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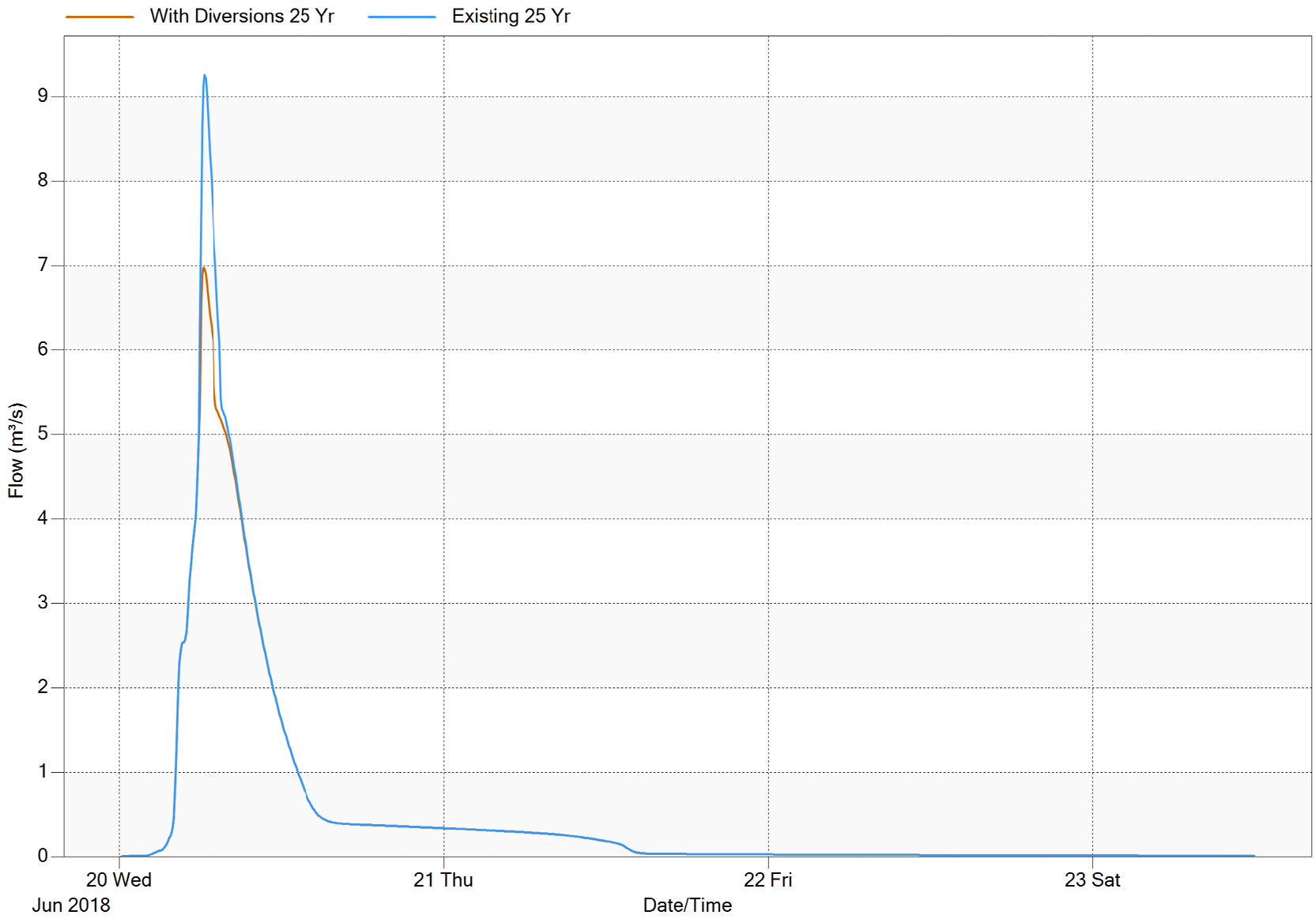
