

**APPENDIX D  
SURFACE WATER TREATMENT**

**801-D ANALYTICAL AND SAMPLING REQUIREMENTS**

A. ANALYTICAL REQUIREMENTS. Only the analytical method(s) specified in this subsection, or otherwise approved by the EPA, may be used to demonstrate compliance with the requirements of §§ 803, 804, and 805. Measurements for pH, temperature, turbidity, and residual disinfectant concentrations must be conducted by a party approved by the Director. Measurements for total coliforms, fecal coliforms, and HPC must be conducted by a laboratory certified by the EPA to do such analysis. Until laboratory certification criteria are developed for the analysis of HPC and fecal coliforms, any laboratory certified for total coliform analysis by EPA is deemed certified for HPC and fecal coliform analysis. The following procedures shall be conducted in accordance with the publications listed in the following section. Copies of the methods published in *Standard Methods for the Examination of Water and Wastewater* may be obtained from the American Public Health Association et al., 1015 Fifteenth Street, NW., Washington, DC, 20005; copies of the Minimal Medium ONPG-MUG Method as set forth in the article "National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and *Escherichia coli* from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method" (Edberg et al.), *Applied and Environmental Microbiology*, Volume 54, PP. 1595-1601, June 1988 (as amended under Erratum, *Applied and Environmental Microbiology*, Volume 54 p. 3197, December, 1988), may be obtained from the American Water Works Association Research Foundation, 6666 West Quincy Avenue, Denver, Colorado, 80235; and copies of the Indigo Method as set forth in the article "Determination of Ozone in Water by the Indigo Method" (Bader and Hoigne), may be obtained from Ozone Science & Engineering, Pergamon Press Ltd., Fairview Park, Elmsford, New York, 10523. Copies may be inspected at the U.S.EPA, Room EB15, 401 M Street, SW., Washington, DC, 20460 or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

1. Public water systems must conduct analysis of pH in accordance with one of the methods listed in Appendix A § 403-A (A)(1) Table 400-A-3. Water systems must conduct analyses of total coliforms, fecal coliforms, heterotrophic bacteria, turbidity and temperature in accordance with one of the following analytical methods and by using analytical test procedures contained in *Technical Notes on Drinking Water Methods*, EPA-600/R-94-173, October 1994, which is available at NTIS PB 95-104766.

**TABLE 800-D-1 ANALYTICAL METHODS**

| Organism                            | Methodology   | Citation <sup>1</sup>                                |
|-------------------------------------|---|--|
| Total Coliforms <sup>2</sup>        | Total Coliform Fermentation technique <sup>3,4,5</sup><br>Total Coliform Membrane Filter technique <sup>6</sup><br>ONPG-MUG Test <sup>7</sup> | 9221A, B, C<br>9222A, B, C<br>9223                   |
| Fecal Coliforms <sup>2</sup>        | Fecal Coliform Procedure <sup>8</sup><br>Fecal Coliforms Filter Procedure   | 9221E<br>9222D                                       |
| Heterotrophic bacteria <sup>2</sup> | Pour Plate Method   | 9215B  |
| Turbidity                           | Nephelometric Method<br>Nephelometric Method<br>Great lakes instruments   | 2130B<br>180.1 <sup>8</sup><br>Method 2 <sup>9</sup> |
| Temperature                         |   | 2550   |

The procedures shall be done in accordance with the documents listed below. Copies of the documents may be obtained from the sources listed below. Information regarding obtaining these documents can be obtained from the Safe Drinking Water Hotline at 800-426-4791. Documents may be inspected at EPA's Drinking Water Docket, 1200 Pennsylvania Ave., NW., Washington, D.C. 20460 (Telephone: 202-260-3027); or at the Office of the Federal Register, 800 North Capitol Street, NW, Suite 700, Washington, D.C. 20408.

<sup>1</sup> Except where noted, all methods refer to Standard Methods for the Examination of Water and Wastewater, 18<sup>th</sup> edition, 1992, and 19<sup>th</sup> edition, 1995, American Public Health Association, 1015 Fifteenth Street NW, Washington, D.C., 20005.

<sup>2</sup> The time from sample collection to initiation of analysis may not exceed 8 hours. Systems must hold samples below 10 °C during transit.

<sup>3</sup> Lactose broth, as commercially available, may be used in lieu of lauryl tryptose broth, if the system conducts at least 25 parallel tests between this medium and lauryl tryptose broth using the water normally

tested, and this comparison demonstrates that the false-positive rate and false-negative rate for total coliforms, using lactose broth, is less than 10%.

<sup>4</sup> Media should cover inverted tubes at least one-half to two-thirds after the sample is added.

<sup>5</sup> No requirement exists to run the completed phase on 10% of all total coliform-positive confirmed tubes.

<sup>6</sup> The ONPG-MUG test is also known as the Autoanalysis Colilert System.

<sup>7</sup> A-1 Broth may be held up to three months in a tightly closed screwcap tube at 4 °C.

<sup>8</sup> "Methods for the Determination of Inorganic Substances in Environmental Samples", EPA-600/R-93-100, August 1993. Available at NTIS, PB94-121811.

<sup>9</sup> GLI Method 2, "Turbidity", November 2, 1992, Great Lakes Instruments, Inc., 8855 North 55<sup>th</sup> Street, Milwaukee, Wisconsin 53223.

2. Water systems must measure residual disinfectant concentrations with one of the analytical methods in the following table. The methods are contained in the 18<sup>th</sup>, 19<sup>th</sup>, and 20<sup>th</sup> editions of Standard Methods for the Examination of Water and Wastewater, 1992 and 1995; any of these three editions may be used. Other analytical test procedures are contained in Technical Notes on Drinking Water Methods, EPA 600/R-94-173, October 1994, which is available at NTIS PB95-104766. If approved by EPA, residual disinfectant concentrations for free chlorine and combined chlorine also may be measured by using DPD colorimetric test kits. Free and total chlorine residuals may be measured continuously by adapting a specified chlorine residual method for use with a continuous monitoring instrument provided the chemistry, accuracy, and precision remain the same. Instruments used for continuous monitoring must be calibrated with a grab sample measurement at least every five days, or with a protocol approved by EPA.

**Table 800-D-2 RESIDUAL DISINFECTANT CONCENTRATIONS ANALYTICAL METHODS**

| Residual         | Methodology   | Methods   |
|------------------|---|---|
| Free chlorine    | Amperometric Titration<br>DPD Ferrous Titrimetric<br>DPD Colorimetric<br>Syringaldazine (FACTS)   | 4500-Cl D<br>4500-Cl F<br>4500-Cl G<br>4500-Cl H  |
| Total Chlorine   | Amperometric Titration<br>Amperometric Titration (low level measurement)<br>DPD Ferrous Titrimetric<br>DPD Colorimetric<br>Iodometric Electrode | 4500-Cl D<br>4500-Cl E<br>4500-Cl F<br>4500-Cl G<br>4500-Cl I   |
| Chlorine dioxide | Amperometric Titration<br>DPD Method<br>Amperometric Titration<br>Spectrophotometric  | 4500-ClO <sub>2</sub> C<br>4500-ClO <sub>2</sub> D<br>4500-ClO <sub>2</sub> E<br>EPA Method 327.0, Rev. 1.1 |
| Ozone            | Indigo Method   | 4500-O <sub>3</sub> B   |

<sup>1</sup> EPA Method 327.0, Rev. 1.1, "Determination of Chlorine Dioxide and chlorite Ion in Drinking Water using Lissamine Green B and Horseradish Peroxidase with Detection by Visible Spectrophotometry," USEPA May 2005, EPA 815-R-05-008. Available online at <http://www.epa.gov/safewater/methods/sourcalt.html>.

- B. Sampling requirements for systems that do not provide filtration. A public water system that uses a surface water source and does not provide filtration treatment must begin sampling unless the Director has determined in writing that filtration is required pursuant to § 2535 of the NNSDWA, in which case the Director may specify alternative sampling requirements, as appropriate, until filtration is in place. A water system that uses a groundwater source under the direct influence of surface water and does not provide filtration treatment must begin sampling 6 months after the Director determines that the groundwater source is under the direct influence of surface water, unless the Director has determined that filtration is required in writing pursuant to § 2535 of the NNSDWA, in which case the Director may specify alternative sampling requirements, as appropriate, until filtration is in place.

1. Fecal coliform or total coliform density measurements as required by § 803 (A)(1) must be performed on representative source water samples immediately prior to the first or only point of disinfectant application. The system must sample for fecal or total coliforms at the following minimum frequency each week the system serves water to the public:

**TABLE 800-D-3 SAMPLE FREQUENCY**

| SYSTEM SIZE (persons served) | SAMPLES/WEEK <sup>1</sup> |
|------------------------------|---------------------------|
| ≤500                         | 1                         |
| 501 TO 3,300                 | 2                         |
| 3,301 TO 10,000              | 3                         |
| 10,001 TO 25,000             | 4                         |
| >25,000                      | 5                         |

<sup>1</sup>Must be taken on separate days.

Also, one fecal or total coliform density measurement must be made every day the system serves water to the public and the turbidity of the source water exceeds 1 NTU (these samples count towards the weekly coliform sampling requirement) unless the Director determines that the system, for logistical reasons outside the system's control, cannot have the sample analyzed within 30 hours of collection.

