The British Columbia Field Sampling Manual

Part E3

Effluent

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1 Introduction

Part E3 of the BC Field Sampling Manual (BCFSM) provides effective guidance for persons required to prepare for and collect effluent samples. Effluent is produced in a number of ways and is typically defined according to the way it is produced. The Municipal Wastewater Regulation defines 'municipal effluent' as the liquid resulting from the treatment of municipal wastewater. Effluent is described in the Environmental Management Act (EMA) as a substance that is introduced into water or onto land that is consistent with one of six categorical conditions; all of which include negative impacts or the potential to cause negative impacts. The USEPA defines effluent as wastewater treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall. In general effluent is a product that requires special handling and safety considerations and in some cases, specialized sampling equipment. For these reasons effluent is presented in this dedicated sub-part of the BCFSM.

The information and guidance presented in this section of the BCFSM is compiled from a wide variety of sources including industry best practices, provincial and federal guidelines, sampling technology manuals and peer-reviewed literature. The protocols and methods provided herein are designed to produce analytical data at a level of quality that satisfies the province's resource protection and management objectives.

The primary objective of environmental sampling is to collect representative, minimally disturbed samples that meet the requirements of the sampling program, and to deliver those samples to a qualified laboratory without deterioration or contamination. The procedures outlined in this manual standardize sampling protocols and methods which may be required by permit, approval, regulation, or bylaw. They also serve as a guideline for regulatory staff, permittees, and consultants.

This *part* of the BCFSM takes into account BC acts, regulations, protocols, and guidelines that pertain specifically to effluent. The primary acts and regulations that apply to the information contained in this *part* are described in more detail below. This list is not exhaustive however, and other acts, regulations or permit requirements may include information pertinent to the collection of effluent samples.

The Environmental Management Act (EMA) regulates industrial and municipal waste discharge, pollution, hazardous waste, and contaminated site remediation. The EMA provides the authority for introducing wastes into the environment, while protecting public health and the environment. The Act enables the use of permits, regulations, and codes of practice to authorize discharges to the environment and enforcement options, such as administrative penalties, orders, and fines to facilitate compliance. Section 14 of the Act enables the Province to issue a permit authorizing the introduction of waste into the environment subject to requirements for the protection of the environment. Permittees may be required to conduct studies and to report information specified by the Province including, but not necessarily limited to, water quality data.

- Under the EMA, the **Municipal Wastewater Regulation (MWR[1])** addresses monitoring and sampling requirements for municipal wastewater treatment plants.
- Under the EMA, the **Pulp Mill and Pulp and Paper Mill Liquid Effluent Control Regulation (LECR[2])** addresses sampling methods and reporting schedules.
- Under the Federal Fisheries Act, the **Pulp and Paper Effluent Regulations (PPER[3])** govern the discharge of harmful substances from pulp and paper mills into water frequented by fish.

[1] *Municipal Wastewater Regulation (MWR)*, B.C. Reg. 87/18, including amendments up to B.C. Reg. 46/2018, April 1, 2018.
[2] *Pulp Mill and Pulp and Paper Mill Liquid Effluent Control Regulation (LECR)*, B.C. Reg. 470/90, including amendments up to B.C. Reg. 46/2018, April 1, 2018.
[3] *Pulp and Paper Effluent Regulations (PPER)*, SOR/92-269, Regulations are current to 2021-06-16.

- Under the EMA, the **Petroleum Storage and Distribution Facilities Storm Water Regulation (PSDFSWR[4])** addresses the introduction of effluent into the environment and provides design and maintenance requirements for oil water separators.
- Under the EMA, the **Environmental Data Quality Assurance Regulation (EDQR[5])** outlines the requirements for the collection and analysis of environmental samples and the environmental data produced from those samples.
- Under the Workers Compensation Act, the **Occupational Health and Safety Regulation (OHSR[6])** provides guidance and requirements regarding, rights and responsibilities, indoor air quality, chemical and biological agents, and exposure control.

1.1 Purpose and Scope

This part of the BCFSM provides guidance, instruction and technical protocols that are required for effluent sampling. The requirements for monitoring are defined by regulation and or permit and are not addressed in this part of the BCFSM. Information regarding Quality Assurance and Quality Control, Data Quality Objectives and Water Quality Parameters is provided in detail in Part E1 Surface Water and is not replicated in this part of the BCFSM. General information regarding the determination of flow measurement are presented to provide a conceptual understanding of the various methods. Comprehensive technical information on flow monitoring is available through the Manual of British Columbia Hydrometric Standards (RISC, 2018) and should be referenced by any party intending on undertaking a flow-monitoring program.

[4] *Petroleum Storage and Distribution Facilities Storm Water Regulation*, B.C. Reg. 168/94 includes amendments up to B.C. Reg. 321/2004.
[5] *Environmental Data Quality Assurance Regulation (EDQAR),* B.C. Reg 301/90, Last amended March 30, 2023 by B.C. Reg. 84/2023.
[6] *Occupational Health and Safety Regulation (OHSR)*, B.C. Reg 296/97, last amended July 14, 2020 by B.C. Reg. 82/2020.

2 Health and Safety Considerations

Effluent can be produced by a wide range of processes that incorporate measured and controlled concentrations of substances or by systems designed to accept a range of substances that vary by characteristic and concentration/volume. Due to this variability the health risks posed by each effluent stream must be assessed individually. The general characteristics of an effluent stream can be categorized based on their source (i.e. wastewater treatment, pulp production) but must consider biological, chemical, and physical constituents or a mixture of two or more of those constituent groups in establishing the health risks posed by the effluent stream.

Part 2 of the Workers Compensation Act (WCA) stipulates that ‘every employer must ensure the health and safety of all workers working for that employer, and any workers present at a workplace at which that employer’s work is being carried out’. The WCA includes legislation designed to ensure that the health risks of any work environment have been identified and that commensurate safety measures have been developed however it is encumbent upon samplers to understand those risks and ensure they are prepared for and have the capacity to comply with the safety measures.

2.1 Health and Safety Precautions

The possibility of elevated levels of contaminants in some effluent streams warrants further safety practices. In preparation for sampling, review applicable sections of the Occupational Health and Safety Regulation (OHSR). Part 5 of the OHSR deals with chemical and biological agents, exposure control, and hazardous wastes and emissions. Samplers are encouraged to familiarize themselves with these and other applicable sections of the OHSR prior to entering a space or accessing a discharge point to sample effluent. Samplers should also read through the site’s safety manual and seek guidance from persons experienced with the sample streams they are tasked to sample.

Effluent samples can be obtained from sampling ports, discharge pipes, oil/water separators, settling ponds or receiving waters such as streams and reservoirs. Regardless of location, sampling stations must conform to Workers’ Compensation Board Regulations and other applicable safety requirements, and be readily accessible under all expected weather conditions. If safety is a concern at a particular sampling station, then search for an alternative location nearby, or simply do not attempt to take the sample. If an alternative location is used, then all details regarding the new station and the reasons why the alternate location was necessary must be recorded in the field notebook.

Receiving waters such as lakes, rivers and streams can be sampled from shore by either wading into the flow or by sampling from the banks of the waterbody. If field personnel are able to safely wade into the waterbody without risk, then the sample can be collected at a depth that does not pose a threat. **Discretion is the key - never wade into water that appears deep or fast flowing**. Always wear a PFD when wading, have a second person nearby, and attach a safety line if conditions pose any potential risk. Samplers must be wary of uneven, slippery or non-visible stream bottoms, especially under turbid conditions. It is very easy to lose your footing / balance in fast flowing waters. In addition, if the river or lake bottom is soft, samplers may sink into the substrate. It is recommended that individuals who sample by wading, take swift-water training and adhere to all water safety precautions (CCME 2011).

