Ottawa River Regulation Planning Board

Commission de planification de la régularisation de la rivière des Outaouais

Limits to the Regulation of the Ottawa River

2019 Spring Flood Overview

Michael Sarich
Senior Water Resources Engineer
Ottawa River Regulation Secretariat

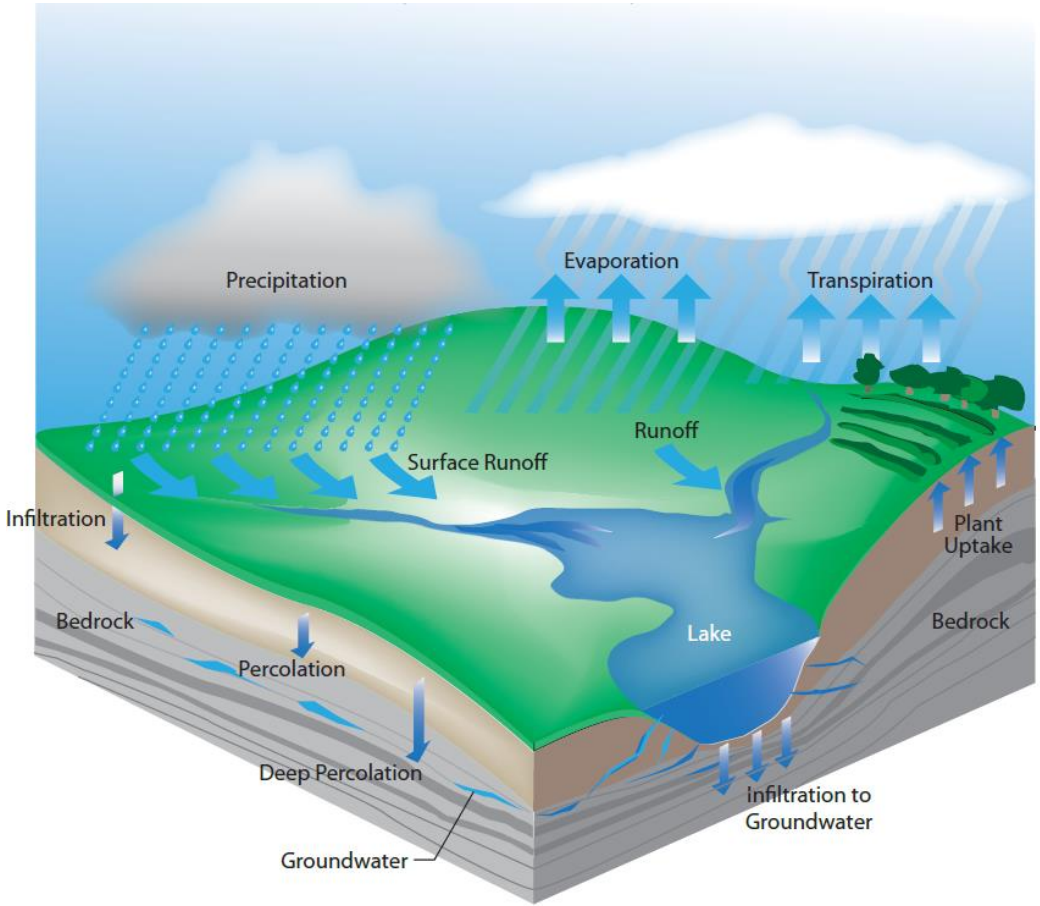
Ottawa River Watershed

SPRING FLOODS VARY

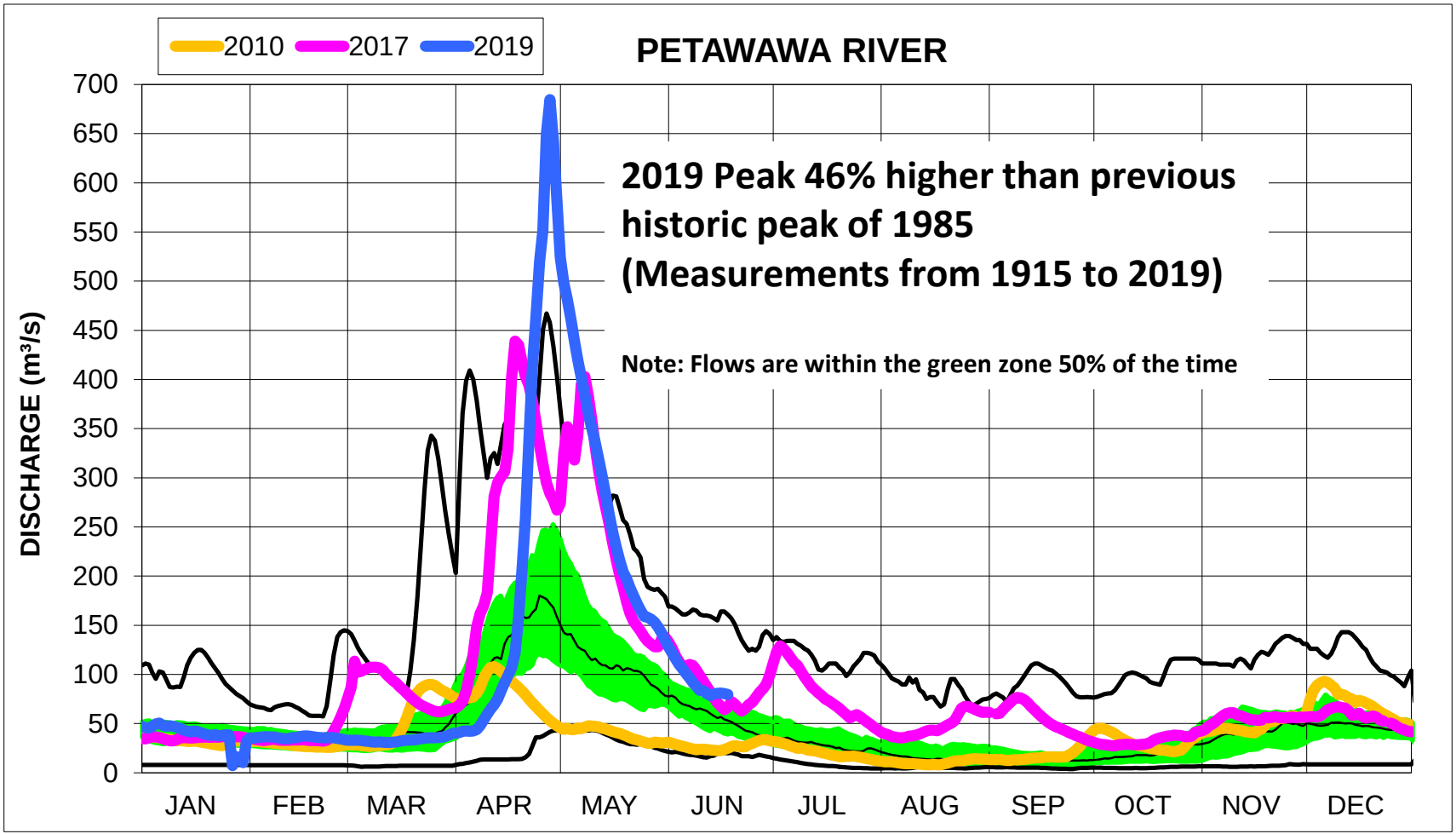
1950-2018:
Maximum daily flow at Carillon dam varied between 3,635 and 9,094 m^3/s

In 2019:
Maximum daily flow on April 30th
9,217 m^3/s

The Water Cycle

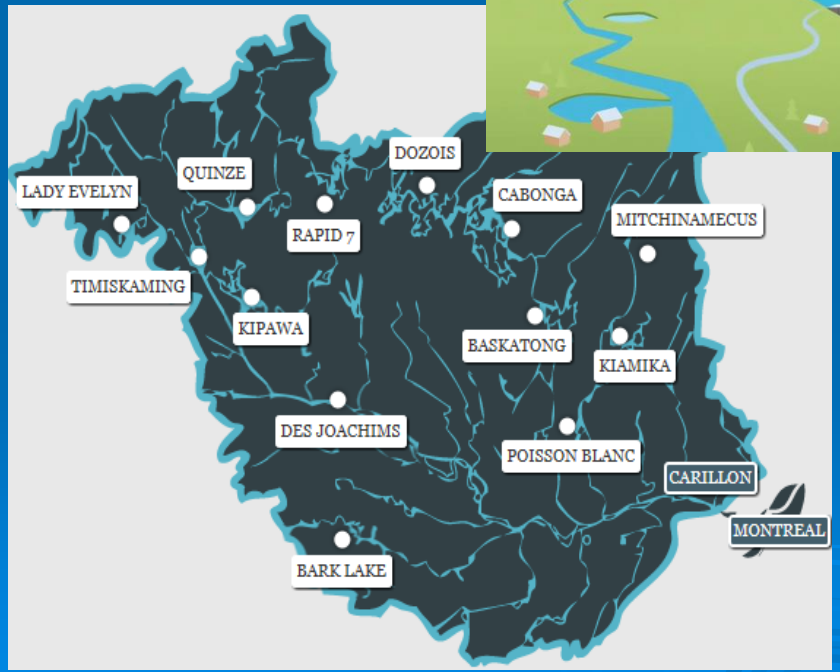


Natural Variability



What about Flow Regulation?

13 Large Reservoirs



- Reservoirs: large bodies of water that are used to:
  - Release water during winter
  - Retain water in the spring
- Flow regulation
  - Increase flows during winter
  - Reduce flows during spring
- 1983 Agreement
  - Integrated management

The 1983 Canada-Ontario Quebec Agreement established:

- Ottawa River Regulation Planning Board
- Ottawa River Regulating Committee
- Ottawa River Regulation Secretariat

- ***Main role*** : to ensure that the flow from the principal reservoirs of the Ottawa River Basin are managed on an integrated basis : minimize impacts – floods & droughts
- ***Secondary role*** : to ensure hydrological forecasts are made available to the public and government agencies for preparation of flood related messages

How is the Planning Board structured?

- Administrative and general policy function

- Operational unit

- Executive unit : supports the Regulating Committee and Planning Board

* Ontario Ministry of Natural Resources and Forestry is an Associate Member

Planning Board Members

Quebec

Ministère de l'Environnement, et de la Lutte contre les changements climatiques (MELCC)

Hydro-Québec

Canada

Public Services and Procurement Canada

Canadian Coast Guard

Environment and Climate Change Canada (ECCC)

Ontario

Ministry of Natural Resources and Forestry (MNRF)

Ontario Power Generation

- Planning Board reports to three parties that signed the 1983 Agreement
  - Ministers of MELCC, ECCC and MNRF

Principal Reservoirs and Dams

Operators of the 13 principal reservoirs under the 1983 agreement:

Hydro Québec
Québec
ONTARIO POWER GENERATION
Gouvernement du Canada

During flood events, OPG and Hydro-Québec operate the large dams on the main stem of the river like run-of-river dams.

Des Joachims (Swisha), the smallest of the 13 principal reservoirs, is managed like a run-of-river dam by OPG during high flow events.

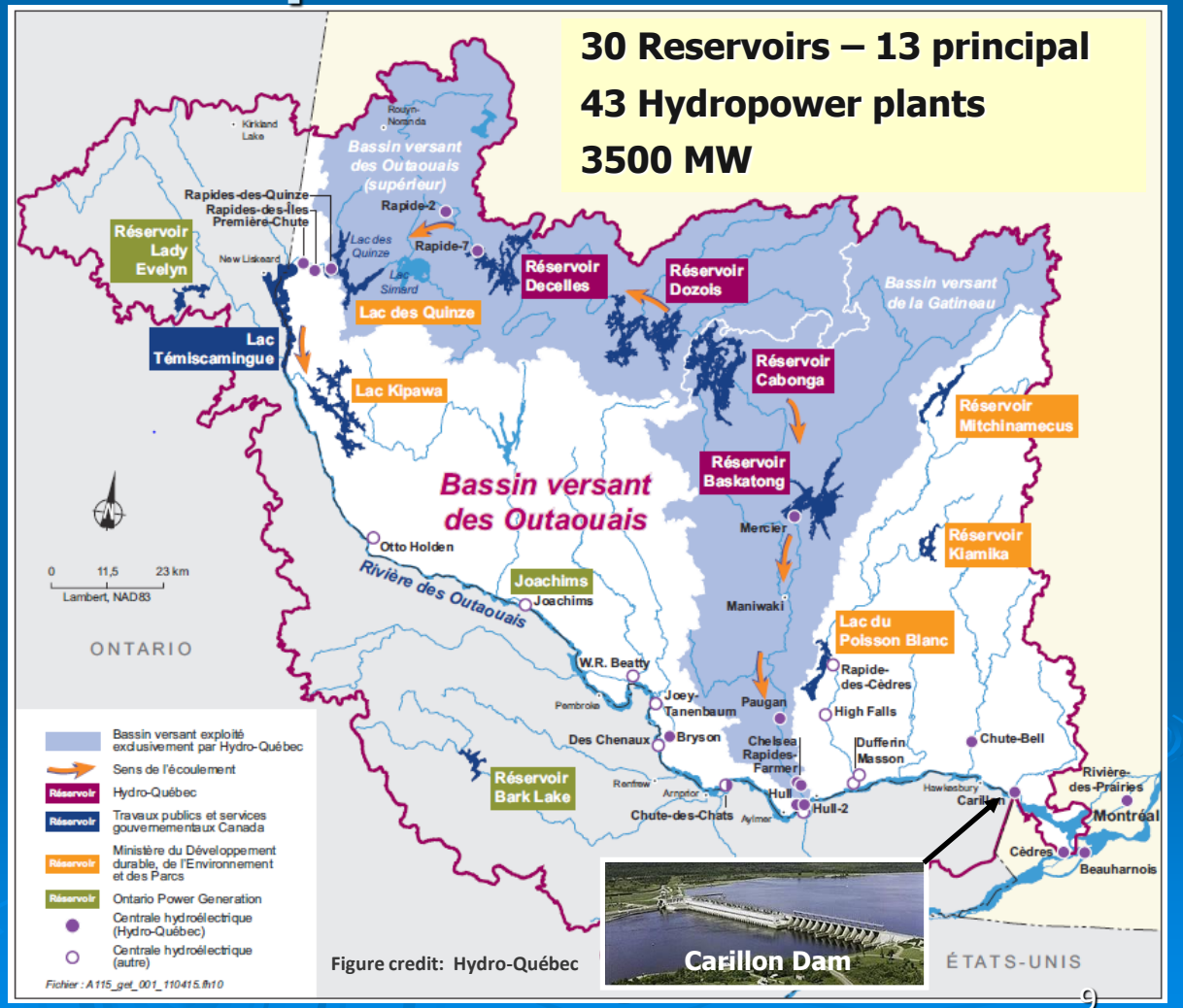
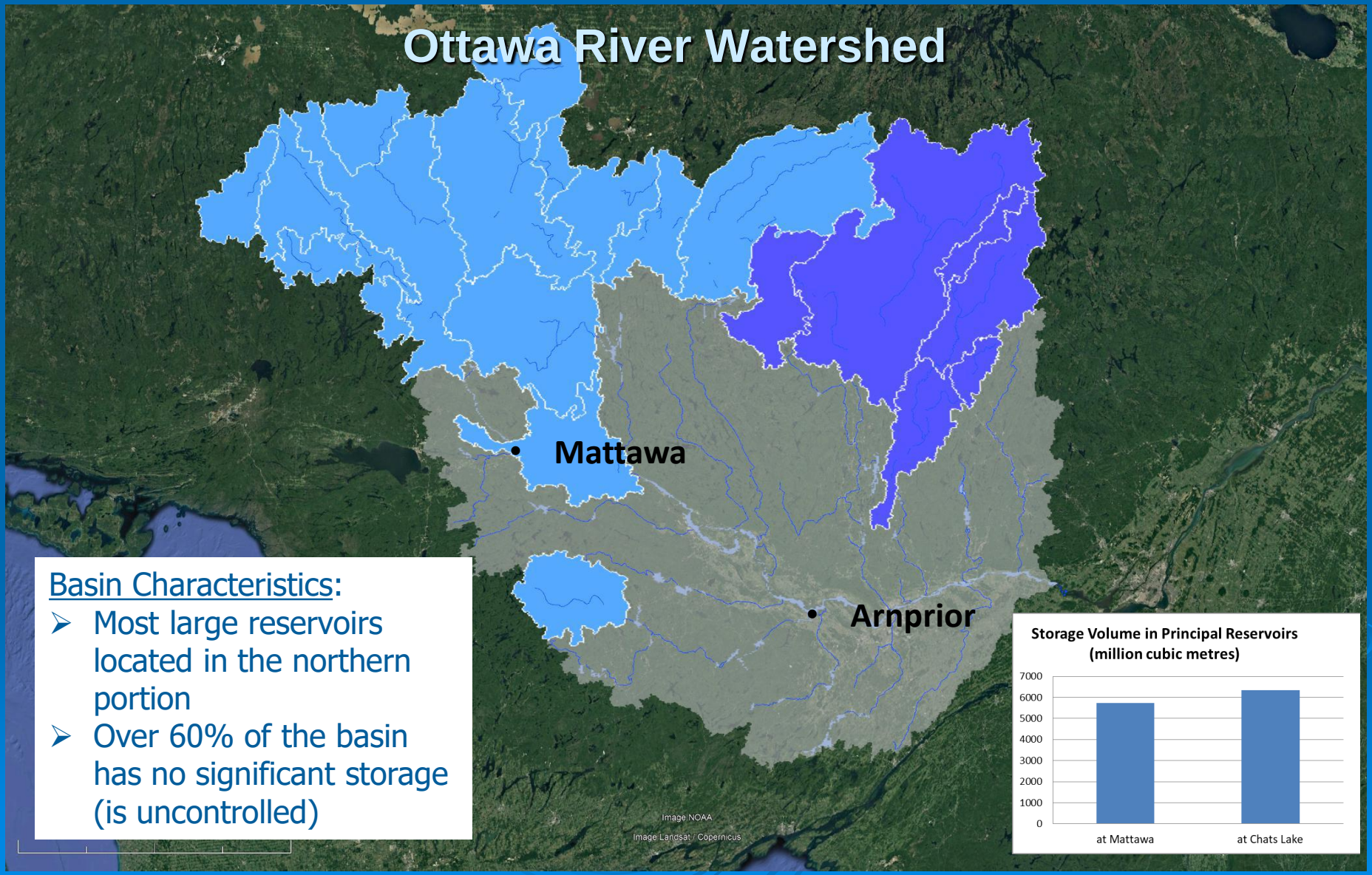


