RVCA Low Water Information Report

In support of the Ontario Low Water Response program (OLWR)

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1.0 Introduction

This report is in response to a Memorandum of Understanding between the Ministry of Natural Resources (MNR) and the RVCA. 'Section 1' of the MoU requests documentation of background information to support low water condition reporting. The following provides the background information used by the RVCA in past low water conditions, as well as additional data that would be beneficial in future projects concerning low water reporting.

2.0 Watershed Characterization

The following watershed characterization is a summary of the important features within the Rideau Valley Conservation Authority (RVCA), in support of low water condition reporting. A description of the natural features, water control structures, available hydrometric and climatic data, water uses, agricultural data and data gaps is given. The summary is adapted from the *Mississippi-Rideau Source Protection Region (MRSPR) Watershed Characterization Report – Preliminary Draft* (March 2008), the *Mississippi-Rideau Source Protection Region (MRSPR) Conceptual Understanding of the Water Budget – Preliminary Draft* (March 2007) and the *Rideau River Watershed Modeling Using Mike11 - Draft* (March 2007) report. For more detailed information please refer to these reports, in particular the MRSPR studies.

2.1 Watershed Description

Physical Description

The area of jurisdiction of the Rideau Valley Conservation Authority is a total of 4257 km^2, including the 3872 km^2 watershed of the Rideau River and the remaining area consisting of the watersheds of other tributaries of the Ottawa River and areas served by urban drainage systems. The topography is highly variable, generally sloping from the southwest towards the northeast, with an average slope of 0.05%, and roughly a 40m drop. The geology and topography in the area produces a complex network of lakes, rivers, wetlands and streams; the majority of lakes being found in the Upper Rideau. The major tributaries include: Tay River, Irish Creek, Kemptville Creek, Stevens Creek and the Jock River. Figure 1.1 shows the major rivers, streams and lakes within the RVCA, as well as municipal boundaries.

The topography – produced from a 10m x 10m Digital Elevation Model (DTM) released by the Ministry of Natural Resources (MNR) – is shown in Figure 1.2.

Water Control Structures

The water control structures within the RVCA are shown in Figure 1.3. Most of the structures are part of the historic Rideau Canal and are operated by Parks Canada's Rideau Canal office, and some are operated by MNR. Typically, the control structures are dams with stoplog control and/or sluice gates. Records of their operation are kept by the responsible agencies. Within the Rideau Canal, Parks Canada strives to maintain adequate water levels in the navigation channel to reduce the impact on recreation and the natural environment. Generally, the dams on the majority of the lakes within the Canal are operated in a similar pattern annually. During the navigation season, a flow sufficient to maintain a minimum 1.6 m depth throughout the Canal is drawn from the reservoir lakes (Parks Canada, 2005). As on the Rideau, the Tay River's streamflows are augmented throughout a low water event by releases from a reservoir lake. Bobs Lake provides flow to the Tay River, while Wolfe Lake and Upper Rideau Lake are the Rideau Canal Reservoir Lakes. The Jock and Kemptville Creek areas are non-regulated parts of the watershed.

Hydrometric and Climatic Data

The streamflow and water level measurement stations are shown in Figure 1.4 and Table 1.1. Several of the streamflow monitoring stations are operated by the Water Survey of Canada within the Canada-Ontario Agreement on Hydrometric Monitoring and are publicly available on the HYDAT CD. Parks Canada and the RVCA also collect streamflow data within the RVCA, mainly to correspond with their own needs as water management agencies.

The climate stations in and around RVCA are shown in Figure 1.5 and are listed in Table 1.2. All stations collect rainfall and temperature measurements, and are operated by Environment Canada. Potential evapotranspiration (PET) data is available for the Ottawa International Airport location. The topographic changes from the upstream areas of the Rideau to the downstream areas near the Ottawa River have a significant influence over the observed temperature and precipitation (MRSPR, 2008). There can be substantial differences between recorded precipitation at MacDonald-Cartier Airport, and southwest portions of the watershed (RVCA, 2001), over daily, weekly and even monthly durations. Annual precipitation amounts do not vary as significantly. Also precipitation data is not current at all stations; refer to Figure 1.5 for the years in which climate stations were operational. This poses some difficulties in performing precipitation analyses.

Land Use and Soils

The land use map for the RVCA, obtained from the MNR, Natural Resources and Values Information System, is shown in Figure 1.6, and is enumerated in Tables 1.3a-b. The

soils map, Figure 1.7 and Tables 1.4a-b, is based on the information provided by Agriculture and Agri-Food Canada, Canadian Soil Information System. (RVCA, 2007b)

Geology

About 70% of the Rideau watershed (in the southwest and middle regions) is characterized as bedrock covered by shallow soils and sparse overburden. The geology of the Precambrian igneous and metamorphic bedrock, in the upper third of the watershed is extremely complex with many faults, folds and a mixture of rock types. The middle third of the watershed is dominated by limestone plains. The northeast third of the watershed is dominated by deeper surface deposits of till, clays and sands overlying the Paleozoic sedimentary bedrocks. Scattered organic deposits are found near the wetland/lowland areas.

Groundwater

Both shallow and deep groundwater tables, generated from water well data, can be found in the MRSPR study. The regional groundwater flow direction is spatially variable; however generally flowing from the southwest to the northeast, or towards the Ottawa River. The recharge/discharge potential was inferred from the relative elevations of the shallow and deep water tables, Figure 1.8. In most of the area, the elevation differential is ±5 m, and the (vertical) flow direction cannot be conclusively established. In some areas, the differential was greater than ±5 m, and flow direction could be assigned with some confidence. (RVCA, 2007b)

Baseflow

Various studies have been completed or are currently being completed to define baseflows. The following briefly describes two of these projects.

1. For each hydrometric station within the RVCA, baseflow was estimated in the MRSPR (2009) study, using the baseflow index method. The information was used to approximate groundwater recharge.

2. The RVCA has been conducting streamflow surveys in an effort to examine relationships between baseflow, as recorded at streamflow recording stations, and at a number of un-gauged locations. As well the surveys are intended to study the spatial variability of baseflow across the watershed. From the year 2003 until the present streamflow measurements were taken in the Jock River, Kemptville Creek, Lower Rideau, Middle Rideau, and the Tay River sub-watersheds. As of yet the accumulated data have not been sufficient to draw any conclusions.

It is understood, however, that baseflows in watercourses throughout the RVCA area of jurisdiction are generally very low, with little natural groundwater discharge to the streams through the typical summer period, as a result of the geological setting. There are exceptions, but an inventory of stream reaches that are known to be recipients of significant baseflow-supporting groundwater discharge has never been assembled.

Naturally Vegetated Areas

"Naturally vegetated areas" refers to ecological features that perform various beneficial functions on the landscape and include wetlands, woodlands and riparian areas. These areas can affect the water table and storage capacity of a specific area.

The Rideau watershed is relatively abundant in naturally vegetated areas – approximately 39% of the total watershed area is forested. A total of 639.6 km^2 or about 15% of the watershed is covered by wetlands. Few wetlands remain within the Lower Rideau region, however those remaining are significant. Most wetland coverage is found in the Middle and Upper Rideau regions.

A recent study completed by the RVCA showed that all wetlands within RVCA attenuate the 1:100 year flood by roughly 10%. The 1:100 year flood flow would be expected to increase by about 4%, at the local scale, if all the non-provincially significant wetlands were removed. (RVCA, 2009a)

Natural area surveys to identify a series of ecological areas consisting of natural landscapes, environments and biotic communities were conducted by the MNR and resulted in the identification of ANSIs (Areas of Natural and Scientific Interest) within the RVCA.

Aquatic Ecology

Specific information regarding the status of fish population and habitat have been collected through the Ontario Stream Assessment Protocol, Macro Stream Assessment, Beaver Dam Monitoring and Municipal Drain Classification. The fish habitat areas within the RVCA mainly consist of warm water fish, including species such as largemouth bass, rock bass, pumpkinseed and bluegill. Eagle Lake and parts of Bobs Lake can exhibit cold water species such as trout, and portions of the Tay River may exhibit cool water species such as smallmouth bass, walleye, muskellunge and northern pike. More detailed analysis of fish communities can be found in such reports as the Rideau River Fisheries Assessment Report, Jock River Watershed Plan, Kemptville Creek Watershed Plan, Lower Rideau Watershed Plan and Fish Habitat of the Tay River Watershed. (MRSPR, 2008)

For more information on aquatic macroinvertebrates and species and habitats at risk, refer to the MRSPR (2008) report.

2.2 Water Use

Available Data

Water use within the RVCA is a mixture of drinking water, recreational, ecological, agricultural and industrial uses. A permit to take water (PTTW) is required for large water users, with potential consumption of greater than 50,000 L/day. The PTTW data, including information about permit holders, the permit itself, and the water sources used, can be obtained from the MOE, Land Information Ontario (LIO)[1] warehouse. It should be noted that the PPTW database is the total permitted volume of water and not necessarily the amount of actual water taken.

A summary of the PTTW database for the RVCA, as completed in the MRSPR study (2007), is shown in Table 1.5. The summary does not include the following permits as they are deemed to not affect the water budget:

- Non-sustainable permits (e.g. construction dewatering)
- Wetland and wildlife conservation permits
- Permits expired for more than 5 years

Additionally, the average annual water uses in the Rideau Region for municipal drinking water facilities and for OMYA (a calcite producing plant on the Tay River) are given in Table 1.6 and Table 1.7.

The above mentioned water use data was obtained by the Mississippi-Rideau Source Water Protection group in the past couple of years. Specifically the PTTW data became available to the group, and to the RVCA, in 2006. The water use information has yet to be utilized for the purpose of low water condition reporting; however will be incorporated in any future projects.

Water Demand and Quantity Stress

The MRSPR (2009) water budget study explains and estimates the current and future water demands within the RVCA. Water demand in the region was considered from these four sources:

- PTTW
- Municipal water takings

[1] LIO is a provincial initiative that supports the province-wide sharing of geographic data. LIO provides centralized access to data through a number of tools and services.

- Agricultural takings (e.g. Livestock and irrigation)
- Private wells

The percent water demand calculation is a relative indicator of water quantity stress, and simply highlights which sub-watersheds require further analysis. A stress assessment evaluates the ratio of the consumptive demand to the water available in a sub-watershed (supply – reserve).

In the MRSPR (2009) study in was determined that, from surface water considerations, none of the RVCA sub-watersheds were under significant stress and therefore no further sensitivity analysis was required. For the groundwater stress assessment it was found that one sub-watershed, defined as the Rideau River at Ottawa, had a moderate stress level. The water demand in that area is primarily from commercial PTTWs, including three for quarry operations and three permits for golf course irrigation. There was however no significant groundwater stress determined in the other sub-watersheds.

It should be pointed out that the above referenced study was completed in order to help assess and protect the quantity of drinking water sources in Ontario; therefore caution should be used when using the results for a low flow analysis. Different stress level results may arise when considering the socio-economic and ecological low flow requirements in the RVCA.

A more thorough assessment of low flows was completed for a portion of the Rideau Valley. Water quantity stresses in an area of the Tay River were investigated by the department of Fisheries and Oceans Canada. An *Environmental Assessment Screening Report for the Tay River Water Intake Project* (DFO, 2002) was completed to examine the impacts of OMYA Canada Inc. (a calcite producing plant) pumping water from the Tay. This study considered the impacts to surface water, groundwater, aquatic habitats and other environmental factors. DFO concluded that the project would not likely cause significant adverse environmental effects, as long as proper management practices were in place.

2.3 Agricultural Data

Agricultural water takings data are available in a report from MNR, compiled by de Loe (2002). The report gives estimates for agricultural water use in 2001 for watersheds in Ontario, including water utilized for livestock, irrigation, and other uses. In the RVCA, most of the water use for agricultural purposes is concentrated in Lanark, Leeds & Grenville, and Ottawa. Agricultural water use estimates for 2001 are shown in Table 1.8 (MRSPR, 2007). The 2006 agricultural census data has recently been acquired from Statistics Canada and is currently being reviewed. A supplementary note on the apparent

demand for irrigation water supplies, as implied by the census data, will be prepared in the near future.

In addition, the MOE PTTW database identifies permits for larger agricultural water users. These permits, along with the water source, their purpose and total amount of water they are permitted are available. Table 1.9 summarizes the daily permitted water use for large agricultural water users.

According to the MRSPR (2008) study, farm irrigation systems have not generally been developed in a large scale within the area. In the low water events that have occurred since inception of the Ontario Low Water Response program, there have been impacts on agriculture, but during the event, water allocation amongst competing irrigation systems did not present itself as an issue. The concerns in the agricultural sector were: diminished crop yields due to the dry, hot weather and in some cases the need to haul water for livestock who would otherwise use water from shallow well systems, farm dugouts, or nearby streams.

2.4 Potential Areas of Stress

As mentioned in Section 2.2, there are no immediate surface water and groundwater quantity stresses within most sub-watersheds of the RVCA. However it was found that one sub-watershed, defined as the Rideau River at Ottawa, had a moderate groundwater stress level. Again, this analysis is from a drinking water perspective and is not necessarily valid for low flow requirements. This analysis assigned a stress category to each sub-watershed by comparing its maximum monthly percent water demand to predefined stress criteria. Very little analysis has been undertaken in the RVCA area of jurisdiction to identify and evaluate potential areas, when under low water conditions, where stress upon natural aquatic ecosystems has been exacerbated by human activities such as artificial drainage works, reservoir storages or water takings for municipal, industrial or agricultural purposes.

2.5 Appropriateness of Data to Detect Low Water Conditions

The appropriateness of stream gauges, precipitation gauges, and provincial groundwater monitoring wells for monitoring and detecting low water conditions is described below.

Stream Gauges

In general there is a lack of stream flow gauges on the un-regulated tributaries in the RVCA; however the existing stream gauges can be utilized, to some extent, to determine low water conditions.

An analysis of streamflow thresholds, with respect to investigating drought severity, was completed in the preliminary Draft report entitled: Low Water Response Plan for the Rideau River Watershed (RVCA, 2007a). It was determined that the characterization of drought severity in the non-regulated sub-watersheds (Jock River and Kemptville Creek) depends on flow data from the hydrometric monitoring stations on the Jock River at Moodie Drive and Kemptville Creek downstream of Oxford Mills. It was found that the application of thresholds for these sub-watersheds, based exclusively on percentage of the 'Lowest Average Summer Month Flow' (LASMF) would result in the declaration of drought conditions prematurely and rather frequently. RVCA staff suspect this is because the computed value of LASMF is influenced by monthly flows for wet weather periods that are in the record – not only the recorded annual low flows. A Low Flow Frequency Analysis (LFA) was completed by RVCA (2007c) for three gauge stations – Rideau at Carleton, Jock at Moodie Drive and Kemptville at Kemptville – to derive the relationship between frequency (or return period) and 7-day minimum flows. The LFA could potentially provide improved results when assessing the severity of drought conditions. For areas in which flows are regulated, i.e. along the Tay River and Rideau River, the status of the reservoirs must be accounted for when determining the severity of low water conditions.

Precipitation Gauges

There are substantial differences between recorded precipitation at MacDonald-Cartier Airport, and southwest portions of the watershed (RVCA, 2001) for daily, weekly and even monthly durations. Annual precipitation amounts are more consistent from station to station. Also precipitation data is not current at all stations; refer to Figure 1.5 for the years in which climate stations were operational. This poses some difficulties in performing precipitation analyses. In view of the variability in rainfall distribution across the watershed, drought severity during any particular event may also be characterized as being variable across the watershed. For example, the upper sub-watersheds could be experiencing 'Level II' conditions while the lower watershed could be in 'Level I' or 'Normal' conditions.

Groundwater Monitoring Wells

The RVCA recently completed a report entitled *Ontario Low Water Response Groundwater Indicator Pilot Project - Final Report* (RVCA, 2009b). The study tested the use of Provincial Groundwater Monitoring Network wells (groundwater levels) as

potential indicators of low water conditions in aquifers. The project has now entered Phase II.

2.6 Other Data Gaps

The previous section outlined several data gaps and Table 1.10 outlines the information available to the water response team. There are however some additional issues that should be mentioned.

There are limitations with the PTTW database. In most cases only permitted water takings are given as opposed to actual water takings and there are also missing entries, expired permits, etc.

The agricultural data has a degree of uncertainty associated with it. The collection of agricultural water takings data was originally done by census area and was then converted to the sub-watershed scale. By assuming the agricultural takings are averaged evenly throughout the census area, some uncertainty is added to the data since agricultural takings are likely from point sources. Therefore, large point source takings are averaged over an area, and possible between sub-watersheds, depending on the distribution of a census area between sub-watersheds. As well, the data does not distinguish between surface water and groundwater takings. (MRSPR, 2009)

There is a need to study the in-stream flow requirements within sensitive areas of the Rideau Valley watershed. It is necessary to determine the level of flow required to maintain/improve the local ecosystems and their associated benefits to various water users.

2.7 Most Sensitive Sub-watershed

In the context of the Ontario Low Water Response framework, identifying the sub-watershed which is “most sensitive” or “most under stress”, as relating to low water conditions, is a matter of overlaying the spatial distribution of water takings and “active water management operations” (i.e. by means of artificial control structures and reservoirs) on a map, showing the spatial distribution of natural water “availability” by season or month. This sort of analysis has not been attempted to date, and is beyond the scope of this paper. Intuitively, however, it is considered that the Tay River at Perth and perhaps the Rideau River at Smiths Falls are likely the most sensitive locations, since water takings for important socio-economic purposes are located there - i.e. both communities use surface water for municipal water supply purposes. The annual runoff is “managed” or regulated to a high degree for Rideau Waterway operations.

3.0 Communications Materials

Presently no formal communication materials and processes exist for a low water event in the RVCA; yet in the past actions were taken to respond to such an event. In 2001 low water conditions were reached and the WRT at the time responded to the situation by circulating a series of news releases and by conducting a survey to determine the economic loss experienced by land owners and businesses, attributed to a failure of their water supply system. The documents were compiled in a *Report on the Social, Environmental and Economic Impacts of Low Water Conditions in the Rideau River Watershed in 2001 - Draft* (RVCA, 2001). There were minimal responses to the survey and therefore the results cannot be considered conclusive in any scientific sense, but the information collected is to some degree indicative of the relatively minor hardships that are suffered during an extended period of dry weather in the Rideau Valley.

Also preliminary steps were taken to create a *Low Water Response Plan for the Rideau River Watershed* (RVCA, 2007a). The draft was discussed at a "start-up" meeting of the WRT held in 2007, and was not formally adopted at that time. It is our understanding that the WRT participants generally value the opportunity to meet face to face with their counterparts in other agencies during developing drought conditions, to share information and hear from the various perspectives that are represented. At that time they were also supportive of intentions to make further refinements to the Plan, so as to be well prepared for the next significant drought event. However, little progress has been made in that direction since then, as the attention of personnel in all participating agencies has been directed to other priorities and issues.

The following requested communication materials have yet to be developed for the Rideau Valley watershed:

- Strategy for communication with water users.
- Brochures and/or Flyers available to the WRT that outline the key messages about the low water condition, expected voluntary reductions in water use, conservation measures, etc.
- Standard letter to send out to permit holders at Level I condition.
- Stakeholder contact list to be used to contact local farm associations, industry, etc. to gain feedback on conservation measures in the case of a drought.
- Written process established with local municipalities to receive assistance with delivering communications to the municipal water supply users and private water well users during drought conditions.

The municipal contact list, outlined in the following section, is to be used to contact municipalities to gain feedback on water conservation measures in the case of a drought.

4.0 Engaging an effective water response team

Table 2.1 shows a contact list for the participants on the Rideau Valley WRT as of 2007. Currently this list is being updated. The preliminary draft of the *Low Water Response Plan for the Rideau River Watershed* (RVCA, 2007a) is intended to provide current strategies to define how the WRT will work towards continued membership in the future.

References

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RVCA, 2007b. Rideau River Watershed Modeling Using Mike11 – Draft. March 2007.

RVCA, 2007c. Low Flow Frequency Analysis (Rideau at Carleton, Jock at Moodie Drive and Kemptville at Kemptville). June 7, 2007.

RVCA, 2009a. Quantifying the Importance of Wetlands in the Management of Floods and Droughts in the Rideau Valley Watershed. January 12, 2009.

RVCA, 2009b. Ontario Low Water Response Groundwater Indicator Pilot Project - Final Report. March 2009.

Table 1.1 Hydrometric Sites

Water-shed	Station ID	Stream / Location	Data availability		Data Type	Collected by
			From	End		
Tay	02LA017	Tay River below Bobs Lake (Bolingbroke)	1984 1991	1991 present	Q: hourly Datagaps was seasonal	WSC PC, RVCA
	02LA017	Tay River below Bobs Lake (B'broke)	1988 1991	1991 present	H: hourly Datagaps: telemetry out of service July, 2006 - present	WSC PC, RVCA
	02LA001	Tay River near Glen Tay	1915	1926	Q: daily	WSC
	02LA024	Tay River at Perth	1994	present	Q: hourly	WSC, RVCA
	02LA016	Tay River at Port Elmsley	1982	1988	Q: hourly	WSC
	-	Tay River at OMYA	2002	present	Q: hourly	RVCA
	-	Christie Lake	1988	present	H: daily	PC
	-	Tay Marsh at Beveridges Locks	1979	2004	H: daily Datagaps: seasonal	PC
Upper Rideau	-	Wolfe Lake	1980	present	H: hourly	PC, RVCA
	02LA025	Upper Rideau Lake at Narrows	1989 1996	1991 present	H: hourly	PC, RVCA
	02LA014	Lower Rideau Lake at Rideau Ferry	1980 1988	1982 present	H: hourly	WSC PC, RVCA
Middle Rideau	02LA005	Rideau River above Smith Falls (Poonamalie)	1970 1997	1996 present	Q: hourly Datagaps: seasonal	WSC PC, RVCA
	02LA018	Rideau River at Merrickville	1988 1989 1996	1988 1991 present	H: hourly	WSC PC, RVCA
	02LA011	Rideau River below Merrickville (Andrewsville)	1979 1997	1996 present	Q & H: hourly	WSC PC, RVCA
Kempt-ville	02LA006	Kemptville Creek near Kemptville	1969 2002	2001 present	Q: hourly	WSC & RVCA
Lower Rideau	-	Rideau River at Burritts Rapids	1998	present	H: hourly	PC, RVCA
	02LA010	Rideau River at Becketts Landing	1988	2004	H: hourly	PC, RVCA
	02LA012	Rideau River below Manotick (Long Island)	1980 1997	1996 present	Q: hourly Datagaps: seasonal	PC, RVCA
	02LA004	Rideau River at Ottawa	1933 2002	2001 present	Q: hourly	WSC & RVCA
	02LA013	Sawmill Creek at Riverside Dr.	1981 2004	1983 present	Q: hourly Datagaps: seasonal	WSC City of Ottawa

Jock	02LA007	Jock River near Richmond (Moodie Dr.)	1969	present	Q: hourly	WSC, RVCA
	-	Jock River at Franktown Road	2004	present	Q: hourly	RVCA

Source: RVCA, 2007b

Table 1.2 Climate stations

Sl. No.	Station Name	Station ID	Coordinates	Period of Record	Remarks
1	Angers	7030170	45o33' N, 75o33' W	1962-2006	Active
2	Appleton	6100285	45o11' N, 76o6' W	1992-present	Active
3	Brockville	6100969	44o36' N, 75o42' W	1971-80	Historic
4	Brockville PCC	6100971	44o36' N, 75o40' W	1965-present	Active
5	Drummond Centre	6102 J13	45o1' N, 76o15' W	1984-present	Active
6	Godfrey	6102857	44o34' N, 76o37' W	1981-2003	Active
7	Kemptville	6104025	45o0' N, 75o37' W	1928-1997	Historic
8	Kemptville CS	6104025	45o0' N, 75o38' W	2001-present	Active
9	Luskville	7034365	45o31' N, 76o3' W	1980-2006	Active
10	Ottawa CDA	6105976	45o22' N, 75o43' W	1989-2006	Active
11	Ottawa Int'l Airport	6106000	45o19' N, 75o40' W	1938-present	Active
12	Ompah	6105760	44o58' N, 76o51' W	1994-2006	Active
13	Ompah-Seitz	6105762	45o3' N, 76o46' W	1994-2006	Active
14	Russel	6107247	45o15' N, 75o21' W	1954-present	Active
15	Smiths Falls WPCP	6107835	44o54' N, 76o0' W	1964-1983	Historic
16	Smiths Falls TS	6107836	45o53' N, 76o0' W	1982-1989	Historic

Source: Environment Canada website: www.climate.weatheroffice.ec.gc.ca

Table 1.3 a Land Use Area (km^2) in each Sub-watershed

Soil Type	Kempt-ville	Jock	Tay	Upper Rideau	Middle Rideau	Lower Rideau	Ottawa West	Ottawa East	Total RVCA
Alvar	30.90	15.55	0.38	0.88	58.65	31.08	nil	nil	137.43
Conifer Swamp	21.83	32.23	8.59	2.24	26.63	17.15	0.69	1.55	110.90
Coniferous Plantation	0.93	nil	nil	nil	nil	0.72	0.64	0.97	3.26
Cropland	52.32	149.18	69.01	34.15	114.90	235.03	20.98	84.38	759.94
Deciduous Swamp	70.13	54.16	31.17	16.22	85.62	40.70	1.17	1.68	300.85
Dense Coniferous Forest	36.86	53.83	18.24	5.70	38.17	58.32	2.02	nil	213.13
Dense Deciduous Forest	61.38	64.78	162.15	101.51	141.05	94.85	8.40	35.37	669.48
Freshwater Coastal Marsh / Inland Marsh	2.66	4.18	5.14	4.69	14.24	4.57	0.48	2.00	37.95
Mine Tailings, Quarries, and Bedrock Outcrop	nil	4.17	4.86	nil	nil	1.13	0.18	0.04	10.39
Mixed Forest Mainly Coniferous	26.88	39.92	134.49	31.64	45.52	35.00	3.85	8.36	325.66
Mixed Forest Mainly Deciduous	24.39	22.14	82.90	43.44	47.06	18.28	1.98	2.76	242.95
Open Fen	7.88	10.67	4.00	5.40	10.66	2.80	0.47	3.06	44.96
Pasture and Abandoned Fields	102.92	101.96	71.18	38.06	194.12	129.46	8.36	59.58	705.65
Settlement and Developed Land	1.73	5.82	nil	nil	5.88	52.48	68.06	56.00	189.97
Sparse Coniferous Forest	nil	nil	36.42	0.01	nil	nil	nil	nil	36.43
Sparse Deciduous Forest	12.50	16.68	47.22	46.81	15.90	20.26	1.47	6.19	167.04
Treed Bog	nil	nil	13.14	0.10	nil	nil	nil	nil	13.24
Water	6.82	2.44	108.33	119.03	29.53	16.89	2.58	1.32	286.94
Total	460.13	577.70	797.21	449.88	827.94	758.73	121.33	263.26	*4256.17*

Source: RVCA, 2007b

Table 1.3b Land Use Area as Percentage of Sub-watershed Area

Soil Type	Kempt-ville	Jock	Tay	Upper Rideau	Middle Rideau	Lower Rideau	Ottawa West	Ottawa East
Alvar	6.72	2.69	0.05	0.19	7.08	4.10	nil	nil
Conifer Swamp	4.74	5.58	1.08	0.50	3.22	2.26	0.57	0.59
Coniferous Plantation	0.20	nil	nil	nil	nil	0.09	0.53	0.37
Cropland	11.37	25.82	8.66	7.59	13.88	30.98	17.29	32.05
Deciduous Swamp	15.24	9.38	3.91	3.61	10.34	5.36	0.96	0.64
Dense Coniferous Forest	8.01	9.32	2.29	1.27	4.61	7.69	1.66	nil
Dense Deciduous Forest	13.34	11.21	20.34	22.56	17.04	12.50	6.93	13.43
Freshwater Coastal Marsh / Inland Marsh	0.58	0.72	0.64	1.04	1.72	0.60	0.39	0.76
Mine Tailings, Quarries, and Bedrock Outcrop	nil	0.72	0.61	nil	nil	0.15	0.15	0.02
Mixed Forest Mainly Coniferous	5.84	6.91	16.87	7.03	5.50	4.61	3.17	3.18
Mixed Forest Mainly Deciduous	5.30	3.83	10.40	9.66	5.68	2.41	1.64	1.05
Open Fen	1.71	1.85	0.50	1.20	1.29	0.37	0.39	1.16
Pasture and Abandoned Fields	22.37	17.65	8.93	8.46	23.45	17.06	6.89	22.63
Settlement and Developed Land	0.38	1.01	nil	nil	0.71	6.92	56.10	21.27
Sparse Coniferous Forest	nil	nil	4.57	nil	nil	nil	nil	nil
Sparse Deciduous Forest	2.72	2.89	5.92	10.41	1.92	2.67	1.21	2.35
Treed Bog	nil	nil	1.65	0.02	nil	nil	nil	nil
Water	1.48	0.42	13.59	26.46	3.57	2.23	2.13	0.50
Total	100	100	100	100	100	100	100	100

Note: 10 MNR land classes are not found within RVCA and are listed below:

Coatal Mudflats
Intertidal Marsh
Old Cuts and Burns
Open Bog
Receny Burns
Recent Cutovers
Supertidal Marsh
Treed fen
Tundra Health
Unclassified (Cloud and Shadow)

Source: RVCA, 2007b

Table 1.4a Soil Coverage (km^2) in each Sub-watershed

Soil Type	Kempt-ville	Jock	Tay	Upper Rideau	Middle Rideau	Lower Rideau	Ottawa West	Ottawa East	Total RVCA
Eroded	nil	nil	nil	nil	nil	53.01	18.80	96.55	233.36
Heavy Clay	nil	nil	nil	nil	nil	nil	nil	78.69	78.69
Loam	275.93	460.3	195.2	168.95	703.75	196.40	nil	nil	2000.64
Loamy Sand	42.14	nil	601.9	209.13	4.80	232.58	nil	66.65	1157.25
Sandy Loam	142.05	1.82	nil	71.80	7.33	74.46	18.75	21.36	337.57
Silt Loam	nil	nil	nil	nil	112.06	nil	nil	nil	112.06
Silty Clay Loam	nil	115.5	nil	nil	nil	202.30	18.77	nil	336.59
Total	460.13	577.7	797.2	449.88	827.94	758.73	121.33	263.26	*4256.17*

Source: RVCA, 2007b

Table 1.4b Soil Coverage as Percentage of Sub-watershed Area

Soil Type	Kempt -ville	Jock	Tay	Upper Rideau	Middle Rideau	Lower Rideau	Ottawa West	Ottawa East
Eroded	nil	nil	nil	nil	nil	6.99	69.07	36.67
Heavy Clay	nil	nil	nil	nil	nil	nil	nil	29.89
Loam	59.97	79.69	24.49	37.55	85.00	25.88	nil	nil
Loamy Sand	9.16	nil	75.51	46.49	0.58	30.65	nil	25.32
Sandy Loam	30.87	0.32	nil	15.96	0.89	9.81	15.46	8.11
Silt Loam	nil	nil	nil	nil	13.54	nil	nil	nil
Silty Clay Loam	nil	nil	nil	nil	nil	26.66	15.47	nil
Total	100	100	100	100	100	100	100	100

Source: RVCA, 2007b

Table 1.5 PTTW Summary for RVCA (October 2006)

Sector	Surface Water		Ground Water		Both		All	
	# of permits	Permitted takings (m^3/d)	# of permits	Permitted takings (m^3/d)	# of permits	Permitted takings (m^3/d)	# of permits	Permitted takings (m^3/d)
Commercial	13	459,857	11	13,061	5	140,877	29	613,796
Construction	7	1,040	3	2,420	1	151,548	11	155,008
Dewatering	6	3,449,948	17	52,507	1	177,000	24	3,679,455
Industrial	7	38,217	13	23,941	1	46,900	21	109,058
Miscellaneous	52	170,099	16	22,418	1	210	69	192,726
Agricultural	4	209,829	3	18,077	0	0	7	227,906
Institutional	0	0	2	22,205	0	0	2	22,205
Recreational	3	1,582	1	64	0	0	4	1,646
Remediation	7	55,353	13	16,634,213	0	0	20	16,689,566
Water Supply	7	27,088	25	1,942,581	0	0	32	1,969,669
Totals	106	4,413,013	104	18,731,487	9	516,535	219	23,661,035

Source: MRSPR, 2007

Table 1.6 Average water takings from municipal drinking water facilities in RVCA (2000-2005)

Surface Water Systems[1]		Ground Water Systems	
Municipal D.W. Plants	Average Taking (1000 m^3/yr)	Municipal Wells	Average Taking (1000 m^3/yr)
Perth	1,764	Kings Park-Richmond	67.9
Smiths Falls	3,465	Munster Hamlet	158
TOTAL	5,229	Kemptville	545
		Merrickville	188
		Westport	133
		TOTAL	1,092

1. Ottawa River plants: Britannia takes 62,768 (1000 m^3) and Lemieux takes 59,269 (1000 m^3) of water each year from the Ottawa River

Source: MRSPR, 2007

Table 1.7 OMYA Water Consumption (2004-2005)

	Upstream Flow Volume (1,000 m^3)	Volume Consumed (1,000 m^3)	Percent Taking
January	30,853	12.3	0.04%
February	18,827	15.4	0.08%
March	9,067	13.0	0.15%
April	24,903	10.4	0.04%
May	20,994	7.7	0.04%
June	13,079	10.3	0.10%
July	7,980	12.4	0.16%
August	7,462	14.0	0.20%
September	10,156	12.0	0.15%
October	11,674	16.4	0.14%
November	6,905	13.9	0.24%
December	21,247	14.2	0.07%
Annual	183,147	152	0.08%
OMYA data is reported from 2004-2005. Upstream flows are measured on the Tay River at the gauge owned/operated by OMYA. Percent taking is calculated as percentage of Volume Consumed/Upstream Flow Volume.			

Source: MRSPR, 2007

Table 1.8 Estimated Agricultural Water Use for RVCA*

Number of Farms	Livestock Water Use (m^3/yr)	Irrigation Water Use (m^3/yr)	Other Water Use (m^3/yr)	Total Water Use (m^3/yr)
1,196	952,421	585,971	87,207	1,625,599

* Adapted from de Loe, 2002 - Agricultural Water Use by Watershed

Source: MRSPR, 2008

Table 1.9 Daily Permitted Water Use (PTTW) for Large Agricultural Water Users, in RVCA

	Purpose		
Sub-watershed	**Market Gardens / Flowers**	**Sod Farm**	**Tender Fruit**
Jock River			4,034,472
Kemptville Creek			
Lower Rideau		6,217,552	352,770
Middle Rideau			
Rideau Lakes			
Tay River			

Source: MRSPR, 2008

Table 1.10 Information available to Rideau Valley Water Response Team

Data/Information	Source	Notes	Accessed by RVCA as of July 16, 2009
• Information about permit holders to send out letters at Level I (name, address) • Information about the water sources used by permit holders • Information about the PTTW and its application	MRSPR	For this report information was obtained from the Mississippi-Rideau SWP group.	X
	MOE	In the future data may be extracted directly from the MNR's Land Information Ontario (LIO) Warehouse[1]. Specific information on a permit can be found on Ontario's Environmental Registry[2].	
• Water use through the PTTW – available for previous year	MOE	Not readily available for all permits however Karen Jones (karen.jones@ontario.ca), at the Ministry of the Environment, can potentially provide information for specific permit numbers.	
	MRSPR	Actual water use by municipal drinking water facilities and by OMYA (a calcite producing plant on the Tay River) was obtained from the Mississippi-Rideau SWP group.	X
• Reports on enforcement activities in the sub-watershed	MOE	Contact the MOE representative on the Water Response Team for more information.	
• Agricultural census data • Expertise about crops and their water requirements	OMAFRA		
	MRSPR	Agricultural water takings data is available in a report from MNR, compiled by de Loe (2002). Estimated water takings for the RVCA, utilizing the previously mentioned report, were obtained from the MRSPR (2008) study.	X
• Bylaws for water conservation (for municipal water and private well users)	MMAH	Contact local municipalities for more information.	
• Baseflow analysis / minimum flow requirements	MNR	Refer to the OLWR indicators.	
	MRSPR	For each hydrometric station within the RVCA, baseflow was estimated in the MRSPR (2009) study, using the baseflow index method.	X
• Groundwater analysis	MOE/ MNR		
• Additional funding for communications; setting up workshops, surveys	MNR		
• Funding for additional stream flow gauges	MNR/ MOE		

[1] http://www.mnr.gov.on.ca/en/Business/LIO/index.html
[2] http://www.ebr.gov.on.ca/ERS-WEB-External/

• A sample PTTW permit and an URL related to PTTW (permits, technical guidelines)	MNR	Posted on MNR's web page	
• Request for review of selected permits	MOE		

Table 3.1 Rideau Valley Low Water Response Distribution List (2007)

Name	Organization
Becky Hubbard	Augusta Township
Heather Fox	Central Frontenac Township
Sarah Cooke	Smith Falls
Susan Freeman	Tay Valley Township
Kathy Coulthart-Dewey	Tay Valley Township
Cynthia Moyle	Township of Beckwith
Paul Snider	Township of Drummond/North Elmsley
Barb Kalivas	Township of Elizabethtown-Kitley
Murray Hackett	Township of Montague
Jim Beeler	Township of North Grenville
Karen Dunlop	Township of North Grenville
Joergen Hoeven	Township of Perth
Kelly Pender	Township of Perth
Robert Maddocks	Township of Rideau Lakes
Jay DeBernardi	Township of Rideau Lakes
Bill Blum	Township of South Frontenac
Peter Vanderwoude	Village of Merrickville and Wolford
Scott Bryce	Westport
Carol Christensen	City of Ottawa
Fel Petti	City of Ottawa
Michel Kearney	City of Ottawa
Brian Stratton	Mississippi- Rideau Source Protection Region
David Coleman	MNR
Sarah Nugent	MNR
Nicholas Murphy	MOE
Steve Burns	MOE
Victor Castro	MOE
Steve Clarke	OMAF
Irv Maserkiewicz	Parks Canada
Kerry McGonegal	Parks Canada
Asher Rizvi	RVCA
Bruce Reid **(WRT Chair)**	RVCA
Charles Billington	RVCA
Ferdous Ahmed	RVCA

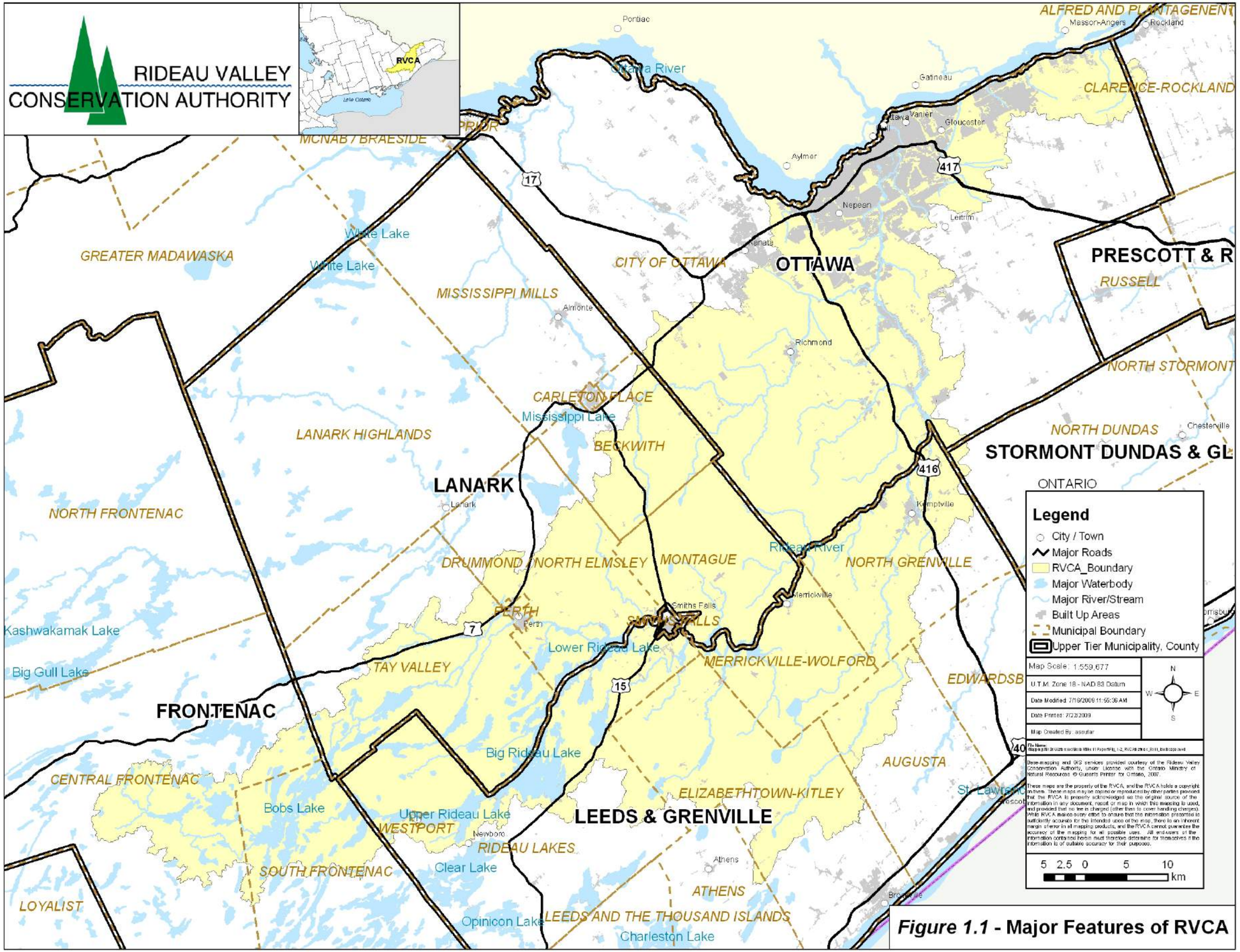

Figure 1.1 **- Major Features of RVCA**

RIDEAU VALLEY CONSERVATION AUTHORITY

Buckingham
Masson-Angers
Rockland
Pontiac
Gatineau
Ottawa
Vanier
Gloucester
Hull
Aylmer
Nepean
Leitrim
Kanata
Almonte
Richmond
Carleton Place
Lanark
Perth
Smiths Falls
Merrickville
Kemptville
Prescott
Athens
Brockville
Elburg

Legend

- City / Town
- Major Waterbody
- Major River/Stream

Elevation (masl)

- 226 - 250
- 201 - 225
- 176 - 200
- 151 - 175
- 126 - 150
- 101 - 125
- 76 - 100
- 51 - 75
- 39 - 50

Map Scale: 1:550,000

U.T.M. Zone 18 - NAD 83 Datum

Date Modified: 7/16/2009 10:06:54 AM

Date Printed: 7/23/2009

Map Created By: asoutar

File Name:

Provincial Digital Elevation Model Version 2.0.0 developed by the Ministry of Natural Resources, Water Resources Information Project, 2006.

