# REPORT:

## SPRING 2019 FLOOD of the MISSISSIPPI RIVER SYSTEM

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## INTRODUCTION

The flood of 2019 was one of the largest floods recorded on the Mississippi River. The flood affected almost every watercourse within the Mississippi River watershed from the headwaters of the system in Addington Highlands Township to the outlet of the river into the Ottawa River at Galetta.  Because major rainfall events were concentrated in the upper watershed of the Mississippi River, the Carp River did not experience the same level of flooding.  This report only addresses the Mississippi River.

### Comparison to previous flood events

Figures 1 and 2 illustrate the Spring 2019 and three previous major floods to occur in the Mississippi watershed at two locations in the watershed:  upstream at Myers Cave (below Mazinaw Lake in the extreme western portion of the watershed); and downstream at Appleton (located below all of the major tributaries to the Mississippi River except the Indian River.)

The 2019 spring flood occurred over a two month period which in itself is highly unusual, beginning in early April with flows not returning to “typical” conditions until early June.  The 2019 event had similar stream flows and water levels to those recorded in 1998—both due to a combination of rain coupled with snowmelt, however, the duration of the 2019 event was significantly longer, with a much greater total volume of runoff.

By comparison, the flood of 2017 had four very distinct spring peaks: the first being snowmelt induced, followed a few weeks later by rainfall and the remainder of the snowmelt, and followed by two rainfall events a few weeks later. Except for Dalhousie Lake, the watershed did not experience significant flooding in 2017 because the lull between peaks allowed the system to recover and water levels to lower.

Many record lake levels were set in June 2002 as result of a large summer rainfall event that occurred when lakes were already at their summer target levels and there was minimal usable storage left in the system to hold the rain and run-off.

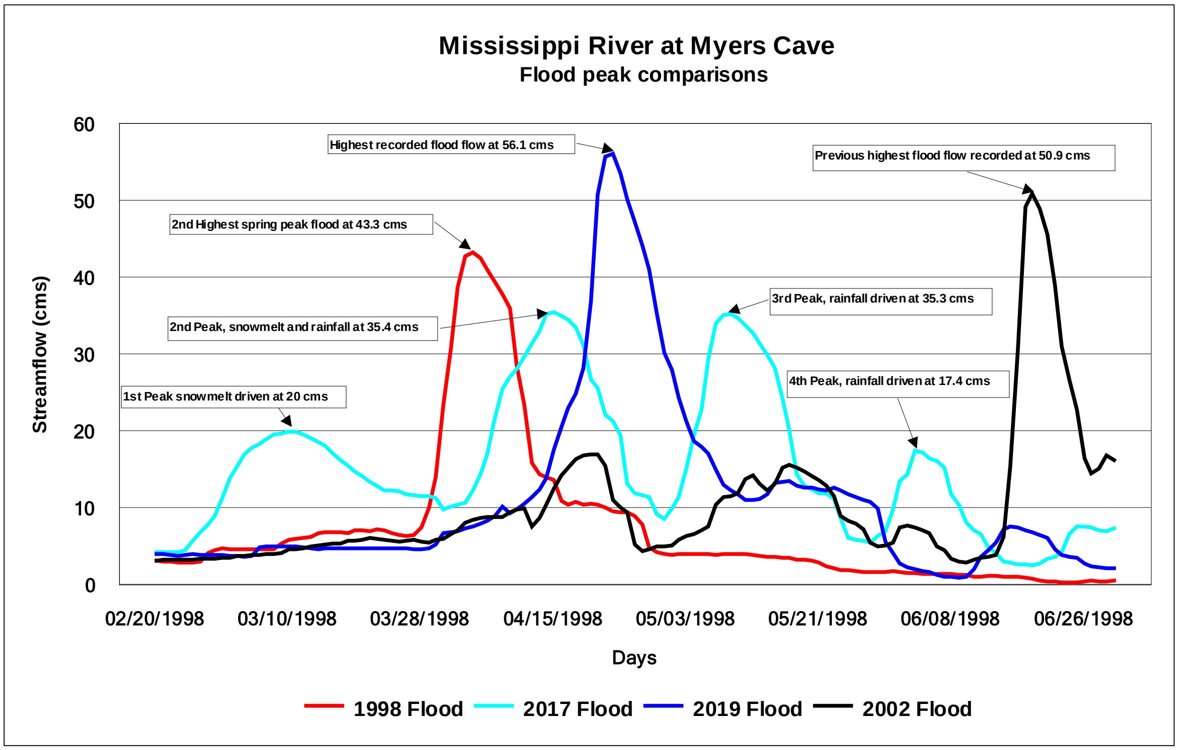



**Figure 1: Myers Cave Flood Records**

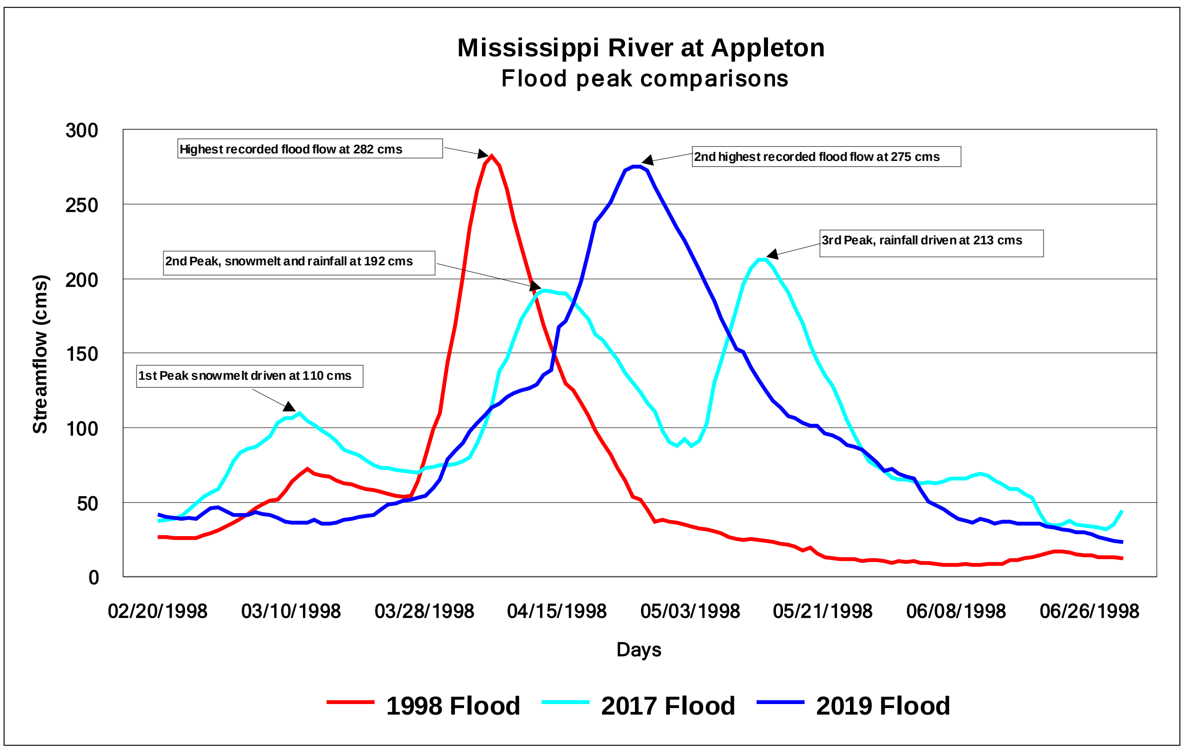



**Figure 2: Appleton Flood Records**

The streamflow gauge on the Mississippi River at Appleton has been in existence since 1918. Table 1 outlines the 10 highest flood flows ever recorded as well as the highest flood flows since 1980 at this gauge. Table 2 provides the highest and previous highest recorded levels on the upper lakes having control dams on them, with data from 1990[1] onward.

| Rank | All-Time High (cubic meters/second) | | Rank | Since 1980 (cm/s) | |
|---|---|---|---|---|---|
| 1 | April 6, 1998 | 282 | 1 | April 6, 1998 | 282 |
| 2 | April 26, 2019 | 275 [2] | 2 | April 26, 2019 | 275 |
| 3 | April 13, 1928 | 260 | 4 | April 20, 2014 | 244 |
| 4 | April 20, 2014 | 244 | 11 | April 17, 2008 | 211 |
| 5 | April 5, 1976 | 236 | 12 | May 12, 2017 | 208 |
| 6 | April 22, 1960 | 227 | 13 | March 1, 1981 | 202 |
| 7 | April 3, 1936 | 219 | 14 | April 22. 1984 | 196 |
| 8 | April 17, 1947 | 217 | 15 T[3] | April 12, 1999 | 194 |
| 9 | April 25, 1971 | 216 | 21 T | April 12, 1997 | 183 |
| 10 | April 28, 1926 | 212 | 24 T | April 17, 1993; April 9, 2005; May 2, 2018 | 181 |

**Table 1 – 10 Maximum Daily Spring Peak Flood Flows Mississippi River Appleton since 1980**

[1] Data on the lakes prior to 1990 is available but only from graphs, no actual levels or dates were recorded to know if peak levels were obtained or the frequency of data being collected. The data is also questionable as data from MVCA observers and those from MRIC observers were significantly different during years of overlap between the two agencies.

[2] Unofficial data from Appleton stream gauge, has not been verified by Environment Canada

[3] T – Flow was equaled in other years.

| Lake | 2019 Peak Elevation | Date | Previous Peak Elevation | Date |
|---|---|---|---|---|
| Shabomeka | 271.28 m | April 22, 2019 | 271.44 m | June 18, 2002 |
| Mazinaw | 268.59 m | April 22, 2019 | 268.37 m | June 19, 2002 |
| Kashwakamak | 261.50 m | April 26, 2019 | 261.40 m | June 19, 2002 |
| Mississagagon | 268.50 m | May 2, 2019 | *268.42 m | June 18, 2002 |
| Big Gull | 253.70 m | April 27, 2019 | 253.73 m | May 9, 2017 |
| Crotch | 240.40 m | April 26, 2019 | 240.50 m | June 21, 2002 |
| Palmerston | 272.08 m | April 22, 2019 | 272.19 m | May 9, 2017 |
| Dalhousie | 158.13 m | April 28, 2019 | *157.86 m | April 2, 1998 |
| Mississippi | 135.67 m | April 25, 2019 | 135.73 m | April 5, 1998 |

**Table 2: Peak Elevations by Lake**

*Matched in 2017

**OVERVIEW OF THE MISSISSIPPI RIVER WATERSHED**

The Mississippi River watershed is located in south-eastern Ontario and is composed of a complex network of rivers, streams, rapids, and over 250 lakes (see Map 1). The Mississippi River has a drainage area of 3,740 sq km from its headwaters in Kilpecker Creek, in the Township of Addington Highlands, to its outlet at the Ottawa River in the City of Ottawa.

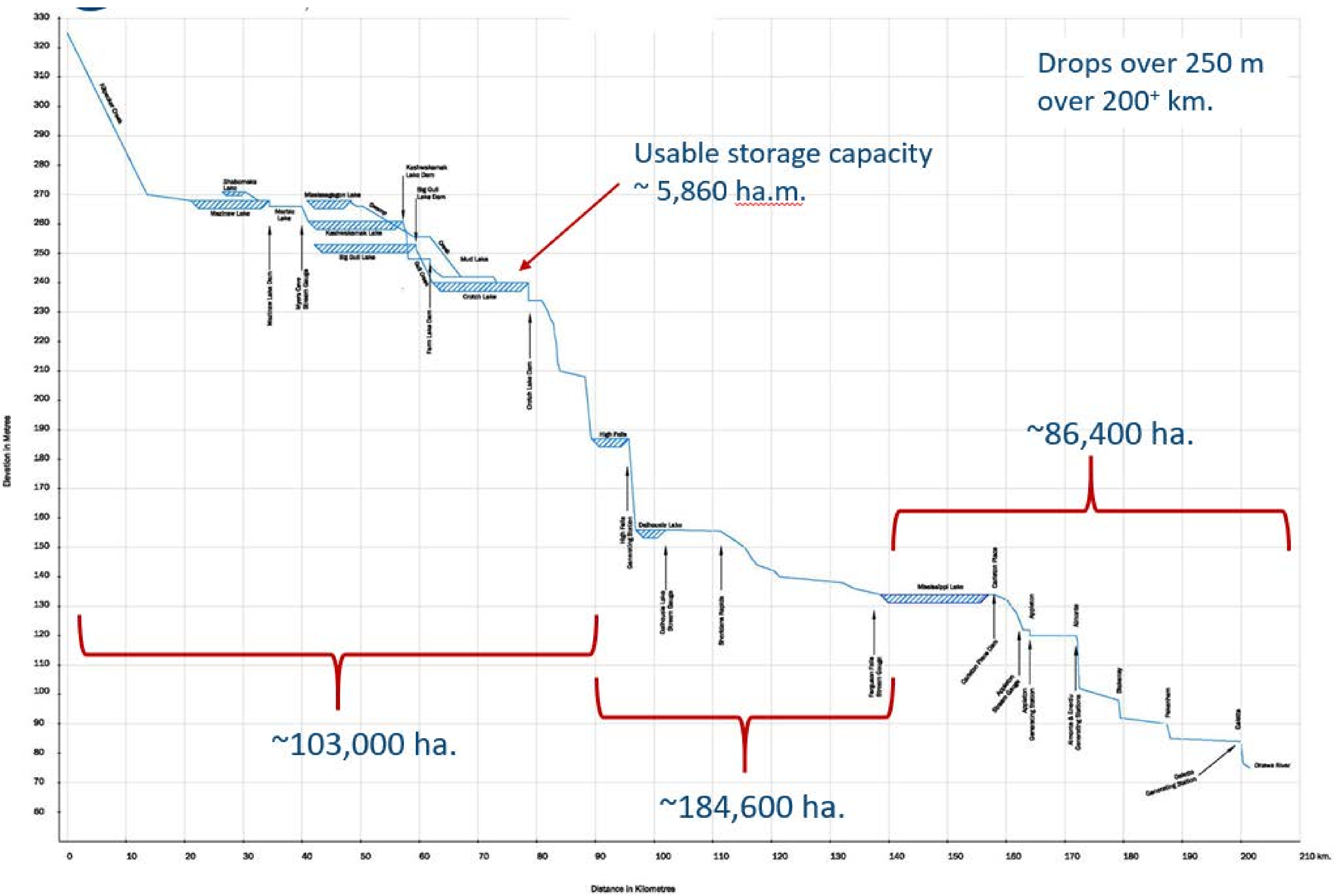
The river is 212 km in length, and begins at an elevation of 325 m (1,066 ft) in the west and drops 252 m (827 feet) gradually towards the east to an elevation of 73 m (240 ft) at the outlet to Ottawa River. Refer to Figure 3. There are three distinct basins within the overall Mississippi River watershed:

1 Upper or Western watershed which includes the drainage area above the outlet of Crotch Lake dam. The sub watershed has the vast majority of usable storage to mitigate potential floods and augment flows in droughts. MVCA owns and /or operates all of the major water control structures in this part of the watershed,

2 The central watershed which is the area between Crotch Lake and the inlet into Mississippi Lake and includes the (for all intents and purposes) unregulated Clyde and Fall River sub-watersheds,

3 The lower or Eastern watershed which includes the majority of major flood damage centers along the main stem of the Mississippi River.

**Figure 3: Mississippi River Profile**



There are 23 water control structures within the Mississippi River watershed that are either owned or operated by the Mississippi Valley Conservation Authority (MVCA), Ministry of Natural Resources and Forestry (MNRF), Ontario Power Generation (OPG), Trans Alta Hydro Generation (TransA), Mississippi River Power Corporation (MRPC) and Enerdu. There were 7 water control structures and 5 hydro-electric generating stations in the Mississippi River that were subject to the **Water Management Planning** exercise. These dams were identified through that process as having the most ability to influence water levels during floods and droughts and/ or had hydro generation associated with the structure.

One of the results at the completion of the plan was that all structures are to be operated as a group to mitigate flooding across the watershed and compliance levels associated with individual structures would not be enforced until such time as water levels returned to below flood stage conditions. The other eleven water control structures and several smaller, privately owned structures in the Mississippi River watershed were not subject to this planning exercise due to their limited capacity to influence flows or water levels at the hydro generating stations. Table 3 provides a listing of dams, the owner and operator and whether it was included in the Mississippi River Water Management Plan.

**Table 3 Dams within the watershed**

| Name | Waterbody | Watercourse | Owner | Operator | MRWMP |
|---|---|---|---|---|---|
| Shabomeka | Shabomeka Lake | Semi Circle Cr | MVCA | MVCA | Yes |
| Mazinaw | Mazinaw Lake | Mississippi R | MVCA | MVCA | Yes |
| Kashwakamak | Kashwakamak Lake | Mississippi R | MVCA | MVCA | Yes |
| Mississagagon | Mississagagon Lake | Swamp Creek | MVCA | MVCA | Yes |
| Farm | Farm Lake | Mississippi R | MVCA | MVCA | No |
| Big Gull | Big Gull Lake | Gull Creek | MVCA | MVCA | Yes |
| Pine | Pine Lake | Unnamed Creek | MVCA | MVCA | No |
| Malcolm | Malcolm Lake | Unnamed Creek | MNRF - Ban | MVCA | No |
| Crotch | Crotch Lake | Mississippi R | OPG | MVCA | Yes |
| High Falls GS | Stump Bay | Mississippi R | OPG | MVCA/OPG | Yes |
| Mosque | Mosque Lake | Conn's creek | MNRF - Ban | MVCA | No |
| Summit | Summit Lake | Dead Beaver Cr | MNRF - Ban | MVCA | No |
| Palmerston | Palmerston Lake | Sunday Cr | MNRF - Ban | MVCA | No |
| Canonto | Canonto Lake | Sunday Cr | MNRF - Ban | MVCA | No |
| Widow | Widow Lake | Clyde R | MVCA | MVCA | No |
| Lanark | | Clyde R | MVCA | MVCA | No |
| Bennett | Bennett Lake | Fall R | MVCA | MVCA | No |
| Carleton Place | Mississippi Lake | Mississippi R | MVCA | MVCA | Yes |
| Appleton GS | | Mississippi R | TransA | TransA | Yes |
| Enerdu GS | | Mississippi R | Enerdu | Enerdu | Yes |
| Almonte GS | | Mississippi R | MRPC | MRPC | Yes |
| Clayton | Clayton Lake | Indian R | MNRF- Kem | MNRF- Kem | No |
| Galetta GS | | Mississippi R | TransA | TransA | Yes |

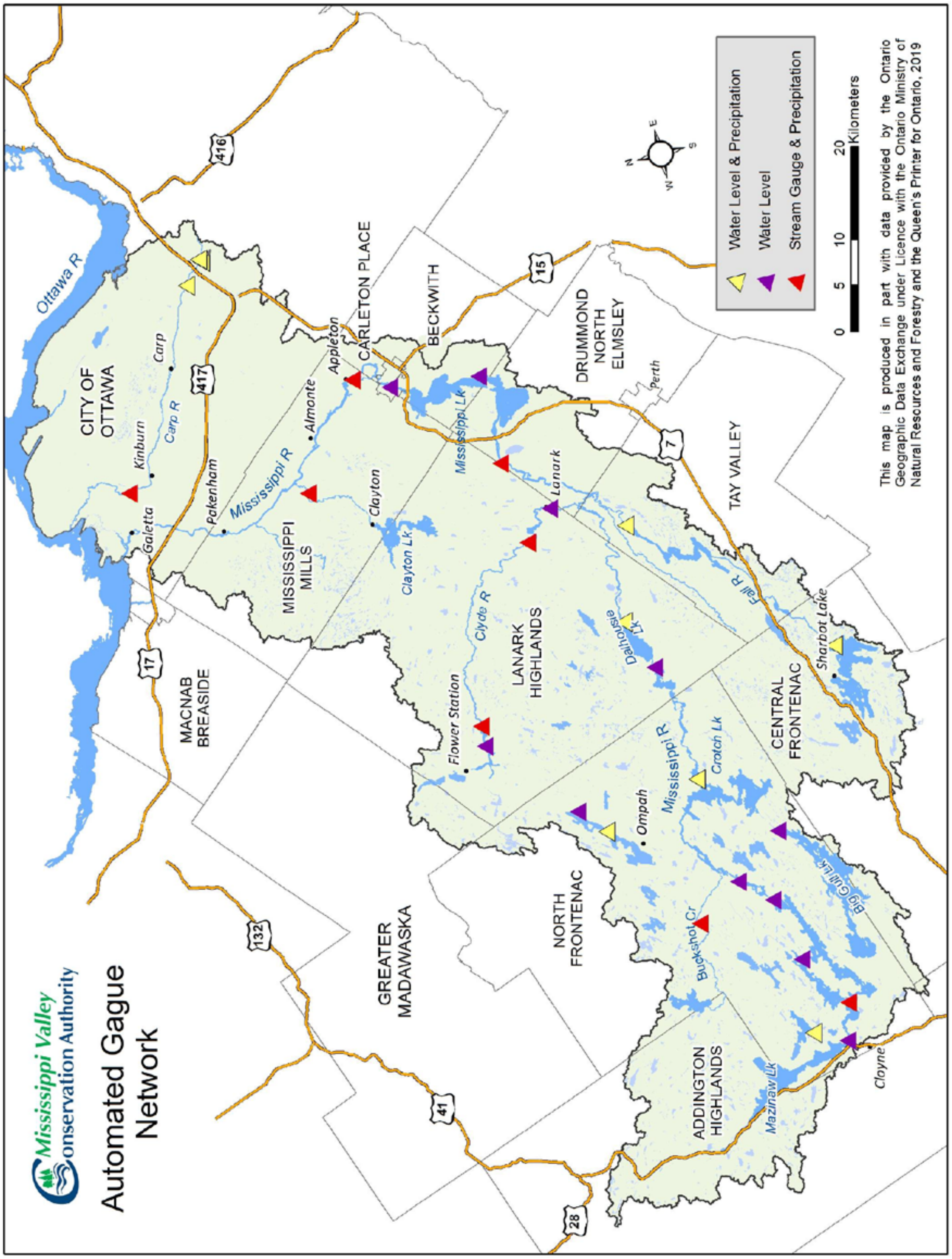

**Map 1 Mississippi River Watershed**

**MVCA MONITORING NETWORK**

Data for this report is collected by various methods including:

- automated lake level gauges which monitor and record hourly water level and water temperature data throughout the year.  Table 4 summarizes the gauges MVCA currently owns and operates.
- automated stream flow gauges which monitor and record hourly water levels and precipitation data throughout the year along the river.  These gauges have a stage-discharge rating table to convert the level to a flow in cubic meters per second (cms). These gauges are all accessed via GOES satelite.  Water Surveys of Canada (WSC), a department of Enviroment Canada, currently operates ten of these sites within this watershed, Table 5 provides a summary, including the length of record for each site.
- manual staff gauges to record lake levels at all MVC owned and operated dams, and other key locations across the watershed.  These gauges are normally read and recorded at least once a week.
- automated tipping buckets are located at all automated streamflow gauges as well as several automated lake level gauges. There is a mixture of heated and unheated gauges. There are 15 gauges located across the watershed which record hourly precipitation. (It should be noted that while MVCA rely heavily on the data from these sites for dam operations and flood forecasting, rainfall events can be very localized events and these gauges may or may not capture the maximum amounts to truly define each event. The tipping buckets themselves typically under record high intensity storm events. The data must be used in conjunction with the streamflow and lake level gauges to analyze runoff amounts).

Map 2 shows the gauging network of the Mississippi Valley Conservation Authority.




**Map 2 Mississippi Watershed Gauging Network**

## GENERAL OUTLINE OF HOW THE SYSTEM FUNCTIONS

### Fall Operations / Drawdown

All of the dams that are operable within the Mississippi river watershed have wooden stoplogs in them that are manipulated to raise and lower water levels.