Figure credit: Hydro-Québec

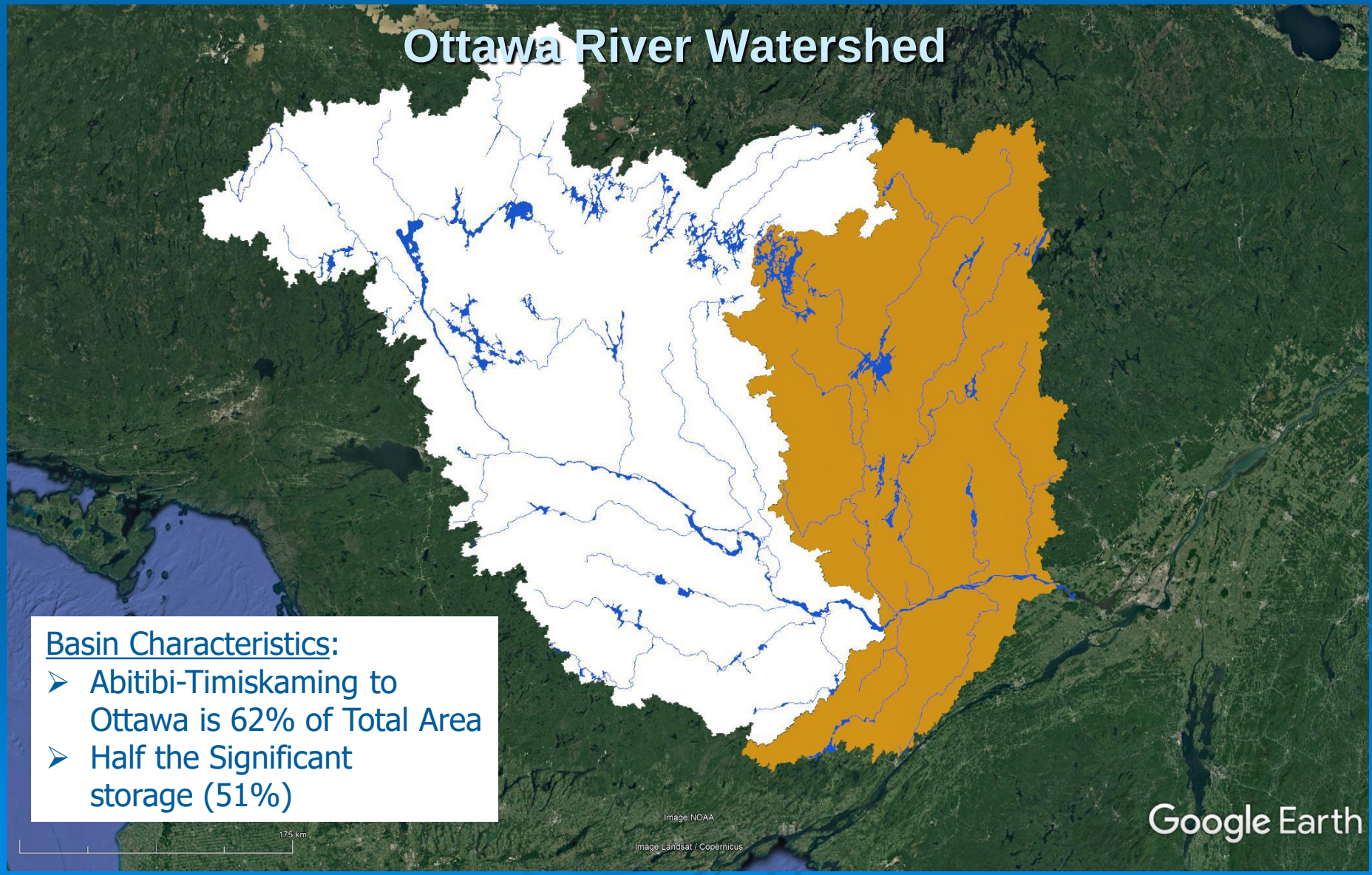
Ottawa River Watershed



Basin Characteristics:

- Most large reservoirs located in the northern portion
- Over 60% of the basin has no significant storage (is uncontrolled)

Ottawa River Watershed



Basin Characteristics:

- Abitibi-Timiskaming to Ottawa is 62% of Total Area
- Half the Significant storage (51%)

Types of Structures

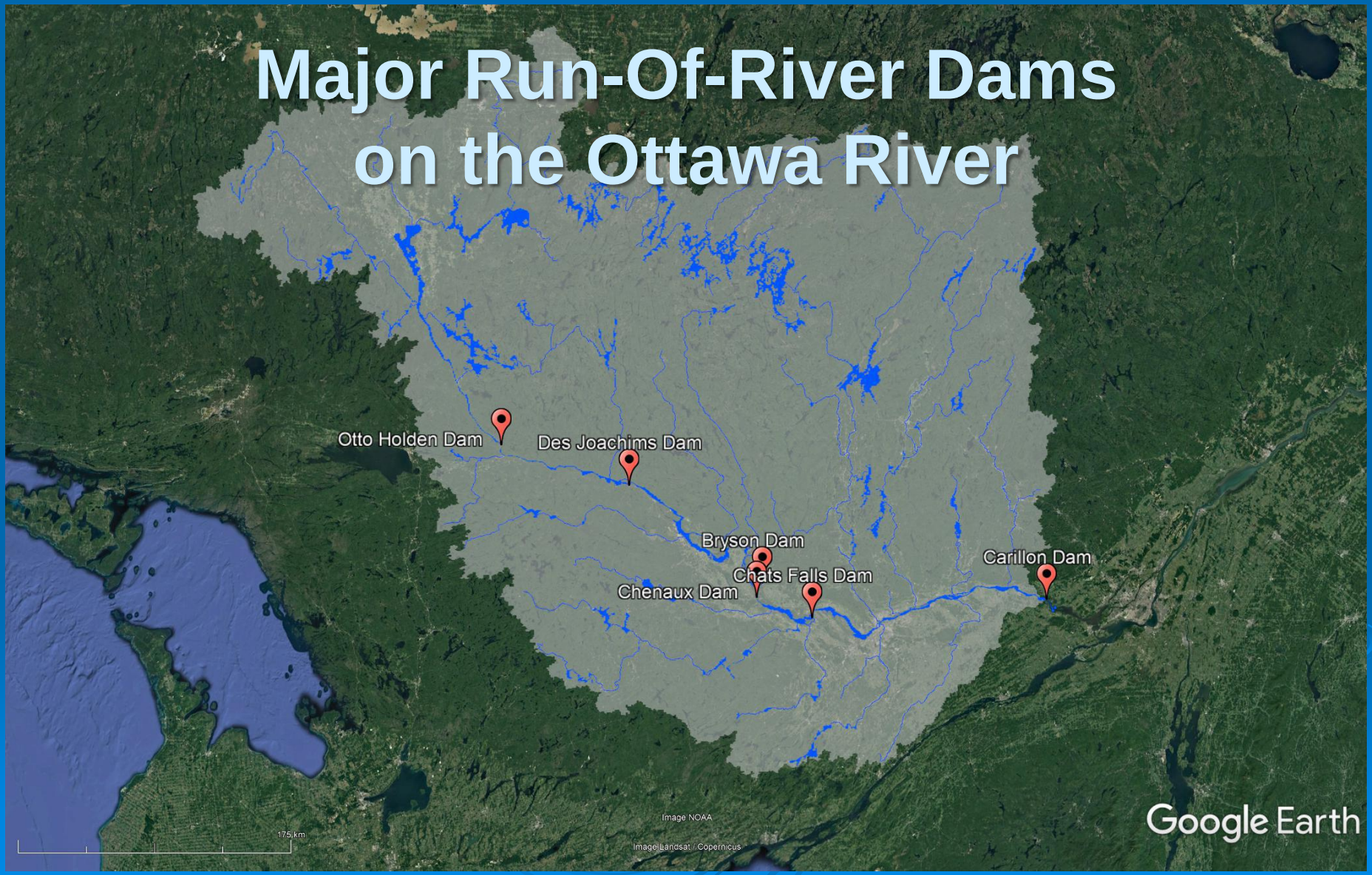
Reservoir Dams

Capacity to store a portion of the spring runoff *(Baskatong, Dozois, Des Quinze, Timiskaming, etc.)*

Run-Of-River Dams

Limited capacity to store spring runoff *(Carillon, Chats Falls, Chenaux, Bryson, Des Joachims, Otto Holden)*

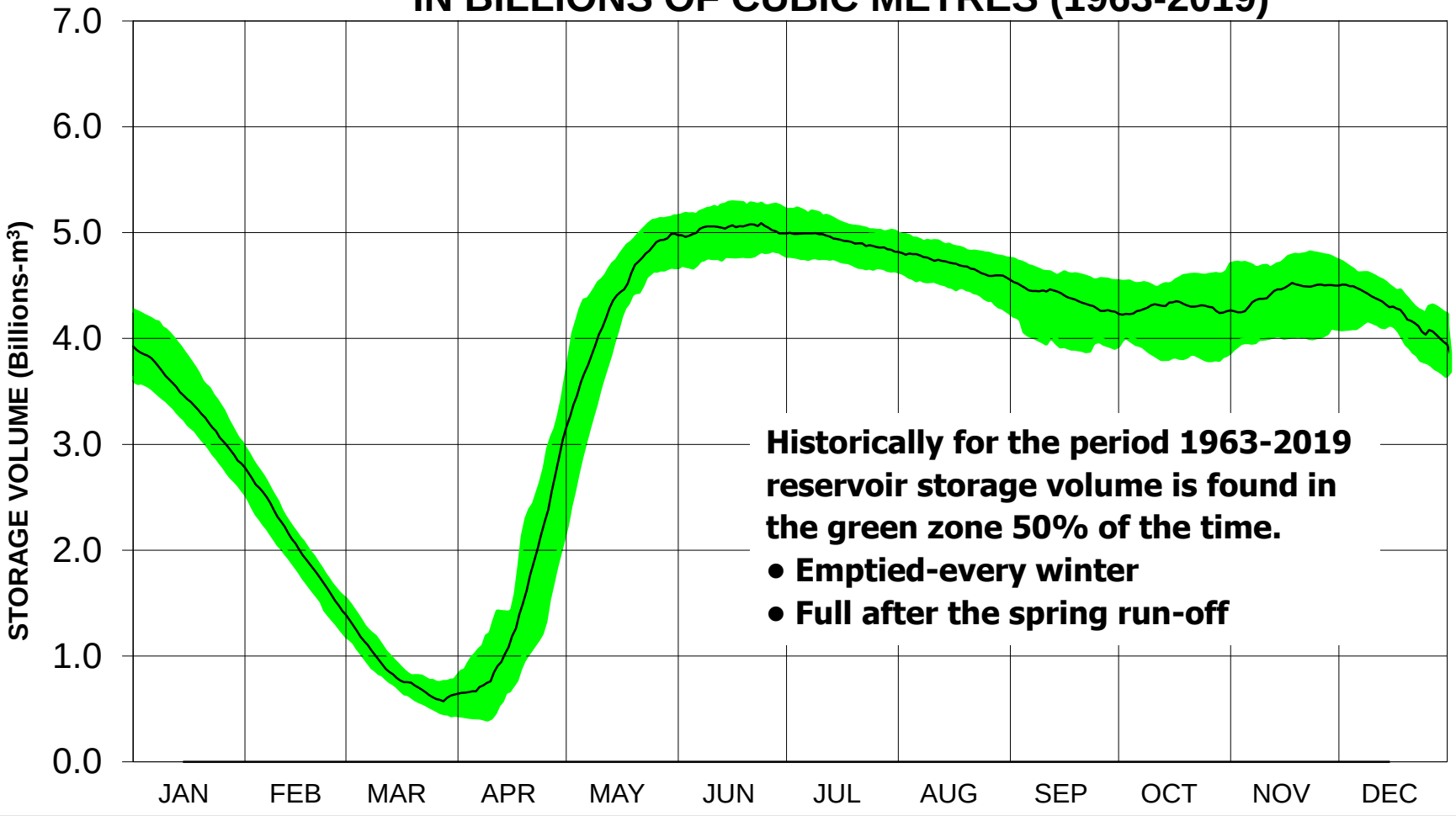
Major Run-Of-River Dams on the Ottawa River



Reservoir Management Annual Cycle

Winter	Spring	Summer	Fall
Winter drawdown and preparation for the spring freshet	Refill and retention of water to reduce downstream flow	Summer level management and drought mitigation	Operations for fall flood control and reservoir refill

WATER STORED IN ABITIBI-TIMISKAMING RESERVOIRS IN BILLIONS OF CUBIC METRES (1963-2019)



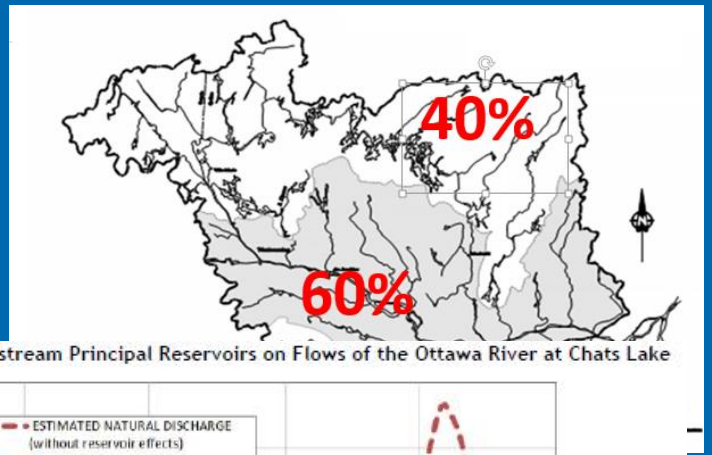
Limits of Flow Regulation

Flooding occurs when:

- Spring runoff greatly exceeds the size of reservoirs
- There is significant spring runoff in areas where there are no reservoirs

