DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

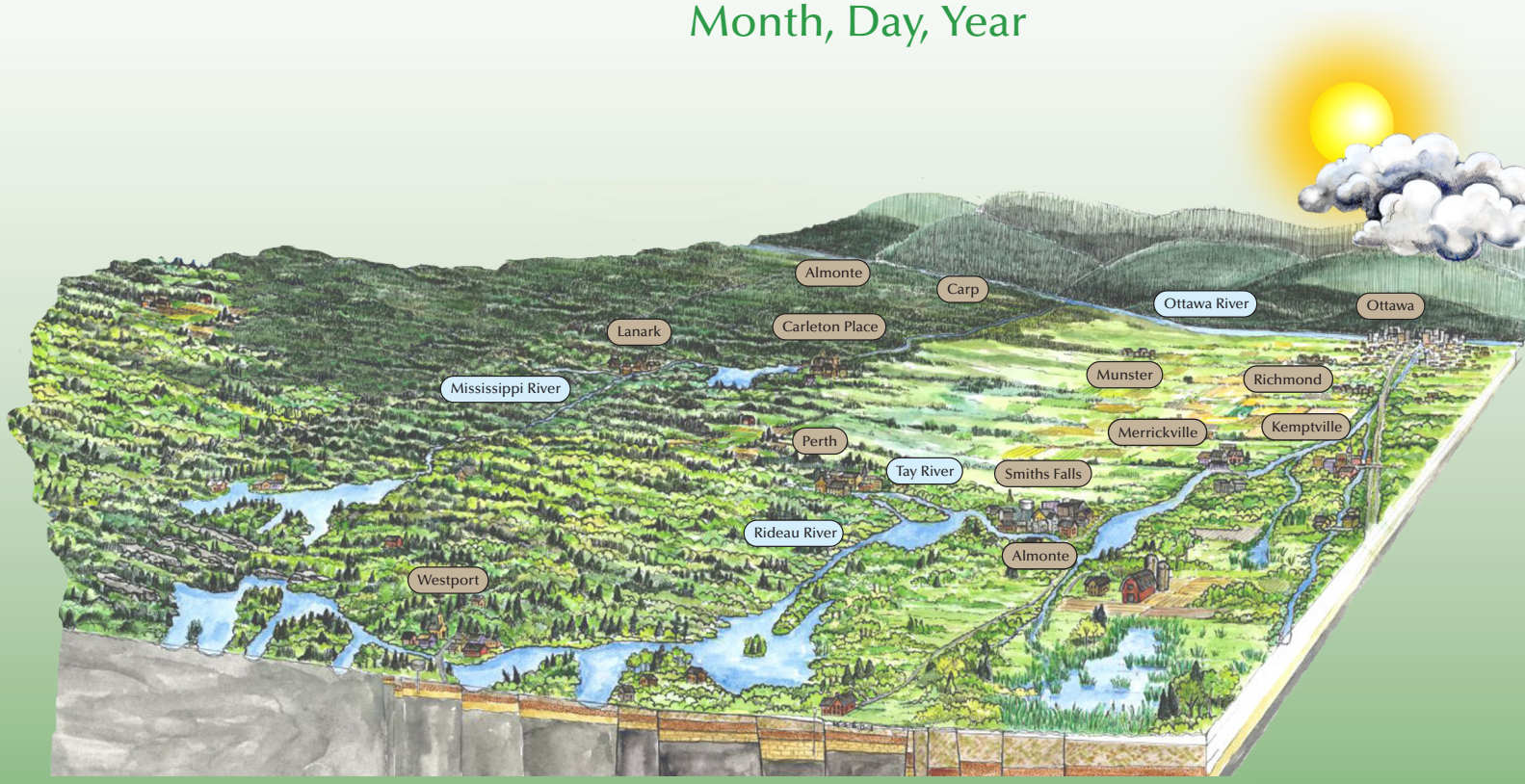
Mississippi-Rideau Source Protection Region

Draft Amendment 1.2

Assessment Report

Rideau Valley Source Protection Area

Submission for Approval
Month, Day, Year



Mississippi Valley Conservation Authority

Rideau Valley Conservation Authority

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Preamble

The Assessment Report for the Rideau Valley Source Protection Area (RVSPA) was approved by the Ministry of the Environment, Conservation and Parks (MECP) on December 19, 2011. On March 23, 2019, Amendment 1.1 came into effect to add the Richmond West municipal drinking water system to the Assessment Report and Source Protection Plan. Chapter 5 of the RVSPA Assessment Report is entitled 'Groundwater Sources' and it provides information on groundwater within the Mississippi-Rideau Source Protection Region (MRSPR), including specific information about each of the groundwater-based municipal drinking water systems in the RVSPA. The 6 groundwater-based municipal drinking water systems in the RVSPA are located in Kemptville, Merrickville, Munster, Richmond (2 systems) and Westport.

The purpose of this Amendment is to provide revised key information about the groundwater-based municipal drinking water system for the Municipality of North Grenville because of the new municipal well installed in 2015. The new well installation and updated groundwater vulnerability work in North Grenville has changed the existing WHPA for the Merrickville Municipal Drinking water system. As such the North Grenville and Merrickville municipal drinking water systems now each have revised a WHPA.

The information provided in this Amendment replaces all existing information from the approved RVSPA Assessment Report related to:

- **Section 5.5 Kemptville Water Supply**; and
- **Section 5.6 Merrickville Water Supply**
- **All Tables and Figures associated with the Kemptville and Merrickville water supplies. More specifically, Tables 5-4 through 5-7, Figures 5-5a through 5-5p and Figures 5-6a through 5-6p**

None of the other chapters have been updated at this time, however, the following summary figures have been updated and are included in this Amendment:

- All wellhead protection areas within the MRSPR (Figure 5-10)
- All wellhead protection areas within the MRSPR with a vulnerability score of 8-10, including DNAPL zone (Figure 5-11)
- All wellhead protection areas and Intake Protection Zones within the MRSPR (Figure 5-12)

5.5 Kemptville Water Supply

The Town of Kemptville obtains its drinking water from four municipal wells, shown in Figure 5-5a, which draws water from the Nepean Formation sandstone. The four wells are drilled to depths between 62 and 110 m below ground surface. The wells have casing down to the Oxford Formation (above the Nepean Formation) and are open holes in the Oxford and Nepean Formations. The groundwater system supplies approximately 5,000 people.

The local geology in the Kemptville area consists of a thin overburden layer (less than two metres) in the western half of the area around Kemptville, while in the eastern half, local areas of increased overburden thickness are present (i.e. up to approximately 20 m). The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The Kemptville water system produces high-quality groundwater, the parameters that are tested for have been extremely stable across the testing period. Total coliform bacteria are detected rarely in raw water samples. Any Total Coliform present in the raw water is removed by disinfecting the water via Sodium Hypochlorite and adequate contact time. E.Coli is never detected in the raw or treated water samples.

Hardness and sodium concentrations are typical of the Nepean formation, the average hardness across the four wells is around 310 mg/L. Typical sodium concentrations range between 30 – 40 mg/L at all wells. 20 mg/L is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Department to protect individuals on sodium reduced diets. Sodium does not exceed any other benchmark, nor does it have human health effects except in a small number of cases that are considered in the advisory limit.

Private wells in the Kemptville area generally obtain water from a bedrock aquifer within the Oxford and March Formations.

In December 2010, the Municipality of North Grenville received funding from the Ontario Drinking Water Stewardship Program to extend the well casing of 3 of Kemptville's municipal drinking water wells (with the exception of the East Quadrant well, which was constructed later). The purpose of the well casing extension project is to ensure that the wells do not draw water from the shallow aquifer, and instead rely only on the deep aquifer. Well casing extensions into the deep aquifer provide an immediate and a cost effective action to reduce the wellhead protection area itself, and reduces the number of properties that would constitute significant threats. The work was completed in April 2011.

5.5.1 Delineation of Kemptville Wellhead Protection Area

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Kemptville area. Also, geologic

and hydrologic data was obtained from provincial and federal studies. These data were used to create the conceptual hydrogeological model for Kemptville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for Kemptville's conceptual model is shown in Figure 5-5b. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Kemptville wells.

Regionally, groundwater flow in the deep Nepean aquifer is from west to east. Locally, in the Town of Kemptville, groundwater flow in the shallow Oxford March Formation differs, flowing from the south, east, and west.

The Kemptville WHPAs were delineated using a forecasted combined flow rate for the four wells of 3,769 m^3/day. This flow rate is greater than the five year average flow rate of 1639 m^3/day. The forecasted flow rate was chosen based on water demands obtained from the J.L. Richards and Associates (JLR) 2011 Class EA Report together with 2018 pumping records for the Kemptville drinking water system to determine how much flow to allocated to each well.

The numerical model calculated WHPA A through D for the Kemptville system. Figure 5-5c shows the Kemptville wellhead protection area around the municipal wellheads. It is made up of a circle with a 100 m radius around the wellheads and the 2, 5, and 25 year times of travel. The total area of the Kemptville WHPAs is 630 km^2. As indicated on Figure 5-5c, a small area of WHPA-D, approximately 3.44 km^2, is located within the Raisin-South Nation Source Protection Region.

Section 5.3.2 discusses sensitivity analysis in WHPAs. The zones of high and low uncertainty are shown in Figure 5-5d for both WHPA delineation and vulnerability scoring.

5.5.2 Aquifer Vulnerability - Kemptville Wellhead Protection Area

Once the WHPA is delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI protocol discussed in Section 5.1.2 without the modification. Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing the ISI results into aquifer vulnerability (Low, Medium or High) for the areas within the WHPAs. Figures 5-5e show the results of the aquifer vulnerability assignment for Kemptville's WHPA.

The aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford aquifer, except for some small areas near the northern boundary of the WHPA which is medium as the Nepean aquifer gets closer to the ground surface.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence, extent and characteristics of water wells, pits and quarries, mines, construction activities, sewer services, septic systems

and stormwater infiltration was examined in the WHPA to determine whether adjustments to the vulnerability scoring were justified.

As shown on Figure 5-5e, twelve areas were identified where transport pathways increase the risk to the aquifer. The transport pathways are due to the presence of aggregate extraction operations. In each case, the vulnerability was increased from low to medium vulnerability because the aggregate extraction reduces the amount of overlying material to filter and/or attenuate contaminants.

5.5.3 Vulnerability Scoring - Kemptville Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPAs. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

The table shown in Section 5.5.3 has the scoring system laid out as per the Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in the table were used to assign vulnerability scores to the areas within the WHPA (Figure 5-5f and 5-5g).

Vulnerability Category (ISI)	WHPA-A	WHPA-B	WHPA-C	WHPA-D
High	10	10	8	6
Medium	10	8	6	4
Low	10	6	4	2

5.5.4 Managed Lands and Livestock Density – Kemptville Wellhead Protection Area

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.3.3. Figures 5-5h show the managed lands and the livestock density in the WHPAs. The percent managed lands and average livestock densities for each zone are listed in Table 5-4. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known.

5.5.5 Impervious Surfaces – Kemptville Wellhead Protection Area

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance may enter surface and groundwater systems. Impervious surface area calculations are required to determine if road salt application in vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Kemptville vulnerable aquifer areas is shown on Figure 5-5i. The results range from 0 to 88%.

5.5.6 Water Quality Threat Assessment - Kemptville Wellhead Protection Area

Water quality threats are existing conditions (i.e. contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Kemptville WHPA was completed in 2009.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be storing fuel, applying commercial fertilizer to land, and applying agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so each is therefore a separate threat.

Land use activities and associated threats that occur where the vulnerability score is high may result in determining it to be a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may store fuel, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

Table 5-7 demonstrates where the 22 prescribed activities are a significant threat. Moreover, the Threats Tool, which is a searchable database can be used to identify which of the prescribed threat activities would be a significant threat in the applicable vulnerability scores shown in Figure 5-5f. It is publicly accessible and can be found at the following link http://swpip.ca/. Information from the Threats Tool can be exported into a spreadsheet that can then be sorted either by threat status or vulnerability score. This tool could be used, along with the maps of vulnerability scores, to understand where the 22 prescribed activities are a significant drinking water threat.

Results of Kemptville Wellhead Protection Area Water Quality Threat Assessment

In the Rideau Valley Source Protection Area Assessment Report (2011), a total of 105 potentially significant drinking water threats were identified in the Kemptville WHPA. As of 2019, this number has been further refined to 50 existing and new threats. For the Kemptville WHPA, significant threats are where the vulnerability score is 10 (as there are no 8 scores), or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA-C. The potentially significant drinking water threats are summarized in Table 5-5. Figure 5-5j shows the areas containing potentially significant threats in red (the vulnerability score is 10). The area containing potentially significant threats is approximately 0.1 km^2. The map also outlines the areas containing potential DNAPL threats with a blue dashed line, an area of approximately 75 km^2. See Section 4.4.3 and Figure 5-5j for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, including major road arteries, exist within the Kemptville WHPA. These corridors are not considered an activity under Clean Water Act definitions and, therefore, do not fall within the prescribed list of threats (see Section 4.3). However, there is potential for the transportation of dangerous and/or hazardous goods along these corridors and the potential for a spill to occur. Transportation corridors will be considered in the development of the Source Protection Plan to ensure the protection of groundwater sources from potential accidental spills. Transportation corridors can be found on all WHPA maps including the Kemptville WHPA map in Figure 5-5d.

5.5.7 Issues and Conditions – Kemptville Wellhead Protection Area

As discussed in Chapter 4, issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. No issues were identified in the Kemptville WHPA.

A condition is a situation where past activities resulted in a drinking water threat. Based on the criteria, there are no confirmed conditions in the Kemptville WHPAs. However, in the Rideau Valley Source Protection Area Assessment Report (2011), there were six potential conditions noted in the Drinking Water Threats and Issues Technical Report.

5.6 Merrickville Water Supply

The Village of Merrickville obtains its drinking water from three municipal wells as shown in Figure 5-6a. Well 1, Well 2 and Well 4 are completed at 35, 49 and 50 m below ground surface, respectively. Well 3 was decommissioned in 2002. All three wells are completed in the Nepean Formation sandstone. The groundwater system supplies water for 1,000 people in Merrickville.

The local geology in the Merrickville area consists of a thin overburden layer (i.e. less than two metres) in the western half of the area around Merrickville, while in the eastern half, local areas of increased overburden thickness are present (i.e. up to approximately 20 m). The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The groundwater has been characterized as having elevated hardness and iron, which do not pose health risks. Elevated turbidity and colour have also been detected in the water, but these are not health risks. The source water has no chemical contaminants. Total coliform bacteria were found periodically between 2003 and 2006. However, *E. coli* has not been detected in the groundwater, and total coliforms are removed during water treatment.

Private wells in the Merrickville area generally obtain water from a bedrock aquifer within the Oxford and March Formation.

In December 2010, the Village of Merrickville-Wolford received funding from the Ontario Drinking Water Stewardship Program to extend the well casing of all 3 of Merrickville's municipal drinking water wells. The purpose of the well casing extension project is to ensure that the wells do not draw water from the shallow aquifer, and instead rely only on the deep aquifer. Well casing extensions into the deep aquifer provide an immediate and a cost effective action to reduce the wellhead protection area itself, and reduces the number of properties that would constitute significant threats. The work was completed in November 2011.

5.6.1 Delineation of Merrickville Wellhead Protection Area

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Merrickville area. Also, geologic and hydrologic data was obtained from provincial and federal studies. These data were used to create the conceptual hydrogeological model for Merrickville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for the conceptual model is shown in Figure 5-6b. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Merrickville wells.

Regionally, groundwater flow in the deep Nepean aquifer is from west to east. Locally, in the Town of Merrickville, groundwater flow in the shallow Oxford and March Formations is from the south and west.

The Merrickville WHPAs were delineated using a forecasted combined flow rate for the three wells of 520 m^3/day. This flow rate is slightly greater than the five year average flow rate of 515 m^3/day presented in Table 2-17 of Chapter 2.

The numerical model calculated WHPA A through D for the Merrickville system for the aquifer systems. Figure 5-6c shows the Merrickville wellhead protection areas around the municipal wellheads. It is made up of a circle with a 100 m radius around the wellheads and the 2, 5, and 25 year times of travel. The total area of the Merrickville WHPAs is approximately 160 km^2.

Section 5.3.2 discusses sensitivity analysis in the WHPA. The zones of high and low uncertainty are shown in Figure 5-6d for WHPA delineation and vulnerability scoring.

5.6.2 Aquifer Vulnerability - Merrickville Wellhead Protection Area

Once the WHPA is delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI protocol discussed in Section 5.1.2 without the modification. Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPAs. Figures 5-6e show the results of the aquifer vulnerability assignment, for the Merrickville WHPA.

The aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford aquifer, except for some small areas near the northwest

boundary of the WHPA which is medium as the Nepean aquifer gets closer to the ground surface.

