MAITLAND VALLEY
ASSESSMENT REPORT: CHAPTER 4

VULNERABILITY, THREATS AND RISKS

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4.1 Regulatory Context

The Assessment Report gives specific attention to those municipal residential drinking water sources identified in the Terms of Reference. The purpose of this section is to identify where the sources of drinking water are susceptible to contamination given the natural environment and human activity around the source of water. This is determined by using scientific models which evaluate the vulnerability of the area around a drinking water source (what exists in nature). Then within these areas, what activities or conditions exist that use chemicals or contain pathogens that could, in a certain circumstance, contaminate drinking water (what humans do or have done). By identifying areas where the potential for such contamination is greatest, protection measures can be directed to the most vulnerable areas through the Source Protection Plan.

Vulnerable Areas

The *Clean Water Act, 2006*, identifies four types of vulnerable areas which are defined by regulation in the following way:

"*highly vulnerable aquifer*" means an aquifer on which external sources have or are likely to have a significant adverse effect, and includes the land above the aquifer;

"*significant groundwater recharge area*" means an area within which it is desirable to regulate or monitor drinking water threats that may affect the recharge of an aquifer,

"surface water intake protection zone" means an area that is related to a surface water intake and within which it is desirable to regulate or monitor drinking water threats,

"wellhead protection area" means an area that is related to a wellhead and within which it is desirable to regulate or monitor drinking water threats.

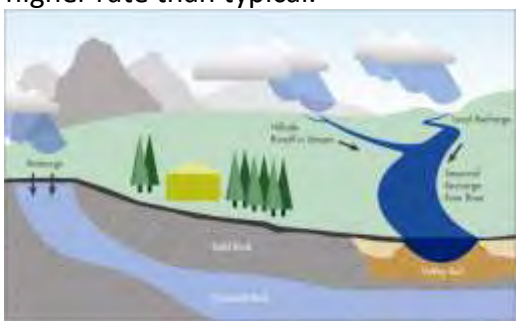
The *Technical Rules* (MOE, 2009) indicate how to delineate each type of vulnerable area and how to assess the degree of vulnerability within each. These methodologies will be expanded upon below. The degree of vulnerability is represented by a score where a score of 8 – 10 is considered high vulnerability, 6 – 8 is moderate vulnerability and 4 – 6 is low vulnerability.

A **wellhead protection area (WHPA)** is the area of land around a well that has an outer boundary from which it takes up to 25 years for water to travel to the wellhead.

A **highly vulnerable aquifer (HVA)** is an area of soil or rock where underground cracks or spaces allow water (and possibly contaminants) through more quickly from the surface to the aquifer.

An **intake protection zone (IPZ)** is the area of water and land around a surface water intake defined by the distance water can travel from upstream or shore to the intake.

A **significant groundwater recharge area** is land where rain or snow seeps underground into an aquifer at a higher rate than typical.



Groundwater Vulnerability Score is shown as a score where 2 is low vulnerability and 10 is high vulnerability. This score combines two ideas: The closer the wellhead, the higher the vulnerability score and the more vulnerable the aquifer, the higher the vulnerability score. Thus the score accounts for both horizontal and vertical movement of water into the aquifer that the well draws from.

4.2 Methods for Delineating Vulnerable Areas

Data was gathered for each of the four types of vulnerable areas in keeping with the *Technical Rules*. The methodology, limitations and uncertainty associated with this methodology are outlined below.

Highly Vulnerable Aquifers (HVAs):

Highly Vulnerable Aquifers (HVAs) are aquifers that are more susceptible to contamination. The Intrinsic Susceptibility Index (ISI), a measure of overburden porosity, was used to delineate HVAs in all areas. While the rules allow for several different approaches, the ISI method was chosen because data was readily available for the entire SPR. ISI for the region was available through county groundwater studies (Grey Bruce Groundwater Study, 2003; Perth County Groundwater Study, 2003; Huron County Groundwater Study, 2003). The areas above aquifers that were designated as having 'high' intrinsic susceptibility (ISI) are considered Highly Vulnerable Aquifers for the purposes of source protection planning.

ISI is a regional aquifer assessment tool designed to identify areas where those aquifer systems are sensitive to contamination via surface activities. Data used in the calculation for the index is derived from water well records housed in the Ministry of Environment's Water Well Information System (WWIS). Wells used in the calculation were screened based on location reliability codes in the WWIS, and only those deemed sufficiently accurate were included in the final ISI calculation. Details on the screening of data can be found in the corresponding reports (Grey Bruce Groundwater Study, 2003; Perth County Groundwater Study, 2003; Huron County Groundwater Study, 2003). The screening process leads to the exclusion of some data sources which may have an impact on the certainty associated with the ISI.

ISI is calculated for individual municipal wells and employs statistical methods for estimating values between wells. This process does not take into account discrete boundaries of local geological features which may be the source of the different index values. Exclusion of data points has a higher impact on the local scale calculations of ISI, as the exclusion of a single data point could have profound implications on the ISI locally, whereas at a regional scale the impact of a single data point has less significant ramifications.

Uncertainty associated with ISI is highly dependent on the scale at which they are viewed. From a regional scale perspective, ISI can be considered a good

indicator of areas where aquifers are highly vulnerable, and as such, can be considered to have low uncertainty at that scale. However, when applied at a local scale, ISI cannot be considered accurate due to the statistical analysis involved in plotting them, and the exclusion of data points from the overall calculation. As such, it should be considered to have high uncertainty at the local, lot specific scale.

Some areas within the SPA which have surficial sands are not mapped as being Highly Vulnerable with the ISI process. The primary reason for this is the lack of wells or well records for these shallow aquifers from which the ISI was developed. Incorporation of surficial geology data into the delineation of highly vulnerable aquifers represents an opportunity for improvement for future source protection planning.

According to the *Technical Rules*, all HVAs have vulnerability scores of 6.

Significant Groundwater Recharge Areas (SGRAs):

A significant groundwater recharge area is land where rain or snow seeps underground into an aquifer at a higher rate than typical, and where water quantity may be vulnerable to certain activities.

Significant groundwater recharge areas (SGRAs) were calculated using a Hydrologic Response Unit (HRU) Approach for the Source Protection Area. HRUs were developed on a 15 m by 15 m grid for the entire SPA based on surficial geology and landcover, and were corrected at a subwatershed scale using Tier 1 water budget models. Individual recharge values for each type of HRU were developed on a subwatershed basis, and mean annual recharge values for the SPA were calculated.

Those HRUs with recharge values that exceed 115% of the mean recharge value for the SPA were identified as being High Volume Groundwater Recharge Areas in accordance with Rule 44 (2) of the Technical Rules. In order to be considered, the high volume recharge area must have a hydraulic connection with a drinking water system (i.e. a well). Due to uncertainties related to the location and distribution of well records, the SPC requested that all high volume recharge areas be included as significant recharge areas. This was considered appropriate given the lack of information on shallow wells and surficial aquifers in the region. Sinkholes, and areas that drain into sinkholes, were included as SGRAs based on Rule 44 (1), as all water which is not lost to evapotranspiration is recharged, either by infiltration or via runoff into surface water bodies which are outlet

directly into sinkholes. SGRAs were further refined within those areas included in the Tier 2 water budget.

The data used for the development of the SGRAs is based on existing climate data, Tier 1 surface water modeling outputs and existing geological and landcover data. These data sets were not developed for the explicit purposes of delineating SGRAs, and have certain limitations which can be attributed to them, specifically:

1. Climate data has been filled and corrected to try and account for missing data for discrete time intervals and locations where no monitoring stations exist;
2. Surface water modeling has been completed for the entire Source Protection Area, yet has not been calibrated in certain regions due to a lack of monitoring data. In such cases models were calibrated to similar subwatersheds;
3. Landcover data is valid only at the time it was collected, and has not been altered or corrected for changes in land use since the time of collection;
4. The SGRAs have not been evaluated with respect to their hydrologic connection to specific aquifers themselves. Rather they have been calculated to the nearest surficial aquifer. Recharge areas for confined regional aquifers may lie outside areas. Future use of this delineation, specifically at local scales, should consider the aquifer of interest before employing this methodology.

Uncertainty for SGRAs is a measure of the reliability of the delineations with respect to providing protection to the overall groundwater system, rather than specific aquifers. In this light, the methodology for calculating SGRAs is highly reliant on the surficial geology of the area and can be considered reliable for the overall groundwater system. The uncertainty for the SGRAs is therefore considered low for the Source Protection Area.

According to the 2017 *Technical Rules,* SGRAs are no longer assigned a vulnerability score and therefore no significant, moderate or low drinking water threats related to water quality are assigned to them. Previously, SGRAs with a score of 6 had identified low and moderate threats. Once HVAs were delineated, it was observed that HVAs consistently aligned with SGRAs with a score of 6, making the scoring of SGRAs redundant.

Intake Protection Zones (IPZs):

The Maitland Valley Source Protection Area has one intake which is at Goderich. It is classified as a Type A intake, an intake located in a Great Lake. This intake is in Lake Huron approximately 500 metres off shore near the breakwater and at seven (7) metres depth.

Consultants with coastal modeling expertise were selected to undertake the delineation of IPZs (Baird and Associates). Their work was peer-reviewed by recognized and qualified experts who concurred with the outcomes and recommended potential improvements (HCCL), which are reflected in this document.

The in-water portion of an IPZ-1 is prescribed as a 1 km radius around the lake intake except where it intersects land. Where the IPZ reaches land, its inland extent is limited to the greater of 120 metres or the regulatory limit. The IPZ-2 is delineated as the two-hour time of travel to the intake under a series of wind and wave conditions considered typical for a 10-year period. The IPZ-2 was delineated using three-dimensional hydro-dynamic models (Delft 3D). This methodology was well-suited, given the intake's distance from shore, availability of data, complicated shoreline boundary conditions, and wave, sediment and water quality capabilities.

As wind is a significant influence on current directions, Baird undertook extensive reviews of wind data from the Goderich Municipal Airport, the Southern Lake Huron meteorological buoy (MEDS Station 45149), and the Princeton Ocean Model (POM). "The airport data were selected for use in the extreme value analysis due to the longer period of record (1986 to 2007). The buoy data were also not appropriate for use in the extreme value analysis as data were not collected during the winter season, which coincides with the highest wind events. The airport data were corrected to represent wind speed over water. The data were then compared with the POM data to identify possible data limitations or inconsistencies and required corrections were made." (Baird, 2010)

In addition, reverse particle tracking was undertaken to refine the IPZ-2. "The limits of the 2-hour travel distance extend approximately 1.2 km north, 3.6 km south, close to 1.0 km offshore of the intake, and within 100 m from shore at some locations. The in-lake IPZ-2 extends further to the south than to the north, as a result of the large circulation patterns in the lake (which mean that the current direction is not always the same as the wind direction) and localized eddy patterns in the vicinity of the intake. The eddy patterns are a localized effect, created by the harbour and breakwaters. As a result, the currents are

predominantly to the north at the intake (this was described in some detail in the Phase 1 report)" (Baird, 2010).

The vulnerability scores for the intake are based on the attributes of the intake (length and depth), type of water body, the physical characteristics of the environment it is situated in, and the influences affecting intake water. It is essentially qualitative, based upon scores assigned to the contributing factors through the professional judgment of coastal modeling consultants. The vulnerability score is derived by multiplying the Area Vulnerability Factor by the Source Vulnerability Factor (as defined in the *Technical Rules*). The Area Vulnerability Factor for IPZ-1 is 10 as prescribed by the *Technical Rules*.

The area vulnerability factor for IPZ-2 must be assigned a whole number ranging from 7 to 9 based upon consideration of the following sub factors:

a. Percentage of area that is land within the IPZ-2;

b. Land cover, soil type and permeability; and

c. Transport pathways within the IPZ-2 upland environment.

Derivation of Area Vulnerability Factor for Goderich IPZ-2, Baird 2010:

Rule	Criterion	Score	Rating			Sub-factor Score	Resulting Score
			Low (7)	Moderate (8)	High (9)		
% Land 92(1)	Land-Water Ratio %	64%	<33	33-66	>66	8	8
Land Characteri-stics 92(2)	SCS CN – Count Twice!	>80	<55	55-80	>80	9	(9+9+8+8)/4 =8.5
	% Imperviousness (Permeability)	34	0-20	20-50	>50	8	
	Slope %	2.6	<2	2-5	>5	8	
Hydrological & Hydrogeolo-gical 92(3)	Outfalls in Proximit y	1 outfall located within 1 hr of intake	No outfalls within IPZ-2	Outfall within 1-3 hours of intake	Outfall within 1 hour of intake	9	(9+8)/2=8.5
	Drainage Density (km/km^2)	1.1	<1	1-3	>3	8	
Area Vulnerability Factor							(8+8.5+8.5)/3 =8.3 **Rounded to 8**

(Table 5.2 from Baird Phase 2 Addendum, May 2010)

Areas without watercourses and other transport pathways were extended inland from the Lake Huron shore 120 m.

An evaluation of each of these factors was completed for the Goderich intake and the Area Vulnerability Factor for IPZ-2 was determined to be 8.

According to the *Technical Rules*, the Source Vulnerability Factor must be assigned a value of 0.5 to 0.7 based on the following factors:

a. The depth of the intake,
b. The distance of the intake from land, and
c. The number of recorded drinking water issues related to the intake.

These factors were quantified for the Goderich intake and the Source Vulnerability Factor was determined to be 0.6, to reflect the proximity of the intake to sources of contamination (see the Surface Water Vulnerability Analysis for Goderich Intake, Baird 2010). Therefore, the final vulnerability score for the IPZ-1 is 6 and the score for IPZ-2 is 4.8.

Intake Vulnerability Criteria based on Intake Distance from Shore and Depth:

Category	Nearshore-Shallow Water	Nearshore-Deep Water	Offshore-Shallow Water	Offshore-Deep Water
Parameters	<300 m offshore <6 m depth	<300 m offshore ≥6 m depth	≥300 m offshore <6 m depth	≥300 m offshore ≥6 m depth
Vulnerability (MDEQ)	High	High to Moderate	High to Moderate	Moderate
Recommended Factor (C) for Type A Intakes	0.7	0.6	0.6	0.5

Table 5.3 from Baird Phase 2 Addendum, May 2010

Summary of Vulnerability Scores for Goderich:

Intake Type	Area Vulnerability Factor (B)		Source Vulnerability Factor (C)	Vulnerability Score (V)	
	IPZ-1	IPZ-2		IPZ-1	IPZ-2
A	10	8	0.6	6	4.8

(Table 5.4 from Baird Phase 2 Addendum, May 2010)

Like any methodology, this approach to vulnerability has limitations. Uncertainty is the confidence in the accuracy of IPZ delineations and vulnerability scores based on factors such as: data quality, quantity and distribution; ability of models and formulas to accurately delineate the zones; and accuracy and relevance of the vulnerability scores for the zones to represent the situation.

The table below provides a summary of uncertainty. The result is that the overall uncertainty is high for both the IPZ delineation and the vulnerability rating.

Summary of Uncertainty Ratings for IPZ Delineation and Vulnerability Scores for Goderich WTP:

IPZ	Uncertainty for IPZ Delineation		Uncertainty for Vulnerability Scores	
	Evaluation Factor	Rating	Evaluation Factor	Rating
IPZ-1	Data	High	Data	High
	QA/QC	Low	QA/QC	Low
			Accuracy of Vuln. Factors	High
	Overall	High	Overall	High
IPZ-2	Data	High	Data	High
	Modeling	High		
	QA/QC	Low	QA/QC	Low
	Calibration/ Validation	High	Accuracy of Vuln. Factors	High
	Overall	High	Overall	High

(Table 6.1 from from Baird Phase 2 Addendum, May 2010)

Under the Technical Rules, an IPZ-3 can be created to include threats which have the potential to interrupt the safe operation of a water supply. An IPZ-3 can be developed for a Great Lakes intake where the Source Protection Committee has identified land use activities that are of sufficient concern to warrant further investigation. These land use activities are then evaluated to determine if, under extreme conditions, they can cause an interruption of water supply. In order to be included, it must be shown that there is a hydrodynamic connection between the land use activity and the intake, and that a sufficient quantity of an identified contaminant could be released resulting in an interruption in the water supply.

In the Maitland Valley SPA, a screening procedure was implemented to identify potential land use activities that require a detailed analysis. This screening procedure began first by identifying all properties located within 120m of Lake Huron or any stream identified in the provincial stream network layer. These properties were further screened to eliminate land uses that are unlikely to have

any sources of contaminants, such as natural environment and conservation lands. Finally, the properties were screened in order to identify only those properties which have a structure located within the 120m buffer surrounding the watercourses or Lake Huron. Under extreme events, any property located within the 120 m buffer of a watercourse has the potential to have a hydrodynamic connection with the intake located in Lake Huron (everything is upstream of Lake Huron).

Properties with a structure located within the 120m buffer were evaluated using aerial photography to identify any major storage tanks which could be of concern. Those included based on the aerial photography were then evaluated based on the volume, concentration, fate and toxicity of any contaminants stored on site. Land use activities were also evaluated based on the likely pathway of any spill to the watercourse. Land use activities that include partially of fully below grade storage were eliminated from the process as they are unlikely to result in rapid spill into surface water systems.

Remaining threats were then assessed for inclusion into an IPZ-3 by developing a realistic spill scenario and using a simple dilution calculation. This scenario considers the potential size and duration of any spill, the concentration of any contaminants, the location and hydrologic situation of the storage facility and the fate of the contaminant. In cases where multiple contaminants have been identified, the contaminant with the most conservative fate was considered for the dilution scenario. Land use activities which were included for the IPZ-3 assessment were then evaluated to determine if a sufficient hydrodynamic connection exists. Once that hydrodynamic connection has been demonstrated through modeling or analysis, a spill scenario was undertaken to determine if a spill has the potential to sufficiently impact the source of municipal drinking water such that it would cause an interruption in water supply.

