Summary of Proposed Amendments to the
Trent Source Protection Plan and Assessment Report

Pursuant to Section 34 of Ontario Regulation 287/07 of the Clean Water Act

November 7, 2019

Recent upgrades to the Stirling Municipal Well System have changed the area where specific activities can be a drinking water threat. The proposed amendments to the Trent Assessment Report and the Trent Source Protection Plan reflect these changes. There were no changes to the policies within the Trent Source Protection Plan.

Township of Stirling-Rawdon recently added a new production well (well #6) to the Stirling municipal drinking water system. This new well is intended serve as backup and/or future replacement source for the existing production wells. No other changes are planned for the existing drinking water system and the maximum approved capacity of 2,687.7 m^3/d for the Stirling Water Treatment Plant remains unchanged. The newly installed well #6 has very similar properties as the existing well #5, with a depth of 13.2m. Updated wellhead protection studies were completed in July 2019 for the Stirling Well System.

As per Section 34 of Ontario Regulation 287/07 of the *Clean Water Act,* this summary document includes the proposed amendments (shown in red) listed below. These include updates to the Stirling municipal drinking water system.

Amendments to Source Protection Plan

Section of Source Protection Plan / Assessment Report	Brief Description of Potential and Completed Amendment	Estimated Timing to Submit Potential Amendment to Ministry of the Environment, Conservation and Parks
Trent Assessment Report 2.5.4.1.2	Update to groundwater systems information	January 2020
Trent Assessment Report Table 5.1-2	Update to well information	January 2020
Trent Assessment Report 5.2.2.7	Stirling well system update	January 2020
Trent Assessment Report Table 5.2-20	Added table for Groundwater extraction scenario	January 2020
Trent Assessment Report Table 5.2-21	Update to vulnerability scores	January 2020
Trent Assessment Report Table 5.2-22	Update to uncertainty ratings	January 2020
TO BE PROVIDED LATER:		
Trent Assessment Report 5.4-3	Update to threats table	January 2020

Trent Assessment Report Maps 5-28a,b,c	Maps: Wellhead Protection Areas Vulnerability Scores Groundwater Vulnerability Managed Lands Total Impervious Surface Area Livestock Density Areas for Chemical Threats Areas for Pathogen Threats Areas for DNAPL Threats	January 2020
Trent Assessment Report Maps 5-28 d, e, f	Maps: WHPA0-E Vulnerability and Areas for Threats WHAP-E – Managed Lands, Total Impervious Surface Area, Livestock Density Issue Contributing Area	January 2020
Trent Source Protection Plan Policy Applicability Map 5-28	Update Map	January 2020

2.5.4.1.2 Groundwater Systems

There are four existing municipal residential groundwater supply systems in the source protection area that obtain their water from groundwater sources. These systems serve about 9,600 people. Under the *Drinking-Water Systems Regulation (O. Reg. 170/03)*, half of these systems are classified as large municipal residential systems and the other half are classified as small municipal residential systems. These systems are discussed in detail in Chapter 5.

GUDI Wells

The Drinking-Water Systems Regulation (O. Reg. 170/03) under the Safe Drinking Water Act defines specific circumstances under which a groundwater supply is considered to be groundwater under the direct influence (GUDI) of surface water. These wells are more susceptible to contamination than non-GUDI wells because they can be affected by short-term water quality issues associated with surface water sources.

The Stirling residential drinking water system draws water from a total of four wells. A 2010 study by Earthfx determined that of the four production wells (wells 1, 3, 4, 5) in the earlier DWS, only two of the wells (well 4 & 5) are considered to be groundwater under the direct influence (GUDI) of surface water. A well (well 6) has been added to the earlier four production wells at this drinking water system. According to a 2019 study by BluMetric, the new well (well 6), installed in the same aquifer and at a similar depth and distance from Rawdon Creek as existing wells (4 & 5), can reasonably assumed to be GUDI. A 2002 study by Middle Earth Hydrogeology determined that the municipal wells appear to be under the influence of surface water from Rawdon Creek and the water table around the pumped wells. This conclusion was based on the following observations:

- ~~Elevations at the water table indicate a cone of depression around production Wells 3 and 4 during pumping.~~

- Analysis of the flow system during pumping of Well 4, with best estimates for the hydraulic parameters of the aquifer and the overlying aquitard, indicates that the flow to Well 4 from Rawdon Creek would take about 54 days. These results are considered to be similar for Well 3.
- Within a 50-metre radius around Well 4, the estimated groundwater discharge through the aquitard is about 4 to 8 cubic metres per hour (m^3/h) under typical pumping conditions, which represents 7 to 14% of the total pumping rate from Well 4 (58 m^3/h).
- There have been sporadic occurrences of coliforms in the raw water from the municipal wells since monitoring was begun in 1995.

Table 5.1-2 (cont.) Summary of Wells and Water Treatment Systems for Existing Municipal Residential Groundwater Systems in the Trent SPAs

System Name	Well(s)								Water Treatment System	
	Location	No. Wells	Depths (m)					GUDI Status	Disinfection	Other Available Treatment Details
			1	2	3	4	5			
Otonabee-Peterborough Source Protection Area										
Alpine Village	East of Bobcaygeon	2	82	100	NA	NA	NA	No	Sodium hypochlorite	2 µm cartridge filtration
Birch Point Estates	Birch Point	2	18.3	19.8	NA	NA	NA	No	Sodium hypochlorite	1 µm cartridge filtration
Buckhorn Lake Estates	Buckhorn	1	16.8	NA	NA	NA	NA	Yes	Sodium hypochlorite	Chemically assisted filtration (Kinetico Macrolite system)
Crystal Springs	Elgeti	2	19.8	26.5	NA	NA	NA	Yes[2]	UV irradiation Sodium hypochlorite	
Keene Heights	Keene	2	20.9	26.5	NA	NA	NA	No	Sodium hypochlorite	Sodium silicate (iron sequestration)
Millbrook	Millbrook	3	30	30	31	NA	NA	No	Sodium hypochlorite	
Norwood	Norwood	4	25	21.3	30.5	30.5	NA	No	Sodium hypochlorite	Sodium hydroxide & sodium silicate
Pinewood	Pinewood	2	30	30	105.9	NA	NA	No	Sodium hypochlorite	
Crowe Valley Source Protection Area										

Cardiff	Cardiff	1	13.4	NA	NA	NA	NA	Yes	Sodium hypochlorite	2 µm cartridge filter for iron removal
Dyno Estates	Dyno Estates	1	11.8	NA	NA	NA	NA	No	Sodium hypochlorite	
Havelock	Northeast side of Havelock	3	15.2	13.7	15	NA	NA	Yes	Wells 1&4: UV irradiation; Chlorine; Sodium hypochlorite Well 3: Chlorine; Sodium hypochlorite; UV irradiation	Well 3: Dual media filtration
Lower Trent Source Protection Area										
Grafton	Grafton	2	78	78	NA	NA	NA	No	Sodium hypochlorite	Sodium silicate (iron sequestration)
Brighton	Brighton	3	40	40	40	NA	NA	No	Gaseous chlorine	
Colborne	Colborne	2	72	72	NA	NA	NA	No	Sodium hypochlorite	Sodium silicate (iron sequestration)
Stirling	Stirling	~~4~~5	~~12~~6.4	13.1	~~10.7~~16.1	~~6.1~~13.2	~~NA~~13.2	Yes	UV irradiation; Sodium hypochlorite	

5.2.2.7 STIRLING MUNICIPAL WELL SYSTEM

The Stirling municipal well system consists of four wells that draw water from sand and gravel deposits adjacent to Rawdon Creek. Wells 4 and 5 are considered to be GUDI (groundwater under the direct influence of surface water).

Wellhead Protection Area Delineation

The WHPAs for the Stirling municipal well system were delineated based on time of travel determined through the application of a three-dimensional groundwater flow model. The data source used to develop this model was the Ministry of the Environment and Climate Change Water Well Information System database. The model that represented the geologic system was six geological layers: five in the overburden and one in the bedrock.

The WHPAs delineated for the Stirling municipal groundwater system are shown on Map 5-28a.

2019 STIRLING WELLHEAD PROTECTION STUDIES UPDATES

Township of Stirling-Rawdon recently added a new production well (well #6) to the Stirling municipal drinking water system. This new well is intended serve as backup and/or future replacement source for the existing production wells. No other changes are planned for the existing drinking water system and the maximum approved capacity of 2,687.7 m^3/d for the Stirling Water Treatment Plant remains unchanged. The newly installed well #6 has very similar properties as the existing well #5, with a depth of 13.2m. Updated wellhead protection studies were completed in July 2019 for Stirling Well System.

The consultant hired by the city used alternative pumping scenarios (see table below) in order to define composite WHPA zones. Scenario 1 was developed to be similar to the original model (Earthfx, 2010); scenarios 2-4 include various combinations of extraction rates, using two groups of wells: well #1 and well #3 in group 1 and well #4, well #5, and well #6 in group 2. For all scenarios, the total extraction rates correspond to the maximum permitted rate 2,687.7 m^3/d.

Table 5.2-20: Groundwater Extraction Scenario

SCENARIO	Well #	EXTRACTION RATE (m^3/d)	PTTW MAX WELL (m^3/d)	PTTW MAX SYSTEM
1	Well #1	544.32	1304.6	2687.7
	Well #3	544.32	1304.6	
	Well #4	951.06	1944.0	
	Well #5	0	648.0	
	Well #6	648.00	648.0	
2	Well #1	1304.6	1304.6	2687.7
	Well #3	0	1304.6	
	Well #4	1383.1	1944.0	
	Well #5	0	648.0	
	Well #6	0	648.0	
3	Well #1	0	1304.6	2687.7
	Well #3	395.7	1304.6	
	Well #4	1644.0	1944.0	
	Well #5	0	648.0	
	Well #6	648.0	648.0	
4	Well #1	1304.6	1304.6	2687.7
	Well #3	1304.6	1304.6	
	Well #4	0	1944.0	
	Well #5	78.5	648.0	
	Well #6	0	648.0	

The consultant has determined that as per Technical Rule 49(3), the interaction between the surface water and groundwater has the effect of decreasing the time of travel of water to the well, thus a WHPA-E needs to be added to the wellhead protection areas.

Using Water Survey of Canada (WSC) stream gauge at Rawdon Creek near West Huntingdon (02HK008), stream flow statistics were prorated for Rawdon Creek in the immediate vicinity of Stirling Wells. The 2-year return flow (assessed to be the Bankfull flow) was calculated to be 14.31 m^3/s; whereas, the existing WHPA-E (XCG, 2009) was delineated using an estimated 2-year flow of 44.3 m^3/s (Kilborn, 1985). Empirical methodologies were used by Kilborn due to insufficient data at the gauge station in 1985.

The 2-hour time of travel distance on Rawdon Creek used by XCG (2009) using 2-year return flow of 44.3 m^3/s was determined to be 10,260m. Assuming the actual 2-year return flow to be 14.31 m^3/s, the 2-hour time of travel can be expected to be significantly shorter than 10,260m. Therefore, the existing WHPA-E being a conservative estimate, the consultant recommended to retain the existing WHPA-E and its vulnerability score.

Groundwater Vulnerability Assessment

Vulnerability of the groundwater was assessed using a water table to well advection time (WWAT) method.

Since unsaturated zone travel time (UZAT) was not included in the analysis of surface to well advection time (SWAT), the identification of transport pathways that could modify the groundwater vulnerability focused on identifying constructed pathways that could reduce travel times in the saturated zone. These included the following:

- Clusters of deep wells (more than 5 wells within 100 m) that were constructed prior to 1990 (when the *Ontario Wells Regulation (O. Reg. 903)* made under the *Ontario Water Resources Act* set out minimum standards for the construction and decommissioning of all types of wells)
- Gravel pits and quarries that breach the upper confining unit
- Landfills located in former pits and quarries that reach through the upper confining unit.

The results of the groundwater vulnerability assessment for the Stirling municipal well system are shown on Map 5-28a. The range of groundwater vulnerability ratings in the WHPAs delineated for these systems is given in Table 5.2-.

2019 Stirling Wellhead Protection Studies Updates

As per the original study (Earthfx, 2010), groundwater (vertical) vulnerability was assessed using the water table to well advection time (WWAT) method.

Table 5.2-21: Vulnerability Scores for Stirling Well System

Well	Method	Transport Pathways By WHPA[1]					Range of Groundwater Vulnerability Ratings by WHPA				Range of Vulnerability Scores By WHPA				
		A	B	C	D	E	A	B	C	D	A	B	C	D	E
Well #1	SWAT	-	-	-	W / Q	-	Low	Low-high	Low-high	Low-high	10	6-10	~~24~~-8	2-6	8
Well #3	SWAT	-	-	-	W / Q	-	High	Low-high	Low-high	Low-high	10	6-10	~~24~~-8	2-6	8
Well #4	SWAT	-	-	-	W / Q	-	Low	Low-high	Low-high	Low-high	10	6-10	~~24~~-8	2-6	8
Well #5	SWAT	-	-	-	W / Q	-	Low	Low-high	Low-high	Low-high	10	6-10	~~24~~-8	2-6	8
Well #6	SWAT	-	-	-	W/Q	-	Low-high	Low-high	Low-high	Low-high	10	6-10	2-8	2-6	8

Table 5.2-22: Uncertainty Ratings for Stirling Well System

Wells	Uncertainty Ratings for WHPA Delineation					Uncertainty Ratings Assignment of Vulnerability					Final Uncertainty Rating				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Well #1	Low	High	High	High	High	Low	High	High	High	Low	Low	High	High	High	High
Well #3	Low	High	High	High	High	Low	High	High	High	Low	Low	High	High	High	High
Well #4	Low	High	High	High	High	Low	High	High	High	Low	Low	High	High	High	High
Well #5	Low	High	High	High	High	Low	High	High	High	Low	Low	High	High	High	High
Well #6	Low	High	High	High	High	Low	High	High	High	Low	Low	High	High	High	High