

**Manitoba
Environment**

**Manitoba
Health**



Guideline 98 – 02 (Formerly ES 155)

GUIDELINES FOR

PUBLIC WATER SYSTEMS :

- ***CHLORINE RESIDUAL TESTING AND REPORTING,
and;***
- ***BACTERIOLOGICAL WATER SAMPLING,
SUBMISSION AND INTERPRETATION.***

August 1998

Guidelines For Public Water Systems: Chlorine Residual Testing and Reporting, and; Bacteriological Water Sampling, Submission and Interpretation

INTRODUCTION

The purpose of this document is to outline the regulatory requirements and associated procedures related to operating a public water supply within the province of Manitoba. Of particular concern are the items of chlorine residual testing and bacteriological water sampling. The regulatory reference for this document is Section 10 of Manitoba Regulation P210-330/88R under the Public Health Act.

A. Chlorine Residual Testing and Reporting

1. General

Subsection 10(4) of the regulation requires that a free chlorine residual of at least 0.5 mg/L be maintained in the treated water before distribution, unless otherwise approved by the Minister.

Subsection 10(2) requires daily testing for chlorine residuals in the water plant.

Subsection 10(1) requires that a measurable free chlorine residual be maintained at all times throughout the public water system.

Subsection 10(3) requires testing for chlorine residuals at reasonable intervals from representative points in the system. *(Once per week to once per month is usually adequate depending on the water system characteristics).*

2. Chlorine Testing Procedures

The **DPD Method** in the 18th Edition of "Standard Methods for the Examination of Water and Wastewater," is an acceptable method for chlorine residual testing under Section 10 of the Regulation.

The use of a different method must be approved by the district Public Health Inspector or the Medical Officer of Health.

3. Recording and Submission of Data

Daily test results for free and total chlorine residuals shall be recorded on the "Monthly Water Chlorination Report" (form ES 137) provided by Manitoba Environment. A sample of this form and instructions on its use are attached for your information in Appendix A. Plant information, residuals, daily water use and comments should be entered on the form in the proper locations.

The form provides three copies of the monthly record. At the end of every month, the copies should be distributed as follows:

Part 1 - to be sent to the district Public Health Inspector;

Part 2 - to be retained in the water treatment plant; and

Part 3 - to be submitted to Manitoba Environment in Winnipeg via the postage-paid, self-addressed envelope provided.

Subsection 10(6) of the Regulation requires that the water supplier maintain a copy of the chlorine residual test records for a period of not less than 24 months.

B. Bacteriological Water Sampling Submission and Interpretation

1. General

The supplier of water is responsible for the safe operation of the water plant and the production of microbiologically safe drinking water. Bacteriological testing is a tool which is used by the operator to monitor water quality and determine the effectiveness and condition of the water treatment, storage, and distribution systems. A general description of the purpose and nature of bacteriological water sampling is contained in Appendix B.

Subsection 10(7) of the Regulation requires water suppliers to take water samples and submit them for analysis according to the set procedure.

2. Frequency and Schedule of Sampling

Samples for bacteriological analysis shall be collected and submitted according to the schedule in Appendix C. A sample of raw water shall be submitted along with each set of treated samples. A Public Health Inspector or the Medical Officer of Health must approve any changes to this schedule.

Note that the sampling schedule is different than the historical schedule in that the number of samples required to be submitted for each sample period has been reduced. (e.g. Communities with populations less than 5,000 are now only required to take one sample from the distribution system, historically it was two). The new schedule is based on the “Guidelines for Canadian Drinking Water Quality, Sixth Edition” produced by Health Canada.

Samples should be collected early in the week so there is enough time for transport and testing. Bacteriological samples must be analyzed as soon as possible and preferably within 24 hours of collection. The results of samples analyzed more than 48 hours after collection are not reliable and are reported accordingly.

Bus express, air express, courier delivery or personal delivery should be used to reduce transport time. Regular mail service should not be used unless absolutely necessary. Coordination of sampling day and time with the transport schedule will minimize the standing time of samples and maximize the reliability and accuracy of results.

Depending on the season and the time of transport, bacteriological samples should be kept cool or insulated to preserve freshness and prevent freezing.