While on site samplers should wear a suite of personal protective equipment (PPE) that is commensurate with the risks posed by the effluent stream. PPE for any given site may include coveralls, Tyvek coveralls, gloves, shoulder length gloves, face shield or safety glasses, steel toed rubber safety boots, hard hat and hearing protection. When samping is complete, properly dispose of any single use PPE, bag up any contaminated clothing and or equipment and thoroughly wash hands with soap and water.

3 Effluent Sampling

Effluent is produced through industrial operations as cooling water or process water at mining sites, pulp and paper operations or municipal wastewater treatment plants. As authorized by permits and other instruments, effluent may be discharged into lagoons, settling ponds or receiving waters such as streams or reservoirs. For these reasons sampling stations, or sampling sites vary as does the method by which a sample is obtained. In general, effluent samples are obtained as grab samples or composite samples (USEPA, 2013). Grab samples are collected manually while composite samples may be collected manually but are commonly collected by automatic samplers.

Where possible, automated and manual sampling devices and equipment, their containers and all tubing, valves and contact components should be dedicated to a single sampling site to minimize the potential for cross contamination. If dedicated equipment is not possible the sampling equipment must be cleaned and free of contamination prior to the collection of subsequent samples. It is the responsibility of the sampler to demonstrate that non-dedicated sampling equipment is free of contamination (Ontario, 2016)

3.1 Effluent Stream

Effluent samples must always be collected at the same location within the effluent stream to ensure that each sample is representative of that established location/site. Representative sampling locations at a receiving site occur where the effluent is well mixed in the river or stream. This is typically near the centre of the effluent stream in order to avoid boundary effects and biasing due to material which has a strong tendency to sink or float. Ideally, the sample should be collected at approximately 40 to 60 percent of the water depth, and skimming the water surface or disturbance of the channel bottom should be avoided (USEPA 2013).

3.1.1 Grab Samples

Grab samples are single discrete samples that represent the wastewater conditions at the time of sampling (USEPA 2013). Grab samples are generally specified when the concentration of a parameter under consideration is not expected to vary significantly with time, when values associated with extreme events are desired; or when the parameter is such that the procedure of compositing would destroy the sample's integrity or representativeness (e.g., VOC's, oil and grease), and in cases where the sample must be shipped to the lab in the original sample bottles.

Grab samples obtained from a slipstream and valve should only be collected after purging the sample line (Ontario 2016). To collect a grab sample, obtain a pre-labeled sample bottle and remove the lid without touching the inner surface of either. Grasp the bottle well below the neck and plunge it into the effluent. Ensure that your hand is always downstream of the bottle opening. Recap the bottle and place it in a pre-chilled cooler. Once all the samples have been collected, process accordingly (see Section 7 of Part E1) and ship to the laboratory without delay (see section 8 of Part E1).

3.1.2 Composite Samples

Composite samples can be collected by continuous sampling over a defined time period or by combining discrete samples collected over time (USEPA 2013). The compositing period is defined according to the terms of the permit (i.e., daily, over a four-hour period, etc.). Composite samples are generally specified when the concentration of the parameter under consideration is expected to vary with time or location. The resulting composite sample will then contain the average effluent characteristics / parameter concentrations present during the compositing period (USEPA 2013). The individual samples that make up the composite may be of equal volume or be proportional to the flow at the time of sampling.

Time composite sampling can be utilized when effluent flow rates are known to be consistent. Time composite samples are collected by combining equal volumes of discrete subsamples into a single container. The discrete subsamples can be collected by hand or with an automatic sampler and must be collected at equally spaced time intervals (USEPA 2013).

Flow proportional composite sampling is necessary when effluent flow rates vary significantly and will normally be specified as a condition of the permit. The actual collection of flow proportional composite samples is similar to the collection of time composite samples (described above). The only differing variable will be the quantity of effluent collected which will change in proportion to the effluent flow. The following is a hypothetical example of calculations for quantity collected:

› If you are required to collect 1% of the effluent discharge (expressed per second) and the discharge is 10 L/sec then you would collect 100 mL. If the discharge doubles to 20 L/sec then in order to collect the required 1% you would have to collect a 200 mL sample.

In order to properly conduct flow proportionate composite sampling, accurate (preferably continuous) flow measurements must be conducted for the effluent stream. Automatic sampling devices (to collect grab or composite samples) are acceptable provided that the sample is in contact with only components made of acceptable materials (stainless steel, glass, plastic or Teflon). Plastic is acceptable except where samples are taken for organic analyses. Automatic sampling devices must be equipped with a purge mechanism to enable the sample line to be evacuated prior to sample extraction. The velocity in the sampling line should be a minimum of 0.75 m/s to prevent the settling of solid material.

If the composite sample is collected using manual methods, the discrete subsample portions should be preserved at the time of sample collection, and must be thoroughly mixed before pouring the subsamples into the composite sample container (USEPA 2013).

It will be necessary to store composite samples in an interim storage container, such as a clean pre-chilled cooler, over the prescribed composite period. The sample must be kept cool (≤ 10°C) throughout the collection process. Interim discrete samples should be preserved if required after they are taken, rather than waiting until the end of the composite period. It is important to maintain a record or the volume and time of collection of the discrete subsamples.

3.2 Receiving Waters

The ambient conditions at each effluent discharge location dictate which sites are ideal as sampling stations. The best locations for sampling, if not established by permit should be based on the following considerations:

› A control station (receiving water in a location not affected by the discharge),

› A station intended to monitor discharge impacts after complete mixing with the receiving water; and,

› Stations intended to monitor the boundaries of an initial dilution zone. Refer to Section 1.4.1 for a description of initial dilution zones.

Samples can be collected as either grab samples or composites. The rationale for composite sampling provided for effluent streams also applies to receiving waters. Receiving water flow variations are not usually significant over the sampling period, therefore, a flow proportional composite is not necessary. There are several methods available for sampling effluent from receiving waters.

3.2.1 Initial Dilution Zones

An initial dilution zone (IDZ) is a regulated zone under the EMA which allows proponents to discharge effluent in a way that restricts the footprint of chronic toxicity to a specified extent in the receiving environment before effluent fully mixes with receiving water. An IDZ allows for somewhat elevated concentrations of contaminants of potential concern to occur within relatively small areas of a receiving water body, without significantly affecting the integrity of the water body as a whole. IDZs can be utilized in situations where best management practices and best achievable technologies for waste treatment are alone insufficient to reduce the toxicities of the effluent. The mixing that occurs in an IDZ allows for the leveraging of dilution to achieve the long term water quality benchmarks that ensure protection of the most sensitive species and life stages against toxicity effects for indefinite exposures (ENV, 2019).

The design and implementation of a water quality monitoring program is a key component in developing an IDZ to confirm water quality at and beyond the boundaries of the IDZ is sufficient to prevent chronic effects to aquatic life. A proposed monitoring program should be included as part of the request to use an IDZ. The monitoring program must be developed prior to discharge commencing, and based on a conceptual site model for the discharge. A monitoring program should include details about sampling design, sampling methods, frequency, sample handling, analytical methods, data reporting and quality assurance/quality control. Monitoring programs are used to assess any changes in the physical, chemical and biological characteristics of the receiving environment within and at the edge of the IDZ relative to baseline conditions. Monitoring programs can also be used as a means to validate and calibrate model predictions. A monitoring program should be initiated prior to project construction in order to collect baseline data and to establish natural variability at the discharge and un-impacted reference locations (ENV, 2019).

