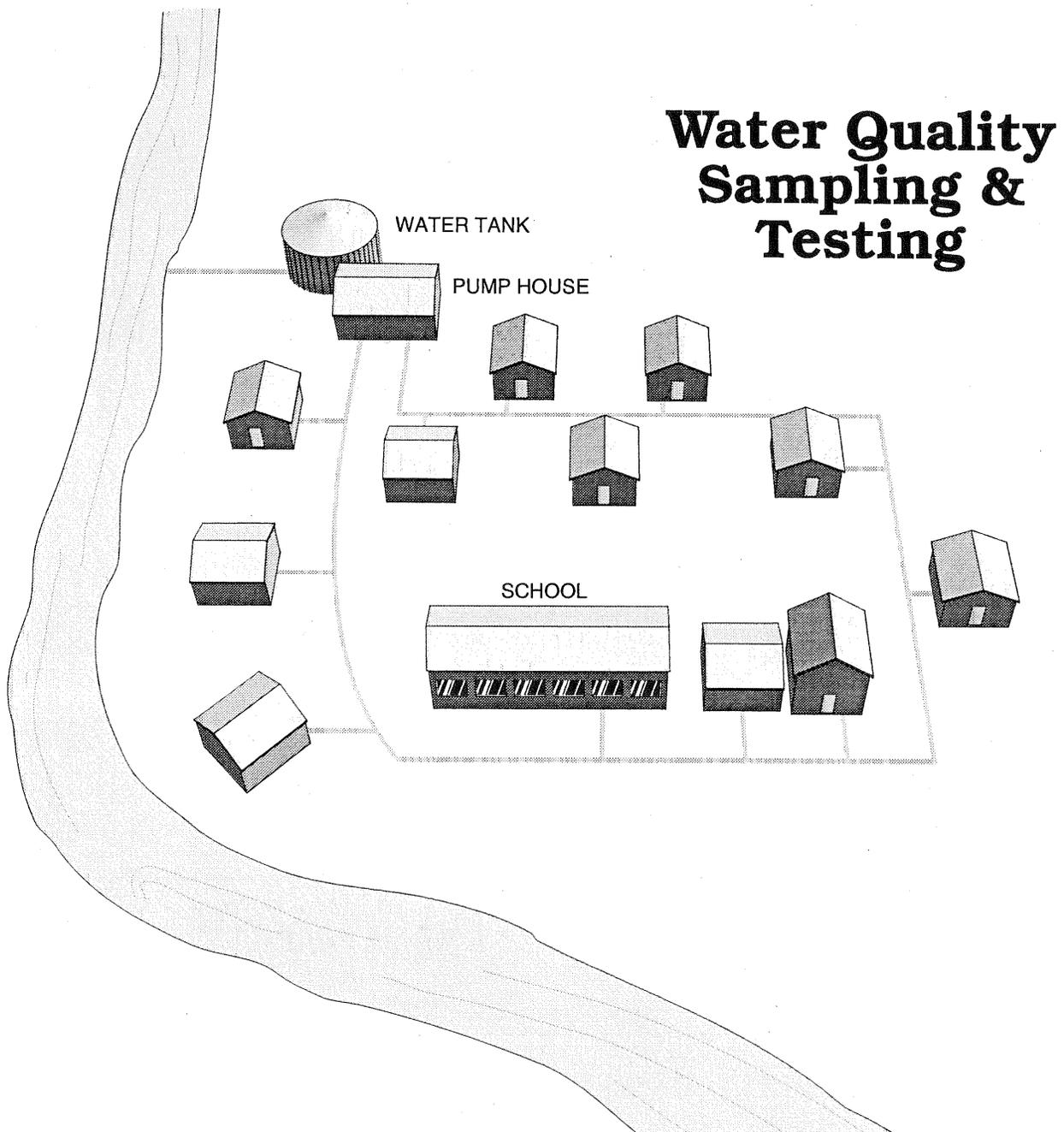


# O & M of Small Water Systems



**Alaska Department of Environmental Conservation**  
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## **O & M of Small Water Systems**

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# **WATER QUALITY SAMPLING AND TESTING**

## **WHAT IS IN THIS MODULE?**

1. How to develop a comprehensive monitoring plan.
2. Summary of state water quality sampling and testing requirements.
3. How to collect a bacteriological sample.
4. Key points for conducting repeat bacteriological sampling.
5. How to test chlorine residual.
6. How to test fluoride concentration.
7. How to measure turbidity.
8. How to measure pH.

## **KEY WORDS**

- Bacteriological
- Monitoring Interval
- Repeat sampling
- Sampling
- Sampling Tap
- Total Coliform
- Coliform Bacteria
- Non-Routine Monitoring
- Routine Monitoring
- Sampling Site
- Testing

## **MATH CONCEPTS DISCUSSED**

- Does not apply

## **SCIENCE CONCEPTS DISCUSSED**

- Does not apply

## **SAFETY CONSIDERATIONS**

- Does not apply

## **MECHANICAL EQUIPMENT DISCUSSED**

- Hach DR-100
- Color Comparator

# WATER QUALITY SAMPLING AND TESTING

## INTRODUCTION

### PREFACE

As we saw in the module on Drinking Water Regulations, water utilities must comply both with product quality standards and with procedural regulations governing how a water system should be designed, constructed and operated. The regulations must be understood and carried out by the owners and operators of water utilities. The public and the regulators must know if and how well the regulations are being followed. Written regulations by themselves do not ensure safe drinking water.

#### **The Monitoring Process Defined**

How does the public know if procedures are faithfully followed and product standards are met? The procedures must be observed and a sample of the product collected and tested. The product and procedures are measured against the applicable regulations to determine compliance. Regulators are notified of the results; the public is notified if the product or the utility's procedures fail to comply with the regulations.

#### **REGULATORS FOCUS ON PREVENTING PROBLEMS**

The regulatory agencies directly, or through qualified third parties, train and certify operators, review each utility's monthly operational and water quality reports, perform sanitary surveys, including evaluating the utility's procedures for operating and maintaining its water system. The emphasis of this regulatory oversight is on the prevention of health hazards and waterborne illness through training and through the enforcement of procedural regulations. Remember, the intent of the procedural regulations is to design and construct a sound physical water system **and** to develop and guide an **utility organization** to maintain and operate that water system to produce water that complies with the quality standards, the MCL's.

#### **WATER UTILITIES MONITOR THEIR OWN PRODUCTS AND OPERATIONS TO DETECT PROBLEMS**

The public must rely on the water utility itself to **monitor**<sup>1</sup> the quality of its finished water. It must sample and test or contract for testing of water samples. The regulatory agencies monitor the water utility's operations and management procedures to ensure compliance with the monitoring requirements, but rarely do

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<sup>1</sup>**Monitor** - In a narrow sense, to evaluate the quality of a process or product against a standard. The term is used in this lesson to broadly refer to the three stage process of:

- collection and analysis of a water sample to measure the presence of a contaminant,
- the comparison of the measurable amount of a contaminant to the Maximum Contaminant Level standard currently in effect, and
- the proper reporting and recordkeeping of that analysis and comparison.

the regulators step in and actually perform the sampling and testing.

## THE FOCUS OF THIS MODULE

This module covers a portion of the monitoring process involved in determining whether a water utility's product, its water, meets the state and federal standards for safe drinking water. Three subjects are covered in this module:

- How to set up a comprehensive monitoring plan.
- Summary of Alaska sampling and testing requirements.
- Procedures for performing routine sampling and testing.

This module does **not** cover the remaining procedures involved in monitoring: reporting to the regulators, notifying the public or record keeping. Nor does this module address the process of determining a water utility's compliance with procedural regulations, which is altogether a separate type of monitoring. See the module on Monitoring Water Utility O & M Procedures.

## WHY WATER QUALITY MONITORING IS IMPORTANT

- Compare the utility's product, water, to the quality standards, the MCLs.
- Measure the effectiveness of the treatment plant.
- Identify potential problems in the distribution network.
- Provide background data for future design.
- Comply with state and federal regulations.

## OVERVIEW OF THE WATER QUALITY MONITORING PROCESS

### KNOW THE CONTAMINATION CONTROL STRATEGY FOR YOUR SYSTEM

To better appreciate the purpose and importance of sampling and testing, the operator needs to understand the contamination control strategy developed by the design engineers and updated by the regulators.

### ESTABLISH A SAMPLING SITE PLAN

Establish sampling sites based upon the type of water treatment, if any, and the vulnerability of the source of supply and other system components to contamination.

Prepare a written sampling plan, accompanied by a map of the water system indicating all sampling sites. Include a calendar of scheduled sampling and testing.

**COLLECT THE WATER SAMPLE**

Collect representative samples for the tests at hand without contaminating the sample. Label the sample. Preserve it by refrigeration or pH control. Carefully pack those samples to be shipped to a laboratory in an insulated, cushioned container.