3. Designation and Identification of Samples

The following codes may be used:

- MW - Municipal supply from one or more municipal wells not connected with a pressure system.
- MP - Municipal supply from well(s) or a surface source connected with or in a pressure distribution system, NOT CHLORINATED.
- MPC - Municipal supply from underground or surface source connected with or in a pressure distribution system, AND CHLORINATED.

Routine sampling points can be identified by a number and code letters. The sample indicated as number 1 is to be raw water before any treatment or conditioning.

Example: Town of Anywhere

- An - 1 - MP - Treatment Plant - Raw
- An - 2 - MPC - Treatment Plant - Wash basin tap
- An - 3 - MPC - Municipal Office - Wash basin tap
- An - 4 - MPC - Anywhere Collegiate - Boy's washroom tap

If sample location codes are used, the district Public Health Inspector should be provided with the list of sites being sampled. If codes are not used, a complete description of the sample location should be given on the submission form for each sampling.

One of the treated water samples shall be taken at the treatment plant downstream of any treated water storage works and after the required chlorine contact time. Total coliform (TC) and a heterotrophic plate count (HPC) analysis should be requested for this sample on the lab submission form unless there are no treated water storage works. If there are no treated water storage works, only a TC analysis should be requested (please note that pressure tanks are not considered treated water storage works).

The remainder of the treated water samples shall be taken from representative points in the distribution system. A TC and a HPC analysis should be requested for these samples on the lab submission form. The district Public Health Inspector or the Medical Officer of Health may decide the sampling stations to be used.

4. Sample Collection and Submission

The laboratory sample submission form supplied by the laboratory should be used to submit water samples. A sample form is attached for your information in Appendix D. **The**

community code must be entered on the laboratory submission form for data handling and billing purposes. Sample analysis must be undertaken by an accredited laboratory. Due to a contractual agreement with Enviro•Test Laboratories for the provision of water microbiological analytical services, Manitoba Health will not subsidize any analytical services provided by other laboratories. Owners of public water utilities will be notified if this situation changes.

Samples should be shipped to:

Enviro•Test Laboratories
745 Logan Avenue
Winnipeg, Manitoba
R3E 3L5

TEL: (204) 945-3705
FAX: (204) 945-0763

The following procedure should be used for taking bacteriological samples:

- i) Only use laboratory supplied sample bottles.
- ii) Keep the sample bottle closed until the sample is to be taken.
- iii) Remove the paper hood and cap as a unit; do not touch the inner surface of the cap or the inner neck of the bottle.
- iv) Do not rinse the bottle as it contains a preservative.
- v) Fill the sample bottle to the shoulder (glass bottle) or the line (plastic bottle) with the water to be sampled.
- vi) Replace the cap and paper hood immediately and secure back around the top of the bottle.
- vii) Identify the sample on the paper hood and on the submission form.
- viii) When taking a sample, allow taps to run for several minutes. Do not sample from hoses. Remove aerators from faucets and collect the sample directly from the source (i.e. Do not use another container).

5. Interpretation of Total Coliform Results

The membrane filter (MF) technique is normally used for total coliform analysis of drinking water samples. The maximum allowable concentration (MAC) for coliforms in treated drinking water is zero organisms/100mL. Because coliforms are not uniformly

distributed in water and are subject to considerable variation in enumeration, the following conditions are considered to be in compliance with the coliform MAC:

- (a) When 10 or more samples are examined per four week period:
 - i) at least 90% of the samples shall be negative for total coliform organisms;
 - ii) none of the positive results for total coliform organism samples shall have greater than 10 total coliforms per 100 milliliters of sample.
- (b) When less than 10 samples are examined per four week period:
 - i) no more than one sample shall be positive for total coliform organisms;
 - ii) none of the positive results for total coliform organism samples shall have greater than 10 total coliforms per 100 milliliters of sample.
- (c) When samples are examined for fecal coliform organisms, none of the results shall be positive.

Note:

- i) Under the membrane filter method, "negative" results are normally reported as "<1" (less than 1).
- ii) If a result is reported as "overgrown with other organisms," a coliform evaluation of the sample has not been possible. If raw water samples consistently test "overgrown," the multiple tube fermentation technique (M.P.N. Method) should be requested for the raw samples only. "Overgrown" treated water results are considered to be unacceptable and repeat samples shall be taken as soon as possible (as indicated in section 6 below).