2. Turbidity measurements as required by § 803 (A)(2) must be performed on representative grab samples of source water immediately prior to the first or only point of disinfectant application every four hours (or more frequently) that the system serves water to the public. A public water system may substitute continuous turbidity sampling for grab sample sampling if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the Director.
3. The total inactivation ratio for each day that the system is in operation must be determined based on the CT<sub>99.9</sub> values in Tables 800-D-4 through 800-D-11 of this section, as appropriate. The parameters necessary to determine the total inactivation ratio must be monitored as follows:
  - a. The temperature of the disinfected water must be measured at least once per day at each residual disinfectant concentration sampling point.
  - b. If the system uses chlorine, the pH of the disinfected water must be measured at least once per day at each chlorine residual disinfectant concentration sampling point.
  - c. The disinfectant contact time(s) ("T") must be determined for each day during peak hourly flow.
  - d. The residual disinfectant concentration(s) ("C") of the water before or at the first customer must be measured each day during peak hourly flow.
  - e. If a system uses a disinfectant other than chlorine, the system may demonstrate to the Director, through the use of a Director-approved protocol for on-site disinfection challenge studies or other information satisfactory to the Director, that CT<sub>99.9</sub> values other than those specified in Tables 800-D-10 and 800-D-11 in this section or other operational parameters are adequate to demonstrate that the system is achieving the minimum inactivation rates required by § 804 (A)(1).

**TABLE 800-D-4 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 0.5 °C OR LOWER<sup>1</sup>**

| Residual mg/L | pH   |     |     |     |     |     |      |
|---------------|------|-----|-----|-----|-----|-----|------|
|               | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |
| ≤0.4          | 137  | 163 | 195 | 237 | 277 | 329 | 390  |
| 0.6           | 141  | 168 | 200 | 239 | 286 | 342 | 407  |
| 0.8           | 145  | 172 | 205 | 246 | 295 | 354 | 422  |
| 1.0           | 148  | 176 | 210 | 253 | 304 | 365 | 437  |

|     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 1.2 | 152 | 180 | 215 | 259 | 313 | 376 | 451 |
| 1.4 | 155 | 184 | 221 | 266 | 321 | 387 | 464 |
| 1.6 | 157 | 189 | 226 | 273 | 329 | 397 | 477 |
| 1.8 | 162 | 193 | 231 | 279 | 338 | 407 | 489 |
| 2.0 | 165 | 197 | 236 | 286 | 346 | 417 | 500 |
| 2.2 | 169 | 201 | 242 | 297 | 353 | 426 | 511 |
| 2.4 | 172 | 205 | 247 | 298 | 361 | 435 | 522 |
| 2.6 | 175 | 209 | 252 | 304 | 368 | 444 | 533 |
| 2.8 | 178 | 213 | 257 | 310 | 375 | 452 | 543 |
| 3.0 | 181 | 217 | 261 | 316 | 382 | 460 | 552 |

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperature of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature and at the higher pH.

**TABLE 800-D-5 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 5.0 °C<sup>1</sup>**

| Free Residual mg/L | pH   |     |     |     |     |     |      |
|--------------------|------|-----|-----|-----|-----|-----|------|
|                    | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |
| ≤0.4               | 97   | 117 | 139 | 166 | 198 | 236 | 279  |
| 0.6                | 100  | 120 | 143 | 171 | 204 | 244 | 291  |
| 0.8                | 103  | 122 | 146 | 175 | 210 | 252 | 301  |
| 1.0                | 105  | 125 | 149 | 179 | 216 | 260 | 312  |
| 1.2                | 107  | 127 | 152 | 183 | 221 | 267 | 320  |
| 1.4                | 109  | 130 | 155 | 187 | 227 | 274 | 329  |
| 1.6                | 111  | 132 | 158 | 192 | 232 | 281 | 337  |
| 1.8                | 114  | 135 | 162 | 196 | 238 | 287 | 345  |
| 2.0                | 116  | 138 | 165 | 200 | 243 | 294 | 353  |
| 2.2                | 118  | 140 | 169 | 204 | 248 | 300 | 361  |
| 2.4                | 120  | 143 | 172 | 209 | 253 | 306 | 368  |
| 2.6                | 122  | 146 | 175 | 213 | 258 | 312 | 375  |
| 2.8                | 124  | 148 | 178 | 217 | 263 | 318 | 382  |
| 3.0                | 126  | 151 | 182 | 221 | 268 | 324 | 389  |

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperature of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature, and at the higher pH.

**TABLE 800-D-6 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 10.0 °C<sup>1</sup>**

| Free Residual mg/L | pH   |     |     |     |     |     |      |
|--------------------|------|-----|-----|-----|-----|-----|------|
|                    | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |

|      |    |     |     |     |     |     |     |
|------|----|-----|-----|-----|-----|-----|-----|
| ≤0.4 | 73 | 88  | 104 | 125 | 149 | 177 | 209 |
| 0.6  | 75 | 90  | 107 | 128 | 153 | 183 | 218 |
| 0.8  | 78 | 92  | 110 | 131 | 158 | 189 | 226 |
| 1.0  | 79 | 94  | 112 | 134 | 162 | 195 | 234 |
| 1.2  | 80 | 95  | 114 | 137 | 166 | 200 | 240 |
| 1.4  | 82 | 98  | 116 | 140 | 170 | 206 | 247 |
| 1.6  | 83 | 99  | 119 | 144 | 174 | 211 | 253 |
| 1.8  | 86 | 101 | 122 | 147 | 179 | 215 | 259 |
| 2.0  | 87 | 104 | 124 | 150 | 182 | 221 | 265 |
| 2.2  | 89 | 105 | 127 | 153 | 186 | 225 | 271 |
| 2.4  | 90 | 107 | 129 | 157 | 190 | 230 | 276 |
| 2.6  | 92 | 110 | 131 | 160 | 194 | 234 | 281 |
| 2.8  | 93 | 111 | 134 | 163 | 197 | 239 | 287 |
| 3.0  | 95 | 113 | 137 | 166 | 201 | 243 | 292 |

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature, and at the higher pH.

**TABLE 800-D-7 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 15.0 °C<sup>1</sup>**

| Free Residual mg/L | pH   |     |     |     |     |     |      |
|--------------------|------|-----|-----|-----|-----|-----|------|
|                    | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |
| ≤0.4               | 49   | 59  | 70  | 83  | 99  | 118 | 140  |
| 0.6                | 50   | 60  | 72  | 86  | 102 | 122 | 146  |
| 0.8                | 52   | 61  | 73  | 88  | 105 | 126 | 151  |
| 1.0                | 53   | 63  | 75  | 90  | 108 | 130 | 156  |
| 1.2                | 54   | 64  | 76  | 92  | 111 | 134 | 160  |
| 1.4                | 55   | 65  | 78  | 94  | 114 | 137 | 165  |
| 1.6                | 56   | 66  | 79  | 96  | 116 | 141 | 169  |
| 1.8                | 57   | 68  | 81  | 98  | 119 | 144 | 173  |
| 2.0                | 58   | 69  | 83  | 100 | 122 | 147 | 177  |
| 2.2                | 59   | 70  | 85  | 102 | 124 | 150 | 181  |
| 2.4                | 60   | 72  | 86  | 105 | 127 | 153 | 184  |
| 2.6                | 61   | 73  | 88  | 107 | 129 | 156 | 188  |
| 2.8                | 62   | 74  | 89  | 109 | 132 | 159 | 191  |
| 3.0                | 63   | 76  | 91  | 111 | 134 | 162 | 195  |

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature, and at the higher pH.

**TABLE 800-D-8 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 20.0 °C<sup>1</sup>**

| Free Residual<br>mg/L | pH   |     |     |     |     |     |      |
|-----------------------|------|-----|-----|-----|-----|-----|------|
|                       | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |
| ≤0.4                  | 36   | 44  | 52  | 62  | 74  | 89  | 105  |
| 0.6                   | 38   | 45  | 54  | 64  | 77  | 92  | 109  |
| 0.8                   | 39   | 46  | 55  | 66  | 79  | 95  | 113  |
| 1.0                   | 39   | 47  | 56  | 67  | 81  | 98  | 117  |
| 1.2                   | 40   | 48  | 57  | 69  | 83  | 100 | 120  |
| 1.4                   | 41   | 49  | 58  | 70  | 85  | 103 | 123  |
| 1.6                   | 42   | 50  | 59  | 72  | 87  | 105 | 126  |
| 1.8                   | 43   | 51  | 61  | 74  | 89  | 108 | 129  |
| 2.0                   | 44   | 52  | 62  | 75  | 91  | 110 | 132  |
| 2.2                   | 44   | 53  | 63  | 77  | 93  | 113 | 135  |
| 2.4                   | 45   | 54  | 65  | 78  | 95  | 115 | 138  |
| 2.6                   | 46   | 55  | 66  | 80  | 97  | 117 | 141  |
| 2.8                   | 47   | 56  | 67  | 81  | 99  | 119 | 143  |
| 3.0                   | 47   | 57  | 68  | 83  | 101 | 122 | 146  |

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature, and at the higher pH.