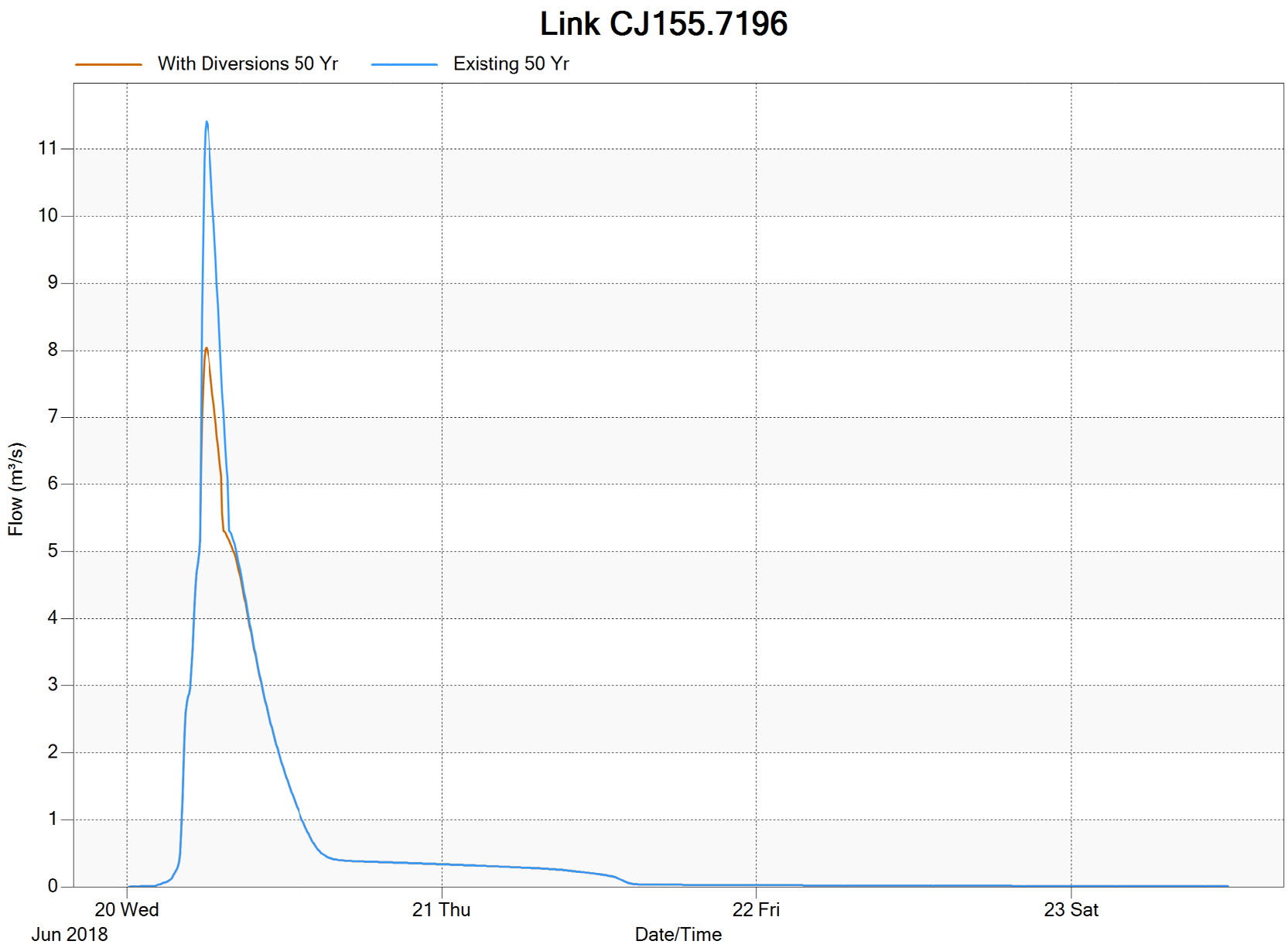
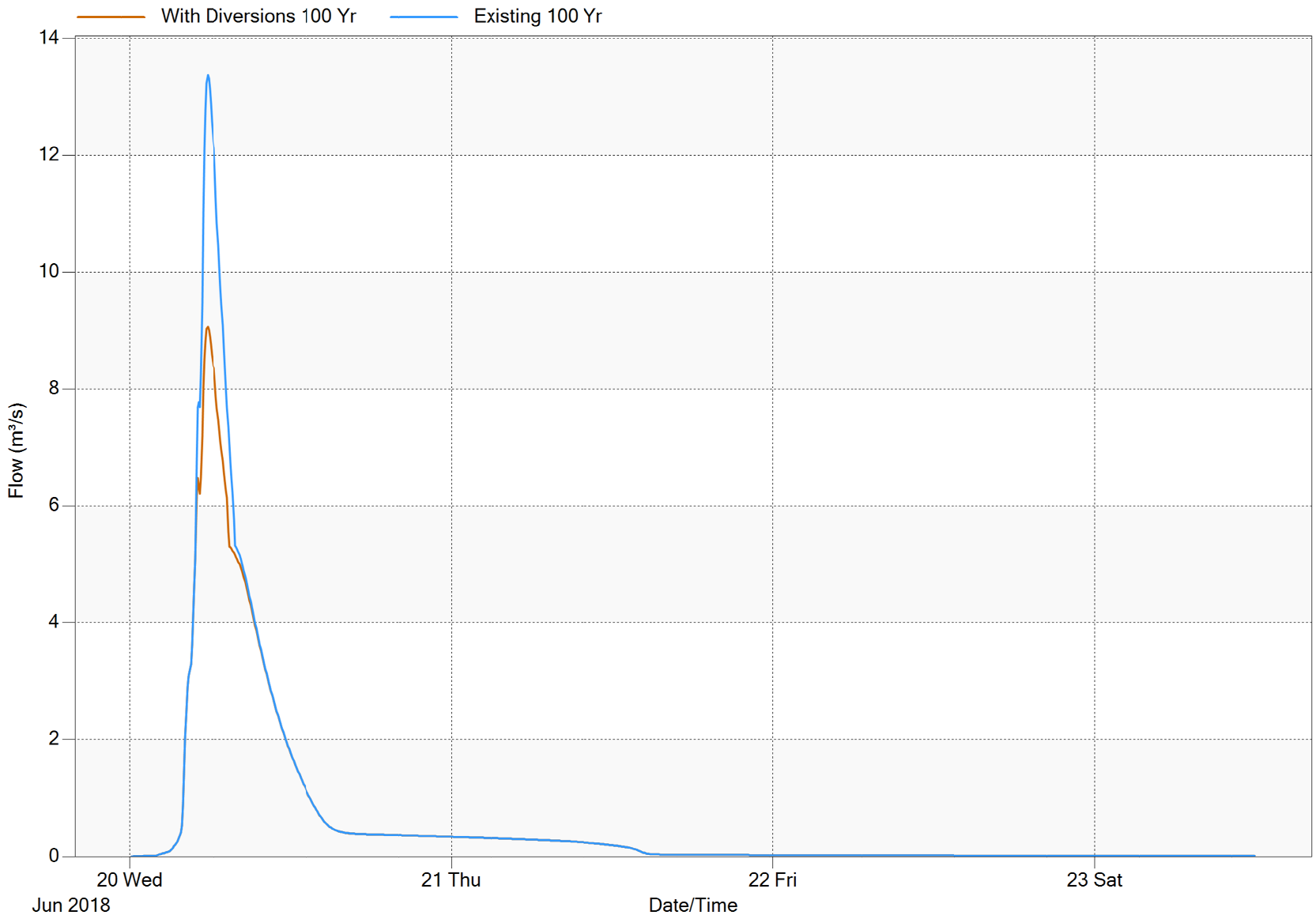
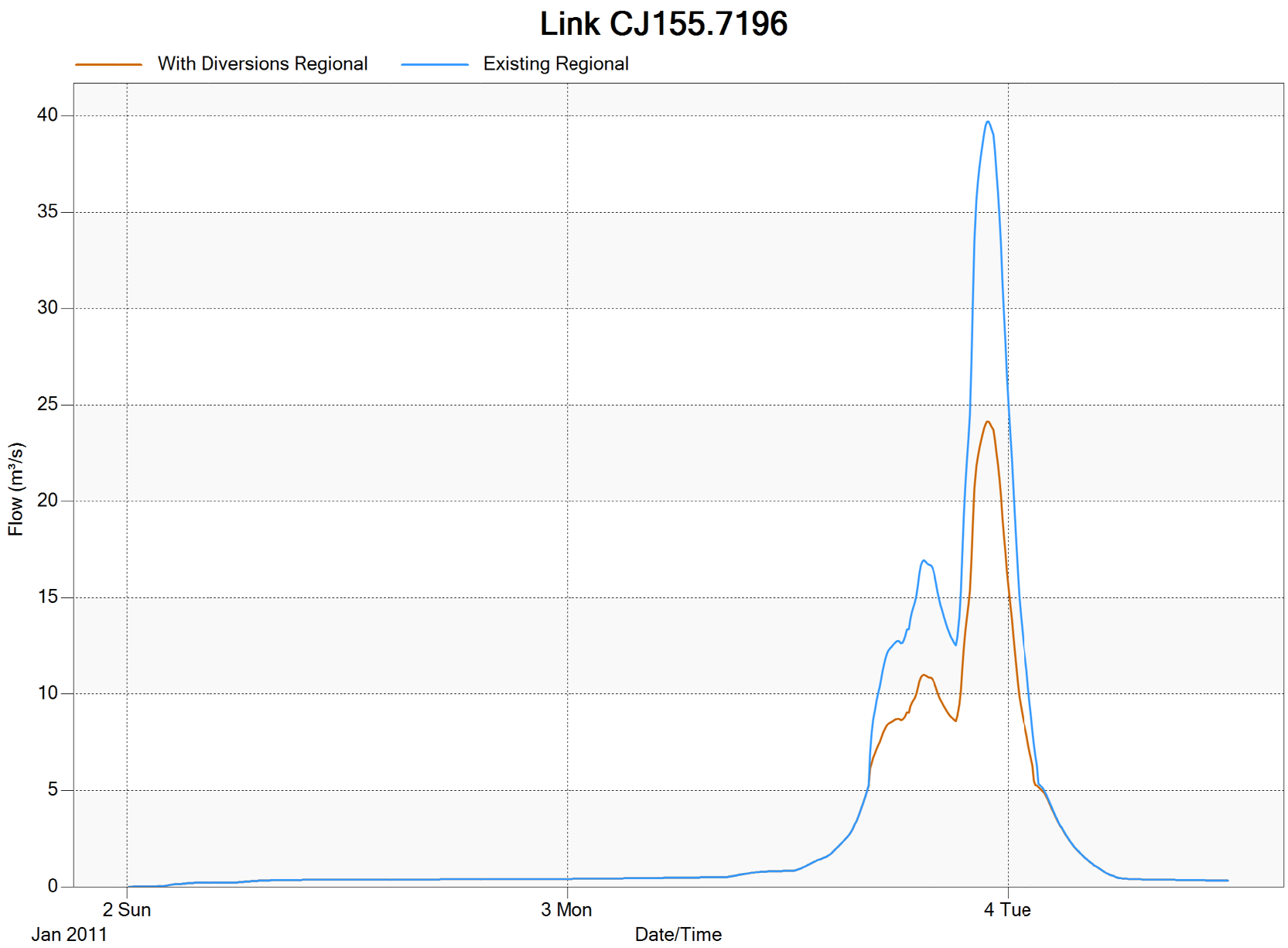