Flooding extent and duration :

- Is always reduced
- Eliminated in many years

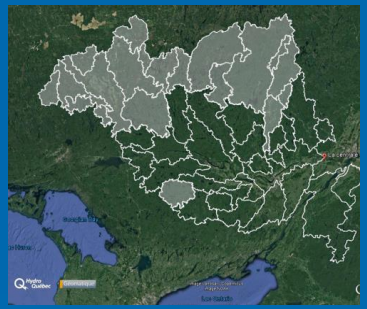


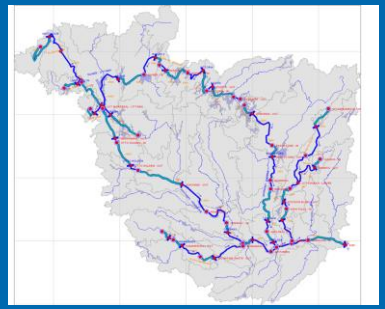
Daily work of the Regulating Committee

- Collect all information relevant to flow forecasting (Secretariat)

- Run flow models

  (Hydro-Québec and Secretariat)





- Assess forecast conditions(weather, inflows and levels/flow rates) and optimize holding back to spring runoff in reservoirs to reduce flows downstream to maximize flood alleviation (Regulating Committee)

- Disseminate river conditions forecast to responsible authorities and the public (Secretariat and MNRF – Surface Water Monitoring Centre)

Communicating Potential Flooding

1. Responsible Government Agencies
   - ON - MNRF, Surface Water Monitoring Centre
   - QC – Sécurité civile, COG
   - Municipalities (Courtesy Calls)
2. Traditional Media
   - Television, Radio and Newspapers
3. Website
   - Record internet usage
   - Twitter

1 - Flood-related Messages

- Look for local conservation authorities and MNRF district office flood-related messages

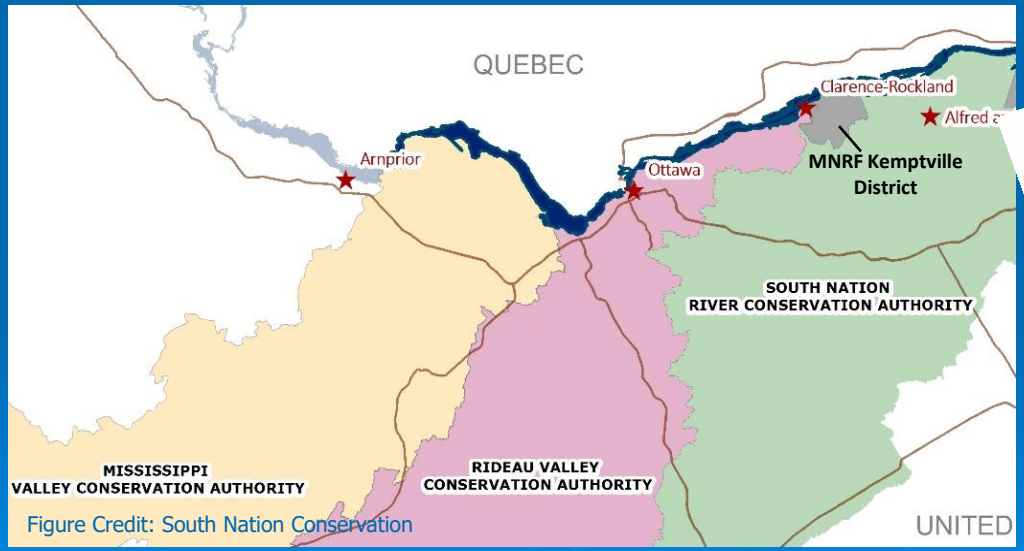
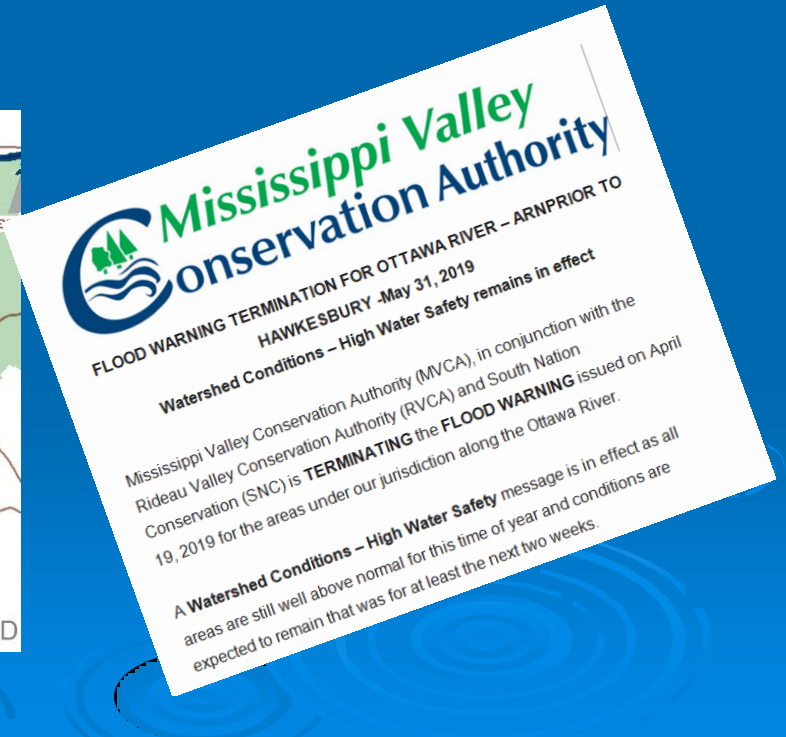


Figure Credit: South Nation Conservation

https://www.ontario.ca/law-and-safety/flood-forecasting-and-warning-program



Mississippi Valley Conservation Authority

FLOOD WARNING TERMINATION FOR OTTAWA RIVER – ARNPRIOR TO HAWKESBURY -May 31, 2019

Watershed Conditions – High Water Safety remains in effect

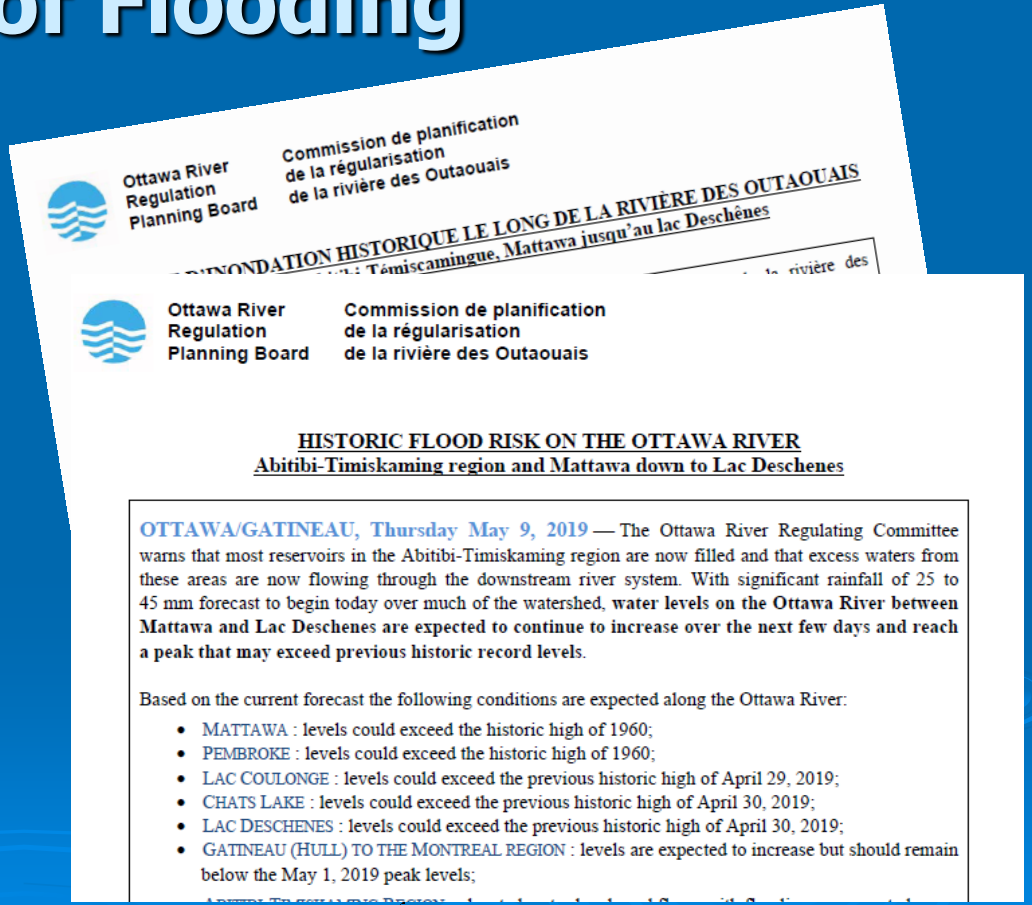
Mississippi Valley Conservation Authority (MVCA), in conjunction with the Rideau Valley Conservation Authority (RVCA) and South Nation Conservation (SNC) is **TERMINATING** the **FLOOD WARNING** issued on April 19, 2019 for the areas under our jurisdiction along the Ottawa River.

A **Watershed Conditions – High Water Safety** message is in effect as all areas are still well above normal for this time of year and conditions are expected to remain that was for at least the next two weeks.

2 – Keeping the Public Informed of the Risk of Flooding

- **6 Press Releases in 2019**

- **11 April– Start of the spring freshet**
- **First peak – warning of the risk of flooding:**
  - **16 April– levels similar to the first peak of 2017**
  - **18 April– levels similar to the peak of 2017**
  - **25 April– level possibly exceeding those of 2017**
- **Second peak–two notices:**
  - **3 May– Levels are high with potential for further increases**
  - **9 May- Historic flooding from Mattawa down to Lac Deschenes**



Ottawa River Regulation Planning Board

Commission de planification de la régularisation de la rivière des Outaouais

HISTORIC FLOOD RISK ON THE OTTAWA RIVER
Abitibi-Timiskaming region and Mattawa down to Lac Deschenes

OTTAWA/GATINEAU, Thursday May 9, 2019 — The Ottawa River Regulating Committee warns that most reservoirs in the Abitibi-Timiskaming region are now filled and that excess waters from these areas are now flowing through the downstream river system. With significant rainfall of 25 to 45 mm forecast to begin today over much of the watershed, **water levels on the Ottawa River between Mattawa and Lac Deschenes are expected to continue to increase over the next few days and reach a peak that may exceed previous historic record levels.**

Based on the current forecast the following conditions are expected along the Ottawa River:

- MATTAWA : levels could exceed the historic high of 1960;
- PEMBROKE : levels could exceed the historic high of 1960;
- LAC COULONGE : levels could exceed the previous historic high of April 29, 2019;
- CHATS LAKE : levels could exceed the previous historic high of April 30, 2019;
- LAC DESCHENES : levels could exceed the previous historic high of April 30, 2019;
- GATINEAU (HULL) TO THE MONTREAL REGION : levels are expected to increase but should remain below the May 1, 2019 peak levels;

ottawariver.ca / rivieredesoutaouais.ca

3 – Follow us on Twitter – twitter.com/ORRPB

ORRPB @ORRPB · May 9

Historic flood risk on the Ottawa River between Mattawa and Lac Deschesnes/Britannia and Abitibi-Timiskaming region. Read the full press release by the Ottawa River Regulating Committee at ottawariver.ca/current-press-... #ONFlood #OttawaRiverLevel

13 4

ORRPB @ORRPB · May 3

Levels could rise rapidly between Mattawa and Lac Coulong flood levels experienced earlier last month. Read the full Pres Ottawa River Regulating Committee at ottawariver.ca/current- #OttawaRiverLevel

10 6

ORRPB @ORRPB · May 3

Ongoing flood risk on the Ottawa River in all areas over the coming tv Levels to remain high for the period. Read the full Press release by the River Regulating Committee at ottawariver.ca/current-press-... #ONFloo #OttawaRiverLevel

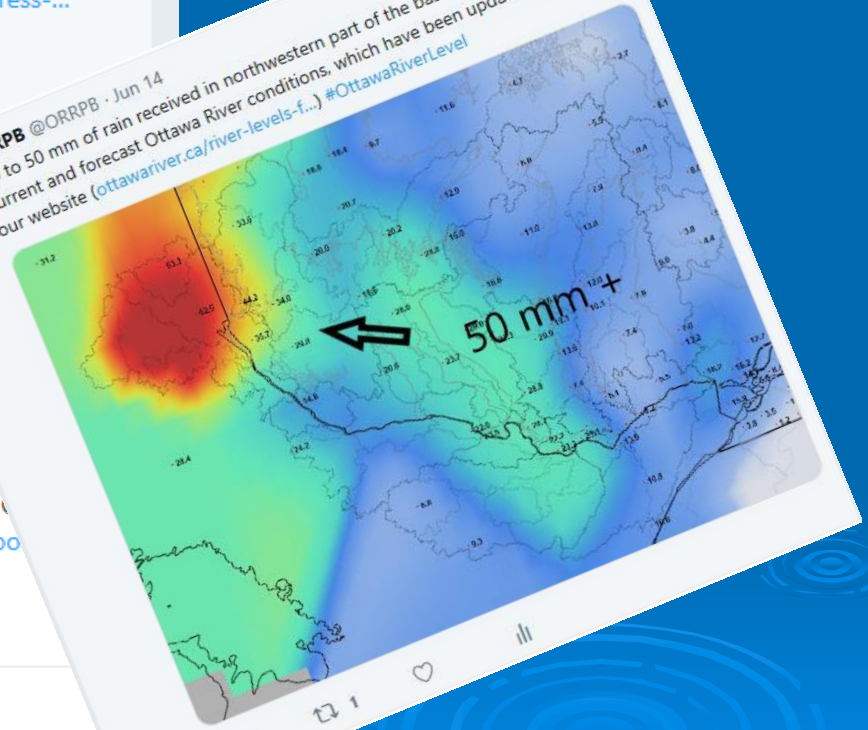
8 1

ORRPB @ORRPB · May 2

Questions about dams answered by Senior Water Resources Engineer Michael Sarich. Hear the interview by Robyn Bresnahan at cbc.ca/listen/live-ra... #ONFlood #OttawaRiverLevel

ORRPB @ORRPB · Jun 14

Up to 50 mm of rain received in northwestern part of the basin. Check out the current and forecast Ottawa River conditions, which have been updated today on our website (ottawariver.ca/river-levels-f...) #OttawaRiverLevel