**TABLE 800-D-9 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 25.0 °C<sup>1</sup> AND HIGHER**

| Free Residual<br>mg/L | pH   |     |     |     |     |     |      |
|-----------------------|------|-----|-----|-----|-----|-----|------|
|                       | ≤6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤9.0 |
| ≤0.4                  | 24   | 29  | 35  | 42  | 50  | 59  | 70   |
| 0.6                   | 25   | 30  | 36  | 43  | 51  | 61  | 73   |
| 0.8                   | 26   | 31  | 37  | 44  | 53  | 63  | 75   |
| 1.0                   | 26   | 31  | 37  | 45  | 54  | 65  | 78   |
| 1.2                   | 27   | 32  | 38  | 46  | 55  | 67  | 80   |
| 1.4                   | 27   | 33  | 39  | 47  | 57  | 69  | 82   |
| 1.6                   | 28   | 33  | 40  | 48  | 58  | 70  | 84   |
| 1.8                   | 29   | 34  | 41  | 49  | 60  | 72  | 86   |
| 2.0                   | 29   | 35  | 41  | 50  | 61  | 74  | 88   |
| 2.2                   | 30   | 35  | 42  | 51  | 62  | 75  | 90   |
| 2.4                   | 30   | 36  | 43  | 52  | 63  | 77  | 92   |
| 2.6                   | 31   | 37  | 44  | 53  | 65  | 78  | 94   |
| 2.8                   | 31   | 37  | 45  | 54  | 66  | 80  | 96   |

|     |    |    |    |    |    |    |    |
|-----|----|----|----|----|----|----|----|
| 3.0 | 32 | 38 | 46 | 55 | 67 | 81 | 97 |
|-----|----|----|----|----|----|----|----|

<sup>1</sup>These CT values achieve greater than a 99.99 % inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature, and at the higher pH.

**TABLE 800-D-10 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY CHLORINE DIOXIDE AND OZONE<sup>1</sup>**

| Temperature      | ≤1 °C | 5 °C | 10 °C | 15 °C | 20 °C | ≥25 °C |
|------------------|-------|------|-------|-------|-------|--------|
| Chlorine Dioxide | 63    | 26   | 23    | 19    | 15    | 11     |
| Ozone            | 2.9   | 1.9  | 1.4   | 0.95  | 0.72  | 0.48   |

<sup>1</sup>These CT values achieve greater than 99.99 % inactivation of viruses. CT values between the indicated temperatures may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature for determining CT<sub>99.9</sub> values between indicated temperatures.

**TABLE 800-D-11 CT VALUES (CT<sub>99.9</sub>) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY CHLORAMINES<sup>1</sup>**

| Temperature |       |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|
| ≤1 °C       | 5 °C  | 10 °C | 15 °C | 20 °C | 25 °C |
| 3,800       | 2,200 | 1,850 | 1,500 | 1,100 | 750   |

<sup>1</sup>These values are for pH values of 6 to 9. These CT values may be assumed to achieve greater than 99.99 % inactivation of viruses only if chlorine is added and mixed in the water prior to the addition of ammonia. If this condition is not met, the system must demonstrate, based on on-site studies or other information, as approved by the Director, that the system is achieving at least 99.99 % inactivation of viruses. CT values between the indicated temperatures may be determined by linear interpolation. If no interpolation is used, use the CT<sub>99.9</sub> value at the lower temperature for determining CT<sub>99.9</sub> values between indicated temperatures.

4. The total inactivation ratio must be calculated as follows:
  - a. If the system uses only one point of disinfectant application, the system may determine the total inactivation ratio based on either of the following two methods:
    1. One inactivation ratio (CT<sub>calc</sub>/CT<sub>99.9</sub>) is determined before or at the first customer during peak hourly flow and if the CT<sub>calc</sub>/CT<sub>99.9</sub> ≥ 1.0, the 99.9 % *Giardia lamblia* inactivation requirement has been achieved; or
    2. Successive CT<sub>calc</sub>/CT<sub>99.9</sub> values, representing sequential inactivation ratios, are determined between the point of disinfectant application and a point before or at the first customer during peak hourly flow. Under this alternative, the following method must be used to calculate the total inactivation ratio:

(1) Determine  $\frac{CT_{calc}}{CT_{99.9}}$  for each sequence.

(2) Add the  $\frac{CT_{calc}}{CT_{99.9}}$  values together  $\left( \sum \frac{CT_{calc}}{CT_{99.9}} \right)$

(3) If  $\sum \left( \frac{CT_{calc}}{CT_{99.9}} \right) \geq 1.0$ , the 99.9 percent *Giardia*

*Lamblia* inactivation requirement has been achieved.

- b. If the system uses more than one point of disinfectant application before or at the first customer, the system must determine the CT value of each disinfection sequence immediately prior to the next point of disinfectant application during peak hourly flow. The  $CT_{calc}/CT_{99.9}$  value of each sequence and

$$\sum \frac{CT_{calc}}{CT_{99.9}}$$

must be calculated using the method in subsection (B)(4)(a)(2) of this section to determine if the system is in compliance with § 804 (A).

- c. Although not required, the total percent inactivation for a system with one or more points of residual disinfectant concentration sampling may be calculated by solving the following equation:

$$\text{Percent inactivation} = 100 - \frac{100}{10^z}$$

$$\text{where } z = 3 \times \sum \left( \frac{CT_{calc}}{CT_{99.9}} \right)$$

5. The residual disinfectant concentration of the water entering the distribution system must be monitored continuously, and the lowest value must be recorded each day, except that if there is a failure in the continuous sampling equipment, grab sampling every 4 hours may be conducted in lieu of continuous sampling, but for no more than 5 working days following the failure of the equipment, and systems serving 3,300 or fewer persons may take grab samples in lieu of providing continuous sampling on an ongoing basis at the frequencies prescribed below:

**TABLE 800 -D- 12 SAMPLING INTERVALS**

| SYSTEM SIZE BY POPULATION | SAMPLES/DAY <sup>1</sup> |
|---------------------------|--------------------------|
| <500                      | 1                        |
| 501 to 1,000              | 2                        |
| 1,001 to 2,500            | 3                        |
| 2,501 to 3,300            | 4                        |

<sup>1</sup>The day's samples cannot be taken at the same time. The sampling intervals are subject to the Director's review and approval.

If at any time the residual disinfectant concentration falls below 0.2 mg/l in a system using grab sampling in lieu of continuous sampling, the system must take a grab sample every 4 hours until the residual concentration is equal to or greater than 0.2 mg/l.

6. a. The residual disinfectant concentration must be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in § 404, except that the Director may allow a public water system which uses both a surface water source or a groundwater source under direct influence of surface water, and a groundwater source, to take disinfectant residual samples at points other than the total coliform sampling points if the Director determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in subsection (A)(1) of this section, may be measured in lieu of residual disinfectant concentration.
- b. If the Director determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified by subsection (A)(1) of this section and that the system is providing adequate disinfection in the distribution system, the requirements of subsection (B)(6)(a)

of this section do not apply to that system.

C. Sampling requirements for systems using filtration treatment.

A public water system that uses a surface water source or a groundwater source under the influence of surface water and provides filtration treatment must monitor in accordance with this subsection (C) when filtration is installed.

1. Turbidity measurements as required by § 805 must be performed on representative samples of the system's filtered water every four hours (or more frequently) that the system serves water to the public. A water system may substitute continuous turbidity sampling for grab sampling if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the Director. For any systems using slow sand filtration or filtration treatment other than conventional treatment, direct filtration, or diatomaceous earth filtration, the Director may reduce the sampling frequency to once per day if it determines that less frequent sampling is sufficient to indicate effective filtration performance. For systems serving 500 or fewer persons, the Director may reduce the turbidity sampling frequency to once per day, regardless of the type of filtration treatment used, if the Director determines that less frequent sampling is sufficient to indicate effective filtration performance.
2. The residual disinfectant concentration of the water entering the distribution system must be monitored continuously, and the lowest value must be recorded each day, except that if there is a failure in the continuous sampling equipment, grab sampling every 4 hours may be conducted in lieu of continuous sampling, but for no more than 5 working days following the failure of the equipment, and systems serving 3,300 or fewer persons may take grab samples in lieu of providing continuous sampling on an ongoing basis at the frequencies each day prescribed below:

**TABLE 800-D-13 SAMPLING FREQUENCIES**

| SYSTEM SIZE BY POPULATION | SAMPLES/DAY <sup>1</sup> |
|---------------------------|--------------------------|
| ±500                      | 1                        |
| 501 to 1,000              | 2                        |
| 1,001 to 2,500            | 3                        |
| 2,501 to 3,300            | 4                        |

<sup>1</sup>The day's samples cannot be taken at the same time. The sampling intervals are subject to the Director's review and approval.

If at any time the residual disinfectant concentration falls below 0.2 mg/l in a system using grab sampling in lieu of continuous sampling, the system must take a grab sample every 4 hours until the residual disinfectant concentration is equal to or greater than 0.2 mg/l.

