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April 1996

ICR Sampling Manual

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Technical Support Division
Office of Ground Water and Drinking Water
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

FOREWORD

The Information Collection Rule (ICR), found in Subpart M to 40 CFR Part 141 - National Primary Drinking Water Regulations, requires each public water system (PWS) that meets certain applicability criteria to collect specified information for a limited period of time. The ICR establishes specific data collection requirements and designates the manner of collecting and transmitting the required data to the United States Environmental Protection Agency (EPA). Additional ICR requirements are found in four technical manuals:

- "ICR Sampling Manual," *EPA 814-B-96-001*
- "DBP/ICR Analytical Methods Manual," *EPA 814-B-96-002*
- "ICR Manual for Bench- and Pilot-Scale Treatment Studies," *EPA 814-B-96-003*
- "ICR Microbial Laboratory Manual," *EPA/600/R-95/178*

These technical manuals serve as "rule by reference" documents, and have two main objectives: (1) To complement the ICR by further specifying the details of the rule requirements; and (2) To provide guidance on how to comply with the ICR requirements. Therefore, each manual typically designates a requirement through the use of terminology such as "shall," "will," or "must," whereas guidance is generally offered through the use of terms such as "may" or "should." Copies of the manuals are available for a fee from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. The toll free number for NTIS is (800)336-4700.

The target audience for the "ICR Sampling Manual" is the person(s) located at each affected PWS who is/are responsible for understanding and complying with the sampling requirements of the ICR. Therefore, the purpose of this manual is to provide detailed requirements and guidance for affected PWSs to accomplish the following in accordance with the ICR:

- Develop an Initial Sampling Plan and utilize it to develop Monthly Sampling Plans and generate Final Design data.
- Utilize Monthly Sampling Plans and reports to collect appropriate samples and supporting information.
- Utilize suitable sampling techniques (and containers) to collect and ship representative samples to EPA-approved laboratories for analyses.
- Report appropriate data electronically to EPA at required intervals.

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DISCLAIMER

Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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1.0 Introduction

1.1 Who Should Read This Manual?

The purpose of this "ICR Sampling Manual" is to provide the detailed information necessary for affected public water systems to accomplish the following in accordance with the ICR requirements:

- Follow the procedure that has been established to submit responses to presumed ICR applicability.
- Conduct monitoring to determine applicability of the ICR treatment study requirements.
- Develop an EPA-approved Initial Sampling Plan and utilize it to develop Monthly Sampling Plans and the generation of Final Design data.
- Utilize Monthly Sampling Plans to collect appropriate samples and supporting information.
- Utilize suitable sampling techniques and containers to collect and ship representative samples to EPA-approved ICR laboratories for analyses.
- Report appropriate data to EPA at required intervals.

Therefore, the target audience for this manual is the person(s) located at each affected PWS who is/are responsible for understanding and complying with the sampling requirements of the ICR.

1.2 Regulatory Background

EPA is currently developing several rules that will: 1) address chemical byproducts that form when disinfectants used for microbial control in drinking water react with various organic chemicals in the source water, and 2) maintain or improve protection against microbial contaminants. To address the risk/risk trade-offs inherent in these rulemaking activities EPA initiated a formal regulation negotiation (Reg/Neg) process with representatives from water utilities, State and local agencies, environmental groups, consumer groups, and EPA. During the negotiations, a number of the members of the negotiating committee expressed their view that adequate data were not available to address some of the DBPs on EPA's priority list. Also of concern were the limited data available for microbiological contaminants. The committee agreed that additional monitoring data should be collected to re-assess the adequacy of the Surface Water Treatment Rule (SWTR) [40 CFR Part 141, Subpart H] and develop appropriate strategies to prevent increased risk from microbial disease when systems are required to begin complying with the D/DBP Rule.

The Negotiating Committee agreed to propose three rules:

- An Information Collection Rule (ICR)
- An interim Enhanced Surface Water Treatment Rule (ESWTR)
- D/DBP regulations, to be proposed concurrently with the interim ESWTR

The ICR is designed to obtain both microbial and DBP occurrence data and to collect water treatment plant design and operating information. An evaluation of the occurrence of DBPs in plant process streams and finished water will be conducted, as well as a determination of source water characteristics and treatment processes that influence DBP formation. Analyses of chemical monitoring data will help EPA and the water industry better understand the relationships between source water quality and disinfection chemicals (and processes) during the creation of disinfection byproducts.

During an 18 month period, each PWS will sample and analyze water at various points in their water treatment and distribution systems. Information collected under this rule will be used to update the Water Treatment Plant (WTP) predictive model. This model, used to predict trihalomethane (THM) and haloacetic acid (HAA) levels, was initially calibrated on fewer than 100 studies (including bench, pilot, and full-scale studies). It used raw water quality and limited process data to predict THM and HAA formation. Data collected during the ICR will provide a sufficiently large database to upgrade the model to include additional processes, predict other DBPs, and further calibrate the model. Plant treatment data will be coupled with the monitoring data to assess how treatment affects precursor removal and the formation of THMs, HAAs, and other DBPs. In addition, the monitoring data will allow for an assessment of how parameters like total organic carbon (TOC), total organic halides (TOX) and simulated distribution system-disinfection byproducts (SDS-DBPs) compare to distribution system compliance parameters. Relationships among the process data, the water quality data, and the chemical data will be evaluated and analyzed to provide the basis for possible changes to the current SWTR and to develop drinking water regulations for disinfectants and disinfection byproducts.

Microbial contamination of source and treated water will also be investigated. Recent outbreaks of cryptosporidiosis, a disease caused by the protozoan *Cryptosporidium,* has emphasized the need to establish treatment requirements for this protozoan. Only limited occurrence data are currently available to support development of a regulation for *Cryptosporidium.* Therefore, *Cryptosporidium* monitoring will be an integral part of the ICR.

Also, recent investigations indicate that the 3-log (99.9%) removal/inactivation of *Giardia* and the 4-log (99.99%) removal/inactivation of enteric viruses specified in the SWTR may be inadequate when a water treatment system is supplied with poor quality source water. New data suggest that *Giardia* cyst concentrations in the source waters of many systems may

be too great for the specified minimum treatment to adequately control waterborne Giardiasis. As a result of this uncertainty, EPA will collect additional occurrence data via the ICR for *Giardia* cysts and viruses in various source waters, under temporal and seasonal influences, to determine whether additional treatment is necessary to provide adequate public health protection against *Giardia* and virus contamination.

Data which will be collected are also expected to help EPA characterize occurrence relationships among *Giardia* cysts, *Cryptosporidium* oocysts, and viruses. These data will be used in various ways; such as to help the Agency evaluate the merits of using *Giardia* as the primary target organism to define treatment requirements, as it did in the SWTR.

1.3 Overview of ICR Implementation from Promulgation to Start of Sampling

1.3.1 Notification of Applicability

Following promulgation and publication of the ICR in the Federal Register, EPA will send a **Notification of Applicability (notification) letter** to each PWS presumed to be affected by the requirements of the ICR. The purpose of each notification letter is to:

- Formally announce the ICR.
- Notify each PWS of its presumed status relevant to ICR applicability.
- Request each PWS to verify EPA estimates of the population it serves.
- Request each PWS to determine the official and technical PWS ICR contacts and identify them for EPA.
- Request each PWS to verify its mailing address.
- Request each PWS to list the treatment plant(s) it operates, and to determine ICR applicability for each plant.

The notification letter shall serve as a formal request from EPA to which each affected PWS shall be required to respond, as stated in the ICR [§141.142(c)]. A PWS which meets the applicability criteria is subject to the requirements of the ICR even if it does not receive a notification letter from EPA. Therefore, a PWS which in fact, meets the applicability criteria of the ICR must contact the EPA Safe Drinking Water Hotline (see Section 1.5 of this manual below) and request a notification letter from EPA in the event one was not received by the PWS.

Each PWS will have 5 weeks (35 calendar days) to respond to the EPA notification letter. The PWS response must provide EPA with the information requested as well as verify the information contained in the notification letter. If relevant, the response to the notification letter may also specify the PWS's initial decision to conduct particle counting in lieu of finished water monitoring for *Giardia* and *Cryptosporidium* as described in the ICR [§141.143(a)(2)(iii)]. In addition, should

a PWS wish to request an exemption from conducting virus monitoring for a particular treatment plant as described in the ICR [§141.143(a)(2)(iv)], it shall indicate its desire for the exemption in the written response to the notification letter and submit the appropriate six consecutive months of coliform data.

If the event that a PWS challenges the presumed ICR applicability, it must provide written justification for excluding the PWS and/or its plant(s) from the requirements of the ICR in their response to the EPA notification letter.

The applicability section of the ICR [§141.141(b)(1)] summarizes the criteria used to place treatment plants into categories (referred to as categories A through G). Further, the ICR [§141.140] defines a treatment plant to include facilities in which ground water or purchased finished water is disinfected prior to entering a distribution system. For example, a site where disinfectant is added to purchased finished water prior to entering a distribution system could realistically serve a very small population but still be classified as an "F" category treatment plant. The monitoring requirements for such a facility as identified in the ICR [§141.141(b)(2)] may not substantially contribute to the objectives of the ICR. Therefore, the costs incurred by a PWS may not be justified by the limited benefits gained through the collection of ICR monitoring data at those treatment plants.

In response to the notification letter, each PWS must identify **every facility** that meets the ICR definition of a treatment plant. Each PWS shall review every treatment plant in its system, including those in categories E and F, and identify all treatment plants which should be included in the ICR. A PWS may request that one or more of its treatment plants be excluded from the ICR requirements, however, it shall also provide the rationale to fully justify such an exemption. **The EPA reviewing officials shall have the authority to grant exemptions**. The rationale for an exemption may include, but not be limited to, criteria such as: a plant treated an average annual 1995 flow of 3 million gallons per day (MGD) or less; a plant serves a small percentage of the PWS population; a treatment plant is scheduled to go out of service in the near future; and/or a plant is not physically connected to the main distribution system of the PWS. The rationale must show that inclusion of a particular plant would not be consistent with the intent of the ICR.

1.3.2 Notice of ICR Final Applicability Determination

EPA will process the information provided by each PWS in response to the notification letter to determine ICR applicability. Each PWS will then receive an **Notice of ICR Applicability Determination (applicability) letter** which will state EPA's final decision on how each treatment plant within a PWS is affected by the ICR. The applicability letter will state which plants are required to conduct ICR microbiological monitoring, DBP monitoring, water quality monitoring, treatment

process monitoring, and treatment studies applicability monitoring. An estimate of requirements for distribution system monitoring will also be included.

NOTE: Treatment studies applicability monitoring is to begin within 3 months of promulgation of the ICR, and is not contingent upon preparation and EPA review of an Initial Sampling Plan as is the 18-month ICR monitoring. Section 3 of this manual provides more detailed information on treatment studies applicability monitoring.

Each PWS which utilizes chloramines, ozone, or chlorine dioxide as a disinfectant at any treatment plant affected by the ICR will receive a sample date reservation form from EPA as an enclosure to the applicability letter. This form must be completed by the PWS and returned to EPA within 5 weeks (35 calendar days) of receipt by the PWS. The purpose of the form is to help establish a sampling schedule with the EPA laboratory conducting special ICR analyses (for cyanogen chloride, aldehydes and low-level bromate).

1.3.3 Initial Sampling Plan Preparation and EPA Approval

Each PWS will have 8 weeks from receipt of the applicability letter to prepare and submit one (1) **Initial Sampling Plan** to EPA for review. An Initial Sampling Plan shall include the location and analytical parameters to be monitored at each sampling point within **each plant and distribution system**. Detailed information about the design parameters of each plant, its unit processes and distribution system shall also be included. Distribution system monitoring is based on the configuration of each plant feeding into the distribution system, so it is important to clearly identify this plant/distribution system arrangement in the Initial Sampling Plan. Further requirements of the Initial Sampling Plan are covered in Section 2, "Developing an Initial Sampling Plan," of this manual.

A PWS can apply for exemptions from individual ICR sampling requirements by including the rationale to justify such an exemption in a cover letter along with its Initial Sampling Plan submittal. The rationale for an exemption may include, but not be limited to criteria such as: a disinfectant applied by a PWS does not achieve the residual assumed in the ICR, therefore monitoring requirements are not consistent with the objectives of the ICR; and/or the configuration of a PWS is such that some distribution system sampling points are in very close proximity to each other, but are not located at the same physical sampling location.

An **American Water Works Association (AWWA) Assistance Team** (A-Team) has been assembled to provide direct, individualized assistance, upon request, to each PWS for developing its Initial Sampling Plan. AWWA is also planning to provide

group assistance through training sessions covering topics such as "Understanding the ICR," sampling, and "hands-on" instruction for using the data entry software necessary for developing an Initial Sampling Plan.

EPA will assess the validity of each Initial Sampling Plan through the use of a formal review process. The results of this review process will be communicated in writing to each PWS, wherein EPA will indicate the status of the Initial Sampling Plan and provide recommendations for modifications when appropriate. EPA approval will be granted to a valid Initial Sampling Plan, whereas an unstisfactory plan will not be granted approval status until it is corrected according to instructions provided by EPA. Each PWS will have four (4) weeks following receipt of the written formal review letter from EPA to correct and resubmit its Initial Sampling Plan, if required, for approval. EPA will then reassess the validity of the revised Initial Sampling Plan and provide a written response to the PWS stating the status of the plan.

Each PWS shall begin ICR monitoring at its plant(s) in the first full month following receipt of the results of the EPA review of the Initial Sampling Plan, regardless of the approval status of the Initial Sampling Plan submittal. Therefore, lack of Initial Sampling Plan approval shall not delay the start of monitoring. However, the monitoring shall be conducted in conformance with the modifications to the Initial Sampling Plan as recommended by the EPA review process. The EPA recommendations will specify sampling locations and analytical parameters which must be included in the modified plan. The PWS shall amend the Initial Sampling Plan and subsequently resubmit it to EPA for official approval.

1.4 Data Quality

The following brief summary describes some of the implementation tools and processes that EPA has developed and put in place to help ensure the collection of ICR data which meets established quality objectives.

1.4.1 Data Management Tools

EPA initiated the development of three separate data management systems for gathering and managing ICR data:

- **The ICR Water Utility Database System** - to facilitate sampling plan development, entry of treatment plant design data, analytical results and data reporting by each PWS.

- **The ICR Laboratory Quality Control Database System** - to facilitate data entry and reporting of Quality Control (QC) data by ICR approved laboratories.

- **The ICR Federal Database System** - to manage and analyze all collected data.

1.4.2 Lab Approval

To ensure that accurate and valid data are collected, EPA initiated a process to evaluate and approve chemical and microbiological laboratories to perform analyses for the ICR. EPA will produce, and routinely update, a list of ICR approved laboratories. The list will be available through the EPA Safe Drinking Water Hotline (see Section 1.5 of this manual below).

1.4.3 Sampling, Laboratory Data and Reporting

The following describes the flow of samples and data during the 18 month ICR sampling period:

- Each PWS will make arrangements with ICR approved laboratories for the analyses of ICR monthly and quarterly samples.

- Each PWS will collect and ship ICR monthly and quarterly samples to ICR approved laboratories.

- The ICR approved laboratories will analyze the samples.

- The ICR approved laboratories will provide the results of the analyses to the PWSs along with the Quality Control (QC) data that must be reported by each PWS. EPA recommends that the laboratories also provide the PWSs with copies of **all** QC data that are associated with the ICR samples.

- The ICR approved laboratories will forward applicable laboratory QC data to the EPA. (Reports are on a monthly basis. The data must be reported within 2 months after the month in which the analyses were performed.) Laboratories will use the ICR Laboratory Quality Control Database Software to record, manage, and report QC data to the EPA.

- Each PWS will verify and validate its ICR monitoring data, and forward these data and the associated plant operating information on diskette to EPA using the ICR Water Utility Database System. Public Water Systems will use the Water Utility Database Software for managing the data, including the verification and validation of the data.

- The ICR Federal Database System will perform QC checks on the monitoring data by evaluating the associated QC data (received from each PWS and ICR approved laboratory), complete various validation and verification processes, and perform review operations to ensure completeness for all data required to be submitted. Monitoring data that do not pass the QC checks will be deleted from the ICR Federal Database.

1.5 Where to Get Additional Technical Assistance

- EPA Assistance:
  - The EPA Safe Drinking Water Hotline:
    (800) 426-4791, or HOTLINE-SDWA@EPAMAIL.EPA.GOV
  - The ICR Data Management System Hotline:
    (703) 908-2155, or 102351.2062@compuserve.com;
- AWWA Assistance via the ICR Assistance Team (A-Team):
  (800) 200-0984, or 103327,2057@compuserve.com

2.0 Developing an Initial Sampling Plan

Before any ICR water samples are collected, each PWS participating in the ICR is required to submit an Initial Sampling Plan package for EPA review and response. The Initial Sampling Plan package is to be sent to:

USEPA (ICR 4600) - ICR Data Center
Room 1111 East Tower
401 M Street SW
Washington, DC 20460

Utilities shall use the ICR Water Utility Database System software, provided by EPA, in developing their Initial Sampling Plan. The software is "user friendly" by providing user prompts to assist the utility in developing the sampling plan, and in entering required data into the system. A handbook entitled, "ICR Water Utility Database System Users' Guide," *EPA 814/B-96-004*, provides detailed instructions and additional information, and will be provided to each PWS. It is suggested that the individual responsible for preparing the Initial Sampling Plan thoroughly review this handbook before attempting to prepare the Initial Sampling Plan. In addition to the "User's Guide," AWWA training courses on the use of the data entry software have been planned. Furthermore, EPA has developed a one-hour "data-entry" videotape which will be available to each PWS.

2.1 Purpose of EPA Review

The Initial Sampling Plan review process will allow each PWS to confirm with EPA that the appropriate sample locations and corresponding analytical requirements have been identified for each treatment plant. Although the rule language goes into great detail on sampling requirements, EPA recognizes that each treatment plant is a unique combination of unit processes that may have been constructed over many years. It is likely that situations exist where it is virtually impossible to collect samples at certain locations exactly as specified in the rule. The Initial Sampling Plan review process will allow EPA the flexibility to approve sampling plans on a case by case basis which may deviate from otherwise "impractical" rule requirements. For example, if the configuration of a particular treatment plant prevents the collection of a required sample at a particular location, the PWS can explain the situation in the cover letter of the Initial Sampling Plan submittal package to EPA. The EPA reviewing official shall have the authority to approve a modification of the sampling requirements which will be consistent with the objectives of the ICR.

A second objective of the Initial Sampling Plan review process is to ensure that each PWS understands how to properly use the software to configure their process trains, to locate sampling points, and to identify samples to be collected and analyses to be performed. The

Initial Sampling Plan (captured on a diskette) which must be sent to EPA prior to the start of sampling will provide the information needed to assess the capability of a PWS to properly utilize the software. Developing an appropriate Initial Sampling Plan is therefore a crucial step toward providing meaningful ICR data. Therefore, prior to the EPA Initial Sampling Plan review process, EPA and AWWA plan to provide technical support, training materials and training courses to help ensure that Initial Sampling Plans are properly prepared.

2.2 Submittal of the Initial Sampling Plan

Each PWS shall submit an Initial Sampling Plan package to EPA. This will include the information captured on diskette through use of the software in addition to plant schematic(s) and a distribution system schematic which portray each treatment process configuration, sampling location, and all monitoring requirements which conform with the intent of the ICR. The cover letter and complete Initial Sampling Plan package shall be submitted to EPA as specified in the ICR [§141.142(c)(2) and §141.143(c)(3)].

The Initial Sampling Plan "package" shall include the following elements:

2.2.1 Letter of Transmittal

A letter of transmittal shall accompany submission of the Initial Sampling Plan diskette. If pertinent, the letter of transmittal shall point out any discrepancies between ICR requirements and the proposed Initial Sampling Plan. The letter of transmittal shall also verify the PWS's final decision to comply with the alternative monitoring requirements (particle counting and in-plant monitoring for protozoa) in lieu of finished water monitoring for protozoa as described in the ICR [§141.143(a)(2)(iii)]. The PWS shall apply appropriate signature authority to the letter of transmittal.

2.2.2 ICR Water Treatment Plant Schematic

A PWS shall submit an ICR water treatment plant schematic **for each treatment plant affected by the ICR** as determined by the EPA applicability letter (see Section 1.3.2 of this manual). An ICR water treatment plant schematic should not be confused with any existing schematics the PWS may already have on file. The specifications for an ICR water treatment plant schematic are detailed below.

NOTE: The ICR A-Team (see section 1.5 of this manual) is available to assist each PWS in developing the required ICR schematics.

Each ICR water treatment plant schematic must provide a pictorial representation of all the unit processes in the treatment plant, depicting the flow of water through each unit process in the plant. Each unit process, sampling location and

the analytes to be monitored at each location must be clearly identified for each water treatment plant. Figure 2-1 contains an example of a hypothetical ICR water treatment plant schematic consisting of a single treatment train. However, in situations where the flow is split into two or more treatment trains, the schematic must display this as well as the unit processes in **each** of the treatment trains. Although two or more treatment trains may be employed at a single treatment plant, the **sampling locations shall be identified for only one treatment train** determined as the **most representative of the water treatment plant**.

An ICR plant schematic will most likely deviate from the standard format/layout of any plant schematics that may already reside at a PWS. The format/layout of each ICR plant schematic should adhere to the guidelines that follow: A minimum of a one-inch margin should be maintained at the top, bottom, right and left sides of each page. In the upper right-hand corner of each plant schematic, include the utility (system) name, system PWSID number, plant name, plant PWSID number (if any), ICR Plant ID number (assigned by EPA), and the design flow in million gallons per day (mgd).

Each ICR plant schematic shall show all applicable water resources, water intakes, plant influent and finished water (as ovals connected by lines). All unit processes shall be depicted by labeled rectangular boxes connected by lines. Each sampling point is to be associated with the unit process directly upstream of it. When possible, sampling locations shall be shown at the effluent of a unit process. Chemicals fed into the process train shall be shown as an arrow feeding into a particular unit process (rectangle). To avoid confusion when using the software, disinfectant addition shall be shown on the schematic as a separate unit process (not a chemical being fed into a unit process). Another unique characteristic of the software is that the washwater return sample point is automatically created when you add a washwater return unit process to the sampling train. It is depicted as a unit process in the schematic to assist the user of the software. Samples collected at the washwater return sample point (#15 in Figure 2-1) reflect the quality of the combined flows. However, the washwater return sample location (#02 in Figure 2-1) reflects the quality of the washwater being added to the process train. Each sampling location shall be identified by a unique two-digit number (see Section 4.0 of this manual). The analytical specifications depicted on each schematic shall be based on monthly and quarterly monitoring requirements.

The schematics are to show only disinfectants and chemical feed points that are anticipated to be in use at the time of monitoring, and should not show all possible disinfectant and chemical feed points. Operational changes that occur over the 18 month monitoring period should be reflected in the monthly sampling plans (see Section 4.1 of this manual).

Finally, the plant schematic is not intended to show detailed design or operating information. The detailed information required by the ICR [§141.142(a)(6)] will be entered into the ICR Water Utility Database software and submitted to EPA on diskette as part of the Initial Sampling Plan package.