Under the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. The presence, extent and characteristics of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA to determine whether adjustments to the vulnerability scoring were justified.

As shown on Figure 5-6f, eight areas were identified where transport pathways increase the risk to the aquifer. The transport pathways are due to the presence of aggregate extraction operations. In each case, the vulnerability was increased from low to medium or medium to high vulnerability because the aggregate extraction reduces the amount of overlying material to filter and/or attenuate contaminants.

5.6.3 Vulnerability Scoring - Merrickville Wellhead Protection Area

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPAs. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score.

The table shown in Section 5.5.3 has the scoring system laid out as per the Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination. The categories in the table were used to assign vulnerability scores to the areas within the WHPA (Figures 5-6f and 5-6g).

5.6.4 Managed Lands and Livestock Density – Merrickville Wellhead Protection Area

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.3.3. Figure 5-6h show the managed lands and the livestock density in the WHPA~~s~~. The percent managed lands and average livestock densities for each zone are listed in Table 5-6. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known.

5.6.5 Impervious Surfaces – Merrickville Wellhead Protection Area

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance may enter surface and groundwater systems. Impervious surface area calculations are required to determine if road salt application in vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 Impervious Surfaces. The percent impervious surfaces results for each grid within the Merrickville vulnerable aquifer areas are shown on Figure 5-6i. The results range from 0 to 88%. The higher values found in this area are attributed to the Town of Smiths Falls.

5.6.6 Water Quality Threat Assessment - Merrickville Wellhead Protection Area

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply. A land use inventory of the Merrickville WHPA was completed in 2009.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be storing fuel, applying commercial fertilizer to land, and applying agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so each is therefore a separate threat.

Land use activities and associated threats that occur where the vulnerability score is high may result in determining it to be a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may store fuel, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

Table 5-7 demonstrates where the 22 prescribed activities are a significant threat. Moreover, the Threats Tool, which is a searchable database can be used to identify which of the prescribed threat activities would be a significant threat in the applicable vulnerability scores shown in Figure 5-6f. It is publicly accessible and can be found at the following link http://swpip.ca/. Information from the Threats Tool can be exported into a spreadsheet that can then be sorted either by threat status or vulnerability score. This tool could be used, along with the maps of vulnerability scores, to understand where the 22 prescribed activities are a significant drinking water threat.

Results of Merrickville Wellhead Protection Area Water Quality Threat Assessment

In the Rideau Valley Source Protection Area Assessment Report (2011), a total of 24 potentially significant drinking water threats were identified in the Merrickville WHPA. As of 2019, this number has been further refined to 5 existing threats. For the Merrickville WHPA, significant threats are where the vulnerability score is 10 (as there is no 8 scores), or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA C. The potentially significant drinking water threats are summarized in Table 5-7. Figure 5-6j shows the areas containing potentially significant threats in red (the vulnerability score is 10). The area containing potentially significant threats is approximately 0.04 km^2. The map also outlines the areas containing potential DNAPL threats with a blue dashed line, an area of approximately 57 km^2. See Section 4.4.3 and Figure 5.6j for information on the full list of significant, moderate, and low threats.

Transportation Corridors

A number of transportation corridors, including major road arteries, exist within the Merrickville WHPA. These corridors are not considered an activity under Clean Water Act definitions and, therefore, do not fall within the prescribed list of threats (see Section 4.3). However, there is potential for the transportation of dangerous and/or hazardous goods along these corridors and the potential for a spill to occur. Transportation corridors will thus be considered in the development of the Source Protection Plan to ensure the protection of groundwater sources from potential accidental spills. Transportation corridors can be found on all WHPA maps including the Merrickville WHPA maps in Figures 5-6c and 5-6d.

5.6.7 Issues and Conditions – Merrickville Wellhead Protection Area

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Merrickville WHPA.

5.1.1 References

Study	Consultant
Kemptville Well Field Managed Lands and Livestock Density Calculations, Final Report, September 20, 2019	Dillon Consulting
Merrickville Well Field Managed Lands and Livestock Density Calculations, Final Report, September 4, 2019	Dillon Consulting
Threats Assessment –Kemptville/Merrickville Well Systems, North Grenville/Merrickville-Wolford, Ontario, September 19, 2019	Golder Associates Ltd.
Groundwater Vulnerability Study, Kemptville-Merrickville Well Systems, September 2019	Golder Associates Ltd.
Assessment Report, Rideau Valley Source Protection Area, December 19, 2011	N/A

List of Tables for Amendment (Assessement Report, RVSPA)	
Table 5-4	Risk to Kemptville WHPAs Based on Managed Lands and Livestock Density
Table 5-5	Summary of Potentially Significant Threats to Kemptville Source Water
Table 5-6	Risk to Merrickville WHPAs Based on Managed Lands and Livestock Density
Table 5-7	Summary of Potentially Significant Threats to Merrickville's Source Water
Table 5-8	Drinking Water Threats

Table 5-4

Risk to Kemptville WHPAs Based on Managed Lands and Livestock Density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density (NU/acre)	Risk for Over Application of ASM
Zone A (10)	45.96%	MODERATE	0.0	LOW
Zone B (8)	3.72%	LOW	0.0	LOW
Zone B (6)	42.97%	MODERATE	0.48	MODERATE
Zone C (6)	0.13%	LOW	0.0	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

Table 5-5

Summary of Potentially Significant Threats to Kemptville Source Water

Mississippi - Rideau Source Protection Region

North Grenville

		Existing/Managed Threats					New Threats		Removed Threats						
Prescribed Drinking Water Threat	Land Use Activity / Threat Subcategory	Electronic and Precision Equipment Repair and Maintenance	Residential Fuel / Hydrcarbon Storage	Road Salt Application	Sewer Mainlines and Connections	Total	Electronic and Precision Equipment Repair and Maintenance	Total	Dry Cleaning and Laundry Services	Electric Power Generation, Transmission and Distribution	Other Ambulatory Health Care Services	Residential Fuel / Hydrcarbon Storage	Dry Cleaning and Laundry Services	Other Wood Product Manufacturing	Total
The application of road salt.	Application Of Road Salt			8		**8**									
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage System Or Sewage Works - Sanitary Sewers and related pipes				3	**3**									
The handling and storage of a dense non-aqueous phase liquid.	Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	15				**15**	4	**4**	2	1			1	1	**5**
	Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	15				**15**	4	**4**	2	1			1	1	**5**
The handling and storage of fuel.	Handling Of Fuel					**0**				1	1				**2**
	Storage Of Fuel		1			**1**				1	1	77			**79**
	Total	**30**	**1**	**8**	**3**	**42**	**4**	**8**	**4**	**4**	**2**	**77**	**2**	**2**	**91**

Table 5-6

Risk to Merrickville's WHPAs Based on Managed Lands and Livestock Density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density (NU/acre)	Risk for Over Application of ASM
Zone A (10)	21.60%	LOW	0.0	LOW
Zone B (6)	30.00%	LOW	0.3	LOW
Zone C (6)	0.00%	LOW	0.0	LOW
Zone D (6)	6.60%	LOW	0.0	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

Table 5-7

Summary of Potentially Significant Threats to Merrickville's Source Water

Mississippi - Rideau Source Protection Region

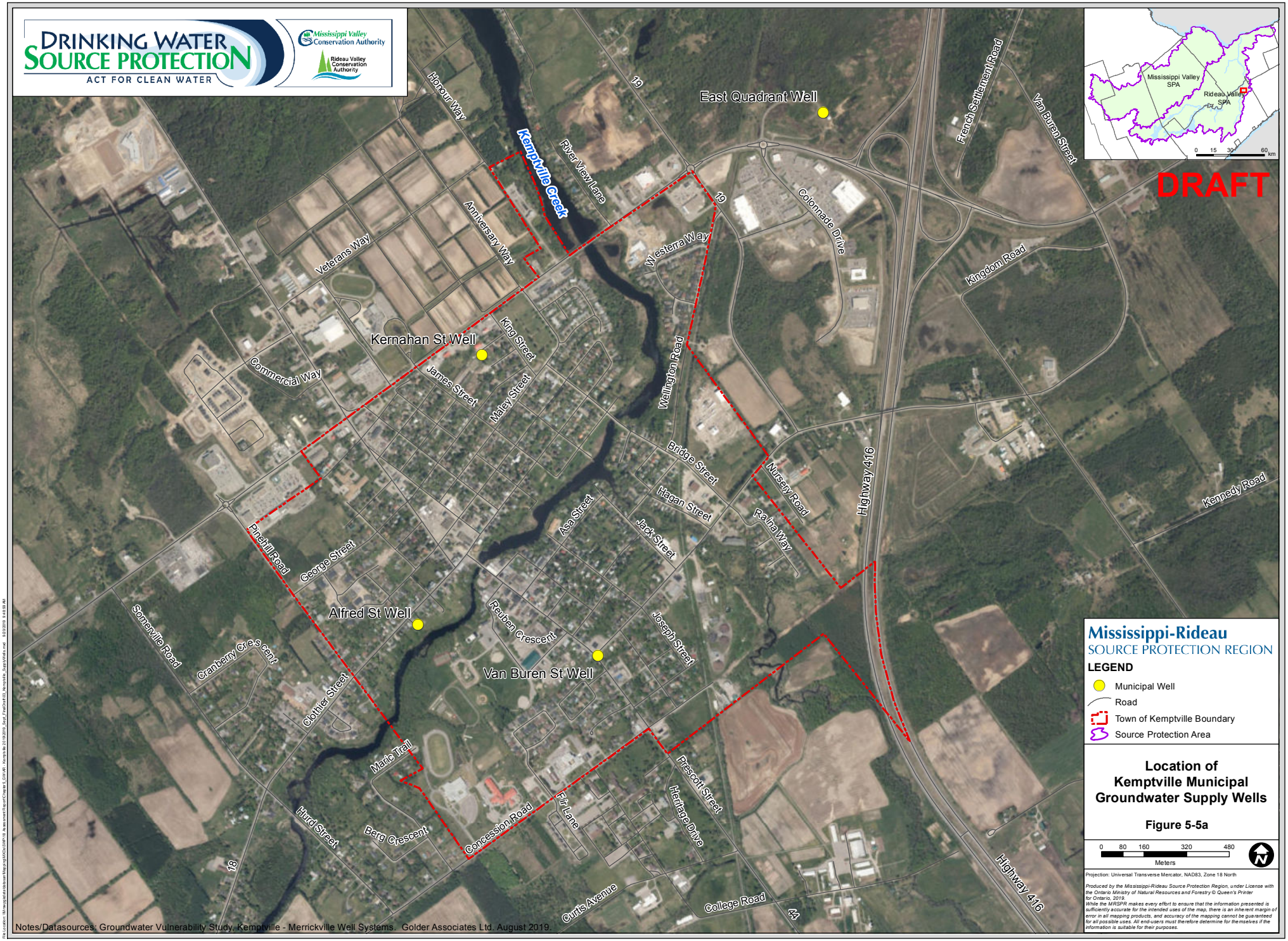
		Existing/Managed Threats			Removed Threats		
Prescribed Drinking Water Threat	Land Use Activity / Threat Subcategory	Electric Power Generation, Transmission and Distribution	Sewer Mainlines and Connections	Total	Electric Power Generation, Transmission and Distribution	Residential Fuel / Hydrcarbon Storage	Total
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage System Or Sewage Works - Sanitary Sewers and related pipes		1	**1**			
The handling and storage of a dense non-aqueous phase liquid.	Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	2		**2**	1		**1**
	Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	2		**2**	1		**1**
The handling and storage of fuel.	Handling Of Fuel						
	Storage Of Fuel					21	**21**
	Total	**4**	**1**	**5**	2	21	**23**

Table 5-8
Drinking Water Threats
Mississippi - Rideau Source Protection Region

	Prescribed Drinking Water Threats Ontario Regulation 287/07 s.1.1 (1)	Land Use/Activity	Wellhead Protection Area (WHPA) Vulnerability Scoring									
			Chemical					Pathogen				
			10	8	6	4	2	10	8	6	4	2
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* .	Landfills - active & closed; Hazardous Waste Disposal; Liquid Industrial Waste	✓	✓				✓				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage Infrastructure; Septic Systems, etc.	✓	✓				✓				
3	The application of agricultural source material to land.	e.g. manure, whey, etc.	✓					✓				
4	The storage of agricultural source material.	e.g. manure, whey, etc.	✓					✓				
5	The management of agricultural source material.	aquaculture										
6	The application of non-agricultural source material to land.	Organic Soil Conditioning; Biosolids	✓					✓				
7	The handling and storage of non-agricultural source material.	Organic Soil Conditioning; Biosolids	✓					✓				
8	The application of commercial fertilizer to land.	Agriculture fertilizer	✓									
9	The handling and storage of commercial fertilizer.	General Fertilizer Storage	✓									
10	The application of pesticide to land.	Pesticides	✓									
11	The handling and storage of pesticide.	General Pesticide Storage	✓									
12	The application of road salt.	Road Salt Application	✓									
13	The handling and storage of road salt.	Road Salt Storage	✓									
14	The storage of snow.	Snow Dumps	✓									
15	The handling and storage of fuel.	Petroleum Hydrocarbons	✓									
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLs)*.	DNAPLs	Anywhere in 5 year time of travel									
17	The handling and storage of an organic solvent.	Organic Solvents	✓									
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	De-Icing	✓									
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.**	Private Water Taking										
20	An activity that reduces the recharge of an aquifer.**	Impervious Surfaces										
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	Agriculture Operations	✓					✓				
22	The establishment and operation of a liquid hydrocarbon pipeline.	Liquid Hydrocarbon Pipeline	✓									

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

List of Figures


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
East Quadrant Well
Kemptville Creek
Kernahan St Well
Alfred St Well
Van Buren St Well
Honour Way
River View Lane
Anniversary Way
Veterans Way
Commercial Way
King Street
James Street
Maley Street
Wellington Road
Western Way
Colonnade Drive
French Settlement Road
Van Buren Street
Kingdom Road
Bridge Street
Hagan Street
Asa Street
Jack Street
Nursery Road
Raina Way
Highway 416
Kennedy Road
Pinehill Road
George Street
Somerville Road
Cranberry Crescent
Reuben Crescent
Joseph Street
Clothier Street
Mario Trail
Prescott Street
Heritage Drive
Fir Lane
Hurd Street
Berg Crescent
Concession Road
Curtis Avenue
College Road
Highway 416
19
18
44
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Town of Kemptville Boundary
Source Protection Area
Location of Kemptville Municipal Groundwater Supply Wells
Figure 5-5a
0 80 160 320 480
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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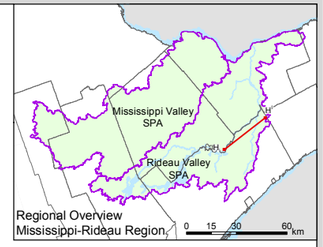
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority



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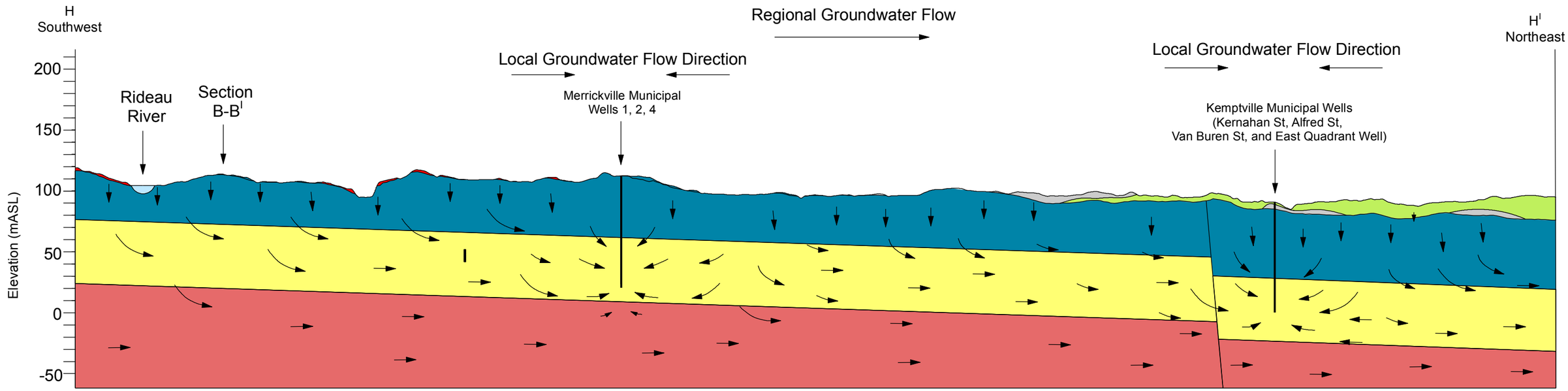