3. a. The residual disinfectant concentration must be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in § 404, except that the Director may allow a public water system which uses both a surface water source or a groundwater source under direct influence of surface water, and a groundwater source to take disinfectant residual samples at points other than the total coliform sampling points if the Director determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in subsection (A)(1) of this section, may be measured in lieu of residual disinfectant concentration.
- b. If the Director determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified by subsection (A)(1) of this section and that the system is providing adequate disinfection in the distribution system, the requirements of subsection (C)(3)(a) of this section do not apply to that system.

TABLE 800 -D- 14 BAFFLING CLASSIFICATION

| BAFFLING CONDITION     | $T_{10}/T$ | BAFFLING DESCRIPTION   |
|------------------------|------------|--|
| Unbaffled (mixed flow) | 0.1        | None, agitated basin, very low length to width ratio, high inlet and outlet flow velocities.               |
| Poor                   | 0.3        | Single or multiple unbaffled inlets and outlets, no intra-basin baffles.                                   |
| Average                | 0.5        | Baffled inlet or outlet with some intra-basin baffles.   |
| Superior               | 0.7        | Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir or perforated launders. |
| Perfect (plug flow)    | 1.0        | Very high length to width ratio (pipeline flow), perforated inlet, outlet, and intra-basin baffles.        |

**APPENDIX E**  
**DISINFECTANT RESIDUALS, DISINFECTION BYPRODUCTS AND**  
**DISINFECTION BYPRODUCT PRECURSORS**

**1101-E ANALYTICAL REQUIREMENTS**

A. General

1. Systems must use only the analytical method(s) specified in Part 1100 and Appendix E, or otherwise approved by EPA in the federal register, to demonstrate compliance with the requirements under Part 1100 or Appendix E. These methods are effective for compliance monitoring February 16, 1999, unless a different date is specified in this section or by this Director.
  
2. The following documents are incorporated by reference. Copies may be inspected at EPA's Drinking Water Docket, 1301 Constitutional Avenue, NW, EPA West, Room B102, Washington, DC, 20460, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to:  
[http://www.archives.gov/federal\\_register/code\\_or\\_federal\\_regulations/ibr\\_locations.htm](http://www.archives.gov/federal_register/code_or_federal_regulations/ibr_locations.htm)  
1. EPA Method 552.1 is in Methods for the Determination of Organic Compounds in Drinking Water-Supplement II, USEPA, August 1992, EPA/600/R-92/129 (available through National Information Technical Service (NTIS), PB92-207703). EPA Methods 502.2, 524.2, 551.1, and 552.2 are in Methods for the Determination of Organic Compounds in Drinking Water-Supplement III, USEPA, August 1995, EPA/600/R-95/131 (available through NTIS, PB95-261616). EPA Method 300.0 is in Methods for Determination of Inorganic Substances in Environmental Samples, USEPA, August 1993, EPA/600/R-93/100 (available through NTIS, PB94-121811). EPA Methods 300.1 and 321.8 are in Methods for the Determination of Organic and Inorganic Compounds in Drinking Water, Volume 1, USEPA, August 2000, EPA 815-R-00-014 (Available through NTIS, PB2000-106981). EPA Method 317.0, Revision 2.0, "Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography with the Addition of a Postcolumn Reagent for Trace Bromate Analysis," USEPA, July 2001, EPA 815-B-01-001, EPA Method 326.0, Revision 1.0, "Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography Incorporating the Addition of a Suppressor Acidified Postcolumn Reagent for Trace Bromate Analysis," USEPA, June 2002, EPA 815-R-03-007, EPA Method 327.0, Revision 1.1, "Determination of Chlorite Ion in Drinking Water Using Lissamine Green B and Horseradish Peroxidase with Detection by Visible Spectrophotometry," USEPA, May 2005, EPA 815-R-05-008 and EPA Method 552.3, Revision 1.0, "Determination of Haloacetic Acids and Dalapon in Drinking Water by Liquid-liquid Microextraction, Derivatization, and Gas Chromatography with Electron Capture Detection," USEPA, July 2003, EPA-815-B-03-002 can be accessed and downloaded directly on-line at <http://www.epa.gov/safewater/methods/sourcalt.html>. EPA Method 415.3, Revision 1.1, "Determination of Total Organic Carbon and Specific UV Absorbance at 254nm in Source Water and Drinking Water," USEPA, February 2005, EPA/600/R-05/055 can be accessed and downloaded directly online at [www.epa.gov/nerlcwww/ordmeth.htm](http://www.epa.gov/nerlcwww/ordmeth.htm). Standard Methods 4500-Cl D, 4500-Cl E, 4500-Cl F, 4500-Cl G, 4500-Cl H, 4500-Cl I, 4500-ClO<sub>2</sub> D, 4500-ClO<sub>2</sub> E, 6251 B, and 5910 B shall be followed in accordance with Standard Methods for the Examination of Water and Wastewater, 19<sup>th</sup> or 20<sup>th</sup> Editions, American Public Health Association, 1995 and 1998, respectively. The cited methods published in either edition may be used. Standard Methods shall be followed in accordance with the Supplement to the 19<sup>th</sup> Edition of Standard methods for the Examination of Water and Wastewater, or the Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition, American Public Health Association, 1996 and 1998, respectively. The cited methods published in either edition may be used. Copies may be obtained from the American Public Health Association, 1015 Fifteenth Street, NW, Washington, DC, 20005. Standard Methods 4500-Cl D-00, 4500-Cl E-00, 4500-Cl F-00, 4500-Cl G-00, 4500-Cl H-00, 4500-Cl I-00, 4500-ClO<sub>2</sub> E-00, 6251 B-94, 5310 B-00, 5310 C-00, and 5310 D-00, and 5910 B-00 are available at <http://www.standardmethods.org> or at EPA's Water Docket. The year in which each method was approved by the Standard Methods Committee is designated by the last two digits in the method number. The methods listed are the only Online versions that are IBR-approved. ASTM Methods D 1253-86 and D1253-86 (Reapproved 1996) shall be followed in accordance with the Annual Book of ASTM Standards, Volume 11.01, American Society for Testing and Materials International, 1996 or any ASTM edition containing the IBR-approved version of the method may be used. ASTM Standards, Volume 11.01, American Society for Testing and Materials International, 2004 or any ASTM edition containing the IBR-approved version of the method may be used. ASTM Method D 6581-00 shall be followed in accordance with the Annual Book Of ASTM Standards, Volume 11.01, American Society for Testing and Materials International, 2001 or any ASTM edition containing the IBR-approved version of the method may be used; copies may be obtained from the American Society for

B. Disinfection byproducts

1. Systems must measure disinfection byproducts by the methods (as modified by the footnotes) listed in the following table:

Table 1101-E-1 Approved Methods for Disinfection Byproduct Compliance Monitoring

| Contaminant and methodology <sup>1</sup>  | EPA method   | Standard method <sup>2</sup>         | SM Online <sup>9</sup>                     | ASTM method <sup>3</sup> |
|---|--|--------------------------------------|--|--------------------------|
| TTHM                                      |  |                                      |  |                          |
| P&T/GC/EICD & PID                         | 502.2 <sup>4</sup>                                 | .....                                | .....                                      |                          |
| P&T/GC/MS                                 | 524.2  | .....                                | .....                                      |                          |
| LLE/GC/ECD                                | 551.1  | .....                                | .....                                      |                          |
| HAA5                                      |  |                                      |  |                          |
| LLE(diamenthane)/GC/ECD                   | .....  | 6251 B <sup>5</sup>                  | 6251 B-94                                  |                          |
| SPE(acidic methanol)/GC/ECD               | 552.1 <sup>5</sup>                                 | .....                                | .....                                      |                          |
| LLE(acidic methanol)/GC/ECD               | 552.2, 552.3                                       | .....                                | .....                                      |                          |
| Bromate                                   |  |                                      |  |                          |
| Ion chromatography                        | 300.1  | .....                                | .....                                      | D 6581-00                |
| Ion chromatography & post column reaction | 317.0 Rev 2.0 <sup>6</sup> ,<br>326.0 <sup>6</sup> | .....                                | .....                                      |                          |
| IC/ICP-MS                                 | 321.8 <sup>6,7</sup>                               | .....                                | .....                                      |                          |
| Chlorite                                  |  |                                      |  |                          |
| Amperometric titration                    | .....  | 4500-CIO <sub>2</sub> E <sup>8</sup> | 4500-CIO <sub>2</sub><br>E-00 <sup>8</sup> |                          |
| Spectrophotometry                         | 327.0 Rev 1.1 <sup>8</sup>                         | .....                                | .....                                      |                          |
| Ion chromatography                        | 300.0, 300.1,<br>317.0, Rev 2.0,<br>326.0          | .....                                | .....                                      | D 6581-00                |

<sup>1</sup>P&T = purge and trap; GC=gas chromatography;EICD=electrolytic conductivity detector; PID=photoionization detector; MS=mass spectrometer; LLE=liquid/liquid extraction; ECD=electron capture detector;SPE=solid phase extraction; ICP-MS= inductively coupled plasma/mass spectrometer.

<sup>2</sup>19<sup>th</sup> and 20<sup>th</sup> editions of Standard Methods for the Examination of Water and Wastewater, 1995 and 1998, respectively, American Public Health Association; either of these editions may be used.

