



Supporting Document 1-5

Surface Water Quantity Existing Conditions Report

Eastern Ontario Waste Handling Facility Future
Development Environmental Assessment

GFL Environmental Inc.

Moose Creek, Ontario

March 15, 2022

Prepared by:

HDR Corporation
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8



Acknowledgements

This Report has been prepared by:

HDR Corporation
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8



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Surface Water Quantity Existing Conditions Report

Environmental Assessment for Future
Development of Eastern Ontario Waste Handling
Facility

GFL Environmental Inc.

North Stormont, Ontario
March 15, 2022

HDR Project Team

Project Manager

Larry Fedec, P.Eng.

Technical Team

Soheil Kashi, PhD, P.Eng.

Janice Look, EIT

Quality Control

Anthony Reitmeier, P.Eng.

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1 Introduction

This study is completed to assess and document the existing surface water quantity conditions for the future development of the Eastern Ontario Waste Handling Facility (EOWHF), located in the Township of North Stormont, Ontario. The proposed 235 ha landfill expansion site is bounded by Concession Road 7 to the north, Highway 138 to the east, Lafleche Road to the south, and the Fraser Drain to the west.

An Environmental Assessment (EA) study is being completed in support of the proposed landfill expansion. Establishing the existing surface water quantity conditions at the site is required as part of the EA study in order to investigate the potential impacts of the development on the receiving surface drainage systems.

The existing surface water quantity conditions for the existing landfill site to the west of the proposed development is documented under a separate cover (Surface Water Existing Conditions Report – Part A: Water Quantity for the Eastern Ontario Waste Handling Facility Landfill Expansion Environmental Assessment, prepared by J.F. Sabourin and Associates Inc., August 2017). Information on the hydrology of watercourses outside the future development site, as it pertains to low flow characteristics of existing receivers for water quality, is also documented under a separate cover (Surface Water Quality Existing Conditions Report, prepared by CanDetec, October 2022).

1.1 Study Area

The project site is located on Lots 13, 14, 15, and the eastern half of Lot 16, Concession 10, Township of North Stormont, in the United Counties of Stormont, Dundas and Glengarry. The land is currently owned by GFL and is currently leased and used mainly as a sod farm with a smaller area for crop production. The site location plan is presented in **Figure 1-1**.

The proposed expansion site currently drains to the two municipal drains that are located within the proposed development, as shown on **Figure 1-1**:

- Fraser Municipal Drain, which runs along the western border of the site and ultimately discharges into Moose Creek; and
- Upper Tayside Municipal Drain, which crosses through the southeast corner of the site and then runs towards the northeast, ultimately discharging to the Scotch River.

The Roxborough-Plantagenet Boundary Drain flows along the north border of the site. However, based on the available topographic information of the site, flows from the study area are captured along a perimeter channel directly south of the Roxborough-Plantagenet Boundary Drain, and flow westerly towards the Fraser Drain.

Albert Fahey drain on the south side of Lafleche Road, which forms the south border of the site, also conveys flows through a series of culverts towards the Fraser Drain.

The study area is located within the Moose Creek and Scotch River subwatersheds, both of which are part of the Lower South Nation River watershed. The Moose Creek and Scotch River watersheds are situated in both the United Counties of Stormont, Dundas and Glengarry, and the United Counties of Prescott and Russell.

Figure 1-1. Site Location Plan



2 Methodology

The following tasks describe the methodology undertaken to complete this study. Each task is described in detail in the following sections.

2.1 Background Information Review

In preparation of this report, the following documents, background reports, and datasets were collected and reviewed to investigate the existing surface water quantity conditions of the project site:

- Surface Water Existing Conditions Report – Part A: Water Quantity for the Eastern Ontario Waste Handling Facility Landfill Expansion Environmental Assessment, prepared by J.F. Sabourin and Associates Inc. (dated August 2017);
- Potential For Surface Water Spill and Flooding from Fraser Drain into the EOWHF – Action Required Memo prepared by J.F. Sabourin and Associates Inc. (dated May 2017)
- Digital Raster Acquisition Project for the East (DRAPE) Digital Elevation Model (2014);
- LiDAR Topographic Data from Airborne Imaging;
- UAV (Drone) survey information of the existing EOWHF site with 0.3m contour intervals by Tetra Tech (December 2015);
- Drone survey information of the proposed EOWHF expansion site by Tetra Tech (April and June 2020);
- Topographic survey of the Fraser Drain (November 2016);
- Topographic survey of the unnamed drain along the southern border of the project site by Tetra Tech (October 2020);
- Historical Engineering Municipal Drain Reports obtained from the Township of North Stormont;
- Local precipitation data obtained from GFL Environmental (Obtained August 5, 2020);
- Rainfall gauge data for the Ottawa CDA RCS Station from Environment Canada;
- Rain Plus Snowmelt Model 5 data for the Ottawa CDA Station from Environment Canada, Engineering Climate Services Unit;
- Ontario Soil Survey Complex soil type information obtained from Land Information Ontario;
- Ontario Land Cover datasets obtained from Land Information Ontario;
- Constructed Drain shapefiles obtained from Land Information Ontario;

- Flow monitoring data for the Fraser Drain and Upper Tayside Drain, collected by CanDetec Inc. (from May 2019 to August 2020); and
- Draft Geotechnical Data Report, prepared by Terrapex Environmental Ltd. (dated April 2020).

2.2 Agency Liaison

Approval agencies and stakeholders, including local municipalities, the Ministry of the Environment, Conservation, and Parks (MECP), Ministry of Transportation (MTO), and South Nation Conservation Authority, were contacted to identify existing flooding issues, confirm project requirements, and obtain available data. Comments received from the Agencies are summarized in **Section 3**.

2.3 Hydrologic Analysis

Using the latest available topographic data, a digital elevation model (DEM) was created to form a basis for the hydrologic and hydraulic modelling software (PC-SWMM). The DEM was used to delineate the subwatersheds for each outfall location. Soil type and land use information for the Moose Creek and Scotch River watersheds, obtained from the Land Information Ontario (LIO) database, as well as the results of the geotechnical investigation, were used to characterize existing hydrologic input parameters.

2.3.1 Rainfall Data

Data collected at the Environment Canada Ottawa CDA RCS station was obtained to develop the rainfall and snowmelt plus rain events distributions with various return periods (2 year to 100 year). Rainfall measurements from the on-site gauge were utilized for the determination of dry weather flows and model calibration.

2.3.2 Flow Monitoring and Model Calibration

Flow monitoring was conducted for the Fraser Drain and Upper Tayside Drain within the project site. The locations of the monitoring stations are shown in **Figure 2-1**. The obtained streamflow data was used to calibrate the hydrologic input parameters in the PC-SWMM model.

Figure 2-1. Flow Monitoring Stations



2.3.3 Modelling Results

The calibrated hydrologic model was used to establish existing peak flows (2-year to 100-year) upstream and downstream of the EOWHF site based on the developed IDF curves and snowmelt plus rainfall distributions. The approach to the hydrologic modelling and resulting flow values are presented in **Section 4**.

2.4 Floodplain Mapping

The results from the topographic survey, including ditch cross-sections and culvert dimensions and inverts, were used to refine the DEM for hydraulic modelling. The hydraulic model was used to delineate the 100-year flooding extents within the project site. The approach to floodplain mapping and results are presented in **Section 5**.

3 Agency Liaison

Based on the correspondence with the approval agencies and stakeholders, the South Nation Conservation Authority and the United Counties reported no existing flooding issues or drainage concerns within the study area.

The Drainage Superintendent from the Township of North Stormont pointed out that the subject site was previously stripped for the sale of muck and topsoil, which created issues for tiles draining land at lower elevations than the design elevations. Additionally, the soils were identified to be erosive, which have required minor repairs over the years.

Due to the scale and extent of the project, the Drainage Superintendent indicated that the drainage requirements for the municipal drains could not be confirmed at this point. Further liaison and coordination with the Drainage Superintendent will be required as the project progresses. Correspondence with the agencies are provided in **Appendix A**.

To inform the analysis, the following historical engineering reports received from the Township of North Stormont were reviewed:

- Engineer's Report for the Repair and Improvement of the East Branch and the Main Fraser Creek Municipal Drain and the Construction of the Legault Branch, Township of Roxborough, prepared by A.J. Graham, last reviewed July 6, 1976;
- Engineer's Report for the Roxborough – South Plantagenet Boundary Drain Maintenance & Improvement, Township of Roxborough, prepared by Stidwill & Associates Ltd, dated December 18, 1973;
- Engineer's Report for the Lower Tayside Municipal Drain, Township of Roxborough and Township of South Plantagenet, prepared by McNeely Engineering Ltd., dated 1976; and
- Engineer's Report for the Maintenance and Improvement of the Tayside Municipal Drain, Township of Roxborough, prepared by McNeely, LeCompte & Associates Ltd., dated 1972.

It was noted that the Roxborough – South Plantagenet Boundary Drain, which runs along the north side of the proposed expansion site, was originally designed to flow easterly towards the Lower Tayside Drain on the north side of Highway 417. However, due to concerns regarding poor drainage, the Roxborough-South Plantagenet Boundary Drain underwent improvements to change the flow direction, flowing from west of Highway 138 in a westerly direction towards the Fraser Drain and Moose Creek.

Based on the available topographic information of the site, flows from the study area are captured along a perimeter channel directly south of the Roxborough-Plantagenet Boundary Drain, and flow westerly towards the Fraser Drain.

4 Hydrologic Analysis

A PC-SWMM model was developed for the site and contributing watershed areas to complete the hydrologic analysis. The following sections detail the steps undertaken to define the appropriate input parameters, establish precipitation data, and create and calibrate the hydrologic model to estimate the flows in the municipal drains for various storm events.

4.1 Hydrologic Input Parameters

Hydrologic input parameters for each subcatchment area are provided in **Appendix B**.

4.1.1 Watershed Delineation

The available topographic data was reviewed for accuracy and suitability for use in the watershed delineation and hydraulic modelling processes and was compared with the available survey data of the Fraser Drain. Based on the review, the LiDAR topographic data, that had been previously obtained from the United Counties of Prescott and Russell and classified by Airborne Imaging, was determined to be the most comprehensive and accurate dataset, and was subsequently used to generate the DEM of the contributing watersheds for the Fraser and Upper Tayside Municipal Drains.

As part of the watershed delineation process conducted in PC-SWMM, the following constructed municipal drains, as obtained from Land Information Ontario, were defined as streams in the model:

- Fraser Municipal Drain;
- Upper Tayside Municipal Drain;
- Moose Creek Lower Municipal Drain, Upper Moose Creek Municipal Drain;
- Roxborough-Plantagenet Boundary Municipal Drain;
- Peter Provost Municipal Drain, Upper Peter Provost Municipal Drain;
- Rosaire Racine Municipal Drain;
- Martillas Charette Municipal Drain; and
- Gerald Latour Municipal Drain, Gerald Latour South Municipal Drain.

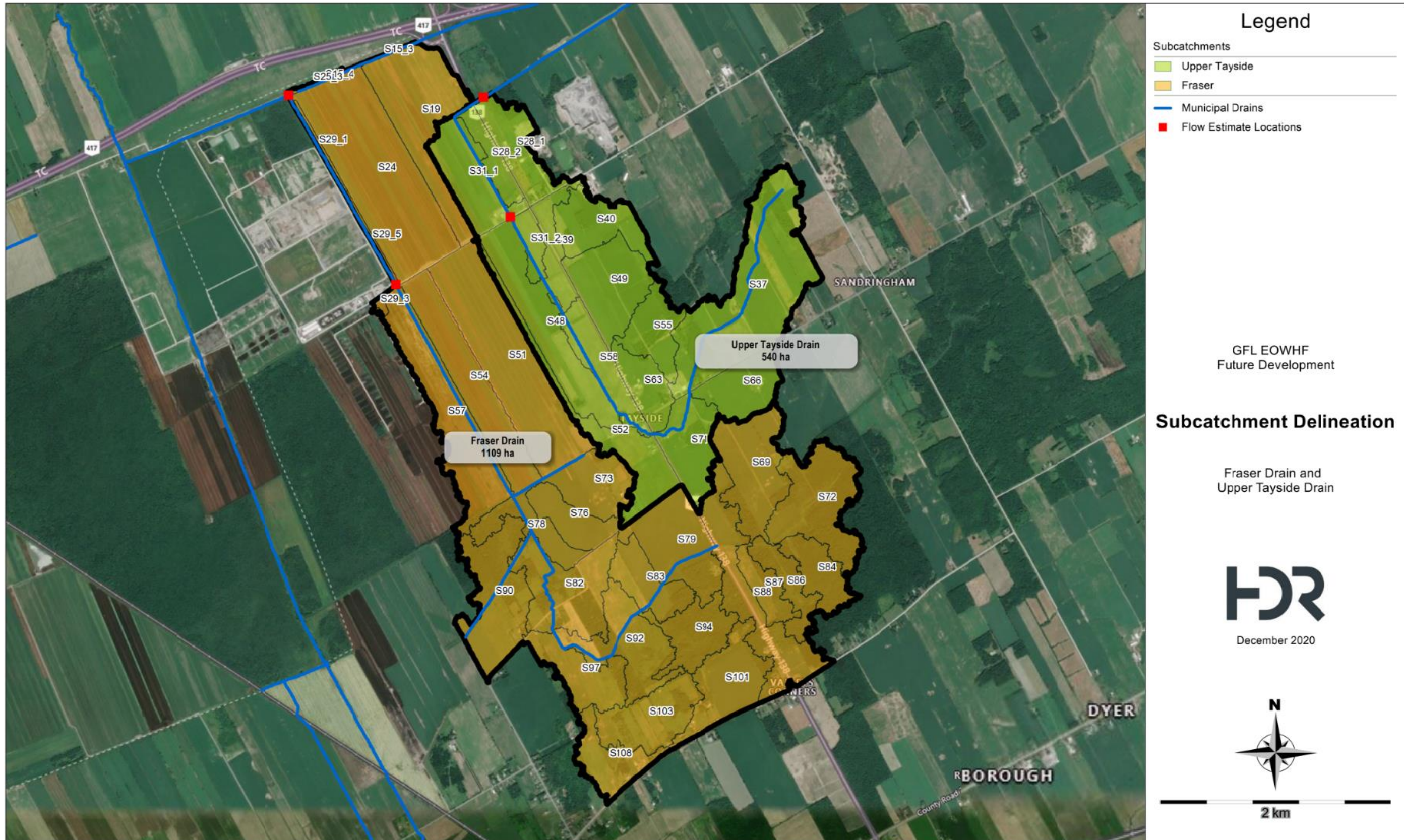
The subcatchment areas were delineated based on the topography and the location of the municipal drains. The target watershed discretization area input into the PC-SWMM model was 40 ha. Channel cross-sections were established along the alignment of the municipal drains, and the DEM was sampled to define the cross-sectional parameters of the drains. Left and right overbanks were defined in the model, with a roughness coefficient of 0.035 within the channel, and 0.08 along the overbank areas.

The culverts along the south side of Lafleche Road east of the Fraser Drain and along the Upper Tayside Drain within the site extents were included in the PC-SWMM model

based on the measurements from the site survey previously conducted as part of the JFSA report, as well as the survey conducted by Tetra Tech in September 2020.

The subcatchment areas and channels generated using the watershed delineation tool were further refined based on available survey data of the Fraser Drain, satellite imagery, and background drainage reports received from the Township of North Stormont. A map of the subcatchment delineation for the Fraser and Upper Tayside subwatersheds is presented in **Figure 4-1**.

Figure 4-1. Fraser and Upper Tayside Drains Watershed Map



Legend

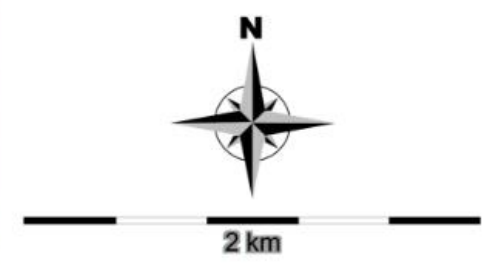
Subcatchments

- Upper Tayside
- Fraser
- Municipal Drains
- Flow Estimate Locations

GFL EOWHF
 Future Development

Subcatchment Delineation

Fraser Drain and
 Upper Tayside Drain



4.1.2 Soil Conditions

Based on the geotechnical investigation of the expansion site conducted by Terrapex Environmental Ltd. (dated April 2020), topsoil is present at the ground surface in all the sampled boreholes and ranges in thickness from 0.28 m to 2.0 m. The soil strata below the topsoil is native soil, consisting of silty clay and sandy and gravelly glacial till. Within the proposed landfill expansion site, the soil type was modelled as silty clay in PC-SWMM.

Beyond the proposed landfill expansion site, soil texture information for the watersheds contributing to the Fraser Drain and Upper Tayside Drain was obtained from the Soil Survey Complex dataset from Land Information Ontario, and an area-weighting method was applied in PC-SWMM to define soil characteristics for each subcatchment area.

The Modified Green-Ampt method was used to model infiltration. To model frozen ground conditions for the rainfall plus snowmelt events, a multiplier of 0.05 was applied to the conductivity of the soil. The parameters that were used to define the soil characteristics based on the identified soil textures are summarized in **Table 4-1**. For the modelling purpose, fine sand was considered to have the characteristics of sand, fine sandy loam and gravelly sandy loam were considered to have the characteristics of sandy loam, and organics, variable soils, and unavailable soils were considered to have the characteristics of clay.

Table 4-1. Soil Texture Characteristics ^a

Soil Texture	Texture Code	Conductivity (mm/hr)	Suction Head (mm)	Initial Deficit
Sand	S	120.4	49.02	0.41
Loamy Sand	LS	29.97	60.96	0.39
Sandy Loam	SL	10.92	109.98	0.37
Loam	L	3.3	88.9	0.35
Silty Loam	SIL	6.6	169.93	0.37
Sandy Clay Loam	SCL	1.52	219.96	0.26
Clay Loam	CL	1.02	210.06	0.28
Silty Clay Loam	SICL	1.02	270	0.26
Sandy Clay	SC	0.51	240.03	0.21
Silty Clay	SIC	0.51	290.07	0.23
Clay	C	0.25	320.04	0.21

^a Rawls, W.J. et al. (1983), J. Hyd. Engr., 109:1316.

4.1.3 Land Use

The current land use of the proposed landfill expansion site is agricultural crop pasture, and with the exception of the existing EOWHF to the west of the project site, most of the surrounding area is agricultural land use.

Beyond the project site, land use information was obtained from the Ontario Land Cover Compilation dataset from Land Information Ontario, and an area-weighting method was applied in PC-SWMM to define imperviousness and depression storage for each subcatchment area.

The parameters that were used to define the catchment characteristics based on the identified land use are summarized in **Table 4-2**.

Table 4-2. Land Use Characteristics ^a

Land Use	Percent Impervious (%)	Impervious Depression Storage (mm)	Pervious Depression Storage (mm)
Open Water	50	1.9	3.81
Marsh / Swamp / Bog	0	1.9	3.81
Forest	10	1.9	5.08
Industrial	93	1.9	3.81
Community / Infrastructure	95	1.9	3.81
Agriculture / Undifferentiated Land Use	10	1.9	5.08

^a Parameters based on PC-SWMM land use look-up tables

4.2 Rainfall Data

To determine the appropriate distribution to use for the simulation, a variety of distributions were input into the PC-SWMM model to identify the one that generates the highest peak flows. The precipitation distributions that were used in the model included:

- SCS Type II 24-hour Storm;
- AES 30% 12-hour Storm; and
- 3-day, 5-day, and 7-day Snowmelt with Rain.

Rainfall depths for the SCS Type II 24-hour Storm and the AES 30% 12-hour Storm distributions were based on the Short Duration Rainfall Intensity-Duration-Frequency (IDF) data from the Ottawa CDA RCS station. The IDF data was obtained from Environment Canada and is provided in **Appendix C**. The AES 30% 12 Hour Storm distribution was adopted from the MNRF Flood Hazard Limit.

Snowmelt with rain depth, duration, and frequency values from the Ottawa CDA Station was used to model the snowmelt with rain events. The data snowmelt with rain data was obtained from Environment Canada and is included in **Appendix C**. The 3-day, 5-day, and 7-day snowmelt amounts derived through Model 5, which is suitable for use in

Ontario, were used in the analysis. The total snowmelt plus rainfall accumulation for a multiple day event was distributed over a specified duration by the following rules, in accordance with the Ministry of Natural Resources (MNR) Snow Hydrology Guide (1989):

1. The one-day total rainfall/snowmelt accumulation occurs in the middle of any given period;
2. The difference between every two consecutive day totals is evenly distributed on either side of the peak in order to produce an approximately symmetric curve;
3. A sine function was used to distribute the accumulative rainfall/snowmelt amount over a 24-hour period for each day.

Table 4-3 summarizes the maximum rainfall depths and rainfall with snowmelt amounts for the various return frequencies.

Table 4-3. Design Storm Rainfall and Rain Plus Snowmelt Amounts ^a

Return Period	Design Storm Rainfall Amounts (mm)		Snowmelt With Rain Amounts (mm)		
	SCS Type II 24-hr	AES 30% 12-hr	3 Day	5 Day	7 Day
2 Year	48.9	44.2	65.67	86.18	101.84
5 Year	64.0	59.1	82.86	111.18	132.50
10 Year	74.1	69.0	94.24	127.73	152.80
25 Year	86.8	81.5	108.62	148.64	178.45
50 Year	96.2	90.8	119.29	164.15	197.48
100 Year	105.5	100.0	129.88	179.55	216.37

^a Ottawa CDA RCS Station data from Environment Canada

4.3 Model Calibration and Limitations

Rainfall data, measured in hourly intervals, was collected from on-site rain gauges from January 2019 to August 2019 and December 2019 to August 2020. The measured rainfall was input as a time series into the PC-SWMM model, to compare the modeled and observed flows.

Point measurements of flows from different points along the Fraser Drain and Upper Tayside were collected to be used for the comparison. Gauges SWFD4, SWFD3, and SWFD2 were used for Fraser Drain, and gauge SWLTD-1 was used for Upper Tayside Drain (refer to **Figure 2-1**). Flow measurements were collected from May 2019 to August 2020, with the exception of SWFD2, where flow measurements began in April 2020, and SWLTD-1, where flow measurements began in March 2020. Point measurements of the flows at the gauge locations were collected in approximately monthly intervals, with frozen conditions generally observed in the months of January and February. However, the intervals at which the point measurements were collected did not provide sufficient accuracy in order to be used for determining baseflows along the drains. Furthermore, due to the lack of continuous flow measurements to depict the hydrologic and hydraulic

response of the catchments to precipitation events, the spot measurements could not be used for calibration and validation of the model. Comparison of the modelled and measured flows are provided in **Appendix D**.

Continuous flow monitoring data with flow measurements in 15-minute intervals was obtained from the Moose Creek logger downstream of the existing EOWHF site and the Fraser Drain confluence with Moose Creek, with data available from May 2020 to October 2020. Flow transposition was conducted from the Moose Creek logger, which has a contributing drainage area of 5775 ha (according to the JFSA report), to transpose the data to the Fraser Drain directly downstream of the proposed EOWHF expansion site, which has a contributing drainage area of 1109 ha. Using the rainfall data collected from the site, flows in the Fraser Drain were generated from the PC-SWMM model and compared to the transposed flows. Using the transposed flows, a monthly baseflow pattern in the Fraser Drain was established and input into the PC-SWMM model. The model was calibrated to match the magnitude of the modelled flows to the transposed measured flows. However, the timing of the peak flows generated by the model did not correspond to the peak flows of the transposed measured flows. This can be attributed to the stormwater management controls at the existing EOWHF site, which over-attenuates the peak flows from the site during frequent storm events. A comparison plot of the modelled flows and transposed measured flows, from May 2020 to August 2020, is included in **Appendix D**.

Due to the limitations described above, the PC-SWMM model could not be fully calibrated and validated. However, comparison between the point and transposed continuous flow measurements indicates that the model predicts flows with sufficient accuracy for the purpose of this study. A sensitivity analysis was completed to further establish the model's robustness.

4.4 Sensitivity Analysis

The Sensitivity-Based Radio Tuning Calibration (SRTC) tool was used in PC-SWMM to test the sensitivity of subcatchment parameters. The subcatchment parameters studied as part of the calibration included the percent imperviousness, percent of impervious area with no depression storage (zero imperviousness percentage), subcatchment flow length, and subcatchment slope. Based on the SRTC tool, the flows downstream of the proposed EOWHF expansion site were insensitive to the zero imperviousness percentage. The flows did appear to be sensitive to the percent imperviousness, subcatchment flow length, and subcatchment slope, which have been defined using the DEM and the land use information.

4.5 Flow Estimates

The PC-SWMM model was used to generate peak flow estimates upstream and downstream of the proposed expansion site, which will be used as the basis for existing surface water quantity conditions. The peak flows estimated along the Fraser Drain and Upper Tayside Drain upstream and downstream of the proposed expansion site, for the 2-year to 100-year design storm events, are summarized in **Table 4-4** and **Table 4-5**.

Table 4-4. Municipal Drain Flow Estimates Upstream of the Site

Return Period	Rainfall Events (m ³ /s)		Snowmelt with Rain Events (m ³ /s)		
	SCS Type II 24-hr	AES 30% 12-hr	3-day	5-day	7-day
Fraser Drain					
2 Year	3.71	2.36	2.97	3.15	3.20
5 Year	5.18	3.65	3.89	4.05	4.20
10 Year	5.77	4.86	4.76	4.92	4.98
25 Year	6.54	5.66	5.40	5.55	5.60
50 Year	7.11	6.33	5.79	6.01	6.10
100 Year	7.57	7.01	6.32	6.58	6.69
Upper Tayside Drain					
2 Year	4.85	1.95	3.04	3.33	3.45
5 Year	6.73	3.28	4.32	4.66	4.83
10 Year	8.07	4.37	5.19	5.62	5.85
25 Year	10.16	5.79	6.35	6.88	7.05
50 Year	11.47	7.05	7.20	7.65	7.82
100 Year	12.52	7.98	8.07	8.64	8.77

Table 4-5. Municipal Drain Flow Estimates Downstream of the Site

Return Period	Rainfall Events (m ³ /s)		Snowmelt with Rain Events (m ³ /s)		
	SCS Type II 24-hr	AES 30% 12-hr	3-day	5-day	7-day
Fraser Drain					
2 Year	4.20	3.40	4.32	4.61	4.66
5 Year	6.20	5.65	5.62	5.91	5.97
10 Year	7.48	7.22	6.46	6.71	6.75
25 Year	9.15	9.07	7.42	7.70	7.77
50 Year	10.18	10.49	8.20	8.52	8.61
100 Year	11.18	11.81	9.01	9.32	9.39
Upper Tayside Municipal Drain					
2 Year	4.46	2.03	3.10	3.43	3.56
5 Year	6.25	3.41	4.48	4.86	5.03
10 Year	7.64	4.58	5.36	5.81	6.01
25 Year	9.60	6.05	6.58	7.12	7.29
50 Year	10.91	7.40	7.43	7.89	8.08
100 Year	11.88	8.50	8.25	8.83	8.99

Based on the model results, the peak flows at both upstream and downstream of the proposed EOWHF expansion site were generally higher with the rainfall event with a SCS Type II 24-hour distribution. For the snowmelt with rain events, the 7-day event yielded the highest flow rates, compared to the 3-day and 5-day events.

5 Floodplain Mapping

5.1 Model Development

A 1-D/2-D integrated hydraulic model was developed using PC-SWMM to generate the floodplain mapping for the municipal drains under the 100-year rainfall event with a SCS Type II 24-hour distribution. The generated floodplain map, indicating the extent and depth of flooding at the subject site, is presented in **Figure 5-1**.

2-D nodes were sampled from the DEM and a 2-D mesh of the site was generated, with a directional mesh within the municipal drains and perimeter channels and a hexagonal mesh outside of the channel locations. The culverts within the vicinity of the site were modelled in 1-D and the 1-D model of the Fraser Drain and Upper Tayside Drain were connected to the 2-D mesh upstream of the EOWHF expansion site. The culvert measurements, including size, length, and invert elevations are provided in **Appendix E**. Outfalls for the mesh were defined at the municipal drains downstream of the site, as well as locations where the flow overtopped the drains and flooded the areas beyond the project site. Adjustments to the nodes and mesh were made at locations where the DEM included the elevations of surrounding vegetation in order to reduce routing and continuity errors.

5.2 Model Results

Based on the model results, flooding during the 100-year storm event is observed at several locations within the site; however, the flood depths generally did not exceed 0.5 m:

- The perimeter drain along the north border of the expansion site. The existing ditch is relatively flat, with a depth of approximately 0.5 m. An existing berm separates the flows between the perimeter channel and the existing Roxborough-Plantagenet Boundary Drain, but the berm is not overtopped during the 100-year storm.
- Upper Tayside Drain, where the flow direction changes from north to east. The existing drain is approximately 1.0 m deep, but the north bank is overtopped during the 100-year storm event. The existing topography beyond the bank slopes towards the north, so flows overtopping the Upper Tayside will flow northerly into the perimeter channel along the north border of the expansion site.

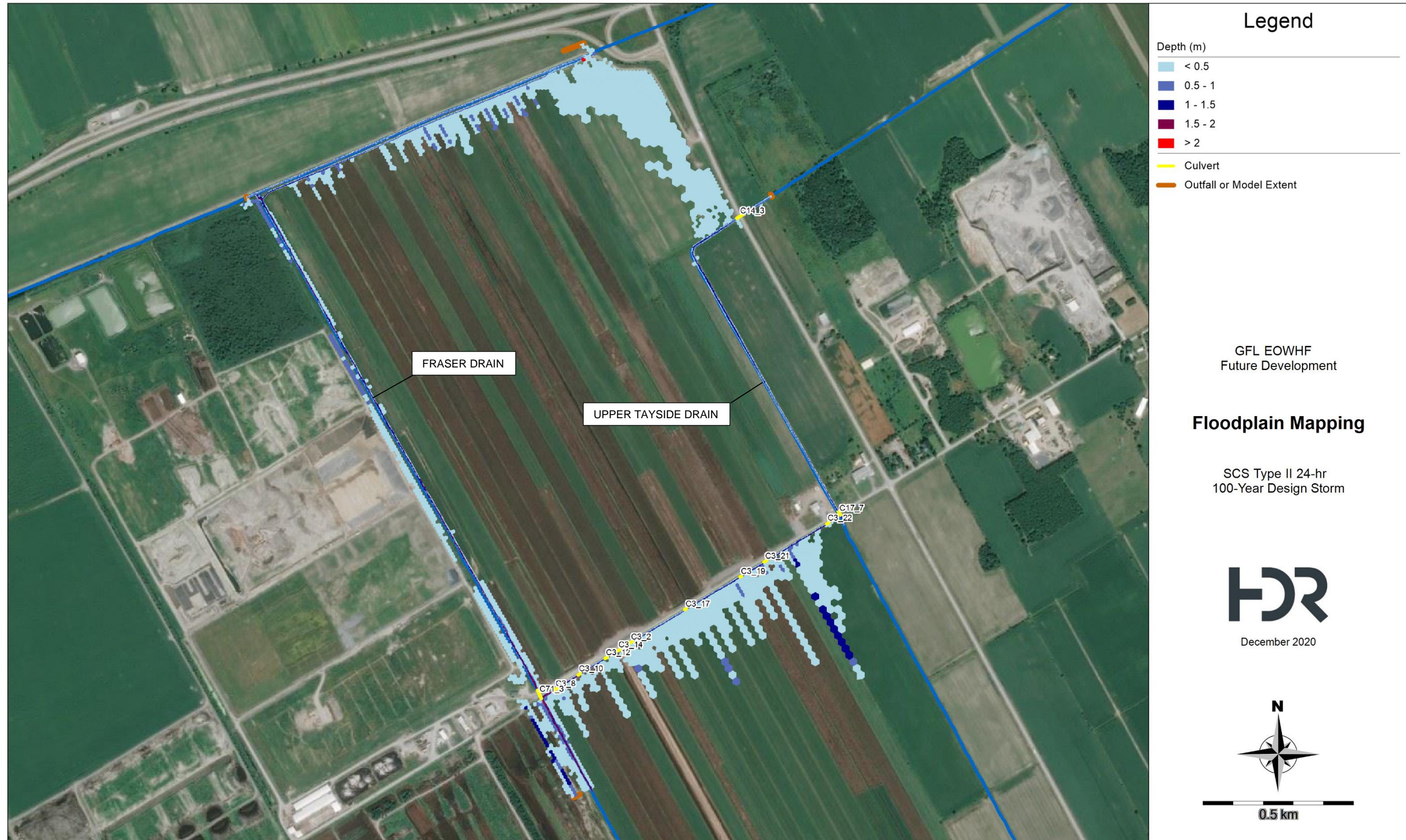
Flooding during the 100-year storm is also observed at several locations adjacent to the site:

- The west bank is overtopped at several locations along the Fraser Drain, and flows contribute to the perimeter drain in the existing EOWHF site. The perimeter drain ultimately discharges back to the Fraser Drain downstream of the EOWHF site.
- The utility area southwest of the proposed expansion site adjacent to the Fraser Drain. Flooding is observed on both the north and south side of the access road.

