Flood Flow Statistics For The Great Lakes Watershed System

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Disclaimer

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Additional Information

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Executive Summary

In 2014, as part of its hydrological data program, the Spatial Data Infrastructure Unit of the Ontario Ministry of Natural Resources and Forestry (MNRF) generated single-station flood frequency estimates for the Water Survey of Canada's (WSC) HYDAT gauges in the Great Lakes watershed systems that lie within the Province of Ontario. The resultant statistics include the flood magnitude with recurrence intervals of 1:2, 1:2.33, 1:5, 1:10, 1:20, 1:25, 1:50, 1:100, 1:200 and 1:500 years.

The flood magnitude statistics can be used for applications such as floodplain delineation and design of hydraulic structures.

The estimated flow statistics are distributed as an MS Access Personal Geodatabase and will be included in the Ontario Flow Assessment Tool (OFAT) III web application in the future.

The following document details how the above statistics were estimated, the structure of the final data packages (as distributed) and considerations on appropriate data uses and data limitations.

Key Words

Flood Flow, Frequency Analysis, Great Lakes, OFAT III

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List of Acronyms

A: Drainage area

C: Creager constant

CFA: Consolidated Frequency Analysis

$C_{v:}$ Coefficient of variation

$C_{s:}$ Coefficient of skewness

EVI: Extreme Volatility Index

EVR: Extreme Volatility Ratio

HOMS: Hydrological Operational Multipurpose System

HYDAT: The archive for Canadian Hydrometric Data

K: Frequency factor

Km: Kilometres

3PLN: Three-Parameter Lognormal Distribution

M: Rank

MNRF: Ministry of Natural Resources and Forestry

m3/s: cubic metre per second

N: Sample size

N: Factor

OFAT III: Ontario Flow Assessment Tool version III

P: Probability

P(F): Probability of an event F

Q: Discharge

Q: Unit discharge

QD1 and QD3: Daily mean flows on days 1 and 3

QD2: Annual maximum daily mean flow

sq. km: Square Kilometres

R: Ratio of magnitude of the 100-year event to the 2-year event

RHBN: Reference Hydrometric Basin Network

T: Student's statistical value at the 90 percent level of significance with (Y-6) degrees of freedom

T: Return period in years

$x_{T:}$ Scale factor

Y: Minimum accepted years of record

Y: return level

Σ: Standard deviation

1. Introduction

1.1 Preamble

Since 2012, under the Far North Planning Initiative, the Spatial Data Infrastructure Unit of the Ontario Ministry of Natural Resources and Forestry has developed a suite of streamflow statistics for the WSC's, HYDAT stream gauge stations for the Southwestern Hudson Bay and Nelson River watershed system that lie within the Province of Ontario. The streamflow matrices are generated for the streamflow regime with respect to the magnitude, frequency, duration and timing.

In the fiscal year of 2014-2015, there was an identified need to update and extend the flood frequency analysis to southern Ontario. This technical document details the flood frequency analysis for the Great Lakes watershed system considering only open water flooding.

1.2 Overview of Flood Frequency Analysis

Hydrological systems are influenced by extreme events with flooding on the higher extreme and drought on the lower extreme of streamflow. The occurrences of these extremes are estimated using a procedure called frequency analysis. The objective of the frequency analysis is to determine the magnitude of the flood/drought to frequency of the responding occurrence. The present study focuses solely on an analysis of flood frequency.

An understanding of the likelihood of a given flood magnitude is necessary for floodplain management, design values for any construction that crosses or passes a stream, flood forecasting, and input into flood line mapping. Some of the application areas where these analyses are used are:

- Design of in-stream structures (culverts, bridges, spillways, etc.)
- Floodplain delineation and management
- Municipal and industrial uses (design of water supplies)
- Environment impact assessment studies
- River navigation

- Reservoir operation (determine minimum downstream release requirements) and aquatic based recreation
- Irrigation facilities
- Mitigating the conflict between in-stream water use and water withdrawal demand
- Engineering feasibility assessment or design and operation of structures

1.3 Objective

The objective of this project is to estimate the flood magnitude with recurrence intervals of 1:2, 1:2.33, 1:5, 1:10, 1:20, 1:25, 1:50, 1:100, 1:200 and 1:500 years for the gauges of Great Lakes watershed system.

1.4 Province of Ontario and the Study Area

The Province of Ontario extends approximately from 42°N to 57° N latitude and from 75° W to 95°W longitude with three primary watersheds: Great Lakes, Nelson and Southwestern Hudson Bay. It is the second largest province based on total area and the most populous province in Canada. The total area is 1,076,395 km^2 with 917,741 km^2 of land and 158,654 km^2 of fresh water (Statistics Canada, 2005). Ontario has three main climatic regions: southwestern Ontario is typical of a moderate humid continental climate, central and eastern Ontario is characteristic of a more severe humid continental climate and the northernmost parts of Ontario (north of 50°N) are within a sub-arctic climate region (Köppen *Dfa Dfb Dfc*).There are four seasons: spring, summer, fall and winter. The annual average temperature decreases with increasing latitude. January temperatures average -6 °C and those of July average 20 °C. Total annual precipitation decreases in amount from 864 mm in the south-west to less than 508 mm in the most northern portions of the Province. The mean annual runoff varies from a low of 200 mm in the western to a high of 500 mm eastern part of the Province.

Unique geographic features include Niagara Falls, Niagara Escarpment, World Biosphere Reserve and Oak Ridges Moraine and four of the five Great Lakes; Huron, Ontario, Erie and Superior lie in the southern parts of Ontario. Other large lakes include Simcoe, Nipigon, Nipissing and St. Clair, Lake of Woods, Lac Seul, Rainy, Abitibi and Big Trout. Some of the major rivers of the province include the Severn, Winisk, Attawapiskat, Albany, Moose and Ottawa River.

Streamflow is dependent on the time of the year. Flows are high during the months of March-April and lower summer flows typically occur during the month of August. Flooding also occurs in Ontario. The primary causes of flooding in the northern Ontario are snowmelt runoff and or ice jams whereas for southern Ontario it is a combination of snowmelt and spring rainfall. In addition, high intensity precipitation events can occur in the summer, but flood peaks are restricted as summer vegetation increases infiltration and surface storage. Summer thunderstorms sometimes produce local floods and coastal flooding can occur along the shorelines of the Great Lakes. Broader climatic processes, such as El Nino and La Nina events, can impact the hydrology within Ontario. Hurricane Hazel occurred in 1954 in southern Ontario causing extreme flooding.

The study area for the present study is the Great Lakes watershed system. The Great Lakes system is located on the Canada–United States border with the Saint Lawrence River connecting to the Atlantic Ocean. The watershed system consists of five lakes namely: Superior, Michigan (wholly within the US), Huron, Erie, and Ontario. These lakes form the largest group of freshwater lakes with 18% of the world's surface fresh water (Environment Canada, 2014). The lakes have a moderating effect on the climate of the region. Great Lakes fall into two physiographic regions, namely the Canadian Shield in the north and the St. Lawrence Lowlands in the southern region of Ontario.

The Canadian Shield is typically dominated by thin soil cover over bedrock. A mix of forest, wetlands, lakes and rivers dominates the area with little agriculture being present. Relief is much greater than other regions resulting in greater and more rapid runoff.

The Great Lakes St. Lawrence Lowlands has a rolling landscape and rich fertile soil which is suitable for agriculture. The main features of the area are the Niagara Escarpment, Niagara Falls and the Oak Ridges Moraine. This area is densely populated and heavily industrialized.

2. Scientific Principles and Methodology

There are two methods available to estimate the magnitude of flood flows.

They are:

1. Mathematical method using frequency factors
2. Graphical method using probability papers

The following section describes the two methods above.

2.1 Mathematical Method Using Frequency Factors

Before discussing the frequency factors, the general concept of recurrence interval is described below. A recurrence Interval or Return Period for flood flow is defined as:

> An annual maximum event has a return period (or recurrence interval) of T years if its magnitude is equalled or exceeded once, on the average, every T years. The reciprocal of T is the exceedance probability, 1- F, of the event, that is, the probability that the event is equalled or exceeded in any one year (Bedient, 2002).

The probability (*P*) that an event (*F*) will occur in any year (*T*) expressed mathematically as:

$$P(F) = \frac{1}{T}$$

Return Period is the reciprocal of probability and expressed mathematically as:

$$T = \frac{1}{P}$$

Flood data are analysed either with the use of the Central Limit Theorem or the Extreme Value Theorem. These two theorems lead to the log-probability law and extreme value law respectively. The log-probability law states that the logarithms of the values are normally distributed; the extreme value theorem states that the instantaneous annual maximum approaches a definite pattern of frequency distribution when the number of observations in each year is large. Based on the above two laws, distributions are chosen to fit the data. The distributions used for the present study are: the Generalized Extreme Value, the Log-Pearson Type III distribution of the extreme value law and the Three-Parameter Lognormal from the log-probability law. The estimated flood magnitudes reported are taken from the Three- Parameter Lognormal distribution and a brief description of the distribution is given at the end of this section. The statistical details of all the distributions and the way the program handles different cases for this can be found in the Consolidated Frequency Analysis (CFA) user manual (Pilon,1985) .

The general equation for estimating the return level in terms of the frequency factor, K for hydrological studies is given by Chow (1964). It is expressed mathematically as:

$$y = \bar{y} + \sigma K$$

$$y = \text{return level}, \ \bar{y} = \text{mean},$$
$$\sigma = \text{standard deviation}, K = \text{frequency factor}$$

The variate, y is represented by the mean plus the departure, σK (product of standard deviation, σ and the frequency factor, K). The frequency factor is a function of a recurrence interval and depends on the type of distribution.

2.1.1 The Three-Parameter Lognormal Distribution

As stated above the details of the Three-Parameter Lognormal distribution is given below. The Three-Parameter Lognormal distribution is a general skew distribution in which the logarithm of any linear function of a given variable is normally distributed. The variable “x” is the random variable, “a” is the lower boundary of the variate “x” and (x-a) is the reduced variable. The parameter “a” can be positive, zero or negative (Sangal and Biswas, 1970). The principal advantage of the Three-Parameter Lognormal distribution is that it provides a simple method for preserving the first three moments of the observed data (Burges et al. 1975).

The probability density function and the general frequency equations of the three-parameter lognormal distribution are given below:

$$f(x) = \frac{1}{\sigma(x-a)\sqrt{2\pi}} \exp\left(\frac{\left(-\left[\ln(x-a)-m\right]^2\right)}{2\sigma^2}\right) \quad \text{.......(1)}$$

$$\begin{aligned} &Q_T = a + \exp(m + t\sigma)\ldots\ldots\ldots \quad Positive - skewness \\ &or \\ &Q_T = a - \exp(m - t\sigma)\ldots\ldots\ldots\ldots Negative - skewness \end{aligned} \quad \text{........(2)}$$

Where m: location parameters for the transformed variate ln(x-a)

σ: scale parameters for the transformed variate ln(x-a)

a: lower boundary of the variate x

t: frequency factor at the required probability level

First parameters of the distribution are estimated using the function (1) and the flood magnitude (s) are estimated using the equation (2) for exceedance probabilities from 0.002 to 0.997.

2.2 Graphical Method Using Probability Papers

The fundamental principle of the graphical method is to develop a linear relationship between the recurrence interval and the event magnitude. The present study uses the Cunnae plotting position to plot data on the Gumbel probability paper. The plotting formula is:

$$T = \frac{(N + 0.2)}{(m - 0.4)}$$

Where N is the sample size and m the rank, starting with rank one for the highest. The graphical output in the probability graph displays the data points (sample series of flood/drought) and the plotted function of the distribution in question.

The software program, CFA uses Gumbel probability paper to plot the data points. The return level, or magnitude of streamflow (discharge), is plotted in the vertical axis (y-axis) and the scale is arithmetic. The return period (T-years) is plotted in the horizontal axis (x-axis) and the scale is Gumbel. The following expression gives the Gumbel variate (scaling factor).

$$x_T = -\left[\ln * \ln\left(\frac{T}{T-1}\right)\right]$$

Where: x_T = scale factor and T = return period

A flood frequency plot is used as a visual check to see the goodness of fit of the series of flood events. Therefore, both mathematical and graphical methods are used to make the decision on the distribution and therefore the return period-return level values.

3. Software Used

The Consolidated Frequency Analysis (CFA) version 3.1 software was created by the Interpretation and Access Division, Surveys and Information Systems Branch, Environment Canada. The software was written in FORTRAN 77 and has been used for frequency analysis. The CFA software is a Hydrological Operational Multipurpose System (HOMS) component (181.2.02) established by the World Meteorological Organization for the transfer of technology in hydrology and water resources developed for flood frequency analysis.

The input data required for analysis are annual maximum instantaneous discharge, the year and month of its occurrence. The theoretical probability distributions used for analysis are: the Generalized Extreme Value, the Three-Parameter Lognormal, the Log-Pearson Type III and the Weibull.

4. Data Source and Gauging Stations

Historic streamflow records from the WSC HYDAT data up to December 31, 2012 were utilized for estimating the magnitude of flood. The time convention used in Canada for reporting streamflow data is the calendar year from January 1 to December 31. Active stream gauge stations with more than 10 years of record, both regulated and natural were selected for a total number of 297 gauges. Of the 297 gauges, there are 12 Reference Hydrometric Basin Network (RHBN) gauges. Figure 1 shows the gauge locations and Appendix A and B show the details of the gauges.

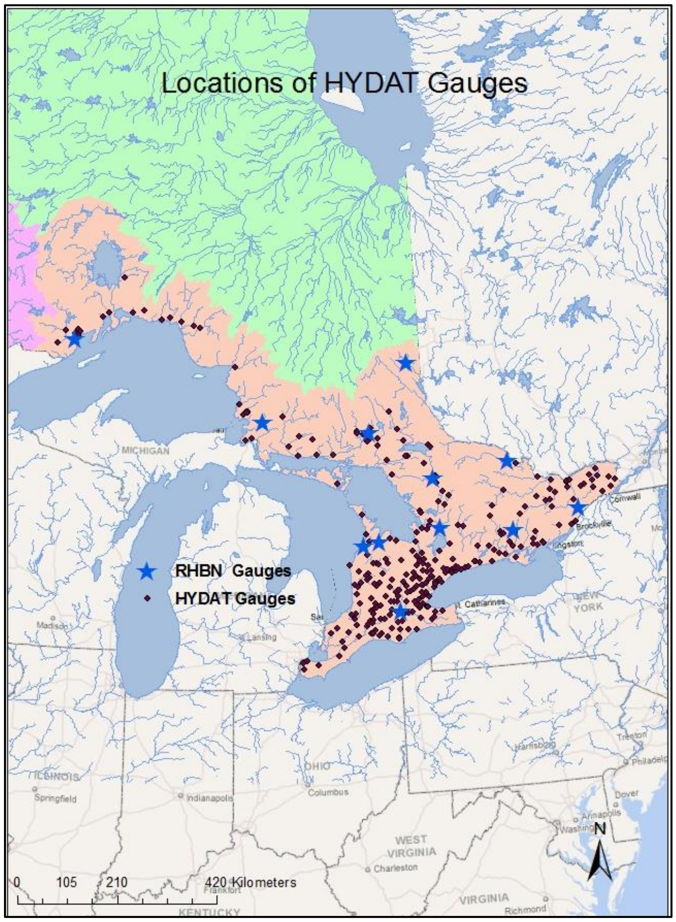
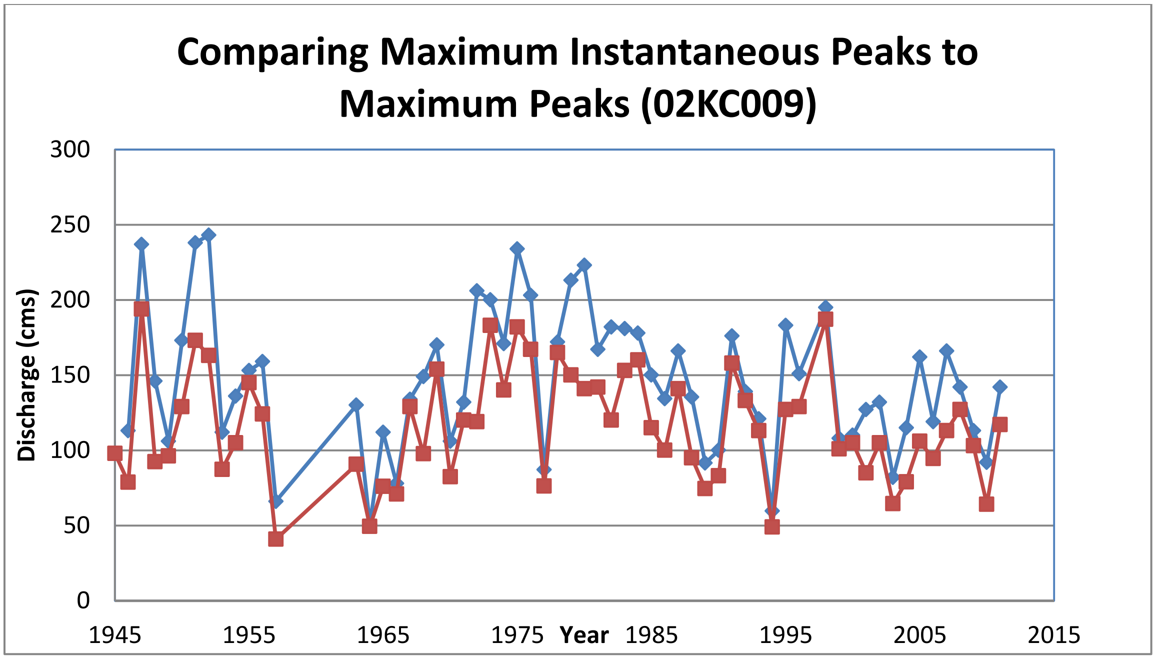


Figure 1: WSC’s HYDAT gauge locations in the Great Lakes watershed system.

5. Parameters Used

Annual flood is the highest momentary peak discharge in a water year/calendar year (Dalrymple, 1960). This flood, technically called annual maximum peak instantaneous streamflow, is used for frequency analysis. It is useful for the design flood estimation as it better represents the highest floods stage encountered at the stream reach. Data from previous flood frequency studies conducted by Moin and Shaw (1985) were updated to 2012.



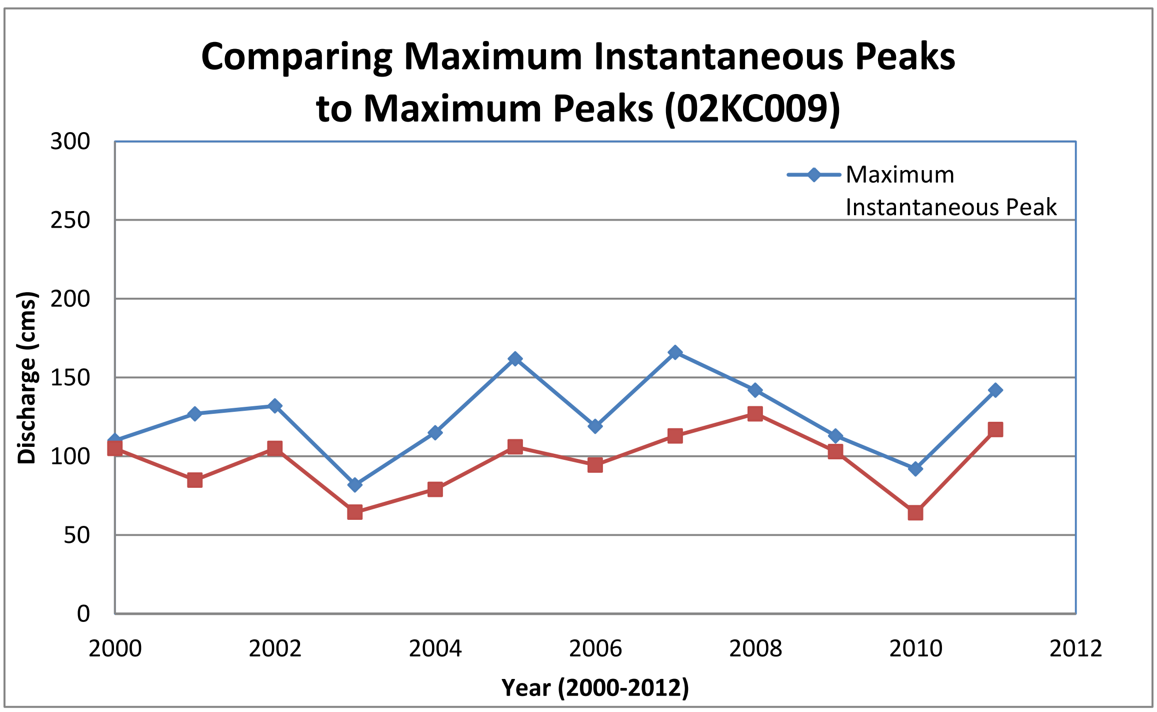


Figure 2(a) and 2(b): Comparing maximum instantaneous peaks to maximum peaks.