If the spill scenario calculations determine that a spill could cause deterioration to the quality of the drinking water, and result in an interruption in supply, an IPZ-3 could be extended to include the evaluated land-use activities. It should be noted that no IPZ-3 has been delineated in the Maitland Valley Source Protection Area.

Wellhead Protection Areas (WHPAs):

The wellhead protection areas were modeled using three-dimensional groundwater flow models by identifying certain areas which correspond to Times of Travel to the well. For each well head the following times of travel have been modeled:

- 100m WHPA – A
- Two-year time of travel WHPA – B
- Five-year time of travel WHPA - C
- 25 year time of travel WHPA – D
- If there is a GUDI well, two-hour time of travel WHPA – E

  WHPA-A is not a time-of-travel model, rather it is a prescribed 100m buffer surrounding all municipal wells.

The groundwater modeling and time-of-travel calculations were all completed in keeping with the *Technical Rules*. The three-dimensional groundwater modeling code MODFLOW-SURFACT, developed by Waterloo Hydrogeologic Inc. (now Schlumberger Water Services), was used for the initial delineation of ~~delineating~~ the wellhead protection areas in the ABMV Source Protection Region. MODFLOW-SURFACT is a commercially available software package that simulates the groundwater flow using a finite difference formulation, incorporating the USGS-developed MODFLOW code. MODFLOW SURFACT is an advance groundwater modeling package that couples unsaturated and saturated subsurface conditions, which allows it to take into account preferential pathways. For each municipal well, the known individual wells are included in the model. The updated models were constructed using the hydrogeologic units from ground surface down to the lowest extents of the aquifers from which the municipal wells were taking their groundwater. Surface water boundaries interacting with the groundwater system were included in the groundwater models. The groundwater models were calibrated to provide good representation of the aquifer systems supplying the groundwater to the municipal wells. Once calibrated, the models were used to run multiple reverse-particle tracking scenarios in order to develop the times of travel for the wellhead protection area.

Recognized and qualified consultants (WESA) undertook a peer review of this methodology and concurred with the outcomes and recommended potential improvements. These will be addressed in an updated Assessment Report. Similar methods by each consultant provided seamless delineation between source protection regions.

This method was chosen because it utilizes the analytical complexity required by the rules while building on existing data. Uncertainty analyses are a conservative approach which is used to account for the intrinsic variations that exist in natural hydrogeologic environments.

The limitations of the modeling tasks are driven by the uncertainty of the data itself, primarily the recharge, hydraulic conductivity and variations in the temporal water level data. In developing the groundwater models for the ABMV Source Protection Region uncertainty was incorporated into the Wellhead Protection Areas. The WHPAs presented within the report include an uncertainty analysis and represent conservative but reasonable zones based on the information available. Sensitivity analysis was conducted, in which those model parameters, for which the WHPA delineations were sensitive to, were varied in a range, above and below the calibrated value, but remained within reasonable limits of that parameter. The most sensitive parameters were found to be recharge and hydraulic conductivity as is usually found with most groundwater modeling simulations. For hydraulic conductivity parameters the uncertainty range was typically assumed to be between a half or a full order of magnitude above and below the calibrated value. For recharge parameters the uncertainty range was assumed to range from twice to half of the calibrated value. The water level data used for calibrating the groundwater models was primarily the static water levels at the time of drilling from the provincial Water Well Information System. Since these water levels have been collected over many decades and at various times throughout the year the static water level at the time of drilling may be quite different from the water level under current conditions. Lastly, the WHPA Zone B and Zone C will generally have less uncertainty than the WHPA Zone D. The size of the WHPA Zone B is smaller and centered closer to the wellhead where the presence of more wells allows for the geology to be typically better understood than farther away from the wellhead. The projected pumping rates for 25 years were used for generating the WHPAs and unlikely to change drastically over the next two years, but may change drastically over the next 25 years for a variety of unforeseen reasons. For these reasons listed above, the WHPA Zone B and Zone C have low uncertainty and the WHPA Zone D has high uncertainty. (see Ausable Bayfield Maitland Valley Wellhead Protection Area Delineation Project, WNMC, 2009)

WHPA-E is required for wells that have been deemed to be Groundwater Under the Direct Influence of surface water (GUDI). In order to expand the protection of the well, a two-hour time of travel zone is completed within the closest surface water body to the well (WHPA-E). WHPA-E is initiated at the closest point to the well within that surface water body, and the in-water portion extends upstream for a period of two hours under 10-year flow conditions. Ten-year year flow velocities were established based on existing HEC-2 flood plain mapping and modeled results under 10-year flow conditions.

The on-land portion of the WHPA-E was extended to the greater of 120m or the Conservation Authority regulatory limit. Accordingly, for the Century Heights WHPA-E, the Conservation Authority regulatory limit was used to delineate the on-land extents of WHPA-E.

Vulnerability scores in WHPAs can be 2, 4, 6, 8, or 10 and are based on the time of travel and the ISI rating. The chart below shows how scores are determined in a WHPA.

Intrinsic Vulnerability	Travel Time Zones			
	100m	2 year	5 year	25 year
HIGH	10	10	8	6
MEDIUM	10	8	6	4
LOW	10	6	4	2

The WHPAs will be updated as needed to reflect changes to municipal water supply systems, such as new or altered wells. Amendments are noted in the preface of the Assessment Report.

Details on data information sources for delineations and scoring are available in the consultant's reports. These reports are noted in the Reference section at the end of this chapter.

Transport Pathways

Within wellhead protection areas, vulnerability scores were developed by intersecting Aquifer Vulnerability scores, typically derived from the Intrinsic Susceptibility Index (ISI) or Aquifer Vulnerability Index (AVI), with the time-of-travel capture zones associated with the WHPA. Where anthropogenic transport pathways exist that circumvent the natural vulnerability of the aquifer, the Aquifer Vulnerability score can be increased according to the following technical rules 39, 40 and 41, listed below:

> 39. Where the vulnerability of an area identified as low in accordance with rule 38 is increased because of the presence of a transport pathway that is anthropogenic in origin, the area shall be identified as an area of medium or high vulnerability, high corresponding to greater vulnerability.
>
> 40. Where the vulnerability of an area identified as medium in accordance with rule 38 is increased because of the presence of a transport pathway

> that is anthropogenic in origin, the area shall be identified as an area of high vulnerability.
>
> 41. When determining whether the vulnerability of an area is increased for the purpose of rules 39 and 40 and the degree of the increase, the following factors shall be considered:
>
> (1) Hydrogeological conditions.
> (2) The type and design of any transport pathways.
> (3) The cumulative impact of any transport pathways.
> (4) The extent of any assumptions used in the assessment of the vulnerability of the groundwater.
>
> *Clean Water Act, 2006*, Technical Rules (December, 2009)

Based on these rules, before an adjustment to aquifer vulnerability to account for transport pathways can be made, the hydrogeology of the site, the type and design of any transport pathways, the cumulative impact of the pathways and any assumptions used in developing the original aquifer vulnerability rating must be considered.

Methodology

Preliminary identification of Transport Pathways was completed through aerial photo interpretation. Properties and areas of interest were identified from the 2007 photos in a GIS environment. Properties located in the WHPA were also visited as part of a larger effort to evaluate drinking water threats throughout the region. As part of these visits, routine questions were asked of the property owners about the location and condition of any wells on the property. The results of these site visits were entered and stored in a geo-referenced database, facilitating review as part of the Transport Pathways review.

Similarly, a number of stewardship programs have been carried out in the Region both relating to drinking water source protection, as well as municipal programs. Well head upgrades are a common constituent of these programs, and properties where upgrades were completed entered into a geo-referenced database and were useful tools in evaluating potential Transport Pathways.

As part of a provincial initiative to verify the Water Well Information System (WWIS) and as part of the data collection phase of the proposed Drinking Water Source Protection project, the Ausable Bayfield and Maitland Valley Conservation Authorities undertook a review of the Water Well Information System: specifically, the Water Well Records with respect to spatial accuracy and

well record completeness. Phase One (2005) refined the WWIS based on existing data and Phase Two (2006/2007) field-verified these records with the ultimate goal of updating provincial records.

Field verification using Global Positioning System (GPS) technology was implemented to capture the position of the well. This location was compared against WWIS Records in order to verify their accuracy. To capture the well location, a team of two individuals visited properties within the 25-year time-of-travel wellhead protection area (WHPA) for municipal wells within the Ausable Bayfield Maitland Valley (ABMV) region. Upon completion of the GPS coordinate reading, a photograph was taken of the well in context to surrounding buildings, and the condition of the well was noted. This data was available for review of the Transport Pathways in the Region.

In the Ausable Bayfield Maitland Valley Source Protection Region (SPR) transport pathways can be grouped into several categories, namely: pits and quarries; private wells; and urban areas and private well clusters. Detailed methodology and consideration of these areas are outlined below. In assigning transport pathway adjustments, the hydrogeology of the site and the condition of the pathway were considered, as well as the cumulative impact of transport pathways.

Pits and Quarries

Pits and quarries were primarily identified through aerial photography. Where prudent, these operations were examined by a roadside or windshield survey in order to ascertain the type of operations. There are relatively few pits and quarries in the region. Where they exist, and dependent on their depth with respect to the water table, aquifer vulnerability was adjusted from low to moderate or high, or from moderate to high. Details of any such adjustments are provided in section 4.5 for individual WHPAs.

Private Wells

Private wells were first identified using the WWIS. Information made available from the well record improvement project undertaken by the Maitland Valley and Ausable Bayfield conservation authorities was used to evaluate the condition of the wells, which was current for the WHPAs for the year 2006. Additional information was gathered from site visits carried out as part of the Drinking Water Source Protection Committee consultation to determine if any upgrades had occurred since 2006.

Wells that were not in compliance with existing regulations were identified as being potential conduits for water that increase the vulnerability of the aquifer locally. Vulnerability scores were adjusted for 30m surrounding the well, and were adjusted a maximum of one level (i.e. low to moderate; or moderate to high).

Additionally, several properties for which no well record exists, nor any well obvious by site inspection, yet have structures which require water were identified. In these cases, vulnerability scores were adjusted for 60m surrounding any of the principal structures on the property, and were adjusted a maximum of one level.

Details of all vulnerability adjustments for private wells are provided in section 4.5 for individual WHPAs.

Urban Areas and Private Well Clusters

Urban areas inside WHPAs were delineated based on aerial photography. These areas warrant special consideration as potential areas for Transport Pathway adjustments under Technical Rule 41 (3) as the cumulative effects of a high density of abandoned historic wells are common. Although these areas today are serviced by a municipal well, most were historically serviced by private wells. Additionally, the age of these wells precludes the existence of a record for the wells.

As part of this review, the historical servicing of these urban areas was reviewed, and the areas themselves visited to determine if former private wells could be in existence. Where this information indicates that wells are in existence and are substantially non-compliant, vulnerability scores were adjusted for the areas, and were adjusted a maximum of one level.

In areas where the aquifer being exploited by the municipal well is poorly protected, vulnerability scores can be adjusted to account for a reduction in the natural protection of the aquifer due to the installation of underground services, including: sewer lines, septic systems, water supply and electricity supply lines.

Where the hydrogeology warranted it, aquifer vulnerability scores were adjusted a maximum of one level in these areas. Details of all vulnerability adjustments within urban areas are for individual WHPAs.

4.3 Overview and Description of Vulnerable Areas

The ISI method (as described previously) was used to determine groundwater vulnerability across the entire SPA and the results of this are shown on **Map 4.1**.

Highly vulnerable aquifers (HVAs) in the SPA are shown on **Map 4.2**. HVAs are scattered throughout the Source Protection Region.

Significant groundwater recharge areas in the SPA are associated with permeable hydrologic response units and are presented on **Map 4.3**. SGRAs correspond to sand plains that parallel the shoreline for the full length of the Source Protection Region.

There is a surface water intake from Lake Huron: Goderich. This intake serviced the Town of Goderich and is located approximately 500 metres offshore.

The Maitland Valley Source Protection Area has eight municipalities with municipal residential well systems: Huron East, Central Huron, Ashfield-Colborne-Wawanosh, Huron-Kinloss, North Huron, Morris-Turnberry, Minto, and North Perth

4.4 Threats, Conditions, Issues and Risk

The **threats** to drinking water are identified in *Ontario Regulation 287/07* as follows:

Table 4.1 List of Threats in Ontario Regulation 287/07, Section 1.1

1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
3. The application of agricultural source material to land.
4. The storage of agricultural source material.
5. The management of agricultural source material.
6. The application of non-agricultural source material to land.
7. The handling and storage of non-agricultural source material.
8. The application of commercial fertilizer to land.
9. The handling and storage of commercial fertilizer.
10. The application of pesticide to land.
11. The handling and storage of pesticide.
12. The application of road salt.
13. The handling and storage of road salt.
14. The storage of snow.
15. The handling and storage of fuel.
16. The handling and storage of a dense non-aqueous phase liquid.
17. The handling and storage of an organic solvent.
18. The management of runoff that contains chemicals used in the de-icing of aircraft.
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.
20. An activity that reduces the recharge of an aquifer.
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.
22. The establishment and operation of a liquid hydrocarbon pipeline. *

*In 2018, the province amended regulation 287/07 to include the establishment and operation of a liquid hydrocarbon pipeline as a prescribed drinking water threat. There are such no pipelines in the MV SPA.

The Source Protection Committee may recommend threats be added to the above list (**Table 4.1**). This can only be done upon provincial approval. No additional threats have been identified by the Ausable Bayfield Maitland Valley Source Protection Committee.

The Source Protection Committee may also identify **conditions** which constitute a risk. As per the *Technical Rules: Assessment Report* (Rule 126) *conditions* are any one of the following that exist in a *vulnerable area* and result from a past *activity*:

- the presence of a non-aqueous phase liquid in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or wellhead protection area;
- the presence of a single mass of more than 100 litres of one or more dense non-aqueous phase liquids in surface water in a surface water intake protection zone;
- the presence of a contaminant in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or a wellhead protection area, if the contaminant is listed in Table 2 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the potable groundwater standard set out for the contaminant in that Table;
- the presence of a contaminant in surface soil in a surface water intake protection zone, if the contaminant is listed in Table 4 of the Soil, Ground Water and Sediment Standards is present at a concentration that exceeds the surface soil standard for industrial/commercial/community property use set out for the contaminant in that Table; and
- the presence of a contaminant in sediment, if the contaminant is listed in Table 1 of the Soil, Ground Water and Sediment Standards and is present at a concentration that exceeds the sediment standard set out for the contaminant in that Table.

The Ausable Bayfield Maitland Valley Source Protection Committee has not identified any conditions within vulnerable areas in the Maitland Valley Source Protection Area.

It is possible for an extreme event to threaten a drinking water source. An **event based approach** was therefore used for surface water intakes, such as the Goderich intake, to determine whether contaminants released during an extreme event may be transported to an intake. This approach models an Intake Protection Zone 3 (IPZ-3), that includes areas beyond IPZ-1 and IPZ-2, based on extreme event conditions, (such as a 100-year storm), and an understanding of contaminant transport to the intake. Activities occurring within an IPZ-3 can then be identified as significant drinking water threats if it can be shown through modeling that a release of a specific contaminant would result in an issue at the

intake. An initial study in the Maitland Valley SPA indicated that the concentration of salt resulting from a failure at a salt storage facility on the northern Pier of the Goderich Harbour had the potential to cause a disruption to the Goderich Intake during an extreme event. However, a motion recommending that further studies and modelling be conducted to confirm the potential was defeated by the ABMV Source Protection Committee in April of 2011. Therefore, no IPZ-3 was delineated.

Finally, there may be a documented water quality **issue** at a drinking water source. An example would be water contamination that threatens to exceed drinking water standards and treatment is beyond the capacity of the water treatment plant. The Source Protection Committee has identified that if a contaminant of concern reaches half the maximum acceptable concentration, then it is an issue. Currently, no issues are known for the Source Protection Region's municipal drinking water sources.

However, there is evidence of nitrates trending toward this threshold in individual and test wells in Huron East in proximity to the sinkholes. Also in Huron East, there was a history of radionuclides in the municipal wells in Seaforth. These wells have been replaced. However, there is concern that road salt use may contribute to the release of radionuclides. Further research is required for both these issues.

A **risk** to drinking water sources exists where the land is sufficiently vulnerable and the threat is great enough. The amount of risk is identified for a location given the degree of vulnerability where there is or may be a prescribed threat under certain circumstances (as identified in the *Table of Drinking Water Threats*). The degrees of risk are significant, moderate or low.

Identifying Threats

The Assessment Report provides an inventory of possible threats. In simple terms, the present land use is identified for each parcel in wellhead protection areas or intake protection zones. Then a range of threats (as noted above) that are normally associated with that type of land use are assigned to the parcel. Finally, the risk associated with that threat activity is determined. This method takes into account intrinsic risk and does not consider risk management activities. In other words, it uses the precautionary principle. Source Protection Plan policies will be based on the potential or intrinsic risk. However, as part of the Assessment Report, an attempt is made to identify the number and type of significant risks that actually exist in each wellhead protection area. The only locations where significant threats

based on activities could exist are in the wellhead protection areas throughout the ABMV Source Protection Region.