<sup>3</sup>Annual Book of ASTM Standards, 2001or any year containing the cited version of the method, Vol 11.01.

<sup>4</sup>If TTHMs are the only analytes being measured in the sample, then a PID is not required.

<sup>5</sup>The samples must be extracted within 14 days of sample collection.

<sup>6</sup>Ion chromatography & post column reaction or IC/ICP-MS must be used for monitoring of bromate for purposes of demonstrating eligibility or reduced monitoring, as prescribed in §1103(B)(3)(b).

<sup>7</sup>Samples must be preserved at the time of sampling with 50 mg ethylenediamine (EDA)/L of sample and must be analyzed within 28 days.

<sup>8</sup>Amperometric titration or spectrophotometry may be used for routine daily monitoring of chlorite at the entrance to the distribution system, as prescribed in §1103(B)(2)(a)(1). Ion chromatography must be used for routine monthly monitoring of chlorite and additional monitoring of chlorite in the distribution system, as prescribed in §1103(B)(2)(a)(2) and (B)(2)(b).

<sup>9</sup>The Standard Methods Online version that is approved is indicated by the last two digits in the method number which is the year of approval by the Standard Method Committee. Standard Methods Online are available at <http://www.standardmethods.org>.

2. Analyses under this section for disinfection byproducts must be conducted by laboratories that have received certification by EPA or the Director, except as specified under paragraph(D)(3) of this section. To receive certification to conduct analyses for the DBP contaminants in §§207, and Parts XXII and XXIII or this part, the laboratory must:
- Analyze Performance Evaluation (PE) samples that are acceptable to EPA at least once during each consecutive 12 month period by each method for which the laboratory desires certification.
  - Until March 31, 2007, in these analyses of PE samples, the laboratory must achieve quantitative results within the acceptance limit on a minimum of 80% of the analytes included in each PE sample. The acceptance limit is defined as the 95% confidence interval calculated around the mean of the PE study between a maximum and minimum acceptance limit of +/-50% and +/-15% of the study mean.
  - Beginning April 1, 2007, the laboratory must achieve quantitative results on the PE sample analyses that are within the following acceptance limits:

Table 1101-E-2 - Acceptance limits for Disinfection Byproducts

| DBP                   | Acceptance limits<br>(percent of true value) | Comments  |
|-----------------------|--|---|
| TTHM                  |  |   |
| Chloroform            | ±20  | Laboratory must meet all 4 individual THM acceptance limits in order to successfully pass a PE sample for TTHM                    |
| Bromodichloromethane  | ±20  |   |
| Dibromochloromethane  | ±20  |   |
| Bromoform             | ±20  |   |
| HAA5                  |  |   |
| Monochloroacetic Acid | ±40  | Laboratory must meet the acceptance limits for 4 out of 5 of the HAA5 compounds in order to successfully pass a PE sample of HAA5 |
| Dichloroacetic Acid   | ±40  |   |
| Trichloroacetic Acid  | ±40  |   |
| Monobromoacetic Acid  | ±40  |   |
| Dibromoacetic Acid    | ±40  |   |
| Chlorite              | ±30  |   |
| Bromate               | ±30  |   |

- Beginning April 1, 2007, report quantitative data for concentrations at least as low as the ones listed in the following table for all DBP samples analyzed for compliance with §§208, and Parts XXII and XXIII of this part:

Table 1103-E-3 Minimum Reporting Level for Disinfection Byproducts

| DBP                  | Minimum reporting<br>level (mg/L) <sup>1</sup> | Comments |
|----------------------|--|----------|
| TTHM <sup>2</sup>    |  |          |
| Chloroform           | 0.0010   |          |
| Bromodichloromethane | 0.0010   |          |

|                       |                  |  |
|-----------------------|------------------|--|
| Dibromochloromethane  | 0.0010           |  |
| Bromoform             | 0.0010           |  |
| HAA5 <sup>2</sup>     |                  |  |
| Monochloroacetic Acid | 0.0020           |  |
| Dichloroacetic Acid   | 0.0010           |  |
| Trichloroacetic Acid  | 0.0010           |  |
| Monobromoacetic Acid  | 0.0010           |  |
| Dibromoacetic Acid    | 0.0010           |  |
| Chlorite              | 0.020            | Applicable to monitoring as prescribed in §1103 (B)(2)(a)(ii) and (B)(2)(b)                                  |
| Bromate               | 0.0050 or 0.0010 | Laboratories that use EPA Methods 317.0 Revision 2.0, 326.0, or 312.8 must meet a 0.0010mg/L MRL for bromate |

<sup>1</sup>The calibration curve must encompass the regulatory minimum reporting level (MRL) concentrations lower than the regulatory MRL as long as the precision and accuracy criteria are met by analyzing an MRL check standard at the lowest reporting limit chosen by the laboratory. The laboratory must verify the accuracy of the calibration curve at the MRL concentration by analyzing an MRL check standard with a concentration less than or equal to 110% of the MRL with each batch of samples. The measured concentration for the MRL check standard must be ±50% of the expected value, if any field sample in the batch has a concentration less than 5 times the regulatory MRL. Method requirements to analyze higher concentration check standards and meet tighter acceptance criteria for them must be met in addition to the MRL check standard requirement.

<sup>2</sup>When adding the individual trihalomethane or haloacetic acid concentration to calculate the TTHM or HAA5 concentrations, respectively, a zero is used for any analytical results that is less than the MRL concentration for that DBP, unless otherwise specified by the Director.

3. A party approved by EPA or NNEPA must measure daily chlorite samples at the entrance to the distribution system.

C. Disinfectant residuals.

1. Systems must measure residual disinfectant concentrations for free chlorine, combined chlorine (chloramines), and chlorine dioxide by the methods listed in the following table:

Table 1101-E-4 Approved Methods for Disinfectant Residual Compliance Monitoring

| Methodology                      | Standard Method (19 <sup>th</sup> or 20 <sup>th</sup> ED) | SM Online <sup>2</sup> | ASTM method        | EPA method | Residual Measured <sup>1</sup> |                   |                |                  |
|----------------------------------|---|------------------------|--------------------|------------|--------------------------------|-------------------|----------------|------------------|
|                                  |   |                        |                    |            | Free Chlorine                  | Combined Chlorine | Total Chlorine | Chlorine dioxide |
| Amperometric Titration           | 4500-C D  | 4500-C D-00            | D 1253-86 (96), 03 |            | X                              | X                 | X              |                  |
| Low Level Amperometric Titration | 4500-C E  | 4500-C E-00            |                    |            |                                |                   | X              |                  |
| DPD Ferrous Titrimetric          | 4500-C F  | 4500-C F-00            |                    |            | X                              | X                 | X              |                  |
| DPD Colorimetric                 | 4500-C G  | 4500-C G-00            |                    |            | X                              | X                 | X              |                  |
| Syringaldazine                   | 4500-C H  | 4500-C                 |                    |            | X                              |                   |                |                  |

|                                     |                         |                            |  |           |  |  |   |   |
|-------------------------------------|-------------------------|----------------------------|--|-----------|--|--|---|---|
| (FACTS)                             |                         | H-00                       |  |           |  |  |   |   |
| Iodometric Electrode                | 4500-C I                | 4500-C I-00                |  |           |  |  | X |   |
| DPD                                 | 4500-C O <sub>2</sub> D |                            |  |           |  |  |   | X |
| Amperometric Method II              | 4500 C O <sub>2</sub> E | 4500-C O <sub>2</sub> E-00 |  |           |  |  |   | X |
| Lissamine Green Spectrophotometric. |                         |                            |  | 327.0 Rev |  |  |   | X |

<sup>1</sup>X indicates method is approved for measuring specified disinfectant residual. Free chlorine or total chlorine may be measured for demonstrating compliance with the chlorine MRDL and combined chlorine, or total chlorine may be measured for demonstrating compliance with the chloramine MRDL.

<sup>2</sup>The standard Methods Online version that is approved is indicated by the last two digits in the method number which is the year of approval by the Standard Method Committee. Standard Methods Online are available at <http://www.standardmethods.org>.

2. If approved by the NNEPA, systems may also measure residual disinfectant concentrations for chlorine, chloramines, and chlorine dioxide by using DPD colorimetric test kits.
3. A party approved by EPA or NNEPA must measure residual disinfectant concentration.

D. Additional analytical methods. Systems required to analyze parameters not included in paragraphs (B) and (C) of this section must use the following methods. A party approved by EPA or NNEPA must measure these parameters.