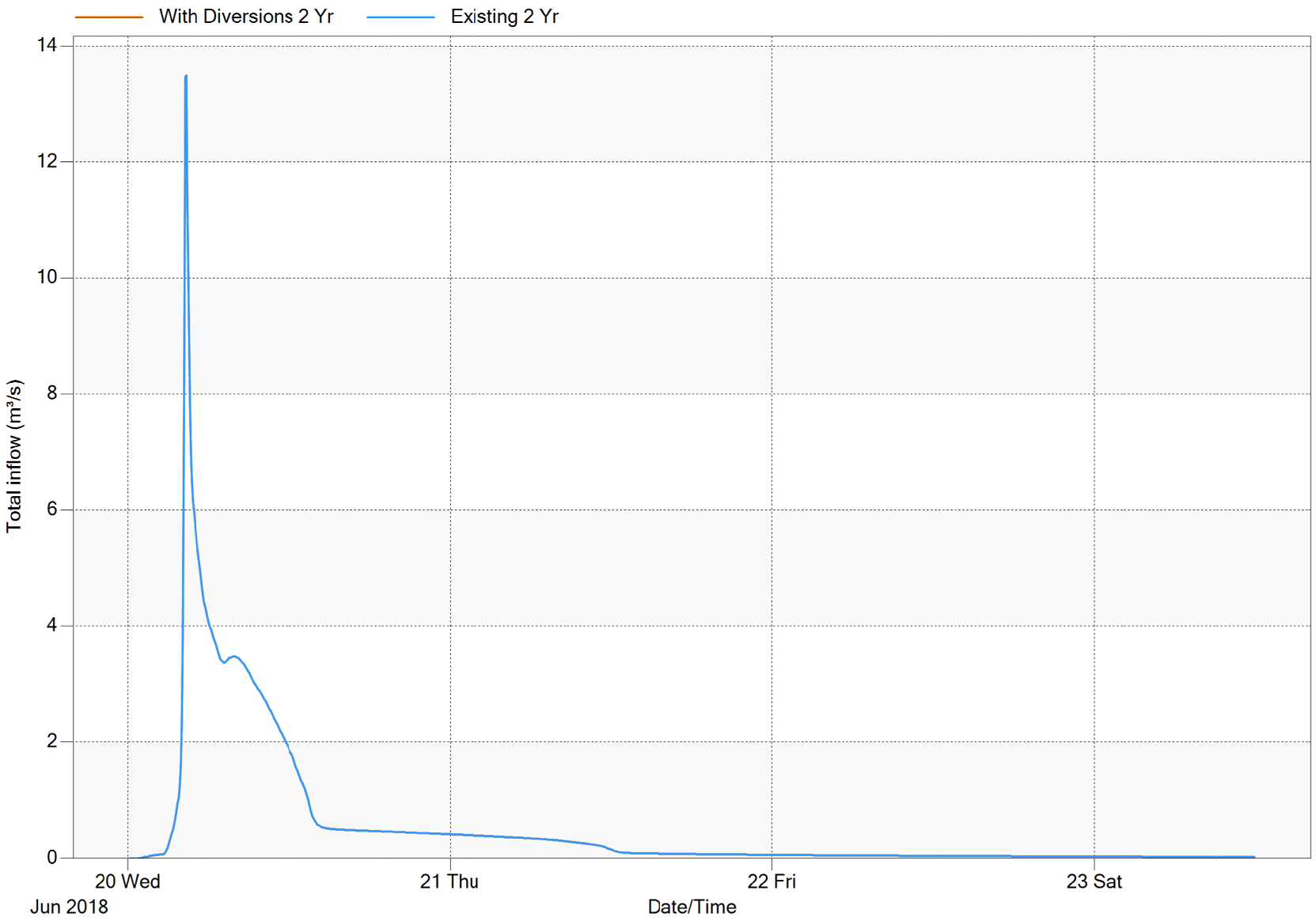

Link CJ155.7196
With Diversions 50 Yr
Existing 50 Yr
Flow (m³/s)
0
1
2
3
4
5
6
7
8
9
10
11
20 Wed
Jun 2018
21 Thu
22 Fri
23 Sat
Date/Time

Link CJ155.7196




Link CJ155.7196
With Diversions Regional
Existing Regional
Flow (m³/s)
40
35
30
25
20
15
10
5
0
2 Sun
Jan 2011
3 Mon
4 Tue
Date/Time

Node J2295.416



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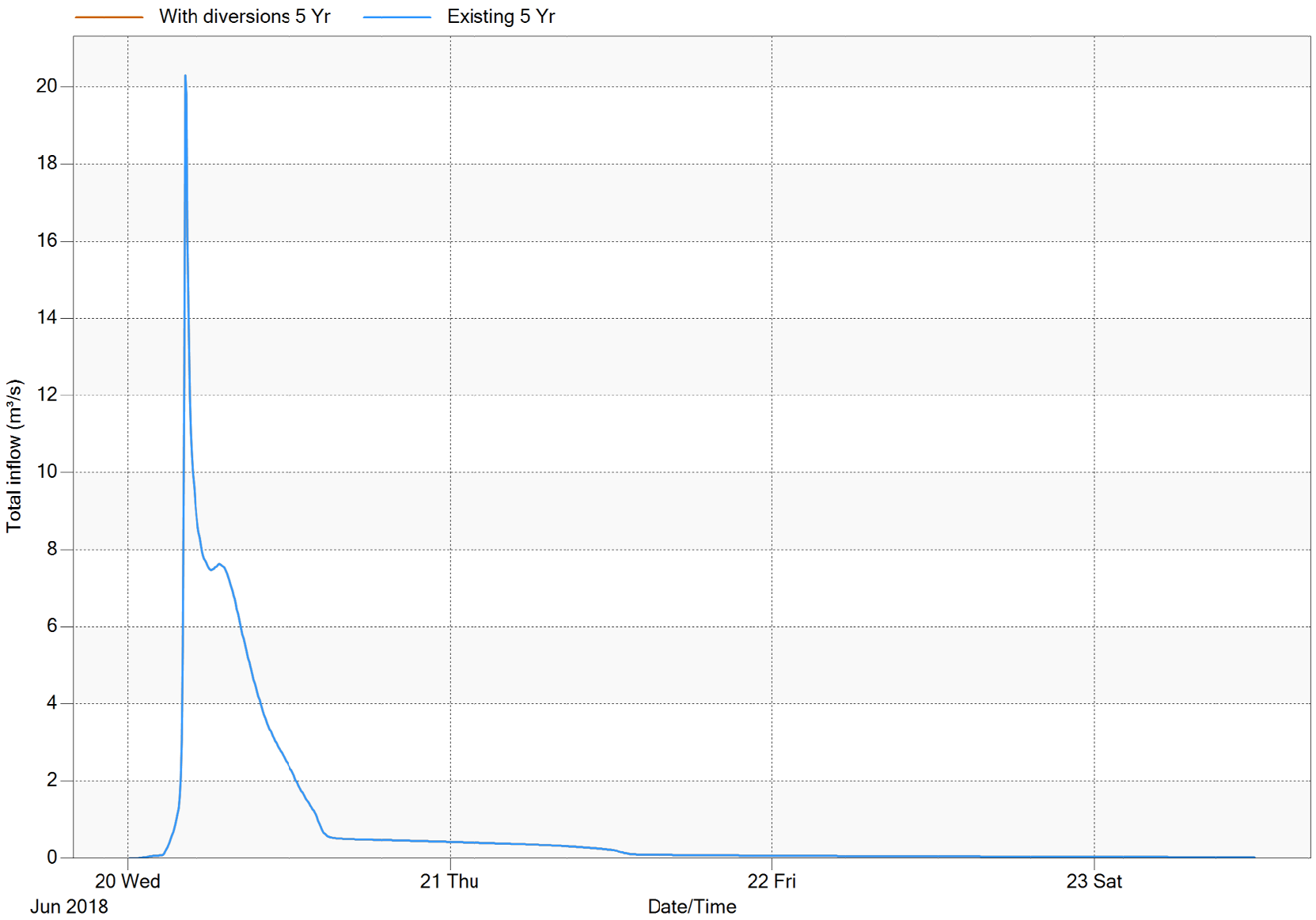

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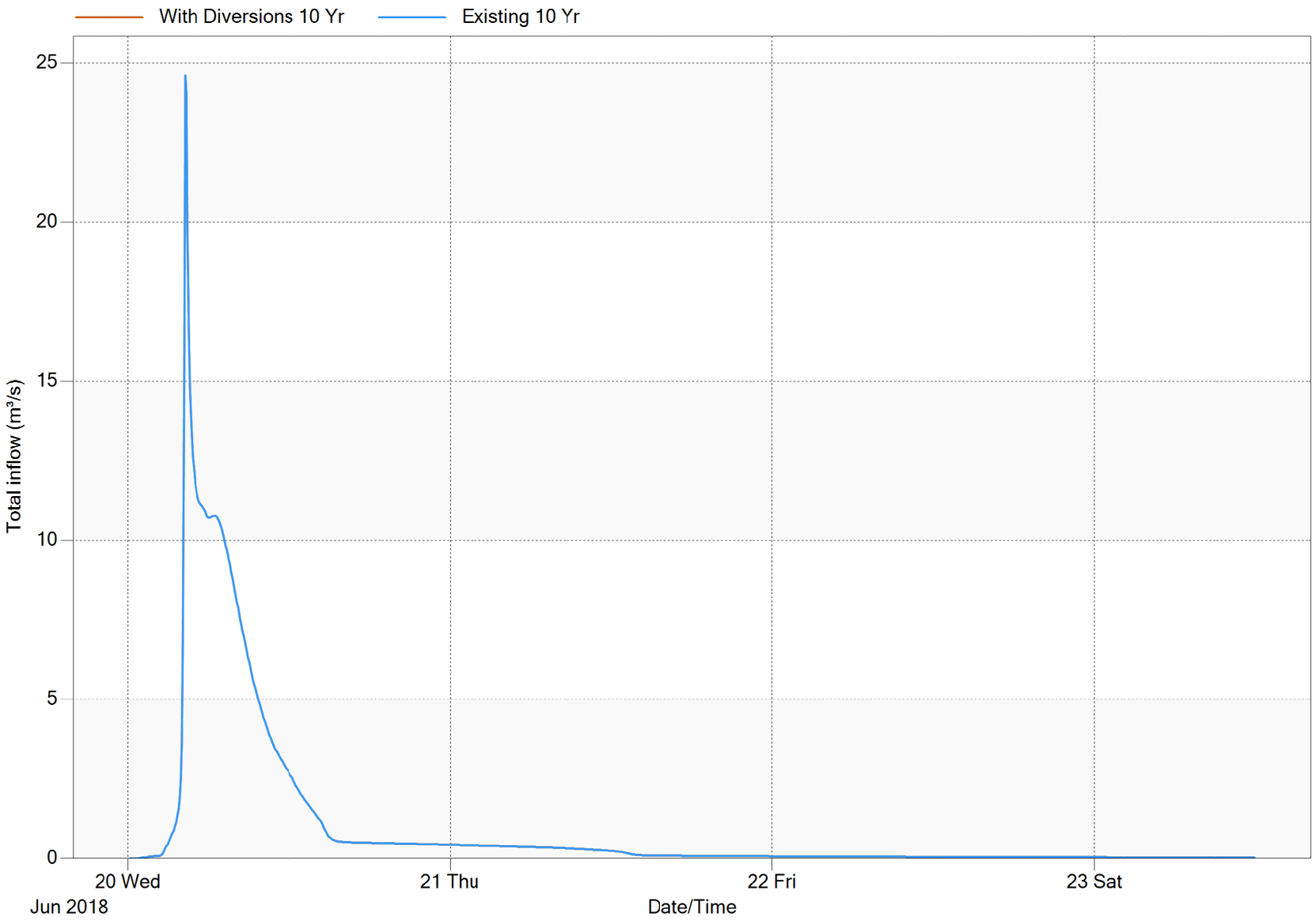