**ANALYZE THE WATER SAMPLE**

Analyze (test), in house or at a contract lab, the sample to detect and measure the concentration of a **contaminant**<sup>2</sup>.

**EVALUATE TEST RESULTS**

Compare the test results to the standard, the Maximum Contaminant Level.

**TAKE CORRECTIVE ACTION**

Make those corrections necessary to bring the water system operation and administration into compliance with procedural standards as well as make any adjustments necessary to bring the drinking water into compliance with the MCL's.

**REPORT TEST RESULTS**

Report the test results to the Department of Environmental Conservation.

**NOTIFY THE PUBLIC**

Notify the public when the water system fails to produce water that meets the MCLs.

**RETAIN WATER QUALITY RECORDS**

Retain the records pertaining to water quality testing, reporting, public notification and variances.

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<sup>2</sup> **Contaminant** - Microorganisms, chemicals and physical properties, which when present in sufficient concentration, make water unappealing or unsafe for human consumption.

## TYPES OF WATER QUALITY MONITORING

Monitoring requirements fall into two groups: sampling and testing that is performed on a scheduled basis and sampling and testing which is performed as a result of a change in conditions, such as after an emergency repair to a distribution main.

### SCHEDULED MONITORING

#### FACTORS REGULATORS CONSIDER TO DETERMINE THE FREQUENCY OF MONITORING

In general, the more likely that drinking water may become contaminated and the greater the severity of consequences from such contamination, the more frequently and more thoroughly we must monitor.

The frequency and type of sampling and testing depends upon the:

- Contaminant.
- Severity of the threat the contaminant poses to the public health if not controlled,
- Vulnerability of the source to that contaminant,
- Type of treatment used to control contaminants,
- Size of the population at risk, and
- Cost of monitoring for the contaminant relative to the size of the population at risk.

#### SEVERITY OF RISK TO PUBLIC HEALTH

##### **Immediate Health Threat**

The presence of pathogenic microorganisms, naturally occurring nitrates and fluoride from treatment at levels which exceed the Maximum Contaminant Levels in the drinking water, represent the greatest danger to the public.

##### **Long Term Health Risk**

The presence of chemicals and radio nuclides at levels in the drinking water which exceed the Maximum Contaminant Levels represent a risk to health when consumed over a long period of years.

#### VULNERABILITY TO CONTAMINATION

How contaminated is the source? How vulnerable is the source to additional contamination (in general groundwater is deemed less vulnerable than surface water)? What measures are in place to protect the watershed or wellhead? Is the distribution system subject to contamination from infiltration, from failure to control cross connections, from facilities in disrepair, such as storage tanks with birds nesting under their roofs?

#### COMPLEXITY OF TREATMENT PROCESS USED TO CONTROL CONTAMINATION

Typically the greater the actual contamination or risk of contamination to the source, the more complex the treatment processes used to control the contamination.

The greater the contamination we are controlling, the more we want to ensure that the treatment processes do not fail. Systems which do not filter surface water or groundwater under the direct influence of surface water have the most stringent monitoring requirements, because the likelihood of faulty treatment is so great and the potential severity of waterborne illness so horrific.

#### THE BENEFITS FROM MONITORING MAY NOT BE WORTH THE PER CAPITA COST OF MONITORING

The Chafee Amendment to the Clean Water Act recognized that the regulations must show some balance between the frequency and severity of the health risk to the size of the population affected on the one hand and the cost of controlling the health risk through monitoring on the other hand. Simply put, it may be less expensive for customer in small systems to assume long term health risks than to control those long term risks through more frequent monitoring and water treatment.

### ROUTINE WATER QUALITY MONITORING<sup>3</sup>

#### BACTERIOLOGICAL MONITORING

**Test for Immediate Threats to Health** Microbiological contaminants may constitute an immediate threat to the public health. Consumption of small quantities of water contaminated by **waterborne pathogens**<sup>4</sup> may cause **waterborne disease**<sup>5</sup> and even death.

#### Frequent Sampling and Testing

Therefore, water utilities are required to test frequently for indications of the presence of these pathogens.

#### Testing for Indicators of Pathogenic Organisms

Since many of these **pathogenic organisms**<sup>6</sup> cannot be directly detected through laboratory testing, the utility must test for a microbiological indicator. The indicator is a group of bacteria known as **Coliform bacteria**<sup>7</sup>.

#### PROCESS CONTROL MONITORING

If the water utility is required to disinfect, filter or otherwise treat its surface water or **GUDISW**<sup>8</sup> source, we

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<sup>3</sup> **Routine Monitoring** - Sampling and testing for immediate threats to public health, followed by reporting and, when necessary, public notification.

<sup>4</sup> **Waterborne Pathogens** - Bacteria, virus and protozoa which cause disease and are carried by water.

<sup>5</sup> **Waterborne Disease** - A disease caused by organisms or toxic substances which are carried by water. The most common water-borne diseases are typhoid fever, Asiatic Cholera, Dysentery, and other intestinal disturbances.

<sup>6</sup> **Pathogenic Organisms** - Bacteria, virus and protozoa which can cause disease.

<sup>7</sup> **Coliform Bacteria** - The coliform group of bacteria is a bacterial indicator of contamination. This group has as one of its primary habitats the intestinal tract of human beings. Coliforms also may be found in the intestinal tract of warm-blooded animals, in plants, soil, air and the aquatic environment.

<sup>8</sup> **GUDISW** - Groundwater Under the Direct Influence of Surface Water - Water under the earth's surface with significant occurrence of insects or other macroorganisms or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity or pH that closely correlate to climatological or surface water conditions.

may presume that the risk of pathogenic contamination is much greater than it would be from groundwater. The treatment is our defense against contamination in the system supply. Should this defense fail, our customers would be at great risk, especially if it failed without anyone knowing of the failure.

How can a water system know at all times that its contamination control process is working correctly? Could the system rely on tests for the presence of pathogenic organisms daily. No! Not only would the cost be prohibitive to test for each and every species of pathogenic organism, there are many microorganisms that we cannot directly detect. Besides, bacteriological testing takes too long to produce results that would give the small, rural system timely feedback.

### **Testing for Indication of Proper Treatment**

Therefore, a small system which treats surface water or GUDISW must perform hourly and daily tests which indirectly indicate whether the treatment process is meeting criteria. Rather than sampling and testing to directly measure the concentration of a contaminant, the system operator samples and tests to determine whether the treatment process is producing water with properties that, having been scientifically established, indicate a safe concentration of pathogenic microorganisms.

## **NON-ROUTINE WATER QUALITY MONITORING<sup>9</sup>**

### **MONITORING FOR LONG TERM HEALTH RISKS**

The EPA has identified the presence of certain inorganic minerals, organic chemicals, disinfection by-products and radio nuclides at specific thresholds as contaminants that present a long-term health risk. While it is technically possible to test for the presence and determine the level of concentration for every listed contaminant, the number of potential contaminants for which a utility must test makes these tests very expensive.

### **Contaminant Levels in Excess of MCL's are not an Immediate Health Threat**

Because the risk to health is low, the monitoring interval, that is, the time between each round of sample collection, is much greater for non-routine monitoring than it is for microbiological or treatment monitoring.

Except for Total Coliforms and nitrates, concentrations of contaminants in excess of Maximum Contaminant Levels do not present an immediate health threat.

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<sup>9</sup> **Non-routine Monitoring** - Sampling and testing for long term health hazards, followed by reporting and, when necessary, public notification.

**Levels of Contamination Do Not Fluctuate Rapidly**

Except for the by-products of water treatment and for fluoride, these concentrations typically do not change rapidly, whether the contaminant exists naturally or has its source in some human activity, such as spraying pesticides on the land.

**UNSCHEDULED MONITORING**

Unscheduled sampling and testing may be required or triggered by events or a change in the condition of the water systems.

**Resampling**

Resampling is required should the water system fail to comply with MCL's or monitoring regulations.

**Customer Complaints**

The Department of Environmental Conservation may require unscheduled for secondary contaminants if it has received complaints from a sufficient percentage of the system's customers.

**Illness**

The water utility must collect bacteriological samples if its customers contract an illness that may be water-borne.

**Distribution Repairs**

The water system operator must disinfect the distribution main and collect a bacteriological sample upon completing repairs.

**New Components**

Before customers are served from newly installed facilities, such as a new reservoir or a new distribution line, the facility must be disinfected and tested for Total Coliforms.

**Hazardous Spill**

In the event of a hazardous spill, such as a leak from fuel tanks, the vulnerable water system components must be monitored.

## **COMPREHENSIVE MONITORING PLAN**

All Alaska Class A and Class B public water systems must perform the required routine monitoring according to a written sample siting plan. The goal of the plan is to ensure that the presence of any contamination in the distribution system will be detected through routine monitoring. These plans are subject to review and revision by the Department of Environmental Quality.