3.3 Oil Water Separators

The primary function of an oil water separator (OWS, or ‘separator’) is the removal of oil and other contaminants from the waste water or surface water that enters it. OWS’s are deployed to treat water at industrial facilities, commercial and retail properties and parking lots. Separators are commonly installed to intercept and treat precipitation, wash water or process water that is contaminated or becomes contaminated with materials such as petroleum hydrocarbons, metals, glycols, detergents, soaps and other materials associated with the site’s land use. Standard OWS’s are typically constructed of concrete or steel and include an inlet, two or more chambers and an outlet. Properly designed separators provide the hydraulic retention time required for oil droplets to rise and accumulate on the surface of the separator while suspended materials such as metals, sand and debris settle out and collect as sludge at the bottom. Many designs include coalescing plates that enhance and improve the collection of oil droplets which subsequently improves the quality of the effluent.

Regardless of design the separator should be installed, maintained and operated in accordance with the manufacturers specifications. For applicable operators, Section 6 of the Petroleum Storage and Distribution Facilities Storm Water Regulation provides requirements regarding management of the separator system which includes inspections, measurement of sludge and petroleum thickness, sample collection and analyses. Depending on the design of the OWS and associated plumbing, effluent samples can be collected from a discharge port, a sampling chamber or directly from the final chamber of the the OWS. Detailed instructions for the collection of effluent samples from an OWS are provided in standard operating procedure (SOP) SOP E3-01 provided in Appendix 2 of this *part* of the BCFSM.

3.4 Sampling Protocols

Effluent samples are obtained using automated samplers or manually by hand or sampling device. Mannually obtained samples are collected by filling a container held just beneath the surface of the water, commonly referred to as a dip or grab sample. Sampling devices such as a swing sampler can be used to reach out into an effluent stream to collect the sample. Sampling by any method should be carried out in a consistent manner following established protocols to ensure that the data generated from the analytical results of those samples is comparable over time and defensible under scrutiny. With the exception of automated samplers and oil water separators, many of the protocols and tools used for sampling effluent are the same as those developed for surface water. Detailed information on sampling methodologies, including *field preparations*, *field measurements*, and *sample collection*, are provided in Sections 4, 5 and 6 respectively, in Part E1 Surface Water.

3.5 Quality Assurance / Quality Control

Sampling must also incorporate both quality assurance and quality control measures to mitigate the potential for cross contamination, to provide analytical evidence demonstrating that the sampling equipment used to obtain the sample did not impact the sample, and to demonstrate that both the sampling and analytical process were in control. Detailed information regarding quality assurance and quality control, including *field quality assurance*, *quality control samples* and *decontamination protocols*, is provided in sections 3.2, 3.3 and 3.4 respectively, in Part E1 Surface Water.

4 Flow Measurement

The measurement of effluent flow is a critical component of effluent monitoring. Measuring flow in a stream or device requires strict adherence to established provincial protocols and as such the descriptions and details are presented here to provide a conceptual understanding of common methods. Detailed instruction for all appropriate methods of flow measurement are provided in the Manual of British Columbia Hydrometric Standards[7].

4.1 Stream Flow

The concurrent measurement of stream flow alongside water quality measurements is often required. Not only do water quality parameter measurements often correlate with flow rate due to dilution or other processes, but pairing water quality data with flow rate allows total chemical loadings for the entire stream flow to be calculated.

Stream flow measurement methods vary in complexity with the main methods commonly used being the point velocity and depth measurement method (Area-Velocity Method) or through Dilution Gauging.

The **Area-Velocity Method** utilizes a current meter and involves the collection of liquid depth and velocity measurements at selected intervals across a channels cross section to determine the flow. The flow is equal to mean cross-sectional velocity multiplied by the cross-sectional flow area. A detailed methodology for performing this type of measurement is provided in the Manual of British Columbia Hydrometric Standards.

The **Velocity Head Rod Method** can be used in shallow streams if the appropriate field equipment is not available and flow estimates need only be approximate. A metre stick is used for this method which provides relatively accurate measurements in small or shallow streams. The metre stick is first placed on a stable streambed feature with the narrow edge of the stick in line with the flow of the stream. While holding the metre stick steady, an average water depth is recorded. The metre stick is then turned 180 degrees so the flat edge is now facing the stream flow causing the water to pile up. In this position, the elevated water depth is recorded. This process is repeated at three to six equidistant locations across the stream. The difference between the two measurements is then used to calculate velocity using the following equation:

$$\textbf{Velocity (m/s)} = \sqrt{(2(\Delta D/100)*g)}$$

Where
ΔD is the difference between the two depths (measured in centimetres), and g is acceleration due to gravity, or 9.81 m/s^2

Detailed steps for this method are provided in the Environment and Climate Change Canada document titled Canadian Aquatic Biomonitoring Network (CABIN) / Field Manual for Wadeable streams.

Dilution Gauging measures the flow rate by determining the dilution of a tracer solution, typically dissolved sodium chloride (salt). The tracer is injected either continuously (constant-rate) or instantaneously (slug injection) from a distance far enough upstream to ensure the trace is uniformly concentrated through the cross section at the point of measurement. The tracer concentration change is proportional to the change in flow rate (Moore, 2004). This method introduces chloride to the watercourse which may not be appropriate for watercourses that are already near or exceeding guidelines or those with sensitive species present. A local Environmental Protection representative should be contacted for more information prior to commencing salt-dilution measurements on those watercourses (RISC, 2018). A detailed methodology for performing this type of measurement is provided Manual of British Columbia Hydrometric Standards.

[7] Resources Information Standards Committee (RISC). 2018. *Manual of British Columbia Hydrometric Standards*, Version 2.0, December 2018.

4.2 Open Channel Flow Measurement

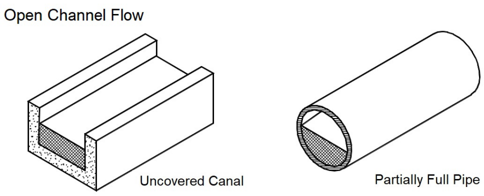


Figure 4.1. Open Channel Flow Configurations

Open channel flow is defined as the flow in a conduit, in which the upper surface of the liquid is in contact with the atmosphere (free surface), such as in the case of an open trough, or a partially filled pipe (see Figure 1). The flow in an open channel is measured using a combination of a stable hydraulic control (either natural or artificial) and a water level gauge (either manual or automatic). Within wastewater specific applications the stable hydraulic control is typically achieved artificially through addition of a rated structure such as a weir or flume, while water level measurements are typically a combination of periodic manual readings to be used as verification on continuous automatic readings.