- The ditch along the south side of the access road between Fraser Drain and Upper Tayside Drain is overtopped, and flooding is observed onto the adjacent site south of the EOWHF expansion site.
- Localized overtopping of the north bank of the perimeter ditch at the northeast of the property, west of the culvert crossing under the Highway 138 ramp, is observed, with flows travelling northerly.

The identified flooding locations within and adjacent to the site correspond with the locations identified in the Potential For Surface Water Spill and Flooding memo prepared by JFSA (dated May 2017).

Figure 5-1. 100-yr Storm Floodplain Map



6 Conclusions and Recommendations

A future development is proposed for the 235 ha GFL Eastern Ontario Waste Handling Facility (EOWHF) landfill expansion site, located in the Township of North Stormont, Ontario. Currently, the land is owned by GFL and leased and used as a sod farm and for corn production. This report was prepared to establish the existing surface water quantity conditions at the site, in support of the EA study that is being completed for the proposed development, in order to investigate the potential impacts of the development on the receiving Fraser and Upper Tayside Municipal Drains.

Available LiDAR data was used to generate a digital elevation model (DEM) for the Fraser and Upper Tayside watersheds. A PC-SWMM hydrologic model was developed using topographic, soil, land use, and rainfall data, along with background engineering reports of the municipal drains. The recently collected flow measurements along the drains, as well as the transposed flows obtained from the Moose Creek continuous logger, were used to compare the modelled and observed flows.

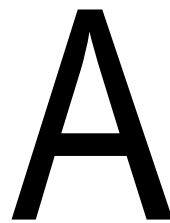
Peak flows were estimated for rainfall and snowmelt with rain events with the 2- to 100-year return periods, in the drains upstream and downstream of the landfill expansion site. The rainfall events with a SCS Type II 24-hr distribution yielded the highest peak flows and were used in the floodplain mapping.

A 1-D/2-D integrated PC-SWMM hydraulic model was developed using the DEM to generate a floodplain map within and in the vicinity of the subject site. Flooding was observed within the site along the north perimeter channel, as well as across the northeast area of the site, where flows overtopped the Upper Tayside Drain and spilled towards the perimeter channel. Flooding outside of the project site was observed at multiple locations along Fraser Drain, the utility area south-west of the expansion site, and along the ditch on the south side of Lafleche Road, between the Fraser and Upper Tayside drains.

It is recommended to use the established surface water quantity conditions at the site as a basis for evaluating the impact of the proposed development on the receiving system and designing the appropriate mitigation measures.

List of References

- Surface Water Existing Conditions Report – Part A: Water Quantity for the Eastern Ontario Waste Handling Facility Landfill Expansion Environmental Assessment, prepared by J.F. Sabourin and Associates Inc. (dated August 2017)
- Potential For Surface Water Spill and Flooding from Fraser Drain into the EOWHF – Action Required Memo prepared by J.F. Sabourin and Associates Inc. (dated May 2017)
- Historical Engineering Municipal Drain Reports obtained from the Township of North Stormont
- Draft Geotechnical Data Report, prepared by Terrapex Environmental Ltd. (dated April 2020)



Agency Liaison
Correspondence

Look, Janice

From: Sean MacDonald <drainsuperintendent@northstormont.ca>
Sent: Wednesday, August 26, 2020 2:53 PM
To: Look, Janice
Cc: Kashi, Soheil
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Janice,
There were no additional capacity calculations included with the report.
Still no luck for the Fraser profile.
Sean

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: August 24, 2020 8:34 PM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Hi Sean,

Yes, thank you for providing the additional plans and profiles last week, and also for inquiring about the Fraser drain profile with the former Drainage Superintendent, which will be helpful.

I just also wanted to confirm there was no additional design capacity calculations or information associated with the reports? We just want to make sure we haven't missed anything, since the South Nation Conservation Authority wanted us to be clear about the municipal drain capacities.

Thanks so much,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [mailto:drainsuperintendent@northstormont.ca]
Sent: Monday, August 24, 2020 5:49 PM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good evening Janice,
I trust you received the plans and profiles that were forwarded to you last week.

Unfortunately the most recent Fraser drain 1976 profile can not be located in the Township's records. I will be inquiring with the former Drainage Superintendent to see if his firm has a copy.

Regards,
Sean

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: August 17, 2020 1:03 PM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Hi Sean,

Hope you had a good weekend. Just wanted to send a quick follow up to inquire about the status of the documents you were going to scan and send over?

Thanks so much, really appreciate the help.

Regards,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [mailto:drainsuperintendent@northstormont.ca]
Sent: Thursday, August 13, 2020 10:44 AM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Janice,

I will send the supporting plan and profiles to go with the report. I will aim to have them scanned and sent tomorrow, if not first thing next week.

The unnamed drain on the South side of Lafleche Road is not municipal, but I can look into the Township files to see if it is an Award or Mutual agreement drain.

Regards,
Sean

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: August 11, 2020 12:17 PM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Hi Sean,

I just wanted to send a follow up email to provide a bit more context to my information request from earlier this morning – we received the following comments about our project’s Terms of Reference from the South Nation Conservation Authority:

- Surface water quantity criteria must consider design capacities outlined in the municipal drain Engineers Reports. The Engineer’s Reports should be listed as a data source.
- An unnamed watercourse flows along the southern boundary along Lafleche Road

Consequently, we want to make sure that we’ve obtained all the relevant information about capacity and all the plan/profile drawings, so we can document it accordingly in our report. We also wanted to see if there was any information about this “unnamed watercourse” along Lafleche road that may be available as well?

Thanks so much and feel free to let me know if have any questions.

Regards,

Janice Look, B.A.Sc.
D 289 695 4719

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From: Look, Janice
Sent: Tuesday, August 11, 2020 9:08 AM
To: 'Sean MacDonald' <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Hi Sean,

Hope you have been doing well. After going through the reports you provided in early July in greater detail, I was wondering if there were any appendices of the reports containing drawings (plan/profile) or capacity calculations that weren’t included previously? The reports seemed to refer to some plan and profile drawings, but I couldn’t find them in the annexes.

Thanks so much, and have a great day.

Regards,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [<mailto:drainsuperintendent@northstormont.ca>]
Sent: Friday, July 3, 2020 8:37 AM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Janice,

Within the one attachment for the Fraser drain you will find the main drain report and a later report for the addition of two culverts.

I see it sent twice but you should only need the one attachment (7MB)

If you have any problems with the documents please let me know.

Sean

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: July 3, 2020 8:29 AM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Good morning Sean,

Thanks so much for this information, it will be really helpful in our analysis. I noticed that there were 2 Fraser Drain Reports in your first email, but I'm unable to open the smaller one (Fraser Drain – 5MB). Just wanted to check if there are two separate reports for Fraser Drain?

Thanks,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [mailto:drainsuperintendent@northstormont.ca]
Sent: Friday, July 3, 2020 8:21 AM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: June 29, 2020 8:25 AM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>; Craig Calder <caldcr@northstormont.ca>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Hi Sean,

Thanks so much for your reply, we will note the existing drainage concerns mentioned below and we also understand that it is difficult to confirm the Township's requirements given the early stages of the project we are currently in.

As part of our existing conditions analysis, we were also wondering if there were any available background information documents, reports, or drawings for the municipal drains around the project site that we could use to supplement our analysis? We want to ensure that we correctly identify which lands are draining to which municipal drain.

Thanks again for your time, and feel free to reach out if you have any questions.

Regards,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [mailto:drainsuperintendent@northstormont.ca]
Sent: Tuesday, June 23, 2020 3:55 PM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>; Craig Calder <ccalder@northstormont.ca>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good afternoon Janice,

I understand GFL would like to relocate the Tayside Municipal drain to better accommodate their proposed future expansion plans. This would only be able to take place if the Engineer's Report was updated through the Drainage Act to facilitate the relocation, as well as land use changes etc. Township Council would appoint a Drainage Engineer to go through the process.

Due to the extent of this expansion, and the early stages we are in now it is difficult to confirm the complete extent of the Township's requirements. There is the possibility that the Township would require an independent drainage Engineer to peer review the results of various studies or the Fraser drain Engineer's report would need to be updated as well.

Will your firm be completing storm water management reports for the pre/post development?

I am also assuming you are only inquiring about the future landfill cells, and not other developments unrelated to the two expansion options you sent earlier in this email thread.

As far as existing drainage concerns: I understand former owners in the area stripped and sold muck and topsoil which presented issues when it came to tile draining land that had lower elevations than the time the drain was designed. The soils can also be erosive and have required minor repairs over the years.

I hope this helps,
Sean MacDonald
Drainage Superintendent

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: June 23, 2020 9:04 AM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Good morning Sean,

I just wanted to send a quick follow up to ask if you've had a chance to identify if there have been any existing drainage concerns around the project site, and also to confirm the drainage requirements to the municipal drains?

Thanks for your time, and if you have any questions, please do not hesitate to reach out.

Regards,

Janice Look, B.A.Sc.

D 289 695 4719

hdrinc.com/follow-us

From: Look, Janice
Sent: Wednesday, June 17, 2020 10:21 AM
To: 'Sean MacDonald' <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: RE: Inquiry - Drainage Concerns in North Stormont

Good morning Sean,

This future development will be an expansion of the existing GFL Eastern Ontario Waste Handling Facility to increase waste disposal capacity, so the proposed land use will be for waste disposal. We are currently just completing an existing conditions analysis to determine the current surface runoff from the project site.

This drainage assessment is currently being conducted in support of the project's Environmental Assessment – please see the two attached site plan alternatives presented at the open house this past January. Additional information about the project from the open house can also be found here: <http://gflenv.com/moose-creek-eowhf/>

As such, we are reaching out to identify if there are any existing drainage concerns at the project site and confirm the drainage requirements to the municipal drains. Hopefully this helps, and let me know if you have any further questions.

Regards,

Janice Look, B.A.Sc.

D 289 695 4719

hdrinc.com/follow-us

From: Sean MacDonald [mailto:drainsuperintendent@northstormont.ca]
Sent: Tuesday, June 16, 2020 10:05 AM
To: Look, Janice <Janice.Look@hdrinc.com>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Re: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Janice,

Can you elaborate on the extent of the future development/ land use changes, proposed water management practices, anticipated increased run off or water velocity? Also what are the proposed plans for Lot 13 in the vicinity of the Tayside drain and the anticipated timelines?

Thank you,
Sean

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: June 15, 2020 3:49 PM
To: Sean MacDonald <drainsuperintendent@northstormont.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Inquiry - Drainage Concerns in North Stormont

Good afternoon Sean,

As per our phone conversation, I am reaching out to you on behalf of HDR Inc., an engineering consulting firm that has been retained by GFL Environmental to provide a drainage assessment on the existing conditions for future development at the Eastern Ontario Waste Handling Facility in North Stormont. Please see the attached for the project site location.

As part of our drainage assessment, we are reaching out to agencies and stakeholders to identify if there are any drainage-related concerns near the project site that we should take note of in our analysis and documentation. This could include existing flooding issues, concerns about the project drainage impacts, or notification of any available relevant data.

Please note that the project site discharges to the Fraser and Upper Tayside municipal drains, and we would also like to confirm the discharge requirements for these two drains.

Should you have any comments, questions, or concerns about the project, please do not hesitate to reach out, and thank you for your attention.

Regards,

Janice Look, B.A.Sc.
Water Resources EIT

HDR
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8
D 289 695 4719
Janice.Look@hdrinc.com

hdrinc.com/follow-us

Look, Janice

From: Benjamin De Haan <b_dehaan@sdgcounties.ca>
Sent: Tuesday, June 16, 2020 7:10 AM
To: Look, Janice
Cc: Kashi, Soheil
Subject: RE: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Janice

Thanks so much for your email. The United Counties of SDG does not have any drainage infrastructure in and around the subject area. Accordingly, please formally accept this email as confirmation that there are no issues or concerns that the United Counties of SDG would like considered/ addressed as part of your study.

Best wishes. Please don't hesitate to contact our office if there are any other questions or concerns.

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: June 15, 2020 3:38 PM
To: Benjamin De Haan <b_dehaan@sdgcounties.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Inquiry - Drainage Concerns in North Stormont

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good afternoon Benjamin,

I am reaching out to you on behalf of HDR Inc., an engineering consulting firm that has been retained by GFL Environmental to provide a drainage assessment on the existing conditions for future development at the Eastern Ontario Waste Handling Facility in North Stormont. Please see the attached for the project site location.

As part of our drainage assessment, we are reaching out to agencies and stakeholders to identify if there are any drainage-related concerns near the project site that we should take note of in our analysis and documentation. This could include existing flooding issues, concerns about the project drainage impacts, or notification of any available relevant data.

Should you have any comments, questions, or concerns about the project, please do not hesitate to reach out, and thank you for your attention.

Regards,

Janice Look, B.A.Sc.
Water Resources EIT

HDR
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8

D 289 695 4719
Janice.Look@hdrinc.com

hdrinc.com/follow-us

Look, Janice

From: James Holland <jholland@nation.on.ca>
Sent: Monday, June 15, 2020 3:44 PM
To: Look, Janice
Subject: RE: Inquiry - Drainage Concerns in North Stormont

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello Janice,

Thanks for consulting with the Conservation Authority. There are minutes from a recent PreConsultation meeting but I'm not sure that they have been finalized and circulated. Our comments included surface water drainage as follows:

South Nation CA – J Holland explain the CA's approvals process and concerns, specifically related to surface and groundwater conditions and any development within their regulated area. J Holland specifically noted that watercourses are regulated and any interference with a watercourse will require a permit from the CA. There are three municipal drains that border or cross the property. The proposed landfill expansion will interfere with the Upper Tayside Municipal Drain on the east side of the site, and J Holland recommended that the municipal Drainage Superintendent be contacted to determine requirements under the Drainage Act.

J Holland advised that the CA would be seeking the following to be submitted as part of a complete application:

- Environmental Impact Statement – illustrating all surface water features on the lands
- Hydrogeological Report
- Stormwater Management
- Geotechnical Report

The municipal drain locations and current classes can be viewed on the Agricultural Information Atlas: <http://www.omafra.gov.on.ca/english/landuse/drain-map.htm>

Please feel free to contact me if you wish to discuss.

Kind regards,
James

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: June 15, 2020 3:16 PM
To: James Holland <jholland@nation.on.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Inquiry - Drainage Concerns in North Stormont

External email - if you don't know or can't confirm the identity of the sender, please exercise caution and do not open links or attachments.

Good afternoon James,

I am reaching out to you on behalf of HDR Inc., an engineering consulting firm that has been retained by GFL Environmental to provide a drainage assessment on the existing conditions for future development at the Eastern Ontario Waste Handling Facility in North Stormont. Please see the attached for the project site location.

As part of our drainage assessment, we are reaching out to agencies and stakeholders to identify if there are any drainage-related concerns near the project site that we should take note of in our analysis and documentation. This could include existing flooding issues, concerns about the project drainage impacts, or notification of any available relevant data.

Should you have any comments, questions, or concerns about the project, please do not hesitate to reach out, and thank you for your attention.

Regards,

Janice Look, B.A.Sc.
Water Resources EIT

HDR
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8
D 289 695 4719
Janice.Look@hdrinc.com

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James Holland | M.Sc. RPP, Watershed Planner

38 Victoria Street, Box 29, Finch, ON K0C 1K0
Tel: 613-984-2948 or 1-877-984-2948 | Fax: 613-984-2872
nation.on.ca | [make a donation](#)

Our local environment, we're in it together.
Notre environnement local, protégeons-le ensemble.

COVID-19 UPDATE: Our offices and facilities are closed to visitors and guests; some Conservation Areas remain open for passive recreation. More info at: www.nation.on.ca/coronavirus. Our staff are working during this time and we do not anticipate any service disruptions.

MISE À JOUR COVID-19: Nos bureaux et installations sont fermés aux visiteurs et invités; certaines aires de conservation restent ouvertes aux loisirs passifs. Plus d'informations sur: www.nation.on.ca/fr/coronavirus. Notre personnel travaille pendant cette période et nous ne prévoyons aucune interruption de service.

Look, Janice

From: Kapusta, Stephen (MTO) <Stephen.Kapusta@ontario.ca>
Sent: Tuesday, July 28, 2020 2:22 PM
To: Look, Janice; Tay, Louis (MTO)
Cc: Kashi, Soheil
Subject: Re: Inquiry - Drainage Concerns in North Stormont

Follow Up Flag: Follow up
Flag Status: Flagged

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good Afternoon Janice,

I am back in action over here and I am going to forward this onto my people to see if we have any issues.

The only concern that I can recall is a crushed culvert at the not so legal entrance at the north east quadrant of the property area that you attached.

Beyond that, I believe that there is a municipal drain that runs through the property but I have no knowledge as to whether we have any concerns there or not.

Sincerely,

Stephen Kapusta MCIP, RPP
Corridor Management Planner
Ministry of Transportation - Eastern Region
1355 John Counter Boulevard
Postal Bag 4000
Kingston, ON K7L 5A3
Phone (613)545-4834
Mobile (613)539-7068
Fax (613)540-5106
Toll Free 1(800)267-0295
Stephen.Kapusta@Ontario.ca

*Coronavirus Note: I will be working from home for the foreseeable future. Please contact me by mobile phone 613-539-7068.

From: Look, Janice <Janice.Look@hdrinc.com>
Sent: July 22, 2020 2:46 PM
To: Tay, Louis (MTO) <Louis.Tay@ontario.ca>

Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>

Subject: RE: Inquiry - Drainage Concerns in North Stormont

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Good afternoon Louis,

I just wanted to follow up on an email I sent previously on behalf of HDR Inc., an engineering consulting firm that has been retained by GFL Environmental to provide a drainage assessment on the existing conditions for future development at the Eastern Ontario Waste Handling Facility in North Stormont. I had previously reached out to your colleague Stephen Kapusta about the project, but was given an email to redirect all inquiries to you.

We were wondering if MTO has previously identified any existing drainage-related concerns near the project site, such as flooding issues or concerns about the project's drainage impacts? Should you have any comments, questions, or concerns about the project, please do not hesitate to reach out, and thank you for your attention.

Regards,

Janice Look, B.A.Sc.
D 289 695 4719

hdrinc.com/follow-us

From: Look, Janice
Sent: Monday, July 6, 2020 8:38 AM
To: 'Louis.tay@ontario.ca' <Louis.tay@ontario.ca>
Cc: Kashi, Soheil <Soheil.Kashi@hdrinc.com>
Subject: Inquiry - Drainage Concerns in North Stormont

Good morning Louis,

I am reaching out to you on behalf of HDR Inc., an engineering consulting firm that has been retained by GFL Environmental to provide a drainage assessment on the existing conditions for future development at the Eastern Ontario Waste Handling Facility in North Stormont. Please see the attached for the project site location. I had previously reached out to your colleague Stephen Kapusta about the project, but was given an email to redirect all inquiries to you.

As part of our drainage assessment, we are reaching out to agencies and stakeholders to identify if there are any drainage-related concerns near the project site that we should take note of in our analysis and documentation. This could include existing flooding issues, concerns about the project drainage impacts, or notification of any available relevant data.

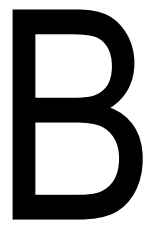
Should you have any comments, questions, or concerns about the project, please do not hesitate to reach out, and thank you for your attention.

Regards,

Janice Look, B.A.Sc.
Water Resources EIT

HDR
100 York Boulevard, Suite 300
Richmond Hill, ON L4B 1J8
D 289 695 4719
Janice.Look@hdrinc.com

hdrinc.com/follow-us

A large, bold, black letter 'B' is positioned on the right side of the page, partially overlapping a large red rectangular area and a grey rectangular area.

Hydrologic Model Input
Parameters

Hydrologic Model Input Parameters

PC-SWMM Subcatchment Parameters

Name	Outlet	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)	Suction Head (mm)	Conductivity (mm/hr)	Initial Deficit (frac.)	Runoff Coefficient
S54	J20	56.3239	294.143	1914.848	5.096	10.432	0.015	0.3	1.9	5.073	25	320.04	0.25	0.21	0.616
S55	J215	25.6281	414.541	618.229	4	9.115	0.015	0.3	1.9	4.968	25	176.428	7.545	0.319	0.155
S57	J13	69.3571	525.968	1318.656	0.5	1.593	0.015	0.3	1.9	4.01	25	320.04	0.25	0.21	0.512
S58	J211	28.6809	266.906	1074.571	2	21.642	0.015	0.3	1.9	4.906	25	267.731	2.907	0.25	0.324
S63	J215	21.7277	311.814	696.816	2	15.589	0.015	0.3	1.9	4.996	25	137.359	9.529	0.349	0.189
S66	J34	29.2082	337.262	866.04	9.893	12.653	0.015	0.3	1.9	5.04	25	135.841	8.01	0.344	0.197
S69	J161	49.6037	556.333	891.619	0.5	8.739	0.015	0.3	1.9	4.92	25	236.979	9.019	0.265	0.1
S71	J143	33.9717	402.427	844.171	1.5	12.447	0.015	0.3	1.9	5.043	25	211.933	2.431	0.283	0.28
S72	J161	55.5809	919.06	604.758	0.5	6.474	0.015	0.3	1.9	4.632	25	172.608	65.61	0.319	0.064
S73	J210	31.4815	364.851	862.86	3	9.079	0.015	0.3	1.9	4.963	25	247.287	1.059	0.257	0.417
S76	J210	22.2094	328.926	675.209	5.911	8.416	0.015	0.3	1.9	4.703	25	242.802	2.241	0.263	0.314
S78	J210	21.835	753.414	289.814	3	4.732	0.015	0.3	1.9	4.292	25	284.779	0.582	0.232	0.544
S79	J163	48.252	567.164	850.759	0.5	10.976	0.015	0.3	1.9	4.871	25	120.277	66.07	0.352	0.108
S82	J7	52.2835	787.372	664.025	2	12.849	0.015	0.3	1.9	4.908	25	142.505	19.387	0.324	0.135
S83	J209	26.3042	1094.932	240.236	1	8.065	0.015	0.3	1.9	4.834	25	85.122	71.921	0.374	0.08
S84	J161	23.1875	287.099	807.648	2	7.126	0.015	0.3	1.9	4.715	25	52.576	114.013	0.408	0.07
S86	J161	19.9503	301.657	661.358	2	8.699	0.015	0.3	1.9	4.915	25	84.187	76.377	0.386	0.086
S87	J161	15.7386	252.802	622.566	2	9.65	0.015	0.3	1.9	5.036	25	89.906	69.839	0.382	0.095
S88	J161	57.2956	533.599	1073.758	1	16.216	0.015	0.3	1.9	4.841	25	121.046	40.357	0.358	0.16
S90	J212	55.5755	767.265	724.333	3	6.934	0.015	0.3	1.9	4.595	25	244.221	1.179	0.256	0.397
S92	J213	45.9086	816.562	562.218	2	5.812	0.015	0.3	1.9	4.548	25	79.348	100.247	0.386	0.057
S94	J209	28.8626	502.714	574.136	2	5.113	0.015	0.3	1.9	4.459	25	49.444	119.791	0.41	0.05
S97	J213	30.7884	657.164	468.504	1	6.977	0.015	0.3	1.9	4.594	25	104.147	52.247	0.371	0.069
S101	J209	40.6619	576.832	704.918	1	11.475	0.015	0.3	1.9	5.025	25	102.903	23.631	0.375	0.117
S103	J213	37.6477	410.793	916.463	2	9.649	0.015	0.3	1.9	5.035	25	70.201	82.36	0.396	0.095
S108	J213	26.0677	280.298	930	1.5	11.211	0.015	0.3	1.9	4.988	25	70.39	82.021	0.396	0.111
S15_3	J59	0.8835	589	15	10	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.702
S15_4	J58	0.8291	552.733	15	10	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.702
S25_3	J47	1.1748	469.92	25	0.5	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.696
S29_3	J48	1.6692	333.84	50	1	0.919	0.015	0.3	1.9	3.927	25	320.04	0.25	0.21	0.674
S29_1	J218	3.4782	993.771	35	3	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.698
S29_5	J16	3.3573	959.229	35	3	10.867	0.015	0.3	1.9	5.067	25	320.04	0.25	0.21	0.701
S31_1	J84	38.6565	357.802	1080.389	0.5	11.693	0.015	0.3	1.9	5.055	25	290.07	0.51	0.23	0.471
S31_2	J52	10.6995	99.034	1080.389	0.5	12.16	0.015	0.3	1.9	5.048	25	271.318	0.893	0.24	0.382
S28_1	J82	31.5706	355.826	887.248	0.5	14.753	0.015	0.3	1.9	5.009	25	303	0.475	0.22	0.521
S28_2	J101	13.7485	154.957	887.248	0.5	14.753	0.015	0.3	1.9	5.009	25	303	0.475	0.22	0.521
S15_4	J26825	0.8291	552.733	15	10	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.706
S25_3	J28491	1.1748	469.92	25	0.5	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.697
S29_3	J55102	1.6692	333.84	50	1	0.919	0.015	0.3	1.9	3.927	25	320.04	0.25	0.21	0.675
S29_1	J20400	3.4782	993.771	35	3	10	0.015	0.3	1.9	5.08	25	320.04	0.25	0.21	0.7
S29_5	J14183	3.3573	959.229	35	3	10.867	0.015	0.3	1.9	5.067	25	320.04	0.25	0.21	0.703
S31_1	J48420	38.6565	357.802	1080.389	0.5	11.693	0.015	0.3	1.9	5.055	25	290.07	0.51	0.23	0.455
S31_2	J65_2	10.6995	99.034	1080.389	0.5	12.16	0.015	0.3	1.9	5.048	25	271.318	0.893	0.24	0.38
S28_1	J51819	30.6029	344.919	887.248	0.5	14.753	0.015	0.3	1.9	5.009	25	303	0.475	0.22	0.509
S28_2	J50032	14.7163	165.865	887.248	0.5	14.753	0.015	0.3	1.9	5.009	25	303	0.475	0.22	0.509



Ottawa CDA RCS
Precipitation Data

Environment and Climate Change Canada
 Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
 Données sur l'intensité, la durée et la fréquence des chutes
 de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2020/03/27

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 OTTAWA CDA RCS ON 6105978

Latitude: 45 23'N Longitude: 75 43'W Elevation/Altitude: 79 m

Years/Années : 1905 - 2017 # Years/Années : 57
 =====

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

Year Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1905	10.4	17.8	20.8	26.4	36.1	42.2	43.9	46.2	53.1
1906	9.1	16.8	21.6	26.7	32.3	32.3	39.1	39.6	39.6
1907	9.9	15.5	17.5	17.5	21.6	24.4	29.5	42.4	47.2
1935	4.3	7.1	8.9	10.7	18.8	25.4	41.7	46.5	46.5
1937	9.7	10.2	14.2	24.4	25.7	25.7	29.5	37.8	38.9
1938	14.0	19.0	23.4	31.7	32.5	34.5	71.1	71.6	71.6
1954	-99.9	-99.9	10.2	20.3	25.7	27.2	39.9	41.1	41.4
1957	-99.9	-99.9	16.3	21.8	28.4	42.7	42.7	42.7	42.7
1959	10.7	18.8	24.1	27.4	28.2	37.3	42.4	44.4	44.4
1960	7.1	8.4	12.2	15.7	19.6	25.7	34.5	37.6	37.6
1961	7.9	12.4	15.7	19.6	24.9	25.1	25.1	25.1	26.4
1962	7.9	13.2	14.0	24.1	29.0	30.2	30.7	37.1	37.1
1963	10.4	16.5	17.8	18.0	18.0	20.6	49.3	57.9	58.2
1964	6.1	9.1	13.7	19.6	23.6	25.7	25.7	30.2	32.5
1965	9.1	13.7	15.7	16.3	18.3	22.4	30.7	36.1	36.1
1966	7.4	12.4	15.2	19.6	23.1	28.4	28.7	28.7	30.5
1967	5.6	8.4	11.9	15.0	21.8	36.3	43.7	47.5	52.8
1968	7.6	8.4	8.4	9.4	15.7	21.6	34.5	43.4	43.4
1969	10.4	14.2	19.6	30.7	38.6	38.6	39.1	51.3	61.0
1970	10.2	11.9	15.2	16.3	23.1	31.0	36.1	40.9	48.8
1972	11.7	19.6	22.4	27.2	33.0	33.0	45.5	48.3	55.4
1973	10.9	15.7	17.8	22.6	41.4	42.2	59.7	60.5	60.5
1974	11.2	14.5	16.3	17.3	21.6	24.6	31.2	33.0	33.8
1975	8.1	10.9	13.2	16.5	21.6	24.1	25.1	32.8	42.7
1976	14.0	18.3	24.4	27.2	33.8	34.3	34.3	34.3	44.2
1977	12.7	18.0	23.9	36.6	42.7	43.7	43.7	43.7	43.7
1978	10.3	12.2	16.3	16.7	19.0	20.1	24.7	33.6	37.4
1980	11.8	12.9	12.9	16.2	19.0	20.8	26.7	43.8	53.9
1981	7.8	15.1	21.7	31.6	38.0	40.6	48.5	51.0	51.8
1982	9.6	10.7	13.4	23.1	24.0	24.2	30.5	34.6	34.6
1983	7.4	14.0	17.8	20.6	33.4	33.8	33.8	33.8	47.4
1984	7.1	9.6	12.0	15.8	22.4	24.7	30.6	32.7	42.6
1985	11.2	13.9	16.3	17.7	20.0	27.4	34.9	34.9	34.9
1986	7.3	7.3	9.4	14.4	20.8	27.2	47.2	75.6	83.4
1987	8.2	11.0	13.9	16.5	16.7	16.8	33.9	40.0	50.8
1988	10.7	20.8	31.2	36.4	53.8	71.0	80.6	82.0	82.0
1989	9.4	11.6	15.3	17.9	20.4	38.2	57.6	59.5	59.9
1990	16.4	19.2	20.8	22.7	22.7	25.5	31.6	62.6	62.6
1991	8.4	10.2	10.4	14.3	15.8	15.8	25.8	37.1	42.9
1992	5.1	6.7	8.6	15.4	25.7	32.4	36.2	38.0	38.2
1993	8.1	13.6	15.5	19.9	20.9	21.3	24.5	26.6	47.4
1994	9.9	12.3	17.3	18.9	20.6	31.2	41.1	42.9	42.9
1995	6.9	9.7	11.9	12.6	19.0	28.0	45.6	74.2	79.4
1996	7.5	14.7	20.4	28.5	33.6	47.1	74.8	74.8	74.8
2000	8.2	12.4	17.3	19.7	21.6	24.3	52.1	66.4	66.4
2001	8.0	12.7	16.8	18.6	18.6	18.6	21.8	31.4	44.7

