

Appendix 'K-1' - Data Gaps

Technical Rule	Sub Rule	Additional Rules/Regs/Acts referenced	Rule	Sub Rule	Data Gap
16			The following shall be included in a characterization of a watershed, where the information is available		
	3			With respect to drinking water systems, (a) the location and area served by a system, (b) the classification of the system into the following classifications as defined by O. Reg. 170/03 (Drinking Water Systems) made under the Safe Drinking Water Act, 2002: (iv) Small municipal non-residential system.	Unable to Map and classify small municipal non-residential systems, due to lack of information.
	6			A comparison of the communities described in clause (5) to similar communities not impacted by anthropogenic factors. (5) The location and types of aquatic habitats, including coldwater, mixed, and warm water fisheries, and macroinvertebrate communities.	No information available in the CSPA
19			Subject to rule 24, a conceptual water budget shall include an assessment of the following		
	5			Groundwater aquifers, their direction of flow, and mapping of the water table and potentiometric surface(s).	Cannot be calculated due to lack of accurate information.
	7			Interactions between groundwater and surface water.	Comprehensive mapping of groundwater recharges and discharges does not exist for the Cataraqui Source Protection Area

Appendix 'K-2' - Metadata (Including Data Concerns / Limitations Related to Continuous Improvement)

Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 1 - Introduction							
Map 1-1	Southeastern Ontario SPA & SPR		-	-	Provided by Conservation Ontario, based upon watershed and political boundaries.	-	-
Map 1-2	Cataraqui Source Protection Area	SPA/R's	-	-	Official CSPA Boundary	-	-
Chapter 2 - Cataraqui Source Protection Area							
Map 2-1	General Description	General Region Landcover	-	-	Regional Scale Geology features	-	-
Map 2-2	Major Watersheds & Subwatersheds	Subwatersheds	-	-	Derived using ArcHydro and the provincial DEM 2.0 from the OGDE warehouse	-	-
Map 2-3	MNDM Bedrock Geology	Bedrock Geology	Lack of accurate scaled data	Spatially inaccurate	Based upon OGDE & MNDM Bedrock geology layers	L	-
Map 2-4	Surficial Geology	Surficial Geology	Lack of accurate scaled data	Spatially inaccurate	OGDE surficial geology layer - Surficial geology information does not appear to exist for Grenadier Island and the area of the Thousand Islands near Brockville.	L	-
Map 2-5	Physiography	Chapman & Putnam	Lack of accurate scaled data	Spatially inaccurate	This is the best available description. Refined topographic information would be useful.	L	-
Map 2-6	Topography	DEM 2.0	Lack of accurate scaled data	Spatially inaccurate	Based upon five metre contour intervals, very poor quality on the Canadian shield	-	-
Map 2-7	Surface Water Quality (based on selected parameters)	WQ Grade	-	-	Grades are based on 75th percentiles for total phosphorous and chloride at the PWQMN stations, CRCA data on Hilsenhoff Order level biotic index for benthic macroinvertebrates, and total phosphorus from the Lake Partner Program.	-	-
Map 2-8	Groundwater Quality (based on selected parameters)	GW Quality	-	-	Grades were based on 75th percentile concentration for nitrate+nitrite, chloride, and sodium. Data was obtained from PGMN (data from 2003-2004 and 2006-2009), Western Cataraqui Groundwater Study (Trow, 2007) with data from 2001, and United Counties Leeds and Grenville Groundwater Management Study (Dillon, 2001) with data spanning 1969-2001.	-	-
Map 2-9	Water Control Structures	Water Control Structures	Flow data - level records	Too sparse	Only level data exists: can transform level to flow with good measurements and better record	H	Site visits, measurements, and calculations, and full time level monitoring - get data from EOP, RC, MNR
Map 2-10	Drinking Water Systems Classification	Permits to Take Water	Lack of updated information	Possibly out of date	Database is not up to date	L	Database needs to be updated regularly
Map 2-11	Drinking Water Systems & Municipally Serviced Areas	Intakes	Lack of accurate scaled data	Exact location of intakes unknown	Intake locations were provided by municipalities in various formats and accuracy. Some are very accurate while other locations are suspect.	H	Need to locate all intakes accurately with scuba gear.
		Water Serviced Area	-	Possibly out of date	Derived from municipality mapping of service areas, and water and sewer pipe mapping	L	Update as new Official Plans become available
Map 2-12	Monitoring Wells	Monitoring Wells	-	-			
		Issues Evaluation Monitoring Wells	-	-			
Map 2-13	Natural Vegetative Cover	OGDE Woodlands	Woodlands	Out of date	We are aware that woodland cover is increasing in the study area, but do not have current and consistent imagery for the entire study area.	L	Collection of vegetation cover off of DRAPE 2008 imagery
		Evaluated Wetlands	Lack of data for smaller (locally significant) wetlands	Partially populated	The provincial wetland layers show mainly large evaluated wetlands, and not the numerous smaller wetlands (especially on the Canadian Shield) that may be important for source water protection.	L	-
		Waterbodies	-	-	OGDE Waterbodies layer	-	-
		Riparian Corridors	Inaccurate	Inaccurate	Based upon 30 metre buffer & does not accurately reflect the presence or absence of vegetative cover. Needs to be redone when a new woodlands layer becomes available	L	Collection of vegetation cover off of DRAPE 2008 imagery
Map 2-14	Waterbody Temperature	Waterbodies	Lack of temperature data for cool and cold water streams	Does not exist	We have limited knowledge about Willys Brook (cold water) and other potential cool water streams (Lyn Creek and Wilton Creek watersheds).	L	-
Map 2-15	Benthic Macroinvertebrates, Sampling from 2003 - 2009	Benthic Monitoring	Lacking spatial distribution and longterm monitoring sites				-
Map 2-16	Population by Municipality & Population Density, 2006	Stats Canada	Lack of accurate scaled data	Not provided	Data based on census subdivision, not on dissemination area, estimates for population based on percentage of area within the CSPA.	-	-
Map 2-17	Areas of settlement	Towns / Landuse28	Lack of accurate scaled data	-	Derived from Land use 28 layer from OGDE warehouse, poor scale.	-	-
		Urban Growth Areas	-	-	Derived from Municipal Official Plan Mapping.	L	Update as new Official Plans become available
Map 2-18a	Highly Vulnerable Aquifers - Total Impervious Surface Area	Impervious Surface	Lack of accurate scaled data	Inaccurate	Total Impervious surface layer was based on built up areas in Landuse 28, along with the ORN being buffered by road class. Classes buffered were 66 feet off of major roads & 25 feet off of secondary roads. For within the city of Kingston a built up areas files was provided.	L	Impervious Surfaces need to be Collected off of Drape Imagery
Map 2-18b	Significant Groundwater Recharge Area - Total Impervious Surface Area	Impervious Surface	Lack of accurate scaled data	Inaccurate	Total Impervious surface layer was based on built up areas in Landuse 28, along with the ORN being buffered by road class. Classes buffered were 66 feet off of major roads & 25 feet off of secondary roads. For within the city of Kingston a built up areas files was provided.	L	Impervious Surfaces need to be Collected off of Drape Imagery