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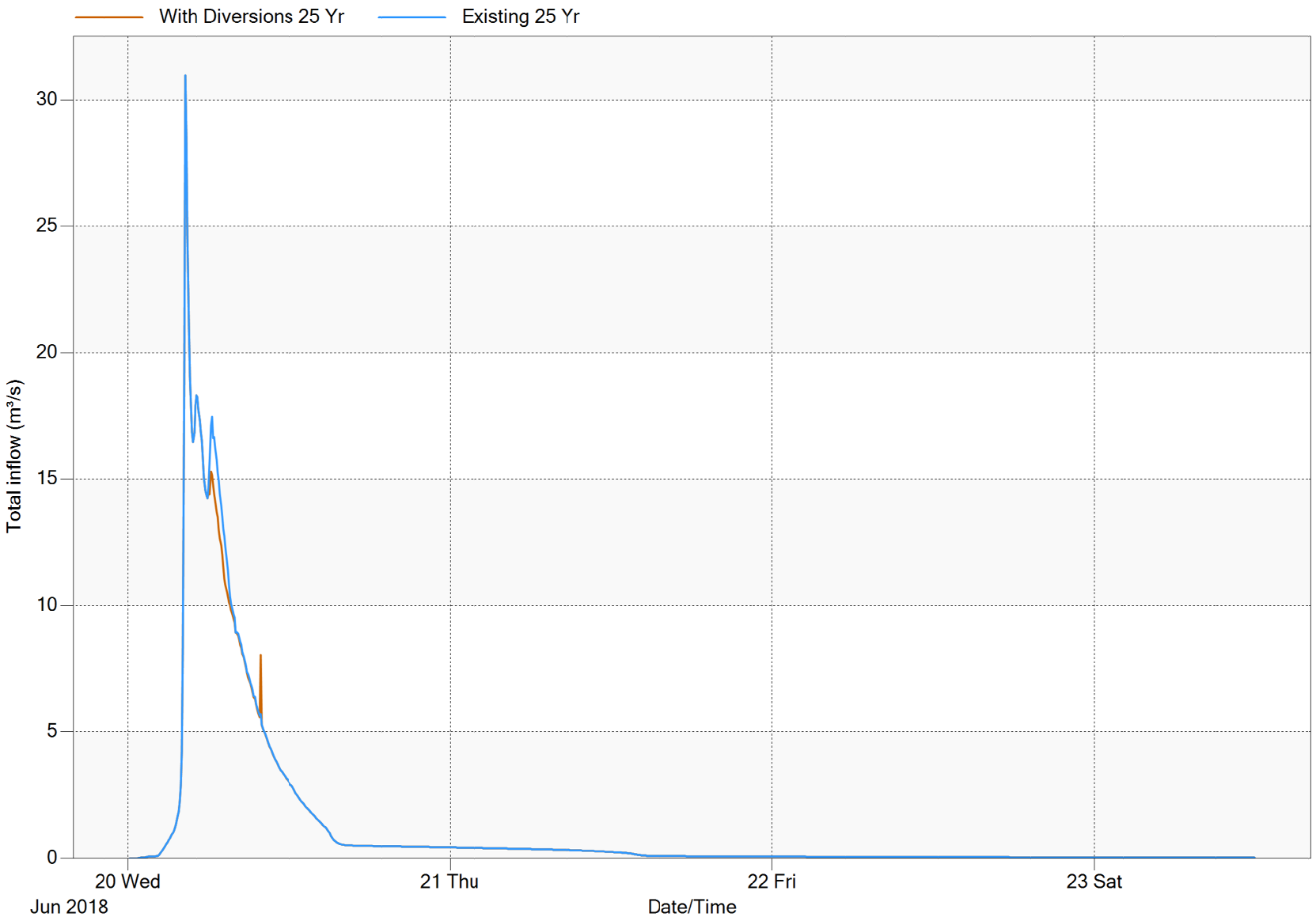

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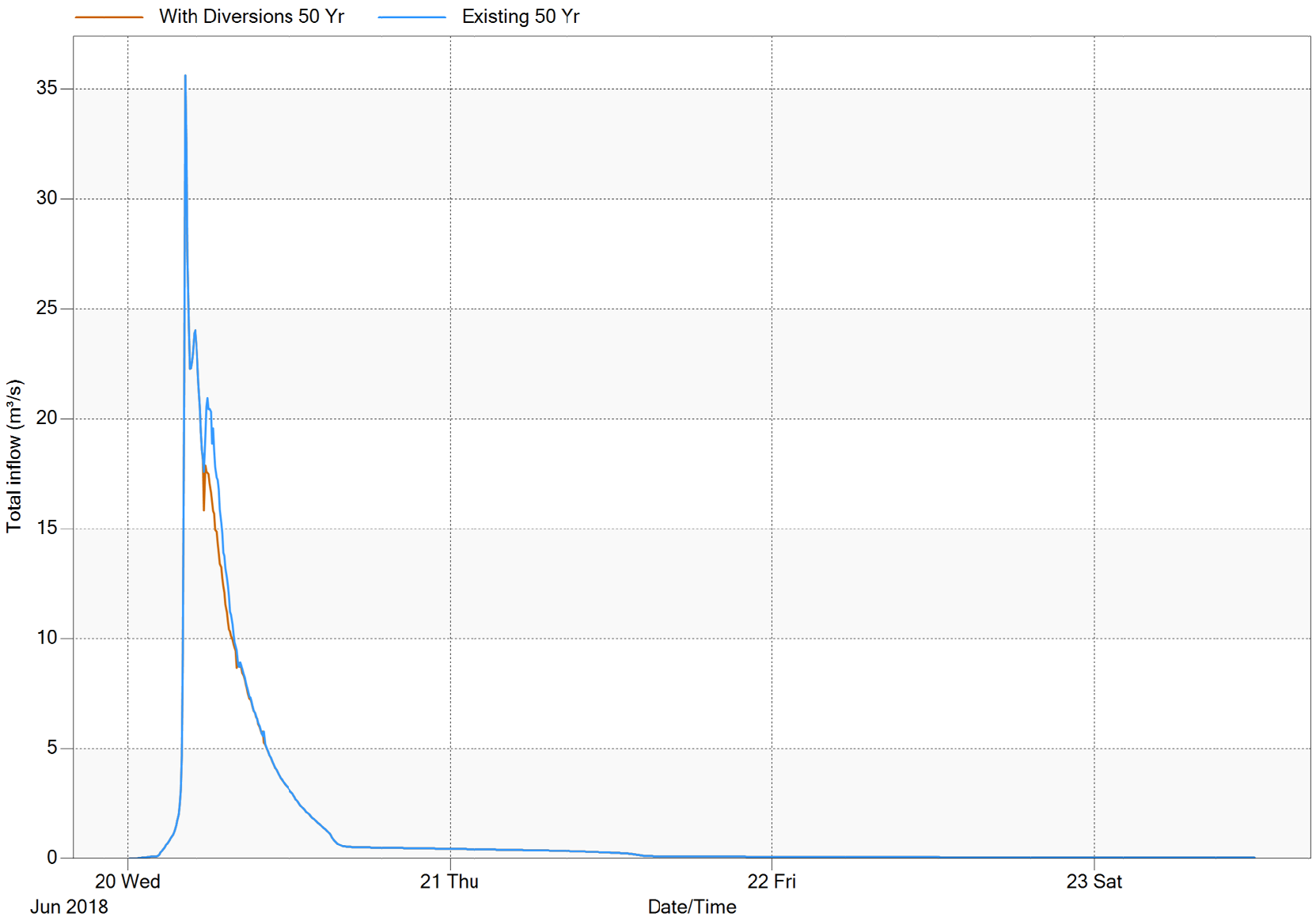

