



# Flood Frequency in the Horizons Region (Task 3-3, FVA)

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**Prepared for:**

Jon Roygard  
Catchment Operations Group Manager

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**Prepared by:**

National Institute of Water & Atmospheric Research Ltd

**CONTACT** 24 hr Freephone 0508 800 800    [help@horizons.govt.nz](mailto:help@horizons.govt.nz)    [www.horizons.govt.nz](http://www.horizons.govt.nz)

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	<b>Taumarunui</b> 34 Maata Street				

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**POSTAL ADDRESS** Horizons Regional Council, Private Bag 11025, Manawatū Mail Centre,  
Palmerston North 4442

F 06 9522 929

# Flood Frequency in the Horizons Region

*Prepared for Horizons Regional Council*

*March 2025*

Prepared by:  
Shailesh Singh, George Griffiths

For any information regarding this report please contact:




Shailesh Singh  
Hydrologist  
+64 3 343 8053  
Shailesh.Singh@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd  
PO Box 8602  
Riccarton  
Christchurch 8440

Phone +64 3 348 8987

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## Executive summary

Flood frequency relationships are determined for 74 sites on rivers within the Horizons Region. Annual flood peak data were modelled by five different probability distributions at each site. An additional investigation was undertaken to ascertain whether supplementing site records with historical flood peak estimates could improve flood frequency estimates. The inclusion of historical data not only expanded flood record length but also increased confidence in the results.

Statistical analysis of the time series of annual maxima at all sites throughout the region showed that these series are stationary and serially independent. Moreover, the Generalised Extreme Value distribution was a suitable model for estimating the flood peak versus return period relationship at all sites.

A regional flood frequency curve was established using all site data for more robust flood frequency estimation than those obtained from site data only.

When applying results from a site, especially for ascertaining large return periods of flood peaks all historical and systematic data should be employed where available as well as the regional curve.

The analysis does not take climate change effects into account explicitly. To allow for potential effects of human induced climate change it is recommended that the guidance given in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change is followed.

## 1 Introduction

NIWA and WSP New Zealand Ltd are undertaking a joint study to contribute to the Horizons Regional Council's flood vulnerability assessment project. The study involves a review of the condition of flood protection assets and built flood protection design levels. To undertake the review, it is necessary to determine current flood frequency relationships at various hydrological recording stations or sites on rivers within the Horizons Region.

In this report we update both at-site and regional flood frequency assessments using extreme value analysis, comprised of four steps. First, annual maximum flood peak discharge or level records are compiled for each site, including an assessment of gaps. Second, time series of annual maxima at each site are checked for evidence of trend, periodicity, persistence and shifts. Third, a range of theoretical flood frequency distributions are fitted to the data for each site with the best fit selected visually and supported by statistical testing. This exercise is repeated at each site with and without historical data where applicable. Fourth, a regional flood frequency curve is derived, using all the annual maxima data, where each annual maximum peak in a site record is made dimensionless by dividing by the mean annual flood peak at the site.

## 2 Data

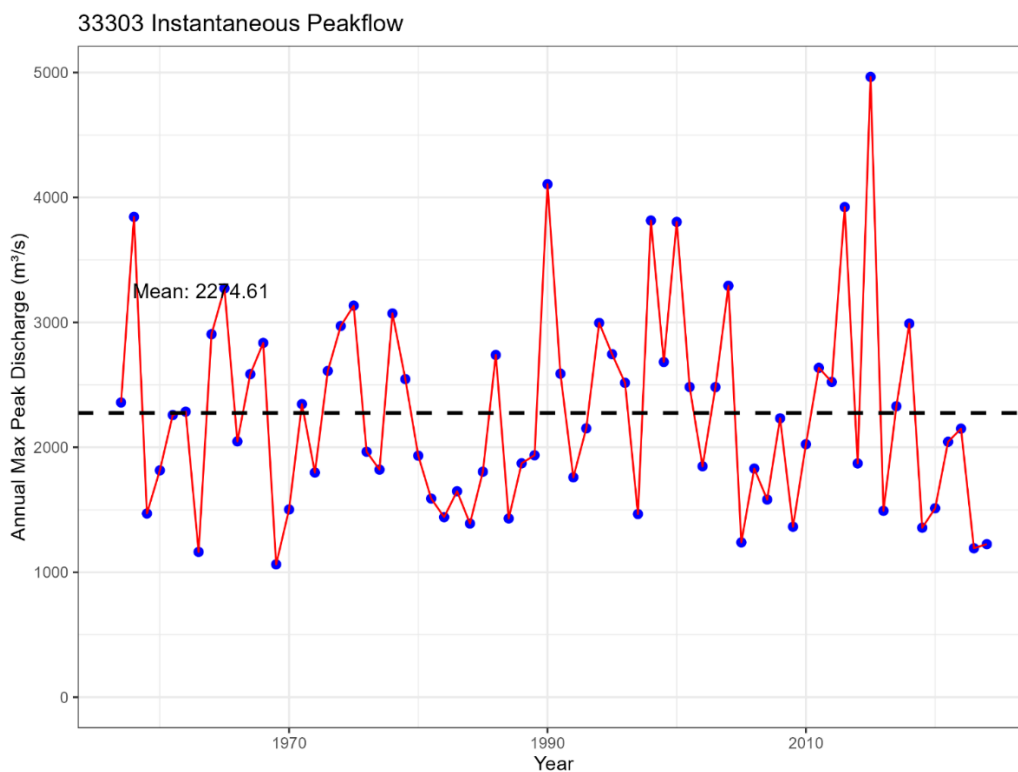
River flow data sets were supplied by Horizons Regional Council (HRC), from HRC and NIWA water level and flow recorder stations. A total of 113 sites were available for this study. Some of the sites had short record lengths and were not suitable for extreme value analysis. We selected sites which had at least 10 years of data. The resulting 74 flow recording stations used in this study are listed in Table 2-1. Two sources of data (the best available to date) were used in the extreme value analysis of flood flows at sites of interest:

- the systematic record from flow recording stations.
- records of historical floods.

The systematic record was taken from hydrological recording stations operated by HRC and NIWA (Table 2-1 and Figure 2-2). Annual maximum floods were extracted from the systematic record for each site.

Historical flood records were studied to identify any large floods that occurred at these sites before the systematic record, which could be used to increase the timeframe that the record covered. Historical flood flow data were collated for individual sites in collaboration with HRC.

No discernible shifts, periodicity, persistence or significant temporal trends in the annual flood peaks were observed in the data used in this report. Consequently, the records examined in this work can be assumed to consist of independent and identically distributed values and so are amenable to the established techniques of flood frequency analysis. An example of an annual flood peak time series plot is shown in Figure 2-1.



**Figure 2-1:** Example of time series plot of annual flood peak. Whanganui at Te Rewa (site number 33303).

## 2.1 Sites involving combined records

Site 25110 Owahanga at Owahanga replaces site 1425101 Branscombe Bridge and so data from this site was combined and flood frequency was done at 25110 Owahanga at Owahanga.

Site 1332556 Tamaki at Stephensons is a composite with 1332567 Tamaki at Hartridges flow site. The two flow sites are stitched together to form a continuous record at 1332556 Tamaki at Stephensons.

Site 1132511 Mangatainoka at Pahiatua Town Bridge is a composite site with site 32531 Mangatainoka at Suspension Bridge.

Site 1132508 Oroua at Almadale Slackline is a composite series from Oroua at Almadale (1947-1979 when this site was closed). The site was re-opened in 1992, and moved to Oroua at Almadale Slackline (same hydraulic reach, 2002).

1032560 Manawatu at Teachers College is a composite flow series: (Manawatu at Fitzherbert [14/06/1902 - 08/12/1982], Manawatu at Ruahine St [16/12/1971-11/2/1987], and Manawatu at Teachers College [11/02/1987 to present]).

Site 2232510 Tokomaru at Riverland Farm data are combined with data from Site 103517 Tokomaru at Quarry. We also analysed flood frequency at Site 103517 Tokomaru at Quarry independently as it has more than 10 years of data. Since combined data at site 2232510 Tokomaru at Riverland Farm is longer, analysis at this site may be more reliable than site 103517 Tokomaru at Quarry (but we look at both sites to estimate the uncertainty).

Site 33303 Whanganui at Te Rewa is composite series from site 33301 Whanganui at Paetawa. We also analysed flood frequency at site 33301 Whanganui at Paetawa as it has more than 10 years of data. Since combined data at site 33303 Whanganui at Te Rewa is longer and it is an open site, analysis at this site may be more reliable than site 33301 Whanganui at Paetawa (but we look at both sites to estimate the uncertainty).

Site 32726 Hautapu at Taihape data are combined with data from Site 32767 Hautapu at Alabaster's and flood frequency was done at 32767 Hautapu at Alabaster's.

Site 1032516 Kiwitea at Spur Rd Extension data are combined with data from Site 1132523 Kiwitea at Strathspey Farm and flood frequency was done at 1132523 Kiwitea at Strathspey Farm.

Site 33004 at Turakina at Otairi data [14/01/2014 – 27/09/2024] are combined with data from Site 33004 Turakina at Otairi [NIWA site] [09/04/1991 – 14/01/2014].

**Table 2-1: Sites used in this study.**

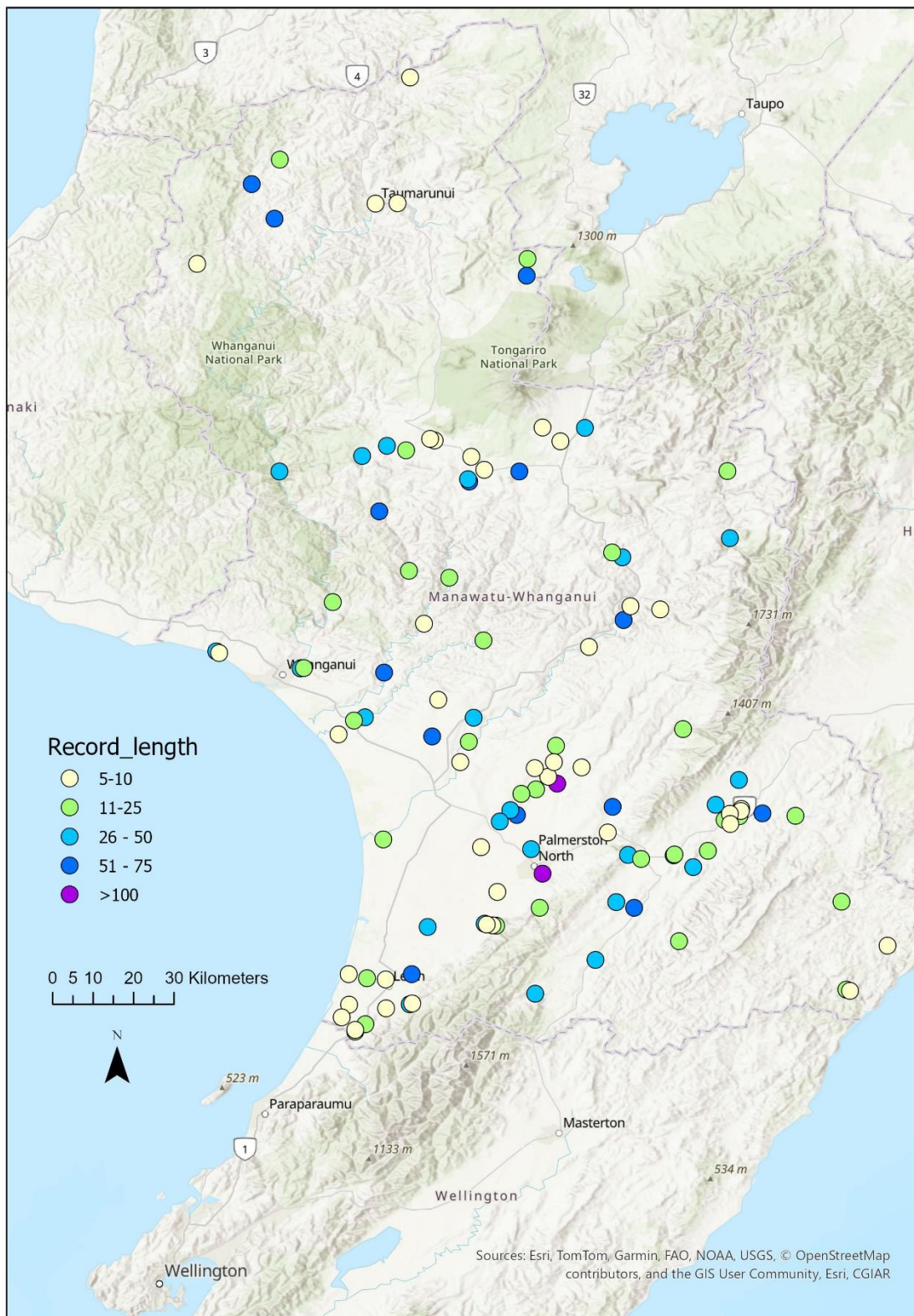
Site No	Sitename	Records		Catchment Area (km <sup>2</sup> )	Lat	Long
		Start	End			
25110	Owahanga at Owahanga Station	22-Jun-1999	11-May-2024	341	-40.630793	176.302447
32001	Manakau at Gleesons Rd	23-Nov-1978	11-May-1989	16.8	-40.720779	175.211535
32106	Ohau at Rongomatane	14-Jul-1978	7-Feb-2024	105	-40.663439	175.332677

Site No	Sitename	Records		Catchment Area (km <sup>2</sup> )	Lat	Long
		Start	End			
32302	Hokio at Lake Horowhenua	1-May-2013	19-Jun-2024	48	-40.60587	175.237291
32503	Manawatu at Weber Rd	3-Jan-1955	27-Sep-2024	713	-40.239468	176.116379
32504	Manawatu at Hopelands	12-Dec-1947	27-Sep-2024	1247	-40.358857	175.962862
32529	Tiraumea at Ngaturi	12-May-1958	27-Sep-2024	266	-40.436111	175.79173
32547	Manawatu at Moutoa	7-Mar-1988	25-Sep-2024	5374	-40.491441	175.372522
32557	Mangaone at Milson Line	29-Jan-1971	25-Sep-2024	154	-40.318908	175.602069
32563	Oroua at Kawa Wool	3-Feb-1967	1-Apr-2024	570	-40.243018	175.570925
32564	Pohangina at Piripiri	1-Jul-2012	23-Sep-2024	88.9	-40.052151	175.940097
32576	Pohangina at Mais Reach	10-Jun-1969	25-Sep-2024	471	-40.22457	175.782998
32590	Koputaroa at Tavistock Rd	11-Jan-1974	25-Sep-2024	21.4	-40.596676	175.337444
32702	Rangitikei at Mangaweka	22-Jul-1955	3-Apr-2024	2787	-39.809424	175.808108
32703	Rangitikei at Onepuhi	19-Feb-2002	9-Apr-2024	3420	-40.079567	175.463842
32708	Rangitikei at Springvale	27-Sep-1963	2-May-1974	583	-39.4781735	176.038788
32715	Porewa at Tututotara	25-Mar-1963	30-Jul-1991	111	-40.02690044	175.4744698
32726	Hautapu at Taihape	2-May-1963	10-Jan-2001	303	-39.66991119	175.8049631
32739	Tutaenui at Hammond St	30-Mar-1968	27-Sep-2024	51	-40.06777	175.382489
32760	Rangitikei at McKelvies	15-Jun-2006	26-Sep-2024	3895	-40.297027	175.274093
32763	Rangitikei at Pukeokahu	16-Mar-1999	26-Sep-2024	769.8	-39.627651	176.044245
32767	Hautapu at Alabaster's	14-Jun-2000	26-Sep-2024	267	-39.659064	175.782256
33003	Turakina at SH3	2-Feb-1977	24-Jun-1992	803	-40.03312122	175.208783
33004	Turakina at Otairi	9-Apr-1991	27-Sep-2024	507	-39.854483	175.496604
33012	Turakina at O'Neills	22-Dec-1934	26-Sep-2024	845	-40.025721	175.233331
33101	Whangaehu at Kauangaroa	01/02/1891	26-Sep-2024	1917	-39.925771	175.27568

Site No	Sitename	Records		Catchment Area (km <sup>2</sup> )	Lat	Long
		Start	End			
33107	Whangaehu at Karioi	1-Nov-1962	26-Sep-2024	338	-39.501504	175.464357
33111	Mangawhero at Ore Ore	7-May-1962	26-Sep-2024	506	-39.568125	175.264769
33112	Tokiahuru at Whangaehu Junction	13-Aug-1979	26-Sep-2024	220	-39.496033	175.46165
33114	Waitangi at Tangiwai	22-Nov-1967	26-Sep-2024	59	-39.478728	175.575925
33115	Mangaetoroa at School	30-Dec-1968	30-Sep-2011	33.2	-39.44463135	175.2271071
33119	Makotuku at Raetihi	31-Oct-1974	26-Sep-2024	62	-39.422132	175.281733
33130	Whangaehu at Mangaio Tunnel	10-Jul-1979	29-Mar-2007	72	-39.38183841	175.7219878
33143	Mangawhero at Hagleys	8-Apr-1999	15-Oct-2013	71	-39.409835	175.387452
33149	Mangawhero at Pakihi Rd Br	28-Mar-2006	26-Sep-2024	139	-39.431742	175.324206
33301	Whanganui at Paetawa	13-Feb-1891	13-Sep-2018	6643	-39.77603137	175.1445421
33303	Whanganui at Te Rewa	2-Oct-2000	27-Sep-2024	6643	-39.769392	175.16185
33307	Whanganui at Headwaters	2-Dec-1959	1-Nov-1978	81.3	-39.00644021	175.5941355
33313	Ohura at Tokorima	7-Sep-1961	27-Sep-2024	668	-38.917504	175.032384
33314	Ohura at Nihoniho	17-May-2007	27-Sep-2024	334	-38.785835	175.043836
33341	Mangaroa at Ohura Town Br	9-May-1965	27-Sep-2024	182	-38.840006	174.981691
33345	Whanganui at Pipiriki	25-May-1904	18-Apr-2024	6138	-39.478766	175.04341
33347	Whanganui at Te Porere	13-Jan-1966	8-Jul-2024	28.2	-39.04393788	175.5920473
33366	Matarawa at Diversion	13-May-1977	14-Jan-1994	NA	-39.916565	175.097506
33502	Kai Iwi at Handley Rd	5-Apr-1978	26-Mar-2024	187	-39.878956	174.903171
1032501	Kumeti at Te Rehunga	20-Aug-1980	27-Sep-2024	15.6	-40.22011818	176.0125869
1032504	Tamaki at Water Supply Weir	17-Nov-1982	27-Sep-2024	31.6	-40.165184	176.063633
1032516	Kiwiata at Spur Rd Extension	5-Nov-1976	22-Oct-1998	246	-40.186195	175.61341
1032517	Tokomaru at Quarry	13-Dec-1979	11-Mar-1998	56.6	-40.489114	175.524867

Site No	Sitename	Records		Catchment Area (km <sup>2</sup> )	Lat	Long
		Start	End			
1032518	Makakahi at Hamua	19-Dec-1979	27-Sep-2024	158	-40.565174	175.745106
1032542	Makino at Reids Line	11-Feb-1987	30-Sep-2004	41.1	-40.19594	175.580886
1032555	Mangatainoka at Larsons Br	20-Jul-1983	27-Sep-2024	57.3	-40.640362	175.610986
1032560	Manawatu at Teachers College	14-Jun-1902	25-Sep-2024	3900	-40.373288	175.62773
1032561	Makino at Rata St	23-Dec-1986	21-Mar-2024	63.8	-40.231629	175.556384
1032564	Makino at Boness Rd	19-Dec-1991	25-Sep-2024	138.8	-40.257383	175.532662
1032591	Makuri at Tuscan Hills	9-Dec-1999	27-Sep-2024	136.2	-40.52366	175.931148
1033153	Whangaehu at Aranui	24-May-2005	26-Sep-2024	797	-39.715543	175.420336
1033154	Mangawhero at Raupiu Road	16-Feb-2004	30-Sep-2016	676	-39.700278	175.331133
1033363	Matarawa at City Branch	28-Nov-1995	6-Jun-2024	71.1	-39.916694	175.090489
1132508	Oroua at Almadale Slackline	21-Aug-1947	25-Sep-2024	293	-40.173415	175.659903
1132511	Mangatainoka at Pahiatua Town Bridge	1-Jan-1954	27-Sep-2024	395	-40.449566	175.83121
1132517	Kiwitea at Haynes Line	9-Aug-2005	1-Aug-2017	165	-40.088761	175.657754
1132519	Kahuterawa at Johnstons Rata	30-Apr-2005	25-Sep-2024	36.45	-40.449068	175.621642
1132523	Kiwitea at Strathspey Farm	19-Mar-2016	25-Sep-2024	239	-40.157574	175.639927
1232561	Raparapawai at Jackson Rd	20-Dec-2002	27-Sep-2024	73.4	-40.322873	175.995426
1232563	Mangapapa at Troup Road	19-Dec-2007	27-Sep-2024	33.419	-40.340157	175.84664
1232564	Manga-Atua at Hopelands Rd	28-Feb-1980	27-Sep-2024	55	-40.332033	175.919298
1232566	Manawatu at Upper Gorge	20/03/1880	25-Sep-2024	3231	-40.331849	175.818031
1232581	Oruakeretaki at SH2(Napier)	18-Sep-2007	27-Sep-2024	54	-40.253423	176.03234
1332518	Mangatoro at Mangahei Road	15-Dec-2003	27-Sep-2024	209	-40.244679	176.189531
1332556	Tamaki at Stephensons	16-Dec-2003	27-Sep-2024	53.051	-40.245353	176.064906
1425006	Waihi at S.H.52	19-Apr-2005	29-Jul-2024	128.9	-40.43556	176.29171

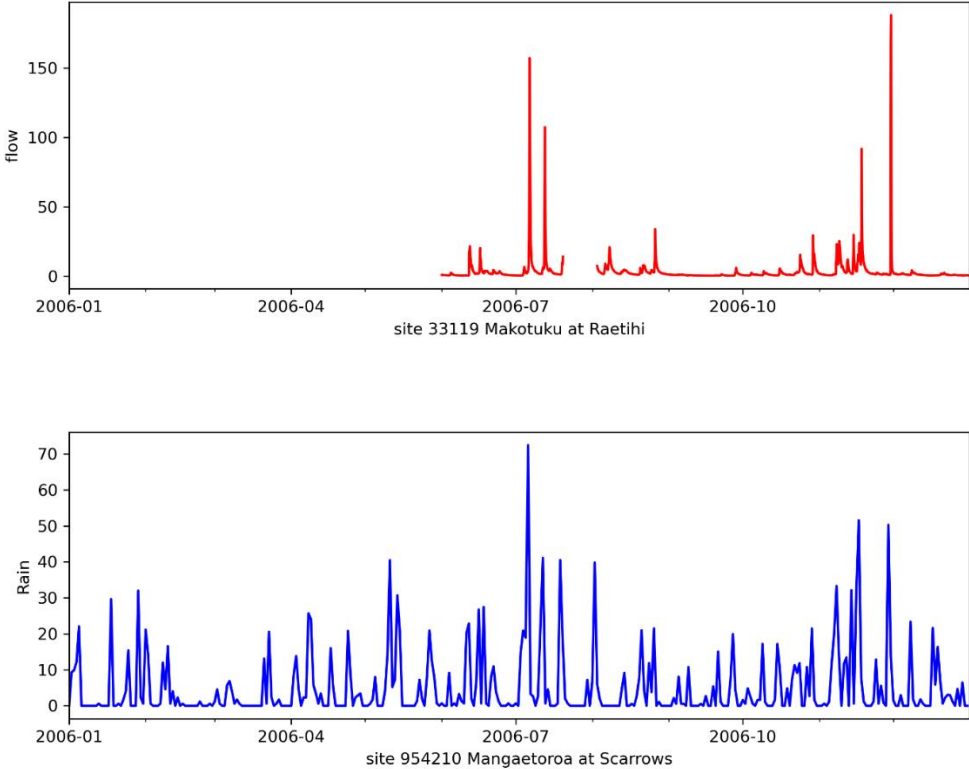
Site No	Sitename	Records		Catchment Area (km <sup>2</sup> )	Lat	Long
		Start	End			
1425101	Owahanga at Branscombe Bridge	22-Jun-1999	11-May-2021	313.3	-40.630793	176.302447
1432003	Manakau at S.H.1 Bridge	3-May-2006	10-Apr-2024	16	-40.72438	175.211655
1432008	Waikawa at North Manakau Road	18-May-2006	12-Mar-2024	28	-40.707742	175.233597
2232510	Tokomaru at Riverland Farm	13-Dec-1979	25-Sep-2024	57.5	-40.484278	175.498726



**Figure 2-2: Location of flow recorders.** The colour of dot is directly related to the magnitude of the record length in years.

## 2.2 Gaps in data

In this analysis, peaks are considered for the calendar year (January-December). During data preparation, it was observed that there were gaps in the flow records for each site. Rather than filling these gaps, we opted to evaluate the data for inclusion or exclusion in the analysis. This evaluation process was based on data from the nearest rainfall site. Using time series plots of flow and rainfall data we inspected each gap to determine whether a recorded peak could be used for the annual maxima analysis. An illustrative example is provided in Figure 2-3. We can see from these plots that there were large gaps in the flow records for 2006. The largest recorded peak of 180 m<sup>3</sup>/s occurred in December. Visually we see that during the January to May flow gaps there was no heavy rain, whereas the large rain events in July, November and December corresponded to the timing of flood events, including the December recorded flow peak. Hence in this case we included this recorded peak in the annual maximum analysis. Following this visual inspection, experts from NIWA and HRC reviewed each annual peak and made decisions regarding its inclusion or exclusion. A detailed summary of the years excluded from the analysis can be found in Table 2-3.



**Figure 2-3: Example of gaps in flow records.** Annual flow record (top) with gaps, and comparison with rainfall (bottom).

**Table 2-2: Sites with years excluded from analysis.**

Site number	Site name	Year excluded
32106	Ohau at Rongomatane	2024
32302	Hokio at Lake Horowhenua	2013
32504	Manawatu at Hopelands	1989
32563	Oroua at Kawa Wool	2004

<b>Site number</b>	<b>Site name</b>	<b>Year excluded</b>
32576	Pohangina at Mais Reach	1969
32590	Koputaroa at Tavistock Rd	1989 to 2023
32702	Rangitikei at Mangaweka	2024
32703	Rangitikei at Onepuhi	2024
32708	Rangitikei at Springvale	1974
32767	Hautapu at Alabaster's	2000
33012	Turakina at O'Neills	1993 to 2004
33313	Ohura at Tokorima	1961
1032561	Makino at Rata St	2024
1132519	Kahuterawa at Johnstons Rata	2005
1232564	Manga-Atua at Hopelands Rd	1990 to 2005
1432003	Manakau at S.H.1 Bridge	2024
1432008	Waikawa at North Manakau Road	2024

### 3 Flood frequency analysis

Using extreme value analysis, we assessed both the Annual Recurrence Intervals (ARI, years) for various peak flood flows at each site of interest in the systematic record (at-site frequency analysis). Where historical data of peak flood flows existed (Table 3-1) a second round of analysis incorporated this, and was used in preference to the analysis of the systematic record only.

Based on a literature review we adopted the standard approach to flood frequency analysis (Hosking and Wallis 1997). This involves using continuous annual maximum flood peak data at a site and fitting the data with a number of statistical distributions. Peaks over an arbitrary threshold or partial duration series were not used – these are usually employed only at sites with short records because they increase the amount of data available for distribution fitting (Kuczera and Frank 2006).

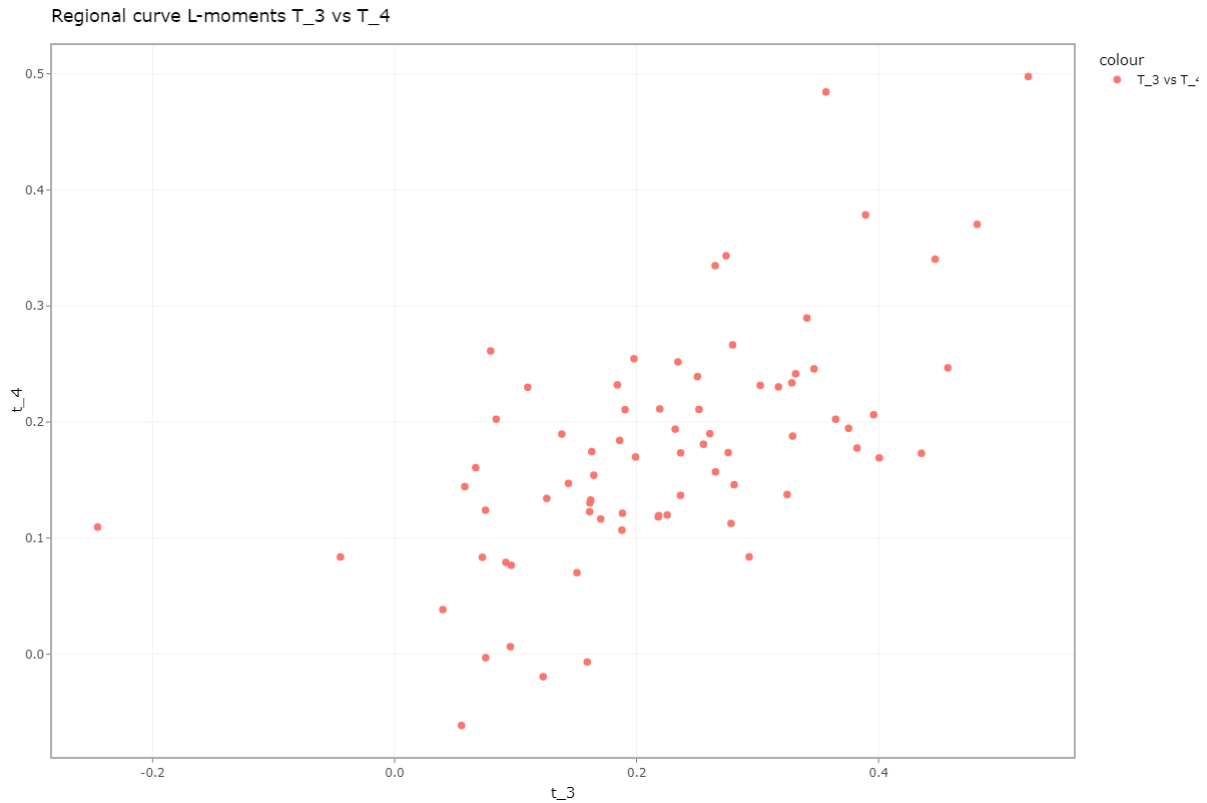
Specifically, we used the Generalised Extreme Value (GEV), Gumbel, log Pearson, log Normal, and Pearson III distributions (Hosking and Wallis 1993, Hosking and Wallis 1997, Kotz and Nadarjah 1999). A (four parameter) two-component extreme value distribution (TCEV) was not included because we do not have sufficient empirical evidence that two populations of flood peaks were present at any site as a result, for example, of major floods being generated by different processes from small floods or from storms coming from different directions (Connell and Pearson 2001). It was also not fitted for single site flood frequency analysis, as this is not advisable for four parameter distributions.

