EPB 338 – Wastewater Works Compliance Monitoring

Introduction

Wastewater quality monitoring is an important function in the operation of a wastewater treatment facility. Some reasons for monitoring include:

- determining operational and treatment performance;
- evaluating upsets, spills, unscheduled releases, or issue oriented concerns;
- determining industrial inputs or site-specific evaluation;
- determining compliance; and
- determining the impact of the effluent or biosolids on agricultural land.

The wastewater monitoring guidelines presented in this document are for compliance monitoring of existing facilities where no outstanding health or environmental issues are occurring. They do not include other process-oriented or site-specific monitoring, sites where effluent irrigation is practiced or upset or spill monitoring which may be required at a specific location.

2. Compliance Monitoring Guidelines

These compliance monitoring guidelines are intended to revise the approach taken by the Water Security Agency staff in determining requirements for wastewater effluent monitoring consistent with the need for present and emerging environmental protection issues and in a manner which is cost effective for permittees. These compliance monitoring guidelines are also intended to compliment the Government of Canada's *Wastewater Systems Effluent Regulations* made pursuant to the *Fisheries Act* as well as the Canadian Council of Ministers of the Environment (CMME) Municipal Wastewater Strategy.

These guidelines are in part based on maximum flow volume of discharge. This maximum flow discharge is determined by the design flow capacity of the facility, or the actual annual average flow, whichever is highest. If there is no data to determine the actual annual average flow, flow shall be determined by assuming a per capita flow of 0.5 m^3/day or 110 igal/day. **Table 2.1** indicates approximate population ranges for the effluent flow volumes indicated in **Tables 9.1 to 9.3**.

Table 2.1 Approximate Population Ranges Based on Effluent Flow Rates

Flow (m^3/day)	Approximate Population
500	1000
>500-2,500	>1000-5000
>2,500-17,500	>5000-35000
>17,500-50,000	>35000-100,000
>50,000	>100,000

The compliance monitoring guidelines for municipal wastewater works are shown in **Tables 9.1 to 9.3**. These guidelines are for effluent monitoring only and do not include upstream and downstream monitoring requirements where effluent is entering fish-bearing waters. Where the effluent flow is between 15 and 25 per cent of the cross-sectional area or volume of flow, near one-third of the receiving stream width or is deemed necessary as a result of the receiving environment's sensitivity, upstream and downstream monitoring should be considered.

Table 9.1 includes possible minimum monitoring scenarios for certain wastewater treatment systems that do not discharge to surface waters. However, additional monitoring may be required if necessitated by historical data, site assessment, past operating records, complaints, or knowledge of a particular facility. The final monitoring requirements should be determined by the Environmental Project Officer (EPO) in accordance with the specific wastewater operation in question.

The monitoring frequencies for acute lethality testing listed in **Tables 9.2 and 9.3** are the minimum required frequency.

The monitoring frequencies for fish bearing water receiving environments are listed in **Table 9.4** and are the minimum required frequency.

Monitoring guidelines for effluent irrigation projects should be in accordance with *EPB 235, Treated Municipal Wastewater Irrigation Guidelines.*

Monitoring guidelines for bio-solids and sewage sludge should be in accordance with *EPB 296, Land Application of Municipal Sewage Sludge Guidelines*.

3. Risk Assessment

To assist EPOs in evaluating the relative risk of municipal wastewater systems on human health and the environment, it is suggested that the Water Security Agency's Relative Rating for Wastewater Works (May 2004) be used as a guide.

4. Safety

Wastewater, whether raw or treated, has the potential to harbor pathogens or toxic substances. Preservatives, which may need to be added to samples, can also have harmful effects if used incorrectly. As a result, proper personal protection equipment and caution must be utilized when sampling or working around wastewater treatment facilities.

5. Collection, Preservation and Analysis of Samples

The intent of any monitoring program is to ensure that sample(s) are collected accurately and represent the population being tested.