2002	4.9	6.7	8.9	13.6	17.9	21.3	26.3	37.4	57.3
2003	7.0	11.4	14.4	19.2	20.8	22.4	22.4	34.2	41.6
2004	7.9	10.0	10.4	17.1	28.3	40.6	99.7	122.5	131.9
2005	11.6	14.9	15.6	20.3	24.5	40.0	47.1	47.1	47.1
2006	7.0	13.2	14.2	22.6	27.8	36.8	52.0	54.4	54.6
2007	11.4	18.8	21.2	21.4	25.2	26.4	51.6	75.4	75.6
2008	8.4	12.4	15.0	15.2	15.2	19.0	32.8	43.2	43.4
2009	9.2	12.6	16.0	23.0	23.0	23.0	29.4	41.4	69.2
2010	10.0	18.0	21.8	29.4	32.8	34.6	40.0	46.0	56.6
2011	8.0	10.8	12.2	15.8	16.6	22.6	33.0	34.0	42.2
2015	7.4	9.6	10.6	13.6	13.8	17.2	28.4	42.2	49.2
2016	11.2	17.0	19.2	22.4	25.6	34.2	42.6	55.2	59.4
2017	10.4	14.4	17.6	18.8	19.4	22.6	44.0	60.0	74.0

# Yrs.	57	57	59	59	59	59	59	59	59
Années									
Mean	9.1	13.2	16.1	20.5	25.0	29.6	39.8	46.9	51.7
Moyenne									
Std. Dev.	2.3	3.6	4.7	5.9	7.8	9.5	14.8	16.9	17.2
Écart-type									
Skew.	0.53	0.19	0.61	0.82	1.33	1.57	1.83	1.97	2.04
Dissymétrie									
Kurtosis	3.92	2.42	3.70	3.54	5.25	7.75	7.52	8.81	10.07

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount

Avertissement : la quantité maximale annuelle excède la quantité pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
1988	15 min	31.2	30.8
1988	1 h	53.8	49.5
1988	2 h	71.0	59.5
2004	6 h	99.7	86.2
2004	12 h	122.5	100.0
2004	24 h	131.9	105.5

Table 2a : Return Period Rainfall Amounts (mm)

Quantité de pluie (mm) par période de retour

Duration/Durée	Return Period (Years)						#Years Années
	2	5	10	25	50	100	
5 min	8.7	10.8	12.2	13.9	15.2	16.4	57
10 min	12.6	15.8	17.9	20.6	22.6	24.5	57
15 min	15.3	19.5	22.2	25.7	28.2	30.8	59
30 min	19.5	24.8	28.2	32.6	35.9	39.1	59
1 h	23.7	30.6	35.2	41.0	45.2	49.5	59
2 h	28.1	36.5	42.0	49.1	54.3	59.5	59
6 h	37.4	50.4	59.1	70.0	78.1	86.2	59
12 h	44.2	59.1	69.0	81.5	90.8	100.0	59
24 h	48.9	64.0	74.1	86.8	96.2	105.5	59

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits

Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

Duration/Durée	Return Period (Years)						#Years Années
	2	5	10	25	50	100	
5 min	104.9	129.6	145.9	166.5	181.8	197.0	57
	+/- 6.7	+/- 11.2	+/- 15.1	+/- 20.4	+/- 24.4	+/- 28.4	57
10 min	75.5	94.7	107.4	123.4	135.3	147.1	57
	+/- 5.2	+/- 8.7	+/- 11.8	+/- 15.9	+/- 19.0	+/- 22.1	57
15 min	61.4	77.9	88.9	102.7	112.9	123.1	59
	+/- 4.4	+/- 7.4	+/- 10.0	+/- 13.4	+/- 16.1	+/- 18.7	59
30 min	39.0	49.5	56.5	65.3	71.8	78.3	59
	+/- 2.8	+/- 4.7	+/- 6.3	+/- 8.5	+/- 10.2	+/- 11.9	59

1 h	23.7	30.6	35.2	41.0	45.2	49.5	59
	+/- 1.8	+/- 3.1	+/- 4.2	+/- 5.6	+/- 6.7	+/- 7.8	59
2 h	14.0	18.2	21.0	24.5	27.1	29.7	59
	+/- 1.1	+/- 1.9	+/- 2.5	+/- 3.4	+/- 4.1	+/- 4.8	59
6 h	6.2	8.4	9.8	11.7	13.0	14.4	59
	+/- 0.6	+/- 1.0	+/- 1.3	+/- 1.8	+/- 2.1	+/- 2.5	59
12 h	3.7	4.9	5.7	6.8	7.6	8.3	59
	+/- 0.3	+/- 0.6	+/- 0.8	+/- 1.0	+/- 1.2	+/- 1.4	59
24 h	2.0	2.7	3.1	3.6	4.0	4.4	59
	+/- 0.2	+/- 0.3	+/- 0.4	+/- 0.5	+/- 0.6	+/- 0.7	59

Table 3 : Interpolation Equation / Équation d'interpolation: $R = A \cdot T^B$

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)

RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)

T = Rainfall duration (h) / Durée de la pluie (h)

Statistics/Statistiques	2	5	10	25	50	100
	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans
Mean of RR/Moyenne de RR	36.7	46.3	52.6	60.6	66.5	72.4
Std. Dev. /Écart-type (RR)	36.5	45.2	51.0	58.3	63.7	69.1
Std. Error/Erreur-type	8.1	10.5	12.1	14.1	15.6	17.1
Coefficient (A)	21.7	27.9	32.0	37.1	41.0	44.8
Exponent/Exposant (B)	-0.707	-0.694	-0.688	-0.682	-0.679	-0.676
Mean % Error/% erreur moyenne	7.5	8.1	8.4	8.7	8.9	9.0

METEOROLOGICAL SERVICE OF CANADA
 RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
 PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

 *

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 1 - Eastern Canada Forested Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

YR	TOTAL %		START FLAG	MAX	START																	MAX SNPK
	DAYS	VALID			1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY				
1890	242	89	**	M/D	2/15	4/ 3	4/ 3	12/ 8	2/25	2/24	2/24	2/24	2/24	3/26	2/15	2/24	3/11	2/13				
				.1MM	295	341	341	352	419	474	474	474	474	511	769	814	1093	1125				
1891	273	100		M/D	3/ 9	4/10	3/21	3/21	3/ 9	3/29	3/28	3/28	3/21	3/21	3/28	3/23	3/21	3/13				
				.1MM	355	460	589	668	725	781	846	865	898	978	1561	1873	2252	2371	1789			
1892	274	100		M/D	4/ 4	4/ 4	4/ 3	4/ 4	4/ 3	4/ 2	4/ 2	4/ 1	3/31	3/30	3/25	3/23	3/23	3/10				
				.1MM	292	537	728	918	1108	1274	1406	1486	1516	1545	1746	1798	1798	1833	1559			
1893	273	100		M/D	4/13	4/12	4/11	4/10	4/10	4/ 8	4/ 8	4/ 8	4/ 8	3/31	3/30	3/24	3/21	3/21				
				.1MM	266	466	616	711	794	983	1066	1066	1091	1164	1414	1550	1686	1755	1673			
1894	273	100		M/D	4/ 4	3/ 6	3/ 5	3/ 4	3/ 3	3/ 2	3/ 2	3/ 5	3/ 4	3/ 2	3/ 5	3/ 2	3/ 1	3/ 3				
				.1MM	211	348	531	580	629	729	743	758	807	887	1203	1564	1676	1873	1999			
1895	273	100		M/D	4/14	4/ 8	4/ 7	4/14	4/14	4/13	4/12	4/ 8	4/ 8	4/ 8	4/ 4	4/ 1	3/25	3/24				
				.1MM	305	536	689	809	1002	1141	1300	1312	1467	1653	2150	2247	2416	2460	1740			
1896	274	100		M/D	3/ 1	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 2	3/30	3/26	3/18				
				.1MM	370	623	837	1073	1218	1348	1452	1522	1596	1650	1726	1895	1928	1941	1819			
1897	273	100		M/D	3/10	3/20	3/20	3/20	3/19	3/19	3/19	3/19	3/19	3/20	3/19	3/19	3/10	3/ 5				
				.1MM	262	289	384	474	538	598	637	666	725	775	1279	1311	1626	1707	975			
1898	273	100		M/D	12/11	3/12	3/11	3/10	3/ 9	3/ 8	3/11	3/10	3/11	3/11	3/ 9	3/ 8	3/ 7	3/ 7				
				.1MM	337	519	685	790	876	915	997	1102	1233	1363	1702	2138	2183	2183	1805			
1899	242	89	**	M/D	4/ 8	4/17	4/12	4/12	4/14	4/13	4/12	4/11	4/10	4/ 8	4/ 6	4/ 3	3/29	3/23				
				.1MM	214	315	427	556	667	792	952	1001	1016	1115	1419	1453	1482	1512				
1900	273	100		M/D	2/13	12/11	4/11	4/11	4/11	4/ 3	4/ 2	4/ 6	4/ 6	4/ 5	4/ 1	3/27	3/23	3/20				
				.1MM	328	361	456	571	638	694	784	885	1000	1109	1521	1686	1710	1794	1580			
1901	273	100		M/D	4/ 4	4/ 3	4/ 3	11/18	4/10	4/ 9	4/ 8	4/ 3	4/ 3	4/ 4	3/31	3/26	3/21	3/21				
				.1MM	287	461	589	703	836	1028	1216	1334	1475	1641	2172	2575	2926	2926	1978			
1902	273	100		M/D	12/15	12/14	12/13	2/28	3/21	3/21	3/20	3/20	3/16	3/17	3/12	3/ 7	3/ 1	2/26				
				.1MM	292	538	555	598	674	799	849	876	883	997	1570	1678	2049	2347	1678			
1903	273	100		M/D	3/23	3/19	3/19	3/20	3/19	3/19	3/18	3/17	3/16	3/15	3/10	3/ 5	2/28	2/27				
				.1MM	246	415	586	726	937	1067	1162	1277	1311	1330	1779	2105	2355	2364	1792			
1904	274	100		M/D	4/ 9	4/ 9	4/ 8	4/ 7	4/ 7	4/ 7	4/ 6	4/ 5	4/ 4	4/ 1	3/30	4/ 6	4/ 1	3/26				
				.1MM	389	661	786	942	1057	1165	1270	1355	1390	1503	1886	2427	2883	3124	2573			
1905	273	100		M/D	4/10	4/ 9	4/ 4	4/ 3	4/ 3	4/ 5	4/ 4	4/ 3	4/ 2	3/28	3/27	3/23	3/18	3/18				
				.1MM	210	346	468	572	648	764	955	1059	1093	1206	1790	2070	2337	2337	2012			
1906	273	100		M/D	3/27	3/27	3/26	3/26	12/27	12/27	12/27	12/27	12/23	12/22	12/22	12/22	12/29	12/27				
				.1MM	339	382	406	406	438	438	438	447	466	485	485	587	818	818	308			
1907	273	100		M/D	3/24	3/23	3/28	3/27	3/26	3/24	3/24	3/23	3/22	3/22	3/22	3/22	3/17	3/13				
				.1MM	236	371	493	603	706	796	947	1082	1177	1232	1465	1652	1736	1873	1096			
1908	274	100		M/D	3/15	4/24	4/23	4/22	4/22	4/21	4/20	4/19	4/18	4/17	4/12	4/ 7	4/ 2	3/28				
				.1MM	341	450	640	815	966	1025	1085	1235	1355	1425	1786	2139	2311	2570	2371			
1909	273	100		M/D	5/ 1	4/13	4/13	4/13	4/12	4/12	4/12	4/ 7	4/ 6	4/ 6	4/ 3	3/29	3/25	3/20				
				.1MM	387	643	752	908	1017	1093	1093	1099	1323	1433	1908	2155	2462	2485	1810			
1910	273	100		M/D	11/23	1/21	1/21	1/21	1/18	3/ 2	3/ 1	2/28	2/27	2/27	2/27	3/ 3	2/27	2/21				
				.1MM	279	388	413	447	472	543	581	686	725	725	834	933	1225	1234	875			
1911	273	100		M/D	4/14	4/14	4/13	4/12	4/12	4/13	4/14	4/13	4/13	4/12	4/ 7	4/ 5	3/27	3/26				
				.1MM	340	493	643	728	788	867	1034	1184	1304	1389	1759	2001	2060	2236	1685			
1912	274	100		M/D	4/15	4/15	4/14	4/13	4/12	4/11	4/11	4/10	4/10	4/ 7	4/ 5	3/29	3/28	3/18				
				.1MM	342	638	707	793	902	1012	1080	1135	1135	1400	1783	1873	1933	1985	1664			
1913	273	100		M/D	1/ 3	3/24	3/19	3/21	3/21	3/20	3/19	3/19	3/18	3/21	3/14	3/11	3/11	3/11				
				.1MM	309	474	537	616	785	910	1055	1103	1107	1107	1602	1979	2335	2335	1374			
1914	273	100		M/D	3/30	3/26	3/30	3/30	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/18				
				.1MM	145	264	351	478	539	628	744	871	871	871	1060	1347	1547	1616	1349			
1915	273	100		M/D	11/16	11/15	11/15	11/13	11/12	3/21	3/21	3/21	3/21	3/21	3/21	3/21	3/11	3/ 6				
				.1MM	395	405	409	429	453	502	502	531	531	531	910	912	984	1046	1123			
1916	274	100		M/D	4/16	4/12	4/11	4/22	4/22	4/11	4/11	4/10	4/ 9	4/16	4/11	4/ 7	4/ 1	3/27				
				.1MM	190	361	501	660	743	856	973	1068	1177	1277	1943	2377	2661	3341	2865			
1917	273	100		M/D	4/ 1	4/19	4/18	4/17	4/17	4/16	4/15	4/14	4/13	4/12	3/24	4/ 1	3/27	3/23				

1918	273	100	.1MM	292	489	727	878	1011	1101	1200	1285	1339	1388	1720	2322	2751	3198	2454
			M/D	4/ 2	4/13	4/13	4/12	4/11	4/10	4/ 2	4/ 1	4/ 6	4/ 6	4/ 1	3/28	3/22	3/17	
			.1MM	211	396	563	709	798	827	921	1102	1251	1417	1962	2316	2458	2672	2547
1919	273	100	M/D	3/17	3/17	3/17	3/17	3/17	4/ 3	4/ 3	3/17	3/17	3/17	3/16	3/17	3/16	3/11	
			.1MM	200	360	410	485	570	594	664	729	798	908	1089	1293	1753	1781	1335
1920	274	100	M/D	3/26	3/25	3/24	3/23	3/23	3/22	3/23	3/22	3/21	3/20	3/16	3/10	3/ 5	3/ 5	
			.1MM	236	437	643	823	996	1106	1208	1318	1358	1408	1587	1844	1984	1984	1444
1921	273	100	M/D	3/20	3/ 8	3/ 7	3/ 6	3/16	3/16	3/ 3	3/ 2	3/ 1	2/28	3/ 6	3/ 1	2/28	2/23	
			.1MM	295	316	325	405	494	494	510	608	697	749	936	1229	1281	1333	551
1922	273	100	M/D	12/18	12/17	3/ 6	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/ 7	3/ 6	3/24	3/20	3/14	3/ 7	
			.1MM	342	378	403	485	565	640	679	684	689	728	1066	1181	1411	1598	1105
1923	273	100	M/D	4/22	4/21	4/21	4/20	4/19	4/18	4/17	4/16	4/15	4/15	4/10	4/ 4	4/ 3	4/ 3	
			.1MM	365	717	971	1223	1297	1337	1416	1491	1520	1521	1666	2297	2516	2516	1999
1924	274	100	M/D	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	3/30	3/22	3/20	3/17	
			.1MM	343	534	665	851	940	1029	1169	1259	1319	1399	1551	1811	2113	2120	1916
1925	273	100	M/D	2/11	2/10	3/26	3/25	3/24	3/24	3/22	3/21	3/19	3/19	3/17	3/ 9	3/ 7	3/ 7	
			.1MM	339	484	583	744	834	834	908	996	1073	1253	1366	1533	1617	1617	981
1926	273	100	M/D	5/ 2	5/ 1	4/23	4/22	4/21	4/27	4/22	4/21	4/21	4/23	4/20	4/13	4/ 8	4/ 3	
			.1MM	219	415	574	790	940	1036	1196	1347	1475	1664	2044	2218	2364	2437	2062
1927	273	100	M/D	3/14	3/13	3/13	3/12	3/14	3/13	3/12	3/12	3/12	3/11	3/ 6	3/12	3/13	3/ 8	
			.1MM	229	367	482	591	702	840	950	1030	1084	1119	1414	1603	2076	2369	2012
1928	274	100	M/D	11/22	4/ 5	4/ 4	4/ 4	4/ 3	4/ 2	4/ 2	4/ 2	4/ 2	4/ 2	3/24	3/19	3/14	3/12	
			.1MM	288	376	550	689	784	798	798	798	798	798	1218	1421	1570	1654	1216
1929	273	100	M/D	1/ 6	3/15	3/14	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/ 4	3/ 4	2/27	
			.1MM	274	337	458	577	577	577	657	750	829	918	1210	1244	1458	1537	757
1930	273	100	M/D	1/ 8	1/ 7	1/ 7	1/ 7	2/20	2/19	1/ 2	1/ 2	12/31	12/31	12/27	2/21	2/19	2/13	
			.1MM	276	434	434	434	484	573	650	650	654	654	733	901	1145	1184	927
1931	273	100	M/D	3/29	3/28	3/27	3/26	3/25	3/24	3/23	3/22	3/21	3/20	3/15	3/10	3/ 5	3/ 5	
			.1MM	210	325	421	536	631	741	830	889	929	1024	1297	1351	1440	1459	1159
1932	274	100	M/D	2/12	4/ 8	4/ 8	4/ 8	4/ 7	4/ 6	4/ 5	4/ 5	4/ 6	4/ 6	3/29	3/26	3/26	3/26	
			.1MM	315	326	462	547	617	697	705	706	755	933	1135	1244	1244	628	
1933	273	100	M/D	12/ 7	4/ 1	4/ 1	3/31	3/30	3/29	3/28	3/27	3/27	3/27	3/20	3/15	3/15	3/ 8	
			.1MM	199	311	403	474	508	537	572	637	637	637	876	920	920	929	451
1934	273	100	M/D	12/31	12/31	4/10	4/ 9	4/10	4/10	4/10	4/10	4/10	4/10	4/ 6	3/31	3/26	3/26	
			.1MM	732	732	853	948	1024	1236	1428	1583	1779	1994	2325	2660	2787	2808	1837
1935	273	100	M/D	1/ 8	1/ 7	1/ 7	1/ 7	1/ 7	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	3/28	3/22	3/16	3/12	
			.1MM	186	352	407	457	457	474	497	552	636	671	984	1121	1316	1446	1279
1936	274	100	M/D	3/11	3/11	3/17	3/24	3/17	3/17	3/21	3/21	3/17	3/17	3/15	3/10	3/ 4	3/10	
			.1MM	301	418	508	658	804	884	1003	1123	1245	1360	1803	2281	2336	2351	1224
1937	273	100	M/D	4/ 5	4/ 5	4/ 4	4/ 3	4/ 2	4/ 2	4/ 1	4/ 1	4/ 1	4/ 1	2/ 8	3/19	3/18	12/10	
			.1MM	310	460	505	534	578	602	621	621	621	621	636	767	786	893	453
1938	273	100	M/D	3/23	3/23	3/21	3/23	3/22	3/21	3/20	3/19	3/18	3/17	3/17	3/12	3/12	3/ 5	
			.1MM	241	342	460	656	750	876	1047	1130	1190	1360	1790	1899	1899	2023	1343
1939	273	100	M/D	2/19	4/26	4/25	4/24	4/23	4/22	4/21	4/19	4/19	4/18	4/13	4/11	4/ 5	3/31	
			.1MM	310	395	540	650	829	964	1081	1208	1388	1478	1712	1830	1884	2162	1547
1940	274	100	M/D	4/18	4/17	4/17	4/17	4/17	4/17	4/15	4/15	4/15	4/15	4/ 8	4/ 4	3/30	3/29	
			.1MM	229	438	583	701	828	939	1064	1174	1240	1240	1587	1838	2117	2121	1520
1941	273	100	M/D	12/29	12/28	12/27	12/26	12/26	4/ 6	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	3/25	3/25	3/16	
			.1MM	414	578	698	769	839	993	1094	1189	1275	1354	1399	1455	1455	1537	1511
1942	273	100	M/D	12/24	12/23	12/23	12/23	12/23	3/16	3/16	3/15	3/16	3/16	3/ 8	3/ 8	3/ 2	2/27	
			.1MM	369	534	534	534	534	547	631	665	695	770	968	1172	1393	1531	861
1943	272	100	M/D	4/25	4/24	4/23	4/23	4/23	4/23	4/22	4/22	4/21	4/20	4/17	4/12	4/ 5	3/31	
			.1MM	270	520	730	896	1089	1275	1440	1579	1694	1782	2015	2093	2186	2448	2178
1944	274	100	M/D	4/ 9	3/24	3/24	3/23	3/23	3/23	3/24	3/23	3/24	3/24	3/23	3/24	3/16	3/16	
			.1MM	158	230	289	318	337	356	376	405	451	501	569	821	919	1012	520
1945	273	100	M/D	12/ 8	3/25	3/24	3/23	3/17	3/16	3/15	3/19	3/18	3/17	3/13	3/13	3/ 2	2/26	
			.1MM	193	359	529	674	818	927	1062	1220	1396	1565	1898	1898	2191	2265	1767
1946	273	100	M/D	3/13	3/13	3/ 6	3/ 6	3/ 6	3/ 3	3/ 8	3/ 7	3/ 6	3/ 6	3/ 2	3/ 2	3/ 2	2/13	
			.1MM	208	376	415	482	482	517	647	752	883	883	1077	1077	1077	1321	776
1947	273	100	M/D	12/ 8	4/23	12/ 8	12/ 8	4/10	4/10	4/ 9	4/ 5	4/ 5	4/ 5	4/10	4/ 5	4/ 2	4/ 2	
			.1MM	326	479	666	682	763	858	942	1067	1132	1261	1727	2226	2303	2303	1975
1948	274	100	M/D	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	
			.1MM	333	472	472	599	694	918	1018	1136	1226	1341	1784	2018	2018	2018	1159
1949	273	100	M/D	12/29	3/22	3/26	3/26	3/25	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/10	3/ 5	
			.1MM	181	284	378	486	573	684	785	892	972	1041	1083	1083	1115	1180	885
1950	273	100	M/D	4/ 3	4/ 3	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	3/28	3/27	3/27	3/22	3/23	3/23	3/21	
			.1MM	295	475	561	593	648	648	662	767	874	959	1256	1464	1734	1753	1241
1951	260	95	M/D	1/ 3	3/29	3/29	3/29	3/28	3/28	3/28	3/28	3/28	3/28	3/24	3/19	3/12	3/ 4	
			.1MM	312	485	590	735	815	886	886	886	886	918	1050	1378	1543	1688	1066
1952	274	100	M/D	4/ 4	4/ 3	4/ 2	4/ 1	3/31	4/ 2	4/ 1	3/31	3/31	3/30	3/25	3/20	3/17	3/10	
			.1MM	311	444	569	704	814	924	1059	1169	1245	1293	1431	1696	1823	2242	1454
1953	273	100	M/D	12/ 5	12/ 5	12/ 3	12/ 3	12/ 3	1/10	1/10	1/10	1/10	1/10	2/ 7	2/ 7	12/24	1/10	
			.1MM	232	238	241	247	247	271	271	271	271	271	357	357	422	437	228
1954	271	99	M/D	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 5	4/ 5	4/ 5	4/ 5	4/ 2	4/ 2	3/25	3/23	3/19	3/14
			.1MM	325	570	695	740	850	865	865	865	899	899	916	1100	1206	1225	952

1955	273	100	M/D	4/10	4/10	4/10	4/ 9	4/ 9	4/ 6	4/ 6	4/ 5	4/ 4	4/ 3	3/30	3/29	3/21	3/15	
			.1MM	210	386	521	636	682	727	863	998	1107	1187	1606	1651	1857	1992	1618
1956	274	100	M/D	4/ 4	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	4/ 2	4/ 1	3/31	3/30	3/30	3/22	3/22	3/11	
			.1MM	206	367	506	596	680	760	779	813	882	926	926	935	935	964	886
1957	273	100	M/D	1/22	1/21	1/21	1/21	1/21	1/21	3/ 9	3/ 8	3/ 8	3/ 8	3/ 8	2/24	2/24	2/18	
			.1MM	360	461	461	461	461	461	507	551	551	551	551	897	897	911	569
1958	273	100	M/D	12/ 7	12/ 6	3/22	3/21	3/22	3/21	3/21	3/20	3/19	3/18	3/13	3/12	3/ 3	2/27	
			.1MM	183	231	310	385	455	530	602	637	691	760	973	997	1307	1528	953
1959	273	100	M/D	4/ 8	4/14	4/ 8	4/ 8	4/ 8	4/ 6	4/ 8	4/ 8	4/ 7	4/ 6	4/ 1	3/30	3/25	3/19	
			.1MM	170	300	394	520	585	699	804	969	1034	1149	1702	1852	1881	2101	1925
1960	274	100	M/D	4/16	4/16	4/15	4/14	4/13	4/12	4/11	4/11	4/ 9	4/ 8	4/ 3	3/29	3/27	3/19	
			.1MM	256	487	707	937	1110	1243	1350	1350	1423	1486	1895	2302	2409	2464	1883
1961	273	100	M/D	2/25	2/24	2/23	2/22	2/23	2/22	2/22	2/18	2/23	2/22	2/18	2/18	2/13	2/18	
			.1MM	265	308	466	515	550	599	624	679	729	778	980	1100	1126	1163	667
1962	273	100	M/D	3/29	3/28	3/27	3/26	3/25	3/24	3/24	3/22	3/21	3/21	3/15	3/12	3/ 6	2/28	
			.1MM	180	300	390	520	634	704	732	823	910	939	1093	1288	1331	1346	1160
1963	273	100	M/D	4/ 2	4/ 1	4/ 1	3/30	3/30	3/30	3/27	3/26	3/25	3/24	3/21	3/13	3/13	3/13	
			.1MM	284	440	542	680	783	846	900	1026	1139	1241	1428	1512	1560	1569	1306
1964	274	100	M/D	1/ 9	1/24	3/ 2	3/ 1	1/21	1/20	1/19	1/19	1/19	1/19	1/19	1/19	1/ 3	1/ 9	
			.1MM	130	241	346	390	425	537	540	540	540	540	589	708	768	852	428
1965	273	100	M/D	12/24	12/24	12/23	12/23	3/ 3	3/ 3	3/ 3	3/ 3	3/ 2	3/ 2	12/11	12/11	2/25	2/ 7	
			.1MM	235	349	429	429	494	533	562	581	600	600	699	699	743	1070	688
1966	273	100	M/D	12/24	2/28	2/28	2/28	2/28	2/28	2/28	2/27	2/26	2/26	2/28	2/27	2/26	2/ 9	
			.1MM	232	325	414	474	666	768	848	852	891	891	936	1140	1179	1192	702
1967	273	100	M/D	4/ 2	4/ 1	4/ 1	3/31	4/ 1	3/31	3/27	3/27	3/26	3/27	3/23	3/22	3/13	3/10	
			.1MM	254	485	585	685	780	880	1048	1148	1188	1343	1514	1539	1593	1702	1332
1968	274	100	M/D	3/16	3/21	3/20	3/19	3/19	3/18	3/16	3/16	3/15	3/15	3/15	3/ 8	3/ 8	2/29	
			.1MM	222	349	500	675	813	908	1098	1236	1249	1249	1515	1715	1715	1758	1001
1969	273	100	M/D	1/24	3/24	3/23	3/22	3/21	3/20	3/19	3/18	3/18	3/16	3/13	3/14	3/13	3/13	
			.1MM	235	349	384	468	563	645	695	730	730	734	837	868	943	943	679
1970	273	100	M/D	12/10	12/10	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 3	4/ 1	3/24	3/19	
			.1MM	284	378	521	691	857	957	961	1021	1191	1321	1434	1513	1770	2028	1434
1971	273	100	M/D	4/28	4/27	4/27	4/27	4/27	4/26	4/25	4/24	4/23	4/22	4/17	4/12	4/ 7	4/ 2	
			.1MM	269	479	645	850	1031	1187	1326	1476	1611	1762	2549	3101	3272	3419	3291
1972	274	100	M/D	12/10	12/ 9	4/18	4/18	4/19	4/18	4/13	4/13	4/13	4/13	4/10	4/ 9	3/31	3/29	
			.1MM	231	385	494	614	735	876	1021	1177	1297	1414	1887	1931	2168	2315	1842
1973	273	100	M/D	2/ 2	3/11	3/11	3/11	3/ 8	3/ 7	3/ 7	3/ 7	3/ 7	3/ 3	3/ 3	3/ 3	2/20	2/20	
			.1MM	188	352	432	509	654	789	869	946	1075	1182	1467	1467	1536	1536	968
1974	273	100	M/D	3/ 4	3/ 4	3/ 4	3/ 4	3/ 3	3/ 3	3/ 1	2/28	3/30	3/29	3/30	3/29	3/23	3/16	
			.1MM	470	575	695	881	920	920	949	1025	1041	1049	1437	1445	1469	1501	1087
1975	273	100	M/D	3/19	3/18	3/18	3/17	3/16	3/16	3/18	3/18	3/17	3/16	3/16	3/12	3/12	3/18	
			.1MM	371	453	523	552	596	596	674	719	748	792	878	946	989	1308	827
1976	274	100	M/D	3/31	3/31	3/31	3/31	3/30	3/27	3/25	3/25	3/24	3/24	3/24	3/20	3/19	3/12	
			.1MM	407	557	655	771	860	982	1112	1263	1413	1511	2014	2288	2313	2431	1885
1977	273	100	M/D	3/13	3/13	3/12	3/10	3/10	3/ 9	3/ 9	3/ 8	3/ 7	3/ 6	3/ 3	2/24	3/ 4	2/27	
			.1MM	295	466	615	739	910	1010	1100	1134	1193	1257	1416	1631	1697	1776	1225
1978	273	100	M/D	1/25	1/25	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/ 9	4/ 4	3/30	3/26	3/20	
			.1MM	358	454	488	636	740	825	960	1118	1216	1220	1598	1889	2122	2393	1571
1979	273	100	M/D	12/31	12/31	3/20	3/19	3/ 3	3/ 3	3/ 3	3/ 3	3/ 2	3/ 2	2/28	3/ 3	2/27	2/22	
			.1MM	224	310	382	427	484	583	647	728	732	732	857	1303	1362	1496	1287
1980	274	100	M/D	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/19	3/18	3/17	3/16	3/10	3/10	3/10	
			.1MM	507	654	762	875	946	1018	1117	1125	1164	1204	1206	1216	1216	1216	590
1981	273	100	M/D	2/23	2/22	2/21	2/19	2/19	2/18	2/17	2/16	2/16	2/16	2/10	2/ 8	2/ 1	1/25	
			.1MM	203	388	531	707	910	1031	1148	1188	1188	1188	1415	1473	1578	1656	921
1982	273	100	M/D	3/31	3/31	3/30	3/31	3/30	3/29	3/29	3/25	3/24	3/25	3/18	3/13	3/11	3/11	
			.1MM	294	402	490	530	618	644	644	690	712	818	1024	1335	1615	1621	1033
1983	273	100	M/D	1/10	2/ 2	2/ 2	1/31	1/31	1/31	1/31	1/31	1/31	1/25	12/15	12/23	1/10	12/15	
			.1MM	282	348	348	408	408	408	408	408	408	466	544	725	838	949	182
1984	274	100	M/D	2/14	2/13	2/13	12/12	12/12	2/14	2/13	2/13	2/12	2/11	2/11	2/ 4	2/ 3	1/25	
			.1MM	298	406	490	566	604	686	793	863	905	914	992	1058	1072	1110	710
1985	273	100	M/D	3/28	3/27	3/26	3/11	3/24	3/23	3/ 8	3/ 8	3/20	3/23	3/ 1	3/ 9	3/ 8	3/ 1	
			.1MM	297	458	500	551	588	682	731	731	733	733	868	1378	1515	1602	1071
1986	273	100	M/D	1/20	1/19	1/18	1/18	1/18	3/14	3/13	3/13	3/11	3/10	3/ 9	3/ 2	3/ 2	2/18	
			.1MM	215	395	493	493	538	545	553	553	559	704	711	808	808	1010	487
1987	273	100	M/D	12/24	12/24	12/23	12/23	12/23	12/23	12/19	12/19	12/18	12/18	3/ 7	3/ 6	2/28	2/28	
			.1MM	170	307	390	427	427	427	473	510	524	524	685	727	870	870	720
1988	274	100	M/D	11/29	11/29	11/29	11/28	11/28	11/29	11/28	11/28	11/26	11/26	11/26	11/26	11/29	11/26	
			.1MM	315	406	464	468	468	493	497	497	521	521	679	679	861	984	456
1989	273	100	M/D	3/28	3/27	3/26	3/25	3/24	3/24	3/24	3/24	3/24	3/24	3/14	3/14	3/ 4	3/ 4	
			.1MM	224	412	536	654	694	694	694	694	700	700	1001	1007	1013	1019	595
1990	273	100	M/D	1/ 4	3/11	3/10	3/10	1/24	1/24	1/24	1/24	1/24	1/17	1/17	1/25	1/17	1/ 3	
			.1MM	172	292	343	371	413	419	452	488	523	546	722	780	980	1101	709
1991	273	100	M/D	12/29	12/21	12/21	12/21	2/ 3	12/18	12/17	12/17	12/21	12/17	12/17	12/17	12/ 7	2/ 3	
			.1MM	203	335	458	458	491	555	607	607	704	763	912	917	1074	1297	641
1992	274	100	M/D	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/26	3/25	3/25	3/10	