L moments (Hosking and Wallis 1997) were employed to fit all of the distributions to site data. For the purposes of illustration, a flood peak,  $Q_p$ , ( $m^3/s$ ) versus ARI, or T (return period, years), graph for each site was plotted using the Gringorten plotting position which is the most appropriate for plotting the extreme value distributions (Gumbel, GEV and TCEV distributions). ARI was used because of its familiarity to most readers rather than annual exceedance probability (AEP) which is often employed in technical publications. Note, however that  $AEP = 1/T$ , T in years, and  $T = 1/AEP$  defines return period and ARI.

The current work has demonstrated that the GEV distribution consistently provides a good fit, as determined both visually and through statistical goodness-of-fit tests. This finding is consistent with previous research conducted in the Horizons Region (McKerchar and Pearson 1989). These results are presented in this report. Results using other extreme value distributions are also provided in this report.

Many of the distributions tested provided an acceptable fit to the data. However, the GEV was identified as the preferred choice for determining ARI values as also found by Pearson (2004).

Hosking and Wallis (1997) recommend the fitting of distributions by L-moments for 'regional' flood frequency – by plotting the L-moment ratios L-kurtosis ( $t_4$ ) versus L-skewness ( $t_3$ ) of annual maximum series in a region. In the  $t_3$ - $t_4$  plane three-parameter distributions (e.g., GEV, log-Pearson) plot as curves and two-parameter distributions appear as dots (e.g., the Gumbel distribution is represented by the coordinates ( $t_3=0.17$ ,  $t_4=0.15$ )). Figure 3-1 shows wide scatter for the HRC L-moment ratios (as for NZ floods in Pearson (1991)) and this indicates that a three-parameter distribution and not Gumbel is a suitable generating distribution of such ( $t_3$ ,  $t_4$ ) behaviour.



**Figure 3-1: HRC L-moment ratios for 74 annual maximum series.** Points would be clustered around the Gumbel distribution coordinates ( $t_3=0.17$ ,  $t_4=0.15$ ) if that distribution was a good fit.

Hosking and Wallis (1997) also recommend use of regional flood frequency curves for extrapolating to high return periods (> 100 years and beyond) rather than just relying on at-site flood frequency analysis. Figure 4-3 shows normalised annual peak flows plotted against their Gringorten positions for all of the 74 sites in this study along with the best fit GEV and Kappa (4-parameter) distributions. The closeness of the GEV and Kappa curves shows that the GEV fit is a good representation of the regional flood frequency in the Horizons Region. This regional flood frequency curve is more robust than the site-specific analyses for estimation of floods with higher return periods.

For locations where information on large flood flows was identified in the historical record, the flood frequency was re-estimated using historical records and the systematic records, using a Bayesian Markov Chain Monte Carlo (BMCMC) (Neppel et al. 2010, Griffiths et al. 2017, Lucas et al. 2023). This methodology requires defining a historical period over which floods are considered and a 'perception' threshold for flood peaks. In this analysis we used 1858 as the start of the historical period. This choice is arbitrary and was applied to each catchment because:

- There was a large historical flood event in 2004 and 2015 across several Horizons catchments.
- We assume that the literature has recorded all the large historical events since the 1858 flood event, i.e., we assume we have captured all the exceedances over the perception threshold at each site during the historical period.
- Using the same historical period at all sites will not introduce any bias into the analysis, as long as any historical peaks over the perception threshold are recorded, and all other years were below that threshold.

The historical record ends at the start of the systematic record for each site. The perception threshold serves as a criterion for identifying and incorporating years in the historical periods when no floods occurred. The specific threshold used differs from site to site and is based on historic knowledge. This helps in acknowledging the absence of flood events during certain years and ensures that such periods are appropriately considered in our analysis. The rationale behind its use is:

- The analysis focuses on events with significant impact, which aligns with the objectives of the project. This threshold helps filter out events that, while part of the historical record, will not impact substantially on the results of our analysis.
- Peaks over this threshold are of greater value to this study, smaller historical flood peaks are of less value.
- The systematic record could be extended by use of the smaller historical floods that are close to the start of the systematic record. But overall, the systematic records are of good length for analysis, and the use of the historical floods is to see if there is any useful frequency-magnitude information over a longer time duration and for the higher magnitude historical flood peak events that can be incorporated into the analysis.

Software employed in the analysis included R (R Core Team 2018) and Tideda to analyse systematic data and the R nsRFA package (Viglione 2020) to analyse a combination of systematic and historical data.

**Table 3-1: Sites where historical information is available for flood frequency analysis.**

Site ID	Site Name	Start and end year of historical information
32504	Manawatu at Hopelands	1948 - 1956
32590	Koputaroa at Tavistock Rd	1974 - 1989
33012	Turakina at O'Neills	1937 - 1976
33119	Makotuku at Raetihi	1974 -1977
33303	Whanganui at Te Rewa (same historical information as 33301)	1858 - 1940
33313	Ohura at Tokorima	1961 - 1978
33341	Mangaroa at Ohura Town Br	1965 - 1971
33345	Whanganui at Pipiriki	1904 - 1969
1032560	Manawatu at Teachers College	1880 - 1897
1132508	Oroua at Almadale Slackline	1947 -1979
1232564	Manga-Atua at Hopelands Rd	1980 - 1990
1232566	Manawatu at Upper Gorge	1880 - 1948

### 3.1 At-site analysis

Two cases were considered at each site, namely, flood frequency versus return period relations for (1) systematic data; (2) systematic data and historical data (only for site where historical information was available). Consideration of the results from these cases assists our understanding of the effects of inclusion of historical information. A range of theoretical flood frequency distributions were fitted to the data for each site with the best fit selected visually and supported by statistical testing.

Goodness of fit statistical tests used were Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Root Mean Square Error (RMSE) and Kolmogorov-Smirnov (KS) Test.

To determine the best-fitted distribution, we used a combination of AIC, BIC, RMSE, and the Kolmogorov-Smirnov (KS) test. Lower AIC values suggest a better balance between model fit and complexity, making the distribution with the lowest AIC the preferred choice. Similarly, BIC, which penalises model complexity more heavily, favours distributions with lower values. For RMSE, a lower score indicates that the model's predictions align more closely with the observed data, implying a better fit. The KS test compares the cumulative distribution function (CDF) of the fitted model to the observed data, with a lower D-statistic suggesting a closer fit. Additionally, a higher p-value (typically above 0.05) from the KS test suggests that the fitted distribution is not significantly different from the observed data. Therefore, the best-fitted distribution would be the one that achieves the lowest AIC, BIC, and RMSE values, along with a low D-statistic and a high p-value in the KS test.

### 3.2 Regional analysis

A regional flood frequency relationship was derived using the systematic data from all sites. Historical data were not included because use of all the regional systematic data is sufficient for adequately estimating the regional dimensionless distribution (each at-site annual maxima series divided by its mean annual flood). The dependant variable here is  $Q_p/Q_a$  where  $Q_p$  is annual maximum flood peak discharge and  $Q_a$  is the mean of the annual maxima comprising the site record. The independent variable is T. Kappa and GEV distributions were used to fit the regional data.

## 4 Results and discussion

### 4.1 At site

Table 4-1 gives the various statistics for the systematic annual maxima timeseries for each site.

Details of the calculated return periods (plotting position) for the ten largest annual maximum flood peak discharges recorded at the 74 sites are given in Appendix A. This allowed recognition of widespread storm across horizons region. For example, years of high frequency in top ten lists for each site were 2015 (44 occurrences), 2004 (42) and 2023 (32), indicating a mix of more monitoring and larger flood peaks in recent years. This information is useful for obtaining flood information to assess vulnerability of assets.

The results of fitting at-site flood frequency distributions to the systematic data are given in Appendix B, both graphically (Figure B-1) and in tabular form (Table B-1). This is required for analysis for obtaining flood information to assess vulnerability of assets.

Selection of the best distribution was done based on AIC, BIC, RMSE and KS tests. For example, for site 32001 in Appendix C, based on the analysis of AIC, BIC, RMSE, and KS Statistic values for various distributions, the LP3 distribution shows the lowest AIC and BIC scores, indicating a strong fit in terms of model parsimony. However, the GEV distribution stands out with the lowest RMSE and KS Statistic, suggesting a superior fit to the data in terms of minimising error and capturing the distribution's shape effectively. While the Gamma distribution also performs reasonably well, the GEV distribution provides a balanced combination of low error and a good fit across multiple criteria. Therefore, the GEV distribution appears to be the best choice overall. This is also supported visually.

Appendix C lists goodness of its statistics for the fitted distributions. Fourteen distributions were fitted to site data originally. This was reduced to five distributions based on goodness of fit as shown in Appendix B.

Appendix D shows plots of sites with both historical and systematics records. The BMCMC model to the systematic and historical data combined are given in Appendix E.

Appendix F lists the historical flood magnitudes.

For systematic data, an acceptable fit for practical purposes is supplied by the GEV distribution at all sites as evidenced visually from the plots of flood peak discharge versus return period in Appendix B. Similarly, where historical data are involved the BMCMC model produces an acceptable fit.

Site 32547 Manawatu at Moutoa and 1032555 Mangatainoka at Larsons Bridge are fitted by an EV3 distribution which is unusual. It is likely that large flood peaks at 32547 Manawatu at Moutoa are moderated by use of the Moutoa floodway. The reason for the EV3 distribution fit for site 1032555 Mangatainoka at Larsons Bridge is unknown.

Please note that site Raparapawai, Tamaki, Oruakeretaki, Mangapapa, Manga-Atua are a water resource site. This means that the sites have limited gauging above the mean annual flow and the main focus is on the low flow. Similarly, flood frequency analysis is not recommended for the sites that impacted by the external factors. For example, Moutoa (Rating is downstream of the gates - and not accounting for floodways flows once the gates are open), Hokio (heavily impacted by lake levels and weed growth). Hence the flood frequency analysis for these sites presented in this report may be not representative.

The inclusion of historical data not only extended the flood record lengths but also increased confidence in the results. For example, Site 33303 Whanganui at Te Rewa 100-year return period at-site flood estimate was 4890 m<sup>3</sup>/s while inclusion of historical flood information updated this to 4980 m<sup>3</sup>/s. This difference of 90 m<sup>3</sup>/s is well within the margin of error.

## 4.2 Regional

Figure 4-1 presents the L-moment ratio diagram for three catchment size categories, highlighting notable variability between small and large catchments. The mean L-skewness for each catchment group is summarised in Table 4-2. Larger catchments tend to be more EV1 distributed ( $t_3 = 0.17$ ).

Figure 4-2 illustrates the L-moment ratios for four major catchments in the Horizons' region, with considerable inter-catchment variability also evident (see Table 4.2). Among these, the Manawatū River appears to be best represented by either the EV1 (Gumbel) or EV2 (Generalized Extreme Value) distribution. The Whanganui catchment may be most suitably modelled by EV1, while the Rangitīkei and Whangaehu catchments align more closely with the EV2 distribution.

However, due to the substantial scatter in the L-moment ratio plots and the absence of clearly defined clusters, there is insufficient evidence to delineate distinct hydrological regions based on the current analysis. In light of this, it is recommended to adopt a single regional growth curve for the whole region. This approach may be revisited and refined in future if any sub-region experiences a significant flood event or exhibits emerging hydrological distinctions.

Figure 4-3 displays all of the sites' data for the region. It is well fitted by GEV and Kappa distributions. As can be seen from Figure 4-3 the data are rather scattered and there are six potential outliers present where  $Q_r > 3.8$ . This behaviour is not unusual for hydrological regions in New Zealand. The predicted values of T for these outliers from GEV and Kappa curves are very large ( $T > 1000$  years) and unrealistic. More realistic values were estimated from site data using an undated empirical formula given in Griffiths et al. (2019).

The outlier for site 33107 with flood peak of 499 m<sup>3</sup>/s, which is 5.2 times the mean annual flood, was excluded from the analysis as it was generated by a lahar rather than by storm rainfall. If it was generated by a storm, then the GEV regional curve predicts that its return period would be around 9,000 years. Based on the updated empirical formula given in Griffiths et al. (2019) the predicted return period would be 500 years.

Updated return periods are given in Table 4-2 for the other five large  $Q_r$  values.

The second largest  $Q_r$  value recorded was 4.30 at site 32702 Hokio at Lake Horowhenua with a revised estimated return period of 145 years.

Figure 4-4 displays the updated regional curves with the lahar outlier removed, and the recommended GEV regional  $Q_r$  estimates are provided in Table 4-4.

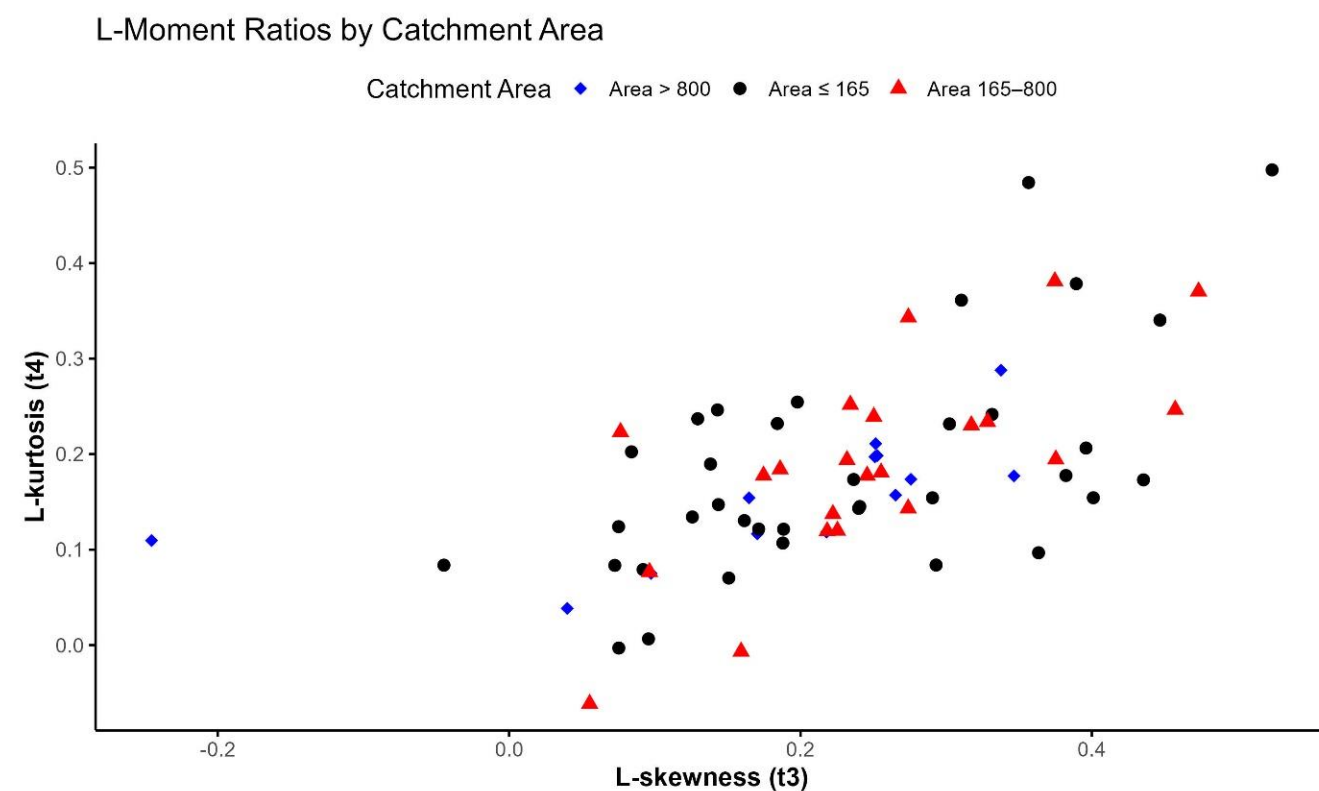
**Table 4-1: Statistics for annual maxima.**

Site ID	Sitename	Record length (yrs)	Minimum (m <sup>3</sup> /s)	Maximum (m <sup>3</sup> /s)	Median (m <sup>3</sup> /s)	Mean (m <sup>3</sup> /s)	Standard Deviation (m <sup>3</sup> /s)	Coefficient of Variation
25110	Owahanga at Owahanga Station	26	122	971	277	348	212	0.609
32001	Manakau at Gleesons Rd	12	2.5	34.8	13.4	16.5	10.3	0.626
32106	Ohau at Rongomatane	46	80.6	493	204	227	95.7	0.421
32302	Hokio at Lake Horowhenua	11	1.4	10.7	4.4	4.4	3	0.667
32503	Manawatu at Weber Rd	70	109.3	1491.2	467.6	522.1	299.1	0.573
32504	Manawatu at Hopelands	36	190.9	1874.7	631.6	677.6	405.9	0.599
32529	Tiraumea at Ngaturi	67	78.9	733.1	282.1	312.2	157.4	0.504
32547	Manawatu at Moutoa	37	891.2	1340.8	1193.3	1153.1	112.4	0.097
32557	Mangaone at Milson Line	54	8.6	216.5	58.1	68.3	41.9	0.615
32563	Oroua at Kawa Wool	57	36.2	464.7	180	204.8	91.3	0.446
32564	Pohangina at Piripiri	13	62.7	248.7	141.5	146.9	60.8	0.414
32576	Pohangina at Mais Reach	55	106.3	1109.1	386.5	450	230.6	0.512
32590	Koputaroa at Tavistock Rd	16	2.5	30.7	10.1	11.4	6.5	0.572
32702	Rangitikei at Mangaweka	69	300.2	3469	721.1	810.4	444.1	0.548
32703	Rangitikei at Onepuhi	22	398.5	2077.7	658.4	787.1	394.4	0.501
32708	Rangitikei at Springvale	11	101.8	530.1	301	302.6	119.2	0.394
32715	Porewa at Tututotara	29	11.8	105.4	25.6	30.6	18	0.59
32739	Tutaenui at Hammond St	48	0.7	67.4	15.2	19.3	13.2	0.686
32760	Rangitikei at McKelvies	19	544.5	1553.8	768.3	852	279.5	0.328
32763	Rangitikei at Pukeokahu	26	183.6	851.7	373.7	403.5	162.5	0.403
32767	Hautapu at Alabaster's	51	18.2	236.6	40.8	51.3	35.5	0.691
33003	Turakina at SH3	16	96.9	372.7	225.8	223.4	87	0.39
33004	Turakina at Otairi	34	79.4	968.1	214.2	288.2	184.2	0.639
33012	Turakina at O'Neills	47	67.8	510.8	239.7	251.5	112.1	0.446
33101	Whangaehu at Kauangaroa	67	209.7	1309.1	491.7	539.5	232.2	0.43
33107	Whangaehu at Karioi	61	32.2	498.6	82.4	94.9	62.7	0.66
33111	Mangawhero at Ore Ore	63	102.2	736.6	216.1	252.4	130.5	0.517
33112	Tokiahuru at Whangaehu Junction	35	16.1	133.7	46.2	51.8	22.2	0.429
33114	Waitangi at Tangiwai	34	1.6	5.8	3.4	3.4	1.1	0.326
33115	Mangaetoroa at School	44	0.5	48.1	20.4	20.7	9.1	0.441
33119	Makotuku at Raetihi	23	31.6	197	56.7	70.7	42.5	0.601
33130	Whangaehu at Mangaio Tunnel	29	5.7	8.6	6.4	6.7	0.7	0.111
33143	Mangawhero at Hagleys	9	24.1	121.3	51.2	55.9	27.4	0.491
33149	Mangawhero at Pakihi Rd Br	19	45.9	236.7	63.7	73.4	41.5	0.565
33303	Whanganui at Te Rewa	68	1063	4965	2150.4	2274.6	811.9	0.357
33307	Whanganui at Headwaters	20	9.9	97.6	41	42.9	22.5	0.524
33313	Ohura at Tokorima	41	150.8	440.8	239.9	258	73	0.283
33314	Ohura at Nihoniho	18	80.5	190.5	130.7	128.8	38	0.295

33341	Mangaroa at Ohura Town Br	18	69.9	165	106.1	111.1	28.3	0.255
33345	Whanganui at Pipiriki	57	113.5	6423.1	2082.6	2304	1141.8	0.496
33347	Whanganui at Te Porere	59	10.9	57.7	30.4	32.8	11.2	0.341
33366	Matarawa at Diversion	18	1.3	21.9	10.4	11	5.2	0.471
33502	Kai Iwi at Handley Rd	47	4.9	107.8	26	31.8	20.5	0.645
1032501	Kumeti at Te Rehunga	45	2.3	22.2	8.3	9.2	4.9	0.533
1032504	Tamaki at Water Supply Weir	43	3	136.6	25.7	40.7	31.5	0.776
1032517	Tokomaru at Quarry	21	24.8	191.7	91	94.6	36.5	0.386
1032518	Makakahi at Hamua	46	75.5	483.1	193.2	200.1	76.2	0.381
1032542	Makino at Reids Line	18	5.6	88	18.3	28.4	22.7	0.799
1032555	Mangatainoka at Larsons Br	42	105.3	273.6	195.3	190.5	43.6	0.229
1032560	Manawatu at Teachers College	123	477.7	3800.0	1465.3	1563.2	614.8	0.393
1032561	Makino at Rata St	38	0.6	111	33.4	38	23.9	0.629
1032564	Makino at Boness Rd	34	2.3	90.8	32.7	37.7	21.5	0.57
1032591	Makuri at Tuscan Hills	26	32.5	269.6	116.7	120.4	56.9	0.472
1033153	Whangaehu at Aranui	20	95	550	143.3	195.3	116.6	0.597
1033154	Mangawhero at Raupiu Road	13	154.1	888.2	295.6	379.4	229.3	0.604
1033363	Matarawa at City Branch	29	0.8	12.5	4.8	5.2	2.1	0.412
1132508	Oroua at Almadale Slackline	66	4.8	568.3	158.1	174.1	92.5	0.531
1132511	Mangatainoka at Pahiatua Town Bridge	71	177.2	948.3	404.1	417.8	155.1	0.371
1132517	Kiwitea at Haynes Line	13	19.8	172.9	42.6	58.1	46.2	0.795
1132519	Kahuterawa at Johnstons Rata	19	30.2	136.6	57.6	68.1	29.7	0.436
1132523	Kiwitea at Strathspey Farm	32	9.7	166.1	51.4	61.1	39.7	0.651
1232561	Raparapawai at Jackson Rd	23	6.1	153.7	27.8	36.3	29	0.797
1232563	Mangapapa at Troup Road	18	5.8	77.2	35	40.8	21.3	0.522
1232564	Manga-Atua at Hopelands Rd	30	21	152.2	64.5	68.2	29.1	0.427
1232566	Manawatu at Upper Gorge	54	126.1	3404.8	1177.9	1363.4	696.3	0.511
1232581	Oruakeretaki at SH2(Napier)	18	15.3	91.8	38.7	40.2	17.2	0.429
1332518	Mangatoro at Mangahei Road	22	2.2	561.4	167.7	190.5	129.1	0.678
1332556	Tamaki at Stephenson's	17	12.8	181.2	43.3	63.7	55.2	0.867
1425006	Waihi at S.H.52	20	33.2	1042.7	185.9	255.6	240.8	0.942
1425101	Owahanga at Branscombe Bridge	22	160.5	824.8	277.3	341.1	175.7	0.515
1432003	Manakau at S.H.1 Bridge	18	8.3	69.5	17.8	23.8	16.9	0.709
1432008	Waikawa at North Manakau Road	18	22.9	171.6	42.6	64.9	42.3	0.652
2232510	Tokomaru at Riverland Farm	45	9.9	366.3	98.3	102.3	55.3	0.541

**Table 4-2: Grouping based on catchments and area.** Number of sites and mean skewness (t3) for each group.

Group	Number of sites	Mean_t3
Manawatu		0.2018
Rangitikei		0.2837
Whangaehu		0.3068
Whanganui		0.1735
Area $\leq 165 \text{ km}^2$		0.2309
$165 \text{ km}^2 < \text{Area} < 800 \text{ km}^2$		0.2502
Area $> 800 \text{ km}^2$		0.1866



**Figure 4-1: HRC L-moment ratios by catchment area size. .**

### L-Moment Ratios: Selected Catchments

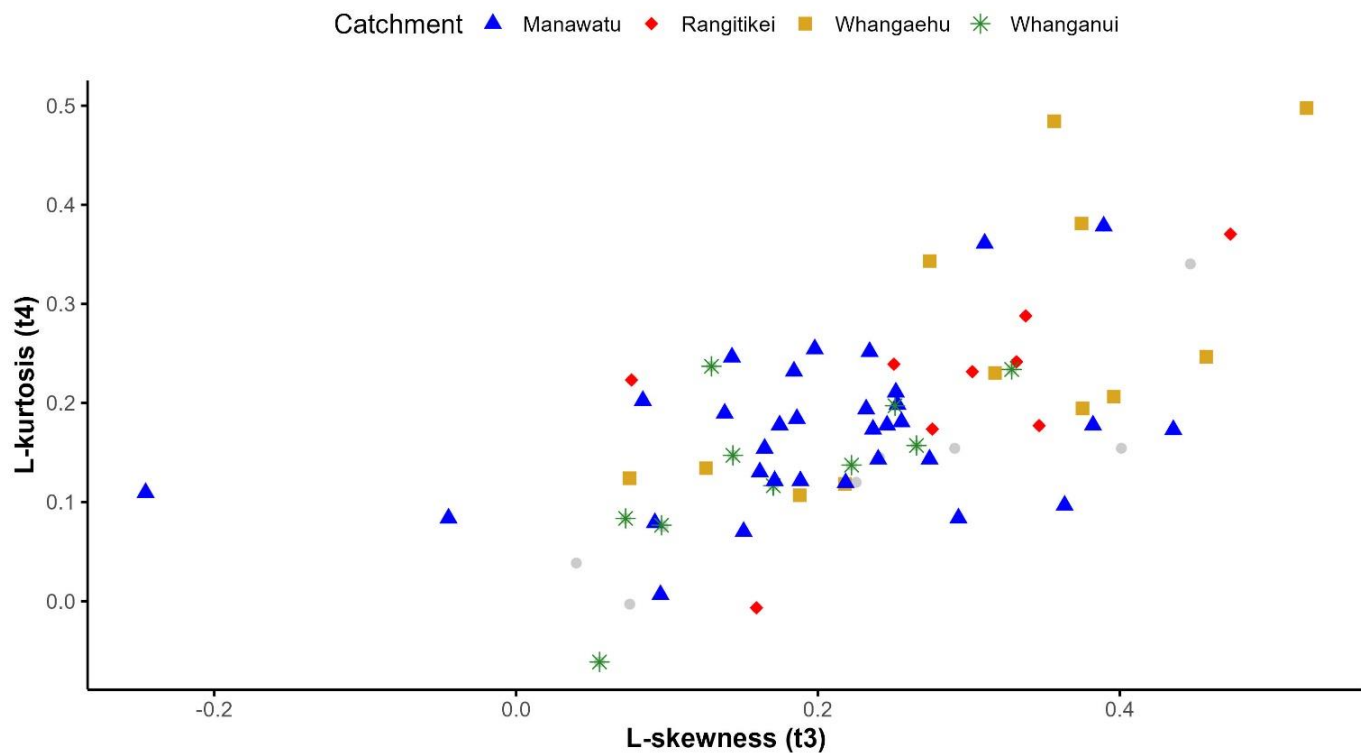
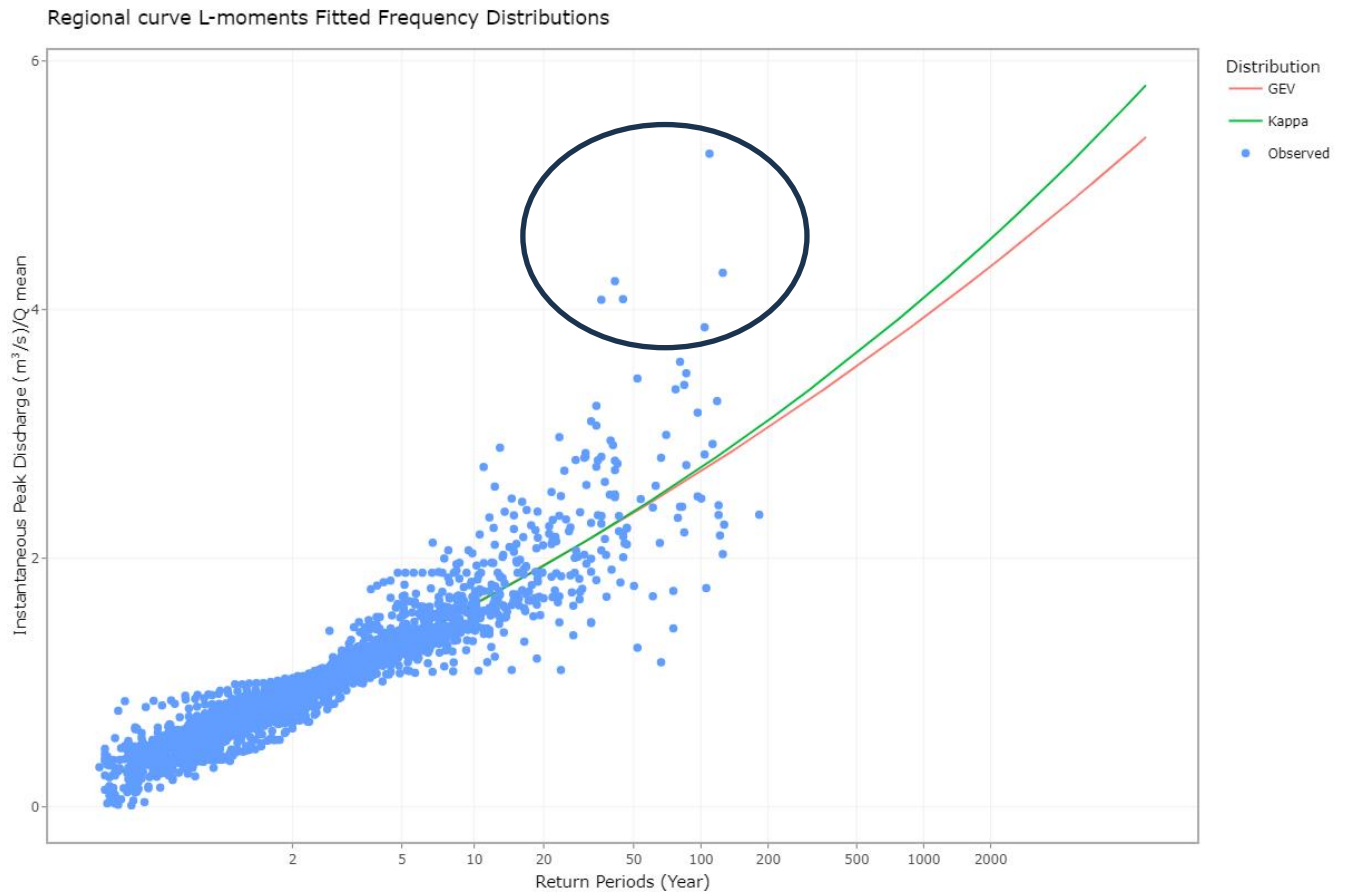