Map 2-18c	Wellhead Protection Areas and Intake Protection Zones - Total Impervious Surface Area	Impervious Surface	Lack of accurate scaled data	Inaccurate	Total Impervious surface layer was based on built up areas in Landuse 28, along with the ORN being buffered by road class. Classes buffered were 66 feet off of major roads & 25 feet off of secondary roads. For within the city of Kingston a built up areas files was provided.	L	Impervious Surfaces need to be Collected off of Drape Imagery
Map 2-19a	Highly Vulnerable Aquifers - Per cent Managed Lands	Managed Lands	Lack of accurate scaled data	Inaccurate	The distribution of managed lands (cropland, fallow land, improved pasture, golf courses, sports fields, and lawns) is broken down into two subsets: agricultural managed lands and non-agricultural managed lands. The per cent of managed land was evaluated in each vulnerable area by the CRCA, according to the method prescribed by the Ministry of the Environment (MOE, 2009). The managed land evaluation method, required each managed land use to be identified and grouped as either agricultural or non-agricultural. The sum of agricultural and non-agricultural land uses was then divided by the total area within the vulnerable area, and multiplied by 100. Assumptions of land usage was based on Official Plans and not field verified.	L	
Map 2-19b	Significant Groundwater Recharge Area - Per cent Managed Lands	Managed Lands	Lack of accurate scaled data	Inaccurate	The distribution of managed lands (cropland, fallow land, improved pasture, golf courses, sports fields, and lawns) is broken down into two subsets: agricultural managed lands and non-agricultural managed lands. The per cent of managed land was evaluated in each vulnerable area by the CRCA, according to the method prescribed by the Ministry of the Environment (MOE, 2009). The managed land evaluation method, required each managed land use to be identified and grouped as either agricultural or non-agricultural. The sum of agricultural and non-agricultural land uses was then divided by the total area within the vulnerable area, and multiplied by 100. Assumptions of land usage was based on Official Plans and not field verified.	L	
Map 2-19c	Wellhead Protection Areas and Intake Protection Zones - Per cent Managed Lands	Managed Lands	Lack of accurate scaled data	Inaccurate	The distribution of managed lands (cropland, fallow land, improved pasture, golf courses, sports fields, and lawns) is broken down into two subsets: agricultural managed lands and non-agricultural managed lands. The per cent of managed land was evaluated in each vulnerable area by the CRCA, according to the method prescribed by the Ministry of the Environment (MOE, 2009). The managed land evaluation method, required each managed land use to be identified and grouped as either agricultural or non-agricultural. The sum of agricultural and non-agricultural land uses was then divided by the total area within the vulnerable area, and multiplied by 100. Assumptions of land usage was based on Official Plans and not field verified.	L	
Map 2-20a	Highly Vulnerable Aquifers - Livestock Density	Livestock Density	Lack of accurate scaled data	Inaccurate	Livestock density was also evaluated within each vulnerable area. Two methods were used based on the availability of data. The livestock density method prescribed by the Ministry of Environment (MOE, 2009) was followed for evaluating wellhead protection areas and intake protection zones. CRCA staff used Municipal Property Assessment Corporation (MPAC) data to estimate the number of animals present within each specific farm type. Aerial photography was then used to verify farm locations and estimate the square footage of farm structures. The square footage was then divided by a conversion factor identified in the Ontario Nutrient Management Act, 2002 for that particular farm type, in order to quantify and standardize the number of nutrient units (NU) generated in that vulnerable area. Permission was given by the Minister, for CRCA staff, to evaluate highly vulnerable areas, significant groundwater recharge areas, and intake protection zone 3 using an alternative method. Agricultural census data was used to identify actual animal numbers per census consolidated subdivision. Similar to method one, conversion tables from the Ontario Nutrient Management Act, 2002 were used to convert to NUs by dividing actual animal numbers by the specified conversion factor.	L	Data needs to be local & not at the census consolidated subdivision. Estimation has been based on imagery & not ground truthed.

Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Map 2-20b	Significant Groundwater Recharge Area - Livestock Density	Livestock Density	Lack of accurate scaled data	Inaccurate	Livestock density was also evaluated within each vulnerable area. Two methods were used based on the availability of data. The livestock density method prescribed by the Ministry of Environment (MOE, 2009) was followed for evaluating wellhead protection areas and intake protection zones. CRCA staff used Municipal Property Assessment Corporation (MPAC) data to estimate the number of animals present within each specific farm type. Aerial photography was then used to verify farm locations and estimate the square footage of farm structures. The square footage was then divided by a conversion factor identified in the Ontario Nutrient Management Act, 2002 for that particular farm type, in order to quantify and standardize the number of nutrient units (NU) generated in that vulnerable area. Permission was given by the Minister, for CRCA staff, to evaluate highly vulnerable areas, significant groundwater recharge areas, and intake protection zone 3 using an alternative method. Agricultural census data was used to identify actual animal numbers per census consolidated subdivision. Similar to method one, conversion tables from the Ontario Nutrient Management Act, 2002 were used to convert to NUs by dividing actual animal numbers by the specified conversion factor.	L	Data needs to be local & not at the census consolidated subdivision. Estimation has been based on imagery & not ground truthed.
Map 2-20c	Wellhead Protection Areas and Intake Protection Zones - Livestock Density	Livestock Density	Lack of accurate scaled data	Inaccurate	Livestock density was also evaluated within each vulnerable area. Two methods were used based on the availability of data. The livestock density method prescribed by the Ministry of Environment (MOE, 2009) was followed for evaluating wellhead protection areas and intake protection zones. CRCA staff used Municipal Property Assessment Corporation (MPAC) data to estimate the number of animals present within each specific farm type. Aerial photography was then used to verify farm locations and estimate the square footage of farm structures. The square footage was then divided by a conversion factor identified in the Ontario Nutrient Management Act, 2002 for that particular farm type, in order to quantify and standardize the number of nutrient units (NU) generated in that vulnerable area. Permission was given by the Minister, for CRCA staff, to evaluate highly vulnerable areas, significant groundwater recharge areas, and intake protection zone 3 using an alternative method. Agricultural census data was used to identify actual animal numbers per census consolidated subdivision. Similar to method one, conversion tables from the Ontario Nutrient Management Act, 2002 were used to convert to NUs by dividing actual animal numbers by the specified conversion factor.	L	Data needs to be local & not at the census consolidated subdivision. Estimation has been based on imagery & not ground truthed.