1. Alkalinity. All methods allowed in Appendix C § 701-C (A) for measuring alkalinity.
2. Bromide. EPA Method 300.0, 300.1, 317.0 Revision 2.0, 326.0, or ASTM D 6581-00.
3. Total Organic Carbon (TOC). Standard Method 5310 B or 5310 B-00 (High-Temperature Combustion Method) or Standard Method 5310 C or 5210 C-00 (Persulfate-Ultraviolet or Heated-Persulfate Oxidation Method) or Standard Method 5310 D or 5310 D-00(Wet-Oxidation Method) or EPA Method 415.3 Revision 1.1. Inorganic carbon must be removed from the samples prior to analyses. TOC samples may not be filtered prior to analysis. TOC samples must be acidified at the time of sample collection to achieve pH less than or equal to 2 with minimal addition of the acid specified in the method or by the instrument manufacturer. Acidified TOC samples must be analyzed within 28 days.
4. Specific Ultraviolet Absorbance (SUVA). SUVA is equal to the UV absorption at 254nm (UV<sub>254</sub>) (measured in m<sup>-1</sup> divided by the dissolved organic carbon (DOC) concentration (measured as mg/L). In order to determine SUVA, it is necessary to separately measure UV<sub>254</sub> and DOC. When determining SUVA, systems must use the methods stipulated in paragraph (D)(4)(i) of this section to measure DOC and the method stipulated in paragraph (D)(4)(ii) of this section to measure (UV<sub>254</sub>). SUVA must be determined on water prior to the addition of disinfectants/oxidants by the system. DOC and (UV<sub>254</sub>) samples used to determine a SUVA value must be taken at the same time and at the same location.
  - a. Dissolved Organic Carbon (DOC). Standard Method 5310 B or 5310 B-00(High- Temperature Combustion Method) or Standard Method 5310 C or 5310 C-00(Persulfate- Ultraviolet or Heated-Persulfate Oxidation Method) or Standard Method 5310 D or 5310 D-00(Wet-Oxidation Method) or EPA method 415.3 Revision 1.1. DOC samples must be filtered through the 0.45 µm pore diameter filter as soon as practical after sampling, not to exceed 48 hours. After filtration, DOC samples must be acidified to achieve pH less than or equal to 2 with minimal addition of the acid specified in the method or by the instrument manufacturer. Acidified DOC samples must be analyzed within 28 days of sample collection. Inorganic carbon must be removed from the samples prior to analysis. Water passed through the filter prior to filtration of the sample must serve as the filtered blank. This filtered blank must be analyzed using procedures identical to those used for analysis of the samples and must meet the following criteria: DOC <0.5mg/L.

- b. Ultraviolet Absorption at 254 nm (UV<sub>254</sub>). Method 5910 B or 5910 B-00 (Ultraviolet Absorption Method) or EPA Method 415.3 Revision 1.1. UV absorption must be measured at 253.7 nm (may be rounded off to 254 nm). Prior to analysis, UV<sub>254</sub> samples must be filtered through a 0.45 μm pore-diameter filter. The pH of UV<sub>254</sub> samples may not be adjusted. Samples must be analyzed as soon as practical after sampling, not to exceed 48 hours.
- 5. pH. All methods allowed in Appendix A § 403-A (A) for measuring pH.
- 6. Magnesium. All methods allowed in Appendix A-403-A (A)(1.)

**Appendix F  
CONSUMER CONFIDENCE REPORT**

**Regulated Contaminants**

| Contaminant (units)                         | Traditional MCL mg/L  | To convert for CCR, multiply by.. | MCL in CCR units  | MCLG | Major Sources in Drinking Water       | Health Effects Language   |
|---|---|-----------------------------------|---|------|---------------------------------------|---|
| <b>Microbiological Contaminants</b>         |   |                                   |   |      |                                       |   |
| Total Coliform Bacteria                     | MCL: (systems that collect ≥40 samples/month) 5% of monthly samples are positive; (systems that collect <40 samples/month) 1 positive monthly sample. |                                   | MCL: (systems that collect ≥40 samples/month) 5% of monthly samples are positive; (systems that collect <40 samples/month) 1 positive monthly sample. | 0    | Naturally present in the environment. | Coliforms are bacteria that are naturally present in the environment and are used as a indicator that other, potentially-harmful, bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.  |
| Fecal Coliform and E.coli                   | 0   |                                   | 0   | 0    | Human and animal fecal waste          | Fecal coliforms and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems. |
| Fecal Indicators (enterococci or coliphage) | TT  |                                   | TT  | N/A  | Human and animal fecal waste.         | Fecal indicators are microbes whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.     |
| Total organic                               |   |                                   |   |      | Naturally present in                  | Total organic carbon (TOC) has no health effects.   |

|                                  |             |      |    |     |  |  |
|----------------------------------|-------------|------|----|-----|--|--|
| carbon (ppm)                     | TT          |      | TT | N/A | the environment.   | However, total organic carbon provides a medium for the formation of disinfection by products. These byproducts include trihalomethanes (THMs) and haloacetic acids (HAAs). Drinking water containing these byproducts in excess of the MCL may lead to adverse health effects, liver or kidney problems or nervous system effects, and may lead to an increased risk of getting cancer. |
| Turbidity (NTU)                  | TT          |      |    | N/A | Soil runoff.   | Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches.   |
| Radioactive Contaminants         |             |      |    |     |  |  |
| Beta/photon emitters (mrem/year) | 4 mrem/year |      | 4  | 0   | Decay of natural and man-made deposits.  | Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.   |
| Alpha emitters (pCi/l)           | 15 pCi/l    |      | 15 | 0   | Erosion of natural deposits.   | Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.   |
| Combined radium (pCi/l)          | 5 pCi/l     |      | 5  | 0   | Erosion of natural deposits.   | Some people who drink water containing radium 226 or 228 in excess of the MCL over many years may have an increase risk of getting cancer.   |
| Uranium                          | 30µg/L      |      | 30 | 0   | Erosion of natural deposits  | Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer and kidney toxicity.  |
| Inorganic Contaminants           |             |      |    |     |  |  |
| Antimony (ppb)                   | 0.006       | 1000 | 6  | 6   | Discharge from petroleum refineries; fire retardants; ceramics; electronics, solder. | Some people who drink water containing antimony well in excess of the MCL over many years could experience increases in blood cholesterol and decreases in blood sugar.  |

|                   |                    |      |                 |                |  |  |
|-------------------|--------------------|------|-----------------|----------------|--|--|
| Arsenic (ppb)     | <sup>1</sup> 0.010 | 1000 | <sup>1</sup> 10 | <sup>1</sup> 0 | Erosion of natural deposits; runoff from orchards; runoff from glass and electronics production wastes.                              | Some people who drink water containing arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.  |
| Asbestos (MFL)    | 7 MFL              |      | 7               | 7              | Decay of asbestos cement water mains; erosion of natural deposits.   | Some people who drink water containing asbestos in excess of the MCL over many years may have an increased risk of developing benign intestinal polyps.  |
| Barium (ppm)      | 2                  |      | 2               | 2              | Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits.  | Some people who drink water containing barium in excess of the MCL over many years could experience an increase in their blood pressure.   |
| Beryllium (ppb)   | 0.004              | 1000 | 4               | 4              | Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries.            | Some people who drink water containing beryllium well in excess of the MCL over many years could develop intestinal lesions.   |
| Bromate (ppb)     | 0.01               | 1000 | 10              | 0              | By-product of drinking water chlorination.   | Some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of getting cancer.  |
| Cadmium (ppb)     | 0.005              | 1000 | 5               | 5              | Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints. | Some people who drink water containing cadmium in excess of the MCL over many years could experience kidney damage.  |
| Chloramines (ppm) | MRDL = 4           |      | MRDL = 4        | MRDL<br>G =4   | Water additive used to control microbes  | Some people who use water containing chloramines well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chloramines well in excess of the MRDL could experience stomach discomfort or anemia. |
| Chlorine (ppm)    | MRDL =4            |      | MRDL = 4        | MRDL<br>G =4   | Water additive used to control microbes  | Some people who use water containing chlorine well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chlorine well in excess of the MRDL could experience stomach                             |

|                        |            |      |           |              |  |   |
|------------------------|------------|------|-----------|--------------|--|---|
|                        |            |      |           |              |  | discomfort.   |
| Chlorite (ppm)         | 1          |      | 1         | 0.8          | By-product of drinking water chlorination.   | Some infants and young children who drink water containing chlorite in excess of the MCL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorite in excess of the MCL. Some people may experience anemia.   |
| Chloride dioxide (ppb) | MRDL = 0.8 | 1000 | MRDL =800 | MRDL G = 800 | Water additive used to control microbes.   | Some infants and young children who drink water containing chlorine dioxide in excess of the MRDL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorine dioxide in excess of the MRDL. Some people may experience anemia.   |
| Chromium (ppb)         | 0.1        | 1000 | 100       | 100          | Discharge from steel and pulp mills; erosion of natural deposits.  | Some people who use water containing chromium well in excess of the MCL over many years could experience allergic dermatitis.   |
| Copper (ppm)           | AL=1.3     |      | AL=1.3    | 1.3          | Corrosion of household plumbing systems; erosion of natural deposits; Leaching from wood preservatives.                    | Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.   |
| Cyanide (ppb)          | 0.2        | 1000 | 200       | 200          | Discharge from steel/metal factories; discharge from plastic and fertilizer factories.                                     | Some people who drink water containing cyanide well in excess of the MCL over many years could experience nerve damage or problems with their thyroid.  |
| Fluoride (ppm)         | 4          |      | 4         | 4            | Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories. | Some people who drink water containing fluoride in excess of the MCL over many years could get bone disease, including pain and tenderness of the bones. Fluoride in drinking water at half of the MCL or more may cause mottling of children's teeth, usually in children less than nine years old. Mottling, also known as dental fluorosis, may include brown staining and/or pitting of the teeth, and occurs only in developing teeth before they erupt from the gums. |