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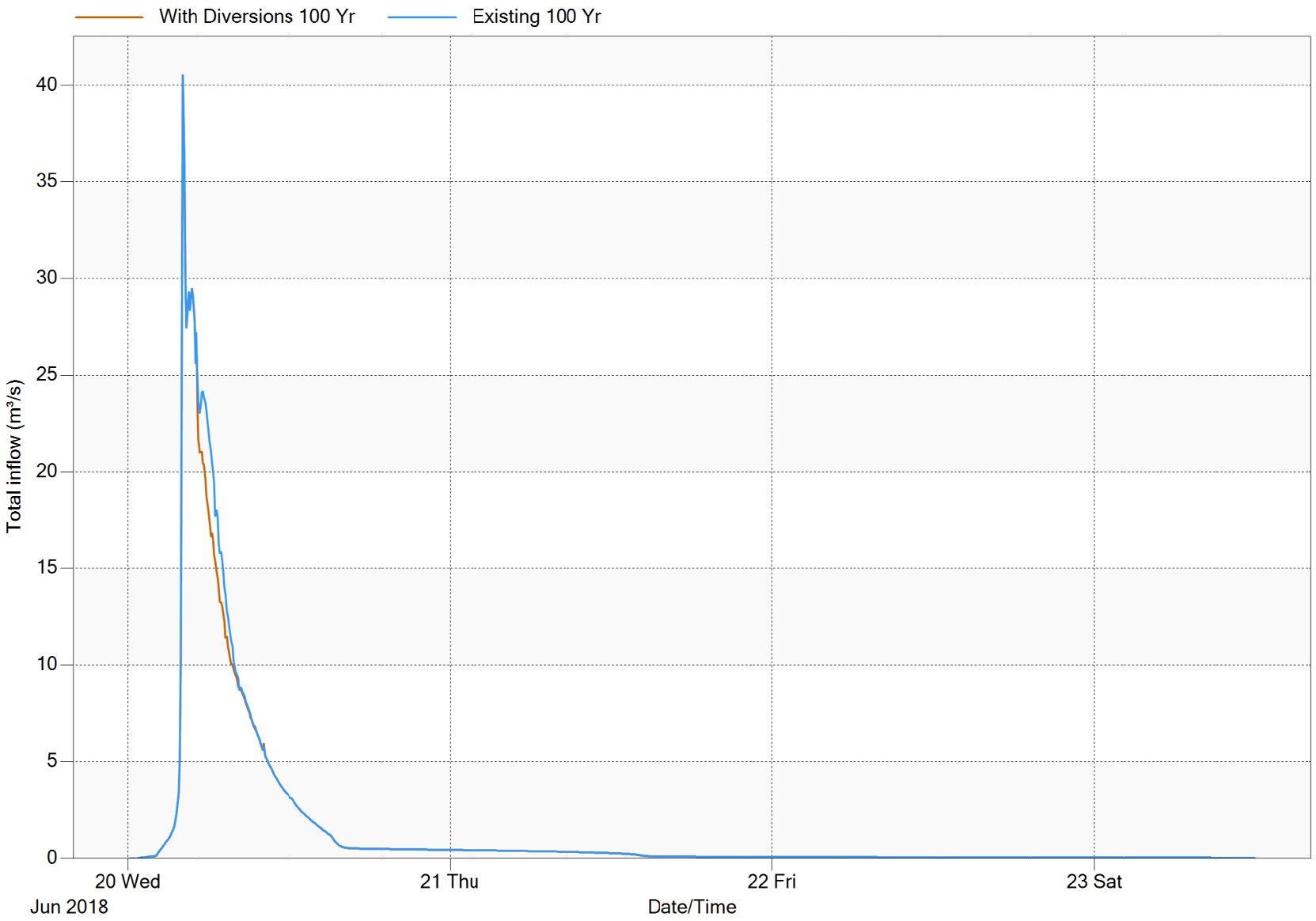
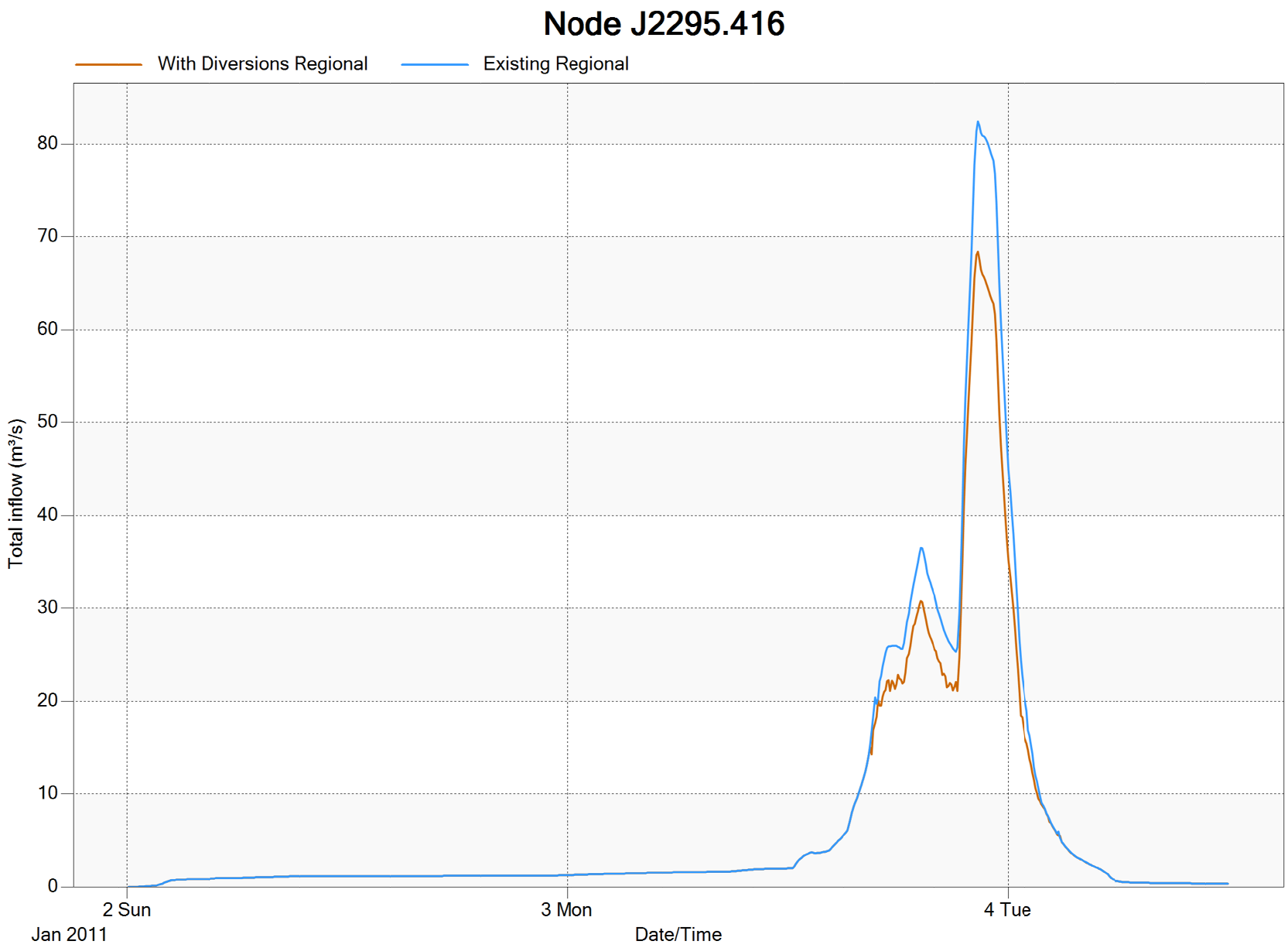



Node J2295.416
With Diversions Regional
Existing Regional
Total inflow (m³/s)
0
10
20
30
40
50
60
70
80
2 Sun
Jan 2011
3 Mon
4 Tue
Date/Time

APPENDIX

H-6 Conservation Halton Material regarding Bronte Creek

3.0 HYDROLOGY

3.1 General

As an initial step in delineating floodplain limits for the Bronte Creek, it was necessary to determine flood flows for selected frequencies along the major watercourses. The selected design storm frequencies were the 5, 10, 25, 50, 100 year and the Regional Storm events. Floodplain limits were based on flood flows for the Regional Storm under future land use conditions.

3.2 Hydrologic Simulation

Reference was made to previous hydrologic studies of Bronte Creek for basic hydrologic data and relationships. An existing hydrologic simulation model, "HYMO", was expanded and updated for the purpose of calculating peak flows in this study. Rainfall hyetograph data for the 5 to 100 year design storm events were determined from the Toronto International Airport and Hamilton Royal Botanical Gardens rainfall stations, and digitized according to the U.S. Soil Conservation Service Type II rainfall distribution over a 12 hour duration. The Regional Storm rainfall pattern for this part of Ontario is based upon Hurricane Hazel. To account for spatial averaging of the rainfall over the watershed, a reduction factor based upon the size of the watershed was applied. Both of these criteria were obtained from the Ministry of Natural Resources.