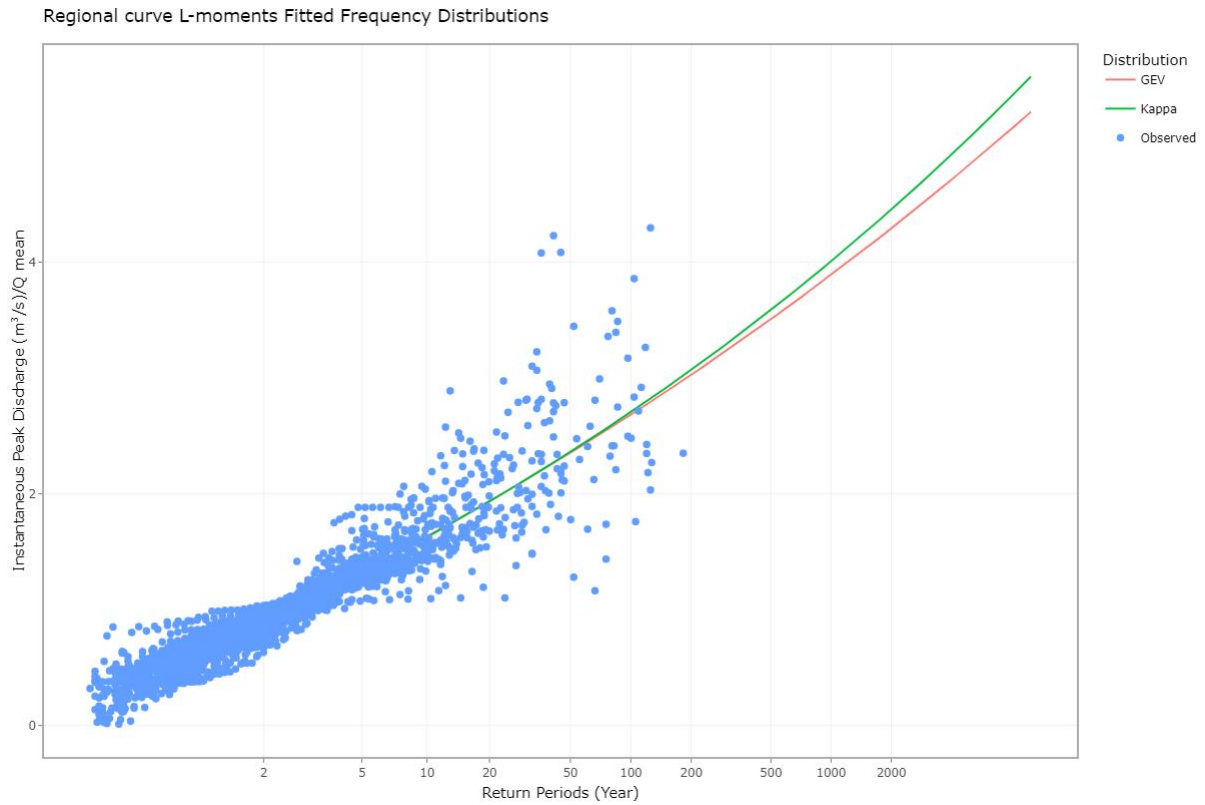
Figure 4-2: HRC L-moment ratios by four major catchments.



**Figure 4-3: Regional flood frequency data and curves.** Six potential outliers are circled.

**Table 4-3: Adjusted return period values for outliers.** The top row is a lahar generated flood.

Site Id	Site name	Qr	Return period (years) Based on Regional Curve	Return Period (years) Adjusted based on Griffiths et al (2019)
33107	Whangaehu at Karioi	5.25	9000	500
32702	Rangitikei at Mangaweka	4.30	2000	145
1232561	Raparapawai at Jackson Rd	4.23	1800	100
32767	Hautapu at Alabaster's	4.08	1400	65
1425006	Waihi at S.H.52	4.08	1385	55
32563	Oroua at Kawa Wool	3.86	950	120



**Figure 4-4: Updated regional flood frequency curve.**

**Table 4-4: Final GEV regional flood frequency Qr values for various return periods.**

Return Period (years)	Probability of Non-Exceedance	Qr
2	0.5	0.90
5	0.8	1.35
10	0.9	1.63
25	0.96	2.03
50	0.98	2.34
75	0.9867	2.53
100	0.99	2,67
200	0.995	3.00
500	0.998	3.48
1000	0.999	3.85

### 4.3 Uncertainty

There are several potential sources of uncertainty and error in this analysis, primarily stemming from data gaps, flood peak magnitude estimation, length of flood records and distribution fitting. A comprehensive treatment of these errors falls beyond the scope of this study, but some relevant considerations are given below.

Severe ex-tropical cyclones only reach New Zealand periodically but often cause extreme flooding when they do. Because they occur less frequently than ordinary rainfall events, we have less understanding of the statistics of their occurrence, making it vital to learn from events such as

Cyclone Gabrielle (2023). Sites where the ARI is greater than 100 years will have considerable uncertainty in the exact values of these estimates, but regardless, these events represent rare and severe floods in those locations. The use of a regional TCEV distribution may be useful for describing Horizons flooding in future.

#### 4.4 Application of the flood frequency analysis

The results shown in Appendix B represent our best estimates of the ARIs for the flooding at river gauges within Horizons Region. Further study of the events may lead to more refined estimates of peak flows at these gauges and future events could lead to further refinement of the results presented in Section 4. The GEV regional curve with the at-site mean annual flood should be used to estimate more realistic values of return periods of flood peaks than those obtained just from site data.

When applying results from a site, especially for ascertaining large return periods of flood peaks all historical and systematic data should be employed where available as well as the regional curve. This should be done by pooling regional and at-site flood frequency estimates as recommended in McKerchar and Pearson (1989), using approximate estimates of uncertainties (e.g., standard errors of say  $\pm 30\%$  for at-site and regional estimates), or simply the average of the regional and at-site estimates. These suggestions are summarised in Table 4-5.

**Table 4-5: Recommended application of flood frequency.**

Criterion	Recommendation	Comments
Record length < 20 year	Use EV1 (Gumbel) and GEV Regional	Short record, better to use 2 parameter distribution
Record length $\geq 20$ year	Use GEV at-site and GEV regional	
EV3	Use EV1 at-site	EV3 could be an underestimate so use EV1 as conservative estimate
Return period $\geq 100$ yr	Always use pooled, at-site and regional	Regional estimate is based on more data
Regional method	Use Table 4-2 and at-site mean annual flood (Table 4-1) to obtained regional estimates	

#### 4.5 Climate change

Climate change is expected to affect rainfall intensity and the occurrence and intensity of ex-tropical cyclones reaching New Zealand. These effects could change the ARI of flood peaks in the future.

Guidance concerning the likely effect of climate change on flooding in New Zealand is given in Bodeker et al. (2022) based on the 2021 Intergovernmental Panel on Climate Change’s Sixth Assessment Report (IPCC AR6 WG1). Bodeker et al. (2022) state that there is medium confidence that river flooding will increase in New Zealand. Projections indicate that the 1-in-50 year and 1-in-100-year flood peaks in rivers in many parts of the country may increase by 5 to 10% by 2050 and more by 2100 (with large variation between models and emission scenarios) with a corresponding decrease in return periods for specific flood levels.

A range of projections rather than a single value can be difficult for a practitioner to deal with. Rather than adopting, say, a median value it is suggested that the user evaluates the impacts of several

climate change projections within the given range. The user should carefully consider the options employing a risk-based framework involving balancing risk and cost of impacts. In a particular case an adaptation strategy may allow less flood protection for flooding of poor-quality agricultural land for example and much higher protection for an urban environment. If resources allow, an optimum adaptation strategy would provide flood protection for the full range of impacts based on a cost benefit analysis.

A regional climate change study by Collins et al. (2018) suggests an increase in mean annual flood magnitudes across the South Island, while no significant change is expected in the North Island. This projected increase aligns closely with the changes in extreme rainfall patterns reported by the Ministry for the Environment (2016), particularly in relation to the 99th percentile of daily rainfall. Furthermore, analysis of historical flow records (Henderson et al., 2018) demonstrates a strong correlation between mean annual flood flows and mean annual rainfall, reinforcing the sensitivity of flood regimes to changes in precipitation intensity and distribution.

## 4.6 Recommendation

To ensure the continued robustness and relevance of the Flood Frequency Analysis (FFA), the following recommendations are proposed:

1. **Periodic Review and Update:**  
It is recommended that the FFA be reviewed and updated on a 10-year cycle to incorporate new data, accounting for land-use changes, and reflecting evolving hydrological patterns.
2. **Event-Triggered Review:**  
In addition to the regular review cycle, an earlier reassessment should be triggered if a significant flood event occurs—specifically, an event with an annual exceedance probability (AEP) of 2% or less (i.e., a 1-in-50-year event) is recorded across 10 or more catchments within the region. Such an occurrence may indicate a shift in regional flood characteristics, warranting an updated FFA.
3. **Seasonal Analysis:**  
Future FFAs should consider seasonal disaggregation of flood data, particularly to better capture the behaviour of extreme events such as ex-tropical cyclones, which may not be well represented in annual maxima series. Seasonal analysis can improve curve fitting and provide more detailed risk assessments.
4. **Incorporation of Climate Change Considerations:**  
To account for the potential impacts of climate change on flood frequency and magnitude, it is recommended that future FFAs include:
  - Trend analysis of annual and seasonal maxima to identify statistically significant shifts over time;
  - The use of climate-adjusted hydrological models or non-stationary frequency analysis techniques that allow flood frequency estimates to vary over time in response to observed or projected climatic drivers;
  - Integration of regional climate model outputs or downscaled projections to assess potential future changes in rainfall intensity and storm patterns;

- Scenario-based sensitivity testing to evaluate the implications of different climate futures on flood risk.

These measures will help ensure that the FFA remains scientifically sound and relevant for long-term planning and risk management under changing climatic conditions.

## 5 Conclusions

At-site flood frequency relationships have been established for 74 sites within the Horizons Region. For each of these sites, flood frequency relationships were modelled using five different frequency distributions.

- The results of the statistical analysis indicate that the time series of annual maximum flood peaks at sites across the Horizons Region can be assumed to be stationary and serially independent.
- In most cases, the GEV distribution provides the best fit for modelling annual maximum flood peaks and their corresponding return periods at a site.
- The regional GEV curve should be used to estimate more realistic values of return periods of flood peaks than those obtained just from site data.
- When applying results from a site, especially for ascertaining large return periods of flood peaks all historical and systematic data should be employed where available as well as the regional curve.

## 6 Acknowledgements

We gratefully acknowledge the support of staff at Horizons Regional Council, especially Brent Watson and Julia Jung.

## 7 Glossary of abbreviations and terms

NIWA	National Institute of Water and Atmospheric Research
HRC	Horizons Regional Council
BMCMC	Bayesian Markov Chain Monte Carlo
GEV	Generalised Extreme Value distribution
ARI, T	Average Recurrence Interval or Return Period (years)
AEP	Annual Exceedance Probability
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion (BIC)
RMSE	Root Mean Square Error
KS	Kolmogorov-Smirnov (KS) Test

## 8 References

- Bodeker, G., Cullen, N., Katurji, M., McDonald, A., Morgenstern, O., Noone, D., Renwick, J., Revell, L., Tait, A. (2022) Aotearoa New Zealand climate change projections guidance: Interpreting the latest IPCC WG1 report findings. Prepared for the Ministry for the Environment, Report number CR 501: 51p.
- Collins, D., Montgomery, K. Zammit, C. (2018) Hydrological projection for New Zealand rivers under climate change. NIWA Client Report No. 2018193CH: 107.
- Connell R. J., Pearson, C. P. (2001) Two-component extreme value distribution applied to Canterbury annual maximum flood peaks, *Journal of Hydrology (NZ)* Vol.40(2).
- Griffiths, G. A., McKerchar, A. I., Renard, B. (2017) Flood frequency analysis combining a systematic record with historical, regional model and analogue information. *Journal of Hydrology (NZ)* 56(1): 1-12.
- Griffiths, G. A., Singh, S. K., McKerchar, A. I. (2019) Towards prediction of extreme floods in New Zealand. *Journal of Hydrology (NZ)* 58(2): 105-116.
- Henderson, R.D., Collins, D.B.G., Doyle, M., Watson, J. (2018) Regional Flood Estimation Tool for New Zealand Final Report Part 2. NIWA Client Report, 2018177CH for Envirolink Tools (MBIE): 44.
- Hosking, J., Wallis, J. (1993) "Some statistics useful in regional frequency analysis." *Water Resources Research* 29(2): 271-281.
- Hosking, J. R. M., Wallis, J. R. (1997) Regional frequency analysis. An Approach Based on L-moments. Cambridge University Press, UK.  
<http://dx.doi.org/10.1017/cbo9780511529443>
- Kotz, S., Nadarajah, S., (1999) *Extreme Value Distributions: Theory and Applications*, Imperial Collage Press, London.
- Kuczera, G., Frank, S. (2006) Australian Rainfall and Runoff, Book IV, Estimation of Peak Discharge – Draft, Engineers Australia, [Online] Available from:  
[http://www.arr.org.au/wpcontent/uploads/2013/Projects/ARR\\_IV-2.pdf](http://www.arr.org.au/wpcontent/uploads/2013/Projects/ARR_IV-2.pdf)
- Lucas, M., Rennard, B., Le Coz, J., Lang, M., Bard, A., Pierrefeu, G. (2023) Are historical stage records useful to decrease the uncertainty of flood frequency analysis? A 200-year long case study. *Journal of Hydrology* 624: 129840.
- McKerchar, A. I., Pearson, C. P. (1989) Flood frequency in New Zealand. Hydrology Centre Publication 20. Christchurch, New Zealand. 87p.
- Ministry for the Environment (2016) Climate Change Projections for New Zealand Atmospheric projections based on simulations undertaken for the IPCC 5th Assessment: 127.
- Neppel, L., Renard, B., Lang, M., Ayrat P-A., Coeur, D., Gaume, E., Jacob, N., Payrastre, O., Pobanz, K., Vinet, F. (2010) Flood frequency analysis using historical data: accounting for random and systematic errors. *Hydrological Sciences Journal* 55(2): 192-208.

Pearson, C. (2004) Frequency analysis of mid-February 2004 Manawatu-Wanganui floods, NIWA Client Report: CHC2004-098, Christchurch. 12p.

Pearson, C.P. (1991) New Zealand regional flood frequency analysis using L-moments. Journal of Hydrology (NZ) 30(2): 53-64.

R Core Team (2018) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

Viglione, A. (2020) `_nsRFA: Non-Supervised Regional Frequency Analysis_`. R package version 0.7-15, <<https://CRAN.R-project.org/package=nsRFA>>.

## Appendix A Top 10 peak flows for each site

**Table A-1: The top 10 peak flows for each site and Gringorten plotting positions.** (Given in Table 2-1).

Site ID	Site name	Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
25110	Owahanga at Owahanga Station	2023	14/02/2023	970.8	1	46.6
		2018	8/03/2018	824.8	2	16.7
		2004	16/02/2004	673.2	3	10.2
		2008	30/07/2008	544.4	4	7.3
		2012	20/03/2012	511.2	5	5.7
		2013	12/07/2013	506.1	6	4.7
		2000	7/10/2000	417.3	7	4
		2001	15/08/2001	392.4	8	3.5
		2005	20/07/2005	340.3	9	3.1
		2006	6/07/2006	330	10	2.7
32001	Manakau at Gleesons Rd	1984	25/11/1984	34.8	1	21.6
		1986	4/10/1986	26.4	2	7.8
		1982	21/12/1982	26.4	3	4.7
		1980	20/01/1980	24.5	4	3.4
		1985	23/12/1985	23.3	5	2.7
		1979	12/04/1979	14.6	6	2.2
		1988	24/08/1988	12.3	7	1.8
		1983	4/11/1983	11.6	8	1.6
		1981	3/06/1981	10.6	9	1.4
		1987	15/06/1987	6.2	10	1.3
32106	Ohau at Rongomatane	1986	4/10/1986	492.7	1	82.4
		2005	6/01/2005	452.5	2	29.6
		2008	8/01/2008	421.7	3	18
		1993	20/11/1993	410.5	4	13
		2000	1/10/2000	353.3	5	10.1
		2010	6/09/2010	352.9	6	8.3
		1990	13/03/1990	349.9	7	7
		2021	27/06/2021	344.4	8	6.1
		1998	28/10/1998	318.7	9	5.4
		2015	19/06/2015	305.4	10	4.8
32302	Hokio at Lake Horowhenua	2015	22/06/2015	10.7	1	19.9
		2021	15/12/2021	8.7	2	7.1
		2019	23/08/2019	5.3	3	4.3
		2022	23/08/2022	4.9	4	3.1
		2016	23/12/2016	4.6	5	2.4
		2017	3/01/2017	4.4	6	2
		2018	25/07/2018	2.8	7	1.7
		2020	25/12/2020	2.5	8	1.5
		2023	23/04/2023	2.2	9	1.3
		2014	14/08/2014	1.4	10	1.2

32503	Manawatu at Weber Rd	2004	16/02/2004	1491.2	1	125.2
		1992	22/07/1992	1418.4	2	44.9
		2023	14/02/2023	1394.9	3	27.4
		1988	2/09/1988	1151.7	4	19.7
		1965	17/03/1965	1065.2	5	15.4
		1956	14/07/1956	1031.8	6	12.6
		1985	27/07/1985	918.1	7	10.7
		1999	29/11/1999	881.7	8	9.3
		1997	3/06/1997	802.6	9	8.2
		1971	4/05/1971	793.7	10	7.3
32504	Manawatu at Hopelands	2023	14/02/2023	1874.7	1	64.5
		2004	16/02/2004	1669.6	2	23.2
		1992	22/07/1992	1656.1	3	14.1
		1988	3/09/1988	1245.5	4	10.1
		1999	29/11/1999	1006.9	5	7.9
		2018	13/06/2018	891	6	6.5
		2017	13/07/2017	849.3	7	5.5
		1997	3/06/1997	834.7	8	4.8
		2015	21/06/2015	796.4	9	4.2
		2006	6/07/2006	785.9	10	3.8
32529	Tiraumea at Ngaturi	1991	11/04/1991	733.1	1	119.9
		2004	16/02/2004	730.5	2	43
		2017	13/07/2017	701.8	3	26.2
		1961	3/09/1961	675.8	4	18.9
		1992	23/07/1992	651.3	5	14.7
		1980	11/04/1980	612.1	6	12.1
		1985	27/07/1985	606.1	7	10.2
		2013	12/07/2013	529.3	8	8.9
		2023	15/02/2023	527.7	9	7.8
		1964	25/10/1964	433.7	10	7
32547	Manawatu at Moutoa	2004	16/02/2004	1340.8	1	66.3
		1994	16/11/1994	1269.3	2	23.8
		2006	25/10/2006	1269.1	3	14.5
		1988	25/07/1988	1261.8	4	10.4
		2021	28/06/2021	1257.3	5	8.1
		1992	16/02/1992	1252.6	6	6.7
		2010	19/09/2010	1242.7	7	5.7
		2003	29/09/2003	1238.9	8	4.9
		2013	12/07/2013	1232	9	4.3
		1998	21/10/1998	1229.3	10	3.9
32557	Mangaone at Milson Line	1976	1/06/1976	216.5	1	96.6
		2004	16/02/2004	190.3	2	34.7
		2015	21/06/2015	154.1	3	21.1
		1988	24/07/1988	144.3	4	15.2
		1980	19/10/1980	122.1	5	11.9
		2010	6/09/2010	111.4	6	9.7
		2001	15/08/2001	109.2	7	8.3

		1998	21/10/1998	97.1	8	7.2
		2017	13/07/2017	97.1	9	6.3
		1994	16/11/1994	95.2	10	5.7
32563	Oroua at Kawa Wool	2023	14/02/2023	464.7	1	102
		2015	20/06/2015	460.6	2	36.6
		1988	2/09/1988	411.6	3	22.3
		1992	22/07/1992	371.7	4	16
		2018	12/06/2018	370.5	5	12.5
		1999	29/11/1999	310.5	6	10.3
		1985	27/07/1985	307	7	8.7
		1976	29/06/1976	303.2	8	7.6
		2010	6/09/2010	296.7	9	6.7
		1980	11/04/1980	276.1	10	6
32564	Pohangina at Piripiri	2023	14/02/2023	248.7	1	23.4
		2017	13/04/2017	248.3	2	8.4
		2018	12/06/2018	200.4	3	5.1
		2013	25/09/2013	177.4	4	3.7
		2015	9/04/2015	160.5	5	2.9
		2022	24/03/2022	155.1	6	2.4
		2014	17/04/2014	141.5	7	2
		2024	21/05/2024	133.7	8	1.7
		2016	8/07/2016	124.5	9	1.5
		2012	5/07/2012	105.1	10	1.4
32576	Pohangina at Mais Reach	2004	16/02/2004	1109.1	1	98.4
		1992	22/07/1992	1046.3	2	35.3
		2023	14/02/2023	1032.1	3	21.5
		1988	2/09/1988	889.2	4	15.5
		2018	12/06/2018	793.5	5	12.1
		1971	4/05/1971	776.1	6	9.9
		1999	29/11/1999	749.7	7	8.4
		1985	27/07/1985	699.7	8	7.3
		1975	12/03/1975	697	9	6.4
		1980	10/04/1980	695.6	10	5.8
32590	Koputaroa at Tavistock Rd	2024	29/08/2024	30.7	1	28.8
		1976	20/12/1976	18.9	2	10.3
		1977	3/01/1977	16.6	3	6.3
		1975	28/08/1975	14.3	4	4.5
		1986	4/10/1986	11.3	5	3.5
		1980	23/01/1980	11.2	6	2.9
		1978	12/07/1978	10.7	7	2.5
		1982	26/12/1982	10.4	8	2.1
		1979	26/12/1979	9.8	9	1.9
		1988	14/09/1988	9.7	10	1.7
32702	Rangitikei at Mangaweka	1958	24/02/1958	3469	1	123.4
		2004	16/02/2004	1756.2	2	44.3
		2023	14/02/2023	1617.4	3	27
		2018	12/06/2018	1523.4	4	19.4

		2013	15/10/2013	1380.2	5	15.2
		2008	30/07/2008	1352.2	6	12.4
		1992	22/07/1992	1265.5	7	10.5
		1967	3/02/1967	1263.1	8	9.1
		1965	18/03/1965	1206.4	9	8.1
		1999	29/11/1999	1068	10	7.2
32703	Rangitikei at Onepuhi	2004	16/02/2004	2077.7	1	39.5
		2023	14/02/2023	1272.9	2	14.2
		2013	15/10/2013	1232.2	3	8.6
		2008	31/07/2008	1201.9	4	6.2
		2015	21/06/2015	956.8	5	4.9
		2011	24/01/2011	942.1	6	4
		2018	13/06/2018	941.7	7	3.4
		2010	19/09/2010	869.3	8	2.9
		2007	18/07/2007	799.3	9	2.6
		2003	4/10/2003	731.1	10	2.3
32708	Rangitikei at Springvale	1964	11/03/1964	530.1	1	19.9
		1967	12/08/1967	437.3	2	7.1
		1966	26/04/1966	382.2	3	4.3
		1972	5/03/1972	340.6	4	3.1
		1970	17/09/1970	301.1	5	2.4
		1965	7/11/1965	301	6	2
		1971	1/06/1971	284.7	7	1.7
		1968	29/06/1968	249.3	8	1.5
		1969	18/12/1969	203.2	9	1.3
		1973	11/01/1973	197.3	10	1.2
32715	Porewa at Tututotara	1991	11/04/1991	105.4	1	52
		1976	29/06/1976	49.8	2	18.7
		1967	3/02/1967	48.2	3	11.4
		1979	25/08/1979	41.8	4	8.2
		1974	4/07/1974	41.4	5	6.4
		1980	19/10/1980	41	6	5.2
		1970	22/08/1970	40.4	7	4.4
		1965	4/03/1965	38.9	8	3.9
		1975	16/06/1975	35.5	9	3.4
		1971	22/10/1971	34.6	10	3
32739	Tutaenui at Hammond St	2004	16/02/2004	67.4	1	85.9
		2010	6/09/2010	50	2	30.8
		2015	20/06/2015	45.9	3	18.8
		1991	26/07/1991	45.9	4	13.5
		1976	29/06/1976	42.3	5	10.6
		2023	21/05/2023	37.9	6	8.7
		1980	19/10/1980	33.4	7	7.3
		1971	22/10/1971	29.4	8	6.4
		1979	25/08/1979	28.8	9	5.6
		1994	16/11/1994	27.1	10	5
32760	Rangitikei at McKelvies	2015	21/06/2015	1553.8	1	34.1

		2013	16/10/2013	1401.2	2	12.3
		2023	14/02/2023	1161.4	3	7.5
		2018	13/06/2018	1029.5	4	5.4
		2008	31/07/2008	1002.3	5	4.2
		2017	13/05/2017	904.2	6	3.4
		2010	19/09/2010	884	7	2.9
		2022	14/06/2022	853.9	8	2.5
		2011	24/01/2011	838.2	9	2.2
		2021	15/12/2021	768.3	10	2
32763	Rangitikei at Pukeokahu	2003	4/10/2003	851.7	1	46.6
		2004	29/02/2004	778.2	2	16.7
		2011	23/01/2011	613.4	3	10.2
		2000	2/10/2000	590.9	4	7.3
		1999	11/11/1999	545.5	5	5.7
		2018	5/01/2018	488.8	6	4.7
		2013	15/10/2013	432.2	7	4
		2001	7/12/2001	428.7	8	3.5
		2008	7/10/2008	421.7	9	3.1
		2023	29/01/2023	408.8	10	2.7
32767	Hautapu at Alabaster's	2004	16/02/2004	236.6	1	91.3
		2013	15/10/2013	142.2	2	32.8
		2006	7/07/2006	118.2	3	20.0
		1967	29/12/1967	77.9	4	14.4
		2001	25/05/2001	76.2	5	11.2
		2010	19/09/2010	73.4	6	9.2
		1985	28/07/1985	73.2	7	7.8
		1992	23/07/1992	69.2	8	6.8
		1988	2/09/1988	67.3	9	6.0
		1998	15/07/1998	65.3	10	5.3
33003	Turakina at SH3	1988	3/09/1988	372.7	1	28.8
		1983	21/05/1983	342.8	2	10.3
		1985	28/07/1985	328.7	3	6.3
		1986	27/07/1986	302.7	4	4.5
		1990	11/03/1990	294.9	5	3.5
		1991	10/08/1991	239.7	6	2.9
		1989	26/05/1989	231.1	7	2.5
		1987	11/04/1987	225.9	8	2.1
		1980	10/07/1980	225.8	9	1.9
		1978	21/10/1978	205.1	10	1.7
33004	Turakina at Otairi	2004	16/02/2004	968.1	1	60.9
		2013	15/10/2013	691.7	2	21.9
		2001	16/12/2001	549.5	3	13.3
		2015	20/06/2015	503.3	4	9.6
		2006	7/07/2006	500.4	5	7.5
		1998	15/07/1998	466.9	6	6.1
		2017	14/07/2017	396.1	7	5.2
		2003	28/09/2003	383.8	8	4.5

