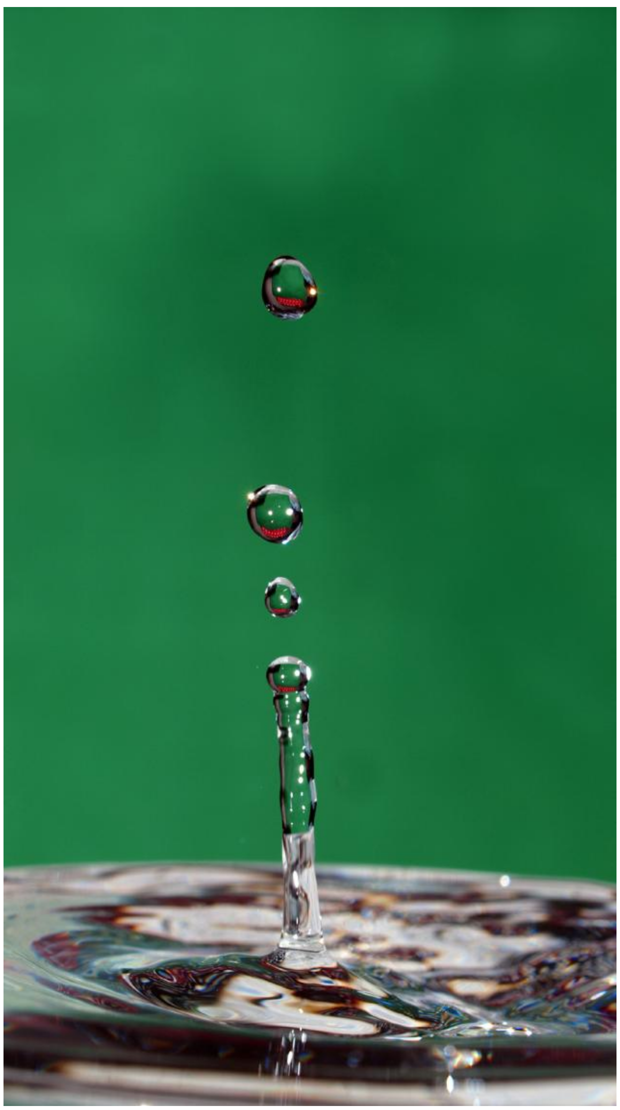
Part Seven

Garson Drinking Water System



The Garson drinking water system consists of three wells: Garson Wells 1 and 3 are located on Falconbridge Road and Garson Well 2 is located on Vale property near Falconbridge Road.

Approved on September 2, 2014
Minor edits on March 1, 2017
Amendments on March 16, 2021

Table of Contents

Chapter 36 - Garson Drinking Water System

The Garson drinking water system consists of three wells: Garson Wells 1 and 3[1] are located on Falconbridge Road and Garson Well 2[2] is located on Vale property near Falconbridge Road. Combined, these wells service the community of Garson and a population of approximately 4,800.

The Garson system is connected to the David Street and Wanapitei distribution system by a pressure sustaining valve. If pressure drops below acceptable levels in the Garson system, water is automatically directed from the Sudbury system to maintain pressure. This normally only occurs in the event of an emergency. Map 7.1 illustrates the distribution system. Treatment at the wells consists of disinfection using sodium hypochlorite, and fluoridation using hydrofluosilicic acid. Table 7.1 summarizes water usage within the Garson drinking water system between 2002 and 2007.

Table 7.1 – Summary of water usage in the Garson drinking water system for 2002-2007

	Garson 1 and 3	Garson 2
Daily Permitted Amount (m^3/day)	4,847	2,981
Monthly Permitted Amount (m^3/month)	147,430	90,672
Average Actual Monthly Volume (m^3/month)	18,773	32,647
Percentage of Monthly Permitted Volume	13%	36%
Maximum Actual Monthly Volume (m^3)	29,867	40,408
Percentage of Monthly Permitted Volume	20%	45%
95th Percentile (m^3)	25,827	38,781
Percentage of Monthly Permitted Volume	18%	43%

[1] Formerly known as Orell Wells 1 and 3
[2] Formerly known as Inco Well 1

Chapter 37 - Garson Wells Contributing Area

The contributing area for the Garson wells was delineated based on the City of Greater Sudbury Municipal Groundwater Study and on modeling updates done by WESA to reflect new data collected in the area. The contributing area to these wells was estimated as the area encompassing the modeled capture zones plus a 500 m buffer down-gradient of the southwestern capture zone limit. The surrounding bedrock topography is above the elevation of the groundwater wells and it can be expected that these uplands contribute to the recharge of the well aquifer. Therefore, the catchment area was expanded to include bedrock to the height of land in the northwest and southeast of the catchment. In the northeast of the well field, the groundwater divide was used as a flow boundary. The estimated catchment area around these wells was 55 km^2. See Map 7.2 for an illustration of the contributing area.

