Geoscape Ottawa-Gatineau

Grade 7 Lesson Plans to accompany the Geoscape Ottawa-Gatineau poster and website
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Theme Six: Ottawa River

List of Expectations		
Grade	Strand and Topic	Expectations
7	Science: Earth and Space Systems The Earth's Crust	• compile data gathered through investigation in order to record results, using diagrams, bar graphs produced by hand.
7	Geography: Patterns in Physical Geography	• analyse, synthesize, and evaluate data

Overview

The Geoscape "Ottawa River" theme consists of resources, which will enable students to get an understanding of facts, related to the Ottawa River as a major watershed and to investigate the relationship between the speed of flow and turbidity of the river.

At the end of these lessons, students will be able to:

- recognize the value of the Ottawa River watershed for hydroelectric production and for recreation
- relate the topography to the direction of flow
- establish a relationship between turbidity and geological bed and speed of flow

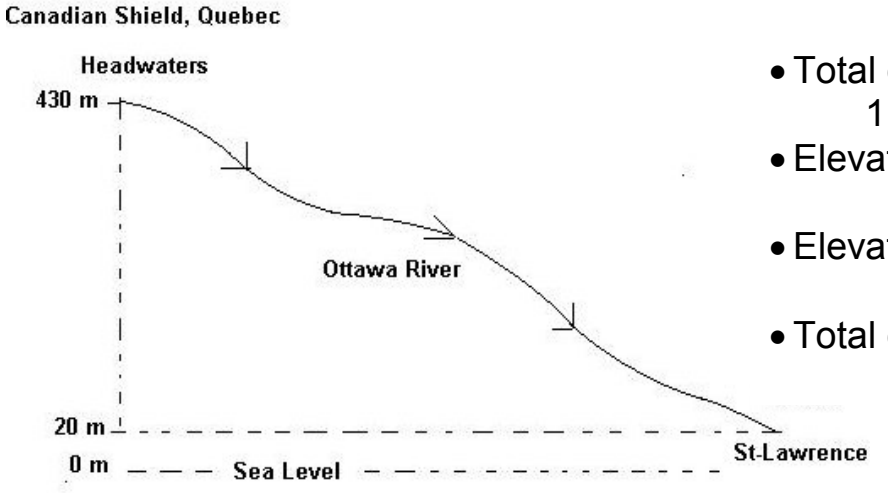
Suggested Lessons	**Brief Description**
Students Take Notes	Ottawa River: A Vital Resource
Key Word Game	Crossword puzzle
Lesson 1	Turbidity Lab
Lesson 2	Discharge Cycle
List of related web sites and resources	The Ottawa River Institute website: information on the watershed, tributaries and other interesting facts http://www.ottawariverinstitute.ca/index.htm The Upper Ottawa Watershed Assessment project: historical overview of the Ottawa River, its reservoirs and dams as well as environmental impacts http://www.algonquinnation.ca/hydro/ Ottawa Riverkeepers http://www.ottawariverkeeper.ca/index.html Water Survey of Canada: discharge data http://www.wsc.ec.gc.ca/

Funding for this project came from Natural Resources Canada and the government of Ontario

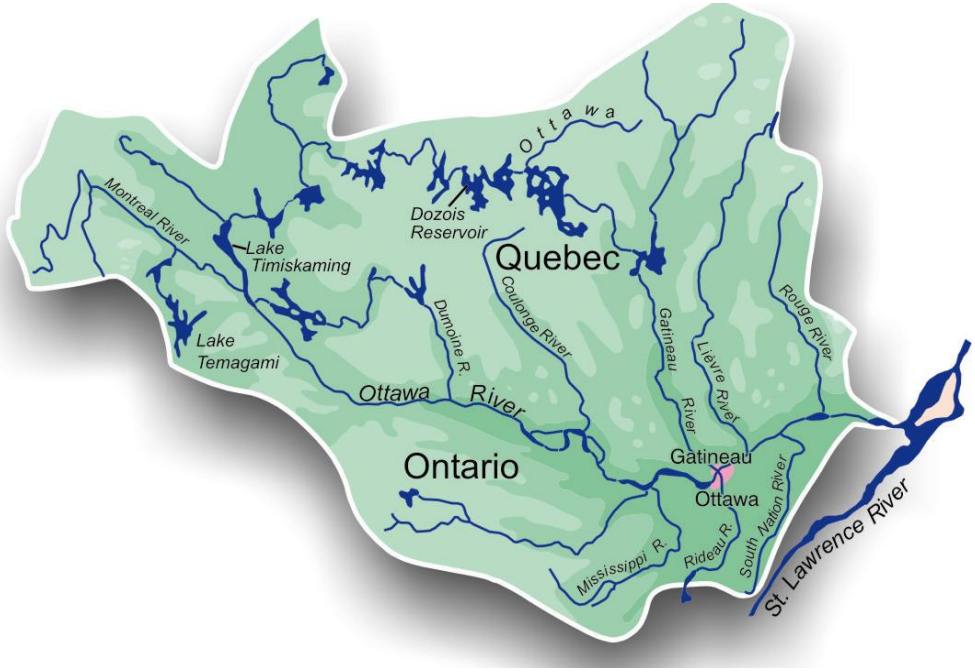
Students take notes: **Ottawa River: A Vital Resource**