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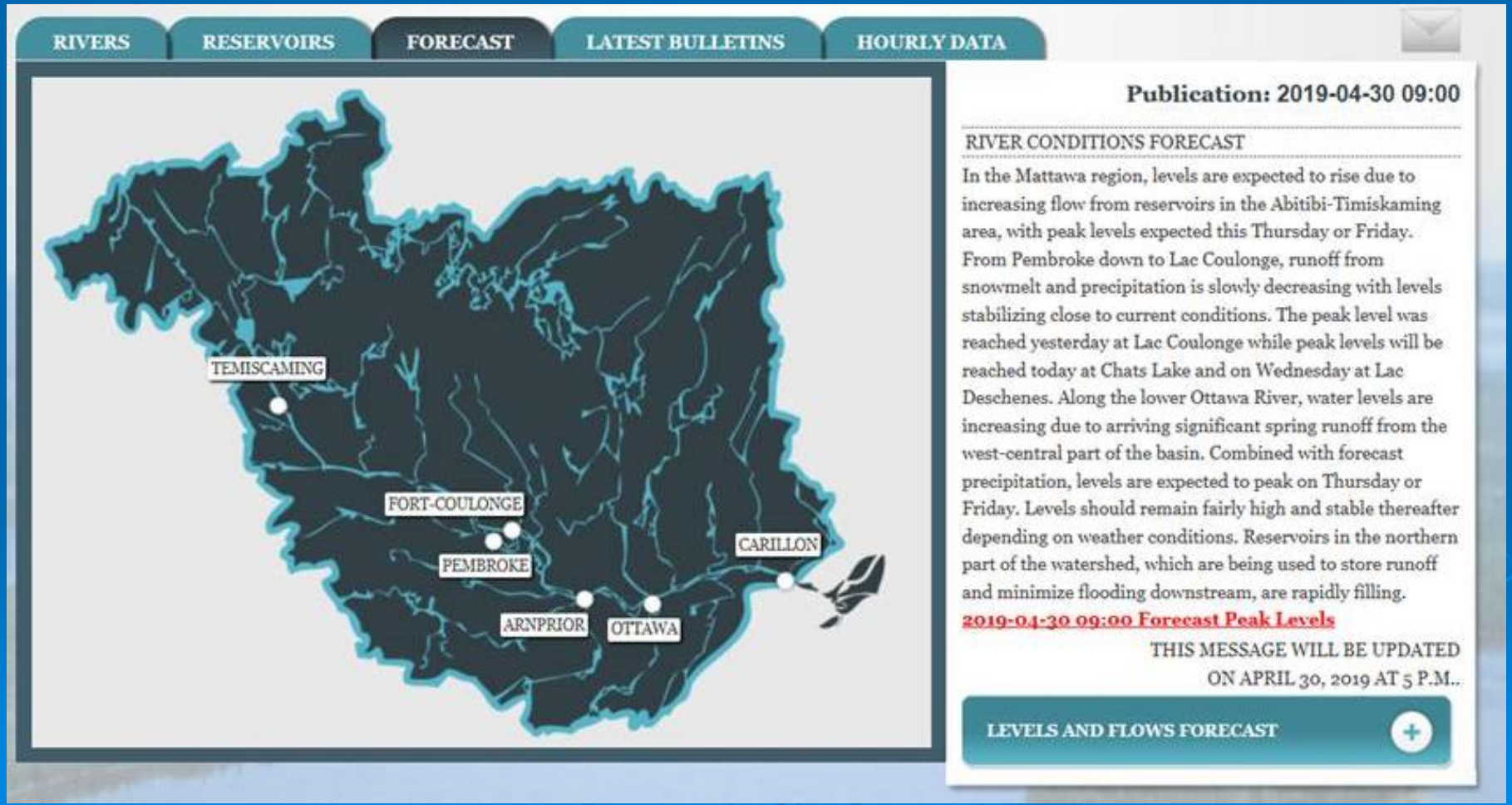
3 - Daily updating of Website



3 - Forecast Peak Flood Levels

Utilized in the case of exceptional flooding

- *Used for the first time in 2017*
- *Used once again in 2019*
- *Published over 50 times in 2019*

OTTAWA RIVER REGULATING COMMITTEE (ORRC)
OTTAWA RIVER
FORECAST PEAK FLOOD LEVELS
2019-04-23 09:00
(Next update 2019-04-23 17:00)

		CURRENT LEVEL		FORECAST PEAK LEVEL		
	2017 PEAK (m)***	DATE-TIME	LEVEL (m) **	DATE	LEVEL (m) **	CHANGE (cm) *
MATTAWA	153.96	2019-04-23 08:00	152.73	2019-05-01	154.00	127
PEMBROKE	113.03	2019-04-23 05:00	112.68	2019-04-27	113.20	52
LAC COULONGE	108.52	2019-04-23 06:45	107.60	2019-04-28	108.50	90
LAC CHATS	75.95	2019-04-23 08:00	75.33	2019-04-27	75.80	47
LAC DESCHENES/BRITANNIA	60.44	2019-04-23 08:00	59.83	2019-04-28	60.30	47
GATINEAU/HULL MARINA	45.20	2019-04-23 06:45	44.20	2019-04-29	44.60	40
THURSO	43.69	2019-04-23 06:45	43.02	2019-04-29	43.30	28
GRENVILLE/HAWKESBURY	42.81	2019-04-23 06:45	42.30	2019-04-29	42.50	20
MANIWAKI	166.10	2019-04-23 06:45	164.33	2019-04-28	165.00	67

3 - Increased Forecasting

2017 : 3-day forecast at 4 locations

SITES (PUBLICATION: 2017-04-27 15:31)		OBSERVATIONS DATE/TIME	OBSERVATIONS VALUE	FORECAST 2017-04-27	FORECAST 2017-04-28	FORECAST 2017-04-29
Ottawa River at Temiscaming	Flow (m^3/s)			1400	1500	1500
Ottawa River at Pembroke	Level (m)	2017-04-27, 8 A.M.	112.44	112.44	112.45	112.60
Ottawa River at Britannia	Level (m)	2017-04-27, 8 A.M.	59.64	59.64	59.64	59.64
	Flow (m^3/s)	2017-04-27, 8 A.M.	3650	3650	3650	3650
Ottawa River at Carillon	Flow (m^3/s)	2017-04-27, 8 A.M.	5684	5600	5600	5650

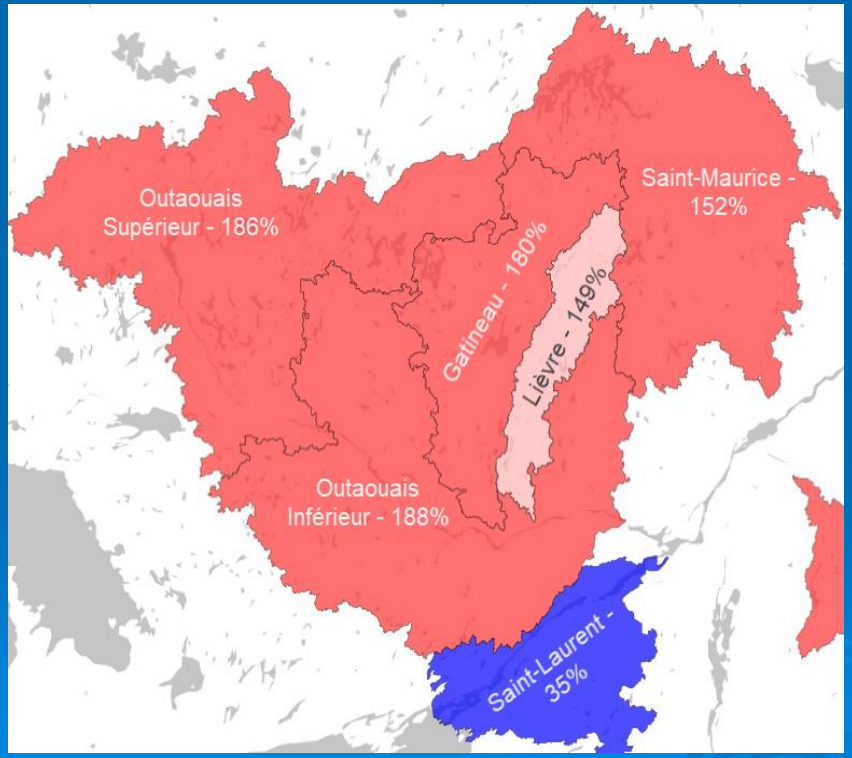
2019 : 4-day forecast at 6 locations

(PUBLICATION: 2019-05-06 18:22)		DATE/TIME	VALUE	2019-05-06	2019-05-07	2019-05-08	2019-05-09
Ottawa River at Temiscaming	Flow (m^3/s)			2600	2800	2900	2900
Ottawa River at Pembroke	Level (m)	2019-05-06, 8 A.M.	113.33	113.35	113.50	113.55	113.60
Lake Coulonge at Fort-Coulonge	Level (m)	2019-05-06, 8 A.M.	108.74	108.78	108.85	108.95	109.05
Chats Lake at Arnprior	Level (m)	2019-05-06, 8 A.M.	75.99	76.00	76.00	76.03	76.05
Lake Deschenes at Britannia	Level (m)	2019-05-06, 8 A.M.	60.45	60.40	60.38	60.40	60.45
(Ottawa)	Flow (m^3/s)	2019-05-06, 8 A.M.	5393	5350	5250	5300	5350
Ottawa River at Carillon	Flow (m^3/s)	2019-05-06, 8 A.M.	8150	8100	7900	7850	7850

Events of 2019

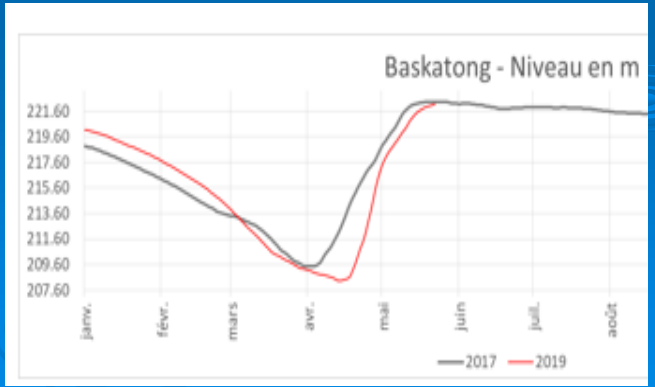
Winter 2019 – Freshet Preparation

Snow on the Ground April 1st % of Average

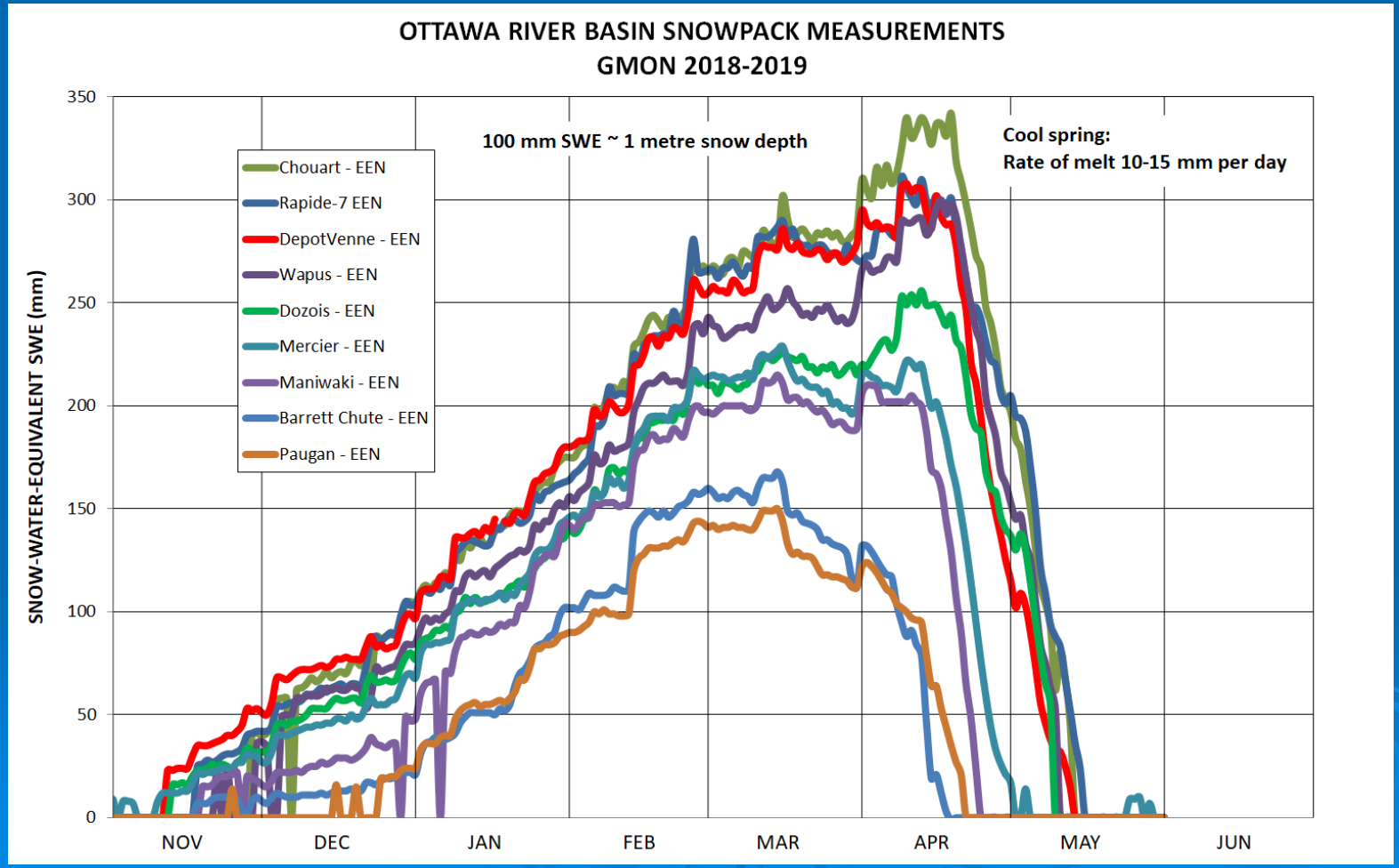


Snowpack measurements

Drawdown of reservoirs



Winter 2019 – Freshet Preparation

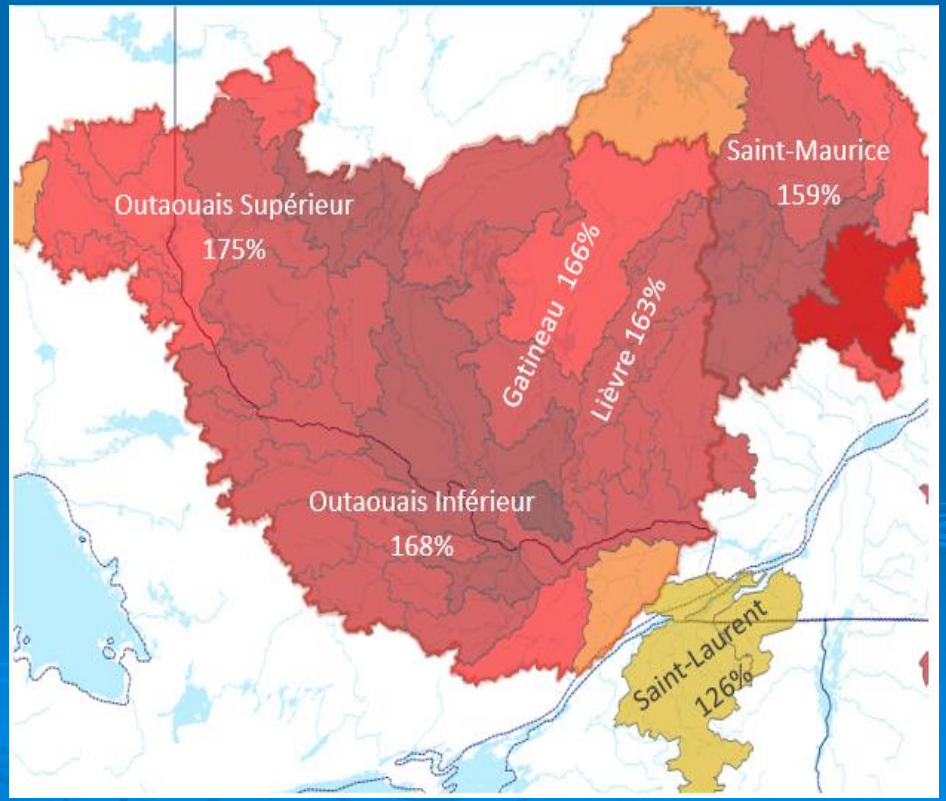


Spring Freshet 2019

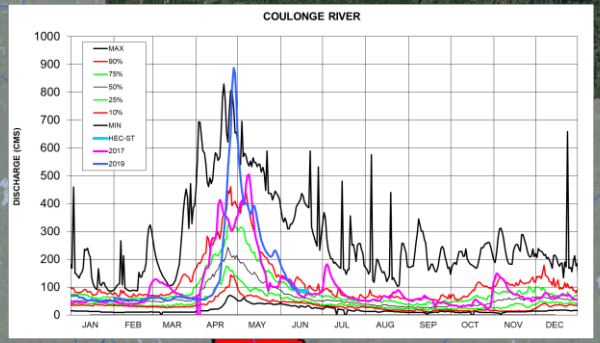
Excess precipitation over the whole basin

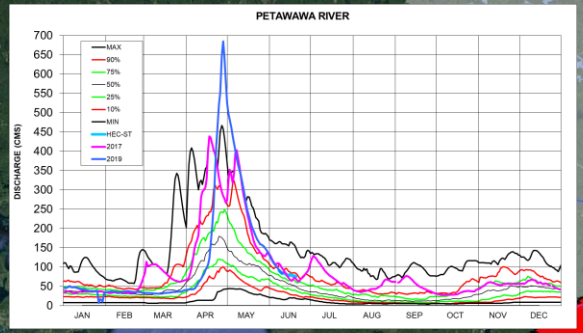
- Precipitation forecasts limited over 1 week in advance
- Historic tributary peaks!

Total Precipitation from April 1st to May 27th
% of Normal



Tributary Flooding 2019



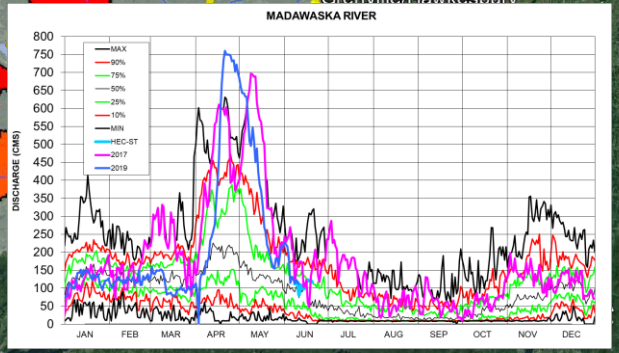


Mattawa

Fort-Coulonge

Pembroke

Grenville/Hawkesbury



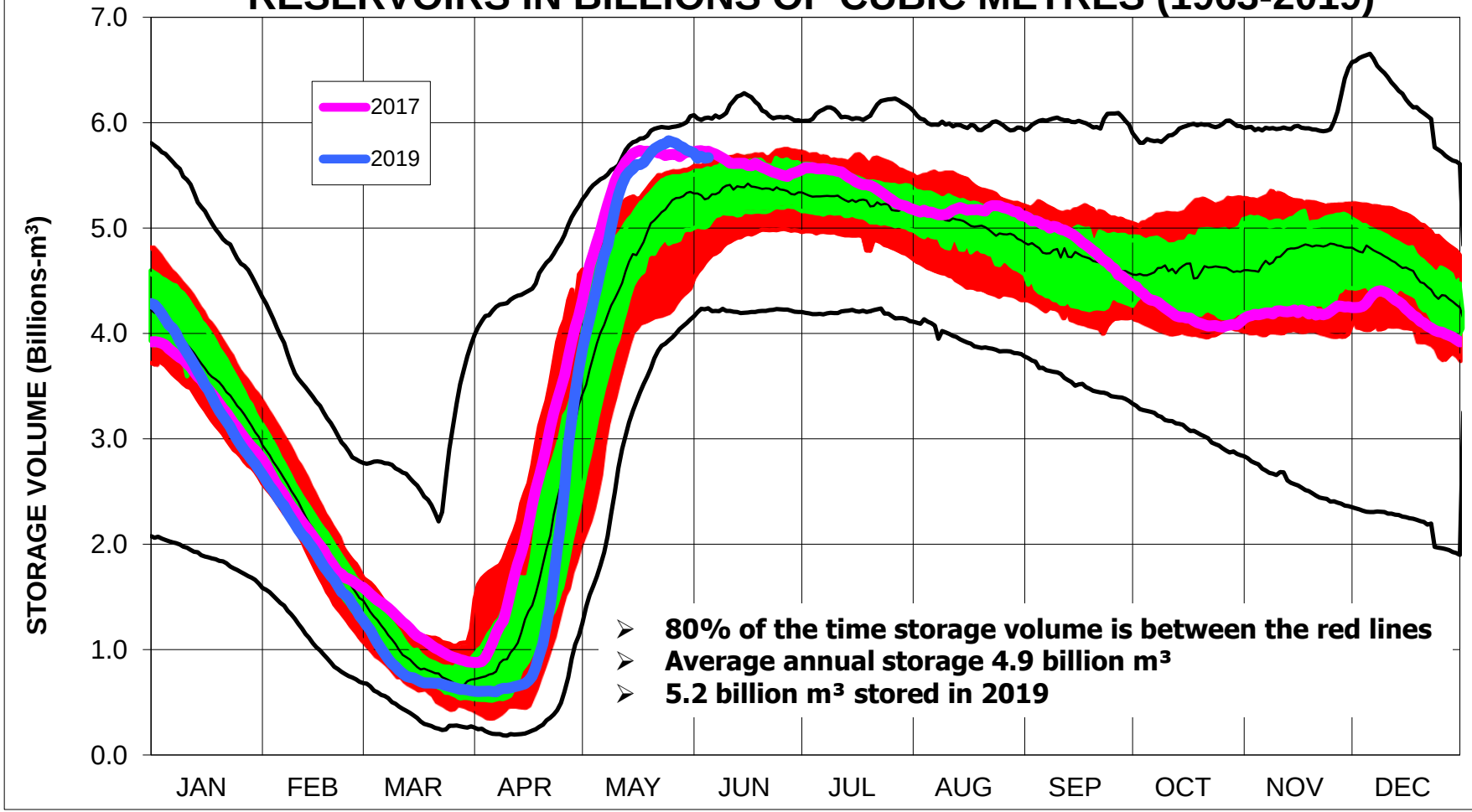
New historic record peak flows from the uncontrolled mid-basin tributaries

Image NOAA
Image Landsat / Copernicus

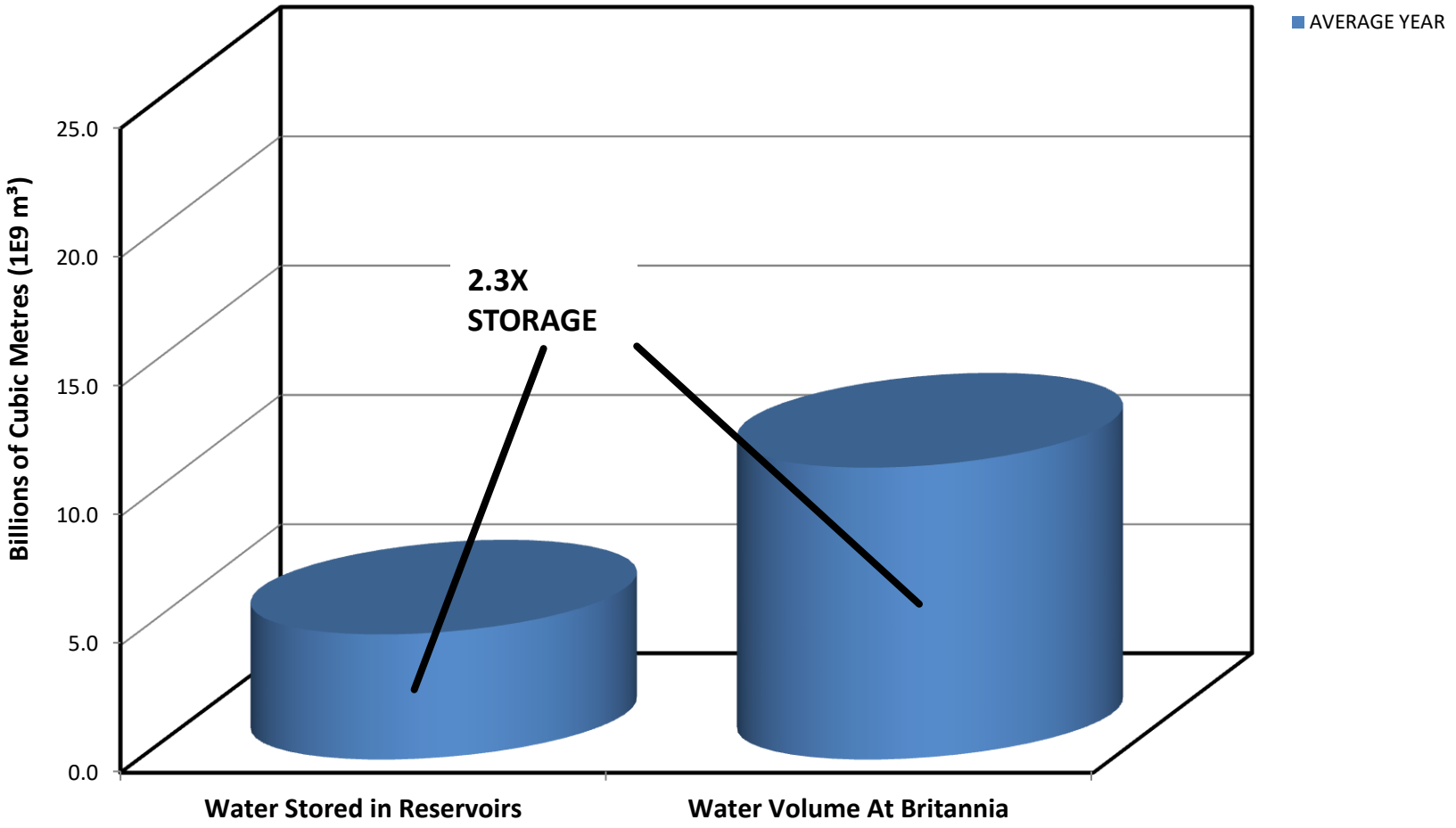
175 km

Earth

WATER STORED IN ABITIBI-TIMISKAMING-BARK LAKE RESERVOIRS IN BILLIONS OF CUBIC METRES (1963-2019)



Ottawa River Water Volumes at Britannia
(April 1st - June 6th)