4.3 Rated Structures – Weirs and Flumes

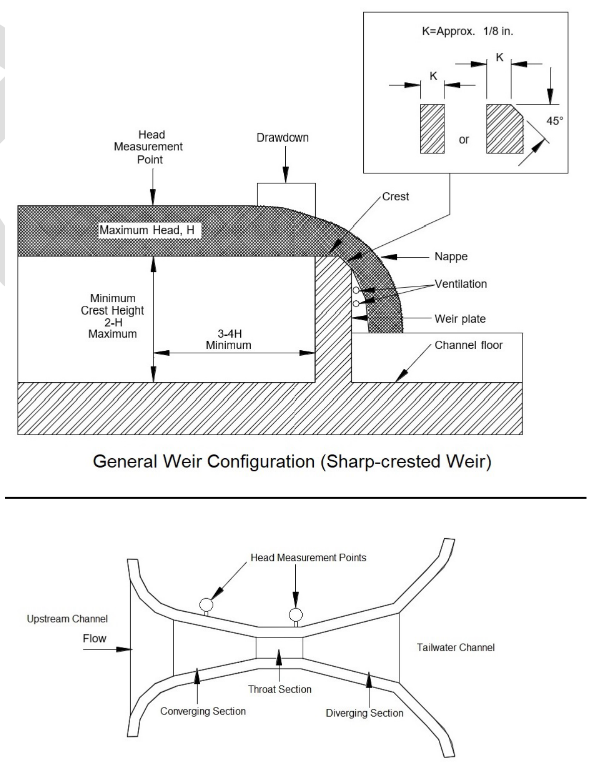
Rated structures are calibrated restrictions which are inserted into the effluent stream, to cause the upstream liquid level to vary proportionately with channel flow. Liquid levels can then be measured and converted to a corresponding flow rate through a stage-discharge equation or rating table.

Wastewater systems typically use two broad categories of rated structures: 1) weirs, and 2) flumes (illustrated as Figure 2). The relationship between liquid depth and flow rate depends upon the shape and dimensions of the restriction.

4.3.1 Rated Structure Selection

The selection of whether to select a weir or a flume as a rated structure is based on a number of factors, including:

- Installation cost;
- Upkeep and maintenance cost;
- Expected head loss;
- Site configuration;
- Location configuration (i.e. space availability, slope, channel size);
- Rate of expected flow;
- Wastewater characteristics (i.e. suspended solids).



General Weir Configuration (Sharp-crested Weir)

General Flume Configuration

Figure 4.2. General Weir and Flume Configurations

Measurement accuracy is generally not a factor in choosing between weirs and flumes as most types of weirs and flumes have a relative accuracy range of +/- 10% (USEPA, 1975)

Within wastewater applications the potential for suspended solids can often be a deciding factor in whether to select a weir or flume. Weirs tend to have poor performance on systems with suspended sediments and floating debris. These solids can either settle and accrue within the reservoir upstream of the weir or become lodged within the weir opening blocking flow and disrupting the hydraulic properties of the weir. Flumes create less of an impedance on flow paths which allows more solids to flow freely through the structure.

The selection of the size of a rated structure depends on the minimum and maximum flow rate expected for the location. The structure must have a useful measurement range, which encompasses the minimum and maximum expected flow rates. It should be sized such that an appreciable change in liquid level occurs for the transition from the minimum to maximum flow.

A detailed discussion on the relative advantages and disadvantages of weirs and flumes can be found in British Columbia Hydrometric Standards (RISC, 2018). Comprehensive technical information on each type of weir and flume can be found in the Channel Flow Measurement Handbook (Grant and Dawson, 1997).

4.3.2 Weirs

A weir is a calibrated obstruction or dam built across an open channel to pool liquid behind it and allow that liquid to flow over it, often through a specially shaped opening or notch (see Figure 2). Each notch shape has its own characteristic equation for determining the flow rate based on the liquid level in the upstream reservoir. Weirs are typically made of aluminum or fiberglass and are the simplest, least expensive, and most common form of rated structure.

There are two weir discharge conditions, which can occur:

- Free-flow condition: when there is insufficient backwater to impede flow over the weir; and,
- Submerged-flow condition: when downstream backwater is high enough to impede flow over the weir.

A weir should be sized and installed to ensure it always operates under a free-flow condition Under free-flow conditions the flow rate can be determined by using a single instrument to measure liquid levels upstream of the weir, while under submerged flow condition both the head upstream and downstream of the weir are needed to determine the flow rate.

Weirs are well suited for measuring low flows, particularly where there is little head available. In addition to being used to measure flows, weirs are commonly used in wastewater treatment systems in secondary clarifiers to ensure uniform flow distribution along the effluent channel. Weirs are not generally considered suitable for raw wastewater (influent) flow measurement as solid materials can accumulate on the upstream side of the weir, which can disturb the conditions for accurate discharge measurement or even block the weir.

4.3.2.1 Common Weir Types

Weirs can be either classified as sharp-crested or broad-crested, where sharp and broad refer to the wall thickness of the weir. Sharp-crested weirs allow the liquid to spring clear of the weir plate, while flow over broad-crested weirs will adhere to the downstream face of the weir. Sharp-crested triangular (V-notch), rectangular, and trapezoidal (Cipolletti) weirs are the most common type of primary measurement devices used in wastewater treatment plants. Broad-crested weirs are less common within wastewater treatment plants as they are typically more advantageous for measuring higher flow rates.

Schematics illustrating the notch geometry of each of these types of weir are presented as Figure 3.

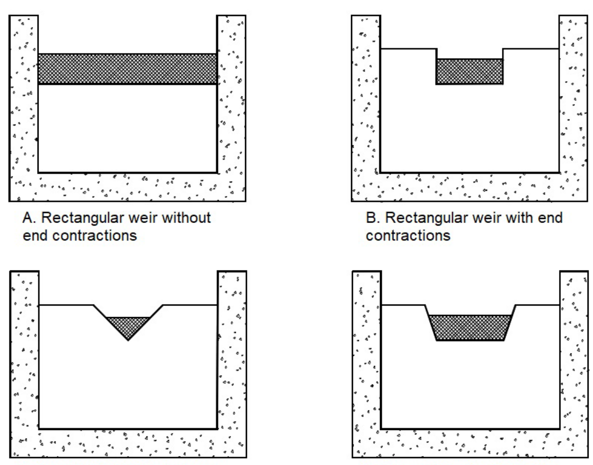


Figure 4.3. Common Sharp-Crested Weir Geometries

Comprehensive technical information on each type of weir can be found in the Channel Flow Measurement Handbook (Grant and Dawson, 1997)

4.3.3 Flumes

Flumes are the second class of commonly used rated structures. They are specially shaped channel restrictions, which change the channel cross sectional area, and slope. This change increases the velocity and alters the level of the liquid flowing through the flume (see Figure 2). Flumes can be made from various construction materials such as fiberglass, and concrete with their structure being composed of three main components:

- 1. Converging section used to restrict the flow;
- 2. Throat section;
- 3. Diverging section used to ensure a free flow condition.

Similar to a weir, there are two flume discharge conditions, which can occur:

- Free-flow condition: when there is insufficient backwater to impede flow through the flume; and,
- Submerged-flow condition: when downstream backwater is high enough to impede flow through the flume.

Where possible, the flume should be sized and installed to ensure it always operates under a free-flow condition Under free-flow conditions the flow rate can be determined by using a single instrument to measure liquid levels within the converging section of the flume, while under submerged flow condition both the head upstream of the flume and in the throat are needed to determine the flow rate (WMO, 2010a). Each flume will have its own characteristic equation for converting these liquid levels to a flow. This conversion equation can either be defined through calibration once the flume is in place or based on empirically derived formula for the selected flume geometry.

Flumes are usually used to measure flow in open channels where higher flows are expected and are better suited for use with flows containing sediment or solids than weirs. Flumes are self-cleaning, and require less maintenance in comparison to weirs, but they still need to be cleaned specially when used with sewage flows where more sediments are expected.