Map 2-21	Federal Lands	OGDE Federal Lands	Lack of data	Spatially inaccurate	Layer does not reflect Crown owned lands. Only Parks and recreational lands.	L	-
Map 2-22	Bay of Quinte Areas of Concern	Bay of Quinte Areas of Concern	-	-	Data set provided by the Bay of Quinte RAP.	-	-
Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 3 – Water Budgets							
Map 3-1	Stream Flow Gauging Stations	HYDAT	Flow data	Too sparse	This large database contains daily, monthly, and/or instantaneous information for streamflow, water level, suspended sediment concentration, sediment particle size, and sediment load data for over 2900 active stations and some 5100 discontinued sites across Canada. This data set is produced and maintained by Environment Canada.	H	Field monitoring is in progress to fill this gap.
Map 3-2	Subwatersheds	Subwatersheds	-	-	Derived using ArcHydro and the provincial DEM 2.0 from the OGDE warehouse. Watersheds were classified into either gauged, semi-gauged or ungauged. The eight gauged watersheds have a reasonable amount of data available. The eight semi-gauged watersheds have some data available to synthesize records. The five ungauged watersheds have minimal data and values were extrapolated from surrounding watersheds.	-	-
Map 3-3	Tier 1 Surface Water Stress Assessment	Surface Water Stress Levels	Lack of data	Does not exist	Precipitation, stream flow, evapotranspiration, and recharge were all quantified for each of the subwatersheds. Once the water budget was completed, a stress assessment was conducted, comparing supply to demand. The MOE's prescribed equation to do this is: %Water Demand = 100 * [Qdemand/Qsupply-Qreserve].	L	-
Map 3-4	Tier 1 Groundwater Stress Assessment	Groundwater Stress Levels	Inaccurate	Not specific enough	It should be noted from a groundwater perspective that much of the hydrogeology of the CSPA is not thought to be a regional system that can be considered on a large-scale basis, but rather a very intricate system that should really only be considered on a site-specific scale. The same formula was used as the surface water stress assessment except that Qsupply is derived as 1/12th of the annual groundwater recharge.	L	-
	Conceptual Water Budget	Assessment of Groundwater Aquifers	Lack of data	Does not exist	Assessment of groundwater aquifers, their direction of flows, and mapping of the water table and potentiometric surface(s).	L	-
Map 3-5	Tier 2 Sydenham Lake Stress Assessment	Sydenham Lake Catchments	-	-	XCG Consultants Ltd. selected the Hydrologic Simulation Program - Fortran (HSP-F) model for use on the Sydenham Lake subwatershed. 50 years of data were used to calibrate the model from the water control structure on the lake. SGRA data from the GVAR 2008 study Tier 1 Water Budget 2009 along with the PTTW database data was used for withdrawal information.	-	-
Map 3-6	Tier 2 Lansdowne Stress Assessment	Lansdowne Watershed	-	-	Intera Engineering Ltd (2009) calculated the Groundwater quantity stress, and is to be determined as a calculation of % Water Demand as described in the WB Guidance (MOE, 2007 - Appendix A). These calculations are to be completed under a variety of scenarios including current pumping, future pumping (25 yrs) and drought scenarios, and on a monthly and annual time-scale.	-	-
Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 4 – Source Water Quality Issue Evaluation and Threat Assessment							
Map 4-1	Surface Water Intake Protection Zones and Wellhead Protection Areas	WHPA & IPZ	-	-	Detailed methodology provided for each system below.	-	-
Chapter 5 – Groundwater Sources							
Map 5-1a	Highly Vulnerable Aquifer Assessment - Intrinsic Susceptibility Index Protocol at Wells	Highly Vulnerable Aquifers	Lack of information at a fine geographic scale	Need better surficial geology, recharge information and well location information.	Based on CSPA GVAR report. Regions where the infiltration is greater than 55 per cent of the annual average surplus water (precipitation minus evapotranspiration) are highlighted in green. These areas are identified as potential HVRAs. Areas highlighted as potential HVRAs include the sandier soil areas on the Precambrian and Frontenac Axis, and the exposed till drumlinoid features in the limestone plains in the southeastern portion of the watershed. The sand plains in the Township of Elizabethtown-Kitley in the west are also highlighted as potential HVRA.	M	-
Map 5-1b	Aquifer Vulnerability Assessment Inverse Distance Weighted (IDW)	AQ ISI					
5-1c	Highly Vulnerable Aquifer Assessment - Surficial Geology	Surficial Geology Vulnerability	Lack of information at a fine geographic scale	Need better surficial geology, recharge information and well location information.	For areas mapped as highly vulnerable based on surface geology, there is a high confidence in the result. Conversely, for areas mapped as low to moderate vulnerability based on surficial geology, the accuracy is anticipated to be lower. In these areas, the thickness of clay, silt or till (which causes the low/moderate vulnerability ranking) is unknown and therefore the vulnerability is less certain.	M	-
5-1d	Aquifer Vulnerability Assessment: Overlay of ISI (Interpolation) and Surficial Geology	SG ISI					

Map 5-1e	Highly Vulnerable Aquifers	HVA	Lack of information at a fine geographic scale	Need better surficial geology, recharge information and well location information.			
Map 5-2	Highly Vulnerable Aquifers - Locations where chemical threats can be significant, moderate, or low	HVA	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this large appendix. Its aim is to	-	-

Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Map 5-3	Highly Vulnerable Aquifers - Locations where pathogen threats can be significant, moderate, or low	HVA	-	-		-	-
Map 5-4	Highly Vulnerable Aquifers - Locations where DNAPL threats can be significant, moderate, or low	HVA	-	-		-	-
Map 5-5	Highly Vulnerable Aquifers - Locations where conditions can be significant, moderate, or low	HVA	-	-		-	-
Map 5-6	Significant Groundwater Recharge Area Assessment, Recharge Rate (Technical Rule 44(1))	Significant Groundwater Recharge Areas	Lack of information at a fine geographic scale	Need better surficial geology, recharge information and well location information.	All SGRA's from CSPA GVAR study that have a well within them, or the well is within the distance of error from the WWIS dataset. SGRA's based upon CSPA GVAR study and are associated with Cold water features, groundwater feed wetlands and potential significant recharge areas.	L	-
Map 5-7	Significant Groundwater Recharge Areas	Vulnerability Scoring	Lack of information at a fine geographic scale	Need better surficial geology, recharge information and well location information.	The highest vulnerability score in a SGRA is a six out of ten. This means that you would never have a score high enough for a threat to be determined as significant. Therefore, only moderate and low threats are possible for a SGRA.	L	-
Map 5-8	Significant Groundwater Recharge Areas - Locations where chemical threats can be moderate, or low	Significant Groundwater Recharge Areas	-	-		-	-
Map 5-9	Significant Groundwater Recharge Areas - Locations where pathogen threats can be moderate, or low	Significant Groundwater Recharge Areas	-	-		-	-
Map 5-10	Significant Groundwater Recharge Areas - Locations where DNAPL threats can be moderate, or low	Significant Groundwater Recharge Areas	-	-		-	-
Map 5-11	Significant Groundwater Recharge Areas - Locations where conditions can be moderate, or low	Significant Groundwater Recharge Areas	-	-		-	-
Map 5-12	Cana Wellhead Protection Area	Cana WHPA	Lack of Flow Direction	Does not Exist	Cana WHPA derived by Golder Consulting Ltd (2009). Wellhead Protection Areas (WHPAs) were delineated by a weighted scenario approach, involving backwards particle traces through simulated groundwater flow fields determined in multiple scenarios. The weighted scenario approach was selected to ensure conservatism in the delineation of the WHPA as it results in a larger WHPA than any individual (scenario) capture zone as delineated using backwards particle tracking (see Section 1.0). The degree to which each scenario was considered for the delineation of the WHPAs was based on model calibration statistics and professional judgment. WHPA Zone A was delineated as a circle of radius 100 metres, centred on the location of the municipal well as determined by the survey conducted for this study. Wellhead protection areas B, C, and D were delineated by drawing a smoothed polygon around each of the three delineated capture zones, at each of the times-of-travel considered. In drawing these polygons, the relative reliability of each of the three scenarios as models of the true groundwater flow field was considered, as was the overall uncertainty in the system. WHPA Zone E was delineated as the area within the surface water body where the time of travel is equal or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water. The precise groundwater flow direction within the sand aquifer and weathered Precambrian bedrock within the clay flats area (ie., in the general vicinity of the Cana Subdivision) well is considered the only notable data gap.	L	Information needed could be obtained with the installation of three or more monitoring wells
		Monitoring Wells	-	-	System monitoring wells for systems with the CSPA	-	-
		Wells	-	-	CSPA Drinking water wells, derived from municipal data and groundtruthing and GPS corrections.	-	-
Map 5-13	Cana WHPA – Intrinsic Susceptibility Index Realignment	Cana ISI	-	-	Groundwater vulnerability mapping was performed within the delineated WHPA Zones A through D using the Intrinsic Susceptibility Index (ISI) method, carried out on a 20 metre raster grid. The ISI provides a quantitative measure of the degree of protection afforded an aquifer by the overlying geologic material: the higher the index, the greater the degree of protection.	-	-
Map 5-14	Cana WHPA Vulnerability Scores	Cana ISI	-	-	Derived by Golder Associates. Groundwater vulnerability mapping was performed within the delineated WHPA Zones A through D using the Intrinsic Susceptibility Index (ISI) method, carried out on a 20 metre raster grid. The ISI provides a quantitative measure of the degree of protection afforded an aquifer by the overlying geologic material: the higher the index, the greater the degree of protection. The order and thickness of the geological layers overlying the supply aquifer were taken directly from the results of the conceptual modelling. Vulnerability scores for WHPA Zones A, S, C and D were calculated as directed by Table 2(a) of the Technical Rules (2009)(Government of Ontario, 2008) Vulnerability scores (V) for WHPA Zones E and F were calculated as indicated in Part VIII of the Technical Rules (2009)(Government of Ontario, 2008) by using the following equation: where: V=BxC B = the area vulnerability factor of the area of WHPA Zone E or F; and, C = the source vulnerability factor of WHPA Zone E or F.	-	-
Map 5-15	Cana WHPA – Locations where chemical threats can be significant, moderate, or low	Cana ISI	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 5-16	Cana WHPA – Locations where pathogen threats can be significant, moderate, or low	Cana ISI	-	-		-	-
Map 5-17	Cana WHPA – Locations where DNAPL threats can be significant, moderate, or low	Cana ISI	-	-		-	-
Map 5-18	Cana WHPA – Locations where conditions can be significant, moderate, or low	Cana ISI	-	-		-	-
Map 5-19	Cana WHPA - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-

Map 5-20	Lansdowne Wellhead Protection Area	Lansdowne WHPA	Lack of information at a fine geographic scale	Lack of geological sandstone information; Depth, vertical and Lateral. Accurate recharge estimates, and the role of cascading water within the well	WHPA Zone A was delineated as a circle of 100 metre radius centred around each of the two municipal production wells. To delineate WHPA Zones B, C, and D it was important to consider that the Lansdowne water supply, with rate estimated at 85,239 m ³ /year may be taken in any rate combination from the two existing production wells. To account for this fact, and to account for the uncertainty in the true values of hydraulic conductivity and recharge, time-of-travel based WHPAs were delineated based on particle tracking conducted in twelve flow simulations: each of the four calibration cases with pumping taken entirely from Well #1, taken entirely from Well #2, and taken evenly from Wells #1 and #2. WHPA Zones B, C, and D were delineated by drawing a smoothed polygon around all of the particle traces from all of the twelve flow simulations truncated to 2 years, 5 years, and 25 years time-of-travel, respectively (see Figure 5-3), weighted according to the calibration. Because of the poorer calibration for Case 3, a lower weighting was applied to this case than to the other cases, which resulted in a slightly smaller WHPA Zone C than would have resulted if all cases were weighted equally. This is apparent from the blue particle traces (2-5 yr travel time) which transition to green particle traces (5-25 yr travel time) just outside the WHPA Zone C line (5 yr t-o-t based WHPA Zone) for Case 3 particle traces. The WHPA is concentric about the municipal production wells, because of the fact that the wells are located on a topographic high, in a system in which groundwater flow is driven by local topographic relief.	H	-
