Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

TOWNSHIP OF CENTRE WELLINGTON
PRELIMINARY WATER QUANTITY THREATS ANALYSIS

Prepared for:
GRAND RIVER CONSERVATION AUTHORITY

Prepared by:
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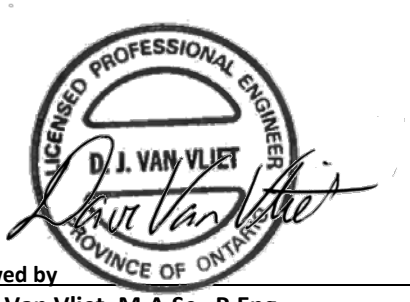

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EXECUTIVE SUMMARY

The Centre Wellington Tier Three Water Budget Assessment (Tier Three Assessment) identified additional pumping of groundwater and future land use development as potentially impacting the quantity of future municipal water supply in Centre Wellington. This report describes a preliminary water quantity threats analysis intended to estimate the relative impact that groundwater takings and land use changes will have on water levels at the Fergus and Elora municipal wells. The purpose of this analysis is to inform Centre Wellington for the development of appropriate policies to mitigate current and future water quantity threats.

The Tier Three Assessment classified groundwater takings and future groundwater recharge reductions as "Significant" threats to water quantity. The intent of this Tier Three Assessment is to complete this classification as a screening level exercise, as the classification does not imply that an individual or group of water takings will impact the municipal wells. The Tier Three classification is intended to highlight a subset of all water takings that should be further evaluated for potential impacts to a water supply.

The water quantity threats analysis considers ten model scenarios designed to estimate and rank the relative impact that groups of municipal and non-municipal groundwater takings or areas of land use change may have on the simulated reduction of groundwater levels at the Centre Wellington municipal wells. This assessment includes groundwater takings and land use areas located within the Vulnerable Area defined within the Tier Three Assessment as well as a those within a smaller area located closer to the Fergus and Elora water supply wells.

The results of the analysis indicate that most of the groundwater reductions at the Centre Wellington municipal wells are in response to the future pumping at the municipal wells. The results suggest that policies considered to manage water quantity risk within the Vulnerable Area should focus on the management and optimization of municipal water takings. These policies would include measures that decrease future demand (e.g., water conservation and demand management) and measures that increase future supply (e.g., optimizing/redeveloping existing wells, installing new wells, and exploring surface water supply) (AECOM 2019).

The effects of existing non-municipal groundwater takings and future areas of land use change at the Centre Wellington municipal wells are predicted to be quite low; however, future polices should consider mitigating any potential impacts. This may involve policies that include the review and assessment of any future potential non-municipal demands having the potential to interfere with municipal wells.

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1 INTRODUCTION

The Province of Ontario introduced the *Clean Water Act, 2006* (Bill 43; Government of Ontario 2019) to ensure that all residents have access to safe municipal drinking water. The Township of Centre Wellington (Centre Wellington) lies within the Grand River Source Protection Area (watershed), which is within the Lake Erie Source Protection Region. The Lake Erie Region Source Protection Committee was established in 2007 and has the responsibility under the *Clean Water Act*, *2006* to develop local Source Protection Plans and report on implementation in four watersheds, including the Grand River watershed. The goal of each Source Protection Plan is to develop policies and programs to eliminate, reduce, and/or manage existing Significant[1] drinking water threats (i.e., water quality and water quantity threats) and ensure no future drinking water threats become Significant. These policies might relate to activities in an identified Vulnerable Area[1] (e.g., Wellhead Protection Areas for Water Quantity [WHPA-Qs][1] and Intake Protection Zones for Water Quantity [IPZ-Qs][1]) and might include programs that educate the public or promote best management practices. Current approved Source Protection Plans address threats related to water quality; however, additional work was undertaken to address threats related to the water quantity component.