4.3.3.1 Common Flume Types

Some of the commonly used flume types are Parshall Flume, Palmer - Bowlus Flume, Leopold-Lagco Flume, Trapezoidal flumes and Cutthroat flumes. Comprehensive technical information on each type of flume can be found in the Channel Flow Measurement Handbook (Grant and Dawson, 1997).

4.3.4 Calibration of Rated Structure

Although rated structures are designed to achieve a theoretically predictable hydraulic response based on their geometry, no structure installation will be without imperfections and therefore some form of calibration must be conducted for in every field installation.

To calibrate the complete measuring system there are four main methods commonly used:

1. Volumetric flow measurement
2. Point velocity and depth measurement (Area-Velocity Method)
3. Dilution (salt or dye)
4. Slope-Area Method

An overview on each method is provided in the sections below. Detailed methodologies for each method are provided within the Manual of British Columbia Hydrometric Standards.

4.3.4.1 Volumetric Method

The volumetric method is considered to be one of the most accurate methods for obtaining liquid-flow relationships. This method is typically used for only small volumes of liquid but can be applied to larger flows if suitably large enough basins are available. The volumetric method involves determining the amount of time to fill a tank or container of a known volume. The rate of flow is calculated by dividing the volume by the fill time.

4.3.4.2 Area-Velocity Method

This method requires the collection of liquid depth and velocity measurements at selected intervals across a channel cross section to determine the flow, which is equal to mean cross-sectional velocity multiplied by the cross-sectional flow area (Q = V x A).

4.3.4.3 Dilution Gauging

This method measures the flow rate by determining the dilution of a tracer solution (typically saline solution or rhodamine dye). The tracer is injected either continuously (constant-rate) or instantaneously (slug injection) from a distance far enough upstream to ensure the trace is uniformly concentrated through the cross section at the point of measurement. The tracer concentration change is proportional to the change in flow rate (Moore, 2004).

4.3.4.4 Slope-Area Method

The slope-area method relies upon Manning’s equation to estimate the flow within a channel. The equation requires inputs of channel cross sectional dimensions, channel slope, channel roughness, and water depth to yield a calculated flow rate and average fluid velocity.

4.3.5 Maintenance of Rated Structures

Proper function and accurate flow measurement are directly related to the level of maintenance rated structures. Inspection and maintenance of rated structures should be completed on a regular basis to ensure the structure is performing as intended with no interference from sediment or debris.

4.4 Liquid Level Gauges

Liquid level gauges are used in conjunction with rated structures (weirs or flumes) to measure liquid level variations. The liquid level is used to estimate the flow rate based on the known liquid-level flow-rate relationship of the rated structure.

A wide variety of liquid level gauges are available for use, each discussed below

1. Manual Gauges
2. Pressure Systems
3. Non-Contact Systems
4. Float Systems

An overview on each type of instrumentation is provided in the sections below. Additional details are provided within Chapter 3 of the Manual of British Columbia Hydrometric Standards.

4.4.1 Manual Gauges

The simplest approach to liquid level measurements is to conduct a manually measurement either visually with the assistance of a vertical gauge, or directly through a survey of the liquid level.

Vertical gauges, most commonly referred to as **staff gauges**, consist of graduated rulers which are typically affixed to the side of a channel or rated structure such that they are partially submerged within a liquid allowing the liquid level to be visually quantified.

Manual gauges do not record liquid levels automatically and therefore cannot be relied upon for continuous level monitoring; however, they should be implemented in conjunction with an automatic gauge and constantly reference to verify the performance of the automatic gauge.

4.4.2 Pressure Systems

Pressure systems involved the measurement of pressure at a fixed submerged point to determine the depth of liquid above the sensor. Pressure measurements can be either absolute or relative, with absolute measurements requiring compensation for concurrent barometric pressure to isolate pressure head of the liquid. The two most popular pressure monitoring instruments are pressure transducers and bubbler sensors:

Submersible Pressure Sensors (Pressure Transducers): are the most common device used in automated measurement of liquid levels. The instrument consists of a submerged transducer with a deformable membrane (diaphragm). The diaphragm is deformed by the pressure differential applied on it, and the deflection is transmitted to a gauge or meter, either electrically or magnetically. The change in measured voltage flowing through the electric strain gauge is proportional to the pressure of the fluid on the diaphragm.

Bubblers: consist of an air tube, which is anchored in the flow stream at a fixed depth along the sidewall of a primary device (flumes or weirs). Bubbler flow meters use an air compressor to force a metered amount of air through a line submerged in the flow channel. The pressure needed to force the air bubbles out of the line corresponds to the hydraulic head of the liquid above the tube. The pressure in the tube is proportional to the liquid level in the primary device and can be measured with a mechanical pressure sensor or an electronic pressure transducer.

4.4.3 Non-Contact Systems

Non-contact systems involve the use of either **radar** or **ultrasonic** based level sensors which are mounted or suspended directly over the flow stream. The instruments transmit signals which are reflected off the surface of the liquid. The transit time required for a pulse to travel from the transmitter to the liquid surface and back to the receiver is used to determine the liquid level.

Since non-contact system sensors are fixed above the flow stream, they are unaffected by grease, suspended solids, silt, corrosive chemicals, and temperature fluctuations in the flow stream. However, non-contact systems may be affected by wind, high humidity, air temperature, radio and electromagnetic waves, rain, shock waves, and floating foam and debris, and they are not suitable for use in very narrow channels.

4.4.4 Float Systems

Historically, floats were the most commonly used device for monitoring liquid level variations because of their relatively low cost, and availability. Over time this has changed due to the decreased cost, increased availability, and improved reliability of electronic measuring devices; however, given its reliability, float systems are still used at many gauging stations today (WMO, 2010a).

Floats are suspended in a stilling well area, located to the side of the rated structure. The stilling well is connected to the channel by a slot or port, such that the liquid level in the stilling well is the same as the critical hydraulic level in the rated structure. The float is usually connected to a shaft encoder which records movement as the float rises and falls.

The stilling well is required for a float system on flumes, as a float could not be placed in the flume channel without creating a hydraulic disturbance, which would interfere with the flume hydraulics and measurement accuracy. The stilling well also prevents the float from being affected by any hydraulic surges.

5 Closed Channel Flow Measurement

Closed channel flow is flow in filled conduits (pipes) under pressure (see Figure 1). There are numerous types of flowmeters available for gauging flow within closed-pipe systems, with each device falling within one of three broad categories discussed below:

1. Differential Pressure
2. Velocity
3. Positive Displacement

5.1 Differential Pressure Devices

Differential pressure flowmeters are the most common devices used in measurement of pressurized flow. The devices typically introduce an engineered obstruction to the flow path and work on the premise that the pressure drop through this obstruction (Figure 4) is proportional to the square of the flow rate (MaxiFlo, 2021). The flow rate is obtained by measuring the pressure differential and extracting the square root.

Differential pressure flowmeters have a primary and secondary element. The primary element causes a change in kinetic energy to create the differential pressure in the pipe while the secondary element measures the differential pressure which is then converted to the actual flow value. The difference in pressure may be measured with a differential manometer or pressure gauges. A straight length of pipe at least 10 diameters long should precede the meter in order for achieve the necessary hydraulic properties for this device to function properly (WMO, 2010b).