1993	273	100	.1MM	468	628	655	693	772	879	951	991	1023	1059	1535	1582	1582	1642	1099
			M/D	1/ 4	1/ 3	3/28	3/27	3/26	3/26	3/25	3/24	3/24	3/26	3/24	3/21	3/16	3/ 9	
			.1MM	379	464	508	657	768	861	941	1011	1012	1060	1519	1557	1654	1695	1326
1994	273	100	M/D	2/20	4/ 9	3/22	3/21	3/21	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	3/27	3/22	3/19	3/13	
			.1MM	174	300	387	463	497	592	674	729	837	887	1137	1583	1660	1741	1273
1995	273	100	M/D	1/15	1/15	1/14	1/13	1/12	1/12	1/13	1/12	1/12	1/12	1/12	1/12	1/12	12/21	
			.1MM	536	654	728	818	878	921	952	1012	1044	1044	1053	1053	1077	1166	397
1996	274	100	M/D	1/19	1/18	1/17	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/ 8	2/20	2/20	
			.1MM	304	449	451	638	790	855	855	877	897	897	897	1045	1117	1339	1296
1997	273	100	M/D	2/21	2/20	2/19	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/29	3/29	3/25	3/25	3/25	3/14	
			.1MM	399	535	718	801	899	1012	1076	1118	1258	1370	1709	1760	1760	1766	1458
1998	273	100	M/D	1/ 5	3/26	3/26	1/ 5	1/ 5	1/ 4	1/ 3	1/ 3	1/ 3	1/ 3	12/27	12/25	12/17	12/13	
			.1MM	258	448	526	541	672	720	825	869	869	869	923	961	1054	1082	383
1999	273	100	M/D	1/18	1/18	1/22	1/22	1/18	1/18	1/18	1/17	1/17	1/17	3/14	1/17	1/17	1/17	
			.1MM	242	321	411	411	518	621	755	817	817	817	830	1065	1098	1168	643
2000	274	100	M/D	2/27	2/27	2/26	2/25	2/24	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23	
			.1MM	156	282	382	456	564	671	721	821	832	832	832	874	1004	1004	746
2001	273	100	M/D	2/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/28	3/21	3/18	3/11	
			.1MM	197	323	453	555	682	770	842	934	973	1039	1184	1533	1698	1828	1546
2002	273	100	M/D	3/30	3/29	3/28	3/28	3/27	3/27	2/15	2/15	2/15	2/15	2/15	2/10	2/15	1/23	
			.1MM	132	259	328	391	422	422	466	466	466	466	515	535	575	660	322
2003	272	100	M/D	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/18	3/17	3/12	3/12	3/16	3/12	
			.1MM	272	384	549	686	816	980	1118	1118	1205	1337	1392	1392	1435	1479	1006
2004	274	100	M/D	3/ 5	3/ 4	3/ 3	3/ 2	3/ 1	2/29	2/28	2/28	2/28	2/28	2/21	2/19	2/10	2/28	
			.1MM	383	485	576	745	817	903	944	944	944	959	977	996	1028	1142	619
2005	273	100	M/D	12/23	12/22	3/27	3/27	3/26	3/24	3/24	3/22	3/21	3/21	3/20	3/15	3/ 6	3/ 6	
			.1MM	283	321	360	414	426	484	538	541	599	653	705	718	733	733	709
2006	273	100	M/D	1/17	1/17	2/ 2	1/17	1/17	1/13	1/12	1/11	1/12	1/11	1/11	1/10	1/11	12/23	
			.1MM	195	341	378	501	526	549	646	723	806	883	958	1083	1451	1540	409
2007	273	100	M/D	3/14	3/13	3/12	3/11	3/10	3/10	3/10	3/10	3/10	3/13	3/10	3/ 3	3/ 3	3/ 3	
			.1MM	243	383	467	511	515	515	515	515	515	641	778	798	803	803	537
2008	274	100	M/D	12/23	1/ 7	1/ 7	1/ 6	4/ 7	4/ 7	4/ 5	4/ 8	4/ 7	4/ 5	3/31	3/28	3/25	3/18	
			.1MM	383	552	723	824	889	992	1144	1252	1375	1485	1930	2148	2271	2568	1884
2009	273	100	M/D	2/11	2/11	2/11	3/15	3/15	3/ 6	3/ 5	3/11	3/10	3/10	3/ 5	2/27	2/26	2/26	
			.1MM	291	427	427	429	498	534	547	571	670	739	1069	1171	1343	1367	1209
2010	273	100	M/D	1/24	1/24	1/24	1/24	1/24	1/24	2/23	2/23	2/23	2/23	2/17	2/17	2/17	2/17	
			.1MM	316	528	597	597	597	597	630	704	743	743	835	835	835	835	559
2011	273	100	M/D	3/ 5	3/10	3/10	3/10	3/ 9	3/ 5	3/ 5	3/ 5	3/ 5	3/ 9	3/ 4	2/27	2/27	2/17	
			.1MM	304	400	476	532	582	657	755	831	886	919	1251	1275	1277	1539	550
2012	274	100	M/D	2/16	2/16	2/15	2/15	2/15	2/15	2/16	2/15	2/15	2/15	2/10	2/15	2/15	2/10	
			.1MM	122	205	275	290	290	290	310	380	385	385	409	513	685	709	420
2013	273	100	M/D	1/30	1/12	1/12	3/26	3/25	3/24	3/23	3/ 6	3/ 5	3/ 5	2/27	3/10	3/ 5	2/28	
			.1MM	259	294	382	430	489	558	581	614	642	642	789	998	1224	1305	954
2014	273	100	M/D	4/ 7	4/ 7	4/ 6	4/ 4	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/30	3/28	3/20	3/15	3/10	
			.1MM	274	416	506	618	761	824	944	993	1094	1159	1389	1469	1563	1678	870
2015	273	100	M/D	4/ 9	4/ 2	4/ 7	4/ 7	4/ 6	4/ 5	4/ 3	4/ 2	4/ 2	4/ 1	3/26	3/21	3/17	3/11	
			.1MM	274	352	424	481	503	516	683	832	890	893	1037	1152	1228	1384	1069
2016	117	43	**	M/D	1/10	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 1	12/29	1/ 9	1/ 1	12/29
			.1MM	301	366	366	366	366	366	366	366	366	366	372	376	388	394	398

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		1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY
MEAN EXTREME	(MM)	28.1	41.9	52.1	61.6	70.0	77.6	85.3	92.0	97.9	104.1	128.4	145.6	158.7	168.8
STD. DEV.	(MM)	8.8	10.7	13.3	17.0	20.4	23.4	26.6	29.1	32.0	35.2	46.3	54.2	58.6	61.7
YEARS ANALYSED		124	124	124	124	124	124	124	124	124	124	124	124	124	124
MAX EXTREME	(MM)	73.2	73.2	97.1	122.3	129.7	134.8	145.2	158.3	177.9	199.4	254.9	310.1	327.2	341.9
YEAR		1934	1934	1923	1923	1923	1896	1896	1934	1934	1934	1971	1971	1971	1971

** NOTE ** VALUE IN FLAG INDICATES YEAR NOT INCLUDED IN ANALYSIS BASED ON % DAYS OPERATIONAL (<90.0%)

METEOROLOGICAL SERVICE OF CANADA
RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

*

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 1 - Eastern Canada Forested Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

RETURN PERIOD VALUES (MM) WITH 50% CONFIDENCE LIMITS

Table with 6 columns: RETURN PERIOD YEARS, 1 DAY, 2 DAY, 3 DAY, 4 DAY, 5 DAY. Rows for 2, 5, 10, 25, 50, 100 years.

Table with 6 columns: RETURN PERIOD YEARS, 6 DAY, 7 DAY, 8 DAY, 9 DAY, 10 DAY. Rows for 2, 5, 10, 25, 50, 100 years.

Table with 5 columns: RETURN PERIOD YEARS, 15 DAY, 20 DAY, 25 DAY, 30 DAY. Rows for 2, 5, 10, 25, 50, 100 years.

** WARNING ** : 100 YEAR VALUES IN 1934 BASED ON 1 DAYS ACCUMULATION
** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 3 DAYS ACCUMULATION
** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 4 DAYS ACCUMULATION

METEOROLOGICAL SERVICE OF CANADA
RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 2 - Western North America Mountain Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

Table with 20 columns: YR, TOTAL DAYS, % VALID, START FLAG, MAX, 1 DAY, 2 DAY, 3 DAY, 4 DAY, 5 DAY, 6 DAY, 7 DAY, 8 DAY, 9 DAY, 10 DAY, 15 DAY, 20 DAY, 25 DAY, 30 DAY, MAX SNPK. Rows for years 1890-1898.

1899	242	89	**	.1MM	382	633	873	999	1088	1092	1217	1343	1462	1630	1909	2209	2209	2243	1831
				M/D	4/18	4/18	4/17	4/16	4/15	4/14	4/13	4/12	4/11	4/11	4/ 7	4/ 7	3/29	3/23	
				.1MM	295	580	743	822	993	1187	1350	1515	1538	1554	1887	1887	1902	1927	
1900	273	100		M/D	2/13	4/ 6	4/11	4/11	4/11	4/ 3	4/ 2	4/ 6	4/ 5	4/ 5	4/ 1	3/29	3/29	3/20	
				.1MM	347	419	556	679	749	849	947	1083	1217	1341	1748	1782	1782	1852	1638
1901	273	100		M/D	11/21	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 4	4/ 1	3/26	3/21	3/21	
				.1MM	368	509	718	910	1121	1324	1541	1648	1780	2027	2573	2950	3264	3264	2315
1902	273	100		M/D	12/14	12/14	3/21	3/21	3/21	3/21	3/21	3/21	3/20	3/20	3/12	3/11	3/ 1	2/28	
				.1MM	330	622	685	783	907	1070	1249	1283	1306	1306	1807	2050	2181	2663	1969
1903	273	100		M/D	3/19	3/19	3/19	3/19	3/19	3/19	3/18	3/17	3/17	3/17	3/10	3/ 5	2/28	2/28	
				.1MM	319	631	866	992	1255	1426	1525	1648	1671	1671	2057	2380	2653	2676	2103
1904	274	100		M/D	4/ 9	4/ 9	4/ 8	4/ 7	4/ 7	4/ 6	4/ 6	4/ 5	4/ 5	4/ 1	3/30	4/ 5	3/31	3/26	
				.1MM	451	796	960	1147	1292	1418	1525	1614	1614	1709	2110	2680	3087	3491	2688
1905	273	100		M/D	3/29	3/29	3/28	3/28	3/27	3/25	3/25	3/29	3/29	3/28	3/27	3/24	3/18	3/18	
				.1MM	256	475	620	735	841	915	1031	1175	1333	1478	1910	2122	2348	2348	2023
1906	273	100		M/D	3/27	3/27	3/27	3/27	3/27	3/27	3/27	1/16	1/16	1/16	1/16	1/16	12/30	12/27	
				.1MM	369	406	406	406	406	406	406	410	410	410	410	441	497	776	419
1907	273	100		M/D	3/28	3/28	3/28	3/27	3/26	3/24	3/23	3/23	3/22	3/22	3/22	3/22	3/22	3/13	
				.1MM	249	449	623	728	835	905	1086	1260	1368	1399	1597	1718	1814	1990	1213
1908	274	100		M/D	4/25	4/24	4/23	4/22	4/22	4/21	4/19	4/18	4/18	4/17	4/11	4/ 6	4/ 2	3/28	
				.1MM	353	666	951	1208	1316	1355	1492	1645	1753	1813	2224	2636	2769	2899	2525
1909	273	100		M/D	4/14	4/13	4/13	4/12	4/12	4/12	4/12	4/ 7	4/ 6	4/ 6	4/ 3	3/28	3/25	4/ 3	
				.1MM	500	909	1043	1178	1277	1277	1277	1443	1741	1876	2219	2402	2613	2642	2012
1910	273	100		M/D	1/22	1/21	3/20	3/20	3/20	3/19	3/19	3/19	3/19	3/19	3/13	3/ 5	2/28	2/27	
				.1MM	300	402	487	566	664	684	684	684	684	684	732	1091	1355	1375	1026
1911	273	100		M/D	4/14	4/13	4/13	4/12	4/12	4/13	4/14	4/13	4/12	4/11	4/ 6	4/ 5	3/27	3/26	
				.1MM	463	672	877	965	1007	1086	1327	1536	1624	1637	2094	2185	2389	2396	1876
1912	274	100		M/D	4/15	4/ 6	4/ 5	4/ 5	4/11	4/11	4/10	4/ 5	4/ 7	4/ 6	4/ 5	3/28	3/28	3/18	
				.1MM	493	661	845	845	911	1032	1065	1147	1350	1606	1911	2046	2046	2164	1775
1913	273	100		M/D	3/24	3/24	3/19	3/21	3/21	3/19	3/19	3/19	3/19	3/19	3/19	3/14	3/13	3/13	
				.1MM	389	582	729	767	960	1131	1324	1367	1367	1367	1962	2396	2459	2459	1697
1914	273	100		M/D	4/17	4/16	4/15	4/14	4/14	4/12	4/11	3/26	3/26	4/ 8	3/26	3/29	3/26	3/26	
				.1MM	276	482	589	658	685	709	806	921	921	922	1026	1434	1884	1884	1597
1915	273	100		M/D	11/16	11/15	4/ 4	4/ 3	4/ 3	4/ 1	4/ 1	4/ 1	4/ 1	4/ 1	3/24	3/21	3/21	3/13	
				.1MM	418	428	483	580	673	766	860	860	860	860	1085	1344	1344	1357	1210
1916	274	100		M/D	4/16	4/12	4/11	4/10	4/12	4/11	4/11	4/10	4/ 9	4/10	4/10	3/28	3/26	3/26	
				.1MM	285	517	704	810	972	1159	1293	1399	1534	1631	2124	2620	3227	3720	3088
1917	273	100		M/D	4/ 1	4/18	4/17	4/16	4/15	4/14	4/13	4/12	4/11	3/26	3/24	3/31	3/26	3/23	
				.1MM	380	710	921	1018	1134	1221	1252	1274	1295	1404	1848	2487	3001	3161	2532
1918	273	100		M/D	4/ 2	4/ 1	4/ 6	3/30	3/29	3/29	4/ 2	4/ 1	3/31	3/30	3/29	3/20	3/17		
				.1MM	323	566	801	930	1009	1009	1206	1449	1649	1812	2383	2462	2688	2748	2623
1919	273	100		M/D	4/ 7	4/ 9	4/ 7	4/ 7	4/ 6	4/ 5	4/ 5	4/ 3	4/ 3	4/ 3	3/27	3/23	3/17	3/16	
				.1MM	218	373	505	715	826	950	950	1020	1020	1020	1232	1582	2130	2140	1577
1920	274	100		M/D	3/26	3/25	3/24	3/23	3/22	3/22	3/21	3/20	3/20	3/17	3/12	3/11	3/ 5	3/ 5	
				.1MM	338	644	957	1224	1358	1395	1399	1422	1422	1488	1761	1819	1946	1946	1518
1921	273	100		M/D	3/20	3/20	3/19	3/ 9	3/ 8	3/16	3/15	3/ 9	3/ 8	3/12	3/ 8	3/ 2	2/28	2/23	
				.1MM	294	468	488	499	559	684	699	751	811	887	1299	1580	1697	1712	761
1922	273	100		M/D	12/18	4/ 6	4/ 5	4/ 4	4/ 3	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	3/26	3/20	3/14	3/14	
				.1MM	353	543	706	793	872	949	1019	1022	1022	1022	1306	1403	1613	1690	1161
1923	273	100		M/D	4/21	4/21	4/20	4/19	4/18	4/17	4/16	4/16	4/16	4/16	4/ 8	4/ 3	4/ 3	3/24	
				.1MM	586	1049	1448	1516	1520	1599	1668	1668	1668	1668	1898	2644	2644	2649	2212
1924	274	100		M/D	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	3/27	3/22	3/21	3/21	
				.1MM	349	576	750	1011	1108	1196	1383	1480	1522	1600	1700	1975	2160	2160	1935
1925	273	100		M/D	2/11	2/10	3/25	3/24	3/24	3/22	3/21	3/21	3/19	3/18	3/18	3/ 8	3/ 8	2/26	
				.1MM	339	512	724	821	821	890	973	973	1233	1320	1320	1471	1471	1585	1025
1926	273	100		M/D	4/22	4/22	4/22	4/22	4/21	4/21	4/22	4/21	4/21	4/21	4/21	4/13	4/ 8	4/ 2	
				.1MM	332	627	856	1151	1362	1393	1629	1840	2006	2221	2432	2543	2611	2645	2343
1927	273	100		M/D	11/16	3/13	4/ 4	3/12	3/12	3/13	3/12	3/12	3/12	3/12	3/ 6	3/12	3/13	3/ 8	
				.1MM	301	421	592	698	777	917	1052	1130	1162	1162	1425	1670	2251	2517	2144
1928	274	100		M/D	11/22	4/ 5	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	3/24	3/19	3/14	3/12	
				.1MM	323	561	772	879	963	963	963	963	963	963	1423	1535	1672	1705	1282
1929	273	100		M/D	1/ 6	3/15	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/13	3/ 4	2/27	
				.1MM	274	345	457	561	561	561	640	706	783	872	1253	1378	1617	1669	885
1930	273	100		M/D	1/ 8	1/ 7	1/ 7	1/ 7	2/20	2/19	1/ 2	1/ 2	1/ 2	1/ 2	2/19	2/19	2/13		
				.1MM	262	468	468	468	535	633	657	657	657	657	690	870	1142	1172	1023
1931	273	100		M/D	3/29	3/28	3/28	3/26	3/26	3/24	3/24	3/24	3/23	3/22	3/17	3/16	3/10	3/ 5	
				.1MM	259	403	521	655	773	889	1007	1114	1212	1251	1473	1620	1652	1677	1411
1932	274	100		M/D	2/12	4/ 8	4/ 8	4/ 8	4/ 8	4/ 7	4/ 6	4/ 5	4/ 5	4/ 6	3/30	3/26	3/26	3/26	
				.1MM	330	376	557	734	875	935	1014	1022	1022	1035	1231	1420	1547	1547	803
1933	273	100		M/D	12/25	4/ 1	4/ 1	4/ 1	4/ 1	4/ 1	3/31	3/31	3/31	3/31	3/27	3/20	3/20	3/20	
				.1MM	207	334	498	595	721	817	888	888	888	888	939	1109	1109	1109	643
1934	273	100		M/D	12/31	4/10	4/10	4/16	4/15	4/14	4/10	4/11	4/11	4/10	4/ 6	4/ 1	3/26	3/26	
				.1MM	732	819	927	1067	1299	1429	1549	1793	2126	2396	2676	2981	3103	3108	2136
1935	273	100		M/D	4/10	4/10	4/ 9	4/ 9	4/ 8	4/ 8	4/ 8	4/ 5	4/ 5	4/ 3	3/29	3/24	3/19	3/16	
				.1MM	274	523	771	946	1081	1081	1081	1112	1112	1144	1338	1457	1533	1667	1378

			.1MM	298	486	664	713	792	995	1182	1220	1245	1493	1990	1990	1990	2037	1209
1974	273	100	M/D	3/ 4	3/ 4	3/ 4	3/ 4	3/ 3	3/ 3	3/30	2/28	3/30	3/29	3/30	3/29	3/29	3/16	
			.1MM	461	587	740	1017	1019	1019	1062	1081	1096	1104	1500	1508	1508	1511	1136
1975	273	100	M/D	3/19	4/17	4/16	4/15	4/14	4/14	4/14	4/14	4/14	4/14	4/ 5	4/ 5	3/29	3/19	
			.1MM	377	654	882	989	1096	1152	1152	1152	1152	1152	1154	1154	1208	1362	1097
1976	274	100	M/D	3/31	3/31	3/31	3/31	3/30	3/27	3/25	3/24	3/24	3/24	3/20	3/19	3/12	3/ 4	
			.1MM	450	637	747	892	989	1149	1345	1556	1742	1853	2268	2455	2564	2612	2027
1977	273	100	M/D	3/13	3/13	3/12	3/10	3/10	3/ 9	3/ 9	3/ 9	3/ 7	3/ 6	3/ 4	2/24	3/ 4	2/27	
			.1MM	342	551	751	954	1162	1278	1376	1376	1416	1466	1551	1705	1872	1914	1284
1978	273	100	M/D	1/25	4/17	4/17	4/16	4/15	4/13	4/13	4/12	4/11	4/10	4/ 5	3/31	3/26	3/21	
			.1MM	332	414	605	787	876	1015	1205	1368	1543	1731	1904	2353	2547	2742	1825
1979	273	100	M/D	3/23	3/22	3/21	3/20	3/19	3/19	3/19	3/ 3	3/ 3	3/14	3/ 9	3/ 4	3/ 3	2/22	
			.1MM	213	421	594	717	729	729	729	750	750	812	955	1472	1592	1691	1482
1980	274	100	M/D	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/18	3/17	3/16	3/10	3/10	3/10	
			.1MM	528	707	839	978	1042	1105	1228	1228	1232	1268	1270	1272	1272	1272	655
1981	273	100	M/D	2/20	2/19	2/19	2/19	2/18	2/17	2/16	2/16	2/16	2/16	2/ 8	2/ 8	2/ 1	1/25	
			.1MM	235	466	661	847	1004	1152	1156	1156	1156	1422	1422	1496	1548	1065	
1982	273	100	M/D	3/31	3/31	3/30	3/31	3/30	3/30	3/30	3/25	3/25	3/25	3/20	3/13	3/11	3/12	
			.1MM	391	522	606	700	784	784	784	822	822	1000	1059	1349	1671	1747	1260
1983	273	100	M/D	1/10	2/ 2	12/23	1/31	1/31	1/31	1/31	1/31	1/31	12/15	12/15	12/23	1/10	12/15	
			.1MM	282	321	340	356	356	356	356	356	356	405	588	644	705	892	359
1984	274	100	M/D	2/14	2/13	2/13	2/13	2/12	2/14	2/13	2/13	2/12	2/14	2/11	2/11	2/ 3	2/ 3	
			.1MM	321	421	509	567	575	657	757	818	825	850	1086	1086	1133	1133	943
1985	273	100	M/D	3/28	3/27	3/27	3/26	3/24	3/23	3/23	3/23	3/27	3/26	3/23	3/11	3/11	3/ 8	
			.1MM	464	687	773	783	784	890	976	976	1020	1030	1223	1521	1768	1888	1114
1986	273	100	M/D	3/19	1/19	1/18	1/18	3/15	3/15	3/13	3/13	3/15	3/10	3/ 9	3/ 9	3/ 2	3/ 2	
			.1MM	261	429	543	543	582	582	590	590	675	705	805	917	963	963	701
1987	273	100	M/D	3/ 8	3/ 7	3/20	3/19	3/18	3/17	3/17	3/17	3/17	3/17	3/ 7	3/ 7	2/28	2/28	
			.1MM	222	384	391	432	499	549	549	549	549	549	787	933	1076	1076	926
1988	274	100	M/D	11/29	3/25	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	11/29	3/ 7	11/29	11/28
			.1MM	315	490	662	662	662	662	662	662	662	662	735	824	827	890	579
1989	273	100	M/D	3/28	3/27	3/26	3/25	3/24	3/24	3/24	3/25	3/25	3/24	3/24	3/14	3/14	3/14	3/ 4
			.1MM	298	579	739	859	871	871	908	933	945	945	1242	1316	1316	1328	832
1990	273	100	M/D	3/12	3/11	3/11	3/11	3/11	3/10	3/10	3/10	3/10	3/10	3/ 2	3/ 2	2/22	2/13	
			.1MM	195	361	511	605	677	702	702	702	702	781	781	942	962	962	865
1991	273	100	M/D	2/ 5	2/ 4	2/ 4	2/ 4	2/ 3	2/ 3	2/ 3	2/ 3	12/21	12/21	12/17	3/ 1	2/21	2/ 3	
			.1MM	202	367	452	541	565	565	583	583	655	695	836	896	1013	1233	852
1992	274	100	M/D	3/26	3/26	3/25	3/25	3/26	3/26	3/26	3/26	3/25	3/25	3/25	3/26	3/26	3/25	3/25
			.1MM	490	664	672	672	742	872	935	943	947	947	1554	1777	2012	2012	1392
1993	273	100	M/D	1/ 4	3/29	3/28	3/27	3/26	3/26	3/25	3/24	3/24	3/26	3/24	3/21	3/16	3/ 9	
			.1MM	361	543	738	945	1081	1185	1264	1324	1324	1344	1749	1750	1847	1853	1542
1994	273	100	M/D	4/10	4/ 9	4/ 9	4/ 8	4/ 7	4/ 5	4/ 5	4/ 4	4/ 3	4/ 2	3/28	3/22	3/21	3/15	
			.1MM	257	461	587	669	731	757	882	945	978	1050	1241	1608	1809	1856	1422
1995	273	100	M/D	1/15	1/15	1/14	1/13	1/12	1/12	1/12	1/12	1/12	1/12	1/12	1/12	1/12	12/18	
			.1MM	608	722	783	873	933	942	942	991	1044	1044	1044	1080	1080	1166	397
1996	274	100	M/D	1/19	1/18	1/17	1/16	2/20	2/20	2/20	2/20	2/20	2/20	3/18	3/13	3/13	2/20	
			.1MM	387	585	587	623	792	843	843	865	865	865	937	1158	1158	1248	1462
1997	273	100	M/D	2/21	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/28	3/25	3/25	3/14	3/14	
			.1MM	384	655	888	1002	1141	1191	1199	1244	1489	1598	1874	1874	1880	1880	1572
1998	273	100	M/D	3/26	3/26	3/25	3/25	1/ 5	1/ 3	1/ 3	1/ 3	1/ 3	1/ 3	2/17	2/11	2/11	2/11	
			.1MM	299	556	562	562	592	666	766	777	777	777	817	903	903	903	679
1999	273	100	M/D	1/18	3/28	3/28	3/27	3/27	1/18	1/18	1/17	1/17	1/17	3/17	3/17	3/17	3/ 1	
			.1MM	204	390	473	532	532	562	742	787	787	787	1049	1049	1049	1135	744
2000	274	100	M/D	2/27	2/27	2/26	2/25	2/24	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23	
			.1MM	222	385	503	556	660	790	796	796	796	796	796	805	903	981	746
2001	273	100	M/D	11/26	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 2	3/28	3/22	3/18	3/14	
			.1MM	309	466	697	844	963	1130	1225	1289	1389	1445	1611	1767	1991	2081	1770
2002	273	100	M/D	3/30	3/30	3/29	3/28	3/28	3/28	3/28	3/28	3/28	3/28	2/15	2/10	2/15	2/10	
			.1MM	176	311	433	492	492	492	492	492	492	492	627	647	687	707	392
2003	272	100	M/D	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/18	3/17	3/17	3/16	3/16	3/17	3/16	
			.1MM	272	404	593	778	933	1154	1211	1246	1421	1478	1498	1498	1573	1593	1119
2004	274	100	M/D	3/ 5	3/ 4	3/ 3	3/ 2	3/ 1	2/29	2/28	2/28	2/28	2/28	2/28	3/ 1	2/28		
			.1MM	428	543	642	868	931	1022	1029	1029	1029	1031	1044	1064	1165	1263	692
2005	273	100	M/D	3/29	3/29	3/29	3/28	3/27	3/27	3/27	3/24	3/24	3/22	3/20	3/20	3/20	3/20	
			.1MM	283	431	674	803	845	845	845	917	917	953	1019	1019	1019	1019	930
2006	273	100	M/D	3/11	2/ 3	2/ 3	3/ 9	3/ 9	3/ 9	1/12	1/11	1/12	1/11	1/11	1/17	1/12	1/10	
			.1MM	215	375	496	523	523	523	579	637	721	779	800	1094	1367	1442	523
2007	273	100	M/D	3/14	3/13	3/12	3/11	3/10	3/10	3/10	3/10	3/10	3/13	3/10	3/10	3/10	3/11	
			.1MM	334	524	611	622	626	626	626	626	626	716	818	818	818	824	578
2008	274	100	M/D	12/23	1/ 7	1/ 7	1/ 6	4/ 7	4/ 6	4/ 5	4/ 5	4/ 5	4/ 5	3/31	3/26	3/25	3/18	
			.1MM	409	704	953	1064	1119	1239	1454	1555	1664	1860	2288	2368	2413	2682	1999
2009	273	100	M/D	2/11	2/11	3/17	3/15	3/15	3/ 6	3/ 5	3/11	3/10	3/10	3/ 5	2/27	2/26	2/19	
			.1MM	272	434	435	519	572	613	626	669	758	811	1198	1338	1419	1421	1230
2010	273	100	M/D	1/24	1/24	1/24	1/24	1/24	1/24	2/24	2/23	2/23	2/23	2/23	2/17	2/17	2/17	
			.1MM	316	538	597	597	597	597	643	696	698	733	969	980	980	980	754

2011	273	100	M/D	3/10	3/17	3/16	3/ 9	3/ 9	3/ 5	3/ 5	3/ 5	3/10	3/ 9	3/ 4	3/ 4	2/27	2/17		
			.1MM	270	393	454	501	534	590	699	771	942	992	1290	1356	1380	1623	634	
2012	274	100	M/D	3/ 8	3/ 7	3/ 7	3/ 7	3/ 7	3/ 3	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	2/22	2/15	2/15		
			.1MM	248	349	349	349	369	393	424	424	424	444	444	556	815	835	516	
2013	273	100	M/D	1/30	3/11	3/27	3/28	3/27	3/26	3/26	3/25	3/24	3/24	3/24	3/24	3/ 8	3/ 6		
			.1MM	289	368	454	618	727	858	936	975	1034	1034	1034	1173	1535	1606	1303	
2014	273	100	M/D	4/ 7	4/ 7	4/ 6	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	3/28	3/28	3/19	3/15		
			.1MM	302	467	564	735	833	921	1074	1122	1275	1298	1654	1654	1734	1735	1115	
2015	273	100	M/D	4/ 3	4/ 2	4/ 2	4/ 2	3/30	4/ 2	4/ 3	4/ 2	4/ 2	4/ 2	3/26	3/21	3/16	3/11		
			.1MM	308	496	496	496	586	603	729	917	917	917	1117	1216	1236	1439	1073	
2016	117	43	**	M/D	1/10	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	12/29	1/ 9	1/ 9	12/29	
			.1MM	336	373	373	373	373	373	373	373	373	373	377	395	395	399		

*

		1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY
MEAN EXTREME	(MM)	32.8	52.1	66.3	77.4	86.8	95.5	103.3	110.0	116.6	122.9	146.4	162.4	174.1	182.6
STD. DEV.	(MM)	8.9	13.6	18.9	23.1	27.2	31.0	34.0	37.3	41.2	45.3	54.2	60.8	64.8	67.2
YEARS ANALYSED		124	124	124	124	124	124	124	124	124	124	124	124	124	124
MAX EXTREME	(MM)	73.2	104.9	144.8	151.6	161.9	182.7	198.1	212.6	220.9	239.6	295.0	350.2	350.2	373.3
YEAR		1934	1923	1923	1923	1943	1943	1943	1943	1943	1934	1971	1971	1971	1971