This section of the module provides you with the background to be able to update the sample siting plan in the Operations and Maintenance Manual that was provided by the engineering firm when your system was constructed or rehabilitated.

### **REVIEW THE CONTAMINATION CONTROL STRATEGY**

#### **WHICH CONTAMINANTS IS THE WATER SYSTEM DESIGNED TO CONTROL?**

What are the contaminants and their maximum concentrations that the water system was designed and constructed to control?

#### **CONTAMINANTS PRESENT IN SOURCE**

What contaminants, at what concentrations were detected in the initial and subsequent sampling and testing of the source(s)?

Have any sources been abandoned or recommended for abandonment as a strategy to avoid removing contamination? Substituting another source to avoid certain or probable contamination may be less expensive than the design, construction and operation of facilities to control exotic contaminants.

#### **CONTAMINANTS TO WHICH THE SYSTEM IS VULNERABLE**

Based upon the initial and subsequent sanitary surveys, what are the contaminants to which the system might be vulnerable? The points of vulnerability could include storage, distribution mains, special customers, source and the treatment plant itself due to physical deterioration or improper operating procedures.

#### **CONTAMINANTS CREATED AS BY-PRODUCTS OF THE COMBINATION OF THE WATER SYSTEM SOURCES, CONSTRUCTION MATERIALS AND TREATMENT PROCESSES**

##### **Lead and Copper**

Based upon sanitary surveys and monitoring for lead and copper, have any substances been identified which, by themselves are within their MCL but when present in conjunction with the treatment process, distribution materials and customers plumbing, yield water at the customer's tap that contains levels of copper or lead that exceed the standard?

**TTHM's**

TTHM's are byproducts of water treatment. At this time, small systems are not covered by this category of the chemical contaminant regulations.

**RESIDUALS OF TREATMENT CHEMICALS IN EXCESS OF SAFE CONCENTRATIONS**

The residual levels of treatment chemicals, such as fluoride or chlorine, can present a health threat when present at high levels.

Not all substances found or introduced into drinking water are in and of themselves bad. Minerals and some treatment chemicals are beneficial within a certain range of concentration. It is only when these substances are present in concentrations that exceed the maximum allowable concentrations are they classified as contaminants.

**WHAT PROCESSES FACILITIES, AND PROCEDURES HAVE BEEN ESTABLISHED TO CONTROL CONTAMINATION?**  
**CONTAMINATION CONTROLS**

Contamination controls may include:

**Active Chemical & Mechanical Processes**

1. Water Treatment to Control Microorganisms.
2. Water Treatment for Corrosion Control.

**Passive Devices**

1. Backflow prevention devices.
2. Corrosion Control devices.

**Procedural (Administrative) Controls**

1. Watershed and Wellhead Protection.
2. Cross Connection Control Procedure.
3. Preventative Maintenance Procedures.
4. Emergency Repair Procedures.
5. Emergency Response Plans for Natural Disasters and Hazardous Spills.

**CONTAMINATION CONTROL SCHEMATIC**

Just as an electrical panel is built and installed according to a schematic, the water system is designed, constructed and operated according to a control strategy which can be represented in a schematic.

**Location of Control Points**

This schematic, included in your original Operations and Maintenance Manual, indicates each type of control and its location(s) in the system. The schematic shows where the system designers located contamination controls within the water supply and distribution system.

**Update of Schematic**

As time passes the schematic needs to be updated to reflect:

- Additional controls that have been implemented to comply with any additional contaminants for which the federal and state regulators have now set Maximum Contaminant Levels.
- Additional controls that have been implemented to comply with additional contaminants to which the system is deemed vulnerable, for example watershed and wellhead protection programs.

**REVIEW THE CURRENT SYSTEM MONITORING PLAN**

What automated processes and what manual monitoring procedures have been established by the system designers and regulators to monitor the control of contamination?

**OBJECTIVES OF SYSTEM MONITORING**

The objective of system monitoring is to determine the following:

1. Does the drinking water meet the product quality standards?
2. Do the production processes meet the procedural and product standards?
3. Is each contamination control device installed and working properly?
4. Are the administrative controls implemented?

**APPROACHES TO MONITORING**

There are several approaches available for system monitoring, depending upon:

- The time available to make corrections.
- The desired frequency of monitoring.
- The capital cost of automation versus any potential savings from reduced labor cost to perform manual sampling and testing.

**Fully Automated Monitoring**

Fully automated monitoring includes sensing/measuring, comparing and corrective action. This approach of instrumentation and control is addressed in the various treatment and storage modules.

**Automated Sampling**

Automated sampling followed by manual adjustments to the system. This approach to continuous monitoring is addressed in the various treatment process modules.

**Combination of Automated Sampling and Manual Testing**

A combination of automated sampling and testing followed by manual interpretations of the test and man-

ual adjustments to system. This approach to continuous monitoring is addressed in the various treatment process modules.

### **Manual Monitoring**

1. Typically used for low frequency water quality sampling and testing where there is ample time for collection, shipping, testing, reporting and making adjustments.
2. When capital costs for continuous sampling are prohibitive for small systems, we can still indirectly evaluate treatment processes by sampling the water quality before, during and after treatment.
3. Typically used for measuring compliance with procedural standards.

## **PROCESS CONTROL MONITORING**

Identify each stage of your plant's process control that requires manual monitoring. The process control monitoring cycle consists of the following stages:

### **Quantify Qualities of Water**

- Capture properties to be measured through sensors or manually collect a sample and then test for the properties.

### **Compare Qualities to Standard**

- Compare the measured properties to the standard.

### **Corrective Action**

- Adjust the production and treatment processes to bring them into compliance with the product quality standards.

## **USES OF MANUAL MONITORING TO ISOLATE THE ORIGIN OF PROBLEMS**

### **LOCATION OF WATER QUALITY PROBLEMS**

Except when used for indirectly measuring treatment plant processes, manual water quality monitoring identifies those contaminants which have not been sufficiently controlled. A red flag is raised to show that our system has a problem. But, where **in** the system is the problem? There are two approaches.

1. If the red flag is for exceeding the total coliform MCL, follow the state procedure for repeat sampling that is included in the Sampling Techniques portion of this module.
2. Sample our system segment by segment to isolate the problem.

### **IDENTIFY FAILURES IN PROCEDURAL CONTROLS, ADMINISTRATIVE CONTROLS, AND CONTROL DEVICES**

We can also indirectly evaluate our maintenance, repair and cross connection control procedures if we establish segments within the distribution where we will periodically sample. Water quality problems can

indicate failures in administrative controls or control devices.

## ESTABLISH SAMPLING SITES

### PROCESS CONTROL SAMPLING SITES

Establish sampling sites that allow you to evaluate the effectiveness of water treatment.

#### Treatment Plant Entrance

Turbidity of raw water.

#### Treatment Plant Exit

**Turbidity**<sup>10</sup>, **Total Chlorine Residual**<sup>11</sup>, **Free Chlorine Residual**<sup>12</sup>, **Contact Time**<sup>13</sup> in the contact chamber.

#### First Service Connection

Turbidity and Chlorine Residual.

### BASELINE SAMPLING SITES

Establish one or more baseline points in the distribution system where samples are always taken to indicate the overall quality of water in the distribution network.

Routine and non-routine samples are collected at these points for testing the levels of Total Coliforms, Chlorine Residual, Fluoride, Lead/Copper, Inorganics, Synthetic Organics, Radio Nuclides, and Disinfection By-products in the distribution system.

### SYSTEM SEGMENT SAMPLING SITES

Establish sampling sites that you will periodically sample and test to reveal the water quality of a particular system component or a segment of the distribution system.

#### Individual Sources

Volatile Organics, any raw water turbidity and coliform monitoring to avoid filtration.

#### Storage

Disinfectant residual and Total Coliforms, especially when water turnover is very low.

#### Discrete Zones in the Distribution System

Sampling sites that will allow the utility to evaluate the water quality in easily isolated zones created to boost water pressure or reduce water pressure. In

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<sup>10</sup> **Turbidity** - A condition in water caused by the presence of suspended matter, resulting in the scattering and absorption of light rays.

<sup>11</sup> **Chlorine Residual** - The amount of chlorine left in solution after a period of time. For instance with new water lines, the reaction time is 24 hours. The residual is usually expressed in mg/L.

<sup>12</sup> **Free Chlorine Residual** - The amount of chlorine available as dissolved gas, hypochlorous acid or hypochlorite ion that is not combined with an ammonia or other organic compounds. It is 25 times more powerful than the combined chlorine residual.