1:25 Vertical Exaggeration

LEGEND

Formation

- River/Lake
- Undifferentiated Overburden (Quaternary Deposits)
- Clay
- Sand and Gravel
- Oxford/March Formations (Dolostone/Limestone)
- Nepean Formation (Sandstone)
- Precambrian (Granite)

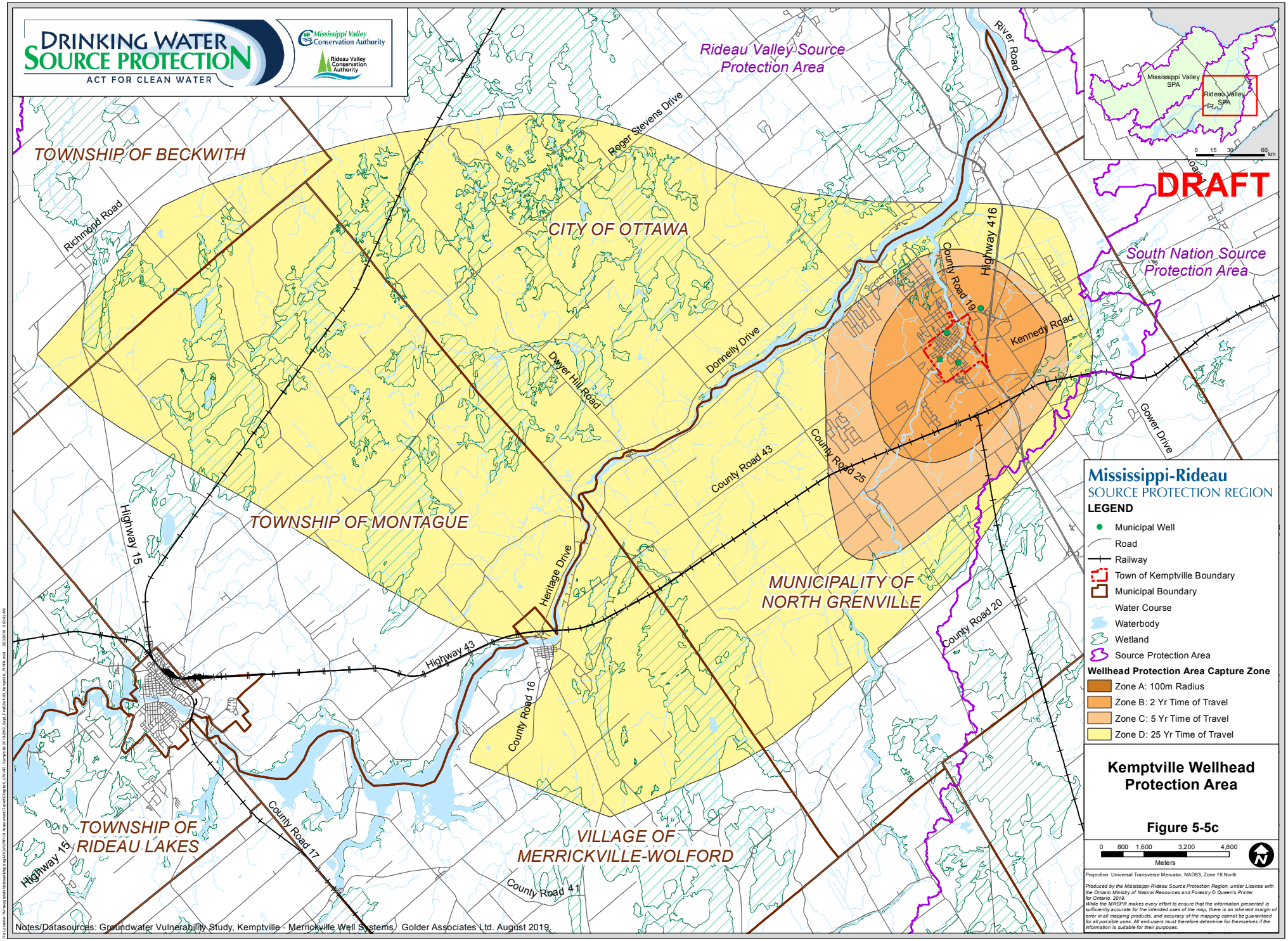
Mississippi-Rideau
SOURCE PROTECTION REGION