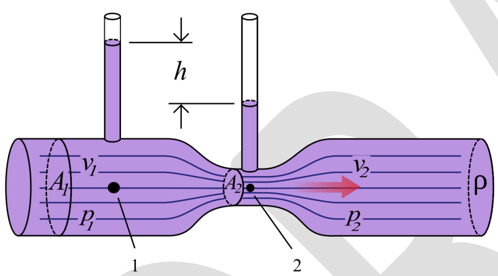


Figure 5.1. Illustration of Pressure Differential through a Venturi Flow Meter.

Many different types of differential pressure devices exist, all operating under the same principles. Common types include: orifice plate, venturi tubes, flow tubes, flow nozzles, pitot tubes, and variable-area. However, not all devices are appropriate for use at all stages of a wastewater treatment plant; orifice plates, for example, should not be utilized on flow streams that have the potential to include solids.

5.2 Velocity Devices

Velocity devices measure linear velocity of a fluid within a conduit allowing the flow rate of the system to be simply calculated by multiplying this velocity by the conduit cross sectional area. Two common types of velocity devices utilized in wastewater applications include electromagnetic and doppler flow meters.

Electromagnetic flow meter: The electromagnetic flow meter operation is based on Faraday's law, which simply states that a voltage is generated in any conductive liquid as the liquid moves through a magnetic field. This voltage is sensed by electrodes embedded in the sensor and is transmitted to the meter. The voltage is proportional to the velocity of the conductive liquid (conductor).

Doppler flow meter: A doppler meter operates by emitting into the flow ultrasonic waves of known frequency and duration from a transmitter located on the outside of the conduit. Suspended particles and air bubbles in the flow reflect the emitted waves. The sensor receives and detects the deflected frequencies and processes them to determine the average velocity.

5.3 Positive Displacement Devices

Positive displacement devices work by partitioning a flow into accurately measured increments and tracking the rate at which these incremental volumes are passed through the meter.

Positive displacement meters are ideal for measuring the flows of corrosive, viscous, and even for dirty fluids or for use where a simple mechanical meter system is needed (Tek-Trol, 2021). Their applications within a wastewater treatment plant would be limited to metering of treatment chemicals as more effective measurement devices are available to measure effluent flow.

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7 Revision History

March 31, 2021:	Entire Section E3 was revised and updated.
February 28, 2001:	Re-publication. Figures enhanced by Bert Brazier. Appendix 1 added.
March, 2020:	NovaTec replaced figures since CAD format was not compatible with Ministry software.
1999:	Draft manual prepared by NovaTec Consultants Inc. under contract to the Ministry (NovaTec Project 1231.14). Method vetted and approved by BCLQAAC.

Appendix 1

Field Forms

No forms provided at this time.

Appendix 2

Standard Operating Procedures (SOPs)

Sampling Method/Media: **Sampling from an OWS/Effluent**	**Standard Operating Procedure for Effluent Sample Collection from an OWS**
Revision No: Original **Revision Date: 18 January, 2024**	**Reference No: SOP-E3-01** **Parent Document: BC Field Sampling Manual – Part E3**

1. Introduction and Scope

This Standard Operating Procedure (SOP) provides operating guidelines and instruction for the collection of samples from an oil water separator (OWS or 'separator') that are representative of the effluent that will discharge from that device. The procedures provided in this SOP can be used as part of a regular maintenance routine or to collect samples to satisfy the requirements of an authorization.

This SOP forms part of the British Columbia Field Sampling Manual (BCFSM). Additional information on effluent and sampling can be found in Part E3 – Effluent.

The Petroleum Storage and Distribution Facilities Storm Water Regulation (PSDFSWR) addresses the introduction of effluent into the environment and provides design and maintenance requirements for oil water separators. Effluent samples collected from an OWS for regulatory purposes within the provincial jurisdiction of BC must be carried out with consideration to the PSDFSWR, Part E3 of the BC Field Sampling Manual, and this document.

2. Document Control

This Standard Operating Procedure (SOP) is a controlled document. Document control provides a measure of assurance that the specifications and guidance it provides are based on current information that has been scrutinized by a qualified reviewer/s. Controlled documents are reviewed within a five year life cycle. Please ensure that the revision date listed in the header of this document does not exceed five years.

3. Principle of the Sampling Method

Separators provide treatment for wastewater which commonly contains hydrocarbons and other contaminants such as metals. Water within a separator include materials with a specific gravity of less than 1 that float and form a film on the surface of the separator while those with a specific gravity greater than 1 settle out and accumulate at the bottom of the separator to form a sludge. Separators are designed to discharge their effluent from a depth between these two layers so it is at or near this depth that a sample must be collected in order for it to be representative of the discharging effluent. The principle of this sampling method is to obtain a sample that is representative of the discharging effluent (i.e., not biased from the film on top of the separator or the sludge on its bottom).

4. Quality Control

- If sludge and petroleum thickness measurements are required, those measurements must be completed after the collection of samples. Measuring thickness prior to collection may stir up contaminants and bias the sample.
- Single use sampling devices are recommended. Sampling devices that are not single use must be decontaminated prior to collection.
- A sampling port or well is the best location to collect a sample from however, there may be a film in this location. If a visible film is present steps will have to be taken to prevent or mitigate the potential for contamination from the film.
- Separators and commonly, the location where the separator is installed, present considerable exposure to contamination. Because the contaminants typically include the parameters the samples will be analyzed for it will be difficult to discern contamination from valid parameter concentrations. A commensurate level of preparation and control is required to prevent or mitigate contamination.

5. Recommended Equipment and Materials

Field equipment should include the following:

- Oil absorbent pads, phosphate free detergent, analyte-free distilled or deionized water, brushes,
- Sample labels, indelible felt pen (VOC-free), field book/field forms, and;
- Laboratory-supplied sample containers, distilled or deionized water, cooler with filled and frozen water bottles or double bagged ice cubes.

One or more of the following sample collection devices:

- Disposable bailers and rope/cord,
- Drum thief (COLIWASA), and;
- Peristaltic pump, flexible LDPE/HDPE tubing, silicone tubing.

6. Sampling Considerations

- The toxicity or carcinogenicity of products contained in an OWS cannot be known without extensive sampling and analyses, which is impractical in most situations. For this reason, samplers are advised to be prudent in the planning and deployment of personal safety measures.
- Samples must not be collected from the surface of the separator. Quite often a bottle or sample device will have to be lowered through a surface layer containing hydrocarbon compounds that will adsorb onto the sample device or bottle, and which may subsequently enter the sample bottle. Contaminant mitigation measures provided in Section 7 of this SOP should be deployed when a surface layer or film is encountered.
- Separators often contain a bottom layer of sludge. To avoid re-suspension and contamination, sampling devices must not be lowered to a depth that is near or within the layer of sludge. If the layer of sludge is encountered, a new device (e.g., bailer, pump hose) should be used/installed, and a subsequent collection attempt be delayed to allow any materials suspended during the encounter to settle out.

7. Procedures

Oil water separators are commonly installed to intercept and separate contaminants from surface water, or process water. Separation is achieved through gravity, isolation and in some cases, absorption. Water that enters a separator passes horizontally through two or more chambers that retain, separate and isolate non-aqueous phase liquids and solids based primarily on specific gravity. Materials with a specific gravity of less than 1 float and form a layer on the surface while those with a specific gravity greater than 1 settle out and form a layer (sludge) on the bottom. Isolating baffles contain the materials as they are separated from water. A discharge pipe installed in the final chamber of the separator allows the effluent to exit the separator while the surface layer and sludge remain within. Properly maintained separators will greatly reduce but not completely remove contaminants from the effluent. In order to obtain a sample that is representative of the effluent the sample must be collected from a depth as close as possible as the effluent discharge depth and free of any surface contaminants.