The input data is zipped with the data package as “GreatLakesFlood_InputData_2014.” For filling the missing data, Sangal (1981) developed a methodology and the details are given in the next section. The previous study mentioned above used this method to fill missing records. This study also used the same method. The annual maximum streamflow and the annual peak instantaneous streamflow are superimposed as shown in Figure 2(a) and 2(b) highlighting the relative streamflow values.

5.1 Estimation of Maximum Instantaneous Flow Data from Maximum Mean Flow Data

The maximum instantaneous flow value is estimated using methods from Sangal (1981). “The method uses variables that are the mean daily flows of three consecutive days with the maximum daily flow occupying the middle position. A parameter, the value of which lies between zero and two, is designated as base factor K and has a governing influence on the estimated peak.”

The following equation was used to fill in missing data.

$$\text{PredictedFlow, QPP} = \frac{(QD1 + QD3)}{2} + \frac{(QD2 - QD1 - QD3)}{(1 - 2\alpha)}$$

Where

QD1, QD2 and QD3: daily mean flows on days 1, 2 and 3 respectively

QD2: annual maximum daily mean flow

K: base factor, (1-2α)

When α = 0 (or k=1) the equation becomes the basic equation

$$\text{PredictedFlow, QPP} = \frac{(4QD2 - QD1 - QD3)}{2}$$

6. Analysis and Results

As discussed in the previous section, the series of historical annual maximum floods are used as input for the frequency analysis. After the data preparation, four steps are involved to derive the final data product. These steps are discussed upcoming sections of the report: Exploratory Analysis (Section 6.1), Statistical Tests (Section 6.2), Flood Modelling (Section 6.3), and Flood Modelling Data Products (Section 6.4).

6.1 Exploratory Analysis

6.1.1 Understanding the Flood Characteristics of Watershed

Frequency analysis is conducted for gathering inference about streamflow. Before making any estimation on flood, a user can draw inferences about the flood characteristics of the watershed by setting up some intermediate steps. The importance of these intermediate steps lies in the fact that it provides an understanding of the whole data (gauges that lie within the region) on one hand and the flood magnitude on the other hand. The intermediate values estimated at the watershed scale are:

- Summary of the mean annual floods and their relationship to the drainage area to derive the flood coefficient
- Summary of the coefficient of variation of the annual floods
- Summary of the coefficient of skew of the annual floods

The mean annual flood is the mean of the historic flood sample (maximum instantaneous peak flow). According to the theory of largest values (Gumbel, 1945a), the mean of the annual floods of a stream gauge should have a value corresponding to the 2.33 year recurrence interval (Dalrymple, 1960) and theoretical exceedance probability of 0.43. This value is the nexus point in connecting the flood generating mechanism with the size of the watershed i.e. the drainage area of the watershed.

Flood coefficient expresses the relation of the annual mean flood to the watershed drainage area. To get this value, exponential regression analysis is done with the annual mean flood with the drainage area. The flood is not linearly dependent on the drainage area but with a factor, n. The equation is given below:

$$\text{Coefficient of Flood} = \frac{\text{Mean Annual Flood}}{(\text{Drainage Area})^{n}}$$

Coefficient of variation gives the ratios of the large floods to the mean flood. It is the relative variation from the mean or in other words, it is the degree of dispersion. If this ratio is small, then the flood magnitude variability is marginal. It is expressed as the ratio of the standard deviation to the mean. The value is independent of the sample size. In other words, the coefficient computed from a small or large sample will be the same.

$$\text{Coefficient of Variation } (C_v) = \frac{\text{Standard Deviation } (\sigma)}{\text{Mean } (\mu)}$$

Coefficient of skew of flood is a measure of the asymmetry of the probability distribution around the mean. All streamflow data forms skew curves and the coefficient of skew is the measure of the curvature of the flood. In terms of the degree of skewness, the flood data is less skewed than daily data (Sangal and Biswas, 1970). Unlike the coefficient of variation, the coefficient of skew depends on the sample size. Therefore, the value has to be adjusted using the formula that accounts for the sample size and the factor, F as given by Foster is: $F = 1 + \frac{8.5}{n}$. The adjustment is made by multiplying the computed coefficient by the factor, F.

$$\text{Coefficient of Skew } (C_{s\,(\text{computed})}) = \frac{n}{(n-1)(n-2)} \sum \left[\frac{x_i - \bar{x}}{\sigma} \right]^3$$

The values for each stream gauge are given in Appendix C. Figures 3 (a), 3(b), and 3(c) show the mean flood, coefficient of variation and coefficient of skewness. Within the Great Lakes watershed system the coefficient of variation is less than one except for one gauge (02HC003: HUMBER RIVER AT WESTON). Only twenty gauges are negatively skewed in the system.

The exponential relationship between the mean flood and the drainage area is generated and the coefficient of flood is 0.8753. The relationship is given below.

$$\text{Mean Flood, Q} = 0.8753 * (\text{Drainage Area})^{0.7072}$$
$$\text{with } R^2 = 0.8147$$

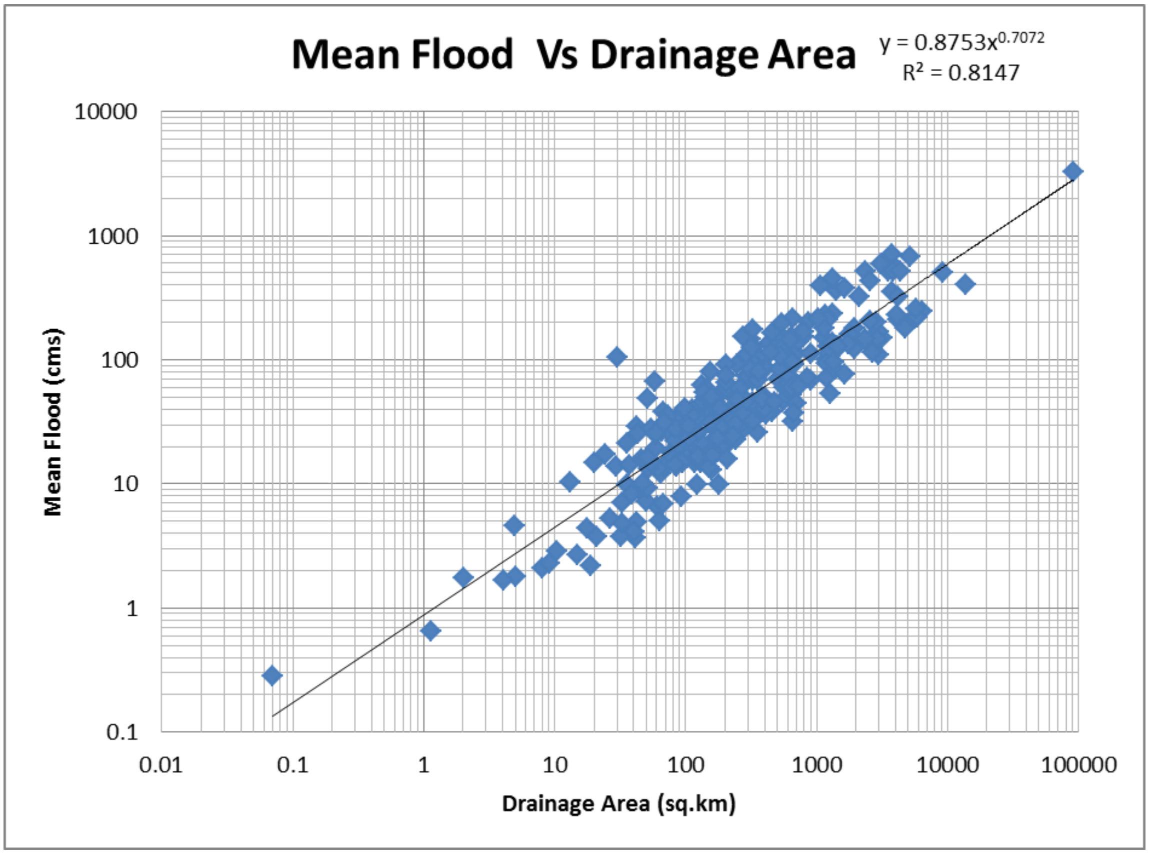


Figure 3(a): Flood characteristics of the Great Lakes watershed system.

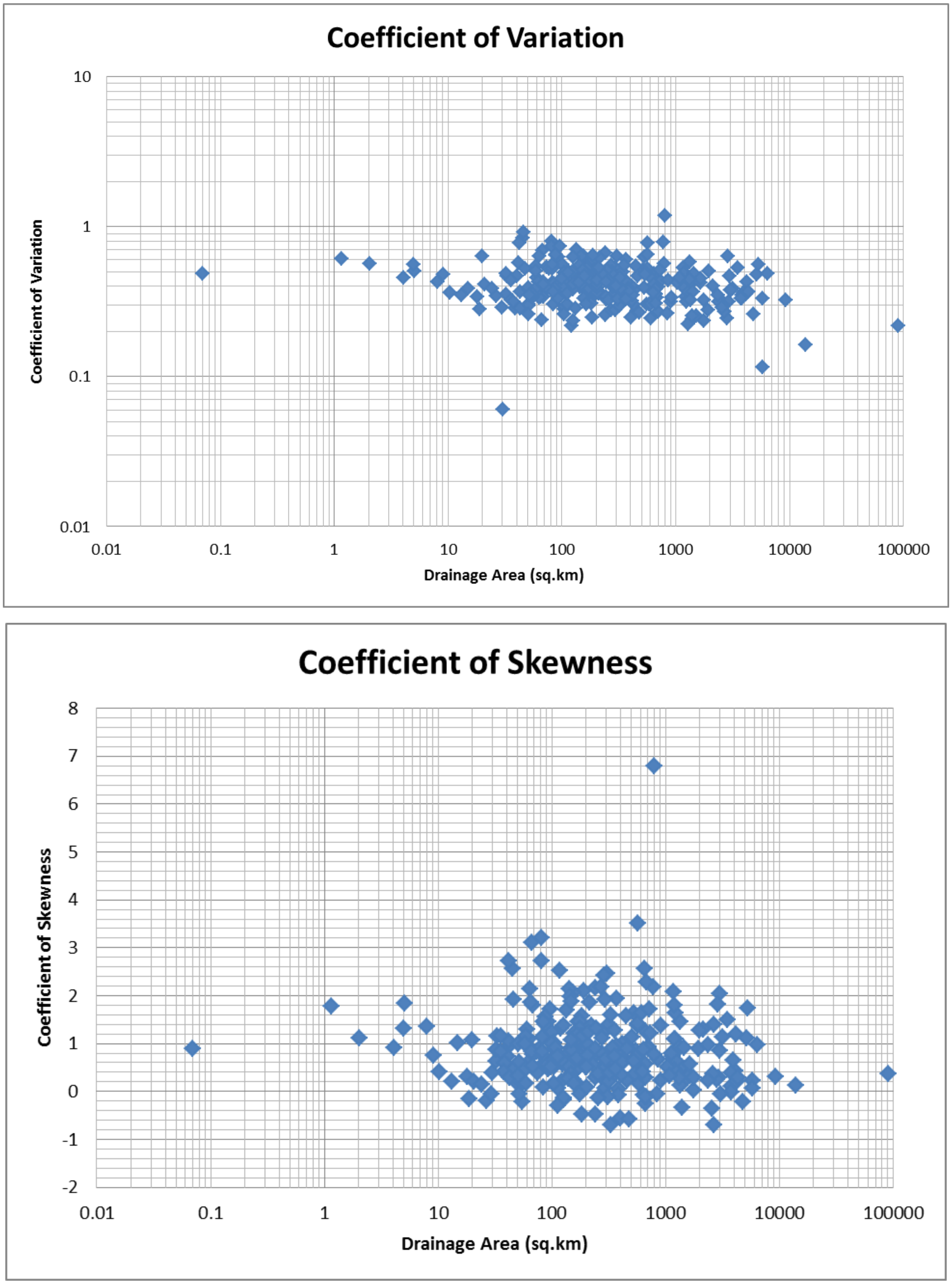


Figure 3(b) and (c): Flood Characteristics of the Great Lakes watershed system.

6.1.2 Maximum Flood and Creager Curve

In 1941, Creager developed an envelope curve based on the compilation of the unusual floods in the Unites States and other countries. The flood envelope diagram was plotted either taking peak discharge or discharge per unit area against the drainage area. The double exponent equation he developed is given below:

$$Q = 46 * C * A^{\left(0.894 * A^{-0.048}\right)}$$

$$or$$

$$q = 46 * C * A^{\left(0.894 * A^{-0.048}\right) - 1}$$

Where,

Q: discharge in cubic feet per second

q: unit discharge in cubic feet per second per square miles

A: drainage area in square miles

C: Creager coefficient

The value of the Creager constant, C depicts the flood severity. In the original plot, a value above 30 and below 100 fit the data. A value of 100 has the lowest exceedance, which means that the associated watershed area has the maximum flood-producing streams in that section. The value of the constant is helpful when comparing extreme floods at a global context. The importance of this curve as stated in the Hydroelectric Handbook (Creager, 1958) is cited below:

> "When the magnitude of the peak of a flood from a given drainage area is known, it is sometimes desired to know what the peak probably would be from a different drainage area of the same characteristics and under the same meteorological conditions-for instance, from another point on the same river or a similar river."
>
> The handbook also talks about "the consideration that future enveloping curves for a given district will continue to rise as time passes and more records are obtained."

In 1989, Watt et al. reproduced the Creager curve by adding highest known Canadian flood data from WSC to the original plot. This included 22 floods in Canada of which one case (hurricane Hazel) was from Ontario. The Canadian values are plotted in the lower part of the curve where the Creager constant lies between 20 and 40. The reason for low values is given by Lawford et al. (1995) and is cited below:

> “On global basis, areas with frequent monsoons, typhoons, hurricanes, tsunamis, and tidal effects experience worse flooding than Canada. One explanation for some of these events may be that surface air at latitudes closer to the equator holds more moisture and under the right synoptic conditions can also yield more precipitation.”

For the present study, to relate and compare the world’s largest floods to the Great Lakes watershed flood, the Creager envelope curve was superimposed on the maximum floods. The construction was done using the following steps:

- For each gauging station under study, the maximum recorded flood is tabulated against the corresponding effective drainage area
- The tabulated data are plotted on log-log paper
- On the above point data plot, the Creager curve was superimposed using the equation and converting to the S.I units. Creager curves corresponding to Creager constants of 10, 20 and 30 are shown in Figure 4.

The Figure 4 shows the maximum flood as a function of drainage area with the Creager curve superimposed. The value fits well with the Creager constant of 10. The lower value of the constant indicates that floods in the Great Lakes watershed are low when compared to the world’s largest floods.

In Canada, British Columbia, Alberta and the Prairies have generated the Creager curve for maximum flood. This curve is used for obtaining a rough estimation of Probable Maximum Flood. It is also used in areas with similar climatological characteristics when data is sparse. It is a better method than using empirical formulas which require runoff coefficients to be selected. The limitation is that curves are based on the past flood events available at the time that the curve is constructed.

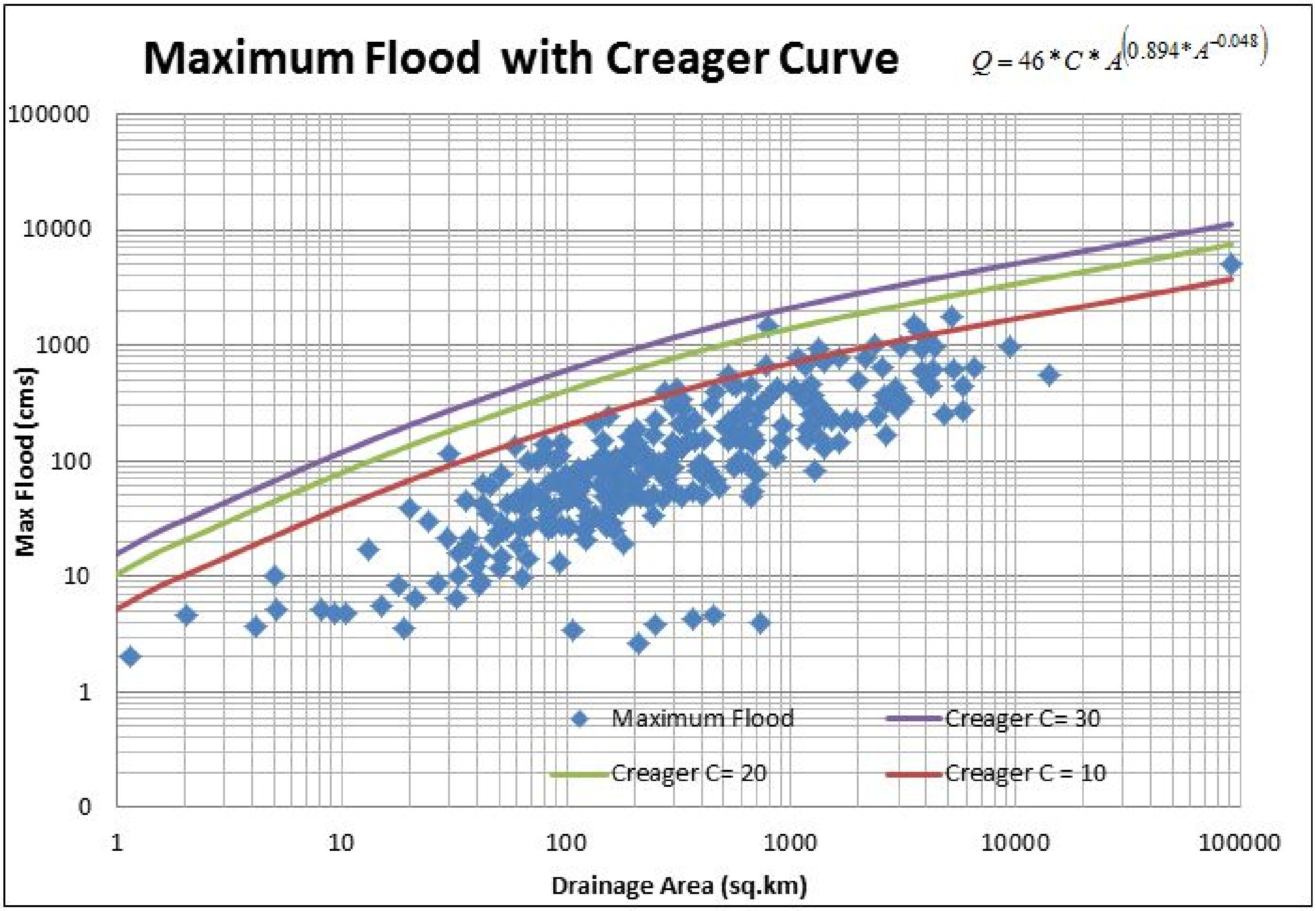


Figure 4: Maximum flood vs drainage area with Creager curve superimposed.

6.2 Statistical Tests

In order for the frequency analysis to be valid, the data need to be tested for the assumptions of the Central Limit Theorem/Extreme Value Theorem. The assumptions are: the data must be independent and identically distributed. In other words, the data should satisfy the statistical criteria: randomness, independence, stationarity (trend) and homogeneity. The null hypothesis for each of the test at a significance level of 5% and 1 % was tested to see whether the computed test value lies within the region of rejection or not. The non-parametric (distribution free) tests conducted are:

- The Spearman Rank Order serial Correlation Coefficient test for Independence
- The Spearman Rank Order Correlation Coefficient Test for Trend
- The Mann-Whitney Split Sample Test for Homogeneity
- Runs above and below the median for general Randomness

Initially, all the 297 gauges were tested for all the above tests. Data was removed from earlier years until all tests were satisfied or only ten years of data remained. All gauges except two gauges failed in the homogeneity test. The gauges are 02HL007 (MOIRA RIVER NEAR TWEED) and 02HM009(WEST BRANCH LITTLE CATARAQUI CREEK AT KINGSTON). These gauges only had 10 and 14 years of record. The summary of the results are given in the Table 1.

Significance	Independence (cases)	Trend (cases)	Randomness (cases)	Homogeneity (cases)
Not significant at 5% and 1%	277	239	293	235
Not Significant at 1%	20	58	4	60
Significant at 5% and 1%	0	0	0	2

Table 1: Station information on statistical tests

The Grubbs and Beck outlier test was carried out to detect outliers. The lower outliers are retrofitted by using the inbuilt capability of the program. The lower outliers affect the skewness of the data. In cases where the coefficient of skewness of the untransformed data sample excluding all low outliers is less than zero, the program initiates the Weibull distribution. There are 20 gauges where the coefficient of skewness is less than zero.Table 2 lists the gauges with negative skewness.