The Watershed

- The Ottawa River watershed is the area drained by the Ottawa River and all its tributaries. It includes the rivers and lakes and all the land that drains into them.
- Also called the drainage basin
- Total area is very large (148,000 km^2)
- The Ottawa River flows from the Canadian Shield in Quebec through the Ottawa Valley and drains into the St. Lawrence River.



- Total distance traversed: 1130 km
- Elevation at the headwaters: 430 m
- Elevation at its mouth: 20 m
- Total drop in elevation: 400 m



Students take notes **Ottawa River: A Vital Resource**

Rapids and Waterfalls, Beaches and Islands

When the elevation drops suddenly, waterfalls or water rapids occur. Here, the water flows very quickly.

The energy of the falling water at hydroelectric dams is used to generate electricity.

Many beaches are found along the Ottawa River where the water flows slower and where there are suitable sediments to be reworked into beaches.

The Gatineau River is a tributary of the Ottawa River. The confluence is the area where the two rivers meet.

Downstream of this confluence, the appearance of the Ottawa River changes. Here, there is an abundance of unconsolidated sand and pebbles that can be reworked and deposited by the river into beaches and long narrow islands in the river called sandbars. (Petrie Island)

A Precious Resource:

The Ottawa River provides :

- drinking water (341 million litres per day)
- transportation route (native people, fur traders, timber industry)
- location for saw, grist, paper and carbide mills
- hydroelectric plants
- recreation

Students take notes: **Ottawa River: A Vital Resource**

Discharge = m^3/s = volume of water flowing past a specific site in 1 second.

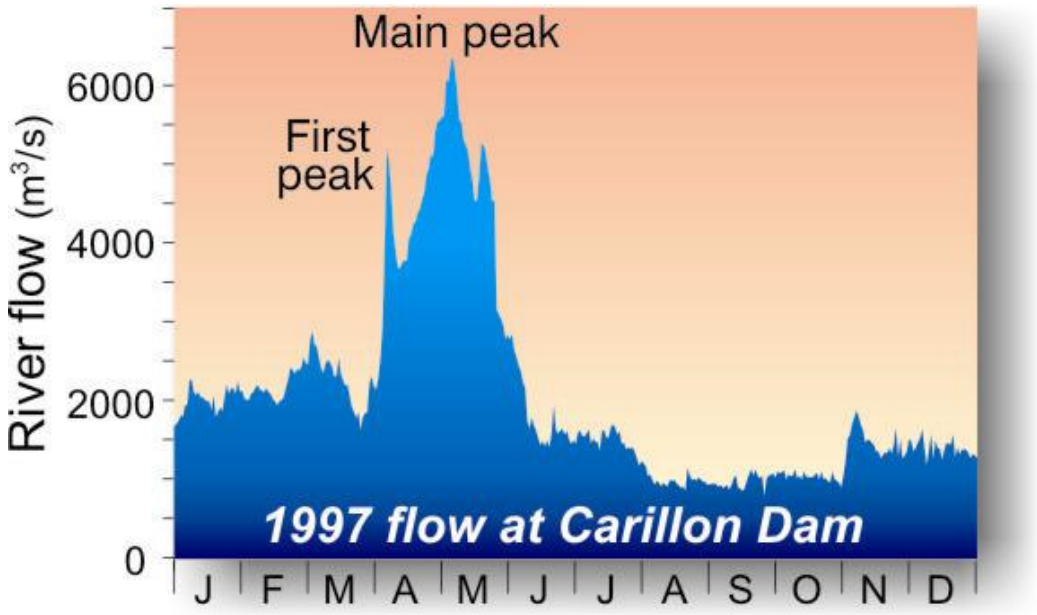
The Runoff Cycle

- In the spring, snow melts and causes greater discharge. With the greater volume, the flow may also be faster.