Ottawa River Water Volumes at Britannia
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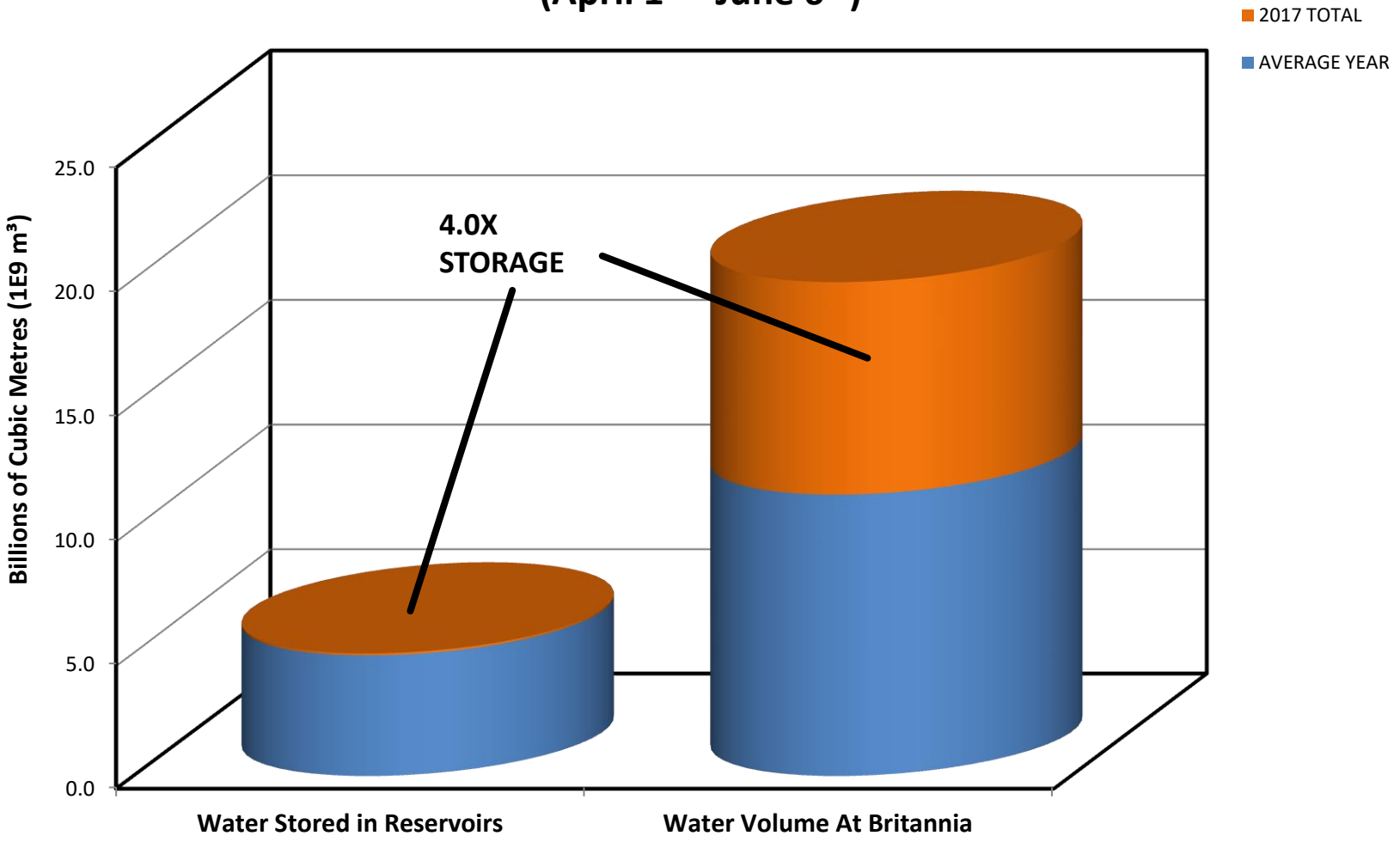
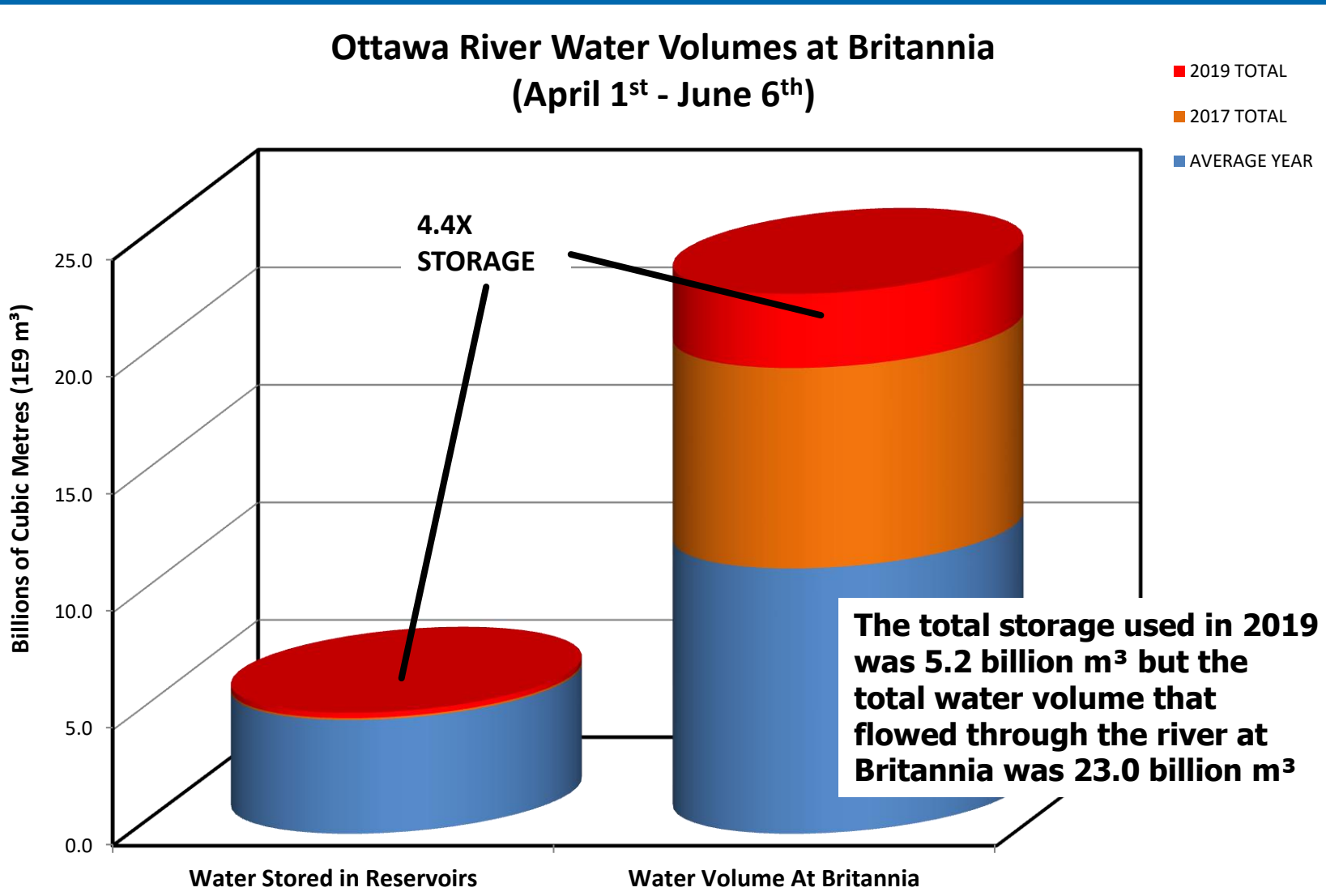
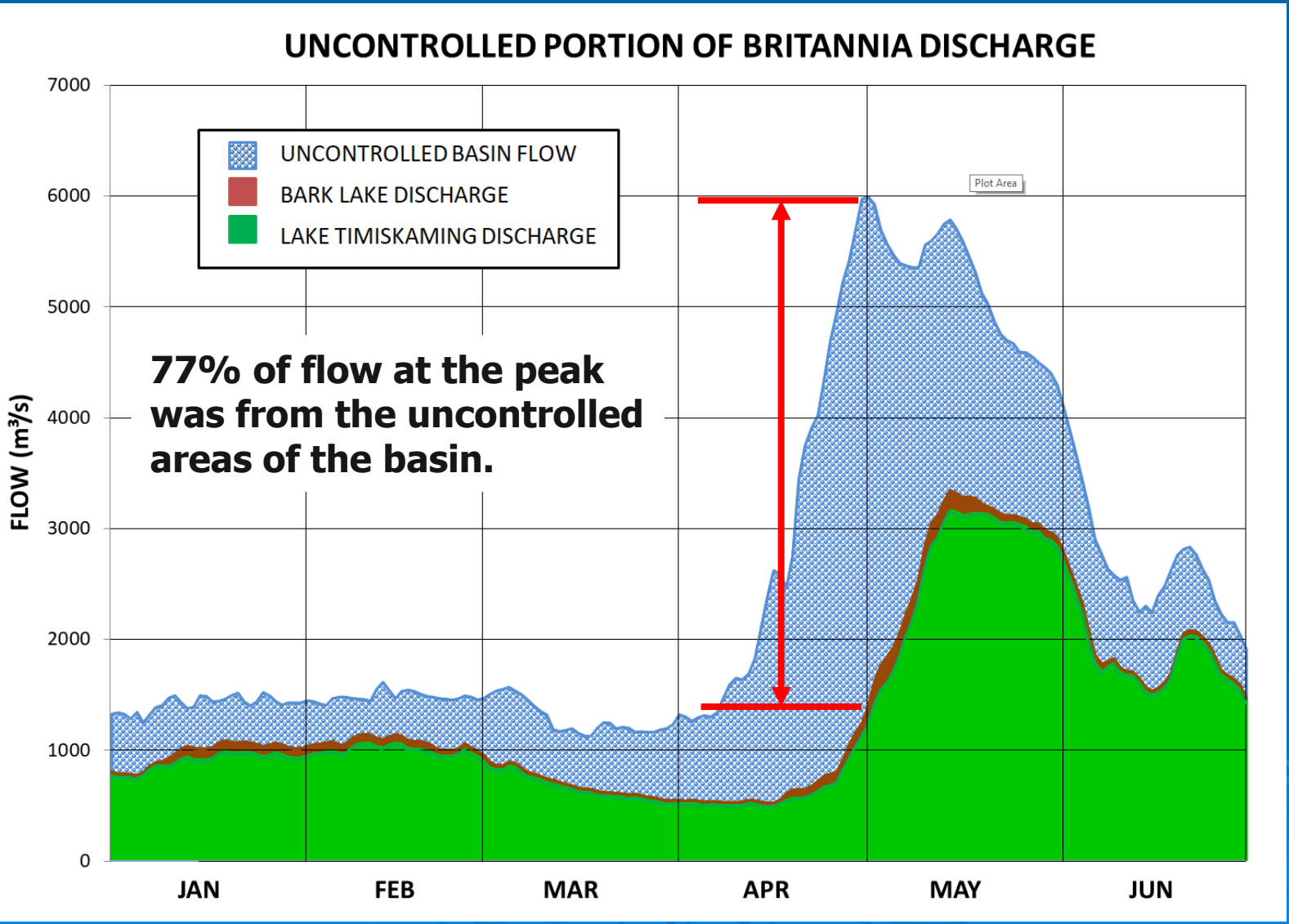
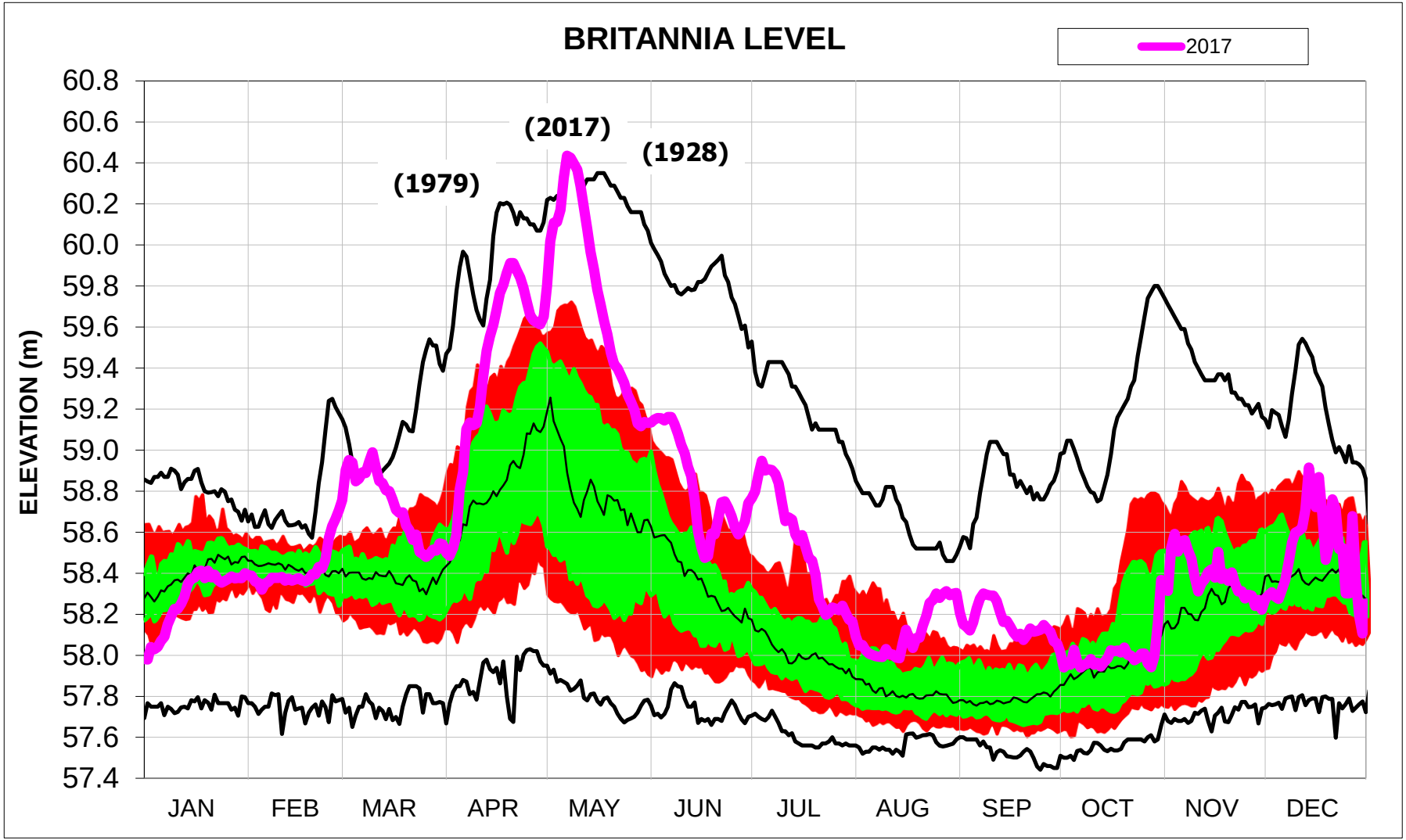
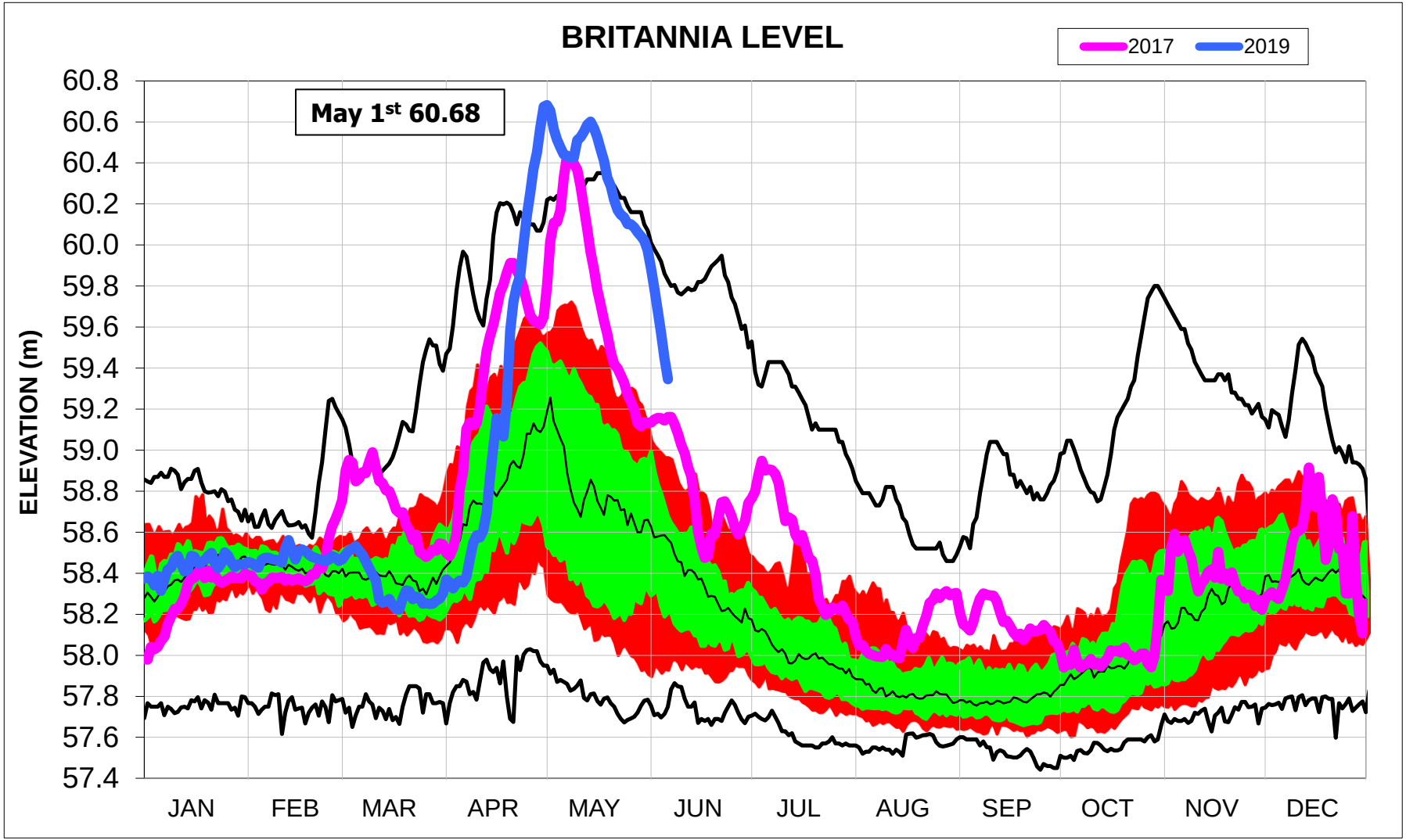



Ottawa River Water Volumes at Britannia
(April 1st - June 6th)
2019 TOTAL
2017 TOTAL
AVERAGE YEAR
4.4X
STORAGE
Billions of Cubic Metres (1E9 m³)
25.0
20.0
15.0
10.0
5.0
0.0
Water Stored in Reservoirs
Water Volume At Britannia
The total storage used in 2019 was 5.2 billion m³ but the total water volume that flowed through the river at Britannia was 23.0 billion m³

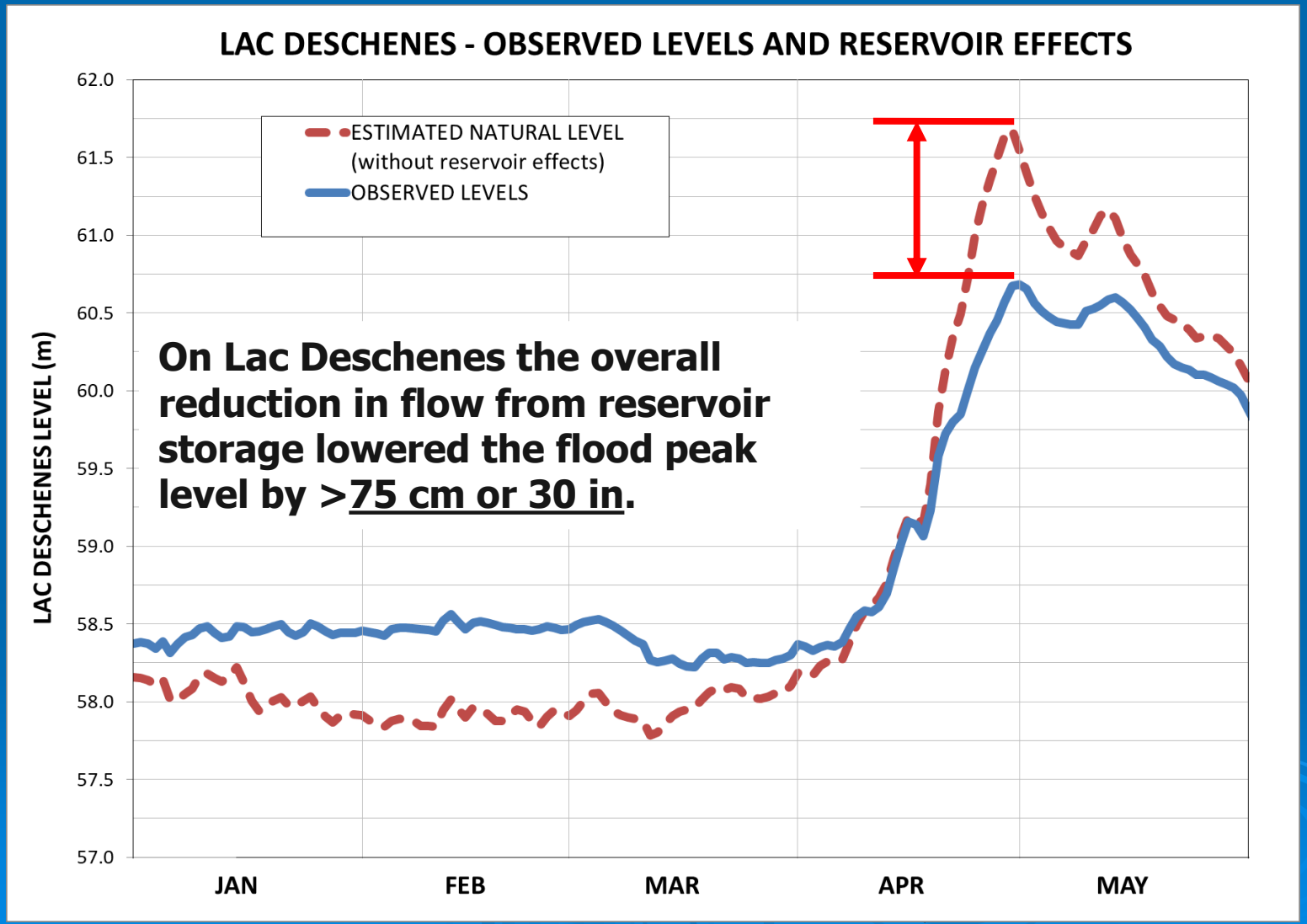

UNCONTROLLED PORTION OF BRITANNIA DISCHARGE
UNCONTROLLED BASIN FLOW
BARK LAKE DISCHARGE
LAKE TIMISKAMING DISCHARGE
77% of flow at the peak was from the uncontrolled areas of the basin.
FLOW (m³/s)
7000
6000
5000
4000
3000
2000
1000
0
JAN
FEB
MAR
APR
MAY
JUN
Plot Area


BRITANNIA LEVEL
2017
(2017)
(1928)
(1979)
ELEVATION (m)
60.8
60.6
60.4
60.2
60.0
59.8
59.6
59.4
59.2
59.0
58.8
58.6
58.4
58.2
58.0
57.8
57.6
57.4
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

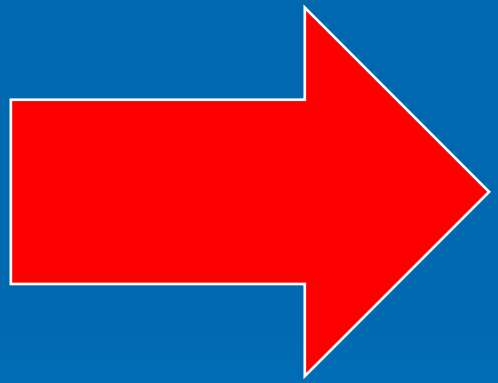

BRITANNIA LEVEL
2017
2019
May 1st 60.68
ELEVATION (m)
60.8
60.6
60.4
60.2
60.0
59.8
59.6
59.4
59.2
59.0
58.8
58.6
58.4
58.2
58.0
57.8
57.6
57.4
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Lake Deschenes – Natural Lake

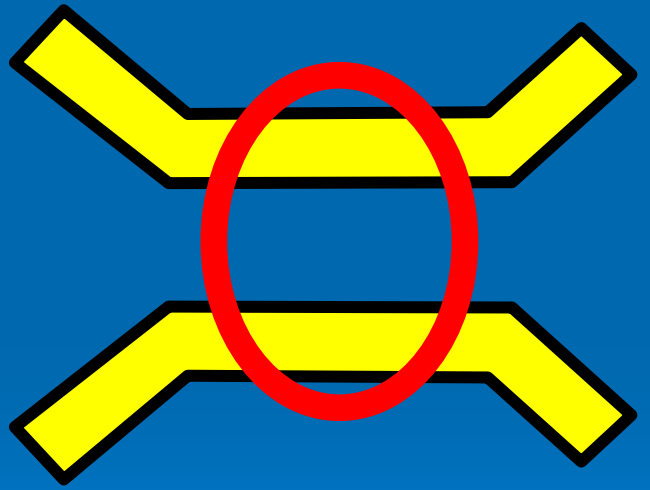
- Water levels are determined by
  - the river flow rate
  - the natural Deschenes rapids
- Ring Dam at Chaudière Falls - Does not affect lake levels
  - during normal or flood conditions
- Carillon Dam - Affects water levels up to Hull
  - during normal conditions
  - but not during flood conditions (given operational levels are lowered)
- Conditions downstream (Hull, Carillon, Great Lakes) – *No effect on lake levels*


LAC DESCHENES - OBSERVED LEVELS AND RESERVOIR EFFECTS
ESTIMATED NATURAL LEVEL
(without reservoir effects)
OBSERVED LEVELS
On Lac Deschenes the overall reduction in flow from reservoir storage lowered the flood peak level by >75 cm or 30 in.
LAC DESCHENES LEVEL (m)
62.0
61.5
61.0
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
JAN
FEB
MAR
APR
MAY

What determines the level in my area?

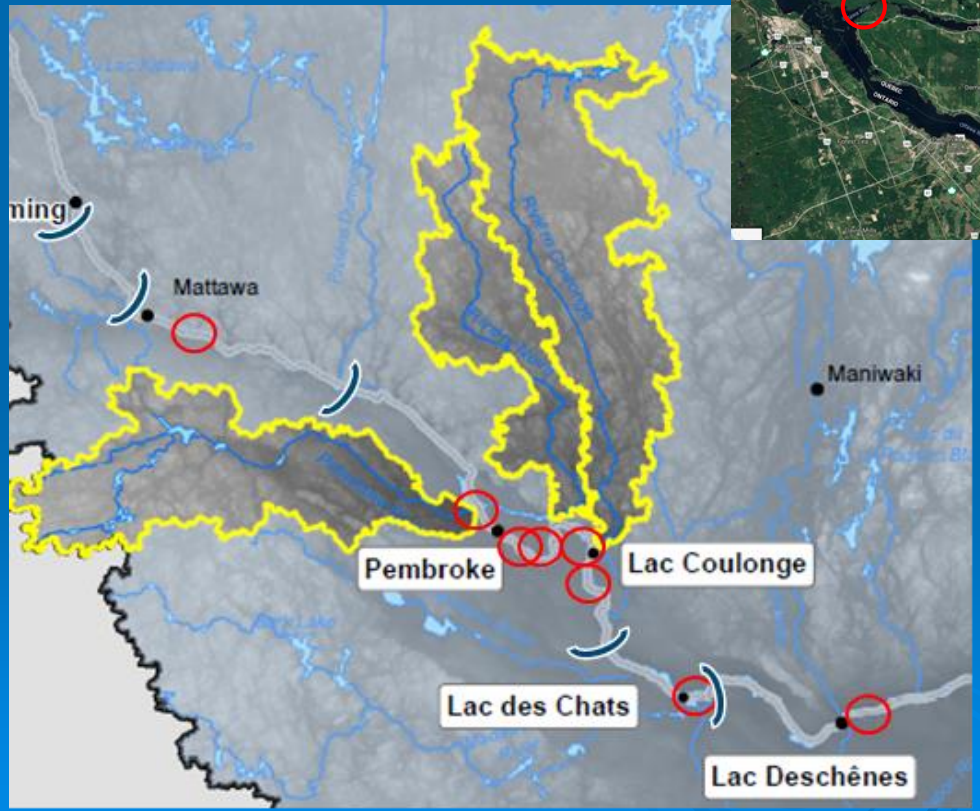


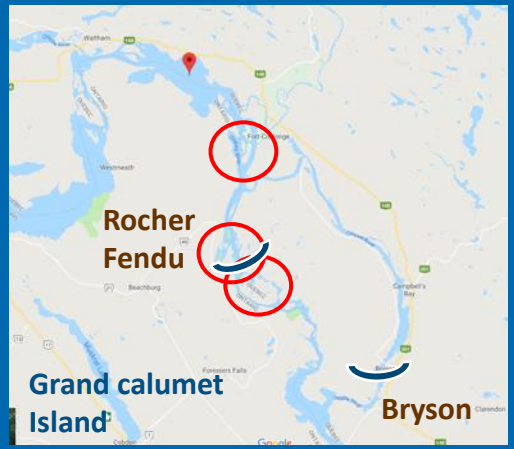
Arriving Upstream Flow



Downstream Constrictions (Control Point)

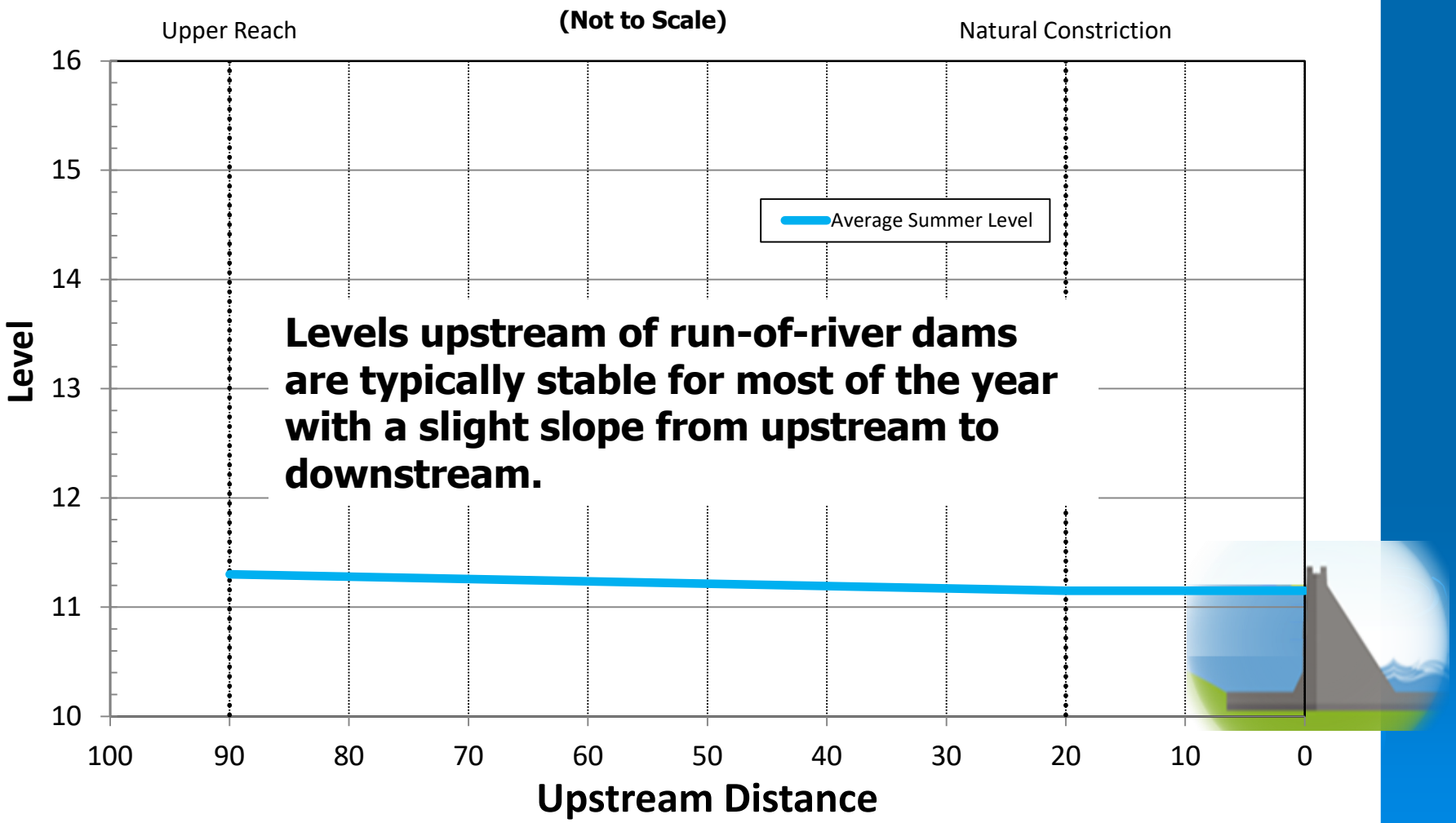
Natural River Narrowing's Restrict the Passage of Water





- Narrowing's cause water to back up (similar to a funnel)
- Before river flows become high, run-of-river dam's lower their level above the dam and conditions return to a near natural state

Upstream Water Level Profile



Upstream Water Level Profile

(Not to Scale)

Upper Reach

Natural Constriction

Average Summer Level

Average Peak Level

2017-2019

Backwater Effect

Potential effect

During flooding run-of-river dams lower levels directly upstream to ensure they do not create a backwater effect worsening upstream flooding.

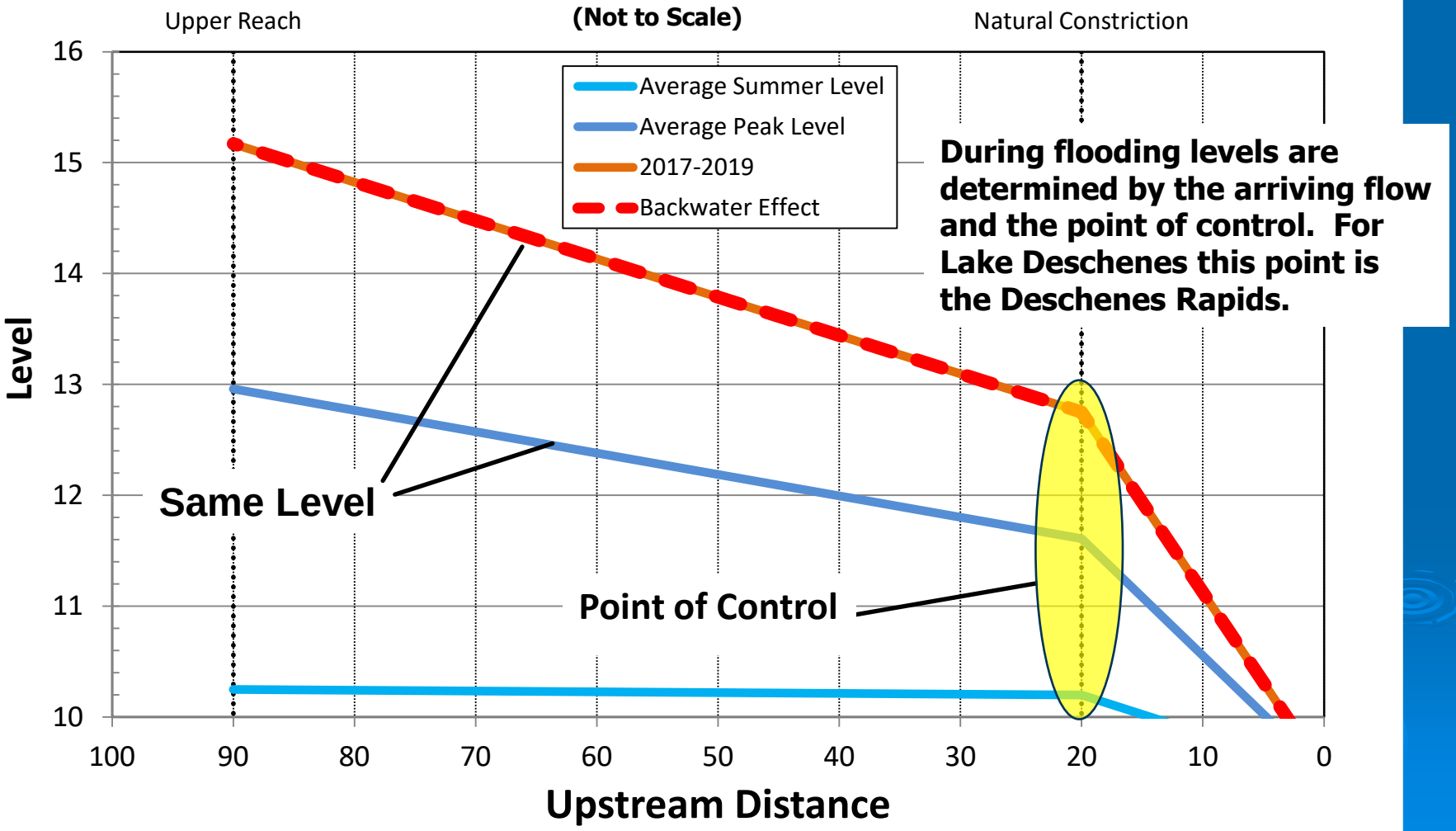
Level

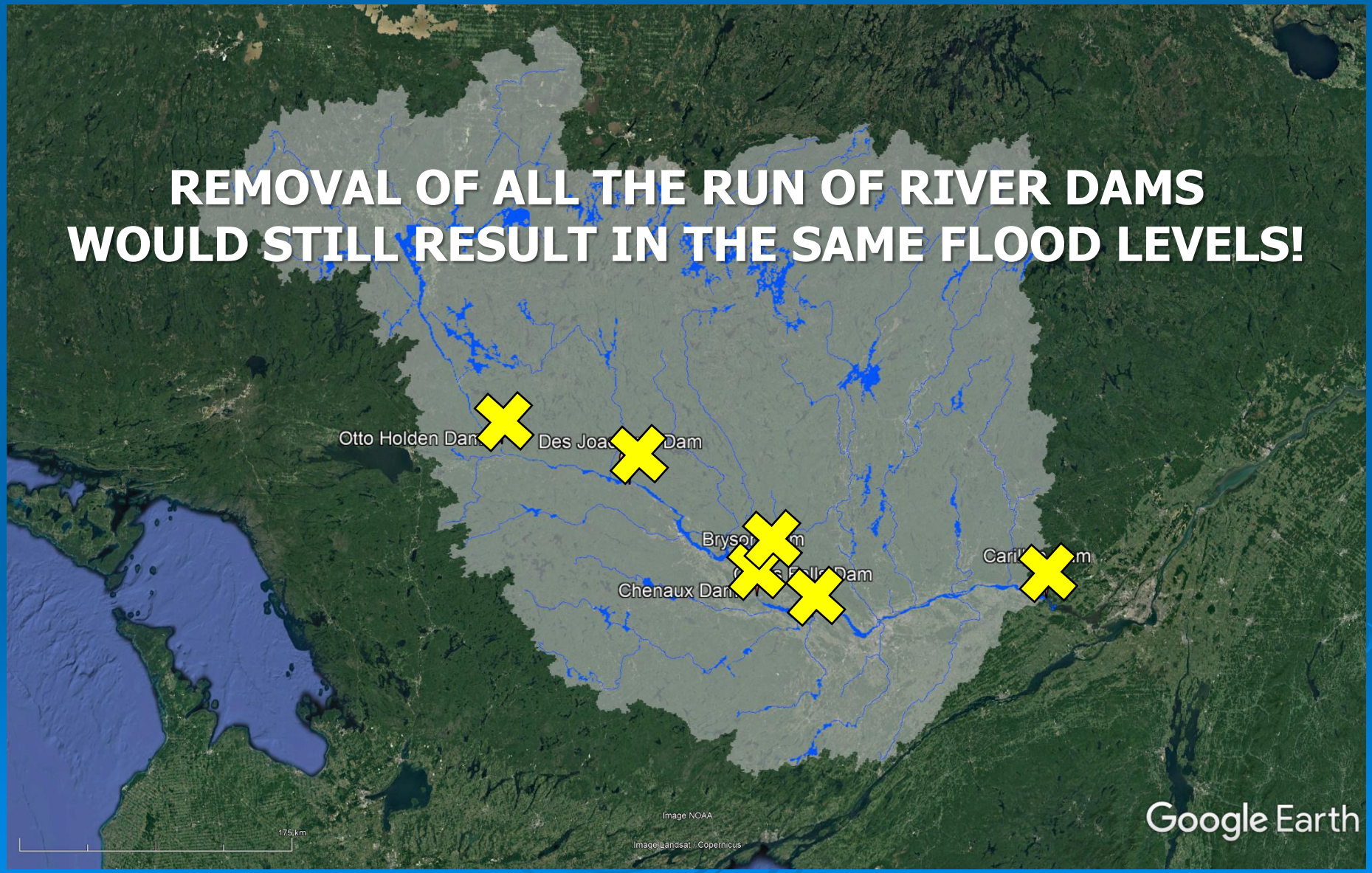
16
15
14
13
12
11
10

100 90 80 70 60 50 40 30 20 10 0

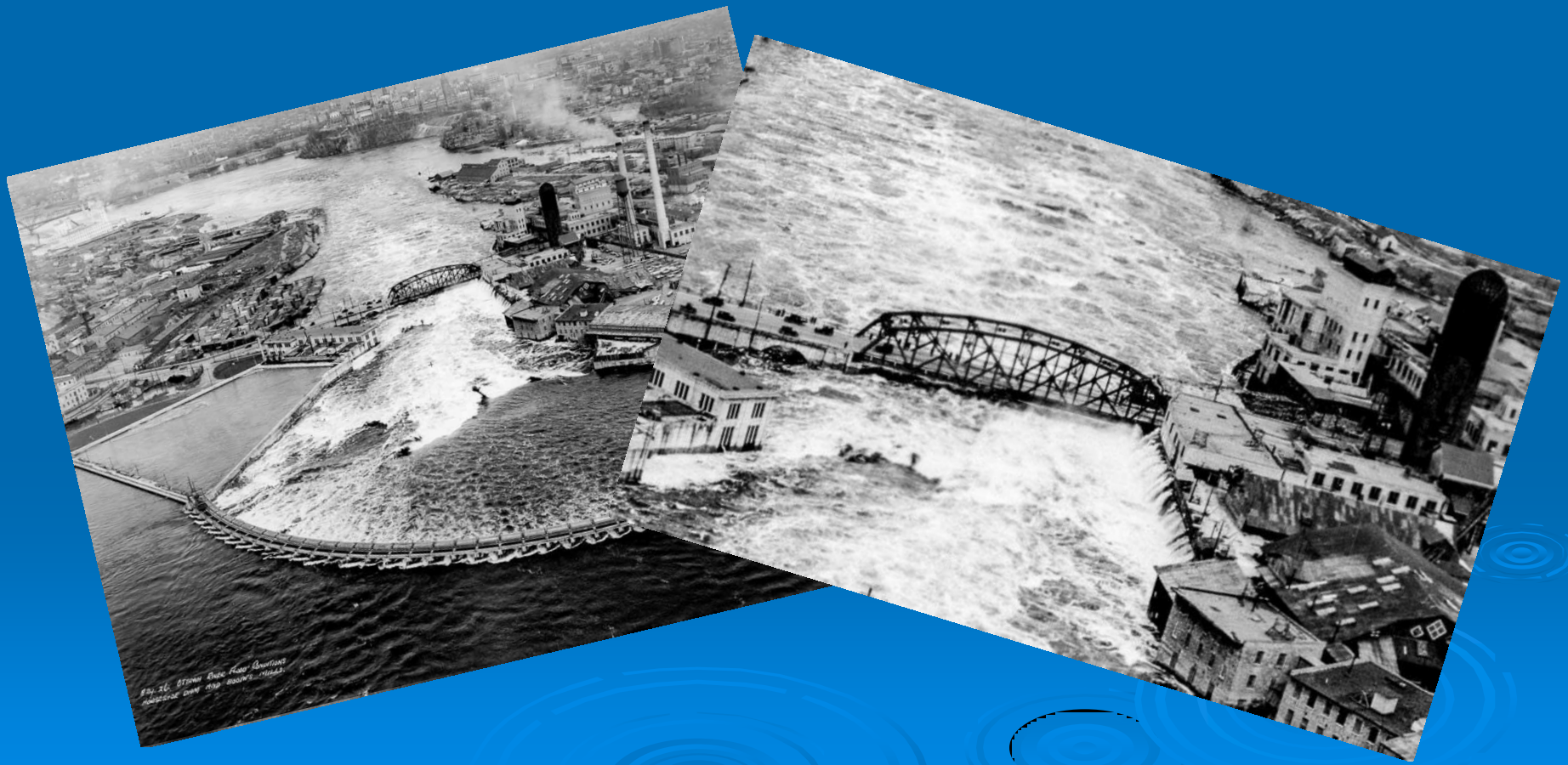
Upstream Distance

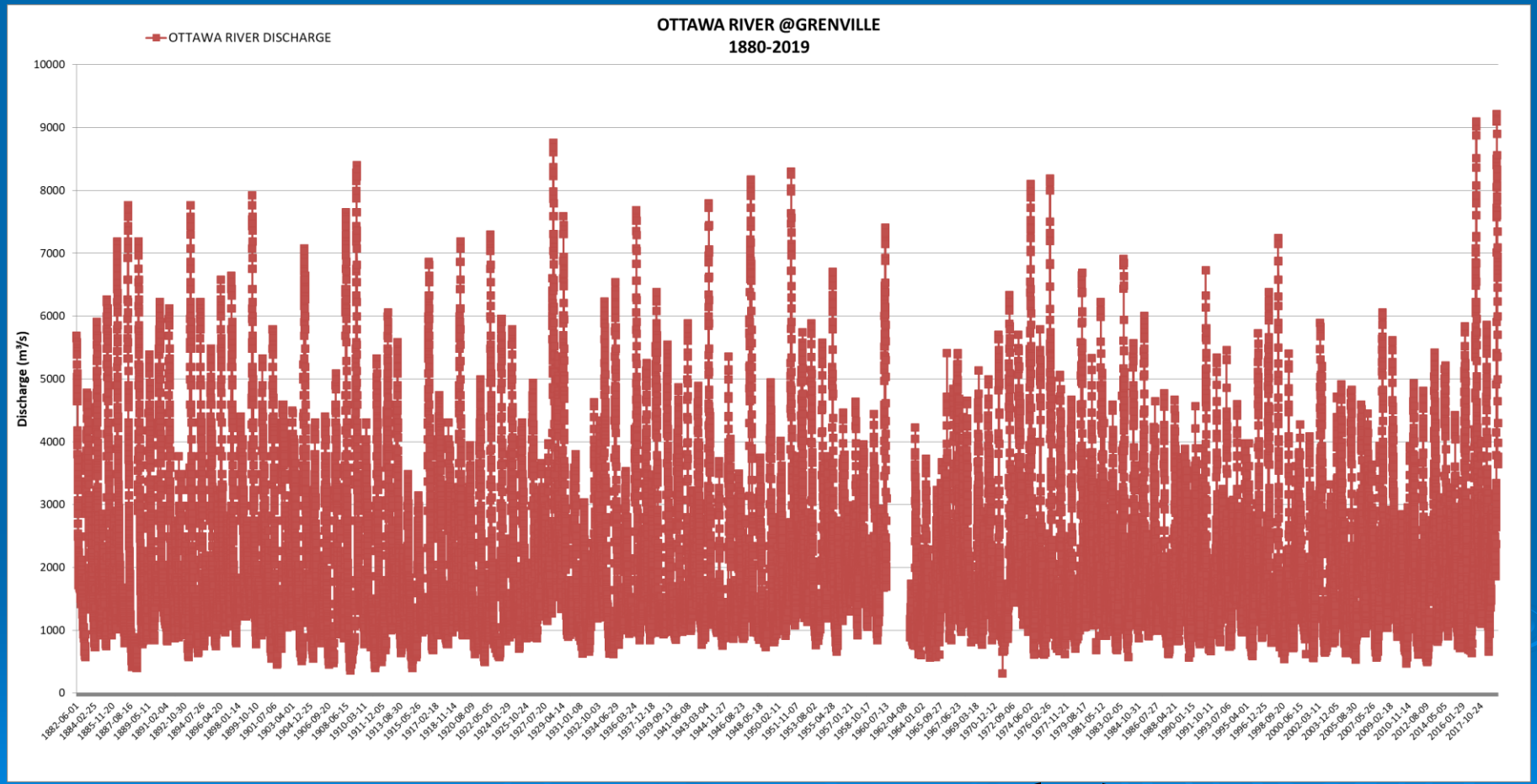
Upstream Water Level Profile




REMOVAL OF ALL THE RUN OF RIVER DAMS
WOULD STILL RESULT IN THE SAME FLOOD LEVELS!
Otto Holden Dam
Des Joa Dam
Bryso m
Chenaux Dam
Cari m
175 km
Image NOAA
Image Landsat / Copernicus
Google Earth

Historic Flooding?



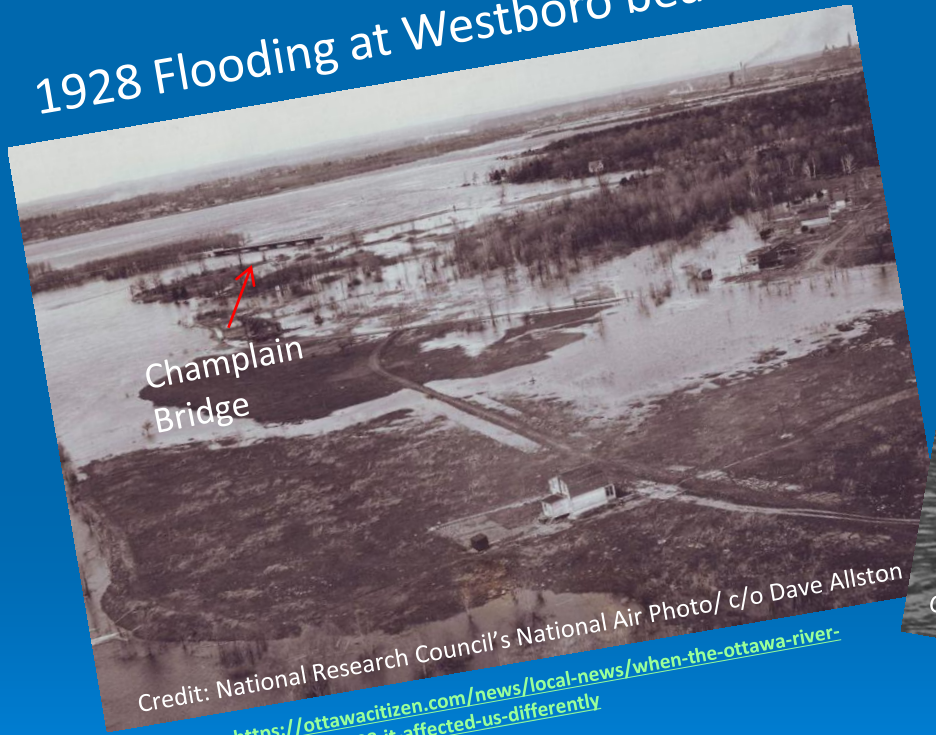

OTTAWA RIVER @GRENVILLE
1880-2019
OTTAWA RIVER DISCHARGE
Discharge (m³/s)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1882-06-01
1884-02-25
1885-11-20
1887-08-16
1889-05-11
1891-02-04
1892-10-30
1894-07-26
1896-04-20
1898-01-14
1899-10-10
1901-07-06
1903-04-01
1904-12-25
1906-09-20
1908-06-15
1910-03-11
1911-12-05
1913-08-30
1915-05-26
1917-02-18
1918-11-14
1920-08-09
1922-05-05
1924-01-29
1925-10-24
1927-07-20
1929-04-14
1931-01-08
1932-10-03
1934-06-29
1936-03-24
1937-12-18
1939-09-13
1941-06-08
1943-03-04
1944-11-27
1946-08-23
1948-05-18
1950-02-11
1951-11-07
1953-08-02
1955-04-28
1957-01-21
1958-10-17
1960-07-13
1962-04-08
1964-01-02
1965-09-27
1967-06-23
1969-03-18
1970-12-12
1972-09-06
1974-06-02
1976-02-26
1977-11-21
1979-08-17
1981-05-12
1983-02-05
1984-10-31
1986-07-27
1988-04-21
1990-01-15
1991-10-11
1993-07-06
1995-04-01
1996-12-25
1998-09-20
2000-06-15
2002-03-11
2003-12-05
2005-08-30
2007-05-26
2009-02-18
2010-11-14
2012-08-09
2014-05-05
2016-01-29
2017-10-24

Exceptional Spring Flooding

- Historic flooding from Pembroke down to Montreal
  - Mattawa highest since 1960, record levels recorded at Pembroke, Westmeath/Lac Coulonge, Chats Lake, Britannia beach
  - Level in Gatineau/Hull similar to 2017
    - Highest since start of recording in 1964
  - Flow rate at Carillon dam similar to 2017
    - Probably the highest flow in recorded history (1880's->)
- Exceptional floods occurred in 20's, 50's, 70's, 2017 and 2019
  - Other exceptional floods are to be expected in the future

Floods of the past

1928 Flooding at Westboro beach



Credit: National Research Council's National Air Photo/ c/o Dave Allston

https://ottawacitizen.com/news/local-news/when-the-ottawa-river-flooded-in-1928-it-affected-us-differently

1947 Flooding in Hull

Credit: Bibliothèque et Archives nationales du Québec

Flooding on the Ottawa River occurred before dams were built

Risks of Living in the Floodplain

Should be called the 1% flood!

Risk over a 50-yr Period

Over a 50-year period, there's 40% chance of getting a 100-yr flood event at least once

100-yr Flood

Is actually a 1% flood, meaning that on any given year, there is a 1% chance of having a flood of this magnitude

Limitations of Regulation in the Ottawa River Basin

- Size of reservoirs smaller than spring runoff, large portion of the watershed uncontrolled
- Flooding cannot be prevented
- Peak of the flood is substantially reduced
- Amount of precipitation, rate of snowmelt and natural stream characteristics are main factors in flood levels
- Meteorological factors are known only a few days ahead

Information

Current Water levels
Toll free number 24 hours per day

Ottawa-Gatineau		Outside
613-995-3443	*English*	**1 800 778-1246**
613-995-3455	*French*	**1 800 778-1243**

Flow forecasts during freshet

Web Site: **http://www.ottawariver.ca**

Twitter @ORRPB

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Ottawa, Ontario
Email : secretariat@ottawariver.ca