Map 5-21	Lansdowne WHPA – Intrinsic Susceptibility Index	Lansdowne ISI	-	-	Groundwater vulnerability mapping was performed within the delineated WHPA Zones A through D using the Intrinsic Susceptibility Index (ISI) method. The ISI provides a quantitative measure of the degree of protection afforded an aquifer by the overlying geologic material: the higher the index, the greater the degree of protection. The ISI was calculated using the prescribed equation. The overburden was assigned a K-Factor of 3 for weathered clay while the bedrock was assigned a K-Factor of 1 in accordance with Table 3.2 of the Vulnerability Guidance (MOE, 2006). The value of ISI was determined to be less than 30 throughout the entire WHPA	-	-
Map 5-22	Lansdowne WHPA Vulnerability Scores	Lansdowne WHPA Vulnerability Scores	-	-	Vulnerability scores for WHPA Zones A, B, C, and D were assigned as directed by Table 2(a) of the Technical Rules (MOE, 2009). Vulnerability scores (V) for WHPA Zones E and F were calculated using the following equation, as provided in Part VIII of the Technical Rules (MOE, 2009) Vulnerability Score (V) = B x C where, B = Area Vulnerability Factor with an assigned value between 7 (lowest vulnerability) and 9 (highest vulnerability) for WHPA Zone E. By definition B for WHPA Zone E must be greater than B for WHPA Zone F. For the purpose of this study, the area vulnerability factor (B) was conservatively assigned a value of 9 due to the high vulnerability associated with the cascading water and potentially poor well seal (i.e. transport pathway). C = Source Vulnerability Factor with an assigned value between 0.5 (lowest vulnerability) and 1.0 (highest vulnerability) for WHPA Zone E and Zone F. For the purpose of this study, the source vulnerability factor (C) was conservatively assigned a value of 1.0 due to the transport pathway, and the fact that bacteriological contamination has been reported.	-	-
Map 5-23	Lansdowne WHPA – Locations where chemical threats can be significant, moderate, or low	Lansdowne ISI	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 5-24	Lansdowne WHPA – Locations where pathogen threats can be significant, moderate, or low	Lansdowne ISI	-	-		-	-
Map 5-25	Lansdowne WHPA – Locations where DNAPL threats can be significant, moderate, or low	Lansdowne ISI	-	-		-	-
Map 5-26	Lansdowne WHPA – Locations where conditions can be significant, moderate, or low	Lansdowne ISI	-	-		-	-
Map 5-27	Lansdowne WHPA – Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 5-28	Miller Manor Wellhead Protection Area	Miller Manor WHPA	Groundwater elevation, shallow bedrock aquifer transmissivity.	Spatially inaccurate	Canana WHPA derived by Golder Consulting Ltd. Wellhead Protection Areas (WHPAs) were delineated by a weighted scenario approach, involving backwards particle traces through simulated groundwater flow fields determined in multiple scenarios. The weighted scenario approach was selected to ensure conservatism in the delineation of the WHPA as it results in a larger WHPA than any individual (scenario) capture zone as delineated using backwards particle tracking (see Section 1.0). The degree to which each scenario was considered for the delineation of the WHPAs was based on model calibration statistics and professional judgment. WHPA Zone A was delineated as a circle of radius 100 metres, centred on the location of the municipal well as determined by the survey conducted for this study. Wellhead protection areas B, C, and D were delineated by drawing a smoothed polygon around each of the three delineated capture zones, at each of the times-of-travel considered. In drawing these polygons, the relative reliability of each of the three scenarios as models of the true groundwater flow field was considered, as was the overall uncertainty in the system. WHPA Zone E was delineated as the area within the surface water body where the time of travel is equal or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water. The groundwater elevation in an area south of County Road 2, and the shallow bedrock aquifer transmissivity distal from the Miller Manor supply well were identified as data gaps. The resolution of these data gaps could result in the delineation of smaller Wellhead Protection Areas.	-	-
Map 5-29	Miller Manor WHPA – Intrinsic Susceptibility Index	Miller Manor ISI	-	-	Derived by Golder Associates. Groundwater vulnerability mapping was performed within the delineated WHPA Zones A through D using the Intrinsic Susceptibility Index (ISI) method, carried out on a 20 metre raster grid. The ISI provides a quantitative measure of the degree of protection afforded by an aquifer by the overlying geologic material: the higher the index, the greater the degree of protection. The order and thickness of the geological layers overlying the supply aquifer were taken directly from the results of the conceptual modeling. Accordingly, the ISI map was contoured, and the 30 contour line and the 80 contour line were used to distinguish between the zones of high, medium, and low vulnerability. Smoothing was implemented at this stage to remove pixelated results.	-	-
Map 5-30	Miller Manor WHPA Vulnerability Scores	Miller Manor Vulnerability	-	-	The ISI was calculated on the basis of the thickness of the clay layer the only hydrostratigraphic layer to overlie the supply aquifer in the conceptual model, and a K-Factor of 6. The ISI calculation resulted in zones of medium and high vulnerability.	-	-
Map 5-31	Miller Manor WHPA – Locations where chemical threats can be significant, moderate, or low	Miller Manor ISI	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-

Map 5-32	Miller Manor WHPA – Locations where pathogen threats can be significant, moderate, or low	Miller Manor ISI	-	-		-	-
Map 5-33	Miller Manor WHPA – Locations where DNAPL threats can be significant, moderate, or low	Miller Manor ISI	-	-		-	-
Map 5-34	Miller Manor WHPA – Locations where conditions can be significant, moderate, or low	Miller Manor ISI	-	-		-	-
Map 5-35	Miller Manor WHPA – Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 5-36	Westport Wellhead Protection Area	Westport WHPA	-	-	The WHPA for the municipal wells were determined using a groundwater flow model (MODFLOW) and a particle tracking model (MODPATH). The model was verified through a steady state calibration to water elevations extracted from the MOE water well record database and water levels measured by <i>Malroz</i> . An uncertainty analysis was then applied to provide a conservative but reasonable wellhead protection area for the municipal wells. The wellhead protection area was divided into four zones as specified by the Ministry of Environment Technical Terms of Reference: Zone A (100 metre), Zone B (two year), Zone C (five year) and Zone D (25 year).	-	-