- Ottawa River has 2 peaks in spring runoff

  1. southern watershed snowmelt (South Nation, Mississippi etc)

  2. northern watershed snowmelt comes later. Larger area – greater discharge

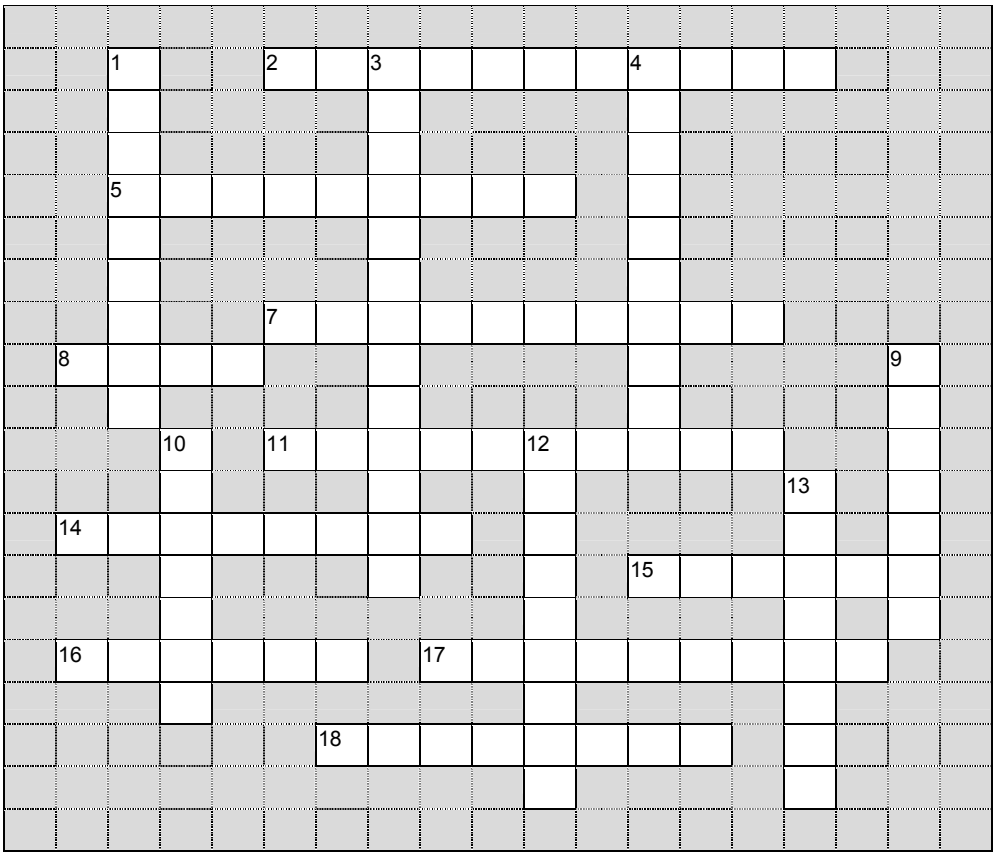


- In the summer and fall, discharge decreases, but responds to major precipitation events.

- In winter, discharge is low because most precipitation events are stored as snow.

Key word game Name:

The Ottawa River

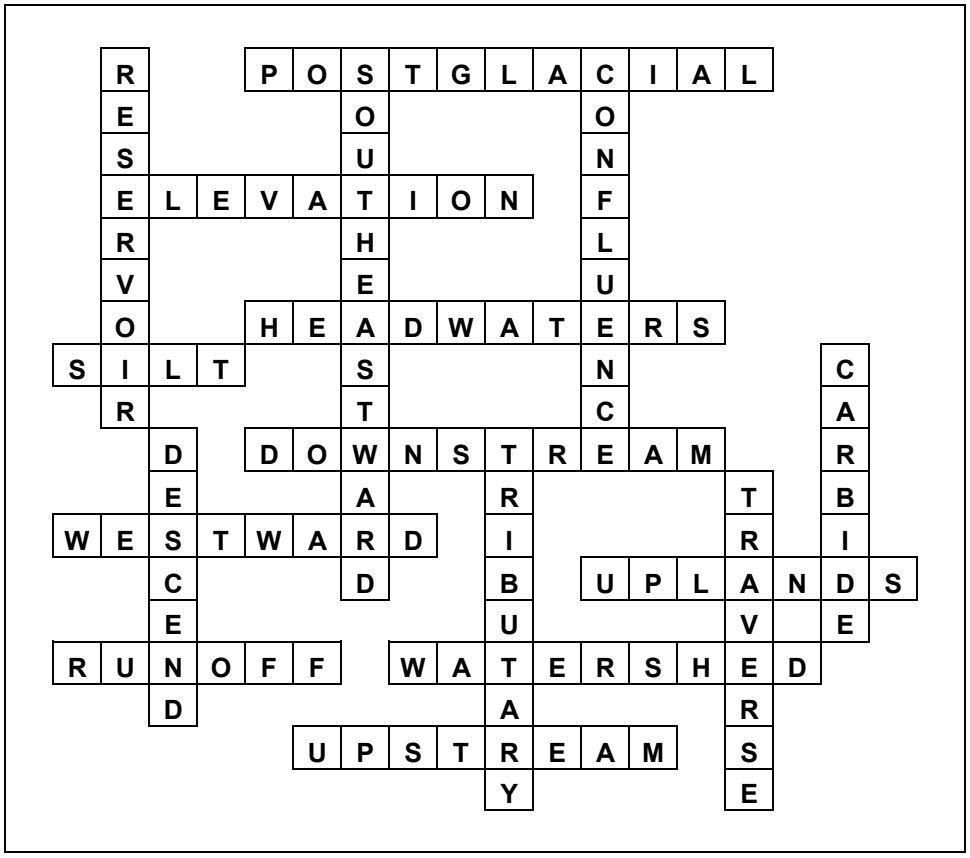


ACROSS
2. events that have taken place after the ice age
5. height above sea level
7. the source of a river
8. fine grain size (1/256 to 1/16 mm)
11. in the direction of the flow of water
14. moving or pointing towards the west
15. an area of hilly land
16. the discharge of water from the land, through streams
17. the total area of land, drained by a river and its tributaries
18. moving in the opposite direction of flowing water

DOWN
1. a contained body of water commonly used as a water supply
3. moving or pointing towards the south-east
4. the junction or meeting point of two rivers
9. a compound of carbon with a metal or other element
10. to move in a downward direction
12. a river or stream that flows into a larger one
13. to travel across or through

Key word game solution

The Ottawa River



6.1 Lesson 1: Turbidity Lab

Brief Description
This laboratory activity allows students to derive the relationship between turbidity of the water and sediment properties and speed that the water flows and associate this relationship with water quality.

Suggested Materials
Large Jar with leak-proof lid
Water
Fine sand or clay
Clean coarse sand or fine gravel
Stopwatch
Student worksheets

Preparation
Teacher may ask students to bring in their own jars and sediments for the activity.

Duration 40 minutes

Lesson Instructions

1. Explain what is meant by the word "turbidity" (A measure of water's clarity or cloudiness caused by suspended sediment in the water)
   Turbidity can be influenced by:
   - rate of flow, as rapidly flowing water can erode, pick up, and transport in suspension further and farther, more sediment than can slower water. Rate of flow is strongly influenced by slope of the river's long profile, and by discharge. However, increased discharge may simply spread out, occupying more of the floodplain and not necessarily increase the rate of flow.
   - texture and susceptibility to erosion of the riverbed and banks, as fine-grained sediment will stay in suspension longer.

2. Teacher leads a discussion about where water clarity is particularly important.

3. Students perform the experiment, following instructions on the worksheet, and then complete the worksheet.

4. Different types of sediment will result in differences in turbidity and time to settle. If the settling of the soil takes too long, you may have to make modifications in the speed. The purpose is to have the students realize that there is a relationship between speed and settling time and grain size and settling time.

Student worksheet: **Turbidity Lab**

Problem: What is the relationship between the motion of the water in a river and the turbidity? Is it affected by grain size?