Ontario Regulation 287/07 prescribes drinking water threats. This list was established after extensive research on the part of the Ontario Ministry of the Environment, Conservation, and Parks. There are 22 threats listed and they pertain to both water quality and water quantity threats. Water quantity threats are considered in the Water Budget process (see Chapter 3). For water quality, the threats are activities which could result in the release of chemicals of concern and/or pathogens. Chemicals are human-made substances of distinct molecular composition. Pathogens are agents that cause infection or disease and can be microorganisms, such as bacteria or protozoa, or viruses.

To understand if an area has the potential for significant, moderate or low threats, the reader should first determine which type of vulnerable area the property is located in:

- WHPA A – 100 metres around the wellhead
- WHPA B – Two-year time of travel around the wellhead
- WHPA C – Five-year time of travel around the wellhead
- WHPA D – 25 -year time of travel around the wellhead
- WHPA E – Two-hour time of travel at a GUDI well*
- IPZ 1 – One-kilometre radius around an intake (See page 4-5)
- IPZ 2 – Two-hour time of travel from the intake
- SGRA – Significant groundwater recharge area
- HVA – Highly vulnerable aquifer

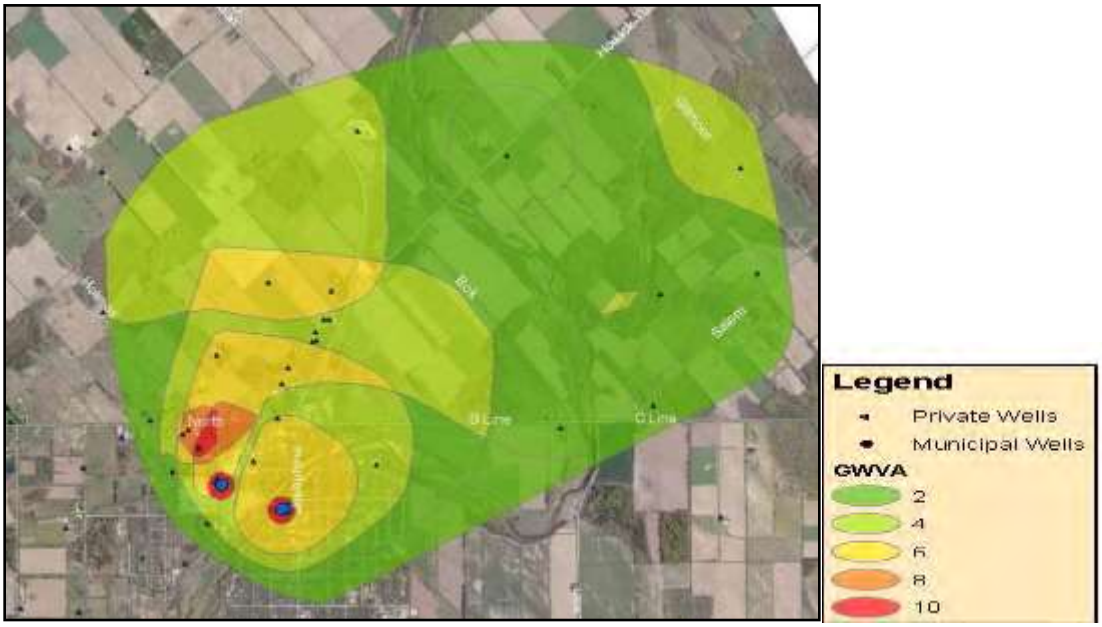
*GUDI means the well is groundwater under direct influence of surface water.

The vulnerability score should then be ascertained for the location. WHPA scores range from 2 to 10 where 10 is the most vulnerable. The IPZ scores range from 4 to 6 and HVAs score 6 or less. SGRAs are not assigned a score. The score is indicated by the colour on the map and map legend (see example below).

Once these two factors are known, the reader can then look up the circumstances in which an activity might be of significant, moderate or low risk. This is done using the Table of Drinking Water Threats in the Technical Rules at https://www.ontario.ca/page/2021-technical-rules-under-clean-water-act.

A Threats Look Up Tool is available at: https://swpip.ca, which allows users to search through the Tables of Drinking Water Threats by the various activities and circumstances.

For example, where the area is located in a WHPA A, the vulnerability score is 10 (signified by the red circle). By using the Table of Drinking Water Threats, one can determine the number and type of possible chemical, DNAPL, or pathogen threats that may occur on the property. It does not mean that these threats exist rather that they might exist given the land uses on the property.



Below is a sample from the Table of Drinking Water Threats which describes specific circumstances in which the threat activity would present a risk. Often the circumstance relates to the quantity of the chemical of concern (it is more risky to have 2,500 litres of fuel stored than 25 litres). Further, these tables of threats and circumstances provide the corresponding degrees of risk (significant, moderate, or low) depending on the groundwater vulnerability score (it is more risky to have 2,500 litres of fuel stored where the score is 10 than where the score is 6).

Table 4.2 Sample from Table of Drinking Water Threats, Road Salt Application

Circumstance type and number	Circumstances	Areas of SDWT	Areas of MDWT	Areas of LDWT
Chemical C12.1.1	1. The road salt is applied in an area where the default percentage of impervious surface area, as	n/a	IPZ/ WHPA-E 9 – 10	IPZ/ WHPA-E 6 – 8.1

Circumstance type and number	Circumstances	Areas of SDWT	Areas of MDWT	Areas of LDWT
	set out on a total impervious surface area map, is less than 1 percent.			WHPA 8 – 10
Chemical C12.1.2	1. The road salt is applied in an area where the default percentage of impervious surface area, as set out on a total impervious surface area map, is at least 1 percent, but less than 8 percent in WHPA-A, B, C, C1, D or HVA; or is at least 1 percent, but less than 6 percent in IPZ-1, 2, 3 and WHPA-E.	n/a	IPZ/ WHPA-E 8 – 10 WHPA 10	IPZ/ WHPA-E 5.4 – 7.2 WHPA 6 – 8 HVA 6
Chemical C12.1.3	1. The road salt is applied in an area where the default percentage of impervious surface area, as set out on a total impervious surface area map, is at least 8 percent, but less than 30 percent in WHPA-A, B, C, C1, D or HVA; or is at least 6 percent, but less than 8 percent in IPZ-1, 2, 3 and WHPA-E.	IPZ/ WHPA-E 10	IPZ/ WHPA-E 8 – 9 WHPA 8 – 10	IPZ/ WHPA-E 4.9 – 7.2 WHPA 6 HVA 6
Chemical C12.1.4	1. The road salt is applied in an area where the default percentage of impervious surface area, as set out on a total impervious surface area map, is 30 percent or more in WHPA-A, B, C, C1, D or HVA; or is 8 percent or more in IPZ-1, 2, 3 and WHPA-E.	IPZ/ WHPA-E 9 – 10 WHPA 10	IPZ/ WHPA-E 7 – 8.1 WHPA 8	IPZ/ WHPA-E 4.5 – 6.4 WHPA 6 HVA 6

Technical Rules, 2021. *CWA, 2006*

The tables below summarize where in the vulnerable areas chemical, dense non-aqueous phase liquids (DNAPL) and pathogen threats, are or would be significant, moderate and low drinking water threats. The level of threat that an activity poses to a drinking water supply depends on the vulnerability scores within a vulnerable area. This table can be used in combination with the vulnerability maps that show vulnerability scores to determine where significant, moderate and low threats can be found. In addition, this table and the vulnerability maps can be used in combination with the provincial Table of Drinking Water Threats to determine the types of activities that would be deemed a significant, moderate and low drinking water threat in each area.

The provincial Table of Drinking Water Threats are found within the Technical Rules at https://www.ontario.ca/page/2021-technical-rules-under-clean-water-act.

Table 4.3 Areas within Highly Vulnerable Aquifers Where Activities and Conditions are or would be Significant, Moderate and Low Drinking Water Threats

Threat	Vulnerability Score	Threat Level Possible		
		Significant	Moderate	Low
Chemical (including DNAPLs)	6		✓	✓
Pathogen	6			

Table 4.4 Deleted SGRA Table

Table 4.4: Areas within SGRA where Activities or Conditions are Drinking Water Threats, was deleted following change to Technical Rules which removed scores, and therefore any drinking water threats, for SGRAs

Sources of Water Considered

The Maitland Valley Source Protection Area has a surface water intake and wells serving municipal drinking water systems specified by the *Clean Water Act, 2006* and identified in the *Terms of Reference*. These sources are the Great Lakes intake, which is the Goderich Intake and the well systems identified as “Type 1 Wells” in the *Technical Rules*. Type 1 Wells are: existing and planned municipal drinking water systems that serve or are planned to serve major residential developments. This list was identified through the Terms of Reference.

Other sources of drinking water are not under consideration at this point. Municipalities may choose to elevate other systems into the source protection planning process, but none have elected to do so.

Table 4.5 Areas within Intake Protection Zones Where Activities and Conditions are or would be Significant, Moderate and Low Drinking Water Threats

Threat	IPZ	Vulnerability Score	Threat Level Possible		
			Significant	Moderate	Low
Chemical (including DNAPLs)	**IPZ-1**	8 – 10	✓	✓	✓
		6 – 7		✓	✓
		5			✓
	IPZ-2	8 – 9	✓	✓	✓
		6.3 – 7.9		✓	✓
		4.2 – 5.9			✓
		<4.2			
	IPZ-3	8 – 9	✓	✓	✓
		6 – 7.9		✓	✓
		4.5 – 5.9			✓

Threat	IPZ	Vulnerability Score	Threat Level Possible		
			Significant	Moderate	Low
		< 4.5			
Pathogen	IPZ-1	8 – 10	✓	✓	✓
		6 – 7		✓	✓
		5			✓
	IPZ-2	8 – 9	✓	✓	✓
		6.3 – 7.9		✓	✓
		4.2 – 5.9			✓
		<4.2			
	IPZ-3	0.8 – 9			

Table 4.6 Areas within Wellhead Protection Areas Where Activities and Conditions are or would be Significant, Moderate and Low Drinking Water Threats

Threat	WHPA	Vulnerability Score	Threat Level Possible		
			Significant	Moderate	Low
Chemical	A	10	✓	✓	✓
	B	10	✓	✓	✓
		8	✓	✓	✓
		6		✓	✓
	C	8	✓	✓	✓
		6		✓	✓
		<6			
	D	6		✓	✓
		<6			
	E	8 – 9	✓	✓	✓
		6.3 – 7.9		✓	✓
		4.2 – 5.9			✓
		<4.2			
DNAPL	A	10	✓		
	B	6 – 10	✓		
	C	4 – 8	✓		
	D	6		✓	✓
		<6			
	E	3.5 – 9			
Pathogen	A	10	✓	✓	
	B	10	✓	✓	
		8		✓	✓
		6			✓
	C	4 – 8			
	D	2 – 6			
	E	8 – 9	✓	✓	✓
		6 – 7.9		✓	✓
		4.2 – 5.9			✓
		<4.2			

Methodology Notes

The storage, handling and application of pesticides, fertilizers and agricultural source material associated with agricultural activities can result in surface water runoff and potential pathogen and chemical contamination. This section utilizes information on managed lands and livestock density as an indicator of areas in a watershed where intensive agricultural and other land management activities are conducted.

Managed Lands Methodology

The purpose of the managed lands layer was to develop a portrayal of how much land was subject to human management. The management of land meant that the land was probably receiving nutrients or fertilizer. The managed land was created from all lands which were classed agricultural, large sports fields/golf courses, as well as a percentage of the residential area of all towns. A constraint was placed on the areas where land was managed to limit the area of interest to those areas where the vulnerability was ≥ 6.

The methodology for the analysis was completed in two separate steps. While the steps were distinct from each other, the methodology was the same.

First, using the wellhead protection and intake protection zones with vulnerability ≥ 6 the datasets were united together and then exploded into distinct polygons. These polygons denoted areas that were physically separated from any other polygon.

The Terranet parcel fabric was united with the areas of interest resulting in roadways being created via the closing of empty space between parcels. By using the MPAC property codes and farm operation codes those areas which were “managed” could be identified.

The area was calculated for all areas with the designation of agricultural managed land vs. non-agricultural managed land being noted. In addition, the footprint of the towns and cities was merged into the dataset. Those areas of the town which were not agricultural were further adjusted to account for the potential for fertilizers to be applied to the grassed areas of the towns. For those non-agricultural areas the land base was considered to be .35 the area or 35% managed land.

Given that unique polygons were created from the vulnerability polygons ≥ 6, the total areas for the polygons was created. The managed land was calculated and then further adjusted for the urban footprints. It is possible to calculate the percentage managed through the following formula:

Managed Land Percentage = Agricultural managed land + ((town footprint parcels exclusive agricultural land and roads * .45) + non-agricultural managed land / total area → for those areas of vulnerability ≥ 6 in the source water region summarized by distinct polygon.

Second, the managed land for the HVA/SGRA was completed in the same manner as above except the areas were handled distinctly from the WHPA/IPZ analysis. This may result in percentage managed land edge match differences at the transition zone between WHPA areas and HVA areas which are portrayed by different colours where they meet. As well, where the score is less than 6, it is not included, thus it appears as the air photo on the maps.

Nutrient Unit per Acre Methodology

The purpose of the livestock density map was to develop a layer which showed the nutrient amounts per acre (NU/acre) that were being generated. The livestock farms under consideration were limited to those in areas where the vulnerability was ≥ 6.

There were two distinct methodologies used in the creation of the NU/acre maps and datasets. The first method was internal to the wellhead protection areas and intake protection zones and involved field verified animal numbers and nutrient calculations for estimating the nutrient units for any given property in the significant areas. The second method was completed in SGRA/HVA areas and involved the use of the agricultural census (2006) data for census consolidated districts.

The areas internal to the WHPA and IPZ had the nutrient units calculated by estimating the nutrient units via field visits and air photo interpretation. To assist in the field visits, a set of maps was created for those properties designated with MPAC farm operation codes indicating livestock was present for those properties with vulnerability scores ≥ 6.

The property level maps were taken to the field by staff to record visit information such as the presence or absence of farm animals and the facilities to house the animals. These observations were completed via windshield survey.

Information was written on the orthophoto based property level maps designating which barns housed animals. The barn footprints were digitized and a square footage for any given barn could be established. By combining the observed animal species, provincial guide tables indicating NU/square foot for any given animal species, and the square footage of a barn, the overall nutrient units for any given farm could be estimated.

All barns housing animals were calculated on any given farm property and then summarized by property. This created the total nutrients on any given property. The woodlots were removed from the property thereby creating the managed land of the property. Since some of the land for a given farm may lie outside the wellhead protection zone the NU were pro-rated to account for only the land internal to the wellhead protection zone.

Two calculations are then completed. The first provides the NU/acre calculation for any give farm by summing the nutrient units/dividing by the hectares and then converting to NU/acre via a factor of 2.45. This provides the NU/acre for a given farm.

The second calculation takes all the nutrient units calculated in a given wellhead protection area and sums them. The total agricultural managed land on the contributory farms is summed and an overall NU/acre is derived from these two summations. The maps portray the nutrient units per acre where the vulnerability is equal to or greater than 6 and the lands are managed (e.g., Excluding the urban footprint or forested areas).

Nutrient units in the HVA/SGRA areas were calculated from the agricultural census (2006) data using total agricultural managed land, animal numbers and finally nu/animal tables for generating nu/acre estimates for each census consolidated district (CCS). The nu/acre was calculated for the entire CCS however when mapping only those HVA/SGRA areas with vulnerability ≥ 6 were symbolized. This methodology required the Directors approval. It was determined that for areas outside wellheads, the vulnerability scores were low enough to preclude significant risks and the results of this methodology would be equivalent to those of the methodology used within the wellhead areas.

Impervious Surface Methodology

Impervious surfaces are mainly constructed surfaces such as sidewalks, roads and parking lots that are covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, repel water and

prevent precipitation and melt water from infiltrating soils. Impervious surfaces can generate large amounts of runoff during storm events. Road salt used during winter road maintenance is regarded as a threat, and the percentage of impervious surfaces is an indicator of the potential for impacts due to road salt. A map showing the percentage of impervious surface in defined vulnerable areas is provided at the municipal level in this report.

The following is an explanation of the creation of the impervious surface layer. The first section is a list and explanation of the input datasets while the second section is an explanation of the methodology used in modifying the input datasets to create the resultant impervious surface layer.

Input layers:

- Highly Vulnerable Aquifers
- Wellhead protection areas delineating the municipal well capture zone areas for groundwater.
- Intake protection zones delineating the capture areas for the surface water intakes.
- The Terranet assessment parcel dataset. The dataset contains the boundaries of the land use parcels. Areas between the parcels represent roads.
- Footprints layer. This layer represents a delineation of the built up or urban area for cities and towns. This layer is used to adjust the impervious surface in urban areas to account for buildings, parking lots and driveways.
- Drinking Water Source Protection Region boundary. This layer is used to limit the data set to those areas inside the ABMV Source Protection Region.

This dataset was used to create 1km square areas to reduce the analysis area for the study to 1km. This allows the local features for any 1km area to be captured and not lost in a large area averaging technique.

Methodology:

The HVA, IPZ, and WHPA all contained a vulnerability score created previously. Those areas which have a vulnerability score of ≥ 6 represent those areas where impervious surface threats can exist. These areas were merged together to create the area of interest to analyze.

The parcel fabric was united with the areas of interest. All areas which were not a parcel were assigned the classification of road as these contribute to the impervious surface. In addition, after merging the footprints of the town, any areas which were in a parcel in the town footprints were assigned an impervious

percentage to account for the driveways and buildings. A factor of .45 was used representing 45% of a parcel being impervious in towns.