Samples can be collected using composite or grab sample methods. "Composite sample" means the collection of a number of small samples (typically twenty-four composite portions of equal volume or twenty-four composite samples directly proportional to the flow rate of the effluent being discharged) collected together to produce an "average" sample composition. A "grab sample" is a single sample taken from a specific location at a specific time.
The size and type of containers, preservation and shipping methods are issues that need to be considered prior to sampling. Sampling equipment and containers must be clean in order to prevent cross-contamination problems. Samples should be collected and preserved as per permit requirements, or as set out in Standard Methods for the Examination of Water and Wastewater, 22nd Edition (or any updated version) or, as designated by the laboratory carrying out the testing. Any special monitoring not identified in Standard Methods, 22nd Edition would require approval of the analytical procedure from the Water Security Agency.

Where possible all wastewater samples collected, other than those that are indicated as "onsite tests" or "field tests" are to be analyzed in an "Accredited Laboratory" that has been accredited in the analytical method for whichever test is being completed.

6. Glossary

The following abbreviations and terms are used in tables below.

Accredited Laboratory	A laboratory that is accredited under the International Organization for Standardization standard ISO/IEC 17025:2005 entitled *General requirements for the competence of testing and calibration laboratories*, as amended from time to time, by an accrediting body that is a signatory to the *International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement* or a laboratory that is accredited under the *Environment Quality Act,* R.S.Q., c. Q-2, as amended from time to time, by an accredited body that is recognized in accordance with the Act.
Acute Lethality	An effluent sample that at 100% concentration, during a 96 hour period, kills more than 50% of the rainbow trout subject to it. - Acute Lethality Testing – Rainbow Trout EPS 1/RM/13
CBOD	Carbonaceous Biochemical Oxygen Demand is a method defined test measured by the depletion of dissolved oxygen by biological organisms in a body of water in which the contribution from nitrogenous bacteria has been suppressed. CBOD is a method defined parameter is widely used as an indication of the pollutant removal from wastewater.
Cl	Chloride
Conductivity	Conductivity at 25°C
Continuous Discharge Wastewater System	Any wastewater treatment system that does not meet the definition of "Intermittent Discharge"
E. coli	Escherichia coli
Fish Bearing Waters	A water body frequented by fish or parts of fish, shellfish, crustaceans, marine animals, or parts of shellfish crustaceans and marine animals, as well as the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
Intermittent Discharge Wastewater System	A wastewater treatment system with a hydraulic retention time of at least 90 days that discharges effluent not more than 4 times per calendar year; each discharge being separated from another by at least 7 days.
K	Potassium
NH_3-N	Ammonia
NO_3	Nitrate
pH (field)	pH, measurement taken in the field
TC	Total Coliforms
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
Temp. (field)	Temperature, measurement taken in the field
TSS	Total Suspended Solids

7. Additional Monitoring Parameters

The following are a list of parameters that may be added to the minimum compliance monitoring requirements based on the discretion of the EPO. This is not an exhaustive list of potential additional monitoring parameters and,

therefore, EPOs may specify monitoring of parameters not included in this list. Please refer to CCME's Canada-wide Strategy for the Management of Municipal Wastewater Effluent for more detail regarding the need for monitoring these additional parameters.

Chronic Toxicity	Chronic Toxicity Testing - Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia* (EPS1/RM/21) and Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows (EPS1/RM/22)
Enterococci	Enterococci Bacteria testing may be incorporated if public health officials consider this the most appropriate indicator of faecal contamination in recreational receiving waters.
Major Ions	Bicarbonate, Calcium, Carbonate, Chloride, Magnesium, Nitrate, Potassium, Sodium, Sulfate, Total Alkalinity, Total Hardness
Metals Scan	Aluminum, Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Uranium, Vanadium and Zinc
Organochlorine Pesticides	Alpha-BHC, Endosulfan (I and II), Endrin, Heptachlor epoxide, Lindane (gamma-BHC), Mirex, DDT, Methoxychlor, Aldrin, Dieldrin, Heptachlor, a-chlordane and g-chlordane, Toxaphene
Pesticide scan	Atrazine, Bromoxynil (Buctril), Carbofuran, Chloropyrifos, Dicamba (Banvel), 2,4-Dichlorophenoxyacetic acid (2,4-D), Diclofop-Methyl (Hoe Grass), Dimethoate, Malathion, Pentachlorophenol (PCP), Picloram and Trifluralin (Treflan)
Phenolic Compounds	2,3,4,6–tetrachlorophenol, 2,4,6-trichlorophenol, 2,4-dichlorophenol, pentachlorophenol
Polychlorinated Biphenyls (PCBs)	Total PCBs
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i,)perylene, Benzo(k)fluoranthene, Chrysenes, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene
NDMA	N-Nitrosodimethylamine
Volatile Organic Compounds (VOCs)	Benzene, Bromodichloromethane, Bromoform, Carbon tetrachloride, Chlorobenzene, Chlorodibromomethane, Chloroform, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, Dichloromethane, Ethylbenzene, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, Tetrachloroethene, Toluene, Trichloroethene, Vinyl chloride m/p-xylene, O-xylene