Chapter 38 - Water Budget and Quantity Assessment

The Garson drinking water system lies within the Vermilion watershed. As previously described in Chapter 28, the Vermilion watershed was given a water quantity stress level of low and, therefore, did not need to progress to the next level of a water quantity assessment. Given the isolated nature of the municipal wells, it was decided by the Greater Sudbury Source Protection Area technical team that a Tier 1 water budget should be completed for each drinking water system. The methodology applied is described in greater detail in Chapter 3 and in Appendix 2.

38.1 Garson Water Budget

A summary for the water budget elements for the Garson watershed is presented in Table 7.2. There are no major stream inputs or outflows in this catchment area, so the model for this catchment was a simple vertical soil moisture budget. In the Garson well contributing area, the average annual water surplus of 398 mm was considered as groundwater recharge for the stress assessment.

Table 7.2 – Water budget for the Garson contributing area

	Water Balance Element (mm)							
Month	Rainfall	Snowfall	Snowmelt	Total Input	PET*	AET**	Water Surplus	Water Deficit
January	2.8	61.8	6.1	8.9	0.0	0.0	8.9	0.0
February	3.1	48.4	13.8	16.9	0.0	0.0	16.9	0.0
March	19.5	45.6	68.2	87.7	0.0	0.0	87.7	0.0
April	51.2	13.0	126.3	177.5	19.5	19.5	158.0	0.0
May	80.8	1.0	8.6	89.3	75.0	74.0	15.3	0.0
June	78.4	0.0	0.0	78.4	110.7	104.3	0.0	-25.9
July	78.8	0.0	0.0	78.8	130.5	113.3	0.0	-34.5
August	85.3	0.0	0.0	85.3	112.5	95.8	0.0	-10.6
September	107.1	0.0	0.0	107.1	69.3	67.7	39.4	0.0
October	81.9	2.4	2.4	84.4	30.1	30.1	54.3	0.0
November	45.1	33.3	19.4	64.4	0.8	0.8	63.6	0.0
December	9.8	55.8	15.0	24.8	0.0	0.0	24.8	0.0
Annual Total	643.7	261.3	259.9	903.5	548.3	505.5	469.0	-70.9
Annual Recharge							**398.1**	

*PET – Potential Evapotranspiration
**AET – Actual Evapotranspiration

38.2 Garson Water Quantity Stress Assessment

Table 7.3 presents the summary of the water quantity stress assessment for the Garson watershed. For the period of 2000-2006, the water removed by the municipal groundwater wells averaged approximately 12 mm, or 22% of the permitted pumping rate. Municipal demand was assumed to be 100% consumed and relatively constant throughout the year.

Municipal demand and industrial mining operations represented the largest groundwater users. The watershed was calculated to have a groundwater stress level of between 5.5% and 9.0% for present conditions, with a monthly maximum occurring in April (8.6%). The forecast municipal demand did not greatly increase monthly stress level calculations, where May increased to 8.9%. Annual average present and forecast stress levels were 6.6% and 6.9%, respectively. These calculations indicated that the watershed was classified as having a 'low' groundwater stress level.

Table 7.3 – Water quantity stress assessment for the Garson watershed

	Supply (m^3/s)		Demand (m^3/s)				Stress (%)	
Month	Recharge	Reserve	Municipal	Other	Total	Forecast	Present	Forecast
January	0.69	0.07	0.02	0.01	0.02	0.02	5.68	5.97
February	0.69	0.07	0.02	0.02	0.02	0.02	5.83	6.13
March	0.69	0.07	0.03	0.02	0.03	0.03	6.68	7.04
April	0.69	0.07	0.02	0.03	0.02	0.03	8.56	8.87
May	0.69	0.07	0.02	0.03	0.02	0.02	7.48	7.78
June	0.69	0.07	0.02	0.02	0.02	0.03	6.86	7.19
July	0.69	0.07	0.02	0.02	0.02	0.03	6.36	6.71
August	0.69	0.07	0.02	0.02	0.02	0.02	6.36	6.66
September	0.69	0.07	0.02	0.02	0.02	0.03	7.03	7.36
October	0.69	0.07	0.02	0.01	0.02	0.03	5.84	6.17
November	0.69	0.07	0.02	0.02	0.02	0.02	6.17	6.48
December	0.69	0.07	0.02	0.02	0.02	0.03	6.76	7.09
Annual	0.69	0.07	0.02	0.02	0.02	0.03	6.63	6.95