6. Positive Coliform Results

When the analysis of a sample indicates a potential bacteriological concern (e.g. conditions in section 5 above are not met), the local Public Health Inspector/Environment Officer shall be notified by the laboratory undertaking the analysis. In turn, the Public Health Inspector/Environment Officer will undertake the following:

- i) If 1-9 total coliform organisms are detected in the distribution system
 - a) the local waterworks authority (i.e. the owner or representative of the owner) and waterworks operator should be notified.
 - b) the sampling site should be re-sampled as soon as possible, but not before the chlorine residual has been tested and increased.

- ii) If total coliform organisms are reported as >10; or any fecal coliforms are detected:
 - a) the local authority, the waterworks operator and the Medical officer of Health should be notified, and
 - b) the sampling site should be re-sampled as soon as possible, but not before the chlorine residual has been tested and increased.
- iii) If the total coliform result is “overgrown with other organisms,” the sampling site should be re-sampled.
- iv) The dosage of the disinfectant, usually chlorine, should be increased immediately to achieve a free chlorine residual in all portions of the distribution system. A range of 0.2 to 0.5 mg/L of free chlorine has generally been proven to be adequate. Once there is no longer a positive bacterial result, a return to the normal operating level of chlorine is suggested.
- v) After step iv) has been performed, special sampling should continue until two consecutive samples are negative:
 - a) For remote areas this means sampling as close as reasonably possible depending on transportation availability; (the time interval between samples should be recorded on the report form).
 - b) For centers not subject to transportation limitations, this means on two consecutive days.
- vi) If additional action is considered necessary, the following can be undertaken:
 - a) the flushing of the water lines,
 - b) an evaluation of the water treatment process, and,
 - c) the implementation of improvements/changes where necessary, will in most instances correct the problem.
- vii) If coliform organisms continue to be present, the local authority should be advised immediately and it is recommended that:
 - a) the local authority and the waterworks operator, with the assistance of the Public Health Inspector and the Medical Officer of Health, prepare a public announcement requesting all consumers to boil their drinking water until further notice: or to use an approved alternative source of drinking water; and

- b) the local authority and the waterworks operator, with the assistance of the Public Health Inspector and the Medical Officer of Health, make available, a written report identifying the problem/cause; the actions taken; the results of these actions; and a detailed report of the water quality testing to support/justify the decision of the public announcement.
- viii) Once the problem of positive samples has been corrected, a return to the regular sampling schedule is recommended.

Note:

- a) Depending on the level of microbial contamination, different levels of action are necessary.
- b) Repeat samples for the purpose of total and fecal coliform analysis shall be taken immediately. If the repeat sampling schedule happens to be the same as the regular sampling schedule, repeat samples may not be required unless continued positive results occur.
- c) The location at which the repeat samples are taken must not be eliminated from future sampling without the approval of the district Public Health Inspector or the Medical Officer of Health. Repeat samples shall not be included in calculating the total number of samples taken to determine compliance with the sampling frequency.

7. Interpretation of Heterotrophic Plate Counts (HPC) Results

The Heterotrophic plate count (formerly standard plate count or SPC) analysis is used as a method for quality control measurement in water treatment plants and as an index of potential water quality deterioration in distribution lines and reservoirs. The reporting range for the HPC analysis is from <10/mL to > 3000/mL.

As a guideline:

- i) The HPC analysis determines the general bacterial population in a water sample, and, therefore, indicates the general sanitary quality of the water.
- ii) Coliform analytical results may not be reliable for water samples with an HPC greater than 500/mL.
- iii) An HPC level of 500/mL should be considered as an objective for finished water, but it is not a set water quality standard. Operators are encouraged to meet this objective.

- iv) Sudden increases in normally low HPC values should be noted as a possible “early warning” sign of potential microbiological problems in the water system. Corrective action such as increasing chlorine residual, examining treatment process, such as filtration, and watermain flushing and/or swabbing may be considered in reacting to significant increases in the HPC level or an HPC level in excess of the objective.