<sup>13</sup> **Contact Time (CT)** - The amount of time in minutes between the dosage of a disinfectant and when the free residual is measured, before the water is delivered to the first customer. The product of "residual disinfectant concentration" (C), in mg/L, determined before or at the first customer, and the corresponding "disinfectant contact time" (T), in minutes.

smaller systems, these same zones can be used to sample for Coliforms after scheduled or emergency repairs to mains.

#### Dead Ends

Disinfectant residual and Total Coliforms.

### SAMPLING TAPS AT INDIVIDUAL CUSTOMERS

- Special Users, such as institutions, food processors, manufacturers, resorts, docks - Sites for monitoring cross connection controls.
- Residential Customers - Sites for routine sampling and lead/copper sampling.

### ADDITIONAL STATE REQUIRED ROUTINE SAMPLING SITES

- A utility that collects fewer than five bacteriological samples per month must indicate sites for collecting the five routine samples required in a month following a **total coliform**<sup>14</sup> positive routine sample.
- The utility must designate at least two alternative bacteriological sampling sites to be used when the site(s) scheduled to be sampled during a particular monitoring period are not accessible.

### AVOID THESE LOCATIONS

- Avoid buildings with separate storage tanks because the tanks may have a low rate of water exchange which will allow the naturally occurring Coliforms to multiply more rapidly than they do in the distribution system. Furthermore, these tanks may be exposed to additional contamination.

### AVOID THESE TAPS

The following taps should be avoided when sampling:

- Faucets down stream of water conditioning equipment, including softeners and filters because Coliforms could be harbored in the filtering media.
- Hot water faucets because Coliforms could be rapidly incubating in the hot water lines or in the water heater if its temperature is low.
- Drinking fountains.
- Faucets with threaded ends.
- Lawn faucets.
- Hoses.
- Swivel faucets.
- Kitchen faucets.
- Leaky faucets.

### SAMPLING ROUTE

Set up the sampling route such that samples that may

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<sup>14</sup> **Total Coliform** - A bacterial species that is used as an indicator of bacterial safety in drinking water.

be held are taken before samples that require immediate analysis.

## **SAMPLING SITE<sup>15</sup> MAP**

This map may be drawn to scale or it may be a schematic of the system. The map must include the following elements: identification of system components, location of sampling sites and a map legend.

### **SYSTEM COMPONENTS**

1. Location and type of source.
2. Water Treatment Facilities.
3. Water Storage Facilities
4. Distribution Lines including:
  - First service connection.
  - Dead ends, including the last service connection.
5. Pressure zones including:
  - Booster pumping stations.
  - Pressure reducing stations.
6. Major commercial and industrial areas.

### **SAMPLING SITES AND SAMPLING TAPS**

Label the location of every sampling site on the map. Where the location has more than one tap, indicate the specific tap to be used as the sampling station.

### **LEGEND**

The map must include a legend of tests to be performed at each station. In the legend and in the narrative of your plan, indicate the time interval for every type of sample you intend to collect at each sampling site.

## **SAMPLING SCHEDULES AND CALENDARS**

### **Routine Sampling and Testing**

Group the routine sampling and testing that the water system operator is required to perform on an hourly, daily, weekly, monthly and quarterly basis. This schedule will vary from system to system, depending upon the type of source, population served, vulnerability to known contaminants and the public health history of the system.

### **Non-Routine Sampling**

List the non-routine testing the water utility must have a certified lab perform. Group the quarterly, annual and multi-year tests on a permanent calendar.

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<sup>15</sup> **Sampling Site** - The location within the water system where a sample of water may be collected. This location may also be referred to as a "sampling point."

This calendar will vary from system to system, depending upon the type of source, population served, vulnerability to known contaminants and the public health history of the system.

## WRITTEN PLAN

### System Summary

Provide a summary which includes:

- Name and identification number of the public water system, address, phone number and contact person.
- The population served each month by the system; do not include persons served by private water sources even though they reside within the boundaries of the city.
- Number of service connections.
- Number of coliform samples required per **monitoring period**<sup>16</sup>.
- A brief description of the type of sources, treatment, storage and distribution components that comprise the system.

### List all Contaminants Monitored

List each contaminant for which the utility must monitor.

### Identify Sampling Sites and Taps

At a minimum, include a written list of locations (sampling sites) where the coliform samples will be taken during each monitoring period. Ideally, include in the list the sampling sites for all contaminant groups. Also locate and describe the sampling station or tap from which the sample will be drawn.

### State Rationale for Site Selection

For each sampling site included, give the reasons for choosing that site.

### Indicate Monitoring Frequency

For every contaminant listed, include the frequency of sampling, sample volume and type of testing required.

### Sampling and Testing Procedures

Include written procedures for:

- Collecting each type of sample.
- Performing analyses on those types of samples tested in house.

### Lab Identification

Identify the certified lab(s) that perform or could perform tests for the water utility. Include their addresses and phone numbers. For every lab listed, indicate which tests they perform.

### Notification List

Include a list of all agencies that must be notified of test results.

- Separately identify those who must be notified by the

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<sup>16</sup> **Monitoring Period** - The time between collection and testing of samples. The period could be hours, days, months, quarters, years or multiples of years. **Caution:** Alaska Administrative Code states that when more than one coliform sample must be collected during each monthly period, samples must be collected at evenly spread intervals throughout the month.

lab at the conclusion of analysis.

**Public Notification Procedures**

- List those who must be notified by the utility's owner/operator.
- Include a copy of the state Public Notification Requirements from the state regulations that determine the procedure for notifying the public in the event the system does not meet water quality standards.
- Include a copy of any additional procedures that the utility's governing body has determined will be used to notify the public in the event the system does not meet water quality standards.

## **SUMMARY OF WATER QUALITY SAMPLING AND TESTING REQUIREMENTS**

### **ROUTINE SAMPLING AND TESTING**

#### **SYSTEMS THAT USE GROUND WATER BUT DO NOT DISINFECT PROCESS CONTROL SAMPLING SITES**

Not applicable.

#### **DISTRIBUTION BASELINE POINTS**

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

#### **DISTRIBUTION SEGMENT**

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

### **SYSTEMS THAT DISINFECT GROUND WATER**

#### **PROCESS CONTROL SAMPLING SITES**

##### **First Service Connection**

Measure **Disinfectant Residual**.

#### **DISTRIBUTION BASELINE POINTS**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

#### **DISTRIBUTION SEGMENT**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

### **SYSTEMS THAT FILTER AND DISINFECT SURFACE WATER OR GROUND WATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER**

#### **PROCESS CONTROL SAMPLING SITES**

##### **Post Filtration**

Measure **Turbidity**.

##### **First Service Connection**

Measure **Disinfectant Residual**.

#### **DISTRIBUTION BASELINE POINTS**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

#### **DISTRIBUTION SEGMENT**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

**SYSTEMS THAT DISINFECT BUT DO NOT FILTER SURFACE WATER OR GROUND WATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER**

**PROCESS CONTROL POINTS**

**Treatment Plant Entrance**

Measure **Turbidity** of Raw Water.

Collect samples for **Total Coliform P/A** and **Coliform Density** testing.

**Disinfection Process**

Measure **Disinfectant Contact Time**.

**Finished Water**

Measure **Disinfectant Residual**.

Measure Water **pH**<sup>17</sup>.

Measure **Temperature**.

**First Service Connection**

Measure **Disinfectant Residual**.

Collect samples for **Total Coliform P/A** testing (Samples must be taken at this point when the turbidity of raw water exceeds 1 ntu.).

**DISTRIBUTION BASELINE POINTS**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

**DISTRIBUTION SEGMENT**

Measure **Disinfectant Residual**.

Collect sample(s) for **Total Coliform P/A** test.

Test **Fluoride Residual**, if fluoride is added.

**FILL AND DRAW SYSTEMS**

**PROCESS CONTROL SAMPLING SITES**

**Post Filtration**

Measure **Turbidity** at least once a day during every day that water is being filtered.

**First Service Connection**

The **Disinfectant Residual** must be tested daily.

**Fluoride** must be measured at least once a day during every day that fluoride is added.

**DISTRIBUTION BASELINE POINTS**

Test for **Disinfectant Residual** daily.

Collect sample(s) for **Total Coliform P/A** test according to the standard sampling frequency, determined by the system class and population served.

Test **Fluoride Residual** once a week, if fluoride was added while the tank was filling.

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<sup>17</sup> pH - An expression of the intensity of the alkaline or acidic strength of a water. Mathematically, pH is the logarithm (base 10) of the reciprocal of the hydrogen ion concentration. pH may range from 0 to 14, where 0 is the most acid, 14 most alkaline, and 7 neutral. Natural waters usually have a pH between 6.5 and 8.5.