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| Lead (ppb)   | AL=0.015 | 1000 | AL=15 | 0   | Corrosion of household plumbing systems; erosion of natural deposits.  | Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. |
| Mercury [inorganic] (ppb)  | 0.002    | 1000 | 2     | 2   | Erosion of natural deposits; discharge from refineries and factories; runoff from landfills; runoff from cropland. | Some people who drink water containing inorganic mercury well in excess of the MCL over many years could experience kidney damage.  |
| Nitrate (ppm)  | 10       |      | 10    | 10  | Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.                       | Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.   |
| Nitrite (ppm)  | 1        |      | 1     | 1   | Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.                       | Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.   |
| Selenium (ppb)   | 0.05     | 1000 | 50    | 50  | Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines.                  | Selenium is an essential nutrient. However, some people who drink water containing selenium in excess of the MCL over many years could experience hair or fingernail losses, numbness in fingers or toes, or problems with their circulation.   |
| Thallium (ppb)   | 0.002    | 1000 | 2     | 0.5 | Leaching from ore-processing sites; discharge from electronic, glass and drug factories.                           | Some people who drink water containing thallium in excess of the MCL over many years could experience hair loss, changes in their blood, or problems with their kidneys, intestines, or liver.  |
| Synthetic Organic contaminants including Pesticides and Herbicides |          |      |       |     |  |   |
| 2,4-D (ppb)  | 0.07     | 1000 | 70    | 70  | Runoff from herbicide used on row crops.   | Some people who drink water containing the weed killer 2,4-D well in excess of the MCL over many years could experience problems with their kidneys, liver, or adrenal glands.  |

|                                    |        |           |     |     |  |   |
|------------------------------------|--------|-----------|-----|-----|--|---|
| 2,4,5-TP [Silvex] (ppb)            | 0.05   | 1000      | 50  | 50  | Residue of banned herbicide.   | Some people who drink water containing silvex in excess of the MCL over many years could experience liver problems.   |
| Acrylamide                         | TT     |           | TT  | 0   | Added to water during sewage/wastewater treatment.                   | Some people who drink water containing high levels of acrylamide over a long period of time could have problems with their nervous system or blood, and may have an increased risk of getting cancer.                       |
| Alachlor (ppb)                     | 0.002  | 1000      | 2   | 0   | Runoff from herbicide used on row crops.                             | Some people who drink water containing alachlor in excess of the MCL over many years could have problems with their eyes, liver, kidneys or spleen, or experience anemia, and may have an increased risk of getting cancer. |
| Atrazine (ppb)                     | 0.003  | 1000      | 3   | 3   | Runoff from herbicide used on row crops.                             | Some people who drink water containing atrazine well in excess of the MCL over many years could experience problems with their cardiovascular system or reproductive difficulties.  |
| Benzo(a)pyrene [PAH] (nanograms/l) | 0.0002 | 1,000,000 | 200 | 0   | Leaching from linings of water storage tanks and distribution lines. | Some people who drink water containing benzo(a)pyrene in excess of the MCL over many years may experience reproductive difficulties and may have an increased risk of getting cancer.                                       |
| Carbofuran (ppb)                   | 0.04   | 1000      | 40  | 40  | Leaching of soil fumigant used on rice and alfalfa.                  | Some people who drink water containing carbofuran in excess of the MCL over many years could experience problems with their blood, or nervous or reproductive systems.  |
| Chlordane (ppb)                    | 0.002  | 1000      | 2   | 0   | Residue of banned termiticide  | Some people who drink water containing chlordane in excess of the MCL over many years could experience problems with their liver or nervous system, and may have an increased risk of getting cancer.                       |
| Dalapon (ppb)                      | 0.2    | 1000      | 200 | 200 | Runoff from herbicide used on rights of way.                         | Some people who drink water containing dalapon well in excess of the MCL over many years could experience minor kidney changes.   |
| Di(2-ethylhexyl)adipate (ppb)      | 0.4    | 1000      | 400 | 400 | Discharge from chemical factories.                                   | Some people who drink water containing di(2-ethylhexyl)adipate in excess of the MCL over many years could experience general toxic effects such as weight loss, liver enlargement, or possible reproductive difficulties.   |
| Di(2-ethylhexyl)phthalate (ppb)    | 0.006  | 1000      | 6   | 0   | Discharge from rubber and chemical factories.                        | Some people who drink water containing di(2-ethylhexyl)phthalate in excess of the MCL over many years may have problems with their  |

|                             |            |               |     |     |  |  |
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|                             |            |               |     |     |  | liver, or experience reproductive difficulties and may have an increased risk of getting cancer.   |
| Dibromochloropropane (ppt)  | 0.0002     | 1,000,000     | 200 | 0   | Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards.       | Some people who drink water containing DBCP in excess of the MCL over many years could experience reproductive problems and may have an increased risk of getting cancer.  |
| Dinoseb (ppb)               | 0.007      | 1000          | 7   | 7   | Runoff from herbicide used on soybeans and vegetables.                                       | Some people who drink water containing dinoseb well in excess of the MCL over many years could experience reproductive difficulties.   |
| Diquat (ppb)                | 0.02       | 1000          | 20  | 20  | Runoff from herbicide use.   | Some people who drink water containing diquat in excess of the MCL over many years could get cataracts.  |
| Dioxin [2,3,7,8-TCDD] (ppq) | 0.00000003 | 1,000,000,000 | 30  | 0   | Emissions from waste incineration and other combustion; discharge from chemical factories.   | Some people who drink water containing dioxin in excess of the MCL over many years could experience difficulties and may have an increased risk of getting cancer.   |
| Endothall (ppb)             | 0.1        | 1000          | 100 | 100 | Runoff from herbicide use.   | Some people who drink water containing endothall in excess of the MCL over many years could experience problems with their stomach or intestines.  |
| Endrin (ppb)                | 0.002      | 1000          | 2   | 2   | Residue of banned insecticide.   | Some people who drink water containing endrin in excess of the MCL over many years could experience liver problems.  |
| Epichlorohydrin             | TT         |               | TT  | 0   | Discharge from industrial chemical factories; an impurity of some water treatment chemicals. | Some people who drink water containing high levels of epichlorohydrin over a long period of time could experience stomach problems, and may have an increased risk of getting cancer.  |
| Ethylene dibromide (ppt)    | 0.00005    | 1,000,000     | 50  | 0   | Discharge from petroleum refineries.   | Some people who drink water containing ethylene dibromide in excess of the MCL over many years could experience problems with their liver, stomach, reproductive system, or kidneys, and may have an increased risk of getting cancer. |
| Glyphosate (ppb)            | 0.7        | 1000          | 700 | 700 | Runoff from herbicide use.   | Some people who drink water containing glyphosate in excess of the MCL over many years could experience problems with their kidneys or reproductive difficulties.  |

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| Heptachlor (ppt)                       | 0.0004 | 1,000,000 | 400 | 0   | Residue of banned pesticide.   | Some people who drink water containing heptachlor in excess of the MCL over many years could experience liver damage and may have an increase risk of getting cancer.  |
| Heptachlor epoxide (ppt)               | 0.0002 | 1,000,000 | 200 | 0   | Breakdown of heptachlor.   | Some people who drink water containing heptachlor epoxide in excess of the MCL over many years could experience liver damage, and may have an increased risk of getting cancer.  |
| Hexachlorobenzene (ppb)                | 0.001  | 1000      | 1   | 0   | Discharge from metal refineries and agricultural chemical factories.             | Some people who drink water containing hexachlorobenzene in excess of the MCL over many years could experience problems with their liver or kidneys, or adverse reproductive effects, and may have an increased risk of getting cancer.  |
| Hexachlorocyclopenta-diene (ppb)       | 0.05   | 1000      | 50  | 50  | Discharge from chemical factories.   | Some people who drink water containing hexachlorocyclopentadiene well in excess of the MCL over many years could experience problems with their kidneys or stomach.  |
| Lindane (ppt)                          | 0.0002 | 1,000,000 | 200 | 200 | Runoff/leaching from insecticide used on cattle, lumber, gardens.                | Some people who drink water containing lindane in excess of the MCL over many years could experience problems with their kidneys or liver.   |
| Methoxychlor (ppb)                     | 0.04   | 1000      | 40  | 40  | Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock. | Some people who drink water containing methoxychlor in excess of the MCL over many years could experience reproductive difficulties.   |
| Oxamyl [Vydate] (ppb)                  | 0.2    | 1000      | 200 | 200 | Runoff/leaching from insecticide used on apples, potatoes and tomatoes.          | Some people who drink water containing oxamyl in excess of the MCL over many years could experience slight nervous system effects.   |
| PCB [Polychlorinated bi-phenyls] (ppt) | 0.0005 | 1,000,000 | 500 | 0   | Runoff from landfills; discharge of waste chemicals                              | Some people who drink water containing PCBs in excess of the MCL over many years could experience changes in their skin problems with their thymus gland, immune deficiencies, or reproductive or nervous system difficulties, and may have an increased risk of getting cancer. |
| Pentachlorophenol (ppb)                | 0.001  | 1000      | 1   | 0   | Discharge from wood preserving factories.  | Some people who drink water containing pentachlorophenol in excess of the MCL over many years could experience problems with their liver or kidneys, and may have an increased risk of getting cancer.   |
| Picloram (ppb)                         | 0.5    | 1000      | 500 | 500 | Herbicide runoff   | Some people who drink water containing picloram  |

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|                                |       |      |     |     |  | in excess of the MCL over many years could experience problems with their liver.   |
| Simazine (ppb)                 | 0.004 | 1000 | 4   | 4   | Herbicide runoff   | Some people who drink water containing simazine in excess of the MCL over many years could experience problems with their blood.   |
| Toxaphene (ppb)                | 0.003 | 1000 | 3   | 0   | Runoff/leaching from insecticide used in cotton and cattle.              | Some people who drink water containing toxaphene in excess of the MCL over many years could have problems with their kidneys, liver, or thyroid, and may have an increased risk of getting cancer. |
| Volatile organic contaminants: |       |      |     |     |  |  |
| Benzene (ppb)                  | 0.005 | 1000 | 5   | 0   | Discharge from factories; Leaching from gas storage tanks and landfills. | Some people who drink water containing benzene in excess of the MCL over many years could experience anemia or a decrease in blood platelets, and may have an increase risk of getting cancer.     |
| Carbon tetrachloride (ppb)     | 0.005 | 1000 | 5   | 0   | Discharge from chemical plants and other industrial activities           | Some people who drink water containing carbon tetrachloride in excess of the MCL over many years could experience problems with their liver and may have an increased risk of getting cancer.      |
| Chlorobenzene (ppb)            | 0.10  | 1000 | 100 | 100 | Discharge from chemical and agricultural chemical factories.             | Some people who drink water containing chlorobenzene in excess of the MCL over many years could experience problems with their liver or kidneys.   |
| o-Dichlorobenzene (ppb)        | 0.60  | 1000 | 600 | 600 | Discharge from industrial chemical factories.                            | Some people who drink water containing o-dichlorobenzene well in excess of the MCL over many years could experience problems with their liver, kidneys or circulatory systems.                     |
| p-Dichlorobenzene (ppb)        | 0.075 | 1000 | 75  | 75  | Discharge from industrial chemical factories.                            | Some people who drink water containing p-dichlorobenzene well in excess of the MCL over many years could experience problems with their liver, kidneys, or circulatory systems.                    |
| 1,2-Dichloroethane (ppb)       | 0.005 | 1000 | 5   | 0   | Discharge from industrial chemical factories.                            | Some people who drink water containing 1,2-dichloroethane in excess of the MCL over many years may have an increased risk of getting cancer.   |
| 1,1-Dichloroethylene (ppb)     | 0.007 | 1000 | 7   | 7   | Discharge from industrial chemical factories.                            | Some people who drink water containing 1,1-dichloroethylene in excess of the MCL over many years could experience problems with their liver.   |

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| cis-1,2,-Dichloroethylene (ppb)  | 0.07  | 1000 | 70  | 70  | Discharge from industrial chemical factories.                         | Some people who drink water containing cis-1,2-dichloroethylene in excess of the MCL over many years could experience problems with their liver.  |
| trans-1,2-Dichloroethylene (ppb) | 0.10  | 1000 | 100 | 100 | Discharge from industrial chemical factories.                         | Some people who drink water containing trans-1,2-dichloroethylene well in excess of the MCL over many years could experience problems with their liver.                                 |
| Dichloromethane (ppb)            | 0.005 | 1000 | 5   | 0   | Discharge from pharmaceutical and chemical factories.                 | Some people who drink water containing dichloromethane in excess of the MCL over many years could have liver problems and may have an increased risk of getting cancer.                 |
| 1,2-Dichloropropane (ppb)        | 0.005 | 1000 | 5   | 0   | Discharge from industrial chemical factories.                         | Some people who drink water containing 1,2-dichloropropane in excess of the MCL over many years may have an increased risk of getting cancer.   |
| Ethylbenzene (ppb)               | 0.7   | 1000 | 700 | 700 | Discharge from petroleum refineries.                                  | Some people who drink water containing ethylbenzene well in excess of the MCL over many years could experience problems with their liver or kidneys.                                    |
| Haloacetic Acids (HAA) (ppb)     | 0.06  | 1000 | 60  | N/A | By-product of drinking water disinfection.                            | Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increase risk of getting cancer.   |
| Styrene (ppb)                    | 0.1   | 1000 | 100 | 100 | Discharge from rubber and plastic factories; leaching from landfills. | Some people who drink water containing styrene well in excess of the MCL over many years could have problems with their liver, kidneys, or circulatory system.                          |
| Tetrachloroethylene (ppb)        | 0.005 | 1000 | 5   | 0   | Discharge from factories and dry cleaners.                            | Some people who drink water containing tetrachloroethylene in excess of the MCL over many years could have problems with their liver, and may have an increased risk of getting cancer. |
| 1,2,4-Trichlorobenzene (ppb)     | 0.07  | 1000 | 70  | 70  | Discharge from textile-finishing factories.                           | Some people who drink water containing 1,2,4-trichlorobenzene well in excess of the MCL over many years could experience changes in their adrenal glands.                               |
| 1,1,1,-Trichloroethane (ppb)     | 0.2   | 1000 | 200 | 200 | Discharge from metal degreasing sites and other factories.            | Some people who drink water containing 1,1,1-trichloroethane in excess of the MCL over many years could experience problems with their liver, nervous system, or circulatory system.    |

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| 1,1,2-Trichloroethane (ppb)         | 0.005     | 1000 | 5      | 3   | Discharge from industrial chemical factories.                          | Some people who drink water containing 1,1,2-trichloroethane well in excess of the MCL over many years could have problems with their liver, kidneys or immune systems.  |
| Trichloroethylene (ppb)             | 0.005     | 1000 | 5      | 0   | Discharge from metal degreasing sites and other factories.             | Some people who drink water containing trichloroethylene in excess of the MCL over many years could experience problems with their liver and may have an increased risk of getting cancer.   |
| TTHMs [Total trihalomethanes] (ppb) | 0.10/0.08 | 1000 | 100/80 | N/A | By-product of drinking water chlorination.                             | Some people who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys or central nervous systems, and may have an increased risk of getting cancer.  |
| Toluene (ppm)                       | 1         |      | 1      | 1   | Discharge from petroleum factories.                                    | Some people who drink water containing toluene well in excess of the MCL over many years could have problems with their nervous system, kidneys or liver.  |
| Vinyl Chloride (ppb)                | 0.002     | 1000 | 2      | 0   | Leaching from PVC piping; discharge from plastics factories.           | Some people who drink water containing vinyl chloride in excess of the MCL over many years may have an increased risk of getting cancer.   |
| Xylenes (ppm)                       | 10        |      | 10     | 10  | Discharge from petroleum factories; discharge from chemical factories. | Some people who drink water containing xylenes in excess of the MCL over many years could experience damage to their nervous system.   |
| Radioactive Contaminants:           |           |      |        |     |  |  |
| Beta/photon emitters (mrem/yr)      | 4 mrem/yr |      | 4      | 0   | Decay of natural and man-made deposits.                                | Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta particle and photon radioactivity in excess of the MCL over many years may have an increased risk of getting cancer. |
| Alpha emitters (pCi/L)              | 15 pCi/L  |      | 15     | 0   | Erosion of natural deposits.   | Certain minerals are radioactive and may emit forms of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.                                    |
| Combined radium (pCi/L)             | 5 pCi/L   |      | 5      | 0   | Erosion of natural deposits.   | Some people who drink water containing radium-226 or -228 in excess of the MCL over many years may have an increased risk of getting   |

|                             |                    |  |    |   |                              |   |
|-----------------------------|--------------------|--|----|---|------------------------------|---|
|                             |                    |  |    |   |                              | cancer.   |
| Uranium ( $\mu\text{g/L}$ ) | 30 $\mu\text{g/L}$ |  | 30 | 0 | Erosion of natural deposits. | Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer and kidney toxicity. |

<sup>1</sup> These arsenic values are effective January 23, 2006. Until then, the MCL is 0.05 mg/L and there is no MCLG.

| Key       |  |
|-----------|--|
| AL        | Action Level   |
| MCL       | Maximum Contaminant Level  |
| MCLG      | Maximum Contaminant Level Goal                                   |
| MFL       | Million fibers per liter   |
| MRDL      | Maximum Residual Disinfectant Level                              |
| MRDLG     | Maximum Residual Disinfectant Level Goal                         |
| mrem/year | Millirems per year (a measure of radiation absorbed by the body) |
| N/A       | Not Applicable   |
| NTU       | Nephelometric Turbidity (a measure of water clarity)             |
| pCi/L     | Picocuries per liter (a measure radioactivity)                   |
| ppm       | Parts per million or milligrams per liter (mg/L)                 |
| ppb       | Parts per billion or micrograms per liter ( $\mu\text{g/L}$ )    |
| ppt       | Parts per trillion or nanograms per liter                        |
| ppq       | Parts per quadrillion or picograms per liter                     |
| TT        | Treatment Technique  |