Station Name	HYDAT
BRONTE CREEK NEAR ZIMMERMAN	02HB011
CREDIT RIVER AT NORVAL	02HB025
DUFFINS CREEK AT AJAX	02HC049
FRENCH RIVER AT CHAUDIERE DAM	02DD017
INNISFIL CREEK NEAR ALLISTON	02ED029
LITTLE FRENCH RIVER AT OKIKENDAWT ISLAND	02DD020
MAGNETAWAN RIVER NEAR EMSDALE	02EA018
MAITLAND RIVER AT BENMILLER	02FE015
MAITLAND RIVER NEAR HARRISTON	02FE011
MOON RIVER AT HIGHWAY NO. 400	02EB011
MUSKRAT RIVER NEAR PEMBROKE	02KC015

Station Name	HYDAT
NOTTAWASAGA RIVER NEAR ALLISTON	02ED101
NOTTAWASAGA RIVER NEAR EDENVALE	02ED027
RAISIN RIVER AT BLACK RIVER	02MC027
SOUTH BRANCH MUSKOKA RIVER AT BAYSVILLE	02EB008
SOUTH CASTOR RIVER AT KENMORE	02LB020
SPENCER CREEK AT HIGHWAY NO. 5	02HB023
THAMES RIVER AT BYRON	02GE002
TURKEY CREEK AT WINDSOR	02GH004
YORK RIVER NEAR BANCROFT	02KD002

Table 2: Stations with negative coefficient of skewness.

6.3 Flood Modelling

6.3.1 Selection of Probability Distribution Function

The theoretical probability distributions, namely the Generalized extreme value, the Three-Parameter Lognormal, the Log-Pearson Type III, were fitted to the data and the flood flow values for each of these distributions were estimated.

As different distributions produce a considerable range of flood estimates, the assessment of fit was subjectively made by testing the Coefficient of Skewness and the Coefficient of Kurtosis together with the visual examination of the plots. First, the coefficients of skewness and kurtosis of the log-transformed data were tested against the theoretical values of 0.0 and 3.00 respectively. Then the goodness of fit was checked with the plot on lognormal probability scale showing the data points and the plotted function of each of three distributions. It is seen that the Three-Parameter Lognormal distribution provides a better fit. Only 20 stream gauges from the study area are negatively skewed and are upper bound. Further to that, studies carried out in the past by Moin and Shaw (1985) and Cumming Cockburn Limited for MNR (2000) identified the Three-Parameter Lognormal (3PLN) distribution as the best fit to flood flows in Ontario. Hence, the flow values based on the Three-Parameter Lognormal (3PLN) distribution was reported. In future, the 3PLN values itself will be taken for OFAT III web application.

6.3.2 Summary of the Parameters of the Three-Parameter Lognormal Distribution

The solution is obtained using the method of maximum likelihood and the numerical values of the parameters of the distribution namely, M (mean/location), S (standard deviation/scale) and A (lower threshold value) are given in Appendix C. The value of "A" for the study area is either positive or negative. Figure 5(a) and (b) shows the parameters of the Three-Parameter Lognormal distribution for the Great Lakes Watershed System.

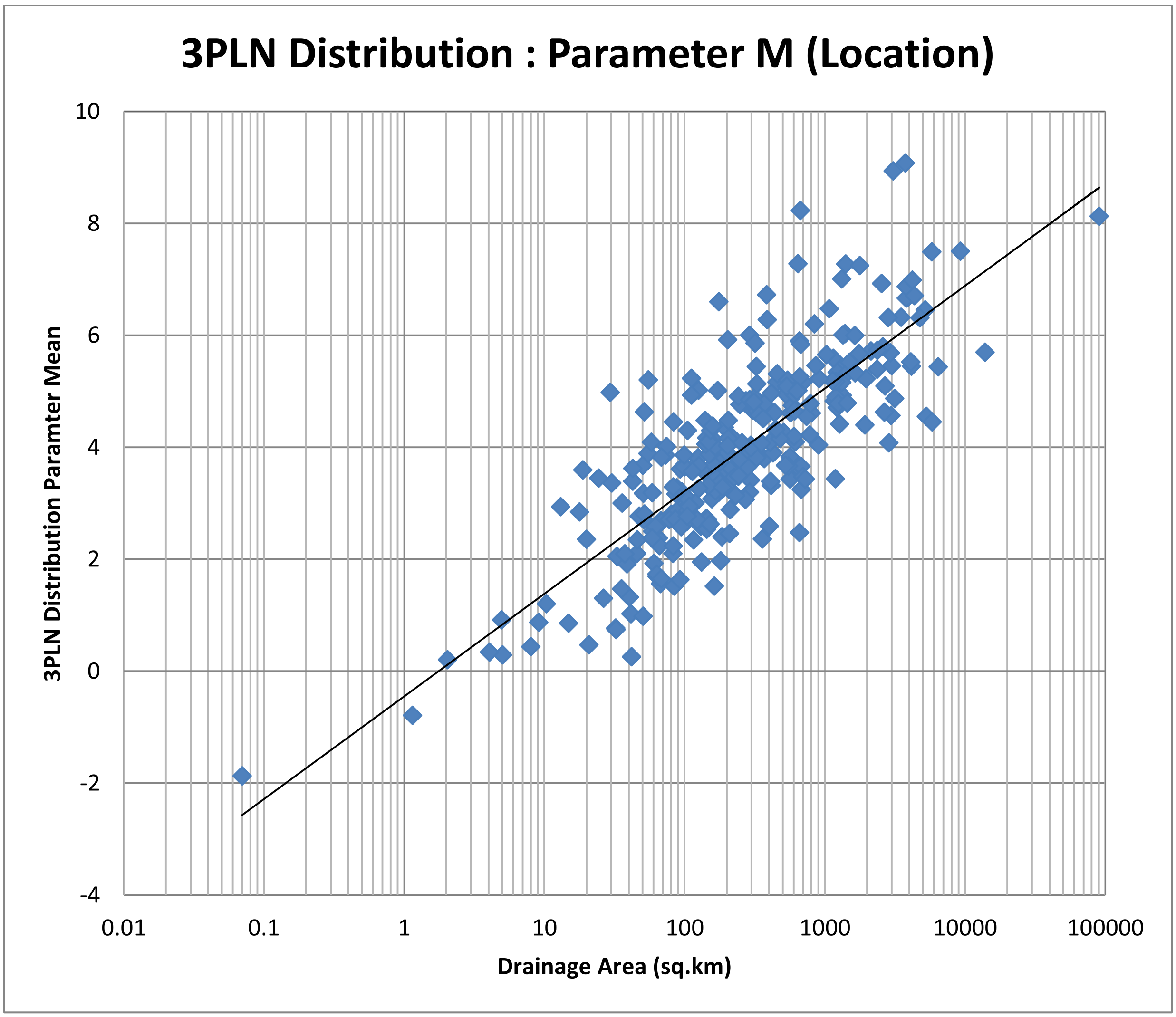


Figure 5(a): Summary of 3PLN distribution parameter: M (location).

Figure 5 (a) suggests that the parameter mean increases with the drainage area. The parameter scale (standard deviation) in Figure 5 (b) shows a clustered pattern with values lying below one. The parameters of the distribution together with characteristics of the flood help to test the consistency of the data and the spatial coherence of flood within the watershed system.

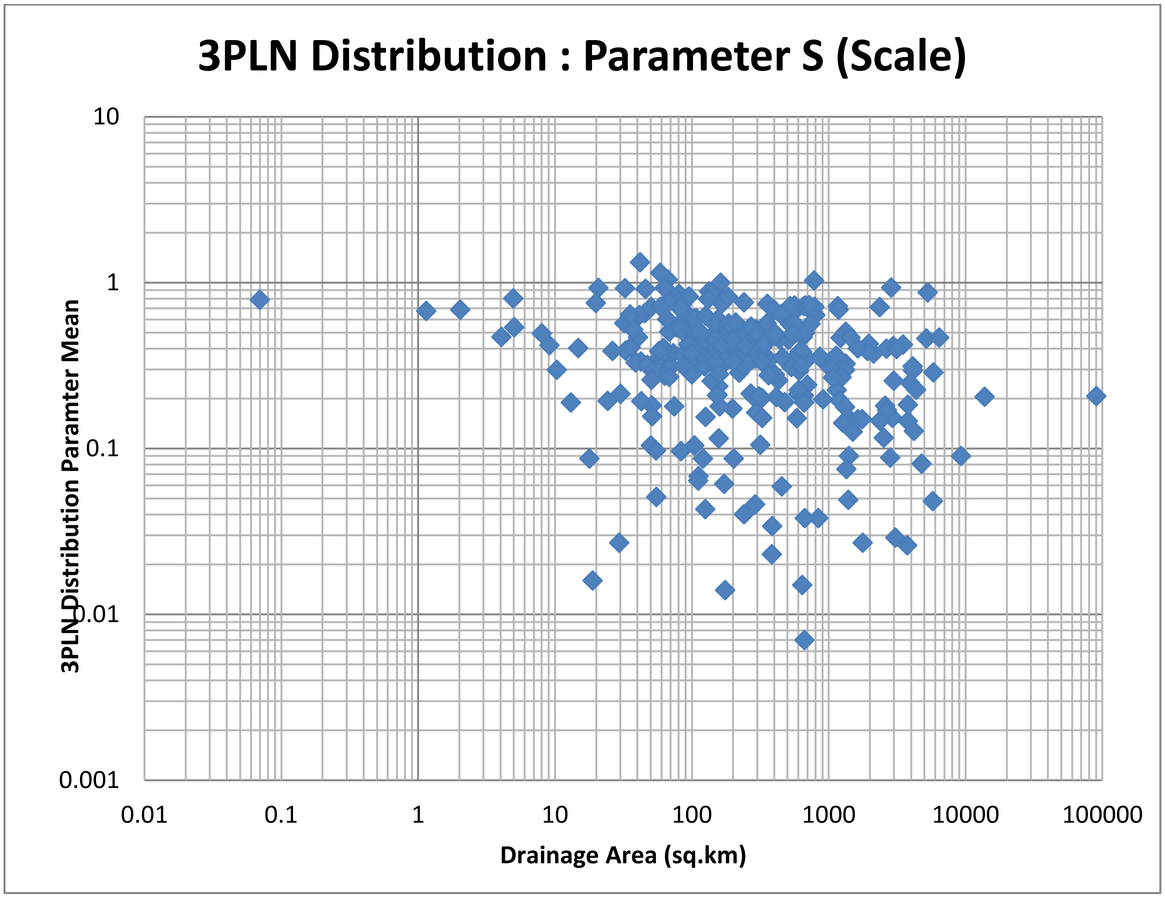


Figure 5(b): Summary of 3PLN distribution parameter: S (scale)

6.4 Flood Modelling Final Data Product and Analysis

Once the parameters of the distribution are modelled, the flood magnitude for different exceedance values is found by applying the general frequency equation of Chow (1964) to the Three-Parameter Lognormal distribution (see Section 2.1.1 for details).

The output (tabular and graphical) from the CFA program for the Three-Parameter Lognormal distributions for the HYDAT gauge 02FC001 (SAUGEEN RIVER NEAR PORT ELGIN) is given below:

```
FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
    02FC001      SAUGEEN RIVER NEAR PORT ELGIN


                         SAMPLE STATISTICS

                    MEAN        S.D.         C.V.        C.S.        C.K.
      X SERIES    569.031    206.743        .363        .646       3.362
   LN X SERIES      6.277       .378        .060       -.382       3.238
LN(X-A) SERIES      6.686       .248        .037       -.017       2.949

   X(MIN)=     197.000                          TOTAL SAMPLE SIZE=  97
   X(MAX)=    1162.000                        NO. OF LOW OUTLIERS=   0
   LOWER OUTLIER LIMIT OF X=  170.873           NO. OF ZERO FLOWS=   0


              SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

         3LN PARAMETERS:      A=  -256.668   M= 6.686   S=  .248


                        FLOOD FREQUENCY REGIME

                 RETURN        EXCEEDANCE         FLOOD
                 PERIOD        PROBABILITY

                  1.003           .997             148
                  1.050           .952             273
                  1.250           .800             393
                  2.000           .500             544
                  5.000           .200             730
                 10.000           .100             844
                 20.000           .050             948
                 50.000           .020            1080
                100.000           .010            1170
                200.000           .005            1260
                500.000           .002            1380
```

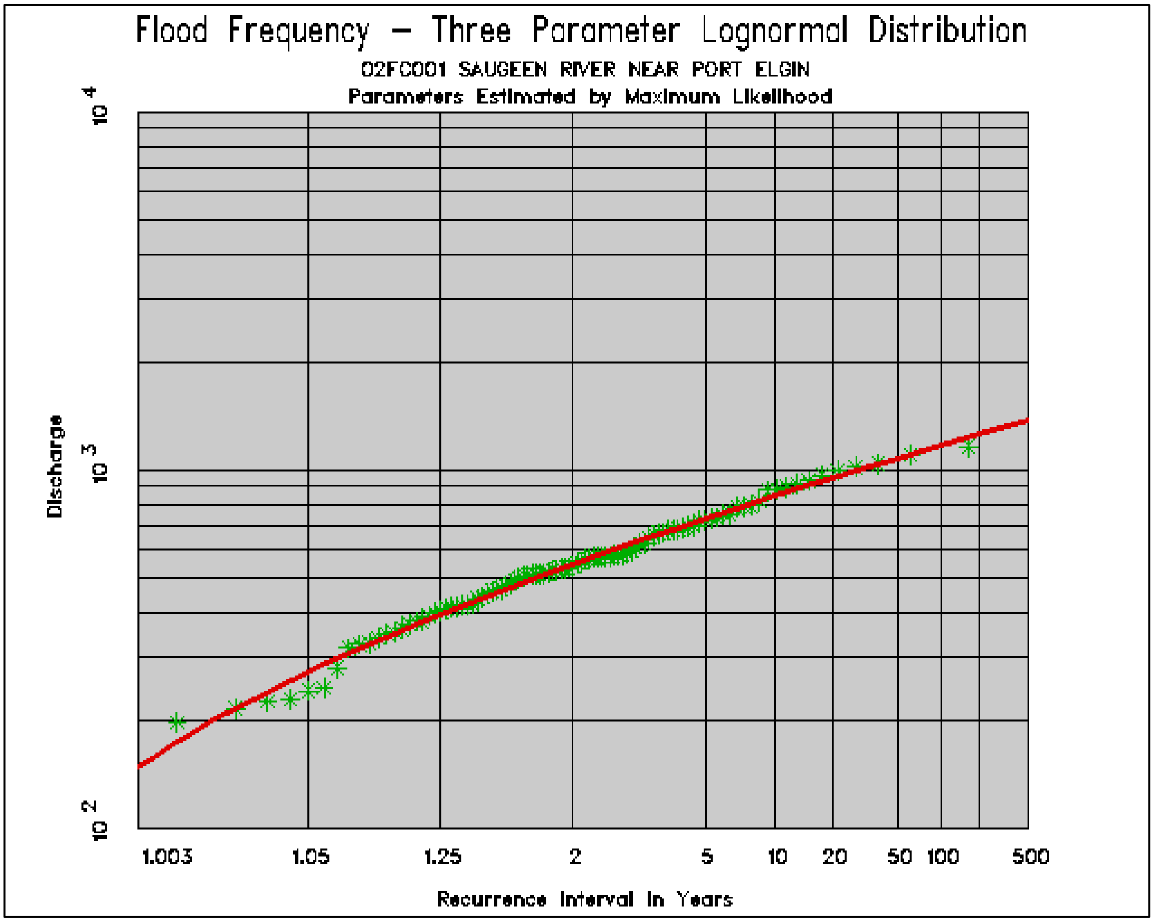


Figure 6: Graphical output for the Three-Parameter Lognormal distribution.

The Ontario Ministry of Transportation, Drainage Management Manual (1997) recommends the use of $Q_{2.33}$ and Q_{25} for design flood. As the output of CFA software does not give the flood magnitude for $Q_{2.33}$ and Q_{25}, these values are estimated using the equation from Section 2.1.1 The frequency factors of the equation are 0.08614 and 1.751 for $Q_{2.33}$ and Q_{25} respectively.

Appendix D (separate document) details the output from CFA for the three distributions namely: Generalized Extreme Value distribution, Three-Parameter Lognormal distribution and Log Pearson Type III distribution.

6.4.1 Data Packages

The single station flood flow frequency estimation data package and the metadata are stored and distributed through Land Information Ontario (LIO). In LIO, the metadata information of the package can be accessed through the LIO Metadata Management Tool.

The final output data is stored in an ESRI 10.1 Personal Geodatabase, “FrequencyAnalysis.mdb”. The database consists of a GIS point shapefile named “Gauge.shp” that stores the information of the HYDAT coordinates, one table for flood flow statistics.

For practical use, in the ESRI ArcMap GIS environment the shapefile, “Gauges.shp” can be related to the flood flow frequency tables. The primary key for all data sets is the HYDAT-ID and the “relate” function will associate the shapefile with the flow statistics tables. See the ArcMap Help for assistance in establishing relationship between tables.

6.4.2 Extreme Volatility Index Using the Ratio of Q_{100}/Q_2 Year Flood

The ratio of two return levels (e.g. Q_{100}/Q_2 year flood) is a measure of the second moment. This measure is called the extreme volatility ratio. The normalized measure is called the Extreme Volatility Index (EVI) and range between zero and one.

Extreme Volatility Ratio, EVR = $Q100/Q_2$

Extreme Volatility Index, EVI = 1-(1/EVR)

EVI values for the Great Lakes Watershed ranged from 0.16 to 0.88 with an average of 0.59 and a standard deviation of 0.13. Figure 7 shows the EVI of the watershed and the numerical values of Q_{100}/Q_2 ratio and EVI are given in Appendix C.

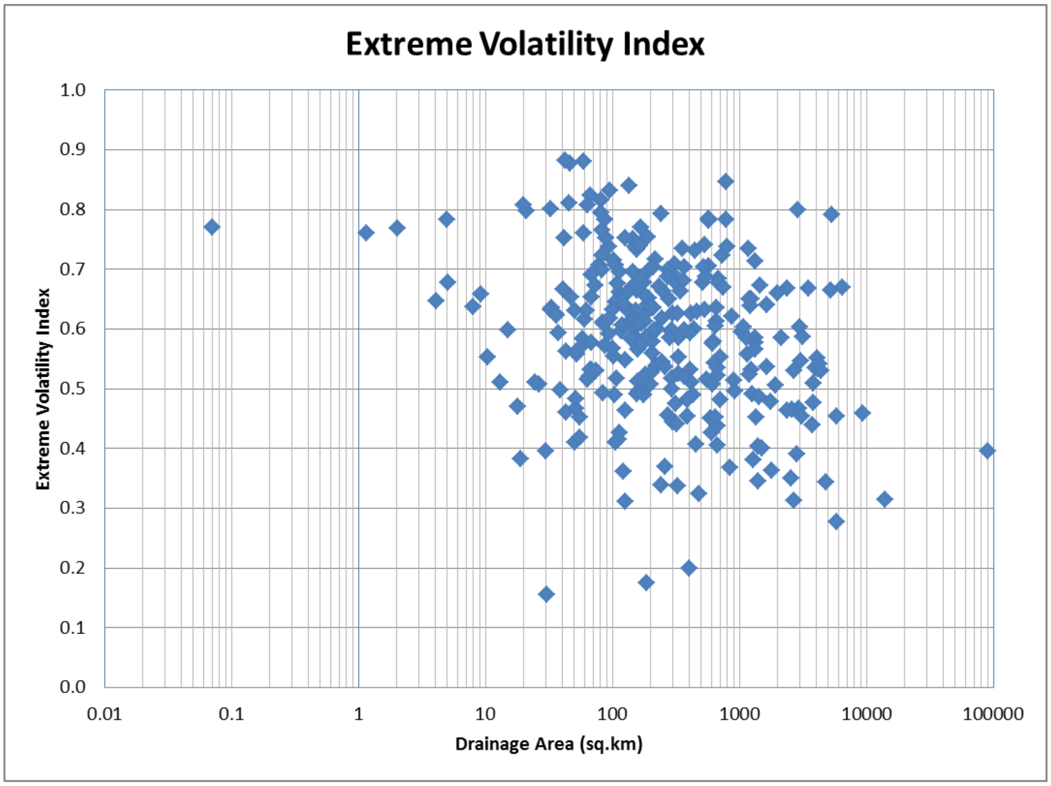


Figure 7: Extreme volatility index summary.

6.4.3 Length of Record

Mockus (1960) give the adequacy of the length of record for 90% significance level. The equation is:

$$Y = (4.30 * t * \log_{10} R)^2 + 6$$

Where Y = minimum accepted years of record

t= Student's statistical value at the 90 percent level of significance with (Y-6) degrees of freedom

R= ratio of magnitude of the 100-year event to the 2-year event

The length of record required based on the above equations for each station is given in Appendix C. It is seen that 28 stations lack adequate record length. Even though it is the combined effect of the record length and the ratio of 100 to 2-year flood, the sensitive parameter is the ratio of 100 to 2-year flood.