# ALASKA PUBLIC DRINKING WATER SUPPLY TESTING SCHEDULE

	CLASS A SURFACE WATER*	CLASS A GROUND WATER	CLASS B SURFACE WATER	CLASS B GROUND WATER	PURCHASED WATER FROM AN AP CLASS A AND CLASS B SYST
Total Coliform Bacteria	Monthly <sup>3</sup>	Monthly <sup>3,5</sup>	Monthly	Quarterly <sup>5</sup>	Quarterly <sup>5</sup>
Inorganic Chemicals					
All Primaries	Annually	Every 3 years			
Nitrate only	Quarterly	Annually		Annually	not required
Nitrite	ALL SYSTEMS: ONE SAMPLE BY DECEMBER 31, 1995				
Organic Pesticides <sup>11</sup>	Every 3 years	As required by DEC	not required	not required	not required
Natural Radioactivity	Every 4 years <sup>1</sup>	Every 4 years <sup>1</sup>	not required	not required	not required
Mannmade Radioactivity <sup>10</sup>	Every 4 years	not required	not required	not required	not required
Turbidity <sup>6</sup> - operator tested	Daily <sup>4,6</sup>	not required	Daily <sup>4,6</sup>	not required	not required
Fluoride <sup>2</sup> - operator tested	Daily <sup>12</sup>	Daily <sup>12</sup>	Daily <sup>12</sup>	Daily <sup>2</sup>	not required
Disinfection Residual <sup>2</sup> operator tested	Daily <sup>2</sup>	Daily <sup>2</sup>	Daily <sup>2</sup>	Daily <sup>2</sup>	not required
Volatile Organic Chemicals <sup>7</sup>	Required	Required	not required	not required	not required
Total Trihalomethanes <sup>8,9</sup>	Quarterly	Annually	not required	not required	not required

\* Includes GUDISW

1. Compliance will be based on the analysis of an annual composite of four consecutive quarterly samples, or the average of the analysis of four samples obtained at consecutive quarterly intervals if added to the water.
2. One sample per month is required for populations less than 1,000; Consult Table '9' in the Drinking Water Regulations if your system's population is greater than 1,000.
3. Measured only on days when water is being produced.
4. For groundwater systems with less than 1,000 persons, DEC, at its discretion, may increase the bacteria sampling frequency to one per month if the system has a history of contamination or a system unresolvable deficiencies noted during a sanitary survey. For systems with greater than 1,000 persons see Table 9 for monthly bacteria sampling requirements.
5. For fill and draw systems: monitor on days when water is being produced.
6. Contact the regional DEC office: South-Central Regional Office (Anchorage) 563-6529, Northern Regional Office (Fairbanks) 451-2360, South-Eastern Regional Office (Juneau) 789-3151.
7. For systems using a chlorine for disinfection, and serving more than 10,000 people.
8. The sampling and analysis requirements for total trihalomethanes are included at 40 C.F.R. 141.30, as amended through August 15, 1989.
9. For systems serving more than 100,000 persons.
10. Samples for organic pesticides must be taken during the period of the year designated by the department as the period when contamination is most likely to occur.
11. For fill and draw systems: monitor every day fluoride is added; monitor weekly thereafter.
- 12.

**NON-ROUTINE MONITORING  
SYSTEMS THAT USE GROUND WATER BUT DO NOT DISINFECT  
SOURCE**

Inorganic, Volatile Organics, Synthetic Organics.

**SYSTEMS THAT DISINFECT GROUND WATER  
ENTRY POINT TO DISTRIBUTION SYSTEM WHICH IS REPRESENTATIVE OF EACH SOURCE**

Collect samples for Inorganic, Volatile Organics,  
Synthetic Organics **after water treatment.**

**SYSTEMS THAT USE SURFACE WATER OR GROUND WATER UNDER THE  
DIRECT INFLUENCE OF SURFACE WATER  
ENTRY POINT TO DISTRIBUTION SYSTEM OR AT POINTS IN DISTRIBUTION SYSTEM THAT ARE  
REPRESENTATIVE OF EACH SOURCE**

Collect samples for Inorganic, Volatile Organics,  
Synthetic Organics **after water treatment.**

**LEAD AND COPPER**

Samples must be taken inside the customer's building, because we are sampling to determine if the combination of the qualities of the source water, the chemicals the utility uses for treatment and the materials in the customers plumbing combine to release excessive levels of lead or copper in the water at the customers tap.

**TESTING OF GUDISW SOURCES TO AVOID FILTRATION**

A minimum of two samples are collected during the period when the source is most vulnerable to surface water influence. Sampling is, therefore, usually performed in periods of heavy rainfall or heavy runoff.

The collection process involves filtering 500 to 1,000 gallons of water through a cartridge filter over a period of 4 to 8 hours. The cartridge filter has a 1 micron nominal porosity.

NON-ROUTINE WATER SAMPLING REQUIREMENTS for SMALL CLASS A SYSTEMS					
CONTAMINANT GROUP	RULE	Over 500 Connections		500 or Fewer Connections	
		SURFACE	GROUND	SURFACE	GROUND
INORGANIC CHEMICALS					
Heavy Metals (see list 1)	18 AAC 80.200	Yearly	Every 3 Yrs	Yearly	Every 3 Yrs
Nitrate	18 AAC 80.200	Quarterly	Yearly	Quarterly	Yearly
ORGANIC CHEMICALS					
Pesticides (see List 2)	18 AAC 80.200	Every 3 Yrs	ADEC Discretion	Every 3 Yrs	ADEC Discretion
VOLATILE ORGANIC CHEMICALS					
VOCs in Lists G, H or I detected	18 AAC 80.405	Qtrly or ADEC Discretion			
No VOCs in lists G, H & I detected but system vulnerable	18 AAC 80.405	Every 3 Years	Every 3 Years	Every 3 Years	Every 3 Years
No VOCs in Lists G and H detected; system not vulnerable	18 AAC 80.405	ADEC Discretion	Every 5 Years	ADEC Discretion	Every 5 Years
VOCs in List J detected	18 AAC 80.405	ADEC Discretion	ADEC Discretion	ADEC Discretion	ADEC Discretion
No VOCs in List J detected	18 AAC 80.405	None	None	None	None
TRICHALOMETHANES					
Total Trihalomethanes (see List 3)	18 AAC 80.200	Not Applicable	Not Applicable	Not Applicable	Not Applicable
RADIOACTIVITY					
Gross Alpha and Combined Radium-226 and 228	18 AAC 80.200	Every 4 Yrs	Every 4 Yrs	Every 4 Yrs	Every 4 Yrs
Gross Beta, Strontium-90, and Tritium	18 AAC 80.200	Not Applicable	Not Required	Not Applicable	Not Required
NON-ROUTINE WATER SAMPLING REQUIREMENTS for SMALL CLASS B SYSTEMS					
CONTAMINANT GROUP	RULE	Over 500 connections		Under 500 Connections	
		SURFACE	GROUND	SURFACE	GROUND
INORGANIC CHEMICALS					
Nitrates	18 AAC 80.200	Annually	Annually	Annually	Annually

## SAMPLING AND TESTING TECHNIQUES

### AVOID CONDITIONS THAT WILL DISTORT A SAMPLE

- Protect the sample against **contamination** from your hands, clothes or the outside of the sampling tap.
- Avoid conditions that encourage the **incubation of Coliforms** such as storage tanks and hot water heaters.
- When collecting samples without benefit of a sampling tap, avoid large **particles, floating material, deposits on vessel surfaces or growths on the water surface.**
- Be sure to collect a large enough quantity of water to run the test.
- Be sure you have selected an **appropriate sampling point** for the test at hand.

## ROUTINE BACTERIOLOGICAL SAMPLING<sup>18</sup>

### BACTERIOLOGICAL SAMPLING

#### INTRODUCTION

##### Description

Sampling of water distribution systems for bacterial contamination is an essential procedure for determination of water quality. It is, therefore, essential that the proper techniques be used to eliminate the possibility of contamination of the sample while it is being collected.

#### EQUIPMENT

##### On-Site Testing

When collecting samples for on-site testing, use sterilized borosilicate glass and wide-mouth bottles with ground glass stoppers and with a minimum capacity of 120 mL.

##### When to Sample

It is best to sample at the first of the month. This allows a chance for a second sample, should the first one be lost or damaged in shipping.

##### Mailing

When mailing samples the following sterilized containers are acceptable:

- Heat resistant polypropylene bottle with plastic screw-on top with 120 mL capacity.
- Borosilicate glass bottle with plastic screw-on top with 120 mL capacity.
- Polypropylene plastic "whirl pack" with 125 mL capacity.
- A bacteriological sample that is mailed must get to

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<sup>18</sup> Routine Bacteriological Sampling - Collection of water samples on a monthly/quarterly basis for analysis for the presence of coliform bacteria.

the laboratory within 30 hours after collection or the laboratory will not test the sample.