** NOTE ** VALUE IN FLAG INDICATES YEAR NOT INCLUDED IN ANALYSIS BASED ON % DAYS OPERATIONAL (<90.0%)

METEOROLOGICAL SERVICE OF CANADA
RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

*

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 2 - Western North America Mountain Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

RETURN PERIOD VALUES (MM) WITH 50% CONFIDENCE LIMITS

*

RETURN PERIOD
YEARS

	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY
2	31.30+/- 0.49	49.86+/- 0.76	63.19+/- 1.05	73.65+/- 1.28	82.34+/- 1.51
5	39.15+/- 0.83	61.90+/- 1.27	79.89+/- 1.77	94.07+/- 2.16	106.40+/- 2.55
10	44.35+/- 1.12	69.87+/- 1.72	90.95+/- 2.39	107.59+/- 2.92	122.32+/- 3.44
25	50.91+/- 1.51	79.94+/- 2.32	104.92+/- 3.22	124.68+/- 3.94	142.45+/- 4.64
50	55.79+/- 1.81	87.41+/- 2.78	115.29+/- 3.85	137.35+/- 4.71	157.38+/- 5.55
100	60.62+/- 2.11	94.82+/- 3.24	125.58+/- 4.49	149.93+/- 5.49	172.20+/- 6.47

RETURN PERIOD
YEARS

	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY
2	90.43+/- 1.72	97.74+/- 1.89	103.83+/- 2.07	109.80+/- 2.29	115.45+/- 2.52
5	117.79+/- 2.90	127.81+/- 3.18	136.81+/- 3.49	146.21+/- 3.85	155.46+/- 4.24
10	135.90+/- 3.91	147.71+/- 4.30	158.65+/- 4.72	170.31+/- 5.21	181.96+/- 5.72
25	158.78+/- 5.27	172.87+/- 5.80	186.25+/- 6.36	200.76+/- 7.02	215.43+/- 7.72
50	175.75+/- 6.31	191.53+/- 6.94	206.72+/- 7.61	223.35+/- 8.40	240.26+/- 9.23
100	192.60+/- 7.35	210.05+/- 8.08	227.04+/- 8.87	245.77+/- 9.78	264.91+/-10.75

RETURN PERIOD
YEARS

	15 DAY	20 DAY	25 DAY	30 DAY
2	137.49+/- 3.01	152.43+/- 3.38	163.46+/- 3.60	171.59+/- 3.73
5	185.42+/- 5.07	206.12+/- 5.69	220.69+/- 6.06	230.94+/- 6.28
10	217.16+/- 6.85	241.68+/- 7.68	258.58+/- 8.18	270.24+/- 8.49
25	257.26+/- 9.24	286.60+/-10.35	306.45+/-11.03	319.89+/-11.44
50	287.00+/-11.06	319.92+/-12.39	341.97+/-13.20	356.72+/-13.69
100	316.53+/-12.88	353.00+/-14.43	377.22+/-15.38	393.29+/-15.95

** WARNING ** : 100 YEAR VALUES IN 1934 BASED ON 1 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1995 BASED ON 1 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 2 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 3 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 4 DAYS ACCUMULATION

METEOROLOGICAL SERVICE OF CANADA
 RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
 PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

*
 STATION : OTTAWA CDA STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 3 - Western Canada Mountain Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6 NOTE : MODIFIED GUMBEL 12/82

YR	TOTAL % DAYS VALID	START FLAG MAX	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY	MAX SNPK
1890	242 89	** M/D	4/ 4	4/ 3	4/ 7	4/ 4	4/ 3	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	3/26	3/21	3/21	3/12	
		.1MM	312	404	447	671	762	828	919	997	997	997	1012	1220	1298	1532	
1891	273 100	M/D	4/11	4/10	4/ 9	4/ 9	4/ 9	4/ 9	3/28	3/28	3/21	3/21	3/29	3/23	3/21	3/13	
		.1MM	342	606	731	826	826	845	845	992	1051	1647	1959	2390	2415	1870	
1892	274 100	M/D	4/ 5	4/ 4	4/ 3	4/ 3	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	4/ 1	3/28	3/28	3/28	3/ 9	
		.1MM	451	827	1169	1404	1640	1870	1929	1938	1938	1938	1997	1997	1997	2093	1796
1893	273 100	M/D	4/13	4/12	4/11	4/10	4/10	4/ 8	4/ 8	4/ 8	4/ 8	4/ 8	3/31	3/31	3/25	3/21	
		.1MM	637	919	1093	1177	1225	1459	1507	1507	1507	1607	1795	1937	1961	2034	1836
1894	273 100	M/D	3/ 6	3/ 5	3/ 5	3/ 4	3/ 3	3/ 2	3/ 2	3/ 5	4/ 4	4/ 4	3/ 5	3/ 2	3/19	3/16	
		.1MM	292	537	706	714	721	824	824	838	985	985	1241	1437	1582	1731	2161
1895	273 100	M/D	4/14	4/ 8	4/13	4/13	4/13	4/12	4/ 8	4/ 8	4/ 8	4/ 8	4/ 5	4/ 2	3/25	3/25	
		.1MM	394	700	925	1156	1317	1457	1477	1766	1997	2157	2380	2421	2519	2519	1821
1896	274 100	M/D	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 7	4/ 2	3/30	3/26	3/26	
		.1MM	699	996	1339	1522	1678	1777	1819	1869	1885	1885	1893	2025	2058	2058	1948
1897	273 100	M/D	4/ 5	4/ 4	4/ 4	4/ 2	4/ 1	3/31	3/30	3/30	3/29	3/29	3/22	3/19	3/19	3/ 9	
		.1MM	379	589	649	755	846	938	1038	1098	1140	1140	1293	1654	1679	1932	1188
1898	273 100	M/D	12/11	3/12	3/11	3/10	3/ 9	3/ 9	3/11	3/10	3/11	3/11	3/ 9	3/ 9	3/ 9	3/ 9	
		.1MM	356	661	934	1034	1102	1102	1262	1362	1466	1611	1815	2263	2263	2314	1885
1899	242 89	** M/D	4/20	4/19	4/18	4/17	4/16	4/15	4/14	4/13	4/12	4/11	4/ 7	4/ 7	3/29	3/23	
		.1MM	396	716	988	1121	1180	1336	1541	1681	1826	1835	2117	2117	2132	2157	
1900	273 100	M/D	2/13	12/11	4/15	4/13	4/12	4/11	4/11	4/11	4/11	4/ 7	4/ 3	3/29	3/29	3/20	
		.1MM	327	374	497	634	797	938	1069	1069	1205	1786	1903	1903	1956	1747	
1901	273 100	M/D	11/21	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 1	3/27	3/24	3/21	
		.1MM	328	622	863	1037	1196	1404	1585	1785	1871	1982	2715	2895	3176	3337	2388
1902	273 100	M/D	3/22	12/14	3/21	3/21	3/21	3/21	3/22	3/21	3/20	3/20	3/16	3/11	3/11	2/28	
		.1MM	342	627	708	783	882	1016	1238	1463	1472	1472	1689	2135	2135	2674	1981
1903	273 100	M/D	3/20	3/19	3/19	3/19	3/19	3/19	3/18	3/17	3/19	3/18	3/11	3/ 8	3/ 5	2/28	
		.1MM	430	725	923	1024	1270	1438	1519	1624	1738	1820	2009	2463	2520	2768	2186
1904	274 100	M/D	4/24	4/ 9	4/ 8	4/ 7	4/ 7	4/ 6	4/ 6	4/ 5	4/ 5	4/ 1	3/30	4/ 6	4/ 1	3/26	
		.1MM	535	886	1019	1183	1306	1406	1493	1560	1560	1656	1976	2859	3231	3447	2739
1905	273 100	M/D	3/29	3/29	3/28	3/28	3/27	3/25	3/25	3/29	3/29	3/28	3/27	3/24	3/18	3/18	
		.1MM	369	599	730	821	909	964	1056	1168	1299	1430	1999	2155	2363	2363	2039
1906	273 100	M/D	3/27	1/22	3/27	3/27	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	12/30	12/27	
		.1MM	346	398	406	406	434	434	434	434	434	434	434	464	502	749	484
1907	273 100	M/D	3/28	3/23	3/28	3/27	3/26	3/23	3/23	3/23	3/22	3/22	3/22	3/23	3/22	3/22	
		.1MM	219	411	540	625	711	801	976	1122	1206	1223	1387	1485	1872	1923	1276
1908	274 100	M/D	4/25	4/25	4/24	4/23	4/22	4/21	4/20	4/19	4/18	4/17	4/13	4/ 7	4/ 2	3/28	
		.1MM	545	913	1203	1445	1680	1704	1730	1929	2053	2095	2408	2727	2885	3012	2622
1909	273 100	M/D	4/13	4/13	4/13	4/13	4/12	4/12	4/12	4/ 7	4/ 6	4/ 6	4/ 3	3/30	3/25	4/ 3	
		.1MM	623	1060	1168	1338	1446	1485	1485	1541	1867	1975	2367	2484	2692	2818	2095
1910	273 100	M/D	1/22	1/21	3/22	3/22	3/20	3/20	3/19	3/19	3/19	3/19	3/13	3/ 6	2/28	2/27	
		.1MM	281	383	519	619	753	852	872	872	872	872	906	1129	1319	1439	1090
1911	273 100	M/D	4/14	4/13	4/13	4/12	4/12	4/13	4/14	4/13	4/13	4/13	4/ 6	4/ 5	3/27	3/27	
		.1MM	605	779	950	1017	1043	1101	1339	1513	1638	1719	1974	2256	2266	2472	1959
1912	274 100	M/D	4/15	4/15	4/14	4/13	4/12	4/11	4/10	4/10	4/ 7	4/ 7	4/ 5	3/28	3/28	3/18	
		.1MM	491	829	871	938	1046	1154	1172	1172	1259	1597	2018	2116	2116	2214	1825
1913	273 100	M/D	3/31	3/30	3/19	3/19	3/21	3/19	3/19	3/19	3/19	3/19	3/19	3/19	3/14	3/13	
		.1MM	446	581	733	733	856	1072	1237	1280	1280	1280	1977	2490	2902	2917	1875
1914	273 100	M/D	4/18	4/17	4/16	4/16	4/15	4/14	4/14	4/12	4/11	4/10	4/ 5	3/31	3/26	3/26	
		.1MM	321	555	734	875	959	1009	1009	1045	1120	1129	1219	1487	2020	2020	1643
1915	273 100	M/D	11/16	4/ 6	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	3/25	3/21	3/21	3/21	
		.1MM	384	472	694	809	884	959	1018	1102	1102	1102	1221	1488	1488	1488	1262

			.1MM	389	389	389	389	405	600	600	600	600	600	600	600	600	697	711	296
1954	271	99	M/D	4/11	4/10	4/ 6	4/ 8	4/ 7	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	3/25	3/19	3/19	
			.1MM	462	698	786	859	1173	1484	1537	1537	1537	1537	1537	1537	1656	1717	1717	1195
1955	273	100	M/D	4/11	4/10	4/10	4/10	4/10	4/ 9	4/ 9	4/ 7	4/ 6	4/ 5	3/31	3/30	3/21	3/16	3/16	
			.1MM	292	566	716	982	1177	1294	1294	1318	1477	1627	2085	2118	2286	2302	1973	
1956	274	100	M/D	4/ 4	4/ 4	4/ 4	4/ 3	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	3/31	3/31	3/31	3/31	3/31	3/31	
			.1MM	279	504	662	741	893	1001	1081	1093	1093	1121	1134	1134	1134	1134	1134	1098
1957	273	100	M/D	1/22	1/21	1/21	1/21	1/21	1/21	1/21	1/21	3/14	3/13	3/ 9	3/ 9	2/26	2/24		
			.1MM	414	512	512	512	512	512	512	512	540	674	812	812	951	1113	776	
1958	273	100	M/D	12/ 7	4/ 2	4/ 1	3/31	3/30	3/30	3/29	3/28	3/27	3/26	3/21	3/16	3/18	3/13		
			.1MM	218	267	384	512	645	747	815	906	1005	1064	1452	1517	1558	1582	1480	
1959	273	100	M/D	4/16	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 2	3/30	3/30	3/20		
			.1MM	412	612	762	828	862	1024	1148	1249	1447	1477	2011	2188	2188	2325	2143	
1960	274	100	M/D	4/15	4/15	4/15	4/14	4/13	4/12	4/11	4/11	4/ 9	4/ 8	4/ 3	3/29	3/27	3/27		
			.1MM	462	806	1246	1525	1739	1925	2008	2008	2040	2063	2423	2757	2844	2844	2299	
1961	273	100	M/D	3/28	3/27	3/27	3/26	3/24	3/24	3/23	3/23	3/27	3/26	3/23	3/23	3/23	3/ 6		
			.1MM	289	413	498	507	589	674	700	700	751	760	953	953	953	1024	877	
1962	273	100	M/D	3/30	3/29	3/28	3/27	3/26	3/25	3/25	3/25	3/22	3/21	3/22	3/17	3/12	3/12		
			.1MM	320	581	703	778	919	1035	1085	1127	1220	1278	1417	1516	1622	1622	1458	
1963	273	100	M/D	4/ 2	4/ 1	4/ 1	3/30	3/30	3/30	3/27	3/26	3/25	3/25	3/25	3/21	3/17	3/17		
			.1MM	556	739	827	989	1077	1106	1145	1295	1393	1481	1644	1693	1716	1716	1488	
1964	274	100	M/D	3/ 5	3/ 4	3/ 3	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2		
			.1MM	263	365	508	629	629	704	704	704	704	704	854	905	914	914	681	
1965	273	100	M/D	4/ 7	12/24	4/ 6	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	12/11	12/11	12/11	11/26		
			.1MM	258	471	523	614	614	614	614	614	614	614	699	699	699	925	819	
1966	273	100	M/D	3/19	3/18	3/18	3/18	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28		
			.1MM	248	473	498	498	567	636	698	698	698	698	698	1171	1197	1197	713	
1967	273	100	M/D	4/ 1	4/ 1	4/ 1	3/31	4/ 1	3/31	3/27	3/27	3/28	3/27	3/27	3/25	3/25	3/13		
			.1MM	398	745	860	952	1086	1177	1268	1384	1445	1609	1944	1970	1970	1980	1711	
1968	274	100	M/D	3/27	3/26	3/20	3/19	3/19	3/16	3/16	3/16	3/15	3/18	3/15	3/ 9	3/ 9	3/ 9		
			.1MM	261	420	530	711	837	953	1133	1260	1273	1341	1693	1836	1836	1836	1130	
1969	273	100	M/D	4/ 7	4/ 7	4/ 7	4/ 7	4/ 5	4/ 5	4/ 4	4/ 4	4/ 4	4/ 4	3/28	3/22	3/19	3/15		
			.1MM	234	335	528	644	777	893	1005	1005	1005	1005	1025	1403	1564	1589	1066	
1970	273	100	M/D	4/17	4/16	4/15	4/14	4/13	4/13	4/12	4/12	4/ 9	4/ 8	4/ 7	4/ 2	3/25	3/21		
			.1MM	383	566	784	1002	1237	1360	1451	1451	1657	1798	1930	1945	2018	2204	1917	
1971	273	100	M/D	4/28	4/27	4/26	4/25	4/25	4/24	4/22	4/21	4/20	4/19	4/15	4/10	4/10	4/ 1		
			.1MM	415	828	1045	1225	1394	1543	1770	2016	2264	2527	3112	3637	3637	3831	3435	
1972	274	100	M/D	12/10	4/19	4/18	4/18	4/20	4/19	4/18	4/17	4/16	4/19	4/13	4/10	4/10	4/ 2		
			.1MM	232	429	568	692	829	1041	1180	1288	1368	1491	2117	2627	2627	2702	2320	
1973	273	100	M/D	3/17	3/16	3/15	3/14	3/13	3/12	3/11	3/10	3/10	3/ 8	3/ 3	3/ 3	3/ 3	3/ 3		
			.1MM	310	507	656	692	750	937	1100	1138	1170	1444	1881	1913	2156	2156	1362	
1974	273	100	M/D	3/ 4	3/ 6	4/ 3	3/ 4	3/ 4	3/ 4	3/ 4	2/28	2/28	2/28	3/31	3/29	3/29	3/16		
			.1MM	439	552	679	1097	1097	1097	1097	1142	1142	1142	1560	1698	1698	1701	1185	
1975	273	100	M/D	4/19	4/18	4/17	4/16	4/15	4/14	4/14	4/14	4/14	4/14	4/14	4/14	3/29	3/22		
			.1MM	483	813	1103	1293	1377	1461	1464	1464	1464	1464	1464	1503	1629	1406		
1976	274	100	M/D	3/31	3/31	3/31	3/24	3/24	3/27	3/25	3/25	3/24	3/24	3/20	3/19	3/13	3/12		
			.1MM	435	651	738	922	972	1074	1330	1546	1753	1840	2269	2558	2563	2667	2130	
1977	273	100	M/D	3/13	3/13	3/12	3/10	3/10	3/10	3/ 9	3/ 9	3/ 7	3/ 6	3/ 4	3/ 9	3/ 5	3/ 4		
			.1MM	410	647	822	1028	1265	1405	1497	1497	1521	1554	1611	1796	1919	1947	1328	
1978	273	100	M/D	4/20	4/19	4/18	4/17	4/17	4/16	4/15	4/13	4/12	4/11	4/ 7	4/ 1	3/28	3/23		
			.1MM	346	673	831	1060	1211	1361	1428	1573	1729	1881	2250	2501	2839	2904	2026	
1979	273	100	M/D	3/24	3/23	3/22	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/10	3/ 5	3/ 3	2/23		
			.1MM	467	669	842	984	1082	1082	1082	1082	1082	1082	1237	1634	1795	1869	1620	
1980	274	100	M/D	3/21	3/20	3/20	3/20	3/20	3/20	3/21	3/20	3/20	3/20	3/16	3/10	3/10	3/10		
			.1MM	502	652	761	874	919	966	1131	1281	1285	1285	1323	1325	1325	1325	710	
1981	273	100	M/D	2/20	2/20	2/19	2/18	2/17	2/17	2/17	2/17	2/17	2/17	2/ 8	2/ 8	2/ 1	1/25		
			.1MM	295	574	807	985	1154	1208	1208	1208	1208	1208	1436	1436	1510	1548	1094	
1982	273	100	M/D	3/31	3/31	3/30	3/31	3/30	3/30	3/30	3/25	3/25	3/25	3/30	3/25	3/22	3/17		
			.1MM	385	522	586	678	743	743	743	769	769	926	1224	1407	1481	1667	1287	
1983	273	100	M/D	1/10	2/ 2	12/23	12/23	12/23	3/10	3/ 9	3/ 8	3/ 8	3/ 6	12/15	12/23	12/23	12/15		
			.1MM	282	307	366	366	366	370	412	454	454	475	588	666	666	888	426	
1984	274	100	M/D	4/ 5	4/ 4	4/ 3	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/29	3/29	3/18	3/15	3/15		
			.1MM	327	649	775	888	981	1085	1148	1232	1307	1307	1307	1545	1567	1567	1103	
1985	273	100	M/D	3/28	3/27	3/27	3/27	3/27	3/24	3/23	3/23	3/28	3/27	3/23	3/20	3/12	3/ 8		
			.1MM	547	734	875	903	903	941	1023	1052	1182	1369	1675	1686	1859	2215	1257	
1986	273	100	M/D	3/19	1/19	1/18	1/18	3/15	3/15	3/13	3/19	3/18	3/17	3/13	3/ 9	3/ 2	3/ 2		
			.1MM	275	418	528	528	548	548	556	656	705	729	936	1058	1088	1088	823	
1987	273	100	M/D	3/22	3/21	3/21	3/20	3/19	3/18	3/17	3/17	3/17	3/17	3/ 8	3/ 7	2/28	2/28		
			.1MM	341	479	536	593	619	667	700	700	700	700	829	1018	1161	1161	1010	
1988	274	100	M/D	11/29	3/25	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/13	3/ 7	3/ 7	11/28		
			.1MM	315	570	732	732	732	732	732	732	732	732	775	843	843	876	599	
1989	273	100	M/D	3/28	3/27	3/26	3/25	3/24	3/24	3/25	3/25	3/24	3/24	3/14	3/14	3/14	3/ 4		
			.1MM	485	745	875	974	986	986	1007	1048	1060	1060	1337	1411	1411	1423	927	
1990	273	100	M/D	3/16	3/15	3/15	3/13	3/12	3/11	3/11	3/10	3/10	3/10	3/10	3/ 2	2/22	2/16		
			.1MM	232	407	519	613	798	934	1046	1056	1056	1056	1056	1115	1256	1260	974	

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 3 - Western Canada Mountain Basin

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

RETURN PERIOD VALUES (MM) WITH 50% CONFIDENCE LIMITS

*

RETURN PERIOD YEARS	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY
2	35.23+/- 0.68	55.60+/- 1.05	68.72+/- 1.33	79.44+/- 1.56	88.55+/- 1.75
5	46.08+/- 1.15	72.29+/- 1.77	89.83+/- 2.24	104.21+/- 2.62	116.33+/- 2.94
10	53.26+/- 1.55	83.34+/- 2.39	103.81+/- 3.02	120.61+/- 3.54	134.73+/- 3.97
25	62.34+/- 2.09	97.31+/- 3.22	121.47+/- 4.07	141.33+/- 4.78	157.97+/- 5.36
50	69.07+/- 2.50	107.67+/- 3.85	134.57+/- 4.87	156.70+/- 5.71	175.21+/- 6.41
100	75.75+/- 2.92	117.95+/- 4.49	147.57+/- 5.67	171.96+/- 6.66	192.32+/- 7.47

RETURN PERIOD YEARS	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY
2	96.94+/- 1.91	104.18+/- 2.03	109.95+/- 2.19	115.97+/- 2.38	121.61+/- 2.58
5	127.27+/- 3.21	136.44+/- 3.42	144.86+/- 3.70	153.89+/- 4.02	162.61+/- 4.34
10	147.36+/- 4.34	157.81+/- 4.61	167.97+/- 4.99	179.00+/- 5.42	189.75+/- 5.86
25	172.73+/- 5.85	184.80+/- 6.22	197.17+/- 6.73	210.73+/- 7.31	224.05+/- 7.90
50	191.56+/- 7.00	204.83+/- 7.44	218.84+/- 8.05	234.26+/- 8.75	249.49+/- 9.46
100	210.24+/- 8.15	224.71+/- 8.67	240.34+/- 9.38	257.63+/-10.19	274.75+/-11.02

RETURN PERIOD YEARS	15 DAY	20 DAY	25 DAY	30 DAY
2	144.16+/- 3.05	159.97+/- 3.44	170.33+/- 3.57	179.55+/- 3.74
5	192.66+/- 5.14	214.74+/- 5.80	227.07+/- 6.01	239.06+/- 6.30
10	224.78+/- 6.94	250.99+/- 7.83	264.64+/- 8.11	278.46+/- 8.51
25	265.35+/- 9.35	296.80+/-10.56	312.11+/-10.94	328.24+/-11.47
50	295.45+/-11.19	330.79+/-12.63	347.32+/-13.09	365.17+/-13.73
100	325.33+/-13.04	364.52+/-14.72	382.28+/-15.25	401.83+/-15.99

- ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 1 DAYS ACCUMULATION
- ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 2 DAYS ACCUMULATION
- ** WARNING ** : 100 YEAR VALUES IN 1947 BASED ON 2 DAYS ACCUMULATION
- ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 3 DAYS ACCUMULATION
- ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 4 DAYS ACCUMULATION

METEOROLOGICAL SERVICE OF CANADA
 RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
 PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

*

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 4 - Southern Ontario

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

YR	TOTAL DAYS	% VALID	START FLAG	START MAX	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY	MAX SNPK
1890	242	89	**	M/D	2/15	2/14	2/13	4/ 2	4/ 1	3/31	3/30	3/30	3/30	3/26	2/15	2/13	2/ 5	1/31	
				.1MM	315	345	370	372	378	393	413	413	413	460	704	765	920	990	
1891	273	100		M/D	3/ 9	3/ 9	4/ 9	4/10	4/10	4/ 9	4/10	4/ 9	4/ 9	4/ 8	3/31	3/28	3/21	3/21	
				.1MM	337	357	444	579	714	815	889	991	1063	1093	1308	1716	2054	2301	1642
1892	274	100		M/D	4/ 4	4/ 4	4/ 3	4/ 4	4/ 3	4/ 2	4/ 2	4/ 1	4/ 1	3/31	4/ 1	3/27	3/23	3/22	
				.1MM	228	401	518	688	805	912	1013	1089	1141	1192	1425	1653	1820	1834	1542
1893	273	100		M/D	4/20	4/20	4/19	4/18	4/17	4/ 8	4/ 8	4/13	4/12	4/12	4/ 7	4/ 2	3/29	3/24	
				.1MM	299	433	485	581	672	737	783	823	965	1099	1532	1701	1876	2005	1609
1894	273	100		M/D	3/ 7	3/ 6	3/ 5	3/ 4	3/ 3	3/ 2	3/ 1	3/ 4	3/ 4	3/31	3/ 5	3/ 2	3/ 1	3/ 6	
				.1MM	165	256	375	431	461	507	568	595	625	683	905	1151	1287	1435	1708
1895	273	100		M/D	4/14	4/ 8	4/18	4/17	4/16	4/14	4/14	4/13	4/12	4/11	4/ 6	4/ 1	3/28	3/22	
				.1MM	231	393	523	665	757	914	1072	1137	1287	1307	1916	2063	2091	2261	1643

1896	274	100	M/D	3/ 1	4/16	4/15	4/14	4/13	4/13	4/12	4/11	4/10	4/ 9	4/ 5	3/30	3/26	3/21	
			.1MM	342	449	652	813	996	1133	1224	1300	1386	1452	1629	1745	1849	1920	1719
1897	273	100	M/D	3/10	4/ 4	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/28	3/23	3/19	3/18	3/ 9	
			.1MM	218	394	491	536	618	689	765	856	918	958	1100	1398	1409	1728	943
1898	273	100	M/D	12/11	3/12	3/11	3/26	3/25	3/24	3/23	3/23	3/23	3/10	3/16	3/10	3/ 7	3/ 4	
			.1MM	283	386	483	595	676	732	793	834	874	948	1338	1888	2167	2239	1872
1899	242	89	**	M/D	4/ 8	4/19	4/18	4/18	4/17	4/16	4/15	4/14	4/12	4/12	4/ 7	4/ 2	3/28	3/23
			.1MM	165	278	421	524	621	677	753	831	914	1017	1370	1523	1574	1610	
1900	273	100	M/D	2/13	12/11	12/11	4/11	4/11	2/ 8	2/ 8	4/ 6	4/ 7	4/ 6	4/ 1	3/28	3/23	3/19	
			.1MM	274	368	368	426	527	613	653	665	756	847	1157	1341	1382	1504	1238
1901	273	100	M/D	11/18	11/20	4/15	11/18	4/13	4/13	4/12	4/11	4/10	4/ 9	4/ 4	3/31	3/26	3/21	
			.1MM	284	355	492	659	812	963	1085	1202	1293	1435	1994	2273	2629	2915	1939
1902	273	100	M/D	3/29	12/14	3/27	3/26	3/26	3/25	3/24	3/22	3/21	3/21	3/16	3/11	3/ 7	3/ 1	
			.1MM	361	536	610	721	813	899	970	1087	1188	1280	1532	1963	2080	2448	1691
1903	273	100	M/D	2/28	3/23	3/19	3/20	3/19	3/19	3/19	3/19	3/19	3/19	3/19	3/14	3/ 8	3/ 4	
			.1MM	196	285	405	521	679	772	823	920	992	1037	1466	1668	2022	2227	1891
1904	274	100	M/D	4/ 9	4/ 9	4/ 8	4/ 7	4/25	4/24	4/24	4/23	4/22	4/21	4/16	4/ 9	4/ 6	4/ 1	
			.1MM	319	512	604	711	840	1013	1146	1273	1390	1462	1756	2121	2735	3125	2467
1905	273	100	M/D	4/ 4	3/18	4/ 9	4/10	4/ 9	4/ 9	4/ 9	4/ 4	4/ 4	4/ 4	3/30	3/25	3/23	3/18	
			.1MM	146	274	350	457	579	640	711	790	881	1018	1353	1701	1960	2276	1989
1906	273	100	M/D	3/27	3/27	3/26	3/25	3/25	3/25	3/25	3/25	3/25	3/25	12/22	12/18	12/29	12/26	
			.1MM	285	345	385	406	406	406	406	406	406	406	418	439	540	747	289
1907	273	100	M/D	3/24	3/23	3/28	3/27	3/24	3/24	3/24	3/23	3/22	3/22	3/22	3/23	3/22	3/17	
			.1MM	197	269	351	427	526	632	740	811	872	918	1105	1230	1576	1683	1098
1908	274	100	M/D	3/15	4/26	4/26	4/25	4/24	4/23	4/22	4/22	4/22	4/21	4/15	4/11	4/ 6	4/ 1	
			.1MM	307	412	565	715	868	1015	1137	1244	1333	1409	1790	2096	2343	2434	2389
1909	273	100	M/D	5/ 1	4/13	4/12	4/13	4/13	4/14	4/13	4/12	4/13	4/13	4/ 6	4/ 3	3/29	3/24	
			.1MM	370	505	607	708	810	1043	1206	1307	1408	1531	1809	2221	2449	2779	1766
1910	273	100	M/D	11/23	1/21	1/21	3/21	3/20	3/19	3/19	3/19	3/19	3/19	3/11	3/ 5	2/28	2/27	
			.1MM	279	341	361	386	489	560	596	596	596	596	718	935	1142	1234	885
1911	273	100	M/D	4/14	4/14	4/13	4/12	4/11	4/10	4/14	4/13	4/13	4/13	4/ 9	4/ 5	4/ 5	3/25	
			.1MM	252	366	478	559	605	671	768	880	971	1063	1424	1674	1674	1903	1353
1912	274	100	M/D	4/15	4/15	4/15	4/15	4/15	4/15	4/15	4/14	4/12	4/11	4/ 6	4/ 2	3/28	3/24	
			.1MM	279	456	548	683	800	911	973	1019	1110	1196	1658	1873	2011	2067	1666
1913	273	100	M/D	3/24	3/24	3/24	3/21	3/21	3/20	3/19	3/18	3/18	3/18	3/21	3/20	3/18	3/13	
			.1MM	277	442	491	536	701	773	849	900	948	948	1309	1684	2101	2409	1312
1914	273	100	M/D	4/17	4/16	4/15	4/14	3/29	4/12	3/27	3/26	3/25	4/ 8	3/25	3/29	3/24	3/19	
			.1MM	145	250	311	385	393	446	504	586	611	650	802	1157	1391	1397	1143
1915	273	100	M/D	11/16	11/16	11/15	4/ 4	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/31	3/24	3/20	3/15	3/10	
			.1MM	351	366	376	432	483	534	580	631	677	677	873	1120	1136	1208	1129
1916	274	100	M/D	4/22	4/22	4/22	4/22	4/22	4/22	4/21	4/20	4/19	4/18	4/13	4/ 8	4/ 3	3/29	
			.1MM	248	459	637	809	1007	1170	1271	1352	1469	1571	2209	2599	2754	3135	2757
1917	273	100	M/D	4/21	4/20	4/19	4/18	4/18	4/17	4/17	4/17	4/17	4/17	4/14	4/10	4/ 1	3/30	
			.1MM	258	434	591	746	894	1021	1107	1178	1279	1379	1796	1928	2317	2767	2415
1918	273	100	M/D	4/15	4/14	4/14	4/13	4/13	4/12	4/11	4/10	4/ 8	4/ 7	4/ 2	3/29	3/24	3/19	
			.1MM	208	385	548	701	811	908	979	1035	1096	1233	1681	2137	2233	2461	2444
1919	273	100	M/D	4/11	4/10	4/10	4/10	4/10	4/ 9	4/ 7	4/ 7	4/ 6	4/ 5	4/ 3	3/26	3/21	3/16	
			.1MM	203	366	473	608	700	781	878	969	1050	1116	1203	1416	1701	2055	1397
1920	274	100	M/D	4/ 5	3/25	3/24	3/23	3/23	3/24	3/23	3/22	3/22	3/22	3/22	3/17	3/12	3/10	
			.1MM	206	315	478	609	713	856	988	1069	1135	1195	1635	1778	1994	2110	1390
1921	273	100	M/D	3/20	3/20	3/19	3/19	3/16	3/16	3/15	3/ 9	3/ 8	3/12	3/ 7	3/ 2	2/28	2/23	
			.1MM	290	408	428	428	514	633	648	686	737	830	1182	1398	1496	1530	591
1922	273	100	M/D	12/18	4/ 7	4/ 6	4/ 5	4/ 5	4/ 3	4/ 3	4/ 2	4/ 1	3/31	3/26	3/21	3/16	3/11	
			.1MM	308	380	497	589	654	719	785	846	856	861	1074	1176	1248	1501	1023
1923	273	100	M/D	4/21	4/21	4/20	4/20	4/20	4/20	4/20	4/19	4/18	4/17	4/12	4/ 7	4/ 3	4/ 2	
			.1MM	248	485	704	889	1021	1158	1335	1417	1452	1488	1625	1851	2390	2395	1873
1924	274	100	M/D	4/ 7	4/18	4/17	4/16	4/15	4/14	4/14	4/12	4/12	4/10	4/ 5	4/ 2	3/27	3/22	
			.1MM	299	470	582	663	749	920	983	1021	1085	1163	1787	2094	2241	2474	1758
1925	273	100	M/D	2/11	2/11	3/26	3/25	3/25	3/24	3/23	3/22	3/21	3/19	3/16	3/10	3/ 5	3/ 2	
			.1MM	289	398	519	620	718	804	810	876	960	1086	1260	1376	1513	1523	861
1926	273	100	M/D	12/ 6	5/ 2	5/ 1	4/30	4/29	4/28	4/27	4/27	4/25	4/24	4/20	4/15	4/10	4/ 5	
			.1MM	312	505	648	765	859	1037	1134	1200	1324	1451	1984	2042	2227	2340	1982
1927	273	100	M/D	11/16	11/15	11/15	4/ 4	3/14	3/13	3/12	3/11	3/11	4/ 2	3/28	3/25	3/14	3/13	
			.1MM	342	393	393	459	552	637	703	768	820	871	1198	1354	1695	2079	1939
1928	274	100	M/D	11/22	11/22	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	4/ 1	3/30	3/25	3/20	3/15	3/12	
			.1MM	284	381	465	582	706	788	839	854	854	864	1157	1391	1432	1595	1156
1929	273	100	M/D	1/ 6	1/18	3/14	3/13	3/12	3/14	3/13	3/14	3/13	3/12	3/13	3/12	3/ 4	2/27	
			.1MM	329	355	355	421	476	488	553	633	698	754	1053	1141	1296	1417	625
1930	273	100	M/D	1/ 8	1/ 7	1/ 6	1/ 6	1/ 6	3/31	1/ 2	1/ 2	1/ 2	1/ 2	3/25	3/20	2/18	3/ 7	
			.1MM	267	346	402	402	402	417	549	549	549	549	666	702	879	1114	1003
1931	273	100	M/D	3/29	3/28	3/27	3/27	3/27	3/29	3/29	3/28	3/27	3/27	3/21	3/18	3/15	3/10	
			.1MM	187	253	334	400	461	545	644	710	791	852	1213	1478	1615	1661	1293
1932	274	100	M/D	2/12	2/12	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 6	4/ 6	4/ 1	3/26	3/25	
			.1MM	277	277	354	430	577	639	674	708	718	730	1115	1178	1365	1496	751
1933	273	100	M/D	12/ 7	3/31	3/31	3/31	3/31	4/ 1	3/31	3/31	3/31	3/30	3/25	3/20	3/17	3/17	