8. Volume of Effluent Measurement

All Intermittent Discharge Wastewater Systems that discharge effluent to fish bearing waters, shall have in place a means of determining the daily volume of effluent discharged by:

- A continuous monitoring device that measures the volume of influent or effluent deposited via the final discharge point or;
- A continuous monitoring device that measures the rate of flow of the influent or effluent upon which the daily volume deposited may be estimated or;
- By using a method of estimation based on generally accepted engineering practices that determines an estimate of the daily volume of effluent deposited via the final discharge point with a margin of error of ± 15%.

All Continuous Discharge Wastewater Systems that discharge more than 2500 m^3/day of effluent to fish bearing waters shall have in place a means of determining the daily volume of effluent discharged by:

- A continuous monitoring device that measures the volume of influent or effluent deposited via the final discharge point

All Continuous Discharge Wastewater Systems that discharge less than 2500 m^3/day of effluent to fish bearing waters shall have in place a means of determining the daily volume of effluent discharged by:

- A continuous monitoring device that measures the volume of influent or effluent deposited via the final discharge point or;
- A continuous monitoring device that measures the rate of flow of the influent or effluent upon which the daily volume deposited may be estimated

9. Tables of Core Monitoring Parameters

Table 9.1: Core Parameters for Wastewater Works with No Discharge

Type of Operation	Flow	Sample Location	Type of Sample	Minimum Monitoring Frequency	Parameters
No discharge to surface water (i.e. infiltration or evaporation)	All works	Piez/wells if available	Grab	Once per year (June to August)	*TC/E.coli*/Cond./Cl/NO_3 **(Group 1)**

Table 9.2: Core Parameters for Intermittent Discharge Wastewater Systems

Type of Operation	Flow	Sample Location	Type of Sample	Minimum Monitoring Frequency	Parameters
Intermittent Wastewater System Discharge to non-fish-bearing waters	All works	At discharge outlet	Grab	Once midway through each discharge period	TC/*E.coli*/TSS/CBOD/Cl **(Group 2)**
		Piez/wells if available		Once per year (June to August)	TC/*E.coli*/Cond./Cl/NO_3 **(Group 1)**
Intermittent Wastewater System Discharge to fish-bearing waters	<500 m^3/day	At discharge outlet	Grab	Once midway through each discharge period	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/pH at 15°C **(Group 4)** pH(field)/Temp.(field) Total Chlorine Residual (if applicable) Calculated Unionized Ammonia[11]
				Once every ten years midway through one of the discharge periods	Acute Lethality
	>500≤2500 m^3/day	At discharge outlet	Grab	Bi-weekly (Once every two weeks)[1] during each discharge period	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N /TKN/ pH at 15°C **(Group 4)** pH(field)/Temp.(field) Total Chlorine Residual (if applicable) Calculated Unionized Ammonia[11]
				Once every three years midway through one of the discharge periods	Acute Lethality
	>2500 m^3/day	At discharge outlet	Grab	Weekly[2] during each discharge period	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/ pH at 15°C **(Group 4)** pH(field)/Temp.(field) Total Chlorine Residual (if applicable) Calculated Unionized Ammonia[11]
				Quarterly (Once every 3 months)[3,4,5]	Acute Lethality
				Once midway through each discharge period	Total Alkalinity/Bicarbonate/Calcium/Carbonate/ Magnesium/Nitrate/Conductivity/Sodium/Sulphate/ Total Dissolved Solids/Total Hardness/ **(Major Ion Scan Plus TDS and Cond.)**
				Once each year midway through one of the discharge periods	Aluminum, Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc **(Metals Scan)**