Kemptville Conceptual Hydrogeoligical Cross-Section

Figure 5-5b

Projection: Universal Transverse Mercator, NAD83, Zone 18 North

Notes/Datasources: Modified from Golder 2003a. This information is regional in nature and not intended for site-specific evaluations. The figure should be used only in conjunction with the accompanying report.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Rideau Valley Source Protection Area
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
MUNICIPALITY OF NORTH GRENVILLE
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
South Nation Source Protection Area
Roger Stevens Drive
Richmond Road
River Road
Highway 416
County Road 19
Kennedy Road
Donnelly Drive
Dwyer Hill Road
Gower Drive
County Road 43
County Road 25
Heritage Drive
Highway 15
Highway 43
County Road 16
County Road 20
County Road 17
County Road 41
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Wellhead Protection Area Capture Zone
Zone A: 100m Radius
Zone B: 2 Yr Time of Travel
Zone C: 5 Yr Time of Travel
Zone D: 25 Yr Time of Travel
Kemptville Wellhead Protection Area
Figure 5-5c
0 800 1,600 3,200 4,800
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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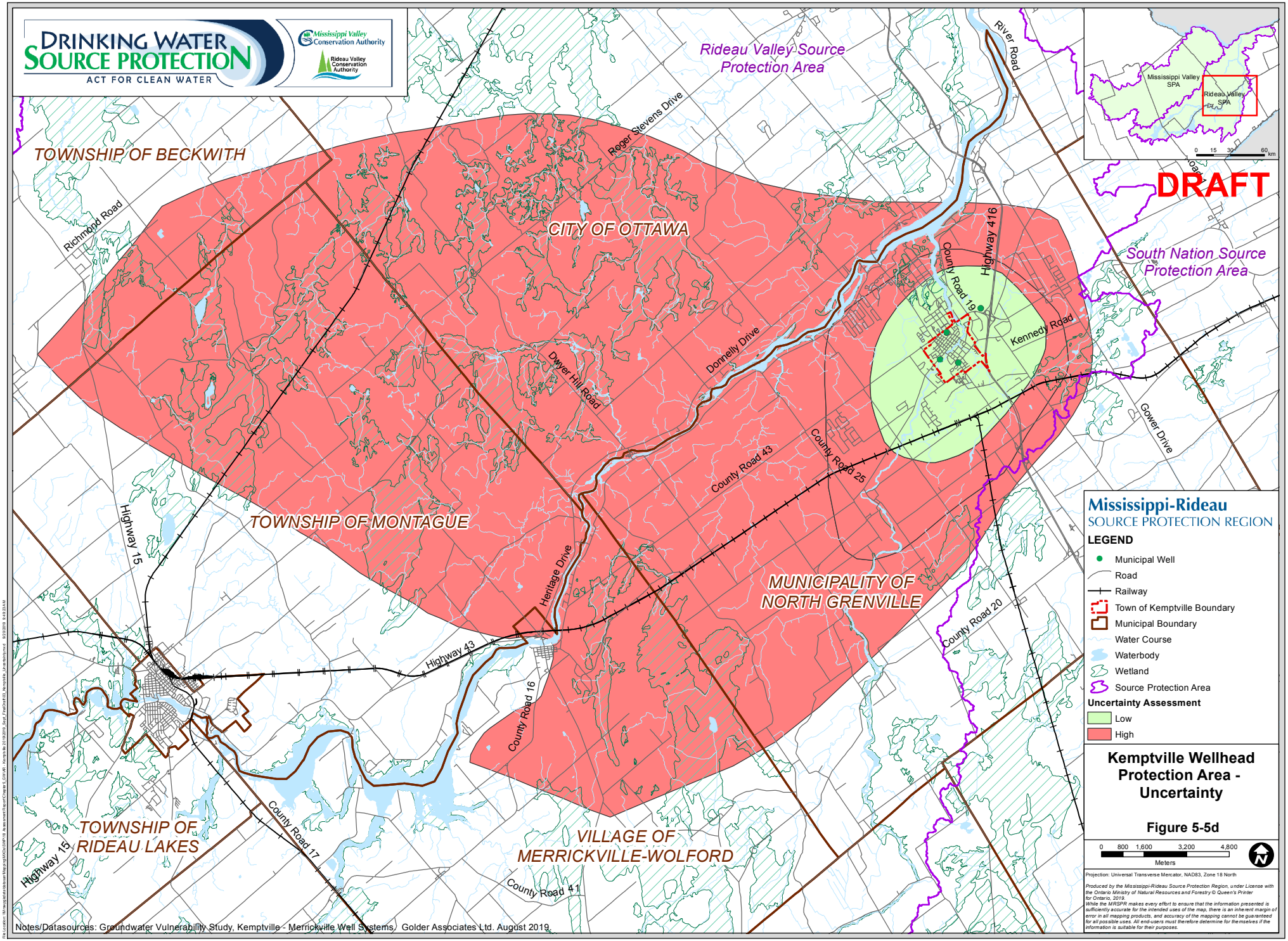
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems, Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Rideau Valley Source Protection Area
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
MUNICIPALITY OF NORTH GRENVILLE
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
South Nation Source Protection Area
Roger Stevens Drive
Richmond Road
River Road
Highway 416
County Road 19
Kennedy Road
Donnelly Drive
Dwyer Hill Road
County Road 43
County Road 25
Gower Drive
Heritage Drive
Highway 15
Highway 43
County Road 16
County Road 20
County Road 17
County Road 41
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Uncertainty Assessment
Low
High
Kemptville Wellhead Protection Area - Uncertainty
Figure 5-5d
0 800 1,600 3,200 4,800
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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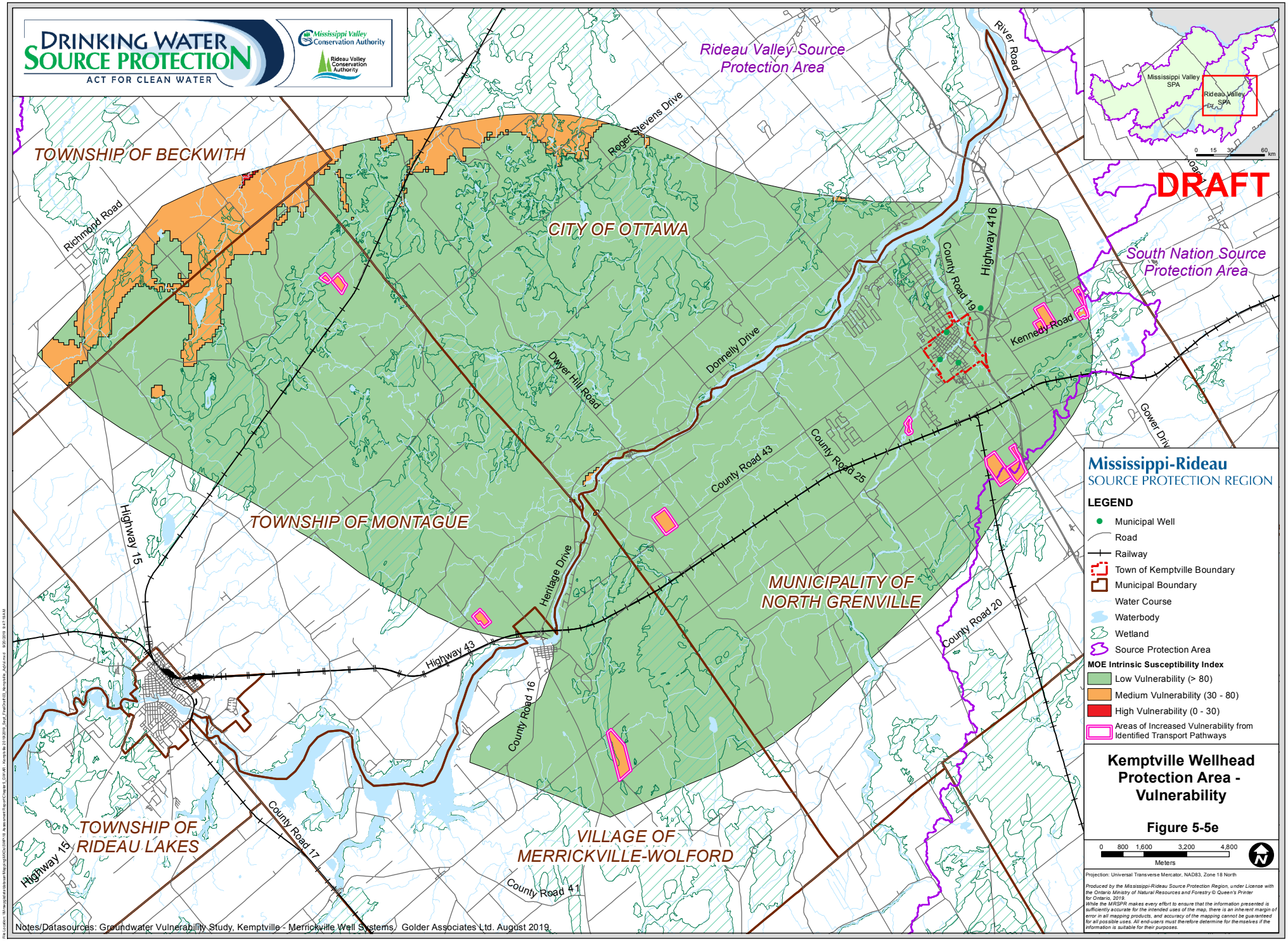
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems, Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Rideau Valley Source Protection Area
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
MUNICIPALITY OF NORTH GRENVILLE
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
South Nation Source Protection Area
Richmond Road
Roger Stevens Drive
River Road
Highway 416
County Road 19
Kennedy Road
Donnelly Drive
Dwyer Hill Road
Gower Drive
County Road 43
County Road 25
Heritage Drive
Highway 15
Highway 43
County Road 16
County Road 20
County Road 17
County Road 41
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
MOE Intrinsic Susceptibility Index
Low Vulnerability (> 80)
Medium Vulnerability (30 - 80)
High Vulnerability (0 - 30)
Areas of Increased Vulnerability from Identified Transport Pathways
Kemptville Wellhead Protection Area - Vulnerability
Figure 5-5e
0 800 1,600 3,200 4,800
Meters
N
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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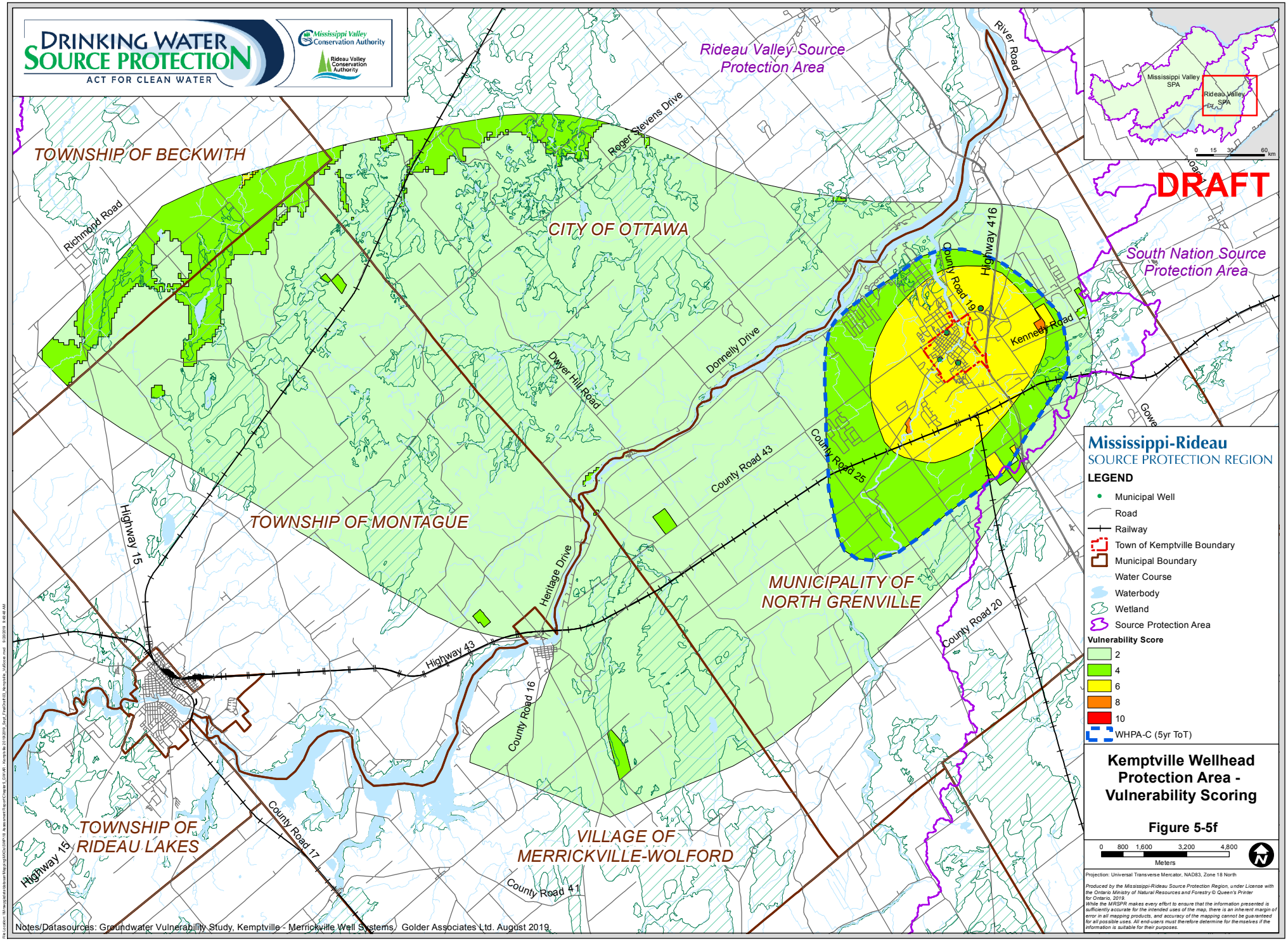
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems, Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Rideau Valley Source Protection Area
South Nation Source Protection Area
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
MUNICIPALITY OF NORTH GRENVILLE
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Roger Stevens Drive
Richmond Road
Dwyer Hill Road
Donnelly Drive
River Road
Highway 416
County Road 19
Kennedy Road
County Road 25
County Road 43
Highway 15
Heritage Drive
Highway 43
County Road 16
County Road 20
County Road 17
County Road 41
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Vulnerability Score
2
4
6
8
10
WHPA-C (5yr ToT)
Kemptville Wellhead Protection Area - Vulnerability Scoring
Figure 5-5f
0 800 1,600 3,200 4,800
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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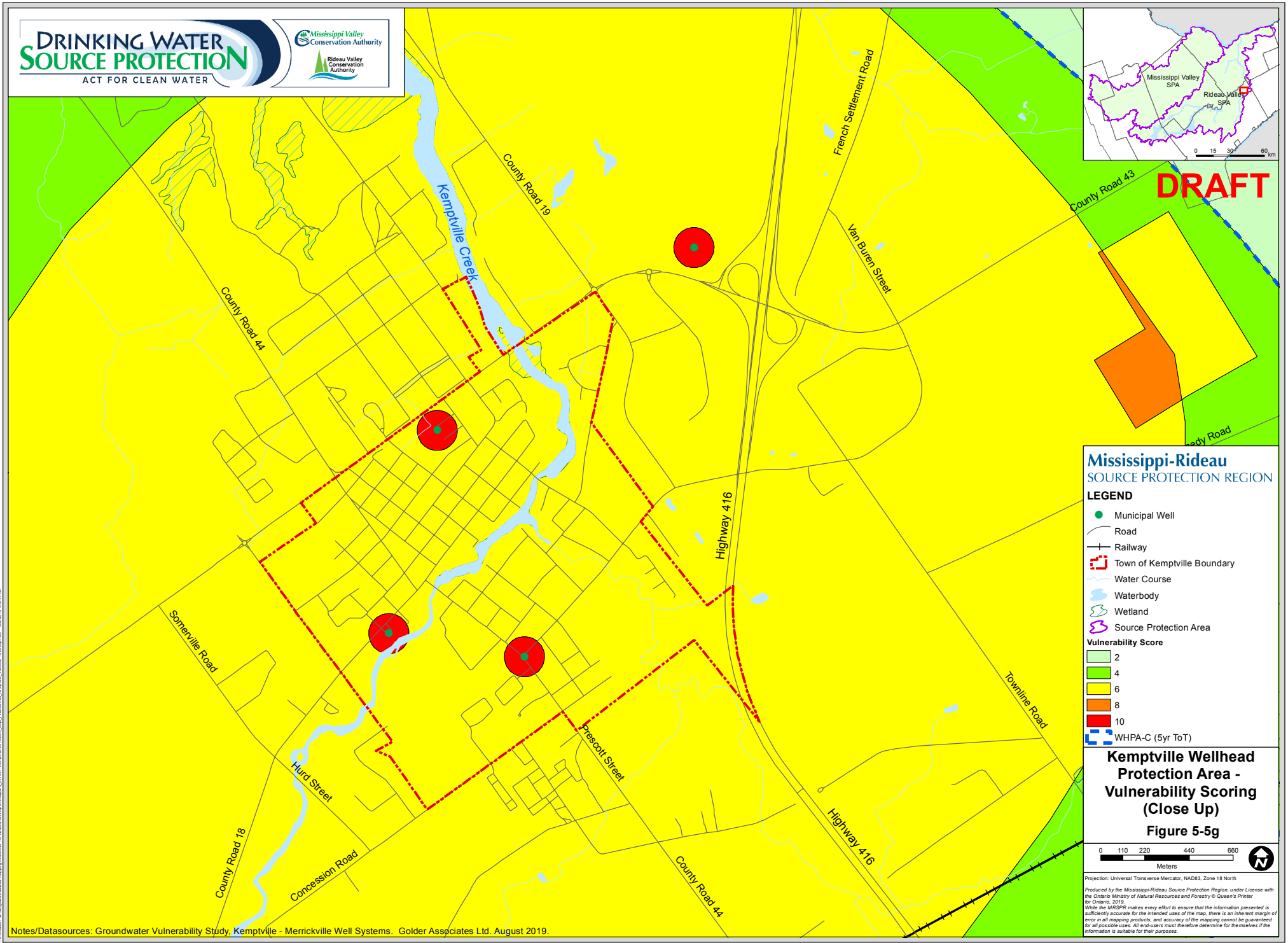
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems, Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Kemptville Creek
County Road 19
French Settlement Road
County Road 43
Van Buren Street
County Road 44
Highway 416
Somerville Road
Townline Road
Prescott Street
Hurd Street
County Road 18
Concession Road
County Road 44
Highway 416
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Vulnerability Score
2
4
6
8
10
WHPA-C (5yr ToT)
Kemptville Wellhead Protection Area - Vulnerability Scoring (Close Up)
Figure 5-5g
0 110 220 440 660
Meters
N
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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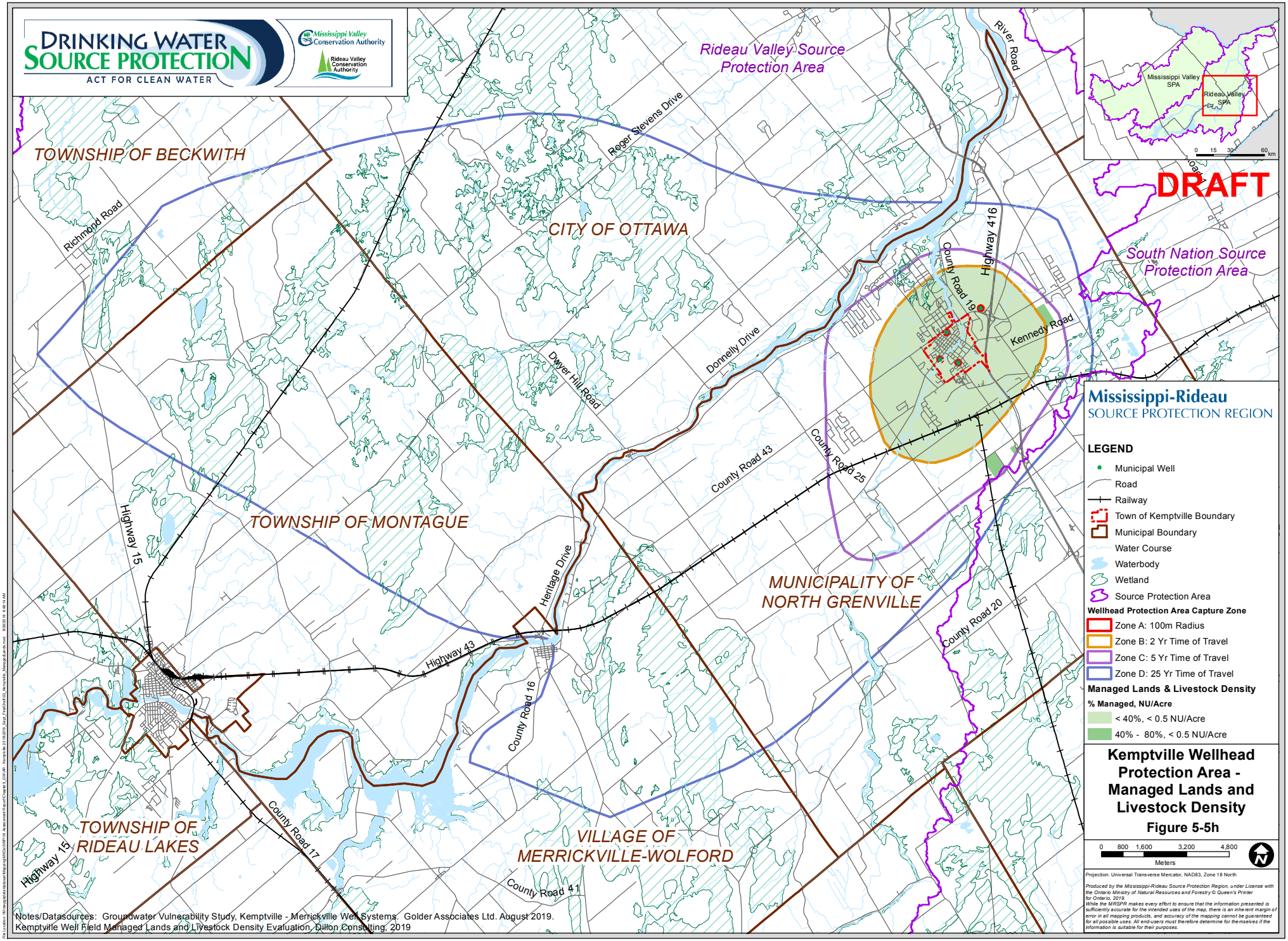
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Rideau Valley Source Protection Area
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF RIDEAU LAKES
MUNICIPALITY OF NORTH GRENVILLE
VILLAGE OF MERRICKVILLE-WOLFORD
South Nation Source Protection Area
Richmond Road
Roger Stevens Drive
Dwyer Hill Road
Donnelly Drive
River Road
Highway 416
County Road 19
Kennedy Road
County Road 43
County Road 25
Heritage Drive
Highway 15
Highway 43
County Road 16
County Road 17
County Road 20
County Road 41
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Wellhead Protection Area Capture Zone
Zone A: 100m Radius
Zone B: 2 Yr Time of Travel
Zone C: 5 Yr Time of Travel
Zone D: 25 Yr Time of Travel
Managed Lands & Livestock Density
% Managed, NU/Acre
< 40%, < 0.5 NU/Acre
40% - 80%, < 0.5 NU/Acre
Kemptville Wellhead Protection Area - Managed Lands and Livestock Density
Figure 5-5h
0 800 1,600 3,200 4,800
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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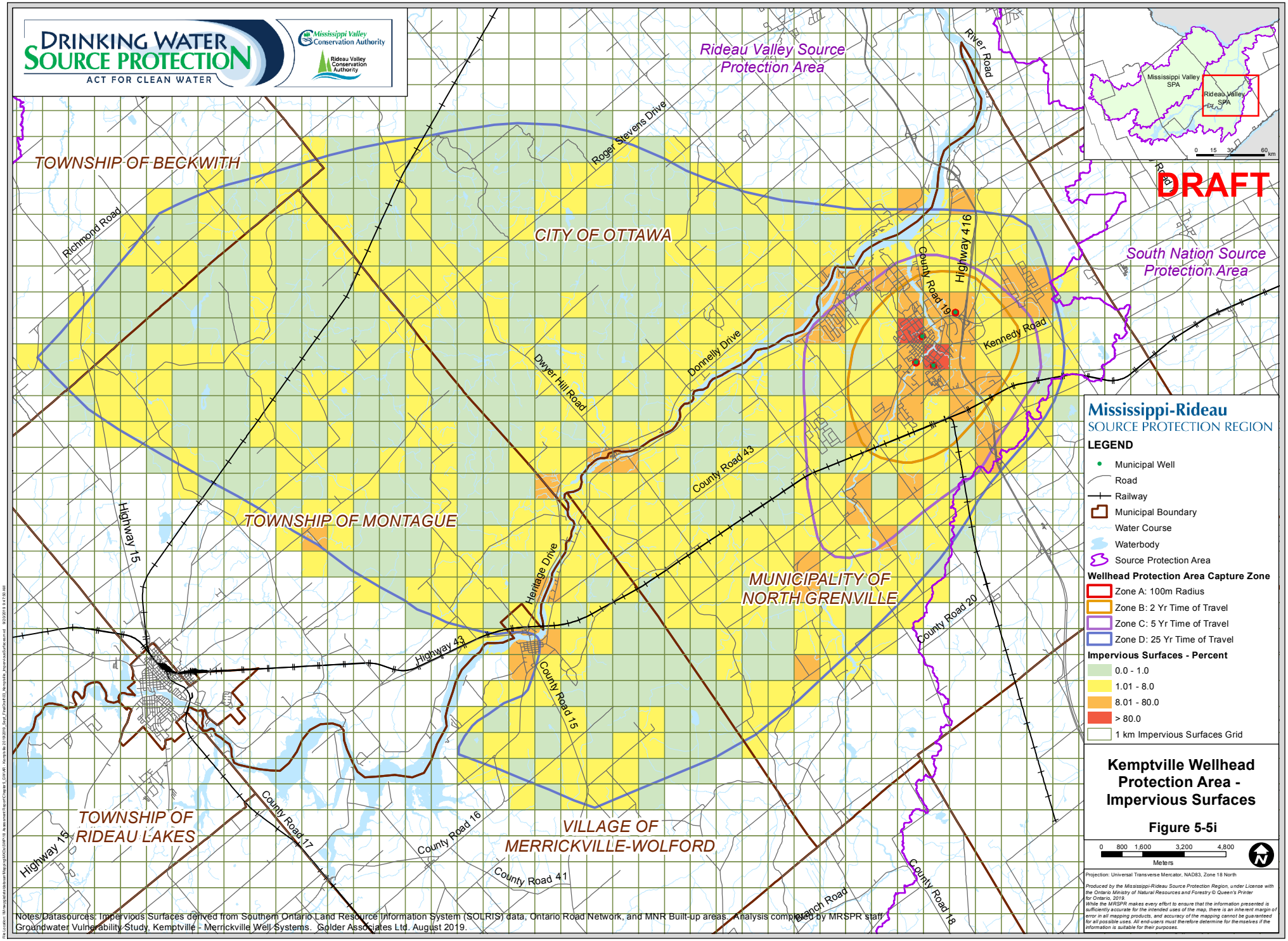
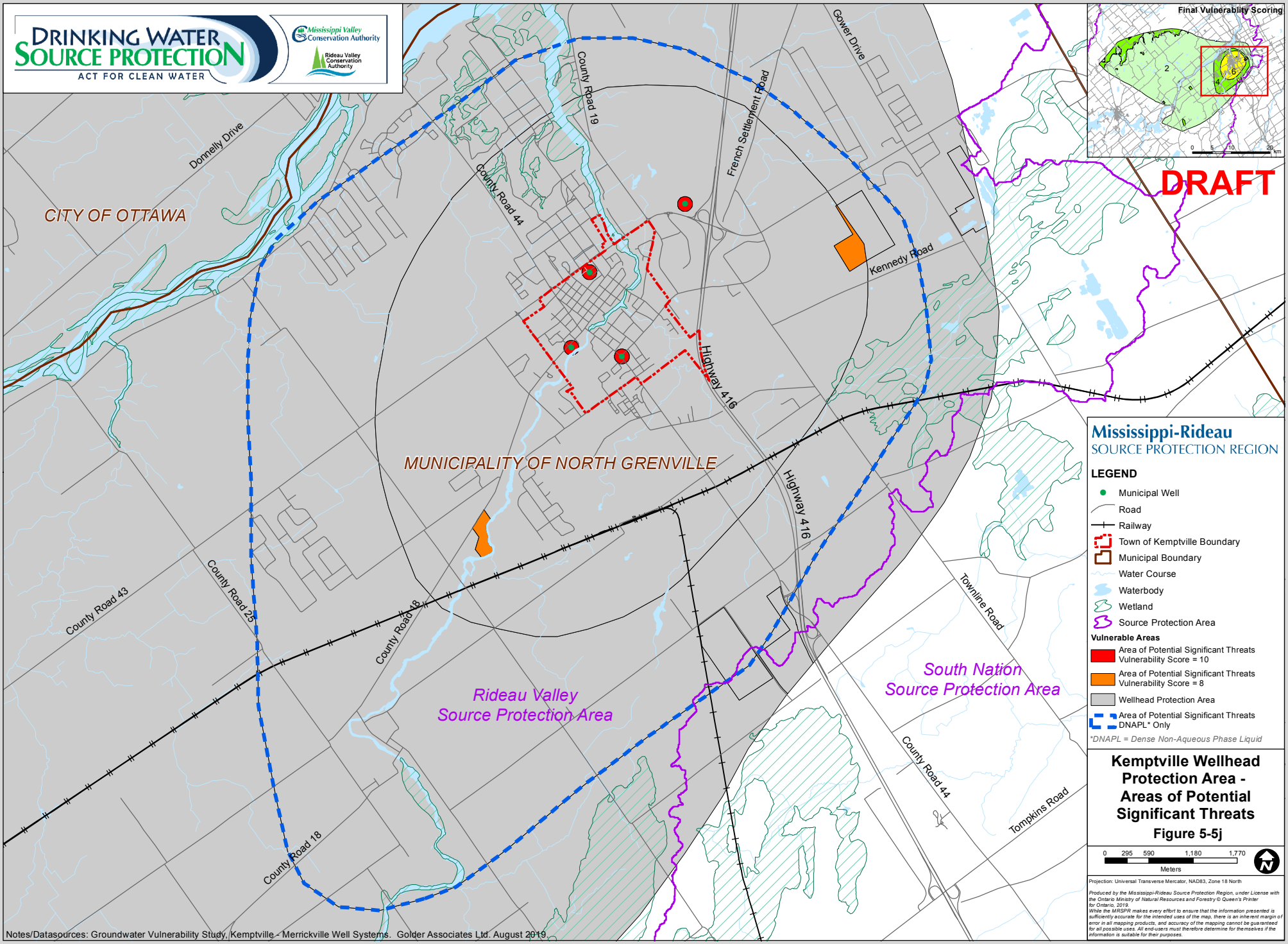
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.
Kemptville Well Field Managed Lands and Livestock Density Evaluation, Dillon Consulting, 2019



