive heat may build up.~~

~~G. Dehumidification. In areas where excess moisture could cause hazards to safety or damage to equipment, means for dehumidification shall be provided.~~

~~H. Lighting. Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the state codes.~~

~~I. Pumps. At least two pumping units shall be provided. If only two units are provided, each shall be capable of delivering the peak demand. If more than two units are installed, they shall have sufficient capacity so that if any one pump is out of service, the remaining pumps are capable of carrying the peak demand. The pumping units shall:~~

- ~~1. Have ample capacity to supply the peak demand without overloading;~~
- ~~2. Be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered; and~~
- ~~3. Have maintenance parts and tools readily available.~~

~~J. Suction lift. If suction lift is necessary, provision shall be made for priming the pumps. Suction lift should be less than 15 feet.~~

~~K. Priming. Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back siphonage. When an air operated ejector is used, the screened intake shall draw clean air from a point at least 10 feet above the ground or other source of contamination, unless the air is filtered by an apparatus approved by the Division. Vacuum priming may be used.~~

A. Enclosures.

1. The structure that houses a pump shall be of durable construction, fire and weather resistant, and furnished with lockable, outward opening doors. Underground structures shall be waterproofed.

2. Floors.

a. Pump house floors shall be of good quality concrete with adequate reinforcement and have a minimum thickness of six inches.

b. Pump house floors shall slope at least 1/8 inch per foot towards a screened four-inch diameter floor drain to the atmosphere or other provisions for gravity drainage.

c. The pump house finished floor elevation should be at least six inches above the finished grade.

3. Openings in floors, roofs, or elsewhere for removal of heavy or bulky equipment shall be provided.

a. Craneways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors, or other heavy equipment shall be provided.

b. Adequate means of access shall be provided to lubrication points of equipment if these are located at intermediate points between floors.

4. Heat shall be provided for the safe and efficient operation of the equipment.

5. Adequate ventilation shall be provided for all pumping stations. Forced draft ventilation of at least six changes of air per hour (continuous operation) shall be provided for:

a. All rooms, compartments, pits, and other enclosures below grade; and

b. Any area where an unsafe atmosphere may develop or where excessive heat may build up.

6. In areas where excess moisture could cause hazards to safety or damage to equipment, means for dehumidification shall be provided.

7. Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the applicable codes.

8. Stair design shall be in accordance with the USBC.

9. Pump stations shall have adequate space for the installation of additional units if needed and for the safe servicing of all equipment.

10. Pump stations shall be designed so that each pump has an individual suction line or the lines shall be so manifolded to ensure similar hydraulic and operational conditions.

B. Suction wells shall:

1. Be watertight;

2. Have floors sloped to allow removal of water and entrained solids;

3. Be covered or otherwise protected against contamination, including contamination by pump lubricants; and

4. Have two pumping compartments or other means to allow the suction well to be taken out of service for inspection, maintenance, or repair.

C. Groundwater well enclosures and aprons.

1. The floor at the well pump house ~~floor~~ shall meet the requirements of subdivision A 2 of this section.

2. Well pump aprons surrounding the well shall: (i) ~~Be-be~~ of quality reinforced concrete; (ii) ~~Extend-extend~~ a minimum of three feet in all directions from the well casing; (iii) ~~Be-be~~ at least six inches thick; and (iv) ~~Be-be~~ sloped 1/8 inch per foot away from the well.

3. Well houses or well pump stations in pits are prohibited.

D. Spring enclosures shall be vented by properly hooded and screened pipe extensions at least 12 inches above the pump floor or ground surface.

**12VAC5-590-1050. ~~Booster pumps~~ Pumps and controls.**

A. General.

1. Pumps, their motors, and all accessories shall be controlled in a manner that they will operate at their rated capacity. Where two or more pumps are installed, provision shall be made for proper alternation of the pumps. Alternation may be automatic or manual. Provision shall be made to prevent operation of the pump in the event of a backspin cycle.

2. All pumps shall be driven by motors designed to operate over the full range of operating conditions.

3. All pumps shall be served by control equipment that has overload protection for ~~the~~ air temperature encountered.

4. Electrical controls shall be protected to the 100-year flood elevation and should be located above grade.

5. If standby power is provided by onsite generators or engines, ~~then~~ the provisions for filling the fuel storage tank, the fuel tank itself, and the fuel line shall be designed to protect the water supply from contamination.

6. Pumps shall be lubricated with water of equal or better quality than the water being pumped or with food grade oil. Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal shall:

a. Have an air gap of at least two inches or two pipe diameters, whichever is greater, where a break-tank is provided; or

b. Be provided with an approved RPZ assembly.

7. When automatic pre-lubrication of pump bearings is necessary and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved ~~by-pass bypass~~ around the automatic control.

8. A suitable outlet for drainage from pump glands shall be provided without discharging onto the floor.

AB. Booster pumps.

1. Booster pumps, except those connected to supply mains not containing service connections and except those taking suction directly from storage facilities, shall be located or controlled so that:

1- a. They will not produce negative gauge pressure in their suction line; and

2- b. The intake pressure shall be at least 20 psi when the pump is in normal operation.

~~3- 2.~~ An automatic pressure cutoff or a pressure regulating valve shall be provided to prevent the suction line pressure from dropping to below 10 psi; and

4. ~~3.~~ Automatic or remote control devices shall have a sufficient range between the start and cutoff pressure, or another mechanism which that will prevent excessive cycling of the pumps.

~~B. Inline booster pumps. In addition to the other requirements of this section, inline booster pumps shall be accessible for servicing and repairs.~~

4. At least two pumping units shall be provided.

a. If only two units are provided, then each shall be capable of delivering the peak hour demand, taking into account storage contributions.

b. If more than two units are installed, then they shall have sufficient capacity so that if any one pump is out of service, the remaining pumps are capable of meeting the peak hour demand, taking into account storage contributions.

c. When using booster pumps to transfer water from atmospheric storage tanks to hydropneumatic tanks located upstream of an entry point into the distribution system, the combined capacity of the two pumps shall equal or exceed the peak hour demand. If fire flow is provided, then a pump or pumps separate from the transfer pumps shall be provided to deliver the required fire flow.

d. When booster pumping is required for small noncommunity systems, the reserve capacity requirements may be reduced in accordance with the type and size of system served.

5. Controls shall be provided to shut off pumps in the event that suction conditions may result in cavitation.

**12VAC5-590-1060. Automatic and remote controlled stations. (Repealed.)**

~~All automatic stations should be provided with an automatic signaling apparatus which will report to a facility manned 24 hours per day when the station is out of service. All remote controlled stations shall be electrically operated and controlled and shall have a signaling apparatus of proven performance. Installation of electrical equipment shall conform with the appropriate state codes.~~

**12VAC5-590-1065. Piping, valves, and meters.**

A. Piping shall:

1. Be adequately sized to minimize energy losses;

2. Not be subject to contamination;

3. Have watertight joints;

4. Be properly anchored to prevent movement;
5. Be protected against surge or water hammer;
6. Have proper labels to identify the contents of the pipes (12VAC5-590-720 C); and
7. Have all exposed piping, valves, and appurtenances protected against physical damage and freezing.

B. Pumps shall be adequately valved to allow satisfactory operation, maintenance, and repair of the equipment.

1. If foot valves are necessary, then they shall have a net valve area of at least 2-1/2 times the area of the suction pipe and they shall be screened.
2. Each pump shall have shutoff valves on both suction and discharge sides of the pump.
3. Each pump shall have a positive-acting check valve on the discharge side between the pump and shutoff valve or suitable control features to prevent flow reversal.
4. Surge relief valves or slow-acting ~~-acting~~ check valves shall be designed to minimize hydraulic transients.
5. Discharge control valves and appurtenances shall be located above the pump floor when an above-ground discharge is provided.
6. Pumps shall be equipped with an air release/-vacuum relief valve located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least 18 inches above the floor and covered with a corrosion-resistant ~~-resistant~~ screen.

C. Gauges. Each pump shall have a standard pressure gauge on its discharge line capable of displaying the maximum allowable pressure of the pump and shall have a standard pressure gauge, or a compound gauge when appropriate, on its suction line.

D. Meters.

1. All booster pump stations located within the distribution system should be fitted with a flow rate indicating and totalizing meter with recording capabilities.
2. A totalizing water meter to measure water production shall be provided for each well and shall be located upstream of the well ~~blow-off~~ blowoff.

E. Additional requirements for well discharge piping.

1. Valves shall be provided to allow testing and control of each well.
2. A non-threaded sampling tap shall be provided for water sampling that discharges in a downward direction and away from the well casing.
3. A standard pressure gauge shall be provided to indicate well discharge pressure. The gauge shall be capable of displaying pressure under all operating conditions.
4. ~~Blow-off~~ Blowoff.
  - a. A separate means to pump (i.e., blowoff ~~blow-off~~) water of unsatisfactory quality to a point away from the groundwater source shall be provided. ~~Blowoff~~ ~~Blow-off~~ discharge shall not create a ~~cross-connection~~ cross connection.
  - b. Systems shall be equipped with a watertight cap or a screened discharge.
  - c. Erosion protection at the point of waste discharge shall be provided.

**12VAC5-590-1070. Appurtenances. (Repealed.)**

~~A. Valves.~~

~~Pumps shall be adequately valved to permit satisfactory operation, maintenance, and repair of the equipment. If foot valves are necessary, they shall have a net valve area of at least two and~~

one-half times the area of the suction pipe and they shall be screened. Each pump shall have a positive acting check valve on the discharge side between the pump and shutoff valve.

**B. Piping, in general, shall:**

1. Be designed so that the friction head will be low;
2. Not be subject to contamination;
3. Be sloped in one direction to drains;
4. Have adequate cleanouts;
5. Have watertight joints;
6. Be protected against surge or water hammer;
7. Be such that each pump has an individual suction line or the lines shall be so manifolded that they will insure similar hydraulic and operational conditions; and
8. Have proper legends to identify the contents of the pipes (see 12VAC5-590-720-L).

**C. Gauges and meters.**

The station should have indicating, totalizing, and recording metering of the total water pumped. Each pump shall:

1. Have a standard pressure gauge on its discharge line;
2. Have a compound gauge on its suction line; and
3. Have recording gauges in the larger stations as required by the division.

**D. Water seals.**

Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal shall:

1. Be provided with a break tank open to atmospheric pressure; and
2. Have an air gap between feeder line and spill line of the tank, at least two inches or two pipe diameters, whichever is greater.

**E. Controls.**

Pumps, their prime movers, and all accessories shall be controlled in such a manner that they will operate at their rated capacity without overloading. Where two or more pumps are installed, provision shall be made for proper alternation. Alternation may be automatic or manual. Provision shall be made to prevent operation of the pump during the backspin cycle. Electrical controls should be located above grade.

**F. Power.**

When power failure would result in cessation of the minimum essential service, the power supply shall be provided from at least two independent sources or an auxiliary source shall be provided.

**G. Auxiliary power supply.**

When automatic prelubrication of pump bearings is necessary and an auxiliary power supply is provided, the prelubrication line shall be provided with a valved by pass around the automatic control.

Article 5  
Finished Water Storage Structures

**12VAC5-590-1080. General Basic finished water storage design criteria.**

A. The materials and designs used for finished water storage structures, including associated pipe and valves, shall provide stability and durability as well as protect the quality of the stored

~~water. Steel structures shall follow the current available American Water Works Association standards concerning steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction are acceptable when properly designed to meet the requirements of this section. Steel, concrete, composite, and plastic storage structures shall be designed, constructed, cleaned, disinfected and tested in accordance with the following AWWA Standards, where applicable: D100-11, D103-09, D107-16, D108-10, D110-13, D115-06, D120-09, D121-12, and C652-11.~~

~~B. Safety cages, rest platforms, roof-ladder handrails, and other safety devices shall be provided as required by VOSH.~~

~~A. C. Location of finished water storage facilities.~~

~~1. The bottom of ground level, ground-level reservoirs, storage tanks, and standpipes should be placed ~~at the normal ground surface~~ above finished grade to ensure positive drainage away from the structure.~~

~~2. Where the bottom must be below normal ground surface, it shall be placed above the groundwater table. Sewers, drains, standing water, and similar sources of contamination shall be kept at least 50 feet from the ~~reservoir-storage facility~~. ~~AWWA approved water pipe~~ Pipe conforming to water distribution pipe standards of 12VAC5-590-1110, pressure tested in place without leakage, shall be used for gravity sewers at lesser separations.~~

~~3. The top of all storage facilities shall not be less than two feet above the normal ground surface and shall be protected from ~~above~~ the 100-year flood level. ~~Clearwells~~ Any clearwell constructed under filters may be ~~excepted~~ exempted from this requirement when the total design gives the same protection.~~

~~D. Pressure variation. The maximum variation between normal operational high and low water levels in finished water storage structures which float on a distribution system shall not exceed 30 feet.~~

~~E. Level controls.~~

~~1. Adequate controls shall be provided to enable sufficient tank turnover, water quality maintenance, avoidance of overflows, and efficient operations.~~

~~2. A telemetry system with recording capability shall be considered to transmit the operating levels in distribution system storage facilities to a location where qualified personnel may access the data at all times.~~

~~3. Altitude valves or equivalent controls shall be provided.~~

~~4. For tanks with a monitoring system, warnings or alarms indicating overflow, low level, and pump malfunction ~~warnings or alarms~~ shall be provided.~~

~~B. All new finished water storage structures shall have suitable watertight roofs or covers which exclude birds, animals, insects, and dust.~~

~~C. No drain on a water storage structure shall have a direct connection to a sewer or storm drain.~~

~~All finished water storage structures shall be equipped with separate drains discharging to the atmosphere. Drainage of finished water storage structures to the distribution system through inlet and outlet piping shall not be allowed.~~

~~D. The overflow pipe of a finished water storage structure shall be brought down near the ground surface where any discharge will be visible and into a drainage inlet structure or a splash plate which will divert the overflow away from the storage structure. No overflow may be connected directly to a sewer or storm drain.~~

~~1. When an internal overflow pipe is used it shall be located in the access tube.~~

~~2. The overflow of a ground level finished water storage structure shall be high enough above normal or graded ground surface to prevent the entrance of surface water.~~

~~3. All nonpressure type finished water storage structures shall be provided with a downward discharging screened overflow.~~

~~E. Finished water storage structures shall be designed with convenient access to the interior for cleaning and maintenance. Manholes or scuttles above the waterline shall be:~~

~~1. Framed at least four inches, preferably six inches, above the surface of the roof at the opening; on ground level structures, manholes should be elevated 24 to 36 inches above the top or covering sod;~~

~~2. Fitted with a solid watertight cover which overlaps the framed opening and extends vertically down around the frame at least two inches (shoebox type);~~

~~3. Hinged at one side; and~~

~~4. Fitted with a locking device.~~

~~F. Finished water storage structures shall be vented by separate vent structures. Open construction between the side wall and roof is not permissible.~~

~~1. Vents shall prevent the entrance of surface water.~~

~~2. Vents shall exclude birds and animals.~~

~~3. Vents shall exclude insects and dust, as much as this function can be compatible with effective venting, for elevated tanks and standpipes, four mesh noncorrodible screen may be used.~~

~~4. Vents on ground level structures shall terminate in an inverted U construction the opening of which is 24 to 36 inches above the roof or sod and is covered with noncorrodible screen cloth to exclude insects.~~

~~G. The roof and sidewalls of all structures must be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.~~

~~1. Any pipes running through the roof or sidewall of a finished water storage structure must be welded or properly gasketed in metal tanks or should be connected to standard wall castings which were poured in place during the forming of a concrete structure; these wall castings shall have flanges imbedded in the concrete.~~

~~2. Openings in a storage structure roof or top designed to accommodate control apparatus or pump columns shall be curbed and sleeved with proper additional shielding and shoebox type cover to prevent the access of surface water into the structure.~~

~~3. Valves and controls shall be located outside the storage structure so that valve stems and similar projections will not pass through the roof or top of the structure.~~

~~H. The roof or cover of the storage structure should be well drained, but downspout pipes shall not enter or pass through the reservoir.~~

~~I. The safety of employees shall be considered in the design of the storage structure. As a minimum, such matters shall conform to pertinent building codes, laws, and regulations of the area where the reservoir is constructed.~~

~~1. Ladders, ladder guards, balcony railings, and safe location of entrance hatches shall be provided.~~

~~2. Elevated tanks with riser pipes over eight inches in diameter shall have protective bars over the riser opening inside the tank.~~



J. All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents, shall be designed to prevent freezing which will interfere with proper functioning.

K. Every catwalk over finished water in a storage structure shall have a solid floor with raised edges so designed that shoe scrapings and dirt will not fall into the water.

L. The area surrounding a ground level structure should be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

M. Proper protection should be given to metal surfaces by paints or other protective coatings, by cathodic protective devices, or both. Paint systems consistent with the most current available American Water Works Association standards and otherwise acceptable to the division shall be used. Cathodic protection should be designed and installed by competent technical personnel.

N. All finished water storage facilities shall be cleaned to remove all dirt and loose materials prior to disinfection of the structure. Only potable water shall be used to clean and rinse the water storage facilities. All equipment including brooms, brushes, spray equipment and workmen's boots shall be disinfected before they are used to clean the storage facilities.

O. All finished water storage facilities shall be satisfactorily disinfected prior to being placed in operation. The disinfection of the storage facilities shall be repeated until it is determined, by bacteriological testing, that the water is free of coliform bacteria:

1. One of the following disinfection methods shall be used. Other methods of disinfection may be approved on a case-by-case basis by the division:

a. The tank shall be filled to the overflow level with potable water to which enough chlorine has been added to produce an initial chlorine concentration of 50 mg/L in the full tank. The full tank should stand for 24 hours; however, in no case shall it stand less than six hours. At the end of the holding period, the chlorinated water shall be drained to waste, the tank refilled with potable water, and tested for satisfactory bacteriological quality before placing the tank in service.

b. All interior surfaces of the tank shall have applied a chlorine solution containing at least 200 mg/L of free available chlorine. The chlorine solution shall be applied with either spray equipment or brushes. Any equipment used to apply the chlorine solution shall either be new or previously used only for disinfection purposes. The chlorine solution shall remain in contact with the tank surfaces for at least 30 minutes. The tank shall then be filled with potable water to the overflow level and tested for satisfactory bacteriological quality before placing the tank in service; or

c. Potable water containing a free chlorine residual of 50 mg/L shall be placed in the tank to such a depth that when the tank is filled, the resulting chlorine concentration in the water will be at least two mg/L. The water containing 50 mg/L of chlorine shall stand in the tank for 24 hours. The tank shall then be filled with potable water and allowed to stand for 24 additional hours. At the end of the second 24 hour period, the chlorine residual shall be at least two mg/L. After analyses of the water for satisfactory bacteriological quality, the tank may be placed in service without draining the water used to disinfect it.

2. Testing of the water following disinfection shall be in accordance with 12VAC5-590-800 G.

### **12VAC5-590-1081. Atmospheric tank storage.**

#### A. Protection.

1. All finished water storage structures shall have suitable watertight roofs or covers that exclude birds, animals, and insects.

2. All finished water storage structures shall be designed to prevent vandalism and entrance by animals or unauthorized persons.

B. The storage facility shall be designed to facilitate turnover of water. Consideration shall be given to locating inlet and outlet pipes at different elevations and locations, tank mixers, and other acceptable means to avoid stagnation. Excessive storage capacity shall be avoided to prevent water quality deterioration. See 12VAC5-590-640 B 3.

C. Drains.

1. No drain on a water storage structure shall create a cross-connection hazard.

2. All finished water storage structures shall be equipped with separate drains discharging to the atmosphere. Drainage of finished water storage structures to the distribution system through inlet and outlet piping is prohibited.

D. Overflows.

1. Atmospheric finished water storage structures shall be provided with a downward-discharging, screened overflow pipe. The discharge pipe shall be brought down near the ground surface and into a drainage inlet structure or a splash plate that will divert the overflow away from the storage structure. The overflow pipe discharge shall be high enough above normal or graded ground surface to prevent the entrance of surface water.

2. Overflow pipe screens shall be installed so as to withstand the force of overflows. Properly designed flapper valves or rubber flex-type valves may be used ~~in lieu~~ instead of screens if approved by the commissioner.

E. Inlet and discharge pipes.

1. Elevated tanks with riser pipes over eight inches in diameter shall have protective bars over the riser opening inside the tank.

2. Inlet and outlet pipes from water storage facilities shall be located in a manner that will prevent the flow of sediment into the distribution system.

F. Finished water storage structures shall be designed with convenient access to the interior for cleaning and maintenance. Ladders, ladder guards, balcony railings, and safely located entrance hatches shall be provided where applicable. Hatches, manholes, or scuttles above the waterline shall be:

1. Framed at least four inches, preferably six inches, above the surface of the roof at the opening; on ~~ground-level~~ ~~ground-level~~ structures, manholes should be elevated 24 ~~--to~~ 36 inches above finished grade;

2. Fitted with a solid watertight cover that overlaps the framed opening and extends vertically down around the frame at least two inches (shoebox type);

3. Hinged at one side; and

4. Fitted with a locking device.

G. Atmospheric finished water storage structures shall be vented by separate vent structures. Open construction between the side wall and roof is prohibited.

1. Vents shall prevent the entrance of surface water.

2. Vents shall exclude birds, animals, and insects, and be constructed of non-corrodible material. Screens shall be designed to be frost-free or capable of relieving pressure or vacuum in the event of frosting or clogging.

3. Vents on ~~ground-level~~ ~~ground-level~~ structures shall terminate in an inverted U construction, with the vent terminating 24 ~~-to~~ 36 inches above roof or finished grade.