Map 5-37	Westport WHPA – Intrinsic Susceptibility Index	Westport ISI	-	-	The intrinsic susceptibility index (ISI) is a measure of how easily an aquifer can be contaminated from activities at the land surface. It is based on the characteristics of the geologic formations which overlie the aquifer. The ISI for the study area was derived using the procedures outlined in Guidance Module 3 (2006), MOE Technical Terms of Reference and the clarification documents. The ISI is based on a score which is derived by adding index values calculated for each hydrogeological unit starting at ground surface to the first significant aquifer. The first significant aquifer has been defined by the MOE as the highest 2 metre thick interval of saturated aquifer material. Specifically, if the aquifer is unconfined the top of the first significant aquifer is the water table whereas if the aquifer is confined, the top of the aquifer is the bottom of the confining unit. The index value for each hydrogeological unit is calculated by multiplying the thickness of each unit that lies above the aquifer by a representative K-Factor specified by the MOE. The K-Factor is inversely proportional to the vertical hydraulic conductivity of the hydrogeologic unit and is essentially an aquifer protection factor. For example, clay having a low hydraulic conductivity is assigned a high K-Factor compared to a gravel unit, which has a high hydraulic conductivity and is assigned a low K-Factor. The index value is calculated for each unit above the aquifer and then summed to provide an overall ISI at each well location.	-	-
Map 5-38	Westport WHPA Vulnerability Scores	Westport Vulnerability	-	-	The WHPA vulnerability scoring is represented by an aquifer vulnerability index (AVI) score system. Part V11.3 of the MOE Technical Rules (2009) specify that the WHPA vulnerability evaluation is conducted by superimposing the WHPA zones (A through D) onto the ISI values (low, medium and high). The WHPA zones (A, S, C, and 0) correspond with the 100 metre, 2 year, 5 year, and 25 year WHPA sensitivities respectively. Zone AA, only applies to non-municipal wells and is not used in this study. Each WHPA polygon was split to the ISI layer and the resulting tessellated polygons were scored using Table 6 below. For example an area of high ISI in zone A would score a 10, which is high vulnerability. An area of low ISI in zone D would score a 2, which is low vulnerability. Note that within an area of high ISI, the lowest score attainable is a 6 which is still moderately vulnerable.	-	-
Map 5-39	Westport WHPA – Locations where chemical threats can be significant, moderate, or low	Westport ISI	-	-		-	-
Map 5-40	Westport WHPA – Locations where pathogen threats can be significant, moderate, or low	Westport ISI	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 5-41	Westport WHPA – Locations where DNAPL threats can be significant, moderate, or low	Westport ISI	-	-		-	-
Map 5-42	Westport WHPA – Locations where conditions can be significant, moderate, or low	Westport ISI	-	-		-	-
Map 5-43	Westport WHPA - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 6 - Surface Water Sources							
Map 6-1	Brockville Intake Protection Zones 1 and 2	Brockville IPZ Zones	-	-	IPZ 1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. For the St. Lawrence River intakes, IPZ 1 was delineated as a half-circle in the upstream direction around the intake (one kilometre), with a rectangle in the downstream direction (100 metres). A combination of the regulation limit and a 120 metre high water mark setback is used for the IPZ 1 setbacks on land, in accordance with the Technical Rules (MOE, 2009). IPZ 2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ 2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ 2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include ditches, and sewer networks. Watercourses such as streams are also considered for the two hour time of travel for IPZ 2. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ 3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-

Map 6-2	Brockville Intake Protection Zones 1 and 2 - Including The USA	BR-USA IPZ 1, 2	-	-	IPZ 3 require identification of all contributing watercourses upstream of the intake of interest and a 120 metre buffer around the high water mark of the water body for each intake.	-	-
Map 6-3	Brockville Intake Protection Zones 1 and 2 - Vulnerability Scoring	Brockville Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to nine for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ 1 \ 10 \times 0.9 = 9$. $IPZ 2 \ 9 \times 0.9 = 8.1$	-	-
Map 6-4	Brockville IPZs - Locations where chemical threats can be significant, moderate, or low	Brockville IPZ Zones	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-5	Brockville IPZs - Locations where pathogen threats can be significant, moderate, or low	Brockville IPZ Zones	-	-		-	-
Map 6-6	Brockville IPZs - Locations where DNAPL threats can be significant, moderate, or low	Brockville IPZ Zones	-	-		-	-
Map 6-7	Brockville IPZs - Locations where conditions can be significant, moderate, or low	Brockville IPZ Zones	-	-		-	-
Map 6-8	Brockville IPZs - Corridors	Corridors	-	-		Corridors that could carry significant threats through the WHPA were mapped.	-
Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 6 - Surface Water Sources							
Map 6-9	James W. King Intake Protection Zones 1 and 2	James King IPZ	-	-	IPZ 1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. For the St. Lawrence River intakes, IPZ 1 was delineated as a half-circle in the upstream direction around the intake (one kilometre), with a rectangle in the downstream direction (100 metres). A combination of the regulation limit and a 120 metre high water mark setback is used for the IPZ 1 setbacks on land, in accordance with the Technical Rules (MOE, 2009). IPZ 2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ 2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ 2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ 3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-
Map 6-10	James W. King Intake Protection Zones 1 and 2 - Vulnerability Scoring	James King Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from 1 to 10 for type C and D intakes. Vfs can range from 0.5 to 1.0. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to 9.0 for IPZ 2. IPZ-3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ 1 \ 10 \times 0.9 = 9$. $IPZ 2 \ 9 \times 0.9 = 8.1$.	-	-
Map 6-11	James W. King IPZs - Locations where chemical threats can be significant, moderate, or low	James King IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-12	James W. King IPZs - Locations where pathogen threats can be significant, moderate, or low	James King IPZ	-	-		-	-
Map 6-13	James W. King IPZs - Locations where DNAPL threats can be significant, moderate, or low	James King IPZ	-	-		-	-
Map 6-14	James W. King IPZs - Locations where conditions can be significant, moderate, or low	James King IPZ	-	-		-	-
Map 6-15	James W. King IPZs - Corridors	Corridors	-	-		Corridors that could carry significant threats through the WHPA were mapped.	-

Figure #	Map Name	Data Set(s)	Data Concern (If any)	Limitations (If any)	Comment / Metadata	Priority (H/M/L)	Potential Solution
Chapter 6 - Surface Water Sources							
Map 6-16	Kingston Central Intake Protection Zones 1 and 2	Kingston Central IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-