Hypothesis:

Materials:
Large Jar with leak proof lid
Water
Fine sand or clay
Clean coarse sand or fine gravel
Stopwatch

Procedure:
1. Put and lightly pat down about 1 cm of fine sediment in the jar.
2. Gently fill jar with water trying not to disturb the sediment. Pour water along the side of the jar.
3. Wait until any sediment settles to the bottom.
4. Without lifting the jar off the table, move it slowly back and forth 5 times, moving approximately 1m each way at a speed of about 1 m/s.
5. Stop moving, start stopwatch, and observe the clarity of the water.
6. Measure the amount of time it takes for the soil to settle to the state it was before.
7. Move the jar back and forth again, this time moving twice as fast, 2 m/s, but still only 1m in distance each way.
8. Observe the clarity of the water and measure the time that it takes for the soil to settle.
9. Repeat procedure, moving 4 m/s

10. Clean the jar.
11. Repeat procedures 1-9, using coarse sediment in the jar.

Observations: fine sediment

Speed (m/s)	Clarity (clear, cloudy, cloudier, cloudiest)	Time to settle (seconds)
0 (not moving)		
1 m/s		
2 m/s		
4 m/s		

Observations: coarse sediment

Speed (m/s)	Clarity (clear, cloudy, cloudier, cloudiest)	Time to settle (seconds)
0 (not moving)		
1 m/s		
2 m/s		
4 m/s		

Concluding Questions:

1. What happens to the clarity of the water as the speed of the water increases?

2. What happens to the time that it takes the soil to settle as the speed of the water increases?

3. Draw a bar graph. Draw one bar for each speed and the height of the bar should correspond with the time to settle. Describe this graph.

4. What difference does grain size make in time needed to settle?

5. What could cause the Ottawa River to flow slower?

6. What could cause the Ottawa River to flow faster?

7. Explain why the water quality depends on the speed of the river.

8. Explain why the water quality depends on the nature of the underlying geology.

6.2 Lesson 2 Discharge Cycle

Brief Description
This activity allows students to derive the relationship between seasonal weather conditions and discharge.

Suggested Materials
Geoscape poster
Data from Environment Canada websites (or attached handout)
Water Survey of Canada : http://www.wsc.ec.gc.ca/
Climate data on-line : http://climate.weatheroffice.ec.gc.ca/climateData/canada_e.html
Student worksheets

Preparation
Teacher may ask students to data from the website as homework:
Water Survey of Canada >> 'Data Products & Services' >> 'Archived Hydrometric Data - Query the Data Base On-Line'
or teacher may prepare handouts of data.
** For your convenience, daily data for 2003 (discharge for the South Nation River and rain (mm), snow (cm), snow on ground (cm) and mean daily temperatures) are attached here.

Duration 40 minutes

Lesson Instructions

1. Teacher explains discharge
   - volume of water that passes a given location in a specific time interval, generally m^3/s.
   - strongly influenced by weather

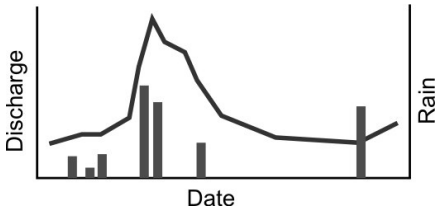
2. On their worksheet, students prepare graphs, analyze results, and complete questions.

Student worksheet: **Discharge Cycle**

1. On graph paper, plot a linear graph of discharge (m^3/s) over a year. Put discharge on the y-axis on the left side of the graph and calendar time on the x-axis.

2. On the same graph, plot a bar graph of rain for the same year. Put values on another y-axis on the right side of the graph.

eg.



3. Compare graphs.

4. When do you see similar peaks on both graphs? What is the relationship?

5. When is discharge highest? Lowest?

6. When do you see significant differences between the patterns? Account for the differences.

7. Optional: Visit the Water Survey of Canada website : http://www.wsc.ec.gc.ca/ , choose station 02KF005 (Ottawa River at Britannia). Can you distinguish the 2 discharge peaks in the spring, neither of which seems related to rainfall? Using the geoscape poster information, explain what causes the peaks and why there are two. (If the second peak is missing, explain why there might be only one peak that year.)