1934	273	100	.1MM	199	218	294	370	416	517	614	687	758	794	926	1119	1152	1152	610	
			M/D	12/31	12/31	12/31	4/ 9	4/11	4/10	4/10	4/10	4/10	4/10	4/10	4/ 5	3/31	3/26		
			.1MM	732	732	732	751	830	1002	1134	1256	1393	1520	2032	2276	2508	2672	1639	
1935	273	100	M/D	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	3/29	3/24	3/19	3/16		
			.1MM	152	273	395	512	598	649	669	709	740	780	993	1158	1399	1609	1287	
1936	274	100	M/D	3/11	4/10	3/27	3/27	3/26	3/25	3/24	3/23	3/21	3/21	3/16	3/11	3/17	3/15		
			.1MM	251	327	390	550	631	728	850	880	954	1114	1556	1942	2145	2465	1267	
1937	273	100	M/D	2/21	4/ 5	4/ 5	4/ 4	4/ 3	4/ 3	4/ 1	4/ 1	3/31	3/31	2/ 8	2/ 8	12/ 6	12/ 6		
			.1MM	276	347	413	449	489	514	545	570	580	580	694	694	741	773	357	
1938	273	100	M/D	3/23	3/25	3/23	3/23	3/22	3/21	3/20	3/19	3/23	3/17	3/17	3/16	3/16	3/13		
			.1MM	182	261	338	495	561	642	780	818	904	976	1385	1547	1688	1846	1220	
1939	273	100	M/D	2/19	2/18	4/26	4/26	4/26	4/26	4/25	4/23	4/23	4/22	4/17	4/13	4/ 8	4/ 1		
			.1MM	310	345	364	486	587	699	800	885	997	1068	1482	1654	1746	1807	1370	
1940	274	100	M/D	12/19	4/17	4/17	4/15	4/15	4/15	4/15	4/15	4/17	4/17	4/14	4/ 9	4/ 4	3/30		
			.1MM	193	345	426	563	645	734	798	859	940	1052	1533	1735	1990	2178	1659	
1941	273	100	M/D	12/29	12/28	12/27	12/26	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	3/31	3/25	3/21	3/15		
			.1MM	355	469	560	626	746	863	955	1056	1127	1189	1351	1483	1580	1649	1606	
1942	273	100	M/D	12/24	12/23	12/23	12/23	12/23	12/19	12/18	12/18	12/16	12/23	3/16	3/11	3/ 6	3/ 1		
			.1MM	365	545	545	545	545	551	586	586	612	784	904	1067	1241	1369	761	
1943	272	100	M/D	3/16	3/15	3/15	4/22	4/23	4/22	4/23	4/23	4/22	4/23	4/21	4/16	4/11	4/ 8		
			.1MM	272	513	543	667	782	919	1056	1221	1358	1463	2011	2247	2313	2399	2058	
1944	274	100	M/D	4/ 9	4/ 9	4/ 9	4/ 8	4/ 7	4/ 6	4/ 6	4/ 6	4/ 7	4/ 6	4/ 1	3/24	3/22	3/17		
			.1MM	147	228	289	345	385	431	457	477	508	554	686	879	1016	1057	581	
1945	273	100	M/D	3/28	3/28	3/26	3/26	3/25	3/24	3/23	3/22	3/21	3/20	3/15	3/11	3/ 5	3/ 1		
			.1MM	234	406	600	773	915	1052	1154	1182	1279	1362	1846	1982	2050	2221	1768	
1946	273	100	M/D	1/ 9	3/13	3/ 6	3/13	3/13	3/13	3/12	3/12	3/ 6	3/ 6	3/ 4	3/ 1	3/ 1	3/ 1		
			.1MM	206	256	354	403	484	557	613	613	689	755	1030	1157	1157	1157	857	
1947	273	100	M/D	4/30	4/29	4/30	4/29	4/29	4/28	4/26	4/23	4/23	4/23	4/20	4/14	4/ 9	4/ 4		
			.1MM	386	538	642	795	917	978	1052	1189	1267	1445	1755	2069	2513	2834	1905	
1948	274	100	M/D	3/15	3/15	3/14	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/14	3/ 9	3/ 9		
			.1MM	360	439	449	592	673	833	895	954	1000	1101	1528	1829	1854	1854	975	
1949	273	100	M/D	12/29	1/18	12/29	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/22	3/13	3/ 5		
			.1MM	152	218	284	305	376	475	527	600	651	691	923	923	939	965	726	
1950	273	100	M/D	4/ 3	12/20	12/20	12/18	12/18	12/17	12/17	12/17	12/18	12/17	12/12	3/29	3/24	3/19		
			.1MM	245	475	569	690	785	791	791	791	925	931	1017	1154	1502	1627	1080	
1951	260	95	M/D	4/12	4/12	4/10	4/ 9	4/ 9	4/10	4/ 9	4/ 9	4/ 9	4/ 9	3/29	3/28	3/27	3/18		
			.1MM	327	454	568	733	860	942	1107	1198	1198	1268	1410	1930	2026	2090	1148	
1952	274	100	M/D	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/30	4/ 4	4/ 3	4/ 2	4/ 4	4/ 1	3/27	3/22	3/17		
			.1MM	267	356	427	508	564	640	783	872	943	1057	1469	1692	1809	1957	1431	
1953	273	100	M/D	2/20	2/20	1/15	1/15	1/13	1/10	1/10	1/10	1/10	1/10	1/ 3	1/ 3	12/24	1/10		
			.1MM	116	185	231	231	257	289	334	414	414	414	420	420	486	573	185	
1954	271	99	M/D	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 5	4/ 5	4/ 5	4/ 1	3/25	3/19	3/16		
			.1MM	291	477	543	594	775	922	993	1044	1078	1078	1124	1294	1412	1477	1029	
1955	273	100	M/D	4/14	4/14	4/13	4/12	4/10	4/10	4/ 9	4/ 9	4/ 8	4/ 6	4/ 1	3/29	3/22	3/20		
			.1MM	229	389	511	608	722	882	994	1038	1068	1165	1561	1809	1900	2058	1646	
1956	274	100	M/D	2/25	4/ 4	4/ 4	4/ 4	4/ 4	4/ 4	4/ 4	4/ 3	4/ 2	4/ 1	3/30	3/22	3/20	3/14		
			.1MM	155	249	350	390	472	543	628	668	698	734	805	840	886	891	764	
1957	273	100	M/D	1/22	1/21	1/20	1/20	1/20	3/11	3/11	3/ 9	3/ 8	3/13	3/ 8	2/25	2/25	2/22		
			.1MM	296	348	368	368	368	370	370	401	426	495	631	742	839	977	624	
1958	273	100	M/D	11/28	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/28	3/27	3/26	3/21	3/16	3/12	3/12		
			.1MM	182	218	315	416	518	619	691	762	828	884	1133	1295	1390	1449	1248	
1959	273	100	M/D	4/16	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 2	3/29	3/24	3/19		
			.1MM	153	300	417	508	560	625	707	768	910	976	1321	1569	1670	1849	1750	
1960	274	100	M/D	4/17	4/16	4/15	4/14	4/13	4/13	4/13	4/14	4/16	4/15	4/11	4/ 6	3/31	3/27		
			.1MM	317	520	657	833	948	1047	1136	1285	1476	1613	2120	2299	2613	2839	2049	
1961	273	100	M/D	2/25	2/24	2/23	2/22	2/22	2/22	2/22	2/18	2/18	2/18	2/18	2/18	2/13	2/ 8		
			.1MM	261	304	423	479	494	530	550	687	703	738	933	1056	1114	1175	648	
1962	273	100	M/D	11/23	3/29	3/28	3/27	3/26	3/25	3/24	3/24	3/22	3/21	3/16	3/12	3/ 8	3/ 7		
			.1MM	143	243	339	421	507	582	654	687	735	783	951	1130	1312	1408	1076	
1963	273	100	M/D	4/ 2	4/ 1	4/ 1	3/30	3/29	3/29	3/29	3/26	3/25	3/25	3/28	3/23	3/21	3/13		
			.1MM	190	327	391	515	590	654	699	761	835	899	1202	1499	1560	1619	1325	
1964	274	100	M/D	1/ 9	3/ 4	3/ 3	3/ 2	3/ 2	3/ 2	3/ 1	2/29	2/29	2/29	3/ 1	3/ 2	2/29	2/29		
			.1MM	175	246	301	357	393	449	484	494	494	494	631	702	771	832	539	
1965	273	100	M/D	2/ 7	12/24	12/23	12/22	12/22	2/ 7	2/ 7	3/ 2	3/ 1	3/ 1	12/11	12/11	2/ 7	2/ 7		
			.1MM	187	343	404	420	420	455	455	477	497	507	699	699	753	1037	657	
1966	273	100	M/D	2/28	2/28	2/27	2/27	2/28	2/28	2/27	2/27	2/26	2/26	2/28	2/28	2/26	2/26		
			.1MM	223	296	352	388	540	599	655	685	715	715	776	1095	1237	1237	696	
1967	273	100	M/D	4/ 2	4/ 1	3/31	3/31	4/ 1	3/31	3/27	3/27	3/25	3/27	3/26	3/24	3/20	3/11		
			.1MM	185	348	419	459	551	622	772	812	889	975	1334	1451	1477	1599	1321	
1968	274	100	M/D	11/22	3/19	3/18	3/19	3/18	3/18	3/16	3/16	3/15	3/15	3/15	3/10	3/ 8	2/29		
			.1MM	180	249	340	490	581	665	795	878	947	947	1420	1445	1608	1674	917	
1969	273	100	M/D	1/30	1/29	3/23	4/ 4	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	4/ 1	3/24	3/21	3/16	3/13		
			.1MM	216	285	328	394	483	589	604	610	625	625	799	1121	1261	1322	806	
1970	273	100	M/D	12/10	12/10	4/15	4/14	4/13	4/13	4/13	4/15	4/14	4/13	4/12	4/ 8	4/ 3	3/31	3/24	
			.1MM	304	349	403	525	632	723	829	950	1057	1133	1427	1566	1659	1840	1460	

1971	273	100	M/D	4/28	5/ 7	5/ 6	5/ 5	5/ 3	5/ 3	5/ 2	5/ 1	4/30	4/28	4/24	4/19	4/14	4/ 9		
			.1MM	195	347	510	672	790	965	1070	1197	1328	1420	2025	2533	2903	3312	3313	
1972	274	100	M/D	12/10	12/ 9	12/ 9	12/ 9	4/18	4/18	4/13	4/13	4/13	4/13	4/13	4/10	4/ 8	4/ 1		
			.1MM	192	342	408	470	501	587	691	788	874	963	1354	1795	1896	2043	1760	
1973	273	100	M/D	3/17	3/16	3/15	3/14	3/13	3/12	3/11	3/10	3/ 9	3/ 8	3/ 3	3/ 3	3/ 3	3/ 3		
			.1MM	271	367	474	522	568	685	828	882	922	1024	1432	1506	1817	1817	1023	
1974	273	100	M/D	3/ 4	3/ 3	3/ 4	3/ 4	3/ 3	3/ 3	3/ 1	4/13	4/12	4/11	4/ 3	3/30	3/29	3/22		
			.1MM	461	537	598	695	771	771	777	858	908	989	1271	1675	1840	1912	1293	
1975	273	100	M/D	3/19	3/18	3/17	4/16	4/15	4/14	4/13	4/12	4/11	4/10	4/ 5	4/ 1	3/29	3/19		
			.1MM	337	436	492	583	675	756	792	817	837	863	960	1000	1069	1290	1066	
1976	274	100	M/D	3/31	3/31	3/31	3/31	3/27	3/27	3/25	3/24	3/24	3/24	3/24	3/20	3/19	3/12		
			.1MM	347	428	503	569	642	723	800	891	973	1047	1396	1672	1858	2029	1430	
1977	273	100	M/D	3/13	3/13	3/28	3/10	3/10	3/ 9	3/ 9	3/ 9	3/ 8	3/ 7	3/ 2	3/10	3/ 6	3/ 2		
			.1MM	215	317	422	523	625	717	788	870	905	926	1109	1360	1640	1798	1200	
1978	273	100	M/D	1/25	1/25	4/18	4/17	4/19	4/19	4/19	4/18	4/17	4/16	4/10	4/ 6	4/ 1	3/27		
			.1MM	345	438	478	574	670	803	940	1045	1141	1233	1706	1979	2305	2519	1712	
1979	273	100	M/D	12/31	12/31	3/22	3/21	3/20	3/20	3/19	3/18	3/17	3/17	3/13	3/ 6	3/ 2	2/24		
			.1MM	257	326	453	554	650	728	796	856	878	901	1052	1246	1451	1538	1358	
1980	274	100	M/D	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/16	3/10	3/ 7	3/ 4		
			.1MM	454	576	635	713	754	777	850	932	1042	1071	1164	1207	1239	1253	549	
1981	273	100	M/D	2/23	2/22	2/22	2/20	2/19	2/19	2/19	2/18	2/17	2/16	2/10	2/10	2/ 8	2/ 1		
			.1MM	247	365	429	528	670	733	795	850	900	960	1208	1405	1492	1616	900	
1982	273	100	M/D	3/31	3/30	3/30	3/31	3/30	3/29	3/29	3/29	3/29	3/24	3/25	3/20	3/13	3/10	3/13	
			.1MM	232	308	354	451	527	572	572	572	599	707	890	1131	1427	1496	1023	
1983	273	100	M/D	2/ 2	2/ 2	2/ 2	1/31	1/31	1/30	1/30	1/30	1/30	1/30	12/14	12/23	1/10	12/14		
			.1MM	291	359	382	388	411	420	420	420	420	420	544	729	776	953	196	
1984	274	100	M/D	4/ 4	4/ 4	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/29	3/27	3/22	3/18	3/14	3/14		
			.1MM	279	519	612	702	787	862	919	969	1001	1043	1161	1327	1383	1383	910	
1985	273	100	M/D	3/28	3/27	3/26	3/26	3/24	3/23	3/22	3/22	3/22	3/27	3/22	3/ 9	3/12	3/ 7		
			.1MM	288	425	486	519	549	628	678	711	711	832	1086	1286	1442	1773	970	
1986	273	100	M/D	12/ 1	1/19	1/18	1/17	1/18	1/17	1/17	1/17	3/18	3/10	3/13	3/ 9	3/ 2	3/ 1		
			.1MM	181	278	319	364	369	414	414	414	466	562	647	841	979	997	574	
1987	273	100	M/D	12/24	12/24	12/23	12/22	12/22	12/20	12/19	3/14	2/28	2/27	3/ 7	2/28	2/26	2/21		
			.1MM	154	285	326	344	354	358	379	401	454	494	627	757	959	1008	721	
1988	274	100	M/D	11/29	3/25	3/24	3/23	3/23	3/23	3/23	3/23	3/23	3/18	11/29	3/ 7	11/29	11/26		
			.1MM	330	386	462	538	558	558	558	558	558	568	662	732	846	933	541	
1989	273	100	M/D	10/24	3/27	3/26	3/25	3/24	3/23	3/22	3/22	3/24	3/23	3/14	3/14	3/10	3/ 4		
			.1MM	185	263	346	418	470	507	512	512	540	577	780	851	865	877	412	
1990	273	100	M/D	1/17	2/21	3/11	3/10	3/11	3/11	3/10	3/ 9	3/ 8	3/ 8	3/ 2	1/25	2/21	1/24		
			.1MM	153	201	270	328	391	461	518	567	592	592	634	646	845	912	746	
1991	273	100	M/D	12/29	12/21	12/21	12/21	12/18	12/18	12/17	12/17	12/21	12/21	12/17	3/ 1	12/ 6	2/19		
			.1MM	245	325	401	401	424	500	552	552	689	712	863	896	1010	1160	670	
1992	274	100	M/D	3/26	3/26	3/25	3/25	3/26	3/26	3/25	3/25	3/25	3/25	3/26	3/26	3/26	3/25		
			.1MM	429	535	581	591	652	712	759	789	818	843	1194	1367	1860	1981	1306	
1993	273	100	M/D	1/ 4	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 2	3/27	3/22	3/21	3/16		
			.1MM	388	514	640	763	859	959	1033	1063	1076	1084	1623	1891	1925	2041	1387	
1994	273	100	M/D	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 8	4/ 7	4/ 5	4/ 4	3/31	3/26	3/21	3/19		
			.1MM	251	414	496	606	716	802	855	908	926	1010	1307	1470	1837	1882	1295	
1995	273	100	M/D	1/15	1/15	1/13	1/13	1/12	1/12	1/12	1/12	1/12	1/12	1/12	1/12	1/12	12/21		
			.1MM	487	555	624	692	752	767	771	806	864	878	888	909	955	397		
1996	274	100	M/D	2/20	2/20	1/17	2/20	2/20	2/20	2/20	2/20	2/20	2/20	3/25	3/12	3/17	3/12		
			.1MM	292	356	384	550	649	665	665	687	687	687	744	895	1129	1359	1405	
1997	273	100	M/D	2/21	2/20	2/19	2/18	2/18	4/ 1	4/ 1	3/31	3/29	3/28	3/24	3/27	3/24	3/19		
			.1MM	396	534	644	706	712	762	809	829	917	994	1253	1503	1665	1724	1251	
1998	273	100	M/D	1/ 5	3/26	3/26	3/25	1/ 5	1/ 4	1/ 3	1/ 2	1/ 2	1/ 2	12/27	12/25	12/16	12/12		
			.1MM	258	336	490	542	624	672	735	787	805	805	823	842	973	1013	532	
1999	273	100	M/D	1/18	1/22	1/22	3/26	1/18	1/18	1/18	1/17	1/16	1/16	3/15	1/16	1/16	2/28		
			.1MM	228	276	347	366	440	535	606	653	690	690	826	925	963	1059	587	
2000	274	100	M/D	12/ 3	2/26	1/ 2	2/27	2/23	2/22	2/22	2/23	2/22	2/22	2/22	2/22	2/20	2/20		
			.1MM	166	169	262	282	343	402	455	515	573	588	789	811	940	966	708	
2001	273	100	M/D	2/ 9	12/16	4/10	4/ 9	4/ 8	4/ 7	4/ 7	4/ 5	4/ 4	4/ 4	3/30	3/27	3/20	3/15		
			.1MM	223	281	381	480	581	661	732	806	899	970	1177	1249	1570	1754	1472	
2002	273	100	M/D	12/23	3/30	3/29	3/28	3/28	3/27	3/27	3/27	3/27	3/23	3/19	2/ 7	3/ 8	1/23		
			.1MM	140	203	315	386	430	462	462	462	462	462	508	529	584	631	346	
2003	272	100	M/D	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/15	3/11	3/16	3/12		
			.1MM	283	363	466	546	645	749	837	909	1032	1114	1362	1372	1416	1453	961	
2004	274	100	M/D	3/ 5	3/ 4	3/ 4	3/ 2	3/ 1	2/29	2/28	2/28	2/27	2/27	2/25	2/21	2/19	2/25		
			.1MM	372	428	478	567	643	703	774	824	843	846	952	982	1004	1144	610	
2005	273	100	M/D	12/23	12/22	12/22	12/22	12/22	12/18	12/18	12/16	12/23	12/22	12/22	12/ 4	12/22	12/16		
			.1MM	304	342	342	342	342	354	354	378	452	490	545	597	808	845	436	
2006	273	100	M/D	1/17	1/17	1/17	1/17	3/ 9	1/13	1/12	1/11	1/10	1/11	1/10	1/10	1/11	1/10		
			.1MM	208	374	383	478	532	584	627	732	768	836	910	1038	1321	1401	562	
2007	273	100	M/D	4/16	3/21	3/21	3/21	3/21	3/21	3/19	3/19	3/14	3/13	3/10	3/10	3/ 2	2/27		
			.1MM	198	275	340	388	404	404	417	417	443	526	780	797	821	847	522	
2008	274	100	M/D	12/23	4/17	4/17	4/16	4/15	4/14	4/13	4/11	4/11	4/10	4/ 5	3/31	3/26	3/25		

2009	273	100	.1MM	345	439	645	802	922	1012	1066	1160	1366	1434	1936	2355	2461	2513	2056
			M/D	2/11	2/11	2/10	2/10	12/24	2/ 7	2/ 7	3/14	3/10	3/10	3/ 5	3/ 7	3/ 5	2/25	
			.1MM	301	371	385	385	399	441	441	485	593	615	839	1062	1163	1366	1128
2010	273	100	M/D	1/24	1/24	1/24	1/24	1/24	1/24	1/24	1/19	1/19	3/ 1	2/25	2/20	2/17	2/10	
			.1MM	352	545	569	569	569	569	569	583	583	615	847	935	956	967	782
2011	273	100	M/D	3/ 5	3/ 9	3/ 9	3/ 9	3/ 9	3/ 5	3/ 5	3/ 5	3/ 4	3/ 4	3/ 4	3/ 4	3/ 5	3/ 1	
			.1MM	310	348	392	433	449	658	702	743	771	787	1108	1219	1280	1365	589
2012	274	100	M/D	3/ 7	3/ 7	3/ 7	1/23	1/23	1/23	3/ 2	3/ 2	3/ 2	3/ 2	1/23	1/ 9	2/14	2/ 9	
			.1MM	100	163	163	213	251	267	289	289	293	298	350	428	583	627	347
2013	273	100	M/D	1/30	1/30	4/ 6	4/ 5	4/ 4	4/ 3	3/25	3/25	3/31	3/30	3/25	3/20	3/15	3/10	
			.1MM	261	297	340	371	465	478	530	580	651	736	1059	1122	1141	1403	1135
2014	273	100	M/D	4/ 7	4/ 7	4/10	4/ 7	4/ 7	4/ 7	4/ 6	4/ 4	4/ 4	4/ 3	3/28	3/27	3/19	3/14	
			.1MM	262	345	416	581	691	813	881	949	1071	1119	1404	1543	1690	1775	1007
2015	273	100	M/D	4/ 9	4/ 9	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 3	4/ 2	4/ 2	3/29	3/24	3/20	3/15	
			.1MM	237	397	487	521	588	611	624	681	819	909	1046	1138	1246	1335	1043
2016	118	43	**	M/D	1/10	1/ 9	1/ 8	1/ 8	1/ 6	1/ 6	1/ 6	1/ 6	1/ 6	12/29	1/ 8	1/ 6	12/29	
			.1MM	245	300	303	303	315	315	315	315	315	315	319	399	410	414	

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		1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY
MEAN EXTREME	(MM)	26.5	37.0	45.1	53.5	61.5	69.4	76.0	81.7	87.8	93.6	120.0	138.7	154.6	168.0
STD. DEV.	(MM)	8.7	10.0	11.3	14.1	16.9	20.0	22.6	25.0	27.5	29.9	41.7	49.2	54.6	60.2
YEARS ANALYSED		124	124	124	124	124	124	124	124	124	124	124	124	124	124
MAX EXTREME	(MM)	92.5	138.0	172.2	177.2	181.4	204.6	224.6	236.8	243.6	252.7	311.2	363.7	363.7	383.1
YEAR		1923	1923	1923	1923	1943	1943	1943	1943	1943	1971	1971	1971	1971	1971

** NOTE ** VALUE IN FLAG INDICATES YEAR NOT INCLUDED IN ANALYSIS BASED ON % DAYS OPERATIONAL (<90.0%)

METEOROLOGICAL SERVICE OF CANADA
RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

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STATION : OTTAWA CDA STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 4 - Southern Ontario

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6 NOTE : MODIFIED GUMBEL 12/82

RETURN PERIOD VALUES (MM) WITH 50% CONFIDENCE LIMITS

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RETURN PERIOD YEARS	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY
2	25.06+/- 0.48	35.35+/- 0.56	43.22+/- 0.63	51.16+/- 0.78	58.72+/- 0.94
5	32.74+/- 0.81	44.19+/- 0.94	53.18+/- 1.06	63.60+/- 1.32	73.66+/- 1.58
10	37.82+/- 1.10	50.04+/- 1.26	59.78+/- 1.42	71.84+/- 1.78	83.54+/- 2.14
25	44.25+/- 1.48	57.44+/- 1.70	68.12+/- 1.92	82.25+/- 2.40	96.04+/- 2.88
50	49.02+/- 1.77	62.92+/- 2.04	74.30+/- 2.30	89.97+/- 2.87	105.30+/- 3.45
100	53.75+/- 2.06	68.37+/- 2.38	80.44+/- 2.68	97.63+/- 3.34	114.50+/- 4.01

RETURN PERIOD YEARS	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY
2	66.16+/- 1.11	72.32+/- 1.26	77.61+/- 1.39	83.31+/- 1.53	88.72+/- 1.66
5	83.79+/- 1.87	92.34+/- 2.12	99.71+/- 2.34	107.66+/- 2.58	115.12+/- 2.80
10	95.47+/- 2.52	105.59+/- 2.86	114.33+/- 3.16	123.78+/- 3.48	132.60+/- 3.78
25	110.23+/- 3.40	122.33+/- 3.86	132.81+/- 4.26	144.14+/- 4.69	154.69+/- 5.09
50	121.17+/- 4.07	134.75+/- 4.62	146.52+/- 5.10	159.25+/- 5.62	171.07+/- 6.09
100	132.04+/- 4.74	147.08+/- 5.38	160.13+/- 5.94	174.25+/- 6.54	187.34+/- 7.10

RETURN PERIOD YEARS	15 DAY	20 DAY	25 DAY	30 DAY
2	113.16+/- 2.31	130.58+/- 2.73	145.65+/- 3.03	158.09+/- 3.34
5	149.98+/- 3.90	174.08+/- 4.61	193.88+/- 5.11	211.28+/- 5.63

10	174.36+/- 5.27	202.88+/- 6.22	225.80+/- 6.90	246.50+/- 7.61
25	205.16+/- 7.10	239.27+/- 8.39	266.15+/- 9.30	291.00+/-10.26
50	228.01+/- 8.49	266.27+/-10.04	296.07+/-11.13	324.01+/-12.27
100	250.69+/- 9.90	293.07+/-11.69	325.78+/-12.96	356.78+/-14.30

** WARNING ** : 100 YEAR VALUES IN 1934 BASED ON 1 DAYS ACCUMULATION

** WARNING ** : 100 YEAR VALUES IN 1934 BASED ON 2 DAYS ACCUMULATION

METEOROLOGICAL SERVICE OF CANADA
 RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
 PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

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STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 5 - Modification of Model 4