Map 6-17	Kingston Central IPZs 1 and 2 - Vulnerability Scoring	Kingston Central Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) Technical Rules (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from 1 to 10 for type C and D intakes. Vfs can range from 0.5 to 1.0. The final vulnerability, V, can therefore range from five to ten for IPZ-1, and 3.5 to 9.0 for IPZ-2. IPZ-3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ-1 \ 10 \times 0.6 = 6$. $IPZ-2 \ 8 \times 0.6 = 4.8$.	-	-
Map 6-18	Kingston Central IPZs - Locations where chemical threats can be significant, moderate, or low	Kingston Central IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-19	Kingston Central IPZs - Locations where pathogen threats can be significant, moderate, or low	Kingston Central IPZ	-	-		-	-
Map 6-20	Kingston Central IPZs - Locations where DNAPL threats can be significant, moderate, or low	Kingston Central IPZ	-	-		-	-
Map 6-21	Kingston Central IPZs - Locations where conditions can be significant, moderate, or low	Kingston Central IPZ	-	-		-	-
Map 6-22	Kingston Central IPZs - Corridors	Corridors	-	-		Corridors that could carry significant threats through the WHPA were mapped.	-
Map 6-23	Point Pleasant Intake Protection Zones 1 and 2	Point Pleasant IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-
Map 6-24	Point Pleasant IPZs 1 and 2 - Vulnerability Scoring	Point Pleasant Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) Technical Rules (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to 1.0. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to 9.0 for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ \ 1 \ 10 \times 0.6 = 6$. $IPZ \ 2 \ 7 \times 0.6 = 4.2$.	-	-
Map 6-25	Point Pleasant IPZs - Locations where chemical threats can be significant, moderate, or low	Point Pleasant IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-26	Point Pleasant IPZs - Locations where pathogen threats can be significant, moderate, or low	Point Pleasant IPZ	-	-		-	-
Map 6-27	Point Pleasant IPZs - Locations where DNAPL threats can be significant, moderate, or low	Point Pleasant IPZ	-	-		-	-
Map 6-28	Point Pleasant IPZs - Locations where conditions can be significant, moderate, or low	Point Pleasant IPZ	-	-		-	-
Map 6-29	Point Pleasant IPZs - Corridors	Corridors	-	-		Corridors that could carry significant threats through the WHPA were mapped.	-
Map 6-30	Fairfield Intake Protection Zones 1 and 2	Fairfield IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-

Map 6-31	Fairfield Intake Protection Zones 1 and 2 - Vulnerability Scoring	Fairfield Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) Technical Rules (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to nine for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ 1 \ 10 \times 0.7 = 7$. $IPZ 2 \ 9 \times 0.7 = 6.3$.	-	-
Map 6-32	Fairfield IPZs - Locations where chemical threats can be significant, moderate, or low	Fairfield IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-33	Fairfield IPZs - Locations where pathogen threats can be significant, moderate, or low	Fairfield IPZ	-	-		-	-
Map 6-34	Fairfield IPZs - Locations where DNAPL threats can be significant, moderate, or low	Fairfield IPZ	-	-		-	-
Map 6-35	Fairfield IPZs - Locations where conditions can be significant, moderate, or low	Fairfield IPZ	-	-		-	-
Map 6-36	Fairfield IPZs - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 6-37	Bath Intake Protection Zones 1 and 2	Bath IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-
Map 6-38	Bath Intake Protection Zones 1 and 2 - Vulnerability Scoring	Bath Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to nine for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ 1 \ 10 \times 0.7 = 7$. $IPZ 2 \ 9 \times 0.7 = 6.3$.	-	-
Map 6-39	Bath IPZs - Locations where chemical threats can be significant, moderate, or low	Bath IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map-6-40	Bath IPZs - Locations where pathogen threats can be significant, moderate, or low	Bath IPZ	-	-		-	-
Map 6-41	Bath IPZs - Locations where DNAPL threats can be significant, moderate, or low	Bath IPZ	-	-		-	-
Map 6-42	Bath IPZs - Locations where conditions can be significant, moderate, or low	Bath IPZ	-	-		-	-
Map 6-43	Bath IPZs - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 6-44	A.L. Dafoe Intake Protection Zones 1 and 2	A.L. Dafoe IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-
Map 6-45	A.L. Dafoe Intake Protection Zones 1 and 2 - Vulnerability Scoring	A.L. Dafoe Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to nine for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. $IPZ 1 \ 10 \times 0.7 = 7$. $IPZ 2 \ 9 \times 0.7 = 6.3$.	-	-
Map 6-51	Sandhurst Shores Intake Protection Zones 1 and 2	Sandhurst IPZ	-	-	IPZ-1 has been mapped based on the Technical Rules (MOE, 2009) as a circle around the intake, with an appropriate setback on land. IPZ-2 has been delineated using a two hour time of travel during a ten year wind condition, as detailed in CWE (2009). In addition, transport pathways have been added to the IPZ-2 where they outlet into the wind delineated IPZ. The extent of transport pathways included in IPZ-2 is intended to include only the length of pathway that is expected to be within a two hour time of travel of the intake. The pathways delineated include streams, ditches, and sewer networks. The extent of the pathway included was decided by using sewer network mapping provided by the municipalities, and assuming full flowing pipes, as well as estimating the cross-section of streams and ditches, and assuming bankfull flow. All time of travel calculations were done using Manning's equation. IPZ-3 was delineated by running the hydrodynamic model for specific sites of interest. For instance, if a chemical storage site was identified to be modeled, the location was added into the model, and the model was run to see whether a release from site could directly reach the intake during an extreme event (i.e. the one in one hundred year storm, or more precisely, a one per cent probability wind condition) in a reasonable time.	-	-

Map 6-52	Sandhurst Shores Intake Protection Zones 1 and 2 - Vulnerability Scoring	Sandhurst Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) Technical Rules (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to nine for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. IPZ 1 $10 \times 0.7 = 7$. IPZ 2 $9 \times 0.7 = 6.3$.	-	-
Map 6-53	Sandhurst Shores IPZs- Locations where chemical threats can be significant, moderate, or low	Sandhurst IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-54	Sandhurst Shores IPZs - Locations where pathogen threats can be significant, moderate, or low	Sandhurst IPZ	-	-		-	-
Map 6-55	Sandhurst Shores IPZs - Locations where DNAPL threats can be significant, moderate, or low	Sandhurst IPZ	-	-		-	-
Map 6-56	Sandhurst Shores IPZs - Locations where conditions can be significant, moderate, or low	Sandhurst IPZ	-	-		-	-
Map 6-57	Sandhurst Shores IPZs - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 6-58	Great Lakes Intake Protection Zone 3	IPZ3	-	-	IPZ-2 and IPZ-3, delineations were constructed at each intake using two-hour reverse progressive vector diagrams calculated from the modelled surface currents at the eight locations during the 24 hour storm events. Reverse progressive vector diagrams are analogous in principle to reverse particle tracking, whereby fluid parcels are continuously released at the intake are tracked backward in time such that their position within the flow domain two hours prior to release may be determined.	-	-