2003 Daily Discharge (m^3/s)

SOUTH NATION RIVER NEAR PLANTAGENET SPRINGS (02LB005)

2003	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.50 B	2.08 B	1.91	270	43	63.2	4.33	3.39	2.49	3.15	135	241
2	5.21 B	2.11 B	2.03	173	69.9	46	3.61	3.53	2.42	3.51	95.2	208
3	4.90 B	2.45 B	2.61	115	94.7	40.3	3.48	2.81	2.72	3.13	70.7	134
4	4.66 B	3.50 B	3.15	78.9	85.2	32.3	3.18	5.12	1.88	3.5	61.9	89.1
5	4.12 B	3.12 B	1.94	49.2	63.6	27.2	3.87	8.59	1.57	2.97	60.8	55.7
6	3.80 B	2.82 B	1.46	41.2	48.3	24.9	2.81	22.6	1.67	2.52	73.3	44.9
7	4.70 B	2.65 B	1.61	44.4	57.3	18.8	3.15	32.9	1.5	2.41	72.8	40.2
8	5.20 B	2.47 B	2.69	37.9	74.5	14.6	3.27	27.7	1.44	2.6	59.3	33.1
9	4.30 B	2.30 B	2.02	33.7	69.2	15.4	2.4	21.1	1.29	2.93	43.9	26.7
10	3.78 B	2.16 B	1.48	39.7	59.2	15	2.64	15.9	1.3	2.37	35.6	23.3
11	3.60 B	2.02 B	1.81	63.6	45.7	14.3	2.46	17.5	1.18	1.86	31.7	43.8
12	3.47 B	1.92 B	2.81	85.9	63.6	16.2	2.97	23.2	1.15	1.64	32.6	181
13	3.32 B	1.82 B	1.85	101	95.4	15.9	4.05	21.4	1.12	1.61	96.1	202
14	3.21 B	1.75 B	1.7	86.8	91.5	59.7	3.66	18.3	1.17	1.75	217	131
15	3.15 B	1.69 B	2.86	76.2	76.5	141	4.02	15.3	1.37	13.2	166	84.1
16	3.06 B	1.60 B	1.82	124	58.8	99.5	3.02	11.5	1.59	43	103	52.2
17	2.99 B	1.58 B	1.43	141	42.1	59.2	3.25	9.3	1.71	41.4	69.6	37.7
18	2.87 B	1.63 B	2.11	98.2	34	36	2.25	7.43	1.47	25.9	51.6	33.6
19	2.75 B	1.78 B	2.67 B	71.3	28.6	27.8	2.2	6.41	1.34 A	20.6	52.3	29
20	2.66 B	1.50 B	3.07	62.7	24.6	25.6	2.33	5.53	1.29	17.1	96.8	26.1
21	2.55 B	1.40 B	6.7	59.8	20.9	18.2	3.28	5.33	1.31	47.4	130	24.2
22	2.48 B	1.50 B	22.9	84	19.3	15.1	3.53	5.26	1.34	131	102	23.6
23	2.40 B	1.80 B	78.5	123	17.7	13.1	2.58	3.26	1.63	103	78.3	23.7
24	2.35 B	2.34	220	161	16.7	11	2.37	3.05	1.53	67.1	64.8	28.7
25	2.28 B	3.24	357	142	32	9.08	5.27	3.06	1.83	39.9	54.2	91.3
26	2.25 B	2.16	385	100	107	7.8	6.69	3.11	1.93	36.4	44.1	170
27	2.21 B	1.75	378 B	81.8	128	6.81	5.1	1.57	2.27	117	38.3	130
28	2.19 B	2.31	402	71	123	5	4.74	1.35	3.94	208	42.2	93.6
29	2.16 B		424 B	56.3	95.5	4.73	4.27	1.69	4.44	187	195	69.1
30	2.12 B		441 B	44.1	82.2	3.32	3.4	2.28	3.64	216	286	99.8
31	2.09 B		406		73.8		3.78	2.7		192		265
Mean	3.27	2.12	102	90.6	62.6	29.6	3.48	10.1	1.85	49.7	88.7	88.2
Max	5.21 B	3.50 B	441 B	270	128	141	6.69	32.9	4.44	216	286	265
Min	2.09 B	1.40 B	1.43	33.7	16.7	3.32	2.2	1.35	1.12	1.61	31.7	23.3

A – Partial day B – Ice conditions

This report was produced using the Archived Hydrometric Data application located at http://www.wsc.ec.gc.ca/hydat/H2O

Ottawa Airport Weather Office

**** Rain in mm; snow in cm**

2003	Jan		Feb		Mar		Apr		May	Jun	Jul	Aug	Sep	Oct	Nov		Dec	
date	rain	snow	rain	snow	rain	snow	rain	snow	rain	rain	rain	rain	rain	rain	rain	snow	rain	snow
1	0	0	0	11.6	0	0	0	0	15.4	0.4	0.4	0.2	0	1.2	0	0	0.2	1.8
2	0	0	0	0.6	0.2	12.8	0	2.0	4.0	0	0	0	0	2.6	1.2	0	0	2.0
3	0	3.6	0	0	0	0	0	0	0	0	0.4	7.6	0.6	0.8	4.6	0	0	1.6
4	0	6.8	9.8	3.6	0	4.0	0	0	0	0	0.6	2.2	0	5.0	5.6	2.2	0	1.0
5	0	0.4	0	0	0	12.0	2.6	14.0	0	3.6	10.8	4.4	0	0.2	0.6	0	0	0
6	0	1.2	0	5.8	0	0	0	0	13.8	3.2	0	5.4	0	0	0	0	0	0.2
7	0	3.4	0	0.4	0	1.0	0	0	0.8	0.2	0	0.2	0	0	0	0	0	0
8	0	2.8	0	0	0	14.0	0	3.2	0.8	0	0	0	0	0	0	0	0	0
9	0	2.4	0	0.2	0	1.2	0	0	0	4.8	0	2.6	0	0	0	0	0	0
10	0	0.8	0	1.8	0	0.4	0	0	0	0	3.0	2.4	0	0	0	0	3.8	0
11	0	0.4	0	0	0	0.2	0	0	13.2	8.6	39.4	14.4	0	0	4.2	0.2	25.2	0
12	0	0	0	2.6	0	0.4	0	0	3.8	0	2.4	0	0	1.0	14.0	0	0	0
13	0	4.2	0	0	0	0	0	0	2.8	28.2	0	0	0.6	0	8.2	1.2	0	0
14	0	0	0	0	0	2	0	0	0.4	0.4	0	0	0	15.2	0	0	0	9.0
15	0	0.2	0	0	0	2.2	11.0	0	0	0	2.4	0	4.6	29.4	0	0	0	4.0
16	0	0.2	0	0	0	0	0.2	0.6	0	0	0.8	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	10.0	0	0	0	0	0	3.2	9.6
18	0	0.2	0	0.4	0	0	0	0	0	1.2	0	0	0	0	0.8	0	0	1.0
19	0	0.8	0	0.2	0	0	0.4	0	0	0.6	2.8	0	8.8	0	15.2	0	0	0
20	0	0	0	0	21.4	0	0	0	7.4	0	2.0	0	0	16.2	0	0	0	0
21	0	0	0	0	6.4	0	13	0	0	0	4.6	1.8	0	28.2	0	0	0	5.8
22	0	0	0	11.2	4.2	0	3.4	0	0	0	0	0	7.6	0	0	0	0	0
23	0	0.2	0	20.2	0.2	0	0	8.4	0	0	0	0	2.8	0	0	0	6.6	0
24	0	0	0	1.2	0	0	0	0	42.4	0	9.0	0.8	0.2	0	1.2	0	24.6	0
25	0	6.0	0	0	4.4	0	0	0	3.0	0	0	2.2	13.8	2.8	0	0	0.4	0
26	0	1.6	0	0	0	0	0	0	13.0	0	1.0	4.8	0	20.4	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0.4	0	10.2	7.4	8.2	0	0	0
28	0	0.2	0	0	0	0	0	0	0.2	0.8	0	0	10.6	0	27.0	0	0	0
29	0	2.3			2.8	0	0	0	7.6	5.0	3.4	14.6	2.4	17.4	1.2	7.8	8.8	0
30	0	0			0	0	2.0	0	0.2	0	0.2	0	3.0	0	3.8	0.6	18.2	0
31	0	0			0	0			0.6		0	0		0.2			0	0