Although samples can be obtained directly by plunging a bottle or sampling device through the surface of the sampling port or final chamber, this technique includes unnecessary exposure to contamination. It is recommended that the preparatory steps provided in Section 7 be used if the sampling port and or chamber from which a sample will be collected exhibits a sheen or surface layer. The indirect techniques described below are designed to mitigate the potential for sample bias caused by contamination.

Confirm the most appropriate sampling technique based on monitoring requirements, separator configuration and condition of both the oil water separator and the effluent it contains.

Direct Collection		
Sampling Device	**Pros**	**Cons**
○ Elbow length gloves & sample bottle, ○ Disposable bailers, ○ Drum thief or COLISWASA,	▪ Simple and relatively quick.	▪ Preparatory measures are required if surface layer is present. ▪ May introduce contamination. ▪ May not be possible to discern bias from contamination.
○ Peristaltic pump	▪ Simple and relatively quick. ▪ Purging prior to sample collection decreases the probability of potential contamination.	▪ Preparatory measures are required if surface layer is present. ▪ May introduce contamination. ▪ May not be possible to discern bias from contamination.
Temporary Shrouding		
Sampling Device	**Pros**	**Cons**
○ Disposable bailers, ○ Drum thief or COLISWASA	▪ Decreases the risk of contamination. ▪ Simple and inexpensive.	▪ Sampling device requires decontamination prior to decanting. ▪ Extracted sampling device requires decontamination.
○ Peristaltic pump	▪ Provides a moderate decrease of potential contamination. ▪ Sampling hose can remain in place until all samples have been collected. ▪ Pump discharge purge prior to sample collection decreases the probability of potential contamination. ▪ Simple and inexpensive.	▪ Sampling hose must be fixed to a rigid decontaminated structure (e.g. a length of wood dowel).
Temporary Pipe Installation		
Sampling Method	**Pros**	**Cons**
○ Disposable bailers, ○ Drum thief or COLISWASA, ○ Peristaltic pump	▪ Provides a considerable decrease of potential contamination. ▪ Pipe can be fixed in place until all samples are obtained. ▪ Simple and inexpensive.	▪ Pipe must be contaminant free or decontaminated prior to installation. ▪ Requires two people.

7.1 Sampling & Decontamination

The actual methods for sampling from an oil water separator are not very different from those used for surface water or groundwater however, samples collected from an OWS will typically include the requirement to breach a surface layer of petroleum hydrocarbons to collect the samples. In some cases, the sampling container or device will have to be decontaminated prior to deployment and again before decanting.

Sample bottles and multi-use sampling devices that pass through the surface layer of a separator must be decontaminated using a phosphate free detergent after extraction from the separator and prior to any futher steps. Phosphate free detergents are available at most industrial suppliers (e.g., Liquinox, Contrad, Extran).

A 0.1 – 2.0 % (v/v) detergent solution is adequate for most decontamination needs. Field cleaning solutions should not exceed 0.2% (v/v) detergent. Prepared detergent solution can be placed in a spray bottle for ease of use in the field. A triple rinse with deionized or distilled water is required to remove the detergent. NEVER place or dispose detergent in an OWS.

7.2 Sample Types & Collection Sequence

Sampling requirements for oil water separator monitoring is typically limited to samples collected for the analysis of petroleum hydrocarbon compounds.

For monitoring programs that report other parameters, samples should be collected in the following order:

i. Volatile organics,
ii. Samples requiring field filtering (e.g. dissolved metals),
iii. Semi-volatile organics,
iv. Non-volatile organics,
v. Total metals,
vi. Nutrients, and;
vii. Other general chemistry parameters.

7.3 Sampling Techniques

Most separators are built with a sampling port providing the simplest method of sample collection. Sample ports are typically provided in the form of a vertical PVC pipe that extends above the water line. In this configuration the pipe is part of a 'T' assembly that also serves as the separator's discharge line providing access to the same effluent being discharged. Samples collected from a sampling port of this configuration offer access to the most representative water and for this reason, is recommended. If a sample port is not provided or available, an accessible discharge point may be used. The discharge access must allow the collection of a sample without contact of the sample bottle or sampling device to any infrastructure such as the inside wall of a pipe that may contain a layer of contaminant. If neither a sample port nor discharge point is available, a sample can be obtained from the final chamber of the separator, typically through an access port.

Samplers are advised to assume that a film or layer of contamination will be present on the surface of the water within each of these sample collection access points and for this reason, ENV recommends that, regardless of sample collection technique, extra steps be taken to mitigate the potential for bias caused by contamination.

The following seven techniques (A thru C) were developed to mitigate the potential for bias caused by contamination. When combined with appropriate sampling methods, these techniques provide reliable measures to mitigate the potential for contamination.

A	**Recommended Sampling Technique – Sample Port**
	Direct Technique – Sample Port

1. For personal protection, at a minimum, eye protection and laboratory grade gloves such as powder free nitrile gloves must be worn.
2. Inspect the sampling port for a sheen or layer of non-aqueous liquid (commonly a petroleum hydrocarbon product). If a sheen is visible place an oil absorbent pad on the surface and allow the pad to sit for approximately 5 minutes. If a layer of non-aqueous liquid (≥ 2 mm, estimate only) is present allow more time for absorption.
3. Remove the oil absorbent pad and inspect the surface of the water again. If a sheen or layer is still visible it may be prudent to use a temporary shroud as described in subsequent sections of this SOP.

Grab Sample – Sample Bottle

4. Decontaminated elbow length gloves are required for this technique.

5. Ensure the sample bottle will fit within the sample port.
6. With the lid of the sampling container secured in place, slowly and in a controlled manner, submerge the container to a depth of approximately 30 cm below the surface. Rotate the bottle to allow any materials from the surface layer to liberate and rise away from the bottle, its lid and neck parts. Allow enough time (approximately 30 s) for the materials to rise away from the bottle and remove the lid.
7. Allow the container to fill, replace and secure the lid prior to extracting it from the wastewater.
8. Ensure the lid is secure in place. Wipe all surfaces of the sample container with an oil absorbent pad and decontaminate with a cloth and phosphate free detergent (see Section 7.1) followed by a triple rinse.
9. Remove the rinse water from the sample container with a clean towel and place into a pre-chilled cooler.

Sample Device – Peristaltic Pump

4. If a peristaltic pump is being used, secure the end of the suction line tubing to a rigid guide made of wood, glass, or metal material. The guide should be of an appropriate length to accommodate the collection of sample material from a depth of approximately 30 cm below the surface of the wastewater.
5. Ensure that the end of the tubing extends beyond the guide by at least 1 cm.
6. Lower the guided hose into the sampling port in a controlled manner to avoid contacting the end of the hose with the inner walls of the port. Secure the guide in place.
7. Configure the discharge tubing to discharge into a bucket but do not allow the tubing to come into contact with the bucket. Start the pump, purge the line for 3 to 5 minutes and stop the pump.
8. Hold the end of the discharge tube over the opening of the sample container without making contact between the tubing and the sample container. Start the pump and slowly fill the container. Secure the lid on the container and decontaminate the container with a cloth and phosphate free detergent followed by a triple rinse. Place the sample container into a pre-chilled cooler.