**Insulation**

Samples mailed or shipped by plane must in insulated and protected from damage.

**SPECIAL INSTRUCTIONS**

**Elimination of Chlorine Residual**

Sample bottles and "whirl packs" prepared in state or commercial laboratories will have sodium thiosulfate in the bottle to eliminate chlorine in the sample. The sodium thiosulfate will appear as a white powder, crystal or clear liquid. This material should not be rinsed from the container.

**Do Not Reuse Containers**

If, for some reason, the sample could not be shipped, dump the sample **but do not** reuse the bottle.

**PROCEDURE**

**1. Select a sample site**

Sample sites should be representative of the system. There are two types of sample locations;

- Those that are identified on the official sample plan.
- O & M sampling points, which include raw water, reservoirs, dead ends, low points in the system and new lines.

**2. Select sample point**

Routine sample points should have been identified as part of the development of the official sampling plan. The best sample points are faucets approximately 30 inches above the ground or from inside faucets that have none of the characteristics listed below.

Sample points to be avoided are:

- Drinking fountains.
- Lawn faucets.
- Hoses.
- Kitchen faucets.
- Leaky faucets.

**Aerators**

If a faucet with an aerator must be used, the aerator should be removed.

**3. Sanitized faucet**

Wipe the outside of the faucet with a mild chlorine solution. **Do not flame the faucet.**

**4. Allow water to run 5 minutes**

Or wait for a sufficient time to allow water from the distribution system to enter the sampling point.

**5. Adjust the flow so that there will be no splashing**

Splashing could cause some of the sodium thiosulfate to be displaced and could cause contamination to drip into the container.

**6. Open container**

Remove the lid or open the whirl pack. Keep the lid or stopper pointed down. **Do not touch the inside of the container. Do not blow into the pack while open.**

**7. Fill the container**

One inch of head space (air) should be left in sample bottles and 2 inches in the whirl pack. This improves mixing of the sample at the laboratory. A minimum of 100 mL is necessary for each sample. Since the container holds 120 mL, leaving an air space will still provide sufficient actual sample volume.

**8. Seal container**

Replace lid on bottles, pull wires of Whirl bag to flatten the top of the bag and whirl the bag over three times. Fold the wires over the bag.

**9. Turn water Off**

**10. Pack for shipping**

The container should be insulated to maintain the temperature of the sample. If shipping is delayed, refrigerate the sample. If the sample cannot be shipped on the same day it was collected, then discard and resample.

**RECORD SAMPLE DATA**

**Standard Sampling**

The containers used by commercial and state laboratories are supplied with a standard sample data form. Completely fill out all portions of the form.

**Essential Data**

When a form is not available, as in a O & M sample, record the following information:

- Public water system number.
- Sources of water, ground, surface and name of stream or lake, if surface.
- Time collected.
- Date sample collected.
- Sample location.
- Name of person collecting sample.
- Was the water chlorinated?
- If the sample is mailed, time and date of mailing. If shipped by plane, date and flight number.

**Copy of Data**

When shipping a sample to a state or commercial laboratory, keep and file a copy of the data form that was sent with the sample.

## REPEAT BACTERIOLOGICAL SAMPLING<sup>19</sup>

### INTRODUCTION

#### Why this Test is Necessary

Once a routine bacteriological sample has yielded a positive coliform test result, the utility must collect Repeat Samples to:

- Verify the results of the first test. Was the original sample contaminated in some manner or is contamination truly present in the water system.
- Isolate the location of the source of contamination within the water system.

### SPECIAL INSTRUCTIONS

#### When to Sample

The utility must collect the Repeat Samples within 24 hours of receiving notification of the positive sample.

#### Duration of Sampling

All Repeat Samples must be collected on the same day.

#### Number of Samples

If the utility normally collects one routine sample per month, it must collect four (4) Repeat Samples.

#### Location of Sample Points

- One sample must be collected from the same tap that was the source of the coliform positive sample.
- One sample must be collected from within (5) customer connections **upstream** of the original sample location.
- One sample must be collected from within (5) customer connections **downstream** of the original sample location.
- One sample from any other location.

#### Exception for Systems with only one Service Connection

- The utility may collect one Repeat Sample a day for each of four consecutive days, OR
- The utility may collect all Repeat Samples from the same tap on the same day in one container. Use a sterilized 400 milliliter bottle for this option.

#### Resampling Frequency

If these Repeat Samples also test coliform positive, the utility must collect another round of repeat samples.

### ADDITIONAL ROUTINE SAMPLING REQUIRED

#### Following Month

During the month following a coliform positive sampling, the utility must collect five (5) routine samples from the system.

These five samples must be collected, **a)** even if there was no MCL violation and **b)** even if the repeat samples indicated the absence of Coliforms.

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<sup>19</sup> Repeat Bacteriological Sampling - Collection of water samples after a routine sample has tested coliform positive.

# CHLORINE RESIDUAL (FREE RESIDUAL - DPD) COMPARATOR METHOD

## INTRODUCTION

### Reason for Residual

The amount of chlorine remaining in a distribution system is important to water quality and an insurance against the cause of waterborne disease which may enter the distribution system.

### DPD Method

The DPD method is the only acceptable color comparator procedure for measuring this residual in water distribution systems.

### Storage of Samples

Samples for chlorine residual cannot be stored or transported. They must be tested within ten minutes of collection.

## EQUIPMENT

Hach Model #CN - 66 or comparable Wallace & Tiernan or LaMotte comparators.

## REAGENTS

DPD Free Chlorine Powder Pillow - Hach #14070-99.

## SPECIAL INSTRUCTIONS

Each brand of color comparators has its own peculiarities. This procedure will be for the HACH comparator. Special instructions will be added in the right hand column of each step of the other comparators.

## PROCEDURE

### 1. Clean comparator glass cells

Periodically wash the cells with hot soapy water and a soft test tube brush. Rinse thoroughly with distilled water. Let the cells drain dry.

### 2. Rinse glass cells with sample

This must be done each time the cells are used. The rinse will remove any remaining chemical and accumulated dust.

### 3. Place 5 mL of sample in the left hand cell

This is referred to as the blank. The purpose for this step is to compensate for any color or turbidity in the sample.

- The Wallace & Tiernan comparator calls for 15 mL of sample. The LaMotte does not use a blank.

### 4. Place 5 mL of sample in the right hand cell

This is the portion of the sample to be tested.

### 5. Add contents of powder pillow to right hand cell

DPD tablets may be substituted for the powder pillow.

### 6. Inset rubber stoppers

These will prevent loss of sample during mixing.

### 7. Stir by swirling the test cell

Do not place your thumb or finger on the top of the test cell - this could contaminate the sample.

**8. Wait 30 seconds**

Do not wait more than 1 minute.

**9. Adjust the comparator wheel**

Match the wheel color over the blank cell with the color that has developed in the sample cell.

- With the LaMotte, move the test cell until it matches the color in one of the vials.

**10. Read the residual**

The residual will be in mg/L.

**11. Record the results**

The results should be recorded as mg/L of free chlorine residual.

**12. Rinse the test cells**

If available, rinse with distilled water twice, invert the cells and allow to dry. If there is no distilled water, rinse with sample water, invert and allow the cells to dry.

# CHLORINE RESIDUAL (FREE RESIDUAL 0-2 mg/L - DPD) HACH DR-100

## INTRODUCTION

### Reason for Residual

The amount of chlorine remaining in a distribution system is important to water quality and an insurance against the cause of waterborne disease which may enter the distribution system.

### DPD Method

The DPD method is the only acceptable color comparator procedure for measuring this residual in water distribution systems.

### Storage of Samples

Samples for chlorine residual cannot be stored or transported. They must be tested within ten minutes of collection.

## EQUIPMENT

HACH Chlorine Test Kit DR-100 (Cat. No. 41100-22).

Polypropylene or borosilicate glass sample container with screw-on top.

## REAGENTS

DPD Free Chlorine Powder Pillow - HACH #14070-99

## SPECIAL INSTRUCTIONS

Each brand of color comparators has its own peculiarities. This procedure will be for the HACH comparator. Special instructions will be added in the right hand column of each step of the other comparators.

## PROCEDURE

### 1. Press On button - check battery

If the battery indicator light is lit, replace the batteries.

### 2. Open the light shield

### 3. Turn the right set knob fully clockwise

### 4. Insert the 1- cm cell holder

Place the cell holder in the Left Set position of the sample well. Press down firmly to seat it in place.

### 5. Close the light shield.

### 6. Holding the "On" button down

### 7. Adjust the left set knob

Align the meter needle with the arrow at the far left of the scale arc.

### 8. Remove the cell holder

### 9. Close the light shield

### 10. Fill both 2.5-cm sample cells

Fill to the 10-mL mark with the water to be tested.

**11. Open a DPD free chlorine powder pillow**

Use the clippers.

**12. Add the contents to one of the 2.5-cm sample cells**

**13. Cap and swirl several times to mix**

If chlorine is present, a red color will develop. Do not allow more than one minute before completing Steps 7 through 10.

**14. Cap the cell containing untreated water sample**

**15. Open the light shield**

**16. Place the cell into the sample well**

Press down firmly to seat the sample cell. Close the Light Shield.

**17. Hold the "On" button down**

**18. Adjust the right set knob**

For a reading of zero mg/L.

**19. Open the light shield and remove the sample cell**

**20. Place the cell containing prepared sample into the sample well**

Press down firmly to seat the sample cell.

**21. Close the light shield**

**22. Hold down on the "On" button**

Allow the meter to stabilize.

**23. Read and record**

Record as mg/L of free chlorine residual.

**24. Clean cells**

Allow the cells to drip dry.

# FLUORIDE RESIDUAL - LOW RANGE (0-2 mg/L)

## HACH DR-100

### INTRODUCTION

**Reason for Residual**

Fluoride is fed into water distribution systems as a means of reducing dental cavities of children.

**Method**

The method describe in the procedure is using the HACH Fluoride Test Kit DR-100 (Cat. No. 41100-21)

**Storage of Samples**

Since fluoride is very stable, samples for testing can be stored for seven (7) days providing that the sample is cooled to 4°C. The storage container should be polypropylene or borosilicate glass.

### EQUIPMENT

HACH Fluoride Test Kit DR-100 (Cat. No. 41100-21).

Polypropylene or borosilicate glass sample container with screw-on top.

### REAGENTS

Distilled water

1 mg/L standard Fluoride solution

### SPECIAL INSTRUCTIONS

Standard solution ampules can be reused within the same day. Steps 1 through 13 are for testing and standardizing the meter. These steps normally need only be done once per day. However, if running more than 5 tests a day, recalibrate the meter after each 5 tests.

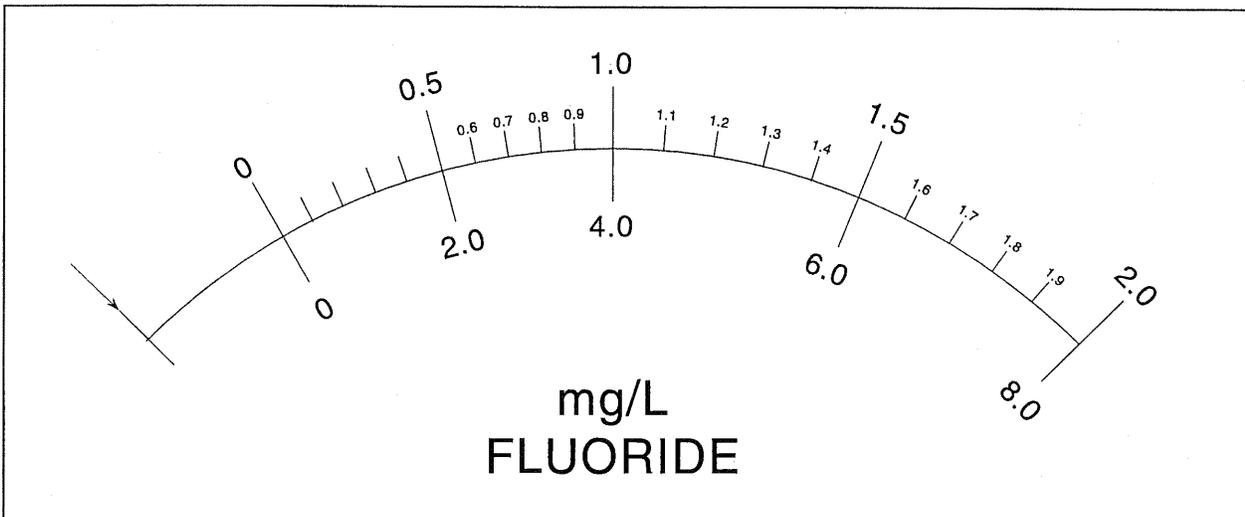
**Ampules or Accuvac**

Fluoride test may be conducted using ampules or accuvac. This procedure is for ampules.

### PROCEDURE

- 1. Press "On" button - check battery** If the battery indicator light is lit, replace the batteries.
- 2. Turn the right set knob fully clockwise**
- 3. Insert cell holder** Align the white mark on holder with left set mark.
- 4. Press on button**
- 5. Adjust Left set until meter needle is aligned with arrow on scale**
- 6. Open 1 ampule** Use breaker tool.
- 7. Add 8 mL of 1 mg/L Standard** Use a 10 mL pipet to transfer the standard to the ampule.
- 8. Rinse pipet with distilled water** Rinse 3 times and discard rinse water.
- 9. Swirl Ampule**

- |  |  |
|--|--|
| <b>10. Insert ampule &amp; close lid</b>       | This is the standard solution.               |
| <b>11. Press and hold "On" button</b>          |  |
| <b>12. Adjust right knob to 1 mg/L</b>         | The meter is now calibrated.                 |
| <b>13. Remove ampule and discard</b>           |  |
| <b>14. Open second ampule</b>                  | Use breaker tool.                            |
| <b>15. Add 8 mL of sample to second ampule</b> | Use 10 mL pipet.                             |
| <b>16. Rinse pipet with distilled water</b>    | Rinse 3 times and discard rinse water.       |
| <b>17. Swirl ampule</b>                        | Thoroughly mix solution.                     |
| <b>18. Insert sample ampule into meter</b>     |  |
| <b>19. Press and hold "On" button</b>          |  |
| <b>20. Read fluoride level</b>                 | Use the upper scale. The reading is in mg/L. |



- |                                 |          |
|---------------------------------|----------|
| <b>21. Remove sample ampule</b> | Discard. |
|---------------------------------|----------|

**Notes:**

1. If the fluoride reading is greater than 2.0 mg/L contact ADEC regional office and/or PHS.

**Safety Concern**

If ampule or accuvac breaks spilling contents on the bench or floor, sprinkle with baking soda before cleaning.

**Discarding Procedure**

1. Empty ampule contents into strong solution of baking soda and water.

• Strong solution:

- ✓ 1/2 cup of baking soda in 3 cups of water
- ✓ Solution is good for two (2) weeks

## TURBIDITY - (NEPHELOMETRIC METHOD)

### INTRODUCTION

#### Description

Turbidity is an expression of the optical properties of a water which cause light to be scattered and absorbed rather than be transmitted in a straight path. The measurement of light scattered at a 90 degree angle is performed with a nephelometer. As the turbidity increases, the amount of light scattered will increase.

#### Sources of Turbidity

This turbidity is usually caused by finely divided suspended matter such as clay, silt, plankton and other organic and inorganic material.

#### Relationship to TSS

Attempts to correlate turbidity to suspended solids is impractical due to the fact that turbidity is related to particle size, shape and refractive index, as well as quantity.

#### Application

The procedure outlined below is general and can be applied to several brands of nephelometers. Be sure to read carefully the manufacturer's operation manual for your particular instrument.

#### Test Frequency

Turbidity tests may be performed at any time. However, Alaska regulations require that the frequency of testing be matched with the system type. A listing of system types and the frequency of testing is found on pages 293 & 294.

### EQUIPMENT

Several nephelometers and turbidimeters have been approved by the Environmental Protection Agency. Manufacturers include Hach, HF Instruments and Turner Designs.

### REAGENTS

Due to the precision necessary for this instrument, it is recommended that standards be purchased rather than prepared. One standard must be on hand for each range used. These purchased standards are called Primary Standards.

Standards purchased after 1992 are very stable and will need to be replaced only when the glass shows any visual sign of scratching. Under normal use these standards should be replaced once a year.

Preparation of standards is described in the 18th Edition of Standard Methods.

## PROCEDURE

**1. Collect sample**

Samples may be stored up to 24 hours in the dark.

**2. Calibrate the instrument**

Be sure to check the manufacturer's instruction for warm-up time and calibration. A separate standard must be used to calibrate each scale used.

**3. Mix the sample**

The sample should be thoroughly mixed by shaking 15 times through a one-foot arc. The air bubbles should be allowed to dissipate before testing

**Cold Water Problems**

When the water is cold the heat from the turbidimeter may cause condensation to develop on the outside of the glass or gas bubbles to form on the inside of the glass. Either condition will give a false, high turbidity reading. It may be necessary to either read the results quickly or allow the sample to warm slightly before proceeding.

**4. Clean sample cell**

The sample cell must be free of fingerprints, water spots and accumulated dust, all of which will give false readings. Use lint free Chem-Wipes.

**5. Pour sample into cell**

Check the manufacturer's information for the amount of sample.