**Photo 1 Stoplog description**


Every year several lakes across the watershed are drawn down in the fall to provide storage in the system to mitigate flooding that normally occurs from the following springs snowmelt and rainfall runoff. This is the only time the system is operated based on a date. The amount each lake is drawn down is fairly consistent but depends on existing conditions going into the fall, how much rainfall occurs throughout the fall, and when solid ice forms on the lakes. It should be noted that not all of the stoplogs are taken out of the dams in some cases. Table 4 summarizes the draw down dates and amounts for each of the lakes.

| Location | Start Date (approx..) | # Logs removed | Size of the stoplogs (m) | Approx. Starting Elevation | Winter Target Elevation |
|---|---|---|---|---|---|
| Shabomeka | Sept 15 | 6 of 8 | 0.25 x 0.25 x 2.44 | 271.00 m | 269.80 m |
| Mazinaw | Nov 7 | 8 of 14 | 0.25 x 0.30 x 3.96 | 267.80 m | 266.90 m |
| Kashwakamak | Oct 8 | 12 or 14 of 20 | 0.25 x 0.30 x 3.43 | 261.13 m | 259.80 m |
| Mississagagon | Oct 8 | 6 of 6 | 0.15 x 0.15 x 1.33 | 268.20 m | 267.70 m |
| Big Gull | Oct 8 | 8 of 12 | 0.20 x 0.30 x 2.34<br>0.20 x 0.30 x 2.90 | 253.40 m | 252.80 m |
| Pine | Sept 15 | 3 of 3 | 0.20 x 0.20 x 3.35 | 255.00 m | 254.65 m |
| Crotch Lake (summer) | July 1 | 12 to 16 of 16 | 0.30 x 0.30 x 3.89 | 240.00 m | 237.00 m |
| Crotch Lake (Winter) | Jan 15 | Varies depending on conditions | | 239.00 m to 240.00 m | 238.00 m to 237.00 m |
| Widow Lake | Oct 8 | 6 to 8 of 16 | 0.25 x 0.25 x 4.90 | 184.00 m | 184.00 m |
| C.P. Dam | Sept 15 | 10 to 20 of 48 | 0.25 x 0.25 x 4.73 | 134.00 m | 134.00 m |

**Table 4: Fall Drawdown**

Each of these lakes were part of the Mississippi River Water Management Plan and the operating guidelines were extensively reviewed over a 6 year period from 2002 to 2008, by all levels of government, the general public and the owners of the structures. That report is available on the MVCA's web site at www.mvc.on.ca. The outcome of that report however, clearly indicated that the current operating guidelines for these structures was the best solution to deal with all of the requirements the dams are now meant to deal with. Each dam has target ranges which operators strive to achieve but it is recognised that the source of water is not controlled and therefore these ranges are guidelines to be achieved as much as possible without adversely impacting conditions upstream or downstream as much as possible.

The release of water from these upper lakes in the fall results in the increase in water levels on the only true reservoir in the system, Crotch Lake. Crotch Lake dam is owned by OPG. As the fall draw down takes place, Crotch Lake will be built through the winter to an elevation somewhere between 239.00 m and 240.00 m, depending on fall conditions. Several discussions between OPG and MVCA staff over the course of the fall and early winter will determine how high the lake goes based on how much precipitation is received. Typically, all of the upper lakes have reached their minimum levels by early January and once that occurs, Crotch Lake is then utilized to maintain downstream flows from mid-January through to mid-March. In January, the 2 agencies review current conditions and set the target for how low Crotch Lake should be taken (between 238.00 m and 237.00 m) depending on current conditions and the dam is operated to reach that target. This is usually reviewed every week or two depending on how the winter unfolds.

**Spring Operations**

By mid-March, the system will have its maximum storage capacity for the spring runoff. Since the spring can occur at any time, there are no operating guidelines established for the dams from mid-March through to early May. Snow conditions can dictate when dams are begun to be operated, especially the headwater lakes or those with small drainage areas (Shabomeka, Mississagagon, Big Gull and Pine Lake dams). Years with minimal snow, these dams may be operated as early as March, despite ice conditions, to capture any runoff that might occur. Years with ample snow, the dams may not be operated until the ice is off or nearly off the lake depending on how quickly the runoff occurs.

Dams are operated for a variety of purposes during this period. Mazinaw Lake is generally not operated at all until levels peak and start to come down, then the dam is operated to maintain summer target levels. Flood mitigation is the number one priority, however, the dams are also operated for ice management (minimizing movement as flows increase, fisheries concerns (mainly walleye April to May, bass – May to June but other species as well), wildlife concerns (loon nesting, frogs, turtles etc), summer tourism and recreational requirements (stable levels within summer target range by long weekend of May), low flow augmentation, water quality and hydro generation.

**Summer Operations**

Once the flood is over, it is critical to replace the stoplogs as quickly as possible to mimic how flows are dropping naturally and getting the system ready for the summer. Usually by the end of May, the dams are closed off and are operated to maintain levels for tourism and recreation, mitigate flooding from summer storms, wild rice from June through September, low flow augmentation and hydro generation. The system is most vulnerable to summer floods in June as all reservoirs are full and the ground is usually still saturated. Extreme rainfall events at this time of year can cause significant flooding as was experienced in June 2002.

Over the course of the summer, the only dam that is operated regularly, is the Crotch Lake dam. The level on that lake will drop approximately 3 m over the course of the summer to maintain minimum flows downstream.

**LEAD-UP TO THE FLOOD – FALL / WINTER 2018 - 2019**

The late summer and early fall of 2018, the Mississippi Valley watershed was subject to a prolonged drought, which was originally identified in July 2018. The decision to keep the lakes at the top end of the fall drawdown range was made in late September. Fall drawdowns on the upper lakes all took place as they normally, historically have, just at a slower rate.

By late November, flows had returned to normal and the drought status was removed from the watershed. Table 5 shows the daily planning cycle output which indicates levels and flows were consistent with the historical averages for that time of year by early December.

By early January the threat of an extended drought still existed. Table 6 provides the snow course data for Jan 1 and the historical comparison.

**Table 5: Part of the Daily Planning Cycle report December 3, 2018**

| Daily Flows: Provisional Data | Flow | Historical Average |
|---|---|---|
| **Stream Gauge Location** | **Cm/s** | **3-Dec** |
| Mississippi River at Myers Cave | 9.92 | 9.93 |
| Buckshot Creek near Plevna | 2.25 | 2.64 |
| Clyde River near Gordon Rapids | 4.49 | 3.46 |
| Clyde River near Lanark (Herron's Mills) | 8.56 | 8.47 |
| Mississippi River at Fergusons Falls | 29.71 | 34.3 |
| Mississippi River at Appleton | 38.36 | 35.5 |
| Indian River near Mill of Kintail | 2.29 | 2.18 |
| Carp River near Kinburn | 11.36 | 3.76 |
| Fall River at Bennett Lake outlet | 3.84 | - |
| Mississippi River at Dalhousie Lake outlet | 13.56 | - |
| Mississippi River at High Falls GS | 12.20 | 16.08 |
| **Daily Water Levels: Provisional Data** | **Level** | **Historical Average** |
| **Lake Gauge Location** | **Meters asl** | **3-Dec** |
| Shabomeka Lake (Semi Circle Creek) ** After completion of MRWMP new target level 269.80 m | 269.91 | 269.57 |
| Mazinaw Lake (Mississippi River) | 267.69 | 267.5 |
| Kashwakamak Lake (Mississippi River) | 260.24 | 260.22 |
| Farm Lake (Mississippi River) | 247.95 | 248.03 |
| Mississagagon Lake (Swamp Creek / Buckshot Creek) | 267.81 | 267.78 |
| Big Gull Lake (Big Gull Creek) | 252.86 | 252.83 |
| Crotch Lake (Mississippi River) | 239.54 | 238.63 |
| High Falls GS forebay (Mississippi River) | 187.42 | 187.44 |
| Dalhousie Lake (Mississippi River) | 156.44 | 156.45 |
| Palmerston Lake (Sunday Creek / Clyde River) | 271.95 | 271.83 |
| Canonto Lake (Sunday Creek / Clyde River) | 268.35 | 268.24 |
| Widow Lake (Clyde River) | 184.17 | 184.19 |
| Lanark (Clyde River) | 144.22 | 144.15 |
| Sharbot Lake (Fall River) | 191.79 | 191.79 |
| Bennett Lake (Fall River) | 153.15 | 153.07 |
| Mississippi Lake (Mississippi River) | 134.15 | 134.18 |
| C.P. Dam (Mississippi River) | 134.14 | 134.12 |

**Table 6 January 1, 2019 snow course data**

| Snow Course Locations | Date | Depth (cm) | WATER EQUIVALENT (WE) (mm) | Historical Depth / WE |
|---|---|---|---|---|
| Ardoch | 2-Jan-19 | 8.2 | 41 | 17.4 / 33 |
| Bon Echo Park | 2-Jan-19 | 15.6 | 65 | 27.6 / 52.4 |
| Mackavoy Lake | 2-Jan-19 | 19.9 | 74 | 27.3 / 50.1 |
| Buckshot Lake | 2-Jan-19 | 15.3 | 60 | 26.8 / 51.0 |
| Canonto Lake | 2-Jan-19 | 10.8 | 54 | 22.2 / 39.6 |
| Lavant | 3-Jan-19 | 13.2 | 39 | 20.7 / 41.2 |
| Gordon Rapids | 2-Jan-19 | 15.0 | 68 | 22.4 / 44.6 |
| Brightside | 2-Jan-19 | 12.6 | 60 | 25.5 / 54.0 |
| Fallbrook | 2-Jan-19 | 5.1 | 26 | 21.1 / 38.0 |
| Snow Road | 2-Jan-19 | 8.4 | 39 | 19.1 / 38.1 |
| Maberley | 2-Jan-19 | 1.8 | 17 | 20.2 / 41.3 |
| Innisville | 2-Jan-19 | 1.5 | 11 | 18.4 / 36.1 |
| Kinburn | 2-Jan-19 | 4.7 | 21 | 21.0 / 40.6 |
| Blakeney | 2-Jan-19 | 8.6 | 32 | 23.5 / 47.6 |

**THE UPPER WATERSHED**

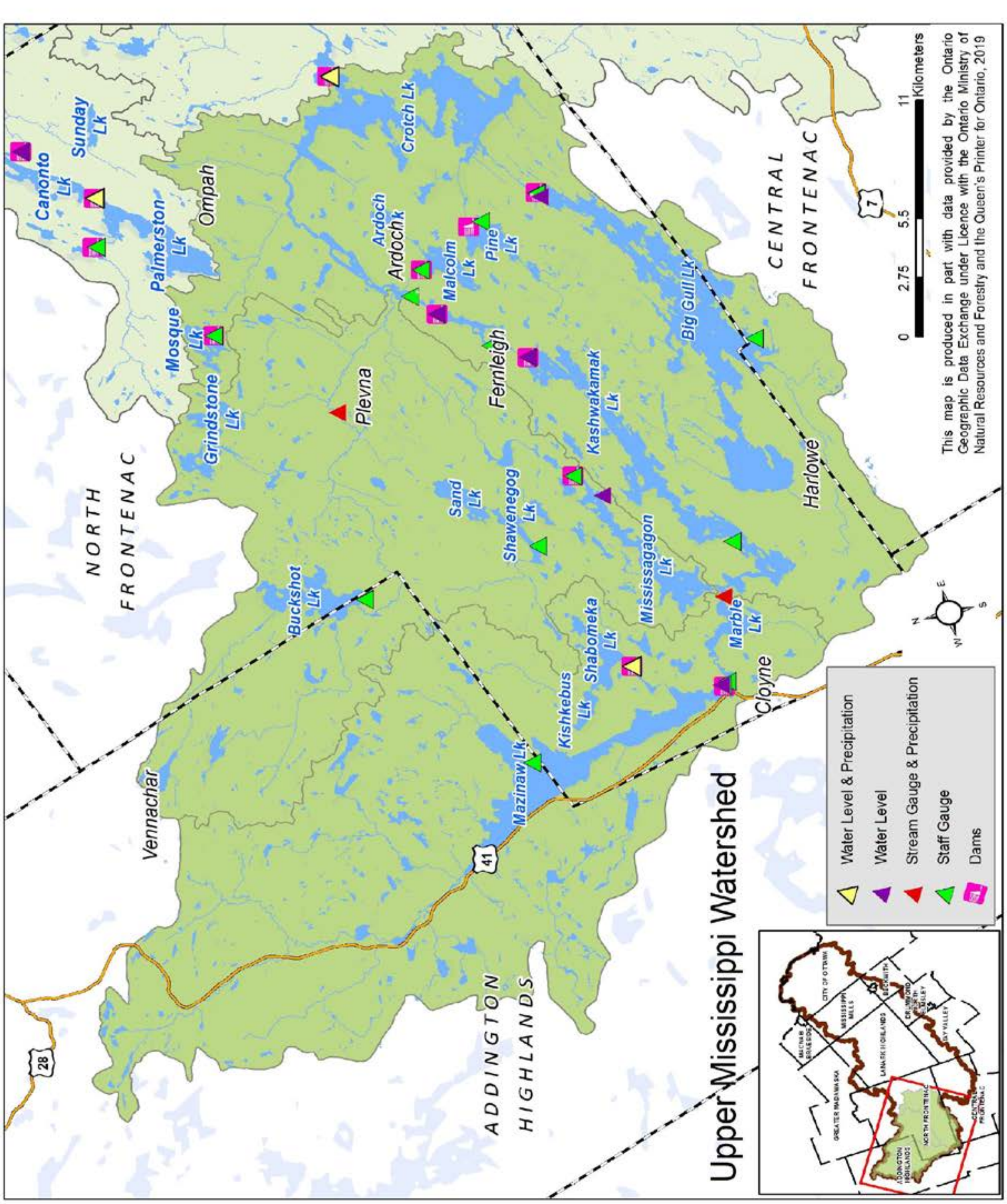
The upper watershed contains the bulk of the usable storage within the Mississippi River system (See Table 7). For the purpose of this report, it is defined as the drainage area above the Crotch Lake Dam. There are numerous swamps, creeks, unnamed streams and lakes in this area and it is totally in the Precambrian shield. There are 10 dams within this part of the watershed which MVCA owns and /or operates. They are:

1. Shabomeka Lake Dam
2. Mazinaw Lake Dam
3. Kashwakamak Lake Dam
4. Farm Lake Dam (weir, not included in this report)
5. Mississagagon Lake Dam
6. Malcolm Lake Dam
7. Pine Lake Dam
8. Big Gull Lake Dam
9. Mosque Lake Dam (weir, not included in this report)
10. Crotch Lake Dam

**Table 7 Physical Characteristics of Upper Lakes**

| Location | Surface Area (ha) | Drainage Area (sq km) | Total Storage[1] (ha m) | Usable Storage[4] (ha m) | Elevation of Deck or Weir |
|---|---|---|---|---|---|
| Shabomeka | 270 | 41 | 536 | 402 | 271. 67 (271.45)[2] |
| Mazinaw | 1590 | 339 | 3423 | 1793 | 269.00 (268.20)[3] |
| Kashwakamak | 1191 | 417 | 3822 | 1911 | 262.26 (261.06) , (261.67)[3] |
| Farm | 120 | 428 | n.a | n.a | 247.50 |
| Mississagagon | 524 | 22 | 491 | 382 | 268.45 (268.42) |
| Malcolm | 224 | 18.7 | 170 | 170 | 253.97 |
| Pine | 194 | 15.3 | 81 | 81 | 255.64 |
| Big Gull | 2360 | 135 | 3048 | 1524 | 254.76 (253.66) , (254.47)[3] |
| Crotch | 2160 | 1030 | 7617 | 5859 | 241.67 (240.00) |

1. Total storage based on height of stoplogs times surface area of the lake. Big Gull is influenced by the channel above the dam and are based on number of logs which impact water levels on the lake.
2. Elevation of top of embankment.
3. Elevation of emergency spill way.
4. Usable storage refers to the actual operating range currently in place (maximum of summer target range to minimum fall level), not maximum spring level to sill elevation of structure.
5. n.a – means not applicable.




**Map 3 Upper Mississippi Watershed**

**SHABOMEKA LAKE DAM**

Shabomeka Lake Dam is owned and operated by MVCA. It is an earth embankment structure with a single concrete control section containing 8 stoplogs. The stoplogs are 0.25 x 0.25 x 2.44 m (10” x 12” x 8’-0”) in size. The total drainage area above the dam is 41 sq. km. The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. maintain summer water levels for tourism and recreation,
3. lake trout spawning, other fisheries and wildlife
4. low flow augmentation.

***It is critical that due to the nature of the dam being an earth embankment structure, that water levels do not exceed the crest of the structure (271.45 m). This could lead to failure of one or both embankments.***

In the fall the dam was operated to maintain water levels at the desired target level of 269.80 m. The normal winter setting is for 2 logs to remain in the dam and while the setting fluctuated between 2 and 3 throughout the fall, by January 1st the level was set at 2 logs in a remained that way throughout the winter.

Flooding in 2019 was not a significant issue on this lake although the operation of the lake was unusual. As a headwater lake and a storage lake, the dam is usually operated in the spring to capture runoff from the snowmelt and any rainfall events to reduce downstream flooding. As with most lakes in the upper watershed, very little operation took place prior to the spring peak.

As the runoff began, two logs were replaced four days apart in mid-April as it appeared the snow was beginning to disappear. With significant ice on the lake and still believed to be significant water content in the snow in the bush the decision was made to gradually refill the lake until the snow was completely gone and or the ice was crystalized so if it did move with the wind, shoreline damage would be minimal. On April 11th, the 2nd log was put in (bringing the total to 5 of 8 logs in the dam), the level on the lake was 270.00 m, leaving one meter of storage remaining in the lake that would need to be filled between then and the long weekend in May. As this is a lake trout lake, fisheries concerns were not an issue.

A significant set of storms hit this part of the watershed between April 14th and April 20th, with approximately 80 mm of rainfall recorded at the gauge on the dam over that period. That resulted in the lake exceeding the summer target range and requiring a log be removed from the dam to prevent levels from overtopping the earth embankment. Due to the magnitude of flooding that was occurring downstream, operations at this structure would only be required to maintain the levels below the crest of the weir.

Levels on the lake peaked at 271.28 m on April 22nd. (It is interesting to note that from April 19 at 0600 to April 21 at 0600, Shabomeka Lake rose 0.47 m with no log operation undertaken while Mazinaw Lake rose 0.53 m with 3 logs removed from the dam and water flowing down the bypass channel).

As flows began to recede, logs were replaced in the dam to maintain summer levels and assist in reducing downstream flooding. All logs were back in the dam by May 29th and water levels have been within the summer target range of 271.10 m to 270.90 m since April 26th.



PHOTO 2 SHABOMEKA DAM

PHOTO 3 - SHABOMEKA DAM DOWNSTREAM

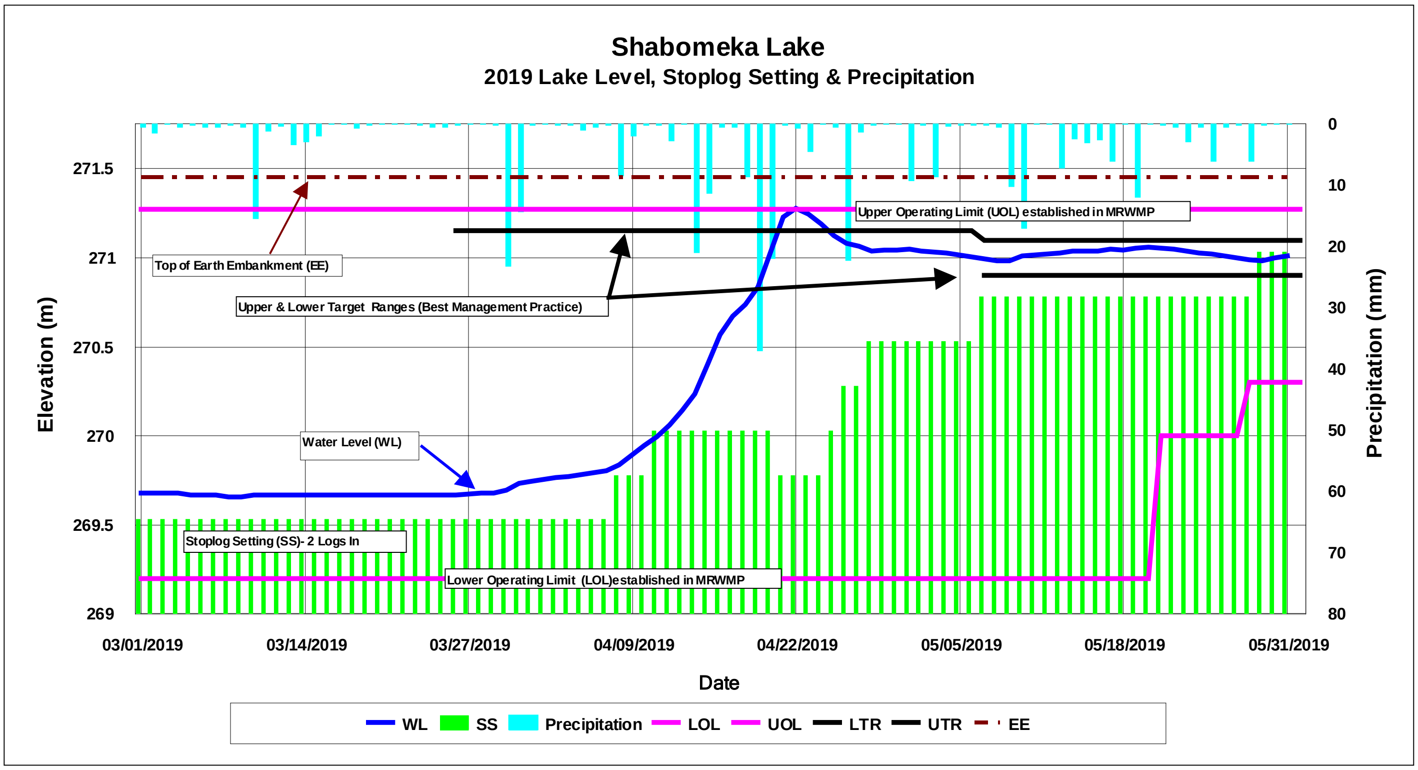



**Figure 3- Shabomeka Lake hydrograph**

**MAZINAW LAKE DAM**

Mazinaw Lake dam is owned and operated by MVCA. It is a concrete structure with two control sections containing seven 0.25 x 0.30 x 3.95 m (10” x 12” x 13’-0”) stoplogs in each bay. The dam has a bypass channel which is designed to be overtopped under high flow conditions. ***The best management operations require to avoid this situation for three reasons’ operators lose access to the control sections, overtopping is associated with extreme flooding immediately downstream on Little Marble and Marble Lakes, and potential erosion and structure stability issues become a concern.*** The total drainage area above the dam is 339 sq. km. The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. maintain summer water levels for tourism and recreation,
3. lake trout spawning, other fisheries and wildlife
4. low flow augmentation.

The fall draw down on Mazinaw Lake proceeded as it historically has with the 1st logs being removed from the dam mid-November (2 logs had already been removed from the dam to maintain levels within the target range). The fall log setting of 8 logs out of the dam was completed on the 17th of December, leaving a total of 6 logs still in the dam. In early March, based on above average snow water equivalent conditions in the upper watershed, an additional log was removed from the dam to create some additional storage for runoff.

Water levels on the lake slowly increased as runoff from snowmelt began to be observed over the first two weeks of April. Prior to the Easter weekend, levels on the lake had just reached the summer target levels. With significant rainfall in the forecast for late Good Friday and all day Easter Saturday, an additional log was pulled from the dam. Significantly more runoff occurred than was expected and levels on the lake rose almost 30 cm overnight. Although guidelines suggest that only one log be pulled from Mazinaw Lake dam in a 24 hour period, inflows dictated that 2 more logs be pulled from the dam on Saturday, leaving only two logs in the dam, one in each bay.