A significant increase in the HPC level at a particular distribution sampling point indicates a deterioration in microbiological quality in that portion of the system. Similarly, a significant HPC increase on treated water discharged from the water treatment plant suggests that a process problem has occurred. This does not necessarily mean the presence of coliform indicators or pathogens, but it does indicate that there is a potential for such microbiological contamination.

Consider the HPC as another tool to help anticipate and correct potential water supply problems.

APPENDIX A

Monthly Water Chlorination Report Form Recording Instructions

This document is intended to provide guidance for completing the attached Monthly Water Chlorination Reports. A copy of the form is attached for reference purposes. Note that each item on the form has been numbered. The explanation for each numbered item is as follows:

- 1. Community/System:** Refers to the name of the community, water co-op, park etc. being served by the water system.
- 2. Plant Code:** Refers to the community code assigned to the water system.
- 3. Month:** Month and year the measurements pertain to.
- 4. Operator:** Refers to the name of the person responsible for recording the measurements.
- 5. Sampling Location:** Refers to exactly where the water was sampled for chlorine residual testing e.g. the plant tap
- 6. Units:** Circle the water meter's unit of measurement.
- 7. Flow metered:** Indicate the type of flow being metered and recorded e.g. is it raw, treated or is no flow being metered.
- 8. Date and Time:** Indicate the day of the month and the time of day the measurements were taken.
- 9. Free Chlorine Residual:** Indicate the measured free chlorine residual.
- 10. Total Chlorine Residual:** Indicate the measured total chlorine residual.
- 11. Consumption:** Subtract the current meter reading from the previous reading taken.

SUMMARY SECTION : The purpose of this area is to summarize the data for the entire month.

12. Total Chlorine:

A: No. of Tests : indicate the total number of total chlorine measurements taken that month (Column 9).

B: High: Indicate the highest concentration of total chlorine measured that month (highest value in column 9).

C: Low: Indicate the lowest concentration of total chlorine measured that month (column 9).

13. Free Chlorine: Follow same instructions as step 12 only use free chlorine measurements in column 8.

14. Water Consumption: The following four values (from A through D) should be in m³. If you have a U.S. gallon water meter divide your values by 264.2. If you have an imperial gallon water meter divide values by 220.0.

A. Max. Day: Maximum value recorded in column 10 (multiplied by appropriate factor if required).

B. Min. day: Minimum value recorded in column 10 (multiplied by appropriate factor if required).

C. Average Day:

1. Subtract the last value entered in column 10 from the first value entered in column 10. This is value 1.
2. Subtract the date of the last value entered in column 10 from the date of the first value entered in column 10. This is value 2.
3. Divide value 1 by value 2. Multiply by appropriate factor if required to convert to m³. This is average day.

D. Monthly Total: Enter value 1 determined above.



Monthly Water Chlorination Report

COMMUNITY / SYSTEM ① PLANT CODE ②
 MONTH ③ 19 OPERATOR ④
 SAMPLING LOCATION ⑤

⑥ DAILY CONSUMPTION UNITS: (circle choice) Imperial Gallons U.S. Gallons Cubic Metres
 ⑦ FLOW METERED FOR DAILY CONSUMPTION: (circle choice) Raw Treated No Metering

DATE & TIME	CHLORINE RESIDUAL mg/l		DAILY CONSUMPTION
	FREE	TOTAL	
⑧	⑨	⑩	⑪

DATE & TIME	CHLORINE RESIDUAL mg/l		DAILY CONSUMPTION
	FREE	TOTAL	

Comments: (Problems etc.)

DISTRIBUTION
 PART 1 - FORWARD TO PUBLIC HEALTH INSPECTOR IN YOUR AREA
 PART 2 - RETAIN FOR YOUR RECORDS
 PART 3 - RETURN TO 'ENVIRONMENTAL CONTROL SERVICES' USING THE
 POSTAGE PAID, SELF ADDRESSED ENVELOPE PROVIDED

SUMMARY

TOTAL CHLORINE: ⑫ NO. OF TESTS: A
 HIGH: B mg/l
 LOW: C mg/l

FREE CHLORINE: ⑬ NO. OF TESTS: _____
 HIGH: _____ mg/l
 LOW: _____ mg/l

WATER CONSUMPTION: ⑭
 MAX. DAY: A M³
 MIN. DAY: B M³
 AVERAGE DAY: C M³
 MONTHLY TOTAL: D M³



APPENDIX B



INTERPRETATION OF BACTERIOLOGICAL WATER QUALITY ANALYTICAL RESULTS

Introduction

Water which is used for domestic purposes must be free from disease producing organisms (pathogens). Although the use of water treatment techniques and disinfection have resulted in a dramatic decrease in the occurrence of water related illness, the occasional outbreak of waterborne diseases indicates the continued need to maintain bacteriological surveillance programs on our drinking water supplies.