		1992	22/07/1992	346.6	9	4.0
		2023	21/05/2023	331.3	10	3.6
33012	Turakina at O'Neills	1937	1/01/1937	510.8	1	84.1
		2013	16/10/2013	479.5	2	30.2
		2015	21/06/2015	469.3	3	18.4
		1961	6/08/1961	457.2	4	13.2
		1947	1/01/1947	395.6	5	10.3
		2006	7/07/2006	374.5	6	8.5
		1988	3/09/1988	372.7	7	7.2
		2023	21/05/2023	372.3	8	6.2
		1975	16/06/1975	350.4	9	5.5
		1983	21/05/1983	342.8	10	4.9
33101	Whangaehu at Kauangaroa	2015	21/06/2015	1309.1	1	119.9
		2004	16/02/2004	1195.9	2	43
		2013	15/10/2013	1004.6	3	26.2
		1897	1897-04-15	977	4	18.9
		1936	3/02/1936	923.3	5	14.7
		2006	7/07/2006	880.8	6	12.1
		1940	25/02/1940	852	7	10.2
		1904	1/05/1904	852	8	8.9
		1891	1891-02-01	774.6	9	7.8
		1998	21/10/1998	774.6	10	7
33107	Whangaehu at Karioi	2007	18/03/2007	498.6	1	109.1
		1995	25/09/1995	238.3	2	39.2
		2011	23/01/2011	176	3	23.9
		2013	15/10/2013	157.5	4	17.2
		2000	2/10/2000	133.2	5	13.4
		1994	8/11/1994	132	6	11
		2004	16/02/2004	127.1	7	9.3
		1967	12/08/1967	118.6	8	8.1
		1998	9/07/1998	117.8	9	7.1
		1964	11/03/1964	117.8	10	6.4
33111	Mangawhero at Ore Ore	2015	20/06/2015	736.6	1	112.7
		2013	15/10/2013	734.3	2	40.5
		2004	16/02/2004	682.4	3	24.7
		1998	15/07/1998	450.3	4	17.7
		2006	7/07/2006	396.3	5	13.8
		1974	4/07/1974	362.1	6	11.4
		1968	7/12/1968	361.7	7	9.6
		2000	2/10/2000	358.8	8	8.3
		1975	29/08/1975	344.9	9	7.4
		2003	28/09/2003	335.4	10	6.6
33112	Tokiahuru at Whangaehu Junction	2013	15/10/2013	133.7	1	62.7
		2011	23/01/2011	112.4	2	22.5
		2021	17/07/2021	79.2	3	13.7
		2015	20/06/2015	69	4	9.9
		2007	18/03/2007	67.3	5	7.7

		2014	3/08/2014	67	6	6.3
		1986	26/07/1986	61.9	7	5.4
		2017	21/07/2017	61.3	8	4.6
		1991	9/08/1991	60.7	9	4.1
		2010	1/10/2010	56.5	10	3.7
33114	Waitangi at Tangiwai	1968	7/12/1968	5.8	1	60.9
		2024	10/09/2024	5.7	2	21.9
		1967	28/12/1967	5.5	3	13.3
		1972	15/06/1972	5	4	9.6
		1988	2/09/1988	4.5	5	7.5
		1971	4/12/1971	4.4	6	6.1
		1985	28/07/1985	4.2	7	5.2
		1976	12/01/1976	4.1	8	4.5
		1977	21/01/1977	4	9	4
		2017	21/07/2017	3.9	10	3.6
33115	Mangaetoroa at School	2004	16/02/2004	48.1	1	78.8
		1998	21/10/1998	41.7	2	28.3
		1990	10/03/1990	35.9	3	17.2
		1999	16/05/1999	32.8	4	12.4
		1976	30/04/1976	30.9	5	9.7
		2003	27/11/2003	29.1	6	7.9
		1995	7/09/1995	29	7	6.7
		1975	29/08/1975	28.6	8	5.8
		2011	23/01/2011	27.9	9	5.2
		1979	8/05/1979	27.8	10	4.6
33119	Makotuku at Raetihi	2006	30/11/2006	197	1	41.3
		2013	15/10/2013	158.1	2	14.8
		1976	29/06/1976	113.9	3	9
		1977	20/01/1977	113.9	4	6.5
		2007	18/03/2007	111	5	5.1
		2015	20/06/2015	93.9	6	4.2
		2014	3/08/2014	70.2	7	3.5
		2008	7/10/2008	66.3	8	3.1
		2010	6/09/2010	65	9	2.7
		2022	2/06/2022	63.5	10	2.4
33130	Whangaehu at Mangaio Tunnel	1998	21/10/1998	8.6	1	52
		2005	25/03/2005	8	2	18.7
		2003	21/05/2003	7.8	3	11.4
		1991	7/08/1991	7.8	4	8.2
		1999	17/01/1999	7.7	5	6.4
		2001	25/05/2001	7.3	6	5.2
		1986	25/07/1986	7.1	7	4.4
		1989	3/01/1989	7.1	8	3.9
		2006	30/11/2006	7.1	9	3.4
		2004	15/02/2004	6.9	10	3
33143	Mangawhero at Hagleys	2013	15/10/2013	121.3	1	16.3
		2004	16/02/2004	67.1	2	5.8

	2000	2/10/2000	57.5	3	3.6	
	2006	7/07/2006	55.4	4	2.6	
	1999	16/05/1999	51.2	5	2	
	2003	3/10/2003	45.8	6	1.6	
	2002	29/09/2002	41.2	7	1.4	
	2001	25/05/2001	39.6	8	1.2	
	2005	8/10/2005	24.1	9	1.1	
33149	Mangawhero at Pakihi Rd Br	2013	15/10/2013	236.7	1	34.1
		2015	20/06/2015	88.6	2	12.3
		2007	17/10/2007	82.9	3	7.5
		2006	7/07/2006	80.2	4	5.4
		2014	3/08/2014	74	5	4.2
		2016	24/07/2016	73.3	6	3.4
		2008	7/10/2008	72.4	7	2.9
		2010	6/09/2010	72.1	8	2.5
		2022	2/06/2022	69	9	2.2
		2023	11/01/2023	63.7	10	2
33303	Whanganui at Te Rewa	2015	21/06/2015	4965	1	121.6
		1990	10/03/1990	4105.8	2	43.7
		2013	15/10/2013	3923.2	3	26.6
		1958	25/02/1958	3844.6	4	19.1
		1998	29/10/1998	3815.4	5	14.9
		2000	3/10/2000	3804.1	6	12.3
		2004	16/02/2004	3292.9	7	10.4
		1965	8/11/1965	3272.4	8	9
		1975	29/08/1975	3133.9	9	8
		1978	13/11/1978	3071.5	10	7.1
33307	Whanganui at Headwaters	1961	20/01/1961	97.6	1	35.9
		1973	11/01/1973	73.1	2	12.9
		1964	10/01/1964	71.8	3	7.9
		1967	2/02/1967	69.8	4	5.7
		1966	26/04/1966	55.7	5	4.4
		1977	28/06/1977	51.9	6	3.6
		1971	14/05/1971	47.9	7	3.1
		1960	16/02/1960	46.7	8	2.7
		1965	7/11/1965	42.8	9	2.4
		1968	7/12/1968	42	10	2.1
33313	Ohura at Tokorima	2004	29/02/2004	440.8	1	73.4
		1973	17/09/1973	410.5	2	26.4
		1965	8/11/1965	405.1	3	16.1
		1964	12/03/1964	402.3	4	11.6
		2012	17/07/2012	371.7	5	9
		2003	4/10/2003	338	6	7.4
		2017	5/04/2017	332.1	7	6.3
		2015	21/06/2015	329.6	8	5.4
		1975	30/08/1975	329.2	9	4.8
		2013	16/10/2013	311.1	10	4.3

33314	Ohura at Nihoniho	2012	16/07/2012	190.5	1	32.4
		2011	24/01/2011	183.3	2	11.6
		2023	29/01/2023	172.9	3	7.1
		2008	8/10/2008	171	4	5.1
		2015	21/06/2015	164.3	5	4
		2013	15/10/2013	156.9	6	3.3
		2024	29/01/2024	137.7	7	2.8
		2022	3/06/2022	136.5	8	2.4
		2017	12/05/2017	133.2	9	2.1
		2010	7/09/2010	128.2	10	1.9
33341	Mangaroa at Ohura Town Br	1965	7/11/1965	165	1	32.4
		1968	7/12/1968	154.4	2	11.6
		1966	6/12/1966	145.9	3	7.1
		2015	20/06/2015	145.3	4	5.1
		2017	4/04/2017	127.6	5	4
		2018	15/05/2018	124.2	6	3.3
		1971	25/02/1971	118.3	7	2.8
		2022	27/07/2022	112.8	8	2.4
		1970	30/09/1970	108.4	9	2.1
		1969	7/05/1969	103.8	10	1.9
33345	Whanganui at Pipiriki	1940	25/02/1940	6423.1	1	102
		1904	25/05/1904	5923.9	2	36.6
		2015	20/06/2015	4258.4	3	22.3
		1990	10/03/1990	4234.8	4	16
		2013	15/10/2013	3939.7	5	12.5
		1998	29/10/1998	3911.5	6	10.3
		2000	2/10/2000	3690.8	7	8.7
		1994	8/11/1994	3474.7	8	7.6
		1965	8/11/1965	3264.4	9	6.7
		2004	29/02/2004	3259.3	10	6
33347	Whanganui at Te Porere	2016	19/01/2016	57.7	1	105.6
		2018	27/01/2018	55.4	2	37.9
		2009	12/02/2009	54	3	23.1
		1990	9/03/1990	51.6	4	16.6
		2013	22/09/2013	49.9	5	13
		1967	2/02/1967	49.8	6	10.6
		1989	3/01/1989	48.3	7	9
		1996	1/12/1996	46.4	8	7.8
		2001	7/12/2001	45.7	9	6.9
		2006	30/11/2006	44.7	10	6.2
33366	Matarawa at Diversion	1992	16/08/1992	21.9	1	32.4
		1988	25/07/1988	17.5	2	11.6
		1979	25/08/1979	16.6	3	7.1
		1991	26/07/1991	15.9	4	5.1
		1986	26/07/1986	15.7	5	4
		1993	22/11/1993	12.7	6	3.3
		1978	21/07/1978	12.6	7	2.8

		1990	20/03/1990	11.1	8	2.4
		1989	18/10/1989	11	9	2.1
		1980	17/08/1980	9.8	10	1.9
33502	Kai Iwi at Handley Rd	2015	20/06/2015	107.8	1	84.1
		2006	24/10/2006	89.2	2	30.2
		2004	16/02/2004	70.7	3	18.4
		1999	29/11/1999	63.8	4	13.2
		2011	24/01/2011	58.1	5	10.3
		2010	6/09/2010	52.6	6	8.5
		1978	20/04/1978	50.3	7	7.2
		2013	15/10/2013	49.9	8	6.2
		1998	21/10/1998	49.7	9	5.5
		2023	21/05/2023	48.3	10	4.9
1032501	Kumeti at Te Rehunga	2004	16/02/2004	22.2	1	80.6
		2015	20/06/2015	21.8	2	28.9
		2017	5/04/2017	20.8	3	17.6
		1988	2/09/1988	15.1	4	12.7
		2018	8/03/2018	14.6	5	9.9
		1999	29/11/1999	14.4	6	8.1
		1992	22/07/1992	14.3	7	6.9
		2000	10/04/2000	14.1	8	6
		2010	6/09/2010	12.5	9	5.3
		2011	23/01/2011	12.5	10	4.7
1032504	Tamaki at Water Supply Weir	2023	14/02/2023	136.6	1	77
		2004	16/02/2004	113.5	2	27.6
		2017	5/04/2017	97.1	3	16.8
		2000	10/04/2000	91.3	4	12.1
		2018	8/03/2018	84	5	9.5
		2011	23/01/2011	75	6	7.8
		2022	24/03/2022	71.5	7	6.6
		2015	20/06/2015	69.7	8	5.7
		2014	17/04/2014	68.8	9	5
		1988	2/09/1988	68.4	10	4.5
1032517	Tokomaru at Quarry	2008	8/01/2008	191.7	1	37.7
		1990	10/03/1990	144	2	13.5
		1991	28/11/1991	126.4	3	8.3
		1993	2/06/1993	126.2	4	5.9
		1985	23/01/1985	118.4	5	4.6
		1979	26/12/1979	114	6	3.8
		1981	3/06/1981	108.7	7	3.2
		1982	26/12/1982	104.5	8	2.8
		1986	4/10/1986	101.7	9	2.5
		1995	21/03/1995	98.3	10	2.2
1032518	Makakahi at Hamua	2000	9/10/2000	483.1	1	82.4
		2010	6/09/2010	351.1	2	29.6
		1998	21/10/1998	306.8	3	18
		2023	22/04/2023	302.6	4	13

		1988	6/10/1988	300.5	5	10.1
		2004	16/02/2004	298.8	6	8.3
		1996	30/06/1996	267.2	7	7
		2012	3/03/2012	262.5	8	6.1
		2024	18/08/2024	244.2	9	5.4
		2015	20/06/2015	240.7	10	4.8
1032542	Makino at Reids Line	2004	16/02/2004	88	1	32.4
		2001	15/08/2001	66	2	11.6
		1988	25/07/1988	53.6	3	7.1
		1999	29/11/1999	46.6	4	5.1
		1994	16/11/1994	43.3	5	4
		1998	21/10/1998	35	6	3.3
		2002	30/09/2002	23.5	7	2.8
		1991	11/04/1991	21.4	8	2.4
		2000	11/09/2000	19.8	9	2.1
		1995	18/09/1995	16.8	10	1.9
1032555	Mangatainoka at Larsons Br	2004	12/02/2004	273.6	1	75.2
		2000	30/09/2000	262.8	2	27
		2015	18/10/2015	253.2	3	16.5
		1994	14/11/1994	244.9	4	11.8
		2010	6/09/2010	239.9	5	9.2
		1998	6/09/1998	239.6	6	7.6
		2005	6/01/2005	237.9	7	6.4
		2020	8/12/2020	236.9	8	5.6
		2001	26/01/2001	234.6	9	4.9
		2024	18/08/2024	232.7	10	4.4
1032560	Manawatu at Teachers College	1902	14/06/1902	3800.0	1	219.9
		2004	16/02/2004	3515.3	2	78.9
		1907	2/05/1907	3340.0	3	48.1
		1953	28/01/1953	3176.2	4	34.6
		1992	23/07/1992	2855.0	5	27.0
		1965	18/03/1965	2744.5	6	22.1
		1906	18/07/1906	2613.1	7	18.8
		1941	5/05/1941	2605.2	8	16.3
		1956	15/07/1956	2513.3	9	14.4
		2010	7/09/2010	2505.8	10	12.9
1032561	Makino at Rata St	2004	16/02/2004	111	1	68.1
		2001	15/08/2001	85.8	2	24.4
		2015	20/06/2015	72.9	3	14.9
		2021	15/12/2021	72.8	4	10.7
		1999	29/11/1999	63.1	5	8.4
		1994	16/11/1994	60.5	6	6.9
		1998	21/10/1998	59.8	7	5.8
		2023	21/05/2023	57.6	8	5
		2010	6/09/2010	57.2	9	4.5
		2017	13/07/2017	56.7	10	4
1032564	Makino at Boness Rd	2004	16/02/2004	90.8	1	60.9

		2015	20/06/2015	81	2	21.9
		2021	16/12/2021	76.4	3	13.3
		2010	6/09/2010	67.2	4	9.6
		2001	15/08/2001	60.8	5	7.5
		1998	21/10/1998	60.7	6	6.1
		2022	13/06/2022	55.6	7	5.2
		2013	15/10/2013	54.2	8	4.5
		1994	16/11/1994	53.9	9	4
		2006	24/10/2006	52	10	3.6
1032591	Makuri at Tuscan Hills	2004	16/02/2004	269.6	1	46.6
		2018	12/06/2018	206	2	16.7
		2023	14/02/2023	195.1	3	10.2
		2017	14/04/2017	187.6	4	7.3
		2000	7/10/2000	171.3	5	5.7
		2019	13/06/2019	157.9	6	4.7
		2024	18/08/2024	155.8	7	4
		2001	15/08/2001	151.9	8	3.5
		2008	30/07/2008	150.4	9	3.1
		2003	9/06/2003	144.9	10	2.7
1033153	Whangaehu at Aranui	2007	18/03/2007	550	1	35.9
		2013	15/10/2013	361.1	2	12.9
		2006	7/07/2006	353	3	7.9
		2015	20/06/2015	322	4	5.7
		2011	11/07/2011	242.4	5	4.4
		2022	2/06/2022	202.2	6	3.6
		2017	5/04/2017	195.3	7	3.1
		2008	7/10/2008	159.9	8	2.7
		2023	15/02/2023	158.5	9	2.4
		2018	5/01/2018	147.3	10	2.1
1033154	Mangawhero at Raupiu Road	2004	16/02/2004	888.2	1	23.4
		2015	20/06/2015	721	2	8.4
		2013	15/10/2013	645.2	3	5.1
		2006	7/07/2006	428.2	4	3.7
		2011	23/01/2011	331.2	5	2.9
		2014	3/08/2014	302.3	6	2.4
		2010	6/09/2010	295.6	7	2
		2008	7/10/2008	283	8	1.7
		2007	17/10/2007	266.7	9	1.5
		2016	24/07/2016	256.6	10	1.4
1033363	Matarawa at City Branch	2023	3/02/2023	12.5	1	52
		2004	16/02/2004	7.8	2	18.7
		2015	20/06/2015	7.8	3	11.4
		2021	16/12/2021	6.8	4	8.2
		1998	21/10/1998	6.6	5	6.4
		2006	7/07/2006	6.6	6	5.2
		1997	15/10/1997	6.4	7	4.4
		2005	21/12/2005	6.2	8	3.9

		2022	17/05/2022	6.2	9	3.4
		1999	29/11/1999	6.1	10	3
1132508	Oroua at Almadale Slackline	2004	16/02/2004	568.3	1	118.1
		2023	14/02/2023	480.7	2	42.4
		2018	12/06/2018	386	3	25.8
		1958	12/05/1958	362.1	4	18.6
		1965	18/03/1965	282.6	5	14.5
		1956	15/07/1956	271.4	6	11.9
		1999	29/11/1999	246.7	7	10.1
		1950	2/07/1950	243.7	8	8.7
		2007	18/07/2007	242.8	9	7.7
		2017	14/04/2017	242.5	10	6.9
1132511	Mangatainoka at Pahiatua Town Bridge	2010	6/09/2010	948.3	1	127
		1964	25/10/1964	885.8	2	45.6
		2000	9/10/2000	860.6	3	27.8
		2004	28/09/2004	701.2	4	20
		2005	6/01/2005	676.9	5	15.6
		2023	22/04/2023	614.6	6	12.8
		2024	18/08/2024	600.1	7	10.8
		1955	26/02/1955	594.6	8	9.4
		2015	20/06/2015	584.1	9	8.3
		1988	24/08/1988	575.5	10	7.4
1132517	Kiwitea at Haynes Line	2015	20/06/2015	172.9	1	23.4
		2017	14/07/2017	113.5	2	8.4
		2013	11/07/2013	103.9	3	5.1
		2012	17/08/2012	73.3	4	3.7
		2010	18/09/2010	54.7	5	2.9
		2005	18/12/2005	43	6	2.4
		2006	7/07/2006	42.6	7	2
		2007	18/07/2007	32.2	8	1.7
		2009	27/10/2009	30	9	1.5
		2011	14/07/2011	26.8	10	1.4
1132519	Kahuterawa at Johnstons Rata	2009	27/12/2009	136.6	1	34.1
		2008	8/01/2008	123	2	12.3
		2006	29/09/2006	101.3	3	7.5
		2010	6/09/2010	93.5	4	5.4
		2007	18/03/2007	92.6	5	4.2
		2024	18/08/2024	81.3	6	3.4
		2021	27/06/2021	75.3	7	2.9
		2015	20/06/2015	63.5	8	2.5
		2011	13/07/2011	58.8	9	2.2
		2018	25/12/2018	57.6	10	2
1132523	Kiwitea at Strathspey Farm	1988	2/09/1988	166.1	1	57.4
		1992	22/07/1992	156.4	2	20.6
		1979	25/08/1979	117.8	3	12.5
		2023	21/05/2023	103.1	4	9.0
		1998	21/10/1998	100.4	5	7.0

		2017	14/07/2017	96.7	6	5.8
		1994	16/11/1994	94.9	7	4.9
		1991	11/04/1991	92.3	8	4.2
		1983	20/05/1983	85.7	9	3.8
		1990	20/03/1990	78.1	10	3.4
1232561	Raparapawai at Jackson Rd	2004	16/02/2004	153.7	1	41.3
		2015	21/06/2015	60.4	2	14.8
		2017	5/04/2017	52.8	3	9
		2012	6/07/2012	46.1	4	6.5
		2006	6/07/2006	44.8	5	5.1
		2010	6/09/2010	44.8	6	4.2
		2019	13/06/2019	44.1	7	3.5
		2008	30/07/2008	42.9	8	3.1
		2023	14/02/2023	38.1	9	2.7
		2013	11/07/2013	29.6	10	2.4
1232563	Mangapapa at Troup Road	2013	15/10/2013	77.2	1	32.4
		2015	20/06/2015	70.8	2	11.6
		2017	5/04/2017	69	3	7.1
		2016	27/08/2016	65.3	4	5.1
		2011	24/11/2011	60	5	4
		2010	6/09/2010	59	6	3.3
		2018	8/03/2018	47.2	7	2.8
		2009	18/11/2009	40.9	8	2.4
		2014	10/12/2014	36.5	9	2.1
		2008	5/10/2008	33.4	10	1.9
1232564	Manga-Atua at Hopelands Rd	2015	20/06/2015	152.2	1	53.8
		1988	19/06/1988	131.3	2	19.3
		2019	13/06/2019	112.4	3	11.8
		1980	9/04/1980	99	4	8.5
		2017	5/04/2017	88.2	5	6.6
		2005	5/10/2005	79.6	6	5.4
		2010	6/09/2010	79.2	7	4.6
		1983	20/05/1983	77.8	8	4
		2018	8/03/2018	76.7	9	3.5
		2021	14/09/2021	75.6	10	3.2
1232566	Manawatu at Upper Gorge	1880	1880-03-20	3404.8	1	96.6
		1897	1897-04-17	3199.3	2	34.7
		1902	14/06/1902	2996.6	3	21.1
		2004	16/02/2004	2697.5	4	15.2
		1907	2/05/1907	2678.4	5	11.9
		1992	23/07/1992	2469.3	6	9.7
		1941	4/05/1941	2135	7	8.3
		2010	6/09/2010	2056.8	8	7.2
		1980	11/04/1980	1957	9	6.3
		2015	21/06/2015	1900.9	10	5.7
1232581	Oruakeretaki at SH2(Napier)	2010	18/09/2010	91.8	1	32.4
		2012	1/08/2012	56.1	2	11.6

		2015	20/06/2015	55.1	3	7.1
		2011	24/11/2011	51	4	5.1
		2008	5/10/2008	49.5	5	4
		2009	29/12/2009	43.3	6	3.3
		2019	13/06/2019	41.4	7	2.8
		2013	28/11/2013	41.3	8	2.4
		2017	5/04/2017	40.3	9	2.1
		2007	11/10/2007	37	10	1.9
1332518	Mangatoro at Mangahei Road	2006	6/07/2006	561.4	1	39.5
		2004	16/02/2004	398.2	2	14.2
		2005	21/10/2005	349.7	3	8.6
		2007	18/07/2007	298.4	4	6.2
		2023	14/02/2023	270.4	5	4.9
		2018	12/06/2018	256.2	6	4
		2017	13/07/2017	245.5	7	3.4
		2008	30/07/2008	220.4	8	2.9
		2022	23/09/2022	192.9	9	2.6
		2012	5/07/2012	180.4	10	2.3
1332556	Tamaki at Stephensons	2023	14/02/2023	181.2	1	30.6
		2004	16/02/2004	174	2	11
		2011	23/01/2011	135.3	3	6.7
		2012	8/01/2012	103.9	4	4.8
		2010	18/09/2010	93.4	5	3.8
		2013	11/07/2013	76.4	6	3.1
		2014	18/04/2014	50	7	2.6
		2005	18/03/2005	43.5	8	2.3
		2006	6/07/2006	43.3	9	2
		2007	18/07/2007	34.3	10	1.8
1425006	Waihi at S.H.52	2023	14/02/2023	1042.7	1	35.9
		2018	8/03/2018	738.4	2	12.9
		2008	30/07/2008	370.1	3	7.9
		2012	5/07/2012	309.1	4	5.7
		2022	25/03/2022	304.2	5	4.4
		2013	28/11/2013	295.7	6	3.6
		2017	13/07/2017	271.2	7	3.1
		2006	14/07/2006	250.3	8	2.7
		2019	13/06/2019	217.9	9	2.4
		2010	19/09/2010	199.1	10	2.1
1425101	Owahanga at Branscombe Bridge	2018	8/03/2018	824.8	1	39.5
		2004	16/02/2004	673.2	2	14.2
		2008	30/07/2008	544.4	3	8.6
		2012	20/03/2012	511.2	4	6.2
		2013	12/07/2013	506.1	5	4.9
		2000	7/10/2000	417.3	6	4
		2001	15/08/2001	392.4	7	3.4
		2005	20/07/2005	340.3	8	2.9
		2006	6/07/2006	330	9	2.6

		2015	23/09/2015	324	10	2.3
1432003	Manakau at S.H.1 Bridge	2015	19/06/2015	69.5	1	32.4
		2008	8/01/2008	58.4	2	11.6
		2018	22/02/2018	35.5	3	7.1
		2014	10/12/2014	31.7	4	5.1
		2009	29/12/2009	30.7	5	4
		2017	9/09/2017	27.2	6	3.3
		2021	27/06/2021	23.6	7	2.8
		2006	17/11/2006	20.2	8	2.4
		2011	26/05/2011	18.1	9	2.1
		2019	17/07/2019	17.5	10	1.9
1432008	Waikawa at North Manakau Road	2022	14/05/2022	171.6	1	32.4
		2021	7/12/2021	132.2	2	11.6
		2015	19/06/2015	125.3	3	7.1
		2008	8/01/2008	103.7	4	5.1
		2023	26/03/2023	84.1	5	4
		2020	23/09/2020	79.3	6	3.3
		2019	17/11/2019	55.3	7	2.8
		2009	27/12/2009	52.8	8	2.4
		2014	10/12/2014	43.1	9	2.1
		2010	6/09/2010	42.1	10	1.9
2232510	Tokomaru at Riverland Farm	2008	8/01/2008	366.3	1	80.6
		2021	27/06/2021	176.9	2	28.9
		2000	29/12/2000	169.7	3	17.6
		2009	27/12/2009	158.1	4	12.7
		2004	1/12/2004	150.2	5	9.9
		2024	18/08/2024	148.9	6	8.1
		1990	10/03/1990	144	7	6.9
		1998	21/10/1998	139.7	8	6
		2020	27/09/2020	137.6	9	5.3
		2010	6/09/2010	129.4	10	4.7

## Appendix B At-site fitted distribution results

**Table B-1: Fitted distributions for each site.**

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
25110	Owahanga at Owahanga Station	2	0.5	283.0	314.7	279.8	279.8	274.1
		5	0.8	451.0	495.2	460.5	462.9	478.2
		10	0.9	596.0	614.7	613.4	629.5	638.4
		25	0.96	829.0	765.7	845.1	904.7	853.6
		50	0.98	1050.0	877.7	1045.9	1166.3	1018.1
		75	0.9867	1190.0	942.8	1174.7	1345.3	1114.7
		100	0.99	1310.0	988.9	1271.4	1485.5	1183.5
		200	0.995	1630.0	1099.7	1523.7	1874.8	1349.7
		500	0.998	2160.0	1245.8	1902.2	2522.6	1570.2
32001	Manakau at Gleasons Rd	2	0.5	15.6	14.6	15.6	15.6	15.6
		5	0.8	25.3	24.5	25.2	26.8	25.3
		10	0.9	30.9	31.1	30.7	32.4	30.8
		25	0.96	37.1	39.4	37.1	37.4	37.0
		50	0.98	41.2	45.6	41.4	40.0	41.3
		75	0.9867	43.3	49.2	43.8	41.2	43.6
		100	0.99	44.8	51.7	45.5	41.9	45.3
		200	0.995	48.0	57.8	49.3	43.2	49.0
		500	0.998	51.8	65.8	54.2	44.5	53.7
32106	Ohau at Rongomatane	2	0.5	205.7	211.5	205.2	205.0	204.4
		5	0.8	290.6	297.2	292.7	293.3	296.6
		10	0.9	352.8	353.9	355.4	358.8	359.7
		25	0.96	438.8	425.5	439.3	449.5	439.2
		50	0.98	508.6	478.7	504.9	523.2	497.4
		75	0.9867	551.6	509.6	544.4	568.7	530.9
		100	0.99	583.2	531.4	573.0	602.1	554.5
		200	0.995	663.3	584.0	644.1	687.1	610.8
		500	0.998	778.6	653.3	742.9	809.9	684.2
32302	Hokio at Lake Horowhenua	2	0.5	3.6	3.9	3.6	3.6	3.6
		5	0.8	6.3	6.7	6.4	6.6	6.6
		10	0.9	8.4	8.5	8.5	9.0	8.7

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		25	0.96	11.4	10.7	11.5	12.7	11.5
		50	0.98	14.0	12.4	13.9	15.8	13.6
		75	0.9867	15.7	13.4	15.4	17.8	14.8
		100	0.99	17.0	14.1	16.5	19.3	15.7
		200	0.995	20.3	15.8	19.3	23.2	17.7
		500	0.998	25.4	17.9	23.3	29.0	20.4
		1000	0.999	29.8	19.6	26.6	33.9	22.4
32503	Manawatu at Weber Rd	2	0.5	454.9	473.8	453.3	455.2	450.7
		5	0.8	711.9	733.4	718.6	724.1	730.8
		10	0.9	901.3	905.2	909.8	916.4	923.6
		25	0.96	1165.2	1122.3	1167.0	1171.6	1167.0
		50	0.98	1380.4	1283.3	1369.1	1369.0	1345.6
		75	0.9867	1513.7	1376.9	1491.1	1487.0	1448.6
		100	0.99	1611.9	1443.2	1579.6	1571.9	1521.0
		200	0.995	1861.7	1602.5	1799.6	1780.9	1694.1
		500	0.998	2223.2	1812.6	2106.7	2067.5	1920.0
		1000	0.999	2522.9	1971.4	2352.2	2292.6	2089.2
32504	Manawatu at Hopelands	2	0.5	585.1	612.8	582.7	585.7	578.9
		5	0.8	930.0	961.8	939.6	946.0	956.9
		10	0.9	1186.7	1192.8	1199.2	1206.6	1219.0
		25	0.96	1547.3	1484.8	1550.7	1555.8	1551.0
		50	0.98	1843.9	1701.4	1828.5	1828.0	1795.4
		75	0.9867	2028.6	1827.3	1996.8	1991.3	1936.4
		100	0.99	2165.1	1916.4	2119.0	2109.2	2035.7
		200	0.995	2514.3	2130.6	2423.9	2400.5	2273.1
		500	0.998	3023.9	2413.2	2851.2	2802.1	2583.3
		1000	0.999	3449.6	2626.8	3194.1	3119.1	2815.8
32529	Tiraumea at Ngaturi	2	0.5	278.3	286.6	277.6	280.2	276.5
		5	0.8	415.3	424.5	418.4	422.0	424.2
		10	0.9	514.4	515.8	518.1	519.6	524.5
		25	0.96	650.0	631.1	650.3	645.6	650.0
		50	0.98	758.8	716.7	753.1	741.0	741.7
		75	0.9867	825.4	766.4	814.7	797.3	794.5
		100	0.99	874.1	801.6	859.2	837.4	831.5
		200	0.995	996.9	886.2	969.3	935.3	919.9
		500	0.998	1171.6	997.9	1121.7	1067.5	1035.0
		1000	0.999	1314.0	1082.3	1242.6	1169.9	1121.0