This was the first time since the dam was rebuilt in 1992 that only two logs remained in the dam. Despite the removal of those logs, water levels continued to increase throughout the night and had increased an additional 0.26 m, bringing the lake level to 268.47 m. Water was now 27 cm over the crest of the bypass channel and levels were still increasing. Crews were dispatched to remove the remaining two logs in the dam as erosion was beginning to be evident to the crest of the emergency overflow bypass. Due to debris in the eye of one of the logs, only one additional log was able to be removed, leaving one log in the dam.

The lake peaked at 268.59 m on April 22. By the long weekend in May, levels had returned to within the target range although not all of the logs have been replaced in the dam. MVCA staff inspected the dam shortly after the peak and also had a consultant inspect the structure to ensure that the erosion which occurred at the dam did not affect the stability of the dam to replace the stoplogs to maintain summer levels. It is expected that the erosion will be repaired by the end of August, 2019.

**PHOTO 4 – MAZINAW LAKE DAM BYPASS APRIL 20**


**PHOTO 5 –MAZINAW LAKE DAM APRIL 20**

**PHOTO 6 – MAZINAW LAKE DAM APRIL 21**

**PHOTO 7 – MAZINAW LAKE DAM UPSTREAM CHANNEL**


**Photo 8 – Mazinaw Lake Dam Upstream View**

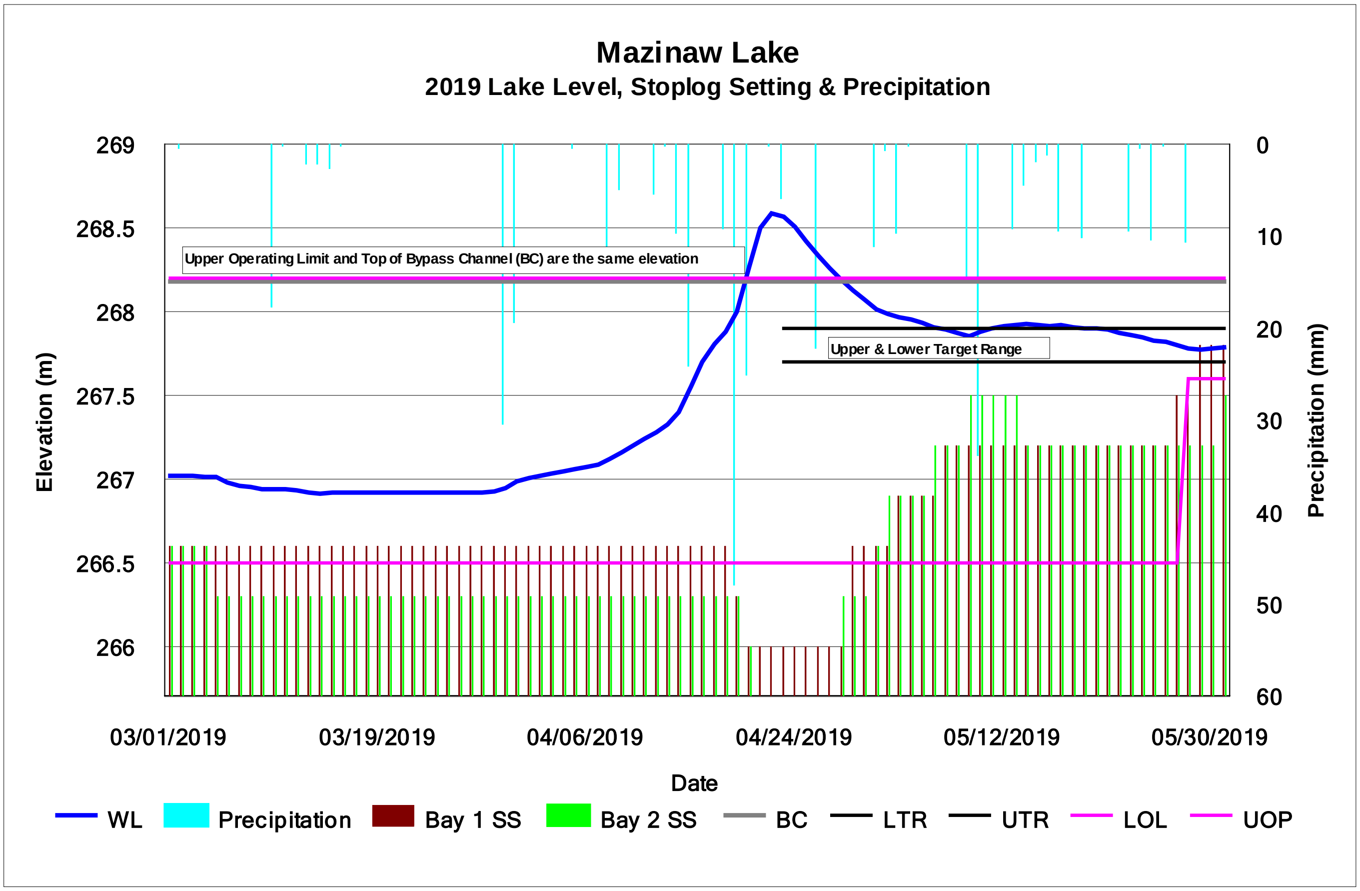



**Figure 4 - Mazinaw Lake dam hydrograph**

**LITTLE MARBLE LAKE**

Located immediately below the Mazinaw Lake dam, this small lake is highly susceptible to flooding when flows increase, necessitating the removal of stoplogs from the dam. As such, MVCA adopted a strategy when they assumed ownership of the dam in the early 1990's to only remove one stoplog per day if conditions on Mazinaw Lake permitted this.

The outflows from Mazinaw Lake at its peak exceeded the top of the staff gauge by a considerable amount, estimated at approximately 0.80 m . Although there is very little documentation of levels on this lake, those observed in 2019 are believed to be the highest since 1992 when MVCA took over the ownership and operation of the dam and the new structure was completed.



**Photo 9 – Little Marble Lake flooding April 21** **Photo 10 – Little Marble Lake flooding April 23**

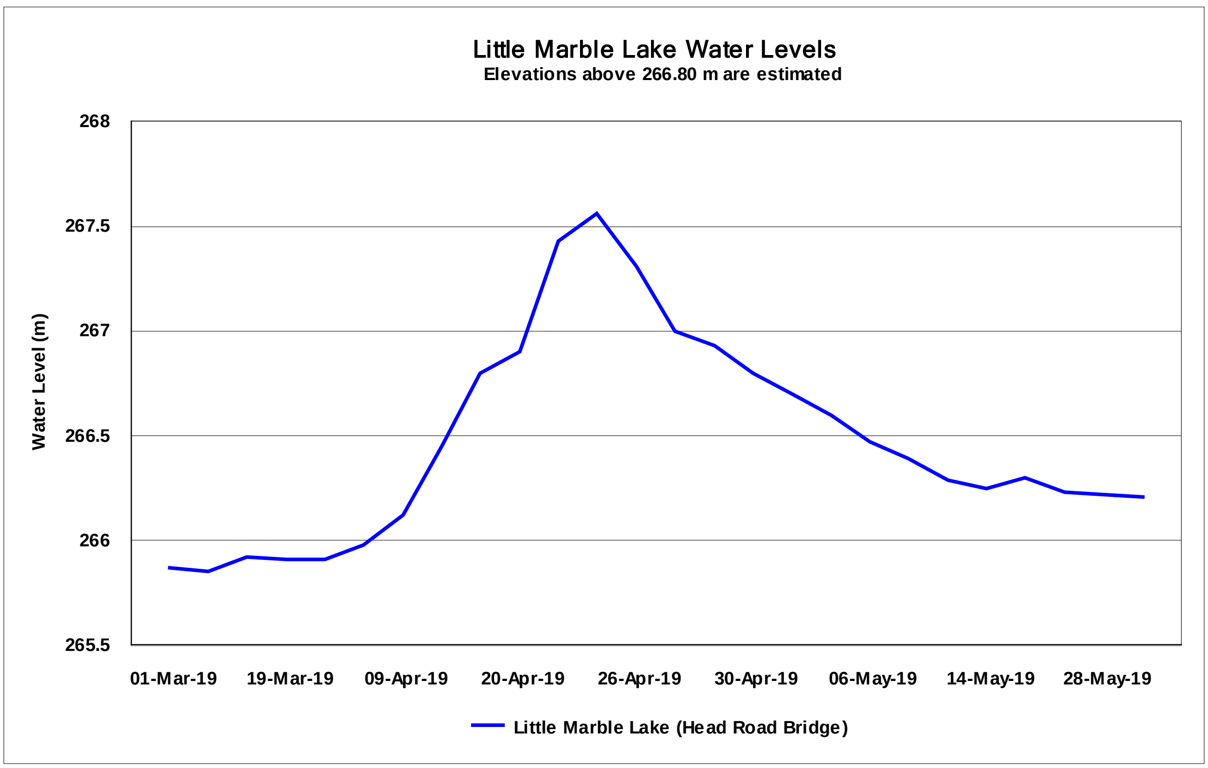



**Figure 5 - Water Levels obtained from the staff gauge mounted on Head Road Bridge.**

**MISSISSIPPI RIVER AT MYERS CAVE**

The Myers Cave stream gauge was installed at the outlet of Marble Lake in 1987. The average spring flow recorded at Myers Cave in the 30 years of record is 26.1 cubic meters per second (cms) with the highest flow recorded prior to 2019 on June 19, 2002 at 50.9 cms. The peak instantaneous flow recorded in 2019 occurred on April 23, at 0400 am at 62.872 cms, the peak daily flow was 62.244 cms on April 23.

The streamflows shown in the following table are not the official record produced by WSC but are considered accurate by MVCA.

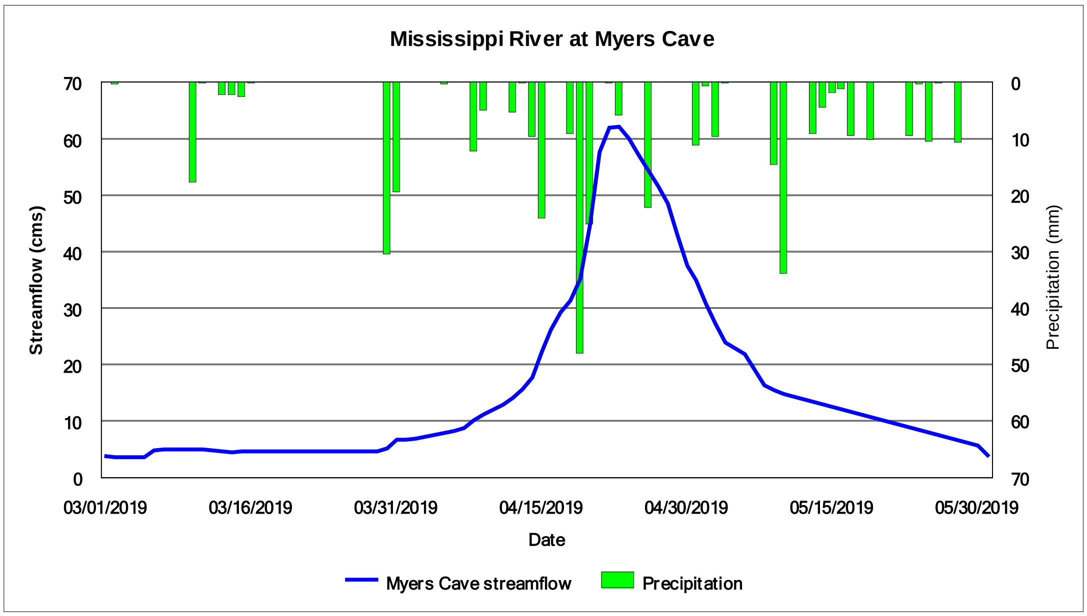



**Figure 6 - 24 hour average data for streamflow and total for precipitation**


**Photo 11 – Myers Cave Stream gauge on Mississippi River, April 21, 2019**

**KASHWAKAMAK LAKE DAM**

Kashwakamak Lake dam is owned and operated by MVCA. It is a concrete structure with two control sections containing ten 0.25 x 0.30 x 3.43 m (10" x 12" x 11'-3") stoplogs in each bay. The dam has a 16.8 m long overflow weir at an elevation of 261.06 m. There is also a side block emergency overflow weir (elevation 261.67 m) associated with this structure. The total drainage area above the dam is 417 sq. km. The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure
2. maintain summer water levels for tourism and recreation
3. walleye and bass spawning, other fisheries and wildlife
4. low flow augmentation

The fall drawdown of Kashwakamak Lake Dam proceeded as usual, beginning immediately after the Thanksgiving weekend and concluding the middle of November with 8 logs out of the total of 20 (4 in each bay) remaining in the dam. Historically, the winter setting is either 6 or 8 logs remaining in the dam. An additional log was pulled from the dam in December to bring levels into the target range for the winter prior to freeze-up. The setting remained that way through most of the winter, but one more log was pulled in mid-March due to the amount of water content in the snow that existed across the watershed.

As runoff begins, the dam is usually operated to store the runoff to meet summer target levels and mitigate downstream flooding. On April 15, with a water level of 260.22 m (roughly one m below the summer target level), two logs were replaced in the dam as flooding began downstream. The lake still had a solid ice covering which required consideration in refilling the lake.

As severe flooding began occurring both upstream and downstream of this structure, no opportunity existed for further log operations to mitigate downstream flooding. By April 23, levels had increased on the lake to 261.40 m and were still building from increased outflows out of Mazinaw Lake. Despite downstream conditions, it was deemed necessary to remove a log from the dam to try to slow down the rate of rise on the lake. Only one log was taken out to minimize the impact of increased flows downstream (to Farm Lake, the village of Ardoch and on Crotch Lake which was still building quickly). The 2$^{nd}$ log that had been replaced on the 15$^{th}$ was pulled the next day as levels continued to increase, now sitting at 261.48 m (roughly 25 cm over the summer target level). No further logs were removed from the dam and the lake peaked at 261.50 m on April 26, surpassing the previous high of 261.42 m in June 2002.

As flows began to recede it is important to replace them as quickly as possible to mimic the natural drop in runoff from the rainfall events and help reduce downstream flooding. Stoplogs began to be replaced in early May as levels approached the summer target range. A mid-May rainfall event caused levels to increase again and it wasn't until May 20$^{th}$ that levels were back in the target range. All of the stoplogs did not get back into the dam until mid-June.

Photo 12 - Kashwakamak Lake Dam

Photo 13 Kashwakamak Lake Dam Weir

Photo 14 – Debris caught in Kashwakamak Lake Boom

Photo 15 Kashwakamak Lake Dam Side Block Dam

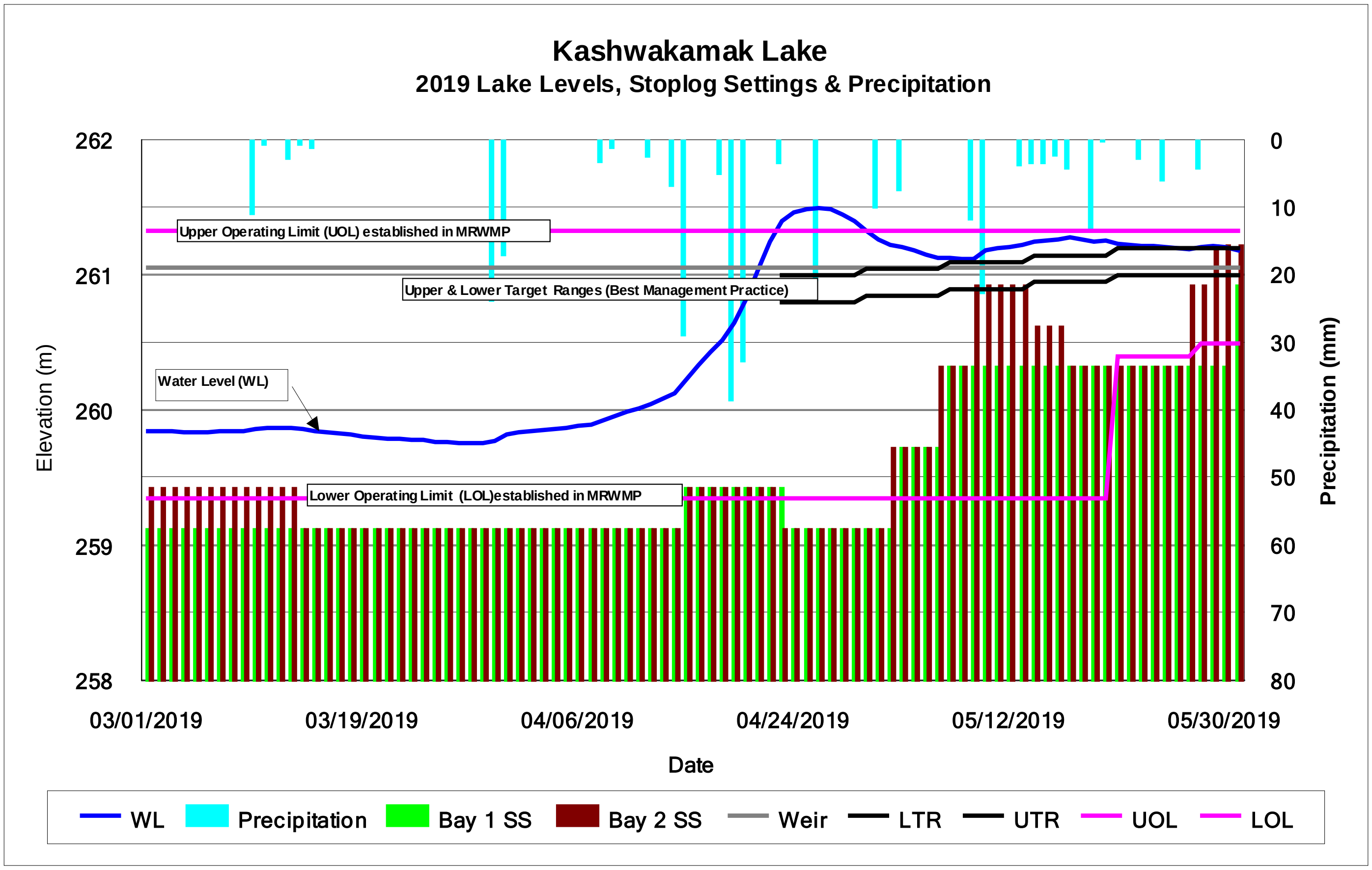



**Figure 7 - Kashwakamak Lake dam hydrograph**

**BIG GULL LAKE DAM**

Big Gull Lake dam is owned and operated by MVCA. It is a concrete structure with two control sections containing five 0.20 x 0.30 x 2.29 m (8" x 12" x 7'-8") and seven 0.20 x 0.30 x 2.90 m (8" x 12" x 9'-6") stoplogs in the south and north bays respectively. The dam has a 7 m long concrete weir with an elevation of 253.66 m. The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. maintain summer water levels for tourism and recreation,
3. walleye and bass spawning, other fisheries and wildlife
4. low flow augmentation.

This is a very large lake (surface area of 2360 ha) with a relatively small drainage area (135 sq. km.) making it complex in how the dam is operated. There are also two walleye spawning beds that are affected by the spring operation of this dam, one below the dam where Gull Creek flows into Crotch Lake and the other just upstream of the dam. Runoff in the spring must be captured to meet summer target levels and maintain static or building levels over the upstream spawning beds but also must be released to maintain flow and levels on the downstream beds.

Big Gull Lake draw down takes place immediately after the Thanksgiving weekend.

Despite the drought through the summer of 2018, Gull Lake maintained fairly stable levels and the drawdown on the lake commenced as it normally would. By early November the winter stoplog setting of one log in Bay 1 and 3 logs in Bay 2 and levels were consistent with the historical average by the end of the year.

No operations took place through the winter. By the end of the first week of April, the snow in this part of the watershed was beginning to disappear, some runoff was occurring but also significant loss through sublimation appeared to be occurring. Despite the lake still having a complete ice cover, the decision to operate the dam to capture that runoff was made. Between April 1 and April 15, six of the eight stoplogs out of the dam had been replaced. The lake level was 253.25 m, still 15 cm below the summer target level of 253.40 m and the majority of the snow had disappeared from this sub watershed.

Over the course of the next two weeks, the lake built to 253.70 m. Due to the magnitude of flooding that was occurring downstream, no logs were taken out of this structure during that period. On April 30, once the peak had occurred on Dalhousie and the rate of rise on Crotch Lake had diminished, 2 logs were removed from the dam to stabilize levels on the lake. With flood levels subsiding downstream, 2 additional logs were removed from the dam on May 13 to bring water levels back within the target range for the dam. Due to the significant outflows from the structure, the high water on Crotch Lake and Big Gull Lake, there were no fisheries issues upstream or downstream of the dam this year. The 2019 peak level of 253.70 m was slightly below the previous high established in May, 2017 of 253.73 m.

As this is a headwater lake with very little inflow, it is critical to close off the dam as quickly as possible to maintain summer levels. As soon as levels approached the upper limits of the summer target operating range, logs began to be replaced. Due to a significant amount of debris getting caught in the logs as they were being replaced, one bay in the dam was stripped on 2 separate occasions before a good seal was achieved with minimal seepage. Water levels reached the summer operating range on May 23rd and all of the stoplogs were finally replaced in the dam on June 1st.



**Photo 16 - Big Gull Lake Dam**

**Photo 17 - Big Gull Lake Dam Upstream Channel**

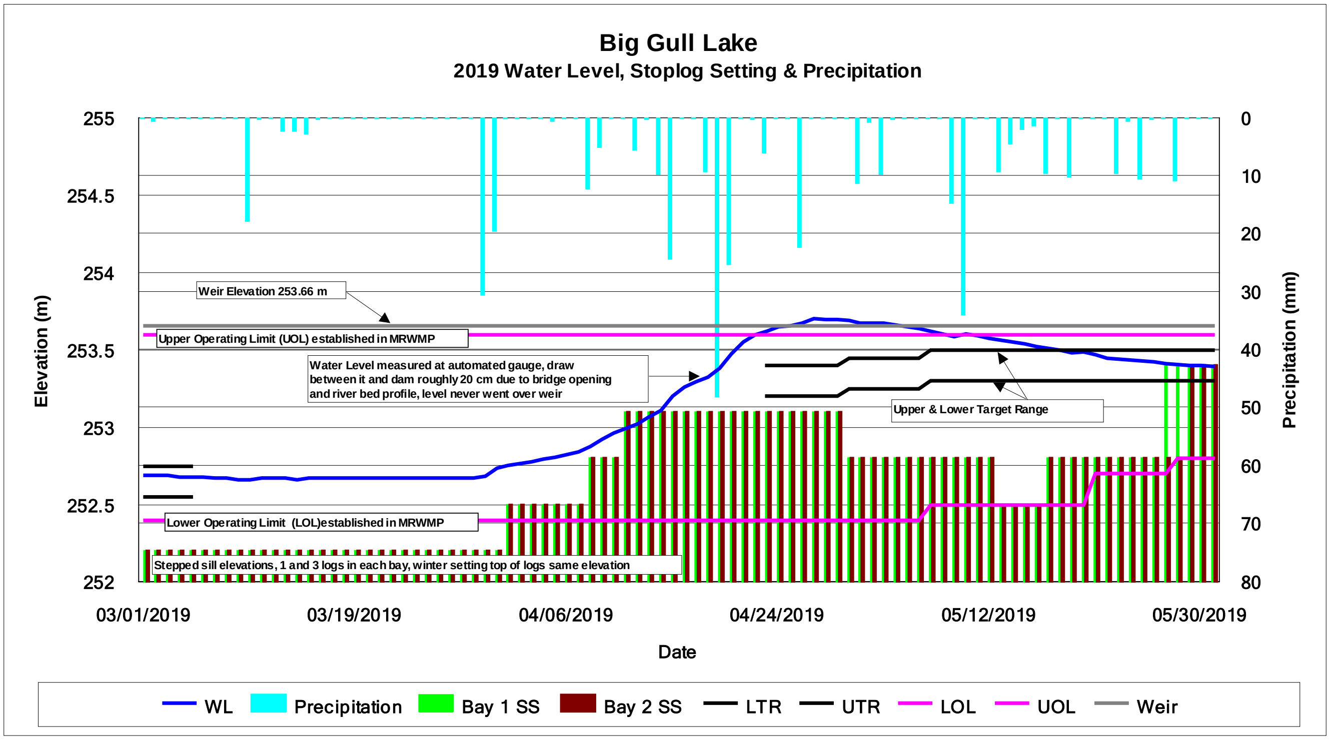



**Figure 8 – Big Gull Lake dam hydrograph**

**PINE LAKE DAM**

Pine Lake dam is owned and operated by MVCA. It is a rock filled timber crib structure with a single control section containing three 0.20 x 0.20 x 3.35 m (8" x 8" x 11'-0") stoplogs in the bay. The stoplogs are bolted together and act as one log. The total drainage area above the dam is 15.3 sq. km. The primary purpose of this structure is to maintain summer water levels for tourism and recreation. There is a significant walleye fishery on the lake. The dam is drawn down in the fall occurs around September 15 to clean of the spawning beds prior to freeze up.