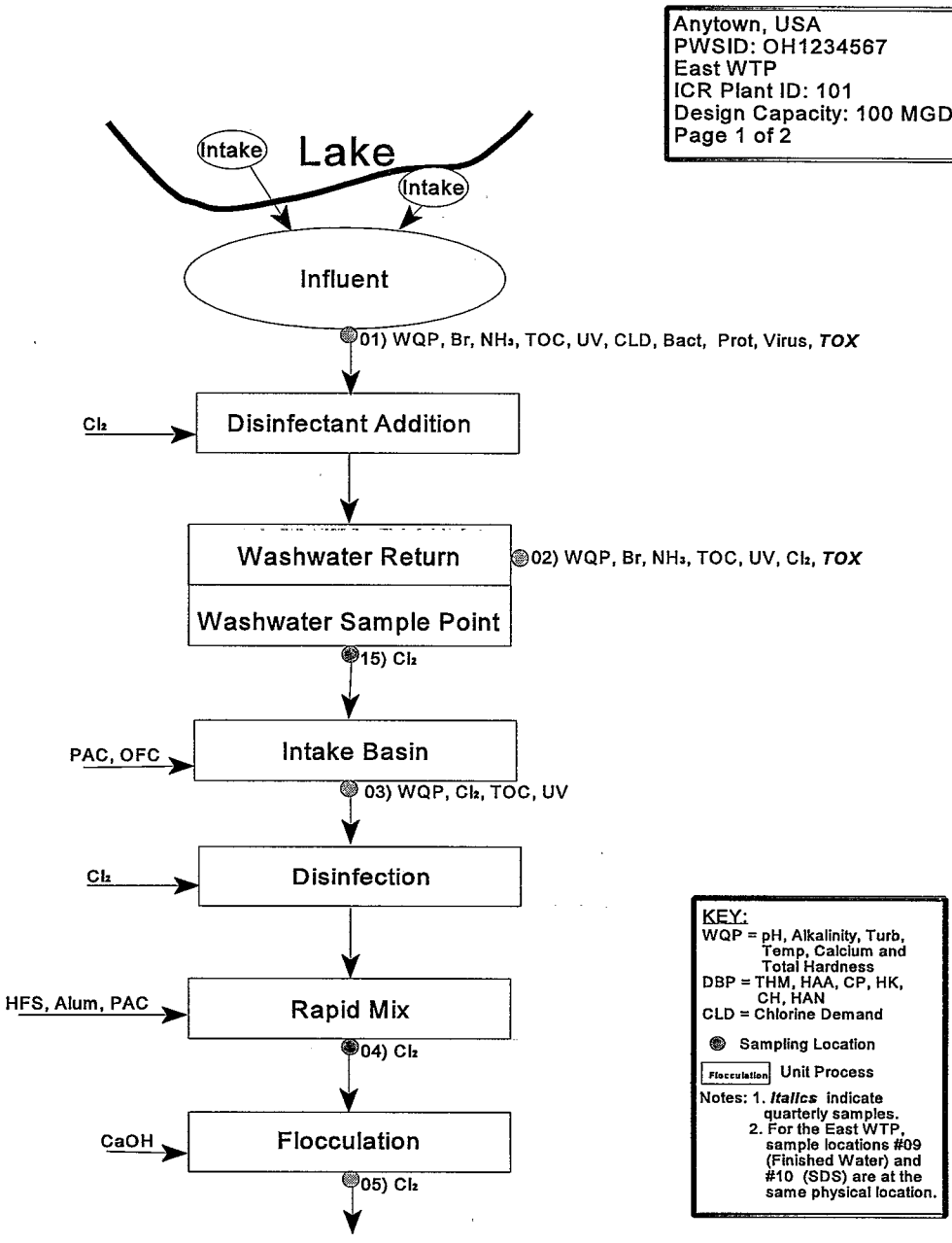

Figure 2-1. ICR Water Treatment Plant Schematic (Example)

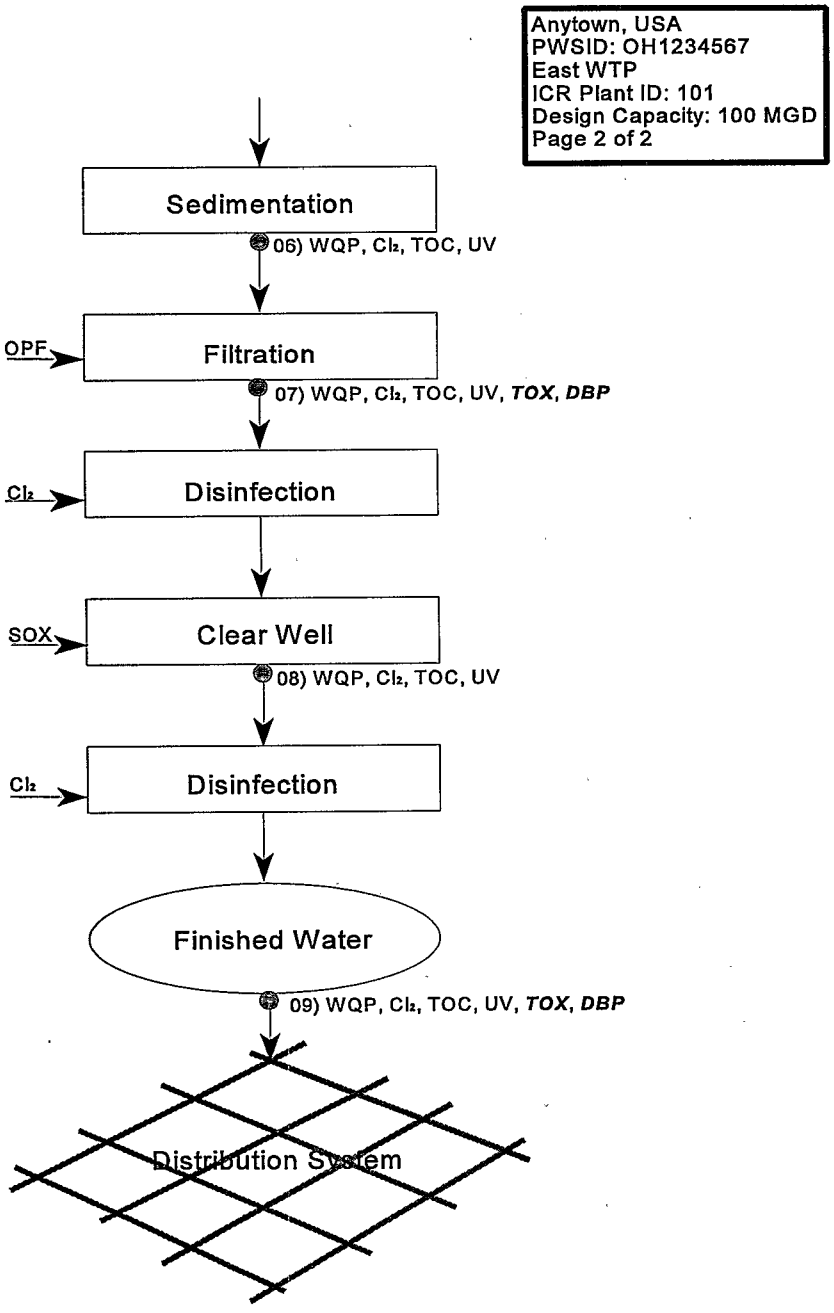

Figure 2-1. (continued)

2.2.3 ICR Distribution System Schematic

An ICR distribution system schematic should not be confused with any existing schematics the PWS may already have on file. The specifications for an ICR distribution system schematic are detailed below. In addition, the ICR A-Team (see section 1.5 of this manual) is available to assist each PWS in developing the required ICR schematics.

An ICR distribution system schematic (see Figure 2-2) will most likely deviate from the standard format/layout of any distribution system schematics that may already reside at a PWS. A PWS shall submit one ICR distribution system schematic showing the complete system as described below. In the upper right-hand corner of the schematic, include the utility information (system name and system PWSID number). The ICR distribution system schematic shall show each treatment plant (as a labeled box or other graphic notation), the sample locations between the end of the process train and the distribution system (excluding the finished water sample location which appears on the ICR plant schematic), distribution system sampling locations associated with each treatment plant, and the analytical parameters to be measured at each sampling location. Sample locations between the end of the process train and the distribution system which should appear on the ICR distribution system schematic include the entry point to the distribution system (Entry Point) sample location and the simulated distribution system (SDS) sample location. The Entry Point sample location is only identified when water is blended from two or more treatment plants before it enters the distribution system. Figure 2-2 does not identify an Entry Point sample because water from the two plants is not blended in this hypothetical example. However, an SDS sample point is identified in Figure 2-2 and is at the same physical location as the Finished Water sample point (#09 in Figure 2-1). Even though they are physically located at the same sample point, they represent two different samples and will therefore have different sample location numbers.

Unlike the ICR plant schematics, the analytical parameters in the ICR distribution system schematic are generally the same for each sample location and can be shown one time for all sample locations. In addition, sampling location numbers in an ICR distribution system schematic may not be unique if more than one plant is feeding the distribution system. In the hypothetical example depicted in Figure 2-2, two plants are feeding a common distribution system. Each plant defines its own distribution system sampling points.

2.2.4 Initial Sampling Plan Diskette

All Initial Sampling Plan information, with the exception of the transmittal letter and the schematics for the plant(s) and distribution system, are to be submitted to EPA via computer diskettes as required by the ICR [§141.142(c)(2) and §141.143(c)(3)].

Each PWS shall therefore submit an Initial Sampling Plan diskette that is generated by the ICR Water Utility Database System software. Use of the software is important because it confirms (for EPA and the PWS) the sampling locations in the treatment plant(s) and distribution system. The software is also used to record detailed information on the design of the treatment facilities and on the samples to be collected routinely over 18 months of ICR data gathering. The software will be used by each PWS to report data to EPA for the duration of the ICR, and the Initial Sampling Plan diskette is the first set of ICR data to be submitted.

2.3 Data Entry Using the ICR Water Utility Database System

Sampling location and analyte information shall be entered from the plant schematic(s) and distribution system schematic into the ICR Water Utility Database System. The PWS shall also enter information specified in the ICR [§141.142(a)(6)]. It is advisable to collect all needed information on the data entry worksheets provided in the "ICR Water Utility Database System Users' Guide" prior to actual data entry utilizing the software. The software provides a series of internal completeness checks to assist the PWS in providing all of the information required by the ICR [§141.142(a)(6)]. However, the software does not systematically check sampling locations or analytical requirements which are found in the ICR [§141.142(a)], or in Sections 5 and 6 of this manual. The Initial Sampling Plan diskette, generated by the software, will contain all information entered into the software up to that point in time.

Each PWS must assign a **unique sample location number to each sampling point associated with a treatment plant.** However, sample location numbers for one treatment plant may be the same as those from another treatment plant. A sample location number can be any two-digit number (01 to 99) applied to any sample location within a treatment plant, as long as the numbers are **unique**. The ICR Water Utility Database System software is designed to ensure the assignment of unique sample location numbers. If the software user discovers that a sample location number entered into the software does not match a number shown on a schematic, the user must change one of the numbers to ensure that they match. It is advisable to **change the number on the schematic** because it is more difficult to change the number in the software.

The ICR Water Utility Database System was developed by EPA in conjunction with the AWWA and contains many features to aid the PWS in planning and collecting samples. It is recommended that the utility refer to the software documentation in the "ICR Water Utility Database System Users' Guide" and enter additional information, such as Laboratory ID numbers, when developing the Initial Sampling Plan. Such additional information, however, does not commit the PWS to sending samples to a particular laboratory.

More detailed information on the content of the Initial Sampling Plan, and on how to develop an Initial Sampling Plan can be found in the "ICR Water Utility Database System Users' Guide", and in the software itself. The software provides detailed instructions and

user-friendly computer screens to guide the PWS data entry person through the development of the various elements of the Initial Sampling Plan, the monthly updating of the process train and the Monthly Sampling Plan, and the monthly data entry process.

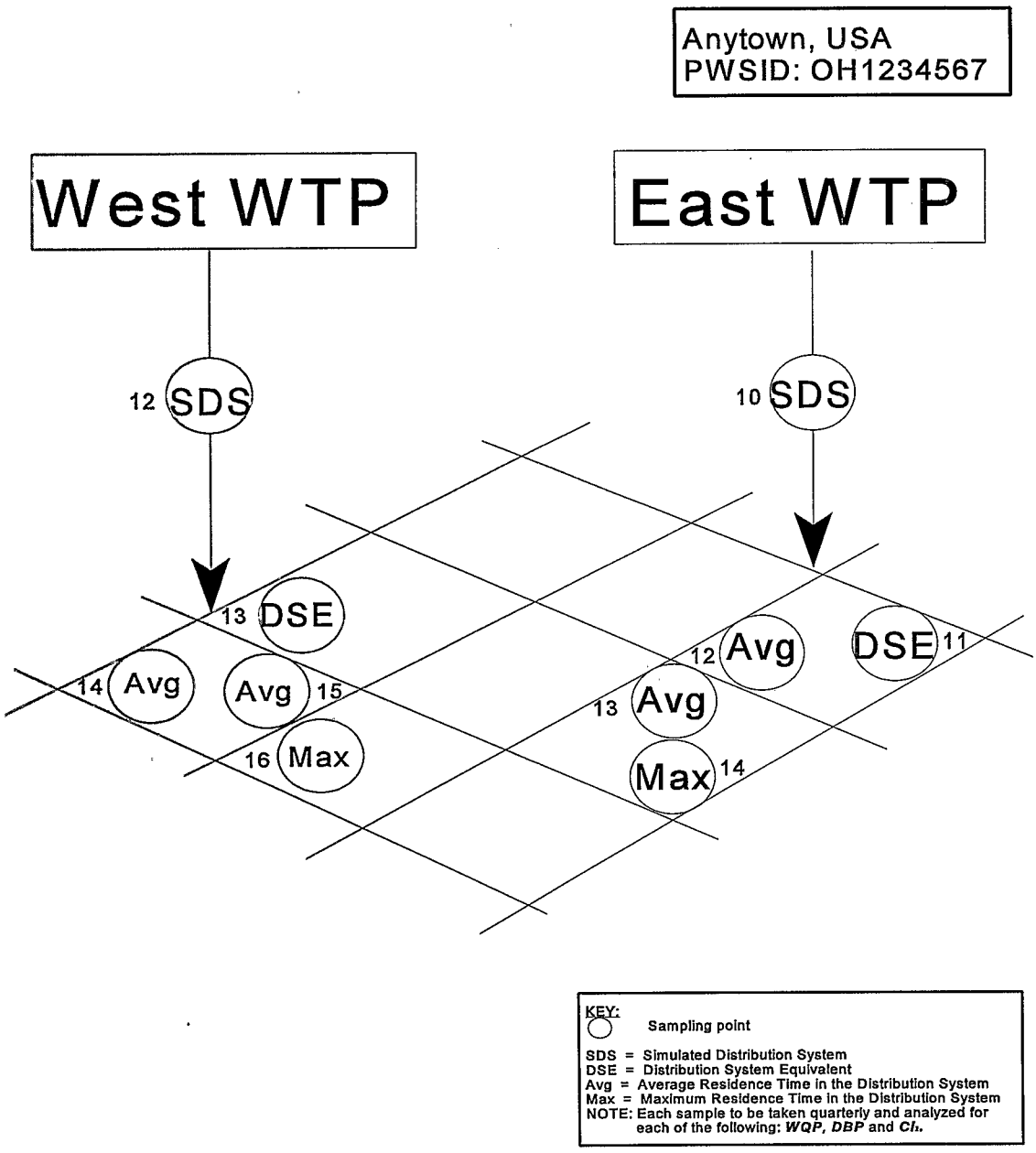

Figure 2-2. ICR Distribution System Schematic (Example)

2.4 Initial Sampling Plan Reports

The software will allow a user to print a set of predefined reports for verification of data that has been entered into the software. Each PWS shall generate Reports A.1 through A.5 and verify that the information entered into the software from the schematics is correct **prior to submittal** of the Initial Sampling Plan to EPA. Upon receipt of the Initial Sampling Plan diskette, EPA will also print reports A.1 through A.5 to assist in the sample plan review process. Therefore, these reports do not need to be submitted to EPA because EPA will generate its own copies from the diskette provided by the PWS. A description of these reports is found below. Example reports for the hypothetical PWS illustrated by the schematics in Figure 2-1 and Figure 2-2 are located in Appendix A.

- Report A.1 - Initial Sampling Plan by Location - This report lists the samples to be collected at each sample location, from the plant influent through the distribution system. The user should compare this report to the sampling schematic to ensure that all of the requisite unit processes, sample locations and samples have been properly identified.

- Report A.2 - Design Plant Parameters - This report lists the design parameters for the plant influent, each process train, each unit process, and the finished water.

- Report A.3 - Design Plant Chemical Parameters - This report specifies the types, measurement formulae, and design doses of the chemicals and disinfectants used at every unit process in each process train.

- Report A.4 - Design Distribution System Information - This report documents the design information for the entry point, SDS, and distribution system sample locations.

- Report A.5 - Design Water System Information - This report summarizes the basic water system and treatment plant data at the start of the 18 month ICR data collection period.

2.5 Final Design Data

A Final Design data transfer package (a diskette and summary report containing treatment plant and process train information) must be submitted to EPA along with the last monthly reporting package. Final Design data are similar to the Initial Sampling Plan information, except that sampling location and analytical parameters are not included. Final Design data should accurately reflect the design of each PWS at the end of the 18 month ICR sampling period. Design data are important to the EPA and the water industry for they are used in cost-benefit analyses of treatment processes in operation at PWSs across the nation.

Please refer to the "ICR Water Utility Database System Users' Guide" for directions on how to prepare and submit the Final Design data transfer package to EPA.

3.0 Treatment Study Applicability Monitoring

Each treatment plant in any PWS that meets the "population served" applicability criteria in the ICR [§141.141 (e)(1)], which is also explained below in section 3.2 of this manual, must conduct treatment study applicability monitoring. The purpose of this monitoring is to determine whether the level of DBP precursors in their water will require them to conduct percursor removal studies. Treatment plants with high levels of DBP precursors, as determined by total organic carbon (TOC) measurements, will be required to conduct precursor removal studies to determine the effectiveness of GAC and/or membrane technology to remove the DBP precursors.

3.1 Applicability Monitoring Requirements

All treatment study applicability monitoring includes twelve (12) consecutive months of TOC monitoring. In some cases treatment study applicability monitoring will include twelve (12) consecutive months of uniform formation condition total organic halide (UFCTOX) monitoring to demonstrate a common water resource. Treatment study applicability monitoring will include quarterly monitoring of distribution system trihalomethanes (THM4) and haloacetic acids (HAA5) if the PWS desires to apply to avoid the treatment study requirement on the basis of distribution system DBPs. THM4 is the sum in micrograms per liter of the trihalomethanes chloroform, bromodichloromethane, dibromochloromethane, and bromoform, rounded to two significant figures. HAA5 is the sum in micrograms per liter of the haloacetic acids mono-, di-, and trichloroacetic acid; and mono-, and di-bromoacetic acid, rounded to two significant figures.

NOTE: Uniform formation conditions (UFC) are a set of standard chlorination conditions. Under UFC conditions, the sample is buffered to a pH of 8.0 ± 0.2, dosed to achieve a 24-hour free chlorine residual of 1.0 ± 0.4 mg Cl_2/L, and incubated headspace free for 24 ± 1 hours at $20.0 \pm 1.0°C$. For UFCTOX, TOX samples are collected and the chlorine residual quenched at the end of the UFC incubation period. The uniform formation conditions procedure is described in greater detail in Part 1 of the "ICR Manual for Bench and Pilot-Scale Treatment Studies," *EPA 814-B-96-003*.

Monthly monitoring for TOC, and UFCTOX if applicable, must begin no later than three (3) months after the date of publication of the final rule in the Federal Register. If distribution system THM4 and HAA5 monitoring is to be conducted to determine treatment study applicability, the first quarterly sample must be collected no later than six (6) months after the date of publication of the final rule in the Federal Register. The results from all treatment study applicability monitoring must be submitted no later than seventeen (17) months after the date of publication of the final rule in the Federal Register. Treatment study

applicability monitoring is independent of the Initial Sampling Plan review process and the start of applicability monitoring is only triggered by rule promulgation (i.e., 3 months after promulgation).

All treatment study applicability monitoring shall be conducted using the methods and the mandatory quality control procedures contained in the "DBP/ICR Analytical Methods Manual," *EPA 814-B-96-002*. Additionally, the TOC analyses shall be conducted by laboratories that have received approval from EPA to perform TOC analysis for compliance with this rule. Although not a requirement, it is recommended that EPA approved laboratories also analyze the UFCTOX, THM4 and HAA5 samples collected during treatment study applicability monitoring.

3.2 Treatment Plants that Must Conduct Applicability Monitoring

3.2.1 Each PWS Serving a Population of 100,000 or More

Each public water **system** that serves 100,000 persons or more must conduct monitoring at each **plant** that provides finished water for 100,000 persons or more, to determine whether they are required to conduct precursor removal studies at any of these plants (Treatment Plant Categories A & B in the ICR [§141.141(b)]). If a PWS serves 100,000 persons or more, but does not have any one plant that treats water for 100,000 persons or more, the applicability monitoring must be conducted at the largest plant operated by the PWS (Treatment Plant Categories C & D in the ICR [§141.141(b)]).

Plants treating **surface water or ground water under the direct influence of surface water** are to monitor treatment plant **influent** (water that represents the water quality challenge to a particular plant) for TOC to determine whether precursor removal studies are required.

Plants treating only **ground water** shall monitor **finished water** for TOC to determine whether precursor removal studies are required. As defined in the ICR [§141.140], finished water is water that does not undergo further treatment by a treatment plant other than maintenance of a disinfectant residual.

3.2.2 Each PWS Using Ground Water and Serving 50,000 to 99,999 Persons

Systems serving from 50,000 persons to 99,999 persons with at least 50,000 persons served by ground water shall conduct the treatment study applicability monitoring at the largest ground water plant owned by the system (Treatment Plant Category G in the ICR [§141.141(b)]). For purposes of the ICR, an example of a ground water plant may include one composed of multiple wells with no treatment other than chlorination, or it may be a central treatment plant (such as a softening

plant) treating water from one or more wells. For multiple wells with treatment on a single aquifer and without a central point of entry to the distribution system, only one (1) well from each aquifer will be required to be sampled.

Plants treating only **ground water** shall monitor **finished water** for TOC to determine whether precursor removal studies are required. As defined in the ICR [§141.140], finished water is water that does not undergo further treatment by a treatment plant other than maintenance of a disinfectant residual.

3.3 TOC Monitoring Requirement

All treatment plants described in the preceding section shall conduct TOC monitoring monthly for twelve (12) months. These treatment plants are not required to conduct precursor removal studies if:

- The average TOC value from the 12 consecutive months of sampling is less than 4.0 mg/L in the **influent** to a plant treating surface water or ground water under the direct influence of surface water.

- The average TOC value from the 12 consecutive months of sampling is less than 2.0 mg/L in the **finished** water from a plant treating only ground water.

3.4 DBP Monitoring Option

A treatment plant may also determine treatment study applicability based on the level of DBPs formed in the distribution system. Treatment plants that use only chlorine as both the primary and residual disinfectant and have, as an annual average of four quarterly averages, levels of THM4 less than 40 μg/L and levels of HAA5 less than 30 μg/L need not conduct treatment studies. Quarterly averages are the arithmetic averages of the four distribution system samples collected at the following points: **one (1)** sample location representative of the **maximum residence time** in the distribution system for the treatment plant and **three (3)** sample locations representative of the **average residence time** in the distribution system for the treatment plant.

3.5 Monitoring Required to Demonstrate a Common Source

Plants that are required to conduct **individual** precursor removal studies, based on the results of their applicability monitoring, can apply for an alternative to the individual study if:

- They demonstrate a common water resource with at least one other plant conducting a study on that source [§141.141(e)(5)], and contribute to a Disinfection Byproducts/Microbial Research Fund (buyout option).

- They conduct a joint study with other treatment plant(s) - if they have similar treatment trains and treat water from a common water resource [§141.141(e)(4)]. (Similar treatment plants, for example, would be plants that are all softening plants, all conventional plants, etc.)

Monthly determination of total organic halides (TOX) formed under uniform formation conditions (UFCTOX) may be required if treatment plants intend to qualify for common source designation under certain conditions described as follows:

- A common water resource for all types of **surface water** resources, **including ground waters under the direct influence**, requires the mean treatment plant influent TOC or UFCTOX (depending on the surface water type and the distance between intakes) of each of the cooperating treatment plants to be within 10% of the average of the mean treatment plant influent TOCs or UFCTOXs of all the cooperating plants.

- A common water resource for all types of **ground water** resources requires the mean treatment plant finished water TOC of each of the cooperating plants to be within 10% of the average of the mean TOCs of all the cooperating plants.

The mean is calculated from the twelve (12) consecutive months of monitoring to determine treatment study applicability as described previously.