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
32547	Manawatu at Moutoa	2	0.5	1181.3	1134.3	1181.1	1181.2	1180.9
		5	0.8	1251.7	1235.5	1251.0	1251.7	1250.2
		10	0.9	1273.5	1302.6	1273.5	1273.6	1273.3
		25	0.96	1287.9	1387.3	1289.0	1287.9	1290.0
		50	0.98	1293.4	1450.1	1295.5	1293.6	1297.4
		75	0.9867	1295.4	1486.7	1298.1	1295.7	1300.4
		100	0.99	1296.5	1512.5	1299.6	1296.9	1302.2
		200	0.995	1298.3	1574.7	1302.1	1298.9	1305.3
		500	0.998	1299.6	1656.7	1304.2	1300.3	1308.0
		1000	0.999	1300.1	1718.7	1305.1	1300.9	1309.3
32557	Mangaone at Milson Line	2	0.5	59.2	61.5	59.0	59.8	58.7
		5	0.8	95.2	97.8	96.1	98.2	97.7
		10	0.9	121.5	121.9	122.5	123.6	124.3
		25	0.96	157.6	152.3	157.7	154.8	157.6
		50	0.98	186.7	174.8	185.2	177.0	182.1
		75	0.9867	204.6	187.9	201.7	189.5	196.1
		100	0.99	217.7	197.2	213.6	198.3	206.0
		200	0.995	250.9	219.5	243.2	218.7	229.6
		500	0.998	298.4	248.9	284.2	244.5	260.3
		1000	0.999	337.3	271.1	316.9	263.2	283.3
32563	Oroua at Kawa Wool	2	0.5	189.2	189.6	189.2	191.6	188.9
		5	0.8	270.9	271.3	271.7	275.4	273.6
		10	0.9	325.4	325.4	325.8	326.9	327.8
		25	0.96	394.7	393.8	393.9	387.2	393.4
		50	0.98	446.4	444.5	444.3	428.8	440.3
		75	0.9867	476.6	474.0	473.8	451.9	467.0
		100	0.99	498.0	494.8	494.7	467.8	485.6
		200	0.995	549.6	545.0	545.3	504.7	529.5
		500	0.998	618.2	611.2	613.0	550.7	586.2
		1000	0.999	670.3	661.2	665.2	583.7	628.2
32564	Pohangina at Piripiri	2	0.5	140.7	136.0	141.0	141.2	140.9
		5	0.8	198.5	194.5	197.9	201.3	198.3
		10	0.9	232.4	233.2	231.5	236.5	231.8
		25	0.96	271.0	282.1	270.5	276.0	270.3
		50	0.98	296.8	318.4	297.6	302.2	296.8
		75	0.9867	310.8	339.5	312.8	316.3	311.5
		100	0.99	320.3	354.4	323.3	325.9	321.6

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		200	0.995	341.7	390.3	348.1	347.5	345.2
		500	0.998	367.3	437.7	379.6	373.6	375.0
		1000	0.999	384.7	473.5	402.9	391.5	396.6
32576	Pohangina at Mais Reach	2	0.5	392.3	412.3	390.5	388.6	387.6
		5	0.8	591.5	615.3	598.0	599.1	609.8
		10	0.9	744.1	749.8	753.4	764.2	767.4
		25	0.96	964.2	919.7	968.2	1003.6	969.3
		50	0.98	1149.8	1045.7	1140.9	1205.7	1119.0
		75	0.9867	1267.4	1119.0	1246.6	1333.5	1205.7
		100	0.99	1355.3	1170.8	1323.9	1429.0	1266.9
		200	0.995	1583.5	1295.5	1518.3	1676.4	1413.5
		500	0.998	1924.9	1459.9	1794.1	2045.3	1605.7
		1000	0.999	2217.4	1584.2	2018.1	2359.8	1750.1
32590	Koputaroa at Tavistock Rd	2	0.5	9.7	10.4	9.6	10.1	9.5
		5	0.8	15.0	15.9	15.2	15.8	15.6
		10	0.9	19.2	19.5	19.6	19.6	20.1
		25	0.96	25.6	24.1	25.9	24.6	26.0
		50	0.98	31.3	27.5	31.1	28.3	30.4
		75	0.9867	35.0	29.5	34.3	30.5	32.9
		100	0.99	37.8	30.9	36.7	32.0	34.8
		200	0.995	45.2	34.3	42.9	35.8	39.1
		500	0.998	56.9	38.7	51.7	40.8	44.9
		1000	0.999	67.2	42.0	59.1	44.7	49.2
32702	Rangitikei at Mangaweka	2	0.5	700.4	750.0	695.1	708.1	686.8
		5	0.8	1008.8	1075.0	1023.7	1022.1	1051.6
		10	0.9	1265.6	1290.1	1291.6	1266.5	1328.8
		25	0.96	1665.6	1562.0	1686.4	1620.0	1696.1
		50	0.98	2028.5	1763.7	2021.0	1918.0	1974.4
		75	0.9867	2270.2	1880.9	2232.5	2106.7	2137.3
		100	0.99	2456.4	1963.9	2390.1	2247.7	2252.9
		200	0.995	2962.2	2163.3	2796.7	2613.5	2531.6
		500	0.998	3776.3	2426.5	3396.6	3160.6	2900.1
		1000	0.999	4525.3	2625.3	3901.2	3628.8	3179.1
32703	Rangitikei at Onepuhi	2	0.5	671.9	725.2	666.2	665.7	657.0
		5	0.8	986.2	1058.3	1002.0	1004.9	1031.9
		10	0.9	1250.8	1278.8	1279.2	1302.7	1319.8
		25	0.96	1667.3	1557.5	1691.3	1779.8	1703.1

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		50	0.98	2049.1	1764.2	2043.3	2221.2	1994.3
		75	0.9867	2305.0	1884.4	2266.9	2518.1	2164.9
		100	0.99	2503.1	1969.4	2433.9	2748.4	2286.1
		200	0.995	3044.3	2173.8	2866.3	3378.6	2578.6
		500	0.998	3924.0	2443.6	3507.7	4404.7	2965.8
		1000	0.999	4741.4	2647.4	4050.0	5358.3	3259.1
32708	Rangitikei at Springvale	2	0.5	292.5	281.4	292.9	301.3	292.9
		5	0.8	404.5	395.5	403.1	414.6	403.6
		10	0.9	468.8	471.0	466.7	471.0	467.1
		25	0.96	540.3	566.5	539.5	525.6	539.3
		50	0.98	587.1	637.3	589.5	556.9	588.4
		75	0.9867	612.1	678.4	617.3	572.2	615.6
		100	0.99	628.9	707.6	636.6	582.0	634.3
		200	0.995	666.4	777.6	681.4	602.3	677.6
		500	0.998	710.1	870.0	738.2	623.6	732.0
		1000	0.999	739.4	939.8	779.6	636.4	771.4
32715	Porewa at Tututotara	2	0.5	26.2	28.0	26.0	26.4	25.8
		5	0.8	39.9	42.1	40.4	40.4	41.4
		10	0.9	50.8	51.4	51.6	51.1	52.9
		25	0.96	67.1	63.3	67.6	66.3	67.8
		50	0.98	81.2	72.0	80.7	78.9	78.9
		75	0.9867	90.4	77.1	88.8	86.7	85.4
		100	0.99	97.4	80.8	94.8	92.5	90.0
		200	0.995	115.8	89.4	110.1	107.4	101.0
		500	0.998	144.3	100.9	132.1	129.2	115.5
		1000	0.999	169.5	109.5	150.3	147.5	126.5
32739	Tutaenui at Hammond St	2	0.5	15.6	17.3	15.5	16.2	15.2
		5	0.8	26.1	28.3	26.6	27.8	27.6
		10	0.9	34.8	35.6	35.7	36.0	36.9
		25	0.96	48.3	44.8	48.9	46.6	49.2
		50	0.98	60.4	51.7	60.1	54.4	58.5
		75	0.9867	68.4	55.7	67.1	59.0	64.0
		100	0.99	74.5	58.5	72.3	62.2	67.8
		200	0.995	91.2	65.2	85.8	70.0	77.1
		500	0.998	117.8	74.2	105.6	80.1	89.4
		1000	0.999	142.2	80.9	122.1	87.8	98.7
32760	Rangitikei at McKelvies	2	0.5	780.3	805.4	778.0	779.6	774.4

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
32763	Rangitikei at Pukeokahu	5	0.8	1026.1	1056.1	1034.3	1039.4	1049.1
		10	0.9	1214.8	1222.2	1226.6	1240.5	1244.2
		25	0.96	1487.7	1431.9	1492.9	1529.6	1494.3
		50	0.98	1718.3	1587.6	1707.3	1772.3	1680.0
		75	0.9867	1864.7	1678.0	1838.8	1925.4	1787.6
		100	0.99	1974.1	1742.0	1934.9	2039.7	1863.5
		200	0.995	2258.6	1895.9	2176.8	2335.5	2045.4
		500	0.998	2685.3	2099.0	2520.4	2776.6	2284.0
		1000	0.999	3051.5	2252.5	2799.7	3153.4	2463.4
		2	0.5	366.0	377.0	365.0	369.1	363.5
		5	0.8	507.2	519.8	511.0	514.4	518.0
		10	0.9	611.9	614.3	616.9	618.7	624.8
		25	0.96	758.7	733.8	759.9	759.9	760.0
		50	0.98	879.0	822.4	872.7	871.9	859.4
32767	Hautapu at Alabaster's	75	0.9867	953.8	873.9	941.0	940.2	916.7
		100	0.99	1009.1	910.4	990.6	990.0	957.1
		200	0.995	1150.1	998.0	1114.1	1115.0	1053.6
		500	0.998	1355.3	1113.6	1286.9	1292.3	1179.6
		1000	0.999	1526.2	1201.0	1425.4	1436.6	1274.1
		2	0.5	41.8	46.6	41.3	42.2	40.3
		5	0.8	65.1	72.0	66.4	66.2	69.2
		10	0.9	85.6	88.8	88.4	86.4	92.4
		25	0.96	119.4	110.0	122.2	117.7	123.8
		50	0.98	151.7	125.8	152.1	145.8	148.1
		75	0.9867	174.0	135.0	171.5	164.2	162.4
		100	0.99	191.5	141.4	186.2	178.3	172.5
		200	0.995	240.7	157.0	224.7	216.1	197.2
		500	0.998	324.2	177.6	283.2	275.7	229.9
33003	Turakina at SH3	1000	0.999	404.9	193.1	333.7	329.2	254.8
		2	0.5	219.3	207.8	219.7	218.5	219.7
		5	0.8	300.3	291.7	298.7	303.4	298.8
		10	0.9	344.2	347.2	342.2	349.4	342.3
		25	0.96	390.4	417.4	390.4	397.7	390.3
		50	0.98	419.1	469.5	422.5	427.7	422.2
		75	0.9867	434.0	499.8	440.0	443.3	439.7
		100	0.99	443.7	521.2	452.0	453.5	451.6
		200	0.995	464.8	572.7	479.7	476.0	479.0

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33004	Turakina at Otairi	500	0.998	488.2	640.6	513.9	501.5	512.8
		1000	0.999	503.1	692.0	538.5	518.1	537.0
		2	0.5	231.4	260.4	228.1	230.4	222.4
		5	0.8	367.7	409.9	376.0	379.2	392.4
		10	0.9	489.0	508.9	505.7	513.5	530.0
		25	0.96	689.6	634.0	707.4	734.0	717.6
		50	0.98	882.7	726.8	886.3	942.3	862.1
		75	0.9867	1016.3	780.7	1002.5	1084.3	947.4
		100	0.99	1121.8	818.9	1090.4	1195.3	1008.2
		200	0.995	1418.9	910.6	1322.4	1502.5	1155.4
33012	Turakina at O'Neills	500	0.998	1925.6	1031.7	1676.1	2010.8	1351.3
		1000	0.999	2419.0	1123.2	1982.7	2490.3	1500.3
		2	0.5	239.8	231.9	240.2	238.4	240.1
		5	0.8	343.8	337.2	343.0	347.6	343.7
		10	0.9	405.6	406.8	404.0	411.2	404.7
		25	0.96	476.2	494.8	475.3	482.1	474.9
		50	0.98	523.9	560.1	525.0	528.6	523.3
		75	0.9867	549.8	598.1	552.9	553.5	550.2
		100	0.99	567.4	624.9	572.3	570.3	568.8
		200	0.995	607.5	689.5	618.0	608.0	612.2
33101	Whangaehu at Kauangaroa	500	0.998	655.6	774.7	676.5	652.8	667.0
		1000	0.999	688.7	839.1	719.7	683.3	706.9
		2	0.5	491.2	500.9	490.5	487.2	489.0
		5	0.8	698.0	708.5	702.0	701.1	709.7
		10	0.9	844.7	845.9	849.0	856.8	857.3
		25	0.96	1041.9	1019.6	1041.5	1069.5	1040.8
		50	0.98	1197.4	1148.4	1189.3	1239.5	1174.0
		75	0.9867	1291.5	1223.2	1277.4	1343.6	1250.4
		100	0.99	1359.8	1276.2	1340.7	1419.7	1304.1
		200	0.995	1530.1	1403.6	1496.5	1611.4	1431.7
33107	Whangaehu at Karioi	500	0.998	1768.5	1571.7	1710.5	1884.8	1597.5
		1000	0.999	1959.6	1698.7	1878.9	2108.2	1721.2
		2	0.5	80.5	87.6	79.7	82.7	78.3
		5	0.8	116.7	126.8	118.8	118.3	122.8
		10	0.9	148.3	152.8	152.3	144.7	158.1
		25	0.96	199.7	185.6	203.7	181.6	205.8
		50	0.98	248.3	210.0	248.6	211.7	242.4

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33111	Mangawhero at Ore Ore	75	0.9867	281.6	224.1	277.5	230.3	263.9
		100	0.99	307.7	234.1	299.3	244.0	279.3
		200	0.995	380.3	258.2	356.5	279.0	316.3
		500	0.998	502.2	290.0	442.7	329.7	365.6
		1000	0.999	618.9	314.0	516.8	371.8	403.0
		2	0.5	219.0	233.1	217.6	219.4	215.4
		5	0.8	318.6	336.7	322.9	321.7	330.8
		10	0.9	399.3	405.3	406.4	402.7	416.6
		25	0.96	522.1	492.0	527.0	521.5	529.1
		50	0.98	631.0	556.3	627.5	622.9	613.7
		75	0.9867	702.3	593.7	690.3	687.7	663.1
		100	0.99	756.8	620.1	736.9	736.3	698.0
		200	0.995	902.6	683.7	856.0	863.3	782.2
		500	0.998	1132.0	767.6	1029.5	1055.3	893.2
1000	0.999	1338.4	831.0	1173.9	1221.3	977.1		
33112	Tokiahuru at Whangaehu Junction	2	0.5	46.7	48.5	46.5	47.7	46.3
		5	0.8	64.2	66.2	64.7	65.3	65.8
		10	0.9	77.5	78.0	78.3	77.2	79.6
		25	0.96	96.8	92.9	97.1	92.5	97.2
		50	0.98	113.1	103.9	112.3	104.1	110.4
		75	0.9867	123.4	110.3	121.5	111.0	117.9
		100	0.99	131.1	114.9	128.3	116.0	123.3
		200	0.995	151.0	125.8	145.3	128.1	136.1
		500	0.998	181.0	140.2	169.5	144.7	153.0
		1000	0.999	206.6	151.1	189.1	157.7	165.6
33114	Waitangi at Tangiwai	2	0.5	3.3	3.2	3.3	3.3	3.3
		5	0.8	4.3	4.3	4.3	4.4	4.3
		10	0.9	4.9	4.9	4.9	4.9	4.9
33115	Mangaetoroa at School	25	0.96	5.6	5.8	5.6	5.6	5.6
		50	0.98	6.0	6.4	6.0	6.0	6.0
		75	0.9867	6.2	6.8	6.3	6.2	6.2
		100	0.99	6.4	7.1	6.4	6.4	6.4
		200	0.995	6.7	7.7	6.8	6.7	6.8
		500	0.998	7.1	8.6	7.4	7.1	7.3
		1000	0.999	7.4	9.2	7.7	7.4	7.7
		2	0.5	19.5	19.2	19.6	20.3	19.6
5	0.8	27.8	27.5	27.8	29.0	27.9		

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33119	Makotuku at Raetihi	10	0.9	32.9	32.9	32.8	32.9	32.9
		25	0.96	39.0	39.9	38.9	36.4	38.9
		50	0.98	43.3	45.0	43.2	38.1	43.0
		75	0.9867	45.6	48.0	45.7	38.9	45.3
		100	0.99	47.3	50.1	47.4	39.4	47.0
		200	0.995	51.1	55.2	51.5	40.4	50.8
		500	0.998	55.9	61.9	56.9	41.2	55.6
		1000	0.999	59.3	67.0	60.9	41.7	59.1
		2	0.5	57.0	64.1	56.2	56.0	54.8
		5	0.8	89.4	99.8	91.4	91.7	95.4
		10	0.9	118.4	123.4	122.5	126.1	128.5
		25	0.96	166.6	153.2	171.1	186.0	173.8
		50	0.98	213.4	175.3	214.5	245.9	208.7
		75	0.9867	245.8	188.2	242.7	288.2	229.3
		100	0.99	271.6	197.3	264.2	322.0	244.0
		200	0.995	344.3	219.2	320.8	418.9	279.7
500	0.998	469.0	248.1	407.5	588.2	327.2		
1000	0.999	591.3	269.9	482.9	756.8	363.3		
33130	Whangaehu at Mangaio Tunnel	2	0.5	6.5	6.6	6.5	6.5	6.5
		5	0.8	7.2	7.2	7.2	7.2	7.3
		10	0.9	7.7	7.7	7.7	7.7	7.7
		25	0.96	8.3	8.3	8.3	8.3	8.3
		50	0.98	8.8	8.7	8.7	8.8	8.7
		75	0.9867	9.0	8.9	9.0	9.0	8.9
		100	0.99	9.2	9.1	9.2	9.2	9.1
		200	0.995	9.7	9.5	9.6	9.7	9.5
		500	0.998	10.3	10.1	10.2	10.3	10.0
		1000	0.999	10.8	10.5	10.7	10.8	10.3
33143	Mangawhero at Hagleys	2	0.5	47.6	51.6	47.2	49.5	46.5
		5	0.8	69.5	74.9	70.7	73.2	72.9
		10	0.9	88.1	90.3	90.3	91.5	93.3
		25	0.96	117.8	109.9	119.7	117.8	120.7
		50	0.98	145.3	124.3	145.1	139.8	141.6
		75	0.9867	163.9	132.8	161.3	153.7	153.8
		100	0.99	178.4	138.7	173.5	164.0	162.5
		200	0.995	218.1	153.0	205.0	190.6	183.6
500	0.998	283.5	171.9	252.1	230.2	211.5		

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33149	Mangawhero at Pakihi Rd Br	1000	0.999	344.9	186.2	292.2	263.8	232.6		
		2	0.5	61.2	68.6	60.2	61.7	58.2		
		5	0.8	81.3	94.5	83.1	84.7	87.2		
		10	0.9	102.2	111.6	107.4	106.2	115.9		
		25	0.96	142.3	133.3	151.1	142.0	158.4		
		50	0.98	186.6	149.4	195.0	176.3	192.6		
		75	0.9867	220.2	158.7	225.7	199.8	213.2		
		100	0.99	248.3	165.3	249.9	218.4	228.1		
		200	0.995	334.8	181.2	317.7	270.1	264.5		
		500	0.998	504.2	202.2	430.9	356.9	313.6		
33303	Whanganui at Te Rewa	1000	0.999	693.0	218.1	537.4	440.3	351.4		
		2	0.5	2137.5	2137.8	2137.4	2130.7	2134.9		
		5	0.8	2873.5	2873.8	2879.4	2879.5	2896.1		
		10	0.9	3361.1	3361.1	3363.9	3381.5	3380.4		
		25	0.96	3977.6	3976.8	3970.0	4023.6	3966.1		
		50	0.98	4435.2	4433.6	4418.1	4508.0	4383.5		
		75	0.9867	4701.3	4699.1	4678.9	4793.7	4620.4		
		100	0.99	4889.7	4887.0	4863.9	4998.0	4785.8		
		33307	Whanganui at Headwaters	200	0.995	5342.7	5338.7	5311.1	5497.2	5176.6
				500	0.998	5940.8	5934.7	5908.2	6175.5	5679.7
1000	0.999			6393.0	6385.1	6366.6	6704.9	6052.1		
2	0.5			39.5	39.0	39.6	40.2	39.5		
5	0.8			60.4	59.9	60.5	62.3	60.8		
10	0.9			73.7	73.8	73.6	75.1	74.0		
25	0.96			90.0	91.3	89.7	89.0	89.6		
50	0.98			101.6	104.3	101.4	97.9	100.7		
75	0.9867			108.2	111.8	108.1	102.5	106.9		
100	0.99			112.8	117.2	112.8	105.6	111.2		
33313	Ohura at Tokorima	200	0.995	123.7	130.0	124.0	112.3	121.4		
		500	0.998	137.6	147.0	138.8	119.9	134.4		
		1000	0.999	147.7	159.8	150.1	124.9	144.0		
		2	0.5	242.4	245.7	242.1	241.9	241.6		
		5	0.8	308.0	311.7	309.4	309.6	311.9		
		10	0.9	354.9	355.3	356.4	358.3	359.1		
		25	0.96	418.2	410.5	418.2	424.4	418.0		
		50	0.98	468.4	451.4	465.8	477.0	460.8		
		75	0.9867	498.9	475.2	494.2	509.1	485.3		

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33314	Ohura at Nihoniho	100	0.99	521.1	492.1	514.7	532.5	502.6
		200	0.995	576.6	532.5	565.2	591.5	543.7
		500	0.998	654.7	585.9	634.6	675.7	597.1
		1000	0.999	717.6	626.3	689.4	744.4	636.9
		2	0.5	126.5	122.1	126.6	124.9	126.6
		5	0.8	161.9	158.5	161.3	161.6	161.4
		10	0.9	181.6	182.6	180.8	183.7	180.9
		25	0.96	202.8	213.1	202.7	209.5	202.6
		50	0.98	216.3	235.7	217.5	227.4	217.3
		75	0.9867	223.3	248.9	225.6	237.4	225.3
		100	0.99	228.0	258.2	231.2	244.4	230.8
		200	0.995	238.3	280.5	244.1	260.7	243.5
		500	0.998	249.9	310.0	260.3	281.3	259.3
1000	0.999	257.5	332.3	272.0	296.4	270.7		
33341	Mangaroa at Ohura Town Br	2	0.5	108.1	106.0	108.2	108.1	108.2
		5	0.8	134.9	133.1	134.6	135.1	134.8
		10	0.9	150.7	151.0	150.3	151.5	150.5
		25	0.96	168.8	173.7	168.6	170.9	168.5
		50	0.98	181.0	190.5	181.3	184.6	180.9
33345	Whanganui at Pipiriki	75	0.9867	187.7	200.3	188.5	192.3	187.8
		100	0.99	192.2	207.2	193.5	197.7	192.6
		200	0.995	202.4	223.8	205.2	210.4	203.7
		500	0.998	214.7	245.7	220.2	226.8	217.8
		1000	0.999	223.1	262.3	231.2	239.0	228.0
		2	0.5	2047.1	2122.9	2040.6	2094.2	2030.2
		5	0.8	3010.6	3097.4	3037.0	3114.5	3084.8
		10	0.9	3726.1	3742.7	3760.3	3768.9	3814.9
		25	0.96	4729.5	4558.0	4738.3	4562.4	4738.8
		50	0.98	5552.8	5162.8	5509.9	5127.8	5418.5
		75	0.9867	6065.0	5514.4	5977.1	5448.2	5810.6
		100	0.99	6443.2	5763.2	6316.3	5671.5	6086.7
		200	0.995	7409.4	6361.4	7161.8	6197.5	6746.4
500	0.998	8816.8	7150.6	8345.3	6870.3	7608.4		
1000	0.999	9990.4	7747.0	9294.3	7364.3	8254.4		
33347	Whanganui at Te Porere	2	0.5	31.9	30.8	31.9	31.9	31.9
		5	0.8	42.2	41.3	42.0	42.4	42.1
		10	0.9	48.1	48.3	47.9	48.3	47.9

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33366	Matarawa at Diversion	25	0.96	54.5	57.1	54.5	54.8	54.5
		50	0.98	58.8	63.6	59.0	59.1	58.9
		75	0.9867	61.0	67.4	61.5	61.4	61.4
		100	0.99	62.5	70.0	63.3	62.9	63.1
		200	0.995	65.9	76.5	67.3	66.4	67.0
		500	0.998	69.8	85.0	72.4	70.6	71.9
		1000	0.999	72.4	91.4	76.2	73.5	75.5
		2	0.5	10.6	10.1	10.7	11.1	10.7
		5	0.8	15.4	15.0	15.3	16.1	15.3
		10	0.9	18.1	18.2	18.0	18.1	18.0
		25	0.96	20.9	22.3	20.9	19.6	20.9
		50	0.98	22.8	25.3	22.9	20.3	22.9
		75	0.9867	23.7	27.1	24.0	20.6	24.0
		100	0.99	24.4	28.3	24.8	20.7	24.7
33502	Kai Iwi at Handley Rd	200	0.995	25.8	31.3	26.5	21.0	26.5
		500	0.998	27.4	35.3	28.8	21.2	28.6
		1000	0.999	28.4	38.3	30.3	21.4	30.2
		2	0.5	26.1	28.6	25.9	26.3	25.5
		5	0.8	42.3	45.6	43.1	43.6	44.5
		10	0.9	55.7	56.8	57.0	57.3	58.8
		25	0.96	76.2	71.0	77.2	77.4	77.6
		50	0.98	94.7	81.6	94.2	94.3	91.8
		75	0.9867	106.9	87.7	104.9	105.0	100.1
		100	0.99	116.2	92.0	112.8	113.0	106.0
		200	0.995	141.5	102.4	133.3	133.7	120.2
		500	0.998	181.7	116.2	163.3	164.3	139.0
		1000	0.999	218.3	126.6	188.3	190.4	153.2
		1032501	Kumeti at Te Rehunga	2	0.5	8.3	8.4	8.3
5	0.8			12.7	12.8	12.8	12.9	12.9
10	0.9			15.7	15.7	15.8	16.0	15.9
25	0.96			19.6	19.4	19.6	19.9	19.5
50	0.98			22.6	22.2	22.4	22.6	22.2
75	0.9867			24.3	23.8	24.1	24.2	23.7
100	0.99			25.6	24.9	25.3	25.4	24.7
200	0.995			28.6	27.6	28.2	28.0	27.2
500	0.998			32.7	31.2	32.1	31.4	30.4
1000	0.999			35.9	33.9	35.2	34.0	32.8

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
1032504	Tamaki at Water Supply Weir	2	0.5	32.3	35.5	32.0	30.2	31.5
		5	0.8	59.4	63.3	60.4	60.7	62.2
		10	0.9	80.7	81.8	82.2	86.8	84.5
		25	0.96	112.1	105.1	113.0	126.8	113.3
		50	0.98	139.2	122.4	138.1	161.7	134.7
		75	0.9867	156.6	132.4	153.6	184.0	147.2
		100	0.99	169.8	139.5	165.0	200.8	156.1
		200	0.995	204.4	156.6	193.9	244.6	177.2
		500	0.998	257.4	179.1	235.4	310.2	205.1
		1000	0.999	303.8	196.2	269.5	366.1	226.1
1032517	Tokomaru at Quarry	2	0.5	91.4	88.4	91.5	93.5	91.5
		5	0.8	124.3	121.8	123.9	126.4	124.1
		10	0.9	143.4	144.0	142.9	143.0	143.0
		25	0.96	164.9	172.0	164.7	159.3	164.6
		50	0.98	179.2	192.7	179.7	168.8	179.4
		75	0.9867	186.8	204.8	188.2	173.5	187.5
		100	0.99	192.0	213.3	194.0	176.6	193.2
		200	0.995	203.6	233.9	207.6	183.0	206.3
		500	0.998	217.3	261.0	224.9	189.9	222.7
		1000	0.999	226.5	281.4	237.6	194.1	234.7
1032518	Makakahi at Hamua	2	0.5	189.8	187.6	189.9	191.5	189.8
		5	0.8	256.9	254.9	256.9	258.3	257.9
		10	0.9	299.3	299.4	298.9	298.1	299.8
		25	0.96	350.6	355.7	349.8	343.9	349.5
		50	0.98	387.1	397.4	386.5	375.3	384.4
		75	0.9867	407.8	421.7	407.5	392.6	404.0
		100	0.99	422.2	438.9	422.3	404.6	417.7
		200	0.995	455.9	480.2	457.6	432.1	449.8
		500	0.998	498.6	534.6	503.9	466.5	490.8
		1000	0.999	529.6	575.8	538.8	491.1	521.0
1032542	Makino at Reids Line	2	0.5	21.0	24.7	20.6	20.4	19.9
		5	0.8	39.1	44.4	40.1	40.9	42.2
		10	0.9	55.0	57.4	57.1	60.8	60.1
		25	0.96	81.0	73.8	83.2	95.1	84.4
		50	0.98	105.9	86.0	106.2	128.8	103.0
		75	0.9867	123.0	93.1	121.1	152.3	114.0
		100	0.99	136.5	98.2	132.3	170.9	121.9

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
1032555	Mangatainoka at Larsons Br	200	0.995	174.2	110.2	161.8	223.2	140.8
		500	0.998	237.9	126.1	206.6	311.7	166.0
		1000	0.999	299.4	138.2	245.3	396.7	185.2
		2	0.5	192.4	182.8	NA	192.5	192.5
		5	0.8	229.7	223.8	NA	229.9	228.4
		10	0.9	247.2	251.0	NA	247.3	246.1
		25	0.96	263.4	285.3	NA	263.7	264.1
		50	0.98	272.2	310.7	NA	273.0	275.3
1032560	Manawatu at Teachers College	75	0.9867	276.4	325.5	NA	277.5	281.1
		100	0.99	279.0	336.0	NA	280.4	285.0
		200	0.995	284.3	361.2	NA	286.5	293.7
		500	0.998	289.5	394.4	NA	293.0	304.0
		1000	0.999	292.4	419.4	NA	296.9	310.9
		2	0.5	1462.0	1461.7	1462.0	1468.5	1460.2
		5	0.8	2008.4	2008.1	2012.7	2021.1	2024.9
		10	0.9	2369.8	2369.8	2371.7	2372.7	2383.8
		25	0.96	2826.1	2826.9	2820.4	2801.6	2817.5
		50	0.98	3164.3	3166.0	3151.8	3110.9	3126.5
1032561	Makino at Rata St	75	0.9867	3360.8	3363.1	3344.6	3287.8	3301.8
		100	0.99	3499.8	3502.6	3481.4	3412.0	3424.2
		200	0.995	3833.8	3838.0	3811.7	3707.8	3713.3
		500	0.998	4274.2	4280.4	4252.6	4093.1	4085.4
		1000	0.999	4606.7	4614.8	4590.8	4381.9	4360.7
		2	0.5	34.0	34.0	34.0	35.5	33.9
		5	0.8	55.8	55.8	55.9	59.8	56.4
		10	0.9	70.2	70.2	70.3	71.6	70.8
		25	0.96	88.5	88.4	88.3	81.7	88.2
		50	0.98	102.1	102.0	101.6	86.8	100.6
1032564	Makino at Boness Rd	75	0.9867	110.0	109.8	109.3	89.0	107.6
		100	0.99	115.6	115.4	114.8	90.4	112.5
		200	0.995	129.1	128.7	128.1	92.9	124.1
		500	0.998	146.9	146.4	145.9	95.1	139.0
		1000	0.999	160.4	159.7	159.5	96.2	150.1
		2	0.5	34.2	34.0	34.2	35.2	34.2
		5	0.8	54.0	53.9	54.1	56.9	54.5
		10	0.9	67.0	67.0	67.0	68.3	67.4

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)		
		25	0.96	83.2	83.6	82.9	79.4	82.8		
		50	0.98	95.0	95.9	94.7	85.7	93.8		
		75	0.9867	101.9	103.0	101.4	88.8	100.0		
		100	0.99	106.7	108.1	106.2	90.7	104.4		
		200	0.995	118.3	120.2	117.8	94.6	114.6		
		500	0.998	133.3	136.3	133.2	98.5	127.7		
		1000	0.999	144.6	148.4	144.9	100.8	137.4		
		1032591	Makuri at Tuscan Hills	2	0.5	111.6	110.6	111.6	110.7	111.5
		5	0.8	164.3	163.3	164.4	166.2	165.4		
		10	0.9	198.2	198.2	198.1	202.3	198.9		
		25	0.96	239.9	242.3	239.3	246.7	239.1		
		50	0.98	270.2	275.0	269.4	278.6	267.4		
		75	0.9867	287.4	294.1	286.7	296.8	283.4		
		100	0.99	299.5	307.5	298.9	309.6	294.6		
		200	0.995	328.2	339.9	328.2	339.8	320.8		
		500	0.998	365.1	382.6	366.9	378.7	354.5		
		1000	0.999	392.3	414.9	396.3	407.6	379.3		
		1033153	Whangaehu at Aranui	2	0.5	154.7	177.7	151.8	151.0	146.3
				5	0.8	235.5	272.7	241.6	243.7	254.7
				10	0.9	313.4	335.5	328.1	341.2	350.8
				25	0.96	452.3	415.0	472.8	524.0	486.9
				50	0.98	595.7	473.9	608.9	719.6	594.1
				75	0.9867	699.9	508.2	700.5	864.5	658.0
				100	0.99	784.7	532.4	771.4	983.9	703.8
				200	0.995	1034.1	590.7	963.8	1340.8	815.3
		500	0.998	1490.8	667.6	1270.3	2011.0	964.8		
		1000	0.999	1967.6	725.8	1547.0	2726.4	1079.1		
1033154	Mangawhero at Raupiu Road	2	0.5	304.9	341.9	300.8	301.2	293.8		
		5	0.8	491.6	544.0	502.2	509.9	523.1		
		10	0.9	654.5	677.8	675.2	707.3	705.1		
		25	0.96	919.6	846.8	940.1	1045.0	951.3		
		50	0.98	1170.5	972.2	1171.9	1376.3	1140.0		
		75	0.9867	1342.2	1045.1	1321.4	1607.8	1251.1		
		100	0.99	1477.0	1096.7	1434.0	1791.6	1330.2		
		200	0.995	1852.4	1220.8	1729.1	2311.5	1521.6		
		500	0.998	2482.5	1384.4	2174.8	3203.4	1775.8		
		1000	0.999	3086.3	1508.1	2557.9	4074.2	1968.9		

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1033363	Matarawa at City Branch	2	0.5	4.9	4.8	4.9	5.1	4.9
		5	0.8	6.7	6.7	6.7	6.9	6.8
		10	0.9	7.9	7.9	7.9	7.8	7.9
		25	0.96	9.2	9.4	9.2	8.7	9.2
		50	0.98	10.2	10.6	10.2	9.1	10.1
		75	0.9867	10.7	11.2	10.8	9.4	10.7
		100	0.99	11.1	11.7	11.1	9.5	11.0
		200	0.995	12.0	12.8	12.1	9.9	11.9
		500	0.998	13.1	14.3	13.3	10.2	13.0
		1000	0.999	13.9	15.4	14.2	10.4	13.8
1132508	Oroua at Almadale Slackline	2	0.5	155.3	160.0	154.9	162.2	154.2
		5	0.8	230.6	235.9	232.4	240.0	235.6
		10	0.9	285.3	286.1	287.4	283.3	291.0
		25	0.96	360.4	349.6	360.6	329.1	360.5
		50	0.98	420.8	396.7	417.6	357.5	411.2
		75	0.9867	457.8	424.1	451.8	372.2	440.4
		100	0.99	484.9	443.5	476.5	381.9	461.0
		200	0.995	553.3	490.0	537.7	402.9	509.9
		500	0.998	651.0	551.5	622.5	426.6	573.7
		1000	0.999	730.9	597.9	689.9	441.8	621.4
1132511	Mangatainoka at Pahiatua Town Bridge	2	0.5	390.4	392.6	390.2	392.0	389.6
		5	0.8	526.3	528.5	527.9	528.4	531.6
		10	0.9	618.4	618.5	619.7	618.2	623.4
		25	0.96	737.3	732.3	736.2	731.5	735.5
		50	0.98	827.4	816.6	823.4	815.7	815.9
		75	0.9867	880.4	865.7	874.5	865.0	861.6
		100	0.99	918.3	900.4	911.0	900.1	893.7
		200	0.995	1010.5	983.8	999.6	985.1	969.5
		500	0.998	1134.6	1093.9	1119.0	1099.2	1067.5
		1000	0.999	1230.3	1177.1	1211.4	1187.3	1140.2
1132517	Kiwitea at Haynes Line	2	0.5	41.6	50.7	40.5	39.7	38.5
		5	0.8	76.5	90.7	79.0	80.0	84.2
		10	0.9	109.3	117.2	114.9	125.8	123.4
		25	0.96	166.3	150.6	173.6	218.2	178.3
		50	0.98	223.9	175.5	227.7	323.7	221.2
		75	0.9867	265.1	189.9	263.7	405.2	246.7

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1132519	Kahuterawa at Johnstons Rata	100	0.99	298.3	200.1	291.4	474.1	264.9
		200	0.995	394.7	224.6	365.7	687.3	309.3
		500	0.998	567.1	257.0	482.5	1110.1	368.6
		1000	0.999	743.1	281.5	586.5	1584.1	413.8
		2	0.5	61.2	63.0	61.1	61.1	60.8
		5	0.8	88.2	90.2	88.8	89.5	90.0
		10	0.9	107.9	108.2	108.7	110.7	110.0
		25	0.96	135.1	130.9	135.2	140.3	135.2
		50	0.98	157.2	147.8	156.0	164.4	153.7
		75	0.9867	170.8	157.6	168.5	179.4	164.3
1132523	Kiwitea at Strathspey Farm	100	0.99	180.8	164.5	177.6	190.4	171.7
		200	0.995	206.1	181.2	200.0	218.4	189.6
		500	0.998	242.5	203.2	231.3	259.1	212.8
		1000	0.999	272.4	219.9	256.2	292.9	230.2
		2	0.5	52.0	54.3	51.8	50.3	51.4
		5	0.8	87.6	90.2	88.4	89.3	90.0
		10	0.9	113.6	114.0	114.6	119.4	116.4
		25	0.96	149.4	144.0	149.6	161.4	149.5
		50	0.98	178.4	166.3	176.9	195.4	173.8
		75	0.9867	196.3	179.3	193.3	216.1	187.8
1232561	Raparapawai at Jackson Rd	100	0.99	209.4	188.4	205.2	231.3	197.6
		200	0.995	242.5	210.4	234.7	269.2	221.0
		500	0.998	290.1	239.5	275.6	322.8	251.6
		1000	0.999	329.1	261.5	308.2	365.8	274.4
		2	0.5	28.5	32.5	28.1	29.9	27.3
		5	0.8	47.3	53.1	48.5	49.6	50.7
		10	0.9	64.1	66.8	66.4	64.4	69.7
		25	0.96	91.7	84.1	94.2	84.9	95.6
		50	0.98	118.3	96.9	118.8	101.3	115.5
		75	0.9867	136.7	104.3	134.8	111.4	127.2
1232563	Mangapapa at Troup Road	100	0.99	151.2	109.6	146.9	118.8	135.6
		200	0.995	192.1	122.3	178.8	137.2	155.9
		500	0.998	261.7	139.0	227.4	163.3	182.8
		1000	0.999	329.4	151.6	269.6	184.5	203.4
2	0.5	38.6	37.1	38.7	38.8	38.7		

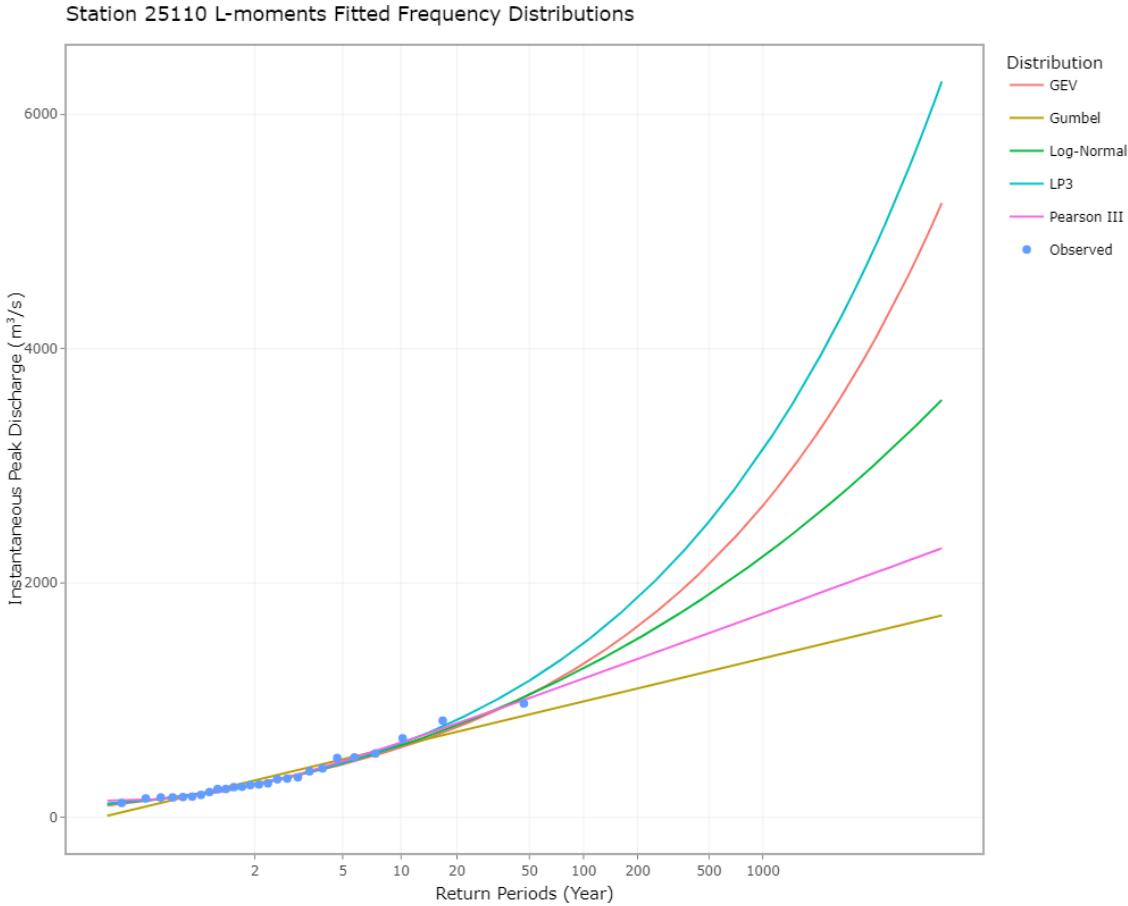
Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		5	0.8	58.7	57.4	58.5	60.9	58.7
		10	0.9	70.6	70.9	70.3	72.6	70.4
		25	0.96	84.2	87.9	84.0	84.4	84.0
		50	0.98	93.3	100.5	93.6	91.3	93.3
		75	0.9867	98.3	107.9	98.9	94.6	98.4
		100	0.99	101.7	113.0	102.7	96.8	102.0
		200	0.995	109.3	125.5	111.4	101.3	110.4
		500	0.998	118.5	142.0	122.6	106.0	120.9
		1000	0.999	124.8	154.5	130.9	108.8	128.5
1232564	Manga-Atua at Hopelands Rd	2	0.5	64.7	63.4	64.7	66.2	64.7
		5	0.8	90.3	89.1	90.2	91.7	90.5
		10	0.9	106.0	106.2	105.8	105.2	106.1
		25	0.96	124.8	127.7	124.5	118.9	124.4
		50	0.98	137.8	143.6	137.8	127.2	137.1
		75	0.9867	145.1	152.9	145.3	131.4	144.3
		100	0.99	150.1	159.5	150.6	134.1	149.2
		200	0.995	161.7	175.3	163.2	140.1	160.9
		500	0.998	176.2	196.1	179.5	146.6	175.7
		1000	0.999	186.5	211.8	191.7	150.8	186.5
1232566	Manawatu at Upper Gorge	2	0.5	1203.2	1250.7	1199.1	1225.8	1192.6
		5	0.8	1802.9	1857.3	1819.4	1858.6	1849.3
		10	0.9	2248.5	2259.0	2270.0	2280.4	2304.1
		25	0.96	2873.9	2766.5	2879.6	2809.0	2879.9
		50	0.98	3387.5	3143.0	3360.7	3197.2	3303.6
		75	0.9867	3707.0	3361.9	3652.1	3421.5	3548.0
		100	0.99	3943.2	3516.7	3863.7	3579.8	3720.2
		200	0.995	4546.5	3889.1	4391.3	3958.6	4131.5
		500	0.998	5425.9	4380.4	5130.1	4455.9	4669.0
		1000	0.999	6159.7	4751.6	5722.6	4830.4	5071.8
1232581	Oruakeretaki at SH2(Napier)	2	0.5	37.0	37.4	36.9	37.7	36.9
		5	0.8	52.0	52.5	52.3	52.8	52.7
		10	0.9	62.4	62.4	62.6	62.4	63.1
		25	0.96	76.0	75.1	75.9	74.1	75.8
		50	0.98	86.5	84.4	86.0	82.6	85.0
		75	0.9867	92.7	89.8	91.9	87.4	90.3

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
1332518	Mangatoro at Mangahei Road	100	0.99	97.2	93.7	96.2	90.7	94.0
		200	0.995	108.2	103.0	106.5	98.7	102.7
		500	0.998	123.2	115.2	120.6	109.1	114.0
		1000	0.999	134.9	124.4	131.5	116.8	122.4
		2	0.5	159.7	169.1	158.9	176.8	157.6
		5	0.8	273.3	284.1	276.5	308.1	282.3
		10	0.9	358.1	360.3	362.3	367.5	369.1
		25	0.96	477.7	456.5	478.9	415.2	479.1
		50	0.98	576.3	527.8	571.2	436.8	560.1
		75	0.9867	637.8	569.3	627.2	445.8	606.9
1332556	Tamaki at Stephensons	100	0.99	683.4	598.7	667.9	450.9	639.9
		200	0.995	800.2	669.3	769.5	460.0	718.7
		500	0.998	971.1	762.4	912.2	467.3	821.7
		1000	0.999	1114.3	832.8	1026.8	470.7	898.9
		2	0.5	46.1	54.6	45.1	42.5	43.6
		5	0.8	91.7	103.5	94.2	94.8	99.0
		10	0.9	131.0	135.9	135.6	148.9	142.3
		25	0.96	194.0	176.9	198.3	247.2	200.6
		50	0.98	252.8	207.3	252.6	347.8	245.1
		75	0.9867	292.8	225.0	287.4	419.6	271.2
1425006	Waihi at S.H.52	100	0.99	323.9	237.5	313.6	477.3	289.8
		200	0.995	410.1	267.5	381.7	642.7	334.8
		500	0.998	552.8	307.2	483.8	931.4	394.4
		1000	0.999	687.8	337.1	571.0	1216.3	439.7
		2	0.5	177.7	221.2	172.3	182.9	162.2
		5	0.8	337.2	406.4	348.9	363.8	373.8
		10	0.9	489.1	529.1	516.5	528.8	558.5
		25	0.96	757.0	684.0	793.7	796.8	818.4
		50	0.98	1030.5	799.0	1052.0	1044.8	1022.4
		75	0.9867	1227.7	865.8	1224.9	1210.7	1143.9
1425101	Owahanga at Branscombe Bridge	100	0.99	1387.5	913.1	1358.2	1338.6	1230.8
		200	0.995	1854.3	1026.8	1718.3	1685.4	1442.3
		500	0.998	2700.0	1176.8	2288.1	2237.9	1725.6
		1000	0.999	3573.3	1290.1	2799.0	2738.5	1942.1
		2	0.5	290.8	312.3	288.6	287.3	285.2
		5	0.8	439.5	467.3	446.1	447.9	458.2

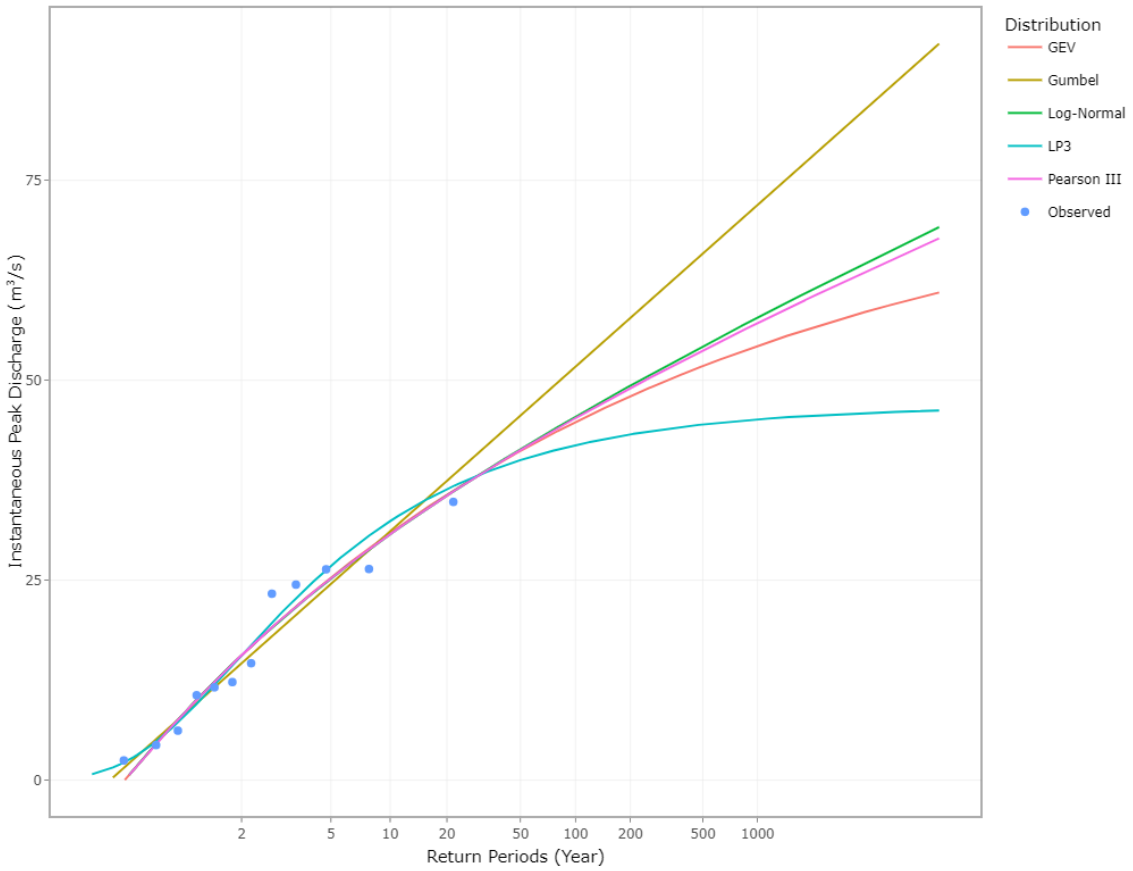
Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
1432003	Manakau at S.H.1 Bridge	10	0.9	560.6	569.9	571.5	586.3	587.1
		25	0.96	745.4	699.6	753.0	804.9	756.4
		50	0.98	909.7	795.8	904.7	1004.3	883.9
		75	0.9867	1017.7	851.8	999.8	1137.2	958.3
		100	0.99	1100.3	891.4	1070.2	1239.7	1011.0
		200	0.995	1321.8	986.5	1250.6	1517.5	1137.9
		500	0.998	1671.3	1112.0	1514.0	1963.3	1305.4
		1000	0.999	1986.8	1206.9	1733.4	2371.5	1432.0
		2	0.5	18.4	21.1	18.1	18.2	17.6
		5	0.8	31.5	35.4	32.3	32.7	33.8
		10	0.9	43.0	44.8	44.6	46.4	46.8
		25	0.96	62.0	56.8	63.6	69.5	64.5
		50	0.98	80.2	65.6	80.4	91.9	78.2
		75	0.9867	92.7	70.8	91.3	107.5	86.2
		100	0.99	102.6	74.4	99.6	119.8	91.9
		200	0.995	130.3	83.2	121.3	154.2	105.8
500	0.998	177.2	94.7	154.2	212.4	124.2		
1000	0.999	222.7	103.5	182.6	268.3	138.2		
1432008	Waikawa at North Manakau Road	2	0.5	50.7	58.1	49.8	48.8	48.3
		5	0.8	83.7	94.7	85.8	85.8	90.0
		10	0.9	113.5	118.9	117.8	123.9	124.2
		25	0.96	163.3	149.4	168.1	194.4	171.0
		50	0.98	211.8	172.1	213.2	268.9	207.2
		75	0.9867	245.7	185.3	242.7	323.4	228.6
		100	0.99	272.5	194.6	265.0	368.1	243.9
		200	0.995	348.7	217.1	324.2	500.3	280.9
2232510	Tokomaru at Riverland Farm	500	0.998	480.1	246.7	415.2	743.9	330.3
		1000	0.999	609.5	269.0	494.6	998.9	367.8
		2	0.5	93.4	94.1	93.4	96.6	93.2
		5	0.8	137.8	138.5	138.3	140.8	139.5
		10	0.9	167.8	167.8	168.2	164.9	169.4
		25	0.96	206.4	205.0	206.1	189.9	205.8
		50	0.98	235.6	232.5	234.4	205.2	231.9
		75	0.9867	252.8	248.6	250.9	213.1	246.8
		100	0.99	265.0	259.9	262.7	218.2	257.2
		200	0.995	294.8	287.1	291.4	229.3	281.8

Site Number	Site name	Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		500	0.998	334.7	323.1	330.1	241.6	313.6
		1000	0.999	365.5	350.3	359.9	249.4	337.2

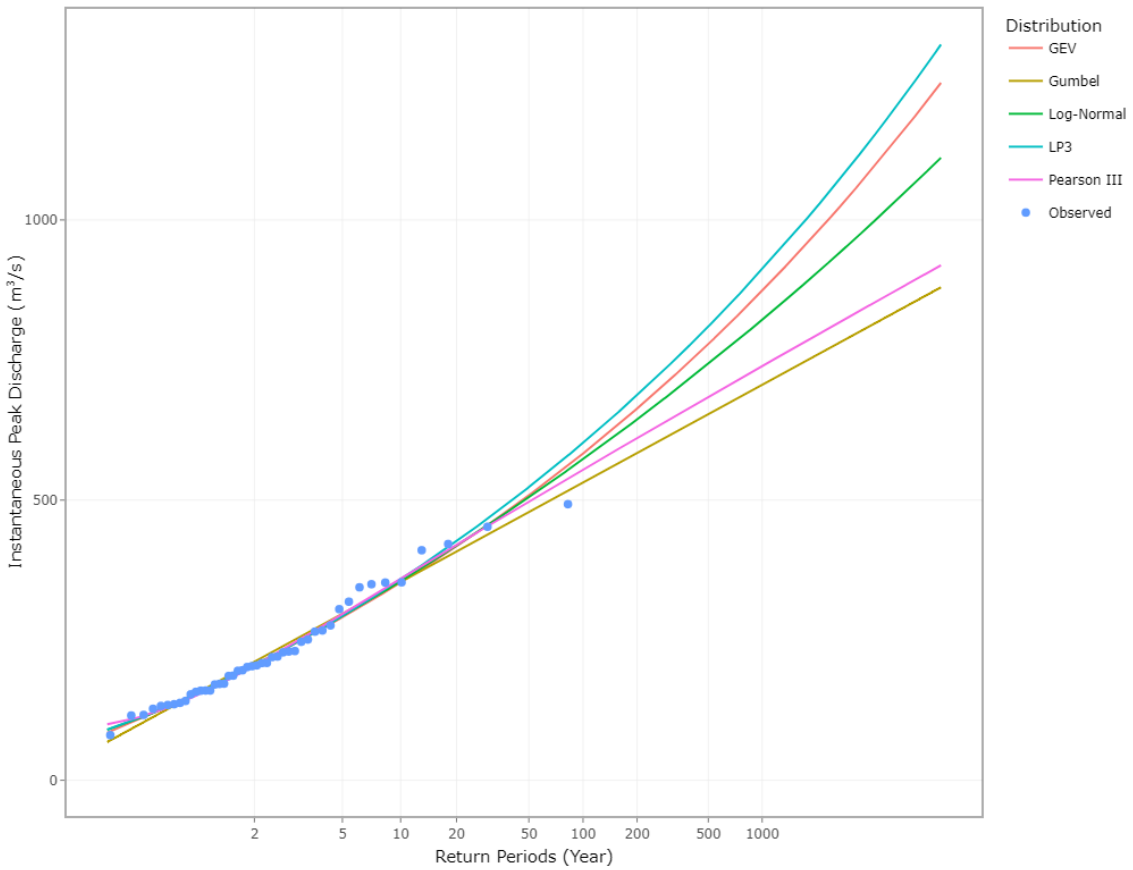
Visual of different fitted distribution for each site.



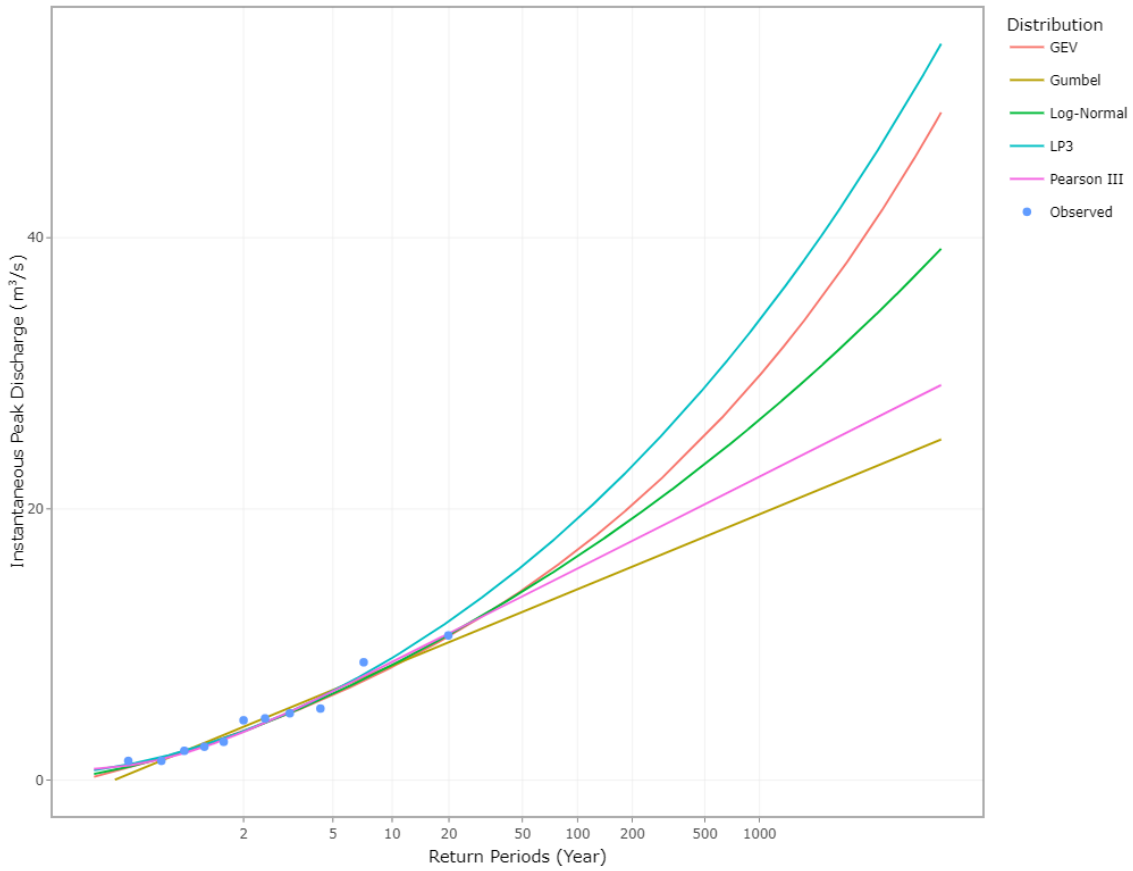
Station 32001 L-moments Fitted Frequency Distributions



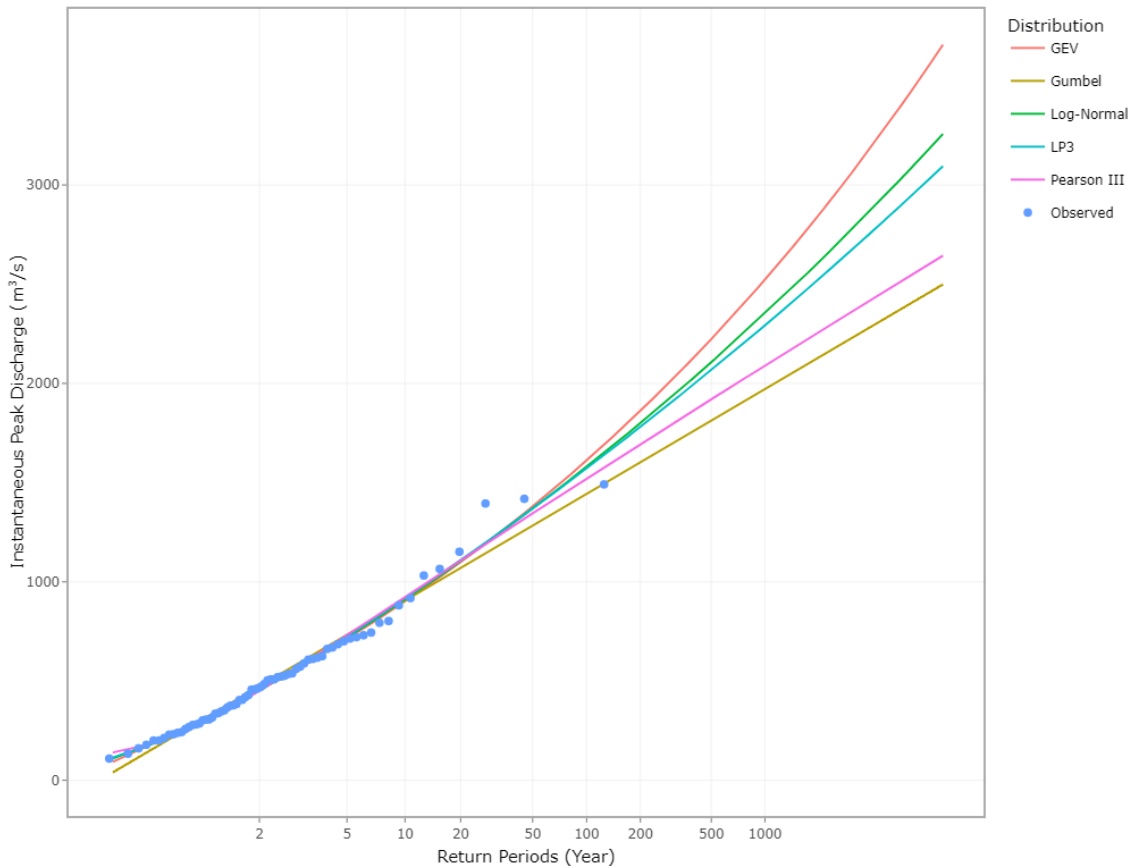
Station 32106 L-moments Fitted Frequency Distributions



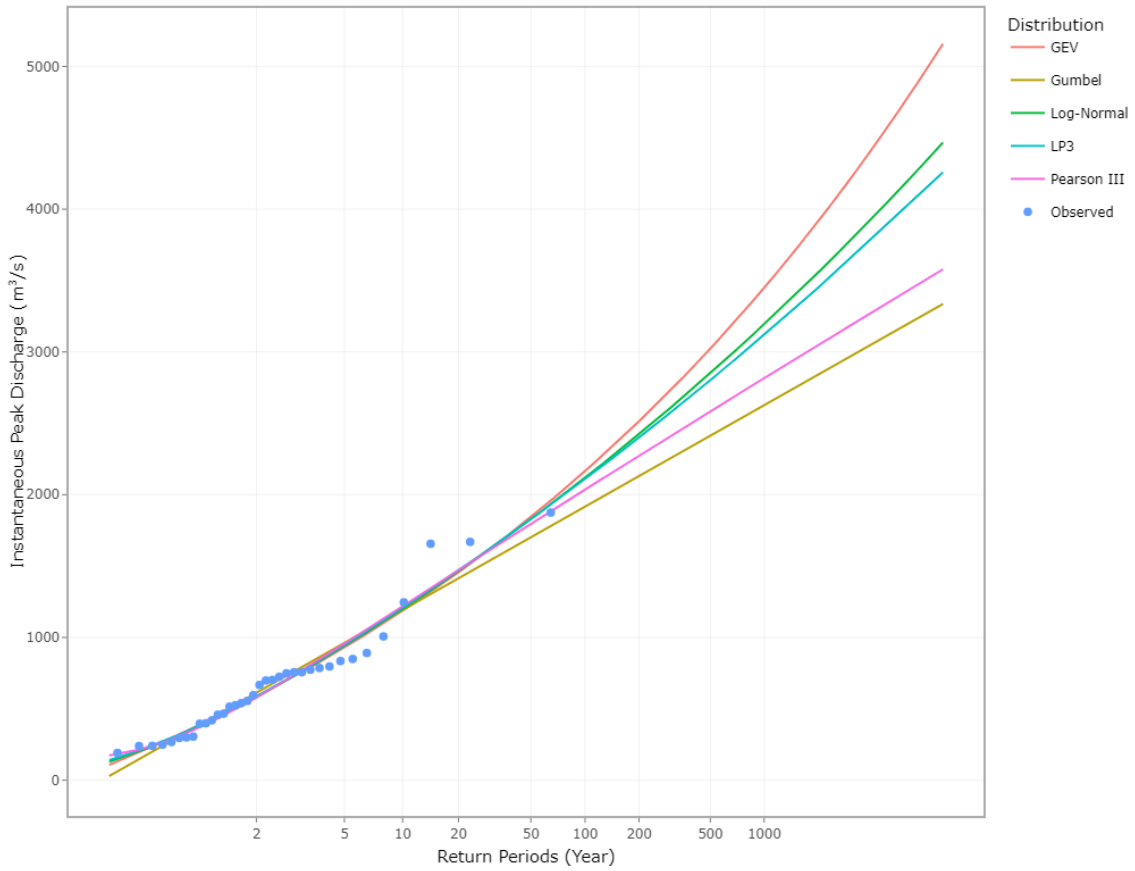
Station 32302 L-moments Fitted Frequency Distributions



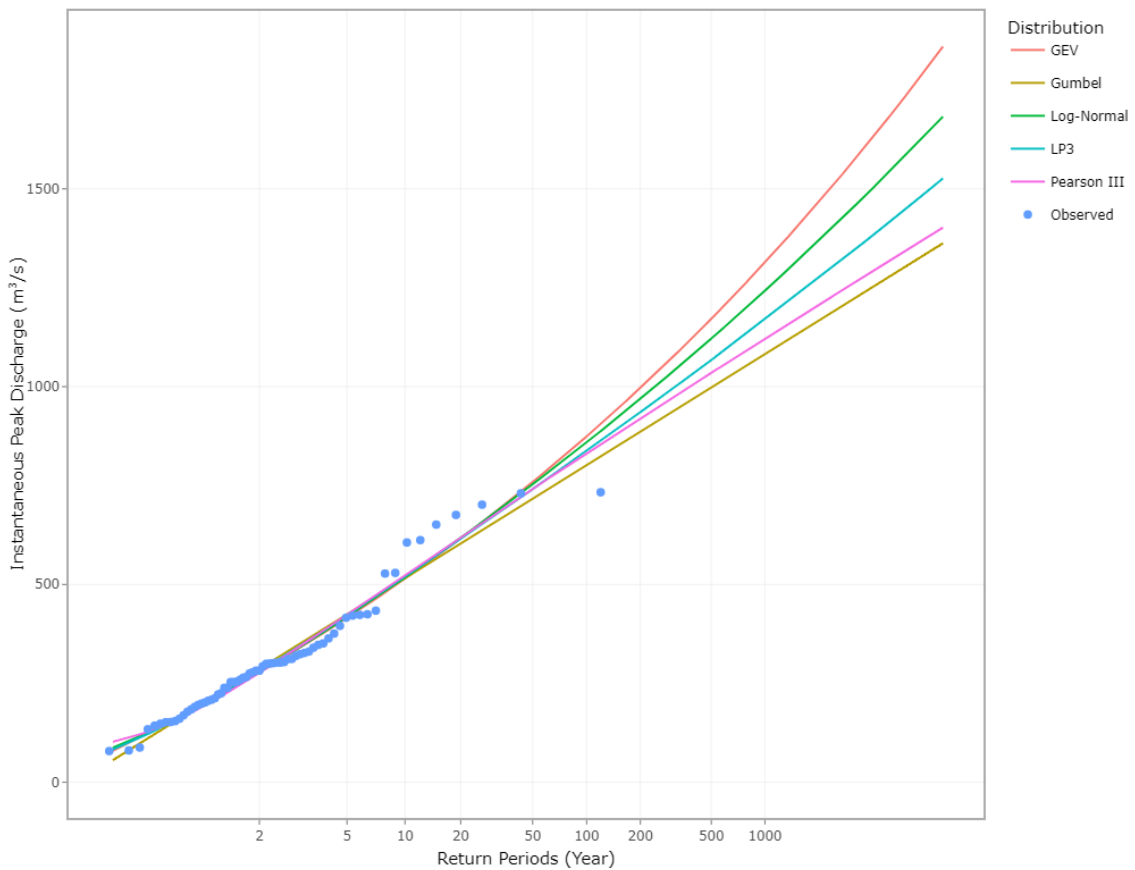
Station 32503 L-moments Fitted Frequency Distributions



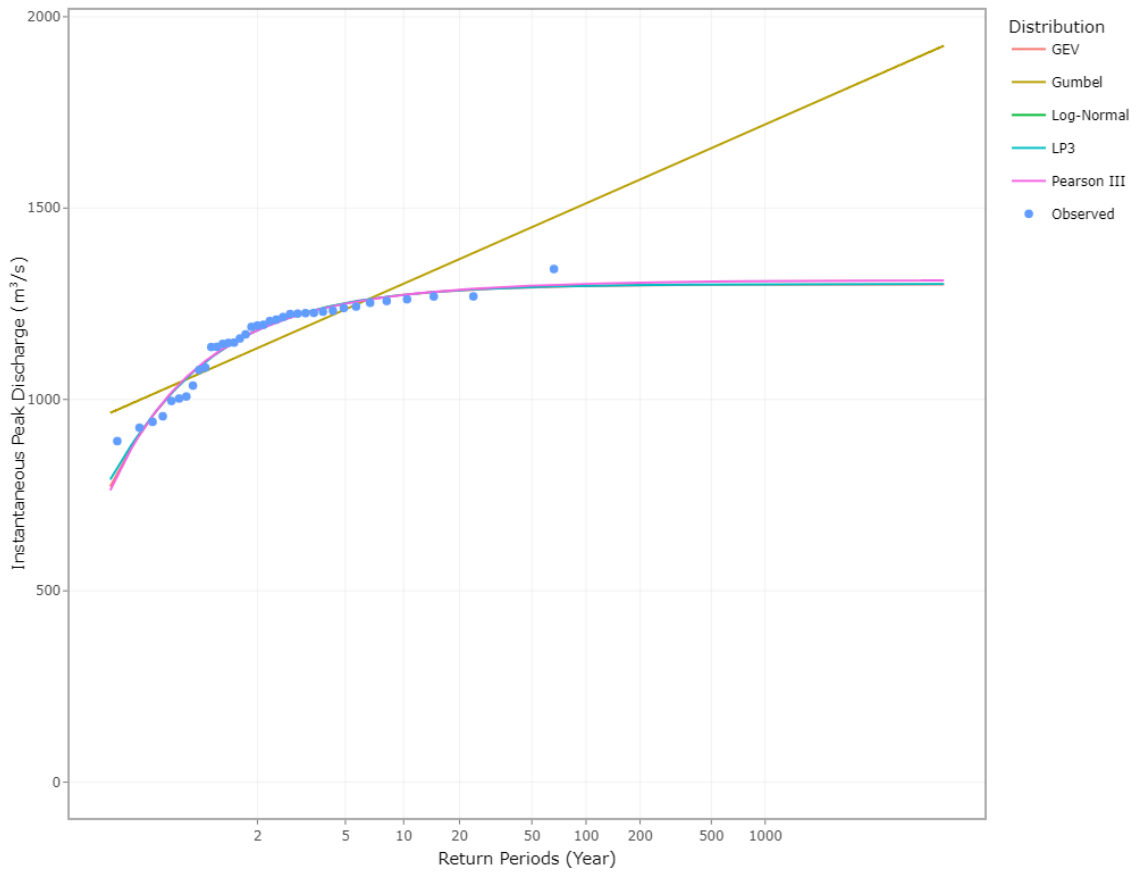
Station 32504 L-moments Fitted Frequency Distributions



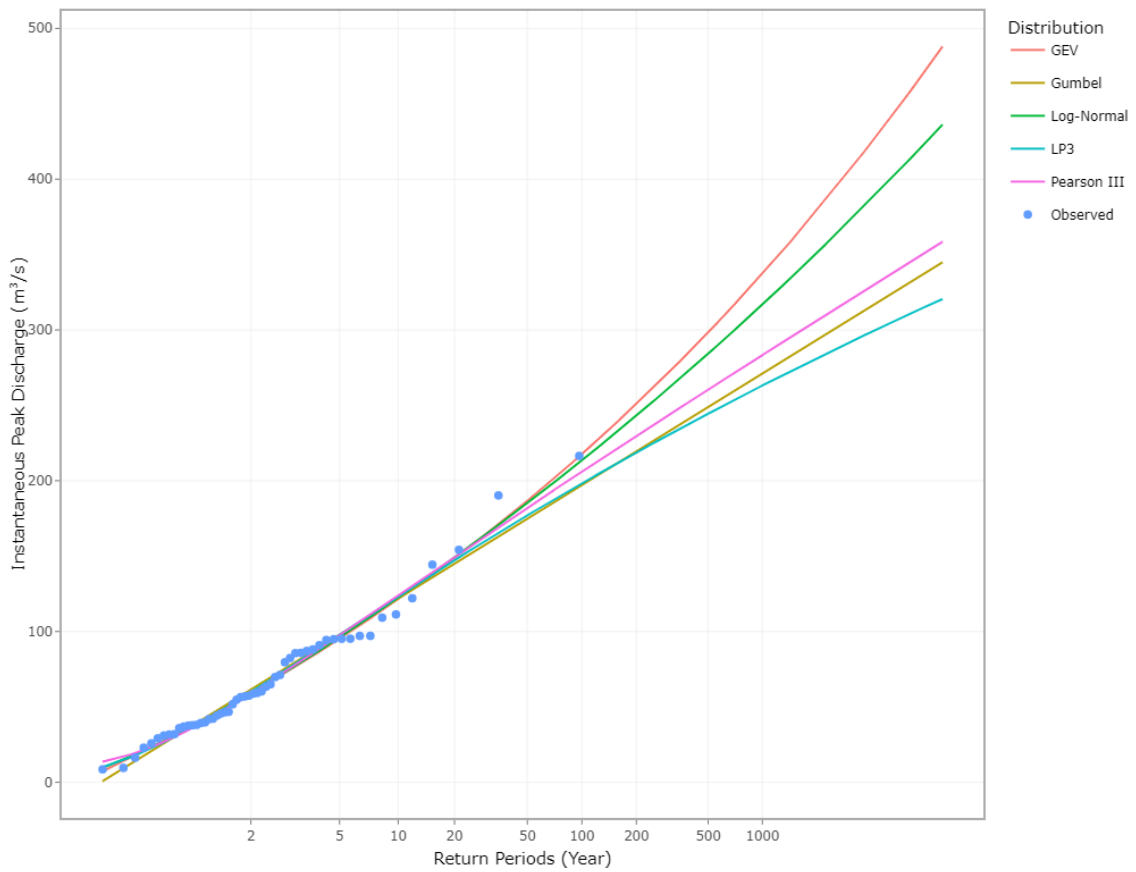
Station 32529 L-moments Fitted Frequency Distributions



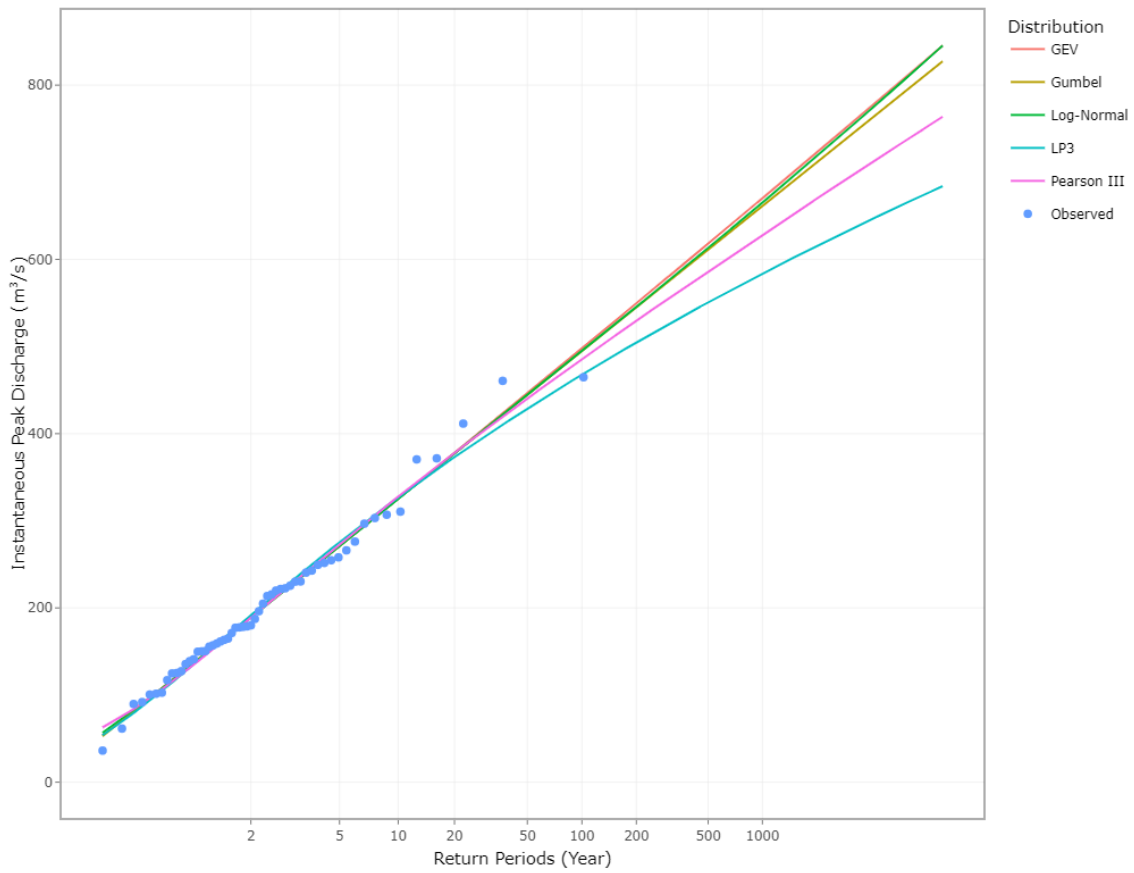
Station 32547 L-moments Fitted Frequency Distributions



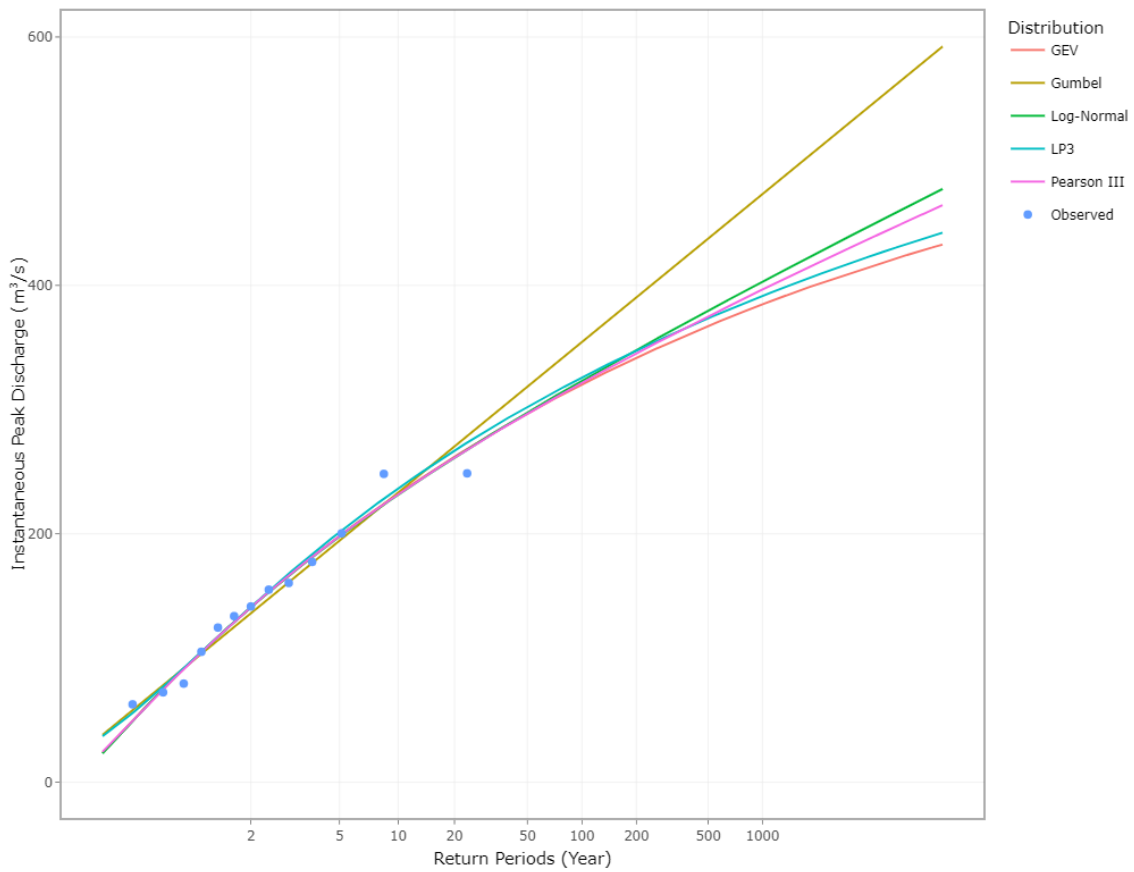
Station 32557 L-moments Fitted Frequency Distributions



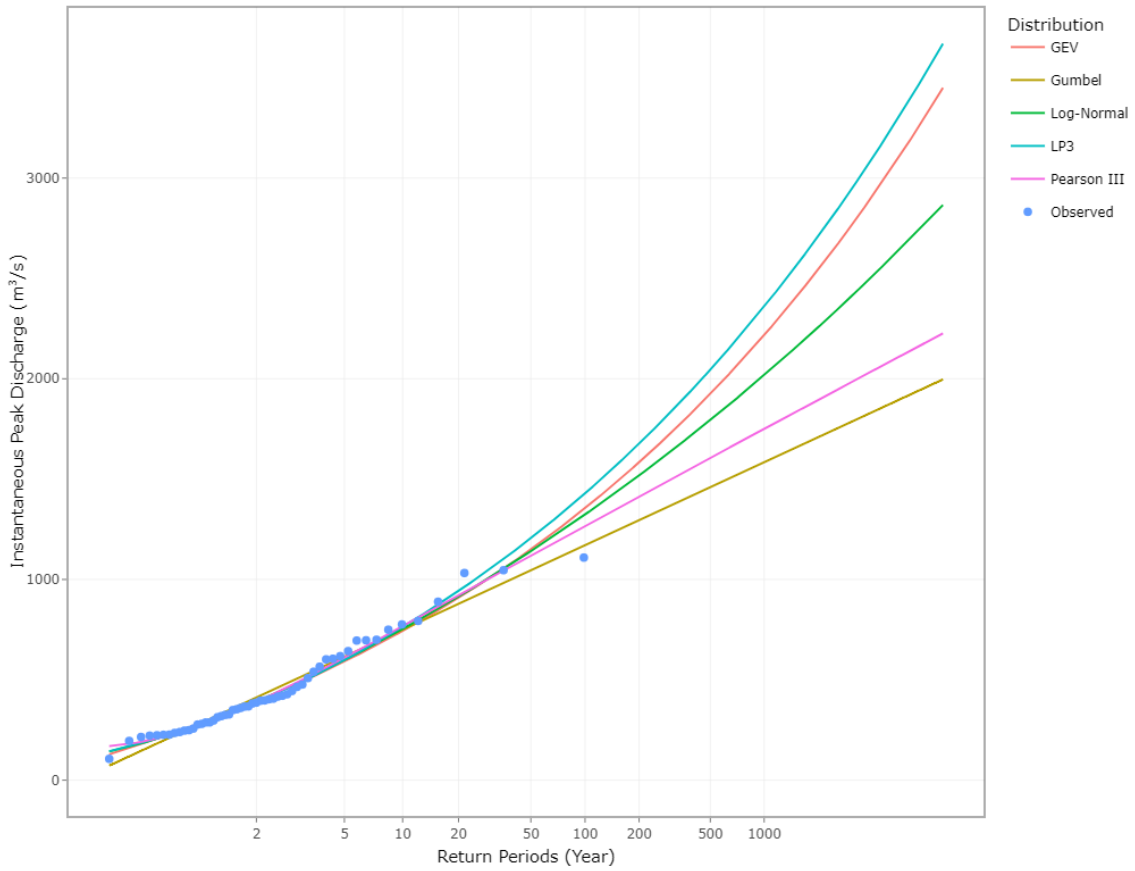
Station 32563 L-moments Fitted Frequency Distributions



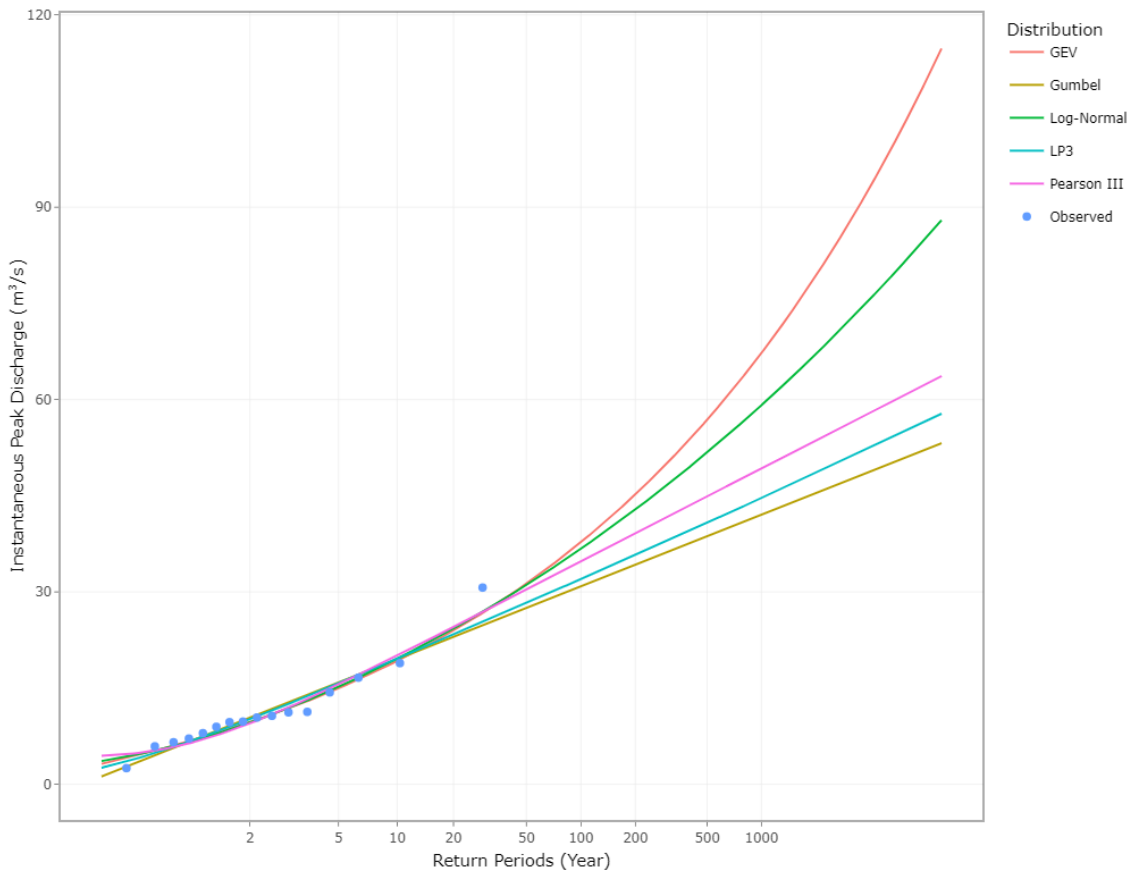
Station 32564 L-moments Fitted Frequency Distributions