The logs are not put back in until the spring peak is over and levels begin to recede. This structure has historically been prone to vandalism. Water levels on Pine Lake were extremely high despite no logs in the dam. Since water levels are only obtained off a staff gauge (instantaneous reading) on a weekly basis, it is impossible to ascertain if this year's level reached or exceeded the highest ever on the lake but it matched (or was extremely close) those recorded in 1998, 2002, and 2017 at 255.25 m. An automated gauge collecting hourly data was installed at the dam in 2019.


**Photo 18 - Pine Lake Dam**


**Photo 19 - Pine Lake Dam Upstream**

There are usually only a few operations at this site due to its limited size and the drainage area of the lake.

**MALCOLM LAKE DAM**

Malcolm Lake Dam is owned by the Ontario Ministry of Natural Resources and Forestry in Bancroft and has been operated by MVCA since 1986. The dam is a concrete structure with a single control section containing three 0.20 x 0.30 x 4.27 m (10" x 12" x 14'-0") stoplogs. It has a 30 m overflow weir at an elevation of 253.06 m. The dam has a drainage area of 18.7 sq.km.

The dam is operated as a weir year round and only in very dry summers is a wedge placed between the top two of three stoplogs to maintain some flow in the creek when levels drop below the top of the weir. The highest observed level in 2019 was on April 23rd, lake level was 253.22 m. Water levels have historically only been collected on a weekly basis at this location but an automated gauge was installed on the dam in 2019 to collect hourly water level data. There were no issues with this structure in 2019.

**Photo 20 - Malcolm Lake Dam**

**Photo 21 - View from Downstream**

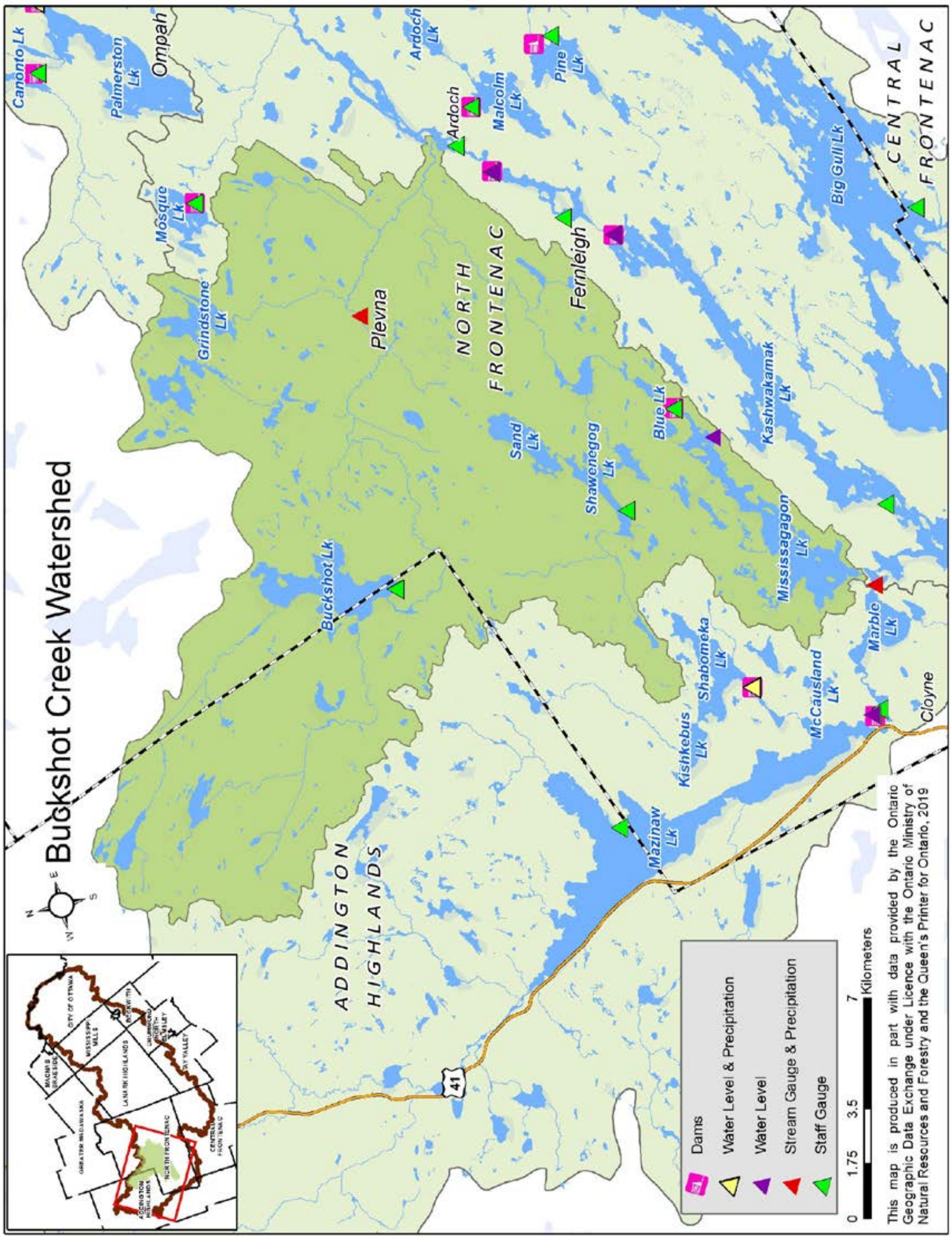
**BUCKSHOT CREEK SUB-WATERSHED**

Buckshot Creek is the largest uncontrolled sub-watershed in the Upper sub-watershed of the Mississippi River system. Two headwater lakes (Finch on Buckshot Creek and Browns on Browns Creek) feed into Buckshot Lake which is the largest lake within this basin. The watershed is dominated by the Canadian Shield and scrub brush with the largest community being Plevna. Swamp Creek is the largest tributary of Buckshot Creek and contains the only water control structure being the Mississagagon Lake Dam. The total drainage area of Buckshot Creek is 309 square kilometres.

**BUCKSHOT LAKE**

One of two control lakes included in this report, MVCA records water levels on a weekly basis on this uncontrolled headwater lake within the Buckshot Creek watershed. Buckshot Lake is a relatively large lake with a moderately size drainage area and is also a deep lake, one of the few remaining lakes within the Mississippi River basin still sustaining a natural lake trout population. The highest recorded level in

2019 was 292.33 m but that was the only recorded value between April 15 and May 7 so it is unlikely that was the highest elevation on the lake. The ice was not observed to be off the lake until the 1st week of May.




**Map 4 Buckshot Creek Sub - Watershed**

**BUCKSHOT CREEK STREAM GAUGE**

Located on Buckshot Creek downstream of the Village of Plevna, this gauge measures the predominantly uncontrolled flows of the Buckshot Creek watershed. The gauging equipment is similar to the equipment in the Myers Cave gauging station. This gauge was installed in 1992 and operational in 1993 as a seasonal gauge. In 1996 it was changed to a year round station. The previous record peak flow was established in April 1998 at 32.5 cms. The peak flow recorded in 2019 was 38.9 cms however, the flow was likely higher than that because the road immediately downstream of the gauge was overtopped making the control for the gauge under those conditions questionable.

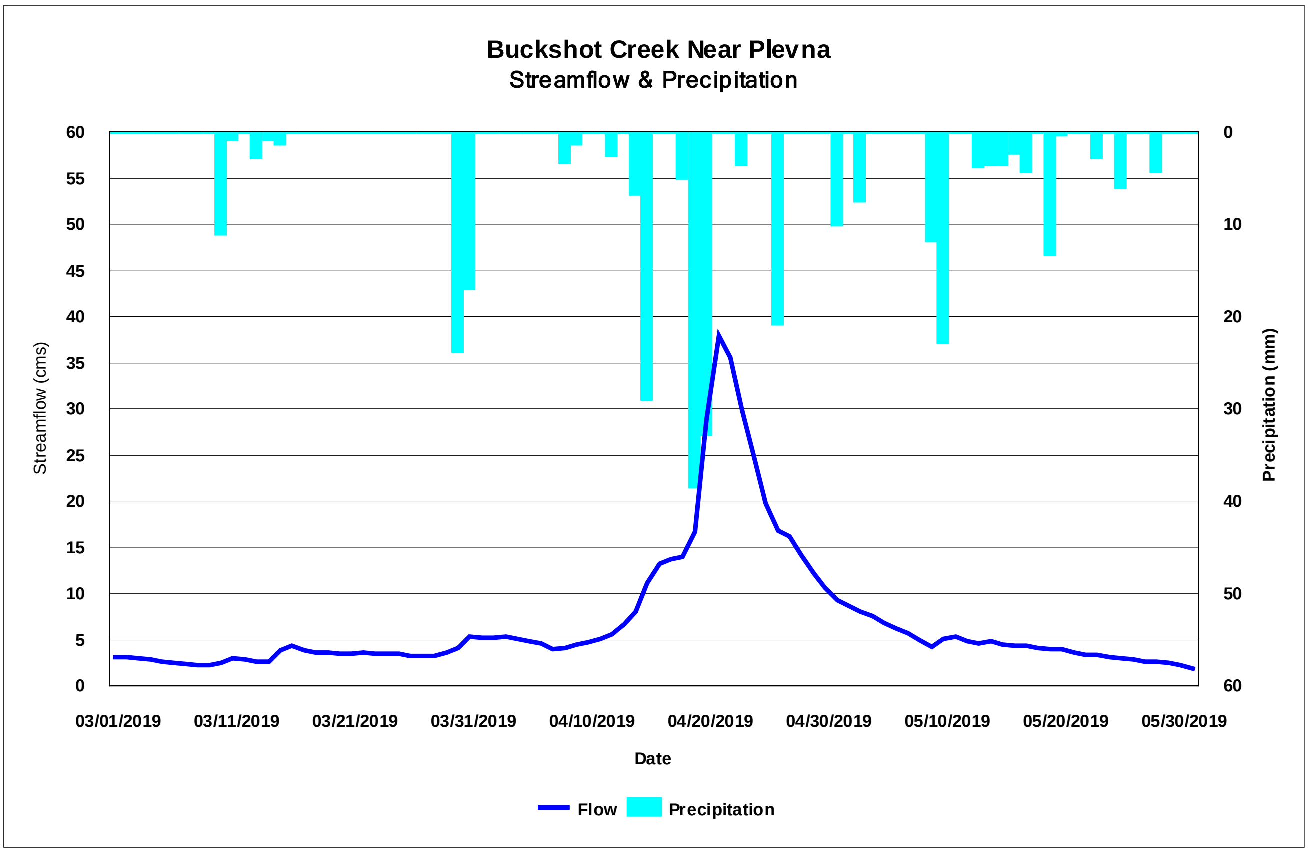



**Figure 1 – Buckshot Creek stream gauge**

**MISSISSAGAGON LAKE DAM**

Mississagagon Lake dam is owned and operated by MVCA. It is a rock filled concrete capped timber crib weir structure with a single control section containing six 0.15 x 0.15 x 1.33 m (6” x 6” x 4’-4”) stoplogs in the bay. The elevation of the top of the weir is 268.42 m. The dam has a drainage area of 22 sq km.

The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. maintain summer water levels for tourism and recreation,
3. walleye spawning, other fisheries and wildlife
4. low flow augmentation.

Considered a headwater lake within the Buckshot Creek sub-watershed, Mississagagon Lake Dam is a small structure at the upper end of Swamp Creek. It‘s small drainage area makes it critical that spring runoff be captured to fill the lake for the summer season. It has historically been a very significant walleye lake, therefore keeping levels building or stable through the spawning season is also a key consideration in the operation of the dam. Typical operations are done by manipulating two logs in whatever fashion is required. The fall drawdown historically begins immediately after the Thanksgiving weekend and the fall of 2018 was no different with 2 logs being taken out on October 9 and over the course of the next two weeks the remaining logs being pulled out. The normal winter setting is for all the logs to be out of the dam.

In early April of 2019, as the snowmelt began and runoff began to be observed, stoplogs began to be replaced. The lake was still completely covered in ice so the rate to replace logs tempered to give the ice a chance to thin, thereby reducing potential shoreline damage. With snow courses and visual observations showing that a significant amount of the snow pack had disappeared and ice conditions appeared to be crystalizing, the remainder of the stoplogs were replaced in the dam. The elevation of the lake at that time was 267.87 m with the summer target level being 268.20 m.

Levels steadily climbed through April but no log operations were done until after the system downstream had peaked. By April 30, the lake had reached 268.50 m and two logs were pulled from the dam to stabilize levels. On May 13, 2 additional logs were pulled in an effort to get levels back within the target range. The previous high water mark for this lake was reached in June 2002 and again in May 2017, reaching an elevation of 268.42 m.

By the end of May all of the logs were back in the dam and levels were within the summer operating target range.

**Photo 22 – Mississagagon Lake Dam**

**Photo 23 - Deck of Dam almost underwater**

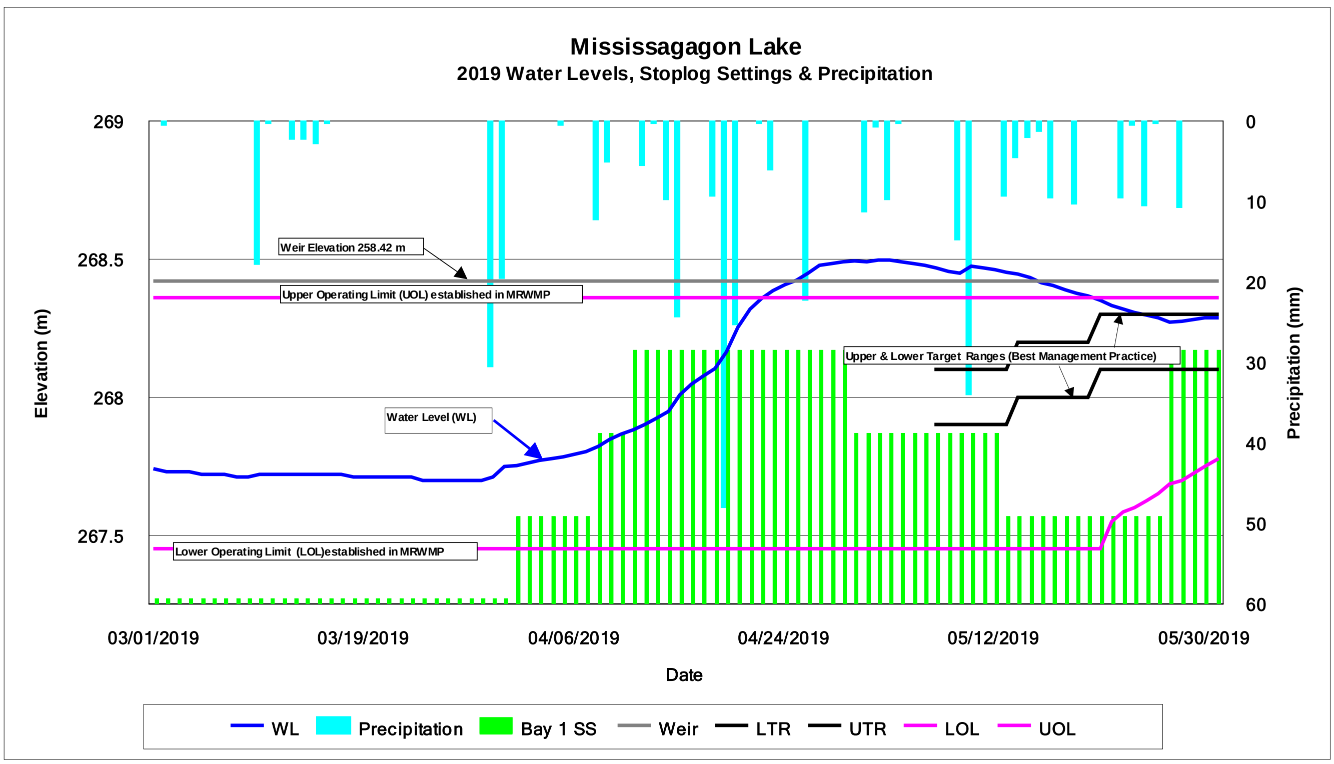



**Figure 10 - Mississagagon Lake Levels**

**CROTCH LAKE DAM**

This is the most significant lake in the watershed in terms of flood control and flow augmentation. The dam is owned by Ontario Power Generation (OPG) and because of this, compliance levels are associated with this structure. The dam has been operated by MVCA since 1987. Crotch Lake dam is a single bay stoplog concrete structure with a 110 m long rock filled gabion basket overflow weir. The height of the weir is at 240.00 m but the impermeable membrane holding water back is at 239.50 m. The control section contains sixteen 0.30 x 0.30 x 4.20 m (12” x 12” x 13’-9”) stoplogs, however the bottom four logs are sealed in the dam and can’t be removed. The total drainage area above the dam is 1030 sq. km. The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. low flow augmentation,
3. tourism and recreation,
4. walleye and bass spawning, other fisheries and wildlife
5. water quality
6. hydro generation.

In September of 2018, MVCA and OPG staff discussed the strategy for the fall refilling the lake in preparation for the winter drawdown. At the time, the watershed was still in a drought situation and the objective was to build the lake to an elevation around 239.50 m if that was possible and maintain at least a minimum flow through the High Falls GS of 5 cms (Best Management Practice BMP) for this structure as outlined in the MRWMP).

Crotch Lake reached its minimum level of 237.32 m in early October and began rebuilding as the drawdowns from the other lakes began. Through October flows remained around the 5 cms range but by mid-November, sufficient rainfall had occurred to bring the watershed out of drought conditions and flows at High Falls were at plant capacity of 15 cms. Additional rainfall through December resulted in significant increases in flows out of Crotch Lake. By the end of the year, despite 4 stoplogs still being out of the dam, Crotch Lake had reached the crest of the weir, 240.00 m. There were 7 stoplogs out of the High Falls dam and flows were near 30 cms. Levels on Dalhousie Lake were approaching minor flood conditions, approaching the 157.00 m elevation.

Discussions between OPG and MVCA staff concluded that the target for Crotch Lake would be to get the lake down to at least 237.50 m by mid-March. Drawing the lake down would have to wait until that could be done without causing flooding to occur in the Snow Road (forebay of High Falls GS) and Dalhousie Lake areas. It would also have to minimize potential for shoreline damage from ice movement and potential issues with recreational users on the ice covered waterways downstream.

By the end of January, levels downstream had receded to a point that the drawdown on Crotch Lake could commence. Crotch Lake was sitting at 239.84 m and 4 stoplogs were still out of the dam. The objectives were reviewed again with the target for mid to late March being between 237.50 m and 237.00 m if possible. By the end of February, 11 of the 12 logs were out of the dam and the lake had dropped to 238.48 m. The 12$^{th}$ stoplog is rarely removed from the dam as numerous issues result with trying to replace the logs through the amount of head that results and sealing the dam for the summer is a very difficult task.

By mid-March, the level on the lake had dropped to 237.87 m. Based on that elevation and the snow pack conditions across the watershed, it was deemed prudent to remove the last log. By the end of March levels had dropped to 237.60 m and the snow pack began to disappear. As the runoff began to show up in the system and tributary flows downstream of Crotch Lake began to increase, the dam was operated to begin to reduce outflow from the upper watershed and utilize the storage in the lake.

Between the 1$^{st}$ and 11$^{th}$ of April, 2 logs were replaced and levels had steadily climbed to 238.24 m (summer target is the top of the weir, 240.00 m). Moderate flood levels had been reached on Dalhousie Lake and flows in the downstream tributaries were increasing but were all still below the average spring peak flow conditions. The weather forecasts on the 12$^{th}$, 13, and 14$^{th}$ of April all indicated 20-25 mm of rainfall on April 14 and no additional rainfall in the 5 day forecast.

On April 14$^{th}$ into April 15$^{th}$, between 30 and 60 mm of rainfall was recorded in the MVCA rain gauges, the highest amounts occurring in the western most gauges in the watershed. This rainfall predicated the severe runoff that ensued. The Mississippi River runs west to east so all of that rainfall would have to make its way through the system. Storage in the system is in the western portion of the watershed. With flows quickly increasing in that area and significant flooding occurring in the for all intents and purposes unregulated area downstream of Crotch Lake, Crotch and Kashwakamak Lake dams were operated to reduce the downstream flows with one and two logs put in respectively at those dams.

The long range forecast on the 15$^{th}$ indicated a 70 % chance of 11 mm of rain occurring over the Easter weekend, April 19$^{th}$ to April 22$^{nd}$. By April 18$^{th}$, Crotch Lake had risen to 239.34 m and was increasing at a rate of 15 cm per day. At that rate, levels would be above the top of the weir within 4 days. The forecast on the 18$^{th}$ had also changed significantly between the 15$^{th}$ and 18$^{th}$ with 50 – 60 mm forecast for the 18$^{th}$ and 19$^{th}$ but no additional rainfall in the ensuing 3 day for the 20$^{th}$ and 21$^{st}$.

Rainfall amounts over the Easter weekend, from April 19$^{th}$ to 21$^{st}$ averaged in excess of 60 mm, with the western portion of the watershed averaging in excess of 80 mm. Based on the rate of rise of conditions at Mazinaw Lake, it was apparent that significantly higher flows from runoff was coming down the system and that the remaining storage in Crotch Lake would be used over the next 48 hours therefore no logs were replaced to reduce outflows to mitigate flooding downstream as would normally be the situation..

With Dalhousie Lake already at flood stage, no additional logs were removed from the dam either and at this point the upper system for all intents and purposes, became an unregulated system. Between April 21$^{st}$ and April 26$^{th}$ from 239.83 m to 240.37 m. The lake peaked on the 26$^{th}$ and as the dams in the upper watershed began to be operated, inflows into the lake dropped. As levels approached the summer target level of 240.00 m, logs were replaced. By the end of May all of the logs were back in the dam and the operating scheme was to maintain levels at or near 240.00 m until the 1st of July when the summer drawdown period would begin.