Additional datasets were united to limit the analysis to both the source water region as well as to provide the 1km grid area scope. The 1km grid, via a unique grid identifier for any given 1km square, was used to summarize the data.

The final dataset represents the percentage of roads and 45 % of the town footprints (exclusive of the roads) in any area of vulnerability ≥ 6 divided by those areas of vulnerability ≥ 6 in any 1km square:

> Percent Impervious = Road area + (town footprint exclusive of roads * .45) / area of interest → for those areas of vulnerability ≥ 6 in the source water region based on a 1km grid summary.

The mapping of the impervious surface was completed using the standard symbology classes as required in the Mapping Symbology for the Clean Water Act, 2006 (MNR, 2009). The coloured areas on these maps represent only those areas with vulnerability ≥ 6. Therefore, some of the grid may contain impervious surface and some part of the grid cell may not. The inclusion of the 1 km grid linework facilitates the understanding of how the impervious surface change occurs at the limits of any grid cell.

Approach to Significant Threat Enumeration

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

It should be noted that the identification of threats is based on a blend of field research and a ‘desktop’ approach. The ‘desktop’ approach relied on Municipal Parcel Assessment Corporation (MPAC) data. This data indicates the type of land use taking place and can be associated with certain types of activities and presence of related chemicals or pathogens. The North American Industry Classification System code (NAICS) data was helpful in associating chemicals typically used at various types of land uses. During the course of the preparation of this document, there was consultation with property owners in vulnerable areas where significant risks would exist. Information was provided by many land owners which helped to refine the data base used to enumerate significant threats. However, not all property owners responded to requests for such

information. In these cases, the desktop approach was the best source of information. This approach made the assumptions that:

1. Home heating is oil, in a basement tank,
2. Houses use septic tanks,
3. Businesses (including home occupations), industries and agricultural uses the five-year time of travel could store DNAPLs.

Due to these assumptions, the threat enumeration provided in the 2011 Assessment Report was conservative (i.e., assessing highest level of potential risk where there was not enough information to demonstrate otherwise). For the updated 2014 Assessment Report, additional information was collected through site visits, landowner contact, and drive-by assessments. For this approach, it was assumed that properties that had a gas meter did not use heating oil and would not pose a significant threat for fuel. It was also assumed that properties with access to municipal sewer did not have a septic system. Where there was insufficient information available to determine the presence or absence of a threat, a conservative approach was taken, and it was assumed that the activity was a potential significant threat. As a result of this verification, the number of potential significant threats dropped significantly.

Threats are assigned to parcels, and represent the best information available at the time of writing. Numbers are expected to vary over time, according to changes in land use and activities, and as additional information becomes available.

Note that some activities, such as Fertilizer application, Non-agricultural Source Material Application and Road Salt application cannot be a significant drinking water threat in some areas due to the percent managed land, livestock density and / or percent impervious surface.

2022 Updated Risk Assessment

A risk assessment was conducted in 2022 to address the changes to the 2021 Technical Rules, which resulted in potential significant threats for snow storage and salt application and storage. The threat numbers were estimated using desktop analysis and are unconfirmed.

4.5 Municipal Profiles

4.5.1 Ashfield-Colborne-Wawanosh

The Municipality of Ashfield-Colborne-Wawanosh (ACW) is located on the Lake Huron shore north of Goderich and completely within the Maitland Valley Conservation Authority jurisdiction. In 2006, the municipality's population was 5,409, unchanged from 2001. There are no large towns. Land use is 62% cropland, largely soybeans, corn, winter wheat and alfalfa. Much of the remainder is forested land associated with the till and kame moraines. Livestock density (cattle: 39.1/km^2; pigs: 104.4/km^2) is below the Huron County average, especially for pigs, but above Western Ontario averages (Statistics Canada 2007).

Map 4.ACW.IS shows the percentage of impervious surface area; **Map 4.ACW.ML** shows the location and percentage of managed lands, and **Map 4.ACW.LD** shows the livestock density within vulnerable areas for Ashfield-Colborne-Wawanosh.

4.5.1.1 ACW – HVAs and SGRAs

Maps 4.ACW.HVA and 4.ACW.SGRA show the locations of HVAs and SGRAs in ACW. The HVAs are scattered throughout the central and eastern portions of the municipality. SGRAs correspond to coarse-textured physiographic units which generally run north/south across the municipality; they include a sand plain, spillways and kame moraine. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. Table 4.3 can be used in combination with Map 4.ACW.HVA to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in ACW. There are no known conditions or issues in the municipality.

4.5.1.2 ACW – Wellhead Protection Areas

ACW has relatively small well systems: Benmiller, Century Heights, Dungannon, Huron Sands. **Map 4.ACW.WHPA** shows the WHPAs for each of these systems. The Lucknow WHPA extends into ACW but the wells are located in the Township

of Huron-Kinloss. In addition, a small portion of the Goderich IPZ extends into ACW.

4.5.1.2.1 Benmiller

The following is a description of the Benmiller well system: Note that Well # 2 was put into service in January 2016, replacing Well # 1.

- Location: 81188 Pfrimmer Rd., Benmiller
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well # 2: 2006
- Depth: 70.1 m
- Users Served: 85
- Design Capacity: 196.3 m^3/day (2.3 litres/sec)
- Permitted Rate: 196.3 m^3/day (2.3 litres/sec)
- Average Usage: 59 m^3/day (2001-2005) *
- Modelled rate: 59 m^3/day *
- Treatment: Chlorination
  *WNMC et al, 2010

Note that the maps were revised in 2017 to reflect replacement of the well in 2016. Well # 2, originally drilled as a monitoring well, is located 30 metres from the pump house and former supply well #1. As this was considered to be a minor change, a new groundwater model and delineation was not required, as per SPC direction. Rather, the WHPA was shifted to account for the new well location.

Groundwater Vulnerability

Map 4.ACW.WHPA-IPZ show the WHPA extending in a narrow strip about 8.2 km eastward over agricultural land and forest to cross the Maitland into Central Huron. A vulnerability score of 10 applies only to WHPA-A, the 100 m radius around the well. WHPA-B, WHPA-C, and WHPA-D all have a vulnerability score of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Benmiller WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.7 Column 1 lists the drinking water threats in Benmiller's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. No other local circumstances were identified.

Map 4.Benm shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas within the WHPA where chemical, pathogen, and DNAPL threats can be significant, moderate and low threats to drinking water.

Table 4.7 Benmiller WHPA: Enumeration of Potential Significant Threats

Threat Type (numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System	0	0	
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	1		
Total:	**1**	**0**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties

Drinking Water Issues and Conditions:

Table 4.8 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.8 Benmiller WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.1.2.2 Century Heights

~~The following is a description of the Century Heights well system~~*Note that the WHPA was revised in 2024 to include an additional well (#3) serving the community of Saltford.~~:~~ B.M. Ross prepared the Municipal Class Environmental Assessment (MCEA) for the drinking water system expansion. The MCEA includes a description of the study area, technical review of the water supply system, plus source water protection impacts (BMRoss, 2023). An updated, local-scale groundwater model was developed by Matrix Solutions Inc., based on local and regional characterization work previously completed in 2010 by Waterloo Numerical Modelling Corp, plus current MECP data sets. Vulnerability scoring was based on existing groundwater vulnerability mapping. An uncertainty analysis was conducted in accordance with the Techical Rules; uncertainty ranking for the wellhead protection areas and vulnerability scores was 'low' (Matrix, Nov 2023).

The following is a description of the Century Heights well system*.

- Location: Century Heights and Maitlandview Subdivisions~~, 400 m east of the Maitland River~~
- SPA: Wells and WHPA are in the MV SPA
- Year constructed: Well 1: 1979; Well 2: 2003; Well #3: 2022
- Depth: Well #1: ~~68.8~~ 66 m, Well #2: 66 m; Well #3: 76 m
- Users Served: ~~145~~85 connections (2023), expanding to over 200 in future
- Design Capacity: ~~328 m^3/day (3.8 litres/sec)~~ maximum day flows to service future growth is 1,084 m3/day
- ~~Permitted Rate: 328 m^3/day~~
- ~~Average Usage: never exceeded 186 m^3/day (2.2 litres/sec)~~
- Modelled Pumping Rate: Wells 1 and 2: 35 m^3/day each; Well 3: 147 m^3/day (2023*)
- Treatment: Chlorination; UV for Wells 1&2

*Matrix Solutions Inc., Nov 2023 (file #35869-527) and BMRoss Ltd, 2024 (File # 21285, MCEA for Century Heights)

Groundwater Vulnerability

Maps 4.ACW.WHPA-IPZ and 4.Cent show the WHPA zones A to D~~, largely agricultural land and forest,~~ extending northeast of the well sites toward Lucknow

Line. As Wells 1 and 2 are located close together, their WHPA is combined. The WHPA for Well 3 is separate, located south of Wells 1 and 2. to ~~in long, tapered shape about 9.75 km eastward across the Sharpe's Creek and as far as the Maitland River at the boundary of Central Huron.~~ Land use is primarily residential, agricultural and wooded areas. A vulnerability score of 10 applies only to WHPA-A, the 100 m radius around the wells. WHPA-B, WHPA-C, and WHPA-D all have a vulnerability score of 6 or less. Since Century Heights Wells 1 and 2 ~~is~~are considered ~~a~~ GUDI wells (groundwater under the direct influence of surface water) a 2 hour time of travel zone is required. This zone is called WHPA-E and has a vulnerability score of 7.2. Well #3 is not considered to be GUDI (BMRoss, 2023)

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Century Heights WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

~~Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.~~

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.9 Column 1 lists the drinking water threats in Century Heights' WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.9** also indicates the number of potential significant threat instances for each threat type. The threats were based on the circumstances in the 2021 Technical Rules, previous threat assessment work and potential activities as determined from

aerial photography and zoning designations; numbers are subject to change. No other local circumstances were identified.

Map 4.Cent shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.9 Century Heights WHPA: Enumeration of Potential Significant Threats

Threat Type (numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System		~~11~~20	
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	0		
16. Dense Non-Aqueous Phase Liquid Storage			0
Total:	**0**	**~~11~~20**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.10 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.10 Century Heights WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.1.2.3 Dungannon

The following is a description of the Dungannon well system: Note that Well # 1 was decommissioned in 2017, leaving well # 2 as the role supply well for this system.

- Location: 37103 Dungannon Rd
- SPA: Well and WHPA are in the MV SPA
- Year constructed: 2002
- Depth: Well #2: 87.2 m

- Users Served: 262
- Design Capacity: 656.6 m^3/day (7.6 litres/sec)
- Permitted Rate: 438 m^3/day (5 litres/sec)
- Average Usage: 90 m^3/day (2004 - 2005)*
- Modelled rate: 90 m^3/day *
- Treatment: Chlorination and iron sequestration

*WNMC et al, 2010

In 2012 Well # 1 was taken out of service as arsenic levels had exceeded ODWS. Well # 1 was decommissioned in 2017 due to the arsenic level; maps were revised to reflect the resulting change in the WHPA. A new groundwater model and delineation was not considered necessary, as per SPC direction. Rather, the WHPA was revised to account for the removal of Well # 1 and submitted in 2018 as part of an amendment under Section 34 of the CWA.

Groundwater Vulnerability

Maps 4.ACW.WHPA-IPZ and 4.Dung show the WHPA extending in a broad swath about 3.75 km eastward across Sharpe's Creek. A vulnerability score of 10 applies only to WHPA-A, the 100 m radius around the well. WHPA-B, WHPA-C, and WHPA-D all have vulnerability scores of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Dungannon WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for one undocumented well which was not visited as part of the Well Location Update. In this case, the well was assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area as it is located entirely outside of all but the WHPA-A, which already has a maximum vulnerability score of 10.

Threats and Risks

Table 4.11 Column 1 lists the drinking water threats in Dungannon's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.11** also indicates the number of significant threat instances for each threat type.

Maps 4.Dung shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant moderate and low.

Table 4.11 Dungannon WHPA: Enumeration of Potential Significant Threats

Threat Type (numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System		4	
8. Commercial Fertilizer Application	1		
10. Pesticide Application	1		
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	3		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			0
Total:	**5**	**4**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.12 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.12 Dungannon WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.1.2.4 Huron Sands

The following is a description of the Huron Sands well system:

- Location: 85019 Michelle St

- SPA: Well and WHPA are in the MV SPA
- Year constructed: 2001
- Depth: 77.7 m
- Users Served: 120
- Design Capacity: 328 m^3/day (3.8 litres/sec)
- Permitted Rate: 328 m^3/day (3.8 litres/sec)
- Average Usage: Not exceeded 28 m^3/day, 8.5% of the permitted rate
- Modelled rate: 20 m^3/day *
- Treatment: Chlorination and iron sequestration

*WNMC et al, 2010

Groundwater Vulnerability

Map 4.ACW.WHPA-IPZ and 4.Huro show the Wellhead Protection Area (WHPA) extending in a broad arc about 7.3 km to the southeast. A vulnerability score of 10 applies only to WHPA-A, the 100 m radius around the well. WHPA-B has a vulnerability score of 6, WHPA-C has a score of 4, and WHPA-D has a score of 2.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Huron Sands WHPA was adjusted for one undocumented well that was inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). This well was located as part of the project, and was found to be out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the well, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area as it is located entirely outside of all but the WHPA-A, which already has a maximum vulnerability score of 10.

Threats and Risks

Table 4.13 Column 1 lists the drinking water threats in Huron Sands' WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of

Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.13** also indicates the number of significant threat instances for each threat type.

Map 4.Huro shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant moderate and low.

Table 4.13 Huron Sands WHPA: Enumeration of Potential Significant Threats

Threat Type (numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System		5	
8. Commercial Fertilizer Application	1		
10. Pesticide Application	1		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	0		
Total:	**2**	**5**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties

Drinking Water Issues and Conditions

Table 4.14 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.14 Huron Sands WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.1.2.5 Lucknow

A portion of the Lucknow WHPA extends into ACW. The wells are located in the Township of Huron-Kinloss. A description of the Lucknow system plus risk assessment can be found under Huron-Kinloss in section 4.5.6.

Table 4.15 Deleted

Table 4.16 Deleted

4.5.2 Central Huron

The Municipality of Central Huron is located on Lake Huron and falls entirely within the Source Protection Region, extending from the Maitland River in the north to the Bayfield River in the south. By conservation authority, Central Huron is 76% in Maitland Valley and 24% in Ausable Bayfield. The 2006 permanent population was 7,641, a decrease of 2.1% since 2001. There are also seasonal residents. The main town is Clinton (2006 population 3,082), upstream on the Bayfield River. Central Huron has attracted extensive shoreline development and pressure mounts to convert from seasonal occupation to year round. Two-thirds of the municipality is in crops – mainly soybeans, corn and winter wheat. Livestock density (cattle: 24.7/km^2; pigs: 126.2/km^2), while low compared to the rest of Huron County, substantially exceeds Western Ontario's average pig density of 78.7/km^2 (Statistics Canada 2006).

Map 4.CH.IS shows the percentage of impervious surface area; **Map 4.CH.ML** shows the location and percentage of managed lands, and **Map 4.CH.LD** shows the livestock density within vulnerable areas for Central Huron.

4.5.2.1 Central Huron – HVAs and SGRAs

Maps 4.CH.HVA and 4.CH.SGRA show the locations of HVAs and SGRAs in Central Huron. Most HVAs are scattered east from Holmesville. Two small HVAs fall in the west portion: one just beyond the south east corner of Goderich and the other immediately across the Maitland River from Benmiller. SGRAs correspond to coarse-textured physiographic units which generally run north/south across the municipality. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. **Table 4.3** can be used in combination with **Map 4.CH.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Central Huron. There are no known conditions or issues in the municipality.

4.5.2.2 Intake Protection Zone – Goderich

The Goderich water intake is located offshore of the Town of Goderich. The Intake Protection Zone 2 (IPZ-2) reaches into Central Huron immediately south of

Goderich town limits. A description of the Goderich intake, IPZ and risk assessment can be found under Goderich in section 4.5.3

Table 4.17 Deleted

Table 4.18 Deleted

4.5.2.3 Central Huron – Wellhead Protection Areas

Central Huron's major wellfield is at Clinton. Smaller well systems are associated with shoreline development and include: McClinchey, Kelly, Vandewetering and SAM. Auburn is in Central Huron though most of its WHPA extends into North Huron. Benmiller is in Ashfield-Colborne-Wawanosh but its WHPA extends into Central Huron. **Map 4.CH.WHPA** shows the WHPAs for each of these systems.

Note that the SAM and Vandewetering groundwater systems are located in the Ausable Bayfield Source Protection Area. Details for these systems are in the Ausable Bayfield Assessment Report.

4.5.2.3.1 Auburn

The following is a description of the Auburn well system:

- Location: South-east edge of the hamlet of Auburn, 500 m east of the Maitland River.
- SPA: Well and WHPA are in the MV SPA
- Year constructed: 2005
- Depth: 56.4 m
- Users Served: 30
- Design Capacity: 61.9 m^3/day (0.7 litres/sec)
- Permitted Rate: 61.9 m^3/day (0.7 litres/sec)
- Average Usage: 9 m^3/day (2003 - 2005)*
- Modelled rate: 9 m^3/day *
- Treatment: Ultraviolet radiation and iron sequestration

* WNMC et al, 2010

Groundwater Vulnerability

Map 4.CH.WHPA and 4.Aubu show that the WHPA extends about 4 km to the east, most of which is in North Huron. A vulnerability score of 10 applies to WHPA-A which is almost entirely within Central Huron. WHPA-B, WHPA-C, and WHPA-D all have a vulnerability score of 6 or less. However, these zones are largely located in North Huron.