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

YR	TOTAL %		START FLAG	MAX	START														MAX SNPK
	DAYS	VALID			1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY	
1890	242	89	**	M/D	4/ 4	4/ 3	4/ 3	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	3/26	3/21	3/14	3/12	
				.1MM	341	453	463	704	816	816	816	816	816	816	920	1161	1220	1428	
1891	273	100		M/D	3/ 9	4/10	4/ 9	4/ 9	4/ 9	3/29	3/28	3/28	3/21	3/21	3/28	3/23	3/21	3/13	
				.1MM	316	602	753	785	785	869	909	909	989	1060	1674	2030	2412	2512	1870
1892	274	100		M/D	4/ 5	4/ 4	4/ 3	4/ 3	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	4/ 1	3/28	3/28	3/28	3/ 9	
				.1MM	405	776	1070	1315	1570	1809	1880	1880	1880	1880	1951	1951	1951	2068	1751
1893	273	100		M/D	4/13	4/12	4/11	4/10	4/10	4/ 8	4/ 8	4/ 8	4/ 8	4/ 8	3/31	3/31	3/24	3/21	
				.1MM	442	736	948	1050	1076	1387	1412	1412	1412	1535	1752	1894	1946	2005	1833
1894	273	100		M/D	4/ 4	3/ 5	3/ 5	3/ 4	3/ 3	3/ 2	3/ 2	4/ 4	4/ 4	3/31	3/ 5	3/ 2	3/18	3/ 6	
				.1MM	285	478	663	672	681	793	793	837	837	908	1277	1487	1650	1707	2154
1895	273	100		M/D	4/14	4/ 8	4/14	4/14	4/13	4/12	4/12	4/ 8	4/ 8	4/ 8	4/ 5	4/ 2	3/25	3/25	
				.1MM	342	616	776	1062	1254	1408	1473	1516	1739	2025	2349	2398	2511	2511	1814
1896	274	100		M/D	4/15	4/14	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 7	4/ 2	3/30	3/26	3/26	
				.1MM	481	814	1200	1403	1575	1696	1747	1807	1827	1827	1837	1998	2031	2031	1921
1897	273	100		M/D	3/10	4/ 4	4/ 4	4/ 2	4/ 1	3/31	3/30	3/29	3/29	3/27	3/22	3/19	3/19	3/ 9	
				.1MM	264	472	472	655	766	878	1000	1051	1051	1081	1306	1629	1654	1923	1163
1898	273	100		M/D	12/11	3/12	3/11	3/10	3/ 9	3/ 9	3/11	3/10	3/11	3/11	3/ 9	3/ 9	3/ 9	3/ 9	
				.1MM	369	620	865	988	1070	1070	1202	1324	1432	1600	1846	2245	2245	2296	1868
1899	242	89	**	M/D	4/18	4/18	4/18	4/17	4/16	4/15	4/14	4/13	4/12	4/11	4/ 7	4/ 7	3/29	3/23	
				.1MM	305	599	802	965	1036	1208	1403	1566	1722	1733	2035	2050	2075	2075	
1900	273	100		M/D	2/13	4/ 6	4/ 5	4/12	4/11	4/11	4/ 2	4/ 6	4/ 5	4/ 6	4/ 1	3/29	3/29	3/20	
				.1MM	334	426	557	675	847	882	924	1076	1208	1376	1813	1858	1858	1918	1703
1901	273	100		M/D	11/21	4/13	4/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 1	3/26	3/21	3/21	
				.1MM	364	640	852	1046	1260	1453	1664	1764	1892	2051	2688	3002	3287	3328	2380
1902	273	100		M/D	12/14	12/14	3/21	3/21	3/21	3/21	3/21	3/21	3/20	3/20	3/12	3/11	3/ 1	2/28	
				.1MM	330	622	700	791	912	1075	1253	1370	1381	1381	1763	2088	2121	2677	1984
1903	273	100		M/D	3/19	3/19	3/19	3/19	3/19	3/19	3/18	3/17	3/17	3/17	3/11	3/ 7	2/28	2/28	
				.1MM	330	654	892	1014	1267	1432	1524	1640	1732	1826	2072	2437	2565	2751	2179
1904	274	100		M/D	4/ 9	4/ 9	4/ 8	4/ 7	4/ 7	4/ 6	4/ 6	4/ 5	4/ 5	4/ 1	3/30	4/ 5	3/31	3/26	
				.1MM	436	776	939	1123	1266	1388	1487	1570	1570	1657	2032	2778	3159	3542	2726
1905	273	100		M/D	3/29	3/29	3/28	3/28	3/27	3/25	3/25	3/29	3/29	3/28	3/27	3/24	3/18	3/18	
				.1MM	263	486	629	740	840	904	1016	1164	1319	1461	1963	2150	2364	2364	2039
1906	273	100		M/D	3/27	3/27	3/27	3/27	2/21	2/21	2/21	2/21	2/21	2/21	2/21	2/21	12/30	12/27	
				.1MM	356	406	406	406	423	423	423	423	423	423	423	423	453	484	448
1907	273	100		M/D	3/28	3/28	3/28	3/27	3/26	3/24	3/23	3/23	3/22	3/22	3/22	3/22	3/22	3/13	
				.1MM	249	448	617	713	813	877	1060	1229	1331	1351	1529	1647	1876	1911	1239
1908	274	100		M/D	4/25	4/24	4/23	4/22	4/22	4/21	4/20	4/19	4/18	4/17	4/13	4/ 7	4/ 2	3/28	
				.1MM	359	684	979	1242	1457	1487	1518	1721	1873	1924	2297	2672	2848	2975	2591
1909	273	100		M/D	4/14	4/13	4/13	4/13	4/12	4/12	4/12	4/ 7	4/ 6	4/ 6	4/ 3	3/30	3/25	4/ 3	
				.1MM	490	918	1050	1252	1384	1413	1413	1432	1730	1862	2316	2459	2667	2763	2069
1910	273	100		M/D	1/22	1/21	3/22	3/21	3/20	3/19	3/19	3/19	3/19	3/19	3/13	3/ 5	2/28	2/27	
				.1MM	289	391	542	564	768	788	788	788	788	788	824	1157	1400	1420	1070
1911	273	100		M/D	4/14	4/13	4/13	4/12	4/12	4/13	4/14	4/13	4/13	4/12	4/ 7	4/ 5	3/27	3/27	
				.1MM	460	672	877	959	991	1062	1309	1521	1657	1739	2050	2249	2316	2452	1952
1912	274	100		M/D	4/15	4/15	4/ 5	4/ 5	4/12	4/11	4/10	4/ 5	4/ 7	4/ 6	4/ 5	3/28	3/28	3/18	
				.1MM	497	704	843	843	969	1101	1123	1128	1311	1575	1966	2084	2084	2198	1809
1913	273	100		M/D	3/24	3/24	3/19	3/21	3/21	3/19	3/19	3/19	3/19	3/19	3/19	3/19	3/13	3/13	
				.1MM	383	569	732	749	936	1115	1301	1344	1344	1344	1924	2394	2829	2829	1787
1914	273	100		M/D	4/17	4/16	4/16	4/15	4/14	4/14	4/12	4/11	4/10	4/10	4/ 5	3/30	3/26	3/26	
				.1MM	285	492	697	799	858	858	900	991	1002	1002	1096	1529	1965	1965	1634

1915	273	100	M/D	11/16	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	4/ 1	4/ 1	4/ 1	3/24	3/21	3/21	3/21	
			.1MM	402	479	620	711	803	874	977	1002	1002	1002	1185	1447	1447	1447	1244
1916	274	100	M/D	4/16	4/12	4/11	4/10	4/12	4/11	4/11	4/ 9	4/ 9	4/10	4/10	3/28	3/26	3/27	
			.1MM	294	528	716	816	990	1178	1307	1410	1540	1631	2152	2590	3175	3721	3118
1917	273	100	M/D	4/19	4/18	4/17	4/17	4/16	4/15	4/14	4/13	4/12	4/11	3/24	4/ 1	3/27	3/23	
			.1MM	395	777	991	1190	1281	1393	1473	1493	1502	1512	1743	2599	2948	3273	2570
1918	273	100	M/D	4/ 2	4/ 1	4/ 6	3/30	3/29	3/29	4/ 2	4/ 1	3/31	3/30	3/30	3/29	3/21	3/17	
			.1MM	336	580	818	946	1017	1017	1215	1459	1662	1825	2414	2535	2718	2789	2664
1919	273	100	M/D	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 5	4/ 3	4/ 3	4/ 3	3/23	3/18	3/16	
			.1MM	271	479	642	762	982	1084	1204	1204	1266	1266	1266	1799	2125	2312	1642
1920	274	100	M/D	3/26	3/25	3/24	3/23	3/22	3/22	3/22	3/20	3/20	3/17	3/12	3/11	3/ 5	3/ 5	
			.1MM	344	660	986	1260	1392	1444	1444	1455	1455	1499	1757	1819	1946	1946	1518
1921	273	100	M/D	3/21	3/20	3/19	3/19	3/20	3/16	3/15	3/15	3/16	3/12	3/ 8	3/ 2	2/28	2/23	
			.1MM	303	584	604	604	650	787	802	802	853	984	1371	1639	1814	1827	868
1922	273	100	M/D	11/19	4/ 6	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 2	4/ 2	4/ 2	3/26	3/20	3/14	3/14	
			.1MM	341	550	745	907	987	1058	1120	1120	1120	1120	1384	1465	1554	1749	1192
1923	273	100	M/D	4/21	4/21	4/20	4/19	4/19	4/17	4/16	4/16	4/16	4/16	4/ 8	4/ 3	4/ 3	4/ 3	
			.1MM	619	1153	1570	1630	1630	1702	1762	1762	1762	1762	1979	2681	2681	2681	2249
1924	274	100	M/D	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	4/ 2	3/27	3/21	3/21	
			.1MM	335	558	731	996	1088	1167	1355	1447	1478	1549	1814	1986	2293	2293	1935
1925	273	100	M/D	3/27	3/26	3/25	3/25	3/24	3/24	3/22	3/21	3/19	3/19	3/18	3/11	3/ 8	3/ 8	
			.1MM	331	585	799	966	1057	1057	1118	1193	1273	1440	1521	1641	1652	1652	1069
1926	273	100	M/D	4/22	4/22	4/22	4/22	4/21	4/21	4/22	4/21	4/21	4/22	4/21	4/13	4/ 8	4/ 8	
			.1MM	345	651	885	1181	1395	1415	1644	1858	2023	2309	2575	2668	2726	2726	2425
1927	273	100	M/D	11/16	4/ 5	4/ 4	4/ 4	4/ 3	3/13	3/12	3/12	3/30	3/29	3/27	3/12	3/13	3/12	
			.1MM	307	454	627	779	830	877	1009	1080	1111	1162	1354	1564	2151	2455	2186
1928	274	100	M/D	4/ 6	4/ 5	4/ 4	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	3/24	3/21	3/14	3/12	
			.1MM	325	579	786	977	1079	1079	1079	1079	1079	1079	1524	1604	1736	1758	1364
1929	273	100	M/D	1/ 6	3/15	3/13	3/13	3/13	3/25	3/25	3/13	3/13	3/13	3/14	3/13	3/ 4	3/ 4	
			.1MM	274	340	443	547	547	623	623	672	742	823	1192	1480	1539	1701	946
1930	273	100	M/D	1/ 8	1/ 7	1/ 7	1/ 7	2/20	2/19	1/ 2	1/ 2	1/ 2	1/ 2	1/ 2	2/19	2/19	2/13	
			.1MM	262	467	467	467	508	599	636	636	636	636	669	808	1053	1083	1056
1931	273	100	M/D	3/29	3/28	3/28	3/26	3/26	3/24	3/24	3/24	3/26	3/25	3/20	3/16	3/10	3/ 5	
			.1MM	248	391	502	636	747	860	971	1073	1179	1271	1626	1800	1820	1831	1486
1932	274	100	M/D	2/12	4/11	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 5	4/ 6	3/31	3/26	3/26	3/26	
			.1MM	317	400	582	745	949	1000	1071	1079	1079	1080	1283	1463	1598	1598	854
1933	273	100	M/D	12/25	4/ 2	4/ 1	4/ 1	4/ 2	4/ 1	3/31	3/31	3/31	3/31	3/27	3/20	3/20	3/20	
			.1MM	214	321	483	575	710	872	943	943	943	943	985	1142	1142	1142	689
1934	273	100	M/D	12/31	4/10	4/ 9	4/16	4/15	4/15	4/14	4/11	4/11	4/10	4/ 6	4/ 1	4/ 1	3/26	
			.1MM	732	793	895	1088	1312	1464	1588	1745	2090	2355	2762	3033	3052	3179	2208
1935	273	100	M/D	4/10	4/ 9	4/ 9	4/ 9	4/ 8	4/ 8	4/ 8	4/ 8	4/ 8	4/ 5	3/31	3/28	3/23	3/16	
			.1MM	283	537	790	973	1104	1216	1240	1240	1240	1260	1362	1548	1568	1707	1410
1936	274	100	M/D	3/11	3/27	3/27	3/24	3/25	3/24	3/24	3/24	3/21	3/21	3/16	3/11	3/10	3/11	
			.1MM	308	420	654	814	1011	1199	1339	1339	1479	1618	2182	2620	2640	2734	1485
1937	273	100	M/D	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	3/20	12/26	
			.1MM	316	530	682	793	843	894	894	894	894	894	894	894	934	1066	678
1938	273	100	M/D	3/23	3/23	3/21	3/23	3/20	3/21	3/20	3/19	3/23	3/17	3/17	3/13	3/13	3/ 5	
			.1MM	304	418	568	716	828	979	1126	1200	1249	1363	1897	1953	1953	2077	1398
1939	273	100	M/D	4/26	4/26	4/25	4/25	4/23	4/22	4/22	4/20	4/19	4/19	4/14	4/11	4/11	3/31	
			.1MM	345	587	790	927	1139	1322	1458	1588	1796	1933	2115	2168	2168	2374	1854
1940	274	100	M/D	4/18	4/17	4/17	4/16	4/17	4/17	4/17	4/17	4/16	4/15	4/11	4/ 8	3/31	3/30	
			.1MM	282	523	726	858	995	1129	1312	1465	1597	1683	1814	2005	2233	2346	1746
1941	273	100	M/D	12/29	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	4/ 3	3/16	
			.1MM	416	629	894	1088	1230	1464	1567	1649	1720	1721	1721	1721	1721	1790	1764
1942	273	100	M/D	12/24	12/23	12/23	12/23	3/27	3/26	3/26	3/25	3/25	3/22	3/16	3/16	3/ 8	3/ 4	
			.1MM	325	490	490	490	502	613	688	748	748	754	1101	1313	1543	1583	1030
1943	272	100	M/D	4/25	4/24	4/23	4/23	4/22	4/22	4/22	4/21	4/20	4/19	4/17	4/ 9	4/ 9	3/31	
			.1MM	451	856	1190	1435	1679	1878	2109	2252	2327	2429	2518	2588	2588	2803	2428
1944	274	100	M/D	3/25	4/ 9	4/17	4/16	4/16	4/16	4/16	4/12	4/ 9	4/ 9	4/ 9	4/ 1	3/25	3/24	
			.1MM	223	416	473	542	542	542	542	583	760	892	1031	1098	1222	1423	910
1945	273	100	M/D	3/18	3/24	3/23	3/18	3/17	3/20	3/18	3/18	3/17	3/16	3/14	3/14	3/ 2	2/26	
			.1MM	265	508	711	861	1021	1144	1362	1617	1777	1882	2152	2152	2423	2497	1999
1946	273	100	M/D	3/13	3/13	3/13	3/13	3/13	3/13	3/ 8	3/ 7	3/ 6	3/ 6	3/ 2	3/ 2	3/ 2	2/13	
			.1MM	296	590	625	625	625	625	763	885	1003	1038	1139	1139	1139	1327	839
1947	273	100	M/D	4/11	4/23	4/10	4/11	4/10	4/10	4/ 9	4/ 5	4/ 6	4/ 5	4/10	4/ 5	4/ 5	4/ 2	
			.1MM	420	767	855	936	1067	1169	1250	1350	1451	1563	2241	2737	2848	2902	2334
1948	274	100	M/D	3/15	3/15	3/20	3/19	3/20	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	3/15	
			.1MM	325	510	545	647	779	1032	1143	1285	1376	1519	1945	2109	2109	2109	1249
1949	273	100	M/D	3/27	4/ 3	4/ 3	4/ 2	4/ 1	3/31	3/30	3/22	3/27	3/27	3/22	3/22	3/22	3/22	
			.1MM	200	354	517	658	687	737	808	902	1053	1216	1710	1710	1710	1710	1444
1950	273	100	M/D	4/ 3	12/20	12/19	12/18	12/18	12/18	12/18	3/28	12/18	3/27	3/23	3/28	3/23	3/23	
			.1MM	322	581	666	821	821	821	821	841	943	1007	1219	1458	1753	1791	1328
1951	260	95	M/D	1/ 3	3/29	3/29	3/29	3/29	3/29	3/29	3/28	3/28	3/28	3/28	3/23	3/16	3/12	
			.1MM	334	545	666	797	893	1004	1154	1226	1226	1226	1508	1531	1653	1928	1200
1952	274	100	M/D	4/ 4	4/ 3	4/ 2	4/ 1	4/ 4	4/ 4	4/ 3	4/ 2	4/ 2	4/ 1	3/27	3/22	3/19	3/11	

1953	273	100	.1MM	328	489	641	763	954	1157	1317	1470	1600	1722	1877	1928	2101	2217	1686
			M/D	12/10	12/10	12/10	12/10	12/ 6	12/ 5	12/ 5	12/ 5	12/ 5	12/ 5	12/ 5	12/ 5	12/ 5	12/ 5	
			.1MM	381	381	381	381	401	600	600	600	600	600	600	600	691	691	278
1954	271	99	M/D	4/11	4/ 6	4/ 6	4/ 6	4/ 7	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	4/ 6	3/25	3/19	3/19	
			.1MM	354	651	814	814	1112	1439	1489	1489	1489	1489	1489	1629	1690	1690	1167
1955	273	100	M/D	4/10	4/10	4/10	4/ 9	4/ 9	4/ 9	4/ 6	4/ 5	4/ 4	4/ 3	3/30	3/30	3/21	3/15	
			.1MM	334	599	782	925	987	987	1147	1330	1461	1533	1990	1990	2158	2249	1957
1956	274	100	M/D	4/ 4	4/ 4	4/ 4	4/ 3	4/ 4	4/ 3	4/ 3	4/ 3	4/ 3	3/31	3/31	3/31	3/31	3/31	
			.1MM	290	524	716	807	979	1071	1135	1135	1135	1184	1184	1184	1184	1184	1149
1957	273	100	M/D	1/22	1/21	1/21	1/21	3/12	3/11	3/11	3/ 9	3/13	3/13	3/ 9	2/25	2/25	2/24	
			.1MM	402	516	516	516	521	539	539	579	628	680	759	875	1003	1068	730
1958	273	100	M/D	12/ 7	3/30	3/30	3/30	3/28	3/27	3/27	3/26	3/24	3/23	3/19	3/16	3/16	3/ 4	
			.1MM	218	314	457	552	650	771	866	938	1007	1141	1419	1477	1517	1692	1439
1959	273	100	M/D	4/15	4/14	4/14	4/ 8	4/ 8	4/10	4/ 9	4/ 8	4/ 8	4/ 6	4/ 1	3/30	3/30	3/20	
			.1MM	243	426	526	675	717	863	985	1223	1323	1396	1983	2155	2155	2312	2130
1960	274	100	M/D	4/16	4/16	4/15	4/14	4/13	4/12	4/11	4/11	4/ 9	4/ 8	4/ 3	3/29	3/27	3/27	
			.1MM	380	744	1099	1402	1619	1794	1887	1887	1921	1944	2331	2687	2778	2778	2233
1961	273	100	M/D	3/28	3/27	3/27	3/26	3/24	3/24	3/23	3/23	3/23	3/23	3/23	3/23	3/23	3/ 3	
			.1MM	305	457	545	556	653	741	771	771	771	771	919	919	919	1043	843
1962	273	100	M/D	3/29	3/29	3/28	3/27	3/26	3/25	3/24	3/24	3/24	3/22	3/21	3/16	3/12	3/12	
			.1MM	274	547	695	786	958	1099	1150	1150	1293	1360	1441	1525	1543	1543	1438
1963	273	100	M/D	4/ 2	4/ 1	4/ 1	3/30	3/30	3/30	3/27	3/26	3/25	3/25	3/25	3/21	3/17	3/17	
			.1MM	374	597	701	902	1007	1041	1077	1225	1340	1444	1624	1684	1707	1707	1479
1964	274	100	M/D	3/ 5	3/ 4	3/ 3	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	3/ 2	
			.1MM	269	383	525	657	657	744	744	744	744	744	858	868	868	868	636
1965	273	100	M/D	4/ 7	12/24	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	4/ 5	12/11	12/11	12/11	2/ 7	
			.1MM	243	449	497	555	555	555	555	555	555	555	555	699	699	699	803
1966	273	100	M/D	3/18	3/18	3/18	3/18	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	2/28	
			.1MM	274	459	459	459	592	667	738	738	738	738	738	1197	1197	1197	713
1967	273	100	M/D	4/ 1	4/ 1	4/ 1	3/31	4/ 1	3/31	3/27	3/27	3/28	3/27	3/25	3/25	3/25	3/10	
			.1MM	376	694	806	917	1040	1151	1286	1397	1457	1631	1909	1909	1909	1959	1691
1968	274	100	M/D	3/16	3/19	3/19	3/19	3/19	3/16	3/16	3/16	3/15	3/15	3/15	3/ 9	3/ 9	3/ 9	
			.1MM	219	376	540	733	862	984	1177	1306	1319	1319	1649	1822	1822	1822	1086
1969	273	100	M/D	4/ 7	4/ 7	4/ 5	4/ 4	4/ 4	4/ 4	4/ 4	4/ 4	4/ 4	4/ 4	3/24	3/21	3/19	3/15	
			.1MM	274	396	537	668	790	877	877	877	877	877	1020	1412	1472	1503	982
1970	273	100	M/D	4/17	4/16	4/15	4/14	4/13	4/12	4/12	4/10	4/ 9	4/ 8	4/ 7	4/ 2	3/24	3/21	
			.1MM	322	545	789	1043	1288	1399	1399	1430	1685	1857	1868	1883	1967	2181	1855
1971	273	100	M/D	4/28	4/27	4/26	4/25	4/24	4/23	4/22	4/21	4/20	4/19	4/15	4/10	4/10	4/ 1	
			.1MM	367	702	927	1108	1281	1464	1652	1846	2104	2399	3044	3564	3564	3777	3406
1972	274	100	M/D	12/10	4/19	4/18	4/18	4/19	4/19	4/18	4/17	4/13	4/13	4/13	4/10	4/ 3	3/29	
			.1MM	257	433	587	739	877	1080	1234	1366	1467	1586	2264	2466	2497	2661	2188
1973	273	100	M/D	3/17	3/16	3/15	3/15	3/13	3/12	3/11	3/10	3/10	3/ 8	3/ 3	3/ 3	3/ 3	3/ 3	
			.1MM	322	505	677	715	786	984	1162	1200	1237	1479	1957	1995	2093	2093	1298
1974	273	100	M/D	3/ 4	3/ 4	3/ 4	3/ 4	3/ 4	3/ 4	3/30	2/28	2/28	2/28	3/31	3/29	3/29	3/16	
			.1MM	446	568	720	1005	1005	1028	1057	1057	1057	1584	1722	1722	1722	1725	1180
1975	273	100	M/D	4/18	4/17	4/16	4/16	4/15	4/14	4/14	4/14	4/14	4/14	4/14	4/14	3/29	3/22	
			.1MM	363	668	901	1114	1216	1318	1318	1318	1318	1318	1318	1318	1361	1487	1261
1976	274	100	M/D	3/31	3/31	3/31	3/24	3/30	3/27	3/25	3/24	3/24	3/24	3/20	3/19	3/12	3/12	
			.1MM	434	618	723	885	957	1117	1319	1533	1717	1822	2224	2495	2550	2604	2066
1977	273	100	M/D	3/13	3/13	3/12	3/10	3/10	3/10	3/ 9	3/ 9	3/ 9	3/ 7	3/ 4	3/ 9	3/ 5	3/ 4	
			.1MM	332	537	739	951	1156	1294	1406	1464	1464	1494	1595	1769	1903	1931	1318
1978	273	100	M/D	1/25	4/19	4/18	4/17	4/16	4/15	4/14	4/13	4/12	4/11	4/ 6	4/ 1	3/27	3/22	
			.1MM	332	544	736	965	1148	1230	1349	1559	1721	1886	2146	2559	2823	2865	1974
1979	273	100	M/D	3/23	3/22	3/22	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/10	3/ 5	3/ 3	2/23	
			.1MM	246	457	638	812	931	931	931	931	931	931	1109	1543	1732	1821	1557
1980	274	100	M/D	3/21	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/16	3/10	3/10	3/10	
			.1MM	509	685	813	950	1005	1060	1216	1267	1267	1267	1305	1307	1307	1307	692
1981	273	100	M/D	2/20	2/19	2/20	2/19	2/18	2/17	2/17	2/17	2/17	2/17	2/ 8	2/ 8	2/ 1	1/25	
			.1MM	236	460	662	886	1041	1188	1188	1188	1188	1188	1434	1434	1508	1548	1087
1982	273	100	M/D	3/31	3/31	3/30	3/31	3/30	3/30	3/30	3/25	3/25	3/25	3/30	3/25	3/11	3/12	
			.1MM	388	516	592	684	760	760	760	804	804	972	1181	1394	1578	1660	1284
1983	273	100	M/D	1/10	2/ 2	12/23	12/23	12/23	12/23	3/ 8	3/ 8	3/ 6	12/16	12/15	12/23	1/10	12/15	
			.1MM	282	309	366	366	366	366	371	371	395	398	588	666	666	888	399
1984	274	100	M/D	2/14	4/ 3	4/ 2	4/ 1	3/31	3/30	3/29	3/29	3/29	3/29	3/21	3/16	3/15	3/15	
			.1MM	309	404	517	644	720	823	914	914	914	914	1154	1205	1207	1207	1018
1985	273	100	M/D	3/28	3/27	3/27	3/27	3/27	3/24	3/23	3/23	3/28	3/27	3/23	3/11	3/12	3/ 8	
			.1MM	453	679	839	874	874	919	1020	1055	1128	1354	1535	1551	1915	2132	1179
1986	273	100	M/D	3/19	1/19	1/18	1/18	3/15	3/15	3/13	3/19	3/18	3/17	3/13	3/ 9	3/ 2	3/ 2	
			.1MM	267	412	522	522	554	554	562	619	674	703	914	1036	1072	1072	800
1987	273	100	M/D	3/22	3/21	3/20	3/19	3/18	3/17	3/17	3/17	3/17	3/17	3/ 8	3/ 7	2/28	2/28	
			.1MM	233	402	471	502	561	601	601	601	601	601	828	989	1132	1132	981
1988	274	100	M/D	11/29	3/25	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/24	3/13	3/ 7	3/ 7	3/ 7	
			.1MM	315	583	754	754	754	754	754	754	754	754	804	887	887	887	643
1989	273	100	M/D	3/28	3/27	3/26	3/25	3/24	3/24	3/24	3/25	3/25	3/24	3/24	3/14	3/14	3/14	
			.1MM	372	663	822	933	945	945	973	1007	1019	1019	1310	1384	1384	1396	900

1990	273	100	M/D	3/15	3/11	3/11	3/12	3/11	3/11	3/10	3/10	3/10	3/10	3/ 2	3/ 2	2/22	2/15		
			.1MM	192	355	504	619	784	870	882	882	882	882	954	954	1105	1111	931	
1991	273	100	M/D	2/ 5	2/ 4	2/ 4	2/ 4	2/ 3	2/ 3	12/17	12/17	12/21	12/21	12/17	3/ 1	3/ 1	2/18		
			.1MM	204	369	448	530	543	543	553	553	633	663	804	981	1121	1230	924	
1992	274	100	M/D	3/26	3/26	3/25	3/25	3/26	3/26	3/26	3/25	3/25	4/ 7	3/26	3/26	3/25	3/25		
			.1MM	472	638	646	646	710	836	891	899	899	919	1482	1682	2073	2073	1441	
1993	273	100	M/D	1/ 4	3/29	3/28	3/27	3/26	3/26	3/25	3/24	3/24	3/26	3/24	3/24	3/16	3/16		
			.1MM	361	559	757	967	1100	1199	1271	1322	1322	1342	1822	1822	1919	1919	1614	
1994	273	100	M/D	4/10	4/ 9	4/ 9	4/ 9	4/ 8	4/ 7	4/ 5	4/ 5	4/ 4	4/ 3	3/29	3/22	3/21	3/15		
			.1MM	265	471	656	770	845	898	934	1048	1099	1121	1279	1531	1905	1942	1484	
1995	273	100	M/D	1/15	1/15	1/14	1/13	1/12	1/12	1/12	1/13	1/12	1/12	1/12	1/12	1/12	12/18		
			.1MM	583	689	740	830	890	890	890	976	1036	1073	1073	1073	1098	1123	405	
1996	274	100	M/D	1/19	1/18	1/17	1/16	2/20	2/20	2/20	2/20	2/20	2/20	3/25	3/13	3/14	3/13		
			.1MM	381	581	583	619	760	802	802	824	824	824	987	1088	1236	1411	1494	
1997	273	100	M/D	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	4/ 1	4/ 1	3/30	3/29	3/28	3/25	3/25	3/25	3/25		
			.1MM	389	729	967	1076	1213	1254	1254	1288	1532	1635	1904	1919	1919	1919	1602	
1998	273	100	M/D	3/26	3/26	3/25	3/25	1/ 5	1/ 3	1/ 3	1/ 3	1/ 3	1/ 3	2/17	2/11	2/11	2/11		
			.1MM	294	556	562	562	592	662	762	762	762	762	922	1000	1035	1035	751	
1999	273	100	M/D	3/30	3/29	3/28	3/27	3/27	3/27	1/18	1/17	3/22	3/22	3/17	3/17	3/17	3/ 1		
			.1MM	204	403	599	648	648	648	729	763	828	828	1119	1119	1119	1194	813	
2000	274	100	M/D	2/27	2/27	2/26	2/25	2/24	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23	2/23		
			.1MM	226	389	502	544	640	766	777	827	827	827	827	827	912	1012	746	
2001	273	100	M/D	11/26	4/10	4/ 9	4/ 8	4/ 7	4/ 6	4/ 5	4/ 4	4/ 3	4/ 2	3/28	3/23	3/18	3/14		
			.1MM	309	478	715	951	1092	1207	1374	1463	1518	1613	1747	1839	2056	2126	1815	
2002	273	100	M/D	3/30	3/30	3/29	3/28	3/28	3/28	3/28	3/28	3/28	3/28	2/15	2/10	2/15	2/10		
			.1MM	177	330	442	492	492	492	492	492	492	492	636	656	696	716	392	
2003	272	100	M/D	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/20	3/17	3/17	3/16	3/16	3/17	3/16		
			.1MM	272	400	583	769	920	1143	1241	1241	1404	1502	1510	1510	1597	1605	1131	
2004	274	100	M/D	3/ 5	3/ 4	3/ 3	3/ 2	3/ 1	2/29	2/29	2/29	2/29	2/29	2/29	2/29	3/ 1	2/29		
			.1MM	438	548	642	868	923	1007	1042	1042	1042	1042	1057	1077	1192	1276	704	
2005	273	100	M/D	3/31	3/30	3/29	3/28	3/27	3/27	3/27	3/24	3/24	3/22	3/20	3/20	3/20	3/20		
			.1MM	322	468	761	887	918	936	936	982	1000	1008	1069	1069	1069	1069	980	
2006	273	100	M/D	3/11	3/10	3/10	3/10	3/ 9	3/ 9	3/ 9	3/ 9	3/ 9	1/11	1/10	1/17	1/12	1/10		
			.1MM	219	373	499	617	726	739	739	739	739	754	771	1047	1302	1377	580	
2007	273	100	M/D	3/14	3/13	3/12	3/12	3/10	3/10	3/10	3/10	3/13	3/13	3/10	3/10	3/10	3/12		
			.1MM	335	527	608	608	612	612	612	612	626	734	819	819	819	825	578	
2008	274	100	M/D	1/ 7	1/ 7	1/ 7	1/ 6	4/ 7	4/ 6	4/ 5	4/ 5	4/ 7	4/ 5	4/ 1	3/31	3/25	3/18		
			.1MM	395	695	951	1055	1121	1236	1456	1548	1669	1850	2302	2424	2512	2762	2084	
2009	273	100	M/D	2/11	2/11	3/17	3/15	3/15	3/ 6	3/ 5	3/11	3/10	3/10	3/ 5	2/27	2/26	2/26		
			.1MM	259	417	435	506	556	599	612	654	743	793	1168	1305	1382	1551	1282	
2010	273	100	M/D	1/24	1/24	1/24	1/24	1/24	1/24	2/24	2/23	2/28	2/27	2/23	2/17	2/17	2/17		
			.1MM	316	528	578	578	578	578	596	638	639	739	1011	1020	1020	1020	823	
2011	273	100	M/D	3/10	3/17	3/16	3/15	3/ 9	3/ 5	3/ 5	3/ 5	3/10	3/ 9	3/ 4	3/ 4	2/27	2/17		
			.1MM	270	438	489	493	510	590	694	758	954	1004	1302	1353	1377	1628	651	
2012	274	100	M/D	3/ 8	3/ 7	3/ 7	3/ 7	3/ 7	3/ 7	3/ 2	3/ 2	3/ 3	3/ 2	3/ 2	2/22	2/15	2/15		
			.1MM	313	408	408	408	448	448	474	474	482	513	513	607	824	863	535	
2013	273	100	M/D	1/30	3/11	3/27	3/28	3/28	3/26	3/26	3/25	3/24	3/24	3/24	3/25	3/ 8	3/10		
			.1MM	280	364	449	610	720	843	952	982	1031	1031	1260	1403	1497	1699	1431	
2014	273	100	M/D	4/ 7	4/ 7	4/ 6	4/ 7	4/ 7	4/ 6	4/ 4	4/ 4	4/ 2	4/ 2	3/28	3/28	3/19	3/19		
			.1MM	291	451	543	811	932	1023	1126	1247	1316	1437	1768	1768	1837	1837	1251	
2015	273	100	M/D	4/ 3	4/ 2	4/ 2	4/ 2	3/30	4/ 2	4/ 3	4/ 2	4/ 2	4/ 2	3/26	3/25	3/21	3/11		
			.1MM	320	505	505	505	588	607	719	904	1001	1001	1092	1191	1278	1393	1073	
2016	117	43	**	M/D	1/10	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	1/ 9	12/29	1/ 9	1/ 9	12/29	
			.1MM	325	350	350	350	350	350	350	350	350	350	354	372	372	376		