6.5 Recommended Data Uses and Considerations

6.5.1 Recommended Data Uses

6.5.1.1 Ontario Flow Assessment Tools

The flood flow estimates of the HYDAT gauges of the Great Lakes watershed systems will be displayed in future within the OFAT III web application.

6.5.1.2 Other Data Uses

The flood flow statistics data product can be used for a wide range of business uses in Ontario. An example of business uses are provided below in association with each respective Ministry that administers the business operation:

Ministry of Natural Resources

- Approval under the Lakes & Rivers Improvement Act (2010)
  Sections 14 and 16: Lakes and Rivers Improvement Act (LRIA) 1927 and Ontario Regulation 454/96
- Flooding Hazard Limit
  Natural Hazard Policies of the Provincial Policy Statement of the Planning Act (2002)
- Adaptive Management
  Natural Channel System: Adaptive Management of Stream Corridors in Ontario

Ministry of Environment

- Peak Flow Rate Criteria
  Storm Water Management Planning and Design Manual (2003)

Ministry of Transportation

- Design Flood for River and Stream Crossing based on Risk MTO Drainage Management Manual (1997)

6.6 Data Use Considerations

The HYDAT gauge locations, coordinates, in the future will be snapped to the river network in OFAT III. Drainage areas published by the WSC and obtained from OFAT III may differ slightly.

The flow values in the regulated gauges are not converted to natural flows.

The estimated values are only for the HYDAT gauge locations, not for ungauged locations of a river reach.

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8. Appendix

8.1 Appendix A: List of WSC's HYDAT gauges

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
ALDER CREEK NEAR NEW DUNDEE	02GA030	43.37229	-80.55109	N	Regulated
ANCASTER CREEK AT ANCASTER	02HB021	43.23117	-79.97386	N	Natural
AUBINADONG RIVER ABOVE SESABIC CREEK	02CB003	46.96842	-83.41686	N	Natural
AUSABLE RIVER NEAR EXETER	02FF009	43.36197	-81.50944	N	Regulated
AUSABLE RIVER NEAR SPRINGBANK	02FF002	43.07192	-81.65975	N	Regulated
AUX SABLES RIVER AT MASSEY	02CE002	46.21494	-82.07081	N	Regulated
AVON RIVER BELOW STRATFORD	02GD018	43.34472	-81.11642	N	Regulated
BATCHAWANA RIVER NEAR BATCHAWANA	02BF001	47.00353	-84.51556	N	Natural
BAYFIELD RIVER NEAR VARNA	02FF007	43.55125	-81.58953	N	Natural
BEAR BROOK NEAR BOURGET	02LB008	45.42600	-75.15322	N	Natural
BEAR CREEK BELOW BRIGDEN	02GG009	42.81203	-82.29842	N	Natural
BEAR CREEK NEAR PETROLIA	02GG006	42.90583	-82.11911	N	Natural
BEATTY SAUGEEN RIVER NEAR HOLSTEIN	02FC017	44.09047	-80.74194	N	Natural
BEAVER CREEK NEAR MARMORA	02HK006	44.53519	-77.69658	N	Regulated
BEAVER RIVER NEAR CLARKSBURG	02FB009	44.51986	-80.46778	N	Regulated
BEAVERTON RIVER NEAR BEAVERTON	02EC011	44.39708	-79.07083	N	Natural
BEETON CREEK NEAR TOTTENHAM	02ED100	44.04914	-79.80339	N	Regulated
BIG CARP RIVER NEAR SAULT STE. MARIE	02BF004	46.51589	-84.46518	N	Natural
BIG CREEK NEAR DELHI	02GC006	42.83772	-80.50989	N	Regulated

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
BIG CREEK NEAR KELVIN	02GC011	42.98681	-80.44469	N	Natural
BIG CREEK NEAR WALSINGHAM	02GC007	42.68561	-80.53847	N	Regulated
BIG OTTER CREEK ABOVE OTTERVILLE	02GC017	42.96583	-80.54258	N	Regulated
BIG OTTER CREEK AT TILLSONBURG	02GC010	42.85731	-80.72358	N	Natural
BIG OTTER CREEK NEAR CALTON	02GC026	42.71067	-80.84081	N	Regulated
BIGHEAD RIVER NEAR MEAFORD	02FB010	44.57017	-80.64850	N	Regulated
BLACK CREEK BELOW ACTON	02HB024	43.62931	-80.01042	N	Regulated
BLACK CREEK NEAR WESTON	02HC027	43.67425	-79.50436	N	Regulated
BLACK RIVER AT BALDWIN	02EC008	44.26064	-79.34389	N	Regulated
BLACK RIVER NEAR ACTINOLITE	02HL003	44.53958	-77.36964	N	Regulated
BLACK RIVER NEAR WASHAGO	02EC002	44.71367	-79.28161	Y	Natural
BLACK STURGEON RIVER AT HIGHWAY NO. 17	02AC002	48.90422	-88.37686	N	Regulated
BLACKWATER RIVER AT BEARDMORE	02AD010	49.59761	-87.96544	N	Natural
BLANCHE RIVER ABOVE ENGLEHART	02JC008	47.88914	-79.87931	Y	Natural
BLUE JAY CREEK NEAR TEHKUMMAH	02CG003	45.65169	-81.98661	N	Natural
BLUE SPRINGS CREEK NEAR EDEN MILLS	02GA031	43.57614	-80.10900	N	Regulated
BLYTH BROOK BELOW BLYTH	02FE014	43.76033	-81.46319	N	Natural
BONNECHERE RIVER NEAR CASTLEFORD	02KC009	45.49647	-76.56461	N	Regulated
BOWMANVILLE CREEK AT BOWMANVILLE	02HD006	43.92147	-78.70200	N	Natural
BOYLE DRAIN NEAR ATWOOD	02FE010	43.67634	-81.07485	N	Natural
BOYNE RIVER AT EARL ROWE PARK	02ED102	44.15250	-79.89664	N	Natural
BRONTE CREEK AT CARLISLE	02HB022	43.38886	-79.98811	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
BRONTE CREEK NEAR ZIMMERMAN	02HB011	43.43689	-79.86433	N	Regulated
BUCKSHOT CREEK NEAR PLEVNA	02KF017	44.96844	-76.96633	N	Natural
BUELLS CREEK AT BROCKVILLE	02MB010	44.58569	-75.69178	N	Natural
BURNLEY CREEK ABOVE WARKWORTH	02HK009	44.19681	-77.91100	N	Regulated
BURNT RIVER NEAR BURNT RIVER	02HF003	44.70986	-78.67753	N	Regulated
CANAGAGIGUE CREEK NEAR ELMIRA	02GA023	43.57992	-80.50919	N	Regulated
CANARD RIVER NEAR LUKERVILLE	02GH003	42.15897	-83.01889	N	Natural
CARP RIVER NEAR KINBURN	02KF011	45.41758	-76.19867	N	Natural
CARRICK CREEK NEAR CARLSRUHE	02FC011	44.11339	-81.01925	N	Natural
CASTOR RIVER AT RUSSELL	02LB006	45.26251	-75.34380	N	Natural
CATFISH CREEK AT AYLMER	02GC030	42.77375	-80.98267	N	Natural
CATFISH CREEK NEAR SPARTA	02GC018	42.74608	-81.05694	N	Natural
CEDAR CREEK AT WOODSTOCK	02GD011	43.12200	-80.75153	N	Regulated
CEDAR CREEK NEAR HEMLO	02BB004	48.70633	-85.90942	N	Regulated
CENTREVILLE CREEK NEAR ALBION	02HC051	43.92444	-79.83444	N	Natural
CHIPPEWA CREEK AT NORTH BAY	02DD014	46.31178	-79.44836	N	Natural
CLYDE RIVER AT GORDON RAPIDS	02KF013	45.13400	-76.62994	N	Regulated
CLYDE RIVER NEAR LANARK	02KF010	45.04583	-76.40089	N	Regulated
COLD CREEK AT ORLAND	02HK007	44.13478	-77.78689	N	Natural
COLD CREEK NEAR BOLTON	02HC023	43.89028	-79.72000	N	Natural
COLDWATER RIVER AT COLDWATER	02ED007	44.70719	-79.64375	N	Natural
COLLINS CREEK NEAR KINGSTON	02HM005	44.25650	-76.61256	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
COMMANDA CREEK NEAR COMMANDA	02DD015	45.94917	-79.60675	N	Natural
CONESTOGO RIVER ABOVE DRAYTON	02GA039	43.78353	-80.63778	N	Regulated
CONESTOGO RIVER AT GLEN ALLAN	02GA028	43.65483	-80.70217	N	Regulated
CONESTOGO RIVER AT ST. JACOBS	02GA006	43.54111	-80.55333	N	Regulated
CONISTON CREEK ABOVE WANAPITEI RIVER	02DB007	46.47528	-80.82153	N	Natural
CONSECON CREEK AT ALLISONVILLE	02HE002	44.02747	-77.36688	N	Regulated
CREDIT RIVER AT BOSTON MILLS	02HB018	43.77358	-79.92683	N	Regulated
CREDIT RIVER AT NORVAL	02HB025	43.64758	-79.85600	N	Regulated
CREDIT RIVER ERIN BRANCH ABOVE ERIN	02HB020	43.77181	-80.09364	N	Regulated
CREDIT RIVER NEAR CATARACT	02HB001	43.83586	-80.02289	N	Regulated
CREDIT RIVER NEAR ORANGEVILLE	02HB013	43.89127	-80.06240	N	Regulated
CREDIT RIVER WEST BRANCH AT NORVAL	02HB008	43.64656	-79.86628	N	Regulated
CROWE RIVER AT MARMORA	02HK003	44.48156	-77.68481	N	Regulated
CROWE RIVER NEAR GLEN ALDA	02HK005	44.84444	-77.93111	N	Regulated
CURRENT RIVER AT STEPSTONE	02AB021	48.56244	-89.24067	N	Natural
DEPOT CREEK AT BELLROCK	02HM002	44.47192	-76.76236	N	Regulated
DINGMAN CREEK BELOW LAMBETH	02GE005	42.93411	-81.35131	N	Natural
DODD CREEK BELOW PAYNES MILLS	02GC031	42.78739	-81.26750	N	Natural
DON RIVER AT TODMORDEN	02HC024	43.68586	-79.36150	N	Regulated
DON RIVER AT YORK MILLS	02HC005	43.74025	-79.40314	N	Regulated
DUFFINS CREEK ABOVE PICKERING	02HC019	43.89128	-79.05928	N	Natural
DUFFINS CREEK AT AJAX	02HC049	43.84889	-79.05611	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
EAST HUMBER RIVER AT KING CREEK	02HC032	43.90278	-79.61278	N	Natural
EAST HUMBER RIVER NEAR PINE GROVE	02HC009	43.79008	-79.58442	N	Natural
EAST RIVER NEAR HUNTSVILLE	02EB013	45.39272	-79.15994	N	Regulated
EAST SIXTEEN MILE CREEK NEAR OMAGH	02HB004	43.49917	-79.77678	N	Natural
ERAMOSA RIVER ABOVE GUELPH	02GA029	43.54778	-80.18203	N	Regulated
ETOBICOKE CREEK AT BRAMPTON	02HC017	43.69158	-79.75939	N	Regulated
ETOBICOKE CREEK BELOW QUEEN ELIZABETH HIGHWAY	02HC030	43.60175	-79.55633	N	Natural
FAIRCHILD CREEK NEAR BRANTFORD	02GB007	43.14739	-80.15461	N	Natural
FISH CREEK NEAR PROSPECT HILL	02GD010	43.22047	-81.23681	N	Natural
FOURTEEN MILE CREEK AT OAKVILLE	02HB027	43.42145	-79.70315	N	Natural
FRENCH RIVER AT CHAUDIERE DAM	02DD017	46.12083	-80.02750	N	Regulated
FRENCH RIVER AT DRY PINE BAY	02DD010	46.06858	-80.61164	N	Regulated
FRENCH RIVER AT PORTAGE DAM	02DD016	46.12278	-80.01639	N	Regulated
GANARASKA RIVER ABOVE DALE	02HD012	43.99094	-78.32819	N	Natural
GANARASKA RIVER NEAR OSACA	02HD003	44.01514	-78.43747	N	Regulated
GOULAIS RIVER NEAR SEARCHMONT	02BF002	46.86094	-83.97181	Y	Natural
GRAHAM CREEK AT NEPEAN	02KF015	45.34358	-75.80808	N	Natural
GRAND RIVER AT BRANTFORD	02GB001	43.13272	-80.26731	N	Regulated
GRAND RIVER AT GALT	02GA003	43.35311	-80.31575	N	Regulated
GRAND RIVER AT WEST MONTROSE	02GA034	43.58503	-80.48147	N	Regulated
GRAND RIVER BELOW SHAND DAM	02GA016	43.73094	-80.34094	N	Regulated
GRAND RIVER NEAR DUNDALK	02GA041	44.14003	-80.36270	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
GRAND RIVER NEAR MARSVILLE	02GA014	43.86172	-80.27222	N	Regulated
GRAVEL RIVER NEAR CAVERS	02AE001	48.92600	-87.69019	N	Regulated
GRINDSTONE CREEK NEAR ALDERSHOT	02HB012	43.30064	-79.86900	N	Natural
GULL RIVER AT NORLAND	02HF002	44.73183	-78.81806	N	Regulated
HARMONY CREEK AT OSHAWA	02HD013	43.88886	-78.82494	N	Natural
HOG CREEK NEAR VICTORIA HARBOUR	02ED017	44.72606	-79.77897	N	Natural
HOLLAND RIVER AT HOLLAND LANDING	02EC009	44.09492	-79.48956	N	Natural
HORNER CREEK NEAR PRINCETON	02GB006	43.17394	-80.55264	N	Regulated
HUMBER RIVER AT ELDER MILLS	02HC025	43.81131	-79.62758	N	Natural
HUMBER RIVER AT WESTON	02HC003	43.69894	-79.52039	N	Regulated
HUMBER RIVER NEAR PALGRAVE	02HC047	43.92850	-79.82300	N	Natural
HUNSBURGER CREEK NEAR WILMOT CENTRE	02GA043	43.36447	-80.63261	N	Natural
INDIAN RIVER NEAR BLAKENEY	02KF012	45.24544	-76.26033	N	Regulated
INNISFIL CREEK NEAR ALLISTON	02ED029	44.13122	-79.78097	N	Natural
JACKSON CREEK AT PETERBOROUGH	02HJ001	44.30278	-78.32139	N	Natural
JOCK RIVER NEAR RICHMOND	02LA007	45.24942	-75.79061	N	Natural
JUNCTION CREEK AT SUDBURY	02CF005	46.47872	-81.01042	N	Regulated
JUNCTION CREEK BELOW KELLEY LAKE	02CF012	46.42731	-81.09844	N	Natural
KAMINISTIQUIA RIVER AT KAMINISTIQUIA	02AB006	48.53231	-89.59636	N	Regulated
KEMPTVILLE CREEK NEAR KEMPTVILLE	02LA006	44.99425	-75.66228	N	Regulated
KETTLE CREEK ABOVE ST. THOMAS	02GC029	42.83519	-81.13472	N	Natural
KETTLE CREEK AT ST. THOMAS	02GC002	42.77769	-81.21400	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
LA VASE RIVER AT NORTH BAY	02DD013	46.26344	-79.39511	N	Natural
LAUREL CREEK AT WATERLOO	02GA024	43.47197	-80.51433	N	Regulated
LITTLE FRENCH RIVER AT OKIKENDAWT ISLAND	02DD020	46.12306	-80.07889	N	NA
LITTLE MAITLAND RIVER AT BLUEVALE	02FE007	43.85439	-81.25050	N	Regulated
LITTLE PIC RIVER NEAR COLDWELL	02BA003	48.84911	-86.60722	N	Natural
LITTLE RIVER AT WINDSOR	02GH011	42.30986	-82.92850	N	Natural
LITTLE ROUGE CREEK NEAR LOCUST HILL	02HC028	43.90789	-79.21628	N	Natural
LITTLE ROUGE RIVER NEAR DICKSONS HILL	02HC053	43.92569	-79.28219	N	Natural
LITTLE WHITE RIVER BELOW BOLAND RIVER	02CC010	46.58114	-82.96800	N	Regulated
LITTLE WHITE RIVER NEAR BELLINGHAM	02CC005	46.39397	-83.28308	N	Regulated
LUCKNOW RIVER AT LUCKNOW	02FD002	43.96528	-81.51344	N	Natural
LYN CREEK NEAR LYN	02MB006	44.52500	-75.80528	N	Natural
LYNDE CREEK AT BROOKLIN	02HC054	43.95908	-78.95997	N	Natural
LYNDE CREEK NEAR WHITBY	02HC018	43.87550	-78.96033	N	Natural
LYNDE CREEK TRIBUTARY NEAR KINSALE	02HC055	43.93197	-78.98847	N	Natural
LYNDHURST CREEK AT LYNDHURST	02MA001	44.54611	-76.12333	N	Natural
LYNN RIVER AT SIMCOE	02GC008	42.82333	-80.28944	N	Regulated
MAD RIVER AT AVENING	02ED015	44.30736	-80.07203	N	Natural
MADAWASKA RIVER AT PALMER RAPIDS	02KD004	45.32808	-77.51550	N	Regulated
MAGNETAWAN RIVER NEAR BRITT	02EA011	45.77306	-80.48233	N	Regulated
MAGNETAWAN RIVER NEAR EMSDALE	02EA018	45.55670	-79.28798	N	Natural
MAITLAND RIVER ABOVE WINGHAM	02FE005	43.91508	-81.26439	N	Regulated

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
MAITLAND RIVER AT BENMILLER	02FE015	43.71756	-81.62619	N	Regulated
MAITLAND RIVER BELOW WINGHAM	02FE002	43.88675	-81.32644	N	Regulated
MAITLAND RIVER NEAR HARRISTON	02FE011	43.90381	-80.89261	N	Natural
MAYHEW CREEK NEAR TRENTON	02HK011	44.10917	-77.61253	N	Regulated
MCGREGOR CREEK NEAR CHATHAM	02GE007	42.38350	-82.09506	N	Natural
MCINTYRE RIVER ABOVE THUNDER BAY	02AB020	48.48269	-89.32464	N	Regulated
MCKENZIE CREEK NEAR CALEDONIA	02GB010	43.03394	-79.94981	N	Regulated
MCVICAR CREEK AT THUNDER BAY	02AB019	48.44942	-89.21850	N	Natural
MEDWAY RIVER AT LONDON	02GD008	43.01367	-81.28044	N	Regulated
MICHIPICOTEN RIVER AT SCOTT FALLS	02BD002	47.91083	-84.74333	N	Regulated
MIDDLE MAITLAND RIVER ABOVE ETHEL	02FE013	43.71839	-81.12464	N	Natural
MIDDLE MAITLAND RIVER NEAR BELGRAVE	02FE008	43.81289	-81.30689	N	Natural
MIDDLE MAITLAND RIVER NEAR LISTOWEL	02FE003	43.72723	-80.97267	N	Regulated
MIDDLE THAMES RIVER AT THAMESFORD	02GD004	43.05911	-80.99486	N	Natural
MILLHAVEN CREEK NEAR MILLHAVEN	02HM006	44.22642	-76.75906	N	Regulated
MIMICO CREEK AT ISLINGTON	02HC033	43.64736	-79.51969	N	Natural
MISSISSAGI RIVER AT MISSISSAGI CHUTE	02CC008	46.20136	-83.02539	N	Regulated
MISSISSIPPI RIVER AT APPLETON	02KF006	45.17633	-76.12347	N	Regulated
MISSISSIPPI RIVER AT FERGUSONS FALLS	02KF001	45.05317	-76.28564	N	Regulated
MISSISSIPPI RIVER BELOW MARBLE LAKE	02KF016	44.84317	-77.12006	N	Natural
MOIRA RIVER NEAR DELORO	02HL005	44.49967	-77.61844	N	Natural
MOIRA RIVER NEAR FOXBORO	02HL001	44.25367	-77.41919	N	Regulated