**Photo 24 – Crotch Lake Dam Weir April 11**


**Photo 25 – Crotch Lake Dam Control April 11**


**Photo 26 – Crotch Lake Dam Weir April 24**


**Photo 27 – Crotch Lake Dam April 24**
Level 240.43 m


**Photo 28 – Downstream of Crotch Lake Dam Weir**

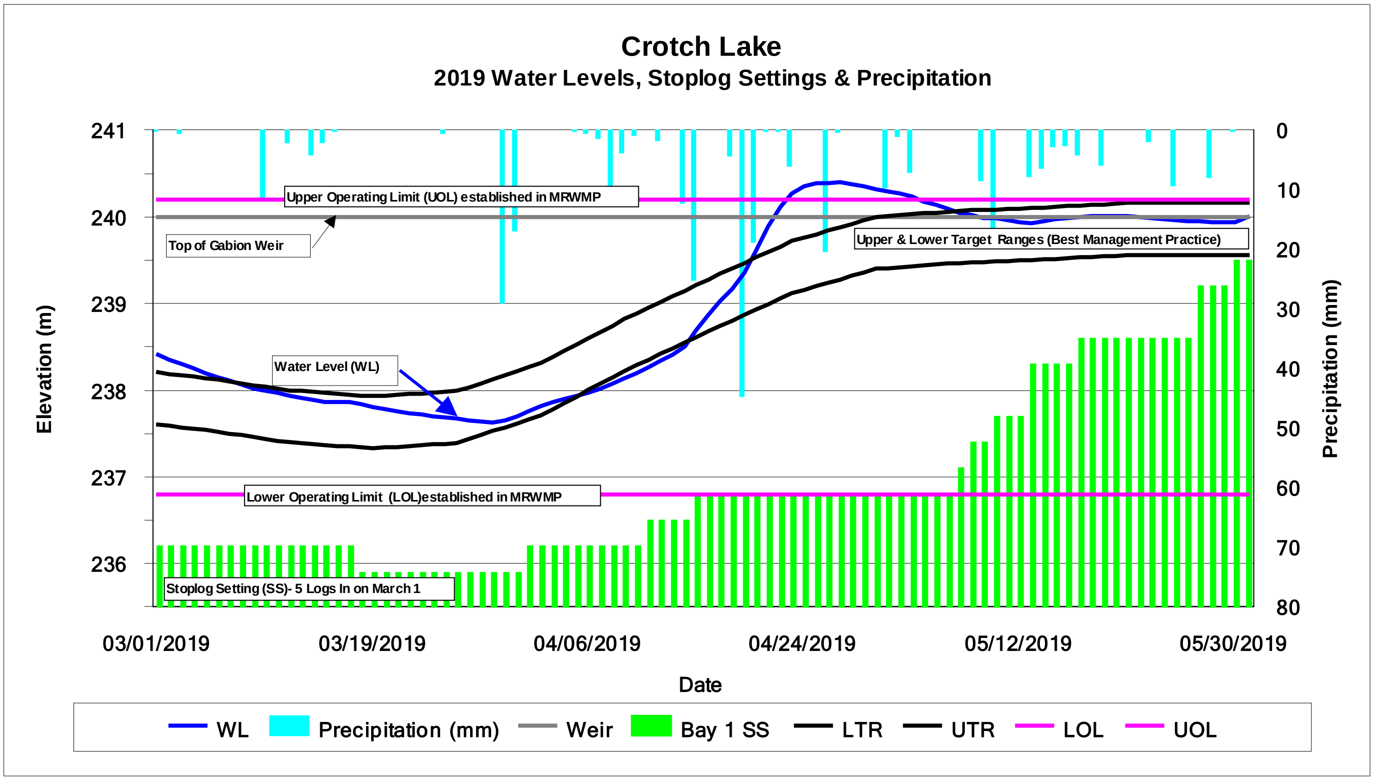



**Figure 2 - Crotch Lake Dam Water Levels**

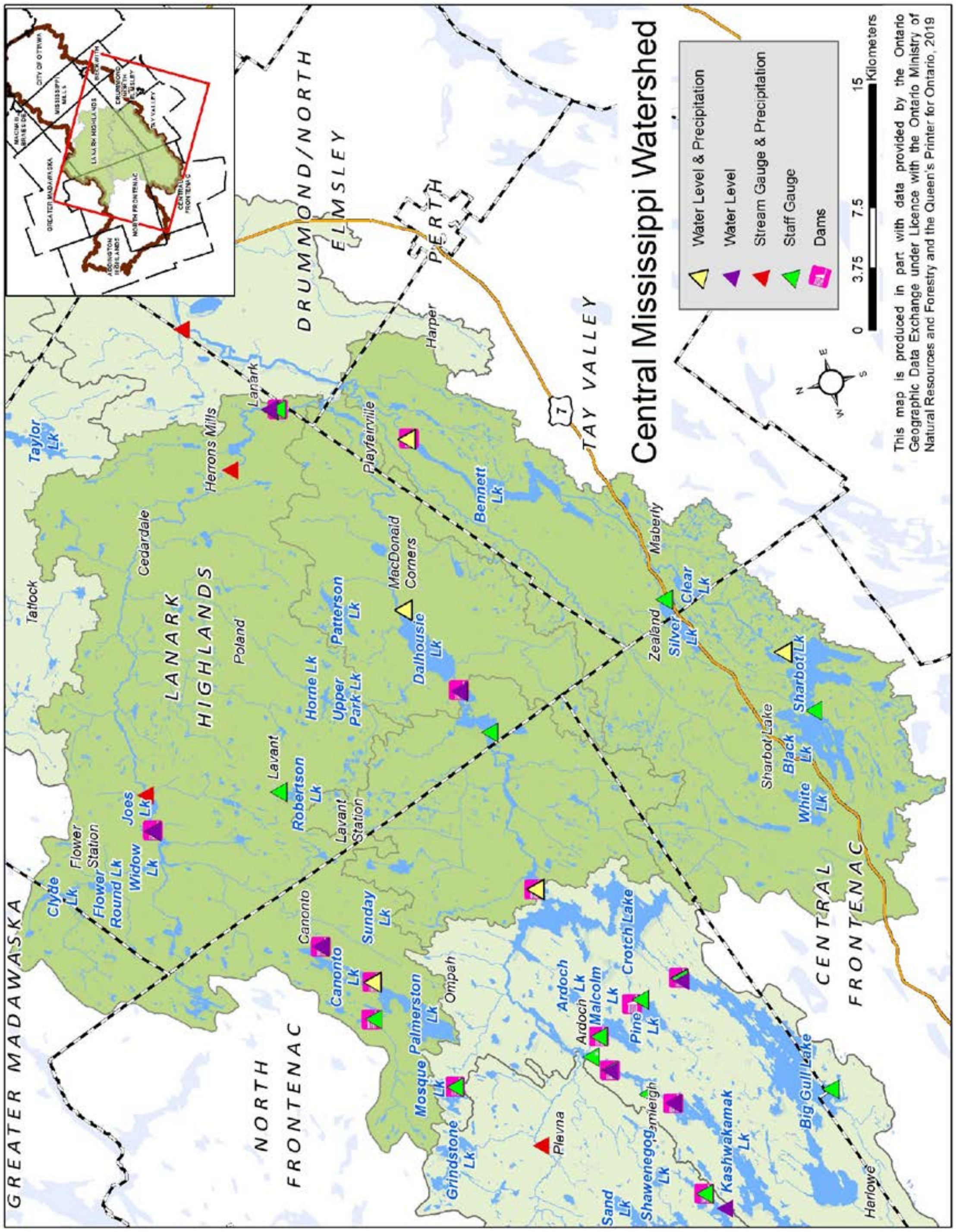
## THE CENTRAL WATERSHED

The central watershed contains four of the largest unregulated tributaries of the Mississippi River with virtually no usable storage within it. For the purpose of this report, it is defined as the drainage area below the Crotch Lake Dam and above Mississippi Lake. From the north, Antoinne Creek and from the south, Cranberry Creek, outlet into the river just above the High Falls GS. The Clyde River (from north) and Fall River (from south) outlet into the Mississippi River just downstream of Dalhousie Lake. There are numerous swamps, creeks, unnamed streams and lakes in this area and the majority is in the Precambrian shield. There are two identified Flood Damage centres within this area, Dalhousie Lake and Lanark Village. There are 7 dams within this part of the watershed which MVCA owns and /or operates. They are:

1. High Falls Generating Station Dam
2. Summit Lake Dam
3. Palmerston Lake Dam
4. Canonto Lake Dam
5. Widow Lake Dam
6. Lanark Dam
7. Bennett Lake Dam

**Table 8 Physical Characteristics of Upper Lakes**

| Location | Surface Area (ha) | Drainage Area (sq km) | Usable Storage (ha m) | Elevation of Deck or Weir |
|---|---|---|---|---|
| High Falls GS | 127 | 1233 | 132 | (187.61) |
| Summit | 39 | 28 | 33.5 | Not geodetic |
| Palmerston | 572 | 47 | 263 | 272.95 |
| Canonto | 240 | 59 | 77 | 268.86 (268.21) |
| Widow | 97 | 267 | 101.5 | 185.08 |
| Lanark | n.a. | 654 | n.a. | 145.13 |
| Bennett | 516 | 284 | 361 | 155.04 |




**Map 5 Central Mississippi Watershed**

**HIGH FALLS GENERATING STATION**

This is the first hydro generation dam on the watershed. The dam is owned by Ontario Power Generation (OPG) and because of this, compliance levels are associated with this structure. The removal and replacement of stoplogs is done by MVCA, decisions on when stoplogs are to be manipulated is a consultation between OPG and MVCA staff. OPG, as the owner has the ultimate responsibility for determining the operations at this structure. This is a *run-of-the-river* structure with minimal storage capacity. OPG is responsible for completing the forms for compliance levels and can be contacted directly regarding water levels and flows at this structure.

The dam is a concrete hydro generating station with a plant capacity of 14.3 cms, four stoplog bays containing a total of fifty-six 0.30 x 0.30 x 4.67 m ( 12" x 12" x 15'-0") stoplogs. There is a concrete weir at elevation 187.61 m. It has a total drainage area of 1233 sq km. The generating station produces 2.3 megawatts annually.

The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. low flow augmentation,
3. tourism and recreation,
4. walleye and bass spawning, other fisheries and wildlife
5. water quality
6. hydro generation.

As mentioned above, with Crotch Lake full and flows near 30 cms at High Falls GS, the year began with seven stoplogs out of the dam. Over the course of the next two months, stoplogs were replaced or removed to maintain levels within the compliance levels for the dam. By the end of February, there were still six logs out of the dam and flows were about 10 cms above the plant capacity. Through the majority of March, the flows remained above the plant capacity but dropped slowly. Stoplogs were replaced to mimic the drop in inflows, which in turn helped the levels on Dalhousie drop over that time frame.

As inflows began to increase in early April, logs were pulled from the dam to get the water from the uncontrolled portion of the watershed, namely Cranberry Creek and Antoinne Creek sub watersheds, through the system as quickly as possible while trying to minimize potential flooding downstream as much as possible. By April 15$^{th}$, there were 16 logs out of the dam and outflow from the structure into Dalhousie Lake was 41.6 cms. Identified in the MRWMP, once flows exceed 40 cms and or levels exceed 157.00 m, the system is considered to be in a flood status and dams are operated as a whole to mitigate flooding as much as possible throughout the system.

By April 19$^{th}$, levels above High Falls dam were at or had exceeded the upper compliance levels for the dam. Flows had reached 62.50 cms but were decreasing slightly and levels on Dalhousie Lake, while very high, had also begun to drop. Weather forecasts for significant rainfall did not bode well but the system was holding its own at the time. The rainfall over the next three days exceeded forecasts, especially in the upper (western) portion and the runoff from that event had to make its way through the entire watershed. By April 26th, 26 stoplogs were out of High Falls (the most in recent memory), flows coming into and going out of High Falls GS had exceeded 100 cms and levels on Dalhousie Lake reached the 1/100 year elevation of 158.00 m.

This structure is a run-of-the-river dam, therefore as soon as the flows started to decrease, stoplogs have to be replaced. By the end of the 1st week of May, stoplogs began being replaced to mimic the drop in flows mainly from the two feeder creeks immediately above the High Falls GS, Antoinne and Cranberry Creeks. With levels still extremely high on Crotch Lake, this was a relatively slow process and several rainfall event through May caused levels and flows in this area to change quickly.

By the end of the month there were still several logs still out of the dam. Under these high flow situations, levels in the Snow Road area tend to fluctuate significantly through this time period as operators try to reduce flows as quickly as possible to help downstream flooding but not exceed upstream levels at the same time. There is also significant bass spawning areas above the dam that have to be considered as the logs are replaced as well.

**Photo 29 - High Falls G.S. Gatehouse**

**Photo 30 - High Falls G.S. Penstock & Powerhouse**

Photo 31 - High Falls G.S. Control Section

Photo 32 - High Falls G.S. Weir

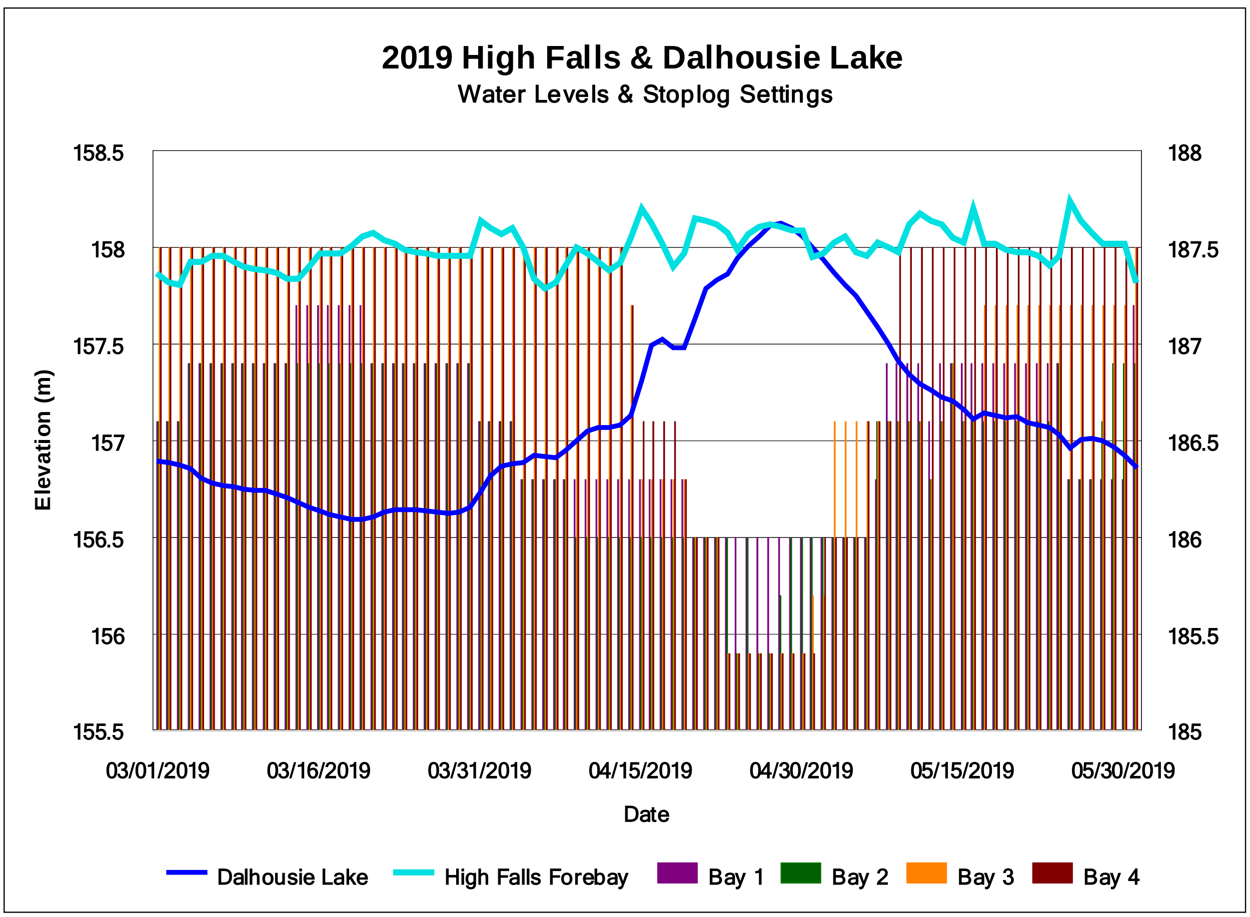



**Figure 12 - High Falls Level Stoplog Setting & Dalhousie Lake Level**

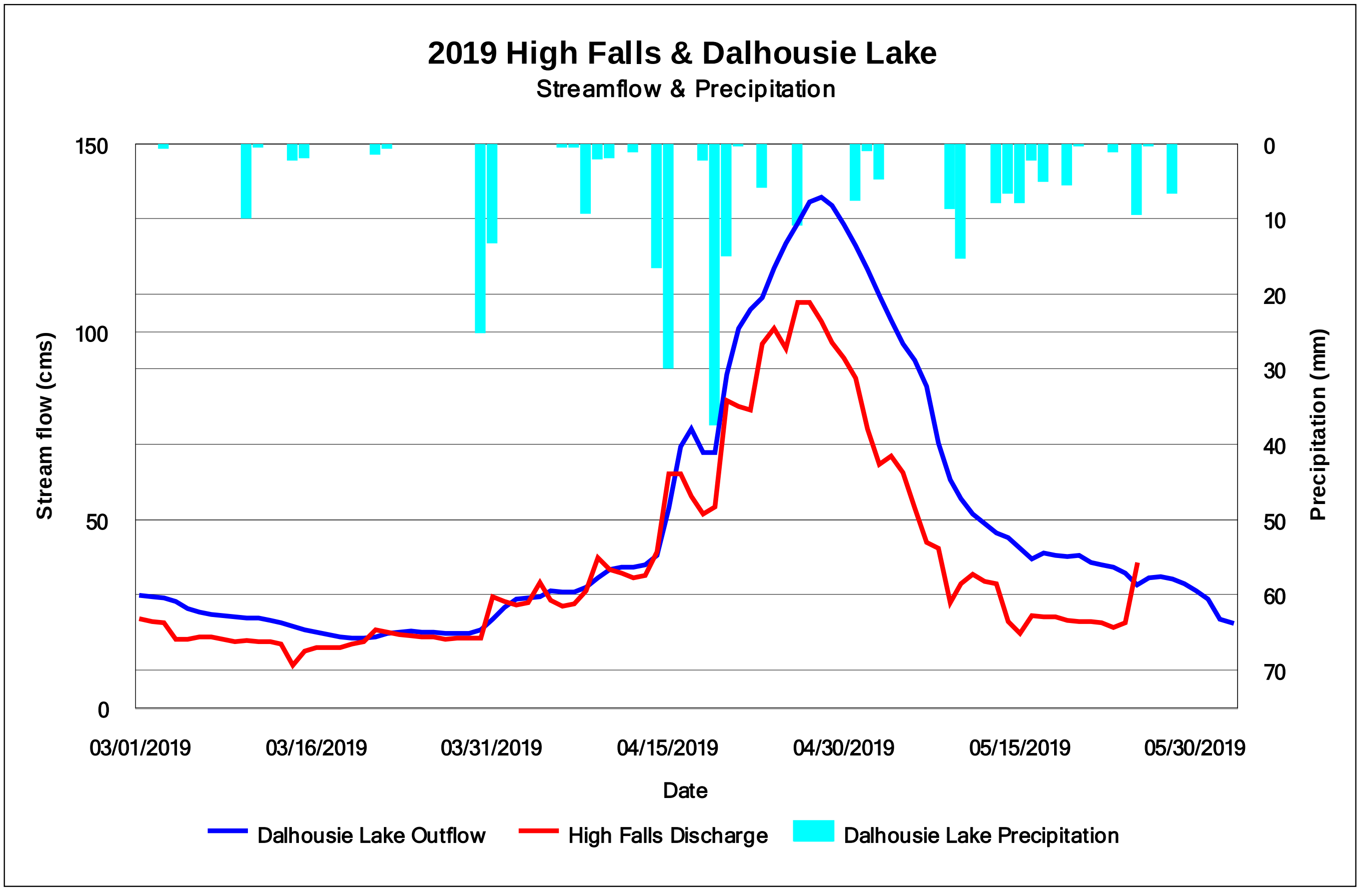



**Figure 13 - High Falls Flow is the noon daily discharge, Dalhousie Lake flow & precipitation data are the 24 hour daily average**

## DALHOUSIE LAKE

Dalhousie Lake is the 1st major flood damage centre on the Mississippi River. Located immediately below the High Falls Generating Station, Dalhousie Lake is a bottleneck for flows during spring floods as all water flowing down the river from the western portion of the watershed must make its way through Dalhousie Lake. This lake has historically had a flooding issue and a low water issue during the summer. There is no water control structure located on this lake so levels and flows cannot be manipulated to directly affect conditions on this lake. Water levels on Dalhousie Lake are recorded by a lake level gauge located at the outlet of the lake.

There is no dam on this lake so levels are derived by inflow and outflow. In addition to the flows coming through the High Falls Generating Station, additional flows come from Paul's Creek and 2 unnamed creeks on the north shore of the lake. MVCA issued several watershed conditions statement from early March through early April indicating the potential for above average flooding and the start of the spring freshet (see Appendix 1). The first Flood Watch statement specifically for Dalhousie Lake was issued April 12th with an update on April 14th. The first Flood Warning statement was issued on April 15th with several updates issued between then and when the Termination message was issued on May 3rd.

The flood of 2019 established a new high water level when the lake peaked on April 28th at an elevation of 158.13 m. The previous high water elevation recorded on the lake was 157.86 m in April 1998 and matched again in May of 2017.

Numerous dwelling were flooded and the water level at the inlet and outlet of the lake was just below the girders of the highway bridges. The road at the beach at the upper end of the lake had 2 or 3 cm of water overtop of it.

**Photo 33 Flooded beach Dalhousie Lake** **Photo 34 Flooded road Dalhousie Lake,** Level 158.11 m

**Photo 35 Outlet Bridge Dalhousie Lake** **Photo 36 Flooding Downstream Dalhousie Lake bridge**

**CLYDE RIVER SUB-WATERSHED**

The Clyde River, having numerous tributaries of its own is the most significant tributary of the Mississippi River in terms of size, with a total drainage area of 614 sq. km. The headwaters of the river are in the Canadian Shield and are characterised by numerous small lakes, many of which are spring fed. There are 5 dams located within this watershed that MVCA owns and or operates, all of which have operating guidelines associated with them. Three of these are MNRF dams, Summit, Palmerston and Canonto Lake dams and 2 are MVCA dams – Widow Lake and Lanark.

None of these dams (by themselves or as a group) have any significant usable storage available to mitigate flooding or augment flows in droughts. For that reason, after considerable scrutiny at the start of the Water Management Planning exercise, these structures were not included in that document. Four of the dams (Palmerston, Canonto, Widow and Lanark) are operated to mitigate flooding in the vicinity immediate upstream of each dam and all five dams have fisheries and recreational issues associated with them. Summit Lake dam has a component of low flow augmentation in its operating guidelines but has minimal ability to impact flows and levels in a drought situation. The most significant settlement on this river is the Village of Lanark, which historically has annual flooding and low flow problems.