Map 6-59	Picton Intake Protection Zones	Picton IPZ	-	-	The Picton Intake is located in the Bay of Quinte, which is considered for the delineation of the IPZ 1 to be a type D intake. To delineate IPZ 2 a field truthed hydrodynamic model was developed using the US EPA's Environment Fluid Dynamics Code, EFDC. IPZ 3 require identification of all contributing watercourses upstream of the intake of interest and a 120 metre buffer around the high water mark of the water body for each intake.	-	-
Map 6-60	Picton Intake Protection Zones - Vulnerability Scoring	Picton Vulnerability	-	-	To summarize, the vulnerability score is a multiplication of two factors, the area vulnerability factor (Vfa) and the source vulnerability factor (Vfs) Technical Rules (MOE, 2009). $V = Vfa \times Vfs$ The criteria for assigning Vfa and Vfs are laid out in the Technical Rules (MOE, 2009) Technical Rules (MOE, 2009). Vfa can range from seven to nine for Type A and B intakes, and from one to ten for type C and D intakes. Vfs can range from 0.5 to one. The final vulnerability, V, can therefore range from five to ten for IPZ 1, and 3.5 to 9.0 for IPZ 2. IPZ 3 is not given a vulnerability score for Great Lake and Connecting Channel intakes. IPZ 1 $10 \times 0.7 = 7$. IPZ 2 $9 \times 0.7 = 6.3$.	-	-
Map 6-61	Picton IPZs - Locations where chemical threats can be significant, moderate, or low	Picton IPZ Zones	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-62	Picton IPZs - Locations where pathogen threats can be significant, moderate, or low	Picton IPZ Zones	-	-		-	-
Map 6-63	Picton IPZs - Locations where DNAPL threats can be significant, moderate, or low	Picton IPZ Zones	-	-		-	-
Map 6-64	Picton IPZs - Locations where DNAPL threats can be significant, moderate, or low	Picton IPZ Zones	-	-		-	-
Map 6-65	Picton IPZs - Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
Map 6-66	Sydenham Intake Protection Zones	Sydenham IPZ	-	-	For Type D intakes, the IPZ 1 is the area within a circle that has a radius of 1,000 metres centred on the crib of the intake. Where an IPZ 1 extends more than 120 metres onto land from the high water mark of a surface water body, the area of the IPZ 1 on the land is reduced to include only a setback of 120 metres. The IPZ 2 is the area within each surface water body that may contribute water to the intake where the time of travel to the intake is equal to or less than the time that is sufficient to allow the operator to respond to an adverse condition in the quality of the surface water. The IPZ 2 area also includes the area within the storm watershed of each storm sewer that discharges into a surface water body that may contribute water to the intake within the specified minimum time of travel. Where the IPZ 2 area abuts land, there is to be a setback inland of 120 metres or the Regulation Limit, whichever is greater, along the abutted land measured from the high water mark of the surface water body. Total Water Contributing Area (TWCA), which was defined as the remaining watershed area upstream of the intake. This area has been modified to be entitled IPZ 3. The IPZ 3 for a Type D intake is the area within each surface water body that may contribute water to the intake. Where the area abuts land, there is to be a setback inland of 120 metres or the Regulation Limit, whichever is greater, along the abutted land measured from the high water mark of the surface water body.	-	-
Map 6-67	Sydenham IPZs - Vulnerability Scoring	Sydenham Vulnerability Scoring	-	-	There are two types of vulnerability associated with an intake: an area vulnerability factor, and a source vulnerability factor. The area vulnerability factor differs for each of the three zones; the closer the zone to the intake, the higher the factor. Therefore the factor for IPZ 1 is the highest, and is fixed at ten. For IPZ 2, the factor can range between seven and nine, and for the IPZ 3, a wide range is provided of one to nine. Type D intakes are considered to be highly susceptible to contamination and therefore have high values (0.9 to one). To obtain an overall vulnerability score for each IPZ 1, IPZ 2, and each area of an IPZ 3 associated with an intake, the two factors are multiplied together.	-	-
Map 6-68	Sydenham IPZs- Locations where chemical threats can be significant, moderate, or low	Sydenham IPZ	-	-	All known (or assumed) threats are listed for each activity. They are listed in order of the prescribed drinking water threats list (1 through 21 as referenced in the Clean Water Act, 2006 Ontario Regulation 287/07) in the "PDWT No." column of the associated vulnerable zone/area, and then by ascending Reference Numbers. Reference numbers and the associated circumstances are taken from the Drinking Water Threats Tables as provided by the Ministry of the Environment (2009). More than one circumstance can be listed per threat: if there are both chemical and pathogen based circumstances present Fuel, Solvents or DNAPLs: one circumstance for handling; a second consideration for storage Fuel: consideration for having two sources of the same threat. For example: fuel stored below grade and additional fuel storage above ground, gasoline. Each circumstance is ranked as a significant (S), moderate (M) or low (L) threat. Only the circumstance producing the highest ranking is used for enumeration of the parcel Threats and their particular Circumstances are determined to be S, M or L based on: The Vulnerability scoring determined for the specific system delineation (WHPA A - D, IPZ 1-3) (the VS is shown in the second column of Appendix "H" for each system). The amount the landowner/parcel has of the particular threat. Each threat will in turn be broken down into more specific detail. This detail is referred to as the 'circumstances' pertaining to the threat. Each circumstance is given the S, M, or L score based on where the parcel geographically sits in the IPZ or WHPA. If a threat is occurring close to the intake, it will have a higher score and similarly; if the circumstance (eg quantity of fuel, Solvents, DNAPLs) is large, the score will be ranked higher (more S or M). Each Threat is given a number (as mentioned in first bullet: 1-21) and each circumstance occurring on the parcel is given a 'reference number'. The reference number is located in Appendix 'H' in the column prior to the detailed circumstance. The detailed circumstances, their assigned reference numbers and corresponding vulnerability scores have been determined in reference to Appendix 'G' which is a summary of the MOE prescribed threat vulnerability scoring. Appendix 'H' is a summary of this larger appendix. Its aim is to provide the reader with an indication of what threats and their associated circumstances are occurring within each system.	-	-
Map 6-69	Sydenham IPZs - Locations where pathogen threats can be significant, moderate, or low	Sydenham IPZ	-	-		-	-
Map 6-70	Sydenham IPZs - Locations where DNAPL threats can be significant, moderate, or low	Sydenham IPZ	-	-		-	-
Map 6-71	Sydenham IPZs - Locations where conditions can be significant, moderate, or low	Sydenham IPZ	-	-		-	-

Map 6-72	Sydenham IPZs – Corridors	Corridors	-	-	Corridors that could carry significant threats through the WHPA were mapped.	-	-
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