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		1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY	15 DAY	20 DAY	25 DAY	30 DAY
MEAN EXTREME	(MM)	33.2	54.0	68.9	80.7	90.8	99.8	107.5	113.8	120.3	127.0	151.4	167.7	178.9	187.7
STD. DEV.	(MM)	8.7	13.9	19.5	24.3	28.3	31.5	34.7	37.6	41.2	45.4	54.6	61.5	65.0	68.1
YEARS ANALYSED		124	124	124	124	124	124	124	124	124	124	124	124	124	124
MAX EXTREME	(MM)	92.5	138.0	172.2	177.2	181.4	204.6	224.6	236.8	243.6	252.7	311.2	363.7	363.7	383.1
YEAR		1923	1923	1923	1923	1943	1943	1943	1943	1943	1971	1971	1971	1971	1971

** NOTE ** VALUE IN FLAG INDICATES YEAR NOT INCLUDED IN ANALYSIS BASED ON % DAYS OPERATIONAL (<90.0%)

METEOROLOGICAL SERVICE OF CANADA
RAIN+SNOWMELT DEPTH, DURATION, FREQUENCY VALUES
PREPARED BY THE ENGINEERING CLIMATE SERVICES UNIT

*

STATION : OTTAWA CDA

STATION NUMBER 6105976

LATITUDE: 45.38N LONGITUDE: 75.72W ELEVATION (M): 79

ARCHIVE: DLY04 (01/11/1889 - 31/12/2006) DLY44 (01/01/2007 - 26/01/2016)

SNOWMELT MODEL 5 - Modification of Model 4

CRITICAL PERIOD : 1ST OF MONTH 10 (PRECEDING YEAR) TO THE END OF MONTH 6

NOTE : MODIFIED GUMBEL 12/82

RETURN PERIOD VALUES (MM) WITH 50% CONFIDENCE LIMITS

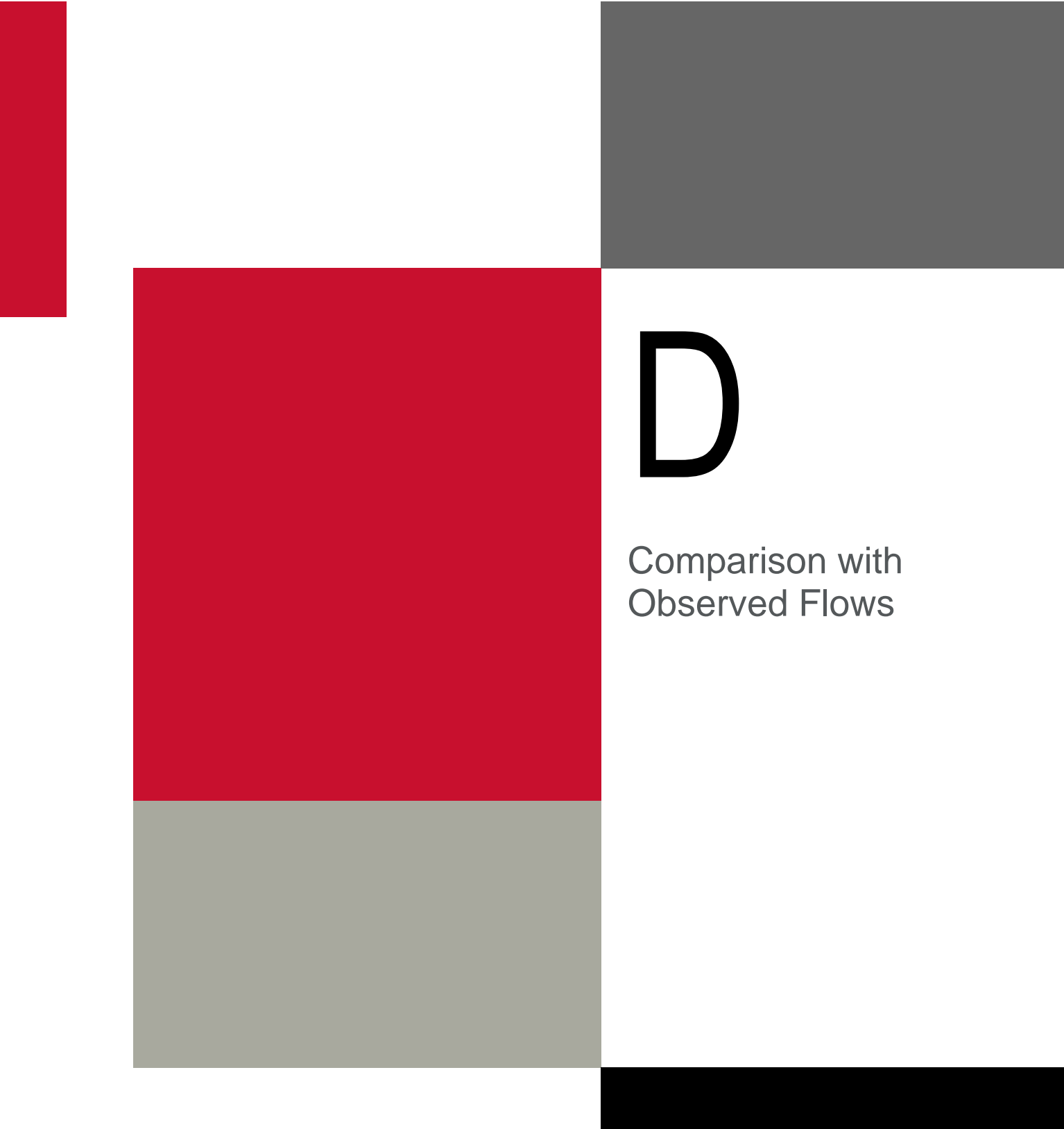
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RETURN PERIOD YEARS	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY
2	31.76+/- 0.48	51.71+/- 0.77	65.67+/- 1.08	76.74+/- 1.35	86.18+/- 1.57
5	39.42+/- 0.81	64.01+/- 1.30	82.86+/- 1.82	98.17+/- 2.27	111.18+/- 2.65
10	44.49+/- 1.10	72.16+/- 1.76	94.24+/- 2.46	112.36+/- 3.06	127.73+/- 3.57
25	50.90+/- 1.48	82.45+/- 2.37	108.62+/- 3.31	130.29+/- 4.13	148.64+/- 4.82
50	55.66+/- 1.77	90.09+/- 2.84	119.29+/- 3.97	143.59+/- 4.94	164.15+/- 5.77
100	60.37+/- 2.06	97.67+/- 3.31	129.88+/- 4.62	156.79+/- 5.76	179.55+/- 6.72

RETURN PERIOD YEARS	6 DAY	7 DAY	8 DAY	9 DAY	10 DAY
2	94.65+/- 1.75	101.84+/- 1.93	107.61+/- 2.09	113.53+/- 2.29	119.52+/- 2.52
5	122.51+/- 2.95	132.50+/- 3.25	140.82+/- 3.52	149.94+/- 3.86	159.60+/- 4.24
10	140.96+/- 3.98	152.80+/- 4.38	162.81+/- 4.75	174.05+/- 5.21	186.13+/- 5.73
25	164.26+/- 5.37	178.45+/- 5.91	190.59+/- 6.40	204.51+/- 7.02	219.66+/- 7.73
50	181.55+/- 6.43	197.48+/- 7.07	211.20+/- 7.66	227.10+/- 8.40	244.54+/- 9.25
100	198.72+/- 7.49	216.37+/- 8.24	231.66+/- 8.93	249.53+/- 9.79	269.23+/-10.77

RETURN PERIOD YEARS	15 DAY	20 DAY	25 DAY	30 DAY
2	142.40+/- 3.03	157.57+/- 3.42	168.18+/- 3.61	176.55+/- 3.78
5	190.66+/- 5.11	211.90+/- 5.75	225.62+/- 6.08	236.74+/- 6.37
10	222.60+/- 6.90	247.87+/- 7.77	263.66+/- 8.21	276.59+/- 8.61
25	262.97+/- 9.30	293.32+/-10.48	311.71+/-11.08	326.93+/-11.60
50	292.92+/-11.13	327.04+/-12.54	347.36+/-13.25	364.28+/-13.89
100	322.64+/-12.97	360.51+/-14.60	382.75+/-15.44	401.36+/-16.18

** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 1 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1934 BASED ON 1 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 2 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 3 DAYS ACCUMULATION
 ** WARNING ** : 100 YEAR VALUES IN 1923 BASED ON 4 DAYS ACCUMULATION

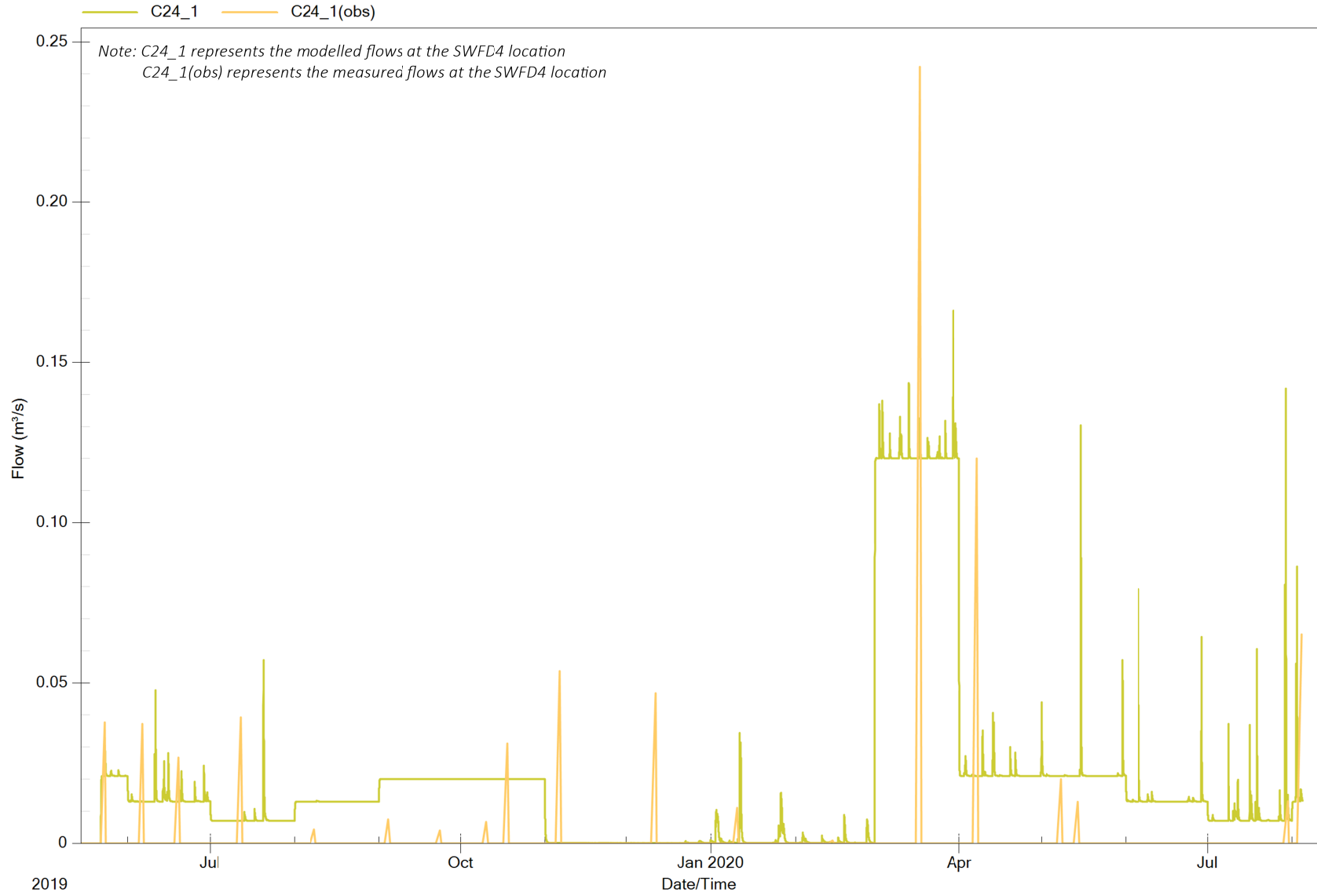
A decorative graphic consisting of several overlapping rectangular blocks. A large red block is on the left, with a grey block above it and another grey block below it. A black block is at the bottom right. The letter 'D' is positioned to the right of the red block.

D

Comparison with Observed Flows

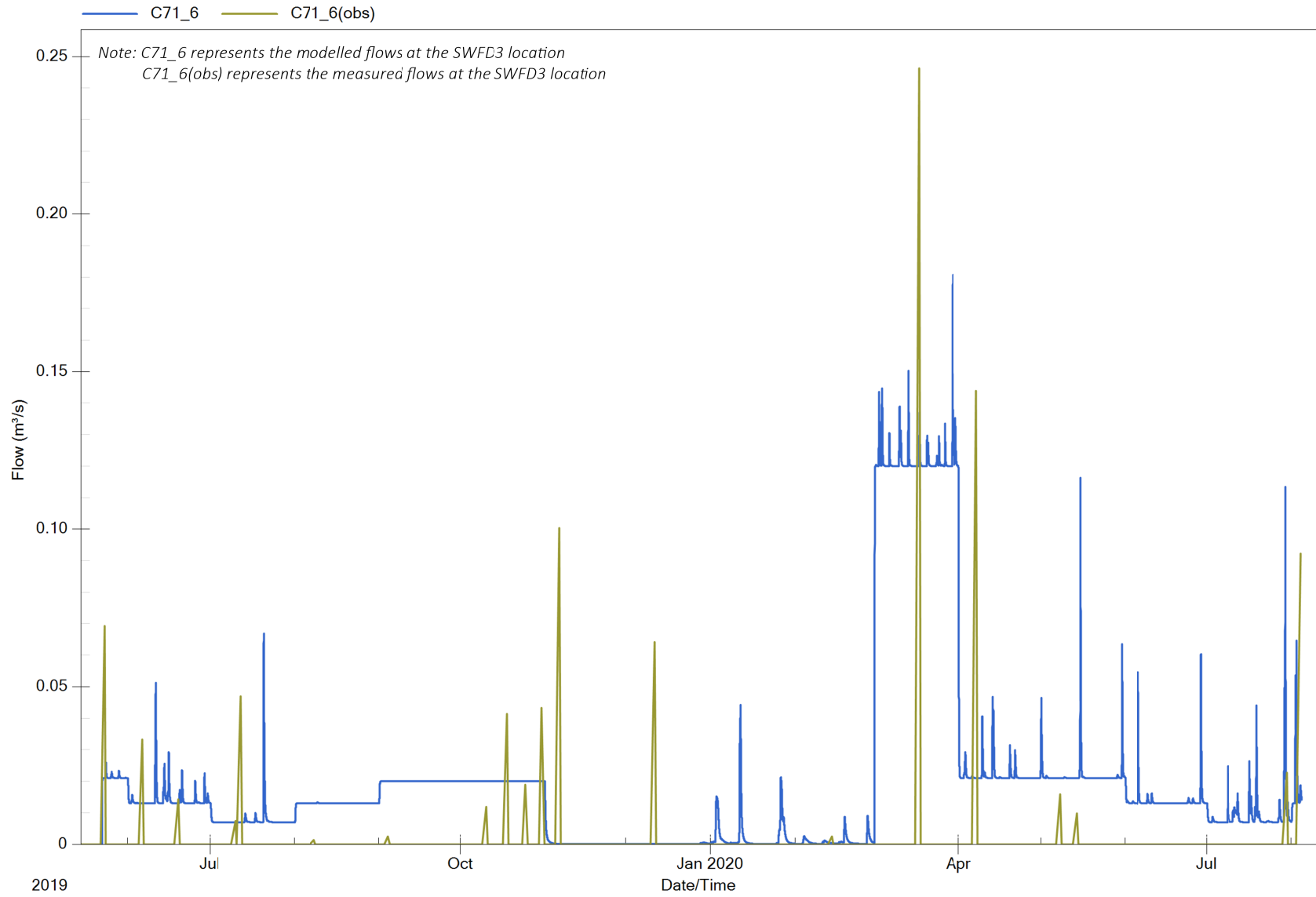
Comparison of Modelled and Measured Flows - SWFD4

May 2019 to August 2020, 5-minute Time Interval



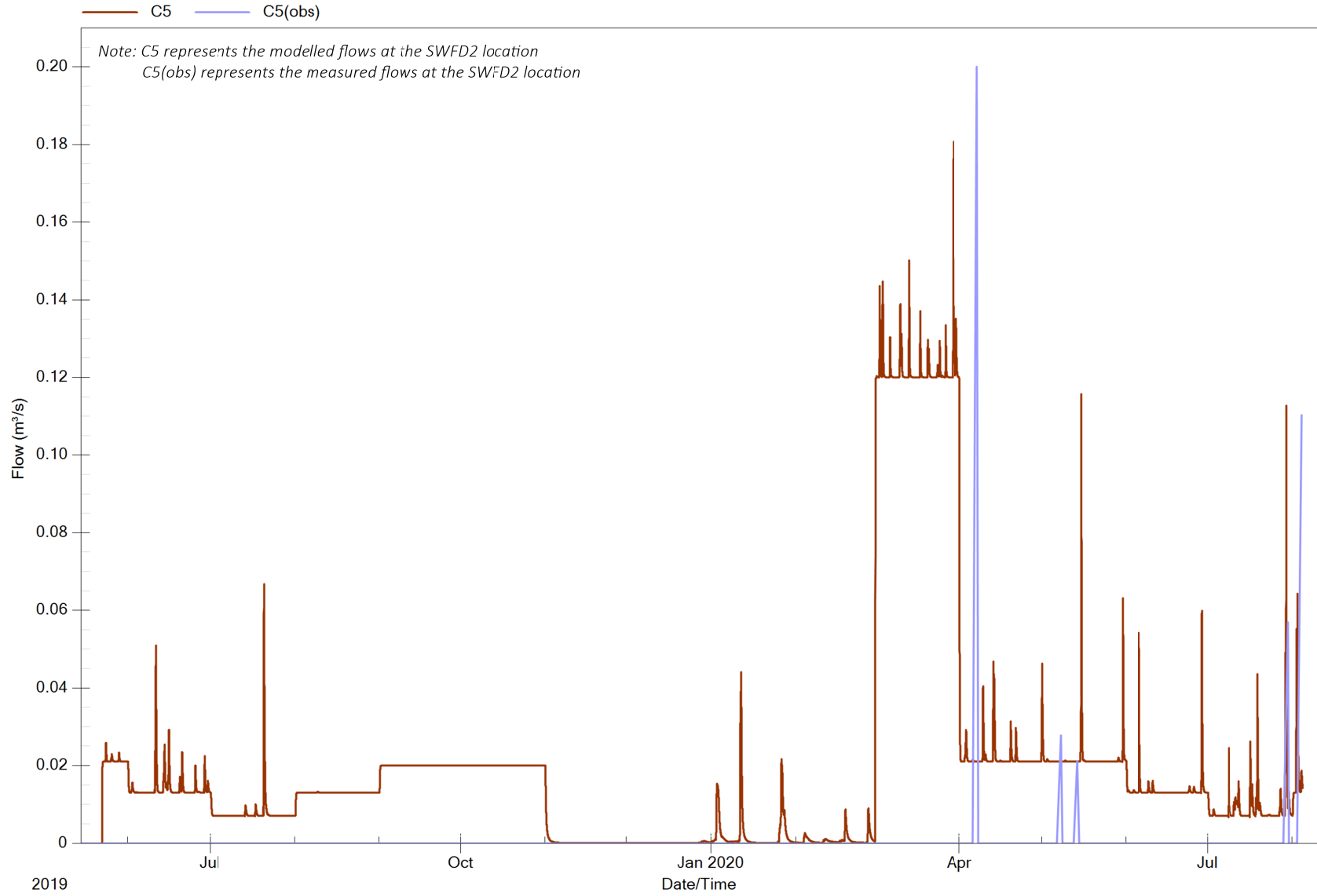
Comparison of Modelled and Measured Flows - SWFD3

May 2019 to August 2020, 5-minute Time Interval



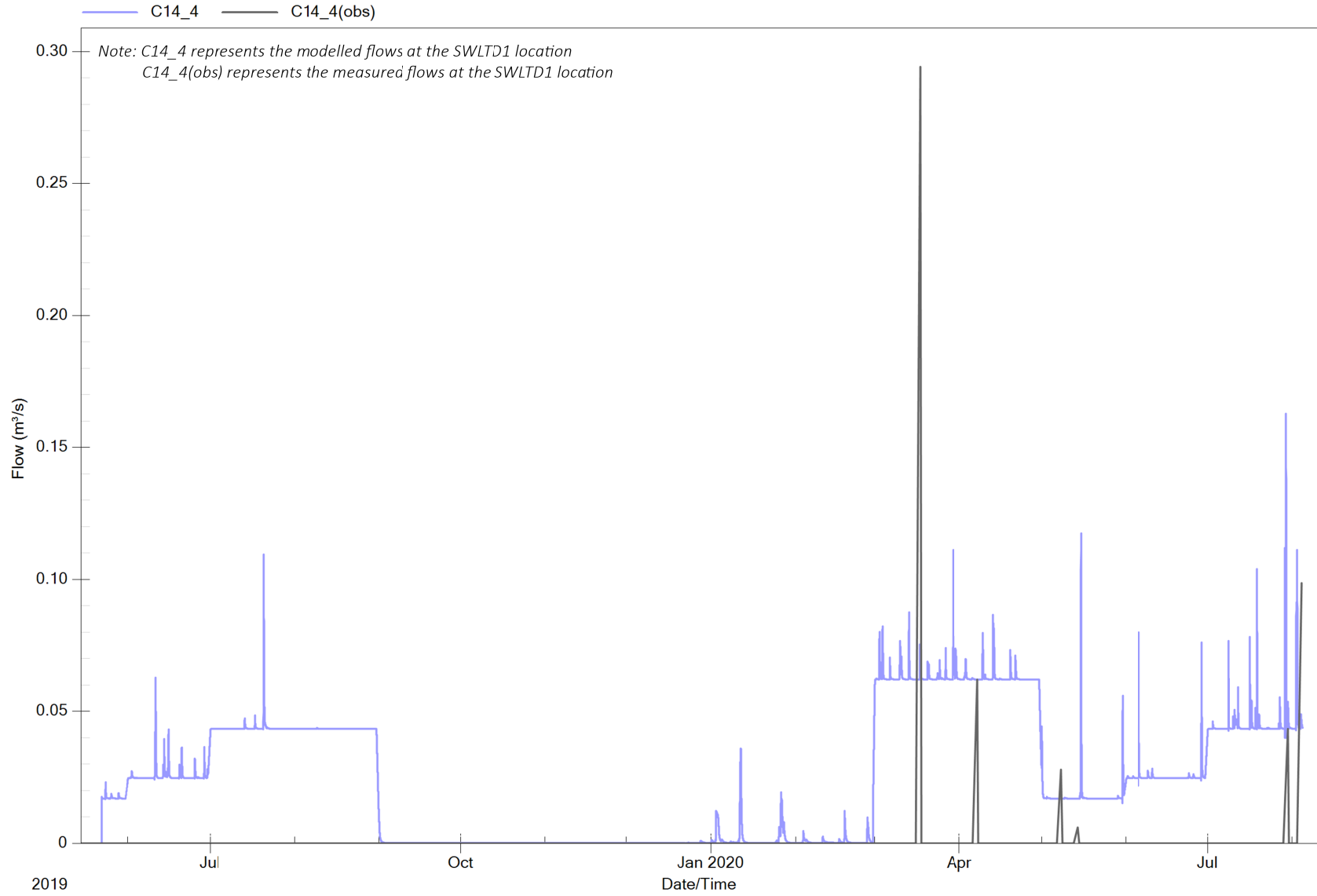
Comparison of Modelled and Measured Flows - SWFD2

May 2019 to August 2020, 5-minute Time Interval



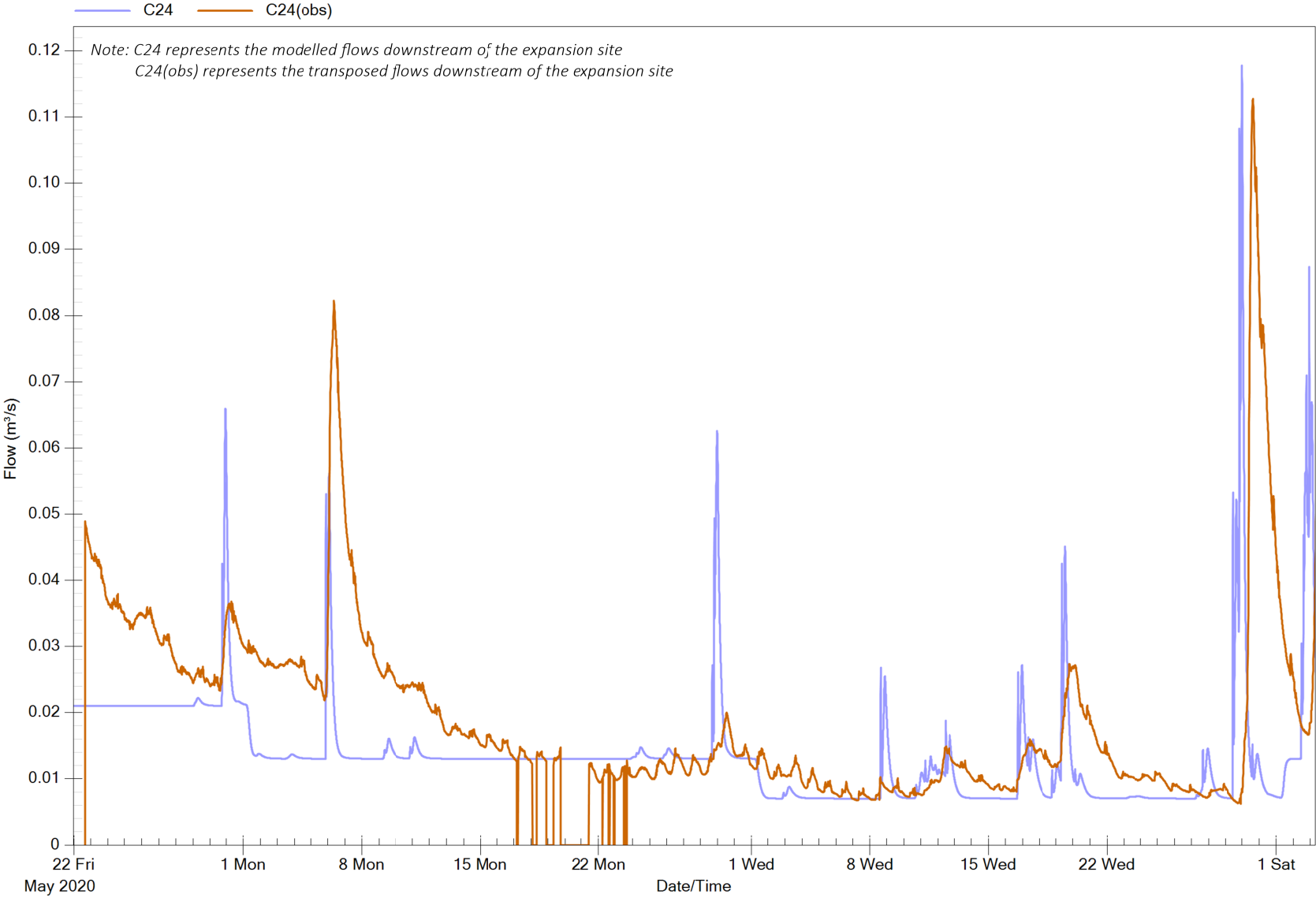
Comparison of Modelled and Measured Flows - SWLTD1

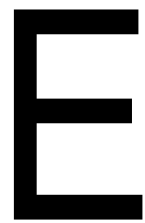
May 2019 to August 2020, 5-minute Time Interval



Comparison of Modelled and Measured Flows - Downstream of EOWHF Future Development Site

May 2020 to August 2020, 5-minute Time Interval





Culvert Summary Table

Hydraulic Model Input Parameters

PC-SWMM Culvert Parameters

Conduits

Name	Inlet Node	Outlet Node	Length (m)	Roughness	Cross-Section	Geom1 (m)	Geom2 (m)	Barrels	Slope (m/m)	Description
C3_8	J20	J19	11.981	0.024	CIRCULAR	0.6	0	1	0.01636	Fraser
C3_10	J24	J22	9.253	0.024	FILLED_CIRCULAR	0.6	0.06	1	0.01016	Fraser
C3_12	J28	J26	9.457	0.024	FILLED_CIRCULAR	0.6	0.2	1	0.00222	Fraser
C3_14	J31	J30	9.239	0.024	FILLED_CIRCULAR	0.6	0.1	1	0.0118	Fraser
C3_2	J12	J33	9.575	0.024	FILLED_CIRCULAR	0.6	0.15	1	-0.00836	Fraser
C3_17	J37	J35	5.058	0.024	FILLED_CIRCULAR	1.05	0.3	1	0.00949	Fraser
C3_19	J39	J38	6.443	0.024	FILLED_CIRCULAR	2	0.9	1	0.00078	Upper Tayside
C3_21	J40	J41	10.171	0.013	CIRCULAR	0.75	0	1	0.00472	Upper Tayside
C3_22	J42	J43	9.119	0.024	FILLED_CIRCULAR	1.2	0.1	1	-0.00548	Upper Tayside
C71_3	J48	J25	29.434	0.024	CIRCULAR	1.5	0	1	0.0051	Fraser
C17_7	J52	J51	12.73	0.024	CIRCULAR	2.1	0	1	0.01116	Upper Tayside
C14_3	J45	J46	26.423	0.024	CIRCULAR	2.4	0	2	0.00643	Upper Tayside

Junctions

Name	X-Coordinate	Y-Coordinate	Invert Elev. (m)	Rim Elev. (m)
J48	500838.73	5016857.744	65.24	65.24
J12	501141.636	5017046.303	66.632	66.632
J19	500881.511	5016886.015	65.58	65.58
J20	500891.712	5016892.29	65.776	65.776
J22	500960.164	5016935.545	66.387	66.387
J24	500968.333	5016939.883	66.481	66.481
J26	501050.038	5016989.716	66.539	66.539
J28	501058.31	5016994.292	66.56	66.56
J30	501091.228	5017014.945	66.63	66.63
J31	501099.296	5017019.441	66.739	66.739
J33	501133.578	5017041.138	66.712	66.712
J35	501315.045	5017150.984	66.752	66.752
J37	501319.393	5017153.563	66.8	66.8
J38	501497.626	5017258.999	65.969	65.969
J39	501503.467	5017261.712	65.974	65.974
J40	501576.989	5017308.147	66.534	66.534
J41	501585.701	5017313.387	66.486	66.486
J42	501784.674	5017434.373	65.896	65.896
J43	501792.558	5017438.948	65.946	65.946
J25	500825.266	5016883.907	65.09	65.09
J51	501823.843	5017474.435	65.34	65.34
J52	501831.35	5017464.16	65.482	65.482
J45	501487.019	5018444.474	64.33	64.33
J46	501509.835	5018457.779	64.16	64.16