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
MOIRA RIVER NEAR TWEED	02HL007	44.48847	-77.31953	N	Regulated
MONTREAL RIVER NEAR MONTREAL RIVER HARBOUR	02BE002	47.21389	-84.61944	N	Regulated
MOON RIVER AT HIGHWAY NO. 400	02EB011	45.06506	-79.79014	N	Regulated
MOOSE CREEK AT LEVACK	02CF013	46.63594	-81.39147	N	Regulated
MUSKRAT RIVER NEAR PEMBROKE	02KC015	45.79775	-77.10833	N	Natural
MUSQUASH RIVER AT HIGHWAY NO. 400	02EB012	45.02253	-79.77681	N	Regulated
NANTICOKE CREEK AT NANTICOKE	02GC022	42.80992	-80.07617	N	Regulated
NAPANEE RIVER AT CAMDEN EAST	02HM007	44.33475	-76.83881	N	Regulated
NEEBING RIVER NEAR THUNDER BAY	02AB008	48.38339	-89.30656	Y	Natural
NITH RIVER ABOVE NITHBURG	02GA038	43.48389	-80.83500	N	Natural
NITH RIVER AT NEW HAMBURG	02GA018	43.37722	-80.71081	N	Natural
NITH RIVER NEAR CANNING	02GA010	43.18972	-80.45503	Y	Natural
NONQUON RIVER NEAR PORT PERRY	02HG002	44.08669	-79.00608	N	Regulated
NORBERG CREEK (SITE A) ABOVE BATCHAWANA RIVER	02BF005	47.06253	-84.43072	N	Natural
NORBERG CREEK (SITE B) AT OUTLET OF TURKEY LAKE	02BF006	47.05053	-84.41278	N	Natural
NORBERG CREEK (SITE C) AT OUTLET OF LITTLE TURKEY LAKE	02BF007	47.04472	-84.41025	N	Natural
NORBERG CREEK (SITE D) BELOW WISHART LAKE	02BF008	47.04625	-84.40319	N	Natural
NORBERG CREEK (SITE E) BELOW BATCHAWANA LAKE	02BF009	47.05778	-84.40000	N	Natural
NORBERG CREEK (SITE F) AT OUTLET OF BATCHAWANA LAKE	02BF012	47.06281	-84.39253	N	Natural
NORTH BRANCH MUSKOKA RIVER AT PORT SYDNEY	02EB004	45.21286	-79.27528	N	Regulated
NORTH CURRENT RIVER NEAR THUNDER BAY	02AB014	48.51956	-89.17503	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
NORTH MAGNETAWAN RIVER ABOVE PICKEREL LAKE	02EA010	45.70377	-79.30879	N	Natural
NORTH MAGNETAWAN RIVER NEAR BURK'S FALLS	02EA005	45.66947	-79.37919	Y	Natural
NORTH RIVER AT THE FALLS	02ED024	44.76767	-79.57828	N	Natural
NORTH THAMES RIVER AT ST. MARYS	02GD005	43.25572	-81.14572	N	Regulated
NORTH THAMES RIVER BELOW FANSHAWE DAM	02GD003	43.04078	-81.18283	N	Regulated
NORTH THAMES RIVER NEAR MITCHELL	02GD014	43.45042	-81.20678	N	Regulated
NORTH THAMES RIVER NEAR THORNDALE	02GD015	43.14931	-81.19214	N	Regulated
NORTH WEST GANARASKA RIVER NEAR OSACA	02HD004	44.01719	-78.43875	N	Regulated
NOTTAWASAGA RIVER AT HOCKLEY	02ED026	44.02475	-79.96989	N	Natural
NOTTAWASAGA RIVER NEAR ALLISTON	02ED101	44.11058	-79.89028	N	Natural
NOTTAWASAGA RIVER NEAR BAXTER	02ED003	44.24981	-79.82142	N	Natural
NOTTAWASAGA RIVER NEAR EDENVALE	02ED027	44.48500	-79.96600	N	Regulated
ONAPING RIVER NEAR LEVACK	02CF010	46.59950	-81.38197	N	Regulated
OSHAWA CREEK AT OSHAWA	02HD008	43.93031	-78.89153	N	Natural
OSWEGO CREEK AT CANBORO	02HA024	42.99131	-79.67825	N	Natural
OTTAWA RIVER AT BRITANNIA	02KF005	45.36450	-75.80567	N	Regulated
OUSE RIVER NEAR WESTWOOD	02HJ003	44.29806	-78.04494	N	Regulated
OXTONGUE RIVER NEAR DWIGHT	02EB014	45.31197	-78.98939	N	Regulated
PARKHILL CREEK ABOVE PARKHILL RESERVOIR	02FF008	43.16413	-81.63151	N	Natural
PAYNE RIVER NEAR BERWICK	02LB022	45.19161	-75.10464	N	Natural
PETAWAWA RIVER NEAR PETAWAWA	02KB001	45.88619	-77.31531	Y	Regulated
PIC RIVER NEAR MARATHON	02BB003	48.77408	-86.29661	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
PINE RIVER AT LURGAN	02FD001	44.09467	-81.72578	N	Natural
PINE RIVER NEAR EVERETT	02ED014	44.20003	-79.96000	N	Natural
RAISIN RIVER AT BLACK RIVER	02MC027	45.08061	-74.86800	N	Natural
RAISIN RIVER NEAR WILLIAMSTOWN	02MC001	45.15542	-74.63803	N	Natural
RAWDON CREEK NEAR WEST HUNTINGDON	02HK008	44.33814	-77.47719	N	Natural
REDHILL CREEK AT HAMILTON	02HA014	43.24097	-79.77389	N	Natural
RIDEAU RIVER AT OTTAWA	02LA004	45.38150	-75.69697	N	Regulated
RIVIERE BEAUDETTE NEAR GLEN NEVIS	02MC026	45.27336	-74.49383	N	Natural
RIVIERE DELISLE NEAR ALEXANDRIA	02MC028	45.32708	-74.64383	N	Natural
ROOT RIVER AT SAULT STE. MARIE	02CA002	46.56286	-84.28169	N	Natural
ROUGE RIVER NEAR MARKHAM	02HC022	43.85836	-79.23356	N	Regulated
RUSCOM RIVER NEAR RUSCOM STATION	02GH002	42.21150	-82.62914	N	Natural
SALMON RIVER NEAR SHANNONVILLE	02HM003	44.20731	-77.20925	N	Regulated
SAUBLE RIVER AT ALLENFORD	02FA004	44.53553	-81.17769	N	Natural
SAUBLE RIVER AT SAUBLE FALLS	02FA001	44.67753	-81.25606	N	Regulated
SAUGEEN RIVER ABOVE DURHAM	02FC016	44.18542	-80.78747	N	Natural
SAUGEEN RIVER NEAR PORT ELGIN	02FC001	44.45647	-81.32644	Y	Regulated
SAUGEEN RIVER NEAR WALKERTON	02FC002	44.12047	-81.11533	N	Regulated
SCHOMBERG RIVER NEAR SCHOMBERG	02EC010	44.01214	-79.68564	N	Natural
SERPENT RIVER ABOVE QUIRKE LAKE	02CD006	46.51122	-82.60069	N	Regulated
SERPENT RIVER AT HIGHWAY NO. 17	02CD001	46.21078	-82.51242	N	Regulated
SEVERN RIVER AT SWIFT RAPIDS	02EC003	44.85694	-79.54167	N	Regulated

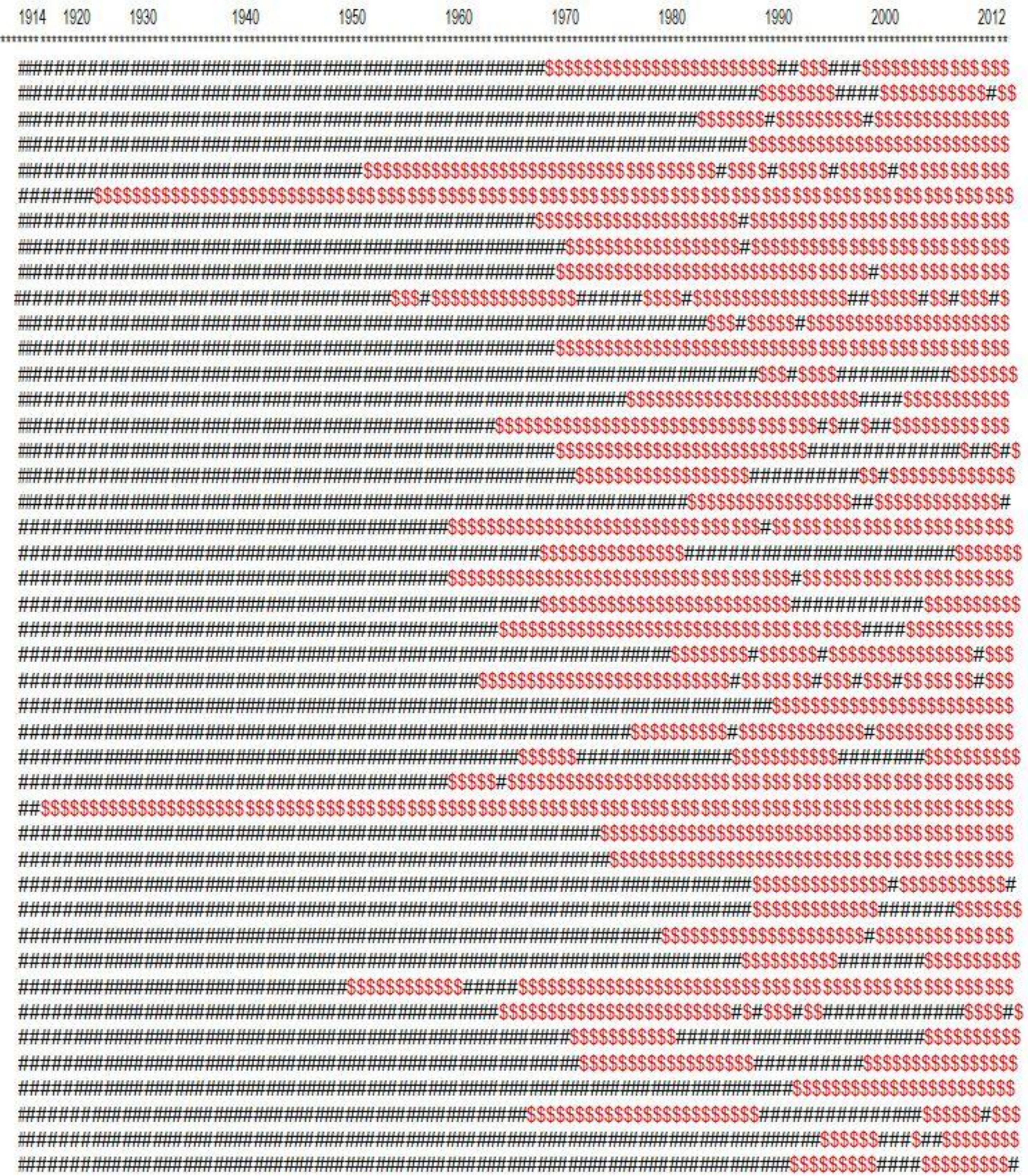
Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
SHELTER VALLEY BROOK NEAR GRAFTON	02HD010	43.99182	-78.00106	N	Regulated
SIXTEEN MILE CREEK AT MILTON	02HB005	43.51389	-79.87972	N	Regulated
SKOOTAMATTA RIVER NEAR ACTINOLITE	02HL004	44.54958	-77.32806	Y	Natural
SOUTH BRANCH MUSKOKA RIVER AT BAYSVILLE	02EB008	45.14797	-79.11350	N	Regulated
SOUTH CASTOR RIVER AT KENMORE	02LB020	45.22833	-75.41272	N	Natural
SOUTH MAITLAND RIVER AT SUMMERHILL	02FE009	43.68436	-81.54117	N	Natural
SOUTH NATION RIVER AT CASSELMAN	02LB013	45.31697	-75.09167	N	Regulated
SOUTH NATION RIVER AT SPENCERVILLE	02LB007	44.84225	-75.54442	Y	Natural
SOUTH NATION RIVER NEAR PLANTAGENET SPRINGS	02LB005	45.51694	-74.97822	N	Regulated
SOUTH PARKHILL CREEK NEAR PARKHILL	02FF004	43.16075	-81.73183	N	Natural
SOUTH SAUGEEN RIVER NEAR HANOVER	02FC012	44.09869	-80.98456	N	Regulated
SPEED RIVER BELOW GUELPH	02GA015	43.53372	-80.25222	N	Regulated
SPEED RIVER NEAR ARMSTRONG MILLS	02GA040	43.63861	-80.27000	N	Regulated
SPENCER CREEK AT DUNDAS	02HB007	43.26542	-79.96428	N	Regulated
SPENCER CREEK AT HIGHWAY NO. 5	02HB023	43.28292	-80.05281	N	Natural
SPENCER CREEK NEAR WESTOVER	02HB015	43.35308	-80.07789	N	Regulated
STEEL RIVER BELOW SANTOY LAKE	02BA006	48.81371	-86.85934	N	Natural
STOKES RIVER NEAR FERNDALE	02FA002	45.03697	-81.33636	N	Natural
STONEY CREEK AT STONEY CREEK	02HA022	43.22553	-79.75117	N	Natural
STURGEON RIVER AT UPPER GOOSE FALLS	02DC012	46.97142	-80.46325	N	Natural
STURGEON RIVER NEAR GLEN AFTON	02DC004	46.63717	-80.26325	N	Regulated
SYDENHAM RIVER AT FLORENCE	02GG003	42.65061	-82.00839	N	Natural

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
SYDENHAM RIVER AT STRATHROY	02GG005	42.95886	-81.62714	N	Natural
SYDENHAM RIVER NEAR ALVINSTON	02GG002	42.83081	-81.85172	N	Natural
SYDENHAM RIVER NEAR OWEN SOUND	02FB007	44.52225	-80.93019	Y	Natural
TAY RIVER IN PERTH	02LA024	44.89692	-76.25250	N	Regulated
TEESWATER RIVER NEAR PAISLEY	02FC015	44.26831	-81.26919	N	Regulated
THAMES RIVER AT BYRON	02GE002	42.96250	-81.33178	N	Regulated
THAMES RIVER AT INGERSOLL	02GD016	43.04128	-80.88617	N	Regulated
THAMES RIVER AT INNERKIP	02GD021	43.21531	-80.69186	N	Natural
THAMES RIVER AT THAMESVILLE	02GE003	42.54486	-81.96731	N	Regulated
THAMES RIVER NEAR DUTTON	02GE006	42.73069	-81.57747	N	Regulated
THAMES RIVER NEAR EALING	02GD001	42.97356	-81.20858	N	Regulated
TRIBUTARY TO NORBERG CREEK AT TURKEY LAKE	02BF013	47.04167	-84.41681	N	Natural
TROUT CREEK NEAR FAIRVIEW	02GD019	43.29558	-80.97303	N	Natural
TROUT CREEK NEAR ST. MARYS	02GD009	43.27322	-81.10322	N	Natural
TURKEY CREEK AT WINDSOR	02GH004	42.26050	-83.03983	N	Natural
TWENTY MILE CREEK ABOVE SMITHVILLE	02HA020	43.11564	-79.56619	N	Natural
TWENTY MILE CREEK AT BALLS FALLS	02HA006	43.13347	-79.38325	N	Natural
VENISON CREEK NEAR WALSINGHAM	02GC021	42.65336	-80.54844	N	Natural
VERMILION RIVER NEAR VAL CARON	02CF011	46.68544	-81.00925	N	Natural
VEUVE RIVER NEAR VERNER	02DD012	46.40825	-80.12331	N	Natural
WANAPITEI RIVER NEAR WANUP	02DB005	46.34567	-80.83956	N	Regulated
WELLAND RIVER BELOW CAISTOR CORNERS	02HA007	43.02178	-79.61802	N	Regulated

Station Name	HYDAT	Latitude	Longitude	RHBN	Regulation Type
WEST BRANCH LITTLE CATARAQUI CREEK AT KINGSTON	02HM009	44.24000	-76.57889	N	Natural
WEST BRANCH SCOTCH RIVER NEAR ST. ISIDORE DE PRESCOTT	02LB018	45.37533	-74.94800	N	Natural
WEST DUFFINS CREEK ABOVE GREEN RIVER	02HC038	43.91575	-79.17953	N	Natural
WEST HUMBER RIVER AT HIGHWAY NO. 7	02HC031	43.75836	-79.67894	N	Natural
WHITE RIVER BELOW WHITE LAKE	02BC004	48.65480	-85.74153	N	Regulated
WHITEFISH RIVER AT NOLALU	02AB017	48.29211	-89.80986	N	Natural
WHITEMANS CREEK NEAR MOUNT VERNON	02GB008	43.12625	-80.38372	N	Regulated
WHITESAND RIVER ABOVE SCHREIBER AT MINOVA MINE	02BA005	48.97811	-87.37678	N	Natural
WHITSON RIVER AT CHELMSFORD	02CF007	46.58303	-81.19919	N	Natural
WHITSON RIVER AT VAL CARON	02CF008	46.61017	-81.03297	Y	Natural
WILMOT CREEK NEAR NEWCASTLE	02HD009	43.93022	-78.61881	N	Natural
WILTON CREEK NEAR NAPANEE	02HM004	44.23931	-76.84953	N	Natural
WOLF RIVER AT HIGHWAY NO. 17	02AC001	48.82169	-88.53461	N	Natural
WYE RIVER NEAR WYEVALE	02ED013	44.64978	-79.90375	N	Regulated
YORK RIVER NEAR BANCROFT	02KD002	45.05214	-77.84603	N	Natural

8.2 Appendix B: Years of Record for Flood Flow Analysis

Station Name	HYDAT
ALDER CREEK NEAR NEW DUNDEE	02GA030
ANCASTER CREEK AT ANCASTER	02HB021
AUBINADONG RIVER ABOVE SESABIC CREEK	02CB003
AUSABLE RIVER NEAR EXETER	02FF009
AUSABLE RIVER NEAR SPRINGBANK	02FF002
AUX SABLES RIVER AT MASSEY	02CE002
AVON RIVER BELOW STRATFORD	02GD018
BATCHAWANA RIVER NEAR BATCHAWANA	02BF001
BAYFIELD RIVER NEAR VARNA	02FF007
BEAR BROOK NEAR BOURGET	02LB008
BEAR CREEK BELOW BRIGDEN	02GG009
BEAR CREEK NEAR PETROLIA	02GG006
BEATTY SAUGEEN RIVER NEAR HOLSTEIN	02FC017
BEAVER CREEK NEAR MARMORA	02HK006
BEAVER RIVER NEAR CLARKSBURG	02FB009
BEAVERTON RIVER NEAR BEAVERTON	02EC011
BEETON CREEK NEAR TOTTENHAM	02ED100
BIG CARP RIVER NEAR SAULT STE. MARIE	02BF004
BIG CREEK NEAR DELHI	02GC006
BIG CREEK NEAR KELVIN	02GC011
BIG CREEK NEAR WALSINGHAM	02GC007
BIG OTTER CREEK ABOVE OTTERVILLE	02GC017
BIG OTTER CREEK AT TILLSONBURG	02GC010
BIG OTTER CREEK NEAR CALTON	02GC026
BIGHEAD RIVER NEAR MEAFORD	02FB010
BLACK CREEK BELOW ACTON	02HB024
BLACK CREEK NEAR WESTON	02HC027
BLACK RIVER AT BALDWIN	02EC008
BLACK RIVER NEAR ACTINOLITE	02HL003
BLACK RIVER NEAR WASHAGO	02EC002
BLACK STURGEON RIVER AT HIGHWAY NO. 17	02AC002
BLACKWATER RIVER AT BEARDMORE	02AD010
BLANCHE RIVER ABOVE ENGLEHART	02JC008
BLUE JAY CREEK NEAR TEHKUMMAH	02CG003
BLUE SPRINGS CREEK NEAR EDEN MILLS	02GA031
BLYTH BROOK BELOW BLYTH	02FE014
BONNECHERE RIVER NEAR CASTLEFORD	02KC009
BOWMANVILLE CREEK AT BOWMANVILLE	02HD006
BOYLE DRAIN NEAR ATWOOD	02FE010
BOYNE RIVER AT EARL ROWE PARK	02ED102
BRONTE CREEK AT CARLISLE	02HB022
BRONTE CREEK NEAR ZIMMERMAN	02HB011
BUCKSHOT CREEK NEAR PLEVNA	02KF017
BUELLS CREEK AT BROCKVILLE	02MB010



