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## 22.0 ORANGEVILLE AND AMARANTH TIER 3 WATER QUANTITY RISK ASSESSMENT

Under the requirements of the *Clean Water Act, 2006* the municipalities of Orangeville and Amaranth have ~~were required to completed~~ a Tier 3 Water Budget and Local Area Risk Assessment (Tier 3 Assessment) to ~~assessevaluate~~ the ability of their municipal water sources to meet committed and planned water demands.

Although the Town of Orangeville is not located within the Grand River watershed, the project's study area extends to portions of the Townships of Amaranth and East Garafraxa which are located within the Grand River watershed.

In 2007, ~~the MNR entered into a contract with AquaResource Inc. (2011) to complete a pilot project to conduct a~~ the Tier 3 Assessment for the Town of Orangeville and the Township of Amaranth ~~began as a pilot project to~~. This project was completed as a pilot to ~~assessevaluate~~ the technical Tier 3 Assessment framework, become available as a reference for future Tier 3 Assessments ~~taking place in~~ within the Province, and be used to complete ~~an~~ the updated Source Protection Assessment Report.

~~Although the Town of Orangeville is not within the Grand River watershed, the model domain for the project includes portions of the Townships of Amaranth and East Garafraxa which are within the watershed.~~

~~The~~ The study was later finalized ~~Final Report, submitted~~ in January 2011, and details the Tier 3 Water Budget and Local Area Risk Assessment carried out for the Town of Orangeville and Mono, and the Township of Amaranth. The report summarizes background information relating to the geology and hydrogeology of the area, current and planned water demands, and the process and results of the Water Quantity ~~Local Area~~ Risk Assessment.

### 22.1 Tier 3 Approach

The Tier ~~2~~Two Water Quantity Stress Assessment completed for the Credit River Watershed in 2009 by ~~AquaResource Inc.,~~ identified the Headwaters Subwatershed, also referred to as ~~(Subwatershed 19,)~~ as having a "Moderate" potential for groundwater stress ~~level~~. The ~~identification of a M~~moderate stress level lead to the requirement of a Tier 3 Assessment for the Town of Orangeville and the Township of Amaranth as most of their municipal wells are located within this subwatershed. To date Orangeville, Mono and Amaranth have not had any issues meeting their water quantity requirements.

As a part of the Tier 3 study, new numerical surface water and groundwater flow models were developed and used ~~The numerical models used within the Tier 2~~Two Assessment were used as the basis from which to develop the Tier 3 models ~~as water budget tools to complete the assessment~~. The HSP-F surface water model was refined from that used for the Tier Two Assessment. The watershed-scale FEFLOW groundwater flow model that was used in the Tier Two Assessment was considered too broad in scale to be used in the Tier 3 Assessment to adequately assess impacts at a wellfield scale. As such, a new groundwater flow model using the MODFLOW-2000 code was developed.

~~Specific updates undertaken in the Tier 3 Assessment included the interpretation of local-scale cross-sections across the study area to refine the subsurface geology, and the assignment of hydrogeologic parameters consistent with local hydraulic testing results within the subwatershed and surrounding areas. The groundwater flow model was calibrated to a finer level of detail with close attention to observations at high quality monitoring wells. The Tier 3 model was calibrated at the municipal wellfield-scale to both steady state (long term average) and transient (time-varying) conditions. It was also verified using long term (15 years) monitoring data to further increase the confidence in the model and~~

~~its ability to simulate the groundwater flow system within the Study Area which included approximately 55 km<sup>2</sup> within the Grand River watershed.~~

The study included an in-depth compilation of current and historical groundwater pumping and monitoring data. **This Results of the monitoring well** assessment ~~of monitoring data~~ indicated that the nine Town of Orangeville wells and the one Township of Amaranth well with capture zones extending into the Grand River watershed ~~have~~ never experienced problems pumping the allocated quantities of water from their respective municipal pumping wells. The Town of Orangeville has implemented very effective water conservation measures resulting in reduced maximum day demands and per-capita average day demands.