Ottawa Airport Weather Office

2003 Mean Temperature °C

date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-5.5	-2.6	-7.2	-5.7	8.6	11.6	20.3	21.0	18.1	7.4	11.7	-1.1
2	-10.6	-1.1	-11.4	-0.9	8.1	12.1	22.5	19.2	17.8	4.7	5.2	-9.8
3	-6.7	-7.2	-23.2	-1.4	7.8	13.4	24.4	22.4	16.0	4.5	4.9	-9.6
4	-4.7	-4.4	-13.3	-4.2	12.3	14.9	25.1	24.4	19.3	5.7	0.1	-9.5
5	-5.2	-13.8	-9.1	-4.4	14.8	15.0	25.8	23.6	15.2	6.4	4.4	-11.8
6	-7.3	-11.2	-13.3	-5.7	9.6	18.8	23.5	22.0	16.5	4.5	2.7	-9.7
7	-10.2	-13.5	-11.6	-5.3	12.6	18.1	22.0	23.3	15.3	7.4	1.9	-8.4
8	-5.3	-10.5	-2.9	-2.6	13.8	19.7	24.9	23.2	15.0	12.4	-4.1	-8.2
9	-12.7	-10.5	-8.4	-0.6	11.0	16.3	20.4	23.0	14.2	13.7	-3.6	-7.4
10	-15.0	-12.8	-13.5	4.9	12.9	15.1	19.0	22.5	16.9	15.5	1.4	-4.0
11	-14.8	-23.2	-8.7	8.7	12.1	17.4	18.1	23.7	21.9	16.3	2.9	0.5
12	-10.0	-17.4	-5.5	5.3	10.0	16.5	17.5	24.3	21.7	14.7	9.0	-8.3
13	-10.5	-23.4	-11.4	2.5	10.9	14.1	20.5	24.1	20.7	11.1	2.3	-13.1
14	-20.5	-22.2	-11.1	7.1	12.3	17.4	20.9	24.6	24.0	12.2	-4.5	-12.3
15	-18.3	-22.6	-4.2	14.4	14.8	17.0	21.9	24.1	22.0	7.3	-2.8	-7.9
16	-15.0	-22.6	0.8	-0.4	14.5	16.4	21.4	21.2	17.9	6.6	-2.4	-8.9
17	-17.4	-17.8	5.9	-2.7	13.2	18.9	20.2	19.8	16.0	4.3	-0.2	-1.0
18	-16.1	-10.4	1.4	4.6	16.5	20.0	17.0	21.6	17.9	4.2	4.9	-4.8
19	-9.6	-2.7	-2.8	9.5	17.3	16.5	17.5	22.4	19.7	3.8	10.2	-8.0
20	-14.7	-1.8	-3.3	14.9	18.1	17.4	18.5	24.3	17.1	3.4	2.9	-13.1
21	-22.7	0.4	3.5	12.1	10.4	19.7	19.2	23.5	15.1	1.7	4.0	-6.4
22	-22.7	-4.1	2.6	7.9	12.4	22.4	20.1	22.3	15.5	2.5	3.3	0.6
23	-17.5	-9.1	4.5	0.4	14.1	24.7	21.5	17.1	16.4	1.6	3.9	1.7
24	-16.9	-15.6	4.3	3.5	11.1	26.1	19.2	16.6	16.1	3.5	8.5	2.5
25	-13.7	-18.5	5.8	3.9	15.2	25.9	21.1	17.9	13.5	4.5	-1.4	0.5
26	-14.6	-17.6	4.8	4.3	13.5	27.2	21.7	19.6	10.9	4.8	2.4	-2.0
27	-23.9	-12.9	3.5	10.2	15.4	19.9	20.9	17.4	18.3	4.7	0.1	-2.7
28	-21.0	-8.4	6.8	16.2	17.5	21.1	18.3	13.7	12.7	6.1	2.7	-4.0
29	-12.5		7.0	9.7	14.4	22.1	19.7	18.1	11.9	5.6	-0.6	-0.8
30	-13.5		-2.1	9.2	15.2	20.2	20.3	14.1	9.7	7.7	1.4	1.8
31	-10.2		-4.9		13.6		22.7	15.9		12.6		1.0

Snow on Ground (cm)

Jan	Feb	Mar	Apr	Nov	Dec
2	23	40	0	0	1
2	31	43	0	0	5
2	25	44	0	0	5
6	21	45	0	0	7
12	18	52	6	0	6
12	18	60	12	0	6
13	24	60	7	0	6
15	23	60	5	0	5
15	21	72	7	0	4
15	20	72	0	0	3
16	22	72	0	0	1
16	24	70	0	0	0
17	24	70	0	0	0
20	24	70	0	0	0
20	24	72	0	0	12
20	24	70	0	0	13
18	24	60	0	0	11
17	24	44	0	0	14
15	20	35	0	0	13
16	18	33	0	0	13
15	16	18	0	0	16
15	13	12	0	0	12
14	37	8	3	0	3
13	43	7	1	0	1
14	44	4	0	0	0
21	43	1	0	0	0
21	43	0	0	0	0
20	43	0	0	0	0
21		0	0	0	0
22		0	0	4	0
21		0			0