H. Penetrations. The roof and sidewalls of all structures shall be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.

1. Any pipes running through the roof or sidewall of a finished water storage structure shall be welded or properly gasketed in metal tanks or should be connected to standard wall castings that were placed during the forming of a concrete structure; these wall castings shall have flanges imbedded in the concrete.

2. Valves and controls shall be located outside the storage structure so that valve stems and similar projections will not pass through the roof or top of the structure.

3. Downspout pipes for roof drainage shall not enter or pass through the structure.

I. All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents, shall be designed to prevent freezing that will interfere with proper functioning.

J. Every catwalk over finished water in a storage structure shall have a solid floor with raised edges ~~so~~ designed so that shoe scrapings and dirt will not fall into the water.

K. The area surrounding a ~~ground-level~~ ~~ground-level~~ structure shall be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

L. Proper protection shall be given to metal surfaces by paints or other protective coatings, by cathodic protective devices, or both, in accordance with the NSF/ANSI Standard 61-2016, AWWA standards D102-14, D104-11, and D106-16, or an approved equivalent, where applicable.

M. All finished water storage facilities shall be cleaned to remove all dirt and loose materials ~~prior to~~ before disinfection of the structure. Only potable water shall be used to clean and rinse the water storage facilities. All equipment including brooms, brushes, spray equipment, and worker's boots shall be disinfected before they are used to clean the storage facilities.

N. Disinfection. All finished water storage facilities shall be satisfactorily disinfected in accordance with AWWA C652-11 ~~prior to~~ before being placed in operation. The disinfection of the storage facilities shall be repeated until it is determined, by bacteriological testing, that the water is free of coliform bacteria.

#### **12VAC5-590-1082. Pressure tank storage.**

When hydropneumatic tanks are used, they shall comply with the requirements of state and local laws and regulations for the construction and installation of unfired pressure vessels.

1. Pressure tanks shall be located above the normal ground surface with the ~~operating end of the tank~~ ~~end~~ containing the inlet pipe, the pressure gauge, and other appurtenances projecting into a building with climate controls to prevent freezing. Alternatively, it may be completely housed, if adequate access is provided for inspection, removal, and replacement.

2. Pressure tanks shall have bypass piping to permit operation of the system while the tank is being cleaned, repaired, or painted.

3. Pressure tanks shall have an access manway, a drain, and control equipment consisting of a pressure gauge, water sight glass, automatic or manual air ~~blew-off~~ ~~blowoff~~, pressure and vacuum relief valves, and mechanical means for adding air. Pressure tanks less than 120 gallons and bladder tanks are not required to have an access manway, sight glass, or vacuum relief valve.

4. Pressure tanks and pumps shall be designed to minimize pump cycling and to operate within manufacturer's recommendations.

**12VAC5-590-1090. Plant storage.**

The applicable design standards of ~~12VAC5-590-1080~~ shall be followed for plant storage.

A. ~~Washwater~~ Backwash water storage tanks shall be sized in conjunction with available pump units and finished water storage to ~~give~~ provide the filter backwash water required. Consideration ~~must~~ shall be given to the possibility of having to wash more than one filter at a time or several filters in succession.

B. Clearwell storage ~~should~~ shall be sized, in conjunction with distribution system storage, to relieve the filters from having to follow fluctuations in water use or meet peak demands, including filter backwash water. When finished water storage is used to provide proper contact time for ~~chlorine disinfection~~, special attention ~~must~~ shall be given to size, drawdown, and baffling. Plant clearwells shall be equipped with a raised viewing port having a clear glass or plastic viewing window and a submerged, waterproofed electric light.

C. Finished water shall not be stored or conveyed in a compartment adjacent to ~~unsafe nonpotable~~ water when the two compartments are separated by a single wall.

D. Receiving basins and pump wet wells for finished water shall be designed as finished water storage structures.

E. ~~Hydropneumatic (pressure) tanks may be acceptable in small water systems. When used, they shall comply with the requirements of state and local laws and regulations for the construction and installation of unfired pressure vessels.~~

~~1. The tank shall be located above the normal ground surface with the tank end containing the inlet pipe, the pressure gauge and other appurtenances projecting into an operating house to prevent freezing or be completely housed.~~

~~2. The tank shall have bypass piping to permit operation of the system while the tank is being cleaned, repaired, or painted.~~

~~3. Pressure or level pressure operated start-stop controls shall be installed on the discharge piping to permit operation of the water supply system.~~

~~4. Each tank shall have an access manhole, a drain, and control equipment consisting of pressure gauge, water sight glass, automatic or manual air blowoff, pressure and vacuum relief valves and mechanical means for adding air. Appurtenances to small capacity tanks shall be determined by the division on a case-by-case basis.~~

~~5. Tanks and pumps shall be designed to minimize pump cycling and shall have at least the following capacity:~~

~~a. When the hydropneumatic tank is fed directly by a well or wells, the effective storage volume is one-third of the hydropneumatic tank's gross volume;~~

~~b. When the hydropneumatic tank is fed directly from ground storage, the effective storage volume is the effective volume of the ground storage tank plus the effective volume of the hydropneumatic tank; and~~

**12VAC5-590-1100. Distribution storage. (Repealed.)**

The applicable design standards of ~~12VAC5-590-1080~~ shall be followed for ~~distribution storage.~~

~~A. The maximum variation between high and low water levels in finished water storage structures which float on a distribution system should not exceed 30 feet. Large diameter, shallow-depth reservoirs are preferable over small diameter, deep-depth reservoirs.~~

~~B. Adequate controls shall be provided to maintain levels in distribution system storage structures at all times.~~

C. Pressure tanks. (Also see 12VAC5-590-1090 E.)

1. A telemetering system and recording equipment should be provided, to a location where qualified personnel are available at all times, for the transmission and recording of storage levels in the distribution system.

2. Altitude valves or equivalent controls may be required for subsequent structures on the system.

3. Overflow, low level, and pump malfunction warnings or alarms should be transmitted to a location where qualified personnel are available for surveillance on a 24-hour basis.

#### Article 6

#### Water Distribution Systems

#### **12VAC5-590-1110. Materials Distribution system materials.**

A. The pipe selected shall have been manufactured in conformity with the current available standards issued by the American Water Works Association if such standards exist or be approved by the National Sanitation Foundation for water distribution piping.

B. In the absence of such standards, pipe meeting applicable commercial standards and acceptable to the division may be considered.

C. Used water mains that meet these standards may be used again after the pipe has been thoroughly cleaned and restored.

D. Packing and joint materials used in the joints of pipe shall meet the standards of the American Water Works Association or the National Sanitation Foundation.

E. Mechanical joints or slip joints with resilient gaskets are preferred.

Pipe, fittings, joints, valves, hydrants, and coatings shall conform to AWWA standards.

#### **12VAC5-590-1120. Minimum pipe size.**

A. The minimum size pipe for water distribution systems mains shall be four inches in diameter. Pipes of lesser diameter may be used in the following instances:

1. When the run is less than 300 feet, two-inch diameter pipe may be used; and,

2. When the run is less than 600 feet but more than 300 feet, three-inch diameter pipe may be used.

3. Any departure in sizing shall be justified by hydraulic analysis and future water demands.

B. The minimum size of pipe where fire protection is to be provided or required shall be six inches in diameter. Fire hydrants shall not be connected to water mains that are not designed to carry fire flows. Connection of a fire hydrant to a pipe of less than six inches in diameter is prohibited.

C. The standard grading schedule of the Insurance Services Office and other related organizations shall be followed in other cases.

D. Any departure in sizing shall be justified by hydraulic analysis and future water use and can be considered only in special circumstances.

E. Water mains not sized to carry fire flows shall not be connected to fire hydrants. Where a noncommunity waterworks serves a single building, the plumbing shall be in accordance with the most recent edition of the USBC. Where a noncommunity waterworks serves two or more buildings, the pipe shall be of sufficient size to provide adequate flow and pressure in order to meet the system demands.

#### **12VAC5-590-1130. System Distribution system design.**

A. Dead-ends should be minimized by the looping of all water mains.

B. Where dead-end lines water mains occur, ~~they shall be provided with a fire hydrant, flushing hydrant, or blowoff for flushing purposes~~ a means of effective flushing shall be provided.

C. No flushing device shall be directly connected to any sewer.

**12VAC5-590-1140. Installation and testing of water mains.**

- A. Adequate supports and restraints shall be provided for all pipes.
- B. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
- C. Stones and rocks found in the trench shall be removed ~~for~~ to a depth of at least six inches below the bottom of the pipe and selected fill bedding provided.
- D. ~~The specifications for installation shall include:~~
  - ~~1. Pressure testing on installed pipe;~~
  - ~~2. Allowable leakage of installed pipe; and~~
  - ~~3. Reference to applicable American Water Works Association standards or manufacturers' recommended installation procedures.~~ Installed pipe shall be pressure-tested and meet allowable leakage as specified in accordance with AWWA C600-10, C604-11, and C605-13, where applicable.
- E. Any plastic or other nonmetallic pressurized conduit pipe installed underground shall ~~have~~ be provided with a material conductive of electricity or some other means of locating the ~~conduit while it is underground~~ buried pipe.

**12VAC5-590-1150. Separation of water mains and sanitary sewers.**

- A. The following factors shall be considered in providing adequate separation of water mains and sanitary sewers:
  - 1. Materials and types of joints for water and sanitary sewer mains;
  - 2. Soil conditions;
  - 3. Service branch connections into the water main and sanitary sewer mains;
  - 4. Compensating variations in the horizontal and vertical separations;
  - 5. Space for repairs and alterations of water and sanitary sewer mains;
  - 6. Offsetting of pipes around manholes; and
  - 7. Identification of the physical restraints preventing normal separation.
- B. Parallel installation of water mains and sanitary sewers.
  - 1. Under normal conditions, water mains shall be laid at least 10 feet horizontally from a sanitary sewer or sewer manhole. The distance shall be measured edge-to-edge.
  - 2. Under unusual ~~conditions~~ situations when local conditions prevent a horizontal separation of 10 feet, the water main may be laid closer to a sanitary sewer or sewer manhole provided that:
    - a. The bottom (invert) of the water main shall be at least 18 inches above the top (crown) of the sanitary sewer;
    - b. Where this vertical separation cannot be obtained, the sanitary sewer shall be constructed of ~~AWWA approved water pipe~~ water distribution pipe, and pressure tested in place ~~without leakage prior to backfilling; and in accordance with 12VAC5-590-1110 and 12VAC5-590-1140;~~
    - c. The commissioner may approve concrete encasement of the water main or other physical barrier;
    - ~~e-d.~~ The sewer manhole shall be of watertight construction and tested in place; and

e. No water pipes shall pass through or come into contact with any part of a sewer manhole.

C. Crossing- of water mains and sanitary sewers.

1. Under normal conditions, water ~~lines~~ mains crossing sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water ~~line-main~~ and the top of the sanitary sewer whenever possible.

2. Under unusual ~~conditions~~ situations when local conditions prevent a vertical separation described in subdivision C 1 of this section, the following construction shall be used:

a. ~~Sewers~~ Sanitary sewers passing over or under water mains shall be constructed of the materials described in ~~subdivision B 2 b~~ subsection B of this section and shall be constructed to a point 10 feet beyond, and on each side of the crossing; and

b. Water ~~lines~~ mains passing under sanitary sewers shall, in addition, be protected by providing:

(1) A vertical separation of at least 18 inches between the bottom of the sanitary sewer and the top of the water ~~line~~ main;

(2) Adequate structural support for the sanitary sewers to prevent excessive deflection of the joints and the settling on and breaking of the ~~waterline~~ water main; and

(3) That the length of the water ~~line~~ main be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sanitary sewer.

D. No water pipes shall pass through or come in contact with any part of a sewer manhole. The minimum horizontal separation distance between water mains and septic tanks and drainfields, measured edge-to-edge, shall be 10 feet. Greater separation ~~distance~~ distances shall be provided wherever practical.

E. Water mains shall be located a safe horizontal distance from sources of contamination not already mentioned in this section, such as sewage treatment works and industrial complexes. The owner's engineer shall contact the department to determine the safe separation distances.

**12VAC5-590-1160. Valve, air relief, meter, and blowoff ~~blow-off~~blowoff chambers.**

A. Air and sediment accumulations may be removed through a standard fire hydrant; compressed air and pumping may be used for dewatering mains through hydrants. Standard fire hydrants or ~~blow-offs~~ blowoffs shall be considered to enable removal of sediment and air accumulations.

B. ~~Chambers~~ Drains in chambers or pits ~~containing~~ that contain valves, blowoffs, meters, or other ~~such~~ appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blowoffs or air relief valves be connected directly to any sewer.

C. ~~Such chambers~~ Chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water or to absorption pits located above the seasonal groundwater table elevation. The backfill material for the water main may serve as an absorption pit if granular embedment material is laid from the pipe bedding up through the final backfill layer for the entire length of pipe in the chamber. Sump pumps may be used where other means are not practicable.

D. The chamber or pit shall be designed to facilitate air valve inspection and servicing.

E. Air relief and ~~blow-off~~ blowoff piping.

~~D. 1.~~ The open end of an air relief pipe shall be extended from the manhole or enclosing chamber to a point at least one foot above ground and provided with a screened, downward facing elbow. The exposed pipe and appurtenances shall be protected from vandalism and other damage.

2. When an above-ground extension is not practical or desired, the open end of the relief pipe or ~~blow-off blowoff~~ shall be extended.

a. ~~Where the pit or chamber is provided with proper drainage, and is not otherwise subject to high groundwater levels, surface flooding, ponding, and contaminant or pollutant spills, the open end may be provided with a screened, downward facing elbow. The valve chamber or pit shall be vented to provide sufficient air flow to allow proper operation of the air valve. Air valves fitted with a smooth vent port and screened hood are allowable under these conditions.~~

b. ~~Where the pit or chamber is not properly drained or is otherwise subject to high groundwater levels, surface flooding, ponding, and contaminant or pollutant spills, a manually-operated manually operated valve or blow-off blowoff shall be used and the open end shall be fitted with a watertight cap or other means to prevent contamination from entering the pipe and valve.~~

**12VAC5-590-1170. Hydrants.**

A. Where hydrant drains are not plugged, they shall be drained to the ground surface or to dry wells provided exclusively for this purpose in a manner that will avoid contamination of the hydrant or water main from high groundwater, surface flooding and ponding, and contaminant or pollutant spills.

B. Hydrant drains shall not be connected to sanitary sewers or storm drains.

C. Fire hydrants shall be connected only to water ~~systems~~ mains adequately designed for fire flows in addition to domestic flow in accordance with the requirements of 12VAC5-590-1120 B.

**12VAC5-590-1180. Surface water crossings.**

~~A.~~ Surface water crossings, both over and under water, present special ~~problems and should~~ challenges and shall be discussed with the ~~division~~ department before ~~final plans~~ project documents are prepared.

~~A. Above~~ ~~B.~~ Aerial water crossings. The pipe above water crossings shall be:

1. Adequately supported;
2. Protected from freeze damage;
3. Accessible for repair or replacement; and
4. Above the 100-year flood level.

~~B.~~ ~~C.~~ Under water crossings.

1. The pipe shall be of special construction, suitable to the method of installation and having flexible watertight joints.

2. ~~Valves~~ Where rigid pipe is used, valves and taps shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves and taps shall be easily accessible and not subject to flooding.

~~3. Sample taps shall be available at each end of the crossing and at a reasonable distance from each side of the crossing and not subject to flooding.~~

~~4. Permanent taps shall be made for testing and locating leaks.~~

**12VAC5-590-1190. Water services and plumbing. (Repealed.)**

~~Water services and plumbing shall conform to the Uniform Statewide Building Code.~~



**12VAC5-590-1200. Water pressure in systems. (Repealed.)**

**12VAC5-590-1210. Disinfection and testing of water mains.**

A. All water mains shall be disinfected in accordance with AWWA C651-14 ~~prior to~~ before being placed in operation. The disinfection of the mains shall be repeated until it is determined, by bacteriological testing, that the water is free of coliform bacteria.

B. ~~Prior to disinfection all water mains shall be flushed unless the tablet method of disinfection is used. All valves and hydrants shall be operated during this operation. Flushing velocities should not be less than 2.5 feet per second.~~

~~C. Methods of chlorine application.~~

~~1. Continuous feed method—Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/L. The chlorinated water shall remain in the main at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main;~~

~~2. Slug method—Potable water shall be introduced into the main at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the main are exposed to the 100 mg/L chlorine solution for at least three hours. The chlorine residual shall be checked at regular intervals not to exceed 2,000 feet to insure that adequate residual is maintained. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances; or~~

~~3. Tablet method—Tablets shall be placed in each section and in all appurtenances. Enough tablets shall be used to insure that a chlorine concentration of 25 mg/L is provided in the water. They shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be acceptable to the division. The velocity of the potable water in the main shall be less than 1 foot per second. The water shall then remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water is in the main.~~

~~This method shall not be used if nonpotable water or foreign materials have entered the mains or if the water temperature is below 5°C (41°F).~~

~~D. Final flushing. After the required retention period, the chlorinated water shall be flushed from the main using potable water.~~

~~E. Testing. After the mains have been flushed, the water mains shall be tested in accordance with 12VAC5-590-800 C. Samples shall be collected at regular intervals, not exceeding 2,000 feet, throughout the length of main.~~

~~F. Repairs. Cleaning, disinfecting, flushing, testing, or similar operational actions shall be in accordance with the current standard issued by AWWA (AWWA-C-604). Project documents shall provide the details of the procedure and include the disinfectant application technique, dosage, contact time, method of testing the results of the procedure, and use or disposal of the disinfecting water.~~

**12VAC5-590-1220. Cover Pipe cover.**

All ~~distribution mains~~ buried distribution pipe shall be provided with sufficient earth or other suitable cover or encasement to prevent from freezing and provide protection from damage by external forces.

**12VAC5-590-1230. Metering ~~Service connection metering, lines and meters.~~**

~~A. Each All new service connections in community waterworks service connection should shall be metered.~~

~~B. Water pipe and appurtenances between the water main and the service connection shall conform to all applicable codes.~~

**12VAC5-590-1235. Water loading stations.**

~~A. The station and its piping and valving arrangement shall be designed to prevent unauthorized use, tampering, and vandalism.~~

~~B. An air gap or RPZ assembly shall be provided on the potable water fill connection to prevent backflow into the ~~potable water supply~~waterworks.~~

~~C. The piping and valving arrangement shall prevent contaminants from being transferred from a hauling tank or vessel to others subsequently using the water loading station.~~

~~D. Hoses used to fill potable water tanks and vessels shall be approved for potable water contact.~~

**Part IV. Exceptions for Noncommunity Waterworks to Specific Sections of the Manual of Practice (Part III)**

**12VAC5-590-1240. General. (Repealed.)**

~~Noncommunity waterworks design shall conform to Part III of this chapter. Due to the types of service provided and size of some noncommunity waterworks, certain exceptions to the design requirement specified in Part III may be allowed. Each of the following subsections will refer to exceptions in corresponding sections of Part III.~~

**12VAC5-590-1250. Exceptions to Article 1 of Part III. (Repealed.)**

~~A. The evaluation of source requirements shall consider the type and use of the noncommunity system. Minimum storage for noncommunity waterworks, in conjunction with the source, must provide system peak hour demand.~~

~~B. A minimum laboratory facility of a sink and workbench shall be provided.~~

**12VAC5-590-1260. Exceptions to Article 2 of Part III. (Repealed.)**

~~A. Exceptions to the minimum size well lot may be made for noncommunity waterworks, based upon site availability and other factors.~~

~~B. When the source requirements for a noncommunity system are determined to be three gallons per minute or less the 48-hour minimum drawdown test may be reduced to no less than eight hours. The drawdown test, approved by the division and based upon system demands and geological conditions, shall be performed to determine well yield.~~

**12VAC5-590-1270. Exceptions to Article 5 of Part III. (Repealed.)**

~~When booster pumping is required for small noncommunity systems, the duplicity and capacity requirements may be reduced in accordance with the type and size of system served.~~

**12VAC5-590-1280. Exceptions to Article 6 of Part III. (Repealed.)**

~~In the instance where a noncommunity water system serves a single building, the water line plumbing (including size) shall be in accordance with the most recent edition of the Uniform Statewide Building Code.~~

~~When a noncommunity water system serves two or more buildings, the water line shall be of sufficient size to provide adequate flow and pressure in order to meet the system demands.~~

**APPENDIX A. [RESERVED] (Repealed.)**

**APPENDIX B. BACKGROUND USED IN DEVELOPING THE CHEMICAL, PHYSICAL AND RADIOLOGICAL LIMITS OF THE DRINKING WATER STANDARDS. (Repealed.)**

## COPPER

### ACTION LEVEL—1.3 mg/L

Copper is an essential and beneficial element in human metabolism. The daily copper requirement for adults has been estimated to be 2.0 mg. Preschool age children require about 0.1 mg daily for normal growth. Copper at high doses has, however, been shown to cause stomach and intestinal distress, liver and kidney damage, and anemia.

A primary source of high concentrations of copper in drinking water is from the internal corrosion of copper plumbing within the home. The EPA has established an action level of 1.3 mg/L of copper in ~~first draw~~first draw tap sample which may result in public waterworks installing measures to control corrosion.

## CORROSION

Corrosion is responsible for many problems in the water distribution system including tuberculation with loss of carrying capacity and increased pumping costs, leaks, main ruptures, discoloration and loss of chlorine residual. The corrosivity of drinking water is a parameter which has not only esthetic and economic significance, but is health significant as well. The products of corrosion having the greatest health significance at the present time, cadmium and lead, are addressed as primary maximum contaminants, but there is also a sufficient basis to include corrosivity as a secondary maximum contaminant level.