Monitoring for Disease - The Total Coliform Count

Many organisms which cause disease in humans originate from sewage or human excrement. Consequently, bacteriological surveillance programs use bacteria commonly found in these contamination sources as a measuring device to establish the biological safety of drinking water. For this purpose the most widely used test involves estimating the number of "coliform bacteria" in a water sample.

Coliform bacteria are always present in fecal wastes and vastly outnumber disease-producing organisms. Given this, and that most pathogens originate from sewage and feces, coliform bacteria are reasoned to be a good indicator species for disease carrying organisms. If there are coliform bacteria present in a water sample it indicates that pathogens could also be present. Alternatively, if coliform bacteria are absent in a water sample, it indicates that pathogens are probably also absent.

Objectives

Lab results for coliform bacteria are measured in colony forming units (CFU's) as they tend to grow in colonies. Manitoba utilizes the values set out in "Guidelines for Canadian Drinking Water Quality", produced by Health Canada, as the criteria for establishing drinking water quality. Based on this criteria, *the maximum acceptable concentration for coliforms in drinking water is zero organisms per 100 ml.*

Corrective Measures

Should the lab results indicate the presence of coliform bacteria you should consult your local Public Health Inspector who will prescribe the appropriate corrective actions to be taken.

The most common immediate actions to the presence of coliform bacteria include resampling to confirm that coliform organisms are present. If resampling confirms that the water supply is

contaminated additional actions will be required. These may include disinfecting your water source, water treatment equipment and plumbing system in the case of a private water supply. In the case of a public water supply reaction may include increasing the chlorine dosage, disinfecting and scrubbing water treatment equipment and reservoirs, as well as watermain flushing and/or disinfection and swabbing. In extreme cases an alternative water source may have to be sought or a boil advisory placed on the system.

Monitoring the Water System - The Heterotrophic Plate Count

The heterotrophic plate count (HPC), formerly known as the standard plate count (SPC), provides a count of the general bacteria population in a water sample including organisms such as iron bacteria which are unrelated to sewage or fecal wastes. Accordingly, the HPC does not indicate the presence or absence of disease carrying organisms. Rather, HPC analysis may be used as an index of the general sanitary condition of the water.

HPC analysis is often used as a diagnostic tool. A significant increase in HPC values at a particular distribution sampling point indicates a deterioration in the microbiological quality in that portion of the system and that corrective action is required. Similarly, significant HPC increases on finished water discharged from the water treatment plant suggests that there is deterioration in the treatment process. Further testing could isolate the problem to a particular component of the water treatment system e.g. the filters, the reservoir etc. so that the appropriate corrective action can be taken.

HPC analysis is also used to establish the accuracy of coliform analytical results because coliform counts are generally not considered reliable on water samples which have an HPC >500 CFU/ml. This occurs because the vast number of bacteria in a water sample of this nature, interfere with the analytical method used to test for coliform bacteria.

Objectives

Similar to total coliform counts, HPC's are measured in colony forming units/ml. *A HPC level of 500/ml should be considered as an objective for drinking water although this is not a set water quality guideline.*

Corrective Action

Sudden increases in the HPC level should be noted as an early warning sign of potential microbiological problems in the water system. In private water systems corrective action may be comprised of disinfecting the water source (usually a well), any water treatment equipment and the home plumbing system including any storage reservoirs.

In a public water supply corrective action may include: disinfecting the water source (if the source is a well), increasing the chlorine dosage, examining components of the water treatment process, as well as watermain flushing, swabbing and/or disinfection.