~~This report (AquaResource, 2011) describes the development of a three-dimensional hydrogeological conceptual model of the study area. This conceptual model was based on the interpretation of both high quality boreholes and domestic water well records throughout the area. An estimated 133 domestic water wells and two non-municipal permits for heat pumps are situated on rural lands within the GRCA portion of the model domain.~~

~~Following the development of the conceptual model, a continuous surface water flow model and three-dimensional groundwater flow model were developed to assess the water budget components in the area and to complete the Water Quantity Risk Assessment scenarios. The report (AquaResource, 2011) shows that these models were calibrated to observed steady state and transient water levels and flows and can be considered as reliable tools for water budget estimation.~~

~~A detailed water budget for the Headwaters Subwatershed was developed and approximately 890 mm/yr of precipitation falls within the subwatershed (measured as average annual precipitation at the MOE Orangeville climate station). Of this, approximately 63% leaves the subwatershed as evapotranspiration, 39% leaves as streamflow, and 6% leaves the subwatershed flowing into the Nottawasaga Valley Watershed to the northeast. Recharge along the Grand River – Credit Valley watershed divide is quite high at 320 mm/yr due to the situation of the divide atop the Orangeville Moraine.~~

~~Groundwater modelling results indicate that groundwater flow into Subwatershed 19 across the subwatershed boundaries is significant with approximately 5,000 m<sup>3</sup>/d flowing into the subwatershed from the Grand River Watershed, representing approximately 3% of the overall water balance. Much of the cross-boundary flow from the Grand River is influenced by municipal pumping.~~

~~Four distinct Wellhead Protection Areas for Quantity (WHPA-Qs) Local Areas~~ were delineated surrounding the municipal supply wells in the Study Area **including WHPA-Q-Local Area A as shown on (Map 22-1).** ~~These~~ **is** areas ~~were~~ **as** delineated following the Province's Technical Rules (MOE, 2009b) based on a combination of the cone of influence of each municipal well as well as land areas where recharge has the potential to have a measurable impact on the municipal wells.

~~A series of Risk Assessment scenarios~~ **as prescribed by the Provincial Technical Rules were evaluated using the Tier 3 groundwater and surface water models. These scenarios assessed the municipality's availability to meet future municipal demand under a range of conditions such as increased pumping, reduced recharge resulting from land use changes (development), and prolonged drought.**

~~were derived to represent the municipal allocated quantity of water (existing plus committed plus planned pumping rates); and current and planned land uses. The calibrated surface water~~

~~and groundwater flow models were used to estimate both the changes in water levels in the municipal supply aquifer and the impacts to groundwater discharge and baseflow under average and drought climate conditions.~~

### Risk Assessment Results

Based on the results of the Risk Assessment ~~modelling~~ scenarios, Local Area A WHPA-QA was classified as having a “Significant” Risk Level. Local Area A includes many of the Town of Orangeville’s municipal supply wells located in the western half of Subwatershed 19, as well as the Town of Mono’s Cardinal Woods Wells and Amaranth’s Pullen Well (Map 22-1). Local Area A WHPA-QA was classified as having a significant water quantity risk level due to a combination of factors including the impacts of pumping the allocated quantity of water (Existing plus Committed plus Planned) and groundwater recharge reductions under both average recharge and drought conditions. Increased pumping within ~~this Local Area~~ the WHPA-QA also resulted in reductions to groundwater discharge in cold water streams that exceeded the Province’s thresholds.

While the Tier 3 Risk Assessment scenarios resulted in a Significant Water Quantity Risk Level for Local Area A the WHPA-QA the Town of Orangeville has never ~~had problems~~ reported operational issues while pumping their municipal wells, even during periods of higher water demand prior to the implementation of water conservation measures. The Water Quantity Risk Level categories do not indicate a problem associated with current municipal wells and their current pumping rates; rather, they reflect a need to manage the drinking water resources in the Local Areas WHPA-QA as future stresses arise. Furthermore, the results indicate a need to manage the drinking water as a regional resource shared by the Town of Orangeville and Township of Amaranth.

Following the Technical Rules, all consumptive water users and reductions to groundwater recharge within Local Area A WHPA-QA are classified as significant water quantity threats. These consumptive water users include the permitted water demands (e.g., municipal pumping) and non-permitted water demands (e.g., domestic water wells). The only consumptive uses within the Grand River watershed portion of Local Area A WHPA-QA are approximately 44 domestic water wells (Map 22-1 and Table 22-1). Almost half of these domestic wells are located within designated areas of land use change in the Township of Amaranth’s Official Plan

~~As part of their earlier Water Supply Strategy, the Town of Orangeville identified several areas near the Town to investigate the potential to provide future groundwater drinking supplies. Several of these areas, including one test well within the Grand River watershed, were studied under an extension of this Tier 3 Assessment. This preliminary investigation suggested that these areas would not be suitable for supporting wells of sufficient capacity to meet municipal requirements; however, this study should not be considered as an exhaustive investigation of future drinking water supply.~~

The potential groundwater discharge reductions associated with recharge reductions in Local Areas A WHPA-QA vary from “Moderate” (between 10% and 20%) to “Significant” (greater than 20%). The model scenarios did not consider the influence of storm water best management practices, and the groundwater recharge was reduced proportionally to the imperviousness assumed for areas where land use changes are expected to occur. The only lands within the Grand River watershed portion of Local Area A with identified groundwater recharge reduction activities are designated for commercial/industrial/ residential activities in the Township of Amaranth’s Official Plan.

While these scenarios are conservative, they indicate where groundwater discharge is most sensitive to land use change, and where the Town of Orangeville and the Grand River Conservation Authority may wish to direct efforts to maintain groundwater recharge in the future.

<b>Table 22-1: Orangeville WHPA-QA Drinking Water Threats within the Grand River Watershed (current to May 2018)</b>			
<b>PDWT<sup>1</sup> #</b>	<b>Threat Subcategory<sup>2</sup></b>	<b>Number of Activities</b>	<b>Vulnerable Area</b>
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.	44	WHPA-QA
<b>Total Number of Activities</b>		<b>44</b>	
1: Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 287/07s.1.1.(1).			
2: Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.			

## 22.2 ~~Tier 3 Assessment SGRAs~~

~~The Technical Rules require that Significant Groundwater Recharge Areas (SGRAs) be delineated for each source protection area. SGRAs are one of four types of vulnerable areas that are used in water quality vulnerability assessments; the other vulnerable areas are wellhead protection areas, intake protection zones, and highly vulnerable aquifers.~~

~~SGRAs were delineated in the Tier 2Two Assessment (AquaResource, 2009c) across the Credit River Watershed using a peer reviewed methodology. The average annual recharge across the entire Credit River Watershed was calculated to be 200 mm/yr; consequently, the SGRA threshold was calculated to be 230 mm/yr. The SGRAs cover a large portion of Subwatershed 19, and are noticeably absent in the urban areas and in areas designated as lakes, ponds or large wetlands.~~

~~The recharge distribution calculated in the Tier 3 Assessment for Subwatershed 19 was refined from that established in the Tier 2Two Assessment; as such the SGRA mapping for Subwatershed 19 was updated. The SGRA threshold established in the Tier 2Two Assessment for the Credit River Watershed (of 230 mm/yr) was used again in this assessment as SGRAs aim to protect groundwater recharge areas across the broader watershed. To account for uncertainty associated with the HSP-F recharge results in the Tier 3 Assessment, recharge rates greater than 225 mm/yr were used to delineate the SGRAs for the Tier 3 Assessment. Professional judgment was used to remove potential groundwater discharge areas (areas where the model simulated water table is less than 2 m below ground surface) from the SGRA mapping.~~

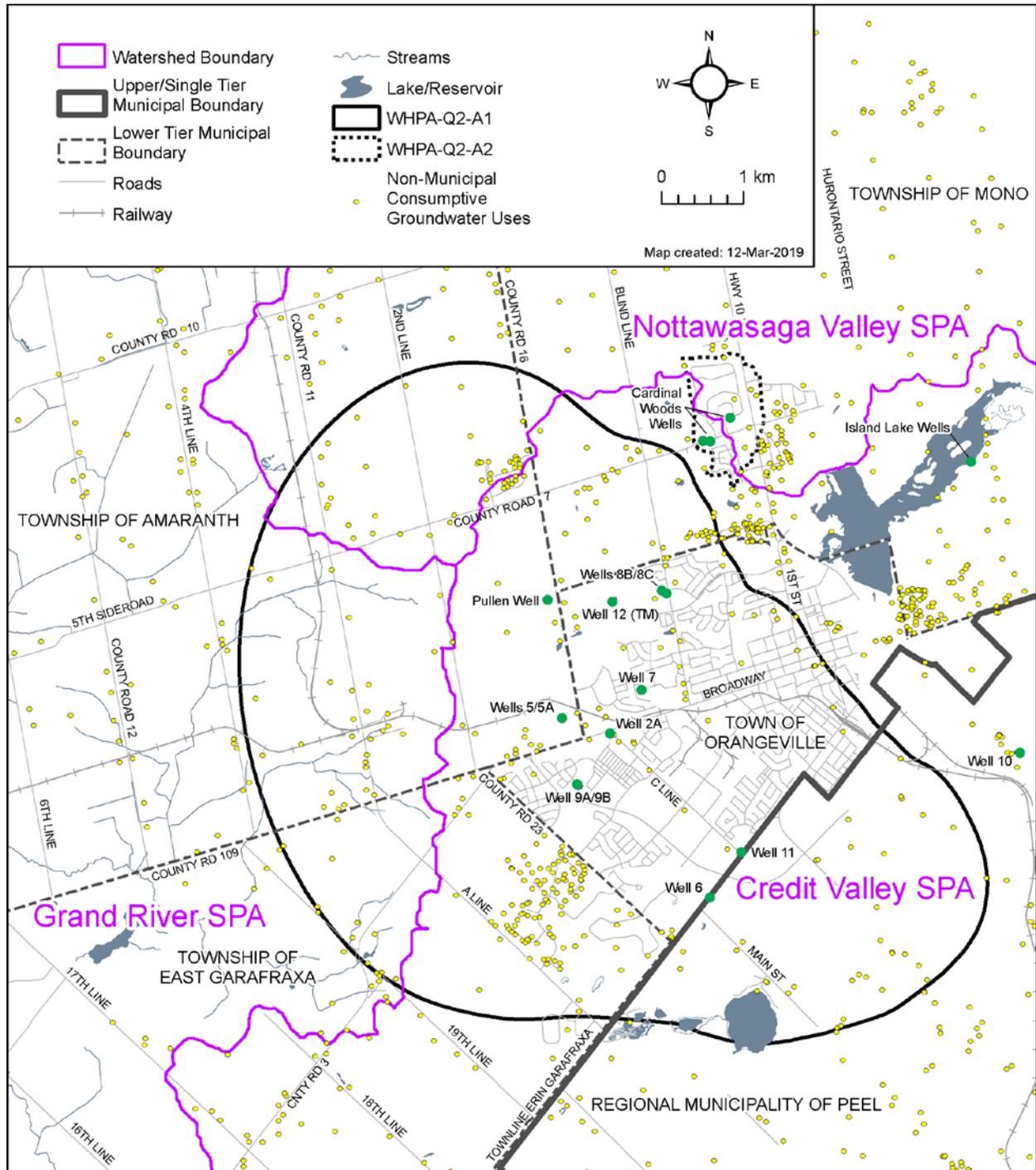
~~Due to changes in methodologies and varying geologic characteristics from one watershed to the next, it is expected that there will be edge matching issues at watershed divides. Therefore, the SGRAs in the Grand River portion of this assessment will not be consistent with Lake Erie Source Protection mapping. It is recommended that modeling and mapping staff from the two source protection regions get together to address edge matching issues.~~

### 22.322.2 Uncertainty

During the Tier 3 Assessment, some knowledge and data gaps were encountered, however the approach undertaken in the study was conservative, and as such, addressing these uncertainties is not considered necessary for **the protection or management of** ~~protecting or managing~~ the water resources within the subwatershed. The Risk Level for the Orangeville water supply wells was classified as

“Significant”, which is appropriate considering the uncertainties associated with urban infiltration and the impact of enhanced recharge through subsurface infrastructure.

**Map 22-1: Orangeville - WHPA-QA Significant Water Quantity Threats Tier 3 Water Budget and Local Area Risk Assessment**



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