Corrosivity is controlled by pH adjustment, the use of chemical stabilizers, or other means which are dependent upon the specific conditions of the water. The two major corrosion indicators utilized in Virginia are the Langelier Index (L.I.) and the Aggressive Index (A.I.). Other indicators also exist. The L.I. and A.I. are determined by utilizing some or all of the following parameters:

- pH
- Calcium Hardness
- Alkalinity
- Temperature
- TDS

All waterworks owners will be notified periodically of the corrosivity of their drinking water by the commissioner, either as L.I., A.I. or other appropriate index. Noncorrosive water should be the goal of each waterworks owner.

Furthermore, EPA requires each owner to be aware of type of materials used in the distribution system (including service connections and household plumbing) such as:

LEAD	COPPER
Pipe	Piping
Solder	Service Lines
Caulking	Household Plumbing
Lining of Distribution Mains	-
Household Plumbing	-
-	-
GALVANIZED	Ferrous Piping (cast iron and steel)
Service Lines	Asbestos Cement Pipe
Household Plumbing	Vinyl Lined Asbestos Cement Pipe

- Coal-Tar Lined Pipes
- Plastic Pipe
- Piping
- Service Line
- Household Plumbing

#### FLUORIDE

When the fluoride concentration in drinking water is maintained within the recommended ranges of 0.8 mg/L minimum and 1.0 mg/L maximum with the optimum being 0.9 mg/L, the consumer will realize a reduction in dental caries. When supplemental fluoridation is practiced, it is particularly advantageous to maintain a fluoride concentration at or near the optimum. The reduction in dental caries experienced at optimal fluoride concentrations will be diminished by as much as 50% when the concentration is 0.2 mg/L below the optimum. An approval limit slightly higher than the optimum can be tolerated without any mottling of teeth, so where fluorides are native to the water supply, these concentrations are acceptable. Higher levels should be reduced by treatment or blending with other sources lower in fluoride content. The U.S. Environmental Protection Agency has determined that the PMCL for fluoride is 4.0 mg/L based on long term toxicity data. The EPA has also determined that the SMCL for fluoride is 2.0 mg/L based on the potential formation of cosmetically objectionable dental fluorosis as a result of long term exposure. The level of the SMCL was based on a balancing of the beneficial and undesirable effects of fluoride.

#### FOAMING AGENTS

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Foaming is an undesirable property of drinking water because it is esthetically displeasing and therefore should be absent. Because no convenient standardized foamability test exists, and because surfactants are one major class of substances that cause foaming, this property is determined indirectly by measuring the anionic surfactant concentration of substances measured by the methylene blue method and should not exceed 0.5 mg/L as methylene blue active substances (MBAS).

#### LEAD

##### ACTION LEVEL—0.015 mg/L

Lead is a toxic metal that tends to accumulate in the bone of man and animals. Signs of lead intoxication include gastrointestinal disturbances, fatigue, anemia, muscular paralysis, and encephalopathy. Irreversible damage to the brain is the frequent result of lead intoxication in children because of their eating lead-containing paint still found in older homes. The most serious effects on the nervous system are seldom seen in the adult population however.

Household plumbing has been identified as a significant contributor of lead to our drinking water; therefore, any notice to the public concerning lead should advise persons served by the system to use only the cold water faucet for drinking and for use in cooking or preparing baby formula, and to run the water until it gets as cold as it is going to get before each use. If there has recently been major water use in the household, such as showering or bathing, flushing toilets, or doing laundry with cold water, flushing the pipes should take 5 to 30 seconds, if not, flushing the pipes could take as long as several minutes. Each notice (see 12VAC5-590-520 A 8) should also advise persons served by the system to check to see if lead pipes, solder, or flux have been used in plumbing that provides tap water and to ensure that new plumbing and plumbing repairs use lead free materials.

The EPA's national primary drinking water regulation requires all public water systems to optimize corrosion control to minimize lead contamination resulting from the corrosion of plumbing

materials. Public water systems serving 50,000 people or fewer that have lead concentrations below 15 parts per billion (ppb) in more than 90% of tap water samples (the EPA "action level") have optimized their corrosion control treatment. Any water system that exceeds the action level must also monitor their source water to determine whether treatment to remove lead in source water is needed. Any water system that continues to exceed the action level after installation of corrosion control and/or source water treatment must eventually replace all lead service lines contributing in excess of 15 ppb of lead to drinking water. Any water system that exceeds the action level must also undertake a public education program to inform consumers of ways they can reduce their exposure to potentially high levels of lead in drinking water.

**NITRATE**

Nitrate nitrogen (NO<sub>3</sub>-N) levels not exceeding 20 mg/L may be allowed in a noncommunity waterworks if the owner demonstrates:

1. Such water will not be available to children under 6 months of age; and
2. There will be continuous posting of the fact that NO<sub>3</sub>-N levels exceed 10 mg/L and the potential health effects of exposure; and
3. Health officials will be notified annually of NO<sub>3</sub>-N levels that exceed 10 mg/L; and
4. No adverse health effects will result.

NOTE: Nitrite in water poses a greater health hazard but fortunately it seldom occurs in high concentrations. Waters with nitrite nitrogen concentrations over 1 mg/L should not be used for infant feedings.

**MANMADE RADIONUCLIDES**

To determine compliance with subsection B of Table 2.5, the detection limits shall not exceed the concentrations listed in the following table:

**DETECTION LIMITS FOR MAN-MADE BETA PARTICLE PHOTON-EMITTERS**

RADIONUCLIDE	DETECTION LIMIT
Tritium	1,000 pCi/L
Strontium-89	10 pCi/L
Strontium-90	2 pCi/L
Iodine-131	1 pCi/L
Cesium-134	10 pCi/L
Gross Beta	4 pCi/L
Other radionuclides	1/10 of the applicable limit

**RADIONUCLIDES**

To determine compliance with subsection B of Table 2.5, the detection limits shall not exceed the concentrations listed in the following table:

**DETECTION LIMITS FOR GROSS ALPHA PARTICLE ACTIVITY, RADIUM-226, RADIUM-228, AND URANIUM**

Contaminant	Detection Limit
Gross alpha particle activity	3 pCi/L

Radium-226	1 pCi/L
Radium-228	1 pCi/L
Uranium	1 µg/L

**TURBIDITY**

Operational requirement: Conventional water filtration plants utilizing surface waters as a source of supply are capable of producing filtered water with a turbidity consistently less than 0.1 NTU. Therefore, for water filtration plants the filter effluent turbidity for each filter, before any post-filtration chemical addition, operational limit is 0.1 NTU.

**APPENDIX C. FIELD OFFICE COUNTIES AND CITIES SERVED: (Repealed.)**

Regional Office	Counties and Cities Served
<b>ABINGDON</b> 454 E. Main Street P.O. Box 1985 Abingdon, VA 24210 703-628-5161	Planning Districts 1, 2, 3, and 4
<b>CULPEPER</b> 102 N. Main Street 3rd Floor Culpeper, VA 22704 703-825-6772	Planning Districts 8, 9, & 16
<b>DANVILLE</b> 1347 Piney Forest Road Danville, VA 24540 804-791-5222	Planning Districts 11, 12, 13, & 14
<b>LEXINGTON</b> 129 S. Randolph Street Lexington, VA 24450 703-463-7136	Planning Districts 5, 6, 7, and 10
<b>RICHMOND</b> 1500 E. Main Street, Room 109, P.O. Box 2448, Richmond, VA 23218 804-662-9530	

SOUTHEAST VIRGINIA  
5700 Thurston Avenue  
Suite 203  
Virginia Beach, VA 23455  
804-363-3876

Planning Districts 19, 20, 21, and 22

~~APPENDIX D. [RESERVED] (Repealed.)~~

~~APPENDIX E. [RESERVED] (Repealed.)~~

~~APPENDIX F. [REPEALED] (Repealed.)~~

~~APPENDIX G. MONITORING AND REPORTING. (Repealed.)~~

~~Analytical laboratory control testing, monitoring, and analyses at waterworks are made to control plant operation, to record plant performance, and to monitor conditions in the distribution system. Test results properly recorded, compiled and reported can be invaluable in improving plant performance, efficiency and cost effectiveness. Operational control testing should present evidence that the water has been properly prepared for each step in the treatment process. Testing should provide evidence that each process has proceeded according to its intended purpose and that finished water is clean, free from taste and odor, free from undesirable chemicals and considered safe.~~

~~Analytical equipment used to determine compliance with 12VAC5-590-510 D shall be of the laboratory type (continuous monitoring equipment may be acceptable if demonstrated to be accurate by correlation with a laboratory type instrument each shift) approved for use at the waterworks per 12VAC5-590-760.~~

~~These suggested monitoring and reporting requirements should be used as a guide in preparing, modifying, and reviewing operation monthly reports.~~

~~The field office of the Office of Water Programs will notify in writing each individual waterworks of the operation monthly report requirements and supply the waterworks with a standard example report form or will assist in the development of system specific report forms.~~

~~The following are suggested operation monthly report requirements that should be reported to the appropriate field office:~~

~~ALL SURFACE WATER SYSTEMS:~~

~~Number of hours in operation~~

~~-hours per day in operation~~

~~Raw water treated~~

~~-gpd and monthly total at each entry point~~

~~Finished water produced~~

~~-gpd and monthly total~~

~~Finished water used for treatment process~~

~~-monthly total~~

~~Finished water delivered to consumers~~

~~-monthly total~~

~~accountability (water lost) in distribution system~~

~~-percentage~~

Raw water temperature

–average °C or °F

Number of connections

–monthly average

Population served

–monthly average

Treatment plant maintenance activities

–brief summary of major activities

Chemical feeder laboratory and instrument calibration as appropriate

–quarterly for each chemical feeder or instrument unless specified elsewhere, i.e., fluoride feeders or manufacturer recommended

Waterworks not requiring operators in attendance whenever the plant is in operation may reduce some of the daily requirements.

#### WATERWORKS THAT PROVIDE DISINFECTION BY CHLORINATION:

Water plant monitoring:

Chlorine compound used

–liquid, dry, calcium hypochlorite or sodium hypochlorite

Amount of chlorine compound used at each application point

daily gallons or pounds

Date chlorine compound replenished

–for each application point

Free chlorine residual testing after the chlorine contact period

–every two hours of plant operation for waterworks requiring operators in attendance whenever the plant is in operation (see 12VAC5-500-440 B). Records must be kept of each residual determination. The daily lowest/highest residuals measured and the number of measurements taken should be reported.

–once per day for waterworks providing treatment or only disinfection and serving 400 or more persons and not requiring operators in attendance whenever the plant is in operation.

–frequency for waterworks providing only disinfection and serving less than 400 persons shall be set by the division on an individual basis.

–daily or at the same time as chlorine residual testing if less than daily.

Distribution system monitoring:

Free chlorine testing

–seven days per week for waterworks serving 400 or more persons

–five days per week for waterworks serving less than 400 persons

–number of tests per test day and test locations shall be set by the division on an individual basis. Records must be kept of each residual determination. The lowest, highest and average residuals measured and the number of measurements taken should be reported.

Total chlorine residual testing

–once per week at locations reflecting the maximum residence time of the water in the system



~~—number of tests per test day and test locations shall be set by the division on an individual basis. Records must be kept of each residual determination. The average residual measured and the number of measurements should be reported.~~

pH

~~—daily or at the same time of chlorine residual testing if less than daily.~~

~~NOTE: If the system performs disinfection utilizing the combined chlorine residual process, total residual testing should be substituted for free residual testing.~~

#### WATERWORKS EMPLOYING TURBIDITY REMOVAL:

Raw water monitoring:

pH

~~—electrometrically, every two hours~~

Alkalinity

~~—total, once per shift~~

Hardness

~~—total, once per shift~~

Turbidity

~~—NTU, every two hours~~

Raw water chemical treatment:

Coagulant

~~—type, weight applied, dosage~~

Coagulant aids

~~—type, weight applied, dosage~~

Stabilizing chemicals

~~—type, weight applied, dosage~~

Taste and odor control chemicals

~~—type, weight applied, dosage~~

Treated water (postflash mix) monitoring:

pH

~~—electrometrically, twice per shift~~

Coagulation control

~~—set on an individual basis~~

Alkalinity

~~—total, once per shift~~

Settled water (applied water) monitoring:

Turbidity

~~—NTU, must be from each sedimentation basin for high rate, may be from top of filter for rapid rate, every two hours~~

Chlorine residual

~~—type and daily average, every two hours~~

Settled water (applied water) chemical treatment:

Chemical

~~—type, weight applied and dosage~~

Filter aids

-type, weight applied and dosage

Filtered water monitoring:

Turbidity

-NTU, from each filter, every two hours, report maximum for the day

Filter operation:

Filters in operation

-number

Filter run time

-number hours between backwashes

Head loss

-each filter, end of each day or prior to backwash

Backwash time

-average, minutes

Backwash rate

-maximum, gpm

Backwash water

-gallons used

Rewash time

-if provided, average, minutes

Filter drop test results

-each filter tested quarterly

Filter rise rate test results

-each filter tested semiannually

Filtered water chemical treatment:

Stabilizing chemical

-type, weight applied per day, average dosage

Finished water monitoring:

pH

-electrometrically, every two hours

Alkalinity

-total, once per shift

Hardness

-total and calcium, once per shift

Turbidity

-NTU, every two hours

Chlorine residual

-every two hours low/high average

NOTES:

1. Daily averages and highest daily reading of the results of the required number of tests or measurements should be reported except for filtered water turbidity. Records of each test should be kept.

2. Frequency of testing is on a per shift basis unless otherwise indicated.

3. Number of tests per shift shall be set by the division on an individual basis.

4. Exact location of sample collection or testing shall be set by the division on an individual basis.

5. Where multiple sources are available, raw water data must be reported for each source.

#### WATERWORKS PRACTICING RECYCLE:

Recycle flow monitoring:

-total flows recycled, gallons

-average and maximum return rate of combined recycle flows

#### WATERWORKS FLUORIDATING:

Type of compound used

-chemical name

Amount of compound used at each application point

-pounds, daily

Feeder calibration date

-monthly

Hardness of water applied to sodium fluoride saturate feeders (where softners is required)

-weekly

Fluoride ion concentration in finished water

-one test per shift, minimum of one daily (monthly split sample with DCLS)

Fluoride ion concentration in the distribution system where two or more entry points contain fluoride

-frequency and location of tests shall be set by the division on an individual basis, both the minimum and maximum values must be reported

#### WATERWORKS EMPLOYING SOFTENING:

Lime, excess lime, and excess lime-soda processes:

-type, frequency and location of tests shall be set by the division on an individual basis

Cation exchange process:

Ion exchange material

-type, trade name

Regeneration

-date and method, each unit

Backwashing

-date and duration of washing, each unit

Softener influent hardness

-daily, each source

Softener effluent hardness

-daily, each unit

Blended water hardness

-daily, where appropriate

Stabilization-chemical

-type, weight, applied daily dosage, stabilized pH, alkalinity, hardness

**WATERWORKS EMPLOYING IRON AND MANGANESE CONTROL:-**

Removal by oxidation using continuous potassium permanganate regeneration, detention, and filtration:

Raw water iron and manganese concentrations

-daily, each source

Pre-oxidation chemical (usually chlorine prior to application of permanganate)

-type, amount applied daily at each source and average dosage

Iron and manganese concentration prior to application of permanganate

-daily

Potassium permanganate

-amount applied daily and average dosage

Filter influent iron and manganese concentrations

-daily, each filter

Filter effluent iron and manganese concentrations

-daily, each filter

Removal by ion exchange:

Ion exchange material

-type, trade name

Regeneration

-date, each unit and method

Backwashing

-date and duration of washing each unit

Raw water iron and manganese concentrations

-daily, each source

Exchange unit iron and manganese influent concentrations

-daily, each unit

Exchange unit iron and manganese effluent concentrations

-daily, each unit

NOTES:

1. Ion exchange process may also remove barium and radium which should be included or substituted in reporting.

2. Testing for other removal processes will be set by the division on an individual basis.

**WATERWORKS EMPLOYING STABILIZATION BY:**

The addition of carbon dioxide or acid to waters treated with excess lime for softening or manganese removal;

The addition of an alkali to reduce free carbon dioxide;

The addition of either soda ash or caustic soda to produce the desired calcium carbonate film where the alkalinity exceeds 35 mg/L;

The addition of lime to produce the desired calcium carbonate film where the water is soft;

The addition of a mixture of lime and soda ash to produce the desired calcium carbonate film where the water is soft and has a low carbon dioxide content;

The addition of polyphosphates for sequestering dissolved minerals.

Each chemical addition process should be monitored to determine the effectiveness of stabilization treatment and concentration of chemicals in the treated water. The type, frequency, and location of tests shall be set by the division on an individual basis.

**WATERWORKS EMPLOYING TASTE AND ODOR CONTROL BY:**

The addition of copper sulfate or other copper compounds to the reservoir;

The addition of activated carbon to the shallow areas of the reservoir;

The addition of potassium permanganate, chlorine, chlorine dioxide, or oxygen through aeration to the raw water;

The addition of powdered activated carbon to the treatment process at various locations; or

The use of granular activated carbon absorption units.

Each process should be monitored to ensure the threshold odor number does not exceed three. The dosage or application rates should be monitored to ensure correct control. The type, frequency, and location of tests and the reporting of usage shall be set by the division on an individual basis.

WATERWORKS EMPLOYING COLOR REMOVAL:	
Raw water color-	platinum-cobalt method
Settled water color-	platinum-cobalt method
Finished water color-	platinum-cobalt method

Monitoring, reporting, and frequencies shall be set by the division on an individual basis.

**CONSECUTIVE WATERWORKS:**

Finished water purchased

-gallons per month per source

Finished water delivered to consumers

-gallons per month

Accountability

-percentage

Number of connections

-monthly average

Population served

-monthly average

Free chlorine residual testing in the distribution system

-same as for waterworks that provide disinfection by chlorination

Total chlorine residual testing in the distribution system

-same as for waterworks that provide disinfection by chlorination

APPENDIX H. [REPEALED] (Repealed.)

APPENDIX I. SUGGESTED OUTLINE OF CONTENTS OF A CROSS CONNECTION CONTROL PROGRAM. (Repealed.)

Adopted ordinance (municipalities) - Make part of the program

Administration – name of individual responsible to carry out requirements of the program.

Procedures:

1. New facilities.
2. Existing facilities.

Records:

1. Locations of devices and types.
2. Inspections/questionnaires.
3. Testing and maintenance.

Notification:

1. Inspections of new and existing facilities.
2. Testing due.
3. Test results.
4. Device or means required.
5. Violations.
6. Termination or denial of service.

Reporting – procedures to follow in the event of or suspicion of contamination through a cross connection.

Backflow prevention device tester list.

Approved devices list.

Consumer education literature.

#### ~~SUGGESTED OUTLINE OF CONTENTS OF AN ORDINANCE FOR A CROSS CONNECTION CONTROL PROGRAM~~

Purpose of the ordinance – to eliminate cross connections and protect the public health.

Authority for ordinance – required by waterworks regulations.

Administration of the ordinance:

1. Who is responsible to carry out the requirements of the ordinance, by position?
2. Reference to an established program or policy procedures.
3. Responsibility to carry out the program or policy.

Enforcement of the ordinance:

1. Right of entry for inspection or testing.
2. Right to terminate or deny service.
3. Notice of violations.
4. Penalties.

Definitions – those in 12VAC5-590-20 of Article 1 of Part I which apply.

General requirements of purveyor and consumer – applicable provisions of Article 3 of Part II should be adopted and included as part of the ordinance. Modifications should be made to identify specific responsibilities.

#### ~~APPENDIX L. DETERMINATION OF CT. (Repealed.)~~

~~Disinfection Criteria~~

~~A treatment system must provide a minimum 3-log (99.9%) reduction of Giardia cysts and a 4-log (99.99%) reduction of viruses, respectively. Table L-1 lists the log removal credits~~

associated with four filtration processes and the inactivation levels that must be achieved by disinfection.

#### Determination of Compliance With Inactivation

To determine compliance with the inactivation requirements, a system must comply with the CT value(s) that is (are) based on disinfection conditions in the system during peak hourly flow. The "T" is the time in minutes it takes for the water during peak hourly flow to move between the point of disinfectant application and a point where "C", the residual concentration in mg/L, is measured before the water reaches the first customer. Contact time may be determined either by calculations, tracer studies, or an equivalent method as approved by the office. The contact time to be used for calculating CT is  $T_{10}$ , which is defined as the detention time at which 90 percent of the water passing through a unit is retained within that unit (e.g. mixing basins, sedimentation basins, clearwells, storage reservoirs, etc.)

Systems with only one point of disinfectant application may determine the total inactivation on the basis of residual measurements at a single point prior to the first customer or at several points within the treatment train after the point of disinfectant application. In the latter instance, the residual profile is determined and the total inactivation is calculated as follows: (1) Determine the disinfectant residual, C, in mg/L at any number of points within the treatment train; (2) Determine the travel time, T, in minutes between the point of disinfectant application and the point where C is measured within the first section. For subsequent measurements of C, T is the time required for water to move from the previous residual measurement point to the next; (3) Calculate CT corresponding to each residual measurement point ( $CT_{calc}$ ); (4) Determine the log inactivation for each section; and (5) Sum the log inactivations for each section to determine the total log inactivation. Tables L-2 through L-7 give CT values required for 99.9 percent inactivation (3 logs) of Giardia cysts at various pHs and temperatures. Tables L-9 through L-15 give CT values required for Giardia cysts and viruses at various temperatures using free chlorine, chlorine dioxide, chloramines and ozone. The minimum expected temperature and the maximum expected pH should be used for the calculations. Generally, if the CT required for 3-logs inactivation of Giardia cysts is achieved, the CT required for 4-logs inactivation of viruses is also achieved.