Note: in 2023 the WHPA was shifted 21 metres to account for an error in the well location. The supply well in Auburn was replaced in 2009 but the change in location was not captured during the wellhead protection area (WHPA) modelling project and subsequent writing of the Maitland Valley Assessment Report

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Auburn WHPA was adjusted for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.20 Column 1 lists the drinking water threats in Auburn's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.20** also indicates the number of significant threat instances for each threat type.

Map 4.Aubu shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.20 Auburn WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System		10	
9. Commercial Fertilizer Handling/Storage	1		

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
12. Application of Road Salt	2		
13. Storage of Road Salt	2		
14. Storage of Snow	1		
15. Fuel Handling/Storage	3		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			0
Total:	**9**	**10**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.21 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA. Research into additional existing threat sources will be undertaken and reported in a future update of the Assessment Report.

Table 4.21 Auburn WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.2.3.2 Benmiller

The Benmiller well is located in ACW and extends into Central Huron. A description of the Benmiller water supply system and risk assessment can be found in section 4.5.1 under ACW.

Table 4.22 Deleted

Table 4.23 Deleted

4.5.2.3.3 Clinton

The following is a description of the Clinton well system:

- Location: The three wells are all located in the vicinity of Park Lane and Princess Street in Clinton
- SPA: All three wells are in AB SPA, WHPA extends into MV SPA
- Year constructed: Well #3 – Established early 1900s, no record for other 2 wells.

- Depth: Well #1 – 99 m, Well #2 – 108 m, Well #3 – 110m
- Users Served: 4500
- Design Capacity: 4838 m^3/day (56 litres/sec)
- Permitted Rate: No known rate
- Average Usage: combined 1,968 m^3/day (2001 – 2005) *
- Modelled rate: 1,968 m^3/day
- Treatment: Gas Chlorination

  * WNMC et al, 2010

Groundwater Vulnerability

Maps 4.CH.WHPA and 4.Clin show the wellhead protection area (WHPA) extending almost 15 km north-eastward into the agricultural land in the Maitland Valley. The only area with a vulnerability score of 10 is WHPA-A, the 100 m radius of the wells, which is located entirely within the AB SPA. Parts of WHPA-B and WHPA-C fall into the MV SPA and have vulnerability scores of 8 and 6. WHPA-D has vulnerability scores of 6 or less. Note that **Map 4.Clin** was revised in 2014 to reflect updated transport pathway information.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Clinton WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.24 Column 1 lists the drinking water threats in Clinton's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.24** also indicates the number of significant threat instances for each threat type.

Map 4.Clin shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.24 Clinton WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System	1	1	
3. Agricultural Source Material Application			
4. Agricultural Source Material Storage			
6. Non-Agricultural Source Material Application			
10. Pesticide Application			
12. Application of Road Salt	8		
13. Storage of Road Salt	4		
14. Storage of Snow	8		
15. Fuel Handling/Storage	2		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			8
21. Grazing/Pasturing Livestock			
Total:	**23**	**1**	**8**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.25 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.25 Clinton WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.2.3.4 Kelly

The following is a description of the Kelly well system:

- Location: 7 km south of Goderich, 170m from Lake Huron shoreline
- SPA: Well and WHPA are in the MV SPA
- Year constructed: 1981
- Depth: 45.7m
- Users Served: 24
- Design Capacity: 196.1 m^3/day (2.3 litres/sec)
- Permitted Rate: 196.1 m^3/day (2.3 litres/sec)
- Average Usage: 22 m^3/day (2001-2005)*
- Modelled rate: 22 m^3/day *
- Treatment: Chlorination and iron sequestration

  * WNMC et al, 2010

Groundwater Vulnerability

Maps 4.CH.WHPA and 4.Kell show the wellhead protection area (WHPA) extending in a narrow strip about 2 km eastward from the well across cropland, forest and a gully. The only area with a vulnerability score of 10 is the WHPA-A, the 100 m radius around the well. WHPA-B, WHPA-C, and WHPA-D all have vulnerability scores of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Kelly WHPA was adjusted for an undocumented well which was not visited as part of the Well Location Update. In this case, the well were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

Threats and Risks

Table 4.26 Column 1 lists the drinking water threats in Kelly's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.26** also indicates the number of significant threat instances for each threat type.

Map 4.Kell shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.26 Kelly WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System		10	
10. Pesticide Application	0		
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	0		
Total:	**0**	**10**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.27 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.27 Kelly WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.2.3.5 McClinchey

The following is a description of the McClinchey well system:

- Location: 5.6 km south of Goderich, 170 m from Lake Huron shoreline
- SPA: Well and WHPA are in the MV SPA
- Year constructed: 1967
- Depth: 43.3 m
- Users Served: 15
- Design Capacity: 100.8 m^3/day (1.1 litres/sec)
- Permitted Rate: 100.8 m^3/day (1.1 litres/sec)
- Average Usage: 8.3 m^3/day (2001 – 2005)*
- Modelled rate: 8 m3/day *
- Treatment: Chlorination and iron sequestration

* WNMC et al, 2010

Groundwater Vulnerability

Maps 4.CH.WHPA and 4.McCl show the wellhead protection area (WHPA) extending about 2 km eastward, widening to 500 metres toward the east end. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the well. WHPA-B has a vulnerability score of 6, WHPA-C has a score of 4 and WHPA-D has a score of 2.

Aquifer vulnerability was not adjusted for Transport Pathways in the McClinchey WHPA.

Threats and Risks

Table 4.28 Column 1 lists the drinking water threats in McClinchey's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.28** also indicates the number of significant threat instances for each threat type.

Map 4.McCl shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.28 McClinchey WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System	0	9	
10. Pesticide Application	1		
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	0		
Total:	**1**	**9**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties

Drinking Water Issues and Conditions

Table 4.29 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.29 McClinchey WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.3 Goderich

The Town of Goderich is located on the shoreline of Lake Huron in the southern portion of the Source Protection Area. The population is approximately 7,600 (7,521 – 2011 Census) and growing modestly. The Town is entirely within the area and obtains drinking water through a Great Lake Intake. The intake also serves a small area south of the Town.

Map 4.GD.IS shows the percentage of impervious surface area; **Map 4.GD.ML** shows the location and percentage of managed lands; and **Map 4.GD.LD** shows the livestock density within vulnerable areas for the Town of Goderich.

4.5.3.1 Goderich – HVAs and SGRAs

Maps 4.GD.HVA and 4.GD.SGRA show the locations of HVAs and SGRAs in Goderich. The vulnerability score for all HVAs is 6; SGRAs are not assigned a score. There are no significant risks within these areas.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. **Table 4.3** can be used in combination with **Map 4.GD.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Goderich.

4.5.3.2 Intake Protection Zone – Goderich

The intake for Goderich is located at the southern break wall for the harbour. **Map 4.GD.IPZ** shows that the intake is approximately 500 metres off shore thus the IPZ-1 intersects with the land and is limited on shore to 120 metres. The IPZ -2 extends north into the mouth of the Maitland River, and includes much of the harbour. Given the storm drainage patterns, the IPZ-2 encompasses almost the entire Town (excludes those areas along the Maitland River where storm water discharges into the river because they exceed the 2 hour time of travel). It continues southward inland and crosses into the municipality south of the Town. No IPZ-3 was modeled at this time. It should be noted that the industrial nature of this harbour may prompt the delineation of an IPZ-3 at a later date.

For the Goderich Intake, there was an analysis of the impact of sewer discharges on water quality, specifically alkalinity**.** Storm sewer discharges only occur during and immediately following rainfall events. The purpose of this analysis was to

determine if there is a relationship between daily rainfall and alkalinity at the Goderich Water Treatment Plant (WTP). A significant change in alkalinity, corresponding with a rainfall event, might indicate that the Goderich storm drainage outlets influence raw water quality at the WTP inlet. Goderich Water Pollution Control Plant (WPCP) rainfall data was available for 2003 to 2006. Rainfall data for Benmiller, close in proximity to Goderich, was available for 2003 to November 2006 and was used to determine if the nearby Maitland River contributed to changes in alkalinity at the WTP. There were rainfall events where alkalinity in the raw water at the Water Treatment Plant increased by more than 30% in a single day. The analysis concluded that the typical lag of two or more days between a rainfall event and an increase in alkalinity requires further investigation. A rainfall event would also tend to increase river flows and a 2 to 5 day delay between increased river flow and an alkalinity event was previously identified. Therefore, the weak relationship with rainfall identified may also be linked to river discharges.

Map 4.GD.IPZ and Table 4.30 show that the areas within the IPZ-1 have a vulnerability score of 6 and the IPZ-2 area has a vulnerability score of 4.8. **Table 4.30** also indicates the vulnerability scores determined by the consultants and verified through peer review as indicated at the outset of this chapter. The source factor is low given the position of the intake well out into Lake Huron.

While the uncertainty around scoring is somewhat high, given the low scores, no significant risks would be present.

Table 4.30 Goderich Intake – Vulnerability Score Summary

Location	Vulnerability Factor		Source Vulnerability Factor	Vulnerability Score	
	IPZ 1	IPZ 2	-	IPZ 1	IPZ 2
Goderich: Lake Huron	10	8 Medium	0.6 Low	6	4.8

(from Baird Phase 2 Addendum, May 2010)

While turbidity after storm events is present, this can be managed by the facility. There are no reports of any issues at this intake; the system is able to meet the required drinking water standards. The system capacity is 11,664 m^3/day (135 litres/sec). The matter of greatest interest is the role of this system within the context of international agreements on water taking from the Great Lakes. At present there is no apprehension about the direction of these agreements as they pertain to the study area.

Threats & Risk

Table 4.31 indicates that no significant risks from chemicals, pathogens, or DNAPLs would be present. **Table 4.5** can be used in combination with **Map 4.Gode** to determine where chemical and pathogen threats can be moderate and low risks in the intake protection zones for the Goderich intake. In addition, the table of drinking water threats within the Technical Rules can be used to determine the types of activities that would be deemed a moderate or low threat in the IPZ.

Table 4.31 Goderich Intake: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
Total:	**0**	**0**	**0**

Table 4.32 indicates that no issues with wells or conditions resulting from past activities were identified within the IPZ.

Table 4.32 Goderich: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.4 Howick

This municipality is located in the northern part of the Source Protection Area. The majority of the municipality is within the MV SPA and has a population of approximately 3,800 people. There are no municipal residential drinking water sources in this area. The population residing throughout the countryside relies on individual wells.

4.5.4.1 Howick – HVAs and SGRAs

Maps 4.HW.HVA and 4.HW.SGRA delineate the locations of HVAs and SGRAs respectively in the municipality. Together the HVAs and SGRAs cover much of the municipality. The vulnerability score for all HVAs is 6; SGRAs are not assigned a score. There are no significant risks within these areas.

Map 4.HW.IS shows the percentage of impervious surface area; **Map 4.HW.ML** shows the location and percentage of managed lands; and **Map 4.HW.LD** shows the livestock density within HVAs and SGRAs for Howick.

Threats and Risk

There are no municipal residential drinking water systems located within the municipality. However, part of the twenty-five year time of travel (WHPA-D) of the Clifford well system does cover a few hectares in the north-east end of the municipality. Nevertheless, no significant threat activities are present within the municipality of Howick. The table of drinking water threats within the Technical Rules can be used to determine the types of activities that would be deemed a moderate or low threat in the HVA.

There are also no known conditions or issues in the municipality (**Table 4.35**).

Table 4.34 Howick Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.35 Howick Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.5 Huron East

The Municipality of Huron East is inland from Lake Huron and adjacent to Perth County. By conservation authority, Huron East is 72% in Maitland Valley and 28% is in Ausable Bayfield. In 2006, the municipality had a population of 9,310, a decline of 3.8% since 2001. The main towns are Seaforth (2006 population 2,634) and Brussels (2001 population 1,143). Cropland is 78% of the land area, dominated by corn, soybeans and winter wheat. Livestock density (cattle: 47.9/km^2; pigs: 298.6/km^2) is high (Statistics Canada 2007).

Map 4.HE.IS shows the percentage of impervious surface area; **Map 4.HE.ML** shows the location and percentage of managed lands; and **Map 4.HE.LD** shows the livestock density within vulnerable areas for Huron East.

4.5.5.1 Huron East – HVAs and SGRAs

Maps 4.HE.HVA and 4.HE.SGRA show the locations of HVAs and SGRAs in Huron East. The HVAs are scattered throughout Huron East with the larger ones tending to be in the north. There are relatively few SGRAs in Huron East. Most areas are narrow eskers or spillways; a larger area in the north-east corner corresponds with a kame. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. The table of drinking water threats within the Technical Rules can be used to determine the types of activities that would be deemed a moderate or low threat in the HVA.

There are no known conditions or issues in the municipality.

4.5.5.2 Huron East – Wellhead Protection Areas

Huron East's main well systems are Seaforth and Brussels. There is also a small system located in Brucefield which is in the Ausable Bayfield SPA. A small portion of the Molesworth well system is also located in Huron East. **Map 4.HE.WHPA** shows the WHPA's for these systems. Only WHPAs that fall within the Maitland Valley SPA will be discussed in this section. See the Ausable Bayfield Assessment Report for details on the Brucefield water supply system.

4.5.5.2.1 Brussels

The following is a description of the Brussels well system:

- Location: Well #1: 66 McCutcheon Dr., Well #2: 240 Turnberry St.
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #1: 1951, Well #2: 1963
- Depth: Well #1: 60 m, Well #2: 60.4 m
- Users Served: 1800
- Design Capacity: 2,184 m^3/day (25.4 litres/sec)
- Permitted Rate: 1097 m^3/day (12.7 litres/sec)
- Average Usage: combined 537 m^3/day (2001-2001) *
- Modelled rate: Well 1 - 520 m^3/day; Well 2 - 17 m^3/day *
- Treatment: Well #1: Chlorination, Well #2: Chlorination and ultraviolet radiation

* WNMC et al, 2010

Groundwater Vulnerability

Maps 4.HE.WHPA and 4.Brus show that Well #1's WHPA reaches about 1.6 km to the east and 2.5 km to the south of the well. For both Well #1 and #2, WHPA-A and WHPA-B have a vulnerability score of 10, while WHPA-C has a score of 8, and WHPA-D has scores of 6 and 4.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Brussels WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

Threats and Risks

Table 4.36 Column 1 lists the drinking water threats in Brussels' WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario*

Regulation 287/07. No other type of local threat was identified. **Table 4.36** also indicates the number of significant threat instances for each threat type.

Map 4.Brus shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.36 Brussels WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal system	1		
2. Sewage System	1	1	
7. Non-Agricultural Source Material Handling/Storage	0		
12. Application of Road Salt	7		
13. Storage of Road Salt	7		
14. Storage of Snow	7		
15. Fuel Handling/Storage	2		
16.Dense Non-Aqueous Phase Liquid Storage			4
21. Grazing/Pasturing Livestock	1	0	
Total:	**25**	**1**	**4**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.37 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.37 Brussels WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.5.2.2 Molesworth

The Molesworth municipal well is located in North Perth and extends into Huron East. A description of the Molesworth water supply system and risk assessment can be found in section 4.5.11 under North Perth.

Table 4.38 Deleted (see section 4.5.11)

Table 4.39 Deleted (see section 4.5.11)

4.5.5.2.3 Seaforth

The following is a description of the Seaforth well system:

- Location: 40 Welsh St.
- SPA: Wells located in MV SPA but WHPAs extend into AB SPA
- Year constructed: Well TW1: 2005, Well PW1: 2006, Well PW2: 2007
- Depth: Well TW1: 42.9 m, Well PW1: 105 m, Well PW2: 105 m
- Users Served: 2900
- Design Capacity: All 3 wells: 3456 m^3/day (40 litres/sec)
- Permitted Rate: TW1: 518.4 m^3/day, PW1: 3024 m^3/day, PW2: 3456 m^3/day
- Modelled Rate: 1628 m^3/day (WESA, 2009)
- Treatment: Sodium Hypochlorinate and Sodium Silicate

Groundwater Vulnerability

Maps 4.HE.WHPA and 4.Seaf show that the wellhead protection area (WHPA) is approximately 3 km long and 2.3 km wide. The majority of the WHPA falls into the MV SPA; however, a portion of it falls into the AB SPA. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the well and a portion of WHPA-B. The remainder of WHPA-B and part of WHPA-C has a vulnerability score of 8. The rest of the WHPA has a vulnerability score of 6 or less.

Aquifer vulnerability within the Seaforth WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells

which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.40 Column 1 lists the drinking water threats in Seaforth's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.40** also indicates the number of significant threat instances for each threat type. The Technical Rules provide details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Seaf shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.40 Seaforth WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System		7	
3. Agricultural Source Material Application	2	2	
4. Agricultural Source Material Storage			
6. Non- Agricultural Source Material Application			
7. Non- Agricultural Source Material Handling/Storage			
8. Commercial Fertilizer Application			
10. Pesticide Application	1		
12. Application of Road Salt	3		
13. Storage of Road Salt	3		
14. Storage of Snow	3		
15. Fuel Handling/Storage	2		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			3
21. Grazing/Pasturing Livestock			
Total:	**14**	**9**	**3**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.41 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.41 Seaforth WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.6 Huron-Kinloss

The Township of Huron-Kinloss is located in Bruce County on the Lake Huron shore at the north end of the Maitland Valley Conservation Authority jurisdiction; 43% of the municipality is within the Maitland watershed. The remainder is in Saugeen watershed.In 2006, the population of Huron-Kinloss was 6,515, an increase of 4.7% since 2001. Several of the towns and all the shoreline development, however, are outside the Maitland watershed. The main town within the watershed is Lucknow (2006 population of 1,162). Cropland covers 72.5% of the municipality. Soybeans, winter wheat, corn and alfalfa are the main crops. Livestock density (cattle: 45/km^2; pigs: 40.3/km^2) is higher than the Western Ontario average for cattle but lower for pigs (Statistics Canada 2007).