**6. Wipe spilled sample from outside of cell**

**7. Place cell in instrument**

**8. Place cover over cell**

**9. Adjust scale**

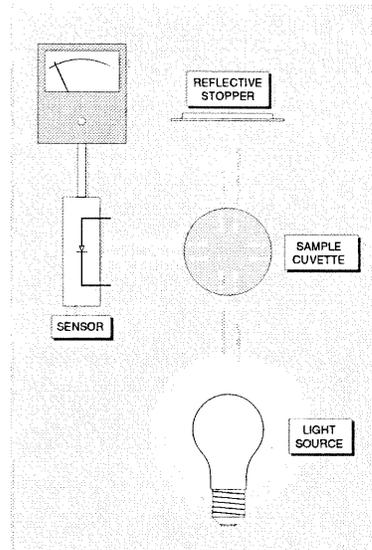
Once the proper range has been found, it may be desirable to check calibration with the standard for that range.

**10. Read and record data**

The reading is recorded as units of ntu's (Nephelometric Turbidity Units).

**11. Discard sample and clean sample cell**

NEPHELOMETRIC TURBIDIMETER



## pH INTRODUCTION

pH is a measure of hydrogen ion ( $H^+$ ) concentration and is generally used to describe a system as being acidic or basic. It is not to be confused with alkalinity or acidity, which are entirely different tests. pH measurements are taken at various points throughout a treatment plant, and any abnormal readings can be an indication of a change in water quality.

## EQUIPMENT

Electronic pH meter.

## REAGENTS

Standard pH buffer.

## PROCEDURE (METER)

**1. Warm up instrument**

The instrument should be left in the standby position. If the instrument is not on and in the standby position, turn it on and allow it to warm up for 30 minutes.

**2. Adjust the temperature**

The temperature is usually set at room temperature. If solutions of lower or higher temperatures are being checked, the standard and the sample must be at the temperature set on the meter.

**3. Adjust the needle to 7**

While in the standby position.

**4. Rinse the probe**

With distilled water.

**5. Immerse the probe in the buffer**

Use about 20 mL desired standard buffer in a clean beaker.

**6. Switch to "pH" position**

**7. Adjust pH to standard**

The needle should read the pH of the standard buffer used.

**8. Switch to standby**

**9. Remove the probe and rinse**

Rinse with distilled water. Discard the standard buffer. Do not put back into the bottle.

**10. Immerse the probe in the sample**

Use about 20 mL samples in a clean beaker.

**11. Switch to "pH" position**

**12. Read pH directly off scale**

**13. Switch to stand-by**

**14. Remove the probe and rinse**

**15. Leave the probe immersed  
in the buffer**

The probe should be continuously soaked in the buffer which has the pH value closest to the suspected pH of the sample to be measured.

**NOTE:**

Although the pH buffer or sample should be well mixed, excessive agitation can trap extra CO<sub>2</sub> and lower the pH of the solution being tested. Samples containing large amounts of dissolved CO<sub>2</sub> must be measured quickly since the CO<sub>2</sub> can escape into the atmosphere.



# WATER QUALITY SAMPLING AND TESTING WORKSHEET

1. The presence of coliform in a bacteriological sample indicates?
  
2. What does a turbidimeter measure?
  
3. How long can a bacteriological sample be held before it must be tested?
  
4. The proper name for disease-causing microorganisms is?
  
5. What are the time limitations and storage conditions for holding a turbidity sample?
  
6. For what period of time can chlorine residual sample be stored?
  
7. When testing for free chlorine residual you must wait \_\_\_\_\_ before you check the intensity of the color, but you should not wait any longer than \_\_\_\_\_.
  
8. What is the cause of turbidity?
  
9. When taking a bacteriological sample the water should be allowed to run \_\_\_\_\_?
  
10. For a Class A filtered surface water system serving a population of fewer than 500 persons, what is the testing frequency for the following:
  - a. Fluoride \_\_\_\_\_
  - b. Chlorine residual \_\_\_\_\_
  - c. pH \_\_\_\_\_
  - d. Temp \_\_\_\_\_
  - e. Bac-T samples \_\_\_\_\_
  - f. Turbidity \_\_\_\_\_



14. What are the three types of scheduled water quality monitoring?

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15. Under what circumstances must a water utility collect Repeat Samples?

16. A utility that normally collects one routine sample per month must collect \_\_\_\_ Repeat Samples over a \_\_\_\_\_ within \_\_\_\_\_ of receiving notification of a positive sample.

17. List the factors which determine the frequency of monitoring.

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18. Give the stages involved in developing a monitoring plan.

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19. List the five types of sampling sites which should be included in the monitoring plan.

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# Alaska Department of Environmental Conservation

## Drinking Water Analysis Report for Chlorine Residual, Turbidity, & Fluoride

Public Water System Name \_\_\_\_\_

PWSID# \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

For the Month of \_\_\_\_\_

TYPE OF FILTRATION \_\_\_\_\_ TURBIDITY LIMIT \_\_\_\_\_ N.T.U.

Date	Chlorine Residual at Entry Point*	Turbidity After Filtration Enter 'NR' during time periods when not filtering water						Daily Fluoride	Did You Add Fluoride	
		12 am	4 am	8 am	12 pm	4 pm	8 pm		Yes	No
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
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30										
31										
Total > = 0.2			Total Samples Tested	A =	Samples < = 1.49 NTU	B =	Days Not Optimum			
Days < 0.2		Days < = 1.49 NTU					Days Over 2.0 mg/l			
Total Days		Total Days					Total Days			

\*Enter 'NR' on days that system does not operate

Date Submitted: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Signature of Operator: \_\_\_\_\_

# TURBIDITY AND DISINFECTION PERFORMANCE CRITERIA FOR FILTERED SYSTEMS

## TURBIDITY PERFORMANCE CRITERIA

- A. Total number of filtered water turbidity measurements during the month;  
 B. Total number of filtered water turbidity measurements that are less than or equal to the specified limits for the filtration technology employed;  
 Conventional or Direct = 0.5 NTU or Waiver to 1 NTU, Alternate = 1 NTU or Waiver to 5 NTU  
 C. The percentage of turbidity measurements meeting the specified limits equals the value in B above divided by the value in A above times 100.

A= \_\_\_\_\_

B= \_\_\_\_\_

$(B/A) \times 100 = ( \quad / \quad ) \times 100 = \quad \%$

Is This Number Less Than 95% (Y/N)

- D. Record in TABLE I the date and turbidity value for any measurements exceeding 5 NTU:  
 If no measurements were over 5 NTU enter "0".

**TABLE I DAYS TURBIDITY MEASUREMENTS EXCEEDED 5 NTU**

Date	Turbidity	Reported to State	Date	Turbidity	Reported to State	Date	Turbidity	Reported to State
<b>Total Number of Days Measurements Exceeded 5 NTU</b>								<input type="checkbox"/>

## ENTRY POINT DISINFECTION PERFORMANCE CRITERIA

Record the date, and duration when the disinfectant residual is less than 0.2 mg/l entering the distribution system. If no measurements were under 0.2 mg/l enter "0". In addition, record the date the state was notified of it.

**TABLE II DAYS CHLORINE RESIDUAL ENTERING DISTRIBUTION WAS LESS THAN 0.2 MG/L**

Date	Duration	Reported to State	Date	Duration	Reported to State	Date	Duration	Reported to State

## DISTRIBUTION SYSTEM DISINFECTANT RESIDUAL CRITERIA

The distribution chlorine residuals must be measured at the same sample sites and times as the total coliform samples are taken.

**TABLE III DISTRIBUTION CHLORINE RESIDUAL READINGS**

Date	Residual	Date	Residual	Date	Residual	Date	Residual	Date	Residual	Date	Residual
<b>Total Number of Distribution Residual Samples Measured</b>										<input type="checkbox"/>	
<b>Total Number of Samples Where Distribution Residual Not</b>										<input type="checkbox"/>	

## Distribution System Disinfectant Residual Criteria For Systems Using HPC Monitoring

- A. Number of sites where disinfectant residual was measured; a = \_\_\_\_\_  
 B. Number of sites where no disinfectant residual was measured, but HPC was; b = \_\_\_\_\_  
 C. Number of sites where disinfectant residual was not detected and no HPC measured; c = \_\_\_\_\_  
 D. Number of sites where disinfectant residual was not detected and HPC > 500/ml; d = \_\_\_\_\_  
 E. Number of sites where disinfectant residual was not measured and HPC > 500/ml; e = \_\_\_\_\_

$V = \frac{(c + d + e) \times 100}{(a + b)} = V\% ; = ( \frac{ \quad + \quad + \quad }{ \quad + \quad } ) \times 100 = \quad \%$

Is "V" greater than 5% (Y/N)

Last month V = \_\_\_\_\_ %

PREPARED BY \_\_\_\_\_ DATE \_\_\_\_\_