#### Determination of Disinfectant Contact Time

The time within contact units (including mixing basins and storage reservoirs) that is to be used in calculations of CT should be the  $T_{10}$  value, as defined earlier. This value can be determined either by calculations that involve the theoretical hydraulic detention time (volume divided by flow rate) and factors that account for the degree of short-circuiting that might be expected through any given unit or by tracer studies.

When  $T_{10}$  values are calculated, the theoretical, hydraulic detention time in a particular unit is reduced by some fraction, the magnitude of which is dictated by the degree of short-circuiting that is possible within that unit. The significant design characteristics that determine the degree of short-circuiting include the length-to-width ratio, the degree of baffling within the basins, and the effect of inlet baffling and outlet weir configurations. The use of these factors to obtain a  $T_{10}$  value effectively reduces the magnitude of T for use in CT calculations so that achieving a required CT requires the application of more disinfectant (i.e. a higher concentration).

The purposes of baffling are to (1) maximize utilization of basin volume, (2) increase the plug-flow zone in the basin, and (3) minimize short-circuiting. Three general classifications of baffling conditions (poor, average, and superior) have been developed to categorize the results of tracer studies for use in  $T_{10}$  determinations. The  $T_{10}/T$  ratios associated with each degree of baffling are summarized in Table L-8.

The three types of basin inlet baffling configurations are: a target baffle pipe inlet, an overflow weir entrance, and a baffled, submerged orifice or port inlet. Typical intra-basin baffling structures include: diffuser (perforated) walls; launders; cross-, longitudinal-, or maze baffling to cause

either horizontal or vertical serpentine flow; and longitudinal divider walls, which prevent mixing by increasing the length-to-width ratio of the basins. Commonly used baffled outlet structures include free-discharging weirs, such as sharp-crested and V-notch, and submerged ports or weirs. Weirs that do not span the width of the basin, such as Cipolletti weirs, should not be used, as they may substantially increase weir overflow rates and the dead-space zone within the basin. Figures L-1 through L-VI give examples of poor, average, and superior baffling conditions for rectangular and circular tanks.

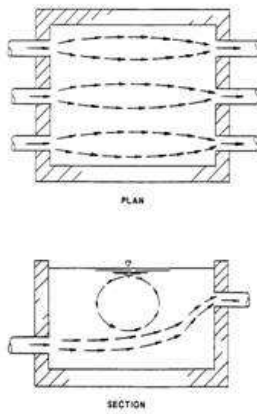


Figure L-1 Poor Baffling Condition — Rectangular Contact Basin

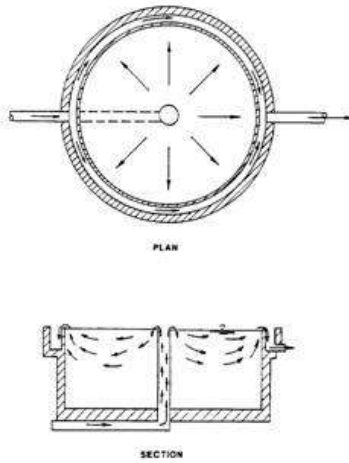
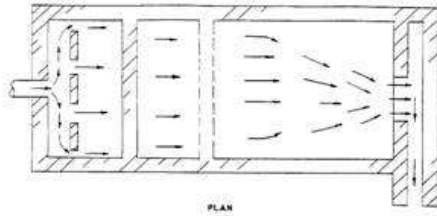
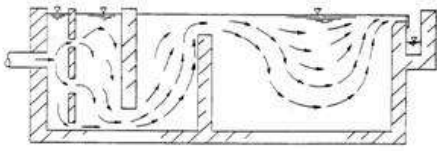


Figure L-2 Poor Baffling Condition — Circular Contact Basin



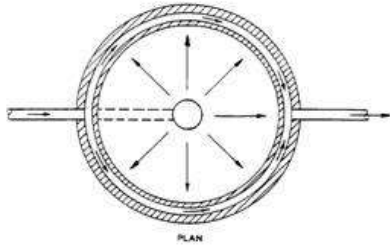


PLAN

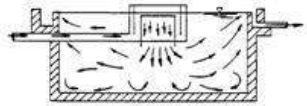


SECTION

Figure L-3 Average Baffling Condition—Rectangular Contact Basin



PLAN



SECTION

Figure L-4 Average Baffling Condition—Circular Contact Basin

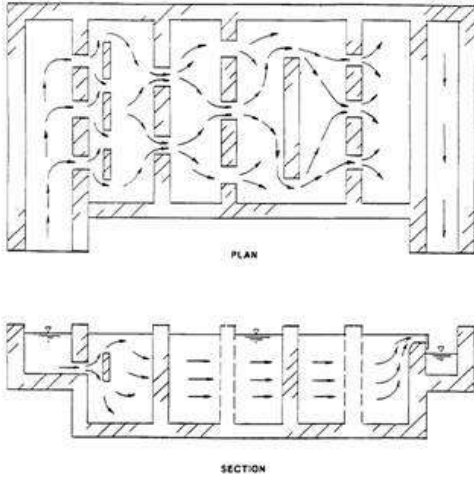


Figure L-5 Superior Baffling Conditions — Rectangular Contact Basin

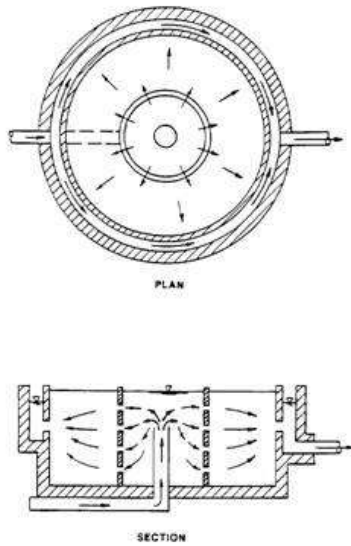


Figure L-6 Superior Baffling Conditions — Circular Contact Basin

The following is a sample problem based on the inactivation tables and  $T_{40}$  values calculated from information regarding the design features of the contact unit and the theoretical detention time. The disinfectant in this example is chlorine which is added just prior to the contact unit and the flow rate, pH, chlorine residual, and water temperature are assumed to be 1.5 MGD, 7.5, 1.0 mg/L, and 5 degrees C, respectively. The contact unit has a baffled inlet, intra-basin baffles, and a theoretical detention time of 90 minutes.

$T_{10}/T = 0.5$  (see Table L-8)

$T_{10} = 0.5 \times 90 \text{ minutes} = 45 \text{ minutes}$

$CT_{\text{calc}} = 1.0 \text{ mg/L} \times 45 \text{ minutes} = 45 \text{ mg-min/L}$

Note—Required inactivation is 0.5 logs since this particular disinfection process follows a conventional water treatment plant.

From Table L-3, 5°C

At pH = 7.5,  $C = 1.0 \text{ mg/L}$  and  $CT_{\text{calc}} = 45 \text{ mg-min/L}$ , interpolate the log inactivation.

$CT_{\text{calc}}$  of 45 mg-min/L falls between CTs of 30 (0.5 log) and 60 (1.0 log) mg-min/L. The corresponding log inactivation would be as follows:

$0.5 + [(45-30)/(60-30)] \times (1.0-0.5) = 0.75 \text{ logs}$

Therefore, the log inactivation requirement of 0.5 logs has been satisfied.

Although the detention time is proportional to flow, the relationship generally is not linear. Therefore, tracer studies may be used to establish detention times for the range of flow rates experienced within each disinfectant section.

Ideally, tracer tests should be conducted at a minimum of four flow rates that span the entire range of flows for the section being tested. The flow rates should be separated by approximately equal intervals to span the range of operation, with one near average flow, two greater than average, and one less than average. The flows should also be selected so that the highest is at least 91 percent of the highest flow rate expected to ever occur in that section. Four data points will ensure a good definition of the section's hydraulic profile.

Systems can perform just one tracer test for each disinfectant residual at a flow rate of not less than 91 percent of the highest flow rate experienced in that section. If only one tracer test is performed, the detention time determined by the test may be used to provide a conservative estimate in CT calculations for that section for all flow rates less than or equal to the flow rate during the tracer test. Since  $T_{10}$  is inversely proportional to flow rate, the  $T_{10}$  at a flow rate other than that occurring during the tracer study can be determined by multiplying the  $T_{10}$  determined from the tracer study by the ratio of the tracer study flow rate to the desired flow rate. That is:

$$T_{10S} = T_{10T} \times Q_T / Q_S$$

Where:

$T_{10S}$  =  $T_{10}$  at system flow rate

$T_{10T}$  =  $T_{10}$  at tracer flow rate

$Q_T$  = tracer study flow rate

$Q_S$  = system flow rate

When tracer studies are performed, several variables other than flow rate will affect the detention time, including varying water levels in tanks, seasonal fluctuations in flow, and differences in water temperature, which may cause thermal stratification. If these variables are significant, additional tracer studies to determine the appropriate  $T_{10}$  values may be warranted.

Two methods of tracer addition are commonly used in water treatment evaluations: the step-dose method and the slug dose method. In general, tracer studies involve the application of a chemical to a system and tracking the effluent concentrations over time. The effluent concentration profile is evaluated to determine the detention time  $T_{10}$ .

Step-dose tracer studies are frequently employed in drinking water applications because the necessary chemical feed equipment is available and the resulting profile of normalized concentrations versus time is used directly to determine the detention time ( $T_{10}$ ) required for calculating CT. The  $T_{10}$  value obtained from the studies is actually the time at which the effluent concentration of the tracer chemical is 10 percent of the added concentration.

The slug-dose method requires the addition of a large, initial dose of tracer to the incoming water. Samples are collected at the exit end of the unit for a period of time until the tracer passes through the unit. Disadvantages of this method include: (1) extremely concentrated solutions of chemicals are required; (2) intensive mixing is required to minimize potential density currents and to obtain uniform distribution; (3) the concentration and volume of the initial tracer dose must be calculated carefully to provide an adequate tracer profile; (4) the resulting profile of concentration versus time cannot be used directly to determine  $T_{10}$ ; and (5) a mass balance on the treatment section is required to determine whether the tracer was completely recovered. One advantage of this method is that it may be applied where chemical feed equipment is not available at the desired point of application or where the equipment that is available does not have adequate capacity.

**Disinfection Profile and Benchmark**

1. A disinfection profile is prepared by calculating the log inactivation for each disinfection segment of the treatment plant, from initial point of disinfectant addition to the entrance to the distribution system. The log inactivations for each segment are summed to yield the total plant log inactivation.
2. The procedure for computing the log inactivation is as follows:
  - a. Collect data daily (plants serving 10,000 or more people), or weekly on the same calendar day (plants serving less than 10,000 people), at each disinfectant residual sampling point during peak hourly flow, for:
    - (1) Water temperature (°C)
    - (2) Water pH (required for free chlorine calculation)
    - (3) Disinfectant residual concentration ("C," in mg/L)
  - b. Calculate contact time ("T," in minutes) for each disinfectant segment based on baffling factors or tracer studies.
  - c. Calculate  $CT_{actual}$  for each disinfection segment under actual operating conditions.
  - d. Determine the  $CT_{required}$  for 3-log Giardia inactivation ( $CT_{3-log\ Giardia}$ ) and/or 4-log virus ( $CT_{4-log\ virus}$ ) inactivation from the CT Tables.
  - e. Calculate the log inactivation for Giardia and/or viruses for each segment using:
    - (1) Log Inactivation of Giardia =  $3.0 * CT_{actual} / CT_{3-log\ Giardia}$
    - (2) Log inactivation of viruses =  $4.0 * CT_{actual} / CT_{4-log\ viruses}$
  - f. Sum the segment log inactivations to determine the plant log inactivation.
3. The disinfection profile is charted over the year and the benchmark is determined based on 12VAC5-590-500.

**TABLE L-1 MAXIMUM LOG REMOVAL CREDITS ALLOWED FOR FILTRATION AND MINIMUM REQUIRED LEVELS OF INACTIVATION BY DISINFECTION**

Minimum Required Disinfection				
Type of Filtration	Maximum Log Removal Credits		(Log Inactivations)	
	Giardia	Viruses	Giardia	Viruses
Conventional	2.5	2.0	0.5	2.0
Direct	2.0	1.0	1.0	3.0
Slow Sand	2.0	2.0	1.0	2.0
Diatomaceous Earth	2.0	1.0	1.0	3.0

NOTE—The sum of the log removals for filtration plus disinfection must equal 3.0 for Giardia and 4.0 for viruses.

TABLE L-2  
CT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE AT 0.5 C OR LOWER

CHLORINE CONCENTRATION (mg/L)	LOG INACTIVATIONS pH ≤ 6						-	LOG INACTIVATIONS pH = 6.5					
	0.5	1.0	1.5	2.0	2.5	3.0		0.5	1.0	1.5	2.0	2.5	3.0
≤ 0.4	23	46	69	94	114	137	-	27	54	82	109	136	163
0.6	24	47	71	94	114	141	-	28	56	84	112	140	168
0.8	24	48	73	97	121	145	-	29	57	86	115	144	172
1.0	25	49	74	99	123	147	-	29	59	88	117	146	174
1.2	25	51	76	101	125	149	-	30	60	90	120	149	177
1.4	26	52	78	103	127	151	-	31	61	92	122	151	179
1.6	26	52	79	104	128	152	-	32	63	95	124	152	180
1.8	27	54	81	105	129	153	-	32	64	97	126	154	181
2.0	28	55	83	107	131	155	-	33	66	99	128	156	182
2.2	28	56	85	109	133	157	-	34	67	101	130	158	184
2.4	29	57	86	111	135	159	-	34	68	103	132	160	185
2.6	29	58	88	113	137	161	-	35	70	105	134	162	187
2.8	30	59	89	115	139	163	-	36	71	107	136	164	188
3.0	30	60	91	117	141	165	-	36	72	109	138	166	190

-	pH=7.0						-	pH=7.5					
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	33	65	98	130	163	195	-	40	79	119	158	197	237
0.6	33	67	100	133	166	200	-	40	80	120	160	200	240
0.8	34	68	102	136	170	204	-	41	82	123	164	205	246
1.0	35	70	104	138	172	206	-	42	84	126	168	210	252
1.2	36	72	106	140	174	208	-	43	86	129	171	213	255
1.4	37	74	108	142	176	210	-	44	88	132	174	216	258
1.6	38	75	110	144	178	212	-	46	91	135	177	219	261
1.8	39	77	112	146	180	214	-	47	93	138	180	222	264
2.0	39	79	114	148	182	216	-	48	95	141	183	225	267
2.2	40	81	116	150	184	218	-	50	99	144	186	228	270
2.4	41	82	118	152	186	220	-	50	99	144	186	228	270
2.6	42	84	120	154	188	222	-	51	101	147	189	231	273
2.8	43	86	122	156	190	224	-	52	103	150	192	234	276
3.0	44	87	124	158	192	226	-	53	105	153	195	237	279

-	pH=8.0						-	pH=8.5					
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	46	92	138	184	230	276	-	55	111	166	221	276	331
0.6	48	95	142	190	236	282	-	57	114	171	226	282	337
0.8	49	98	146	196	242	288	-	59	117	176	231	288	343

1.0	51	40	45	20	25	30	-	64	12	18	24	30	36
	4	2	3	3	4			2	3	3	4	5	
1.2	52	40	45	20	26	34	-	63	12	18	25	34	37
	4	7	9	4	3			5	8	4	3	6	
1.4	54	40	46	24	26	32	-	65	12	19	25	32	38
	7	4	4	8	4			9	4	8	3	7	
1.6	55	44	46	24	27	32	-	66	13	19	26	33	39
	0	5	9	4	9			2	9	5	4	7	
1.8	56	44	46	22	28	33	-	68	13	20	27	33	40
	3	9	5	2	8			6	4	4	9	7	
2.0	58	44	47	23	28	34	-	70	13	20	27	34	41
	5	3	4	8	6			9	9	8	8	7	
2.2	59	44	47	23	29	35	-	74	14	21	28	35	42
	8	7	5	4	3			2	3	4	5	6	
2.4	60	42	48	24	30	36	-	73	14	21	29	36	43
	0	4	4	4	4			5	8	0	3	5	
2.6	64	42	48	24	30	36	-	74	14	22	29	37	44
	3	4	5	7	8			8	2	6	0	4	
2.8	63	42	48	25	34	37	-	75	15	22	30	37	45
	5	8	0	3	5			4	6	4	7	2	
3.0	64	42	49	25	34	38	-	77	15	23	30	38	46
	7	4	5	8	2			3	0	7	3	0	
-	pH = 9.0							-	-	-	-	-	-
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	-	-	-	-	-	-
≤0.4	65	43	49	26	32	39	-	-	-	-	-	-	-
	0	5	0	5	0								
0.6	68	43	20	27	33	40	-	-	-	-	-	-	-
	6	4	4	9	7								
0.8	70	44	24	28	35	42	-	-	-	-	-	-	-
	4	4	4	2	2								
1.0	73	44	24	29	36	43	-	-	-	-	-	-	-
	6	9	4	4	7								
1.2	75	45	22	30	37	45	-	-	-	-	-	-	-
	6	4	6	4									
1.4	77	45	23	30	38	46	-	-	-	-	-	-	-
	5	2	9	7	4								
1.6	80	45	23	34	39	47	-	-	-	-	-	-	-
	9	9	8	8	7								
1.8	82	46	24	32	40	48	-	-	-	-	-	-	-
	3	5	6	8	9								

2.0	83	46	25	33	44	50	-	-	-	-	-	-	-
	7	0	3	7	0								
2.2	85	17	25	34	42	54	-	-	-	-	-	-	-
	0	6	4	6	4								
2.4	87	17	26	34	43	52	-	-	-	-	-	-	-
	4	4	8	5	2								
2.6	89	17	26	35	44	53	-	-	-	-	-	-	-
	8	7	5	4	3								
2.8	94	18	27	36	45	54	-	-	-	-	-	-	-
	4	2	2	3	3								
3.0	92	18	27	36	46	55	-	-	-	-	-	-	-
	4	6	8	0	2								

TABLE L-3  
GT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE AT 5-C

CHLORINE CONCENTRA TION	LOG INACTIVATIONS						-	LOG INACTIVATIONS					
	pH ≤ 6							pH = 6.5					
(mg/L)	0.	1.	1.	2.	2.	3.	-	0.	1.	1.	2.	2.	3.
	5	0	5	0	5	0	-	5	0	5	0	5	0
≤0.4	4	32	49	65	84	97	-	2	39	59	78	98	11
	6						-	0					7
0.6	4	33	50	67	83	10	-	2	40	60	80	10	12
	7					0	-	0				0	0
0.8	4	34	52	69	86	10	-	2	44	64	84	10	12
	7					3	-	0				2	2
1.0	4	35	53	70	88	10	-	2	42	63	83	10	12
	8					5	-	4				4	5
1.2	4	36	54	74	89	10	-	2	42	64	85	10	12
	8					7	-	4				6	7
1.4	4	36	55	73	94	10	-	2	43	65	87	10	13
	8					9	-	2				8	0
1.6	4	37	56	74	93	11	-	2	44	66	88	11	13
	9					4	-	2				0	2
1.8	4	38	57	76	95	11	-	2	45	68	90	11	13
	9					4	-	3				3	5
2.0	4	39	58	77	97	11	-	2	46	69	92	11	13
	9					6	-	3				5	8
2.2	2	39	59	79	98	11	-	2	47	70	93	11	14
	0					8	-	3				7	0



2.4	2 0	40	60	80	10 0	12 0	-	2 4	48	72	95	11 9	14 3
2.6	2 0	41	61	81	10 2	12 2	-	2 4	49	73	97	12 2	14 6
2.8	2 4	41	62	83	10 3	12 4	-	2 5	49	74	99	12 3	14 8
3.0	2 4	42	63	84	10 5	12 6	-	2 5	50	76	10 4	12 6	15 4
-		pH=7.0					-		pH=7.5				
mg/L)	0 5	1 0	1 5	2 0	2 5	3 0	-	0 5	1 0	1 5	2 0	2 5	3 0
≤0.4	2 3	46	70	93	11 6	13 9	-	2 8	55	83	11 4	13 8	16 6
0.6	2 4	48	72	95	11 9	14 3	-	2 9	57	86	11 4	14 3	17 4
0.8	2 4	49	73	97	12 2	14 6	-	2 9	58	88	11 7	14 6	17 5
1.0	2 5	50	75	99	12 4	14 9	-	3 0	60	90	11 9	14 9	17 9
1.2	2 5	51	76	10 1	12 7	15 2	-	3 1	61	92	12 2	15 3	18 3
1.4	2 6	52	78	10 3	12 9	15 5	-	3 1	62	94	12 5	15 6	18 7
1.6	2 6	53	79	10 5	13 2	15 8	-	3 2	64	96	12 8	16 0	19 2
1.8	2 7	54	81	10 8	13 5	16 2	-	3 3	65	98	13 1	16 3	19 6
2.0	2 8	55	83	11 0	13 8	16 5	-	3 3	67	10 0	13 3	16 7	20 0
2.2	2 8	56	85	11 3	14 1	16 9	-	3 4	68	10 2	13 6	17 0	20 4
2.4	2 9	57	86	11 5	14 3	17 2	-	3 5	70	10 5	13 9	17 4	20 9
2.6	2 9	58	88	11 7	14 6	17 5	-	3 6	71	10 7	14 2	17 8	21 3
2.8	3 0	59	89	11 9	14 8	17 8	-	3 6	72	10 9	14 5	18 1	21 7
3.0	3 0	61	91	12 1	15 2	18 2	-	3 7	74	11 1	14 7	18 4	22 4
-		pH=8.0					-		pH=8.5				

mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	33	66	99	132	165	198	-	39	79	118	157	196	235
0.6	34	68	102	136	170	204	-	41	81	122	163	204	245
0.8	35	70	105	140	175	210	-	42	84	126	168	210	252
1.0	36	72	108	144	180	216	-	43	87	130	174	218	262
1.2	37	74	111	148	186	222	-	44	89	134	180	226	270
1.4	38	76	114	152	192	228	-	45	91	138	186	234	278
1.6	39	77	116	154	195	232	-	46	92	140	189	238	282
1.8	40	79	118	156	198	234	-	47	94	142	192	242	286
2.0	41	81	120	160	204	240	-	48	96	144	196	246	290
2.2	42	83	122	162	206	242	-	49	100	150	200	250	300
2.4	43	84	124	164	208	244	-	50	102	152	204	254	304
2.6	44	86	126	166	210	246	-	51	104	154	208	258	308
2.8	45	88	128	168	212	248	-	52	106	156	212	262	312
3.0	46	89	130	170	214	250	-	53	108	158	216	266	316
-	pH=9.0												
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	-	-	-	-	-	-
≤0.4	47	93	140	186	232	278	-	-	-	-	-	-	-
0.6	49	97	144	192	240	286	-	-	-	-	-	-	-
0.8	50	100	148	196	244	290	-	-	-	-	-	-	-
1.0	51	102	150	200	248	294	-	-	-	-	-	-	-

1.2	5 3	10 7	16 0	24 3	26 7	32 0	-	-	-	-	-	-
1.4	5 5	11 0	16 5	24 9	27 4	32 9	-	-	-	-	-	-
1.6	5 6	11 2	16 9	22 5	28 4	33 7	-	-	-	-	-	-
1.8	5 8	11 5	17 3	23 0	28 8	34 5	-	-	-	-	-	-
2.0	5 9	11 8	17 7	23 5	29 4	35 3	-	-	-	-	-	-
2.2	6 0	12 0	18 4	24 4	30 4	36 4	-	-	-	-	-	-
2.4	6 4	12 3	18 4	24 5	30 7	36 8	-	-	-	-	-	-
2.6	6 3	12 5	18 8	25 0	31 3	37 5	-	-	-	-	-	-
2.8	6 4	12 7	19 4	25 5	31 8	38 2	-	-	-	-	-	-
3.0	6 5	13 0	19 5	25 9	32 4	38 9	-	-	-	-	-	-

TABLE L-4  
CT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE AT 10 C

CHLORINE CONCENTRA TION	LOG INACTIVATIONS						-	LOG INACTIVATIONS					
	pH ≤ 6						-	pH = 6.5					
	0.	1.	1.	2.	2.	3.	0.	1.	1.	2.	2.	3.	
(mg/L)	5	0	5	0	5	0	-	5	0	5	0	5	0
≤ 0.4	1	2	37	49	64	73	-	1	2	44	59	73	88
	2	4						5	9				
0.6	1	2	38	50	63	75	-	1	3	45	60	75	90
	3	5						5	0				
0.8	1	2	39	52	65	78	-	1	3	46	64	77	92
	3	6						5	4				
1.0	1	2	40	53	66	79	-	1	3	47	63	78	94
	3	6						6	4				
1.2	1	2	40	53	67	80	-	1	3	48	63	79	95
	3	7						6	2				
1.4	1	2	41	55	68	82	-	1	3	49	65	82	98
	4	7						6	3				

1.6	4 4	2 8	42	55	69	83	-	4 7	3 3	50	66	83	99
1.8	4 4	2 9	43	57	72	86	-	4 7	3 4	51	67	84	10 4
2.0	4 5	2 9	44	58	73	87	-	4 7	3 5	52	69	87	10 4
2.2	4 5	3 0	45	59	74	89	-	4 8	3 5	53	70	88	10 5
2.4	4 5	3 0	45	60	75	90	-	4 8	3 6	54	71	89	10 7
2.6	4 5	3 1	46	61	77	92	-	4 8	3 7	55	73	92	11 0
2.8	4 6	3 1	47	62	78	93	-	4 9	3 7	56	74	93	11 0
3.0	4 6	3 2	48	63	79	95	-	4 9	3 8	57	75	94	11 3

	pH = 7.0							pH = 7.5					
(mg/L)	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0	-	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0
≤0.4	4 7	3 5	52	69	87	10 4	-	2 4	4 2	63	83	10 4	12 5
0.6	4 8	3 6	54	71	89	10 7	-	2 4	4 3	64	85	10 7	12 8
0.8	4 8	3 7	55	73	92	11 0	-	2 2	4 4	66	87	10 9	13 4
1.0	4 9	3 7	56	75	93	11 2	-	2 2	4 5	67	89	11 2	13 4
1.2	4 9	3 8	57	76	95	11 4	-	2 3	4 6	69	91	11 4	13 7
1.4	4 9	3 9	58	77	97	11 6	-	2 3	4 7	70	93	11 7	14 0
1.6	2 0	4 0	60	79	99	11 9	-	2 4	4 8	72	96	12 0	14 4
1.8	2 0	4 1	61	81	10 2	12 2	-	2 5	4 9	74	98	12 3	14 7
2.0	2 4	4 1	62	83	10 3	12 4	-	2 5	5 0	75	10 0	12 5	15 0
2.2	2 4	4 2	64	85	10 6	12 7	-	2 6	5 1	77	10 2	12 8	15 3
2.4	2 2	4 3	65	86	10 8	12 9	-	2 6	5 2	79	10 5	13 4	15 7

2.6	2 2	4 4	66 67	87 89	10 11	13 13	-	2 7	5 3	80 82	10 10	13 13	16 16
2.8	2 2	4 5	67 69	89 94	11 11	13 13	-	2 7	5 4	82 83	10 11	13 13	16 16
3.0	2 3	4 6	69 69	94 94	11 11	13 13	-	2 8	5 5	83 83	11 11	13 13	16 16
-	pH=8.0						-	pH=8.5					
(mg/L)	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0	-	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0
≤0.4	2 5	5 0	75 75	99 99	12 4	14 9	-	3 0	5 0	89 89	11 8	14 8	17 7
0.6	2 6	5 1	77 77	10 10	12 8	15 3	-	3 1	6 1	92 92	12 2	15 3	18 3
0.8	2 6	5 3	79 79	10 10	13 5	15 2	-	3 2	6 3	95 95	12 6	15 8	18 9
1.0	2 7	5 4	81 81	10 10	13 8	16 5	-	3 3	6 5	98 98	13 0	16 3	19 5
1.2	2 8	5 5	83 83	11 11	13 8	16 6	-	3 3	6 7	10 10	13 3	16 7	20 0
1.4	2 8	5 7	85 85	11 11	14 2	17 0	-	3 4	6 9	10 10	13 7	17 2	20 6
1.6	2 9	5 8	87 87	11 11	14 6	17 5	-	3 5	7 0	10 10	14 1	17 6	21 1
1.8	3 0	6 0	90 90	11 11	14 9	17 9	-	3 6	7 2	10 10	14 3	17 9	21 5
2.0	3 0	6 1	91 91	12 12	15 2	18 2	-	3 7	7 4	11 11	14 7	18 4	22 1
2.2	3 1	6 2	93 93	12 12	15 5	18 6	-	3 8	7 5	11 11	15 0	18 8	22 5
2.4	3 2	6 3	95 95	12 12	15 8	19 0	-	3 8	7 7	11 11	15 5	19 3	23 0
2.6	3 2	6 5	97 97	12 12	16 2	19 4	-	3 9	7 8	11 11	15 7	19 6	23 4
2.8	3 3	6 6	99 99	13 13	16 4	19 7	-	4 0	8 0	12 12	15 0	19 9	23 9
3.0	3 4	6 7	10 10	13 13	16 8	20 1	-	4 1	8 1	12 12	16 2	20 3	24 3
-	pH=9.0						-	-	-	-	-	-	-
(mg/L)	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0	-	-	-	-	-	-	-

≤0.4	3 5	7 0	10 5	13 9	17 4	20 9	-	-	-	-	-	-
0.6	3 6	7 3	10 9	14 5	18 2	21 8	-	-	-	-	-	-
0.8	3 8	7 5	11 3	15 4	18 8	22 6	-	-	-	-	-	-
1.0	3 9	7 8	11 7	15 6	19 5	23 4	-	-	-	-	-	-
1.2	4 0	8 0	12 0	16 0	20 0	24 0	-	-	-	-	-	-
1.4	4 1	8 2	12 4	16 5	20 6	24 7	-	-	-	-	-	-
1.6	4 2	8 4	12 7	16 9	21 4	25 3	-	-	-	-	-	-
1.8	4 3	8 6	13 0	17 3	21 6	25 9	-	-	-	-	-	-
2.0	4 4	8 8	13 3	17 7	22 4	26 5	-	-	-	-	-	-
2.2	4 5	9 0	13 6	18 4	22 6	27 4	-	-	-	-	-	-
2.4	4 6	9 2	13 8	18 4	23 0	27 6	-	-	-	-	-	-
2.6	4 7	9 4	14 4	18 7	23 4	28 4	-	-	-	-	-	-
2.8	4 8	9 6	14 4	19 4	23 9	28 7	-	-	-	-	-	-
3.0	4 9	9 7	14 6	19 5	24 3	29 2	-	-	-	-	-	-

TABLE L-5  
CT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE AT 15 C

CHLORINE CONCENTRA TION	LOG INACTIVATIONS						LOG INACTIVATIONS						
	pH ≤ 6.0						pH = 6.5						
(mg/L)	0. 5	1. 0	1. 5	2. 0	2. 5	3. 0	-	0. 5	1. 0	1. 5	2. 0	2. 5	3. 0
≤0.4	8 6	4 5	2 5	33	41	49	-	4 0	2 0	3 0	39	49	59
0.6	8 7	4 5	2 5	33	42	50	-	4 0	2 0	3 0	40	50	60

0.8	9	4	2	35	43	52	-	4	2	3	41	51	61
	7	6						0	0	4			
1.0	9	4	2	35	44	53	-	4	2	3	42	53	63
	8	7						4	4	2			
1.2	9	4	2	36	45	54	-	4	2	3	43	53	64
	8	7						4	4	2			
1.4	9	4	2	37	46	55	-	4	2	3	43	54	65
	8	8						4	2	3			
1.6	9	4	2	37	47	56	-	4	2	3	44	55	66
	9	8						4	2	3			
1.8	4	4	2	38	48	57	-	4	2	3	45	57	68
	0	9	9					4	3	4			
2.0	4	4	2	39	48	58	-	4	2	3	46	58	69
	0	9	9					2	3	5			
2.2	4	2	3	39	49	59	-	4	2	3	47	58	70
	0	0	0					2	3	5			
2.4	4	2	3	40	50	60	-	4	2	3	48	60	72
	0	0	0					2	4	6			
2.6	4	2	3	41	51	61	-	4	2	3	49	61	73
	0	0	4					2	4	7			
2.8	4	2	3	41	52	62	-	4	2	3	49	62	74
	0	4	4					2	5	7			
3.0	4	2	3	42	53	63	-	4	2	3	51	63	76
	4	4	2					3	5	8			

-	pH=7.0						-	pH=7.5					
(mg/L)	0.	1.	1.	2.	2.	3.	-	0.	1.	1.	2.	2.	3.
	5	0	5	0	5	0		5	0	5	0	5	0
≤0.4	4	2	3	47	58	70	-	4	2	4	55	69	83
	2	3	5					4	8	2			
0.6	4	2	3	48	60	72	-	4	2	4	57	72	86
	2	4	6					4	9	3			
0.8	4	2	3	49	61	73	-	4	2	4	59	73	88
	2	4	7					5	9	4			
1.0	4	2	3	50	63	75	-	4	3	4	60	75	90
	3	5	8					5	0	5			
1.2	4	2	3	51	63	76	-	4	3	4	61	77	92
	3	5	8					5	4	6			
1.4	4	2	3	52	65	78	-	4	3	4	63	78	94
	3	6	9					6	4	7			
1.6	4	2	4	53	66	79	-	4	3	4	64	80	96
	3	6	0					6	2	8			

1.8	4 4	2 7	4 1	54	68	81	-	4 6	3 3	4 9	65	82	98
2.0	4 4	2 8	4 2	55	69	83	-	4 7	3 3	5 0	67	83	10 0
2.2	4 4	2 8	4 3	57	71	85	-	4 7	3 4	5 1	68	85	10 2
2.4	4 4	2 9	4 3	57	72	86	-	4 8	3 5	5 3	70	88	10 5
2.6	4 5	2 9	4 4	59	73	88	-	4 8	3 6	5 4	71	89	10 7
2.8	4 5	3 0	4 5	59	74	89	-	4 8	3 6	5 5	73	91	10 9
3.0	4 5	3 0	4 6	64	76	91	-	4 9	3 7	5 6	74	93	11 1

-	pH=8.0						-	pH=8.5					
(mg/L)	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0	-	0- 5	1- 0	1- 5	2- 0	2- 5	3- 0
≤0.4	4 7	3 3	5 0	66	83	90	-	2 0	3 9	5 9	79	98	11 8
0.6	4 7	3 4	5 1	68	85	10 2	-	2 0	4 1	6 1	81	10 2	12 2
0.8	4 8	3 5	5 3	70	88	10 5	-	2 1	4 2	6 3	84	10 5	12 6
1.0	4 8	3 6	5 4	72	90	10 8	-	2 2	4 3	6 5	87	10 8	13 0
1.2	4 9	3 7	5 6	74	93	11 1	-	2 2	4 5	6 7	89	11 2	13 4
1.4	4 9	3 8	5 7	76	95	11 4	-	2 3	4 6	6 9	91	11 4	13 7
1.6	4 9	3 9	5 8	77	97	11 6	-	2 4	4 7	7 1	94	11 8	14 1
1.8	2 0	4 0	6 0	79	99	11 9	-	2 4	4 8	7 2	96	12 0	14 4
2.0	2 0	4 1	6 1	81	10 2	12 2	-	2 5	4 9	7 4	98	12 3	14 7
2.2	2 1	4 1	6 2	83	10 3	12 4	-	2 5	5 0	7 5	10 0	12 5	15 0
2.4	2 1	4 2	6 4	85	10 6	12 7	-	2 6	5 1	7 7	10 2	12 8	15 3
2.6	2 2	4 3	6 5	86	10 8	12 9	-	2 6	5 2	7 8	10 4	13 0	15 6



2.8	2	4	6	88	11	13	-	2	5	8	10	13	15
	2	4	6		0	2		7	3	0	6	3	9
3.0	2	4	6	89	11	13	-	2	5	8	10	13	16
	2	5	7		2	4		7	4	1	8	5	2
-	pH = 9.0												
(mg/L)	0.	1.	1.	2.	2.	3.	-	-	-	-	-	-	-
	5	0	5	0	5	0							
≤0.4	2	4	7	93	11	14	-	-	-	-	-	-	-
	3	7	0		7	0							
0.6	2	4	7	97	12	14	-	-	-	-	-	-	-
	4	9	3		2	6							
0.8	2	5	7	10	12	15	-	-	-	-	-	-	-
	5	0	6	1	6	1							
1.0	2	5	7	10	13	15	-	-	-	-	-	-	-
	6	2	8	4	0	6							
1.2	2	5	8	10	13	16	-	-	-	-	-	-	-
	7	3	0	7	3	0							
1.4	2	5	8	11	13	16	-	-	-	-	-	-	-
	8	5	3	0	8	5							
1.6	2	5	8	11	14	16	-	-	-	-	-	-	-
	8	6	5	3	1	9							
1.8	2	5	8	11	14	17	-	-	-	-	-	-	-
	9	8	7	5	4	3							
2.0	3	5	8	11	14	17	-	-	-	-	-	-	-
	0	9	9	8	8	7							
2.2	3	6	9	12	15	18	-	-	-	-	-	-	-
	0	0	1	1	1	1							
2.4	3	6	9	12	15	18	-	-	-	-	-	-	-
	1	1	2	3	3	4							
2.6	3	6	9	12	15	18	-	-	-	-	-	-	-
	1	3	4	5	7	8							
2.8	3	6	9	12	15	19	-	-	-	-	-	-	-
	2	4	6	7	9	1							
3.0	3	6	9	13	16	19	-	-	-	-	-	-	-
	3	5	8	0	3	5							

TABLE L-6  
CT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE AT 20°C

CHLORINE CONCENTRA TION	LOG INACTIVATIONS	-	LOG INACTIVATIONS
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	pH ≤ 6.0							pH = 6.5					
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤ 0.4	6	4	4	2	30	36	-	7	4	2	2	37	44
0.6	6	4	4	2	32	38	-	8	4	2	3	38	45
0.8	7	4	2	2	33	39	-	8	4	2	3	38	45
1.0	7	4	2	2	33	39	-	8	4	2	3	39	47
1.2	7	4	2	2	33	40	-	8	4	2	3	40	48
1.4	7	4	2	2	34	41	-	8	4	2	3	41	49
1.6	7	4	2	2	35	42	-	8	4	2	3	42	50
1.8	7	4	2	2	36	43	-	9	4	2	3	43	51
2.0	7	4	2	2	37	44	-	9	4	2	3	43	52
2.2	7	4	2	2	37	44	-	9	4	2	3	44	53
2.4	8	4	2	3	38	45	-	9	4	2	3	45	54
2.6	8	4	2	3	38	46	-	9	4	2	3	46	55
2.8	8	4	2	3	39	47	-	9	4	2	3	47	56
3.0	8	4	2	3	39	47	-	10	4	2	3	48	57

	pH = 7.0							pH = 7.5					
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤ 0.4	9	4	2	3	43	52	-	4	2	3	4	52	62
0.6	9	4	2	3	45	54	-	4	2	3	4	53	64
0.8	9	4	2	3	46	55	-	4	2	3	4	55	66

1.0	0	1	2	3	47	56	-	1	2	3	4	56	67
	0	9	8	7				1	2	3	4	5	
1.2	1	1	2	3	48	57	-	1	2	3	4	58	69
	0	9	9	8				2	3	5	6		
1.4	1	1	2	3	48	58	-	1	2	3	4	58	70
	0	9	9	9				2	3	5	7		
1.6	1	2	3	3	49	59	-	1	2	3	4	60	72
	0	0	0	9				2	4	6	8		
1.8	1	2	3	4	51	61	-	1	2	3	4	62	74
	0	0	1	1				2	5	7	9		
2.0	1	2	3	4	52	62	-	1	2	3	5	63	75
	0	1	1	1				3	5	8	0		
2.2	1	2	3	4	53	63	-	1	2	3	5	64	77
	1	1	2	2				3	6	9	1		
2.4	1	2	3	4	54	65	-	1	2	3	5	65	78
	1	2	3	3				3	6	9	2		
2.6	1	2	3	4	55	66	-	1	2	4	5	67	80
	1	2	3	4				3	7	0	3		
2.8	1	2	3	4	56	67	-	1	2	4	5	68	81
	1	2	4	5				4	7	1	4		
3.0	1	2	3	4	57	68	-	1	2	4	5	69	83
	1	3	4	5				4	8	2	5		

-	pH = 8.0						-	pH = 8.5					
(mg/L)	0.	1.	1.	2.	2.	3.	-	0.	1.	1.	2.	2.	3.
	5	0	5	0	5	0	-	5	0	5	0	5	0
≤0.4	1	2	3	4	62	74	-	1	3	4	5	74	89
	2	5	7	9				5	0	5	9		
0.6	1	2	3	5	64	77	-	1	3	4	6	77	92
	3	6	9	1				5	1	6	1		
0.8	1	2	4	5	66	79	-	1	3	4	6	79	95
	3	6	0	3				6	2	8	3		
1.0	1	2	4	5	68	81	-	1	3	4	6	82	98
	4	7	1	4				6	3	9	5		
1.2	1	2	4	5	69	83	-	1	3	5	6	83	10
	4	8	2	5				7	3	0	7		0
1.4	1	2	4	5	71	85	-	1	3	5	6	86	10
	4	8	3	7				7	4	2	9		3
1.6	1	2	4	5	73	87	-	1	3	5	7	88	10
	5	9	4	8				8	5	3	0		5
1.8	1	3	4	5	74	89	-	1	3	5	7	90	10
	5	0	5	9				8	6	4	2		8

2.0	4 5	3 0	4 6	6 4	76	94	-	4 8	3 7	5 5	7 3	92	14 0
2.2	4 6	3 4	4 7	6 2	78	93	-	4 9	3 8	5 7	7 5	94	14 3
2.4	4 6	3 2	4 8	6 3	79	95	-	4 9	3 8	5 8	7 7	96	14 5
2.6	4 6	3 2	4 9	6 5	84	97	-	2 0	3 9	5 9	7 8	98	14 7
2.8	4 7	3 3	5 0	6 6	83	99	-	2 0	4 0	6 0	7 9	99	14 9
3.0	4 7	3 4	5 4	6 7	84	104	-	2 0	4 4	6 4	8 4	102	12 2

	pH = 9.0												
(mg/L)	0. 5	1. 0	1. 5	2. 0	2. 5	3. 0	-	-	-	-	-	-	-
≤0.4	4 8	3 5	5 3	7 0	88	10 5	-	-	-	-	-	-	-
0.6	4 8	3 6	5 5	7 3	94	10 9	-	-	-	-	-	-	-
0.8	4 9	3 8	5 7	7 5	94	11 3	-	-	-	-	-	-	-
1.0	2 0	3 9	5 9	7 8	98	11 7	-	-	-	-	-	-	-
1.2	2 0	4 0	6 0	8 0	10 0	12 0	-	-	-	-	-	-	-
1.4	2 4	4 4	6 2	8 2	10 3	12 3	-	-	-	-	-	-	-
1.6	2 4	4 2	6 3	8 4	10 5	12 6	-	-	-	-	-	-	-
1.8	2 2	4 3	6 5	8 6	10 8	12 9	-	-	-	-	-	-	-
2.0	2 2	4 4	6 6	8 8	11 0	13 2	-	-	-	-	-	-	-
2.2	2 3	4 5	6 8	8 0	11 3	13 5	-	-	-	-	-	-	-
2.4	2 3	4 6	6 9	8 2	11 5	13 8	-	-	-	-	-	-	-
2.6	2 4	4 7	6 4	8 4	11 8	14 4	-	-	-	-	-	-	-
2.8	2 4	4 8	6 2	8 5	11 9	14 3	-	-	-	-	-	-	-

3.0            2    4    7    9    12    14    -    -    -    -    -    -    -  
 4    9    3    7    2    6

TABLE L-7  
 CT VALUES FOR INACTIVATION OF GIARDIA CYSTS BY FREE CHLORINE

CHLORINE CONCENTRAT ION (mg/L)	LOG INACTIVATIONS pH ≤ 6.0						-	LOG INACTIVATIONS pH = 6.5					
	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤ 0.4	4	8	12	16	20	24	-	5	10	15	20	25	30
0.6	4	8	12	16	20	24	-	5	10	15	20	25	30
0.8	4	8	12	16	20	24	-	5	10	15	20	25	30
1.0	4	8	12	16	20	24	-	5	10	15	20	25	30
1.2	5	10	15	20	25	30	-	6	12	18	24	30	36
1.4	5	10	15	20	25	30	-	6	12	18	24	30	36
1.6	5	10	15	20	25	30	-	6	12	18	24	30	36
1.8	5	10	15	20	25	30	-	6	12	18	24	30	36
2.0	5	10	15	20	25	30	-	6	12	18	24	30	36
2.2	5	10	15	20	25	30	-	6	12	18	24	30	36
2.4	5	10	15	20	25	30	-	6	12	18	24	30	36
2.6	5	10	15	20	25	30	-	6	12	18	24	30	36
2.8	5	10	15	20	25	30	-	6	12	18	24	30	36
3.0	5	10	15	20	25	30	-	6	12	18	24	30	36

pH = 7.0

pH = 7.5

(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	6	12	18	23	29	35	-	7	14	21	28	35	42
0.6	6	12	18	24	30	36	-	7	14	21	29	36	43
0.8	6	12	19	25	31	37	-	7	14	22	30	37	44
1.0	6	12	20	26	32	38	-	8	16	24	32	40	48
1.2	6	13	20	27	33	39	-	8	16	25	33	41	49
1.4	7	14	21	28	34	40	-	8	16	25	34	42	50
1.6	7	14	22	29	35	41	-	8	16	26	35	43	51
1.8	7	14	23	30	36	42	-	8	16	27	36	44	52
2.0	7	14	24	31	37	43	-	8	17	28	37	45	53
2.2	7	14	25	32	38	44	-	9	18	29	38	46	54
2.4	7	14	26	33	39	45	-	9	18	30	39	47	55
2.6	7	15	27	34	40	46	-	9	18	31	40	48	56
2.8	8	16	28	35	41	47	-	9	18	32	41	49	57
3.0	8	16	29	36	42	48	-	9	18	33	42	50	58

	pH = 8.0							pH = 8.5					
(mg/L)	0.5	1.0	1.5	2.0	2.5	3.0	-	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	8	17	25	33	41	50	-	10	20	30	40	50	60
0.6	9	18	27	36	45	54	-	10	21	31	41	51	61
0.8	9	18	28	37	46	55	-	10	21	32	42	52	62
1.0	9	18	29	38	47	56	-	10	21	33	43	53	63

1.2	0	1	2	3	4	5	-	1	2	3	4	5	6
	8	8	7	6	5	5		1	2	3	4	5	6
1.4	1	1	2	3	4	5	-	1	2	3	4	5	6
	0	0	0	8	8	7		2	3	5	6	8	9
1.6	1	1	2	3	4	5	-	1	2	3	4	5	7
	0	0	0	9	8	8		2	3	5	7	8	0
1.8	1	2	3	4	5	6	-	1	2	3	4	6	7
	0	0	0	0	0	0		2	4	6	8	0	2
2.0	1	2	3	4	5	6	-	1	2	3	4	6	7
	0	0	1	1	1	1		2	5	7	9	2	4
2.2	1	2	3	4	5	6	-	1	2	3	5	6	7
	0	1	1	1	2	2		3	5	8	0	3	5
2.4	1	2	3	4	5	6	-	1	2	3	5	6	7
	1	1	2	2	3	3		3	6	9	1	4	7
2.6	1	2	3	4	5	6	-	1	2	3	5	6	7
	1	2	3	3	4	5		3	6	9	2	5	8
2.8	1	2	3	4	5	6	-	1	2	4	5	6	8
	1	2	3	4	5	6		3	7	0	3	7	0
3.0	1	2	3	4	5	6	-	1	2	4	5	6	8
	1	2	4	5	6	7		4	7	1	4	8	1
-	pH=9.0						-	-	-	-	-	-	-
(mg/L)	0.	1.	1.	2.	2.	3.	-	-	-	-	-	-	-
	5	0	5	0	5	0							
≤0.4	1	2	3	4	5	7	-	-	-	-	-	-	-
	2	3	5	7	8	0							
0.6	1	2	3	4	6	7	-	-	-	-	-	-	-
	2	4	7	9	1	3							
0.8	1	2	3	5	6	7	-	-	-	-	-	-	-
	3	5	8	0	3	5							
1.0	1	2	3	5	6	7	-	-	-	-	-	-	-
	3	6	9	2	5	8							
1.2	1	2	4	5	6	8	-	-	-	-	-	-	-
	3	6	0	3	7	0							
1.4	1	2	4	5	6	8	-	-	-	-	-	-	-
	4	7	1	5	8	2							
1.6	1	2	4	5	7	8	-	-	-	-	-	-	-
	4	8	2	6	0	4							
1.8	1	2	4	5	7	8	-	-	-	-	-	-	-
	4	0	3	7	2	6							
2.0	1	2	4	5	7	8	-	-	-	-	-	-	-
	5	0	4	9	3	8							

2.2	4 5	3 0	4 5	6 0	7 5	9 0	-	-	-	-	-	-	-
2.4	4 5	3 1	4 6	6 1	7 7	9 2	-	-	-	-	-	-	-
2.6	4 6	3 1	4 7	6 3	7 8	9 4	-	-	-	-	-	-	-
2.8	4 6	3 2	4 8	6 4	8 0	9 6	-	-	-	-	-	-	-
3.0	4 6	3 2	4 9	6 5	8 1	9 7	-	-	-	-	-	-	-

TABLE L-8  
BAFFLING CLASSIFICATIONS

Baffling Condition	$T_{10}/T$	Baffling Description
Unbaffled (mixed flow)	0.1	None, agitated basin, very low length to width ratio, high inlet and outlet flow velocities
Poor	0.3	Single or multiple unbaffled inlets and outlets, no intrabasin baffles
Average	0.5	Baffled inlet or outlet with some intrabasin baffles
Superior	0.7	Perforated inlet baffle, serpentine or perforated intrabasin baffles, outlet weir or perforated launders
Excellent	0.9	Serpentine baffling throughout basin, very high length to width ratio
Perfect (plug flow)	1.0 <sup>(1)</sup>	Very high length to width ratio (pipeline flow), perforated inlet, outlet, and intrabasin baffles

<sup>(1)</sup>At perfect plug flow conditions,  $T_{10}$  is equal to  $T$ .

Table L-9:  
CT Values for Inactivation of Viruses by Free Chlorine, pH 6.0-9.0

Inactivation (log)	Temperature (°C)												
	0.5	1	2	3	4	5	6	7	8	9	10	11	12
2	6.0	5.8	5.3	4.9	4.4	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.6
3	9.0	8.7	8.0	7.3	6.7	6.0	5.6	5.2	4.8	4.4	4.0	3.8	3.6
4	12.0	11.6	10.7	9.8	8.9	8.0	7.6	7.2	6.8	6.4	6.0	5.6	5.2
Inactivation (log)	Temperature (°C)												
	13	14	15	16	17	18	19	20	21	22	23	24	25
2	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1.0	1.0	1.0	1.0	1.0	1.0



3	3.4	3.2	3.0	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1.0
4	4.8	4.4	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.2	2.0

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-10.  
CT Values for Inactivation of Giardia Cysts by Chlorine Dioxide, pH 6.0-9.0

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
0.5	10.0	8.6	7.2	5.7	4.3	4.2	4.2	4.1	4.1	4.0	3.8	3.7	3.5
1	21.0	17.9	14.9	11.8	8.7	8.5	8.3	8.1	7.9	7.7	7.4	7.1	6.9
1.5	32.0	27.3	22.5	17.8	13.0	12.2	12.6	12.4	12.2	12.0	11.6	11.2	10.8
2	42.0	35.8	29.5	23.3	17.0	16.6	16.2	15.8	15.4	15.0	14.6	14.2	13.8
2.5	52.0	44.5	37.0	29.5	22.0	21.4	20.8	20.2	19.6	19.0	18.4	17.8	17.2
3	62.0	53.8	44.5	35.3	26.0	25.5	24.8	24.2	23.6	23.0	22.2	21.4	20.6
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
0.5	3.4	3.2	3.1	2.9	2.8	2.6	2.5	2.4	2.3	2.2	2.1	2.0	-
1	6.6	6.3	6.0	5.8	5.5	5.3	5.0	4.7	4.5	4.2	4.0	3.7	-
1.5	10.4	10.0	9.5	9.0	8.5	8.0	7.5	7.1	6.7	6.3	5.9	5.5	-

2	1 3. 4	1 3. 0	12. 4	11. 8	11. 2	10. 6	1 0. 0	9. 5	8.9	8.4	7. 8	7. 3	-
2.5	1 6. 6	1 6. 0	15. 4	14. 8	14. 2	13. 6	1 3. 0	1 2. 2	11. 4	10. 6	9. 8	9. 0	-
3	1 9. 8	1 9. 0	18. 2	17. 4	16. 6	15. 8	1 5. 0	1 4. 2	13. 4	12. 6	1 1. 8	1 1. 0	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-11.  
CT Values for Inactivation of Viruses by Chlorine Dioxide, pH 6.0-9.0

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	8. 4	7.7	7.0	6.3	5.6	5 . 3	5. 0	4.8	4.5	4 . 2	3. 9	3. 6	3. 4
3	2 5. 6	23.5	21. 4	19. 2	17. 1	1 6 . 2	1 5. 4	14.5	13. 7	1 2 . 8	1 2. 0	1 1. 4	1 0. 3
4	5 0. 1	45.9	41. 8	37. 6	33. 4	3 1 . 7	3 0. 1	28.4	26. 8	2 5 . 1	2 3. 4	2 1. 7	2 0. 4
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
2	3. 1	2. 8	2.7	2.5	2.4	2.2	2. 1	2. 0	1.8	1.7	1. 5	1. 4	-
3	9. 4	8. 6	8.2	7.7	7.3	6.8	6. 4	6. 0	5.6	5.1	4. 7	4. 3	-
4	1 8. 4	1 6. 7	15. 9	15. 0	14. 2	13. 3	1 2. 5	1 1. 7	10. 9	10. 0	9. 2	8. 4	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-12.  
CT Values for Inactivation of Giardia Cysts by Chloramine, pH 6.0-9.0

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
0.5	63.5	56.8	50.0	43.3	36.5	30.4	24.3	18.2	12.1	6.0	2.9	2.6	2.4
1	127.0	113.6	100.3	86.9	73.5	61.4	50.7	40.3	30.9	22.5	15.2	13.9	12.6
1.5	190.0	170.0	150.0	130.0	110.0	90.6	73.2	58.8	46.4	35.0	24.4	22.8	21.2
2	253.5	226.0	200.3	173.6	147.0	122.2	97.4	74.6	58.8	44.3	30.4	27.8	25.2
2.5	317.0	283.5	250.0	216.6	183.0	147.2	114.4	86.6	65.8	48.0	32.2	29.4	26.6
3	380.0	340.0	300.0	260.0	220.0	173.0	130.0	97.0	72.0	52.0	35.0	31.0	27.0
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
0.5	26.2	25.0	23.7	22.4	21.1	19.8	18.5	17.3	16.1	14.9	13.7	12.5	-
1	52.3	50.0	47.4	44.8	42.2	39.6	37.0	34.6	32.2	29.8	27.4	25.0	-
1.5	78.6	75.0	71.0	67.0	63.0	59.0	55.0	51.5	48.0	44.5	41.0	37.5	-
2	104.6	100.0	94.7	89.4	84.1	78.8	73.5	68.8	64.1	59.4	54.7	50.0	-

2.5	1,308	1,250	1,183	1,116	1,049	982	915	857	799	741	683	625	-
3	1,570	1,500	1,420	1,340	1,260	1,180	1,100	1,020	960	890	820	750	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-13.  
CT Values for Inactivation of Viruses by Chloramine

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	1,243	1,147	1,050	954	857	761	677	592	506	423	340	257	174
3	2,063	1,903	1,743	1,583	1,423	1,262	1,101	940	779	618	457	296	135
4	2,883	2,659	2,436	2,212	1,988	1,764	1,540	1,316	1,092	868	644	420	196
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
2	471	428	387	345	304	262	221	180	138	97	55	14	-
3	783	712	641	570	500	429	358	287	216	145	74	3	-
4	1,093	994	944	895	845	796	746	696	646	597	547	497	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-14.  
CT Values for Inactivation of Giardia Cysts by Ozone

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
0.5	0.48	0.44	0.40	0.36	0.32	0.30	0.28	0.27	0.25	0.22	0.20	0.19	
1.0	0.97	0.89	0.80	0.72	0.63	0.60	0.57	0.54	0.51	0.45	0.42	0.38	
1.5	1.50	1.36	1.23	1.09	0.95	0.90	0.86	0.81	0.77	0.67	0.62	0.58	
2.0	1.90	1.75	1.60	1.45	1.30	1.23	1.16	1.09	1.02	0.89	0.82	0.76	
2.5	2.40	2.20	2.00	1.80	1.60	1.52	1.44	1.36	1.28	1.12	1.04	0.95	
3.0	2.90	2.65	2.40	2.15	1.90	1.81	1.71	1.62	1.52	1.33	1.24	1.14	
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
0.5	0.17	0.16	0.15	0.14	0.14	0.13	0.12	0.11	0.10	0.10	0.09	0.08	-
1.0	0.35	0.32	0.30	0.29	0.27	0.26	0.24	0.22	0.21	0.19	0.18	0.16	-
1.5	0.53	0.48	0.46	0.43	0.41	0.38	0.36	0.34	0.31	0.29	0.26	0.24	-
2.0	0.69	0.63	0.60	0.57	0.54	0.51	0.48	0.45	0.42	0.38	0.35	0.32	-
2.5	0.87	0.79	0.75	0.71	0.68	0.64	0.60	0.56	0.52	0.48	0.44	0.40	-
3.0	1.05	0.95	0.90	0.86	0.81	0.77	0.72	0.67	0.62	0.58	0.53	0.48	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments.

Table L-15.  
CT Values for Inactivation of Viruses by Ozone

Inactivation (log)	Temperature (°C)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	0.90	0.83	0.75	0.68	0.60	0.58	0.56	0.54	0.52	0.50	0.46	0.42	0.38
3	1.40	1.28	1.15	1.03	0.90	0.88	0.86	0.84	0.82	0.80	0.74	0.68	0.62
4	1.80	1.65	1.50	1.35	1.20	1.16	1.12	1.08	1.04	1.00	0.92	0.84	0.76
Inactivation (log)	Temperature (°C)												
	14	15	16	17	18	19	20	21	22	23	24	25	-
2	0.34	0.30	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.17	0.15	-
3	0.56	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.34	0.31	0.28	0.25	-
4	0.68	0.60	0.58	0.56	0.54	0.52	0.50	0.46	0.42	0.38	0.34	0.30	-

Source: AWWA, 1991. Modified by linear interpolation between 5°C increments

APPENDIX M. LEAD AND COPPER [REPEALED]

APPENDIX M. LEAD AND COPPER

Table M1  
Monitoring Frequency for Initial Sampling Requirements

PWS Size	Monitoring Type	Location	No. Samples	Frequency
Large PWSs >100,000	-	-	-	-
-	Lead and Copper	Taps	100	6 months
-	Water Quality Parameters	Distribution System	25	Twice per 6 months
-	Source Water	Entry Points	-	-

-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Twice per 6 months
50,001-100,000	Lead and Copper	Taps	60	6 months
-	Water Quality Parameters	Distribution System	40	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Twice per 6 months
Medium PWSs 10,001-50,000	-	-	-	-
-	Lead and Copper	Taps	60	6 months
-	If ALs Exceeded	-	-	-
-	Water Quality Parameters	Distribution System	40	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months
-	—Water Quality Parameters	-	4	Twice per 6 months
3,301-10,000	Lead and Copper	Taps	40	6 months
-	If ALs Exceeded	-	-	-
-	Water Quality Parameters	Distribution System	3	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months
-	—Water Quality Parameters	-	4	Twice per 6 months
Small PWSs 501-3,300	-	-	-	-
-	Lead and Copper*	Taps	20	6 months
-	If ALs Exceeded	-	-	-
-	Water Quality Parameters	Distribution System	2	Twice per 6 months
-	Source Water	Entry Points	-	-

-	—Lead and Copper	-	4	6 months
-	—Water Quality Parameters	-	4	Twice per 6 months
101-500	Lead and Copper	Taps	10	6 months
-	If ALs Exceeded	-	-	-
-	Water Quality Parameters	Distribution System	4	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months
-	—Water Quality Parameters	-	4	Twice per 6 months
£100	Lead and Copper*	Taps	5	6 months
-	If ALs Exceeded	-	-	-
-	Water Quality Parameters	Distribution System	4	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months
-	—Water Quality Parameters	-	4	Twice per 6 months
Nontransient Noncommunity Water Systems	Lead and Copper Water Quality Parameters	Taps Distribution System	No more than one per building per monitoring period	

\*If system wants to attempt to demonstrate optimization based on difference between source water levels and 90% tap level. Otherwise, one sample per entry point required if an AL is exceeded.

**LEAD AND COPPER**  
Table M2

Monitoring Frequency for Follow-up and Routine Sampling Requirements

PWS Size	Monitoring Type	Location	No. Samples	Frequency
Large PWSs	-	-	-	-
>100,000	Lead and Copper	Taps	100	6 months
-	Water Quality Parameters	Distribution System	25	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*



-	—Water Quality Parameters	-	4	Biweekly
50,001-100,000	Lead and Copper	Taps	60	6 months
-	Water Quality Parameters	Distribution System	40	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Biweekly
Medium PWSs	-	-	-	-
10,001-50,000	Lead and Copper	Taps	60	6 months
-	Water Quality Parameters	Distribution System	40	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Biweekly
3,301-10,000	Lead and Copper	Taps	40	6 months
-	Water Quality Parameters	Distribution System	3	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Biweekly
Small PWSs	-	-	-	-
501-3,300	Lead and Copper	Taps	20	6 months
-	Water Quality Parameters	Distribution System	2	Twice per 6 months
-	Source Water	Entry Points	-	-
-	—Lead and Copper	-	4	6 months*
-	—Water Quality Parameters	-	4	Biweekly
101-500	Lead and Copper*	Taps	40	6 months
-	Water Quality Parameters	Distribution System	4	Twice per 6 months

-	Source Water	Entry Points	-	-
-	— Lead and Copper	-	4	6 months
-	— Water Quality Parameters	-	4	Biweekly
£100	Lead and Copper*	Taps	5	6 months
-	Water Quality Parameters	Distribution System	4	Twice per 6 months
-	Source Water	Entry Points	-	-
-	— Lead and Copper	-	4	6 months*
-	— Water Quality Parameters	-	4	Biweekly
Nontransient Noncommunity Water Systems	Lead and Copper Water Quality Parameters	Taps Distribution System	No more than one per building per monitoring period	

\*If source water treatment installed; otherwise, see reduced monitoring requirements.

LEAD AND COPPER  
Table M3

Monitoring Frequency for Reduced Sampling Requirements

PWS Size	Monitoring Type	Reduced Monitoring	Ultimate Reduced Monitoring
Large PWSs ≥100,000	-	-	-
-	Lead and Copper	50 per year	50 per 3 years
-	Water Quality Parameters	10 twice per 6 months	10 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
-	Water Quality Parameters	Biweekly	Biweekly
50,001-100,000	Lead and Copper	30 per year	30 per 3 years
-	Water Quality Parameters	7 twice per 6 months	7 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years

-	Water Quality Parameters	Biweekly	Biweekly
Medium PWSs 10,001-50,000	- Lead and Copper	- 30 per year	- 30 per 3 years
-	Water Quality Parameters	7 twice per 6 months	7 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
3,301-10,000	Water Quality Parameters	Biweekly	Biweekly
-	Lead and Copper	20 per year	20 per 3 years
-	Water Quality Parameters	3 twice per 6 months	3 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
-	Water Quality Parameters	Biweekly	Biweekly
Small PWSs 501-3,300	- Lead and Copper	- 10 per year	- 10 per 3 years
-	Water Quality Parameters	2 twice per 6 months	2 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
101-500	Water Quality Parameters	Biweekly	Biweekly
-	Lead and Copper	5 per year	5 per 3 years
-	Water Quality Parameters	1 twice per 6 months	1 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
-	Water Quality Parameters	Biweekly	Biweekly
£100	Lead and Copper	5 per year	5 per 3 years

-	Water Quality Parameters	1 twice per 6 months	1 twice per year
-	Points of Entry Lead and Copper	-	-
-	— Groundwater Supply	1 per 3 years	1 per 9 years
-	— Surface Water Supply	Annually	1 per 9 years
-	Water Quality Parameters	Biweekly	Biweekly

Table M4

SUMMARY OF MONITORING REQUIREMENTS FOR WATER QUALITY PARAMETERS<sup>1</sup>

Monitoring Period	Parameters <sup>2</sup>	Location	Frequency
Initial Monitoring	pH, alkalinity, orthophosphate or silica, <sup>3</sup> calcium, conductivity, temperature	Taps and at entry point(s) to distribution system	Every 6 months
After Installation of Corrosion Control	pH, alkalinity, orthophosphate or silica, <sup>3</sup> calcium <sup>4</sup> pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual <sup>5</sup>	Taps Entry point(s) to distribution system <sup>6</sup>	Every 6 months No less frequently than every two weeks.
After State Specifies Parameter Values For Optimal Corrosion Control	pH, alkalinity, orthophosphate or silica, <sup>3</sup> calcium <sup>4</sup> pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual <sup>5</sup>	Taps Entry point(s) to distribution system	Every 6 months No less frequently than every two weeks.
Reduced Monitoring	pH, alkalinity, orthophosphate or silica, <sup>3</sup> calcium <sup>4</sup> pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual <sup>5</sup>	Taps Entry point(s) to distribution system	Every six months, annually <sup>7</sup> or every 3 years <sup>8</sup> at a reduced number of sites No less frequently than every two weeks.

<sup>1</sup>Table is for illustrative purposes; consult the text of this section for precise regulatory requirements.

<sup>2</sup>Small and medium-size systems have to monitor for water quality parameters only during monitoring periods in which the system exceeds the lead or copper action level.

<sup>3</sup>Orthophosphate must be measured only when an inhibitor containing a phosphate compound is used. Silica must be measured only when an inhibitor containing silicate compound is used.

<sup>4</sup>Calcium must be measured only when calcium carbonate stabilization is used as part of corrosion control.

<sup>5</sup>Inhibitor dosage rates and inhibitor residual concentrations (orthophosphate or silica) must be measured only when an inhibitor is used.

<sup>6</sup>Groundwater systems may limit monitoring to representative locations throughout the system.

<sup>7</sup>Waterworks may reduce frequency of monitoring for water quality parameters at the tap from every six months to annually if they maintain the minimum values or range of values for water quality parameters reflecting optimal corrosion control treatment during three consecutive years of monitoring.

<sup>8</sup>Waterworks may further reduce the frequency of monitoring for water quality parameters at the tap from annually to once every three years if they have maintained the minimum values or range of values for water quality parameters reflecting optimal corrosion control treatment during three consecutive years of annual monitoring. Waterworks may accelerate the triennial monitoring for water quality parameters at the tap if they have maintained 90th percentile lead levels less than or equal to 0.005 mg/L, 90th percentile copper levels less than or equal to 0.65 mg/L, and the range of water quality parameters designated by the Commissioner under 12 VAC 5-590-420-G 1 f as representing optimal corrosion control during two consecutive six-month periods.

APPENDIX N. INORGANIC COMPOUNDS AND ORGANIC CHEMICALS. (Repealed.)

APPENDIX N. INORGANIC COMPOUNDS AND ORGANIC CHEMICALS.

TABLE I  
INORGANIC COMPOUNDS

Contaminant	BAT(s)
Arsenic <sup>d</sup>	1, 2, 5, 6, 7, 9, 12 <sup>e</sup>
Antimony	2, 7
Asbestos	2, 3, 8
Barium	5, 6, 7, 9
Beryllium	1, 2, 5, 6, 7
Cadmium	2, 5, 6, 7
Chromium	2, 5, 6 <sup>b</sup> , 7
Cyanide	5, 7, 13
Fluoride	1, 7, 9
Mercury	2 <sup>a</sup> , 4, 6 <sup>a</sup> , 7 <sup>a</sup>
Nickel	5, 6, 7
Nitrate	5, 7, 9
Nitrite	5, 7
Selenium	1, 2 <sup>c</sup> , 6, 7, 9
Thallium	4, 5

Key to Best Available Technologies/Treatment Techniques

1. Activated Alumina
2. Coagulation/Filtration (except for waterworks serving less than 500 service connections)
3. Direct or Diatomite Filtration
4. Granular Activated Carbon
5. Ion Exchange
6. Lime Softening (except for waterworks serving less than 500 service connections)
7. Reverse Osmosis
8. Corrosion Control
9. Electrodialysis/Electrodialysis Reversing
10. Chlorine
11. Ultraviolet
12. Oxidation/Filtration
13. Alkaline Chlorination pH  $\geq$  8.5

NOTES ON BAT DESIGNATIONS

- a. BAT only if influent mercury concentrations are less than or equal to 10  $\mu\text{g/l}$
- b. BAT for Chromium III only
- c. BAT for Selenium IV only
- d. BATs for Arsenic V. Preoxidation may be required to convert Arsenic III to Arsenic V.
- e. To obtain high removals, iron to arsenic ratio must be at least 20:1.

TABLE II  
ORGANIC CHEMICALS

Contaminant	BAT(s)
Acrylamide	3
Alachlor	4
Aldicarb	4
Aldicarb sulfoxide	4
Aldicarb sulfone	4
Atrazine	4
Benzene	1, 2
Carbofuran	4
Carbon tetrachloride	1, 2
Chlordane	4
2,4-D	4
Dibromochloropropane (DBCP)	1, 2
o-Dichlorobenzene	1, 2

p-Dichlorobenzene	1,2
1,2-Dichloroethane	1,2
1,1-Dichloroethylene	1,2
cis-1,2-Dichloroethylene	1,2
trans-1,2-Dichloroethylene	1,2
1,2-Dichloropropane	1,2
Epichlorohydrin	3
Ethylene dibromide (EDB)	1,2
Ethylbenzene	1,2
Heptachlor	4
Heptachlor epoxide	4
Lindane	4
Methoxychlor	4
Monochlorobenzene	1,2
PCBs	4
Pentachlorophenol	4
Styrene	1,2
2,4,5-TP (Silvex)	4
Tetrachloroethylene	1,2
1,1,1-Trichloroethane	1,2
Trichloroethylene	1,2
Toluene	1,2
Toxaphene	4
Vinyl chloride	2
Xylenes (total)	1,2
Benzo(a)pyrene	4
Dalapon	4
Dichloromethane	2
Di(2-ethylhexyl)adipate	1,2
Di(2-ethylhexyl)phthalate	4
Dinoseb	4
Diquat	4

Endothall	4
Endrin	4
Glyphosate	4
Hexachlorobenzene	4
Hexachloropentadiene	1,2
Oxamyl (Vydate)	4
Picloram	4
Simazine	4
1,2,4-Trichlorobenzene	1,2
1,1,2-Trichloroethane	1,2
2,3,7,8-TCDD (Dioxin)	4

Key to Best Available Technologies/Treatment Techniques

1. Granular Activated Carbon
2. Packed Tower Aeration
3. Polymer Addition Practices
4. Oxidation (chlorination, with the exception of water having cyanide (as free cyanide) exceeding 0.2 mg/l, or ozonation)

Statutory Authority

APPENDIX O.

REGULATED CONTAMINANTS FOR CONSUMER CONFIDENCE REPORTS AND PUBLIC NOTIFICATION (Repealed.)

Key

- AL = Action Level
- PMCL = Primary Maximum Contaminant Level
- MCLG = Maximum Contaminant Level Goal
- MFL = million fibers per liter
- mrem/year = milirems per year (a measure of radiation absorbed by the body)
- MRDL = Maximum Residual Disinfectant Level
- MRDLG = Maximum Residual Disinfectant Level Goal
- NTU = Nephelometric Turbidity Units
- pCi/l = picocuries per liter (a measure of radioactivity)
- ppb = parts per billion, or micrograms per liter (µg/L)
- ppm = parts per million, or milligrams per liter (mg/L)
- ppq = parts per quadrillion, or picograms per liter
- ppt = parts per trillion, or nanograms per liter
- TT = Treatment Technique

Contaminant (units)	Traditional PMCL in mg/l	To convert for CCR, multiply by	MCL in CCR units	MCLG	Major Sources in Drinking Water	Health Effects Language



**Microbiological Contaminants**

(1) Total coliform bacteria	FF	n/a	Naturally present in the environment	Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially-harmful, waterborne pathogens may be present or that a potential pathway exists through which contamination may enter the waterworks.
(2) E. coli	PMCL: In compliance unless (i) the waterworks has an E. coli positive repeat sample following a total coliform-positive routine sample; (ii) the waterworks has a total coliform-positive repeat sample following an E. coli-positive routine sample; (iii) the waterworks owner fails to take all required repeat samples following an E. coli-positive routine sample; or (iv) the waterworks owner fails to test for E. coli when any repeat sample tests positive for total coliform.	0	Human and animal fecal waste	E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely-compromised immune systems.
(3) E. coli	FF	n/a	Human and animal fecal waste	E. coli are bacteria whose presence indicates that the water may be

						contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely compromised immune systems.
(4) Source water fecal indicator (E. coli)	TT	-	TT	0 for E. coli	Human and animal fecal waste	Fecal indicators are microbes whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune system.
(5) Groundwater rule TT violations	TT	-	-	TT	-	Inadequately treated or inadequately

other than (4) above <sup>4</sup>						protected water may contain disease-causing organisms. These organisms can cause symptoms such as diarrhea, nausea, cramps, and associated headaches.
(6) Turbidity	II	-	II	n/a	Soil runoff	Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches.
(7) Giardia lamblia, viruses, Heterotrophic plate count, Legionella, Cryptosporidium <sup>4</sup>	III <sup>3</sup>	-	n/a	0	n/a	Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites which can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.
<b>Radioactive Contaminants</b>						

(8) Beta/Photon emitters (mrem/yr)	4 mrem/yr	-	4	0	Decay of natural and man-made deposits	Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.
(9) Alpha emitters (pCi/L)	15 pCi/L	-	15	0	Erosion of natural deposits	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
(10) Combined radium (pCi/L)	5 pCi/L	-	5	0	Erosion of natural deposits	Some people who drink water containing radium-226 or radium-228 in excess of the MCL over many years may have an increased risk of getting cancer.
(11) Uranium (ppb)	30 µg/L	-	30	0	Erosion of natural deposits	Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting

						cancer and kidney toxicity.
<b>Inorganic Contaminants</b>						
(12) Antimony (ppb)	0.006	1000	6	6	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	Some people who drink water containing antimony well in excess of the MCL over many years could experience increases in blood cholesterol and decreases in blood sugar.
(13) Arsenic (ppb)	0.010	1000	10	0 <sup>2</sup>	Erosion of natural deposits; Runoff from orchards; Runoff from glass and electronics production wastes	Some people who drink water containing arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.
(14) Asbestos (MFL)	7 MFL	-	7	7	Decay of asbestos cement water mains; Erosion of natural deposits	Some people who drink water containing asbestos in excess of the MCL over many years may have an increased risk of developing benign intestinal polyps.
(15) Barium (ppm)	2	-	2	2	Discharge of drilling wastes; Discharge from metal refineries; Erosion of	Some people who drink water containing barium in excess of the MCL over many years could experience an

					natural deposits	increase in their blood pressure.
(16) Beryllium (ppb)	0.004	1000	4	4	Discharge from metal refineries and coal-burning factories; Discharge from electrical, aerospace, and defense industries	Some people who drink water containing beryllium well in excess of the MCL over many years could develop intestinal lesions.
(17) Cadmium (ppb)	0.005	1000	5	5	Corrosion of galvanized pipes; Erosion of natural deposits; Discharge from metal refineries; Run-off from waste batteries and paints	Some people who drink water containing cadmium in excess of the MCL over many years could experience kidney damage.
(18) Chromium (ppb)	0.1	1000	100	100	Discharge from steel and pulp mills; Erosion of natural deposits	Some people who drink water containing chromium well in excess of the MCL over many years could experience allergic dermatitis.
(19) Copper (ppm)	AL=1.3	-	AL=1.3	1.3	Corrosion of household plumbing systems; Erosion of natural deposits	Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink

						water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.
(20) Cyanide (ppb)	0.2	1000	200	200	Discharge from steel/metal factories; Discharge from plastic and fertilizer factories	Some people who drink water containing cyanide well in excess of the MCL over many years could experience nerve damage or problems with their thyroid.
(21) Fluoride (ppm)	4	-	4	4	Erosion of natural deposits; Water additive which promotes strong teeth; Discharge from fertilizer and aluminum factories	Some people who drink water containing fluoride in excess of the MCL over many years could get bone disease, including pain and tenderness of the bones. Fluoride in drinking water at half the MCL or more may cause mottling of children's teeth, usually in children less than nine years old. Mottling, also known as dental fluorosis, may include brown staining and/or pitting of the teeth, and occurs only in developing teeth before they

						erupt from the gums.
(22) Lead (ppb)	AL=0.015	1000	AL=15	0	Corrosion of household plumbing systems; Erosion of natural deposits	Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.
(23) Mercury [inorganic] (ppb)	.002	1000	2	2	Erosion of natural deposits; Discharge from refineries and factories; Runoff from landfills; Runoff from cropland	Some people who drink water containing inorganic mercury well in excess of the MCL over many years could experience kidney damage.
(24) Nitrate (ppm)	10	-	10	10	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.



(25) Nitrite (ppm)	4	-	4	4	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.
(26) Total Nitrate and Nitrite	10	-	n/a	10	n/a	Infants below the age of six months who drink water containing nitrate and nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.
(27) Selenium (ppb)	0.05	1000	50	50	Discharge from petroleum and metal refineries; Erosion of natural deposits; Discharge from mines	Selenium is an essential nutrient. However, some people who drink water containing selenium in excess of the MCL over many years could experience hair or fingernail losses, numbness in fingers or toes, or problems with their circulation.
(28) Thallium (ppb)	0.002	1000	2	0.5	Leaching from ore-processing sites; Discharge from electronics,	Some people who drink water containing thallium in excess of the MCL over many years could experience hair

					glass, and drug factories	loss, changes in their blood, or problems with their kidneys, intestines, or liver.
<b>Synthetic Organic Contaminants including Pesticides and Herbicides</b>						
(29) 2,4-D (ppb)	0.07	1000	70	70	Runoff from herbicides used on row crops	Some people who drink water containing the weed killer 2,4-D well in excess of the MCL over many years could experience problems with their kidneys, liver, or adrenal glands.
(30) 2,4,5-TP [Silvex] (ppb)	0.05	1000	50	50	Residue of banned herbicide	Some people who drink water containing silvex in excess of the MCL over many years could experience liver problems.
(31) Acrylamide	II	-	II	0	Added to water during sewage/wastewater treatment	Some people who drink water containing high levels of acrylamide over a long period of time could have problems with their nervous system or blood, and may have an increased risk of getting cancer.
(32) Alachlor (ppb)	0.002	1000	2	0	Runoff from herbicide used on row crops	Some people who drink water containing alachlor in excess of the MCL over many years could have problems with their eyes, liver, kidneys, or

						spleen, or experience anemia, and may have an increased risk of getting cancer.
(33) Atrazine (ppb)	0.003	1000	3	3	Runoff from herbicide used on row crops	Some people who drink water containing the atrazine well in excess of the MCL over many years could experience problems with their cardiovascular system or reproductive difficulties.
(34) Benzo(a)pyrene[P AH] -	0.0002	1,000,000	200	0	Leaching from linings of water storage tanks and distribution lines	Some people who drink water containing benzo(a)pyrene in excess of the MCL over many years could experience reproductive difficulties and may have an increased risk of getting cancer.
(35) Carbofuran (ppb)	0.04	1000	40	40	Leaching of soil fumigant used on rice and alfalfa	Some people who drink water containing carbofuran in excess of the MCL over many years could experience problems with their blood, or nervous or reproductive systems.

(36) Chlordane (ppb)	0.002	1000	2	0	Residue of banned termiticide	Some people who drink water containing chlordane in excess of the MCL over many years could experience problems with their liver or nervous system, and may have an increased risk of getting cancer.
(37) Dalapon (ppb)	0.2	1000	200	200	Runoff from herbicide used on rights of way	Some people who drink water containing dalapon well in excess of the MCL over many years could experience minor kidney changes.
(38) Di(2-ethylhexyl) adipate (ppb)	0.4	1000	400	400	Discharge from chemical factories	Some people who drink water containing di(2-ethylhexyl)adipate well in excess of the MCL over many years could experience toxic effects, such as weight loss, liver enlargement or possible reproductive difficulties.
(39) Di(2-ethylhexyl)phthalate (ppb)	0.006	1000	6	0	Discharge from rubber and chemical factories	Some people who drink water containing di(2-ethylhexyl)phthalate in excess of the MCL over many years may have problems with their liver, or experience reproductive difficulties, and

						may have an increased risk of getting cancer.
(40) Dibromochloropropane (ppt)	0.0002	1,000,000	200	0	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	Some people who drink water containing DBCP well in excess of the MCL over many years could experience reproductive problems and may have an increased risk of getting cancer.
(41) Dinoseb (ppb)	0.007	1000	7	7	Runoff from herbicide used on soybeans and vegetables	Some people who drink water containing dinoseb well in excess of the MCL over many years could experience reproductive difficulties.
(42) Diquat (ppb)	0.02	1000	20	20	Runoff from herbicide use	Some people who drink water containing diquat in excess of the MCL over many years could get cataracts.
(43) Dioxin [2,3,7,8-TCDD] (ppq)	0.0000 0003	1,000,000 0,000	30	0	Emissions from waste incineration and other combustion; Discharge from chemical factories	Some people who drink water containing dioxin in excess of the MCL over many years could experience reproductive difficulties and may have an increased risk of getting cancer.
(44) Endothall (ppb)	0.1	1000	100	100	Runoff from herbicide use	Some people who drink water containing endothall in

						excess of the MCL over many years could experience problems with their stomach or intestines.
(45) Endrin (ppb)	0.002	4000	2	2	Runoff of banned insecticide	Some people who drink water containing endrin in excess of the MCL over many years could experience liver problems.
(46) Epichlorohydrin	FF	-	FF	0	Discharge from industrial chemical factories; An impurity of some water treatment chemicals	Some people who drink water containing high levels of epichlorohydrin over a long period of time could experience stomach problems, and may have an increased risk of getting cancer.
(47) Ethylene dibromide (ppt)	0.0000 5	1,000,00 0	50	0	Discharge from petroleum refineries	Some people who drink water containing ethylene dibromide in excess of the MCL over many years could experience problems with their liver, stomach, reproductive system, or kidneys, and may have an increased risk of getting cancer.

(48) Glyphosate (ppb)	0.7	1000	700	700	Runoff from herbicide use	Some people who drink water containing glyphosate in excess of the MCL over many years could experience problems with their kidneys or reproductive difficulties.
(49) Heptachlor (ppt)	0.0004	1,000,000	400	0	Residue of banned pesticide	Some people who drink water containing heptachlor in excess of the MCL over many years could experience liver damage and may have an increased risk of getting cancer.
(50) Heptachlor epoxide (ppt)	0.0002	1,000,000	200	0	Breakdown of heptachlor	Some people who drink water containing heptachlor epoxide in excess of the MCL over many years could experience liver damage, and may have an increased risk of getting cancer.
(51) Hexachlorobenzene (ppb)	0.001	1000	1	0	Discharge from metal refineries and agricultural chemical factories	Some people who drink water containing hexachlorobenzene in excess of the MCL over many years could experience problems with their liver or kidneys or adverse reproductive

						effects, and may have an increased risk of getting cancer.
(52) Hexachlorocyclopentadiene (ppb)	0.05	1000	50	50	Discharge from chemical factories	Some people who drink water containing hexachlorocyclopentadiene well in excess of the MCL over many years could experience problems with their stomach or kidneys.
(53) Lindane (ppt)	0.0002	1,000,000	200	200	Runoff/leaching from insecticide used on cattle, lumber, gardens	Some people who drink water containing lindane in excess of the MCL over many years could experience problems with their kidneys or liver.
(54) Methoxychlor (ppb)	0.04	1000	40	40	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	Some people who drink water containing methoxychlor in excess of the MCL over many years could experience reproductive difficulties.
(55) Oxamyl [Vydate] (ppb)	0.2	1000	200	200	Runoff/leaching from insecticide used on apples, potatoes and tomatoes	Some people who drink water containing ethylene oxamyl in excess of the MCL over many years could experience slight nervous system effects.