Map 4.HK.IS shows the percentage of impervious surface area; **Map 4.HK.ML** shows the location and percentage of managed lands; and **Map 4.HK.LD** shows the livestock density within vulnerable areas for Huron-Kinloss.

4.5.6.1 Huron-Kinloss – HVAs and SGRAs

Maps 4.HK.HVA and 4.HK.SGRA show the locations of HVAs and SGRAs in Huron-Kinloss. The HVAs are all in the eastern section of the municipality. SGRAs correspond to coarse-textured physiographic units which generally run north/south across the municipality: a sand plain, spillways and kame moraine. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. **Table 4.3** can be used in combination with **Map 4.HK.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Huron-Kinloss. There are no known conditions or issues in the municipality.

4.5.6.2 Huron-Kinloss – Wellhead Protection Areas

Within the MV SPA, Huron-Kinloss has two well systems: Lucknow and Whitechurch. Part of the WHPA for Lakeshore, a well system outside the Maitland Valley boundary, also extends into the Maitland Valley SPA. In 2018 Ripley was added to the Maitland Valley Assessment Report following the addition of a new well and subsequent WHPA re-delineation. The revised WHPA

now extends into the Maitland Valley SPA. **Map 4.HK.WHPA** shows the locations of each of the WHPAs in the municipality.

4.5.6.2.1 Lakeshore (Point Clark)

Part of the WHPA-D extends into the Maitland Valley portion of Huron-Kinloss (**Map 4.HK.WHPA**). The well, the remainder of the WHPA and all significant threats are located in the Saugeen Valley SPA. No issues or conditions have been identified in this area.

4.5.6.2.2 Lucknow

Note that the Lucknow WHPA was revised in 2024 to reflect an application to increase the pumping rates to accommodate future development. Given the proposed increase to pumping rates at Well 5, the WHPAs and associated vulnerability scores were re-modeled to update the capture zones to reflect the long-term projected pumping rates. The modeling work was completed by Matrix Solutions Inc. (Matrix, July 2023).The original groundwater flow model developed for the Township of Huron-Kinloss (Waterloo Hydrogeologic Inc., 2003) was updated to re-delineate WHPAs for the two existing water supply wells, based on the increased Permit to Take Water (PTTW). Vulnerability scoring was based on existing groundwater vulnerability mapping. An uncertainty analysis was conducted in accordance with the Techical Rules; uncertainty ranking for the wellhead protection areas and vulnerability scores was 'low' (Matrix, 2023).

The following is a description of the Lucknow well system (updated in 2024 per municipal reports and Matrix, July 2023 WHPA report):

- Location: Well #4: 533 Hamilton St., Well #5: 399 Bob St.
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #4: 1957, Well #5: 1967
- Depth: Well #4: 54.8 m, Well #5: 58.8 m
- Users Served: ~~1100~~ 670 connections
- ~~Design~~ Maximum Daily Supply Capacity: ~~3404.16 m^3/day (39.4 litres/sec)~~ 2,000 m^3/day (beginning Oct 2022)
- ~~Permitted Rate: Well #4: 820 m^3/day, Well #5: 3274.56 m^3/day~~
- Average Usage: 4: ~~43~~ 100 m^3/day; 5: ~~517~~ 562 m^3/day (~~2001-2006~~2014-2016) *
- Modelled rate: 4: ~~48~~ 100 m^3/day; 5: ~~637~~ 700 m^3/day *
- Treatment: Chlorination

* ~~CRA, 2007~~Matrix, Jul 2023

Groundwater Vulnerability

Maps 4.HK.WHPA and 4.Luck show that the WHPAs extends ~~south~~ eastward from the wells ~~to include about 7.7 km~~ along the south Huron-Kinloss border and into ACW. The re-defined WHPAs for wells 4 and 5 are separate,

The WHPA for Lucknow Well 4, located near the intersection of Havelock and Rose Streets, extends northeast of the well site then continues eastward. WHPA-A is primarily residential; vulnerability score is 10. WHPA-B includes residential, municipal properties plus open space and forest; vulnerability scores are 8 and 10. WHPA-C and D are largely composed of agricultural land, forested areas, and wetlands; vulnerability scores are 8 and 6, respectively.

The WHPA for Lucknow Well 5 extends southeast of the well site on South Delhi Street. The WHPAs of Well 5 are significantly larger than that of Well 4, due to increased pumping rate from this well. WHPA-A includes the residential, institutional and municipal land uses. WHPA-B, C, and D extend into ACW and encompass largely agricultural, forested and wetland areas. Portions of WHPA-B have a high vulnerability score of 10, with remainder scoring 8 and 6. WHPA-C has vulnerability scores of 8, 6 and 4, and WHPA-D has vulnerability scores of 6, 4 and 2.

~~In Huron-Kinloss, a vulnerability score of 10 applies to WHPA-A for both well number 4 and 5, as well as a small part of WHPA-B for well number 5. The remainder of WHPA-B for well 4 and 5 has vulnerability scores of 8 or 6. WHPA-C has vulnerability scores of 8, 6 and 4, and WHPA-D has vulnerability scores of 6, 4 and 2. Note that the WHPA map was revised in 2014 to reflect updated transport pathway information.~~

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Lucknow WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are assumed to be on municipal water, and there were not sufficient records of wells which pre-date the system.~~, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.~~

Threats and Risks

Table 4.42 Column 1 lists the drinking water threats in Lucknow's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.42** also indicates the number of significant threat instances for each threat type. The numbers were updated in 2024 to reflect the revised WHPA; numbers are subject to change upon confirmation of threat activities. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Luck shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.42 Lucknow WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System	1	~~4~~6	
3. Agricultural Source Material Application		~~0~~1	
4. Agricultural Source Material Storage		0	
6. Non-Agricultural Source Material Application			
7. Non-Agricultural Source Material Handling/Storage			
8. Commercial Fertilizer Application	~~1~~2		
9. Commercial Fertilizer Handling/Storage			
10. Pesticide Application	~~1~~2		
11. Pesticide Handling/Storage			
12. Application of Road Salt	2		
13. Storage of Road Salt	2		
14. Storage of Snow	~~2~~0		
15. Fuel Handling/Storage	9		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			0
21. Grazing/Pasturing Livestock	~~2~~3	~~2~~3	
Total:	**~~20~~21**	**~~6~~10**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.43 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.43 Lucknow WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.6.2.3 Whitechurch

The following is a description of the Whitechurch well system:

- Location: Whitechurch, Corner of County Rd. 86 and Whitechurch St.
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #1: 2008, Well #2: 2007
- Depth: Well #1: 73 m, Well #2: 55 m

- Users Served: 93
- Design Capacity: Well #1: 283 m^3/day, Well #2: 283 m^3/day
- Permitted Rate: Well #1: 283 m^3/day, Well #2: 283 m^3/day
- Average Usage: 25 m^3/day (2001-2006) *
- Modelled flow rate: 29 m^3/day *
- Treatment: Chlorination and iron sequestration

* CRA, 2007

Groundwater Vulnerability

Maps 4.HK.WHPA and 4.Whit show the WHPA extending about 1 km to the north east. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the well. Most of WHPA-B has a vulnerability score of 8, with the remainder having a score of 6. WHPA-C and WHPA-D have vulnerability scores of 6 or less.

Aquifer vulnerability was not adjusted for transport pathways in the Whitechurch WHPA.

Threats and Risks

Table 4.44 Column 1 lists the drinking water threats in Whitechurch's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.44** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Whit shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.44 Whitechurch WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System		13	
10. Pesticide Application	1		
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	2		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			0
21. Grazing/Pasturing Livestock	1	1	
Total:	**4**	**14**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.45 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.45 Whitechurch WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.6.2.4 Ripley

The Ripley Municipal Drinking Water System was added to the Maitland Valley (MV) Assessment Report following the addition of a supply well and subsequent WHPA re-delineation in 2017. The well system is located in the Saugeen Valley (SV) SPA. The WHPA-C and D of the newly delineated WHPA extend into the Maitland Valley SPA. As such, this system must be included in the MV Assessment Report and Source Protection Plan.

The description of well system, vulnerable areas and methodologies used to assess threats, transport pathways and vulnerable areas are detailed in the Assessment Report for the Saugeen Valley Source Protection Area (SGSNBP SPR, 2017)

The following is a general description of the Ripley well system:

- Location: Village of Ripley
- SPA: Wells are in the SV SPA; WHPA extends to MV SPA
- Year constructed: Well 1: 1947, Well 2: 1994, Well 3: 2011, Well 4: 2013
- Depth: Well 1: 84m, Well 2:85m, Well 3: 85m, Well 4: 85m
- Users Served: 680 persons
- Design Capacity: Well 1 and 2: 864 m^3/day; Well 3 and 4: Unknown
- Permitted Rate: Well 1 and 2: 864 m^3/day, Well 3 and 4: unknown
- Treatment: Chlorination

Enumeration of Significant Drinking Water Threats is included in Appendix E of the SV SPA Assessment Report (Table 4.6.G1.3 Ripley: Significant Drinking Water Threats by Activity and Land Use in WHPA A-D) (SGSNBP SPR, 2017).No significant threats have been identified for properties in the Maitland Valley portion of the Ripley wellhead protection area at time of writing.

Groundwater Vulnerability

Map 4.Ripl shows the WHPA extending about 18 km to the south-east. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the well. WHPA-B has a vulnerability score of 6. WHPA-C and WHPA-D have vulnerability scores of 6 or less.

Aquifer vulnerability was not adjusted for transport pathways in the Ripley WHPA.

Map 4.Ripl shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

4.5.7 Mapleton

This municipality is located in the eastern part of the Source Protection Area. Five percent of the municipality is within the study area having a population of approximately 450 people. There are no municipal residential drinking water sources in this area. The population residing throughout the countryside relies on individual wells.

4.5.7.1 Mapleton – HVAs and SGRAs

No HVA exist in the portion of the municipality within the MV SPA. **Map 4.MP.SGRA** delineates the locations of SGRAs. No significant, moderate, or low drinking water threats exist in these areas.

Since impervious surface, managed lands and livestock density are only mapped in vulnerable areas that have vulnerability scores of 6 or higher, none of these maps were required for Mapleton.

Threats & Risk

As there are no municipal residential drinking water sources there are no significant risks in this area (**Table 4.46**). There are also no known conditions or issues in the in the area (**Table 4.47**).

Table 4.46 Mapleton Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.47 Mapleton Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.8 Minto

The Town of Minto is located in the north-west corner of Wellington County and the north-eastern portion of the Maitland Valley Conservation Authority; 64% of the municipality is in the watershed. In 2006, the population of Minto was 8,504, an increase of 4.2% since 2001. The main towns in the Maitland portion are Harriston (2006 population of 2108) and Palmerston (2006 population of 2,579).

Cropland covers about 77% of the municipality. Soybeans, corn, winter wheat and alfalfa are the main crops. Livestock density (cattle: 49.2/km^2; pigs: 228.7/km^2) is higher than the Western Ontario average (Statistics Canada 2007).

Map 4.MN.IS shows the percentage of impervious surface area; **Map 4.MN.ML** shows the location and percentage of managed lands; and **Map 4.MN.LD** shows the livestock density within vulnerable areas for Minto.

4.5.8.1 Minto – HVAs and SGRAs

Maps and 4.MN.SGRA show the locations of HVAs and SGRAs in Minto. The HVAs are scattered and small. SGRAs correspond to coarse-textured physiographic units: a network of spillways throughout the municipality, a kame moraine area north of Harriston, an esker in the west portion of Minto and scattered drumlins. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in these areas. **Table 4.3** can be used in combination with **Map 4.MN.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Minto. The Technical Rules can be used to determine the types of activities that would be deemed a moderate or low threat in the HVA. There are no known conditions or issues in the municipality.

4.5.8.2 Minto – Wellhead Protection Areas

Harriston and Palmerston are the two main Minto well systems in the Maitland watershed. In addition, the well head protection area of Clifford, a town just outside the Maitland Valley watershed, extends into the MV SPA. **Map 4.MN.WHPA** shows the locations of each of the WHPAs in the municipality.

4.5.8.2.1 Clifford

The following is a description of the Clifford well system:

- Location: Well #1: 9 Allan St., Well #3,4: 25 Nelson St.
- SPA: Wells are in the Saugeen Valley SPA, part of WHPA is in the MV SPA
- Year constructed: Well #1: 1964, Well #3: 2004, Well #4: 2004
- Depth: Well #1: 52.4 m, Well #3: 35 m, Well #4: 43 m
- Users Served: 804
- Design Capacity: Well #1: 1304 m^3/day, Well #3: 1304 m^3/day, Well #4: 1304 m^3/day
- Permitted Rate: Well #1: 1304 m^3/day, Well #3: 1304 m^3/day, Well #4: 1304 m^3/day
- Average Usage: Well #1: 170 m^3/day, Well #3: 148 m^3/day, Well #4: 43 m^3/day
- Treatment: Chlorination and iron sequestration

Groundwater Vulnerability

Maps 4.MN.WHPA and 4.Clif indicate that the WHPA extends from the Saugeen Valley SPA into the Maitland Valley SPA about 1.5 km in a 2.5 km wide swath. Most of the WHPA is in Minto but a small portion reaches into the Township of Howick. The WHPA-A for both wells is outside of the MV SPA. The portion of WHPA-B inside the MV SPA has a vulnerability score of 8. All other WHPAs inside the MV SPA have a vulnerability score of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Clifford WHPA was adjusted for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.48 Column 1 lists the drinking water threats in Clifford's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.48** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Clif shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.48 Clifford WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances***		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System	0		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			0
21. Grazing/Pasturing Livestock			
Total:	**0**	**0**	**0**

*Note: enumeration is for MVCA portion of Clifford WHPA only – WPHA-B and WPHA-C; WHPA-A is located in Saugeen SPA. See Saugeen Assessment Report for threat numbers outside Maitland Source Protection Area. Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.49 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.49 Clifford WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.8.2.2 Harriston

The following is a description of the Harriston well system:

- Location: Well #1: 117-131 King St., Well #2: 124 John St., Well #3: 107 King St.
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #1: early 1930's, Well #2: 1961, Well #3: 1998
- Depth: Well #1: 61 m, Well #2: 59 m, Well #3: 56.6 m
- Users Served: 2108
- Design Capacity: Well #1: 976 m^3/day (11.3 litres/sec), Well #2: 2065 m^3/day (23.9 litres/sec), Well #3: 1633 m^3/day (18.9 litres/sec)
- Permitted Rate: Well #1: 976 m^3/day (11.3 litres/sec), Well #2: 2065 m^3/day (23.9 litres/sec), Well #3: 1633 m^3/day (18.9 litres/sec)
- Average Usage: Well #1: 475 m^3/day Well #2: 485.3 m^3/day, Well #3: 514.9 m^3/day
- Modelled rate: 1,374 m^3/day *
- Treatment: Chlorination and iron sequestration

* WNMC et al, 2010

Groundwater Vulnerability

Maps 4.MN.WHPA and **4.Harr** show the WHPA to be 6.8 km long and 2.9 km wide at its widest point, extending south-east and across the North Maitland River from the wells. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the wells. WHPA-B for both wells has a vulnerability score of 8. WHPA-C and WHPA-D have scores of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Harriston WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical

depths) are insignificant in comparison to the depth to the municipal supply aquifer

Note that vulnerability was revised in 2014 to reflect updated transport pathway information.

Threats and Risks

Table 4.50 Column 1 lists the drinking water threats in Harriston's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.50** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats.

Map 4.Harr shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.50 Harriston WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances***		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System	1	1	
12. Application of Road Salt	4		
13. Storage of Road Salt	4		
14. Storage of Snow	4		
15. Fuel Handling/Storage	1		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			10
Total:	**14**	**1**	**10**

*Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.51 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.51 Harriston WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.8.2.3 Palmerston

The following is a description of the Palmerston well system:

- Location: Well 1 and 2: 215 William St., Well 3 and 4: 445 Whites Rd.
- SPA: Well and WHPA in MV SPA
- Year constructed: Well 1: 1928, Well 2: 1956, Well 3: 1956, Well 4: 2012
- Depth: Wells 1: 27.3 m, Well 2; 30.5 m, Well 3: 53.3 m: Well 4: 45.7 m
- Users Served: 2579
- Design Capacity: Well 1: 1970 m^3/day, Well 2: 1970 m^3/day, Well 3: 2307 m^3/day; Well 4: 2291 m^3/day
- Permitted Rate: 1,964 m^3/day (22.8 litres/sec) for Wells 1 and 2 combined, and 2,291 m^3/day (26.66 litres/sec) for Well #3 and Well #4 combined
- Average Usage: usage for Wells 1 and 2 combined was 207.9 m^3/day, Well 3: 499.2 m^3/day*
- Modelled rate: 1,2: 512 m^3/day; 3: 704 m^3/day *
- Treatment: Chlorination and iron sequestration

* WNMC et al, 2010

Note that Well 4 was constructed after the WHPA delineations were completed and therefore was not included in the initial maps. It is located approximately 17 metres from Well 3. Wells 3 and 4 supply the White's Road wellhouse and alternate duties as primary supply. WHPA-A for wells 3 and 4 has been adjusted to incorporate Well 4 and the maps amended accordingly (2023 amendment). No change was made to the remainder of the WHPA.

Groundwater Vulnerability

Maps 4.MN.WHPA and 4.Palm show the WHPA to be 4.6 km long and 2.7 km wide at its widest point and extending into North Perth. Only WHPA-A has a vulnerability score of 10, which is entirely within Minto. WHPA-B has vulnerability scores of 8 and 6. WHPA-C has a small portion with a score of 8, with the remainder of the zone scoring 6 or less. WHPA-D has scores of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Palmerston WHPA was adjusted for several

undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer. Note that the vulnerability was revised in 2014 to reflect updated transport pathway information.

Threats and Risks

Table 4.52 Column 1 lists the drinking water threats in Palmerston's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.52** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Palm shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.52 Palmerston WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	0		
2. Sewage System	1	1	
3. Agricultural Source Material Application	0	0	
4. Agricultural Source Material Storage			
6. Non-Agricultural Source Material Application			
7. Non- Agricultural Source Material Handling/Storage			
8. Commercial Fertilizer Application			
10. Pesticide Application			
11. Pesticide Handling/Storage			
12. Application of Road Salt	4		
13. Storage of Road Salt	4		
14. Storage of Snow	2		
15. Fuel Handling/Storage	2		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			6
21. Grazing/Pasturing Livestock			
Total:	**13**	**1**	**6**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties

Drinking Water Issues and Conditions

Table 4.53 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.53 Palmerston WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.9 Morris-Turnberry

The Municipality of Morris-Turnberry is located in north Huron County and central Maitland Valley watershed, extending northward so 5% is outside the Source Protection Region and in the Saugeen Valley watershed. In 2006, Morris-Turnberry population was 3,403, a decline of 2.7% since 2001. The municipality includes no large towns although it surrounds Wingham, a separate municipality. Land use is 55.8% cropland, largely soybeans, corn, alfalfa and winter wheat. Much of the remainder is forested. Livestock density (cattle: 55.8/km^2; pigs: 252.1/km^2) is high for both Huron County and Western Ontario (Statistics Canada 2007).

Map 4.MT.IS shows the percentage of impervious surface area; **Map 4.MT.ML** shows the location and percentage of managed lands, and **Map 4.MT.LD** shows the livestock density within vulnerable areas for Morris-Turnberry.

4.5.9.1 Morris-Turnberry – HVAs and SGRAs

Maps 4.MT.HVA and 4.MT.SGRA show the locations of HVAs and SGRAs in Morris-Turnberry. The HVAs are throughout the municipality with the largest area along the east side. SGRAs correspond to coarse-textured physiographic units which form a dense network across the municipality: spillways, kame moraine and drumlines. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in this area. Table 4.3 can be used in combination with **Map 4.MT.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Morris-Turnberry. There are no known conditions or issues in the municipality.

4.5.9.2 Morris-Turnberry – Wellhead Protection Areas

Belgrave is the only WHPA entirely in the municipality. Parts of WHPAs for Wingham, Blyth and Brussels fall within Morris-Turnberry. **Map 4.MT.WHPA** shows the WHPA's for each of these systems.

4.5.9.2.1 Belgrave

The following is a description of the Belgrave well system:

- Location: New McCrea St. Well: 23 McCrea St., Jane St. Well: 32 Hamilton St.
- SPA: Well and WHPA in MV SPA
- Year constructed: New McCrea St. Well:2021, Jane St. Well: 1983
- Depth: New McCrea St. Well: 42.7 m, Jane St. Well: 42.4 m
- Users Served: 245
- Design Capacity: 596 m^3/day (6.9 litres/sec)
- Permitted Rate: 501.1 m^3/day (5.8 litres/sec) (2021)
- Average Usage: 40 m^3/day (1999); 88.7 m^3/day (2018-2020)*
- Modelled rate: 88.7 m^3/day *
- Treatment: Chlorination and Filtration

*Burnside, 2021

Note that the McCrea Street well was replaced in 2022. The new well is located about 15 metres from the former well, and is completed in the same bedrock formation. WHPA-A was shifted accordingly. The pumping rate has doubled since the WHPA was modelled, so WHPAs B, C and D were expanded based on ratios of current to modelled rate (R.J.Burnside, 2021)

Groundwater Vulnerability

Maps 4.MT.WHPA and 4.Belg show that the WHPA extends about 5 km southward from the wells and away from Belgrave Creek over agricultural land and some forest. A vulnerability score of 10 applies only to WHPA-A, the 100 m radius around the wells. A portion of WHPA-B has a vulnerability score of 8, while the remainder has a score of 6. WHPA-C and WHPA-D have vulnerability scores of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Belgrave WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed

to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.54 Column 1 lists the drinking water threats in Belgrave's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.54** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Belg shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.54 Belgrave WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered per the *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage System		46	
12. Application of Road Salt	NA		
13. Storage of Road Salt	1		
14. Storage of Snow	0		
15. Fuel Handling/Storage	1		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			2
Total:	**3**	**46**	**2**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties

Drinking Water Issues and Conditions

Table 4.55 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.55 Belgrave WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.9.2.2 Blyth

The Blyth municipal wells are located in the Municipality of North Huron and extend into Morris-Turnberry. A description of the Blyth water supply system and risk assessment can be found in section 4.5.10 under North Huron.

Table 4.56 Deleted (see section 4.5.10)

Table 4.57 Deleted (see section 4.5.10)

4.5.9.2.3 Brussels

The Brussels municipal wells are located in the Municipality of Huron East and extend into Morris-Turnberry. A description of the Brussels water supply system and risk assessment can be found in section 4.5.5 under Huron East.

Tabe 4.58 Deleted (see section 4.5.5)

Table 4.59 Deleted (see section 4.5.5)

4.5.9.2.4 Wingham

The Wingham municipal wells are located in the Municipality of North Huron and extend into Morris-Turnberry. A description of the Wingham water supply system and risk assessment can be found in section 4.5.10 under North Huron.

Table 4.60 Deleted (see section 4.5.10)

Table 4.61 Deleted (see section 4.5.10)

4.5.10 North Huron

The Municipality of North Huron is located in central Maitland Valley Conservation Authority, entirely within its jurisdiction. In 2006, the municipality's population was 5,015, an increase of 0.6% from 2001. North Huron includes the former Town of Blyth (2001 population of 987), the former Town of Wingham (population 1000), and the former Township of East Wawanosh (population 1000). Land use is 48% cropland, largely soybeans, corn, and alfalfa. Much of the remainder is forested land associated with spillways and kame moraines. Livestock density (cattle: 70.5/km^2; pigs: 83.4/km^2) is well above the Huron County average for cattle, though below Huron County and about equal to Western Ontario for pigs (Statistics Canada 2007).

Map 4.NH.IP shows the percentage of impervious surface area; **Map 4.NH.ML** shows the location and percentage of managed lands, and **Map 4.NH.LD** shows the livestock density within vulnerable areas for North Huron.

4.5.10.1 North Huron – HVAs and SGRAs

Maps 4.NH.HVA and 4.NH.SGRA show the locations of HVAs and SGRAs in North Huron. The larger HVAs are all in the south half of the municipality. SGRAs correspond to coarse-textured physiographic units which cover much of the municipality. They include spillways, kame moraines and drumlins. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in this area. **Table 4.3** can be used in combination with **Map 4.NH.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in North Huron. There are no known conditions or issues in the municipality.

4.5.10.2 North Huron – Wellhead Protection Areas

Blyth and Wingham are North Huron's only municipal well systems. Most of Auburn's WHPA, however, extends into North Huron. In addition, a sliver of Whitechurch's WHPA crosses into the Municipality. **Map 4.NH.WHPA** shows the WHPAs for each of these systems. Note that the Blyth WHPA was revised in 2017 to reflect the addition of Well #5.

4.5.10.2.1 Auburn

The Auburn municipal well is located in Central Huron and extends into North Huron and ACW. A description of the Auburn water supply system and risk assessment can be found in section 4.5.2 under Central Huron.

Table 4.62 Deleted (see section 4.5.2)

Table 4.63 Deleted (see section 4.5.2)

4.5.10.2.2 Blyth

The following is a description of the Blyth well system. Note that an additional groundwater well, Well # 5, was put into service in December, 2016, as a second isolated source of water for this system. Well # 5 supplements the current water needs and is part of a planned upgrade to the Blyth water system.

- Location: Well #1 and 2: 201 Thuell Rd;,Well # 5:377 Gypsy Lane Blyth
- SPA: Well and WHPA in MV SPA
- Year constructed: Well #1: 1953, Well #2: 1972; Well # 5: 2015
- Depth: Well #1: 73.2 m, Well #2: 79.25 m; Well # 5: 83.5 m
- Users Served: 975
- Design Capacity: 2877 m^3/day (33.3 litres/sec)
- Permitted Rate: 3505 m^3/day (40.6litres/sec)
- Average Usage: 400 m^3/day (2005-2014) *
- Modelled rate: 400 m^3/day *
- Treatment: Chlorination and Iron Sequestration

*WNMC, 2015

Groundwater Vulnerability

An updated groundwater model and WHPA delineation to include Well # 5 was completed by Waterloo Numerical Modelling Corporation in 2015 ((WNMC*, 2015*). The methodology to complete the updated WHPA delineation was consistent with that used in previous studies for this region, as described in Section 4.2 above. The Assessment Report maps were revised accordingly and submitted as an amendment of the Source Protection Plans as per Section 34 of the *Clean Water Act, 2006*. The amendment was approved in 2019.

Maps 4.NH.WHPA and 4.Blyt show the WHPA about 2 km long, extending generally northeast from the wells. The North Huron portion includes all of the WHPA-A and WHPA-B which have vulnerability scores of 10 and 8. The majority of WHPA-C is in North Huron and has vulnerability scores of 8 and 6. WHPA-D is split between North Huron and Morris-Turnberry and has scores of 6, 4 and 2.

Aquifer vulnerability was not adjusted for transport pathways in the Blyth WHPA.

Threats and Risks

Table 4.64 Column 1 lists the drinking water threats in Blyth's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of Ontario Regulation 287/07. No other type of local threat was identified. **Table 4.64** also indicates the number of significant threat instances for each threat type. No other local circumstances were identified.

Map 4.Blyt shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.64 Blyth WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage System			
3. Agricultural Source Material Application	1	1	
4. Agricultural Source Material Storage	0	~~1~~0	
6. Non- Agricultural Source Material Application			
7. Non- Agricultural Source Material Handling/Storage			
8. Commercial Fertilizer Application	0		
10. Pesticide Application	0		
11. Pesticide Handling/Storage			
12. Application of Road Salt	3		
13. Storage of Road Salt	3		
14. Storage of Snow	3		
15. Fuel Handling/Storage	1		
16. Dense Non-Aqueous Phase Liquid Handling and Storage			3
21. Grazing and Pasturing Livestock	1	1	
Total:	**13**	**~~3~~2**	**3**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.65 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.65 Blyth WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.10.2.3 Whitechurch

The Whitechurch well is located in Huron-Kinloss and extend into North Huron. A description of the Whitechurch water supply system and risk assessment can be found in section 4.5.6 under Huron-Kinloss.

Table 4.66 Deleted

Table 4.67 Deleted

4.5.10.2.4 Wingham

The following is a description of the Wingham well system:

- Location: Well #3 - Arthur St.; Well #4 23 Albert St W., Wingham
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #3: 1973, Well #4: 1996
- Depth: Well #3: 102.1 m, Well #2: 92.3 m
- Users Served: 2,845
- Design Capacity: 11,836.8 m^3/day
- Permitted Rate: 11,816.2 m^3/day
- Average Usage: combined average 1797 m^3/day (1997-2001) *
- Modelled rate: 1797 m^3/day *
- Treatment: Chlorination and Iron Sequestration

*WNMC et al, 2010

Groundwater Vulnerability

Maps 4.NH.WHPA and 4.Wing show the WHPA to be a broad oval shape (approximately 5 km by 3.4 km) extending west and north from the wells. Most of the WHPA is in Morris-Turnberry; however, both wellheads are located in North Huron. A vulnerability score of 10 applies to WHPA-A, the 100 m radius around the wells. WHPA-B for the two wells have vulnerability scores of 8 and 6. The portions of WHPA-C and WHPA-D that are located in North Huron have vulnerability scores of 4 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Wingham WHPA was adjusted for several undocumented

wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Note that the vulnerability was adjusted in 2022 to reflect updated transport pathway information for Wingham. Several assumed wells were removed and the location of other wells was corrected.

Threats and Risks

Table 4.68 Column 1 lists the drinking water threats in Wingham's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.68** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats.

Map 4.Wing shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, and low.

Table 4.68 Wingham WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage System	1	3	
7. Non- Agricultural Source Material Handling/Storage	0	0	
10. Pesticide Application	0		
12. Application of Road Salt	5		
13. Storage of Road Salt	3		
14. Storage of Snow	5		
15. Fuel Handling/Storage	1		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			10
Total:	**16**	**3**	**10**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.69 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.69 Wingham WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.11 North Perth

North Perth is located in the north end of Perth County at the headwaters of the Middle and Little Maitland Rivers. Maitland Valley Conservation Authority jurisdiction applies to 98% of the municipality. North Perth abuts Upper Thames River Conservation Authority in the south and Grand River Conservation Authority in the east. In 2006, the municipality's population was 12,254, an increase of 1.7% since 2001. Listowel is the major town (2006 population of 6,303). Other settlements include: Atwood (2001 population of 278), Britton, Donegal, Gowanstown, Kurtzville, Monkton, Newry, Trowbridge and Wallace. Land use is 80.4% cropland, largely corn, soybeans, alfalfa and winter wheat. Livestock density (cattle: 79.4/km^2; pigs: 242.7/km^2) is high: slightly above Perth County averages for cattle and slightly below for pigs but well above Western Ontario averages for both (Statistics Canada 2007).

Map 4.NP.IP shows the percentage of impervious surface area; **Map 4.NP.ML** shows the location and percentage of managed lands, and **Map 4.NP.LD** shows the livestock density within vulnerable areas for North Perth.

4.5.11.1 North Perth – HVAs and SGRAs

Maps 4.NP.HVA and 4.NP.SGRA show the locations of HVAs and SGRAs in North Perth. The HVAs are few and very small. SGRAs correspond to coarse-textured physiographic units that are also infrequent in North Perth. They include a spillway network associated with the Little Maitland River in the north part of the municipality as well as a few drumlins and eskers. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats and Risks

Since the vulnerability scores for the HVAs are 6 or less, only moderate and low drinking water threats may exist in this area. **Table 4.3** can be used in combination with **Map 4.NP.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in North Perth. There are no known conditions or issues in the municipality.

4.5.11.2 North Perth – Wellhead Protection Area

North Perth's main well system is at Listowel. Smaller well systems in the municipality are Molesworth, Atwood and Gowanstown. The Palmerston system,

although in Minto, extends its WHPA into North Perth. **Map 4.NP.WHPA** shows the WHPAs for each of these systems.

4.5.11.2.1 Atwood

The following is a description of the Atwood well system:

- Location: Atwood, south part of the Hamlet
- SPA: Well and WHPA are in the MV SPA
- Year constructed: Well #1: 1997, Well #2: 2003
- Depth: Well #1: 24.4 m, Well #2: 49 m
- Users Served: 250
- Design Capacity: Well #1: 326 m^3/day, Well #2: 265 m^3/day
- Permitted Rate: Well #1: 326 m^3/day, Well #2: 265 m^3/day
- Average Usage: 69 m^3/day (2001-2005) *
- Modelled rate: Well 1: 36 m^3/day ; Well 2: 33 m^3/day *
- Treatment**:** Chlorination and iron sequestration

*WNMC et al, 2010

Groundwater Vulnerability

Maps 4.NP.WHPA and 4.Atwo show that the WHPA is a very narrow strip extending eastward about 7.3 km. A vulnerability score of 10 applies to the 100 m radius of the two WHPA-As, both associated with residential uses, as well as to a narrow (approximately 20 m wide) scrubland strip about ½ km east of Well #2. A vulnerability score of 8 applies to a small area in town between the two wells and to several narrow strips in agriculture and scrubland just east of Atwood; all areas with vulnerability scores of 8 are in WHPA-B. The remainder of the WHPA has a vulnerability score of 6 or less.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Atwood WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for an undocumented well which was not visited as part of the Well Location Update. In this case, the well was assumed to be within 30m of the principal structure on the property, and vulnerability was

therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.70 Column 1 lists the drinking water threats in the Atwood WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.70** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Atwo shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.70 Atwood WHPA: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage System		0	
3. Agricultural Source Material Application	0	0	
4. Agricultural Source Material Storage			
6. Non- Agricultural Source Material Application			
7. Non- Agricultural Source Material Handling/Storage			
8. Commercial Fertilizer Application			
9. Commercial Fertilizer Handling/Storage			
10. Pesticide Application	0		
12. Application of Road Salt	2		
13. Storage of Road Salt	2		
14. Storage of Snow	2		
15. Fuel Handling/Storage	1		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			1
21. Grazing/Pasturing Livestock	0	1	
Total:	**5**	**6**	**2**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.71 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.71 Atwood WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.11.2.2 Gowanstown

The following is a description of the Gowanstown well system:

- Location: Gowanstown, 50 m east of Wallace Ave. in the south end
- SPA: Well and WHPA are in the MV SPA
- Year constructed: 1964
- Depth: 36.6 m

- Users Served: 70
- Design Capacity: 131 m^3/day (1.5 litres/sec)
- Permitted Rate: 71 m^3/day (0.8 litres/sec)
- Average Usage: 11 m^3/day (2002-2005) *
- Modelled rate: 11 m^3/day
- Treatment: Chlorination

* WNMC et al, 2010

Groundwater Vulnerability

Maps 4.NP.WHPA and 4.Gowashow the WHPA as a very narrow strip extending east-north-east about 7.6 km. The only area with a vulnerability score of 10 applies to the 100 m radius of WHPA-A. WHPA-B has a vulnerability score of 6, and WHPA-C and D have vulnerability scores of 4 and 2.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Gowanstown WHPA was adjusted for an undocumented well that was inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). This well was located as part of the project, and was found to be out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the well, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.72 Column 1 lists the drinking water threats in Gowanstown's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.72** also indicates the number of significant threat instances for each threat type.

The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Gowa shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.72 Gowanstown WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
2. Sewage System	0	17	
12. Application of Road Salt	0		
13. Storage of Road Salt	0		
14. Storage of Snow	0		
15. Fuel Handling/Storage	0		
Total:	**0**	**17**	**0**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.73 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.73 Gowanstown WHPA: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.11.2.3 Listowel

The following is a description of the Listowel well system:

- Location: Well #4: Wallace Ave., Well #5: 580 Main St., Well #6: Bright St.
- SPA: Wells and WHPA are in the MV SPA
- Year constructed: Well #4: 1946, Well #5: 1962, Well #6: 1989
- Depth: Well #4: 92.4 m, Well #5: 92.7 m, Well #6: 118.6 m
- Users Served: 5900
- Design Capacity: 9819 m^3/day (113.7 litres/sec)

- Permitted Rate: 9819 m^3/day (113.7 litres/sec)
- Average Usage: combine average of 2307 m^3/day (2001-2005) *
- Modelled rate: Well 4 - 795 m^3/day; Well 5 – 693 m^3/day ; Well 6 – 819 m3/day *
- Treatment: Chlorination

  * WNMC et al, 2010

Groundwater Vulnerability

Maps 4.NP.WHPA and 4.List show the WHPAs all extend east-north-east: Well #4's for about 7.4 km, Well #5's for about 8.9 km, and Well # 6's for about 10 km including about 2 km into the Grand River SPA. For all three wells, only WHPA-A has a vulnerability score of 10. The WHPA-Bs have a vulnerability score of 8 or 6, and WHPA-Cs and WHPA-Ds all have vulnerability scores of 6 or less

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Listowel WHPA was adjusted for several undocumented wells that were inspected and georeferenced as part of the Well Location Update completed by the Ausable Bayfield Maitland Valley Source Protection Region (2007). These wells were located as part of the project, and were found to have wells that are out of compliance with provincial requirements for well construction. Vulnerability was adjusted one level for a 30m area surrounding the wells, based on the updated coordinates.

Additional adjustments were completed for undocumented wells which were not visited as part of the Well Location Update. In these cases, wells were assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.74 Column 1 lists the drinking water threats in Listowel's WHPAs. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. The table of drinking water threats within the Technical Rules provides details on

circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.List shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen, and DNAPL threats can be significant, moderate, or low.

Table 4.74 Listowel Wells #4, 5 and 6 WHPAs: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage			
12. Application of Road Salt	12		
13. Storage of Road Salt	4		
14. Storage of Snow	8		
15. Fuel Handling/Storage	3		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			5
Total:	**28**	**0**	**75**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Table 4.75 (Deleted, 2014)

Table 4.76 (Deleted, 2014)

Drinking Water Issues and Conditions

Table 4.77 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.77 Listowel Well #4, #5, and #6 WHPAs: Issues and Conditions

Drinking Water Issue	**Parameter**
None	None
Drinking Water Condition	**Threat**
None	None

4.5.11.2.4 Molesworth

The following is a description of the Molesworth well system:

- Location: 8116-8112 Road 177
- SPA: Well and WHPA are in the MV SPA

- Year constructed: 2010 (located approximately 13 metres north-west of the former well)
- Depth: 47.8 m
- Users Served: 43 connections
- Design Capacity: 190 m^3/day (2.2 litres/sec)
- Permitted Rate: 190 m^3/day (2.2 litres/sec)
- Average Usage: 19.5 m3/day (2018-2020)
- Modelled rate: 30 m^3/day *
- Treatment: Chlorination and iron sequestration

* WNMC et al, 2010

Note that the Maps were revised in 2017 to reflect replacement of the well in 2010. As this was considered to be a minor change, a new groundwater model and delineation was not required, as per SPC direction. Rather, the WHPA was shifted to account for the new well location. The updated maps were submitted as an amendment of the Source Protection Plans as per Section 34 of the *Clean Water Act, 2006.*

Groundwater Vulnerability

Maps 4.NP.WHPA and 4.Mole show the WHPA as a narrow strip extending south-east over 6 km. The entire WHPA falls within the municipality of North Perth except for a very small portion of WHPA-A that reaches into Huron East. WHPA-A has a vulnerability score of 10, WHPA-B has a score of 6, WHPA-C has a score of 4 and WHPA-D has scores of 4 or 2.

A review of transport pathways was conducted with the following results. Aquifer vulnerability within the Molesworth WHPA was adjusted for an undocumented well which was not visited as part of the Well Location Update. In this case, the well was assumed to be within 30m of the principal structure on the property, and vulnerability was therefore adjusted for 60m surrounding the principal structure to account for the uncertainty with both the location of the well and the condition of the well.

No adjustments to the urban area were incorporated into the WHPA as all residences are on municipal water, there were not sufficient records of wells which pre-date the system, and the depth to the services (placed at typical depths) are insignificant in comparison to the depth to the municipal supply aquifer.

Threats and Risks

Table 4.78 Column 1 lists the drinking water threats in Molesworth's WHPA. They are all prescribed drinking water threats listed in Subsection 1.1(1) of *Ontario Regulation 287/07*. No other type of local threat was identified. **Table 4.78** also indicates the number of significant threat instances for each threat type. The table of drinking water threats within the Technical Rules provides details on circumstances pertaining to these threats. No other local circumstances were identified.

Map 4.Mole shows the WHPA and vulnerability scores. It can be used with Table 4.6 to identify the areas where chemical, pathogen and DNAPL threats can be significant, moderate, or low.

Table 4.78 Molesworth WHPA: Enumeration of Potential Significant Threats

Threat Type	**Significant Instances**		
(numbered according to *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	1		
2. Sewage System		14	
3. Agricultural Source Material Application	0	0	
12. Application of Road Salt	1		
13. Storage of Road Salt	1		
14. Storage of Snow	1		
15. Fuel Handling/Storage	2		
16. Dense Non-Aqueous Phase Liquid handling/Storage			1
Total:	**6**	**14**	**1**

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Drinking Water Issues and Conditions

Table 4.79 indicates that no issues with wells or conditions resulting from past activities were identified within the WHPA.

Table 4.79 Molesworth WHPA: Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.11.2.5 Palmerston

The Palmerston municipal wells are located in Minto and extend into North Perth. A description of the Palmerston water supply system and risk assessment can be found in section 4.5.8 under Minto.

Table 4.80 Deleted

Table 4.81 Deleted

4.5.12 Perth East

This municipality is located in the southern part of the Source Protection Area. Nine per cent of the municipality is within the study area having a population of approximately 1,100 people. The population residing throughout the countryside relies on individual wells.

Map 4.PE.IS shows the percentage of impervious surface area; **Map 4.PE.ML** shows the location and percentage of managed lands, and **Map 4.PE.LD** shows the livestock density within vulnerable areas for Perth East.

4.5.12.1 Perth East – HVAs and SGRAs

Maps 4.PE.HVA and 4.PE.SGRA show the locations of HVAs and SGRAs in the Municipality. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats & Risk

As there are no municipal residential drinking water sources and HVAs score 6 or less, there are no significant risks in this area (**Table 4.82**). **Table 4.3** can be used in combination with **Map 4.PE.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Perth East. There are no known conditions or issues in the portion of the municipality within the Maitland Valley SPA (**Table 4.83**).

Table 4.82 Perth East Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.83 Perth East Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.13 South Bruce

This Township is located in the northern part of the Source Protection Area. Only one percent of the land area is within the study area. The population in this area is approximately 60 people. There are no municipal residential drinking water sources in this area. The population relies on individual wells.

Map 4.SB.IS shows the percentage of impervious surface area; **4.SB.ML**shows the location and percentage of managed lands, and **4.SB.LD** shows the livestock density within vulnerable areas for South Bruce.

4.5.13.1 South Bruce – HVAs and SGRAs

Maps 4.SB.HVA and 4.SB.SGRA delineate the locations of HVAs and SGRAs in the municipality. Almost the entire area is either SGRA or HVA. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score. There are no significant risks associated with SGRA or HVA.

Threats & Risk

As there are no municipal residential drinking water sources and the vulnerability scores for HVAs are less than 6, there are no significant risks in this area (**Table 4.84**). **Table 4.3** can be used in combination with **Maps 4.SB.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in South Bruce. There are no known conditions or issues in the portion of the municipality within the MV SPA (**Table 4.85**).

Table 4.84 South Bruce Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.85 South Bruce Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.14 Wellington North

This Township is located in the northeastern part of the Source Protection Area and sixteen percent of the municipality is in the study area, having a population of about 1,800. There are no residential municipal drinking water sources in this area. This area has a dispersed population which is rural in character and the majority of the population relies on individual wells.

Map 4.WN.IS shows the percentage of impervious surface area; **Map 4.WN.ML** shows the location and percentage of managed lands, and **Map 4.WN.LD** shows the livestock density within vulnerable areas for Wellington North.

4.5.14.1 Wellington North – HVAs and SGRAs

Maps 4.WN.HVA and 4.WN.SGRA delineate the locations of HVAs and SGRAs in the Municipality. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score. There are no significant risks.

Threats & Risk

As there are no municipal residential drinking water sources there are no significant risks in this area (**Table 4.86**). **Table 4.3** can be used in combination with **Map 4.WN.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in Wellington North. There are no known conditions or issues in the portion of the municipality within the MV SPA (**Table 4.87**).

Table 4.86 Wellington North Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.87 Wellington North Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.5.15 West Perth

This municipality is located in the southeastern part of the Source Protection Area. The portion of the municipality within the study area represents approximately three percent of the land mass and a population of approximately 230 people. There are no municipal residential drinking water sources in this predominantly rural area. Therefore, the majority of the population within this area relies on individual wells.

Map 4.WP.IS shows the percentage of impervious surface area; **Map** 4**.WP.ML** shows the location and percentage of managed lands, and **Map 4.WP.LD** shows the livestock density within HVAs and SGRAs (where the vulnerability score is 6) for West Perth.

4.5.15.1 West Perth – HVAs and SGRAs

Maps 4.WP.HVA and 4.WP.SGRA delineate the locations of HVAs and SGRAs respectively in the municipality. The vulnerability score for all HVAs is 6, while SGRAs are not assigned a score.

Threats & Risk

As there are no municipal residential drinking water sources there are no significant risks in this area (**Table 4.88**). **Table 4.3** can be used in combination with **Map 4.WP.HVA** to determine where chemical, pathogen, and DNAPL threats can be moderate and low risks in HVAs in West Perth. There are no known conditions or issues in the portion of the municipality within the MV SPA (**Table 4.89**).

Table 4.88 West Perth Risks to Drinking Water Summary

Threat	Circumstance	Number of Locations
None	None	None

Table 4.89 West Perth Issues and Conditions

Drinking Water Issue	Parameter
None	None
Drinking Water Condition	**Threat**
None	None

4.6 Maitland Valley SPA - Summary

Table 4.90 shows a summary of all of the potential significant threats for the MV SPA by parcel. These numbers represent the best information available at the time of writing. It is anticipated that numbers will vary over time, according to changes in land use, and as additional information becomes available. In 2017, the threat numbers for Benmiller, Blyth and Dungannon were updated to reflect changes in these WHPAs. In 2022, numbers were updated to reflect property changes and to address the amended 2021 Technical Rules, which recreated potential significant threats for snow and salt activities. Note that the numbers for snow and salt activities in particular are estimates, based on desktop assessment of land use. It is anticipated that these numbers will drop significantly once the salt and snow activities can be confirmed. In 2024, the threat numbers were adjusted to reflect changes to the Century Heights and Lucknow systems. The numbers are subject to change as threat activities are confirmed.

Certain types of activities on residential sites that are incidental in nature and may be significant threats are not enumerated. These activities include storage of DNAPLs, storage of road salt and application of road salt, on residential properties.

Table 4.90 All* WHPAs: Enumeration of Potential Significant Threats

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
1. Waste Disposal Site	7	0	
2. Sewage System	6	~~158~~169	
3. Agricultural Source Material Application	3	~~3~~4	
4. Agricultural Source Material Storage	0	~~1~~0	
6. Non- Agricultural Source Material Application	0	0	
7. Non- Agricultural Source Material Handling/Storage	0	0	
8. Commercial Fertilizer Application	~~3~~4		
9. Commercial Fertilizer Handling/Storage	1		
10. Pesticide Application	~~6~~7		
11. Pesticide Handling/Storage	0		
12. Application of Road Salt	53		
13. Storage of Road Salt	40		
14. Storage of Snow	~~47~~45		
15. Fuel Handling/Storage	36		
16. Dense Non-Aqueous Phase Liquid Handling/Storage			53

Threat Type	Significant Instances		
(numbered per *Clean Water Act, 2006*)	**Chemicals**	**Pathogens**	**DNAPL**
21. Grazing/Pasturing Livestock	~~4~~5	5	
Total:	**~~206~~207**	**~~167~~179**	**53**

*Atwood, Auburn, Belgrave, Benmiller, Blyth, Brussels, Century Heights, Clifford, Clinton, Dungannon, Gowanstown, Harriston, Huron Sands, Kelly, Listowel (Wells 4, 5, 6), McClinchey, Molesworth, Palmerston, Wingham, Lucknow, Seaforth, Whitechurch

References

Author & Publisher	Title	Date	Purpose
Baird	Surface Water Vulnerability Analysis Goderich Intake	August 2007	To delineate the Goderich Intake Protection Zones
Baird	Surface Water Vulnerability Analysis for Goderich Intake Addendum: Numerical Modeling for IPZ-2 Delineation	May 2010	To refine the delineation of the Goderich Intake Protection Zones
B.M. Ross & Associates	Surface Water Vulnerability Analysis: Town of Goderich Intake	October, 2009	To provide an explanation of the methodology, limitations and an inventory of possible threats to water quality in keeping with MOE Technical Rules
B.M. Ross & Associates (BMRoss, 2023)	Township Of Ashfield-Colborne-Wawanosh Municipal Class Environmental Assessment for Expansion of Century Heights Drinking Water System	Draft November 2023	MCEA Environmental Screening Report for expansion of the Century Heights drinking water system
Conestoga Rovers & Associates (CRA, 2007)	2005-2006 Groundwater Technical Study, Saugeen-Grey Sauble-NBP SPA		Includes WHPA delineation for Huron-Kinloss
Matrix Solutions Inc. (Matrix, 2016)	Town of Ripley, Township of Huron Kinloss Wellhead Protection Area Delineation Ripley Wells 3 And 4	December 2016	To provide updated WHPA delineation Ripley
Matrix Solutions Inc. (Matrix, Jul 2023)	Preliminary Wellhead Protection Area Delineation and Vulnerability Scoring Lucknow Well 4 and Well 5 (35611-527 R 2023-07-31 final V2.0)	July 2023	To provide updated WHPA delineation for Lucknow, to reflect increase PTTW
Matrix Solutions Inc. (Matrix, Nov 2023)	Preliminary Wellhead Protection Area Delineation and Vulnerability Scoring, Century Heights Well 3 Community of Saltford, Ontario, November 2023 (35869-527 Saltford LR 2023-11-22 Final V1.0)	November 2023	Update the WHPA to reflect the addition of Well # 3
Province of Ontario	Technical Rules, *Clean Water Act, 2006* *https://www.ontario.ca/page/2021-technical-rules-under-clean-water-act*	2009; 2017; 2021	Technical rules for assessing risks to sources of drinking water in Ontario and identifying vulnerable areas. 2021 version includes the Tables of Drinking Water Threats

Author & Publisher	Title	Date	Purpose
R.J. Burnside & Associates Limited (Burnside, 2021)	New McCrea Well Source Protection Letter (report)	October 28, 2021	New WHPA due to replacement of McCrea St Well
Saugeen, Grey Sauble, NBP Source Protection Region	Saugeen Valley Source Protection Area Assessment Report, Chapter 4, Draft for Consultation	Draft, 2017	Includes updated information for Ripley
Statistics Canada	Population Counts, 2006. http://www12.statcan.ca/english/census06/data/popdwell/Table.cfm?T=302&PR=35&S=1&O=A&RPP=25	2007	Provincial census data
Waterloo Numerical Modelling Corp, BM Ross, IWS (WNMC et al, 2010)	Final Phase I Report ABCA / MVCA Groundwater Model Updates and Capture Zone Delineation (Report for Well Head Protection Area Delineation Project)	October, 2010	To provide the delineation of WHPAs in the area and details on methodologies, limitations and general characterization of the well systems
Waterloo Numerical Modelling Corp. (WNMC, 2015)	Blyth Groundwater Modelling and Wellhead Protection Area Delineation Draft Technical Memo	May 2015	To provide updated WHPA delineation, to include addition of Well # 5 to the Blyth system
WESA	Groundwater Vulnerability Assessment: Municipality of Huron East (Seaforth)	October, 2009	To provide the delineation of Seaforth WHPA and details on methodologies, limitations and general characterization of the well system