Table 9.3: Core Parameters for Continuous Discharge Wastewater System

Type of Operation	Flow	Sample Location	Type of Sample	Minimum Monitoring Frequency	Parameters
Continuous discharge to fish-bearing waters	<500 m^3/day	At discharge outlet	Grab	Monthly[6]	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/pH at 15°C **(Group 4)** pH(field)/Temp.(field) Total Chlorine Residual (if applicable) Calculated Unionized Ammonia[12]
				Once every ten years midway through one of the discharge periods	Acute Lethality
	>500≤2500 m^3/day	At discharge outlet	Grab	Monthly[6]	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/ pH at 15°C **(Group 4)** pH(field)/Temp.(field) Total Chlorine Residual (if applicable) Calculated Unionized Ammonia[11]
				Once every three years	Acute Lethality
	>2,500 to ≤17,500 m^3/day	At discharge outlet	Grab	Daily	Total Chlorine Residual (if applicable)
			24 Hour Composite	Bi-Weekly (Once every two weeks)[1]	CBOD/Cl/ TSS/TP/TN/NH^3-N/TKN/ pH at 15°C **(Group 4)** Calculated Unionized Ammonia[11]
			Grab		TC/*E.coli*/ pH(field)/Temp.(field)
			Grab	Quarterly (Once every 3 months)[5,7,8]	Acute Lethality
			24 Hour Composite	Semi-annually (Once every 6 months)	Total Alkalinity/Bicarbonate/Calcium/Carbonate/ Magnesium/Nitrate/Conductivity/Sodium/Sulphate/ Total Dissolved Solids/Total Hardness/ **(Major Ion Scan Plus TDS and Cond.)**
			24 Hour Composite	Annually	Aluminum, Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc **(Trace Metals Scan)**
	>17,500 to≤50,000 m^3/day	At discharge outlet	Grab	Twice Daily	Total Chlorine Residual (if applicable)
			24 Hour Composite	Weekly[2]	CBOD/Cl//TSS/TP/TN/ NH^3-N /TKN/ pH at 15°C **(Group 4)** Calculated Unionized Ammonia[11]
			Grab		TC/*E.coli*/ pH(field)/Temp.(field)
			Grab	Quarterly (Once every 3 months)[5,7,8]	Acute Lethality
			24 Hour Composite	Quarterly (Once every 3 months)[5]	Total Alkalinity/Bicarbonate/Calcium/Carbonate/ Magnesium/Nitrate/Conductivity/Sodium/Sulphate/ Total Dissolved Solids/Total Hardness/ **(Major Ion Scan Plus TDS and Cond.)**
			24 Hour Composite	Semi-annually (Once every 6 months)	Aluminum, Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc **(Trace Metals Scan)**
	>50,000 m^3/day	At discharge outlet	Grab	Three times daily	Total Chlorine Residual (if applicable)
			24 Hour Composite	Five days per week	CBOD/Cl/TSS/TP/TN/ NH^3-N /TKN/ pH at 15°C **(Group 4)** pH(field)/Temp.(field) Calculated Unionized Ammonia[11]
			Grab		TC/*E.coli*/ pH(field)/Temp.(field)/Dissolved Oxygen(field)
			Grab	Monthly[6,9,10,]	Acute Lethality
			24 Hour Composite	Monthly[6]	Total Alkalinity/Bicarbonate/Calcium/Carbonate/ Conductivity/Magnesium/Nitrate/Sodium/Sulphate/ Total Dissolved Solids/Total Hardness/ **(Major Ion Scan Plus TDS and Cond.)**
			24 Hour Composite	Semi-annually Once every 6 months)	Aluminum, Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc **(Trace Metals Scan)**

Table 9.4: Core Parameters for Receiving Environments that are fish bearing waters