(56) PCBs [Polychlorinated biphenyls] (ppt)	0.0005	1,000,00 0	500	0	Runoff from landfills; Discharge of waste chemicals	Some people who drink water containing PCBs in excess of the MCL over many years could experience changes in their skin, problems with their thymus gland, immune deficiencies, or reproductive or nervous system difficulties, and may have an increased risk of getting cancer.
(57) Pentachlorophene I (ppb)	0.001	1000	4	0	Discharge from wood preserving factories	Some people who drink water containing pentachlorophene I in excess of the MCL over many years could experience problems with their liver or kidneys, and may have an increased risk of getting cancer.
(58) Picloram (ppb)	0.5	1000	500	500	Herbicide runoff	Some people who drink water containing picloram in excess of the MCL over many years could experience problems with their liver.
(59) Simazine (ppb)	0.004	1000	4	4	Herbicide runoff	Some people who drink water containing simazine in excess of the MCL over many years could

						experience problems with their blood.
(60) Toxaphene (ppb)	0.003	1000	3	0	Runoff/leaching from insecticide used on cotton and cattle	Some people who drink water containing toxaphene in excess of the MCL over many years could experience problems with their thyroid, kidneys, or liver and may have an increased risk of getting cancer.
<b>Volatile Organic Contaminants</b>						
(61) Benzene (ppb)	0.005	1000	5	0	Discharge from factories; Leaching from gas storage tanks and landfills	Some people who drink water containing benzene in excess of the MCL over many years could experience anemia or a decrease in blood platelets, and may have an increased risk of getting cancer.
(62) Carbon tetrachloride (ppb)	0.005	1000	5	0	Discharge from chemical plants and other industrial activities	Some people who drink water containing carbon tetrachloride in excess of the MCL over many years could experience problems with their liver and may have an increased risk of getting cancer.
(63) Chlorobenzene (ppb)	0.1	1000	100	100	Discharge from chemical	Some people who drink water containing

					and agricultural chemical factories	chlorobenzene in excess of the MCL over many years could experience problems with their liver or kidneys.
(64) o-Dichlorobenzene (ppb)	0.6	1000	600	600	Discharge from industrial chemical factories	Some people who drink water containing o-dichlorobenzene well in excess of the MCL over many years could experience problems with their liver, kidneys, or spleen, or changes in their blood.
(65) p-Dichlorobenzene (ppb)	0.075	1000	75	75	Discharge from industrial chemical factories	Some people who drink water containing p-dichlorobenzene in excess of the MCL over many years could experience anemia, damage to their liver, kidneys, or circulatory systems.
(66) 1,2-Dichloroethane (ppb)	0.005	1000	5	0	Discharge from industrial chemical factories	Some people who drink water containing 1,2-dichloroethane in excess of the MCL over many years may have an increased risk of getting cancer.
(67) 1,1-Dichloroethylene (ppb)	0.007	1000	7	7	Discharge from industrial	Some people who drink water containing 1,1-dichloroethylene

					chemical factories	in excess of the MCL over many years could experience problems with their liver.
(68) cis-1,2-Dichloroethylene (ppb)	0.07	1000	70	70	Discharge from industrial chemical factories	Some people who drink water containing cis-1,2-dichloroethylene in excess of the MCL over many years could experience problems with their liver.
(69) trans-1,2-Dichloroethylene (ppb)	0.1	1000	100	100	Discharge from industrial chemical factories	Some people who drink water containing trans-1,2-dichloroethylene well in excess of the MCL over many years could experience problems with their liver.
(70) Dichloromethane (ppb)	0.005	1000	5	0	Discharge from pharmaceutical and chemical factories	Some people who drink water containing dichloromethane in excess of the MCL over many years could have liver problems and may have an increased risk of getting cancer.
(71) 1,2-Dichloropropane (ppb)	0.005	1000	5	0	Discharge from industrial chemical factories	Some people who drink water containing 1,2-dichloropropane in excess of the MCL over many years may have an increased risk of getting cancer.

(72) Ethylbenzene (ppb)	0.7	1000	700	700	Discharge from petroleum refineries	Some people who drink water containing ethylbenzene well in excess of the MCL over many years could experience problems with their liver or kidneys.
(73) Styrene (ppb)	0.4	1000	100	100	Discharge from rubber and plastic factories; Leaching from landfills	Some people who drink water containing styrene well in excess of the MCL over many years could experience problems with their liver, kidneys, or circulatory system.
(74) Tetrachloroethylene (ppb)	0.005	1000	5	0	Discharge from factories and dry cleaners	Some people who drink water containing tetrachloroethylene in excess of the MCL over many years could have problems with their liver, and may have an increased risk of getting cancer.
(75) 1,2,4-Trichlorobenzene (ppb)	0.07	1000	70	70	Discharge from textile-finishing factories	Some people who drink water containing 1,2,4-trichlorobenzene well in excess of the MCL over many years could experience changes in their adrenal glands.
(76) 1,1,1-Trichloroethane (ppb)	0.2	1000	200	200	Discharge from metal degreasing	Some people who drink water containing 1,1,1-

					sites and other factories	trichloroethane in excess of the MCL over many years could experience problems with their liver, nervous system, or circulatory system.
{77} 1,1,2-Trichloroethane (ppb)	0.005	1000	5	3	Discharge from industrial chemical factories	Some people who drink water containing 1,1,2-trichloroethane well in excess of the MCL over many years could have problems with their liver, kidneys, or immune systems.
{78} Trichloroethylene (ppb)	0.005	1000	5	0	Discharge from metal degreasing sites and other factories	Some people who drink water containing trichloroethylene in excess of the MCL over many years could experience problems with their liver and may have an increased risk of getting cancer.
{79} Toluene (ppm)	4	-	4	4	Discharge from petroleum factories	Some people who drink water containing toluene well in excess of the MCL over many years could have problems with their nervous system, kidneys, or liver.
{80} Vinyl Chloride (ppb)	0.002	1000	2	0	Leaching from PVC piping; Discharge	Some people who drink water containing vinyl chloride in excess

					from plastic factories	of the MCL over many years may have an increased risk of getting cancer.
(81) Xylenes (ppm)	10	–	10	10	Discharge from petroleum factories; Discharge from chemical factories	Some people who drink water containing xylenes in excess of the MCL over many years could experience damage to their nervous system.
<b>Disinfection By-Products, Precursors, and Residuals</b>						
(82) THMs [total trihalomethanes] (ppb)	0.080	1000	80	n/a	By-product of drinking water disinfection	Some people who drink water containing trihalomethanes in excess of the MCL over many years could experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.
(83) Haloacetic acids (HAA) (ppb)	0.060	1000	60	n/a	By-product of drinking water disinfection	Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer.
(84) Bromate (ppb)	0.010	1000	10	0	By-product of drinking water disinfection	Some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of getting cancer.

(85) Chloramines (ppm)	MRDL= 4.0	-	MRDL =4.0	MRDLG =4	Water additive used to control microbes	Some people who use water containing chloramines well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chloramines well in excess of the MRDL could experience stomach discomfort or anemia.
(86) Chlorine (ppm)	MRDL= 4.0	-	MRDL =4.0	MRDLG =4	Water additive used to control microbes	Some people who use water containing chlorine well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chlorine well in excess of the MRDL could experience stomach discomfort.
(87) Chlorine dioxide (ppb) <sup>2</sup>	MRDL= 0.8	1000	MRDL =800	MRDLG =800	Water additive used to control microbes	Some infants and young children who drink water containing chlorine dioxide in excess of the MRDL could experience nervous system effects. Similar effects may occur in fetuses of



						pregnant women who drink water containing chlorine dioxide in excess of the MRDL. Some people may experience anemia.
(87a) Chlorine dioxide, where any two consecutive daily samples taken at the entrance to the distribution system are above the MRDL. <sup>4</sup>	MRDL= 0.8	-	-	MRDLG =0.8	-	The chlorine dioxide violations reported today are the result of exceedances at the treatment facility only, not within the distribution system which delivers water to consumers. Continued compliance with chlorine dioxide levels within the distribution system minimizes the potential risk of these violations to consumers.
(87b) Chlorine dioxide, where one or more distribution system samples are above the MRDL. <sup>4</sup>	MRDL= 0.8	-	-	MRDLG =0.8	-	The chlorine dioxide violations reported today include exceedances of the EPA standard within the distribution system which delivers water to consumers. Violations of the chlorine dioxide standard within the distribution system may harm human health based on short-term exposures. Certain groups,

						including fetuses, infants, and young children, may be especially susceptible to nervous system effects from excessive chlorine dioxide exposure.
(88) Chlorite (ppm)	1.0	-	1.0	0.8	By-product of drinking water disinfection	Some infants and young children who drink water containing chlorite in excess of the MCL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorite in excess of the MCL. Some people may experience anemia.
(89) Total organic carbon (ppm)	11	-	11	n/a	Naturally present in the environment	Total organic carbon (TOC) has no health effects. However, total organic carbon provides a medium for the formation of disinfection byproducts. These byproducts include trihalomethanes (THMs) and haloacetic acids (HAAs). Drinking water containing these byproducts in excess of the MCL may lead to adverse health effects, liver or

						kidney problems, or nervous systems effects, and may lead to an increased risk of getting cancer.
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<sup>1</sup>This information is for public notification purposes only.

<sup>2</sup>This information is for Consumer Confidence Report purposes only.

<sup>3</sup>Violations of the treatment technique requirements for filtration and disinfection that involve turbidity exceedances may use the health effects language for turbidity instead.

**APPENDIX P (Repealed.)**

Best available technologies (BATs) for radionuclides. The commissioner identifies as indicated in the following table the best technology available for achieving compliance with the maximum contaminant levels for combined radium-226 and radium-228, uranium, gross alpha particle activity, and beta particle and photon radioactivity.

Table 1:  
BAT for Combined Radium-226 and Radium-228, Uranium, Gross Alpha Particle Activity, and Beta Particle and Photon Radioactivity.

Contaminant	BAT
1. Combined radium-226 and radium-228.	1. Ion exchange, reverse osmosis, lime softening.
2. Uranium.	2. Ion exchange, reverse osmosis, lime softening, coagulation/ filtration.
3. Gross alpha particle activity (excluding Radon and Uranium).	3. Reverse osmosis.
4. Beta particle and photon radioactivity.	4. Ion exchange, reverse osmosis.

Small systems compliance technologies list for radionuclides.

Table II.  
List of Small Systems Compliance Technologies for Radionuclides and Limitations to Use.

Unit technologies	Limitations (see footnotes) <sup>1</sup>	Operator Skill Level required <sup>2</sup>	Raw water quality range and considerations. <sup>2</sup>
1. Ion exchange (IE).	(a)	Intermediate.	All ground waters.
2. Point of use (POU <sup>3</sup> ) IE.	(b)	Basic.	All ground waters.
3. Reverse osmosis (RO).	(c)	Advanced.	Surface waters usually require pre-filtration.
4. POU <sup>3</sup> RO.	(b)	Basic.	Surface waters usually require pre-filtration.
5. Lime softening.	(d)	Advanced.	All waters.
6. Green sand filtration.	(e)	Basic.	All waters.
7. Co-precipitation with Barium sulfate.	(f)	Intermediate to Advanced.	Ground waters with suitable water quality.
8. Electrodialysis/Electrodialysis Reversal.	--	Basic to Intermediate.	All ground waters.
9. Pre-formed hydrous Manganese oxide.	(g)	Intermediate.	All ground waters.
10. Activated alumina.	(a), (h)	Advanced.	All ground waters; competing anion concentrations may affect regeneration frequency.
11. Enhanced coagulation/ filtration.	(i)	Advanced.	Can treat a wide range of water qualities.

<sup>1</sup>Limitations Footnotes: Technologies for Radionuclides:

- a. The regeneration solution contains high concentrations of the contaminant ions. Disposal options should be carefully considered before choosing this technology.
- b. When POU devices are used for compliance, programs for long-term operation, maintenance, and monitoring must be provided by water utility to ensure proper performance.
- c. Reject water disposal options should be carefully considered before choosing this technology. See other RO limitations described in the SWTR Compliance Technologies Table.

d. The combination of variable source water quality and the complexity of the water chemistry involved may make this technology too complex for small surface water systems.

e. Removal efficiencies can vary depending on water quality.

f. This technology may be very limited in application to small systems. Since the process requires static mixing, detention basins, and filtration, it is most applicable to systems with sufficiently high sulfate levels that already have a suitable filtration treatment train in place.

g. This technology is most applicable to small systems that already have filtration in place.

h. Handling of chemicals required during regeneration and pH adjustment may be too difficult for small systems without an adequately trained operator.

i. Assumes modification to a coagulation/filtration process already in place.

<sup>2</sup>National Research Council (NRC). *Safe Water from Every Tap: Improving Water Service to Small Communities*. National Academy Press. Washington, D.C. 1997.

<sup>3</sup>A POU, or "point-of-use" technology is a treatment device installed at a single tap used for the purpose of reducing contaminants in drinking water at that one tap. POU devices are typically installed at the kitchen tap. See the April 21, 2000, NODA for more details.

Table III.  
Compliance Technologies by System Size Category for Radionuclide NPDWR's.

Contaminant	Compliance technologies <sup>1</sup> for system size categories (population served)		
	25—500	501—3,300	3,300—10,000
1. Combined radium-226 and radium-228.	1, 2, 3, 4, 5, 6, 7, 8, 9.	1, 2, 3, 4, 5, 6, 7, 8, 9.	1, 2, 3, 4, 5, 6, 7, 8, 9.
2. Gross alpha particle activity.	3,4.	3,4.	3,4.
3. Beta particle activity and photon activity.	1, 2, 3, 4, 11.	1, 2, 3, 4.	1, 2, 3, 4.
4. Uranium.	-	1, 2, 3, 4, 5, 10, 11.	1, 2, 3, 4, 5, 10, 11.

Note: <sup>1</sup> Numbers correspond to those technologies found listed in Table II.

DOCUMENTS INCORPORATED BY REFERENCE (12VAC5-590)

"Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," National Bureau of Standards Handbook 69.

Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association, American Waterworks Association, and Water Pollution Control Federation, 1992 23<sup>rd</sup> Edition, 2017, American Water Works Association/American Public Works Association/Water Environment Federation.

ANSI/NSF Standard for Drinking Water Treatment System Components, ANSI/NSF 61, American National Standard Institute, November, 1994.

AWWA Standard for American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water, C-104, American Waterworks Association.

~~AWWA Standard for American National Standard for Polyethylene Encasement for Ductile-Iron Pipe and Fittings for Water, C-105, American Waterworks Association.~~

~~AWWA Standard for American National Standard for Ductile-Iron and Gray-Iron Fittings 3-Inch Through 48-Inch for Water, C-110, American Waterworks Association.~~

~~AWWA Standard for American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings, C-111, American Waterworks Association.~~

~~AWWA Standard for American National Standard for Flanged Ductile-Iron Pipe with Threaded Flanges, C-115, American Waterworks Association.~~

~~AWWA Standard for American National Standard for the Thickness Design of Ductile-Iron Pipe, C-150, American Waterworks Association.~~

~~AWWA Standard for American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids, C-151, American Waterworks Association.~~

~~AWWA Standard for American National Standard for Ductile-Iron Pipe, Compact Fittings, 3-Inch Through 16-Inch, for Water and Other Liquids, C-153, American Waterworks Association.~~

~~AWWA Standard for Steel Water Pipe, 6-Inch and Larger, C-200, American Waterworks Association.~~

~~AWWA Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied, C-203, American Waterworks Association.~~

~~AWWA Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4-Inch and Larger-Shop Applied, C-205, American Waterworks Association.~~

~~AWWA Standard for Field Welding of Steel Water Pipe, C-206, American Waterworks Association.~~

~~AWWA Standard for Steel Pipe Flanges for Waterworks Service 4-Inch and Larger-Shop Applied, C-207, American Waterworks Association.~~

~~AWWA Standard for Dimensions for Fabricated Steel Water Pipe Fittings, C-208, American Waterworks Association.~~

~~AWWA Standards for Cold-Applied Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines, C-209, American Waterworks Association.~~

~~AWWA Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines, C-210, American Waterworks Association.~~

~~AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, C-213, American Waterworks Association.~~

~~AWWA Standards for Tape Coating Systems for the Exterior of Steel Water Pipelines, C-214, American Waterworks Association.~~

~~AWWA Standard for Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines, C-215, American Waterworks Association.~~

~~AWWA Standard for Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines, C-216, American Waterworks Association.~~

~~AWWA Standard for Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines, C-217, American Waterworks Association.~~

~~AWWA Standard for Coating the Exterior of Aboveground Steel Water Pipelines and Fittings, C-218, American Waterworks Association.~~

~~AWWA Standard for Bolted, Sleeve-Type Couplings for Plain End Pipe, C-219, American Waterworks Association.~~

~~AWWA Standard for Stainless Steel Pipe, 4 Inch and Larger, C-220, American Waterworks Association.~~

~~AWWA Standard for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, C-300, American Waterworks Association.~~

~~AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, C-301, American Waterworks Association.~~

~~AWWA Standard for Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids, C-302, American Waterworks Association.~~

~~AWWA Standard for Reinforced Concrete Pressure Pipe, Noncylinder Type, Pretensioned, for Water and Other Liquids, C-303, American Waterworks Association.~~

~~AWWA Standard for Design of Prestressed Concrete Cylinder Pipe, C-304, American Waterworks Association.~~

~~AWWA Standard for the Selection of Asbestos-Cement Transmission and Feeder Main Pipe, C-403, American Waterworks Association.~~

~~AWWA Standard for Cement-Mortar Lining of Water Pipelines-4 Inch (1000 mm) and Larger-In Place, C-602, American Waterworks Association.~~

~~AWWA Standard for Underground Service Line Valves and Fittings, C-800, American Waterworks Association.~~

~~AWWA Standard for Polyvinyl Chloride Pressure Pipe, 4 Inch Through 12 Inch for Water Distribution, C-900, American Waterworks Association.~~

~~AWWA Standard for Polybutylene Pressure Pipe and Tubings, 1/2 Inch Through 3 Inch, for Water Service, C-902, American Waterworks Association.~~

~~AWWA Standard for Polyethylene Pressure Pipe and Fittings, 4 Inch Through 63 Inch, for Water Distribution, C-906, American Waterworks Association.~~

~~AWWA Standard for Polyethylene Pressure Pipe and Tubing, 1/2 Inch Through 3 Inch, for Water Service, C-901, American Waterworks Association.~~

~~AWWA Standard for Polyvinyl Chloride Water Transmission Pipe, Nominal Diameters 14 Inch Through 36 Inch, C-905, American Waterworks Association.~~

~~AWWA Standard for Polyvinyl Chloride Pressure Fittings, 4 Inch Through 8 Inch, C-907, American Waterworks Association.~~

~~AWWA Standard for Fiberglass Pressure Pipe, C-950, American Waterworks Association.~~

~~AWWA Standard for Asbestos-Cement Pressure Pipe, 4 Inch Through 16 Inch, for Water Distribution Systems, C-400, American Waterworks Association.~~

~~AWWA Standard for Selection of Asbestos-Cement Pressure Pipe, 4 Inch Through 16 Inch, for Water Distribution Systems, C-401, American Waterworks Association.~~

~~AWWA Standard for Asbestos-Cement Transmission Pipe, 18 Inch Through 42 Inch, for Potable Water and Other Liquids, C-402, American Waterworks Association.~~

~~AWWA Standard for Installation of Ductile-Iron Pipe and Their Appurtenances, C-600, American Waterworks Association.~~

~~AWWA Standard for Installation of Asbestos-Cement Pressure Pipe, C-603, American Waterworks Association.~~

~~AWWA Standard for Grooved and Shouldered Joints, C-606, American Waterworks Association.~~

~~AWWA Standard for Disinfecting Water Mains, C-651, American Waterworks Association.~~

Control of Communicable Diseases in Man, 15 edition, American Public Health Association, 1990.

2017 ASME Boiler and Pressure Vessel Code (BPVC), American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

American Water Works Association, 666 W. Quincy Avenue, Denver, CO 80235:

AWWA Standard, ANSI/AWWA C600-10, Installation of Ductile-Iron Mains and Their Appurtenances, Nov 1, 2010.

AWWA Standard, ANSI/AWWA C604-17, Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger, Aug 1, 2017.

AWWA Standard, ANSI/AWWA C605-13, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings, Feb 1, 2014.

AWWA Standard, ANSI/AWWA C651-14, Disinfecting Water Mains, Feb 1, 2015.

AWWA Standard, ANSI/AWWA C652-11, Disinfection of Water-Storage Facilities, Oct 1, 2011.

AWWA Standard, ANSI/AWWA C653-13, Disinfection of Water Treatment Plants, Dec 1, 2013.

AWWA Standard, ANSI/AWWA C654-13, Disinfection of Wells, Jul 1, 2013.

AWWA Standard, ANSI/AWWA D100-11, Welded Carbon Steel Tanks for Water Storage, July 1, 2011.

AWWA Standard, ANSI/AWWA D102-14, Coating Steel Water-Storage Tanks, Nov 1, 2014.

AWWA Standard, ANSI/AWWA D103-09, Factory-Coated Bolted Carbon Steel Tanks for Water Storage, Nov 1, 2009.

AWWA Standard, ANSI/AWWA D104-11, Automatically Controlled, Impressed-Current Cathodic Protection for the Interior Submerged Surfaces of Steel Water Storage Tanks, Mar 1, 2011.

AWWA Standard, ANSI/AWWA D106-16, Sacrificial Anode Cathodic Protection Systems for the Interior Submerged Surfaces of Steel Water Storage Tanks, Jun 1, 2016.

AWWA Standard, ANSI/AWWA D107-16, Composite Elevated Tanks for Water Storage, Jan 1, 2017.

AWWA Standard, ANSI/AWWA D108-10, Aluminum Dome Roofs for Water Storage Facilities, Jun 1, 2010.

AWWA Standard, ANSI/AWWA D110-13, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks, Dec. 1, 2013.

AWWA Standard, ANSI/AWWA D115-06, Tendon-Prestressed Concrete Water Tanks, Sept. 1, 2006.

AWWA Standard, ANSI/AWWA D120-09, Thermosetting Fiberglass-Reinforced Plastic Tanks, Oct. 1, 2009.

AWWA Standard, ANSI/AWWA D121-12, Bolted Aboveground Thermosetting Fiberglass-Reinforced Plastic Panel-Type Tanks for Water Storage, Jun 1, 2012.

ANSI/AWWA D121a-14, Addendum to ANSI/AWWA D121-12, March 1, 2014.