5 2.5 0 5 10 km

***Figure 1.2* - Topography**

RIDEAU VALLEY CONSERVATION AUTHORITY

Buckingham
Pontiac
Masson-Angers
Rockland
Gatineau
Ottawa
Vanier
Gloucester
Aylmer
Nepean
Leitrim
Kanata
Almonte
Richmond
Carleton Place
Winchester
Chesterville
Lanark
Kemptville
Perth
Smiths Falls
Merrickville
Prescott
Westport
Newboro
Athens

Legend

- City / Town
- Major Waterbody
- Major River/Stream
- RVCA_Boundary
- RVCA Catchments

Water Control Structure

- Dam

Map Scale: 1:550,046	N W E S
U.T.M. Zone 18 - NAD 83 Datum	
Date Modified: 7/16/2009 12:03:36 PM	
Date Printed: 7/22/2009	
Map Created By: asoutar	

File Name: [illegible]

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5 2.5 0 5 10 km

Figure 1.3 **- Water Control Structures**

RIDEAU VALLEY CONSERVATION AUTHORITY

Figure 1.4 **- Hydrometric Sites**

RIDEAU VALLEY CONSERVATION AUTHORITY

RVCA

Lake Ontario

LUSKVILLE
1980-2006

ANGERS
1962-2006

Gatineau

Ottawa

Vanier

Hull

Gloucester

OTTAWA CDA
1889-2006

Nepean

OTTAWA MACDONALD-CARTIER
1938-present

Kanata

RUSSEL
1954-present

APPLETON
1992-present

OMPAH-SEITZ
1994-2006

DRUMMOND CENTRE
1984-present

KEMPTVILLE
1928-1997

KEMPTVILLE CS
1997 - present

OMPAH
1994-2006

SMITHS FALLS WPCP
1964 - 1983

SMITHS FALLS TS
1982 - 1989

BROCKVILLE PCC
1965 - present

BROCKVILLE
1871-1980

Brockville

GODFREY
1981-2003

Legend

- Major Waterbody
- Major River/Stream
- RVCA_Boundary
- RVCA_Boundary
- Environment Canada Climate Stations

Map Scale: 1:550,000

U.T.M. Zone 19 - NAD 83 Datum

Date Modified: 7/16/2009 12:06:28 PM

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N W E S

5 2.5 0 5 10 km

Figure 1.5 **- Climate Stations**

RIDEAU VALLEY CONSERVATION AUTHORITY

Pontiac
Masson-Angers
Rockland
Gatineau
Aylmer
Kanata
Almonte
Richmond
Carleton Place
Lanark
Perth
Smiths Falls
Prescott
Newboro
Athens
Brockville

Legend

- City / Town

Waterbodies (outside RVCA)

- Major Lakes
- Major River/Stream

Land Cover Classification

- Water
- Freshwater Coastal Marsh / Inland Marsh
- Deciduous Swamp
- Conifer Swamp
- Open Fen
- Treed Bog
- Dense Deciduous Forest
- Dense Coniferous Forest
- Coniferous Plantation
- Mixed Forest - mainly Deciduous
- Mixed Forest - mainly Coniferous
- Sparse Coniferous Forest
- Sparse Deciduous Forest
- Mine Tailings, Quarries, and Bedrock Outcrop
- Settlement and Developed Land
- Pasture and Abandoned Fields
- Cropland
- Alvar

Map Scale: 1:550,000

U.T.M. Zone 18 - NAD 83 Datum

Date Modified: 7/16/2009 12:07:22 PM

Date Printed: 7/22/2009

Map Created By: asautar

N W E S

Ontario Land Cover data (1991-1998) obtained from the Ministry of Natural Resources, Natural Resources and Values Information System.

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5 2.5 0 5 10 km

***Figure 1.6* - Land Use**

RIDEAU VALLEY CONSERVATION AUTHORITY

Pontiac
Masson-Angers
Rockland
Gatineau
Ottawa
Vanier
Gloucester
Hull
Aylmer
Nepean
Leitrim
Kanata
Almonte
Richmond
Carleton Place
Lanark
Kemptville
Perth
Smiths Falls
Merrickville
Prescott
Westport
Newboro
Athens
Brockville

Legend

- City / Town
- Major Waterbody

CanSIS Soils Landscape

Soil Texture

- Sandy Loam
- Loamy Sand
- Loam
- Silt Loam
- Silty Clay Loam
- Heavy Clay
- Unclassified/Urban
- Water

Map Scale: 1:550,000

U.T.M. Zone 18 - NAD 83 Datum

Date Modified: 7/16/2009 12:08:41 PM

Date Printed: 7/22/2009

Map Created By: asoutar

N
W
E
S

Soil texture data (Version 3, December 2004) obtained from Agriculture and Agri-Food Canada, Canadian Soil Information System, 2004.

5 2.5 0 5 10
km

***Figure 1.7* - Soil Classification**

RIDEAU VALLEY CONSERVATION AUTHORITY

Pontiac
Masson-Angers
Rockland
Gatineau
Ottawa
Vanier
Gloucester
Hull
Aylmer
Nepean
Leitrim
Kanata
Almonte
Richmond
Carleton Place
Lanark
Kemptville
Perth
Smiths Falls
Merrickville
Prescott
Westport
Newboro
Athens
Brockville

Legend

- City / Town
- Major Waterbody (outside RVCA)

Difference between Potentiometric Surface and Watertable Elevation

- Greater than +5m (Potential Discharging)
- -5m to +5m (Transitional)
- Less than -5m (Potential Recharging)

Note: Based on mapped vertical hydraulic gradients, assuming hydraulic connectivity between shallow and deep flow systems. Does not incorporate hydraulic conductivity

Map Scale: 1:550,000

U.T.M. Zone 18 - NAD 83 Datum

Date Modified: 7/16/2009 12:08:35 PM

Date Printed: 7/22/2009

Map Created By: asoutar

N W E S

Groundwater data produced for the Renfrew-Mississippi-Rideau Regional Groundwater Study by Golder Associates, 2001

5 2.5 0 5 10 km

Figure 1.8 **- Potential Groundwater Recharge/Discharge Areas**