These rainfall amounts were transformed into runoff hydrographs at selected locations along the watercourses on the basis of local hydrologic characteristics. Hydrographs routed through the stream valleys were added to discharges from successive downstream subcatchments to obtain flow estimates at selected locations along the river.

Runoff from the watershed is directly related to drainage area, soils, land use, topography, vegetation, and storage in the form of lakes and swamps.

These factors were combined and interpreted using U.S. Soil Conservation Service techniques to determine runoff potential for each subcatchment. Appropriate changes to the runoff indices were made to account for the effect of the impervious urban areas on runoff volumes. Figure 3 shows the various subwatersheds included in the analysis. In addition, hydrologic parameters defining the runoff response times of the drainage areas, namely the time to peak (tp) and recession constant (K), were required.

These values are most commonly estimated from empirical relationships developed on similar drainage basins or calibrated against local streamflow data. The time to peak (tp) and the recesssion constant (K) were calculated within the HYMO model using William's 2 - parameter formulae:

$$K = 16.1A^{0.24}(H/L)^{-0.84}$$

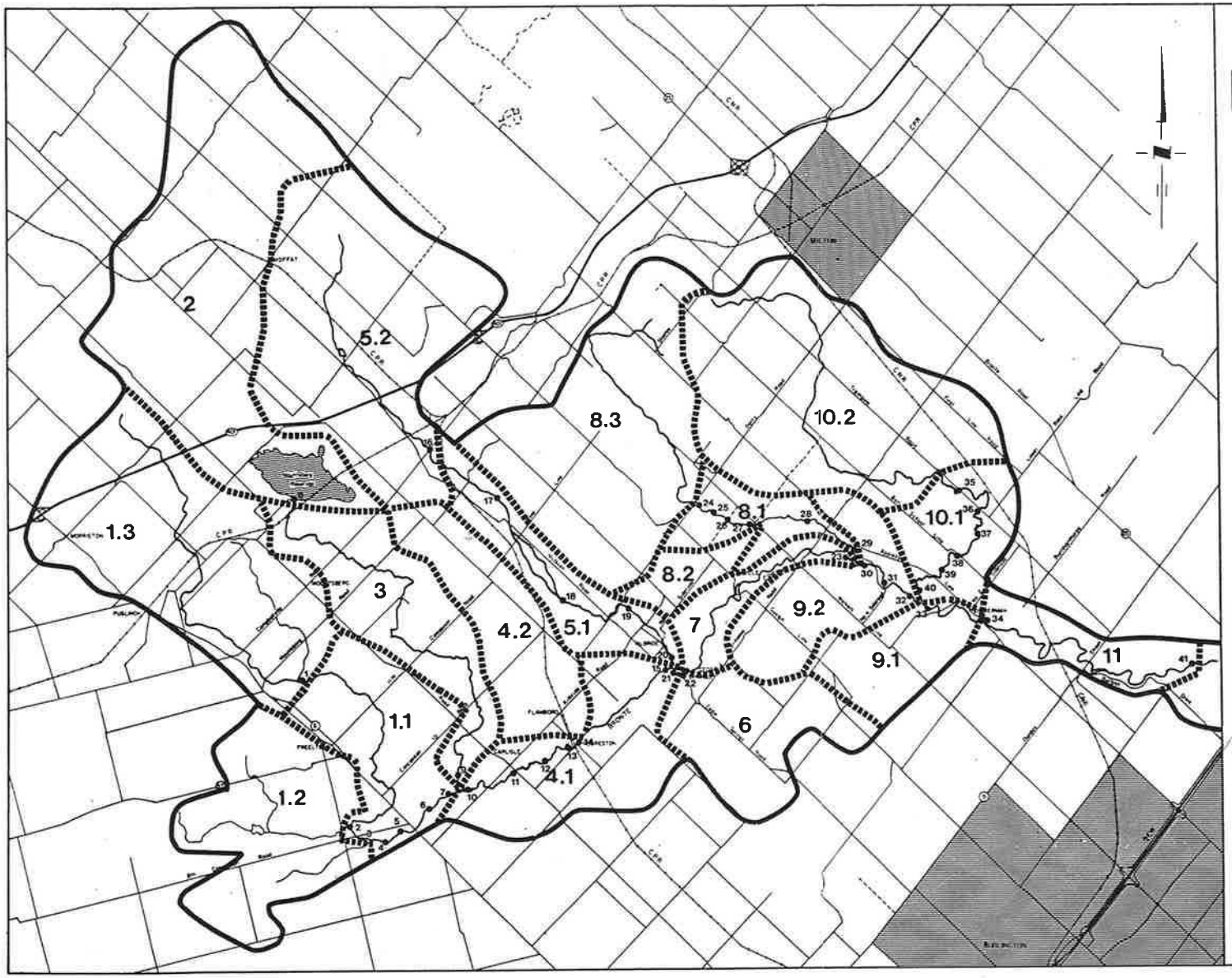
$$tp = 6.54A^{0.39}(H/L)^{-0.5}$$

where A is the subwatershed area (sq.mi.) and H/L is the watershed height (ft) to length (mi) ratio.

The main hydrologic parameters used for simulation purposes are summarized on Tables 1A and 1B. These parameters were found to be suitable in a previous study of this watershed through calibration against a recorded flood hydrograph. There is only a relatively short streamflow record for Bronte Creek, and sufficient data for a complete calibration/validation was not available.

3.3 Mountsberg Dam

The lake created by Mountberg Dam has a surface area of approximately 500 ac., and it has significant impacts on storing part of the flood and reducing downstream flows. The watershed area that contributes runoff to this lake is sub-area 2, which has a size of 14.25 sq.mi. Flood hydrographs generated from this area were routed in the HYMO model in order to simulate the storage effects.



THE HALTON REGION CONSERVATION AUTHORITY

BRONTE CREEK
FLOODPLAIN MAPPING STUDY

SUBCATCHMENT AREAS

LEGEND

- WATERSHED BOUNDARY
- SUBCATCHMENT BOUNDARY
- •[1] FLOW REFERENCE POINT

5000 4000 3000 2000 1000 0 2500 5000m

Proctor & Redfern Limited
Consulting Engineers and Planners
Toronto

FIGURE 3

TABLE 1B

SUMMARY OF SUBWATERSHED PARAMETERS

WATERSHED	AREA SQ MI	CN	WT SLOPE FT/MI	WT HT FT	LENGTH MI	TP HR	K HR	K/TP	B
1	24.70	69.0	16.47	179.	10.89	6.09	7.8	1.3	264.2
2	14.25	69.0	22.42	156.	6.94	4.00	5.2	1.3	262.0
3	5.50	61.0	19.95	124.	6.23	3.11	5.0	1.6	220.9
4	10.30	62.0	42.29	177.	4.18	2.37	2.7	1.1	291.5
5	15.50	62.0	45.15	474.	10.50	3.31	3.4	1.0	318.8
6	4.45	75.0	50.50	163.	3.24	1.60	2.0	1.3	268.8
7	1.90	71.0	31.44	114.	3.63	1.61	2.7	1.7	210.6
8	14.30	67.0	54.83	398.	7.26	2.68	2.6	1.0	329.3
9	6.70	75.0	69.00	283.	4.10	1.67	1.7	1.1	310.0
10	15.50	75.0	26.51	243.	9.15	4.08	4.9	1.2	277.9
11	1.80	74.0	25.22	123.	4.89	1.90	3.5	1.8	198.3
1.1	5.35	69.0	16.87	133.	7.89	3.55	6.0	1.7	211.5
1.2	7.15	69.0	21.41	47.	2.21	2.47	3.8	1.5	230.3
1.3	12.20	69.0	20.78	108.	5.21	3.66	5.0	1.4	250.2
4.1	2.50	62.0	38.85	35.	1.90	1.87	3.63	1.9	262.3
4.2	7.80	62.0	50.41	310.	4.50	1.78	1.82	1.0	272.3
5.1	3.30	62.0	42.25	247.	5.84	1.87	2.6	1.4	248.0
5.2	12.20	62.0	28.91	144.	4.97	3.11	3.8	1.2	271.9
8.1	2.00	67.0	38.71	150.	3.87	1.51	2.4	1.6	224.0
8.2	1.10	67.0	50.18	99.	1.97	.94	1.5	1.6	217.2
8.3	11.20	67.0	48.01	303.	6.31	2.56	2.7	1.1	306.6
9.1	2.97	75.0	69.18	278.	4.02	1.31	1.6	1.2	275.4
9.2	3.73	75.0	70.43	278.	3.95	1.38	1.6	1.2	285.9
4 (Upper)	2.5	62.0		35.	1.90	1.87	3.63		
4 (Lower)	7.8	62.0		310.	4.50	1.78	1.82		

TP and B Calculated by HYMO Formulas

3.4 Design Flows

Design flows for the 5 year through the Regional Storm event are presented in Table 2. In estimating these flows, the effect of storage at road crossings was neglected, as is the usual practice when dealing with floods for regulatory purposes.

TABLE 2

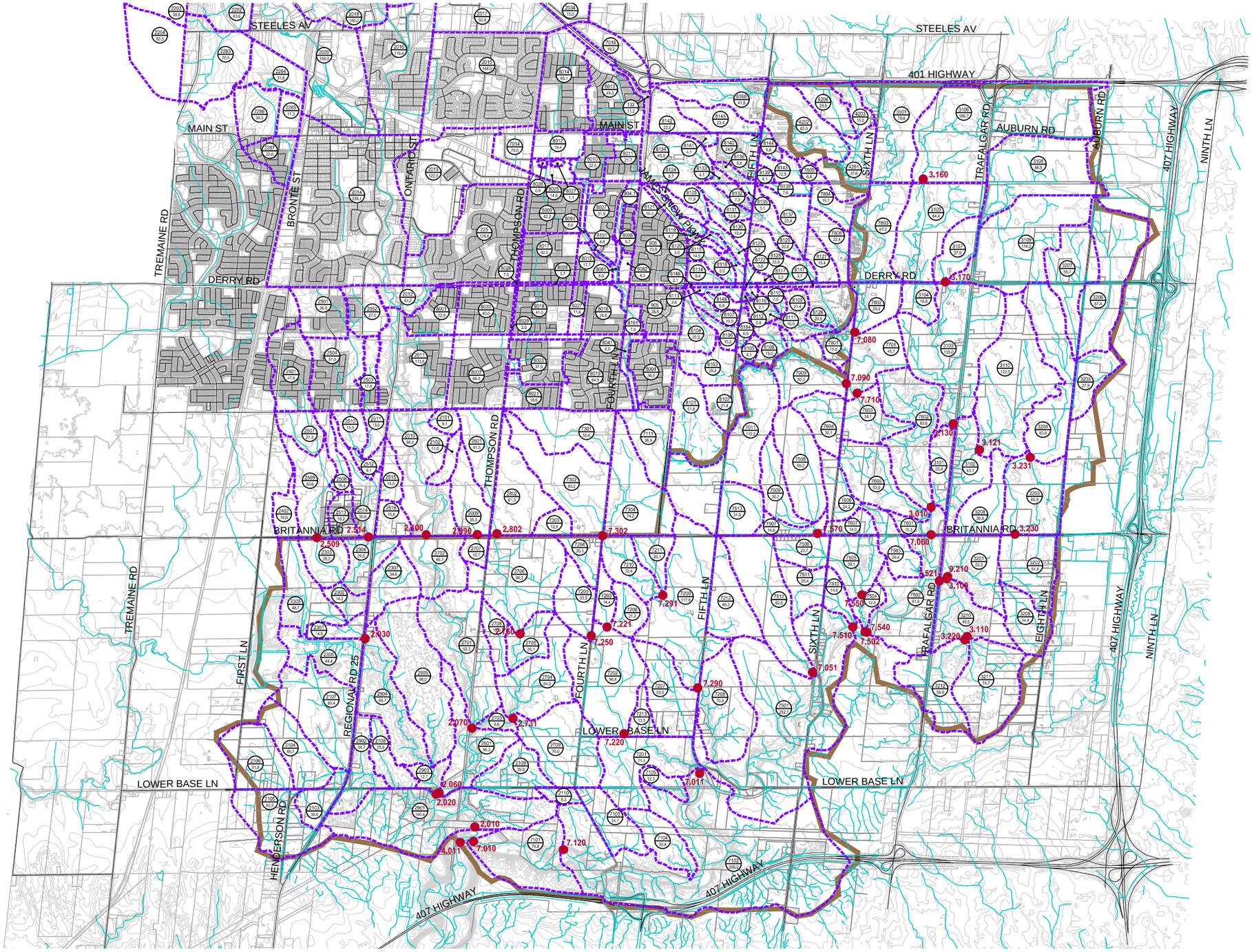
SUMMARY OF PEAK FLOOD FLOWS

DRAINAGE SUB-AREA	LOCATION	*	CROSS-SECTION NUMBER	FLOOD FLOWS IN CFS					
				REGIONAL	100 (Yr.)	50 (Yr.)	25 (Yr.)	10 (Yr.)	5 (Yr.)
1	- U/S Study Limit of Bronte Creek	1	1.91	4279	723	574	435	273	166
	- U/S of Sub-area 1.2	2	1.42	4279	723	574	435	273	166
	- D/S of 8th Concession Rd.	3	1.35	4465	770	610	465	290	175
	- Between 8th Concession & Hwy.6	4	1.27	4810	815	650	490	310	190
	- U/S of Hwy. 6	5	1.18	5160	865	685	520	325	200
	- D/S of Hwy. 6	6	1.05	5510	910	725	550	345	210
	- Outlet	7	1.00	5856	959	761	578	363	220
3	- U/S Study Limit of Mountsberg Trib.	8	3.61	3199	209	136	103	54.5	25.6
	- Outlet	9	3.00	3263	209	148	103	54.5	25.6
4	- U/S of Carlisle	10	4.49	8428	1114	876	658	405	240
	- Earth Embankment	11	-	-	1183	928	695	426	250
	- Section 13 (Previous Mapping)	12	-	8429	-	-	-	-	-
	- CPR Embankment	13	-	8903	-	-	-	-	-
	- U/S of Sub-area 4.2	14	4.12	8903	1199	931	695	426	250
	- Outlet	15	4.04	9591	1346	1030	765	441	250
5	- U/S Study Limit of Kilbride Trib.	16	5.78	4729	572	431	305	167	82
	- U/S of Base Line Road	17	5.58	5065	625	470	335	180	90
	- U/S of Derry Road	18	5.43	5400	675	510	360	195	97
	- D/S of Derry Road	19	5.22	5740	725	550	390	210	104
	- Outlet	20	5.01	6076	780	588	416	226	112
7	- Old Mill Pond U/S of Cedar Springs (incl. Area 5)	21	7.57	15329	2112	1609	1164	635	329
	- Just U/S of Cedar Springs Community (incl. Area 6)	22	7.48	16689	2573	1978	1425	813	453
	- Outlet	23	7.01	17152	2608	2001	1458	838	471
8	- U/S Study Limit of Lowville Trib.	24	-	5713	942	738	548	331	193
	- D/S of Derry Road	25	-	6065	1010	790	585	350	200
	- D/S of Derry Road	26	-	6420	1075	840	620	370	210
	- U/S of Sub-area 8.2	27	-	6772	1139	888	657	393	221
	- U/S of Brittania Road	28	-	7010	1180	925	685	410	235
	- Outlet	29	-	7245	1226	958	711	432	252
9	- WSC Gauge	30	9.33	23321	3743	2885	2112	1249	716
	- D/S of No. 4 Sideroad	31	9.27	24200	3940	3050	2240	1340	780
	- U/S of Indian Creek	32	9.17	25067	4140	3216	2370	1435	842
	- D/S of Indian Creek	33	9.13	30952	5729	4513	3402	2127	1303
	- Zimmerman	34		32581	6123	4838	3650	2299	1416
10	- U/S Study Limit of Indian Creek (limit of previous mapping)	35	10.44	5320	1369	1127	903	628	433
	- D/S of Tremaine Road	36	10.35	5715	1485	1220	980	660	470
	- U/S of Bell School Line	37	10.28	6100	1595	1320	1055	730	505
	- Bell School Line	38	10.19	6490	1710	1415	1130	785	540
	- U/S of Appleby Line	39	10.14	6880	1825	1510	1205	825	575
	- Outlet of Indian Creek	40	10.01	7266	1940	1605	1282	888	608
11	- Outlet - D/S Study Limit	41	11.00	31300	6123	4838	3650	2299	1416

* Flow Reference Pt. (See Figure 3)

APPENDIX

H-7 South Milton Excerpts



LEGEND

- STUDY AREA
- ROADWAY CENTRELINE
- PROPERTY LINE
- WATERCOURSE
- CONTOUR (2m)
- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID# / SUBCATCHMENT AREA
- FLOW NODE LOCATION AND REFERENCE ID# (e.g. 2.040)

SCALE VALID ONLY FOR 24"x36" VERSION

SOUTH MILTON URBAN EXPANSION AREA

TOWN OF MILTON

SUBCATCHMENT PLAN (EXISTING CONDITION)

amec foster wheeler

Scale 1:25000 (0 250 500 1000)

Consultant File No. TP116007

Figure: 4.1.8

Path: P:\Work\TP116007\06_DES-ENG\01_CAD\02_DWGS\05_WR\01_PRO\18-03\Fig4.1-08 ExCatchmentPlan.dwg

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Last Saved By: richard.bartolo

Plotted: 2018-04-12

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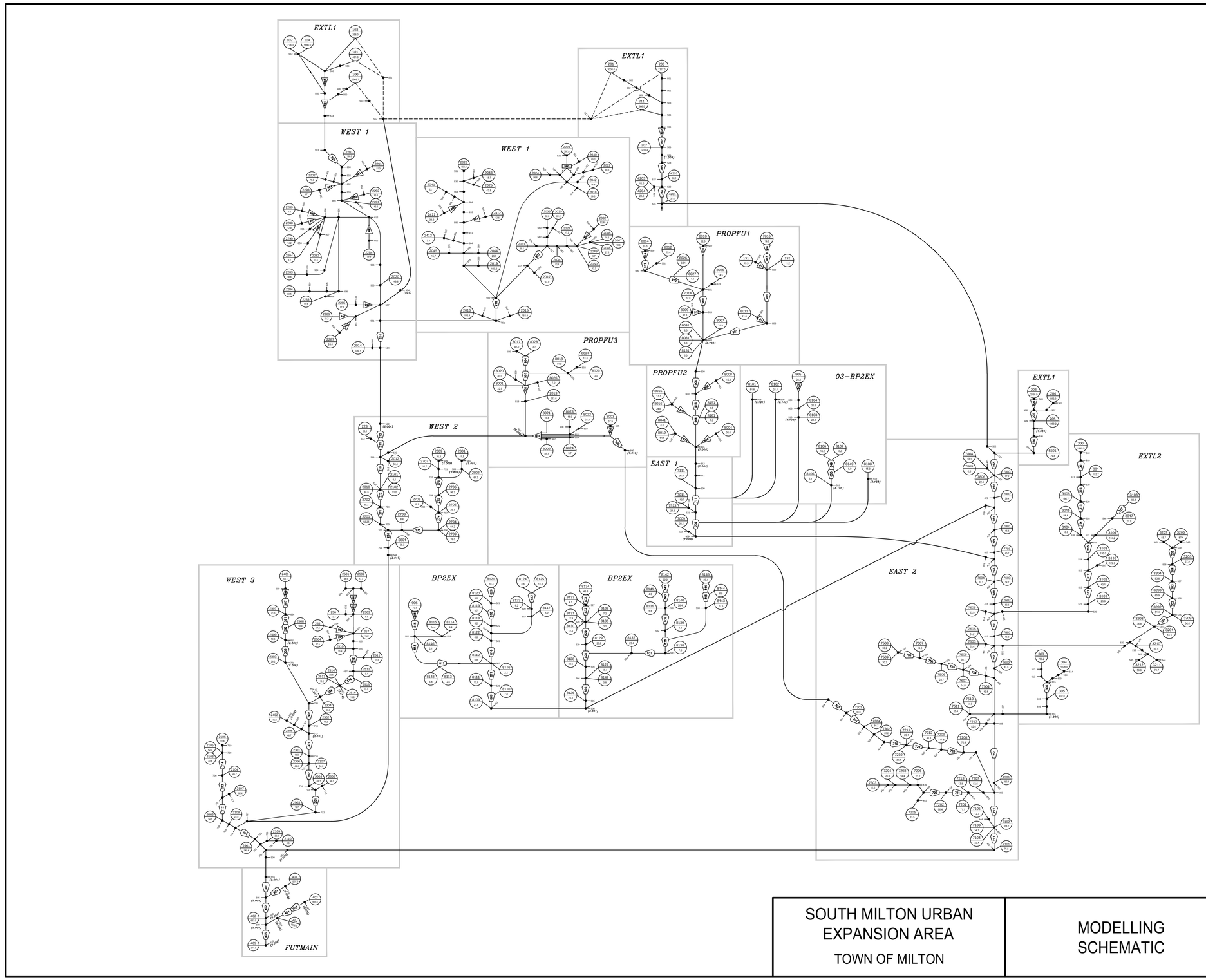


Path: P:\Work\TP116007\06_DES-ENG\01_CAD\02_DWGS\05_WR\01_PROJ\Fig 4.4.7 Modelling Schematics.dwg

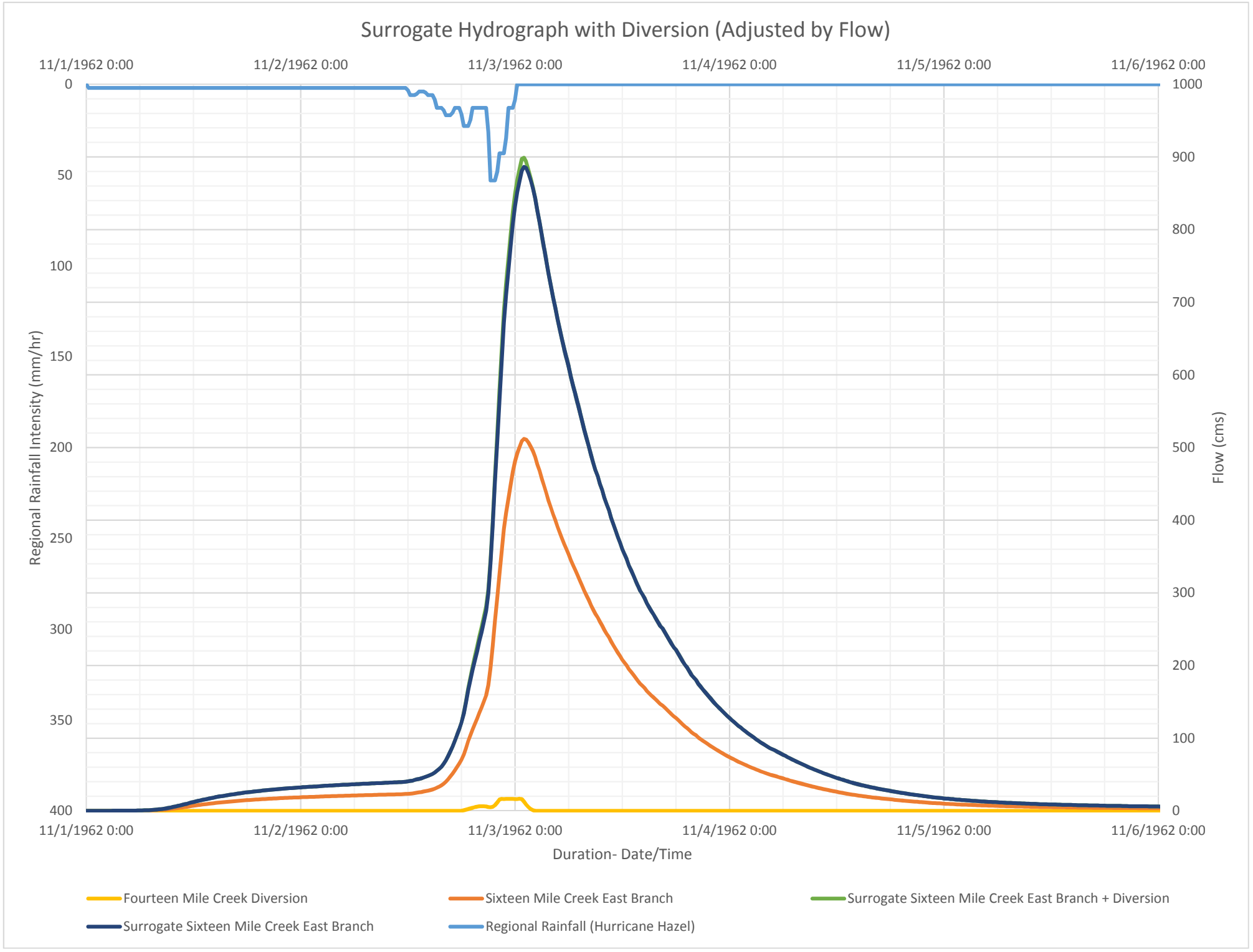
Plotted By: mary.kelly
Last Saved By: mary.kelly

Plotted: 2017-03-17
Last Saved: 2017-03-17

SCALE VALID ONLY FOR 24"x36" VERSION

SOUTH MILTON URBAN EXPANSION AREA TOWN OF MILTON	MODELLING SCHEMATIC	amec foster wheeler

Scale: N/A
Consultant File No.: TP116007
Figure No.: 4.4.7


Surrogate Hydrograph with Diversion (Adjusted by Flow)
11/1/1962 0:00
11/2/1962 0:00
11/3/1962 0:00
11/4/1962 0:00
11/5/1962 0:00
11/6/1962 0:00
0
50
100
150
200
250
300
350
400
Regional Rainfall Intensity (mm/hr)
1000
900
800
700
600
500
400
300
200
100
0
Flow (cms)
Duration- Date/Time
Fourteen Mile Creek Diversion
Sixteen Mile Creek East Branch
Surrogate Sixteen Mile Creek East Branch + Diversion
Surrogate Sixteen Mile Creek East Branch
Regional Rainfall (Hurricane Hazel)

APPENDIX

H-8 Appendix C Drawings from 2023 Assessment