Notes/Datasources: Impervious Surfaces derived from Southern Ontario Land Resource Information System (SOLRIS) data, Ontario Road Network, and MNR Built-up areas. Analysis completed by MRSPR staff.
Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Final Vulnerability Scoring
DRAFT
CITY OF OTTAWA
MUNICIPALITY OF NORTH GRENVILLE
Donnelly Drive
County Road 19
County Road 44
French Settlement Road
Gower Drive
Kennedy Road
Highway 416
Highway 416
County Road 43
County Road 25
County Road 18
County Road 18
Townline Road
County Road 44
Tompkins Road
Rideau Valley Source Protection Area
South Nation Source Protection Area
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Town of Kemptville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Vulnerable Areas
Area of Potential Significant Threats Vulnerability Score = 10
Area of Potential Significant Threats Vulnerability Score = 8
Wellhead Protection Area
Area of Potential Significant Threats DNAPL* Only
*DNAPL = Dense Non-Aqueous Phase Liquid
Kemptville Wellhead Protection Area - Areas of Potential Significant Threats
Figure 5-5j
0 295 590 1,180 1,770
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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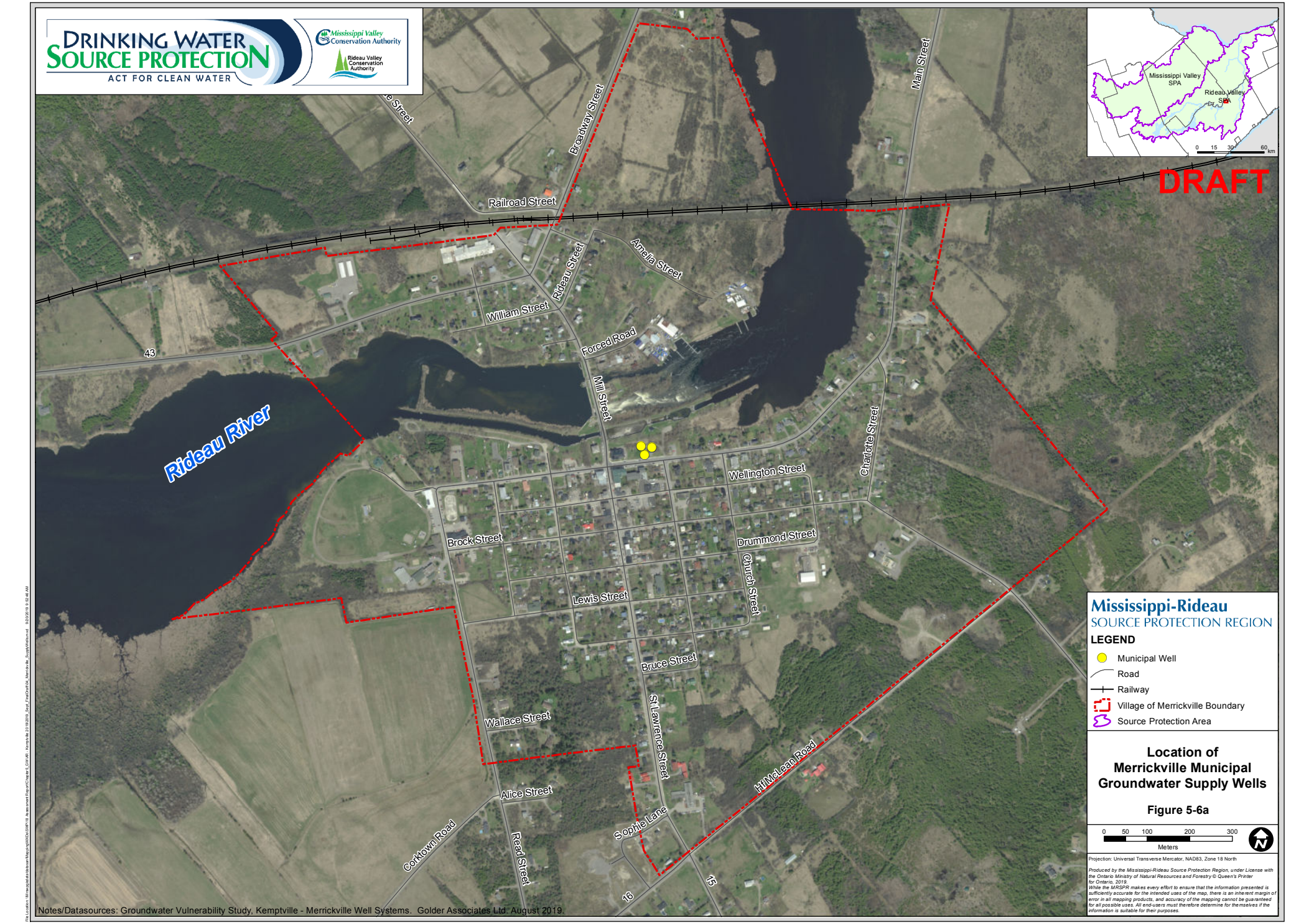
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Broadway Street
Main Street
Railroad Street
Rideau Street
Amelia Street
William Street
Forced Road
43
Mill Street
Rideau River
Charlotte Street
Wellington Street
Brock Street
Drummond Street
Church Street
Lewis Street
Bruce Street
St Lawrence Street
Wallace Street
HiMcLean Road
Alice Street
Corktown Road
Read Street
Sophie Lane
16
15
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Source Protection Area
Location of Merrickville Municipal Groundwater Supply Wells
Figure 5-6a
0 50 100 200 300
Meters
N
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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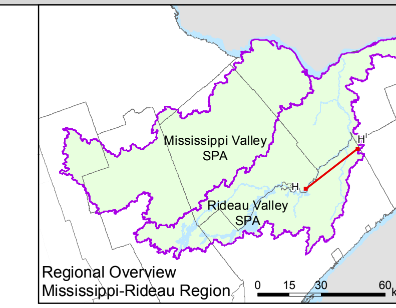
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority



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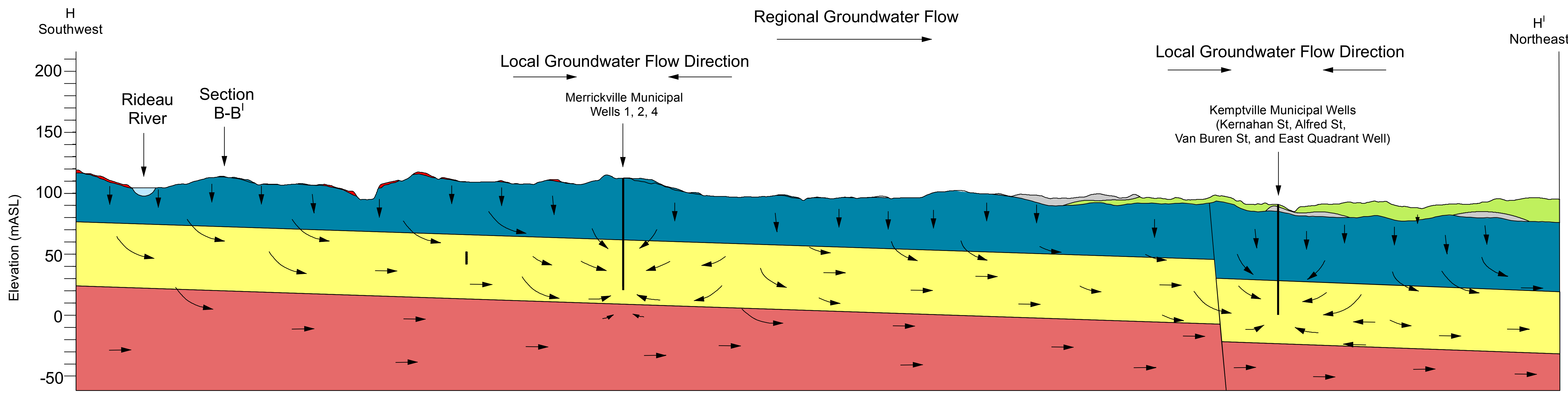


LEGEND

Formation

- River/Lake
- Undifferentiated Overburden (Quaternary Deposits)
- Clay
- Sand and Gravel
- Oxford/March Formations (Dolostone/Limestone)
- Nepean Formation (Sandstone)
- Precambrian (Granite)

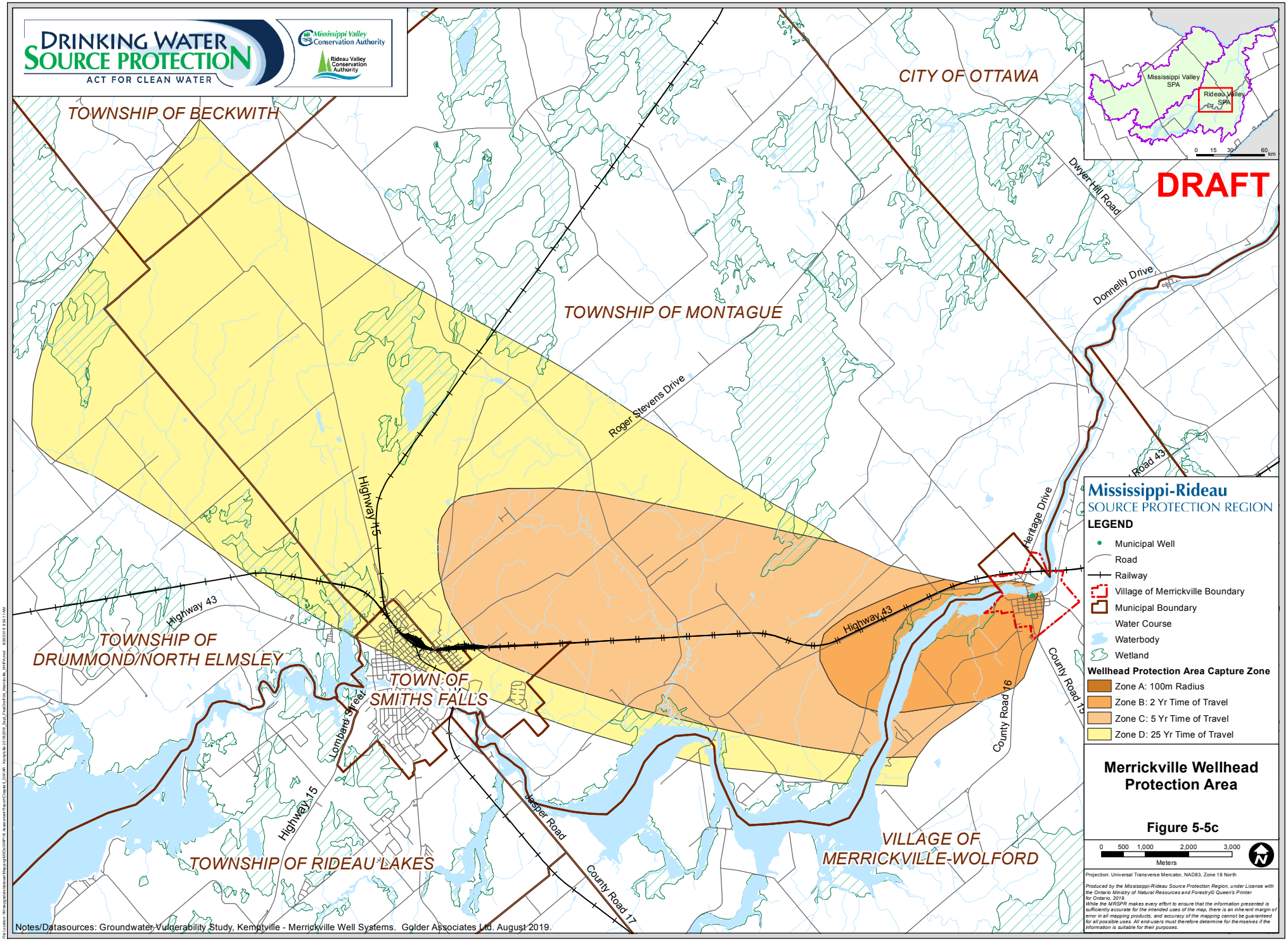
Mississippi-Rideau SOURCE PROTECTION REGION