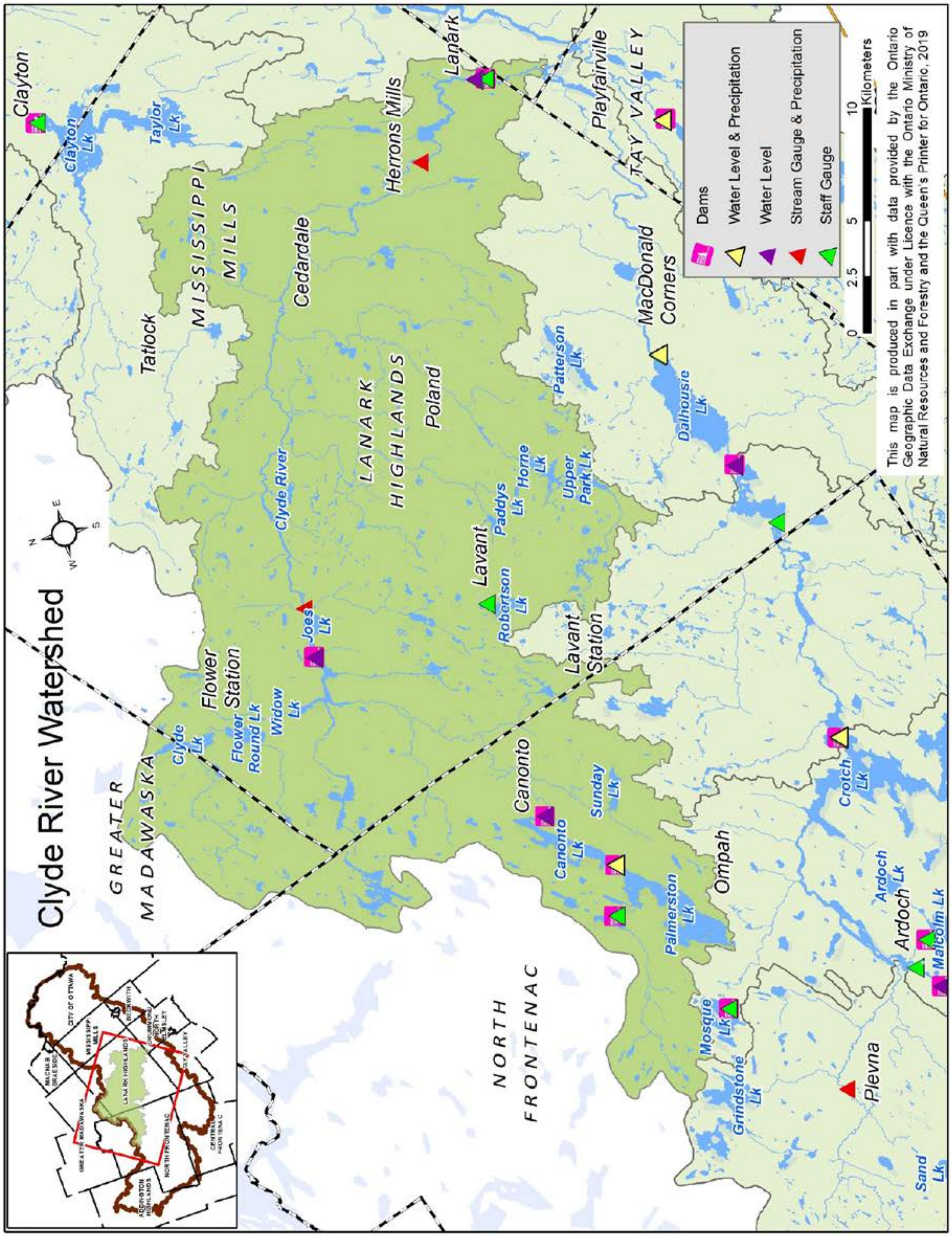
**SUMMIT LAKE DAM**

The Summit Lake dam is owned by the Ontario Ministry of Natural Resources and Forestry, Bancroft District and has been operated by MVCA since 1986i. It is a single bay concrete structure with a weir on either side of the control section. There are five 0.20 x 0.20 x 4.27 m (8” x 8” x 14’-0”). The dam has not been tied to a geodetic elevation so there is no weir elevation. It has a drainage area of 28 sq km. The primary purpose of this structure is to maintain water levels for a brown trout fishery, the only one in the Mississippi River watershed.

The operation of Summit Lake consists of removing the five stoplogs from the dam in the fall and replacing them in the spring. Water levels are not obtained on a regular. Nothing of significance occurred at this dam during the flood of 2019.

**Photo 37 Summit Lake Dam**

**Photo 38 Upstream View of Summit Lake Dam**




**Map 6 Clyde River Sub - Watershed**

**PALMERSTON & CANONTO LAKE DAMS**

The Palmerston and Canonto Lake dams are owned by the Ontario Ministry of Natural Resources and Forestry, Bancroft District and have been operated by MVCA since 1986. Palmerston Lake dam is a single bay concrete structure with six full logs and one half log in the dam. The stoplogs are 0.25 x 0.30 x 4.90 m (10” x 12” x 16’-0”). It has a total drainage area of 47 sq. km. Canonto Lake Dam is a concrete weir dam with a raised metal deck and two stoplog bays centered in the structure with an overflow weir at either end of the control structure. There are a total of five 0.15 x 0.20 x 2.85 m (6” x 8” x 9’-6”) in each bay. The dam has a drainage area of 59 sq km. The primary purposes of operating these two structures are:

1. mitigate flooding on the lake upstream of each dam,
2. walleye spawning and other fish and wildlife issues,
3. maintain summer levels for tourism and recreation.

Water levels remained fairly static throughout the majority of the winter. As runoff began and levels started to increase, the stoplogs were removed from the dam at a rate to keep water levels below the maximum for the lake of 272.15 m. The operation of this lake is tied closely to the Canonto Lake downstream, the removal of a ½ log from Palmerston dam usually associated with a full log from Canonto dam, matching increase inflow with a corresponding outflow and helping maintain stable levels through Canonto Lake. In 2019, there were no significant issues with the Palmerston Lake Dam. Flood levels were getting very close to the threshold for Canonto Lake dam and removal of additional logs was contemplated but delayed to allow assist the lower part of the river a n opportunity to peak. Levels began to recede at Canonto so no additional logs were pulled. Palmerston Lake peaked at 272.08 m on April 22, 2019. Canonto Lake peaked at 268.46 m on April 20, 2019.

By mid-May only a half log remained out of Palmerston and no logs were out of Canonto and the dams were being operated to maintain summer levels.


**Photo 39 Palmerston Dam**


**Photo 40 Palmerston Dam Downstream Channel**

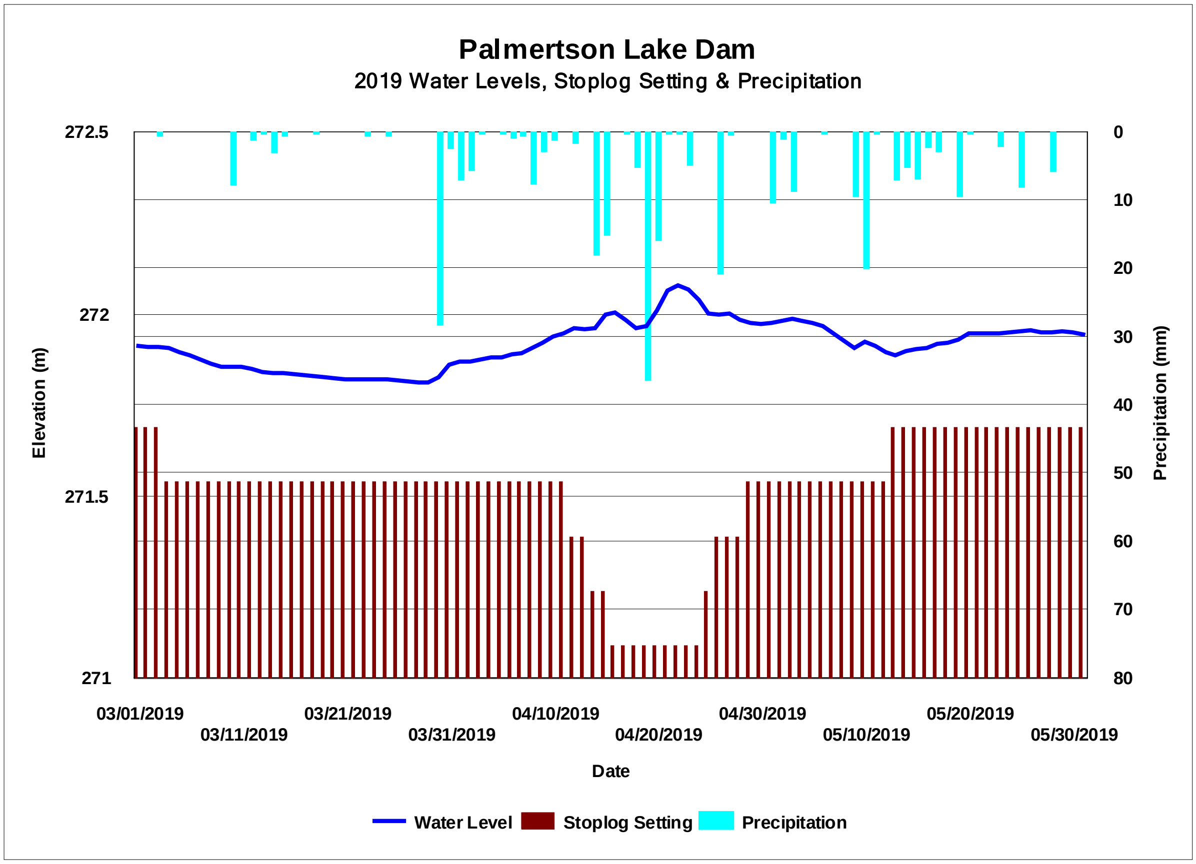



**Figure 14 Palmerston Lake Hydrograph**

**Photo 41 Upstream View of Canonto Lake Dam**

**Photo 42 Downstream View of Canonto Lake Dam**

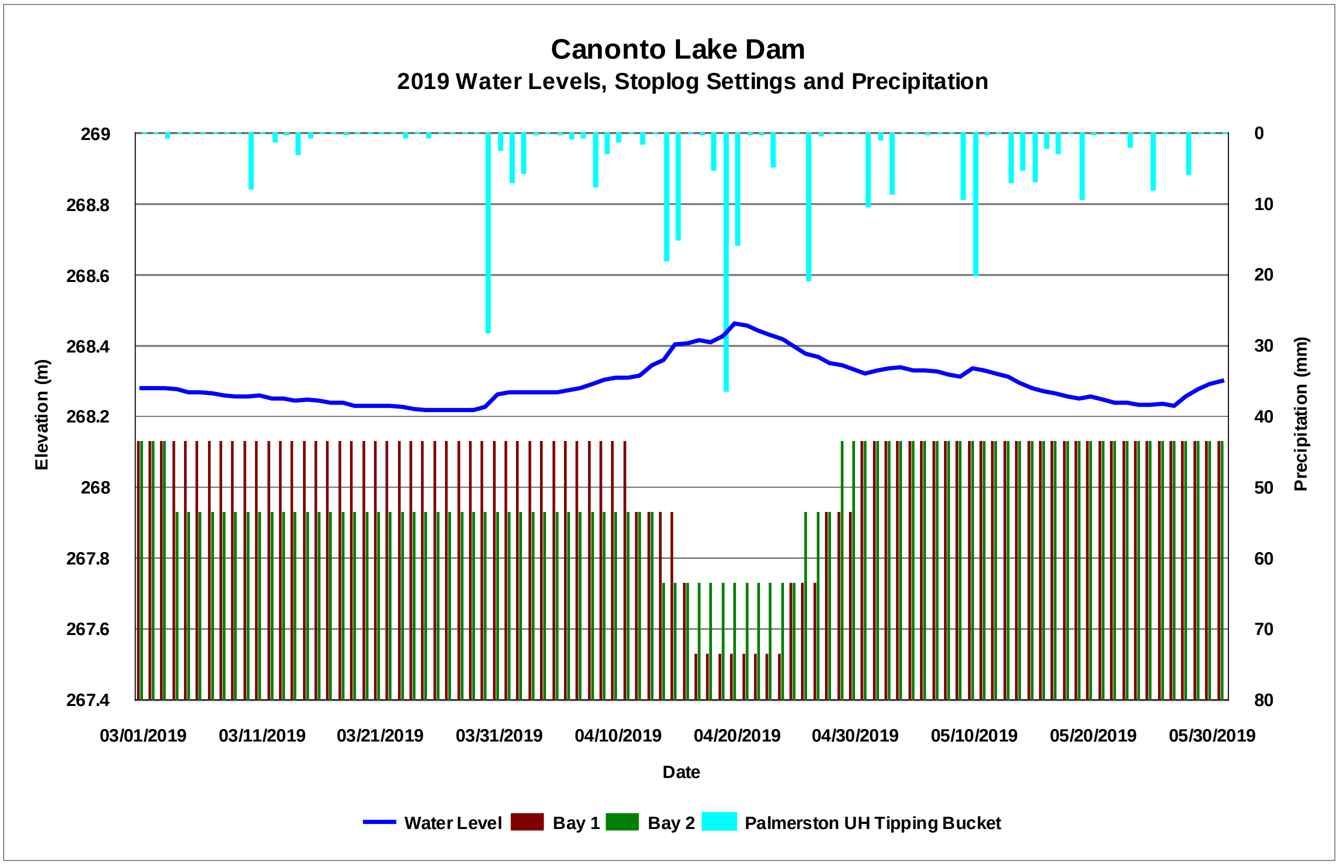



**Figure 15 Canonto Lake Dam Hydrograph**

## WIDOW LAKE DAM

The Widow Lake dam is owned and operated by MVCA. The dam is a concrete capped rock filled gabion basket structure with four stoplog bays. Each bay contains four 0.25 x 0.25 x 4.90 m (10" x 10" x 16'-0"). The dam has a drainage area of 267 sq km. The primary purpose is to maintain water levels in Widow Lake. Cattails plugging the control sections of this structure is an annual problem. In 2016, MVCA installed an automated gauge on the dam to monitor levels directly at the site as flooding of the road below the dam has occasionally made access to the site difficult.

Widow Lake dam does has a fall drawdown associated with it to provide some storage in the spring. Usually between 6 and 8 of the 16 stoplogs in the dam are removed in the fall. These logs are typically dry by the end of September so there is no real drawdown done but the removal of the logs allows any increase over the winter months to flow unchecked maintaining the minimal storage that is present. In early March, based on the snow course data, an additional stoplog was pulled from the dam. As the runoff began, additional stoplogs were removed from the dam, mainly to prevent the structure from overtopping and allow cattail mats which historically come down this section of the river to pass through the structure unimpeded. Before the level actually peaked, the Township road leading to the dam was flooded and access to the dam was eliminated. The levels at the dam were monitored and the dam was never overtopped during the event.

Vandalism was an issue at this dam in 2019, as two stoplogs were destroyed. However, by mid-May those logs had been replaced and all of the logs were back in the dam.

**Photo 43 Upstream View Bays 3 & 4 of Widow Lake Dam**   **Photo 44 Upstream of Bays 1 & 2 of Widow Lake Dam**

**Photo 45 Downstream View of Widow Lake Dam**   **Photo 46 Vandalism of stoplogs at Widow Lake Dam**

**Photo 47 Cattail Mats in Widow Lake Dam**

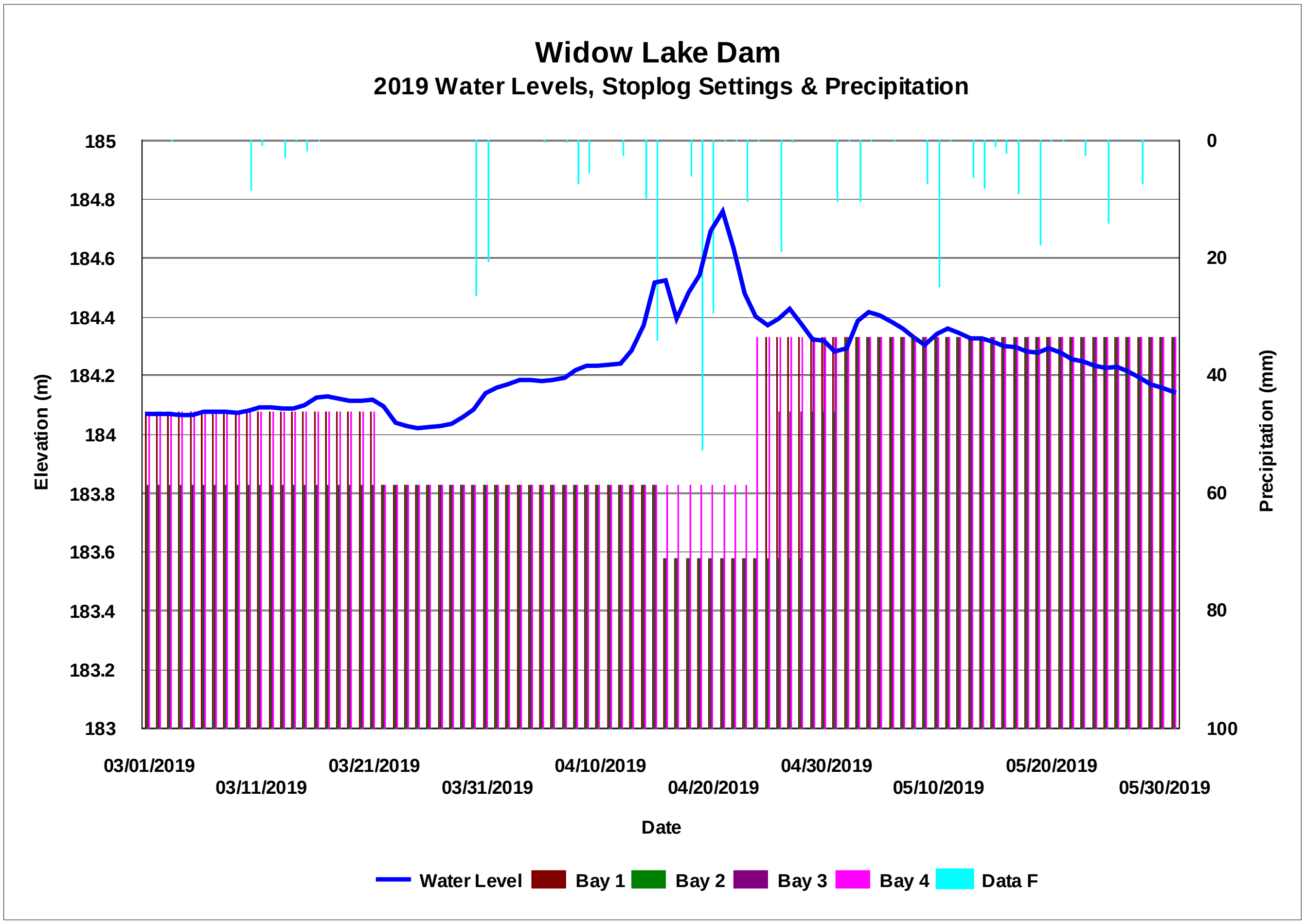



**Figure 16 Widow Lake Dam Hydrograph**

**GORDON RAPIDS AND LANARK STREAM GAUGES**

The Gordon Rapids Stream Gauge is situated on the Clyde River at the outlet of Joe's Lake. As with the other gauges, this site records hourly water levels and precipitation. The actual peak flow for the 2019 flood has yet to be determined as the gauging site was flooded at the peak of the event. At this time the raw data indicates the peak occurred on April 22nd at 72 cms but that flow is will be adjusted once the data has been reviewed by Environment Canada (owners of the site and data).

The gauge was installed in 1972 and the highest recorded flow of 92.3 cms occurred April 1, 1998.

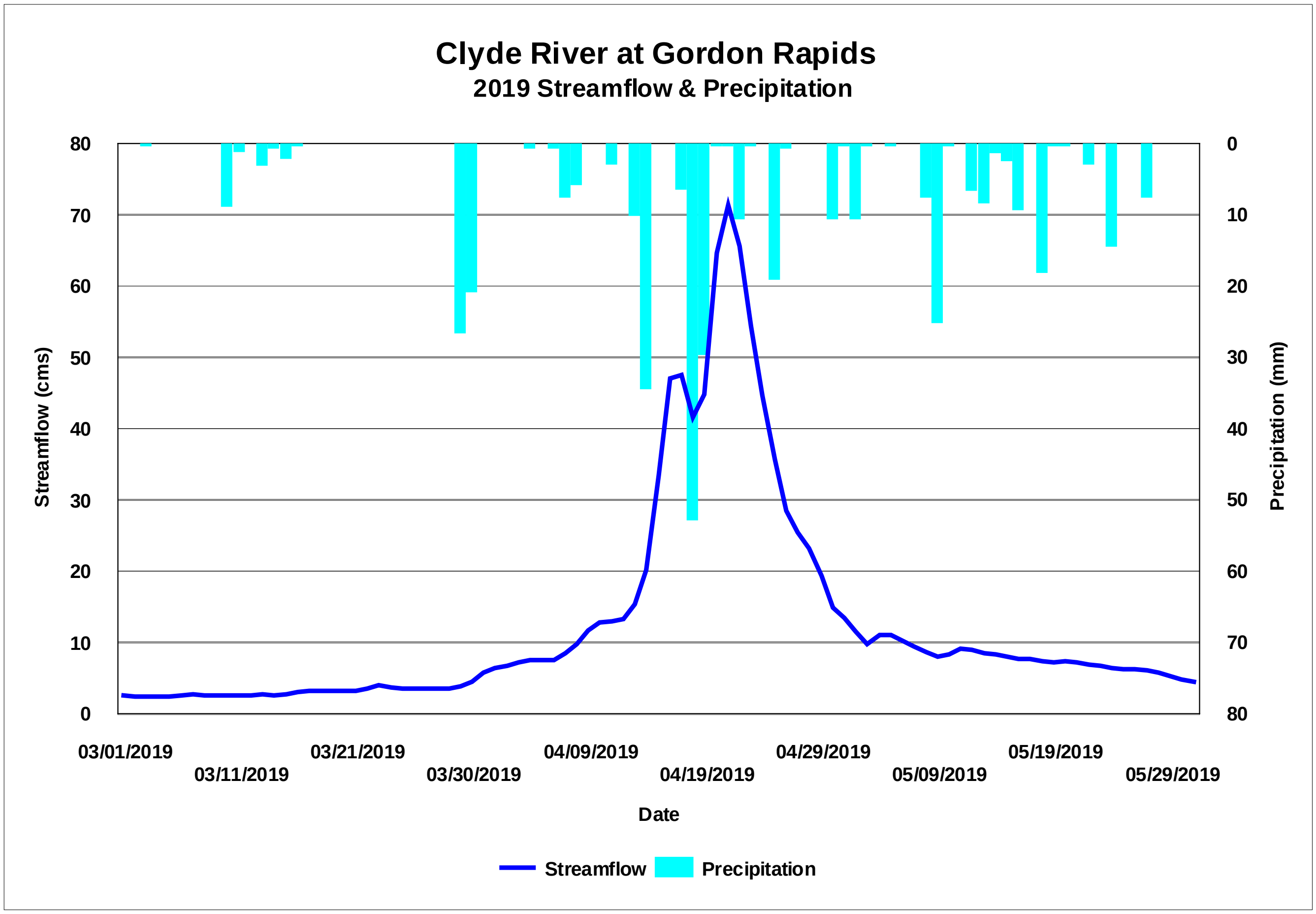



**Figure 37 Gordon Rapids Stream Gauge Hydrograph**

**LANARK STREAM GAUGE**

Located on the Clyde River just downstream of Herron's Mills and immediately above Kerr Lake, the Lanark gauge has been in existence since 1971. This gauge is utilized in conjunction with the automated gauge located by the park above the main street bridge in Lanark and the staff gauges located immediately above the bridge and at the dam to operate the Lanark Dam. The information is also used to provide Flood Forecasting and Warning to the residents along the Clyde River and with the Village of Lanark. See Appendix 1 for messages regarding the flood on the Clyde River posted by MVCA.

The peak flow at this gauge occurred April 21st at 135 cms. The highest recorded daily flow at this site was on April 2, 1998 at 168 cms.