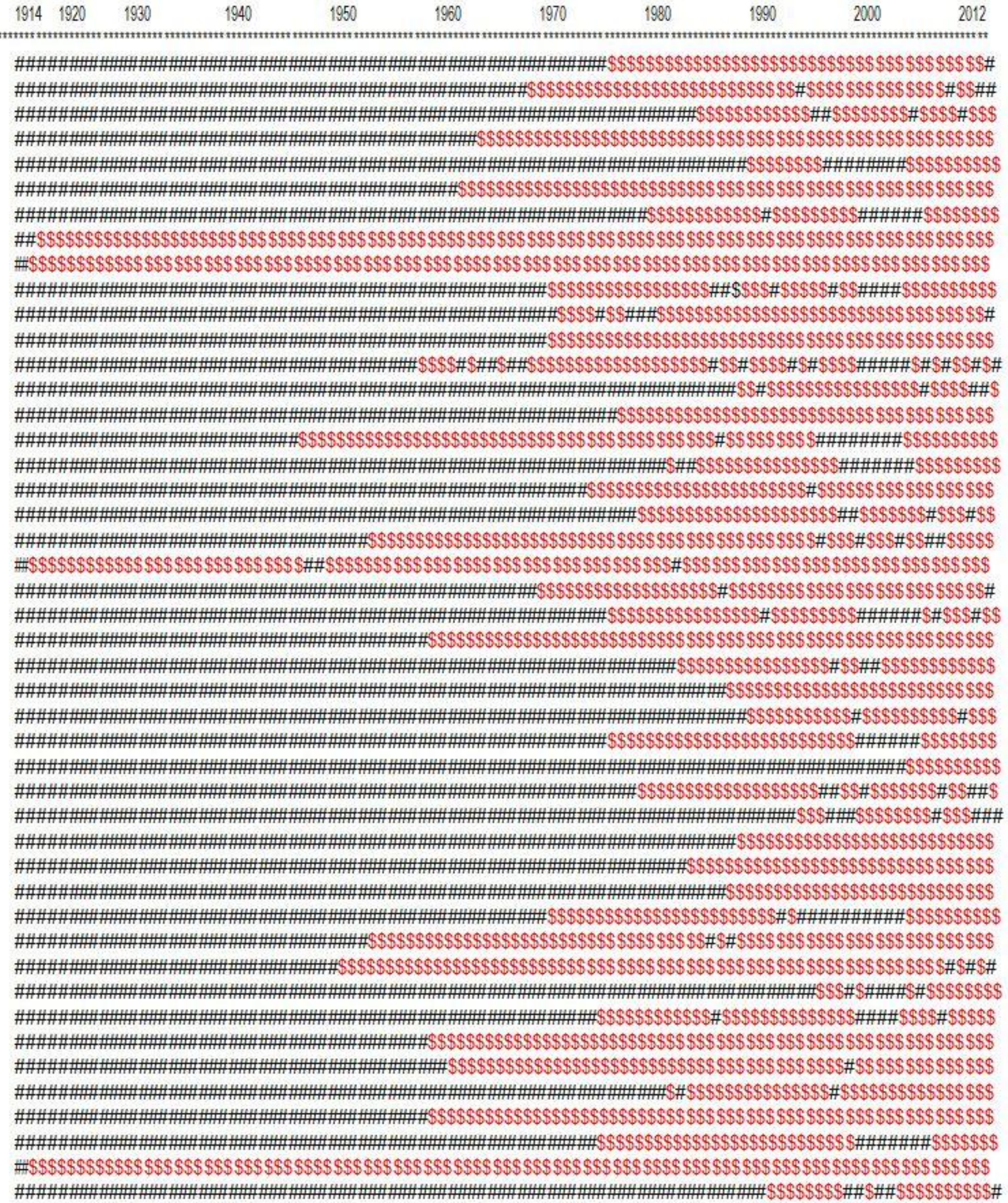
Station Name	HYDAT
BURNLEY CREEK ABOVE WARKWORTH	02HK009
BURNT RIVER NEAR BURNT RIVER	02HF003
CANAGAGIGUE CREEK NEAR ELMIRA	02GA023
CANARD RIVER NEAR LUKERVILLE	02GH003
CARP RIVER NEAR KINBURN	02KF011
CARRICK CREEK NEAR CARLSRUHE	02FC011
CASTOR RIVER AT RUSSELL	02LB006
CATFISH CREEK AT AYLMER	02GC030
CATFISH CREEK NEAR SPARTA	02GC018
CEDAR CREEK AT WOODSTOCK	02GD011
CEDAR CREEK NEAR HEMLO	02BB004
CENTREVILLE CREEK NEAR ALBION	02HC051
CHIPPEWA CREEK AT NORTH BAY	02DD014
CLYDE RIVER AT GORDON RAPIDS	02KF013
CLYDE RIVER NEAR LANARK	02KF010
COLD CREEK AT ORLAND	02HK007
COLD CREEK NEAR BOLTON	02HC023
COLDWATER RIVER AT COLDWATER	02ED007
COLLINS CREEK NEAR KINGSTON	02HM005
COMMANDA CREEK NEAR COMMANDA	02DD015
CONESTOGO RIVER ABOVE DRAYTON	02GA039
CONESTOGO RIVER AT GLEN ALLAN	02GA028
CONESTOGO RIVER AT ST. JACOBS	02GA006
CONISTON CREEK ABOVE WANAPITEI RIVER	02DB007
CONSECON CREEK AT ALLISONVILLE	02HE002
CREDIT RIVER AT BOSTON MILLS	02HB018
CREDIT RIVER AT NORVAL	02HB025
CREDIT RIVER ERIN BRANCH ABOVE ERIN	02HB020
CREDIT RIVER NEAR CATARACT	02HB001
CREDIT RIVER NEAR ORANGEVILLE	02HB013
CREDIT RIVER WEST BRANCH AT NORVAL	02HB008
CROWE RIVER AT MARMORA	02HK003
CROWE RIVER NEAR GLEN ALDA	02HK005
CURRENT RIVER AT STEPSTONE	02AB021
DEPOT CREEK AT BELLROCK	02HM002
DINGMAN CREEK BELOW LAMBETH	02GE005
DODD CREEK BELOW PAYNES MILLS	02GC031
DON RIVER AT TODMORDEN	02HC024
DON RIVER AT YORK MILLS	02HC005
DUFFINS CREEK ABOVE PICKERING	02HC019
DUFFINS CREEK AT AJAX	02HC049
EAST HUMBER RIVER AT KING CREEK	02HC032
EAST HUMBER RIVER NEAR PINE GROVE	02HC009
EAST OAKVILLE CREEK NEAR OMAGH	02HB004

Station Name	HYDAT
EAST RIVER NEAR HUNTSVILLE	02EB013
ERAMOSA RIVER ABOVE GUELPH	02GA029
ETOBICOKE CREEK AT BRAMPTON	02HC017
ETOBICOKE CREEK BELOW QUEEN ELIZABETH HIGHWAY	02HC030
FAIRCHILD CREEK NEAR BRANTFORD	02GB007
FISH CREEK NEAR PROSPECT HILL	02GD010
FOURTEEN MILE CREEK AT OAKVILLE	02HB027
FRENCH RIVER AT CHAUDIERE DAM	02DD017
FRENCH RIVER AT DRY PINE BAY	02DD010
FRENCH RIVER AT PORTAGE DAM	02DD016
GANARASKA RIVER ABOVE DALE	02HD012
GANARASKA RIVER NEAR OSACA	02HD003
GOULAIS RIVER NEAR SEARCHMONT	02BF002
GRAHAM CREEK AT NEPEAN	02KF015
GRAND RIVER AT BRANTFORD	02GB001
GRAND RIVER AT GALT	02GA003
GRAND RIVER AT WEST MONTROSE	02GA034
GRAND RIVER BELOW SHAND DAM	02GA016
GRAND RIVER NEAR DUNDALK	02GA041
GRAND RIVER NEAR MARSVILLE	02GA014
GRAVEL RIVER NEAR CAVERS	02AE001
GRINDSTONE CREEK NEAR ALDERSHOT	02HB012
GULL RIVER AT NORLAND	02HF002
HARMONY CREEK AT OSHAWA	02HD013
HOG CREEK NEAR VICTORIA HARBOUR	02ED017
HOLLAND RIVER AT HOLLAND LANDING	02EC009
HORNER CREEK NEAR PRINCETON	02GB006
HUMBER RIVER AT ELDER MILLS	02HC025
HUMBER RIVER AT WESTON	02HC003
HUMBER RIVER NEAR PALGRAVE	02HC047
HUNSBURGER CREEK NEAR WILMOT CENTRE	02GA043
INDIAN RIVER NEAR BLAKENEY	02KF012
INNISFIL CREEK NEAR ALLISTON	02ED029
JACKSON CREEK AT PETERBOROUGH	02HJ001
JOCK RIVER NEAR RICHMOND	02LA007
JUNCTION CREEK AT SUDBURY	02CF005
JUNCTION CREEK BELOW KELLEY LAKE	02CF012
KAMINISTIQUIA RIVER AT KAMINISTIQUIA	02AB006
KEMPTVILLE CREEK NEAR KEMPTVILLE	02LA006
KETTLE CREEK ABOVE ST. THOMAS	02GC029
KETTLE CREEK AT ST. THOMAS	02GC002
LA VASE RIVER AT NORTH BAY	02DD013
LAUREL CREEK AT WATERLOO	02GA024
LITTLE FRENCH RIVER AT OKIKENDAWT ISLAND	02DD020
LITTLE MAITLAND RIVER AT BLUEVALE	02FE007
LITTLE PIC RIVER NEAR COLDWELL	02BA003

Station Name	HYDAT
LITTLE RIVER AT WINDSOR	02GH011
LITTLE ROUGE CREEK NEAR LOCUST HILL	02HC028
LITTLE ROUGE RIVER NEAR DICKSONS HILL	02HC053
LITTLE WHITE RIVER BELOW BOLAND RIVER	02CC010
LITTLE WHITE RIVER NEAR BELLINGHAM	02CC005
LUCKNOW RIVER AT LUCKNOW	02FD002
LYN CREEK NEAR LYN	02MB006
LYNDE CREEK AT BROOKLIN	02HC054
LYNDE CREEK NEAR WHITBY	02HC018
LYNDE CREEK TRIBUTARY NEAR KINSALE	02HC055
LYNDHURST CREEK AT LYNDHURST	02MA001
LYNN RIVER AT SIMCOE	02GC008
MAD RIVER BELOW AVENING	02ED015
MADAWASKA RIVER AT PALMER RAPIDS	02KD004
MAGNETAWAN RIVER NEAR BRITT	02EA011
MAGNETAWAN RIVER NEAR EMSDALE	02EA018
MAITLAND RIVER ABOVE WINGHAM	02FE005
MAITLAND RIVER AT BENMILLER	02FE015
MAITLAND RIVER BELOW WINGHAM	02FE002
MAITLAND RIVER NEAR HARRISTON	02FE011
MAYHEW CREEK NEAR TRENTON	02HK011
MCGREGOR CREEK NEAR CHATHAM	02GE007
MCINTYRE RIVER ABOVE THUNDER BAY	02AB020
MCKENZIE CREEK NEAR CALEDONIA	02GB010
MCVICAR CREEK AT THUNDER BAY	02AB019
MEDWAY RIVER AT LONDON	02GD008
MICHIPICOTEN RIVER AT HIGH FALLS	02BD002
MIDDLE MAITLAND RIVER ABOVE ETHEL	02FE013
MIDDLE MAITLAND RIVER NEAR BELGRAVE	02FE008
MIDDLE MAITLAND RIVER NEAR LISTOWEL	02FE003
MIDDLE THAMES RIVER AT THAMESFORD	02GD004
MILLHAVEN CREEK NEAR MILLHAVEN	02HM006
MIMICO CREEK AT ISLINGTON	02HC033
MISSISSAGI RIVER AT MISSISSAGI CHUTE	02CC008
MISSISSIPPI RIVER AT APPLETON	02KF006
MISSISSIPPI RIVER AT FERGUSONS FALLS	02KF001
MISSISSIPPI RIVER BELOW MARBLE LAKE	02KF016
MOIRA RIVER NEAR DELORO	02HL005
MOIRA RIVER NEAR FOXBORO	02HL001
MOIRA RIVER NEAR TWEED	02HL007
MONTREAL RIVER NEAR MONTREAL RIVER HARBOUR	02BE002
MOON RIVER AT HIGHWAY NO. 400	02EB011
MOOSE CREEK AT LEVACK	02CF013
MUSKRAT RIVER NEAR PEMBROKE	02KC015
MUSQUASH RIVER AT HIGHWAY NO. 400	02EB012
NANTICOKE CREEK AT NANTICOKE	02GC022

Station Name	HYDAT	1914 1920 1930 1940 1950 1960 1970 1980 1990 2000 2012
NAPANEE RIVER AT CAMDEN EAST	02HM007	
NEEBING RIVER NEAR THUNDER BAY	02AB008	
NITH RIVER ABOVE NITHBURG	02GA038	
NITH RIVER AT NEW HAMBURG	02GA018	
NITH RIVER NEAR CANNING	02GA010	
NONQUON RIVER NEAR PORT PERRY	02HG002	
NORBERG CREEK (SITE A) ABOVE BATCHAWANA RIVER	02BF005	
NORBERG CREEK (SITE B) AT OUTLET OF TURKEY LAKE	02BF006	
NORBERG CREEK (SITE C) AT OUT OF LITTLE TURKEY LAKE	02BF007	
NORBERG CREEK (SITE D) BELOW WISHART LAKE	02BF008	
NORBERG CREEK (SITE E) BELOW BATCHAWANA LAKE	02BF009	
NORBERG CREEK (SITE F) AT OUT OF BATCHAWANA LAKE	02BF012	
NORTH BRANCH MUSKOKA RIVER AT PORT SYDNEY	02EB004	
NORTH CURRENT RIVER NEAR THUNDER BAY	02AB014	
NORTH MAGNETAWAN RIVER ABOVE PICKEREL LAKE	02EA010	
NORTH MAGNETAWAN RIVER NEAR BURK'S FALLS	02EA005	
NORTH RIVER AT THE FALLS	02ED024	
NORTH THAMES RIVER AT ST. MARYS	02GD005	
NORTH THAMES RIVER BELOW FANSHAWE DAM	02GD003	
NORTH THAMES RIVER NEAR MITCHELL	02GD014	
NORTH THAMES RIVER NEAR THORNDALE	02GD015	
NORTH WEST GANARASKA RIVER NEAR OSACA	02HD004	
NOTTAWASAGA RIVER AT HOCKLEY	02ED026	
NOTTAWASAGA RIVER NEAR ALLISTON	02ED101	
NOTTAWASAGA RIVER NEAR BAXTER	02ED003	
NOTTAWASAGA RIVER NEAR EDENVALE	02ED027	
OAKVILLE CREEK AT MILTON	02HB005	
ONAPING RIVER NEAR LEVACK	02CF010	
OSHAWA CREEK AT OSHAWA	02HD008	
OSWEGO CREEK AT CANBORO	02HA024	
OTTAWA RIVER AT BRITANNIA	02KF005	
OUSE RIVER NEAR WESTWOOD	02HJ003	
OXTONGUE RIVER NEAR DWIGHT	02EB014	
PARKHILL CREEK ABOVE PARKHILL RESERVOIR	02FF008	
PAYNE RIVER NEAR BERWICK	02LB022	
PETAWAWA RIVER NEAR PETAWAWA	02KB001	
PIC RIVER NEAR MARATHON	02BB003	
PINE RIVER AT LURGAN	02FD001	
PINE RIVER NEAR EVERETT	02ED014	
RAISIN RIVER AT BLACK RIVER	02MC027	
RAISIN RIVER NEAR WILLIAMSTOWN	02MC001	
RAWDON CREEK NEAR WEST HUNTINGDON	02HK008	
REDHILL CREEK AT HAMILTON	02HA014	
RIDEAU RIVER AT OTTAWA	02LA004	
RIVIERE BEAUDETTE NEAR GLEN NEVIS	02MC026	
RIVIERE DELISLE NEAR ALEXANDRIA	02MC028	

Station Name	HYDAT
ROOT RIVER AT SAULT STE. MARIE	02CA002
ROUGE RIVER NEAR MARKHAM	02HC022
RUSCOM RIVER NEAR RUSCOM STATION	02GH002
SALMON RIVER NEAR SHANNONVILLE	02HM003
SAUBLE RIVER AT ALLENFORD	02FA004
SAUBLE RIVER AT SAUBLE FALLS	02FA001
SAUGEEN RIVER ABOVE DURHAM	02FC016
SAUGEEN RIVER NEAR PORT ELGIN	02FC001
SAUGEEN RIVER NEAR WALKERTON	02FC002
SCHOMBERG RIVER NEAR SCHOMBERG	02EC010
SERPENT RIVER ABOVE QUIRKE LAKE	02CD006
SERPENT RIVER AT HIGHWAY NO. 17	02CD001
SEVERN RIVER AT SWIFT RAPIDS	02EC003
SHELTER VALLEY BROOK NEAR GRAFTON	02HD010
SKOOTAMATTA RIVER NEAR ACTINOLITE	02HL004
SOUTH BRANCH MUSKOKA RIVER AT BAYSVILLE	02EB008
SOUTH CASTOR RIVER AT KENMORE	02LB020
SOUTH MAITLAND RIVER AT SUMMERHILL	02FE009
SOUTH NATION RIVER AT CASSELMAN	02LB013
SOUTH NATION RIVER AT SPENCERVILLE	02LB007
SOUTH NATION RIVER NEAR PLANTAGENET SPRINGS	02LB005
SOUTH PARKHILL CREEK NEAR PARKHILL	02FF004
SOUTH SAUGEEN RIVER NEAR HANOVER	02FC012
SPEED RIVER BELOW GUELPH	02GA015
SPEED RIVER NEAR ARMSTRONG MILLS	02GA040
SPENCER CREEK AT DUNDAS	02HB007
SPENCER CREEK AT HIGHWAY NO. 5	02HB023
SPENCER CREEK NEAR WESTOVER	02HB015
STEEL RIVER BELOW SANTOY LAKE	02BA006
STOKES RIVER NEAR FERNDALE	02FA002
STONEY CREEK AT STONEY CREEK	02HA022
STURGEON RIVER AT UPPER GOOSE FALLS	02DC012
STURGEON RIVER NEAR GLEN AFTON	02DC014
SYDENHAM RIVER AT FLORENCE	02GG003
SYDENHAM RIVER AT STRATHROY	02GG005
SYDENHAM RIVER NEAR ALVINSTON	02GG002
SYDENHAM RIVER NEAR OWEN SOUND	02FB007
TAY RIVER IN PERTH	02LA024
TEESWATER RIVER NEAR PAISLEY	02FC015
THAMES RIVER AT BYRON	02GE002
THAMES RIVER AT INGERSOLL	02GD016
THAMES RIVER AT INNERKIP	02GD021
THAMES RIVER AT THAMESVILLE	02GE003
THAMES RIVER NEAR DUTTON	02GE006
THAMES RIVER NEAR EALING	02GD001
TRIBUTARY TO NORBERG CREEK AT TURKEY LAKE	02BF013



Station Name	HYDAT
TROUT CREEK NEAR FAIRVIEW	02GD019
TROUT CREEK NEAR ST. MARYS	02GD009
TURKEY CREEK AT WINDSOR	02GH004
TWENTY MILE CREEK ABOVE SMITHVILLE	02HA020
TWENTY MILE CREEK AT BALLS FALLS	02HA006
VENISON CREEK NEAR WALSINGHAM	02GC021
VERMILION RIVER NEAR VAL CARON	02CF011
VEUVE RIVER NEAR VERNER	02DD012
WANAPITEI RIVER NEAR WANUP	02DB005
WELLAND RIVER BELOW CAISTOR CORNERS	02HA007
WEST BRANCH LITTLE CATARAQUI CREEK AT KINGSTON	02HM009
WEST BRANCH SCOTCH RIVER ST. ISIDORE DE PRESCOTT	02LB018
WEST DUFFINS CREEK ABOVE GREEN RIVER	02HC038
WEST HUMBER RIVER AT HIGHWAY NO. 7	02HC031
WHITE RIVER BELOW WHITE LAKE	02BC004
WHITEFISH RIVER AT NOLALU	02AB017
WHITEMANS CREEK NEAR MOUNT VERNON	02GB008
WHITESAND RIVER ABOVE SCHREIBER AT MINOVA MINE	02BA005
WHITSON RIVER AT CHELMSFORD	02CF007
WHITSON RIVER AT VAL CARON	02CF008
WILMOT CREEK NEAR NEWCASTLE	02HD009
WILTON CREEK NEAR NAPANEE	02HM004
WOLF RIVER AT HIGHWAY NO. 17	02AC001
WYE RIVER NEAR WYEVALE	02ED013
YORK RIVER NEAR BANCROFT	02KD002