Merrickville Conceptual Hydrogeoligical Cross-Section

Figure 5-6b

Projection: Universal Transverse Mercator, NAD83, Zone 18 North

Notes/Datasources: Modified from Golder 2003a. This information is regional in nature and not intended for site-specific evaluations. The figure should be used only in conjunction with the accompanying report.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Dwyer Hill Road
Donnelly Drive
Roger Stevens Drive
Road 43
Heritage Drive
Highway 15
Highway 43
Lombard Street
Jasper Road
County Road 16
County Road 15
County Road 17
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Wellhead Protection Area Capture Zone
Zone A: 100m Radius
Zone B: 2 Yr Time of Travel
Zone C: 5 Yr Time of Travel
Zone D: 25 Yr Time of Travel
Merrickville Wellhead Protection Area
Figure 5-5c
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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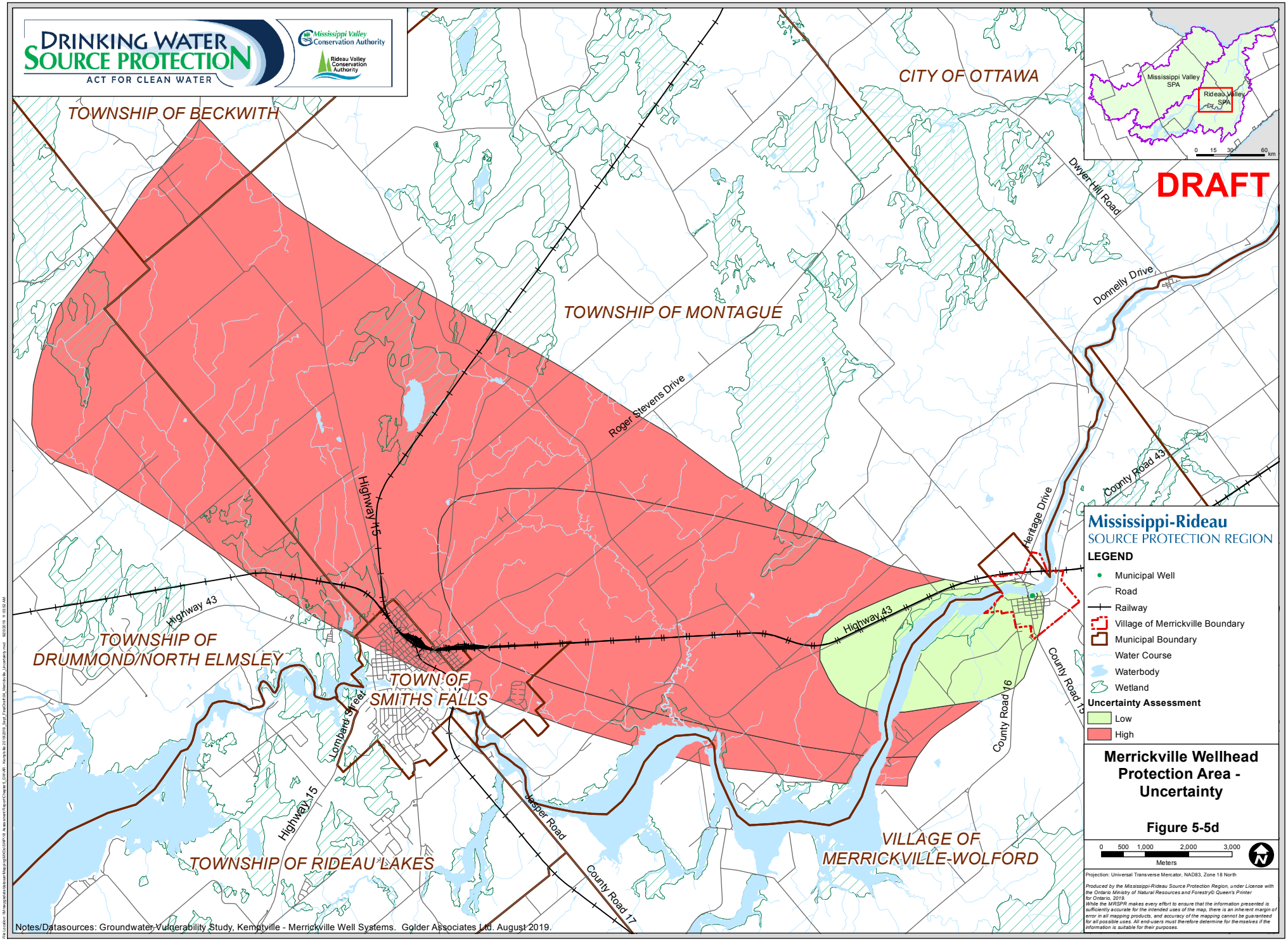
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Dwyer Hill Road
Donnelly Drive
Roger Stevens Drive
County Road 43
Heritage Drive
Highway 43
Highway 15
Lombard Street
Jasper Road
County Road 16
County Road 15
County Road 17
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Uncertainty Assessment
Low
High
Merrickville Wellhead Protection Area - Uncertainty
Figure 5-5d
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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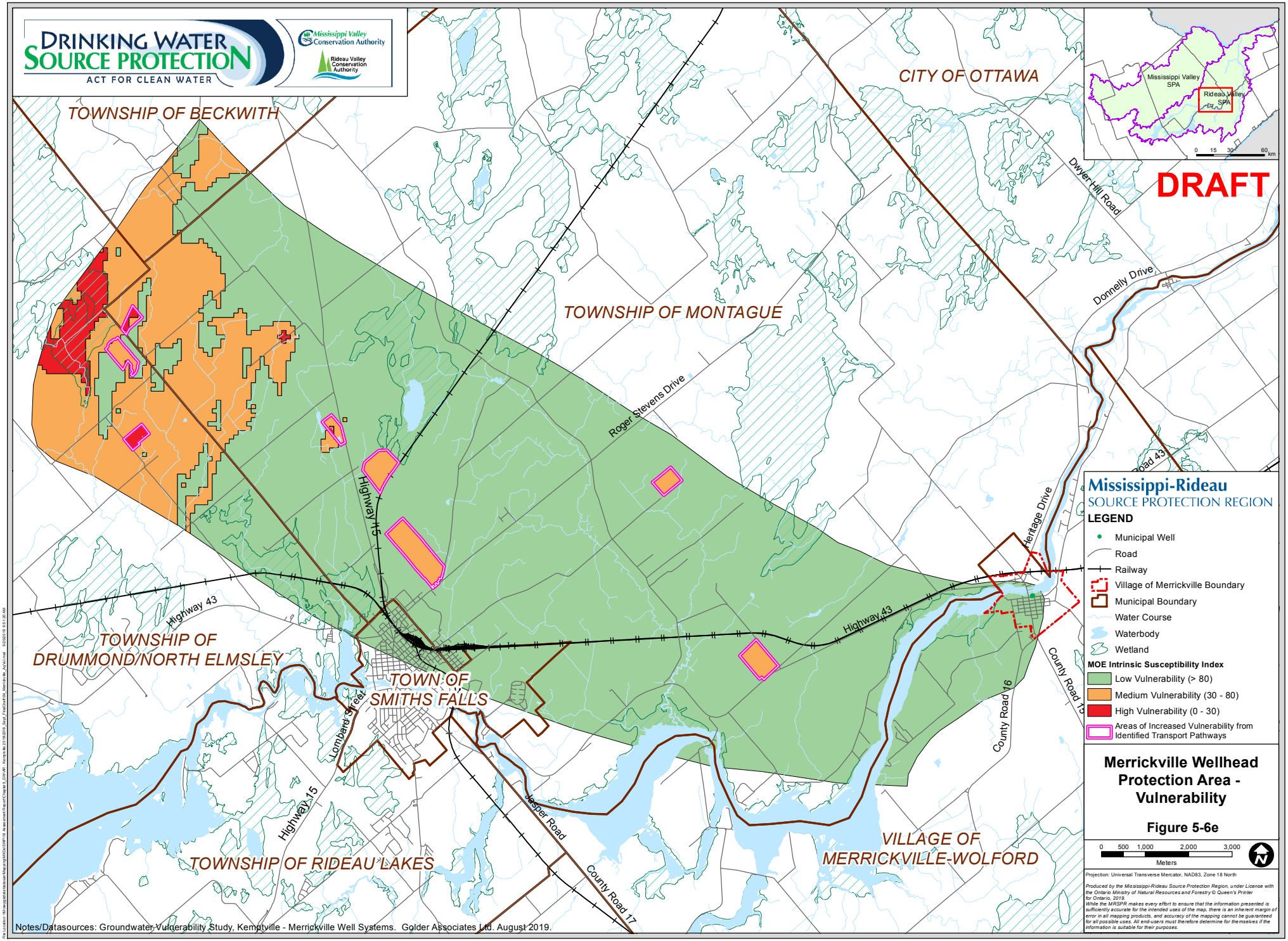
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Dwyer Hill Road
Donnelly Drive
Roger Stevens Drive
Highway 15
Highway 43
Heritage Drive
County Road 16
County Road 15
Lombard Street
Jasper Road
County Road 17
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
MOE Intrinsic Susceptibility Index
Low Vulnerability (> 80)
Medium Vulnerability (30 - 80)
High Vulnerability (0 - 30)
Areas of Increased Vulnerability from Identified Transport Pathways
Merrickville Wellhead Protection Area - Vulnerability
Figure 5-6e
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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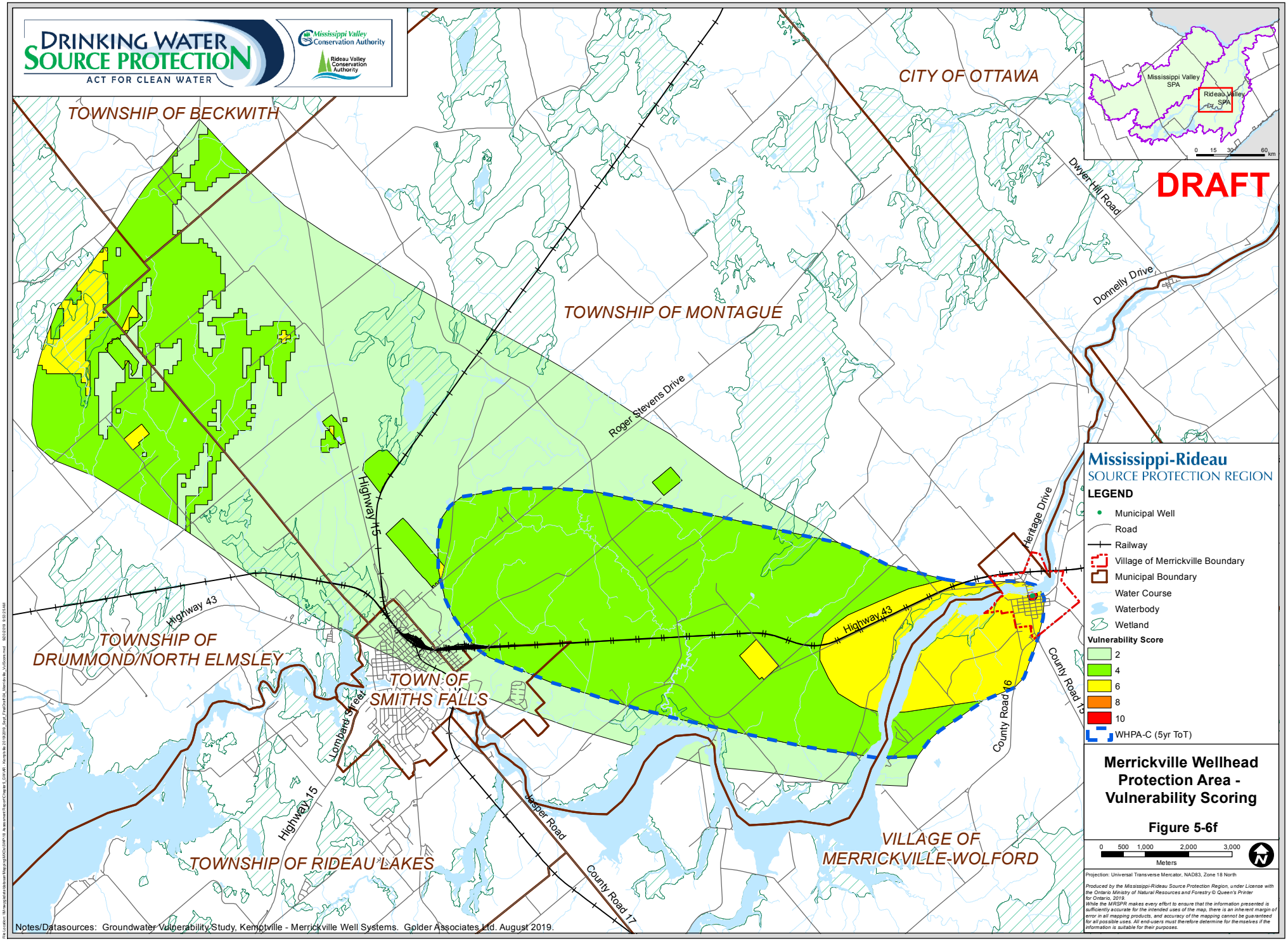
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Roger Stevens Drive
Dwyer Hill Road
Donnelly Drive
Heritage Drive
Highway 15
Highway 43
Lombard Street
Jasper Road
County Road 16
County Road 15
County Road 17
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Vulnerability Score
2
4
6
8
10
WHPA-C (5yr ToT)
Merrickville Wellhead Protection Area - Vulnerability Scoring
Figure 5-6f
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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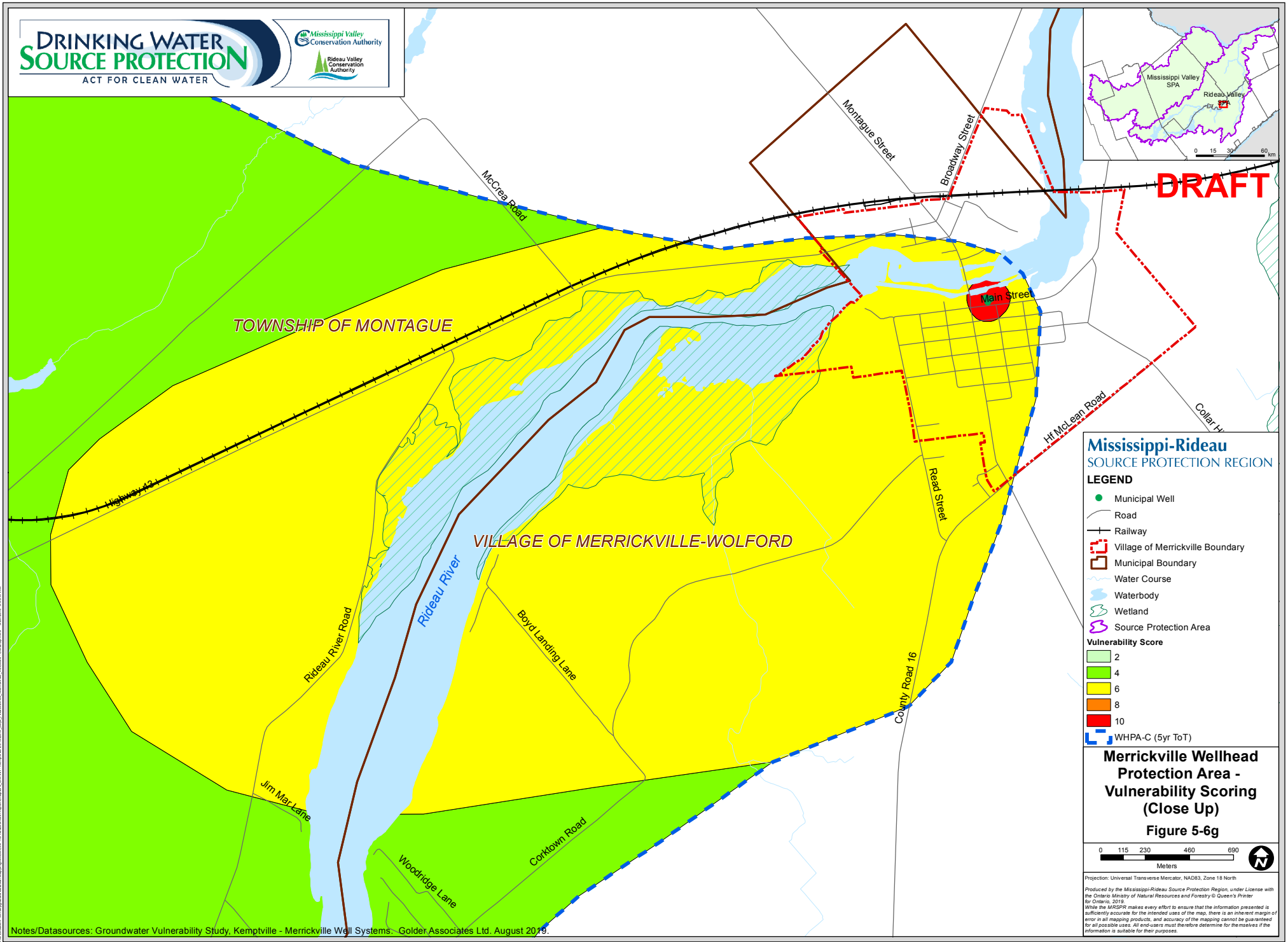
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
TOWNSHIP OF MONTAGUE
VILLAGE OF MERRICKVILLE-WOLFORD
McCrea Road
Montague Street
Broadway Street
Main Street
Hf McLean Road
Collar H
Highway 42
Rideau River
Rideau River Road
Boyd Landing Lane
Read Street
County Road 16
Jim Mar Lane
Woodridge Lane
Corktown Road
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Source Protection Area
Vulnerability Score
2
4
6
8
10
WHPA-C (5yr ToT)
Merrickville Wellhead Protection Area - Vulnerability Scoring (Close Up)
Figure 5-6g
0 115 230 460 690
Meters
N
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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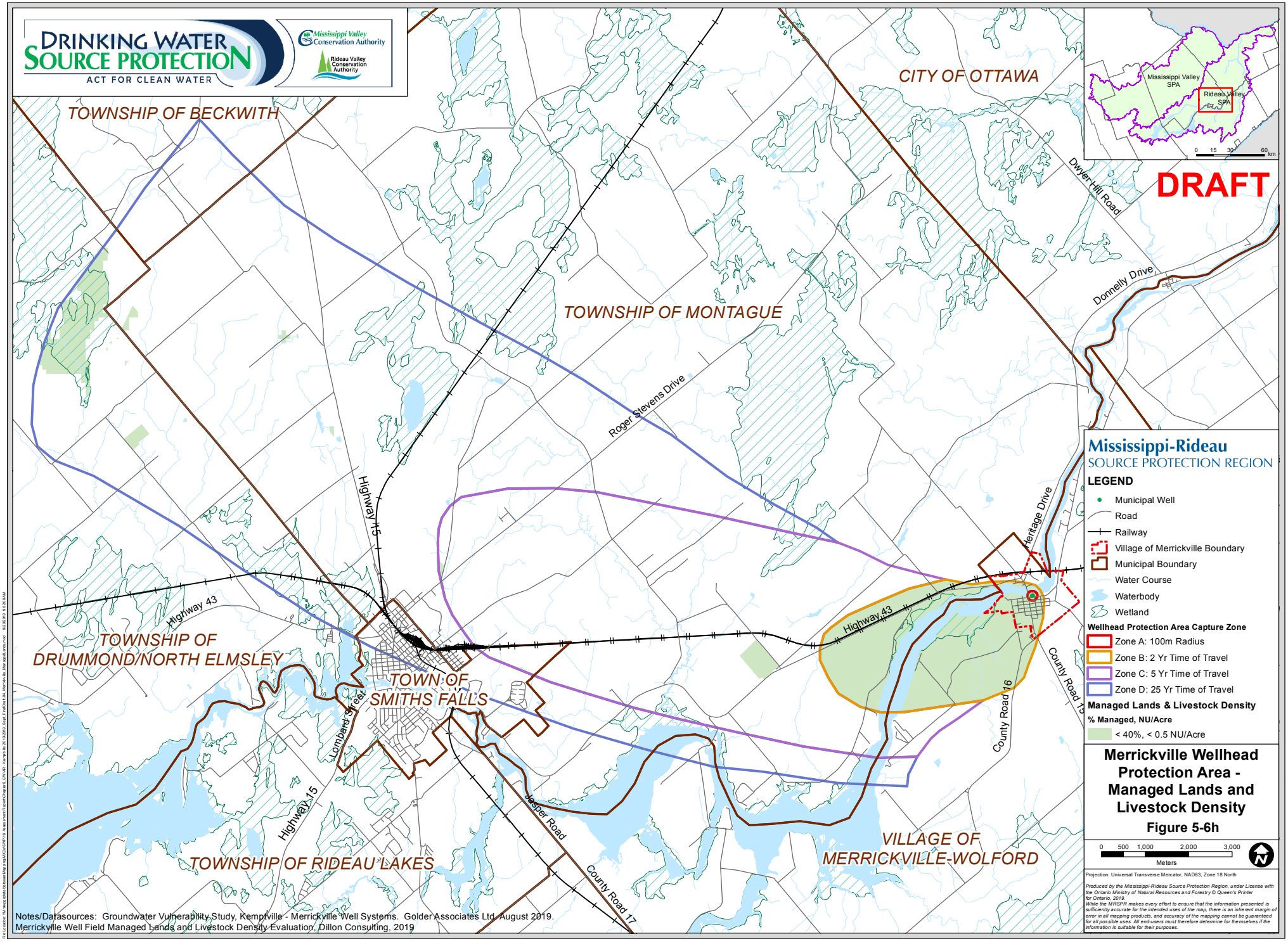
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Mississippi Valley SPA
Rideau Valley SPA
DRAFT
Dwyer Hill Road
Donnelly Drive
Roger Stevens Drive
Highway 15
Highway 43
Lombard Street
Jasper Road
County Road 17
Heritage Drive
County Road 16
County Road 15
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Wellhead Protection Area Capture Zone
Zone A: 100m Radius
Zone B: 2 Yr Time of Travel
Zone C: 5 Yr Time of Travel
Zone D: 25 Yr Time of Travel
Managed Lands & Livestock Density
% Managed, NU/Acre
< 40%, < 0.5 NU/Acre
Merrickville Wellhead Protection Area - Managed Lands and Livestock Density
Figure 5-6h
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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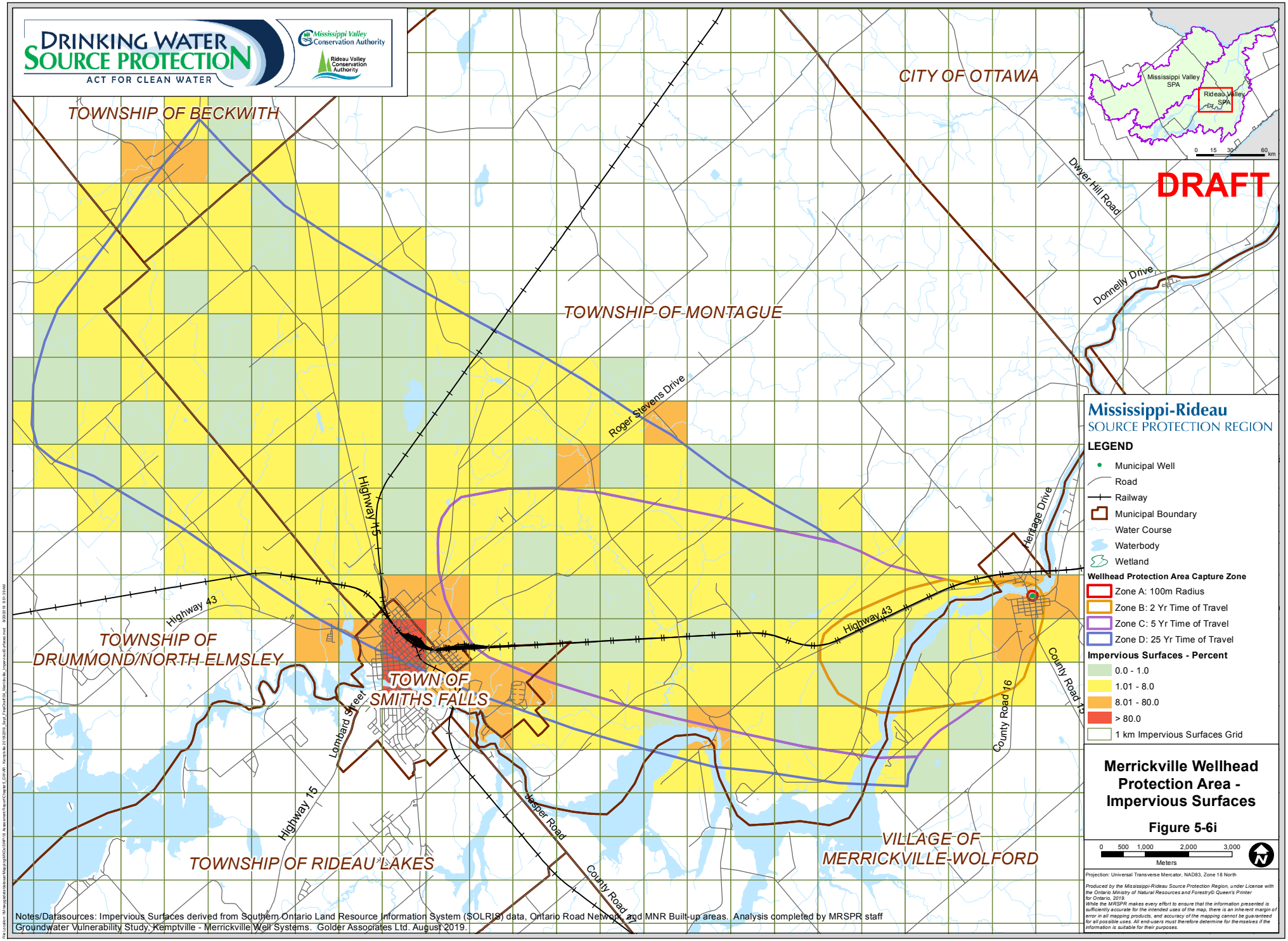
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.
Merrickville Well Field Managed Lands and Livestock Density Evaluation, Dillon Consulting, 2019