38.3 Water Budget and Stress Assessment Uncertainty

Uncertainty in the Tier 1 process takes into account the quality of the available data. Municipal water removals and water use trends were obtained from the City of Greater Sudbury and from industry, and large volume permits to take water were checked for actual use and active status. For each Tier 1 water budget, the water surplus was in the range of that reported in the literature (e.g. Richards 2002). For all groundwater sources the estimated uncertainty is low.

Chapter 39 - Garson Water Quality Risk Assessment

The following sections provide the results for the water quality risk assessment process for the Garson drinking water system.

39.1 Wellhead Protection Areas and Vulnerability Scoring

The wellhead protection areas were delineated according to Rules 47 through 50, and followed the methodology outlined in Chapter 2. The resulting vulnerable areas are illustrated on Maps 7.3 through 7.5 for each well in the Garson drinking water system.

Vulnerability scoring for the wellhead protection areas followed Rules 82 through 85 and the methodology outlined in Chapter 2. Maps 7.6 through 7.8 illustrate the vulnerability scoring for the Garson drinking water system.

The variability in vulnerability scores in the top east of the Garson 2 WHPA, as illustrated on Map 7.8, is lower due to the lower scoring of the groundwater intrinsic susceptibility index for this area.

The geometric appearance of the medium vulnerability zones within the Garson 2 WHPA is caused by a combination of factors, such as the data density in the Garson area, intrinsic susceptibility index values at several wells being close to 30, and the grid size used to krige the intrinsic susceptibility index values.

Across most of the Source Protection Area, the ISI calculation relied primarily on data in the Water Well Information System and the data density is relatively sparse. In the Garson area, Vale granted permission for WESA to use data obtained during a groundwater characterization study for Vale's Garson Mine. As part of that study, a series of monitoring well nests were installed across the community of Garson including near Garson Well No. 1. As a result, the data density in this area is significantly higher than elsewhere in the area. WESA also conducted a detailed well-by-well review of the data used to generate the ISI for the Garson area. The ISI for a number of the wells near Inco Well No. 1 was either slightly less than or slightly greater than 30, which separates high and medium vulnerability areas. The data used to calculate the ISI at these wells were reviewed to ensure that the calculation was based on the most representative data available. As a result of this review, the ISI values for some locations changed. Finally, the original ISI map was generated using a 100 m grid for the kriging calculation. This grid size is appropriate for the data density across this regional area. However, the data density available in the Garson area requires that a finer grid be used to obtain smooth boundaries between medium and high vulnerability areas. So WESA re-kriged this area using a 25 m grid. The resulting ISI grid was smoothly inserted into the larger 100m grid for the rest of the area.

More detail on the intrinsic susceptibility index is available in Chapter 2 and on Map 2.9.

Vulnerable Area Delineation Uncertainty

Modeling groundwater flow is complex and requires good information and adequate data to be certain of the model results. The groundwater model represents a first step in providing a general understanding of groundwater flow conditions. A degree of uncertainty is always present when using a model to interpret real world situations. In general, geological, hydrogeological and methodological factors contribute to the level of uncertainty within a model. Table 7.4 summarizes the uncertainty in these factors for the Garson drinking water system. For a detailed description of each factor, refer to Appendix 2.

There is generally a moderate level of uncertainty related to the groundwater model. The delineation of the wellhead protection areas used a conservative approach and thereby overestimates the size of the protection area. The uncertainty in the WHPA-A, WHPA-B and WHPA-C delineations is low. Generally, the uncertainty in delineating the WHPAs decreases closer to the wellhead as there is less compounding of errors. The overall uncertainty for the WHPA-D was assessed to be high.

Table 7.4 – Summary of wellhead protection delineation uncertainty for the Garson drinking water system

Geological Factors	Depth to aquifer, thickness of overburden	Sufficient data from MECP and WESA databases
	Soil and Rock Characteristics	Data entry estimations, reporting inconsistencies, averaging by assigning Geologic Survey of Canada codes, no grain size analyses
Hydrogeological Factors	Hydraulic Parameters	Difference between calculated hydraulic conductivity and value assigned in the model, no porosity data
	Hydraulic Head Measurements	Low uncertainty for WESA data, but distribution limited. Questionable accuracy of values in WWIS, no data from some areas.
	Recharge	Recharge assigned according to top layer
	Boundary Conditions	Streams assigned as River boundaries. Boundary parameters adjusted during calibration; no sensitivity analyses
Methodological Factors	Model Used for WHPA Delineation	MODFLOW /MODPATH are industry standards. Only saturated zone flow considered. Natural attenuation not considered.
	Model Calibration and Sensitivity Analysis	Calibrated hydraulic conductivity, recharge and river boundary parameters; sensitivity analyses found high sensitivity to bedrock hydraulic conductivity
	Pump Rate Used for Model	95th percentile of monthly pumping rate is considered a conservative estimate
	Capture Zones Delineation	Low uncertainty within WHPA's B and C. High uncertainty in the WHPA-D.

Uncertainty Level

High Uncertainty (red) Moderate Uncertainty (yellow) Low Uncertainty (green)

Vulnerability Assessment Uncertainty

The vulnerability scores are based on the Intrinsic Susceptibility Index (ISI) and the wellhead protection area (as explained in Chapter 2). Therefore, the uncertainty associated with each score is a function of these two variables. The uncertainty of the wellhead protection areas has been described above.

The ISI score is based in part on the presence or absence of an aquitard or confining layer above the aquifer. In the Garson contributing area, there is no, or a very thin, aquitard, resulting in a highly vulnerable ISI score. There is great reliability in this information; therefore, the uncertainty of this score is low.

39.2 Garson Drinking Water Quality Threats Activities

The assessment of potential threats to drinking water quality followed the Technical Rules (2009) 118 to 125 and the methodology is outlined in Chapter 2. The list of prescribed drinking water threats is located in Table 1.7 in Part 1 of this report.

Identification of areas where threats can occur

The areas where a potential threat is or would be significant, moderate or low are illustrated on Maps 7.6 through 7.8. According to the Technical Rules (2009):

- Areas with a vulnerability score of 8 or greater has the potential for a significant, moderate or low threat.
- Areas with a vulnerability score of 6 or greater has the potential for a moderate or low threat to occur.*
- Areas with a vulnerability score of 4 or greater has the potential for a low threat to occur.*
- Areas with a vulnerability score of less than 4 cannot contain a drinking water threat.*

*DNAPLs are an exception because they are always a significant threat in WHPA-A, B, C/C1 regardless of the vulnerability score.

The MECP has established an online tool that incorporates the Provincial Table of Drinking Water Threats into an interactive mapping tool, accessible via http://swpip.ca/. With the address search function, this tool lets you identify what vulnerable area(s) a property is located in and what the vulnerability score is at that location. It also identifies a list of circumstances of all is or would be significant, moderate or low drinking water threats. For more detailed instructions on how to use the above mentioned website refer to Appendix 5.

Managed Lands

The storage, handling and application of agricultural source material, non-agricultural source material, pesticides and fertilizers can result in potential contamination of municipal water supplies. The methodology used to calculate percentage of managed lands in the vulnerable areas is described in Chapter 2.

The percentage of managed lands in the Inco 1 wellhead protection area was assessed to be under 40% (low) and between 40 and 80% (moderate) for the Orell wellhead protection areas. Results are illustrated on Map 7.9.

Impervious Surfaces

Impervious surfaces are measured as an indicator of the amount of area where road salt can be applied. The percentage of surface area within a vulnerable area which will not allow surface water or precipitation to be absorbed into the soil is measured. According to these calculations, most of the wellhead protection area for the Garson Well 2 has a 1-8% impervious area, while most of the wellhead protection area for the Garson Wells 1 & 3 has a 8-80% impervious area, as shown on Map 7.10. The calculation of impervious surfaces resulted in the vulnerable area being designated as a moderate threat or a low threat for the application of road salt depending on the vulnerability score, as shown in Table 7.6. It is noted in Section 39.4 that the Garson wells consistently have sodium levels above 20 mg/L, but there is insufficient data to determine if there is a significant increasing trend.

The methodology used to calculate percentage of impervious surfaces in the vulnerable areas is described in Chapter 2.

Livestock Density

The calculation of livestock density is based on the calculation of nutrient units per acre of agricultural managed lands. The methodology used to calculate the livestock density in the vulnerable areas is described in Chapter 2. There are no agricultural lands in the Garson wellhead protection areas, therefore the area has a score of under 0.5 nutrient units per acre. The results are illustrated on Map 7.11.

The combination of livestock density and managed land calculations assigns a threat rating for the application of commercial fertilizer. Table 7.5 shows the number of occurrences of this threat in different vulnerability areas.

Enumeration of Threats

Table 7.5 lists an estimate of the current number of significant, moderate and low drinking water quality threats in the drinking water system in accordance with the Drinking Water Threats Tables.

Table 7.5 – Drinking water quality threats for the Garson drinking water system

Drinking Water Threat Category	Number of Occurrences with Threat Classifications		
	Significant	Moderate	Low
WHPA A & B – Areas with a vulnerability score of 10			
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.		1	
The application of commercial fertilizer to land.		2	
The application of road salt.		2	
The handling and storage of fuel.	1	1	
Local threat: Transportation of hazardous substances along transportation corridors.	2	1	
WHPA B & C – Areas with a vulnerability score of 8			
The application of commercial fertilizer to land.			2
The application of road salt.			2
WHPA C – Areas with a vulnerability score of 6			
The application of road salt.			2
The handling and storage of an organic solvent.			1
Local threat: Transportation of hazardous substances along transportation corridors.			2

39.3 Garson Drinking Water Threats Conditions

A drinking water condition is a situation resulting from a past activity and meeting the criteria laid out in Chapter 2. For a more detailed review of methodology for identifying drinking water conditions, please refer to Part 1, Chapter 2.

The areas where a significant, moderate or low threat condition could exist are the same as the areas where a potential threat could occur. For an illustration, please see Maps 7.6 through 7.8.

Currently, there are no identified conditions within the Garson vulnerable areas. However, recent information received on April 27, 2011, and discussed in section 39.4 below may lead to two sites being identified as conditions. Information is currently being collected on these sites and if these areas of past activities meet the criteria for addition as a condition they can be added in an amendment or in a scheduled update to the assessment report. More investigation is needed to determine whether this concern should be identified as a drinking water issue or a concern under the source protection program.

39.4 Garson Drinking Water Quality Issues

Drinking water quality issues were assessed based on the methodology outlined in Chapter 2 and Rules 114 and 115.

The Garson wells have sodium levels consistently above 20 mg/L. Currently, there is insufficient data to determine if there is a significant increasing trend.

Information received on April 27, 2011, from the MECP Sudbury District Office indicated a rising trend of trace levels of tetrachloroethylene in treated water samples taken from the Orell wells 1 and 3. Tetrachloroethylene is used primarily as a solvent for the dry cleaning and metal cleaning industries. It can be found in groundwater after improper disposal or dumping of cleaning solvents. The results may suggest some possible historical impact from service stations that would have operated in the vicinity of the wells at one time.

The recommended maximum acceptable concentration for tetrachloroethylene in drinking water is 30 ug/L. Data collected by the City of Greater Sudbury between 1999 and 2012 indicates that the amount found in the raw and treated water ranges from 0.05 to 5.7 ug/L and 0.05 to 3.4 ug/L respectively. A thorough examination also highlights that concentrations of 2 ug/L or higher of tetrachloroethylene have consistently been observed in the raw water data collected between 1993 and 2012.

In response to a request from the Ministry of the Environment, Conservation and Parks, the City of Greater Sudbury has increased monitoring of raw water and treated water. The source protection committee will continue to monitor this concern. If the concentration of tetrachloroethylene trends upwards it may be identified as an issue in an amendment or in a scheduled update to the assessment report. Recent testing results from the Drinking Water System Inspection Report for 2011 measured the level of tetrachloroethylene in treated water at these wells at 0.05 and 3.4 ug/L.

Chapter 40 - Data Availability

The analyses for this drinking water system were carried out using the best data available to meet the assessment report requirements. Completing scientific assessments on the quality and quantity of water undoubtedly raises a number of questions and uncertainties regarding the methodologies used, availability of data, reliability of data and overall outcome. As new information arises, either from increased or continuous monitoring, improved models, or a change in methodology, the results from this report will need to be updated to reflect the additional information.

The assessment report is a continually evolving document as new information becomes available and refinements in approaches are made. Changes in land use will also impact the identification of potential threats to water quality and quantity.