Note:
: - No record
$:- With Record

8.3 Appendix C: Flood Flow Sample Summary and Analysis

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02AB006	6466.65	248.492	121.082	0.487	0.978	3.608	644.00	-7.416	5.438	0.467	3.03	0.67	86	18
02AB008	187.00	28.254	18.106	0.641	1.158	4.085	75.00	-2.765	3.284	0.566	4.05	0.75	55	25
02AB014	104.70	23.111	11.349	0.491	0.648	2.827	46.60	4.451	2.770	0.605	3.42	0.71	33	21
02AB017	225.81	32.098	14.247	0.444	1.382	6.676	80.70	-1.844	3.462	0.379	2.50	0.60	31	15
02AB019	45.63	8.747	7.346	0.840	2.568	12.072	35.00	-1.350	2.100	0.652	5.27	0.81	20	36
02AB020	83.11	14.167	7.392	0.522	0.757	3.093	29.40	2.581	2.233	0.704	4.25	0.76	24	28
02AB021	406.84	50.014	17.341	0.347	0.723	4.367	94.20	-12.010	4.091	0.278	2.13	0.53	21	12
02AC001	726.39	60.631	31.186	0.514	1.728	7.945	3.98	21.745	3.429	0.729	3.61	0.72	38	23
02AC002	2980.00	109.724	51.411	0.469	2.043	10.074	323.00	5.541	4.568	0.413	2.52	0.60	42	15
02AD010	651.91	51.511	24.957	0.485	2.559	11.858	151.00	9.536	3.630	0.470	2.58	0.61	41	15
02AE001	607.98	73.952	33.544	0.454	0.474	3.495	149.00	-68.946	4.943	0.225	2.36	0.58	25	14
02BA003	1324.17	136.193	55.274	0.406	0.921	4.511	299.00	-45.427	5.159	0.298	2.37	0.58	40	13
02BA005	20.90	3.726	1.531	0.411	0.211	2.128	6.51	1.501	0.468	0.926	4.94	0.80	22	33
02BA006	1190.00	71.080	34.573	0.486	1.801	9.539	158.00	34.616	3.438	0.685	2.86	0.65	10	24
02BB003	4221.73	322.155	138.061	0.429	0.202	2.627	607.00	-768.103	6.986	0.127	2.18	0.54	38	12
02BB004	210.02	15.792	8.382	0.531	1.244	4.725	2.63	2.248	2.459	0.575	3.37	0.70	28	21
02BC004	4156.28	211.060	74.573	0.353	1.189	5.520	444.00	-31.387	5.448	0.295	2.14	0.53	45	12
02BD002	5311.43	205.242	114.516	0.558	1.737	6.371	601.00	71.593	4.552	0.873	4.79	0.79	57	30
02BE002	2880.00	146.042	92.256	0.632	1.822	5.956	431.00	55.606	4.078	0.934	5.00	0.80	53	31
02BF001	1227.64	210.245	71.152	0.338	1.083	5.641	460.00	-8.857	5.341	0.317	2.14	0.53	44	12
02BF002	1138.67	178.860	71.530	0.400	0.785	3.759	370.00	-11.107	5.189	0.362	2.41	0.59	45	14
02BF004	50.98	16.237	6.336	0.390	0.319	2.433	28.90	-8.517	3.177	0.259	2.28	0.56	30	13
02BF005	10.36	2.833	1.023	0.361	0.401	2.649	4.92	-0.638	1.202	0.298	2.24	0.55	31	13
02BF006	8.03	2.093	0.898	0.429	1.360	5.693	5.03	0.350	0.438	0.494	2.76	0.64	32	16
02BF007	5.05	1.790	0.903	0.504	1.830	8.072	5.09	0.249	0.292	0.537	3.09	0.68	31	19
02BF008	4.08	1.660	0.759	0.457	0.904	4.046	3.61	0.112	0.341	0.470	2.84	0.65	32	17
02BF009	2.04	1.733	0.981	0.566	1.107	4.580	4.61	0.223	0.201	0.685	4.30	0.77	28	28
02BF012	1.15	0.654	0.402	0.615	1.772	7.085	2.01	0.093	-0.793	0.673	4.19	0.76	29	27

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02BF013	0.07	0.284	0.137	0.484	0.898	4.132	0.63	0.085	-1.874	0.788	4.33	0.77	19	28
02CA002	108.49	31.849	13.264	0.417	0.914	3.295	66.80	9.381	2.940	0.608	3.08	0.68	39	19
02CB003	1451.66	127.313	62.162	0.488	0.903	3.372	261.00	-5.939	4.790	0.465	3.06	0.67	30	19
02CC005	1971.45	180.328	90.531	0.502	1.284	5.170	497.00	-23.245	5.227	0.426	2.93	0.66	71	17
02CC008	9300.00	507.350	164.402	0.324	0.311	3.742	962.00	-1308.04	7.500	0.090	1.85	0.46	50	10
02CC010	1205.15	100.866	49.917	0.495	1.091	5.516	262.00	-41.238	4.900	0.343	2.76	0.64	31	17
02CD001	1354.24	95.226	30.648	0.322	0.119	2.460	156.00	-311.693	6.006	0.075	1.83	0.45	46	10
02CD006	157.08	12.924	5.299	0.410	0.554	3.736	28.60	-9.366	3.077	0.237	2.30	0.57	40	13
02CE002	1338.60	116.572	47.794	0.410	0.907	4.051	278.00	-28.542	4.926	0.323	2.41	0.59	92	13
02CF005	87.04	20.416	7.857	0.385	0.614	2.875	38.00	-4.489	3.167	0.315	2.34	0.57	42	13
02CF007	277.46	36.151	17.675	0.489	1.119	4.553	91.80	-5.797	3.655	0.408	2.86	0.65	47	17
02CF008	179.00	24.243	11.044	0.456	0.714	3.653	52.20	-6.055	3.360	0.348	2.58	0.61	35	15
02CF010	1647.69	75.698	32.195	0.425	0.333	3.609	147.00	-131.326	5.325	0.150	2.16	0.54	32	12
02CF011	680.43	59.733	26.730	0.448	2.281	9.175	149.00	26.741	3.245	0.726	3.17	0.68	30	20
02CF012	198.80	25.290	8.977	0.355	0.500	3.890	50.90	-25.956	3.922	0.174	2.03	0.51	35	11
02CF013	40.60	4.148	1.935	0.466	0.737	2.885	8.42	-0.017	1.323	0.469	2.99	0.67	29	18
02CG003	17.90	4.432	1.509	0.340	0.305	4.426	8.19	-12.786	2.842	0.087	1.89	0.47	20	10
02DB005	3154.02	149.152	57.777	0.387	1.139	4.562	326.00	8.371	4.870	0.397	2.42	0.59	60	14
02DB007	59.00	24.586	8.948	0.364	0.473	2.860	43.90	-1.133	3.188	0.356	2.35	0.57	29	13
02DC004	3006.40	166.572	63.034	0.378	0.854	4.859	359.00	-75.640	5.458	0.256	2.20	0.55	32	12
02DC012	1200.00	94.348	36.402	0.386	0.444	3.887	188.00	-84.708	5.174	0.195	2.10	0.52	27	12
02DD010	13900.0	400.137	65.590	0.164	0.136	3.202	560.00	98.218	5.695	0.205	1.46	0.31	51	7
02DD012	741.00	141.356	61.588	0.436	1.224	4.967	313.00	31.978	4.548	0.563	3.03	0.67	25	19
02DD013	68.59	13.662	4.628	0.339	0.842	4.411	27.80	-1.356	2.664	0.304	2.14	0.53	38	12
02DD014	35.64	9.933	3.223	0.325	0.825	2.968	17.90	4.664	1.472	0.643	2.67	0.63	38	16
02DD015	104.00	16.232	4.596	0.283	0.504	2.886	27.00	1.022	2.677	0.305	1.96	0.49	35	11
02DD016	NA	178.713	57.774	0.323	0.575	5.866	322.00	53.191	4.790	0.393	2.03	0.51	15	12
02DD017	NA	174.842	19.494	0.112	-0.202	4.172	215.00	510.312	5.814	0.058	1.25	0.20	20	7
02DD020	NA	70.409	27.005	0.384	-0.127	2.779	118.50	359.830	5.664	0.093	1.79	0.44	17	10
02EA005	328.84	45.632	16.970	0.372	1.592	8.642	129.00	-2.722	3.824	0.332	2.24	0.55	96	12

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02EA010	155.00	33.024	10.988	0.333	0.383	3.223	60.80	-17.240	3.900	0.210	1.97	0.49	45	11
02EA011	2839.38	200.528	49.265	0.246	0.246	3.440	331.00	-356.303	6.318	0.088	1.64	0.39	36	8
02EA018	402.51	39.860	9.887	0.248	-0.555	3.417	51.90	55.988	2.588	0.683	1.25	0.20	10	7
02EB004	1410.00	128.367	31.153	0.243	0.518	3.928	238.00	-74.528	5.301	0.152	1.67	0.40	97	9
02EB008	1400.00	82.931	21.123	0.255	-0.327	3.596	128.00	499.085	6.029	0.049	1.53	0.34	62	8
02EB011	4789.76	178.179	46.383	0.260	-0.216	2.552	254.00	732.090	6.312	0.081	1.52	0.34	47	8
02EB012	30.28	104.014	6.268	0.060	0.393	3.129	116.00	74.571	3.361	0.213	1.18	0.16	22	6
02EB013	610.00	103.315	31.543	0.305	0.423	2.774	172.00	-5.347	4.647	0.294	2.03	0.51	37	11
02EB014	605.00	58.100	14.266	0.246	0.415	3.303	93.60	-9.412	4.191	0.212	1.74	0.43	32	9
02EC002	1510.27	128.541	32.473	0.253	0.292	3.544	229.00	-122.784	5.520	0.126	1.67	0.40	97	9
02EC003	5850.00	217.305	25.045	0.115	0.219	2.061	263.00	127.966	4.453	0.287	1.38	0.28	41	7
02EC008	271.78	26.728	14.797	0.554	2.173	10.474	81.90	1.931	3.069	0.542	3.32	0.70	26	21
02EC009	176.03	33.122	15.850	0.479	1.460	5.945	88.00	4.914	3.199	0.541	3.10	0.68	41	19
02EC010	51.30	9.314	2.754	0.296	0.170	2.188	15.00	-5.965	2.711	0.182	1.87	0.47	38	10
02EC011	291.27	46.034	18.522	0.402	0.072	2.651	83.60	-357.747	6.000	0.046	2.00	0.50	29	11
02ED003	1230.58	128.140	60.828	0.475	1.630	7.197	370.00	4.635	4.710	0.464	2.85	0.65	63	17
02ED007	168.46	27.594	10.714	0.388	0.745	3.575	57.00	-5.714	3.456	0.319	2.34	0.57	42	13
02ED013	121.49	16.373	3.553	0.217	0.199	3.415	24.80	-24.645	3.710	0.087	1.57	0.36	23	8
02ED014	189.99	20.343	9.942	0.489	0.975	4.967	53.00	-7.576	3.270	0.352	2.78	0.64	40	16
02ED015	244.14	52.199	17.095	0.328	0.885	4.508	98.10	6.713	3.751	0.374	2.19	0.54	23	12
02ED017	65.20	12.160	4.144	0.341	1.853	9.202	26.40	0.782	2.377	0.334	2.09	0.52	23	12
02ED024	243.61	30.702	10.466	0.341	0.292	2.337	51.70	-3.626	3.490	0.312	2.20	0.55	24	13
02ED026	175.68	23.296	10.180	0.437	-0.059	2.847	41.70	756.322	6.597	0.014	1.96	0.49	23	11
02ED027	2686.37	115.241	31.311	0.272	-0.693	4.139	167.00	282.226	5.093	0.170	1.45	0.31	17	8
02ED029	479.46	46.000	12.398	0.269	-0.582	3.176	59.30	110.792	4.152	0.190	1.48	0.32	10	8
02ED100	86.00	13.953	5.800	0.416	0.564	2.872	26.90	-2.128	2.714	0.366	2.55	0.61	33	15
02ED101	327.60	31.932	10.175	0.319	-0.708	3.792	48.38	78.453	3.810	0.201	1.51	0.34	25	8
02ED102	216.43	38.995	24.250	0.622	1.861	7.270	122.00	-3.322	3.614	0.514	3.52	0.72	34	22
02FA001	913.50	112.820	38.112	0.338	0.220	2.609	203.00	-75.765	5.223	0.198	1.98	0.50	55	11
02FA002	50.50	15.717	4.099	0.261	0.155	2.572	24.00	-23.843	3.673	0.104	1.70	0.41	31	9

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02FA004	312.03	84.094	27.490	0.327	-0.107	2.910	129.00	-39.506	4.808	0.206	1.90	0.47	18	10
02FB007	182.97	34.183	15.758	0.461	1.578	7.170	99.00	-3.078	3.543	0.398	2.41	0.59	65	15
02FB009	587.07	60.155	18.343	0.305	0.168	3.114	104.00	-55.756	4.745	0.152	1.82	0.45	47	10
02FB010	298.02	72.866	29.374	0.403	0.667	2.898	139.00	12.815	3.992	0.481	2.67	0.63	50	16
02FC001	3953.52	569.031	206.743	0.363	0.646	3.362	1162.0	-256.668	6.686	0.248	2.15	0.54	97	12
02FC002	2136.36	319.913	130.523	0.400	1.295	5.487	774.00	-6.161	5.720	0.373	2.41	0.59	97	13
02FC011	156.44	32.821	16.157	0.492	1.221	4.634	82.00	-1.193	3.425	0.458	2.98	0.66	47	18
02FC012	635.00	142.077	51.552	0.363	0.404	3.223	251.00	-12.592	5.003	0.317	2.19	0.54	31	12
02FC015	669.92	91.320	28.153	0.308	-0.122	2.658	142.00	3841.476	8.229	0.007	1.68	0.41	35	9
02FC016	329.00	67.940	26.234	0.386	0.273	2.854	126.00	-103.507	5.133	0.153	2.11	0.53	29	12
02FC017	50.73	7.234	2.207	0.305	0.985	4.100	11.80	3.925	0.979	0.711	2.70	0.63	14	18
02FD001	155.80	80.430	51.039	0.635	2.063	8.208	250.00	6.542	4.123	0.600	3.75	0.73	25	24
02FD002	54.90	14.826	4.983	0.336	0.166	3.900	25.20	-33.922	3.886	0.097	1.82	0.45	22	10
02FE002	1644.42	376.538	169.568	0.450	0.567	2.683	776.00	-56.501	5.994	0.400	2.78	0.64	52	16
02FE003	73.39	35.356	19.078	0.540	0.822	3.849	97.70	-15.404	3.859	0.375	3.06	0.67	60	18
02FE005	527.45	155.245	97.152	0.626	1.639	7.179	560.00	-9.657	4.953	0.559	3.86	0.74	60	24
02FE007	340.27	91.543	45.539	0.498	0.906	3.543	201.00	-14.767	4.580	0.424	2.97	0.66	40	18
02FE008	644.82	151.611	62.495	0.412	0.877	3.668	306.00	-9.683	5.013	0.383	2.52	0.60	35	15
02FE009	370.56	102.800	43.837	0.426	0.951	4.007	228.00	-22.464	4.774	0.341	2.49	0.60	41	14
02FE010	205.02	58.293	22.730	0.390	0.760	3.694	109.00	-9.147	4.158	0.334	2.37	0.58	21	14
02FE011	112.00	35.826	12.834	0.358	-0.305	3.164	57.30	223.605	5.231	0.064	1.71	0.41	23	9
02FE013	416.00	85.952	30.054	0.350	0.602	3.883	158.00	-60.125	4.964	0.204	2.05	0.51	24	11
02FE014	74.66	26.011	10.039	0.386	0.395	3.599	49.50	-30.208	4.014	0.179	2.13	0.53	20	12
02FE015	2544.78	433.523	124.753	0.288	-0.351	3.302	635.00	1459.969	6.923	0.116	1.54	0.35	22	8
02FF002	865.41	201.167	88.789	0.441	0.677	3.087	423.00	-48.229	5.457	0.357	2.63	0.62	61	15
02FF004	42.72	28.990	10.657	0.368	0.951	4.680	63.50	-2.432	3.393	0.334	2.28	0.56	45	13
02FF007	460.39	164.263	77.162	0.470	0.901	3.895	383.00	-50.453	5.309	0.354	2.70	0.63	45	16
02FF008	112.53	32.315	9.798	0.303	0.072	3.154	53.90	-106.553	4.933	0.068	1.74	0.43	40	9
02FF009	113.80	39.846	19.732	0.495	0.740	3.190	84.00	-0.115	3.568	0.509	3.29	0.70	27	21
02GA003	3515.27	512.984	271.519	0.529	1.493	6.602	1550.0	-96.118	6.324	0.423	3.01	0.67	63	18

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02GA006	790.00	169.337	95.676	0.565	0.767	3.701	357.00	21.929	4.779	0.714	4.60	0.78	12	37
02GA010	1034.28	215.640	91.022	0.422	0.517	2.724	428.00	-83.761	5.656	0.306	2.47	0.60	60	14
02GA014	663.01	213.874	81.724	0.382	0.567	4.185	447.00	-156.199	5.897	0.208	2.09	0.52	51	11
02GA015	567.86	60.064	31.671	0.527	1.422	5.240	166.00	6.466	3.826	0.565	3.38	0.70	58	21
02GA016	784.76	167.409	132.562	0.792	2.173	8.139	670.00	53.950	4.217	1.027	6.51	0.85	38	41
02GA018	544.24	195.331	96.202	0.493	0.703	2.910	453.00	-7.067	5.197	0.489	3.20	0.69	59	19
02GA023	114.06	30.048	15.202	0.506	0.785	3.950	80.00	-10.207	3.626	0.379	2.95	0.66	55	18
02GA024	59.21	19.373	10.615	0.548	1.154	3.893	47.90	4.049	2.495	0.713	4.19	0.76	45	26
02GA028	571.13	131.098	85.118	0.649	1.366	5.519	447.00	5.665	4.615	0.678	4.63	0.78	52	29
02GA029	231.49	24.331	11.507	0.473	0.557	2.307	48.00	-1.213	3.138	0.464	3.05	0.67	49	18
02GA030	47.43	10.038	5.245	0.523	0.463	2.679	22.00	-6.680	2.768	0.318	2.89	0.65	42	17
02GA031	41.50	3.704	2.124	0.573	1.054	3.463	9.00	0.339	1.024	0.636	4.04	0.75	43	25
02GA034	1170.00	231.110	123.490	0.534	2.074	8.414	674.00	71.671	4.825	0.719	3.76	0.73	42	23
02GA038	326.00	176.363	80.421	0.456	0.397	2.393	346.00	-67.798	5.444	0.336	2.67	0.63	38	16
02GA039	274.71	152.668	76.383	0.500	1.225	4.700	388.00	10.320	4.827	0.523	3.20	0.69	37	20
02GA040	167.00	42.052	22.641	0.538	1.178	4.546	108.00	9.977	3.220	0.745	4.34	0.77	36	28
02GA041	66.49	26.743	6.387	0.239	0.842	3.546	40.40	15.718	2.240	0.600	2.14	0.53	16	13
02GA043	14.90	2.659	1.035	0.389	1.003	5.076	5.44	0.115	0.858	0.403	2.49	0.60	19	15
02GB001	5200.52	676.710	325.653	0.481	1.106	4.709	1780.0	-24.395	6.451	0.459	2.99	0.67	62	18
02GB006	150.00	35.973	16.698	0.464	0.852	4.053	79.10	-14.224	3.872	0.316	2.54	0.61	47	15
02GB007	388.64	47.947	17.926	0.374	-0.070	2.778	81.20	581.500	6.279	0.034	1.83	0.45	46	10
02GB008	385.86	49.985	19.364	0.387	0.047	2.698	92.00	-782.325	6.724	0.023	1.93	0.48	50	10
02GB010	172.78	23.560	9.163	0.389	0.126	2.776	43.00	-126.558	5.010	0.061	1.98	0.50	51	11
02GC002	330.88	125.328	47.292	0.377	0.643	4.040	275.00	13.104	4.649	0.409	2.41	0.58	45	14
02GC006	369.83	39.650	23.984	0.605	1.931	9.854	148.00	-9.480	3.793	0.453	3.38	0.70	56	21
02GC007	566.73	47.426	36.771	0.775	3.509	20.317	252.00	7.090	3.429	0.727	4.59	0.78	56	29
02GC008	143.76	17.393	9.187	0.528	2.140	10.764	60.00	0.198	2.729	0.482	3.04	0.67	55	18
02GC010	354.10	68.216	37.471	0.549	0.724	2.542	149.00	-0.121	4.073	0.567	3.75	0.73	48	23
02GC011	154.04	31.345	16.090	0.513	0.241	2.703	62.00	-43.494	4.300	0.208	2.52	0.60	22	15
02GC017	101.08	23.569	13.198	0.560	1.002	3.813	59.10	-2.215	3.126	0.510	3.51	0.72	36	22

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02GC018	294.50	109.305	47.450	0.434	1.262	7.526	296.00	-18.750	4.799	0.349	2.47	0.59	43	14
02GC021	68.40	6.847	2.918	0.426	0.763	2.923	14.00	0.974	1.650	0.505	2.88	0.65	34	17
02GC022	177.17	31.592	13.536	0.429	1.324	5.962	78.20	1.218	3.324	0.430	2.64	0.62	38	15
02GC026	664.55	95.518	36.638	0.384	0.290	2.552	169.00	-99.348	5.255	0.189	2.15	0.53	34	12
02GC029	134.08	62.455	44.125	0.707	1.703	7.153	212.00	10.914	3.597	0.884	6.24	0.84	27	41
02GC030	126.70	34.211	21.336	0.624	1.382	4.486	82.10	2.638	3.262	0.631	4.04	0.75	19	26
02GC031	99.56	40.997	18.543	0.452	0.519	2.812	77.40	-9.568	3.858	0.374	2.72	0.63	24	17
02GD001	1338.10	232.814	135.818	0.583	1.456	6.168	813.00	-25.113	5.428	0.504	3.50	0.71	97	21
02GD003	1416.28	356.477	131.302	0.368	0.179	2.991	718.00	-1088.62	7.273	0.090	1.95	0.49	80	10
02GD004	306.00	94.323	59.881	0.635	2.463	14.249	412.00	-22.758	4.658	0.459	3.44	0.71	66	21
02GD005	1080.00	389.758	176.840	0.454	0.327	2.317	770.00	-280.789	6.473	0.267	2.52	0.60	62	14
02GD008	203.19	75.200	32.884	0.437	0.082	2.419	146.00	-297.805	5.919	0.087	2.11	0.53	39	12
02GD009	149.27	14.993	9.546	0.637	1.882	8.437	50.00	-0.755	2.605	0.558	3.81	0.74	30	24
02GD010	144.35	58.137	32.238	0.555	0.892	3.798	150.00	-12.842	4.170	0.448	3.28	0.69	54	20
02GD011	87.75	22.455	14.681	0.654	1.400	4.865	68.00	0.919	2.856	0.673	4.60	0.78	58	29
02GD014	315.40	147.808	74.306	0.503	1.404	6.447	413.00	-0.462	4.885	0.486	3.11	0.68	37	19
02GD015	1323.30	447.732	197.958	0.442	0.289	2.611	926.00	-670.809	7.004	0.178	2.31	0.57	56	13
02GD016	509.95	70.118	36.058	0.514	1.140	4.808	194.00	-8.251	4.263	0.451	3.11	0.68	55	19
02GD018	140.35	54.112	22.847	0.422	0.258	2.110	97.00	-36.753	4.478	0.255	2.40	0.58	47	14
02GD019	36.00	21.055	9.255	0.440	1.161	4.469	46.00	-0.763	3.001	0.408	2.64	0.62	39	15
02GD021	148.85	50.239	20.737	0.413	0.370	2.539	96.50	-13.010	4.094	0.336	2.52	0.60	32	15
02GE002	3082.61	595.560	225.906	0.379	-0.064	2.202	977.00	8188.952	8.934	0.029	1.83	0.45	58	10
02GE003	4370.37	520.716	192.170	0.369	0.291	2.548	960.00	-317.978	6.710	0.226	2.13	0.53	58	12
02GE005	148.59	34.309	13.899	0.405	1.065	4.439	69.00	4.023	3.313	0.453	2.63	0.62	33	15
02GE006	3815.71	512.132	178.839	0.349	0.384	3.046	940.00	-466.140	6.870	0.183	2.04	0.51	34	11
02GE007	203.80	64.878	26.281	0.413	0.503	2.473	117.00	3.214	4.027	0.451	2.75	0.64	27	17
02GG002	701.18	112.341	44.474	0.396	0.901	4.459	238.00	-68.081	5.167	0.241	2.23	0.55	62	12
02GG003	1149.32	151.471	64.616	0.427	0.728	5.071	344.00	-120.710	5.587	0.225	2.26	0.56	28	13
02GG005	170.59	36.756	17.455	0.475	1.459	7.200	99.00	-8.410	3.756	0.350	2.56	0.61	35	15
02GG006	248.72	90.457	46.430	0.513	0.741	3.608	226.00	-34.724	4.763	0.373	2.96	0.66	46	18

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02GG009	535.61	107.259	51.476	0.480	0.373	2.673	219.00	-62.115	5.087	0.310	2.72	0.63	29	16
02GH002	125.00	41.412	15.731	0.380	0.636	4.715	85.60	-5.375	3.810	0.312	2.21	0.55	26	12
02GH003	159.00	49.490	23.041	0.466	0.160	2.241	92.70	-32.438	4.374	0.279	2.56	0.61	34	15
02GH004	29.60	13.778	3.976	0.289	-0.051	2.814	21.20	158.950	4.978	0.027	1.65	0.39	29	9
02GH011	55.26	27.632	9.794	0.354	-0.223	2.684	42.60	209.734	5.201	0.051	1.72	0.42	23	9
02HA006	291.72	73.012	26.227	0.359	0.534	3.530	143.00	-57.572	4.852	0.200	2.07	0.52	54	11
02HA007	222.61	53.796	19.181	0.357	0.708	3.429	107.00	-12.677	4.157	0.286	2.17	0.54	55	12
02HA014	51.67	48.968	17.183	0.351	-0.047	2.721	76.70	-54.518	4.634	0.156	1.93	0.48	26	10
02HA020	166.14	46.917	24.743	0.527	0.691	3.540	106.00	-13.000	4.010	0.421	3.18	0.69	23	20
02HA022	20.00	14.869	9.501	0.639	1.077	4.793	37.70	1.427	2.354	0.754	5.19	0.81	14	39
02HA024	83.22	27.897	15.514	0.556	0.834	3.818	62.60	-2.529	3.292	0.522	3.61	0.72	16	25
02HB001	208.75	20.502	10.216	0.498	1.322	6.789	65.00	-6.889	3.251	0.354	2.75	0.64	83	16
02HB004	192.99	55.961	28.900	0.516	1.010	5.363	162.00	-26.501	4.354	0.346	2.87	0.65	52	17
02HB005	101.27	19.537	7.131	0.365	1.227	5.862	45.00	-1.125	2.974	0.333	2.24	0.55	52	12
02HB007	157.91	19.079	7.421	0.389	0.404	4.190	38.80	-45.440	4.161	0.115	2.05	0.51	28	11
02HB008	130.99	14.935	6.227	0.417	0.706	3.422	33.00	0.350	2.589	0.437	2.72	0.63	48	16
02HB011	241.99	22.809	5.888	0.258	-0.487	3.847	34.00	158.919	4.911	0.040	1.51	0.34	33	8
02HB012	77.94	17.516	9.169	0.524	0.896	3.764	45.00	0.460	2.706	0.536	3.42	0.71	46	21
02HB013	60.58	6.651	3.029	0.455	1.289	6.450	18.00	-0.685	1.926	0.385	2.61	0.62	45	15
02HB015	63.50	4.974	1.667	0.335	1.098	5.432	10.00	-0.879	1.730	0.275	2.07	0.52	34	11
02HB018	414.70	36.255	14.519	0.401	1.002	4.341	76.00	5.588	3.317	0.474	2.67	0.63	30	16
02HB020	32.30	3.788	1.333	0.352	0.626	2.753	6.52	1.292	0.768	0.568	2.72	0.63	29	16
02HB021	9.14	2.264	1.080	0.477	0.760	3.658	4.82	-0.335	0.873	0.419	2.92	0.66	21	18
02HB022	123.42	9.845	4.918	0.500	0.563	3.329	20.80	-5.770	2.701	0.317	2.79	0.64	23	17
02HB023	126.19	16.450	6.791	0.413	-0.170	3.291	30.50	167.856	5.018	0.043	1.86	0.46	24	10
02HB024	18.90	2.211	0.621	0.281	-0.157	3.876	3.51	-34.061	3.592	0.016	1.62	0.38	25	8
02HB025	644.84	59.520	22.513	0.378	-0.078	2.693	97.40	1510.336	7.279	0.015	1.83	0.45	22	10
02HB027	24.45	17.231	6.698	0.389	0.144	4.469	29.60	-14.377	3.449	0.193	2.04	0.51	10	14
02HC003	802.04	151.632	178.873	1.180	6.785	52.940	1449.0	21.341	4.613	0.636	3.80	0.74	59	23
02HC005	88.10	31.639	20.460	0.647	1.551	5.456	99.00	0.092	3.273	0.602	4.04	0.75	49	25

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02HC009	190.91	31.658	18.821	0.595	2.093	11.402	121.00	-6.842	3.550	0.451	3.31	0.70	55	20
02HC017	68.56	30.963	12.771	0.413	0.533	2.942	56.20	-16.366	3.822	0.270	2.36	0.58	33	13
02HC018	100.27	28.163	11.146	0.396	0.611	3.345	56.00	-11.652	3.646	0.279	2.31	0.57	42	13
02HC019	93.50	34.859	21.917	0.629	1.447	6.447	113.00	-6.906	3.608	0.509	3.80	0.74	39	24
02HC022	181.31	43.005	20.383	0.473	1.062	4.706	104.00	-3.145	3.742	0.437	2.90	0.65	44	17
02HC023	62.20	13.200	5.627	0.426	0.589	3.227	26.00	-1.142	2.587	0.403	2.71	0.63	30	16
02HC024	318.50	124.900	37.029	0.297	0.205	2.825	207.00	-228.332	5.862	0.105	1.79	0.44	40	9
02HC025	296.28	36.326	19.416	0.535	1.927	9.267	116.00	1.705	3.411	0.523	3.25	0.69	41	20
02HC027	58.00	66.026	25.363	0.384	1.001	3.953	133.00	2.040	4.086	0.386	2.40	0.58	37	14
02HC028	83.58	22.368	8.228	0.368	0.085	2.051	36.50	-63.771	4.451	0.096	1.97	0.49	44	11
02HC030	204.99	91.216	33.247	0.365	0.992	4.128	186.00	-2.336	4.480	0.346	2.27	0.56	44	13
02HC031	142.18	50.142	21.198	0.423	0.503	2.643	102.00	-11.117	4.056	0.351	2.58	0.61	43	15
02HC032	94.80	14.756	6.099	0.413	0.479	2.762	27.70	0.494	2.580	0.425	2.62	0.62	36	15
02HC033	67.77	37.652	14.649	0.389	1.803	8.334	97.90	18.395	2.687	0.771	3.23	0.69	46	20
02HC038	52.00	13.337	5.035	0.378	0.615	3.570	24.00	-3.882	2.806	0.292	2.26	0.56	17	13
02HC047	163.54	16.819	5.089	0.303	0.439	2.246	24.60	10.149	1.517	0.995	3.83	0.74	17	26
02HC049	257.46	58.510	25.710	0.439	-0.138	1.944	93.80	122.692	4.078	0.429	1.59	0.37	21	8
02HC051	42.00	4.967	3.889	0.783	2.727	12.300	15.60	2.296	0.257	1.326	8.52	0.88	10	79
02HC053	58.99	25.264	12.727	0.504	0.173	2.752	43.70	8.538	2.377	1.142	8.39	0.88	10	78
02HC054	39.01	8.220	2.330	0.283	0.585	3.791	12.20	1.112	1.913	0.329	1.99	0.50	10	14
02HC055	37.58	14.072	4.428	0.315	0.416	3.228	21.60	4.942	2.096	0.520	2.46	0.59	10	19
02HD003	67.30	13.682	9.461	0.692	3.109	15.026	51.70	5.837	1.564	1.044	5.67	0.82	24	38
02HD004	46.07	15.759	14.398	0.914	1.913	7.046	61.20	0.475	2.343	0.916	8.09	0.88	37	50
02HD006	80.94	29.654	23.717	0.800	3.216	16.275	139.00	6.848	2.772	0.853	5.39	0.81	36	35
02HD008	95.79	37.600	27.980	0.744	1.710	6.869	145.00	4.167	3.203	0.823	5.94	0.83	48	37
02HD009	80.74	26.322	19.506	0.741	2.719	13.269	115.00	4.426	2.799	0.764	4.88	0.80	41	31
02HD010	63.77	12.526	7.933	0.633	2.147	8.874	39.70	4.494	1.691	0.926	5.17	0.81	23	34
02HD012	241.87	51.301	34.266	0.668	2.155	9.660	170.00	8.982	3.479	0.759	4.81	0.79	22	32
02HD013	42.87	25.614	7.305	0.285	0.281	2.637	41.60	-12.534	3.624	0.192	1.85	0.46	29	10
02HE002	119.10	24.549	10.482	0.427	1.316	6.021	62.00	2.541	3.008	0.432	2.54	0.61	43	15

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02HF002	1281.49	53.279	11.922	0.224	0.361	3.251	81.70	-30.372	4.417	0.142	1.62	0.38	50	8
02HF003	1250.00	111.977	35.189	0.314	0.640	4.341	211.00	-10.370	4.778	0.269	1.96	0.49	50	10
02HG002	32.60	4.839	2.350	0.486	0.865	3.428	10.20	1.863	0.740	0.925	5.03	0.80	18	33
02HJ001	116.50	14.881	6.344	0.426	2.527	12.660	43.30	3.241	2.344	0.465	2.48	0.60	41	14
02HJ003	282.60	36.202	14.305	0.395	0.763	3.369	68.00	-4.603	3.651	0.347	2.41	0.59	33	14
02HK003	1934.69	122.476	34.065	0.278	0.886	3.967	229.00	34.834	4.401	0.386	2.03	0.51	50	11
02HK005	456.00	38.084	10.426	0.274	0.232	4.268	69.00	-137.344	5.166	0.059	1.69	0.41	37	9
02HK006	553.00	46.960	14.252	0.304	0.853	4.530	89.00	5.666	3.665	0.343	2.07	0.52	29	11
02HK007	160.52	21.472	7.281	0.339	0.429	3.635	40.50	-19.236	3.691	0.179	1.99	0.50	29	11
02HK008	93.00	7.800	2.582	0.331	0.467	2.599	13.40	2.112	1.633	0.479	2.45	0.59	25	14
02HK009	82.60	16.135	6.798	0.421	1.140	4.549	33.00	6.004	2.101	0.694	3.32	0.70	18	21
02HK011	32.98	7.115	3.311	0.465	1.144	5.859	16.10	-1.225	2.051	0.388	2.75	0.64	17	17
02HL001	2594.93	203.206	61.253	0.301	0.362	2.993	366.00	-129.794	5.794	0.181	1.87	0.46	97	10
02HL003	429.00	43.491	13.143	0.302	0.613	3.483	80.00	-7.496	3.899	0.257	1.96	0.49	56	10
02HL004	677.65	66.051	22.100	0.335	1.230	5.427	139.00	22.281	3.660	0.499	3.10	0.68	38	14
02HL005	296.89	33.760	9.380	0.278	0.198	2.227	53.00	-23.363	4.032	0.165	1.80	0.44	47	9
02HL007	1762.67	134.920	43.793	0.325	0.284	4.179	214.00	-157.330	5.668	0.150	1.92	0.48	10	13
02HM002	181.00	9.829	3.035	0.309	1.146	4.868	19.10	2.131	1.970	0.381	2.10	0.52	52	11
02HM003	906.73	67.986	21.341	0.314	1.374	7.089	152.00	7.945	4.038	0.341	2.06	0.51	53	11
02HM004	105.20	23.325	9.766	0.419	1.009	4.325	52.00	3.632	2.863	0.499	2.82	0.65	32	17
02HM005	160.13	31.737	11.929	0.376	0.725	3.741	65.00	-1.760	3.450	0.358	2.38	0.58	39	14
02HM006	144.17	15.164	6.034	0.398	0.805	3.618	31.00	1.352	2.534	0.441	2.61	0.62	29	15
02HM007	700.24	44.384	12.034	0.271	0.931	3.894	78.00	10.203	3.474	0.344	1.93	0.48	39	10
02HM009	4.98	4.543	2.535	0.558	1.315	4.955	10.10	1.249	0.916	0.800	4.61	0.78	14	34
02JC008	1782.25	160.692	37.865	0.236	0.030	2.404	225.00	-1244.56	7.248	0.027	1.57	0.36	25	8
02KB001	4122.32	229.256	82.792	0.361	0.419	2.887	469.00	-32.444	5.523	0.313	2.23	0.55	86	12
02KC009	2380.00	147.226	46.480	0.316	0.218	2.728	243.00	-162.766	5.728	0.147	1.86	0.46	62	10
02KC015	674.00	37.542	13.244	0.353	-0.115	2.480	53.00	382.037	5.841	0.038	1.78	0.44	13	10
02KD002	844.00	71.714	18.876	0.263	-0.055	2.368	106.00	566.242	6.203	0.038	1.58	0.37	50	8
02KD004	5800.00	255.227	85.226	0.334	0.060	2.236	449.00	-1532.79	7.488	0.048	1.83	0.45	66	10

HYDAT	Drainage Area(sq.km)	Mean (cms)	Standard deviation(cms)	Coefficient of variation	Coefficient of skewness	Coefficient of kurtosis	Max. flood (cms)	Parameters of the 3PLN A	Parameters of the 3PLN M	Parameters of the 3PLN S	Q 100/2 Ratio	EVI	Yrs of data	Yrs of data required
02KF001	2660.00	145.955	45.485	0.312	1.404	7.339	311.00	35.899	4.624	0.399	2.13	0.53	33	12
02KF005	90900.0	3292.76	713.473	0.217	0.368	2.747	5110.0	-164.069	8.127	0.207	1.65	0.39	50	8
02KF006	2940.00	146.701	46.281	0.315	0.285	3.052	283.00	-151.394	5.687	0.153	1.88	0.47	94	10
02KF010	618.00	67.683	26.025	0.385	1.631	8.881	174.00	3.147	4.095	0.383	2.37	0.58	41	13
02KF011	258.00	48.500	15.695	0.324	0.366	2.461	82.60	-0.668	3.845	0.327	2.15	0.54	38	12
02KF012	212.26	24.089	8.679	0.360	0.724	3.481	48.40	4.386	2.885	0.451	2.49	0.60	38	14
02KF013	291.00	30.085	12.662	0.421	2.424	13.846	88.70	3.373	3.195	0.427	2.49	0.60	41	14
02KF015	26.50	5.303	1.830	0.345	-0.196	4.679	8.52	1.540	1.302	0.386	2.03	0.51	14	12
02KF016	359.00	25.908	9.494	0.366	1.275	5.314	53.70	12.390	2.360	0.743	3.13	0.68	25	20
02KF017	152.00	13.596	6.065	0.446	0.883	4.022	26.50	-1.322	2.628	0.402	2.71	0.63	15	18
02LA004	3811.14	353.345	116.904	0.331	0.110	2.261	597.00	-436.572	6.663	0.146	1.91	0.48	58	10
02LA006	411.12	47.033	15.119	0.321	0.353	2.286	80.00	13.901	3.390	0.490	2.45	0.59	36	14
02LA007	526.09	82.903	32.380	0.391	0.625	2.317	148.00	33.083	3.678	0.721	3.37	0.70	34	21
02LA024	661.00	31.502	11.319	0.359	-0.259	4.043	48.30	17.841	2.476	0.719	2.74	0.63	13	19
02LB005	3770.00	706.676	235.183	0.333	-0.013	2.574	1269.0	-8064.65	9.079	0.026	1.78	0.44	94	9
02LB006	438.66	136.599	52.301	0.383	0.972	4.353	304.00	25.506	4.616	0.455	2.50	0.60	62	14
02LB007	246.00	47.717	20.492	0.430	1.308	6.122	3.78	-0.070	3.782	0.416	2.62	0.62	59	15
02LB008	448.00	113.330	62.000	0.547	1.571	5.775	4.61	21.398	4.321	0.645	3.71	0.73	49	23
02LB013	2370.00	516.929	181.676	0.352	0.976	3.875	1010.0	241.403	5.393	0.711	3.02	0.67	33	18
02LB018	105.00	29.330	7.687	0.262	0.162	3.219	3.35	-44.660	4.299	0.104	1.69	0.41	14	9
02LB020	185.00	40.671	10.059	0.247	-0.485	2.166	53.10	55.234	2.397	0.818	1.21	0.18	25	6
02LB022	146.09	41.540	19.784	0.476	1.988	8.221	112.00	20.019	2.705	0.894	4.00	0.75	29	26
02MA001	271.04	30.675	8.477	0.276	0.491	4.301	48.00	-8.847	3.656	0.214	1.84	0.46	12	11
02MB006	106.72	28.164	8.191	0.291	0.890	3.828	49.60	7.325	2.964	0.388	2.07	0.52	32	11
02MB010	13.10	10.260	3.584	0.349	0.215	2.723	16.70	-8.865	2.934	0.189	2.04	0.51	19	11
02MC001	365.10	79.351	26.042	0.328	0.478	2.851	4.32	-15.452	4.515	0.276	2.08	0.52	52	11
02MC026	132.61	21.306	6.088	0.286	0.568	2.780	33.90	12.166	1.948	0.795	2.96	0.66	27	18
02MC027	126.38	25.871	6.117	0.236	-0.139	2.968	34.20	65.596	3.671	0.155	1.45	0.31	12	8
02MC028	84.52	14.463	4.371	0.302	1.450	5.440	25.60	8.618	1.518	0.738	2.58	0.61	18	15