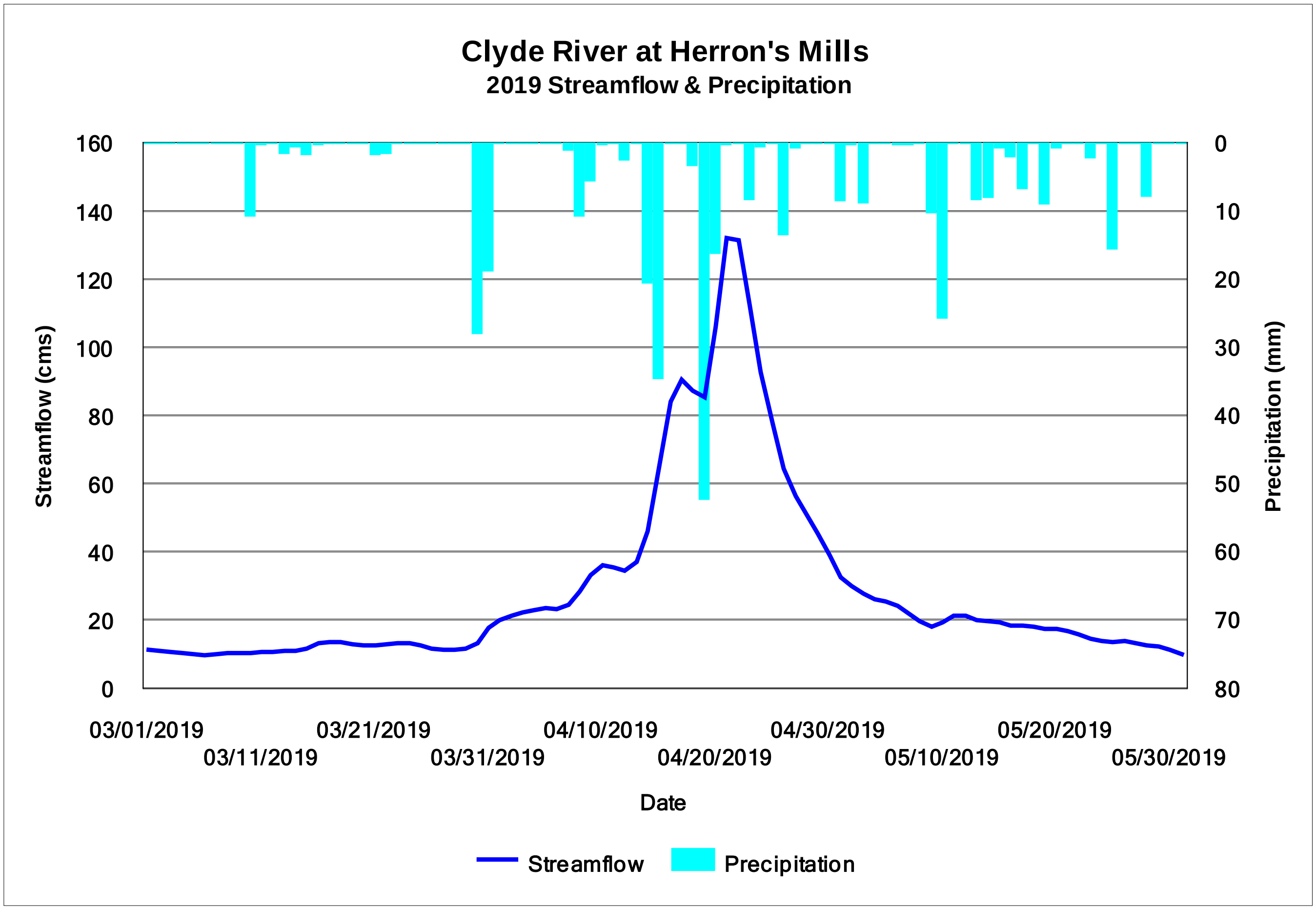



**Figure 48 Lanark Stream Gauge Hydrograph**

**LANARK DAM**

The Lanark Dam owned and operated by MVCA and is located in the Village of Lanark. It is a four bay concrete dam with 52 stoplogs, each bay contains thirteen 0.27 x 0.27 x 3.96 m (11” x 11” x 13’-0”) stoplogs. The dam has a drainage area of 654 sq km. The primary purposes of this dam are:

1. mitigate flooding from the village of Lanark upstream to Kerr Lake,
2. walleye, bass and other fisheries and wildlife issues
3. maintain water levels for recreation and tourism.

There is no storage associated with this structure so there is no drawdown associated with operation of the dam. The effectiveness of the dam to impact water levels begins to be reduced by the capacity of the main street bridge opening and the profile of the river bed between the bridge and the dam during floods which exceed approximately 50 cms at the Lanark stream gauge.

As flows increase, the dam is operated to keep levels at the bridge below 144.50 m as long as possible. Once 32 stoplogs have been removed from the dam, removal of additional logs from the dam has very little impact on flood levels above that bridge. Since there is no storage along the river, removal of the stoplogs can’t occur until flows begin to increase from an environmental perspective. As well, to mitigate issues downstream, not all the stoplogs can be removed at once so they are typically removed in stages over the course of several days mimicking the increase in flows coming to the structure.

In 2019, between March 31st and April 20th, a total of 29 stoplogs had been removed from the dam, bringing the total number of logs out of the dam to 32. Water levels peaked above the bridge at an elevation of 146.04 m on April 22nd while the corresponding level at the dam was 144.00 m.


**Photo 48 Stoplogs on Lanark Dam**


**Photo 49 Upstream channel above Lanark Dam**

Photo 50 Downstream Channel Below Lanark Dam

Photo 51 Main Street Bridge Control Above Lanark Dam

Photo 52 Flooded Road in Lanark Village

Photo 53 Automated gauge above Main Street Bridge

The dam is operated as much as possible to reduce flood levels within the village however due to channel restrictions upstream and no storage, it has a very limited capacity to meet this objective.

With no storage available in the system, it is imperative to start replacing stoplogs as soon as levels start to decrease. It is also important to replace those logs as a rate that compliments the natural drop in flows. It is also important to try to minimise the potential for debris to get caught between the logs as they are being replaced so generally speaking logs are replaced one bay at a time. It is also important to understand that as flows decline, the elevation difference between the bridge and the dam also increases and under the extreme high flow conditions there can be aver a 2 m difference between the two areas.

Stoplogs began being replaced in the dam on April 27th and was almost a daily operation over the next two weeks until conditions stabilized and levels were consistent from the bridge to the dam. By the end of the month, there were still logs out of the dam.

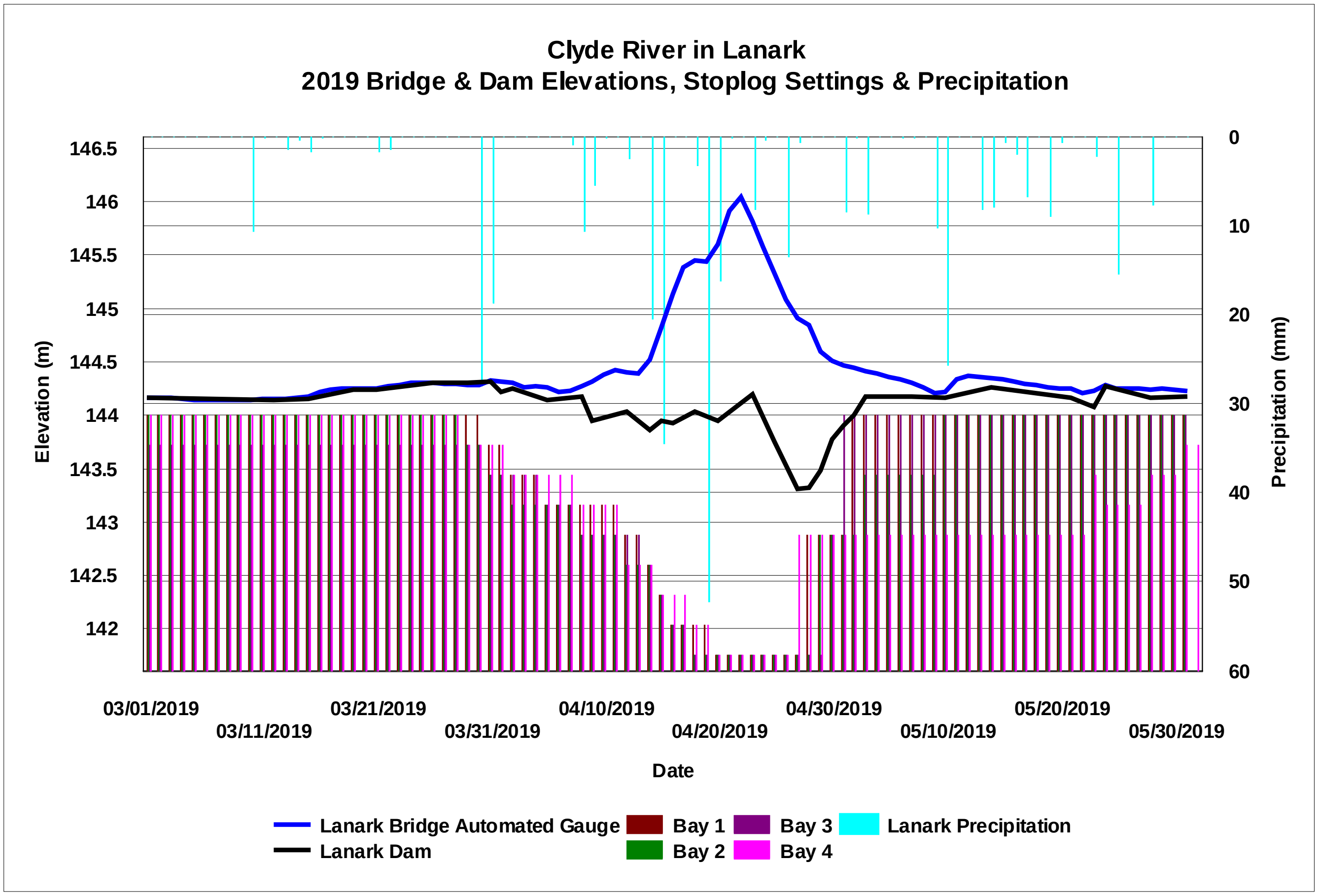



**Figure 5 Lanark Dam Hydrograph**

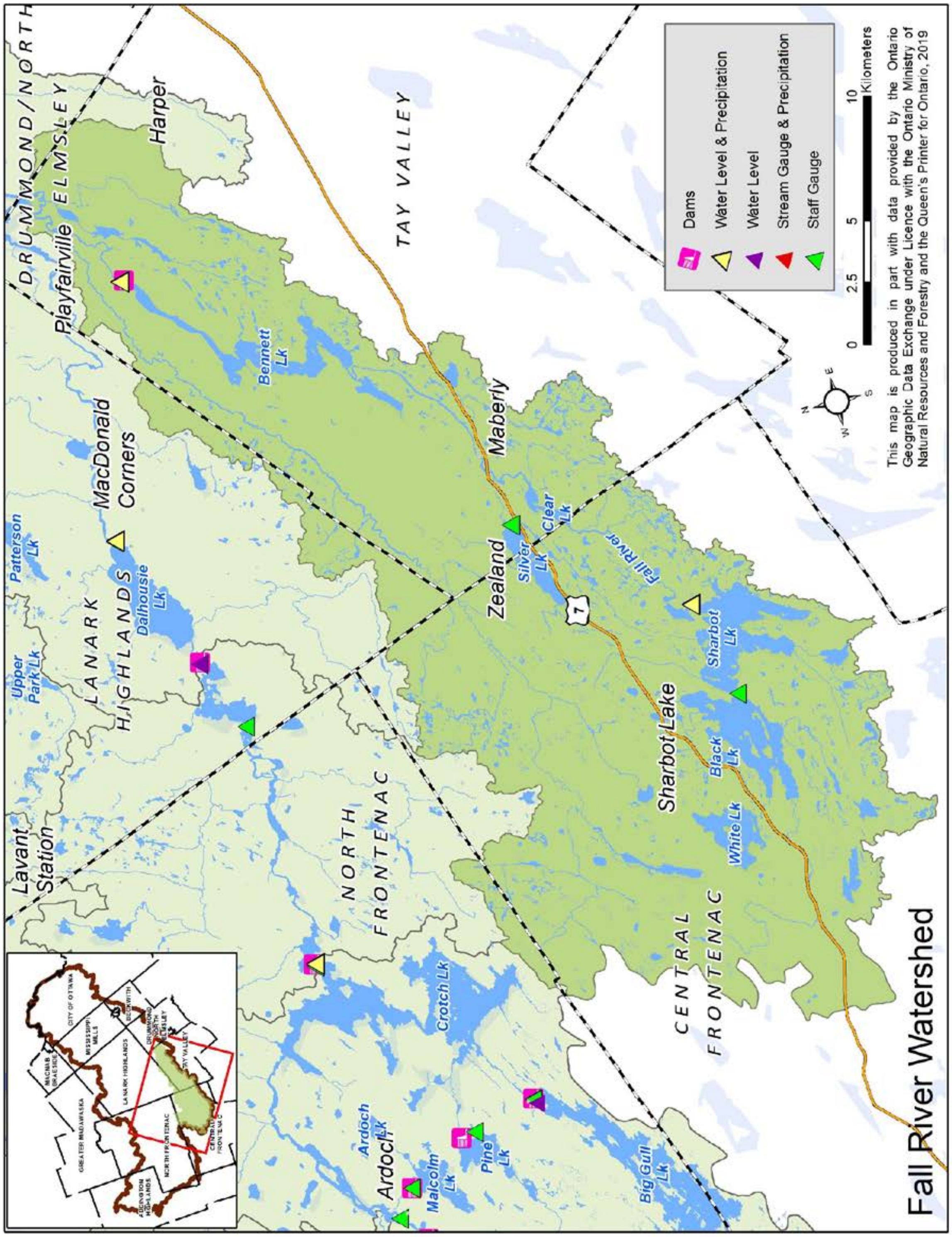
**FALL RIVER SUB-WATERSHED**

The Fall River sub-watershed is largely uncontrolled with two significant lakes – Sharbot and Bennett Lake. MVCA has automated lake level gauges on both of these lakes, recording hourly water levels and both sites have automated tipping buckets recording precipitation.

**BENNETT LAKE DAM**

The Bennett Lake Dam is owned by the MVCA. The dam has been left to function as a weir since the mid-1980's, with no operations being undertaken regardless of the peak spring level.

In 2019, the dam was left to function as a weir and the lake level peaked at 153.72 m on April 21st. While no complaints have been received regarding these levels, it would be prudent to review the operating guidelines and either revise to the current practice or establish a new flood threshold at which point the dam would be operated.




**Map 7 Fall River Sub - Watershed**

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**Photo 54 Upstream View of Bennett Lake Dam**

**Photo 55 Downstream View of Bennett Dam**

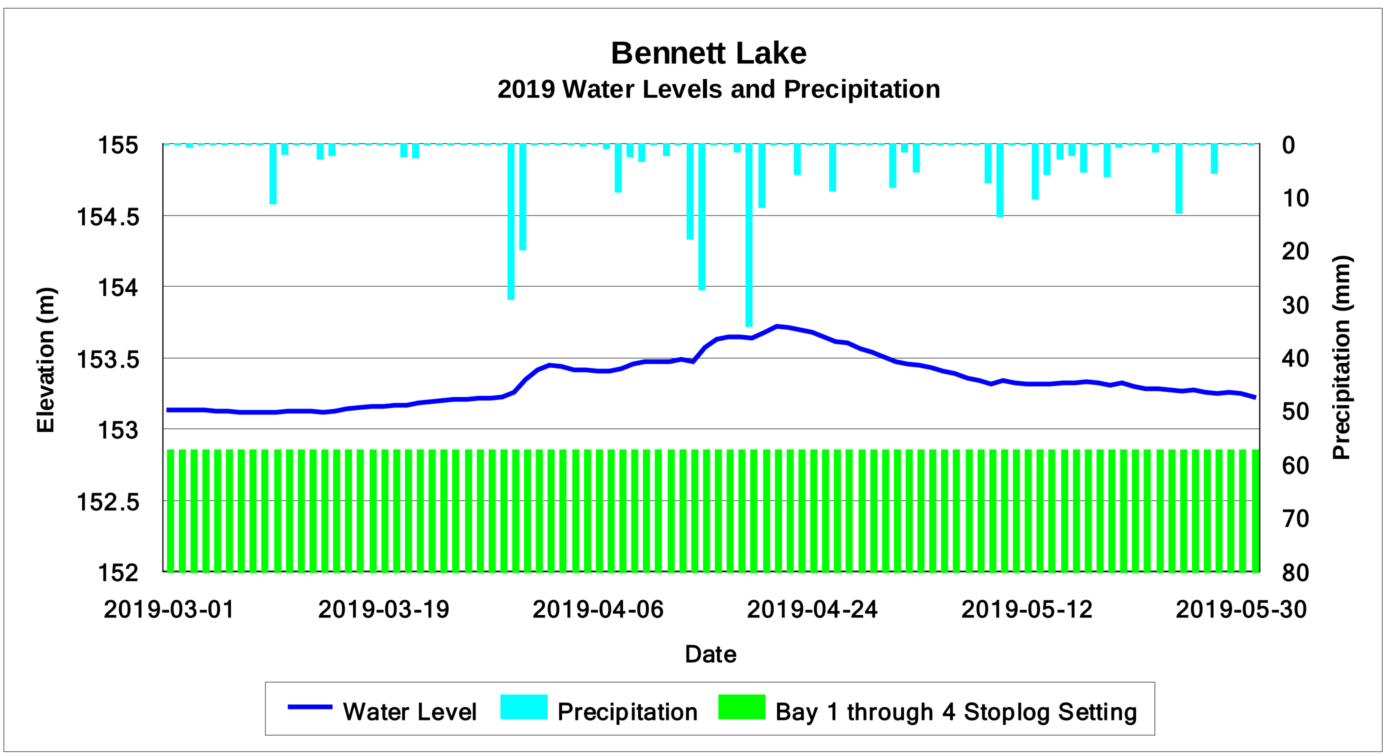


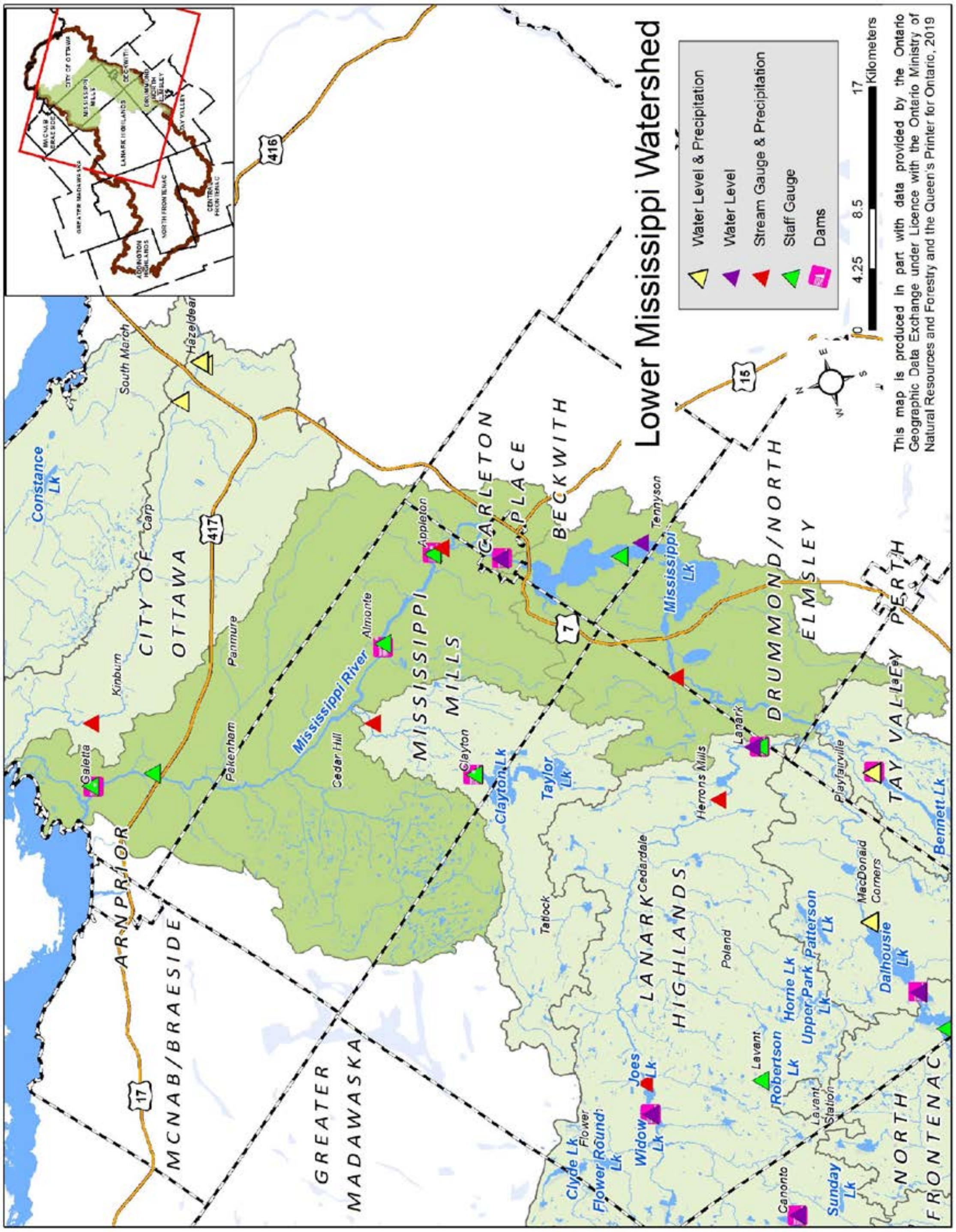

**Figure 20 Bennett Lake Dam Hydrograph**

## THE LOWER WATERSHED

The lower watershed is defined as the drainage area of the Mississippi River from Ferguson's Falls to the outlet at Galetta. There are two significant tributaries that flow into Mississippi Lake, McIntyre Creek and McGibbons Creek, and three major tributaries downstream of Almonte, Indian River, Indian Creek and Coady Creek. There is very limited storage in comparison to the drainage area above the last MVCA owned and operated structure, the Carleton Place Dam. This area contains the majority of the urban development along the watercourse, with identified Flood Damage centers being Mississippi Lake, the Town of Carleton Place, Village of Appleton, Town of Mississippi Mills (Almonte and Pakenham) and the Village of Galetta.

There are 6 dams within this part of the watershed, only one of which MVCA owns and operates:

1. Carleton Place Dam (MVCA)
2. Appleton GS
3. Enerdu GS
4. Mississippi River Power GS
5. Clayton Lake Dam
6. Galetta GS




**Map 8 Lower Mississippi Watershed**

**FERGUSON'S FALLS and APPLETON STREAM GAUGES**

The Ferguson's Falls stream gauge was installed in 1983 by MVCA. This gauge is located above the inlet into Mississippi Lake. The normal spring peak flows are between 120 and 170 cms and the highest recorded flow was April 9, 1998 at 308 cms. In 2019, the Ferguson's Falls gauge peaked at 282 cms on April 24th. The Appleton stream gauge is located about 0.5 km upstream of the Appleton Dam. This gauge has been in continuous operation since 1918. The normal spring peak flows are between 120 and 170 cms and the highest recorded daily flow since 1918 was April 6, 1998 at 279 cms. In 2019, this gauge peaked at 275 cms on April 26th.

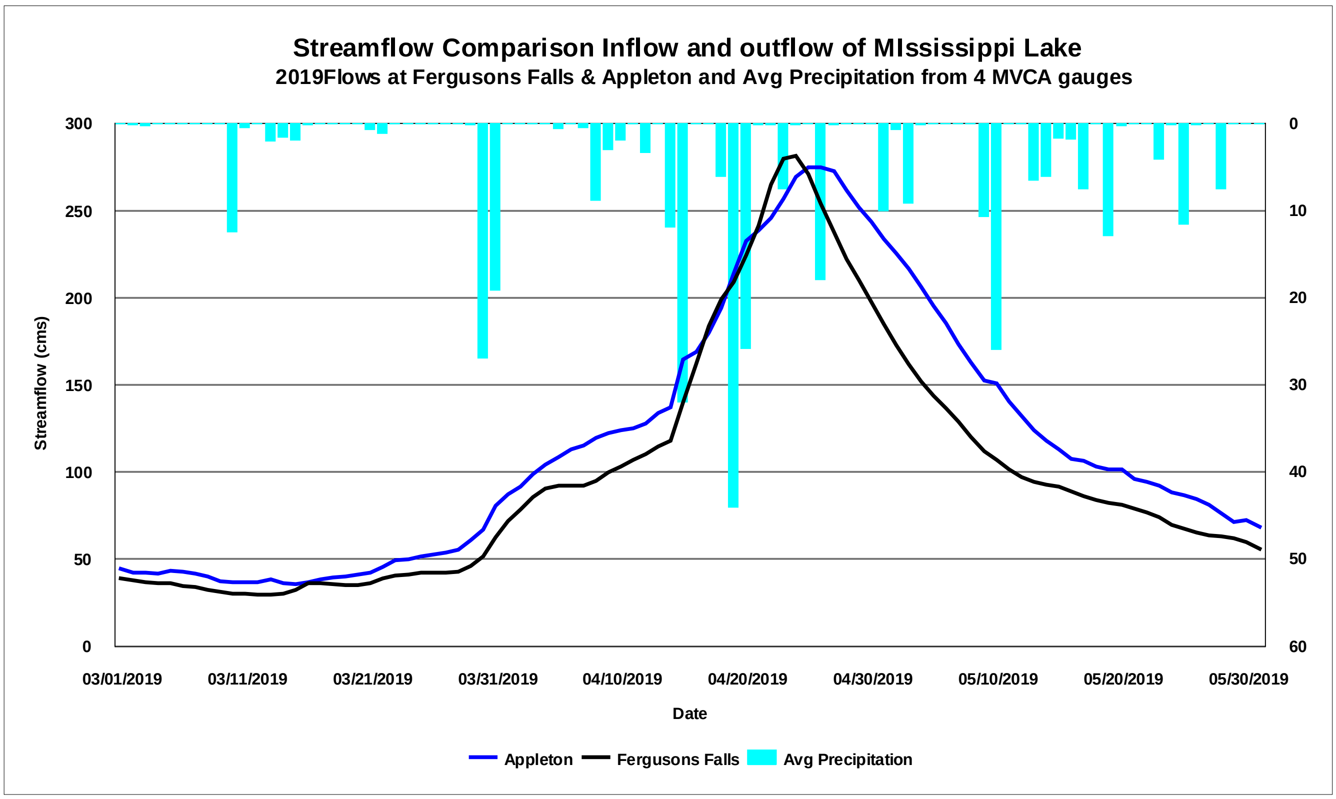



**Figure 6 Ferguson's Falls and Appleton stream gauge Hydrographs**

**MISSISSIPPI LAKE and CARLETON PLACE DAM**

Carleton Place dam is owned and operated by MVCA. It is a concrete structure with five control sections, three containing ten and two containing nine 0.25 x 0.25 x 4.72 m (10” x 10” x 15’-6”) stoplogs in each bay (total of 48). The dam has a 75 m long overflow weir at an elevation of 133.92 m. The dam has a total drainage area of 2876 sq. km. and a total storage capacity of 3787 ha.m.

The primary purposes of this structure are (each purpose has different priority depending on the time of year):

1. mitigate flooding upstream and downstream to the capacity of the structure,
2. maintain summer water levels for tourism and recreation,
3. walleye and bass spawning, other fisheries and wildlife
4. low flow augmentation.
5. water supply for Town of Carleton Place

The Carleton Place dam is limited in its ability to mitigate flooding on Mississippi Lake, especially during extreme flood events. It has been well documented that, similar to the bridge in Lanark on the Clyde River, the bed of the river at the main street bridge above the dam is higher than the top of the 6$^{th}$ log in each bay of the dam. Therefore under flood flow conditions, once 25 logs (out of a total of 48) are out of the dam, the dam has less ability to influence levels on the lake. When flows at Appleton exceed 50 cms, there becomes a noticeable difference in elevations between Mississippi Lake and the dam.

In the fall of 2018, a total of 15 logs were removed from the dam, which is the standard operation for the structure. As the snow pack conditions continued to increase through the winter, the potential for significant runoff increased. Despite no observed increase in flows, an additional 10 logs were taken out of the dam between mid-March and the end of March, leaving the log setting with 25 logs out. Care must be taken when operating the dam when ice is still on the lakes that the ice doesn’t move significantly up or down as this becomes a safety risk for winter sports enthusiast and potential shoreline damage.

As flows begin to increase, the dam is operated to maintain a higher outflow (Appleton) than inflow (Ferguson’s Falls) for as long as possible. Despite having minimal impact on conditions on the lake, an additional 13 stoplogs were removed from the dam over the first two weeks of April. At that time the Ferguson’s Falls flow was 134 cms, Appleton was 166 cms, Mississippi Lake level was 134.83 and C.P. Dam elevation was 134.30 m.

FLOOD WATCH statements were issued for Mississippi Lake on April 12th and 14$^{th}$ and based on the volume of water coming from the upper watershed, FLOOD WARNING statement began being issued on April 15$^{th}$.

Mississippi Lake level peaked on April 25$^{th}$ at 135.66 m, slightly below the record level recorded in 1998 of 135.73 m. Numerous houses, and cottages were flooded as well as many access roads. The elevation at the Carleton Place Dam on the 26th was 134.57 m and there was considerable flooding from the Highway 7 bridge over the Mississippi River through to the dam.

As flows began to recede, the dam was closed off to mimic those dropping inflows. As with other dams, it is important to close bays one at a time to minimize seepage that causes issues later on. The dam began being closed off on May 8th. Due to the volume of water still coming down the system it wasn't until early June that all of the logs were back in the dam.


**Photo 56 Carleton Place Dam View From Upstream**


**Photo 57 Carleton Place Dam Upstream channel**


**Photo 58 Carleton Place Dam Weir**

**Photo 59 Carleton Place Dam Downstream channel**


**Photo 60 Carleton Place Dam View from Downstream**

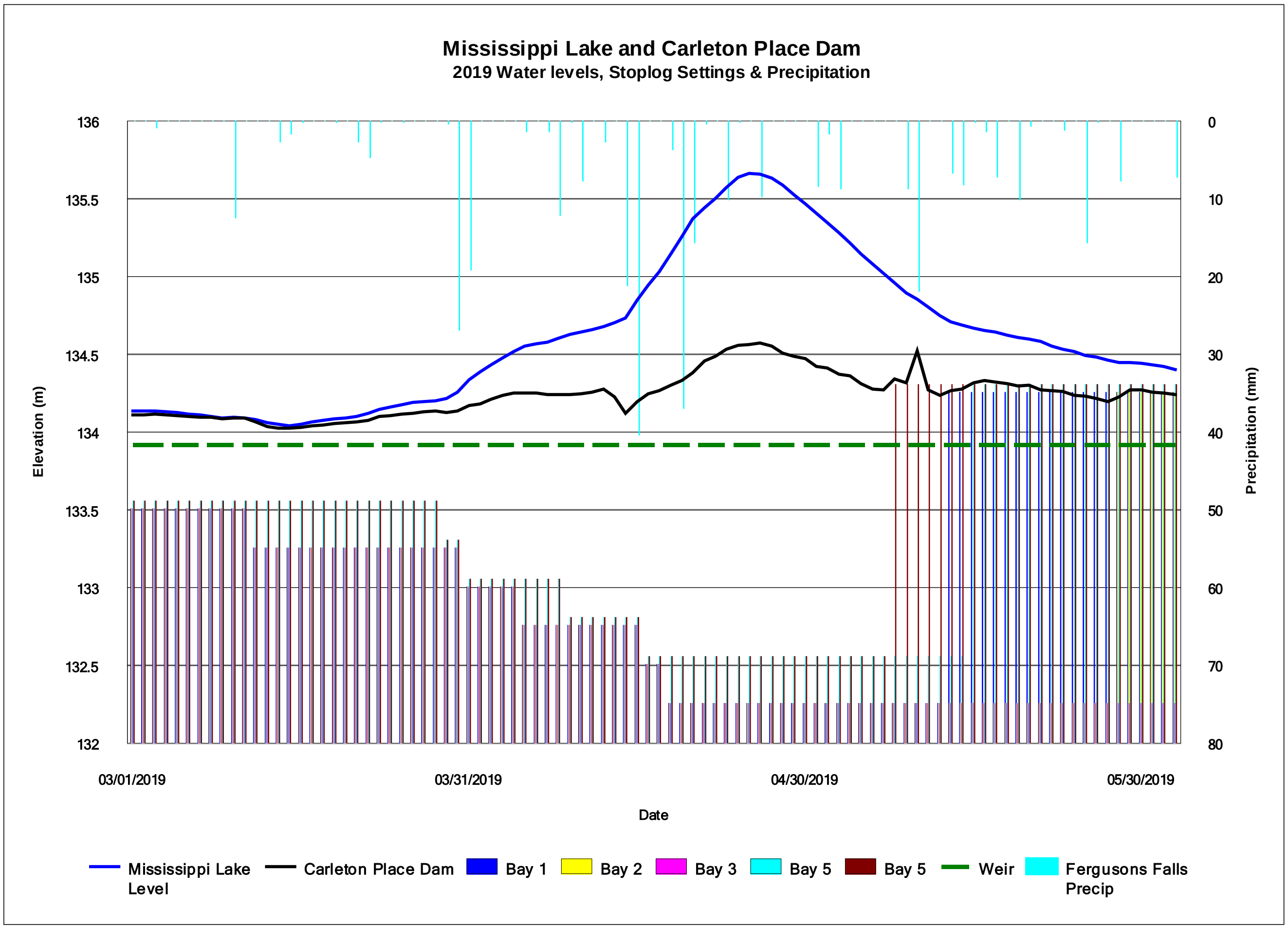



**Figure 7  Mississippi Lake and Carleton Place Dam Water Levels.**
Rain gauge data is an average of the data provided by the volunteers on Mississippi Lake.

# Appendix 1: 2019 Flood Forecasting and Warning Messaging

The spring of 2019 was one of the busiest with regards to Flood Forecasting and Warning messages issued for the Mississippi River Watershed. A total of 18 messages directed at residents of the Mississippi River, its tributaries and the Carp River were issued.

Two **Watershed Conditions - Flood Outlook** statements were issued:

March 5 - “**Potential for above average flooding across the Mississippi and Carp River watersheds**”

March 19 - “**Potential remains for above average flooding across the Mississippi and Carp River watersheds**”

Three **Watershed Conditions – High Water Safety Bulletins** were issued between March 22 and April 5:

March 22 - “**Increasing water levels / flows expected over next week, stay off ice covered waterways and away from ditches and streams**”

April 2 - “**Flows continue to increase steadily, potential for above average flooding remains high**”

April 5 - “**Warmer temperatures and rainfall early next week, potential for levels to increase rapidly through the week”**

Two **FLOOD WATCH STATEMENTS** were issued April 12 and April 14

April 12 - **FLOOD WATCH – Dalhousie Lake**

**Forecasted rainfall creates potential for levels to increase 10-15 cm on Dalhousie Lake**

“rain forecast for today and 25 to 40 mm forecast for Sunday and Monday, levels on Dalhousie Lake could increase by 10-15 cm levels by early next week.”

Dalhousie Lake level on April 12 was 157.07 m.
Forecasted rainfall on April 12– April 12 – 9, April 13 – 0, April 14 – 21, April 15 - 5
Actual Rainfall (avg across WSC tipping buckets) – April 12 – 2.22 mm, April 13 – 0.05 mm, April 14 – 13.75 mm
April 15 Dalhousie Lake Level was 157.26 m

April 14 - **FLOOD WATCH Update # 1 – Lower Mississippi River**

**Rainfall forecasts could increase levels 25-35 cm on Dalhousie Lake by end of week**

“40 mm of rain forecasted for today could raise levels on Dalhousie Lake 25-35 cm. Flows on the Clyde, Fall, Indian and Carp Rivers have increased steadily over the weekend and are expected to increase significantly over the next four days. Levels on Mississippi Lake are expected to increase 30 to 40 cm by mid-week”

April 14 Dalhousie Lake level was 157.11 m. Mississippi Lake level was 134.73 m
April 14 - Clyde River – 43.3 cms; Fall River – 15.7 cms; Indian River – 19.6 cms; Carp River - 36.9 cms
Forecasted rainfall on April 14: April 14 – 22 mm, April 15 – 3 mm, April 16 – 0 mm, April 17 – 0 mm
Actual Rainfall: April 14 – 13.75 mm; April 15 – 31.24 mm; April 16 – 2.48 mm; April 17 – 0.00 mm
April 19 Dalhousie Lake level was 157.47 m, Mississippi Lake was 135.23 m
April 18 - Clyde River – 89.2cms; Fall River – 22.7 cms; Indian River – 28.0 cms; Carp River – 47.0 cms

Eleven **FLOOD WARNING STATEMENTS** were issued between April 15 and May 3.

April 15 - **FLOOD WARNING – DALHOUSIE LAKE**

**FLOOD WATCH - MISSISSIPPI LAKE, CLYDE RIVER**

**WATER LEVELS EXPECTED TO INCREASE 20 TO 30 CM OVER NEXT THREE DAYS**

"…Dalhousie Lake to increase faster than anticipated. Current estimates put levels on the lake rising another 20 to 30 cm above today's current level of 157.26. Levels on Mississippi Lake are expected to increase 30 to 50 cm over today's levels by mid-week"

April 15 Dalhousie Lake level was 157.26 m. Mississippi Lake level was 134.83 m
April 18 Dalhousie Lake level was 157.50 m, Wednesday April 24, Mississippi Lake was 135.63 m

April 17 - **FLOOD WARNING – MISSISSIPPI & CARP RIVER WATERSHEDS**

**SUBSTANTIAL RAIN IN FORECAST COULD LEAD TO SIGNIFICANT FLOODING ACROSS WATERSHEDS**

"Forecasted rainfall amounts of 50 to 65 mm (some forecasts indicate higher amounts) from Thursday to Saturday… . Levels on Dalhousie Lake have stabilized and are expected to remain close to where they are for the next 24 hours. Levels on Mississippi Lake are expected to increase by 10 to 30 cm over today's levels by Thursday."

April 17 Dalhousie Lake level was 157.53 m, Mississippi Lake level was 135.01 m
April 18 Dalhousie Lake level was 157.50 m, Mississippi Lake level was 135.12 m
Actual Rainfall: April 18 – 4.22 mm; April 19 – 45.4 mm; April 20 – 17.19 mm
Avg of MC, BC and Shab Lake gauges: April 18 – 7.63 mm; April 19 – 41.21 mm; April 20 – 26.66 mm

April 20 - **FLOOD WARNING – Update # 1 – April 20, 2019**

**MISSISSIPPI & CARP RIVER WATERSHEDS**

**SEVERE FLOODING EXPECTED ACROSS THE MISSISSIPPI VALLEY WATERSHED**

"**Dalhousie Lake** - levels increasing 25 – 40 cm above today's current elevation of 157.58 m. Depending on the timing of the rainfall, those levels are anticipated to be reached by Sunday or Monday. **Mississippi Lake** – levels increasing 20 – 35 cm above today's current elevation of 135.36 m. Peak levels are expected to be reached Tuesday or Wednesday of next week."

April 20 Dalhousie Lake level was 157.58 m; Mississippi Lake level was 135.36 m
April 22 Dalhousie Lake level was 157.83 m; April 24 Mississippi Lake level was 135.63

April 21 - **FLOOD WARNING – Update # 2 – April 21, 2019**

**MISSISSIPPI RIVER WATERSHED**

**SEVERE FLOODING EXPECTED ACROSS THE MISSISSIPPI VALLEY WATERSHED**

"A band of rain hit the western portion of the watershed last night with rainfall amounts in excess of 30 mm**. Mazinaw Lake / Little Marble and Marble Lakes–** levels increased by approximately 30 cm overnight and are expected to increase another 5 to 10 cm over the next 24 hours. **Dalhousie Lake** - over the next 24 hours levels are expected to increase 5 to 10 cm from this morning's elevation of 157.77 m. Levels should remain stable until Tuesday. **Mississippi Lake** – levels increasing 10 – 15 cm above today's current elevation of 135.47 m. Peak levels are expected to be reached Tuesday or Wednesday of next week. **Mississippi River downstream of Mississippi Lake –** flows are expected to continue to increase throughout the weekend. **Clyde and Fall Rivers** – flows are still increasing but are expected to peak later today or early tomorrow. **Indian and Carp Rivers –** flows on the Indian and Carp Rivers have peaked and are beginning to drop. Flows are expected to be below flood stage by the middle of the week. **The FLOOD WARNING is terminated for these rivers.**"

April 21 Mazinaw Lake level was 268.48 m; Dalhousie Lake was 157.77 m; Mississippi Lake was 135.47 m; Mississippi River at Appleton – 237.52 cms; Clyde River – 129.5 cms; Fall River – 25.9 cms
April 22 Dalhousie Lake Level was 157.83 m; Clyde River – 135.2 cms; Fall River – 26.1 cms
April 23 Dalhousie Lake Level was 157.84 m; Clyde River – 117.7 cms; Fall River – 25.4 cms
April 24 Mississippi Lake level was 135.63 m, Mississippi River at Appleton – 268.54 cms

April 23 - **FLOOD WARNING – Update # 3 – April 23, 2019**

**MISSISSIPPI RIVER WATERSHED**

**SEVERE FLOODING EXPECTED ACROSS THE MISSISSIPPI VALLEY WATERSHED**

"**Mazinaw Lake / Little Marble / Marble Lakes–** levels have stabilized on Mazinaw Lake and are expected to begin dropping tomorrow. **Kashwakamak Lake / Buckshot Creek:** levels on Kashwakamak Lake have increased steadily overnight and may increase another 5 to 10 cm through today and tomorrow. Levels are expected to peak tomorrow. **Dalhousie Lake** – Levels have been relatively stable over the last 18 hours … are expected to increase 20 to 30 cm above the current elevation of 157.84 m over the next 24 to 36 hours.

**Mississippi Lake** – levels continued to climb through the weekend and are currently at 135.56 m. … still expected to increase another 10 to 15 cm over the next 48 to 72 hours. **Mississippi River downstream of Mississippi Lake –** flows are expected to continue to increase through the week. **Clyde and Fall Rivers** – flows are dropping steadily in both of these watersheds. A **FLOOD WATCH** will remain in effect for these watersheds until the next update is issued."

April 23 Mazinaw Lake level was 268.58 m; Kashwakamak Lake was 261.37 m; Dalhousie Lake was 157.84 m; Mississippi Lake was 135.56 m; Mississippi River at Appleton – 253.28 cms; Clyde River – 117.7 cms; Fall River – 25.4 cms
April 24 Mazinaw Lake level was 268.52 m; Kashwakamak Lake level was 261.47 m
April 25 Mazinaw Lake level was 268.45 m; Kashwakamak Lake level was 261.49 m; Dalhousie Lake level was 158.00 m; Mississippi Lake was 135. 66 m; Mississippi River at Appleton – 274.18 cms

April 25 - **FLOOD WARNING – Update # 4 – April 25, 2019**

**MISSISSIPPI RIVER WATERSHED STABILIZED**

**SIGNIFICANT RAINFALL & WIND TOMORROW COULD CAUSE ADDITIONAL PRESSURE ON LAKES IN FLOOD CONDITIONS**

"Significant rainfall is forecasted for tomorrow but the amount of precipitation from that system is uncertain, with a range of 20 to 50 mm. **Mazinaw Lake / Little Marble / Marble Lakes:** Levels continue to drop. **Kashwakamak Lake / Buckshot Creek:** Levels on Kashwakamak Lake have stabilized and are expected to begin to subside by the weekend. **Dalhousie Lake**: Levels are expected to peak today. The level is currently 158.00 m and should not increase more than 1 to 3 cm. **Mississippi Lake**: Levels have stabilized at 135.66 m. **Mississippi River downstream of Mississippi Lake:** Flows appear to have stabilized.

Forecast – **SPECIAL WEATHER STATEMENT, Ottawa (Kanata – Orléans)**

Accuweather for C.P. – April 25 - 0 mm; April 26 – 23 mm, April 27 – 2.7 cm snow, Apr 28 – 0 mm
Weather Network - April 25 - 0 mm; April 26 – 22.1 mm, April 27 – 3.5 mm, Apr 28 – 0 mm
Actual Rainfall: April 25 – 0 mm; April 26 – 13.34 mm; April 27 – 0.21 mm; April 28 – 0.00 mm
April 25 Mazinaw Lake level was 268.45 m; Kashwakamak Lake level was 261.49 m; Dalhousie Lake level was 158.00 m; Mississippi River at Appleton – 274.18 cms
April 26 Mazinaw Lake level was 268.35 m; Kashwakamak Lake level was 261.48 m; Dalhousie Lake level was 158.04 m; Mississippi Lake was 135.66 m; Mississippi River at Appleton – 274.39 cms

April 26 - **FLOOD WARNING – Update # 5 – April 26, 2019**

**DALHOUSIE LAKE LEVELS EXPECTED TO INCREASE 5 – 10 CM**

"Significant rainfall is forecasted for Friday but the amount of precipitation from that system is uncertain, with a range of 20 to 50 mm. **UPDATE Snow Road /**

**Dalhousie Lake:** Continued high flows out of the upper watershed will cause levels in the Snow Road area fluctuate over the next 48 to 72 hours. The expected operations over the next few days could cause water levels on Dalhousie Lake to increase 0.05 to 0.10 m.

Actual Rainfall: April 26 – 13.34 mm (bulk of rainfall in western watershed MC/BC/Shab – avg 21.75 mm)
April 26 Dalhousie Lake level was 158.04 m
April 27 Dalhousie Lake level was 158.11 m
April 28 Dalhousie Lake level was 158.13 m

April 27 - **FLOOD WARNING – Update # 6 – April 27, 2019**

**DALHOUSIE LAKE LEVELS EXPECTED TO INCREASE 2 – 5 CM**

"Rainfall amounts between 10 and 20 mm fell across the watershed yesterday. **Mazinaw Lake / Little Marble / Marble Lakes:** Levels continue to drop. **Kashwakamak, Mississagagon and Big Gull Lakes:** Levels on these lakes are at or near all-time high levels but have been relatively stable over the last 24 hours. Water levels on Dalhousie Lake continue to increase and are currently projected to rise another 2 to 5 cm above the current elevation of 158.11 m. **Mississippi Lake**: Levels have been stable over the last 36 hours and appear to be just beginning to recede."

April 29 - **FLOOD WARNING – Update # 7 – April 29, 2019**

**MISSISSIPPI RIVER WATERSHED FLOWS AND LEVELS DECLINING**

"Water levels on Dalhousie Lake peaked at 158.13 m and have been declining since the evening of April 28th. **Mississippi Lake**: Levels peaked on Mississippi Lake at 135.66 m and have been declining since midnight on April 26th."

May 1 - **FLOOD WARNING – Update # 8 – May 1, 2019**

**MISSISSIPPI RIVER FLOWS AND LEVELS CONTINUE TO DECLINE**

May 3 - **FLOOD WARNING – TERMINATION – May 3, 2019**

**WATER LEVELS DECLINING ACROSS THE WATERSHED**

Three **Watershed Conditions – High Water Safety Bulletins** were issued between May 10 and May 28:

May 10 - **Watershed Conditions – High Water Safety Bulletins – May 10, 2019**

**Water levels declining but still well above normal from Dalhousie Lake to Galetta**

May 17 - **Watershed Conditions – High Water Safety Bulletin Update # 1 – May 17, 2019**

**Water levels continue to decline**

May 28 - **Watershed Conditions – High Water Safety Bulletin Update # 2 – May 28, 2019**

**Water levels continue to decline**

In addition to the messages issued for the Mississippi Valley watershed, staff also issued 19 messages (**2 FLOOD WATCH and 17 FLOOD WARNING statements)** regarding the Ottawa River between April 17 and May 31, 2019.