A tier three water budget assessment (Tier Three Assessment) was completed for the municipal water supply system of Centre Wellington (Matrix 2020). A set of risk assessment scenarios were performed using the groundwater flow model developed for the Tier Three Assessment (Tier Three model) to assess whether the municipality will have enough water while considering existing and future municipal rates, land use changes, and drought conditions. The risk assessment scenarios predicted there is a Low Risk Level[1] associated with groundwater level decline at the municipal wells in response to meeting the Allocated[1] rates (e.g., 2031 to 2036 time horizon; see Matrix [2020] for further details on the development of the Allocated rates) considering future land use development and drought conditions. The scenarios also predicted a Low Risk Level associated with the magnitude of reduced groundwater discharge to coldwater streams and Provincially Significant Wetlands. However, the uncertainty associated with meeting future water supply demands due to planned population growth, as assessed in the Centre Wellington Water Supply Master Plan (AECOM 2019), suggests that the future demand will exceed the supply potential of the existing water supply wells. This circumstance results in a Significant Risk Level designation for the Vulnerable Area. The Vulnerable Area, also known as the WHPA-Q1/WHPA-Q2 (Figure 1), represents the composite 2 m drawdown contour created by municipal wells pumping at their Allocated rates and non-municipal wells pumping at their current rates (Matrix 2020). Following the Province's *Technical Rules: Assessment Report, Clean Water Act, 2006* (Technical Rules; MOECC 2017), existing consumptive water users and areas where future land use development may reduce groundwater recharge are classified as Significant water quantity threats in the Vulnerable Area.

[1] terms are capitalized where they have been defined in the 2017 Technical Rules under the Clean Water Act (MOECC 2017)

This report describes a preliminary analysis of the Significant water quantity threats identified during the Centre Wellington Tier Three Assessment. This analysis includes evaluating the relative impact of groups of consumptive water takings and areas within Fergus and Elora identified for development in the Centre Wellington Official Plan on municipal well groundwater levels within the Vulnerable Area (Figure 1).

2 IDENTIFICATION OF SIGNIFICANT DRINKING WATER QUANTITY THREATS

As outlined in the Technical Rules (MOECC 2017), a drinking water quantity threat is defined as 1) any consumptive water demand, or 2) any activity that reduces groundwater recharge to an aquifer. For each Vulnerable Area identified under clause 15 (2) (d) or (e) of the *Clean Water Act*, drinking water threats that are or would be classified as Moderate[1] or Significant need to be identified within that area. In the Tier Three Assessment, the Vulnerable Area was assigned a water quantity Risk Level of Significant; therefore, all water quantity threats within the Vulnerable Area are classified as Significant. The classification of "Significant" represents a conservative screening-level outcome of the Tier Three Assessment intended to identify water takings and future areas of land use change in the Vulnerable Area where there is a potential to impact the quantity of the municipal water supply. Individual takings and land use change areas may not have any effect on the water supply. For example, an individual consumptive water taking within the Vulnerable Area may be very small or located too far away from the municipal wells to have a measurable effect on water levels at the wells.

2.1 Consumptive Water Demands

Consumptive demands are activities that extract water from an aquifer or surface water body without returning that water to the same aquifer or surface water body. Figure 1 illustrates the consumptive demands classified as Significant threats within the Vulnerable Area. These existing threats include 9 municipal wells, 17 non-municipal, permitted water takers (i.e., for industrial, commercial, remediation, and miscellaneous purposes), and 2,715 non-municipal, non-permitted water takers (e.g., domestic wells and livestock watering). Additional existing municipal water supply wells in surrounding municipalities (i.e., Arthur and Marsville) and other existing non-municipal water takers are located outside of the Vulnerable Area and reported in the Tier Three Assessment (Matrix 2020). However, the focus of the preliminary threats analysis was on takings found within the Vulnerable Area. The magnitude of the municipal and non-municipal takings considered in the threats analysis scenarios are described in Table 1 of Section 3.

2.2 Reductions in Recharge

The Technical Rules (MOECC 2017) specify that land use development activities that have the potential to reduce groundwater recharge are potential water quantity threats within the Vulnerable Area.

[1] terms are capitalized where they have been defined in the 2017 Technical Rules under the Clean Water Act (MOECC 2017)

The Tier Three Assessment scenarios (Matrix 2020) considered the impact of future land use development activities on water levels in the municipal wells. The groundwater recharge reduction areas identified within the Vulnerable Area of the Tier Three Assessment that are classified as Significant water quantity threats are shown on Figure 1. These areas of recharge reduction totaled an area of 4.3 km^2 or 2.2% of the Vulnerable Area.

3 PRELIMINARY THREATS ANALYSIS

3.1 Approach

Ten scenarios were conducted using the Tier Three model and designed to evaluate the relative impact of groups of Significant threats within the Vulnerable Area (i.e., 2 m drawdown cone) and within a smaller, 5 m drawdown cone surrounding Fergus and Elora (Figure 1). The impact to the water supply was evaluated as the simulated drawdown that a group of threats produces at the Centre Wellington municipal wells. Table 1 summarizes a description, recharge, and the municipal and non-municipal pumping rates applied for each of the ten scenarios. Each of the demands simulated outside of the Vulnerable Area or 5 m drawdown cone were maintained constant in their respective scenarios (Table 1). The following descriptions summarize each scenario in greater detail:

- **Scenario 1**: represents the **baseline steady-state scenario** that is the benchmark against which all modelling results of other scenarios were compared. The breakdown of municipal and non-municipal demands both inside/outside of the Vulnerable Area, and inside/outside a 5 m drawdown contour, is presented in Table 1.

- **Scenario 2**: estimates the relative impact where the **Centre Wellington municipal wells have increased pumping from their existing (2018) rates to their future (≈2031 to 2036) rates**. The future municipal rates were developed from a water demand projection assessment conducted as part of Centre Wellington's Water Supply Master Plan (WSMP; AECOM 2019) and represent the average daily demand that the current configured system of wells and pumps is estimated to achieve (9,060 m^3/day; AECOM 2019). This future demand approximately represents the average day water supply needs of the projected 2031 to 2036 serviced population of Centre Wellington (i.e., 8,523 to 9,969 m^3/day; AECOM 2019).

- **Scenario 3**: estimates the relative impact of **reduced groundwater recharge due to future land development in Fergus and Elora**. Future land use was based on land use data from the Centre Wellington Official Plan and recharge was reduced proportionately to the percentage of impervious area (see Matrix [Matrix 2020] for more details).

- **Scenario 4 and 4b**: **Scenario 4** estimates the relative impact of all simulated **non-municipal takings in the Vulnerable Area**, which included both permitted and non-permitted takings. **Scenario 4b** is equivalent to Scenario 4, except that the relative impact of all simulated **non-municipal takings is evaluated within a 5 m drawdown cone**, rather than within the Vulnerable Area (i.e., 2 m drawdown cone).

- **Scenario 5 and 5b**: **Scenario 5** estimates the relative impact of all simulated **non-municipal permitted takings in the Vulnerable Area**. **Scenario 5b** is equivalent to Scenario 5, except that the relative impact of all simulated **non-municipal permitted takings is evaluated within a 5 m drawdown cone**, rather than within the Vulnerable Area (i.e., 2 m drawdown cone).

- **Scenario 6**: estimates the relative impact of all simulated **non-permitted takings in the Vulnerable Area**.

- **Scenario 7:** estimates the relative impact of all simulated non-permitted **domestic takings in the Vulnerable Area**.

- **Scenario 8:** estimates the relative impact of all simulated non-permitted **livestock watering takings in the Vulnerable Area**.

TABLE 1 Preliminary Threats Ranking Scenarios

Scenario	Scenario Description Relative to Baseline Scenario, the Scenario Estimates the Relative Impact of:	Recharge	Simulated Demands Inside Vulnerable Area or 5 m Drawdown Cone (m^3/day)				Simulated Demands Outside Vulnerable Area or 5 m Drawdown Cone (m^3/day)			
			Municipal	Non-Municipal			Municipal	Non-Municipal		
			Centre Wellington	Permitted	Non-Permitted Domestic	Non-Permitted Livestock Watering	Arthur and Marsville	Permitted	Non-Permitted Domestic	Non-Permitted Livestock Watering
Scenarios Evaluating the Relative Impact of Groups of Significant Threats Within the Vulnerable Area (i.e., 2 m Drawdown Cone)										
1	**Baseline Scenario (Future Pumping) -** against which all model scenarios were compared	existing	9,060 (future)	5,256	754	294	993	218	190	302
2	**Increase to Future Pumping** Compared to Current Pumping at Centre Wellington Municipal Wells	existing	5,103 (existing)	5,256	754	294	993	218	190	302
3	**Reduced Recharge**	Future (reduced)	9,060 (future)	5,256	754	294	993	218	190	302
4	All Simulated **Non-municipal Takings in Vulnerable Area**	existing	9,060 (future)	0	0	0	993	218	190	302
5	Simulated **Non-municipal Permitted Takings in Vulnerable Area**	existing	9,060 (future)	0	754	294	993	218	190	302
6	Simulated **Non-permitted Takings in Vulnerable Area**	existing	9,060 (future)	5,256	0	0	993	218	190	302
7	Simulated Non-permitted **Domestic Takings in Vulnerable Area**	existing	9,060 (future)	5,256	0	294	993	218	190	302
8	Simulated Non-permitted **Livestock Watering Takings in Vulnerable Area**	existing	9,060 (future)	5,256	754	0	993	218	190	302
Scenarios Evaluating the Relative Impact of Groups of Significant Threats Within a Local 5 m Drawdown Cone										
1	**Baseline Scenario (Future Pumping) -** against which all model scenarios were compared	existing	9,060 (future)	41	538	168	993	5,433	406	428
4b	All simulated **Non-municipal Takings in 5 m Drawdown Cone**	existing	9,060 (future)	0	0	0	993	5,433	406	428
5b	Simulated **Non-municipal Permitted Takings in 5 m Drawdown Cone**	existing	9,060 (future)	0	538	168	993	5,433	406	428

Notes:

Shaded cell denotes a change in the scenario setup relative to the baseline scenario

3.2 Results

Table 2 summarizes the absolute change in simulated water level between a given scenario and the baseline scenario. The results are summarized as follows:

- **Impact from Increase from Existing (2018) to Future (≈2031 to 2036) Municipal Pumping:** The largest changes in water levels at Centre Wellington municipal wells are in response to municipal pumping at future rates. The water level drawdown in the aquifer in response to increased municipal pumping ranges from 1.5 to 24.2 m as compared to existing municipal pumping. At some wells the drawdown is relatively low; however, the higher range of predicted drawdown (i.e., 24.2 m) will require the municipality to monitor and analyze aquifer monitoring data regularly to ensure that they can continue to meet these increased pumping rates reliably.

- **Impact from Existing Non-municipal Pumping:** The total drawdown from existing non-municipal pumping (permitted and non-permitted) ranges from 0.1 to 0.5 m (Scenario 4). Simulated non-permitted takings (Scenario 6) are estimated to have the next greatest impact to water level change at the municipal wells (i.e., 0.1 to 0.4 m). Of the non-permitted takings, simulated domestic demands result in aquifer drawdown at the municipal wells (Scenario 7) ranging from 0.1 to 0.4 m. Simulated livestock watering takings (Scenario 8) result in minimal (<0.05 m) aquifer drawdown at the municipal wells.

- **Impact from Reduced Recharge:** The impact caused by reduced groundwater recharge as the result of future land use change in the Vulnerable Area (Scenario 3) is predicted to be 0.1 to 0.2 m at the municipal wells.

Table 2 also summarizes the effect of all existing non-municipal takings (permitted and non-permitted; Scenario 4b) and just non-municipal permitted takings (Scenario 5b) in a 5 m drawdown cone relative to the 2 m drawdown cone of the Vulnerable Area. The simulated results show that the relatively low non-municipal, permitted demands located within the 5 m drawdown cone (41 m^3/day) results in minimal (<0.05 m) aquifer drawdown at the municipal wells (i.e., Scenario 5b); the greatest impacts from takings within a 5 m drawdown cone is predicted to be from non-permitted takings (i.e., difference between Scenario 4b and 5b), nearly all of which is in response to domestic wells.

TABLE 2 Absolute Change in Simulated Water Level (m) Relative to Baseline Scenario

Scenario	Description	Municipal Well Absolute Simulated Water Level Change (m)							
		Elora			Fergus				
		E1	E3	E4	F1	F4	F5	F6	F7
2	**Increase to Future Pumping** at Centre Wellington Municipal Pumping	21.3	7.1	22.7	11.4	9.9	1.5	6.5	24.2
3	**Reduced Recharge**	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
4	All Simulated **Non-municipal Takings in Vulnerable Area**	0.5	0.3	0.3	0.3	0.3	0.1	0.2	0.2
4b	All Simulated **Non-municipal Takings in 5 m Drawdown Cone**	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.2
5	Simulated **Non-municipal Permitted Takings in Vulnerable Area**	0.1	0.1	0.1	<0.05	<0.05	<0.05	<0.05	0.1
5b	Simulated **Non-municipal Permitted Takings in 5 m Drawdown Cone**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6	Simulated **Non-permitted Takings in Vulnerable Area**	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.2
7	Simulated Non-permitted **Domestic Takings in Vulnerable Area**	0.4	0.2	0.1	0.2	0.2	0.1	0.2	0.2
8	Simulated Non-permitted **Livestock Watering Takings in Vulnerable Area**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

While the magnitudes of the simulated water level change are relatively small for most of the scenarios, it is informative to evaluate the change in terms of the amount of remaining available head (water) in each municipal well. For example, a well with an available head of 20 m and a water level change of 0.5 m would reduce the available head to 19.5 (i.e., a minimal amount for that well). Conversely, a well with an available head of 1.0 m and a water level change of 0.5 m would reduce the available head to 0.5 m, which may be considered significant for that well. Higher values of available head in a well suggests that a well has the capacity to accommodate additional drawdown.

Table 3 summarizes the simulated available head for each municipal well for each scenario. The low well operation thresholds (called “setpoints”) established in the Centre Wellington WSMP (Matrix 2020) are used in this calculation. These thresholds are based on low-level lock-out elevations provided by the municipal well operators for the pumps in each municipal well and were subsequently adjusted to consider model error and local geological/operator knowledge.

The results (Table 3) illustrate that the amount of remaining simulated available head in the municipal wells ranges from 4.3 to 47.3 m for Scenarios 2 through 8. None of the scenarios predict that the simulated water levels will fall below the low operating threshold of the well (i.e., a simulated available head of 0); these results are consistent with the results of the Tier Three Assessment.

TABLE 3 Remaining Available Head (m) Relative to Low Well Operation Thresholds (Setpoints)

Scenario	Description	Simulated Available Head (m)							
		Elora			Fergus				
		E1	E3	E4	F1	F4	F5	F6	F7
Simulated Available Head under Existing Conditions		**25.6**	**22.1**	**47.3**	**38.5**	**26.2**	**7.4**	**18.7**	**35.4**
2	**Increase to Future Pumping** Compared to Current Pumping at Centre Wellington Municipal Wells	4.3	15.0	24.6	27.1	16.3	5.9	12.2	11.2
3	**Reduced Recharge**	25.5	22.0	47.2	38.4	26.1	7.2	18.6	35.3
4	All Simulated **Non-municipal Takings in Vulnerable Area**	25.1	21.8	47.0	38.2	25.9	7.3	18.5	35.2
4b	All Simulated **Non-municipal Takings in 5 m Drawdown Cone**	25.2	21.9	47.1	38.3	26.0	7.3	18.5	35.2
5	Simulated **Non-municipal Permitted Takings in Vulnerable Area**	25.5	22.0	47.2	38.5	26.2	7.4	18.7	35.3
5b	Simulated **Non-municipal Permitted Takings in 5 m Drawdown Cone**	25.6	22.1	47.3	38.5	26.2	7.4	18.7	35.4
6	Simulated **Non-permitted Takings in Vulnerable Area**	25.2	21.9	47.1	38.3	26.0	7.3	18.5	35.2
7	Simulated Non-permitted **Domestic Takings in Vulnerable Area**	25.2	21.9	47.2	38.3	26.0	7.3	18.5	35.2
8	Simulated Non-permitted **Livestock Watering Takings in Vulnerable Area**	25.6	22.1	47.3	38.5	26.2	7.4	18.7	35.4

4 IMPLICATIONS FOR POLICY DEVELOPMENT

As mentioned earlier, the goal of a drinking water Source Protection Plan is to develop policies to eliminate, reduce, and/or manage Significant drinking water threats. The results of this preliminary water quantity threats analysis indicate that most of the water level drawdown in Centre Wellington's municipal aquifer will be caused by the future pumping demands of those municipal wells. Existing non-municipal pumping has impacted the aquifer to a much lesser degree; however, there always remains an opportunity for potential future increased or new non-municipal water takings to interfere with the municipal wells given the high transmissivity of the aquifer. Transmissivity is a term that describes the ability of groundwater to flow through an aquifer. As a result, the most effective policies for managing the water quantity risk will be:

- Management and optimization of the municipal system including measures that decrease future demand (e.g., water conservation and demand management) and measures that increase future supply (e.g., optimizing/redevelopment of existing wells, installation of new wells, exploring surface water supply) (AECOM 2019).

- Review and assessment of any future potential non-municipal demands having the potential to interfere with municipal wells.

The Toronto and Region Conservation Authority (TRCA) assembled a risk management measures catalogue (TRCA 2014) that enables a user to search for relevant measures that are most applicable for managing the water quantity threats activities within a Vulnerable Area. The catalogue contains more than 60 water quantity risk management measures that are grouped into one or more of the following water conservation and "terrain" (e.g., land-use and land-practice) management target groups to address water quantity threats (TRCA 2013):

1. indoor water use reduction
2. outdoor water use reduction
3. industrial, commercial, and institutional water efficiencies
4. municipal water loss management
5. water resource awareness
6. increase in recharge
7. increase in water supply
8. municipal water efficiencies
9. agricultural water efficiencies - crop management
10. agricultural water efficiencies - livestock management

Management target groups 1 to 5 and 7 to 8 are the most applicable to address municipal, non-municipal and domestic consumptive water takings and therefore policies could be developed which target these measures.

As part of preliminary discussions on possible policy approaches, the project team discussed examples of policies that may be relevant to water quantity in Centre Wellington during a meeting on September 19, 2019. These approaches are discussed below using learnings from the Tier Three Assessment, WSMP, and preliminary threats analysis modelling:

- **Non-permitted, Non-municipal Water Takings:** The current analysis does not identify any known large non-municipal water takings that are exempted from the Permit to Take Water Program (i.e., livestock watering) that have impacted the municipal supply. Aside from private water wells, it is unlikely that any future exempted water takings (e.g., livestock watering) would be located close enough to the current municipal system to have an impact on the municipal aquifer. However, this should be reassessed where new municipal wells are established closer to agricultural areas.

- **Municipal Water Supply System Optimization:** Optimization of pumping rates of existing municipal wells was completed recently using the Tier Three model as part of the WSMP. Optimization scenarios and comparison to measured conditions using the model are useful on a routine (e.g., annual or biannual) basis as a check on the validity of the model, any trends with monitoring data, and to identify operational or maintenance conditions that reduce the efficiency of the municipal system. Optimization strategies may include, but are not limited to, the following:

    - optimizing existing capacity to realize existing permitted capacity;
    - exploring the potential for expanding the existing capacity beyond the current permitted capacity; and/or
    - balancing the municipal pumping to optimize/maximize municipal water taking.

- **Aquifer and Surface Water/Groundwater Interaction Monitoring:** Calibration of the groundwater flow model relied on a combination of aquifer monitoring data and surface water flow measurements used to estimate groundwater discharge into streams. There is always an opportunity to improve model calibration to increase the reliability of model predictions. It is recommended that the municipality maintain its groundwater monitoring program, include baseflow monitoring, and then revisit the model to validate calibration as part of its threats management process.

- **Private Water Taking Restrictions in Serviced Areas:** The scenarios considered suggest that the presence of private water wells within the municipality may have a negligible to small effect on water levels in the aquifer. Developing policies relating to private servicing versus private domestic wells is unlikely to have an effect on water levels in the water supply aquifer; however, there may be other important benefits of servicing private homes including management of water quality risks to those residences.

- **Groundwater Recharge Reductions:** While the preliminary threats analysis predicted a relatively small impact (i.e., maximum 0.2 m) at municipal wells as a result of future reduced recharge, larger water level declines are possible in the shallower flow system, which may result in reduced groundwater discharge to other water uses such as coldwater streams. Therefore, while recharge reductions do not result in a relatively high impact at existing municipal wells, policies should maintain recharge to maintain the existing water budget, water quality, and ecological functions. Further, many best management practices such as those implemented in the Rural Water Quality Program are designed to improve water quality; however, they have the additional benefit of maintaining groundwater recharge and concurrently reducing surface water runoff.

- **Non-municipal Permitted Water Takings**: This preliminary water quantity threats analysis focused on evaluating the relative impacts of identified existing consumptive water takings and future areas of recharge reduction. As mentioned above, increased existing or new consumptive non-municipal water

takings have the potential to impact municipal water wells into the future, particularly if those wells are constructed close enough to the municipal wells to result in interference. Policies should be in place for the careful review and assessment of new or expanded non-municipal permitted takings and how they may impact the municipal water supply system.

5 SUMMARY AND CONCLUSIONS

A preliminary water quantity threats analysis was completed for the Significant water quantity threats identified in the Centre Wellington Tier Three Assessment. The goal of the analysis was to evaluate the relative impact of groups of consumptive water taking threats and recharge reduction threats on groundwater levels within municipal wells within the Vulnerable Area.

A series of scenarios were performed using the Tier Three groundwater flow model to evaluate the relative impact of reduced recharge areas and different groupings of municipal and non-municipal water groundwater takings within the Vulnerable Area. The results suggested that the largest magnitude of water level change in the Centre Wellington municipal wells is caused by future pumping demands of those municipal wells. The results suggest that policies that are considered to manage water quantity risk within the Vulnerable Area should focus on the municipal water takings. The Centre Wellington WSMP (AECOM 2019) introduced a number of potential approaches to address municipal water supply concerns including: reducing demand through water conservation and demand management, and increasing supply through new groundwater (e.g., optimization/redevelopment of existing wells and installation of new wells) and surface water supplies. Policies should also consider the mitigation of potential impacts to municipal water supply wells from increased existing or new non-municipal groundwater takings in the future.

Based on the results of this preliminary water quantity threats analysis, it is not anticipated that further significant insights would be gained by conducting a more formal Risk Management Measures Evaluation Process (RMMEP). As a result, it is recommended that policies that address water quantity threats use the results of this report in place of a full RMMEP.

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Easting (m)

536250 540000 543750 547500 551250

Northing (m)

4845000 4841250 4837500 4833750 4830000

TOWNSHIP OF MAPLETON

TOWNSHIP OF CENTRE WELLINGTON

TOWNSHIP OF WOOLWICH

TOWNSHIP OF GUELPH/ERAMOSA

Alma

Fergus

Elora

Salem

F1 F2 F4 F5 F6 F7

E1 E3 E4

Belwood Reservoir

Conestogo Lake

Woolwich Reservoir

Parker Creek

Irvine Creek

Grand River

Canagagigue Creek

Carroll Creek

Swan Creek

Cox Creek

West Montrose Creek

Wellington 12 Road

Sideroad 12

16th Line

Sideroad 20

Wellington 16 Road

Sideroad 15

12th Line

Sideroad 18

Sideroad 5

2nd Line

Sideroad 19

Wellington 29 Road

Townline Eramosa Garafraxa

Sideroad 5 West

Wellington 7 Road

4th Line

Sideroad 6 North

6th Line

Sideroad 6

Sideroad 6 South

8th Line

Sideroad 10

N

WHPA-Q1/WHPA-Q2/Groundwater Vulnerable Area

5 m Drawdown Contour around Fergus/Elora

Municipal Boundary

Groundwater Recharge Reduction Threat

Wetland

Waterbody

Watercourse

Highway

Road

Railroad Trail

Municipal Well

Non-Permitted Consumptive Water Taking Threat

Permitted Consumptive Water Taking Threat

Commercial

Industrial

Miscellaneous

Remediation

Note: the Risk Level assignment to the Groundwater Vulnerable Area does not imply that an individual groundwater taking or recharge reduction activity within that area will threaten the reliability of the municipal water supply.

1:75,000 metres

750 0 750 1,500

NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Grand River Conservation Authority
Township of Centre Wellington - Preliminary Water Quantity Threats Analysis

Water Quantity Threats

Date:	Project:	Submitter:	Reviewer:	Figure
October, 2019	23876	J. Melchin	D. Van Vliet	1

I:\GrandRiverCA\23876\Figures\nTables\T3\2019\Report\PreliminaryWaterQuantityThreatsAnalysis\Memo\Figure-1-Water_Quantity_Threats.mxd - Tabloid_L - 24-Oct-19, 09:53 AM - ehollinger - TID305