Sample Device – Bailer, Drum Thief, COLIWASA

4. Lower the sampling device into the sampling port in a controlled manner to avoid making contact with the device and the inner walls of the port.
5. Allow the device to fill and carefully withdraw to a work area.
6. Wipe all surfaces of the sample device with an oil absorbent pad. Decontaminate the device by spraying with a phosphate free detergent (see Section 7.1) followed by a triple rinse.
7. Remove the rinse water with a clean towel and decant into a sample container. Place the sample container into a pre-chilled cooler.

Filtration and Preservation

8. If preservation and or filtration are required, follow the steps below.
    a. If filtration is required, pour sample water from the sample container into a syringe fitted with a disc filter. Purge the device allowing 10 to 20 mL to pass through the filter. Remove any water from the filtration assembly, push the plunger to fill the required volume of a sample container leaving enough space to add preservative if required. If required, add the preservative, seal the container, and rotate it several times to mix. Place the processed sample in a pre-chilled cooler.
    b. If chemical preservation is required, remove the lid of the sample container and a small amount of sample water. Add the preservative, seal the container, and rotate it several times to mix. Place the processed sample in a pre-chilled cooler.

A1	**Temporary Pipe Installation**
	Temporary Pipe Installation Technique

This technique is recommended for separators that do not provide a sampling port or adequate access to the discharge line. In this situation a temporary pipe can be installed through an opening or access port in the final chamber of the separator. Treated water in this section of the separator will be of a lower quality and less representative of the discharging effluent and must be identified as such in field notes and reports.

For this technique a length of PVC pipe with a minimum diameter of 4 inches is recommended. The pipe should be long enough to extend approximately 30 cm below the surface. The pipe can be temporarily fixed to the access port (recommended) or held in place by a second person. This technique will allow the collection of samples using a bailer, drum thief, COLIWASA or peristaltic pump.

With the pipe secured in place follow the applicable steps provided in A above.

B1	**Final Chamber**
	Direct Technique – Final Chamber using a Sample Bottle

If the separator is not equipped with a sample port or access to its discharge, samples can be collected as grab samples directly from the final chamber of the separator. This technique is only to be used if the separators configuration allows safe and adequate access. Samples are collected through an opening or access port. Treated water in this section of the separator will be of a lower quality and less representative of the discharging effluent and must be identified as such in field notes and reports.

1. For personal protection, eye protection and elbow or arm length gloves are required. Unless the elbow or arm length gloves are known to be or have been, decontaminated, laboratory grade gloves such as powder free nitrile gloves should be worn over the hand portion of the larger gloves.
2. With the lid of the sampling container secured in place, slowly and in a controlled manner, submerge the container to a depth of approximately 30 cm below the surface. Rotate the bottle to allow any surface materials captured and held on the bottle to liberate and rise away from the bottle, its lid and neck parts. Allow enough time (approximately 30 s) for the materials to rise away from the bottle and then remove the lid.
3. Allow the container to fill, replace and secure the lid and then extract it from the separator.
4. Ensure the lid is secure in place. Wipe all surfaces of the sample container with an oil absorbent pad and decontaminate with a cloth and phosphate free detergent followed by a triple rinse.
5. Remove the rinse water from the sample container with a clean towel and place into a pre-chilled cooler.

Filtration and Preservation

6. If preservation and or filtration are required, follow the steps below.
    a. If chemical preservation is required, remove the lid of the sample container and a small amount of sample water. Add the preservative, seal the container, and rotate it several times to mix. Place the processed sample in a pre-chilled cooler.
    b. If filtration is required, pour sample water into a syringe fitted with a disc filter. Purge the device allowing 10 to 20 mL to pass through the filter. Remove any water from the filtration assembly, push the plunger to fill the required volume leaving enough space to add preservative if required. Place the processed sample in a pre-chilled cooler.

B2	**Final Chamber**
	Direct Technique – Final Chamber using a Bailer, Drum Thief or COLIWASA

1. For personal protection, eye protection and laboratory grade gloves such as powder free nitrile gloves must be worn.
2. slowly and in a controlled manner, submerge the device to a depth of approximately 30 cm below the surface. Open the device and allow it to fill with the wastewater.
3. Secure the device to contain the collected sample material. Extract the device in a controlled manner brining it to the surface.
4. Wipe all surfaces of the device with an oil absorbent pad. Decontaminate the discharge area with a cloth and phosphate free detergent followed by a triple rinse.
5. [Drum thief or COLIWASA] Remove the rinse water from the device with a clean towel. Release and or extract the plunger and decant into a sample container.
6. [Bailer] Remove the rinse water from the bailer with a clean towel. Invert and decant the sample material from the top opening of the bailer or insert the discharge tube in the bottom of the bailer and decant into a sample container.

Filtration and Preservation

7. If preservation and or filtration are required, follow the steps below.
    a. If chemical preservation is required, remove the lid of the sample container and a small amount of sample water. Add the preservative, seal the container, and rotate it several times to mix. Place the processed sample in a pre-chilled cooler.
    b. If filtration is required, pour sample water into a syringe fitted with a disc filter. Purge the device allowing 10 to 20 mL to pass through the filter. Remove any water from the filtration assembly, push the plunger to fill the required volume leaving enough space to add preservative if required. Place the processed sample in a pre-chilled cooler.

B3	**Final Chamber**
	Direct Technique – Final Chamber using a Peristaltic Pump

1. Two people are recommended for this technique.
2. For personal protection, eye protection and laboratory grade gloves such as powder free nitrile gloves must be worn.
3. Secure the end of the suction line tubing to a rigid guide made of wood, glass, or metal material. The guide should be of an appropriate length to accommodate the collection of sample material from a depth of approximately 30 cm below the surface of the wastewater.
4. Ensure that the end of the tubing extends beyond the guide by at least 1 cm.
5. Configure the discharge tubing to discharge into a bucket but do not allow the tubing to come into contact with the bucket. Start the pump, purge the line for 3 to 5 minutes and stop the pump.
6. Hold the discharge tube end over the opening of the sample container without making contact between the tubing and the sample container. Start the pump and slowly fill the container. Secure the lid on the container and decontaminate the container with a cloth and phosphate free detergent followed by a triple rinse.

Filtration and Preservation

7. If preservation and or filtration are required, follow the steps below.
    a. If chemical preservation is required, remove the lid of the sample container and a small amount of sample water. Add the preservative, seal the container, and rotate it several times to mix. Place the processed sample in a pre-chilled cooler.
    b. If filtration is required, pour sample water into a syringe fitted with a disc filter. Purge the device allowing 10 to 20 mL to pass through the filter. Remove any water from the filtration assembly, push the plunger to fill the required volume leaving enough space to add preservative if required. Place the processed sample in a pre-chilled cooler.

C1	**Temporary Shrouding**
	Temporary Shrouding Technique – Final Chamber

Temporary shrouding allows the sampler to submerge a sampling device to the desired depth without passing through the surface layer of the separator. During extraction, the sampling device will pass through the surface layer and must be decontaminated prior to decanting. The exception to this is peristaltic pumps that, after purging, provide sample water while still submerged. The simplest method of temporary shrouding is to loosely place a layer of contaminant free plastic around the collection end of the device prior to submerging. When the device has passed through the surface layer and or has been lowered to the desired depth, the plastic is punctured and removed while the device stays in place to collect the sample.

This technique can be combined with the steps provided in B2 or B3 to reduce the potential for contamination.

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Approval: