

Waterworks System Assessment Questions and Answers Part 2



Details of the waterworks system assessment are published in Waterworks System Assessment Standards EPB 233.

What is a Waterworks System Assessment (WSA)?

A WSA (found on <http://www.saskh20.ca/DWBinder.asp>) is a periodic inspection and evaluation of waterworks infrastructure and activities. This will enhance functionality and avoid unnecessary health risks associated with waterworks. The WSA is similar to assessments used in other jurisdictions in Canada that have recently renewed their drinking water legislation.

What is involved in a WSA? The WSA is to focus on detailing upgrades needed to provide drinking water that meets all Ministry of Environment (Environment) requirements and detailing system capacity upgrade requirements. The WSA is to include a determination if recommendations from prior WSA have been undertaken, and is to specify actions taken to fulfill prior recommendations. The WSA planning phase involves a review of the available information on the water supply, treatment, storage and distribution systems. The review includes raw and treated water quality and system capacities. The WSA is to contain recommended improvements with conceptual cost estimates for these quality and capacity upgrades.

Who can conduct a WSA? WSAs are to be conducted by a professional engineer or under the direct supervision of a professional engineer. Where the waterworks operation is under the direct day-to-day supervision of a professional engineer, an assessment that has been conducted in conjunction with an independent engineer or engineering firm (audited assessment) is acceptable.

We have or plan to have a Hygienic water system? Do we need a WSA? Municipal and other systems that have Hygienic status do not require a WSA. Permittees that wish to have Hygienic status but have not yet attained Hygienic status are to immediately ensure the relevant Environmental Project Officer (EPO) is aware of the requested change to Hygienic status. Systems that do not have Hygienic status by December 31 2010 are required by law to have a finished WSA approved by Environment by March 31 2011. *If your system wishes to have Hygienic status but does not achieve this by December 31, 2010 then a WSA is required.* For more information on Hygienic systems, please see publication Hygienic Water Use EPB 232, which is found in the Drinking Water Information Binder (<http://www.saskh20.ca/foroperators.asp>).

What is the definition of estimated capital replacement cost? Estimated capital replacement cost is the "estimated current cost of replacing an asset with a new one of equal effectiveness". Please note that this is not the same as the conceptual cost of recommended upgrades which are also required by the WSA. All conceptual cost estimates may use an accuracy of $\pm 25\%$. For reporting estimated capital replacement cost and remaining service life in table format, the minimum table column headers are:

- item;
- estimated capital replacement cost (\$ Canadian); and
- estimated remaining service life (years).

When is water quality sampling and analysis required? Water Quality (WQ) testing is required where adverse risk is suspected but cannot be determined without new WQ testing. For example new testing is acceptable if organic carbon is elevated but trihalomethane results do not exist in the WQ record. Field kit test use shall be minimized, on-site chlorine and turbidity are

EPB 233A Dec/09



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exceptions to this. The WSA seeks risk management information, there is no strict requirement to perform in-field corrective optimization work. Should a permittee wish to pay for WQ testing and other work that is beyond the scope of the WSA, the permittee must be made aware by the party performing the WSA that they are paying for a product outside the WSA scope.

Can Environmental Project Officers provide assistance? Permittees, consultants and representatives may contact EPOs to discuss waterworks issues. EPOs may provide clarification or comments to a consultant on a regulatory issue.

Can prior reports be used in the WSA? Use of prior design and evaluation and similar reports as part of the WSA submittal is acceptable and encouraged. The prior reports need not be up-to-date, provided supplemental information is provided to ensure the Waterworks System Assessment Standards EPB 233 is met by the submitted WSA. The submitted WSA needs to cover off all items seen in the Waterworks System Assessment Standards EPB 233.

Combined WSA: A combined WSA includes two or more separately-permitted works. A combined WSA is acceptable conditional to the WSA covering off all applicable WSA standards for all permitted works.

When is a report considered complete? The Ministry of Environment will determine that a report is complete when it is satisfied that the report addresses all applicable items in the WSA standard document.

What is the scope of WSA? The WSA is not as detailed as a facility design report; instead the WSA focus is risk to public health. A WSA must contain firm recommendations for works or recommendations for further detailed study where such need exists.

What is the WSA completion timeline? The second round of WSA is to be completed by December 31, 2010. WSA are to be submitted to the Ministry of Environment within 90 days of the above completion date, which means the Ministry is to receive the finished WSA by March 31, 2011.

Our community recently built a waterworks project - do we need to submit a WSA? Waterworks projects that submitted construction design plans after December 5, 2002 as part of the Permit to Construct Waterworks process and received a new Permit to Construct Waterworks dated from December 5, 2002 to December 31, 2010, are not required to complete a WSA for that newly-permitted portion of the waterworks.

Our Community is Newly-Regulated by Environment – Do We Need a WSA? For waterworks systems not previously regulated by Environment, issuance of a first-time operating permit by Environment after December 31 2004, means that the permittee will be required to submit a combined WSA within three years of the first permit to operate. These systems would then revert to the normal WSA schedule.

Our community has wells - do we need to submit a full Groundwater Under Direct Influence (GUDI) assessment as part of the WSA? The WSA shall categorize all raw water sources as either true groundwater, groundwater under the influence of surface water or surface water, or present a firm written plan and detailed timeline to determine GUDI status. For more information on determining GUDI status see Environment's publication Groundwater Under the Influence of Surface Water (GUDI) Guideline EPB 284.

Technical Section

Early Contact with Consultants: Consultants are encouraged to contact the EPO at the start of the WSA study to foster an early discussion of the known waterworks problems, issues and challenges.

Use of Errata Sheets: Environment will allow any draft or final WSA reports to have addenda or errata sheet(s) as part of that draft or final report.

Submitting Draft WSA: It is acceptable that first drafts are submitted to Environment and the community at the same time. The community must have received a draft of the WSA prior to Environment's final acceptance of the WSA.

Meetings: EPO's may be requested to attend a meeting with the consultant and the community.

WSA Exemption and Decommissioning of Facilities: Decommission is defined as no longer in active service by plan. If the first day of decommission (first day works are no longer in active service) is in the two years prior to or one year after a WSA submittal date (ex December 31 2010), then a WSA is not required on that WSA submittal date. A letter is to be sent to the appropriate EPO including;

- waterworks permittee and brief description of works to be decommissioned;
- timeline for decommissioning activities and person responsible for decommissioning activities; and
- statement that WSA will not be performed

A reversal or major alteration of decommissioning plans means the permittee must inform Environment of the changes to determine if a WSA is required. For works with a very lengthy decommissioning period Environment may consider extending the three year exemption period.

The above decommissioning refers to whole facilities and not to parts or components of a facility. Examples of whole facilities include raw water transmission lines, treatment plants, reservoirs and treated water pipelines. The above does not apply to components such as filters, pumps, motors and other components contained within a facility.

For example, a treatment plant is to be decommissioned effective December 30 2011. This day is the first day the plant is planned to be out of active service. As the decommission date is within one year after a WSA submittal date (December 31 2010), then a WSA is not required. As another example, a pressure booster station is to be decommissioned effective January 1 2008. This day is the first day the plant is planned to be out of active service. As the decommission date is within two years before a WSA submittal date (December 31 2010) then a WSA is not required.

Obtaining Plans for Waterworks: Consultants are required to obtain whatever plans and reports communities may have for waterworks; many may be listed in prior WSA. In the event that no plans or insufficient plans are available, Environment may be contacted to provide any plans available. Environment plans are archived and obtaining these plans may take several weeks. Only persons or parties acting as agents for the community may receive plan copies. Consultants will need to make copies and return the original plans. This plan source provision also applies to non-WSA consultant work. Use of plans is voluntary and Environment does not guarantee content or accuracy.

Selection of CT Calculation Method

Following is a procedure to assist with selecting the appropriate WSA CT (disinfectant Concentration X Time) calculation method;

- 1) Determine if wells require a GUDI (Groundwater Under the Direct Influence of surface water) evaluation.
- 2) For true groundwater (no GUDI evaluation is required):
 - perform CT calculations based on 4 log virus reduction; and
 - calculate if water reservoir meets guideline of two days of average annual flow.
- 3) For surface water or for systems requiring a GUDI evaluation:
 - perform CT calculations based on 3 log Giardia reduction; and
 - for systems requiring a GUDI evaluation, indicate above CT findings are pending outcome of GUDI study
 - calculate if water reservoir meets guideline of two days of average annual flow.

Performing and Reviewing CT Calculations

Section 3.2.11 of [A Guide to Waterworks Design EPB 201](#) contains a broad review of CT calculations. To perform a full CT calculation reference number three in the guideline would be used; the [EPA 1999 Disinfection Profiling and Benchmarking Guidance Manual](#) which may be viewed/downloaded at no charge at: <http://www.epa.gov/safewater/mdbp/mdbptg.html>.

All CT calcs should generally follow the 1999 EPA Manual referenced above.

The best summary explanation of CT calculation/review is in Chapters 3, 4 and 5 of the above [Disinfection Profiling and Benchmarking Technical Guidance Manual](#). Chapter 4 is Calculating CT. Note that the data collection and population limits in the manual do not apply to facilities for WSA.

CT Calculation Values for Reservoir Volume, Flow, Temperature, pH, Residual Disinfectant, etc.

For daily operations, CT calculations at water plants may be calculated using actual values for reservoir volume, flow, temperature, pH, chlorine residual and so on. However, for the WSA, this is a worst case scenario calculation to determine if the system meets CT requirements at all times. Therefore, conservative or worst case scenario values need to be used. Sometimes multiple calculations such as winter and summer conditions need to be calculated to determine seasonal worst case scenarios.

CT Calculation for Multiple Facilities

Consider a small community receiving treated water by pipeline from a large community. The water is first chlorinated at the large community and CT requirements are met in this large community. There is no requirement for a new CT calculation for either the pipeline or the small community, if there are no new risk factors such as a second water source feeding in midway of the pipeline. For cases where the CT requirement can be shown to be met upstream of a facility, and there are no new risk factors such as other water sources, there is no requirement for a CT calculation for that facility. That facility WSA will need to indicate that the CT requirements are met at another location.

Alternate Disinfectants and the CT Calculation

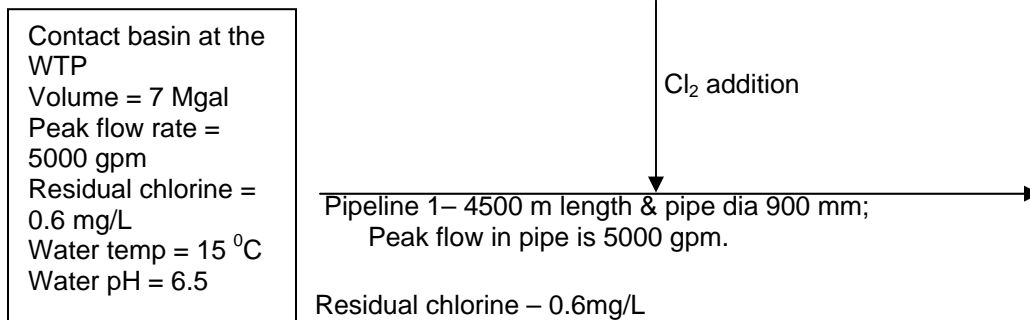
The CT calc is to be based on *disinfectant residual concentration*, as seen in Chapter 3 - page 3 to 4 of the [EPA 1999 Disinfection Profiling and Benchmarking Guidance Manual](#) which is at: <http://www.epa.gov/safewater/mdbp/mdbptg.html>.

From the reference, the CT is to be based on disinfectants actually in the drinking water. In the case of a groundwater plant with natural ammonia in a well, CT may be based on residual free chlorine, on chloramine, or on a combination of free chlorine and chloramine if the system is truly generating these disinfectants *consistently*.

CT Calculation Examples

The following examples show CT calculations at a WTP with contact basin and a pipeline prior to the first service connection, and at a groundwater plant & reservoir where disinfection is the only treatment.

1. Contact basin at the WTP and pipeline



For CT calculations conservative values should be used. For contact volume, the minimum volume should be used. In this case the reservoir volume is 7 Mgal but the minimum reservoir volume is (50%) **3.5 Mgal**. Also, the peak hour flow rate should be used and in this case it is **5000gpm**. For chlorine residual the minimum regulated value should be used. In this case the minimum free chlorine allowed is **0.1 mg/L** even though the system of operates at higher values. The intention of this calculation is to demonstrate effective disinfection in the worst case situation possible within the operating conditions of the facility.

Water Plant

Volume, $V = 7\text{Mgal} \times 50\% = 3.5 \text{ Mgal}$

Peak hour flow rate, $Q = 5000 \text{ gpm}$

Theoretical detention time (T) = $V/Q = 3.5 \text{ Mgal}/5000 \text{ gpm} = 700 \text{ minutes}$

Since baffling conditions are superior in the basin, the baffling factor for the basin is 0.7 (T_{10}/T)

Hence, $CT \text{ (actual)} = (V/Q) \times (T_{10}/T) \times \text{chlorine residual} = 700 \text{ min} \times 0.7 \times 0.1 \text{ mg/L} = 49 \text{ mg}\cdot\text{min}/\text{L}$

- from Appendix A Table 2 of 'A Guide to Waterworks Design', a CT of 59 mg·min/L is required for 3 log inactivation of *Giardia*.

Note: The CT actual of 49 mg·min/L does not exceed the CT required of 59 mg·min/L. Therefore, the CT requirement is not met by the WTP contact basin. See Part 2 – Pipeline. If you back calculate you can determine the required minimum free chlorine residual to meet the required CT at this point. In this case the required minimum free chlorine to exceed the required CT is 0.13 mg/L.

Pipeline

Chlorine is added to the pipeline at or just downstream of the WTP

Chlorine level at the first consumer is 0.6 mg/L but the minimum regulated value is 0.1 min·mg/L

Peak hour flow in the pipe = 5000 igpm.; Diameter of the pipe = 900mm

Cross-sectional area of the pipe = $\pi \times 0.45^2 = 0.64 \text{ m}^2$.

Volume of water in the pipe = $4500\text{m} \times 0.6362 \text{ m}^2 = 2863 \text{ m}^3 = 629,750 \text{ igaal}$

$T = V/Q = 629750\text{igaal} / 5000\text{igpm} = 125 \text{ minutes}$

Since it is a pipeline, the baffling factor is 1. Hence, actual CT

$CT \text{ actual} = (V/Q) \times (T_{10}/T) \times \text{chlorine residual} = 125 \text{ min} \times 1 \times 0.1\text{mg}/\text{L} = 12.5 \text{ mg}\cdot\text{min}/\text{L}$

Note: The sum of the actual CT values is about $49 + 12.5 = 61.5 \text{ mg}\cdot\text{min}/\text{L}$ and does exceed the CT required of 59 mg·min/L. Therefore, the CT requirement is met by the combination of WTP contact basin and the pipeline.

If required, the evaluation could have included the log removal/inactivation CT credits for treatment equipment in the WTP, as seen in Table 3.1 of Section 3.2.1 of A Guide to Waterworks Design.

2. Reservoir at a Groundwater Treatment Plant

a) Collect data and calculate theoretical detention time, T:

reservoir volume = 2 million igal so 50% of reservoir = 1 million igal

peak hour flow rate = 500 igpm

reservoir is unbaffled, square, medium inlet velocities

minimum regulated free residual chlorine concentration = 0.1 mg/L free chlorine residual

treatment = chlorination only

$$T = V/Q = 1 \text{ Migal}/500 \text{ igpm} = 2000 \text{ minutes}$$

b) Determine actual CT:

- for the basin, T_{10}/T is 0.2 (see Table 3-2 in Reference 3 of SE's 'A Guide to Waterworks Design' which is the USEPA (1999). "Disinfection profiling and benchmarking guidance manual." EPA 815-R 99-013, Washington, DC. The manual may be downloaded at: <http://www.epa.gov/safewater/mbp/mbpbtg.html>.)

$$\text{actual contact time } T_{10} = (2000 \text{ minutes}) (0.2) = 400 \text{ minutes}$$

$$CT = (T_{10})(\text{residual concentration}) = (400 \text{ min})(0.1 \text{ mg/L}) = 40 \text{ mg}\cdot\text{min/L}$$

c) Collect data for calculation of CT required:

pH = 7.2

temperature = 6 C

- from Appendix A Table 7 of A Guide to Waterworks Design, a CT of 7.6 mg-min/L is required for 4-log inactivation of virus by free chlorine. (Groundwater plants require 4-log virus reduction, GUDI and surface water plants require 3-log Giardia reduction)

d) Comparison of CT actual to CT required:

- CT actual of 40 mg-min/L exceeds the CT required of 7.6 mg-min/L, therefore the CT requirement is met by the reservoir.

- Alternatively, $CT \text{ actual}/CT \text{ required} = (0.1 \text{ mg/L})(400 \text{ min})/7.6 \text{ mg}\cdot\text{min/L} = 5.2$ which is greater than 1 therefore the CT requirement is met by the reservoir.