3.6 Reporting Requirements

A form for reporting the results from treatment study applicability monitoring is included in Part 1 of the "ICR Manual for Bench and Pilot-Scale Treatment Studies," *EPA 814-B-96-003*. Monitoring results are to be submitted on this form no later than seventeen (17) months after the date of promulgation of the ICR to the following address:

USEPA, Technical Support Division
ICR Precursor Removal Studies Coordinator
26 W. Martin Luther King Drive
Cincinnati, OH 45268

4.0 General Sampling Requirements

Each PWS is to monitor its influent, water treatment plant process streams, and distribution system sampling points for a period of eighteen (18) consecutive months as specified in the ICR [§141.141(c) and 141.141(d)]. Furthermore, each PWS is to monitor monthly for eighteen (18) consecutive months at each treatment plant (see Section 5 of this manual for monitoring requirements). The first month of monitoring will be designated sampling period 01, and subsequent monthly periods will be consecutively numbered up to sampling period 18. ICR monitoring is not to start until EPA has reviewed and provided written comments back to the PWS regarding the ICR Initial Sampling Plan.

The main steps involved in ICR sampling following receipt of the Initial Sampling Plan EPA review letter are listed below. These steps will be repeated each month during the course of the 18 month monitoring period.

- Develop a Monthly Sampling Plan
- Coordinate with Approved Laboratories
- Collect and Ship Samples
- Record Appropriate Information
- Verify Monthly Sampling Information
- Report Monthly Sampling Information to EPA

4.1 Develop a Monthly Sampling Plan

The Monthly Sampling Plan is a **tool** which is to be used by field operators/sample collectors and is **not to be submitted to EPA**. The Monthly Sampling Plan is developed using the ICR Water Utility Database System by copying information over from the Initial Sampling Plan (or a previously developed Monthly Sampling Plan). It can be a useful tool for the sample collectors because it provides them with a list of the treatment information they will need to gather and the samples they will collect for the sampling period. It can also be used as a planning aid for many of the other activities associated with sample collection such as arranging for analyses from ICR approved labs. The Initial Sampling Plan, from which the first Monthly Sampling Plan is developed, contains design data for the treatment plant, however, the Monthly Sampling Plan must reflect the operating conditions in the plant at the time of sampling. Therefore, the Monthly Sampling Plan must be altered as necessary to reflect changing conditions at the water system. Data copied from the Initial Sampling Plan may require updating to reflect the current operating conditions in the plant and the samples which must be collected for the current sampling period. Reports can then be generated from the Monthly Sampling Plan that can be used by the sample collectors. The Monthly Sampling Plan must include all quarterly samples (samples required to be collected four times a year) that happen to fall in the particular monthly sampling period.

NOTE: Sampling locations, once defined in the Initial Sampling Plan, cannot be changed. Once a sample location number is established, it cannot be changed or reassigned to a different location. However, because of potential variations in plant operating conditions during a particular month, samples at given sampling locations may not be required for that monthly sampling period, and the **samples** for a particular location can be deleted for any particular month. New sample locations can also be added. Therefore, variations in plant operating conditions, such as a change in the type of disinfectant applied, can be reflected in the Monthly Sampling Plan. For example, the Monthly Sampling Plan must reflect a change from the application of chloramines at a treatment plant to the application of chlorine. A change in the supplier or product line for the same type of disinfectant does not need to be reflected in the Monthly Sampling Plan .

4.2 Coordinate With ICR Approved Laboratories

Each PWS should contact its laboratories as soon as possible after determining what analyses are required and when the first ICR sample collection will occur. Early communication with the laboratories can help ensure the PWS that:

- Laboratories have the required ICR lab approval.
- Laboratories have sufficient capacity to analyze the samples in the required time-frame.
- Proper sample collection and handling procedures are followed.

4.2.1 ICR Laboratory Approval

ICR laboratory approval is granted on a method by method basis, and must be obtained by a laboratory prior to performing analyses on ICR samples. EPA will also evaluate laboratory performance throughout the 18-month monitoring period. Details on the initial approval process and the on-going evaluation during the 18-month period are described in the DBP/ICR Analytical Methods Manual, *EPA 814-B-96-002*.

A PWS must be aware of the approval status of the laboratories performing its analytical work. Monitoring data generated by laboratories that are not ICR approved will be deleted from the ICR Federal Database.

Laboratories that have been approved by EPA to conduct ICR analyses will be identified on a list which will be periodically updated. This list will be available from the EPA Safe Drinking Water Hotline (see section 1.5 of this manual) for the duration of the ICR 18-month sampling period. Furthermore, if a laboratory loses its approval, EPA will attempt to notify each PWS which may be affected by such action.

4.2.2 Laboratory Capacity

Many of the samples that a PWS is required to collect for the ICR must be analyzed within a relatively short time-frame in order to ensure that sample integrity is maintained between sample collection and analysis. Laboratories have a finite capacity to analyze samples and must therefore plan the work load in order to ensure that they can provide sample analyses within specified periods of time. If the laboratory is not routinely performing the necessary analysis, it may require several days of preparatory work before it can perform a requested analysis. Therefore, it is in the best interest of the PWS to contact its laboratories and establish a sample analysis schedule. This will help prevent the loss of data due to samples not being analyzed according to specified holding times. Data from samples that were analyzed after the specified holding time will not be included in the ICR Federal Database.

4.2.3 Sample Collection and Handling

Analytical methods generally describe proper sample collection techniques and requirements for storing samples after collection. Since laboratories must be familiar with the methods, they can be very helpful to PWS personnel who are responsible for the actual sample collection. Some laboratories provide their clients with sample collection kits which include sample bottles containing the necessary dechlorinating agents and/or preservatives, sample collection instructions, gel packs for keeping the samples cold during shipment, etc. If the PWS does not desire this assistance, then it is recommended that the PWS check with the laboratory to be sure the proper containers, etc. are being used. Samples that are collected or stored improperly must not be analyzed. ICR approved laboratories have been directed to reject all samples that do not conform to the specifications and to notify the PWS that the samples are not being analyzed. Data resulting from the analysis of improperly collected or stored samples will not be accepted into the ICR Federal Database.

4.3 Collect And Ship Samples

The exact samples that need to be collected at a specific location can be determined through use of the ICR Water Utility Database System. This software allows for the development of reports such as Report B.1, Monthly Sampling Plan by Location (also lists the quarterly samples). An example of Report B.1 is included in Appendix B, and was generated for the hypothetical PWS illustrated in the schematics in Figures 2-1 and 2-2.

4.3.1 Monthly ICR Samples

Ideally all the samples representing a particular monthly sampling period can be collected within a working day, so that both the plant operating data and the collected

samples are reflective of the treatment conditions within the plant at the time of sampling. However, this may not be practical in all cases, especially when sampling must be coordinated with several water plants and laboratories. Therefore, all samples representing an individual sampling period shall be collected within a three-day (72 hour) time period. Furthermore, samples are to be collected when the plant operating mode and water quality conditions are representative of that particular sampling period. Similarly, it is desirable to have monthly samples collected approximately one month apart. This may not always be practical due to abnormal conditions within the water system or scheduling logistics with the laboratories performing the analyses. Therefore, consecutive monthly (72 hour sampling period) samples shall be collected with at least 14 days time between the completion of one sampling period and the subsequent initiation of the next sampling period. Examples of monthly ICR samples (analyte group codes) are: TOC, UV254, WQP, and microbiological influent samples (PROT, VIRU, BACT, COLI). The analyte group names associated with these codes are listed in Table 4-1.

4.3.2 Quarterly ICR Samples

A PWS shall collect 6 quarterly samples during 18 months of ICR monitoring. Ideally, quarterly samples will be collected approximately three (3) months apart. Again, this may not always be practical due to unusual conditions in the water system or for a variety of other reasons. Therefore, consecutive quarterly samples shall be collected with at least two months (and not more than four months) between sampling periods. For example, if quarterly samples were collected on May 15,1997, the next set of quarterly samples must not be collected before July 15, 1997 nor later than September 15, 1997. Examples of quarterly ICR samples (analyte group codes) are: THM/HAN, HAA, CH, and TOX. The analyte group names associated with these codes are listed in Table 4-1.

4.3.3 Sample Identification Labels

Sample identification labels, whether printed, or hand-written (in waterproof ink) must be securely affixed to all sample bottles and/or vials. The labels must contain the **ICR sample identification number**.

NOTE: Each water sample collected during the ICR monitoring period **must be assigned a unique sample identification number.** This number will be assigned by the data entry software when the sampling points are defined and will uniquely define the sample by plant, date, location, and analyte. For example, a typical sample identification number might look something like this:

239049707HAA

where,

- The first three digits, **239**, indicate the ICR Treatment Plant ID Number,
- The next four digits, **0497**, indicate the month and year (i.e., April, 1997) that the sample was collected,
- The next two digits, **07**, indicate the sampling location number (for example, 07 might indicate a sample obtained after filtration), and
- The last three characters, **HAA**, indicate the analyte group (Haloacetic acids)

NOTE: The **ICR Plant Identification Number** is a unique three digit number assigned by EPA to each water treatment plant participating in the ICR. This number will be assigned by EPA upon receipt of the PWS response to the notification letter (see Section 1.3 of this manual).

NOTE: In the above example, the analyte group HAA is only sampled for on a quarterly basis. The complete list of ICR Analyte Group Codes is shown below:

Table 4-1. ICR Analyte Group/Codes

Analyte Group Code	Analyte Group Name	Analyte Group Code	Analyte Group Name
ALD[1]	Aldehydes	AOC*	Assimilable Organic Carbon
BACT	Bacteria	BDOC*	Biodegradable Organic Carbon
Br	Bromide	CH	Chloral Hydrate
CL2	Chlorine Residuals	CLD	Chlorine Demand
CLO2	Chlorine Dioxide Residual	CLOST	Clostridium*
CNCl[1]	Cyanogen Chloride	COLI	Coliphage*
EPABrO3[1]	Low Level Bromate	HAA	Haloacetic Acids

Analyte Group Code	Analyte Group Name	Analyte Group Code	Analyte Group Name
HAN	Haloacetonitriles, Haloketones and Chloropicrin	HYPO	Hypochlorite Analyses
IONC	Bromate, Chlorite, Chlorate	NH3	Ammonia
O3	Ozone Residual	PART	Particle Size Count
PROT	Protozoan	THM	Trihalomethanes
THM/CH	Trihalomethanes/ Chloral Hydrate	THM/HAN	Trihalomethanes/ Haloacetonitriles, Haloketones and Chloropicrin
TOC	Total Organic Carbon	TOX	Total Organic Halide
UV254	Ultraviolet (UV) Absorbance at 254 nanometers (nm)	VIRU	Virus
WQP	Water Quality Parameters		

1. ALD, CNCl, EPABrO3 are collected by the PWS and sent to EPA for analysis.

* The analyses represented by these analyte groups are **optional**, i.e., not required for monitoring as specified in the ICR. Analyte groups representing optional analyses are functional in the software and can be used if needed.

Additional information that water systems or laboratories should find desirable to put on the labels includes:

- space in which to write sample collection date and time (with AM and PM designations)
- sample collection location
- space in which to write sampler's name or initials.
- dechlorinating agent and/or preservative contained in the bottle

Before collecting the water sample, the sampler should complete the information (if required) on the sample identification label. Waterproof ink should be used. Note that if the bottle is filled first, condensation on the surface of the bottle may make it very difficult to write on the label.

4.3.4 Sample Containers

The result of any laboratory analysis is only as good as the sample collected. The objective of sampling is to obtain a sample that "represents" the true character of the water being tested. The ICR samples are no exception. To achieve this goal, ICR samples should be collected at the proper location, in the right container, and labeled properly, using consistent methods. This representative sample must also receive proper handling (preservation, transport, storage, etc.) after it has been collected, to ensure that its composition will not be altered before being analyzed.

In order to ensure the integrity of the sample, analytical methods often specify or provide guidance concerning sample containers. The PWS should use containers that are consistent with the information provided in the methods. A summary of the methods information concerning appropriate containers is given in Table 4-2.

NOTE: Laboratories often take additional precautions when selecting sample containers. For example, amber glass is often used when collecting samples for the organic DBPs because it protects the samples from light.

4.3.5 Sample Preservatives and Dechlorinating Agents

To ensure that the analytes of interest do not deteriorate between sample collection and sample analysis, preservatives must be added to certain samples either prior to or immediately following sample collection. Dechlorinating agents are also added to certain samples prior to, during, or immediately following sample collection to eliminate free residual chlorine. (Disinfection byproducts will continue to form in samples that contain a free residual chlorine. Therefore, DBP concentrations can increase during the time between sample collection and analysis, and won't be representative of concentrations at the time of sampling. Therefore, the residual disinfectant must be eliminated to obtain representative results). Requirements for adding preservatives and dechlorinating agents to samples are defined in the analytical methods and are summarized in Table 4-2. Samples collected for ICR analyses must contain appropriate preservatives and/or dechlorinating agents consistent with those described in this table.

NOTE: The analytical methods vary in their recommended quantities of dechlorinating agent. However, recommended amounts are provided as guidance for dechlorinating a "typical" sample. The actual requirement is to **dechlorinate the sample**, and deviations from specified amounts of dechlorinating agents may be needed to achieve dechlorination of an "atypical" sample. The laboratory should be able to assist the PWS in determining the quantity of dechlorinating agent needed for its samples.

The laboratory must measure the pH of certain samples (TOC, TOX, CH, HAN, THM/HAN, and THM/CH) before it begins the analysis. If the pH is not in the range specified in Table 4-2, the sample was not collected or stored properly and must **not** be analyzed. The laboratory must report this situation to the PWS, so that the mistake is not repeated when samples are collected during the next sampling period. If the problem is determined within the three day sampling window for a sampling period, it may be possible to re-sample to prevent loss of data.

Table 4-2. Sample Collection Containers and Preservatives/Dechlorinating Agents

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
ALD	Aldehydes: Acetaldehyde (Acetald) Butanal Formaldehyde (Formald) Glyoxal Methyl glyoxal (Methyl Gly) Pentanal Propanal Additional aldehydes that EPA may include in the analysis: Benzaldehyde (Benzald) Decanal Hexanal Heptanal Nonanal Octanal	Glass	Teflon lined polypropylene screw caps	Dechlor: 0.1 mL of a 20% NH_4Cl or $(NH_4)_2SO_4$ soln/ 40 mL sample. (0.5 mg NH_4Cl or $(NH_4)_2SO_4$/ mL of sample) When an ozone residual is present: 0.1 mL of a 0.3% KI soln/ 40 mL vial (7.5 μg KI/ mL of sample)
AOC*	Assimilable Organic Carbon (AOC) Mean P17 Mean NOX P17 AOC NOX AOC Total AOC Incubation Temperature Incubation Time	Borosilicate glass	Teflon lined silicone septa	Dechlor: If a chlorine residual is present, add 0.5 mL of a freshly prepared 3% $Na_2S_2O_3$ soln/ 500 mL sample (0.03 mg $Na_2S_2O_3$/ mL of sample)
BACT	Bacteria: Total coliform Fecal coliform *E. coli*	Sterile, nontoxic: - glass, or - rigid plastic or - other approp. material	Leak-proof lid; Non-toxic liner	Dechlor: If a chlorine residual is present, add 0.1 mL of a freshly prepared 10% $Na_2S_2O_3$ soln/ 120 mL sample

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
BDOC*	Biodegradable Organic Carbon (BDOC) TOC before BDOC Reactor DOC before BDOC Reactor DOC after BDOC Reactor Incubation Time	Acid cleaned glass	Teflon lined silicone septa	Dechlor: If a chlorine residual is present, add 0.5 mL of a freshly prepared 3% $Na_2S_2O_3$ soln/ 500 mL sample (0.03 mg $Na_2S_2O_3$/ mL of sample)
Br	Bromide ion (Br-)	Plastic or glass	No specified material	None specified
CH	Chloral hydrate (CH)	Glass	Teflon lined septum	Preserve & Dechlor: 1 g phosphate buffer & Na_2SO_3 mixture /60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, & 0.6 parts Na_2SO_3. 1g/60 mL results in a pH of 4.5-5.5 and 0.1 mg Na_2SO_3/ mL of sample.)
CL2	Chlorine residuals: Free residual chlorine (Free Cl2) Total residual chlorine (Total Cl2)	Field analysis	Not Applicable	None
CLD	Chlorine demand (Cl2 Demand) Chlorine dose Free residual chlorine pH Contact time	Glass	Not Applicable	None
CLO2	Chlorine dioxide residual (ClO_2)	Field analysis	Not Applicable	None
CLOST*	*C. perfringens*	Sterile, nontoxic: - glass, or - rigid plastic or - other approp. material	Leak-proof lid; Non-toxic liner	Dechlor: If a chlorine residual is present, add 0.1 mL of a freshly prepared 10% $Na_2S_2O_3$ soln/ 120 mL sample
CNCL	Cyanogen chloride (CNCl)	Glass	Teflon lined septum	Dechlor: 0.1 mg ascorbic acid / mL of sample
COLI*	Coliphage Somatic coliphage Male-specific coliphage	Filter cartridge, pos. charged: 1MDS, Virosorb	Cartridge Housing: Cuno #AP11T or equivalent	pH adj: Inject 0.1, 1.0, or 5 M HCl at appropriate flow rate to attain a sample pH of 6.5 - 7.5 Dechlor: If a chlorine residual is present, inject sterile, freshly prepared 2% Na_2SO_3 at a rate of 2.5mL/Liter of sample.

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
EPABrO3	Low level bromate (LowBrO3)	Plastic or glass	No specified material	If sample contains an ozone residual, add 0.05 μL ethylenediamine (EDA)/ mL of sample If sample contains a ClO_2 residual, purge the sample (approx 10-15 min) with an inert gas (N_2 or Ar) to remove ClO_2 and then add 0.05 μL EDA/ mL of sample. The addition of EDA to all samples is recommended.
HAA	Haloacetic acids (HAAs): Bromochloroacetic acid (BCAA) Dibromoacetic acid (DBAA) Dichloroacetic acid (DCAA) Monobromoacetic acid (MBAA) Monochloroacetic acid (MCAA) Trichloroacetic acid (TCAA) Additional acids that may be included in analysis: Bromodichloroacetic acid (BDCAA) Chlorodibromoacetic acid (CDBAA) Tribromoacetic acid (TBAA)	Glass	Teflon lined septum	Dechlor: 0.1 mg NH_4Cl/ mL of sample for Methods 552.1 & 552.2; 65 mg NH_4Cl/ 40-60 mL sample for Method 6251 B.
HAN	Chloropicrin (CP) Haloacetonitriles (HANs): Bromochloroacetonitrile (BCAN) Dibromoacetonitrile (DBAN) Dichloroacetonitrile (DCAN) Trichloroacetonitrile (TCAN) Haloketones (HKs): 1,1-Dichloropropanone (DCP) 1,1,1-Trichloropropanone (TCP)	Glass	Teflon lined septum	Preserve & Dechlor: 1 g phosphate buffer & NH_4Cl mixture /60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, & 0.6 parts NH_4Cl. 1g/60 mL results in a pH of 4.5-5.5 and 0.1 mg NH_4Cl/ mL of sample.)
HYPO	Hypochlorite Stock: Chlorate (ClO3) Free residual chlorine pH Temperature	See individual analyses	See individual analyses	See individual analyses

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
IONC	Bromate Ion (BrO3) Chlorate Ion (ClO3) Chlorite Ion (ClO2)	Plastic or glass	No specified material	If sample contains an ozone residual, add 0.05 mg ethylenediamine (EDA)/ mL of sample If sample contains a ClO_2 residual, purge the sample (approx 10-15 min) with an inert gas (N_2 or Ar) to remove ClO_2 and then add 0.05 mg EDA/ mL of sample. The addition of EDA to all samples, except the hypochlorite solution, is recommended. The laboratory should add EDA to the hypochlorite sample after it is diluted for analysis.
NH3	Ammonia	Glass or plastic	No specified material	Preserve: If immediate analysis is not possible, acidify with H_2SO_4 to pH to <2.
O3	Ozone residual	Field Analysis	Not Applicable	None
PART	Particle Size Count: 3-5 um 5-7 um 7-10 um 10-15 um >15 um	Supercleaned borosilicate glass	No specified material	None
PROT	Giardia Empty cysts Cysts with amorphous structures Cysts with 1 internal structure Cysts with >1 internal structure Total count Cryptosporidium Empty oocysts Oocysts with amorphous structures Oocysts with >1 sporozite Total count	Filter: 25.4 cm long, 1 um nominal porosity polypropylene cartridge	Filter Holder: Commercial LT-10 or Filterite LMO10U-3/4	Dechlor: If a chlorine residual is present, inject sterile, freshly prepared 2% Na_2SO_3 at a rate of 250mL/100 Liter of sample.

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
SDS[1] Sample Location	Individual Analyte Groups to be analyzed from this sample after incubation include: THM HAA HAN CH TOX CL2 WQP Incubation time is also reported.	Glass during incubation See individual analyses for after incubation	Teflon lined septum during incubation See individual analyses for after incubation	None during incubation. After incubation, transfer to sample bottles containing preservatives/dechlorinating agents appropriate for the individual analyses (See individual analyses for recommendations)
THM	Trihalomethanes (THMs): Bromodichloromethane (BDCM) Bromoform (CHBr3) Chloroform (CHCl3) Dibromochloromethane (DBCM)	Glass	Teflon lined septum	Dechlor: For 502.2 & 524.2: 1. 3 mg $Na_2S_2O_3$/40 mL sample or 2. 3 mg $Na_2S_2O_3$/40 mL sample and immediate acidification using HCl to pH < 2 or 3. 25 mg ascorbic acid/40 mL sample and immediate acidification using HCl to pH < 2. (**Note**: Samples must be dechlorinated prior to acidification) For 551: 0.1 mg Na_2SO_3 or 0.1 mg $Na_2S_2O_3$ or 0.1 mg NH_4Cl/ mL of sample. For 551.1: Preserve & Dechlor: 1 g phosphate buffer & NH_4Cl or Na_2SO_3 mixture /60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, & 0.6 parts NH_4Cl or Na_2SO_3. 1g/60 mL results in a pH of 4.5-5.5 and 0.1 mg NH_4Cl or Na_2SO_3 / mL of sample.)
THM/CH	Chloral hydrate (CH) Trihalomethanes (THMs): Bromodichloromethane (BDCM) Bromoform (CHBr3) Chloroform (CHCl3) Dibromochloromethane (DBCM)	Glass	Teflon lined septum	Preserve & Dechlor: 1 g phosphate buffer & Na_2SO_3 mixture /60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, & 0.6 parts Na_2SO_3. 1g/60 mL results in a pH of 4.5-5.5 and 0.1 mg Na_2SO_3/ mL of sample.)

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
THM/HAN	Chloropicrin (CP) Haloacetonitriles (HANs): Bromochloroacetonitrile (BCAN) Dibromoacetonitrile (DBAN) Dichloroacetonitrile (DCAN) Trichloroacetonitrile (TCAN) Haloketones (HKs): 1,1-Dichloropropanone (DCP) 1,1,1-Trichloropropanone (TCP) Trihalomethanes (THMs): Bromodichloromethane (BDCM) Bromoform (CHBr3) Chloroform (CHCl3) Dibromochloromethane (DBCM)	Glass	Teflon lined septum	Preserve & Dechlor: 1 g phosphate buffer & NH_4Cl mixture /60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, & 0.6 parts NH_4Cl. 1g/60 mL results in a pH of 4.5-5.5 and 0.1 mg NH_4Cl/ mL of sample.)
TOC	Total organic carbon (TOC)	Amber glass bottles	Teflon lined septum	Preserve: Adjust to pH ≤ 2 using phosphoric or sulfuric acid (or alternate acid if recommended by the instrument manufacturer).
TOX	Total organic halide (TOX)	Amber glass bottles	Teflon lined septum	Dechlor: 5 mg Na_2SO_3 /mL of sample. (Use crystalline Na_2SO_3) Preserve: Acidify with nitric or sulfuric acid to pH ≤2. Sample must be dechlorinated prior to acid addition.
UV254	Ultraviolet absorbing organics at 254 nm (UV254)	Glass (Amber preferred)	Teflon lined septum	None
VIRU	Total Culturable Virus	Filter cartridge, pos. charged: 1MDS, Virosorb	Cartridge Housing: Cuno #AP11T or equivalent	pH adj: Inject 0.1, 1.0, or 5 M HCl at appropriate flow rate to attain a sample pH of 6.5 - 7.5 Dechlor: If a chlorine residual is present, inject sterile, freshly prepared 2% Na_2SO_3 at a rate of 2.5mL/Liter of sample.
WQP	Water Quality Parameters: Alkalinity (Alk)	Polyethylene or borosilicate glass	No specifications	None
	Water Quality Parameters: Calcium Hardness Total Hardness	Polypropylene or linear polyethylene or borosilicate glass	Polyethylene cap	Preserve: Acidify with nitric acid (1:1) to pH<2

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)	Bottle Material	Cap/Septa Material	Preservative/Dechlorinating Agent (Recommended amount)
WQP	Water Quality Parameters: pH	Field Analysis	Not applicable	None
	Water Quality Parameters: Temperature	Field Analysis	Not applicable	None
	Water Quality Parameters: Turbidity	Field Analysis	Not applicable	None

* Optional sample; not a requirement of the ICR

1. SDS is not an ICR analyte group code. It is included here to provide guidance on collection and handling of the sample collected at the SDS sample location.

4.3.6 General Sampling Procedures

In order to ensure that representative samples are collected, a few general sampling techniques must be observed (only the first item applies to samples for protozoan and virus analyses, because they are collected by passing large volumes of water through filters):

- The sampling line must be flushed immediately prior to sample collection, so that stagnant water in the line is not collected.
- If the sample bottle contains preservatives or dechlorinating agents, care must be taken to not flush them out of the bottle.
- Bottles should not be overflowed.
- The sample should be shaken after filling and capping the container in order to dissolve preservatives and/or dechlorinating agents.
- In order to avoid breaking the sample caps, they must not be over-tightened.

Sampling techniques must also take into account the general characteristics of the component(s) to be measured. For example, if the component is volatile, then care must be taken to not aerate the sample as the bottle is filled. The bottle must be completely filled (head-space-free), so that the component does not volatilize into the air remaining in the bottle.

Detailed sampling guidance may be found in the analytical methods since they generally provide instructions concerning proper sample collection techniques. A summary of the method specific information concerning appropriate sample collection techniques is also provided in Table 4-3 of this manual. Each PWS must use techniques that are consistent with the information provided in this table. In addition,

many laboratories provide their clients with sample collection containers which have been prepared with the proper preservatives/dechlorinating agents. Specific sampling instructions are typically provided with the sampling containers.

The ICR does not require the PWS to collect duplicate samples, but the PWS should work with the laboratory to ensure that enough sample volume is collected to allow a backup analysis if something happens to the first analysis. This will minimize the loss of data due to a QC failure at the laboratory. The laboratories are required to perform duplicate analyses on all TOC, TOX and UV_{254} samples. These duplicates are laboratory duplicates which means that two analyses are performed on water from the same sample bottle. Laboratories are also required to analyze a minimum of 5% of several other sample types in duplicate and as fortified samples. The laboratory may ask the PWS to fill a second bottle in order to meet this requirement for some types of analyses. (If two bottles are filled for the same analysis, they must be assigned the same sample ID number.) More information identifying the analyses which are subject to requirements of duplicate and fortified analyses is contained in the DBP/ICR Analytical Methods Manual *EPA 814-B-96-002*.

4.3.7 Sample Handling, Packaging, and Shipping

In order to maintain the integrity of the samples after they are collected, samples must be stored under conditions that won't change the analyte concentrations. The analytical methods usually provide specific instructions both on storage conditions and length of time the sample is stable under those conditions. A summary of these method recommendations are listed in Table 4-3.

NOTE: Table 4-3 contains information identifying the **maximum holding times for alkalinity, UV_{254}, aldehydes, and cyanogen chloride** as "**ASAP**" followed by the maximum number of days allowable under the ICR. However, since sample stability is matrix-site dependent, it is preferable to analyze these parameters **before** the maximum times. This will ensure that the data obtained for these analytes are representative of the actual conditions at the treatment plant. Until more effective methods of preservation are developed for these four parameters, rapid analysis is the best means of obtaining representative data.

Many of the ICR analytical methods require that the samples be kept cold after collection. The methods specify temperatures ranging from 4°C to less than 10°C. To ensure that samples are maintained properly, they should be packed in ice or frozen gel packs immediately after collection for transporting from the field back to the PWS. At the PWS, the samples should be refrigerated if they are not immediately packaged for shipment to the lab. Prior to shipping to an approved laboratory, samples should be carefully packaged in an insulated shipping container (Styrofoam, or commercial ice chest), and packed with sufficient ice or frozen gel packs to ensure that they will be

received at the laboratory in a chilled condition. The samples should also be protected from freezing.

A lack of visible ice or gel packs that have completely thawed when the samples arrive at the laboratory indicates that the samples were not properly packed for shipment. The integrity of samples that are not received in a chilled condition would be questionable in such cases, so these samples must not be analyzed. The laboratory must notify the PWS as soon as possible if this occurs. The samples should be collected again, if the three day sampling window for the sampling period has not expired.

The maximum holding time for samples is listed in Table 4-3. Sample shipping decisions must reflect sample holding times. It may be necessary to ship some samples to the laboratory via overnight carrier, whereas other samples cannot even be held overnight, i.e., source water BACT samples.

NOTE: Ice should not be treated as an effective packing material because as the ice melts, the bottles may be able to move freely within the package, potentially breaking during shipment. Instead, wrap the bottles individually in "bubblepack" or some other protective material before packing them in ice.

Table 4-3. Sample Collection, Handling, and Storage

Analyte Group Code	Analytical Method	Storage Temp	Max Hold Time	Special Sample Collection Guidelines
ALD	SM 6252 B	Keep at 4°C	ASAP[1]; not to exceed 2 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free.
AOC*	SM 9217 B	Keep below 10°C	24 Hrs Up to 72 hrs. if sample is pasteurized in the sealed vial	Flush & disinfect sample ports and use aseptic techniques to avoid contamination. Keep sample bottle closed until it is to be filled. Fill container without rinsing and replace cap immediately. Leave at least 2.5 cm air space at top of bottle to facilitate mixing.
BACT	SM 9060A&B or ICR Microbial Laboratory Manual (Section X)	Keep below 1-4°C	8 Hrs.	Flush & disinfect sample ports and use aseptic techniques to avoid contamination. Keep sterile sample bottle closed until it is to be filled. Fill container without rinsing and replace cap immediately. Leave at least 2.5 cm air space at top of bottle to facilitate mixing.

Analyte Group Code	Analytical Method	Storage Temp	Max Hold Time	Special Sample Collection Guidelines
BDOC*	Servais et al, 1987 Joret et al, 1988 Mogren et al, 1990 Frias et al, 1992 Summers, 1993	Keep at 4°C	2 Days	None specified
Br	EPA 300.0	None specified	28 Days	None specifed
CH	EPA 551.1	Keep at 4°C	14 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free
CL2	Free Chlorine[2]: SM 4500-Cl D SM 4500-Cl F SM 4500-Cl G SM 4500-Cl H Total Chlorine[2]: SM 4500-Cl D SM 4500-Cl E SM 4500-Cl F SM 4500-Cl G SM 4500-Cl I	Field Analysis	Not applicable	Do not expose samples to sunlight or bright light. Avoid excessive agitation. Analyze immediately after sampling, do not store samples.
CLD	SM 2350 B	Perform test on a freshly collected sample.	Do not store sample.	None specified
CLO2	SM 4500-ClO_2 C SM 4500-ClO_2 D SM 4500-ClO_2 E	Field Analysis	Not applicable	Do not expose samples to sunlight or bright light. Do not aerate to mix. Analyze immediately after sampling, do not store samples.
CLOST*	ICR Microbial Laboratory Manual (Section XI)	Keep below 10°C	8 Hrs.	Flush & disinfect sample ports and use aseptic techniques to avoid contamination. Keep sterile sample bottle closed until it is to be filled. Fill container without rinsing and replace cap immediately. Leave at least 2.5 cm air space at top of bottle to facilitate mixing.
CNCL	Modified EPA 524.2	Keep at 4°C	ASAP[1]; not to exceed 2 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free.
COLI*	ICR Microbial Laboratory Manual (Section IX)	Keep at 4°C	72 Hours (See VIRU)	Samples collected during enteric virus sampling. No additional requirements.

Analyte Group Code	Analytical Method	Storage Temp	Max Hold Time	Special Sample Collection Guidelines
EPABrO3	Selective Anion Concentration (SAC) Procedure	4°C recommended	28 Days	None Specified.
HAA	EPA 552.1 EPA 552.2 SM 6251 B	Keep at 4°C	14 Days (ICR Specification)	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Do not overfill. Seal sample vials with no headspace.
HAN	EPA 551.1	Keep at 4°C	14 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free
HYPO	See individual analyses	See individual analyses; and in addition to the methods listed under CL2 in this table, SM 4500-Cl B may be used.	See individual analyses	See individual analyses
IONC	EPA 300.0	4°C recommended	14 Days (ICR Specification)	None specified.
NH3	EPA 350.1 SM 4500-NH_3 D SM 4500-NH_3 G 379-75 WE	Keep at 4°C	28 Days (if preserved)	None specified
O3	SM 4500-O_3 B	Field Analysis	Not applicable	Do not aerate sample. Analyze immediately after sampling, do not store sample.
PART	SM 2560 (Proposed)	---------	----------	Instantaneous analysis preferred; site specific storage and holding permissable. (See section 7 of this manual)
PROT	ICR Microbial Laboratory Manual (Section VII)	Keep at 2 - 5°C	96 Hours (Start of sampling thru filter elution)	Target sample volume to pass through filter: 100 L Raw Water 1,000 L Finished Water
SDS[3] Sample Location	SM 5710 C	Distribution system temperature during incubation. Also see individual analyses.	Within ± 25% of DSE retention time during incubation. Also see individual analyses	Fill bottle completely with a minimum of turbulence. After incubation, carefully fill sample bottles for individual analyses. Do not aerate sample. Fill THM, TOX, HAN, and CH sample bottles first. See individual analyses for additional recommendations.

Analyte Group Code	Analytical Method	Storage Temp	Max Hold Time	Special Sample Collection Guidelines
THM	EPA 502.2 EPA 524.2 EPA 551 EPA 551.1	Keep at 4°C	14 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free
THM/CH	EPA 551.1	Keep at 4°C	14 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free
THM/HAN	EPA 551.1	Keep at 4°C	14 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample must be head-space-free
TOC	SM 5310 B SM 5310 C SM 5310 D	Keep at 4°C	28 Days	Fill bottle to just overflowing but do not flush out preservatives. No air bubbles. Sample should be head-space-free
TOX	SM 5320 B	Keep at 4°C	14 Days	Completely fill sample bottles but take care not to volatilize any organic halogen compounds. Minimize exposure to light. Store in a dark place if amber bottles are not used. Sample must be head-space-free
UV254	SM 5910	Keep at 4°C (ICR Specification)	ASAP[1]; not to exceed 2 Days (ICR Specification)	Fill bottle to just overflowing. No air bubbles. Sample must be head-space-free
VIRU	ICR Microbial Laboratory Manual (Section VIII)	Keep at 2 - 5°C	72 Hours (Start of sampling thru filter elution)	pH adjustment required if water is not between pH 6 to pH 8. Prefilter if necessary. 200 L ≤ Source water samp vol ≤ 300L 1500 L ≤ Finished water samp vol ≤ 1800L
WQP	Alkalinity: SM 2320 B ASTM D1067-92B I-1030-85	Keep at 4°C (ICR Specification)	ASAP[1]; not to exceed 14 Days	Fill bottle completely & cap tightly. Avoid sample agitation & prolonged exposure to air.
	Calcium Hardness: EPA 200.7 SM 3111 B SM 3120 B SM 3500-Ca D	Keep at 4°C	28 Days (ICR Specification)	None specified.
	Total Hardness: SM 2340 B SM 2340 C	Keep at 4°C	28 Days (ICR Specification)	None specified

Analyte Group Code	Analytical Method	Storage Temp	Max Hold Time	Special Sample Collection Guidelines
WQP	pH: SM 4500-H^+ EPA 150.1 EPA 150.2 ASTM D1293-84	Field Analysis	Not applicable	None specified
	Temperature: SM 2550 B	Field Analysis	Not applicable	None specified
	Turbidity: EPA 180.1 SM 2130 B GLI Method 2	Field Analysis	Not applicable	None specified

* Optional Sample; not a requirement of the ICR
1. ASAP means As Soon As Practical
2. 40 CFR §141.74(a)(2) states: "If approved by the State, residual disinfectant concentrations for free and combined chlorine also may be measured by using DPD colorimetric test kits." Therefore, water sytems that are using these test kits to perform drinking water compiance monitoring under approval from the State, may also use the test kits to perform analyses for the ICR.
3. SDS is not an ICR analyte group code. It is included here to provide guidance on collection and handling of the sample collected at the SDS sample location.

4.4 Record Appropriate Information

An important piece of information that needs to be collected at the time of sampling is the Sample Quality Assurance (QA) Code. This code is used to summarize the sampler's assessment of the quality of the sample. The available codes are: Acceptable (A), Questionable (Q), Rejected (R), Lost (L), and No Sample Collected (N).

Various forms and worksheets have been developed to assist the samplers in collecting the appropriate information along with their ICR samples. These tools are described below. Once the samples have been collected, and the appropriate information has been captured on the forms, the information must be entered into the ICR Water Utility Database using the data entry software.

4.4.1 Forms and Worksheets

Each month, a Monthly Sample Data Collection Form (see Appendix C, Form C.1) should be created from the Monthly Sampling Plan using the ICR Water Utility Database software. This form is intended to be a handy reference document which will be used by the sample collector. The use of this form will ensure that the sample collector takes the required

samples and collects the necessary sampling data in the treatment plant. The form identifies all the samples that are to be collected for the ICR sampling period, the location in the water treatment system where the sample is to be taken, the sample identification number of each sample, and the date on which each sample was taken. Furthermore, since many water quality characteristics (e.g., turbidity, temperature, etc.) are measured immediately after collecting ICR samples, the form also provides a space for the sample collector to permanently record such data. These data will be entered into the ICR database at a later date by the PWS.

The date and time the sample was collected **must** be entered in the ICR Water Utility Database System, for each analyte group. To facilitate the collection of these data, it should be recorded on the appropriate data collection form. It may also be recorded on the sample identification label.

The three data collection forms which can be generated via the ICR Water Utility Database System for use in the field include:

- C.1 - Monthly Sample Data Collection Form - Use this form to ensure that the required samples and necessary sampling data are collected.

- C.2 - Monthly Process Data Collection Form - Use this form to collect the required unit process data.

- C.3 - Monthly Chemical Data Collection Form - Use this form to collect the required data on chemical feed and disinfectant addition.

Worksheets located in an appendix to the ICR Water Utility Database System Users' Guide may also be used to collect process and chemical data during the sampling activities. Some of the information which must be collected during the sampling period includes:

- Population and Flow Rate - Retail and wholesale population equivalents.

- Treatment Plant Operating Conditions - Record additional treatment plant operating information and changes to the existing information to reflect current conditions for the following items:

    - Basic Plant Configuration
    - Water Resource and Intakes
    - Influent
    - Process Train Configuration
    - Unit Processes
    - Finished Water
    - Hypochlorite Stock
    - Distribution System

4.4.2 Analytical Data from Laboratories

The laboratories will report the results of their analyses to the PWS in hard copy reports. The PWS may find it helpful to provide their laboratories with a copy of the various data entry screens that will be used to enter the sample analytical data, so that the laboratories can report the data in a similar format. In addition to the concentrations of the various analytes, the laboratories will report:

- The analytical method that was used to analyze each sample.
- The pH that was measured in TOX, TOC, HAN, CH, THM/HAN and THM/CH samples prior to their analyses.
- The % recovery of surrogate and internal standards that were added to certain samples prior to analysis.
- Any samples or analytes within samples that failed to meet the QC criteria and the reason for failure.

The PWS must enter the above information into the Water Utility Database System, because monitoring data will be deleted from the ICR Federal Database if the specified QC information is not available. Monitoring data should not be entered into the Water Utility Database System for samples (or analytes within samples) that the laboratory reports as failing QC criteria. (The QC information from the laboratory should be entered instead.) Should monitoring data be reported under these circumstances, such data will be deleted from the ICR Federal Database when EPA performs its verification and validation analysis.

Laboratories are required to submit QC reports to EPA on a monthly basis. It is the responsibility of each PWS to request a copy of the portion of the QC reports that are associated with its samples if the PWS wishes to review the performance of its laboratory. Reviewing the QC reports will enable the PWS to gauge laboratory performance and therefore keep track of a laboratory's ICR approval status.

4.5 Verify Monthly Sampling Information

The ICR Water Utility Database System allows for the generation of two types of Monthly Sampling Results Reports to assist in verification of data prior to submitting the data to EPA. The PWS shall verify monthly analytical results (which also includes results from quarterly samples) received from the laboratory prior to submittal of ICR data to EPA. The two types of reports provide for:

- Verification of sample analytical results for a selected sampling period.

- Through plant analysis to reveal changes in sample data across the treatment train.

4.6 Report Monthly Sampling Information to EPA

After the PWS has thoroughly reviewed all of the information from a monthly sampling period, it must generate an electronic report for the period using the Water Utility Database System. The report must be submitted to EPA within four months of completion of the sampling period. The process for preparing this report is fully documented in the Water Utility Database System Users' Guide. The diskette is submitted to EPA at the address specified in the Users' Guide.

5.0 ICR Sampling Requirements - By Location

5.1 Samples Required for ICR 18-Month Monitoring Period

The ICR [§141.142(a) and §141.143(a)] requires monthly and quarterly water samples to be collected at a series of locations in the water treatment plant and water distribution system. Water samples are to be analyzed for a specific series of analytes to determine the levels of these contaminants at these locations.

The ICR [§141.141(b)] describes how a PWS determines applicability. If a PWS is required to conduct monitoring for disinfection byproducts and related contaminants, then the affected treatment plants shall monitor monthly for 18 consecutive months at each treatment plant (even when a treatment plant was not used for one or more months). Treatment plant influent monitoring is the **only** monitoring requirement when the plant is not operating. A category "F" plant (a ground water or purchased finished water plant serving less than 100,000 people which is not the largest plant in the system) does not have to monitor when the plant is not in use. A PWS must also monitor for microbiological contaminants for certain treatment plant categories (A, C, and E) that treat surface water. This microbiological monitoring shall also be conducted for 18 consecutive months (even if the plant is not operated each calendar month). The basic microbiological parameters to be monitored include: total culturable viruses, total coliforms, fecal coliforms or *E. coli*, *Giardia,* and *Cryptosporidium* in the treatment plant influent and the finished water. Some types of monitoring (such as finished water microbiological monitoring) may be avoided if the PWS meets special conditions (see Finished Water Sample Point below).

Throughout this section, when a sampling point is described, the types of samples to be collected at that location will be listed by an "analyte group code" as they are described in Table 4-1 of this manual. For example, CL2 refers to chlorine residual, CLD to chlorine demand, TOX to Total Organic Halide, whereas, WQP refers to the Water Quality Parameters and includes: pH, alkalinity, turbidity, temperature, calcium and total hardness. Refer to Figure 2-1 for an example of a plant schematic which displays the sampling points and types of samples to be collected in a hypothetical conventional water treatment plant (WTP).

5.2 Monitoring Requirements

References : §141.142(a) DBP monitoring
§141.143(a) Microbiological monitoring

5.2.1 General

If a treatment plant configuration results in the placement of two sampling points at a single location, **duplicate analyses are not required** for the same location

and time. An example of two sampling points being placed in the same physical location is found in Figure 2-1 with the Influent Sample (sample #01) and a "before point of disinfection" sample. Another example is the entry point to the distribution system (Entry Point) sample, which is only required for treatment plants that blend finished water with finished water from other treatment plant(s) prior to entry into the distribution system. For the hypothetical example in Figure 2-1, however, the finished water sample collection point (sample #09) is the same as the Entry Point, in which case the Entry Point sample should not be collected (and is not shown in Figure 2-2).

A PWS shall collect a complete set of samples at the frequency and location noted in Tables 5-1 and 5-2, and summarized in the ICR [§141.142(a)(1)]. Also refer to Table 4-2 and Table 4-3 in this manual for additional information on the collection and handling of the ICR samples. The general locations, and the rationale for collecting samples at these locations are described below.

Table 5-1. Monthly Monitoring Requirements for Treatment Plants

Sampling Point	WQP	TOC	UV254	Br	NH3	CL2[1]	CLD	PROT [2]	VIRU [2]	BACT [2]
Treatment plant influent for nonfinished water	✔	✔	✔	✔	✔			✔	✔[3]	✔
Treatment plant influent for purchased finished water[4]	✔	✔	✔			✔				
Before first point of oxidant addition							✔			
Washwater return between washwater treatment plant and point of addition to process train	✔	✔	✔	✔	✔	✔[5]				
Additional water sources added to process train after treatment plant influent. The sample point is before additional water is blended with the process train.	✔	✔	✔	✔	✔	✔				
Before filtration	✔	✔	✔							
After filtration	✔	✔	✔							
Before each point of disinfection[6]	✔	✔	✔							
After every unit process that is downstream from the addition of chlorine/chloramines						✔				
Finished water sample point (plant effluent)	✔	✔	✔			✔		✔[7]	✔[7]	✔[7]
Entry point to distribution system[8]	✔	✔	✔			✔				

1. Free chlorine residual and total chlorine residual shall be measured in treatment systems using free chlorine. Total chlorine residual, but not free chlorine residual, shall be measured in systems using chloramine as the residual disinfectant.
2. For water treatment plant categories A, C, and E only.
3. See section 5.2.2 of this manual for requirements to avoid virus monitoring at this sampling point.
4. Samples of purchased finished water shall be taken prior to addition of any more disinfectant.
5. Disinfectant residual is measured if disinfectant is used to treat the washwater.
6. For utilities using ozone or chlorine dioxide, Tables 6-3, 6-4, 6-5 and 6-6 show additional monitoring requirements at this sampling point. Addition of ammonia for the purpose of converting free chlorine to chloramines is considered a point of disinfection addition. PWSs that disinfect just before filtration may use the "before filtration" sampling point analytical results to meet the monitoring requirement for this point.
7. See section 5.2.9 of this manual for conditions that trigger microbiological monitoring at this sampling point.
8. Entry point to the distribution system only required for treatment plants that blend finished water with finished water from other plants prior to the entry point to the distribution system. For most treatment plants, the finished water sample point and the entry point to the distribution system are the same.

Table 5-2. Quarterly Monitoring Requirements for Treatment Plants

Sampling Point	TOX	THM	HAA[6]	HAN	CH	WQP	CL2[4]
Treatment plant influent	✔						
Treatment plant influent for purchased finished water	✔	✔	✔	✔	✔		
Washwater return between washwater treatment plant and point of addition to process train	✔						
After filtration if disinfectant is applied at any point in the treatment plant prior to filtration	✔	✔	✔	✔	✔		
Finished water sample point (Plant Effluent)	✔	✔	✔	✔	✔		
Entry point to distribution system[1]	✔	✔	✔	✔	✔		
Simulated distribution system sample[2] (SDS)	✔	✔	✔	✔	✔	✔	✔
Four monitoring points in distribution system[3,5]	✔	✔	✔	✔	✔	✔	✔

1. Entry point to the distribution system only required for treatment plants that blend finished water with finished water from other plant(s) prior to the entry point of the distribution system. For most treatment plants, the finished water sample point and the entry point to the distribution system are the same.
2. SDS sample shall be collected at the finished water sampling point (or entry point to the distribution system if finished water from two or more plants are blended prior to entering the distribution system) and analyzed using the method specified in §141.142. PWSs using purchased finished water are not required to take an SDS sample at treatment plants that use only purchased finished water.
3. For each treatment plant, 1 distribution system equivalent sample location (DSE) shall be chosen to correspond to the SDS sample, 1 sample location shall be chosen to be representative of maximum residence time for the treatment plant, and the remaining 2 sample locations shall be representative of the average residence time in the distribution system for the treatment plant. PWSs using purchased finished water shall take 3 samples representing the average residence time in the distribution system for the treatment plant and 1 representing the maximum residence time for the treatment plant (no DSE sample required).
4. Free chlorine residual and total chlorine residual shall be measured in treatment systems using free chlorine. Total chlorine residual, but not free chlorine residual, shall be measured in systems using chloramines as the residual disinfectant.
5. A PWS may use TTHM compliance monitoring locations and analytical results under the THM Rule [§141.30] to the extent that such locations and analytical results are consistent with the requirements of this section.
6. PWSs are encouraged to also analyze for the additional haloacetic acids bromodichloro-, chlorodibromo- and tribromo- acetic acid, and to report the results as part of the reports specified in the ICR [§141.142(c)(1)].

5.2.2 Treatment Plant Influent

References: [§141.142(a)(1)(ii)]& [§141.143(a)(2)]

Treatment plant influent samples are collected to provide an indication of baseline water quality and to determine the water quality challenge it presents to the treatment plant. The sampling frequency was chosen to provide data on the variation over time and seasons. The influent may be either non-finished water or finished water.

- **Non-Finished Water**

  (Monthly - WQP, TOC, UV254, Br, NH3)
  (Monthly Micro - PROT, VIRU, BACT, COLI*, CLOST* for plant categories A, C and E only)
  (Quarterly - TOX)
  *Optional

An ICR sample of treatment plant influent for a PWS that treats untreated water (non-finished water) shall be collected at a location at the upstream (head) end of a treatment plant where waters from all intakes are blended prior to any treatment or chemical addition. Figures 5-1, 5-2, and 5-3 illustrate the proper sampling location for some typically encountered plant influent configurations. These figures also illustrate the how an ICR schematic should depict these different physical sampling locations.

- **Single Intake** samples are collected **after** the intake, **before** addition of chemicals or any treatment. Refer to Figure 5-1.

- **Multiple Intakes without Treatment or Chemicals Added** prior to blending. Collect one complete set of samples at the upstream (head) end of treatment plant where waters from all intakes are blended prior to any treatment or chemical addition. Refer to Figure 5-2.

- **Multiple Intakes with Chemicals Added** - For treatment plants that have multiple intakes and add chemicals at or near the intake, a flow proportional composite sample (complete set of ICR samples) before chemical addition or pretreatment must be collected. However, if the intakes are expected to have the same source water quality, one representative sample may be taken. Refer to Figure 5-3.

A PWS must conduct monthly **microbiological** monitoring as specified in the ICR [§141.141(d)] for 18 consecutive months at each treatment plant that is classified as an A, C, or E plant (even if it is not operated each calendar month). Samples shall

be analyzed for total culturable viruses, total coliforms, fecal coliforms or *E. coli*, *Giardia*, and *Cryptosporidium*. Analyses for *Clostridium* and coliphage may also be performed at the discretion of the PWS. Results from these samples will provide a better understanding of the seasonal variation in the microbial "challenge" to treatment plants as well as general occurrence information.

A PWS may, however, avoid virus monitoring if they have monitored total coliforms, fecal coliforms or *E. coli* in the source water for at least five (5) days every week for any period of six (6) consecutive months beginning after January 1, 1994, and 90% of *all* samples taken in that six month period contained **no greater than** 100 total coliforms/100ml, or 20 fecal coliforms/100ml, or 20 *E. coli*/100ml.

- **For micro samples** [§141.143(a)(2)(B)], if the plant has multiple intakes and adds chemicals at the intake, the PWS shall take an intake sample of the water resource with the **poorest microbiological quality** (or if that cannot be determined, the water resource with the highest flow) collected **before** chemical addition and **before** pretreatment.

- If a disinfectant is added **at or before** the intake (e.g., for zebra mussel control) take the sample in the vicinity of the intake, but avoid contaminating the sample with the disinfectant. This is important for microbiological samples as well as for the water quality parameters (WQP), TOX, and Bromide.

- **Finished Water**
  (Monthly - WQP, TOC, UV254, CL2)
  (Quarterly - TOX, THM, HAA, HAN, CH)

  - Collect the sample of purchased finished water **before** the purchased finished water is further treated (e.g., addition of **any more** disinfectant). A PWS shall only collect a sample of purchased finished water if the purchasing PWS redisinfects the purchased water.

NOTE: PWSs are encouraged to measure nine (9) HAAs, even though the rule only requires HAA6 (six (6) HAAs). The additional three haloacetic acids are: bromodichloroacetic acid, chlorodibromoacetic acid, and tribromoacetic acid.

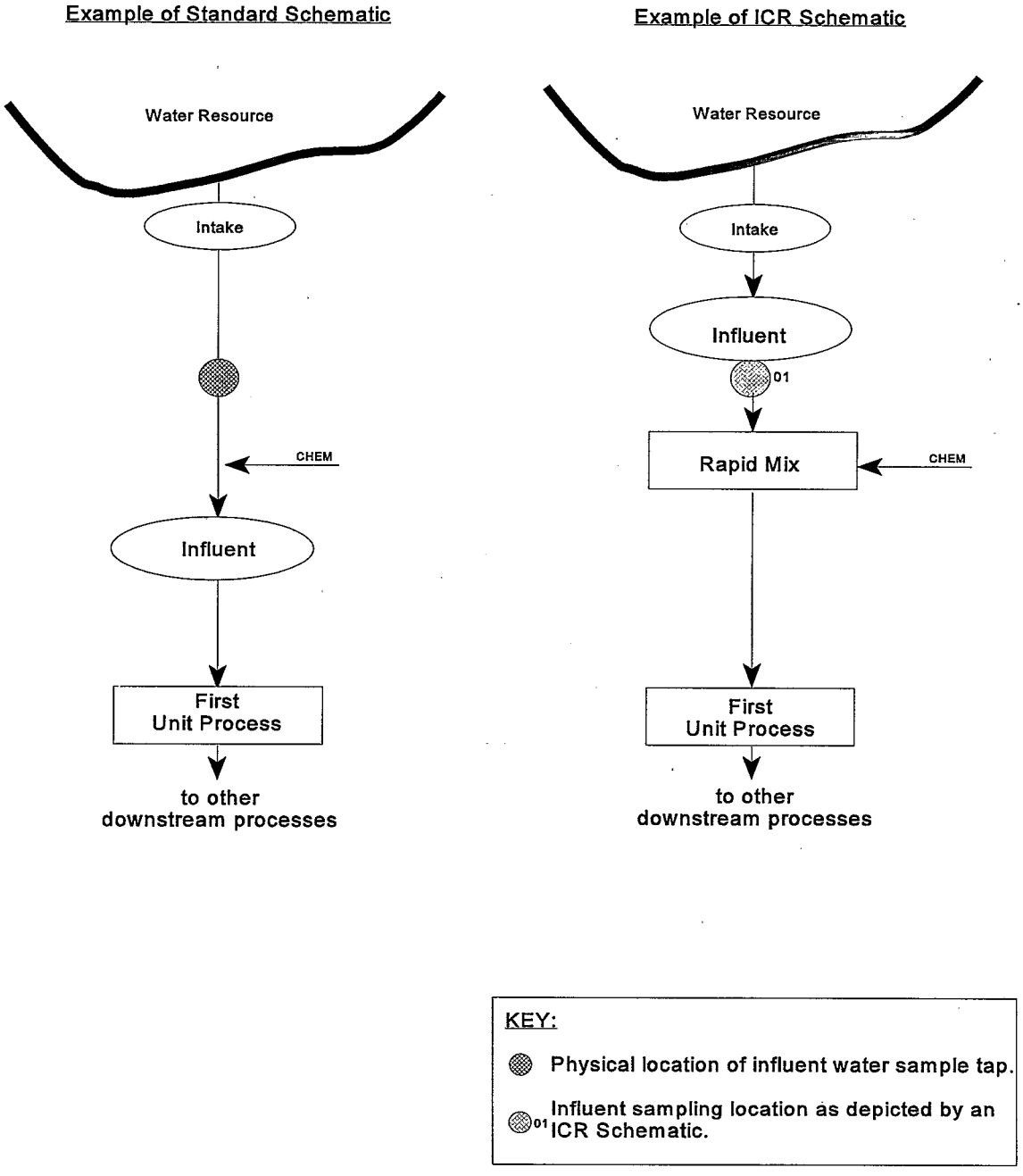

Figure 5-1. Treatment Plant Influent Sample - Single Intake

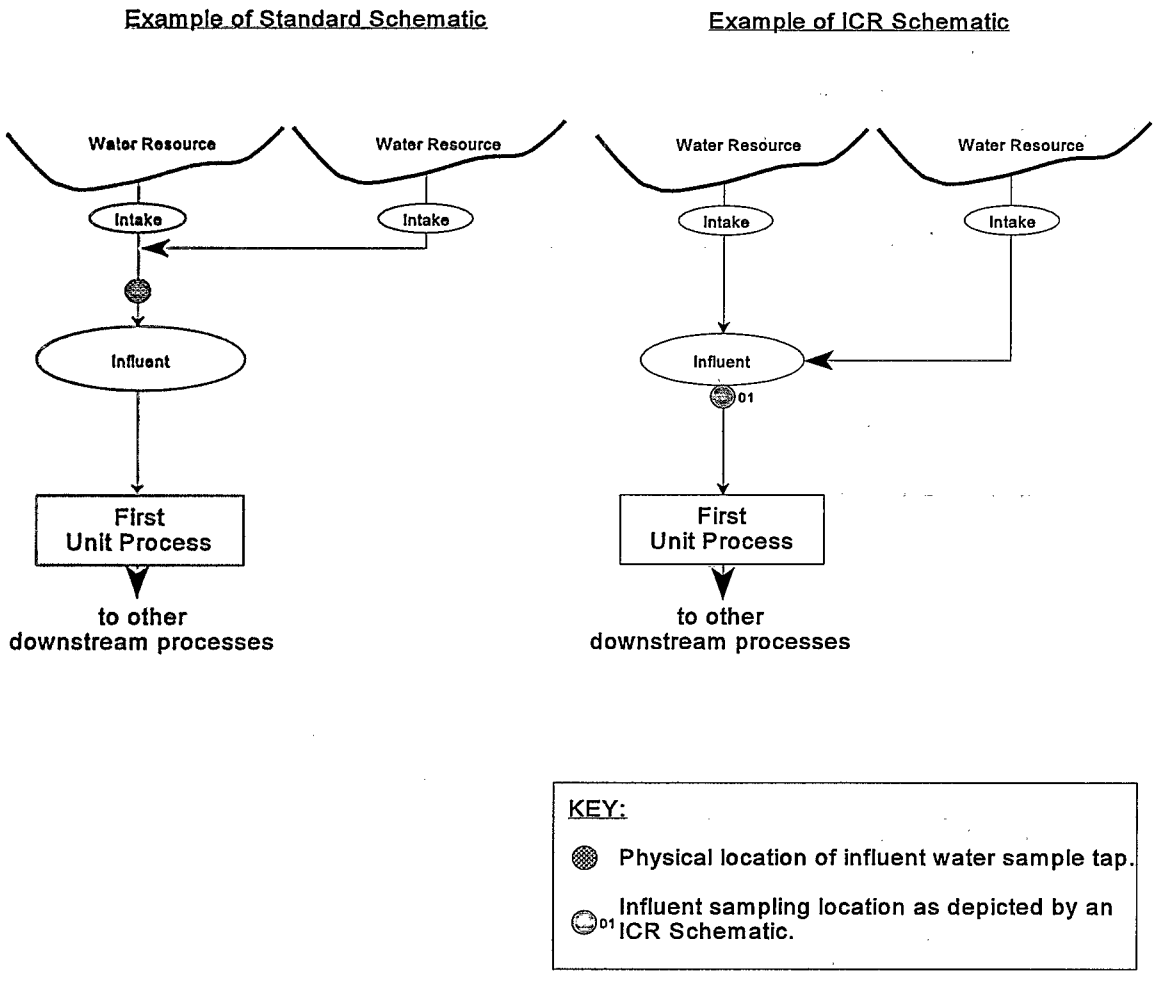

Figure 5-2. Treatment Plant Influent Sample - Multiple Intakes

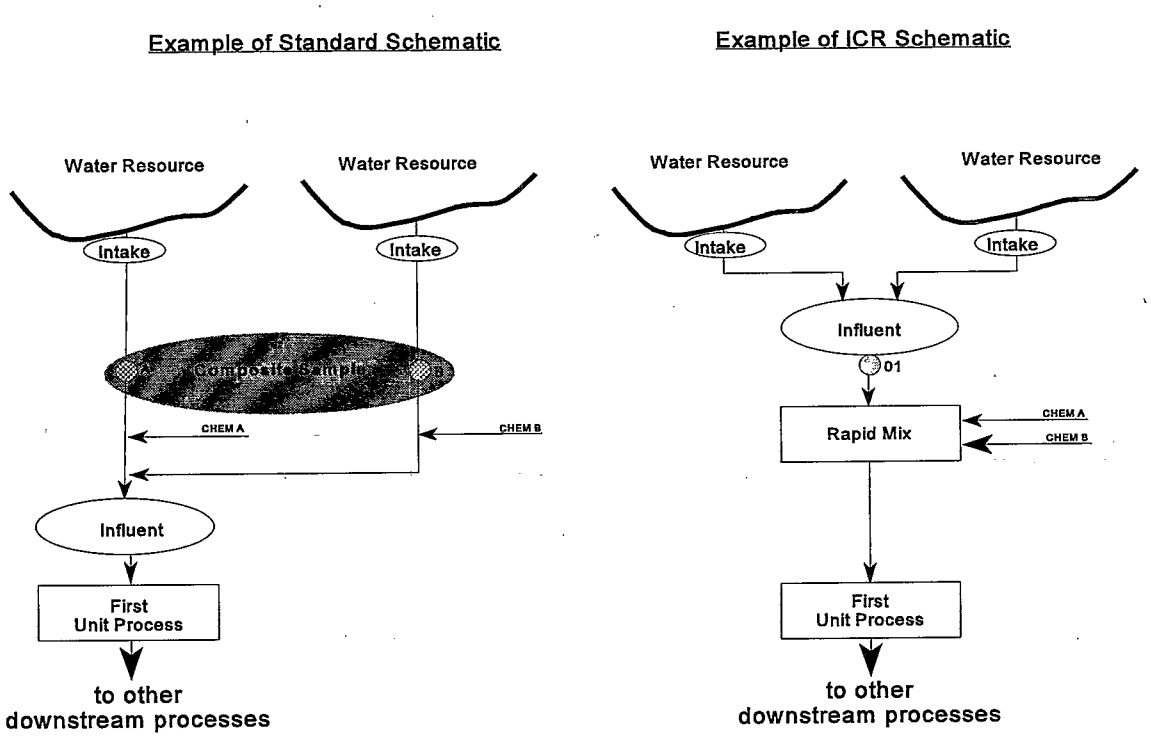

Figure 5-3. Treatment Plant Influent Sample - Multiple Intakes w/Chemical Addition

5.2.3 Before First Point of Oxidant Addition

(Monthly - CLD)

A sample shall be collected before the first point of oxidant addition and tested for chlorine demand to determine the inorganic oxidant demand of the water. Inorganic compounds in the influent water quickly react with oxidants (e.g., potassium permanganate and the primary disinfectants used in drinking water treatment). Therefore, once consumed, the disinfectants are no longer available to provide disinfection or to react with organic material (precursors) to form disinfection byproducts (DBPs). The chlorine demand test used in the ICR will permit the determination of how much disinfectant is available to react with the organic precursors to form DBPs after the inorganics have been oxidized. This is critical for predicting DBP formation. Therefore, it is important to know the inorganic oxidant demand of the water at the point of the first addition of oxidant. Basically, the chlorine demand test involves dosing an aliquot of water collected prior to this point in the treatment process with a known amount of chlorine and then measuring the chlorine residual after a known contact time. The test is conducted under conditions (chlorine dose, temperature, and pH) specific to each water treatment plant. Furthermore, since the water sample should be at the same temperature as the process water, the test should be conducted on a freshly collected aliquot of water. The pH of the water should not be adjusted. Contact time is less than 10 minutes.

NOTE: This test must be conducted in accordance with the DBP/ICR Analytical Methods Manual requirements. It is also included in Appendix D of this manual.

5.2.4 Washwater Return

(Monthly - WQP, TOC, UV254, Br, NH3, and Cl2 if disinfectant is used)
(Quarterly - TOX)

Filter backwash water may or may not be treated before it is returned to the main process stream, and it may not be returned to the main process stream at all. If it is returned, however, washwater return could represent a significant change in the water quality within the process stream. The purpose of this sample is to be able to predict how washwater will impact the water quality and thereby provide better modeling of DBP formation in the process stream. It should be sampled prior to blending with the process train for the water quality parameters (pH, Alkalinity, Turbidity, Temperature, Calcium and Total Hardness), TOC, UV_{254}, Bromide, and Ammonia, and Disinfectant residual (if a disinfectant is used) on a monthly basis. TOX should be monitored quarterly.

5.2.5 Additional Water Sources (added to process train after treatment plant influent)

(Monthly - WQP, TOC, UV254, Br, NH3, and CL2 if disinfectant is added)
(Quarterly - none)

This sample is collected from the main process stream before additional water is blended with the process stream. An example of an additional water source is the addition of ground water to the process stream after a surface water source has undergone preliminary treatment such as chemical addition, rapid mix, coagulation, and sedimentation. Then the blended (combined) flow would undergo filtration and any other subsequent treatment in the main process stream. In this hypothetical example, the next sampling point (before filtration) would capture the water quality of the blended flow at that point. Comparison of the results from this sample point and the next one will indicate the impact the additional water source had on the water quality of the process stream. This information is critical for modeling DBP formation.

5.2.6 Before and After Filtration

(Monthly - WQP, TOC, UV254)
(Quarterly - None unless disinfection is applied prior to filtration. Then **after filtration** - THM, HAA, HAN, CH, TOX)

Comparison of these sample results will provide data on changes in water quality across the filtration process. Of particular importance are data on how the organic precursor material (as represented by TOC and UV_{254}) is removed prior to and through filtration. The quarterly parameters, THMs, etc. in the filter effluent are also important in trying to relate DBP formation to water quality and treatment practices. This data point (filter effluent) will be compared to the plant effluent sample to get an indication of how formation increases concentrations in the final stage of treatment, for example, in the clearwell where additional disinfectant is added. Parameters and analytes to be evaluated at these locations are similar to those collected at the plant influent.

5.2.7 Before each Point of Disinfection

(Monthly - WQP, TOC, UV254)

Most data currently available for determining DBP formation are based on source water parameters. Since many utilities apply some form of treatment to the water prior to the first addition of disinfectant, source water parameters do not always accurately reflect the quality of the water prior to the point where disinfectant is added.

Ammonia (NH_3) addition is also considered a point of disinfection for purposes of determining this sample point. The ICR data will provide for a more accurate determination of how water treatment processes influence DBP formation, because the water quality will be known at each point where disinfectant is applied. Again, monthly parameters and analytes measured at this point in the treatment scheme are similar to those of the plant influent sample.

5.2.8 After Every Unit Process Downstream from the Addition of Chlorine

(Monthly - CL2)

Free chlorine and total chlorine residual will be measured at these ICR sampling locations (in plants using free chlorine or chloramines) to provide a better understanding of the decay of chlorine through the water treatment plant and to give a more accurate picture of DBP formation.

5.2.9 Finished Water Sample Point

(Monthly - WQP, TOC, UV254, CL2)
(Monthly Micro - PROT, VIRU, BACT, COLI*, CLOST* for Water Treatment Plant Categories A,C & E only)
(Quarterly - THM, HAA, HAN, CH, TOX)
*Optional

The previously mentioned samples have tracked the changes in water quality characteristics through the treatment plant in order to better predict DBP formation. This finished water sample now provides a comparison of actual DBP concentrations to what is predicted by modelling the formation through the plant. In addition, the micro samples provide occurrence data.

Monthly and quarterly DBP samples are required for the ICR [141.142(a)(1)] at the finished water sample collection point. In addition, **microbiological** sampling of the finished water is also required under the ICR [§141.143(a)(2)(ii)] if, during **any** of the first twelve (12) months of monitoring at the treatment plant **influent** the **PWS detects:**

- 10 or more *Giardia* cysts, or
- 10 or more *Cryptosporidium* oocysts, or
- 1 or more total culturable viruses, in one liter of water; **or a PWS:**

- **calculates** a numerical value of the *Giardia* or *Cryptosporidium* concentration equal to or greater than 1000 per 100 liters, or

- a virus concentration equal to or greater than 100 per 100 liters; or

- **detects** no pathogens in the sample and calculates a numerical value of the detection limit for *Giardia* or *Cryptosporidium* concentration equal to or greater than 1000 per 100 liters or virus concentration equal to or greater than 100 per 100 liters;

Then the PWS shall also collect one sample of finished water per month. The first sample shall be collected beginning in the first calendar month after the PWS learns of such a result as described above. This finished water monitoring must then continue until the full 18 months of treatment plant influent monitoring has been completed.

The finished water sample collection point [§141.143(a)(2)(B)(ii)] is also referred to as the **plant effluent** sample and represents the **single** point in the treatment plant where a sample may be collected that is representative of the treated water leaving the plant following all treatment process units (including the clear well and final point of disinfection).

NOTE: Finished water monitoring for *Giardia* and *Cryptosporidium* may or may not be required, depending on the results of the influent monitoring as stated above. In lieu of having to conduct any finished water monitoring for *Giardia* and *Cryptosporidium*, the ICR [§141.143(a)(2)(iii)] stipulates that the PWS may conduct particle count measurements at three (3) locations in the process stream; in the treatment plant influent, and at points immediately prior to and after filtration.

However, each PWS which elects to conduct particle counting must also collect and analyze at least four consecutive months of *Giardia* and *Cryptosporidium* samples at the same locations specified for particle counting. (See Section 7.0 of this manual for details of the particle counting procedure). The PWS must also continue to conduct the required finished water monitoring for all other microorganisms (total coliforms, fecal coliforms, *E. coli*, and possibly total culturable viruses. Coliphage (both somatic and F-specific and *Clostridium* analyses at this sample point are optional.

Any PWS which elects to conduct particle counting may notify EPA of this decision in its response to the notification letter, and/or must confirm this decision in its Letter of Transmittal of its Initial Sampling Plan. (See sections 1.3.1 and 2.2.1 of this manual). Commitment to comply with the particle counting requirements of the ICR [§141.143(a)(2)(iii)] must be communicated prior to the start of ICR sampling and will apply throughout the eighteen (18) month monitoring period, regardless of the results of influent monitoring for protozoa.

5.2.10 Entry Point to the Distribution System

(Monthly - WQP, TOC, UV254,CL2)
(Quarterly - THM, HAA, HAN, CH, TOX)

The entry point to the distribution system (Entry Point) sample(s) is **only** required for treatment plants that blend finished water with finished water from other treatment plant(s) prior to entry into the distribution system. For most treatment plants, however, the finished water sample collection point is the same as the entry point to the distribution system, in which case the Entry Point sample should not be collected.

5.2.11 Simulated Distribution System

(Quarterly - WQP, THM, HAA, HAN, CH, TOX and CL2)

The Simulated Distribution System (SDS) sample is a finished water sample which is incubated at the same temperature and detention time as a Distribution System Equivalent (DSE) sample collected from the distribution system. It is collected at the entry point to the distribution system sampling point or the finished water sampling point, if an entry point sample is not required. Analytical results of the SDS sample will be compared with the DSE sample to determine how well the SDS sample predicts disinfection byproduct formation in the actual distribution system (sample). The SDS and DSE samples are not required for plants that only redisinfect purchased finished water.

This sample is collected for two reasons: (1) To look at DBP formation under controlled conditions; and (2) To determine if SDS samples could be a cost effective monitoring tool in place of distribution system sampling.

The volume of the SDS sample must be large enough to accommodate all the analyses listed above. A single, large (~0.5 gallon), amber glass container with a Teflon lined cap is preferable to several smaller containers. The container must be filled completely, that is, with zero head-space, sealed tightly, and protected from light during storage. The SDS sample should be stored for a time period comparable in length to the DSE sample's detention time. The storage temperature should be comparable to the temperature of the water in the distribution system (between the treatment plant and the DSE sampling point). At the end of the storage time, the SDS sample must be divided for analysis (the reason for the large sample) by pouring it into sample bottles containing the appropriate dechlorinating agents/preservatives. Be careful not to aerate the sample during transfer to prevent the loss of volatile compounds.

NOTE: The DBP/ICR Analytical Methods Manual describes the procedural requirements for the SDS sample (Standard Method 5710 C). A copy of the procedure is also included in Appendix D of this manual. In most cases the incubation part of this test and dividing the sample into smaller bottles for the individual analyses will be done at the treatment plant.

5.2.12 Distribution System

(Quarterly - WQP, THM, HAA, HAN, CH, TOX, CL2)

Four (4) monitoring points are to be sampled quarterly in the distribution system for each treatment plant. These data will provide occurrence information on the DBPs thereby assisting in making national exposure estimates. The DSE sample results will also be used in conjunction with the SDS sample results in order to evaluate the usefulness of SDS for future regulatory purposes. Figure 2-2 contains an example ICR Distribution System Schematic, depicting the four samples, which are:

- **Maximum Residence Time** - Collect one sample at a location in the distribution system that represents the maximum residence time. This point will often be the point farthest from the plant or possibly at a dead end in the system.

- **Average Residence Time** - Collect samples from two (2) locations within the distribution system that are representative of the average residence time in the distribution system.

- **Distribution System Equivalent (DSE)** - Collect one sample at a location in the distribution system that corresponds to the "simulated distribution system" (SDS) sample. The following criteria should be used in the selection of this sampling location:

  - No additional disinfectant added between the treatment plant and the sampling location,
  - Approximate residence time of the water at the sampling location is available, and
  - There is no blending with finished water from other treatment plants.

  Plants that only redisinfect purchased finished water must substitute an average residence time sample for the DSE sample, because they are not collecting an SDS sample for comparison to the DSE sample.

NOTE: A PWS may use TTHM compliance monitoring locations and analytical results gathered to conform with Part 40, §141.30 (the THM Rule) to satisfy

this requirement if the sampling locations and analytical results are consistent with the ICR requirements.

5.2.13 Full-Scale GAC or Membrane Treatment

For a treatment plant that already uses full-scale GAC or membrane technology capable of achieving precursor removal, a PWS shall conduct the monitoring listed in Table 5-3 and submit full-scale plant data, as per the ICR [§141.141(e)(3)(iv)], ensuring that the GAC or membrane processes are included in the process train being monitored.

Table 5-3. Monitoring Required Across Full-Scale GAC Or Membrane Processes

Sampling Point	Monthly Analyses
Before GAC or membranes	WQP, TOC and UV254
After GAC or membranes	WQP, TOC and UV254
Sampling Point	**Quarterly Analyses**
Before GAC or membranes if disinfectant is applied at any point in the treatment plant prior to these processes	THM, HAA, HAN, CH, TOX
After GAC or membranes if disinfectant is applied at any point in the treatment plant prior to these processes	THM, HAA, HAN, CH, TOX

6.0 Additional Sampling Requirements for PWSs Using Alternative Disinfectants

The foregoing sampling requirements for DBP samples (Section 5.0 of this manual) are for all PWSs required to monitor under the ICR. However, for treatment plants that use alternative disinfectants such as chloramines, hypochlorite solutions, ozone, or chlorine dioxide, additional monthly and/or quarterly monitoring is required. The additional samples are required to determine the disinfection byproducts that are likely to be formed when the alternative disinfectants are used.

NOTE: When preparing or checking a sampling schematic, check each sample point against the requirements in the rule. For example, if a plant uses chlorine dioxide as its disinfectant, the ICR [§141.142(a)(5)] requires that chlorine dioxide residual (CLO2), Chlorite, Chlorate, Bromate (collectively, IONC) be monitored on a monthly basis in the finished water. Furthermore, if more than one disinfectant is applied within a plant, the monitoring requirements associated with each type of disinfectant will apply. As an additional example, if ozone is applied at a treatment plant and followed downstream by chloramines, additional samples will need to be collected and analyzed for the presence of cyanogen chloride.

Following is a brief discussion of the additional monitoring required at treatment plants using various alternative disinfectants. Each section is further broken down by sampling location as in Section 5.0 of this manual.

6.1 Treatment Plants Using Chloramines

Treatment plants using chloramines are required by the ICR [§141.142(a)(2)] to analyze for cyanogen chloride at the locations described below (also see Table 6-1) on a quarterly basis. Cyanogen chloride is formed when chlorine reacts with organic material in the presence of the ammonium ion. Little data are currently available on the occurrence of cyanogen chloride and the factors influencing its formation. Therefore, additional data are necessary to determine how the distribution of byproducts would change if utilities switched from free chlorine to chloramines to meet the proposed D/DBP Rule MCLs for TTHM and HAA5. An EPA laboratory in Cincinnati will analyze the ICR water samples for cyanogen chloride (See Section 6.5 of this manual).

6.1.1 Treatment Plant Influent

(Quarterly - CNCL)

There is only one case when the treatment plant influent must be sampled for cyanogen chloride under the ICR, and that is when the wholesale water provider is

using chloramines. The samples collected at this point will be sent to EPA in Cincinnati for cyanogen chloride analysis. All of the other purchased water influent samples required by the ICR must also be collected (see Section 5.0 of this manual).

6.1.2 Finished Water

(Quarterly - CNCL)

The finished water sample point (plant effluent) must be sampled quarterly at plants using chloramines. This sample will be sent to EPA for analysis. All of the other finished water ICR samples described in Section 5.0 of this manual must also be collected at this sampling point.

6.1.3 Distribution System

(Quarterly - CNCL)

For treatment plants using chloramines, an additional sample must be collected in the distribution system and analyzed for cyanogen chloride. This sample must be collected at the distribution system sampling point representing the **maximum residence** time in the distribution system. As with the other cyanogen chloride samples described above, this sample must be sent to EPA for analysis.

Table 6-1. Additional Quarterly Monitoring for Treatment Plants Using Chloramines

Sampling Point	Cyanogen Chloride[1]
Treatment plant influent for purchased finished water (only if wholesaler uses chloramines)	✔
Finished water sample point (plant effluent)	✔
Distribution system sample point representing a maximum residence time in distribution system relative to the treatment plant	✔

1. EPA is to analyze water samples for Cyanogen Chloride. See paragraph "Arranging for special EPA ICR Analyses.

6.2 Treatment Plants Using Hypochlorite Solutions

Treatment plants using hypochlorite solutions are required by the ICR [§141.142(a)(3)] to analyze for chlorate at the locations described below (see also Table 6-2) on a quarterly basis. The plant influent sample is necessary because chlorate has been measured in both

surface and ground water sources. Therefore, the influent sample will provide information on the background level of chlorate.

EPA anticipates that chlorate may be regulated as part of the Stage 2 DBP Rule. Chlorate is a decomposition product found in hypochlorite feedstock, and is not a DBP resulting from chlorine reactions under drinking water treatment conditions. Therefore, its concentration in drinking water is not expected to change unless additional hypochlorite solution is added to the process stream. To better understand the factors that influence chlorate formation, water treatment plants using hypochlorite solutions will be required to analyze quarterly samples collected from the influent and effluent for chlorate.

6.2.1 Treatment Plant Influent

(Quarterly - IONC (Chlorate only))

Treatment plants that **use** hypochlorite solutions for treatment or disinfection residual maintenance shall collect an additional influent sample and have it analyzed for the presence of chlorate on a quarterly basis. In addition, treatment plants that **purchase** finished water from another provider (wholesaler) that uses hypochlorite solutions shall analyze their influent for chlorate.

6.2.2 Hypochlorite Stock Solution

(Quarterly - HYPO (pH, Temp., Free Residual Chlorine, & Chlorate))

The hypochlorite solution that is being used at the plant to feed chlorine into the process stream shall be analyzed quarterly for pH, Temperature, Free Residual Chlorine, and Chlorate. The hypochlorite "stock" solution to be sampled is the one **at the treatment plant that is being used to feed chlorine into the process stream at the time of sampling**, and **not** the stock solutions at booster stations in the distribution system. In some instances, this may be a dilution from the feedstock that is purchased (i.e., a 15% solution diluted to 5% OR a solution of calcium hypochlorite).

NOTE: If a plant is utilizing more than one stock solution to feed chlorine into the process stream at the time of sampling, the PWS must obtain a composite sample of the stock solutions being used. Therefore, only one (1) "representative" sample will be submitted to the laboratory for analysis.

EPA will use the chlorate data from this sample and the influent and finished water samples to do a mass balance on chlorate. The temperature, pH and free residual chlorine measurements will provide information concerning the quality of the stock material.

6.2.3 Finished Water

(Quarterly - IONC (Chlorate only))

An additional sample shall be collected at the finished water sampling point (plant effluent) of plants using hypochlorite solutions and it shall be analyzed for chlorate.

Table 6-2. Additional Quarterly Monitoring for Treatment Plants Using Hypochlorite Solutions

Sampling Point	Chlorate	pH	Temp.	Free Residual Chlorine
Treatment plant influent	✔			
Treatment plant influent for purchased finished water (only if wholesaler uses hypochlorite solutions)	✔			
Hypochlorite stock solution	✔	✔	✔	✔
Finished water sample point (plant effluent)	✔			

6.3 Treatment Plants Using Ozone

Treatment plants that use ozone are required under the ICR [§141.142(a)(4)] to monitor for specific DBPs that are known to form as the result of oxidation reactions (specifically, bromate and aldehydes). These plants are also encouraged (by EPA) to determine either assimilable organic carbon (AOC) or biodegradable organic carbon (BDOC), since ozonation increases the biodegradable fraction of organic material available to support bacterial growth. Refer to Table 6-3, Additional Monthly Monitoring for Treatment Plants Using Ozone, and Table 6-4, Additional Quarterly Monitoring for Treatment Plants Using Ozone.

6.3.1 Ozone Contactor Influent

(Monthly - Br, EPABrO3, and NH3)
(Quarterly - ALD, AOC* or BDOC*)
*Optional

Treatment plants using ozone are required to collect samples from the ozone contactor influent and have them analyzed for bromide, low-level bromate, and ammonia. These samples, in addition to the samples collected upstream of this point as described in Section 5.0, will characterize the quality of the water at this point in the process stream.

This sample is not expected to contain bromate at concentrations that can be measured using the routine method (EPA Method 300.0). Therefore, EPA will not require the PWS to have it analyzed by that method. Instead, EPA will analyze the sample for low-level bromate using a research technique that can measure bromate concentrations down to less than 1 μg/L. The PWS shall, therefore, collect the ozone contactor **influent** bromate sample in bottles provided by EPA and ship them to EPA for analysis. See Section 6.5 of this manual for additional information concerning this sample.

The utility **does not** have to collect a separate contactor influent bromate sample for analysis by their ICR approved lab. They must, however, collect samples and have them analyzed for bromide and ammonia.

6.3.2 Each Ozone Contact Chamber Effluent

(Monthly - O3)

Treatment plants using ozone shall monitor the ozone residual in the effluent of all contact chambers (each ozone contactor can be subdivided into its individual contact chambers) until less than 0.05 mg/L of ozone is measured in two consecutive chambers. If the residual is >0.05 mg/L ozone exiting the last chamber, then it is recommended (not required) that the O3 residual be measured after the downstream processes until it is <0.05 mg/L after 2 consecutive processes. These extra data will provide a better understanding of ozone decay.

6.3.3 Ozone Contactor Effluent

(Monthly - IONC (Bromate only) and EPABrO3)
(Quarterly - ALD, AOC* or BDOC*)
*Optional

The PWS shall collect two (2) samples of the ozone contactor effluent for bromate analyses. It is the responsibility of the PWS to have one sample analyzed for bromate (using EPA Method 300.0) by an ICR approved lab. The PWS shall collect the other bromate sample in bottles provided by EPA and ship them to EPA for the low-level bromate analysis.

Quarterly samples for aldehydes shall also be collected from the ozone contactor effluent. Optional samples for AOC or BDOC analyses may also be collected quarterly at this sampling point. Analysis of the aldehyde samples will be done by EPA.

NOTE: EPA will use the data generated from the IONC (Bromate only) samples to evaluate the performance of the analytical method proposed for compliance monitoring under the Stage 1 D/DBP Rule. Bromate data from the EPABrO3 samples will be used to further research bromate issues, such as to determine how treatment practices and source water characteristics influence bromate formation.

6.3.4 Finished Water

(Monthly - IONC (Bromate only) and EPABrO3)
(Quarterly - ALD, AOC* or BDOC*)
*Optional

Treatment plants using ozone shall also collect two (2) samples of finished water (plant effluent) for bromate analysis monthly. It is the responsibility of the water system to have one sample analyzed for bromate (using EPA Method 300.0) by an ICR approved lab. The PWS shall collect the other bromate sample in the bottles provided by EPA and ship them to EPA for the low-level bromate analysis.

Quarterly samples for aldehydes shall be collected from the finished water sampling point (plant effluent). Optional samples for AOC or BDOC analyses may also be collected quarterly at this sampling point. Analysis of the aldehyde samples will be done by EPA.

Table 6-3. Additional Monthly Monitoring Required of Treatment Plants Using Ozone

Sampling Point	Br	IONC (Bromate only)	EPABrO3[1]	NH3	O3
Ozone contactor influent	✔		✔	✔	
Each ozone contact chamber effluent[2]					✔
Ozone contactor effluent		✔	✔		
Finished water sample point (plant effluent)		✔	✔		

1. EPA is to analyze water samples for low-level Bromate. See section 6.5 of this manual.
2. Each ozone contactor can be subdivided into its contact chambers. Measure ozone residual in effluent of all contact chambers until <0.05 mg/L is measured in two consecutive chambers. If the residual is >0.05 mg/L exiting the last chamber, then it is recommended (not required) that the O3 residual be measured after the downstream processes until it is <0.05 mg/L after 2 consecutive processes.

Table 6-4. Additional Quarterly Monitoring for Treatment Plants Using Ozone

Sampling Point	ALD[1]	AOC* or BDOC* (optional)
Ozone contactor influent	✔	✔
Ozone contactor effluent	✔	✔
Finished water sample point (plant effluent)	✔	✔

1. EPA is to analyze water samples for the following aldehydes: formaldehyde, acetaldehyde, propanol, butanol, pentanol, glyoxal, and methyl glyoxal, and potentially, for other aldehydes. See section 6.5 of this manual.

* Analysis and submission of data for both assimilable organic carbon (AOC) and biodegradable organic carbon (BDOC) are optional. Analytical methods for AOC and BDOC are listed in "DBP/ICR Analytical Methods Manual," EPA 814-B-94-002.

6.4 Treatment Plants Using Chlorine Dioxide

Treatment plants using chlorine dioxide are required by the ICR [§141.142(a)(5)] to collect additional samples at several locations in the treatment plant as well as in the

distribution system. Refer to Tables 6-5 and Table 6-6 of this manual for locations and analytes.

6.4.1 Treatment Plant Influent for Purchased Finished Water

(Monthly - CLO2, IONC (chlorite & chlorate only))

There are very little data currently available on the concentrations of chlorite and chlorate in drinking water as a result of chlorine dioxide use. Treatment plants that purchase finished water from a wholesale water provider that uses chlorine dioxide shall monitor their treatment plant influent monthly for chlorine dioxide residual, chlorite, and chlorate.

6.4.2 Before First Chlorine Dioxide Application

(Monthly - IONC (chlorate only) and EPABrO3)
(Quarterly - ALD, AOC* or BDOC*)
*Optional

Low levels of chlorate have been reported in source water. Therefore, treatment plants will be required to monitor for chlorate in a sample of water collected at a point prior to the addition of chlorine dioxide in order to provide data on the relative amounts of chlorate from source water versus the amount produced as the result of chlorine dioxide use.

There are limited data indicating that bromate may be formed as a result of sunlight catalyzed reactions between chlorine dioxide and bromide ion. In order to confirm or disprove this, EPA must also understand whether bromate is present in the water prior to the application of chlorine dioxide. Therefore, EPA is requiring treatment plants that use chlorine dioxide to collect a sample from a location before the first chlorine dioxide application and have it analysed for low-level bromate. PWSs are not required to analyze a bromate sample collected at this location. They will only have to collect a bromate sample, in a bottle provided by EPA, and submit it to EPA for low level bromate analysis.

Chlorine dioxide oxidizes organic material in the water, so oxidation byproducts such as aldehydes are expected to be formed. The nutrient levels available to support microbial growth (as indicated by AOC and BDOC) may also increase as a result of these oxidation reations. In order to understand the changes in water quality as a result of chlorine dioxide use, it is critical to know the water quality prior to its use. Therefore, the PWS shall also monitor quarterly for aldehydes at the sampling point before chlorine dioxide is applied to determine background concentrations. Optional samples for assimilable organic carbon (AOC) or biodegradable organic

carbon (BDOC) analyses may also be collected at this sampling point. Analysis of the aldehyde samples will be done by EPA.

6.4.3 Before First Point of Downstream Chlorine/Chloramine Application: after chlorine dioxide addition

(Quarterly - ALD, AOC* or BDOC*)
*Optional

Chlorine can also oxidize organic material in the water to form oxidation byproducts such as aldehydes. In order to determine the levels of aldehydes produced from chlorine dioxide versus chlorine, it is important to determine aldehyde concentrations in the water **before** chlorine or chloramines are applied. Therefore, plants that use chlorine dioxide shall also monitor for aldehydes **before** the first point of downstream chlorine/chloramine application **after** chlorine dioxide addition. Assimilable organic carbon (AOC) and biodegradable organic carbon (BDOC) analyses are **optional** at this sampling point (but the data will be accepted if the analyses are performed).

6.4.4 Before Application of Ferrous Salts, Sulfur Reducing Agents, or GAC

(Monthly - CLO2, IONC (chlorite & chlorate only) and pH)

The application of ferrous salts or sulfur reducing agents changes the concentrations of chlorine dioxide byproducts. Therefore, treatment plants are also required to monitor monthly for chlorite and chlorate prior to and following these treatment processes. Monitoring will also be required before and after granular activated carbon (GAC) filtration to provide a better understanding of the formation and control of these by-products. The affected water treatment plants are also required to monitor the chlorine dioxide residual concentrations, and pH at this sampling point(s).

6.4.5 Finished Water

(Monthly - CLO2, IONC, and EPABrO3)
(Quarterly - ALD, AOC* or BDOC*)
*Optional

Treatment plants shall monitor their finished water (plant effluent) by collecting samples and having them analyzed monthly for chlorine dioxide residual, chlorite, chlorate, and bromate. Affected PWSs are also required to submit a sample

collected from the "finished water sample point" to EPA for low-level bromate analysis. The PWS will collect this finished water bromate sample in bottles provided by EPA.

The PWS shall also monitor quarterly for aldehydes at this point. Assimilable organic carbon (AOC) or biodegradable organic carbon (BDOC) analyses are **optional** at this sampling point (but the data will be accepted if the analyses are performed). Analysis of the aldehyde samples will be done by EPA.

The concentrations in the finished water sample will be compared with those measured at earlier points in the treatment process in order to understand how the byproducts from chlorine dioxide are formed and affected by the various treatment processes.

6.4.6 Distribution System

(Monthly - CLO2, IONC (chlorite & chlorate only), pH, Temp.)

The concentrations of chlorite and chlorate are expected to change as the water is distributed through the system, so distribution system samples are needed to assess the magnitude of the changes. In addition, there is evidence that chlorine dioxide may be generated within the distribution system as a result of reaction between chlorite and chlorine. Therefore, treatment plants using chlorine dioxide shall monitor for chlorine dioxide residual, chlorite, chlorate, pH, and temperature at three locations in the distribution system:

- near first customer
- middle of distribution system
- max residence time

These sampling points were chosen in order to be consistent with the proposed chlorite monitoring requirements in the Stage 1 D/DBP rule, which is on a monthly basis.

Table 6-5. Additional Monthly Monitoring for Treatment Plants Using Chlorine Dioxide

Sampling Point	CLO2	IONC	pH	EPABrO3	Temp.
Treatment plant influent for purchased finished water (only if wholesaler uses chlorine dioxide)	✔	✔ Chlorite and Chlorate only			
Before first chlorine dioxide application		✔ Chlorate Only		✔	
Before application of ferrous salts, sulfur reducing agents, or GAC	✔	✔ Chlorite and Chlorate Only	✔		
Finished water sample point (plant effluent)	✔	✔		✔	
Three (3) distribution system sampling points[2]	✔	✔ Chlorite and Chlorate Only	✔		✔

1. EPA is to analyze water samples for Bromate. See section 6.5 of this manual.
2. One near first customer, one in middle of distribution system, and one representative of maximum residence time in the distribution system.

Table 6-6. Additional Quarterly Monitoring for Treatment Plants Using Chlorine Dioxide

Sampling Point	ALD[1]	AOC* or BDOC* (optional)
Before first chlorine dioxide application	✔	✔
Before first point of downstream chlorine/chloramine application after chlorine dioxide addition	✔	✔
Finished water sample point (plant effluent)	✔	✔

1. EPA is to analyze water samples for the following aldehydes: formaldehyde, acetaldehyde, propanol, butanol, pentanol, glyoxal, and methyl glyoxal, and potentially, for other aldehydes. See section 6.5 of this manual.

* Analysis and submission of data for both assimilable organic carbon (AOC) and biodegradable organic carbon (BDOC) are optional. Analytical methods for AOC and BDOC are listed in "DBP/ICR Analytical Methods Manual," EPA 814-B-94-002.

6.5 Arranging for Special EPA ICR Analyses: Cyanogen Chloride, Aldehydes, and Low-Level Bromate

Each PWS that uses chloramines as a disinfectant must collect samples for cyanogen chloride analysis. In addition, a PWS which uses ozone, as well as a PWS which uses chlorine dioxide, must collect samples for aldehydes and low-level bromate analyses as required by the ICR [§141.142(a)]. **The EPA laboratory in Cincinnati, OH is the only ICR laboratory approved for cyanogen chloride, aldehydes and low-level bromate analyses.** Therefore, each affected PWS must coordinate with the EPA laboratory in Cincinnati, OH to monitor for these compounds.

6.5.1 Scheduling Sample Analyses

Cyanogen chloride and aldehyde samples have very short holding times as indicated in Table 4-3 of this manual. Therefore, the EPA laboratory will begin sample analysis on the day of receipt of the samples, which allows for no errors in scheduling. This being the case, sample collection and delivery must be closely coordinated with the USEPA laboratory capacity. Coordination with the EPA laboratory will involve the following activities:

- **Reserving Calendar Dates**: Each PWS must reserve a week of the month, (from any of the first four weeks in a month) and one or more days of the week

(Monday through Thursday), for collection of their samples. This reservation will be maintained for the 18 month ICR monitoring period. Reservations will be secured on a first-come, first-served basis. Therefore, as the calendar fills up, a PWS may not receive its first choice for a sampling date, and should provide at least two other choices of dates to reserve.

Sampling date reservation requests shall be submitted to EPA by each PWS within 5 weeks (35 calendar days) following receipt of an **applicability letter** which communicates EPA's final decision on how each treatment plant within a PWS is affected by the ICR. A reservation request form will be enclosed with the applicability letter for use by the PWS. The reservation request form should be submitted by the PWS via letter or facsimile to the EPA at the following address:

ICR Sample Coordinator
U.S. EPA/Technical Support Division
26 West Martin Luther King Dr.
Cincinnati, OH 45268
ATTN: Room 188
Facsimile No: (513)569-7191

The contents of the sampling date reservation request must include:

- The PWS name, address and public water system identification number (PWSID)
- The name, **street address**, phone and facsimile numbers, and E-mail address (if available) of the person(s) responsible for receiving each sample kit.
- The treatment plant name(s), **street address(es)**, ICR Plant ID number(s), and types of disinfectants currently being used at each affected treatment plant. In addition, any plans to change the disinfectants currently utilized at an affected treatment plant, such as for seasonal changes in raw water quality or other reasons, must be identified by the PWS.
- First, second, and third choices for a sampling date reservation.

NOTE: Subsequent to receipt of a PWS reservation request, the **EPA will develop a schedule and contact each PWS** to confirm its sampling date reservation.

- **Start of Sampling:** Each PWS shall begin ICR monitoring at their plant(s) following receipt of their Initial Sampling Plan review letter from EPA. Therefore, the EPA ICR Sample Coordinator will contact the PWS to confirm

receipt of the EPA review letter and establish the month in which the PWS will begin sampling. Unscheduled samples will **not** be accepted by the EPA laboratory.

- **Routine Sampling:** Once the initial sampling date has been established, the PWS should maintain contact with the EPA ICR Sample Coordinator for routine communication such as acknowledging receipt of sample kits (with appropriate contents) and confirming upcoming monthly and/or quarterly sampling dates. Should a PWS miss a scheduled sampling day, the EPA ICR Sample Coordinator will work with them to reschedule. However, each PWS should notify the EPA ICR Sample Coordinator of any sample delivery problem no later than the morning after a scheduled sampling day. In addition, each PWS must notify the EPA ICR Sample Coordinator five (5) weeks (35 calendar days) in advance of any change in the type(s) of disinfectant(s) being applied at any affected treatment plant. For example, EPA must be notified of a change from the application of chloramines at a treatment plant to the application of chlorine. A change in the supplier or product line for the same type of disinfectant does not require notification by the PWS.

6.5.2 Shipping/Sample Kits

The EPA will ship an appropriate sample kit(s) to each PWS one week prior to a scheduled collection date. The sampling kit will contain:

- Two (2) sample bottles for each analyte with preservatives for each sampling location
- Gel ice packs (to be frozen upon receipt)
- Shipping and sampling instructions
- An information card and return address labels.

Sampling personnel will be instructed to fill two sample bottles for each sampling location as a precaution. The second bottle will act as a back up should the first bottle be lost due to breakage or other problem. Sampling personnel will also be instructed to open each sampling kit upon receipt and to place the enclosed gel packs in a freezer. The frozen gel packs should subsequently be used for shipping samples to the EPA. Problems encountered with the sampling kits, such as receipt of an incorrect sampling kit, missing components, or failure to receive an expected kit, should be brought to the attention of the EPA ICR Sample Coordinator immediately to correct the problem.

Return of the sampling kits after samples are collected will require the repacking of sample bottles with the frozen gel packs from the kit. The kit should then be sealed with the return address label attached to the outside. Finally, the kit

should be sent via overnight carrier (priority - before noon delivery) to the ICR Sample Coordinator at the address listed in Section 6.5.1 above.

Cyanogen chloride, adehydes and low-level bromate analyses will be provided by EPA at no cost to the PWS. However, the PWS is responsible for the shipping costs associated with sending the filled sample bottles to EPA.

6.5.3 Analytical Data from the EPA Laboratory

The EPA laboratory will report the results of their analyses to the PWS in hard copy reports. In addition to the concentrations of the various analytes, the EPA laboratory will report:

- The analytical method that was used to analyze each sample.
- The percent recovery of surrogate and internal standards that were added to certain samples prior to analysis.
- Any samples (or analytes within samples) that failed to meet the QC criteria and the reason for failure.

The PWS must enter the above information into the Water Utility Database System, because monitoring data will be deleted from the ICR Federal Database if the specified QC information is not available. Monitoring data will not be provided to the PWS for samples or analytes within samples that the EPA laboratory determines as failing QC criteria. (The QC information from the laboratory should be entered instead).

The EPA laboratory will submit QC reports for entry into the ICR Federal Database on a monthly basis. Copies of the applicable portion of the QC reports that are associated with its samples will also be provided to the PWS to keep with its records.

7.0 Particle Counting

For each treament plant required to conduct microbiological monitoring under the provisions of the ICR [§141.141(b)], a PWS may choose to comply with the alternative monitoring requirements described in the ICR [§141.143(a)(2)(iii)(A) and (B)] and in section 7.1 of this manual. This decision should then be communicated to EPA in the PWS response to EPA's notification of applicability. A PWS which selects this approach for a treatment plant **does not have to submit finished water monitoring data for *Giardia* and *Cryptosporidium*** for that plant as required in the ICR [§141.143(a)(2)(ii)]. Instead, to comply with the alternative monitoring requirements, the PWS must provide *Giardia* and *Cryptosporidium* data, along with particle count data, for **three (3) monitoring locations** in the treatment train. Furthermore, the PWS shall still comply with the microbiological monitoring requirements for all other microorganisms except for *Giardia* and *Cryptosporidium*, as described in the ICR [§141.143(a)(2)(ii)].

7.1 Alternative Monitoring Requirements

The alternative monitoring approach entails simultaneous monitoring of *Giardia* and *Cryptosporidium* and collection of particle count samples under specific conditions and locations in the treatment train. The simultaneous monitoring/sampling must occur in three (3) required locations, and be designated by the PWS in the Initial Sampling Plan. Sampling locations designated in the Initial Sampling Plan may be placed in a single treatment train but must be representative of the treatment plant. The three (3) required locations are as follows:

- Treatment Plant Influent - Sampling location must reflect source water conditions prior to any chemical additions or influences due to washwater return.

- Prior to Filtration - A single site representative of "on top of the filters" or in the sedimentation basin effluent weirs.

- Immediately After Filtration - A single site prior to the addition of post-filtration chemicals (e.g., pH adjustment, corrosion inhibitors, or disinfectants).

Giardia and *Cryptosporidium* samples must be collected one day per month for four months during the 18-month monitoring period. These four months, however, must be consecutive and occur during the first 12 months of the 18-month monitoring period. *Giardia* and *Cryptosporidium* sampling and reporting must be conducted at the three (3) required locations as specified in the ICR [§141.143(a)(2)(iii) and §141.143(c)(2)(i)] and in this manual.

Particle count samples must be collected one (1) day per month for each month of the 18-month monitoring period. Also, the particle count samples must be collected on the same

day and at the same sites where the *Giardia & Cryptosporidium* samples are collected. The PWS choosing to conduct grab sampling is required to collect twelve (12) particle count samples per day per sample site. A day is defined as 24 hours or the length of the filter run (on the day sampled), whichever is shorter. The twelve particle count samples are to be collected at equal increments throughout the sampling period (e.g., every 2 hours for a 24-hour sampling period or every 1.5 hours for an 18-hour sampling period, etc.). Systems with in-line continuous particle counters installed at each of the required sampling locations may record twelve readings obtained at equal increments throughout the sampling day.

Utilities may use any type of particle counter capable of counting and sizing particles in five specific size ranges. These size ranges are as follows:

Range 1: ≥3.00μm-4.99μm
Range 2: ≥5.00μm-6.99μm
Range 3: ≥7.00μm-9.99μm
Range 4: ≥10.00μm-14.99μm
Range 5: ≥15.00μm

The utility must report the mean value of the twelve samples for each of the specified size ranges. Particle counts are to be reported in units of counts per milliliter (#Counts/mL) for each size range. It is not necessary to report each of the twelve particle counts used to determine the mean value for each size range.

All particle count data should be reported as specified in the ICR Water Utility Database System.

7.2 Discrete Sample Container Selection and Preparation

Discrete samples are susceptible to particle contamination from sloughing of the interior container surfaces. Recent studies conclude that supercleaned glass containers result in less particle contamination than plastic or polytetrafluoroethylene (PTFE)[AWWA, 1992]. All samples should be collected in "supercleaned" borosilicate glass containers as described below. Selected glass containers should be of adequate size to ensure multiple replicates of each sample.

Properly cleaned glassware should contribute less than 5 particles per milliliter in the lowest size range of interest (≥3.00μm-4.99μm). Any sample container cleaning technique which meets this criterion is acceptable. A proven "supercleaning" technique is described below [Goldgrabe, 1992 and Ollier, 1995].

- **Glassware "Supercleaning" Technique**

Step 1. - Soak glassware for 30 minutes in a cleaning solution of distilled water and 2% Conrad (ultrasonic soap) solution.
Step 2. - Sonicate glassware containing cleaning solution for 5 minutes.
Step 3. - Rinse glassware with distilled water to remove visible traces of cleaning solution.
Step 4. - Sonicate glassware with distilled water for 2 minutes.
Step 5. - Rinse glassware twice with particle-free water and invert to dry. Particle-free water is reagent grade water which contributes less than one percent of the number of particles anticipated for the size range of interest.
Step 6. - Cap bottles loosely for storage.

Selection of capping material is also important in minimizing contamination of the sample. Research [AWWA, 1992] has shown that most contributions of particles from various types of caps typically occur in the < 1.00 μm size range. Users should select a procedure that assures whatever caps they choose do not contribute particles in the specific size range of interest.

7.3 Sampling

Collection of discrete particle count samples is straightforward. Samples of desired volume are collected in supercleaned borosilicate glass containers and capped. Users should follow manufacturer's recommended procedures for sampling and collection of appropriate volumes for sample replicates. Prior to sample collection any particle contamination attributed to the sample taps, lines, or the surrounding environment needs to be minimized.

Sample lines and taps should be constructed of materials that minimize contribution of particles to the sample stream. Replace sample lines which are encrusted, contain obvious biological growth, or have become discolored. All sample tap materials and components should be cleaned and lines thorqughly flushed prior to sampling. Care must also be taken to collect samples in a dust-free environment.

Placement of sample taps and length of sample lines is also critical in assuring minimal interferences to particle count samples. Sample taps should not be placed near points of agitation which may cause particle shear and alter the particle size distributions of the sample source. Pumping of samples through sample lines has also demonstrated particle shear and should be minimized. Long running horizontal sample lines offer opportunities for particle settling regardless of flow rate and should be avoided.

Placement of sensors for continuous particle counters is also critical. Users should install or place sensors in locations free from sources of electrical and mechanical interference.

7.4 Sample Storage/Holding Conditions

Studies have shown that particle counts and subsequent particle size distributions can change significantly when analysis is not performed immediately upon sample collection [Ollier, 1995]. Numerous techniques involving variations of storage and analysis, temperature and mixing conditions have shown limited success in re-establishing original particle count characteristics. Ideally, samples should be analyzed immediately with no holding or storage. For certain situations, immediate sample analysis may not be practical (e.g., a utility having access to a single particle counter but responsible for particle count analyses for several plants, etc.). Studies have shown that filter effluent samples can be held longer (<8 hours) than filter influent samples (<4 hours) while maintaining particle counts or particle size distributions within +/- 5 percent of the original condition [Ollier, 1995]. However, these studies were very limited and demonstrated the need for in-situ determination of storage capabilities.

Utilities choosing to hold, store, or ship samples prior to analysis need to demonstrate that particle counts and particle size distributions do not deviate more than 10 percent from the results obtained if immediate analysis had been performed. This +/- 10 percent value should be the deviation of the mean values (in the particle size ranges of interest) of replicate samples (2 runs of 3 replicates per run) analyzed immediately (or as quickly as conditions allow) after sample collection. This demonstration will require conducting immediate on-site particle counting of samples. The evaluation should include samples held under desired conditions for various lengths of time and determinations of maximum holding time under these conditions such that deviations less than +/- 10 percent from original conditions are maintained. Ideally, the same particle counter should be used for the entire storage/holding study.

Techniques for sample storage have included cold storage of samples at 4°C with acclimation of samples to ambient temperatures prior to analysis. Mixing of the sample prior to analysis is also important. Sonication has been shown to be extremely destructive to sample particle size distributions and should be avoided. Gentle swirling of the sample prior to analysis produced the best results for maintaining original particle size distributions.

7.5 Sample Preparation and Analysis

All particle counter manufacturers provide guidance on acceptable procedures for obtaining particle counts from samples. Care needs to be taken to ensure that contamination

of the sample is minimized. Also, each particle count sensor has been calibrated at a specific flow rate and must be operated within the allowable flow rates or results will not be accurate. Particle counter manufacturers are very specific on the particle concentration limits of each sensor. Do not exceed this allowable concentration. Users should conduct an over-concentration check if they suspect samples will exceed allowable concentrations. Specifications on conducting an over-concentration check may be obtained from particle counter manufacturers or referenced material [AWWA, 1992].

Samples should be gently inverted prior to sampling to assure even distribution of particles throughout the sample volume. Be careful not to over mix, agitate, or contaminate the sample with the stir bar or other mixing apparatus.

7.6 Quality Assurance/Quality Control

Several parameters impact the use of laser particle counting to achieve an accurate and precise depiction of numbers and sizes of particles contained in a water sample. Instrument calibration, standard sampling procedures, proper glassware preparation and minimization of contamination of the samples are key to assuring good quality data. Particle counting is typically very unforgiving. No corrections can be made in counts to account for use of a sensor out of calibration or for analysis of a sample that exceeds allowable concentration limits. Users need to adhere to manufacturer's recommended sampling procedures and to periodically verify instrument calibration and the use of contaminant-free sample containers and caps.

Particle counters are calibrated by manufacturer's technicians either in the field or at a central calibration laboratory. Daily calibration by utilities is usually not possible. Utilities, however, should periodically verify the instrument calibration using monodisperse polystyrene beads or spheres of certified size. Prepare a suspension of monodisperse spheres and analyze using normal procedures. Repeat the process several times using different size monodisperse spheres. Be careful not to exceed the concentration limits of the sensor for the prepared suspensions. Should results deviate in excess of 10 percent in all size ranges from the calibration curve provided by the manufacturer, arrange for calibration of the sensor. Most particle count manufacturers recommend annual calibration of sensors. Sensors must always be calibrated following any mechanical changes or repairs.

Blank samples should be run for each sample set to assure that particle-free water, glassware and caps are contributing less than 5 particles per milliliter in the particle size ranges of interest [AWWA, 1992 and *Standard Methods*, 19th Ed.]. Fill each sample container with particle-free water and analyze according to normal procedures. Should counts exceed 5 particles per milliliter in the lowest size range of interest repeat the cleaning process or select another cleaning procedure.

Particle count sensors have been calibrated using precise flow rates for sample input. Flow rates of samplers should be measured and adjusted several times during analysis of a set of samples. No deviation from the acceptable flow rate is permissible.

7.7 Particle Counting References

American Water Works Research Foundation, 1992. *Evaluation of Particle Counting as a Measure of Treatment Plant Performance.*

Goldgrabe, J.C., 1992. *Particle Counting as a Method of Evaluating Conventional and Biological Filter Performance* - Master of Engineering Thesis, University of Cincinnati - Department of Civil and Environmental Engineering.

Ollier, L.L., Bissonette, E.M., Summers, R.S. 1995. Interim Report - *Evaluation of Parameters Affecting Discrete Particle Counting* - US EPA/OGWDW Technical Support Division and University of Cincinnati College of Civil and Environmental Engineering.

Standard Methods for the Evaluation of Water and Wastewaster, 19th Edition, 1995. Method 2560 - Particle Counting and Size Distribution (Proposed).

APPENDIX A

Information Collection Rule (ICR) Water Utility Database System Reports: A-Series

A.1 -- Initial Sampling Plan by Location

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: Design
Design Sampling Start Date: 1/6/97
Design Sampling End Date: 6/30/98

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Treatment Plant Name: East WTP						
ICR Treatment Plant ID: 101						
Treatment Plant Type: CONV						
	Influent	INF	1	101009701BACT	Bacteria Lab	BACTERIA
				101009701Br	Inhouse Lab	WQP
				101009701CLD	Inhouse Lab	WQP
				101009701NH3	Inhouse Lab	WQP
				101009701PROT	Protozoa Lab	PROTOZOA
				101009701TOC	Inhouse Lab	WQP
				101009701TOX	DBP Lab	DBP
				101009701UV-254	Inhouse Lab	WQP
				101009701VIRU	Virus Lab	VIRUS
				101009701WQP	Inhouse Lab	WQP
Process Train Name: Convention train						
Process Train Type: CONV						
1	Chlorine gas 1	Disinfectant Addition				

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
2	WW Return	Washwater Return	2	101009702Br	Inhouse Lab	WQP
				101009702CL2	Inhouse Lab	WQP
				101009702NH3	Inhouse Lab	WQP
				101009702TOC	Inhouse Lab	WQP
				101009702TOX	Inhouse Lab	WQP
				101009702UV-254	Inhouse Lab	WQP
				101009702WQP	Inhouse Lab	WQP
3	WW Sample	Washwater Return Sample Point	15	101009715CL2	Inhouse Lab	WQP
4	Intake Basin	Other Treatment Process	3	101009703CL2	Inhouse Lab	WQP
				101009703TOC	Inhouse Lab	WQP
				101009703UV-254	Inhouse Lab	WQP
				101009703WQP	Inhouse Lab	WQP
5	Chlorine gas 2	Disinfectant Addition				
6	Rapid Mix	Rapid Mix	4	101009704CL2	Inhouse Lab	WQP
7	Test	Washwater Return				
8		Washwater Return Sample Point				
9	Flocculation	Flocculation Basin	5	101009705CL2	Inhouse Lab	WQP
10	Sedimentation	Sedimentation	6	101009706CL2	Inhouse Lab	WQP
				101009706TOC	Inhouse Lab	WQP
				101009706UV-254	Inhouse Lab	WQP
				101009706WQP	Inhouse Lab	WQP
11	Filtration	Filtration	7	101009707CH	DBP Lab	DBP
				101009707CL2	Inhouse Lab	WQP
				101009707HAA	DBP Lab	DBP
				101009707THM/HAN	DBP Lab	DBP
				101009707TOC	Inhouse Lab	WQP
				101009707TOX	DBP Lab	DBP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
				101009707UV-254	Inhouse Lab	WQP
				101009707WQP	Inhouse Lab	WQP
12	Chlorine gas 3	Disinfectant Addition				
13	Clearwell	Clearwell	8	101009708CL2	Inhouse Lab	WQP
				101009708TOC	Inhouse Lab	WQP
				101009708UV-254	Inhouse Lab	WQP
				101009708WQP	Inhouse Lab	WQP
14	Chlorine gas 4	Disinfectant Addition				
	Finished Water	FIN	9	101009709CH	DBP Lab	DBP
				101009709CL2	Inhouse Lab	WQP
				101009709HAA	DBP Lab	DBP
				101009709THM/HAN	DBP Lab	DBP
				101009709TOC	Inhouse Lab	WQP
				101009709TOX	DBP Lab	DBP
				101009709UV-254	Inhouse Lab	WQP
				101009709WQP	Inhouse Lab	WQP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Distribution System Samples for Non-Blending Plants						
Treatment Plant Name: East WTP						
ICR Treatment Plant ID: 101						
	SDS	SDS	10			
				101009710CH	DBP Lab	DBP
				101009710CL2		
				101009710HAA	DBP Lab	DBP
				101009710THM/HAN	DBP Lab	DBP
				101009710TOX	DBP Lab	DBP
				101009710WQP	Inhouse Lab	WQP
	DSE Sample	DSE	11			
				101009711CH	DBP Lab	DBP
				101009711CL2	Inhouse Lab	WQP
				101009711HAA	DBP Lab	DBP
				101009711THM/HAN	DBP Lab	DBP
				101009711TOX	DBP Lab	DBP
				101009711WQP	Inhouse Lab	WQP
	Average 1	AVG	12			
				101009712CH	DBP Lab	DBP
				101009712CL2	Inhouse Lab	WQP
				101009712HAA	DBP Lab	DBP
				101009712THM/HAN	DBP Lab	DBP
				101009712TOX	DBP Lab	DBP
				101009712WQP	Inhouse Lab	WQP
	Average 2	AVG	13			
				101009713CH	DBP Lab	DBP
				101009713CL2	Inhouse Lab	WQP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
				101009713HAA	DBP Lab	DBP
				101009713THM/HAN	DBP Lab	DBP
				101009713TOX	DBP Lab	DBP
				101009713WQP	Inhouse Lab	WQP
	Max Sample	MAX	14			
				101009714CH	DBP Lab	DBP
				101009714CL2	Inhouse Lab	WQP
				101009714HAA	DBP Lab	DBP
				101009714THM/HAN	DBP Lab	DBP
				101009714TOX	DBP Lab	DBP
				101009714WQP	Inhouse Lab	WQP

A.2 -- Design Plant Parameters

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: Design
Design Sampling Start Date: 1/6/97
Design Sampling End Date: 6/30/98

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101
Treatment Plant PWS ID:
Treatment Plant Category: CONV

State Approved Plant Capacity (MGD): 100.0
Historical Min. Water Temperature (deg C): 2.0
Instalee Sludge Handling Capacity (WTD): 100.00
Blending Indicator: N

Water Resource Name: Lake
Water Resource Type: Reservoir/lake
Average Residence Time (Days): 100
Intake Name: Crib
Watershed Control: N

Hydrologic Unit Code:
River Reach:
Latitude (degrees, minutes, seconds): +42°1'0"
Longitude (degrees, minutes, seconds): -88°0'0"
River Reach Miles:

Water Resource Name: Lake
Water Resource Type: Reservoir/lake
Average Residence Time (Days): 100
Intake Name: Shore
Watershed Control: N

Hydrologic Unit Code:
River Reach:
Latitude (degrees, minutes, seconds): +42°59'59"
Longitude (degrees, minutes, seconds): -88°59'59"
River Reach Miles:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
	Influent	INF	1	
Process Train Name: Convention Train				
Process Train Type: CONV				
1	Chlorine gas 1	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 2.00
2	WW Return	Washwater Return	2	Washwater Treated: Y Coagulation/Sedimentation: N Filtration: N Disinfectant Addition: Y Plain Sedimentation: N Other Treatment: 24 hr average Water flow Returned (MGD): 10.0
3	WW Sample	Washwater Return Sample Point	15	
4	Intake Basin	Other Treatment Process	3	Surface Area (ft2): 100,000 Liquid Volume (gal): 100,000 Short Circuiting Factor:
5	Chlorine gas 2	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 1.00

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
6	Rapid Mix	Rapid Mix	4	Type of Mixer: ME Baffling Type: UN Liquid Volume (gal): 100,000 Short Circuiting Factor: Mean Velocity Gradient (sec-1): 100.0
7	Test	Washwater Return		Washwater Treated: N Coagulation/ Sedimentation: N Filtration: N Disinfectant Addition: N Plain Sedimentation: N Other Treatment: 24 hr average Water flow Returned (MGD): 2.0
8	Test	Washwater Return Sample Point		
9	Flocculation	Flocculation Basin	5	Type of Mixer: ME Liquid Volume (gal): 1,000,000 Short Circuiting Factor: 0.5 Baffling Type: PR Stage Sequence Number: 1 Stage Mean Velocity Gradient (sec-1): 20.0 Stage Liquid Volume (gal): 500,000

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Stage Sequence Number: 2 Stage Mean Velocity Gradient (sec-1): 20.0 Stage Liquid Volume (gal): 500,000
10	Sedimentation	Sedimentation	6	Surface Area (ft2): 100,000 Liquid Volume (gal): 1,000,000 Baffling Type: AV Short Circuiting Factor: Plate Settler Surface Area (ft2): Plate Settler Brand Name: Tube Settler Surface Area (ft2): Tube Settler Brand Name:
11	Filtration	Filtration	7	Surface Area (ft2): 100,000 Liquid Volume (gal): 1,000,000 Total Media Depth (in): 24 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (in): 8.0 Depth From Top of Media to Top Backwash Trough (in): 6.0
12	Chlorine gas 3	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 1.00

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
13	Clearwell	Clearwell	8	Surface Area (ft2): 100,000 Liquid Volume (gal): 1,000,000 Minimum Liquid Volume (gal): 100,000 Baffling Type: AV Short Circuiting Factor: Covered Indicator Code: Y
14	Chlorine gas 4	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 2.00
	Finished Water	FIN	9	

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End of Report A2, Total Pages: 5

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A.3 -- Design Plant Chemical Parameters

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: Design
Design Sampling Start Date: 1/6/97
Design Sampling End Date: 6/30/98

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101
Treatment Plant Type: CONV

Process Train Name: Convention Train
Process Train Type: CONV

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (Mg/L)
1	Chlorine gas 1	Disinfectant Addition		Chlorine gas	C12	2
2	WW Return	Washwater Return	2			
3	WW Sample	Washwater Return Sample Point	15			
4	Intake Basin	Other Treatment Process	3	Organic polymer - Coagulant aid	mg/L	1
				Powdered activated carbon	C	2
5	Chlorine gas 2	Disinfectant Addition		Chlorine gas	C12	1
6	Rapid Mix	Rapid Mix	4	Hydroflorosilic acid	F	0.5
				Aluminum sulfact (Alum)	A1	2
				Powdered activated carbon	C	2
7	Test	Washwater Return				

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (Mg/L)
8		Washwater Return Sample Point				
9	Flocculation	Flocculation Basin	5	Calcium hydroxide	CaOH	20
10	Sedimentation	Sedimentation	6			
11	Filtration	Filtration	7	Organic polymer - filter aid	mg/L	1
12	Chlorine gas 3	Disinfectant Addition		Chlorine gas	C12	1
13	Clearwell	Clearwell	8	Sodium hexametaphosphate	PO4	2
14	Chlorine gas 4	Disinfectant Addition		Chlorine gas	C12	2

A.4 -- Design Distribution System Information

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: Design
Design Sampling Start Date: 1/6/97
Design Sampling End Date: 6/30/98

Distribution System General Information

Typical Maximum Residence Time (days): 30
Average Residence Time (days): 1.00

Storage Volume (MG): 10.0
Open Storage Surface Area (ft2): 0.00

Disinfectant Booster Stations

Type	Count	High Doseage (mg/L)	Low Dosage (mg/L)
CL2	5	5.00	1.00
CLNH			
CLO2			
HYPO			

Sample Location Number	Sample Location Name	Sample Location Type	Confidence Level	Contact Time from Effluent (Hours)
Distribution System Sample Locations for Non-Blending Treatment Plants				
Treatment Plant Name: East WTP				
ICR Treatment Plant ID: 101				
10	SDS	SDS		24
11	DSE Sample	DSE	H	24
12	Average 1	AVG	H	24
13	Average 2	AVG	H	24
14	Max Sample	MAX	H	72
Distribution System Sample Locations for Blending Treatment Plants				

A.5 -- Design Water System Information

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:

Official Contact Person: Mr. Any Body
Job Title: Enviro Engineer
Address: 26 W, Martin Luther King Drive,
City: Cincinnati **State:** OH
Zip Code: 45268-
Mail Stop:
Phone Number: (513) 569-7191
Fax Number:
E-mail Address: Body.Any@epamail.epa.gov

Sampling Period: Design
Design Sampling Start Date: 1/6/97
Design Sampling End Date: 6/30/98

ICR Contact Person: Mr. Any Body
Job Title: Enviro Engineer
Address: 26 W, Martin Luther King Drive,
City: Cincinnati **State:** OH
Zip Code: 45268-
Mail Stop:
Phone Number: (513) 569-7191
Fax Number:
E-mail Address: Body.Any@epamail.epa.gov

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101
Treatment Plant PWS ID:
Treatment Plant Type: CONV
Process Train Name: Convention train

State Approved Plant Capacity (MGD): 100.0
Historical Min. Water Temperature (deg C): 2
Installed Sludge Handling Capacity (WTD): 100.0
Process Train Type: CONV

APPENDIX B

Information Collection Rule (ICR) Water Utility Database System Reports: B.1 -- Monthly Sampling Plan by Location

B.1 -- Monthly Sampling Plan by Location

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: 1
Design Sampling Start Date: 1/20/97
Design Sampling End Date: 1/22/97

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Treatment Plant Name: East WTP						
ICR Treatment Plant ID: 101						
Treatment Plant Type: CONV						
	Influent	INF	1	101019701BACT	Bacteria Lab	BACTERIA
				101019701Br	Inhouse Lab	WQP
				101019701CLD	Inhouse Lab	WQP
				101019701NH3	Inhouse Lab	WQP
				101019701PROT	Protozoa Lab	PROTOZOA
				101019701TOC	Inhouse Lab	WQP
				101019701TOX	DBP Lab	DBP
				101019701UV-254	Inhouse Lab	WQP
				101019701VIRU	Virus Lab	VIRUS
				101019701WQP	Inhouse Lab	WQP
Process Train Name: Convention train						
Process Train Type: CONV						
1	Chlorine gas 1	Disinfectant Addition				

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc.	Sample ID Number	Laboratory Name	Laboratory ICR ID
2	WW Return	Washwater Return	2	101019702Br	Inhouse Lab	WQP
				101019702CL2	Inhouse Lab	WQP
				101019702NH3	Inhouse Lab	WQP
				101019702TOC	Inhouse Lab	WQP
				101019702TOX	Inhouse Lab	WQP
				101019702UV-254	Inhouse Lab	WQP
				101019702WQP	Inhouse Lab	WQP
3	WW Sample	Washwater Return Sample Point	15	101019715CL2	Inhouse Lab	WQP
4	Intake Basin	Other Treatment Process	3	101019703CL2	Inhouse Lab	WQP
				101019703TOC	Inhouse Lab	WQP
				101019703UV-254	Inhouse Lab	WQP
				101019703WQP	Inhouse Lab	WQP
5	Chlorine gas 2	Disinfectant Addition				
6	Rapid Mix	Rapid Mix	4	101019704CL2	Inhouse Lab	WQP
7	Flocculation	Flocculation Basin	5	101019705CL2	Inhouse Lab	WQP
8	Sedimentation	Sedimentation	6	101019706CL2	Inhouse Lab	WQP
				101019706TOC	Inhouse Lab	WQP
				101019706UV-254	Inhouse Lab	WQP
				101019706WQP	Inhouse Lab	WQP
9	Filtration	Filtration	7	101019707CH	DBP Lab	DBP
				101019707CL2	Inhouse Lab	WQP
				101019707HAA	DBP Lab	DBP
				101019707THM/HAN	DBP Lab	DBP
				101019707TOC	Inhouse Lab	WQP
				101019707TOX	DBP Lab	DBP
				101019707UV-254	Inhouse Lab	WQP
				101019707WQP	Inhouse Lab	WQP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc.	Sample ID Number	Laboratory Name	Laboratory ICR ID
10	Chlorine gas 3	Disinfectant Addition				
11	Clearwell	Clearwell	8	101019708CL2	Inhouse Lab	WQP
				101019708TOC	Inhouse Lab	WQP
				101019708UV-254	Inhouse Lab	WQP
				101019708WQP	Inhouse Lab	WQP
12	Chlorine gas 4	Disinfectant Addition				
	Finished Water	FIN	9	101019709CH	DBP Lab	DBP
				101019709CL2	Inhouse Lab	WQP
				101019709HAA	DBP Lab	DBP
				101019709PART	Inhouse Lab	WQP
				101019709THM/HAN	DBP Lab	DBP
				101019709TOC	Inhouse Lab	WQP
				101019709TOX	DBP Lab	DBP
				101019709UV-254	Inhouse Lab	WQP
				101019709WQP	Inhouse Lab	WQP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Distribution System Samples for Non-Blending Plants						
Treatment Plant Name: East WTP						
ICR Treatment Plant ID: 101						
	SDS	SDS	10			
				101019710CH	DBP Lab	DBP
				101019710CL2	Inhouse Lab	WQP
				101019710HAA	DBP Lab	DBP
				101019710THM/HAN	DBP Lab	DBP
				101019710TOX	DBP Lab	DBP
				101019710WQP	Inhouse Lab	WQP
	DSE Sample	DSE	11			
				101019711CH	DBP Lab	DBP
				101019711CL2	Inhouse Lab	WQP
				101019711HAA	DBP Lab	DBP
				101019711THM/HAN	DBP Lab	DBP
				101019711TOX	DBP Lab	DBP
				101019711WQP	Inhouse Lab	WQP
	Average 1	AVG	12			
				101019712CH	DBP Lab	DBP
				101019712CL2	Inhouse Lab	WQP
				101019712HAA	DBP Lab	DBP
				101019712THM/HAN	DBP Lab	DBP
				101019712TOX	DBP Lab	DBP
				101019712WQP	Inhouse Lab	WQP
	Average 2	AVG	13			
				101019713CH	DBP Lab	DBP
				101019713CL2	Inhouse Lab	WQP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc.	Sample ID Number	Laboratory Name	Laboratory ICR ID
				101019713HAA	DBP Lab	DBP
				101019713THM/HAN	DBP Lab	DBP
				101019713TOX	DBP Lab	DBP
				101019713WQP	Inhouse Lab	
	Max Sample	MAX	14			
				101019714CH	DBP Lab	DBP
				101019714CL2	Inhouse Lab	WQP
				101019714HAA	DBP Lab	DBP
				101019714THM/HAN	DBP Lab	DBP
				101019714TOX	DBP Lab	DBP
				101019714WQP	Inhouse Lab	

APPENDIX C

Information Collection Rule (ICR) Water Utility Database System Reports: C-Series

C.1 -- Monthly Sample Data Collection Form

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body

Sampling Period: 1
Sampling Start Date: 1/20/97
Sampling End Date: 1/22/97
Sample Collector Name: _____

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101
Treatment Plant Type: CONV

	Influent	INF	1	101019701BACT	____	____	____	____	
				101019701Br	____	____	____	____	
				101019701CLD	____	____	____	____	
				101019701NH3	____	____	____	____	
				101019701PROT	____	____	____	____	

Collection Start Time: _____
Collection End Time: _____
Volume (L): _____
Temperature (deg C): _____
pH: _____

QA Comment No.					
QA Comment					

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data
									Turbidity: _____
				101019701TOC	____	____	____	____	
				101019701TOX	____	____	____	____	
				101019701UV-254	____	____	____	____	
				101019701VIRU	____	____	____	____	Collection Start Time:_____
									Collection End Time:_____
									Volume (L):_____
									Temperature (deg C):_____
									pH:_____
									Turbidity:_____
				101019701WQP	____	____	____	____	pH:_____
									Temperature (deg C):_____
Process Train Name:	Convention train								
Process Train Type:	CONV								
2	WW Return	WWR	2	101019702Br	____	____	____	____	
				101019702CL2	____	____	____	____	Free C12:_____
									Total C12:_____
				101019702NH3	____	____	____	____	
				101019702TOC	____	____	____	____	
				101019702TOX	____	____	____	____	
				101019702UV-254	____	____	____	____	
				101019702WQP	____	____	____	____	pH:_____

QA Comment No.					
QA Comment					

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data
									Temperature (deg C):_____
3	WW Sample	WSP	15	101019715CL2	____	____	____	____	Free C12:_____ Total C12:_____
4	Intake Basin	OTH	3	101019703CL2	____	____	____	____	Free C12:_____ Total C12:_____
				101019703TOC	____	____	____	____	
				101019703UV-254	____	____	____	____	
				101019703WQP	____	____	____	____	pH:_____ Temperature (deg C):_____
6	Rapid Mix	RAP	4	101019704CL2	____	____	____	____	Free C12:_____ Total C12:_____
7	Flocculation	FLC	5	101019705CL2	____	____	____	____	Free C12:_____ Total C12:_____
8	Sedimentation	SED	6	101019706CL2	____	____	____	____	Free C12:_____ Total C12:_____
				101019706TOC	____	____	____	____	
				101019706UV-254	____	____	____	____	

QA Comment No.					
QA Comment					

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data
				101019706WQP	____	____	____	____	pH:_____ Temperature (deg C):_____
9	Filtration	FIL	7	101019707CH	____	____	____	____	Dechlorinating Agent:_____
				101019707CL2	____	____	____	____	Free C12:_____ Total C12:_____
				101019707HAA	____	____	____	____	
				101019707THM/HAN	____	____	____	____	Dechlorinating Agent:_____
				101019707TOC	____	____	____	____	
				101019707TOX	____	____	____	____	
				101019707UV-254	____	____	____	____	
				101019707WQP	____	____	____	____	pH:_____ Temperature (deg C):_____
11	Clearwell	CLR	8	101019708CL2	____	____	____	____	Free C12:_____ Total C12:_____
				101019708TOC	____	____	____	____	
				101019708UV-254	____	____	____	____	
				101019708WQP	____	____	____	____	pH:_____ Temperature (deg C):_____

QA Comment No.					
QA Comment					

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data
	Finished Water	FIN	9	101019709CH	____	____	____	____	Dechlorinating Agent:_____
				101019709CL2	____	____	____	____	Free C12:_____
									Total C12:_____
				101019709HAA	____	____	____	____	
				101019709PART	____	____	____	____	Time Interval (hours):_____
									Model:_____
									Counter Mfgr:_____
									Type:_____
									Lower Size Range Measure:_____
									Upper Size Range Measure:_____
				101019709THM/HAN	____	____	____	____	Dechlorinating Agent:_____
				101019709TOC	____	____	____	____	
				101019709TOX	____	____	____	____	
				101019709UV-254	____	____	____	____	
				101019709WQP	____	____	____	____	pH:_____
									Temperature (deg C):_____

QA Comment No.					
QA Comment					

Seq. No.	Sample Location Name	Location Type	Sample Loc. No.	Sample ID Number	Sample Coll. Date	Sample Coll. Time	QA Code	QA Com. No.	Collection Data

Distribution System Samples for Non-Blending Treatment Plants

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101

	SDS	SDS	10	101019710CH	____	____	____	____	Dechlorinating Agent:_____
				101019709CL2	____	____	____	____	Free C12:_____
									Total C12:_____
				101019710HAA	____	____	____	____	
				101019710THM/HAN	____	____	____	____	Dechlorinating Agent:_____
				101019710TOX	____	____	____	____	
				101019710WQP	____	____	____	____	pH:_____
									Temperature (deg C):_____
	DSE Sample	DSE	11	101019711CH	____	____	____	____	Dechlorinating Agent:_____
				101019701CL2	____	____	____	____	Free C12:_____
									Total C12:_____
				101019711HAA	____	____	____	____	
				101019711THM/HAN	____	____	____	____	Dechlorinating Agent:_____
				101019711TOX	____	____	____	____	
				101019711WQP	____	____	____	____	pH:_____
									Temperature (deg C):_____

QA Comment No.					
QA Comment					

C.2 -- Monthly Process Data Collection Form

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body
Data Collector Name: _____

Sampling Period: 1
Sampling Start Date: 1/20/97
Sampling End Date: 1/22/97
Sample Collector Name: _____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Operating Data
Treatment Plant Name: East WTP **ICR Treatment Plant ID:** 101 **Treatment Plant Type:** CONV				**Average Daily Hours of Operation During Sampling:**_____ **Sludge Solids Production:**_____ **Units:**_____ **Percent Solids in Sludge:**_____
	Influent	INF	1	Water Flow at Time of Sampling (MGD): _____ Monthly Average Flow (MGD): _____
Process Train Name: Convention train **Process Train Type:** CONV				
1	Chlorine gas 1	Disinfectant Addition		Chemical: _____
2	WW Return	Washwater Return	2	Washwater Treated: _____ Coagulation/Sedimentation: _____ Filtration: _____ Disinfection Addition: _____ Plain Sedimentation: _____ Other Treatment: _____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Operating Data
				Flow of WWR at time of sampling (MGD): _____
				24 hr average flow prior to sampling (MGD): _____
3	WW Sample	Washwater Return Sample Point	15	Flow at Time of Sampling (MGD): _____
4	Intake Basin	Other Treatment Process	3	Surface Area (ft2): _____
				Liquid Volume (gal): _____
				Short Circuiting Factor: _____
				Tracer Study Methodology: _____
				T50 (min): _____
				T10 (min): _____
				Water Flow Into Basin (MGD): _____
5	Chlorine gas 2	Disinfectant Addition		Chemical: _____
6	Rapid Mix	Rapid Mix	4	Liquid Volume (gal): _____
				Tracer Study Methodology: _____
				T50 (min): _____
				T10 (min): _____
				Water Flow Into Rapid Mix (MGD): _____
7	Flocculation	Flocculation Basin	5	Liquid Volume (gal): _____
				Tracer Study Methodology: _____
				T50 (min): _____
				T10 (min): _____
				Water Flow Into Basin (MGD): _____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Operating Data	
				Stage Sequence Number:	1
				Stage Liquid Volume (gal):	_____
				Stage Mean Velocity Gradient (sec-1):	_____
				Stage Sequence Number:	2
				Stage Liquid Volume (gal):	_____
				Stage Mean Velocity Gradient (sec-1):	_____
8	Sedimentation	Sedimentation	6	Surface Area (ft2):	_____
				Liquid Volume (gal):	_____
				Tracer Study Methodology:	_____
				T50 (min):	_____
				T10 (min):	_____
				Plate Settler Surface Area (ft2):	_____
				Tube Settler Surface Area (ft2):	_____
				Water Flow into Basin (MGD):	_____
9	Filtration	Filtration	7	Surface Area (ft2):	_____
				Liquid Volume (gal):	_____
				Tracer Study Methodology:	_____
				T50 (min):	_____
				T10 (min):	_____
				Filter Run Time (hrs):	_____
				Water Flow into Filter (MGD):	_____
10	Chlorine gas 3	Disinfectant Addition		Chemical:	_____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Operating Data	
11	Clearwell	Clearwell	8	Surface Area (ft2):	
				Liquid Volume (gal):	
				Tracer Study Methodology:	
				T50 (min):	
				T10 (min):	
				Water Flow into Clearwell (MGD):	
12	Chlorine gass 4	Disinfectant Addition		Chemical:	
	Finished Water	FIN	9	Water Flow at Time of Sampling (MGD):	
				Monthly Average Flow (MGD):	

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Operating Data

Distribution System Samples for Non-Blending Treatment Plants

Treatment Plant Name: East WTP
ICR Treatment Plant ID: 101
Treatment Plant Type: CONV

SDS	SDS	10	Confidence Level:	_____
			Contact Time from Effluent (hours):	_____
DSE Sample	DSE	11	Confidence Level:	_____
			Contact Time from Effluent (hours):	_____
Average 1	AVG	12	Confidence Level:	_____
			Contact Time from Effluent (hours):	_____
Average 2	AVG	13	Confidence Level:	_____
			Contact Time from Effluent (hours):	_____
Max Sample	MAX	14	Confidence Level:	_____
			Contact Time from Effluent (hours):	_____

C.3 -- Monthly Chemical Data Collection Form

Date: 4/11/96

PWS Name: Anytown, USA
PWS ID: OH1234567
WIDB:
ICR Contact Person: Mr. Any Body
Data Collector Name: _____

Sampling Period: 1
Sampling Start Date: 1/20/97
Sampling End Date: 1/22/97
Chemical Data Collection Date: _____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
Treatment Plant Name: East WTP						
ICR Treatment Plant ID: 101						
Treatment Plant Type: CONV						
Process Train Name: Convention train						
Process Train Type: CONV						
1	Chlorine gas 1	Disinfectant Addition		Chlorine gas	C12	_____
2	WW Return	Washwater Return	2			
3	WW Sample	Washwater Return Sample Point	15			
4	Intake Basin	Other Treatment Process	3	Organic polymer - coagulant aid	mg/L	_____
				Powdered activated carbon	C	_____
5	Chlorine gas 2	Disinfectant Addition		Chlorine gas	C12	_____
6	Rapid Mix	Rapid Mix	4	Hydroflorosilic acid	F	_____
				Aluminum sulfate (Alum)	Al	_____
				Powdered activated carbon	C	_____

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
7	Flocculation	Flocculation Basin	5	Calcium hydroxide	CaOH	_____
8	Sedimentation	Sedimentation	6			
9	Filtration	Filtration	7	Organic polymer - filter aid	mg/L	_____
10	Chlorine gas 3	Disinfectant Addition		Chlorine gas	C12	_____
11	Clearwell	Clearwell	8	Sodium hexametaphosphate	PO4	_____
12	Chlorine gas 4	Disinfectant Addition		Chlorine gas	C12	_____

APPENDIX D

Procedural Requirements for Simulated Distribution System (SDS) and Chlorine Demand (CLD) Samples

Simulated Distribution System (SDS) Test. This test involves storing a sample of disinfected water for a set period of time at a known temperature and pH and then analyzing the sample for certain parameters. The ICR specifies Standard Method 5710 C for the SDS test. This method provides a general description of the test, but users are given many procedural options depending upon the purpose of conducting the test. For the ICR, the DBP concentrations in the SDS sample will be compared to the DBP concentrations measured in a sample from the distribution system. Therefore, the conditions under which the SDS test is conducted for the ICR are specific to each **water treatment plant**.

The SDS test conditions (i.e., storage time and temperature) are selected based on information about the distribution system equivalent (DSE) sample which is collected from the distribution system of each water treatment plant. The DSE sample's detention time (time the water has spent traveling from the water treatment plant to the sampling point in the distribution system) is used as the basis for establishing the SDS storage time. The SDS sample should be stored for a time period comparable in length to the DSE sample's detention time. The storage temperature should be comparable to the temperature of the water in the distribution system between the treatment plant and the DSE sampling point. In order to accomplish this, the SDS sample should be maintained at the temperature measured at either the SDS sampling point or the DSE sampling point. The goal should be to achieve a temperature within $\pm 2°C$ of one of these temperatures.

The contact time of the SDS test begins when the sample is collected. Therefore the storage part of the test is best conducted at the treatment plant where the sample is collected. If this is not possible, then the sample should be transported to a nearby site for the test. The SDS sample must not be iced or treated in any other manner and shipped to off-site laboratories until after the storage part of the test is completed and the sample is divided into aliquots with the appropriate dechlorinating agents for the individual analyses.

There are many techniques available to maintain the SDS sample at a constant temperature during the storage period. Some examples include (but are not limited to):

- using an incubator or constant temperature water bath set at the appropriate temperature
- placing the SDS sample container(s) in an insulated container (e.g., an ice chest) and allowing a constant flow of finished water to pass through the container to maintain the sample at the finished water temperature
- placing the SDS sample container(s) in a bucket in a sink and allowing a constant flow of finished water to pass around the sample to maintain it at the finished water temperature

- suspending the SDS sample container(s) in the treatment plant clearwell to maintain it at the finished water temperature

The goal should be to store the SDS sample for the same length of time as the detention time of the DSE sample. Since the DSE detention time is estimated, the SDS storage time should reasonably approximate (within ±25%) the DSE detention time.

At the conclusion of the storage time, the SDS sample must be analyzed for several parameters. The SDS sample must be divided by pouring it into sample bottles containing the appropriate dechlorinating agents/preservatives. (This may be done at the storage site or at a nearby laboratory, if the sample temperature is maintained during transport and the transport time is factored into the storage time.) Care must be taken to not aerate the sample during this transfer, in order to prevent the loss of volatile compounds such as THMs. (The samples for THM, HAN, TOX, and CH analyses should be transferred first, because they contain volatile analytes which can be easily lost during the pouring process.) The subsamples must be analyzed by ICR approved laboratories using the appropriate analytical methods. Three analyses must be conducted as soon as possible after the conclusion of the storage period: chlorine residual, pH and temperature. Holding times for the remainder of the analyses begin when the SDS sample is divided for individual analyses.

Chlorine Demand Test. The method cited in the ICR is Standard Method 2350 B. This method describes how to perform the test, but it leaves the choice of chlorine dose, temperature, pH and contact time up to the discretion of the person performing the test. In order to meet the objectives of determining the chlorine demand resulting from the presence of inorganics, specific guidelines are established which must be followed in order to comply with the ICR. The test is to be conducted under conditions specific to **each water treatment plant**.

> **Chlorine Dose.** If the first disinfectant (or oxidant) used in the treatment process is chlorine and breakpoint chlorination is practiced, selection of an appropriate chlorine dose should be based on what is used at this point in the treatment process to achieve a desired free chlorine residual. Ideally, the same dose should be used, with the exception that the goal for this test is to obtain a final free residual chlorine concentration (as measured in this test) between 0.5 and 1.0 mg/L. In order to consider the test results valid, the residual must be no less than 0.2 mg/L and no greater than 1.5 mg/L.
>
> If breakpoint chlorination is not practiced at the first point of chlorine application, then the dose used for the chlorine demand test must be based on a dosage that will result in a free residual chlorine between 0.2 and 1.5 mg/L (goal is between 0.5 and 1.0 mg/L, as described above). Selection of an appropriate dosage may require several iterations in the test. If the water contains ammonia-nitrogen as the major contributor to inorganic chlorine demand, then the chlorine dose necessary for this test can be

estimated by multiplying the ammonia concentration (as mg nitrogen/L) by 7.6 and then adding an additional 1.0 mg/L. (This should provide a free residual chlorine concentration near 1 mg/L.)

If chlorine is not the first disinfectant (or oxidant) used in the treatment process, then the chlorine dose must be determined using the same guidelines as for when breakpoint chlorination is not practiced.

Contact Time. Free residual chlorine should be measured approximately 5 minutes after the chlorine is added to the sample. If the residual cannot be measured in the dosed sample within 10 minutes, then the test must be repeated with a fresh sample. This short time period was chosen because reactions with the inorganics are expected to occur quickly and it is physically feasible to make the free residual chlorine measurement within the 10 minute time frame.

The free residual chlorine measurement must be made using the same method as is used to make other free residual chlorine measurements for the ICR.

Temperature. The water sample must be at the same temperature as the process water. This means that the test should be conducted on a freshly collected aliquot of water. The temperature of the sample should be determined after the free residual chlorine measurement is completed.

pH. The pH of the water must not be adjusted for this test. It should reflect the pH of the water at the point of first disinfectant/oxidant addition in the treatment process. The pH of the sample should be determined after the free residual chlorine measurement is completed.

Reporting Requirements. The following data must be reported for this test:

- Chlorine dose (mg/L)
- Contact time (min)
- Analysis date
- Chlorine residual (mg/L)
- pH (after contact time)
- Temperature (°C) (after contact time)

EPA will calculate the chlorine demand by subtracting the chlorine residual from the chlorine dose.

United States
Environmental Protection Agency
Office of Ground Water and Drinking Water
Cincinnati, OH 45268

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