Your local Public Health Inspector may be consulted to guide you regarding what corrective action may be required and how it may be undertaken. Inspectors may be contacted through the Manitoba Environment office nearest you as listed in the telephone directory under Government

of Manitoba. The department has regional offices in Winnipeg, Brandon, The Pas, Selkirk and Steinbach.

APPENDIX C

Number and Frequency of Bacteriological Sample Submissions

COMMUNITY POPULATION	Minimum Monthly Total Number of Treated Samples	Sampling frequency
<5,000	4 per month	bi-weekly
5000 to 10,000	1 per thousand population	bi-weekly
10,001 to 90,000	1 per thousand population	Weekly
Greater than 90,000	90 + (1 per 10,000 population)	Weekly

Notes:

- i) The above sample numbers refer to samples of treated water. A sample of raw water (from each source) shall be submitted along with each set of treated water samples.
- ii) One of the treated water samples shall be taken at the water treatment plant after the required contact time. The remainder of the treated water samples shall be taken from representative points in the distribution system.

APPENDIX D

FOR LABORATORY USE ONLY (SHADED AREAS)

Sample Condition Upon Receipt: ACCEPTABLE NON-ACCEPTABLE

Frozen Cold Ambient Broken Leakage Incorrec. Sample Container

COMMENT: _____

LAB NO: _____
DATE RECEIVED: _____
TIME RECEIVED: _____
BY: _____

Date Sampled: Jan 1, 2001 Time: 12:00 A.M. P.M. DATE REQUIRED: _____

Location: TOWN OF ANEWATERIS Sample Submitted by: J. Doe
(Town, Community, City, Federal Reserve)

Community Code Number: 705.05 Rural Municipality/LGD/UVD: _____

SAMPLE TYPE PLEASE PRINT & PRESS FIRMLY

DRINKING WATER
 Treated Well
 Non-Treated Well
 Treated Municipal
 Non-Treated Municipal
 Distribution Municipal
 OTHER (specify) _____

NON-DRINKING WATER
 Precipitation
 Sewage/Waste Water
 Lake/River
 Swimming Pool
 Whirl Pool
 OTHER (specify) _____

NOTES & CONDITIONS
 1. Quote number must be provided to insure proper pricing.
 2. Turn around times will vary dependent on complexity of analysis and lab workload at time of submission.
 3. Failure to properly complete all portions of this form may delay analysis.
 4. Samples should be submitted to the lab by 2:00 p.m.
 5. See sampling instructions on back of form.

LAB NUMBER	SAMPLE IDENTIFICATION	MTC CUSTOMER #: <u>X</u> QUOTE #: _____
	LABEL BOTTLES BY USING THE FIRST LETTER OF THE TOWN PLUS R (RAW), T (TREATED) OR D (DISTRIBUTION). A MORE CONDENSED DESCRIPTION CAN BE INDICATED ON THE FORM AS FOLLOWS: AR: WATER PLANT - TC AT: WATER PLANT - TC+HPC AD1: FARM'S BSSD - TC+HPC AD2: SCHOOL - TC+HPC	REPORT TO BE SENT TO NAME: _____ COMPANY: _____ ADDRESS: _____ CITY/TOWN: _____ PROV.: _____ POSTAL CODE: _____ PHONE: _____ FAX: _____ BY: MAIL <input type="checkbox"/> OR FAX <input type="checkbox"/> OR PICKUP <input type="checkbox"/>
		BILLING ADDRESS NAME: _____ COMPANY: _____ ADDRESS: _____ CITY/TOWN: _____ PROV.: _____ POSTAL CODE: _____ PHONE: _____ FAX: _____
		PAYMENT PARTICULARS <input checked="" type="checkbox"/> INVOICE NEEDED / CLIENT'S P.O. NO. _____ <input type="checkbox"/> INTERAC <input type="checkbox"/> CASH Subtotal \$ _____ <input type="checkbox"/> CHEQUE G.S.T. \$ _____ <input type="checkbox"/> VISA Total \$ _____ *OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT*

Reason for Sampling: Analyses and/or Test No. Required ENTERED IN LIMS BY: _____
AS INDICATED

POSSIBLE LEGAL ACTION: YES NO
 PRIOR NOTIFICATION REQUIRED FOR LEGAL SAMPLES Submitter's Signature: _____

SUBMITTER COPY