Type of Operation	Flow	Minimum Monitoring Frequency	Location	Type of Sample	Parameters
Continuous Discharge	All works	Monthly	Upstream (if applicable) and Downstream	Grab	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/pH at 15°C **(Group 4)** pH(field)/Temp.(field) Calculated Unionized Ammonia[12] Conductivity and TDS
	>2,500 m^3/day				Total Alkalinity/Bicarbonate/Calcium/Carbonate/ Magnesium/Nitrate/Potassium/Sodium/Sulphate/ Total Hardness/ **(Major Ion Scan)**
	>50,000 m^3/day	Annually	Downstream		Chronic Toxicity - Biological Test Method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia* (EPS1/RM/21) And Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows (EPS1/RM/22)
Intermittent Discharge	All works	Monthly or Once midway through each discharge period	Upstream (if applicable) and Downstream	Grab	CBOD/Cl/TC/*E.coli*/TSS/TP/TN/NH^3-N/TKN/pH at 15°C **(Group 4)** pH(field)/Temp.(field) Calculated Unionized Ammonia[12] Conductivity and TDS

1. Samples shall be collected at least seven (7) days after any other sample
2. Samples shall be collected at least five (5) days after any other sample
3. Effective January 1, 2015, if a treated wastewater effluent sample is determined to be acutely lethal, the permittee must collect a grab sample of treated wastewater effluent twice per month but at least seven days after any previous sample and conduct the acute lethality test on each of the samples. The permittee shall continue to sample twice per month until such time as three consecutive samples are found not to be acutely lethal. Once three consecutive samples are found not to be acutely lethal, the permittee shall revert back to quarterly acute lethality testing.
4. Effective January 1, 2015 and following the collection of 4 consecutive quarterly samples (collected after January 1, 2015), that have been collected and analyzed and found not to be acutely lethal, the acute lethality sampling and testing requirement may be reduced to yearly (one per calendar year but at least 6 months after any other sample).
5. Samples shall be collected at least 60 days after any other sample. If an Intermittent discharge is less than one Quarter (3 months) in duration, then sample shall be collected at a minimum of "Once per Discharge Event"
6. Samples shall be collected at least twenty-one (21) days after any other sample
7. Effective January 1, 2015, if a treated wastewater effluent sample is determined to be acutely lethal, the permittee must collect a grab sample of treated wastewater effluent twice per month but at least seven days after any previous sample and conduct the acute lethality test on each of the samples. The permittee shall continue to sample twice per month until such time as three consecutive samples are found not to be acutely lethal. Once three consecutive samples are found not to be acutely lethal, the permittee shall revert back to quarterly acute lethality testing.
8. Effective January 1, 2015 and following the collection of 4 consecutive quarterly samples (collected after January 1, 2015), that have been collected and analyzed and found not to be acutely lethal, the acute lethality sampling and testing requirement may be reduced to yearly (one per calendar year but at least 6 months after any other sample)
9. Effective January 1, 2015, if a treated wastewater effluent sample is determined to be acutely lethal, the Permittee must collect a grab sample of treated wastewater effluent twice per month but at least seven days after any previous sample and conduct the acute lethality test on each of the samples. The Permittee shall continue to sample twice per month until such time as three consecutive samples are found not to be acutely lethal. Once three consecutive samples are found not to be acutely lethal, the Permittee shall revert back to monthly acute lethality testing.
10. Effective January 1, 2015, and following the collection of 12 consecutive monthly samples (collected after January 1, 2015), that have been found not to be acutely lethal, the acute lethality sampling and testing requirement may be reduced to quarterly (every three months but at least 60 days after any other sample). Should an acute lethality test fail, the Permittee shall revert to sampling as per the frequency noted in footnote 9.
11. The un-ionized portion of total ammonia (NH_3) in the treated effluent shall be calculated using the formula:

    Total Ammonia Nitrogen x 1 ÷ (1+ $10^{9.56-pH}$)

    - where pH is the pH of the effluent adjusted to 15°C ± 1°C
12. The un-ionized portion of total ammonia (NH_3) in the receiving waters shall be calculated using the formula:

    Total Ammonia Nitrogen x 1 ÷ (1+ 10^{pKa-pH})

    - where pKa is 0.09018 + 2729.92/T
    - where T is the ambient receiving water temperature in degrees Kelvin
    - where pH is the pH of the receiving water