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
TOWNSHIP OF BECKWITH
CITY OF OTTAWA
TOWNSHIP OF MONTAGUE
TOWNSHIP OF DRUMMOND/NORTH ELMSLEY
TOWN OF SMITHS FALLS
TOWNSHIP OF RIDEAU LAKES
VILLAGE OF MERRICKVILLE-WOLFORD
Highway 43
Highway 15
Roger Stevens Drive
Dwyer Hill Road
Donnelly Drive
Heritage Drive
County Road 16
County Road 12
Lombard Street
Jasper Road
County Road
Mississippi Valley SPA
Rideau Valley SPA
0 15 30 60 km
DRAFT
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Municipal Boundary
Water Course
Waterbody
Wetland
Wellhead Protection Area Capture Zone
Zone A: 100m Radius
Zone B: 2 Yr Time of Travel
Zone C: 5 Yr Time of Travel
Zone D: 25 Yr Time of Travel
Impervious Surfaces - Percent
0.0 - 1.0
1.01 - 8.0
8.01 - 80.0
> 80.0
1 km Impervious Surfaces Grid
Merrickville Wellhead Protection Area - Impervious Surfaces
Figure 5-6i
0 500 1,000 2,000 3,000
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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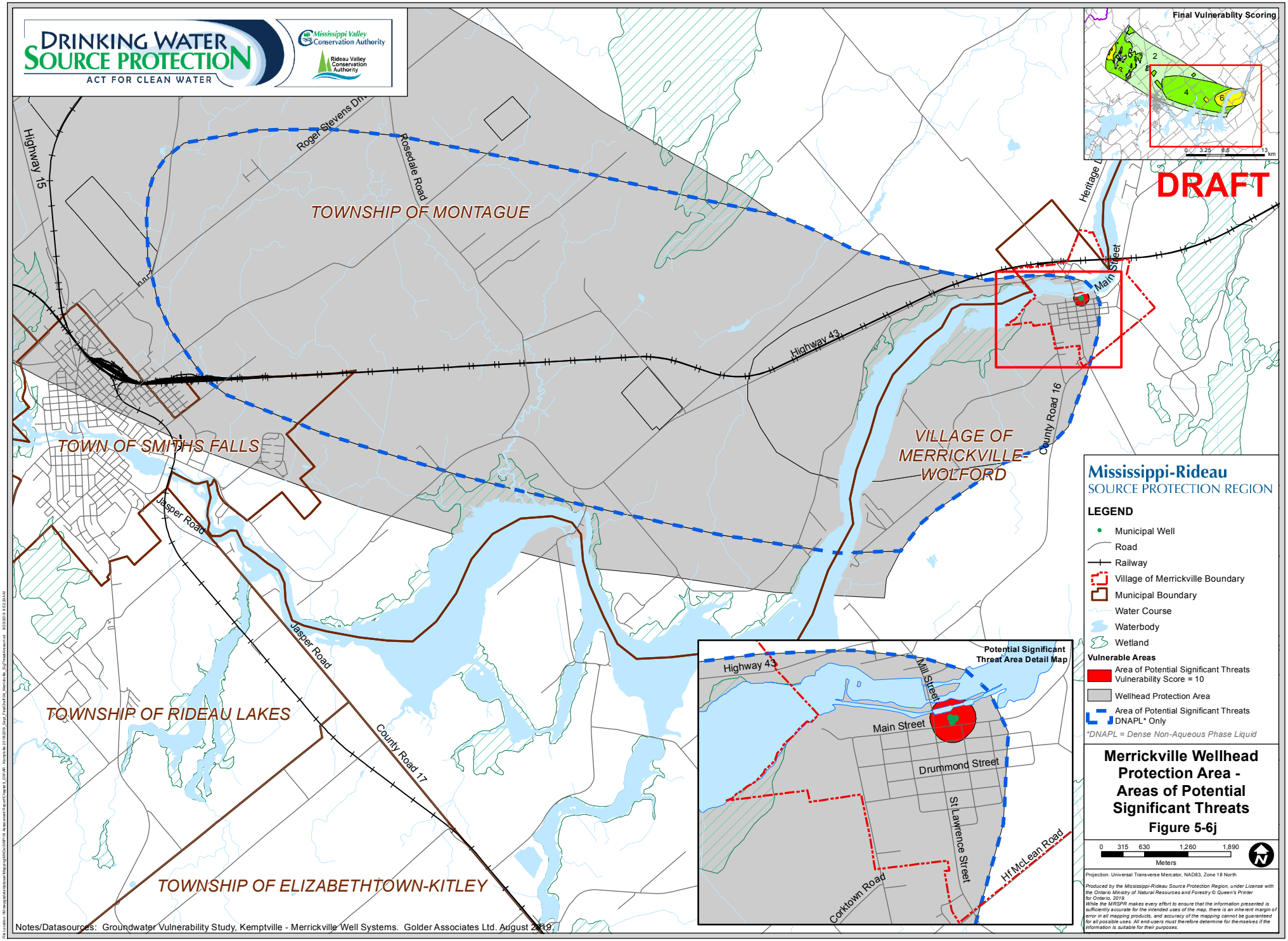
Notes/Datasources: Impervious Surfaces derived from Southern Ontario Land Resource Information System (SOLRIS) data, Ontario Road Network, and MNR Built-up areas. Analysis completed by MRSPR staff
Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Final Vulnerablity Scoring
DRAFT
TOWNSHIP OF MONTAGUE
TOWN OF SMITHS FALLS
VILLAGE OF MERRICKVILLE-WOLFORD
TOWNSHIP OF RIDEAU LAKES
TOWNSHIP OF ELIZABETHTOWN-KITLEY
Highway 15
Roger Stevens Dr
Rosedale Road
Highway 43
Main Street
County Road 16
Jasper Road
County Road 17
Potential Significant Threat Area Detail Map
Mill Street
Drummond Street
St Lawrence Street
Hf McLean Road
Corktown Road
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Municipal Well
Road
Railway
Village of Merrickville Boundary
Municipal Boundary
Water Course
Waterbody
Wetland
Vulnerable Areas
Area of Potential Significant Threats Vulnerability Score = 10
Wellhead Protection Area
Area of Potential Significant Threats DNAPL* Only
*DNAPL = Dense Non-Aqueous Phase Liquid
Merrickville Wellhead Protection Area - Areas of Potential Significant Threats
Figure 5-6j
0 315 630 1,260 1,890
Meters
Projection: Universal Transverse Mercator, NAD83, Zone 18 North
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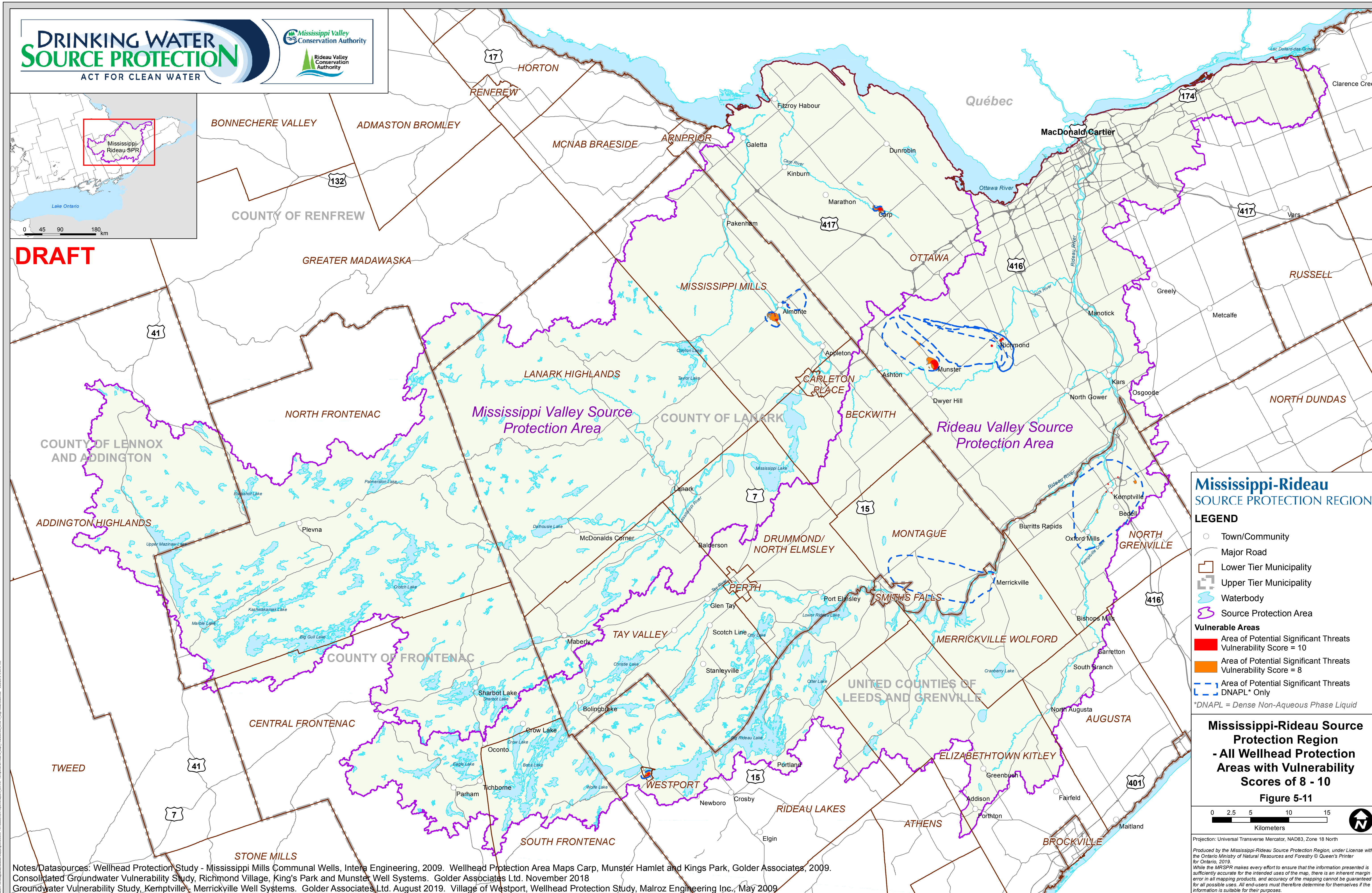
Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi-Rideau SPR
Lake Ontario
0 45 90 180 km
DRAFT
Québec
HORTON
RENFREW
BONNECHERE VALLEY
ADMASTON BROMLEY
MCNAB BRAESIDE
ARNPRIOR
COUNTY OF RENFREW
GREATER MADAWASKA
OTTAWA
RUSSELL
MISSISSIPPI MILLS
LANARK HIGHLANDS
NORTH FRONTENAC
COUNTY OF LENNOX AND ADDINGTON
ADDINGTON HIGHLANDS
Mississippi Valley Source Protection Area
COUNTY OF LANARK
CARLETON PLACE
BECKWITH
Rideau Valley Source Protection Area
NORTH DUNDAS
DRUMMOND/ NORTH ELMSLEY
MONTAGUE
NORTH GRENVILLE
PERTH
SMITHS FALLS
TAY VALLEY
MERRICKVILLE WOLFORD
COUNTY OF FRONTENAC
UNITED COUNTIES OF LEEDS AND GRENVILLE
CENTRAL FRONTENAC
TWEED
AUGUSTA
ELIZABETHTOWN KITLEY
WESTPORT
RIDEAU LAKES
ATHENS
SOUTH FRONTENAC
STONE MILLS
BROCKVILLE
Fitzroy Habour
Galetta
Dunrobin
Kinburn
Marathon
Carp
Pakenham
MacDonald Cartier
Clarence Creek
Vars
Greely
Metcalfe
Manotick
Almonte
Appleton
Ashton
Munster
Richmond
Dwyer Hill
Kars
North Gower
Osgoode
Kemptville
Bedell
Burritts Rapids
Oxford Mills
Lanark
Plevna
McDonalds Corner
Balderson
Merrickville
Port Elmsley
Glen Tay
Scotch Line
Maberly
Stanleyville
Bishops Mills
Garretton
South Branch
Sharbot Lake
Bolingbroke
North Augusta
Crow Lake
Oconto
Tichborne
Parham
Portland
Newboro
Crosby
Greenbush
Addison
Fairfield
Forthton
Maitland
Elgin
Ottawa River
Rideau River
Mississippi Lake
Big Rideau Lake
Upper Mazinaw Lake
Kashwakamak Lake
Big Gull Lake
Crotch Lake
17
132
41
7
417
416
174
15
401
Mississippi-Rideau SOURCE PROTECTION REGION
LEGEND
Town/Community
Major Road
Lower Tier Municipality
Upper Tier Municipality
Waterbody
Source Protection Area
Vulnerable Areas
Area of Potential Significant Threats Vulnerability Score = 10
Area of Potential Significant Threats Vulnerability Score = 8
Area of Potential Significant Threats DNAPL* Only
*DNAPL = Dense Non-Aqueous Phase Liquid
0 2.5 5 10 15
Kilometers
Projection: Universal Transverse Mercator, NAD83, Zone 18 North

Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas with Vulnerability Scores of 8 - 10

Figure 5-11

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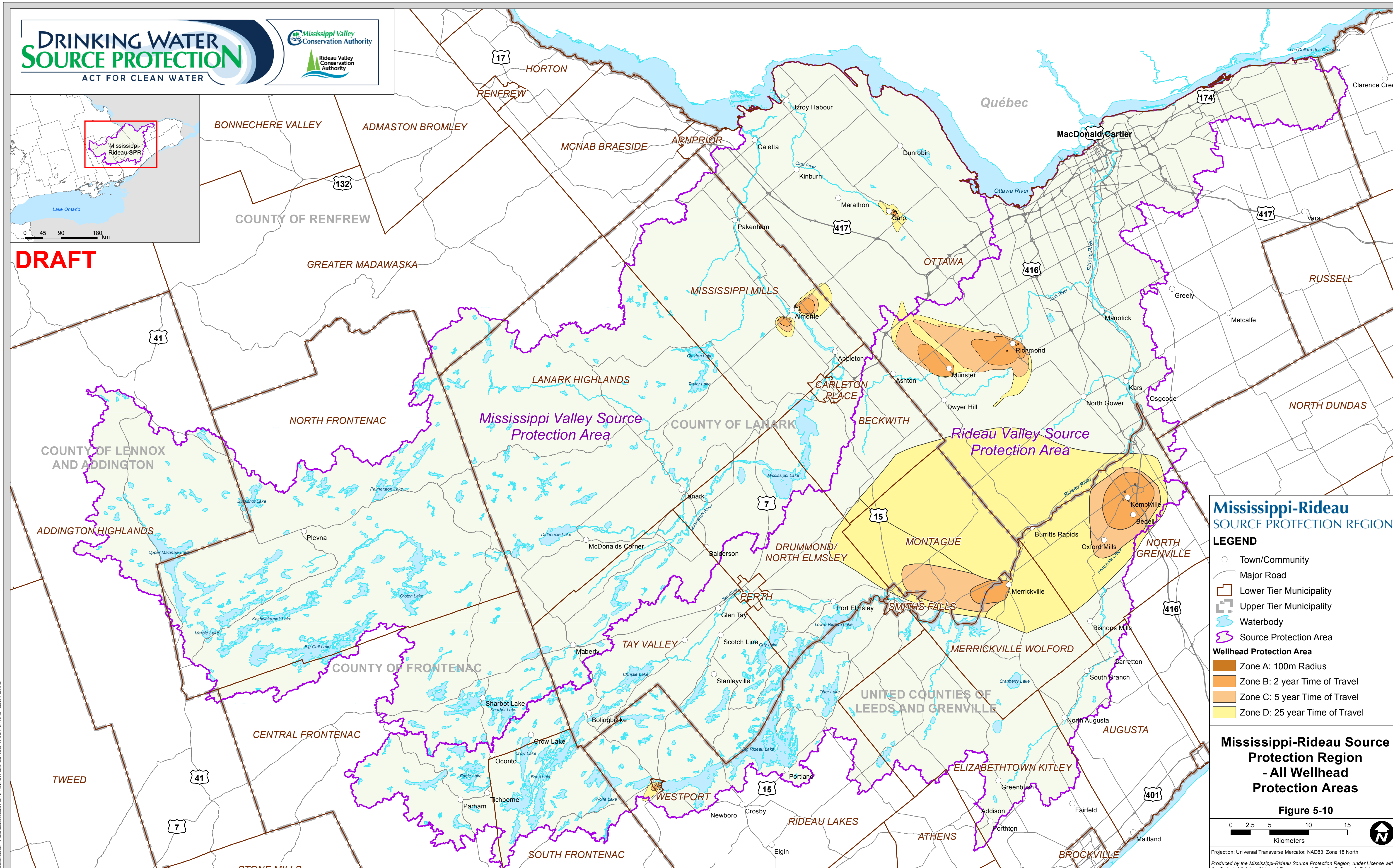
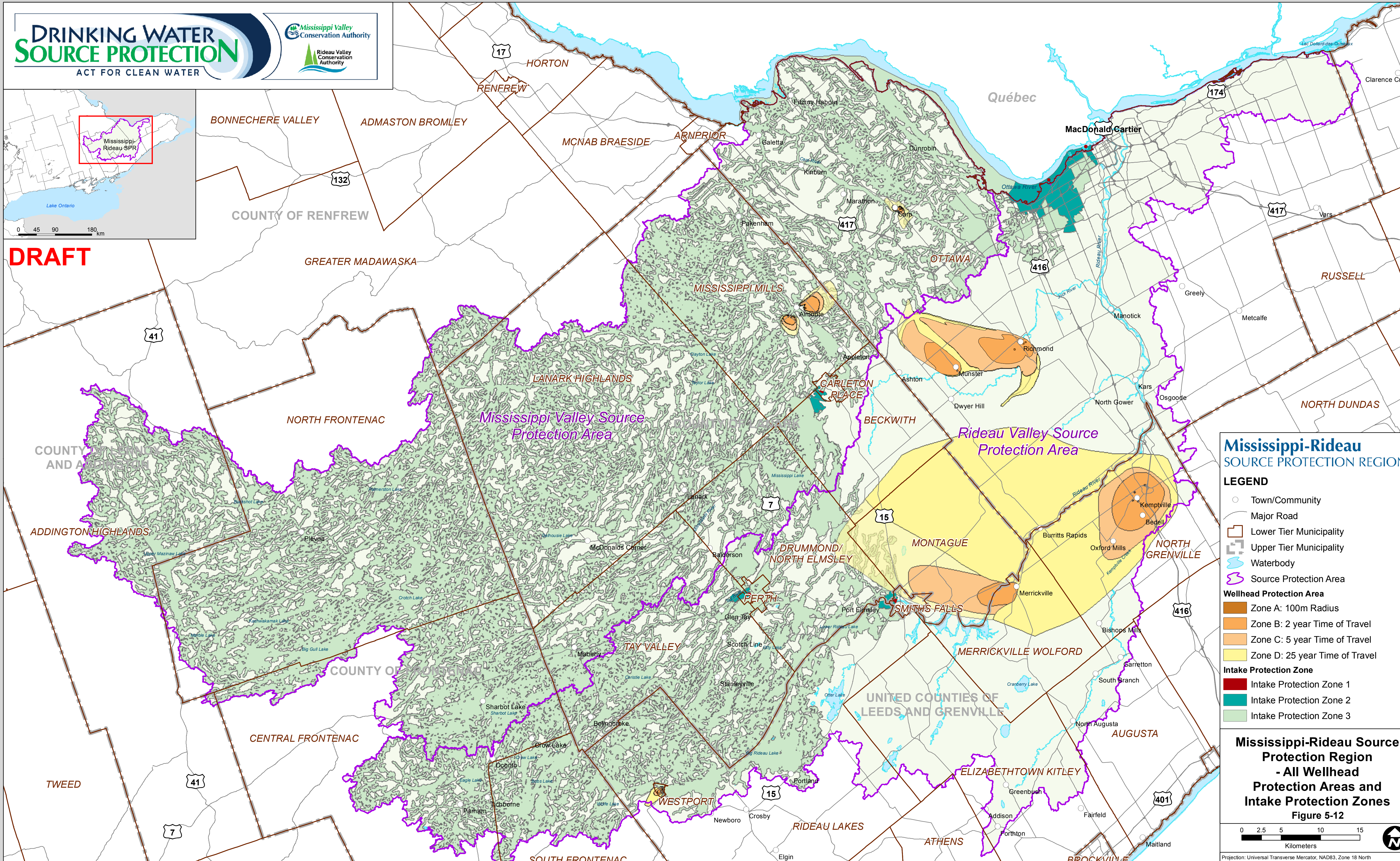
Notes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009.
Consolidated Groundwater Vulnerability Study, Richmond Village, King's Park and Munster Well Systems. Golder Associates Ltd. November 2018
Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi-Rideau SPR
Lake Ontario
0 45 90 180 km
DRAFT
HORTON
RENFREW
BONNECHERE VALLEY
ADMASTON BROMLEY
MCNAB BRAESIDE
ARNPRIOR
COUNTY OF RENFREW
GREATER MADAWASKA
Québec
Fitzroy Habour
Galetta
Dunrobin
Kinburn
Marathon
Carp
Pakenham
MacDonald Cartier
Ottawa River
OTTAWA
MISSISSIPPI MILLS
Almonte
Appleton
Richmond
Munster
Ashton
CARLETON PLACE
Dwyer Hill
Manotick
Greely
Metcalfe
Clarence Creek
Vars
RUSSELL
Kars
Osgoode
North Gower
NORTH DUNDAS
LANARK HIGHLANDS
NORTH FRONTENAC
Mississippi Valley Source Protection Area
COUNTY OF LANARK
BECKWITH
Rideau Valley Source Protection Area
COUNTY OF LENNOX AND ADDINGTON
ADDINGTON HIGHLANDS
Plevna
Lanark
McDonalds Corner
Balderson
DRUMMOND/ NORTH ELMSLEY
MONTAGUE
Burritts Rapids
Oxford Mills
Kemptville
Bedell
NORTH GRENVILLE
Merrickville
SMITHS FALLS
PERTH
Port Elmsley
Glen Tay
Bishops Mills
TAY VALLEY
Maberly
Scotch Line
COUNTY OF FRONTENAC
MERRICKVILLE WOLFORD
Garretton
South Branch
Stanleyville
UNITED COUNTIES OF LEEDS AND GRENVILLE
Sharbot Lake
Bolingbroke
North Augusta
AUGUSTA
CENTRAL FRONTENAC
Crow Lake
Oconto
TWEED
ELIZABETHTOWN KITLEY
Portland
Greenbush
Tichborne
Parham
WESTPORT
Newboro
Crosby
Addison
Fairfeld
RIDEAU LAKES
ATHENS
Forthton
Maitland
Elgin
STONE MILLS
SOUTH FRONTENAC
BROCKVILLE
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Town/Community
Major Road
Lower Tier Municipality
Upper Tier Municipality
Waterbody
Source Protection Area
Wellhead Protection Area
Zone A: 100m Radius
Zone B: 2 year Time of Travel
Zone C: 5 year Time of Travel
Zone D: 25 year Time of Travel
Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas
Figure 5-10
0 2.5 5 10 15
Kilometers
Projection: Universal Transverse Mercator, NAD83, Zone 18 North

Notes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009.
Groundwater Vulnerability Study, Richmond Village Well System, Richmond Ontario, July 2018 Golder Associates Ltd.
Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009


DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Mississippi Valley Conservation Authority
Rideau Valley Conservation Authority
Mississippi-Rideau SPR
Lake Ontario
0 45 90 180 km
DRAFT
Québec
Mississippi Valley Source Protection Area
Rideau Valley Source Protection Area
COUNTY OF RENFREW
UNITED COUNTIES OF LEEDS AND GRENVILLE
HORTON
RENFREW
BONNECHERE VALLEY
ADMASTON BROMLEY
MCNAB BRAESIDE
ARNPRIOR
GREATER MADAWASKA
MISSISSIPPI MILLS
OTTAWA
RUSSELL
LANARK HIGHLANDS
CARLETON PLACE
BECKWITH
NORTH FRONTENAC
NORTH DUNDAS
ADDINGTON HIGHLANDS
DRUMMOND/ NORTH ELMSLEY
MONTAGUE
NORTH GRENVILLE
PERTH
SMITHS FALLS
TAY VALLEY
MERRICKVILLE WOLFORD
CENTRAL FRONTENAC
AUGUSTA
ELIZABETHTOWN KITLEY
TWEED
WESTPORT
RIDEAU LAKES
ATHENS
SOUTH FRONTENAC
BROCKVILLE
STONE MILLS
Fitzroy Harbour
Galetta
Dunrobin
Kinburn
Marathon
Carp
Pakenham
MacDonald Cartier
Clarence Creek
Vars
Almonte
Appleton
Richmond
Munster
Ashton
Dwyer Hill
Manotick
Greely
Metcalfe
Kars
North Gower
Osgoode
Lanark
Plevna
McDonalds Corner
Balderson
Burritts Rapids
Oxford Mills
Kemptville
Bedell
Merrickville
Port Elmsley
Glen Tay
Scotch Line
Maberly
Stanleyville
Sharbot Lake
Bolingbroke
Crow Lake
Ompah
Tichborne
Parham
Portland
Newboro
Crosby
Elgin
Bishops Mills
Garretton
South Branch
North Augusta
Greenbush
Addison
Fairfield
Portlhon
Maitland
Ottawa River
Rideau River
Mississippi Lake
Crotch Lake
Big Gull Lake
Cranberry Lake
17
132
417
416
41
7
15
174
401
Mississippi-Rideau
SOURCE PROTECTION REGION
LEGEND
Town/Community
Major Road
Lower Tier Municipality
Upper Tier Municipality
Waterbody
Source Protection Area
Wellhead Protection Area
Zone A: 100m Radius
Zone B: 2 year Time of Travel
Zone C: 5 year Time of Travel
Zone D: 25 year Time of Travel
Intake Protection Zone
Intake Protection Zone 1
Intake Protection Zone 2
Intake Protection Zone 3
0 2.5 5 10 15
Kilometers
N

Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas and Intake Protection Zones

Figure 5-12

Projection: Universal Transverse Mercator, NAD83, Zone 18 North

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Notes/Datasources: RNotes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009.
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Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009
Inland Rivers (Carleton Place, Perth, Smiths Falls) Surface Water Vulnerability Study, 2010, J.F. Sabourin and Associates Inc., and Water and Earth Science Associates. Ottawa River Surface Water Vulnerability Study, 2010, Baird & Associates Ltd.