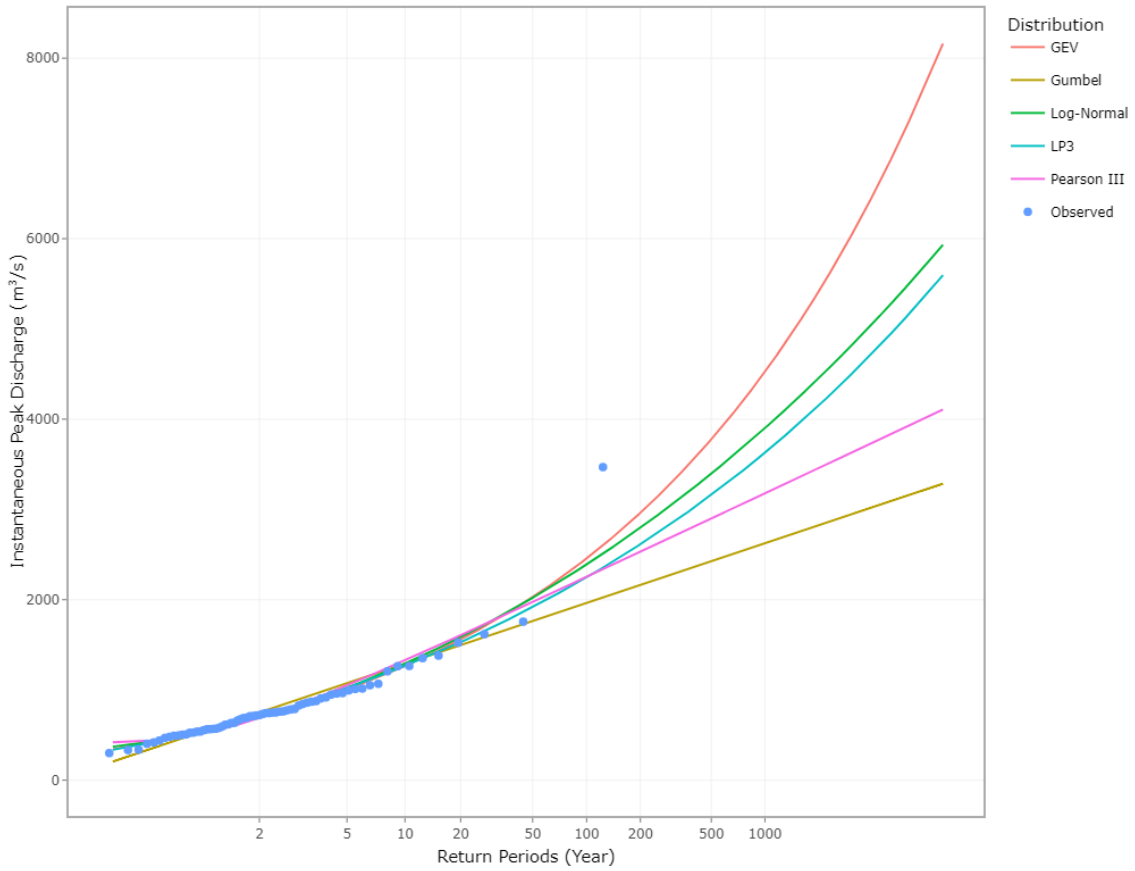
Station 32576 L-moments Fitted Frequency Distributions



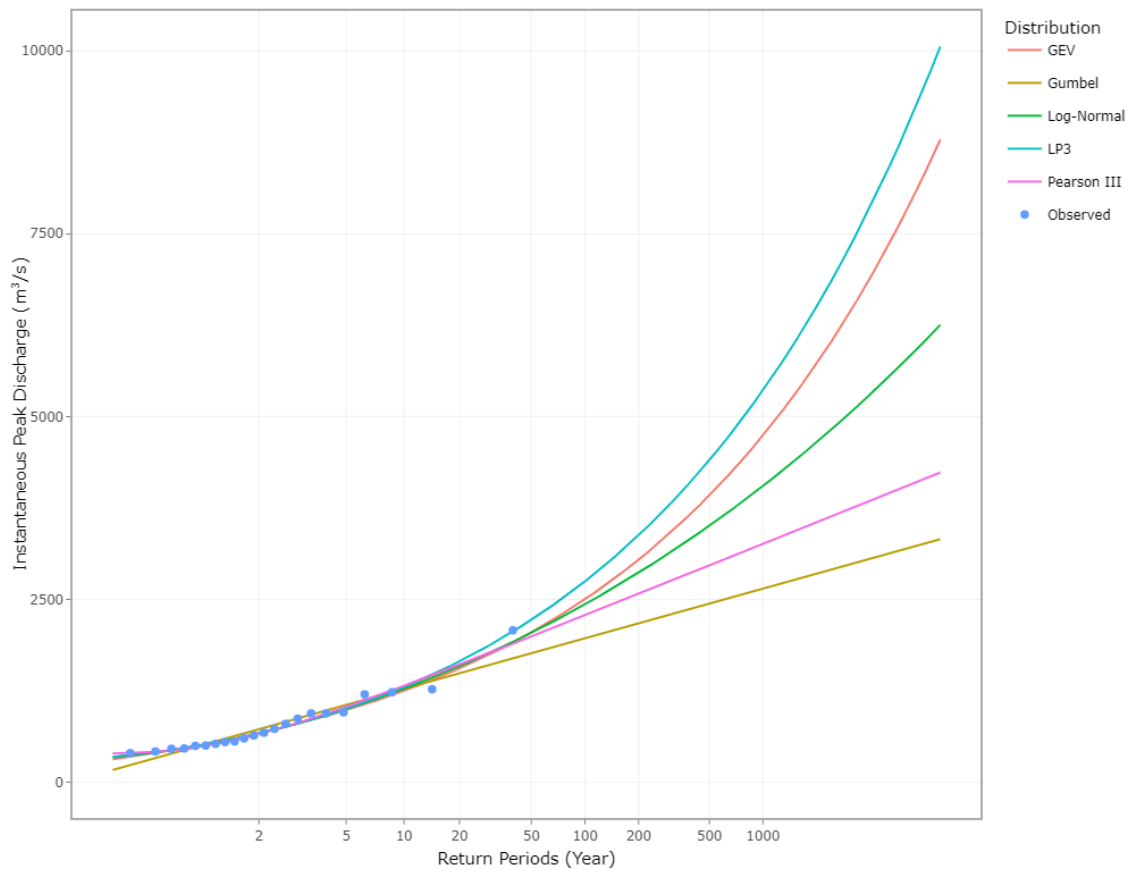
Station 32590 L-moments Fitted Frequency Distributions



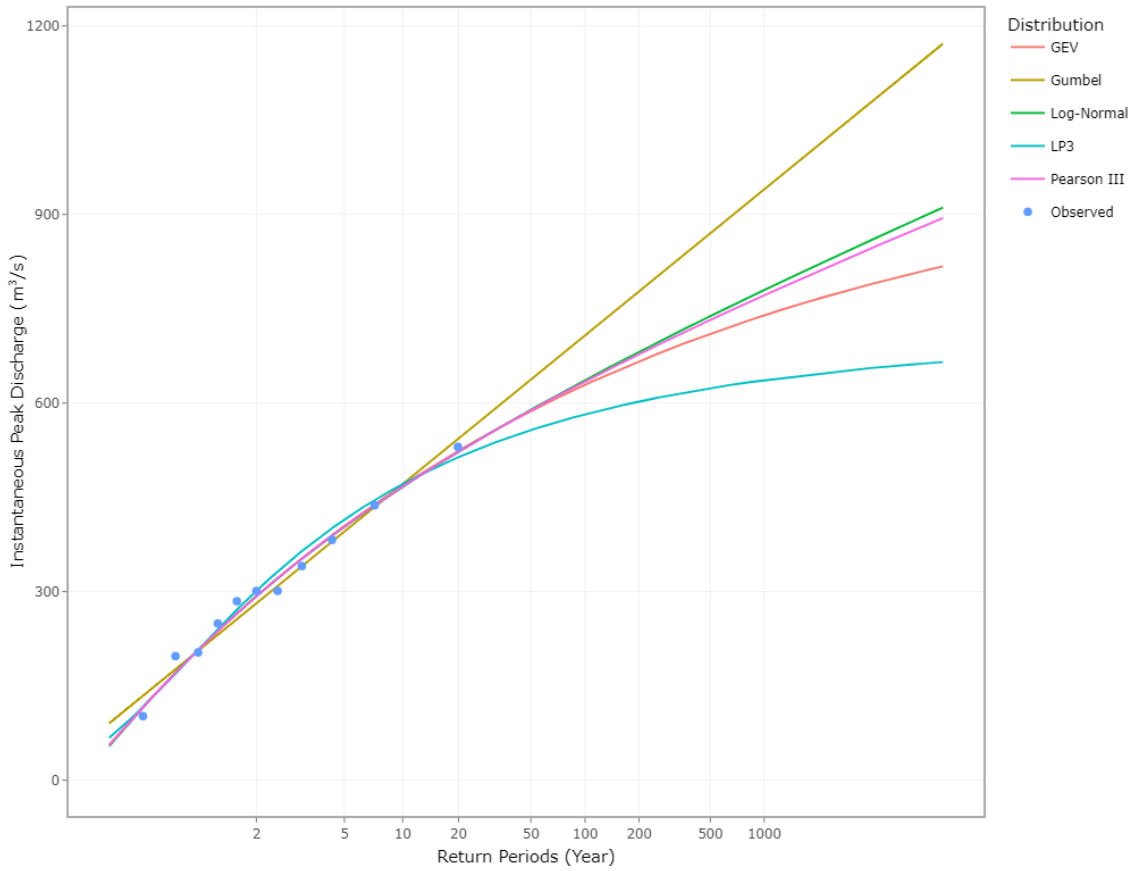
Station 32702 L-moments Fitted Frequency Distributions



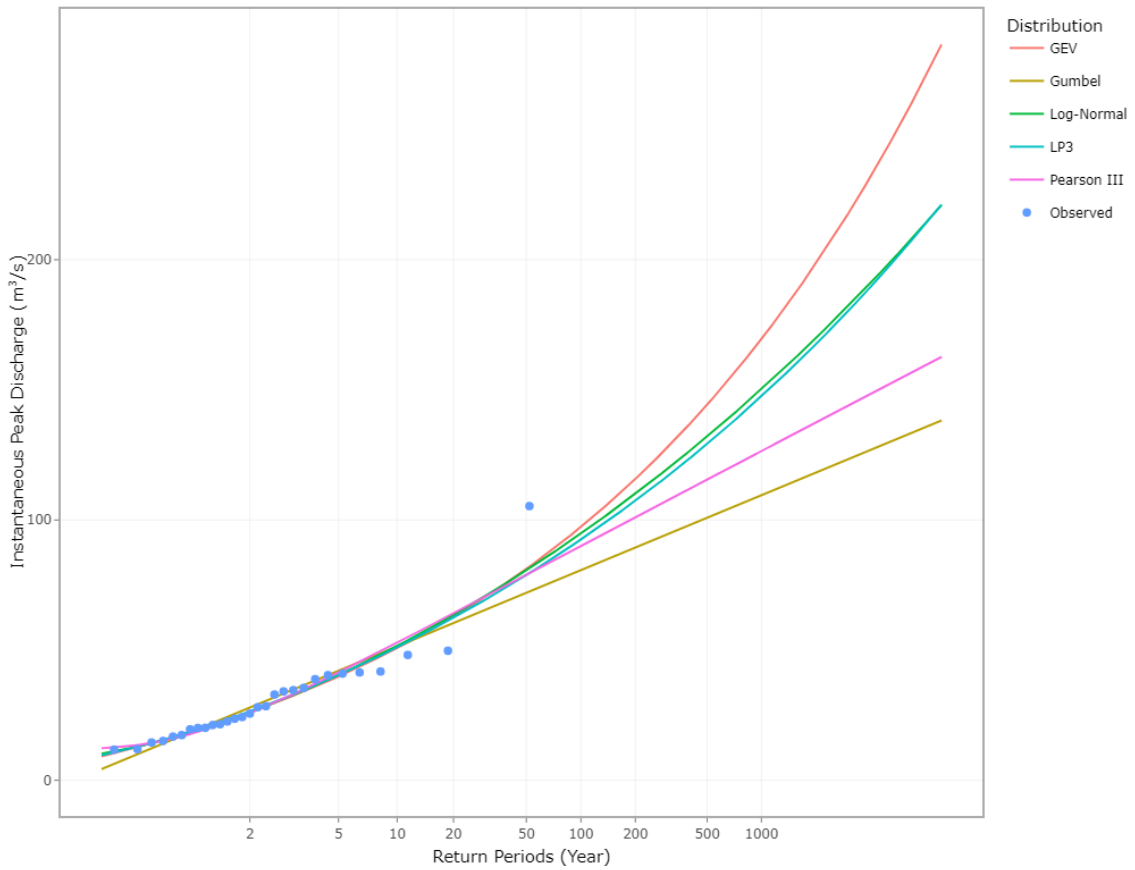
Station 32703 L-moments Fitted Frequency Distributions



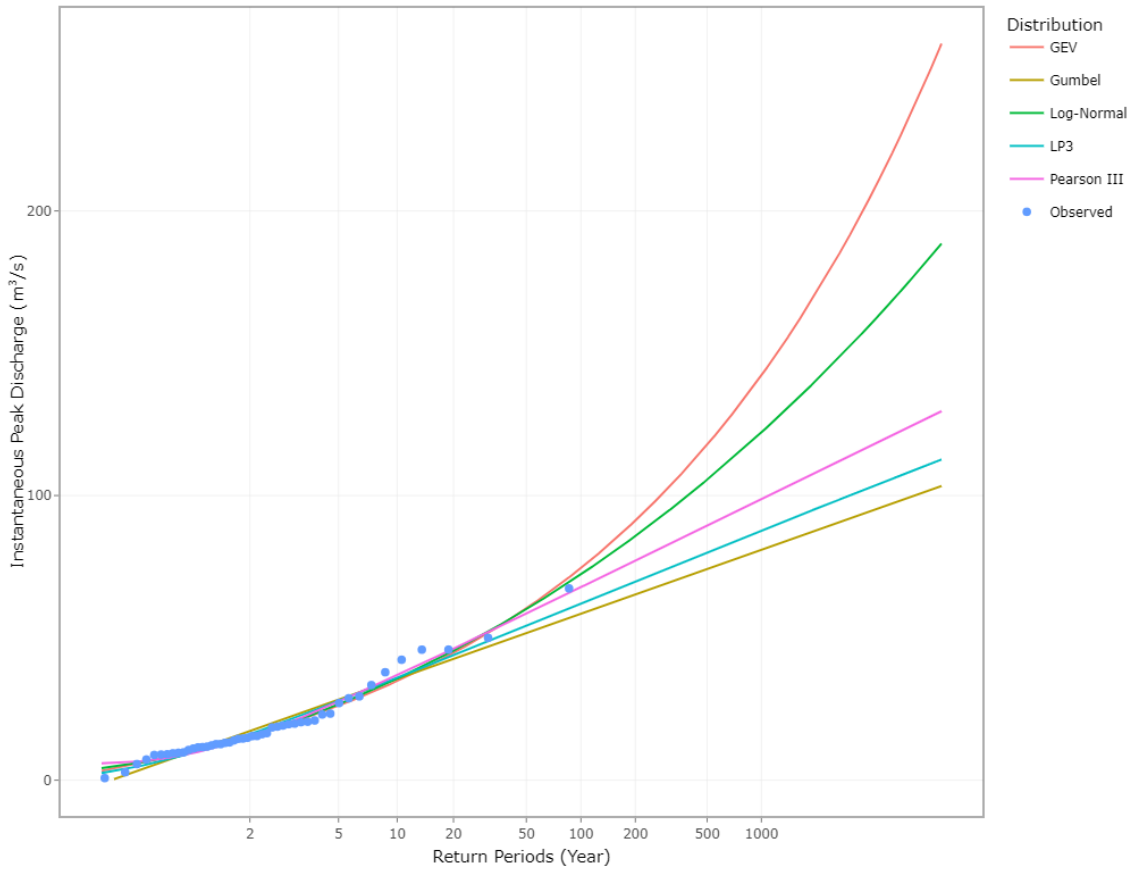
Station 32708 L-moments Fitted Frequency Distributions



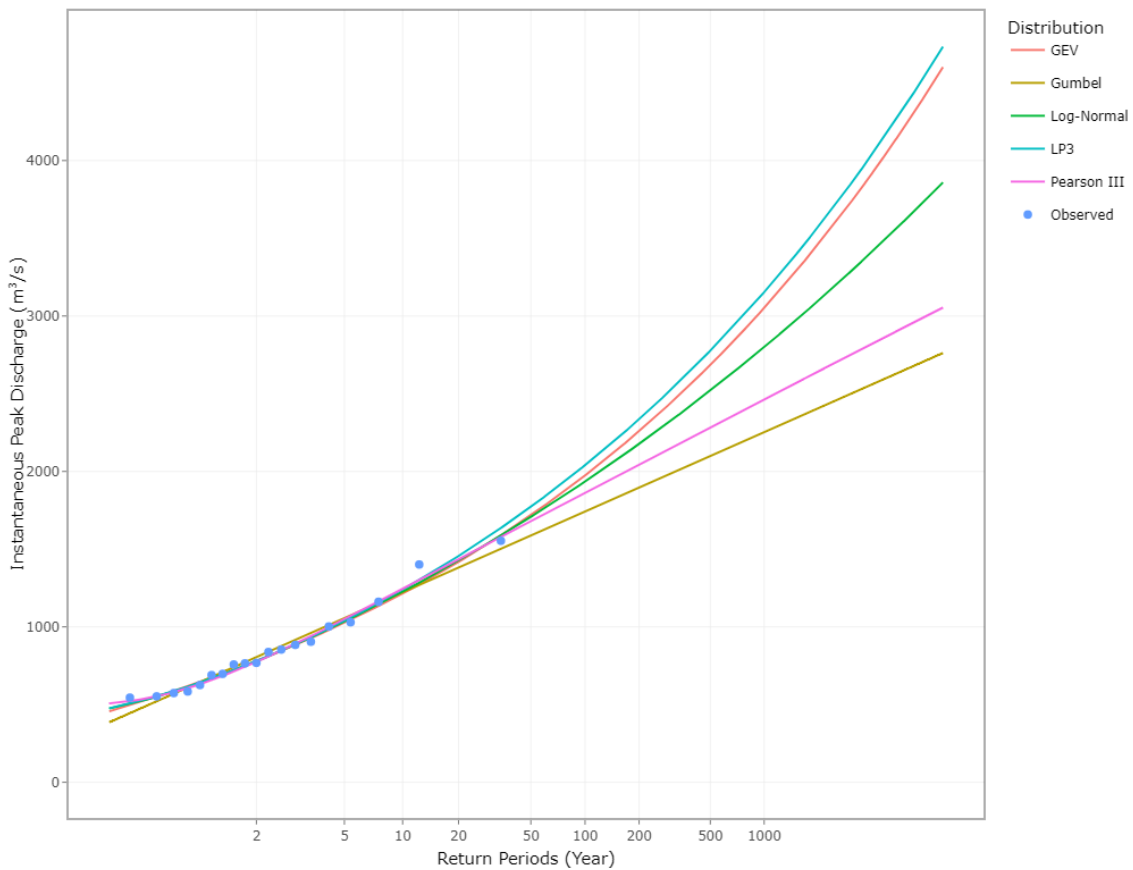
Station 32715 L-moments Fitted Frequency Distributions



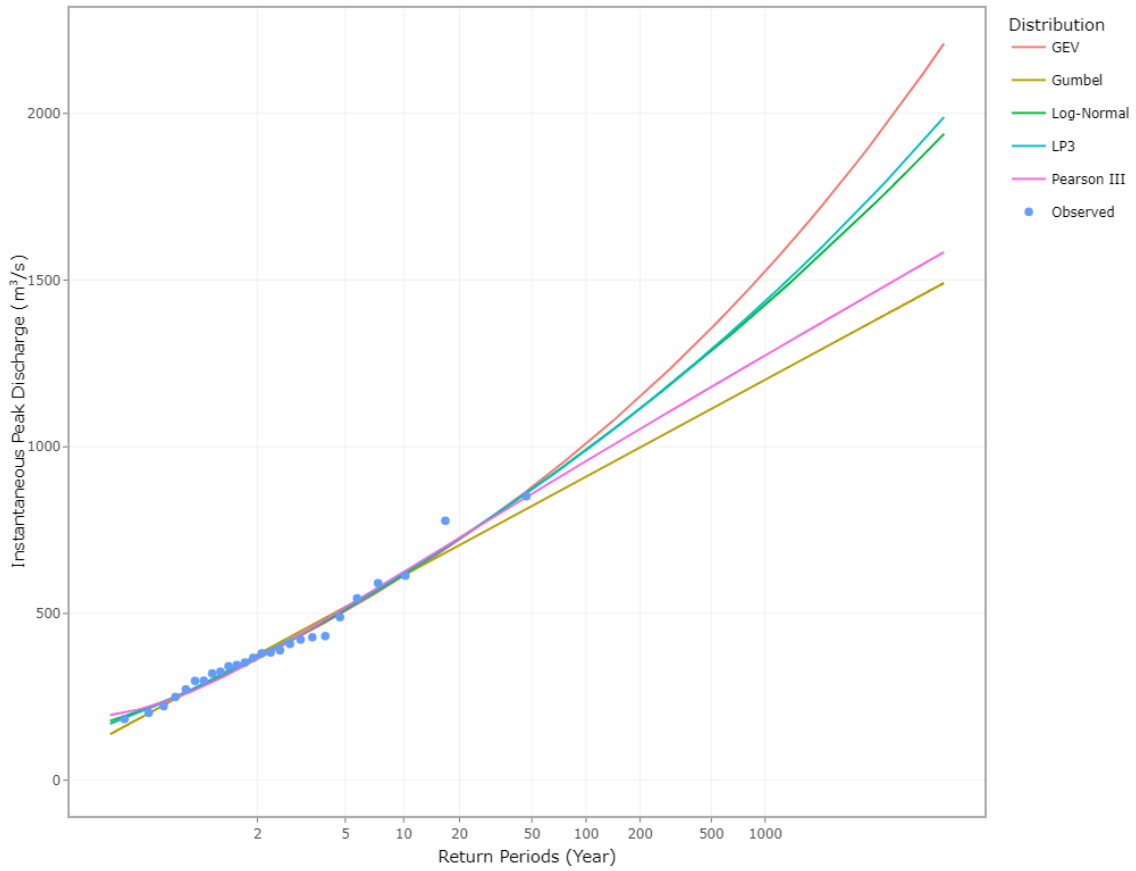
Station 32739 L-moments Fitted Frequency Distributions



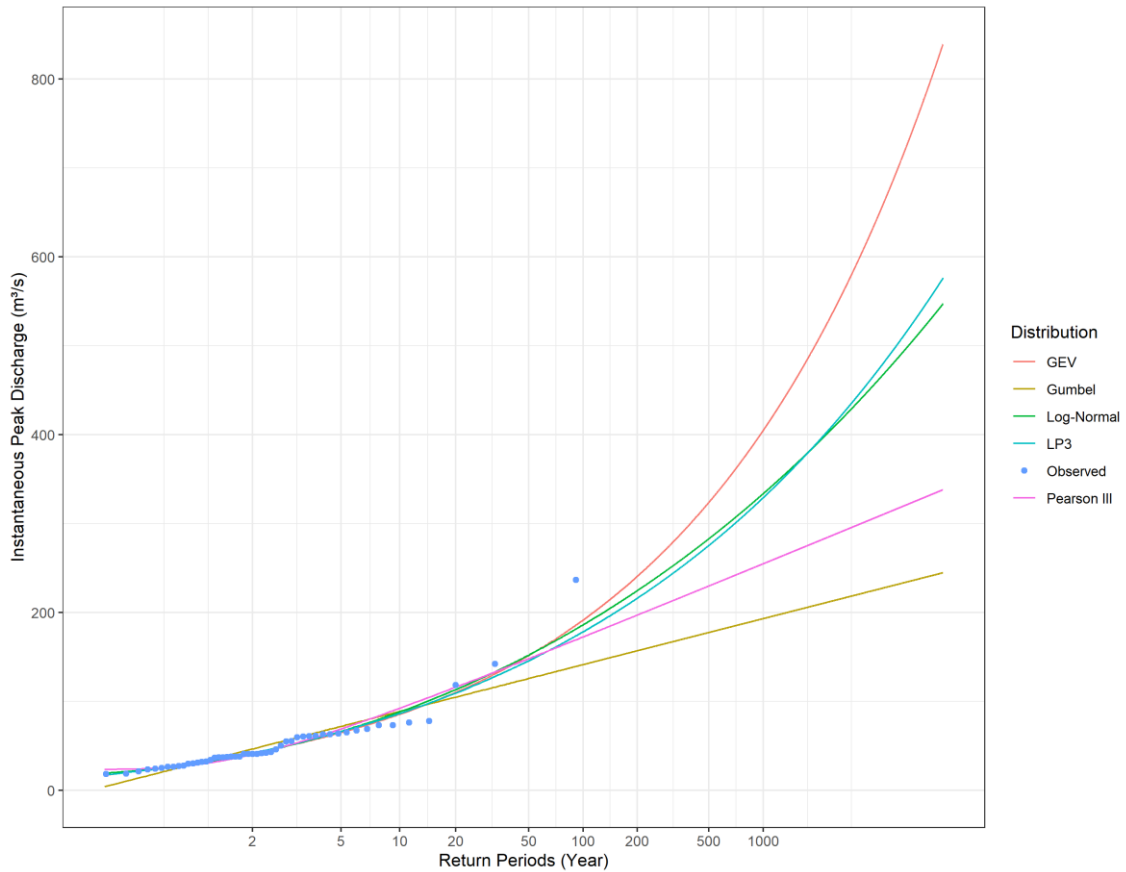
Station 32760 L-moments Fitted Frequency Distributions



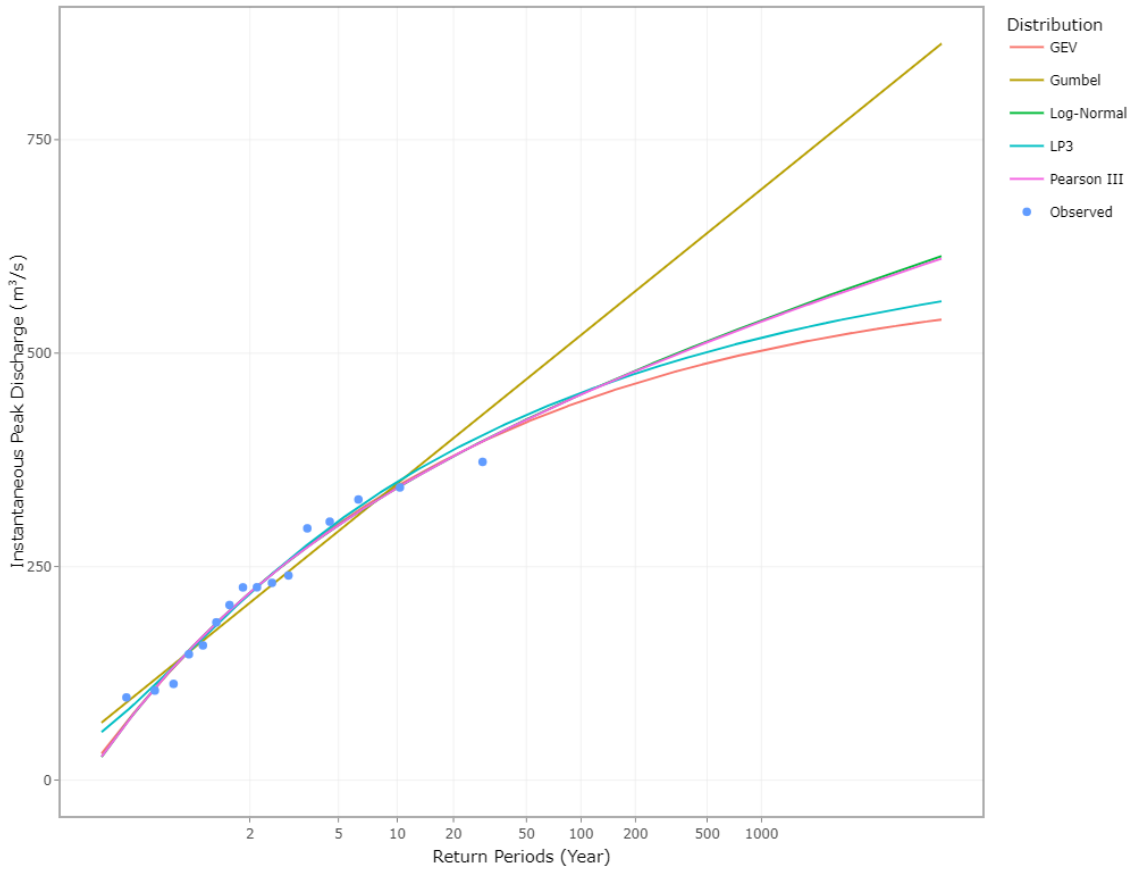
Station 32763 L-moments Fitted Frequency Distributions



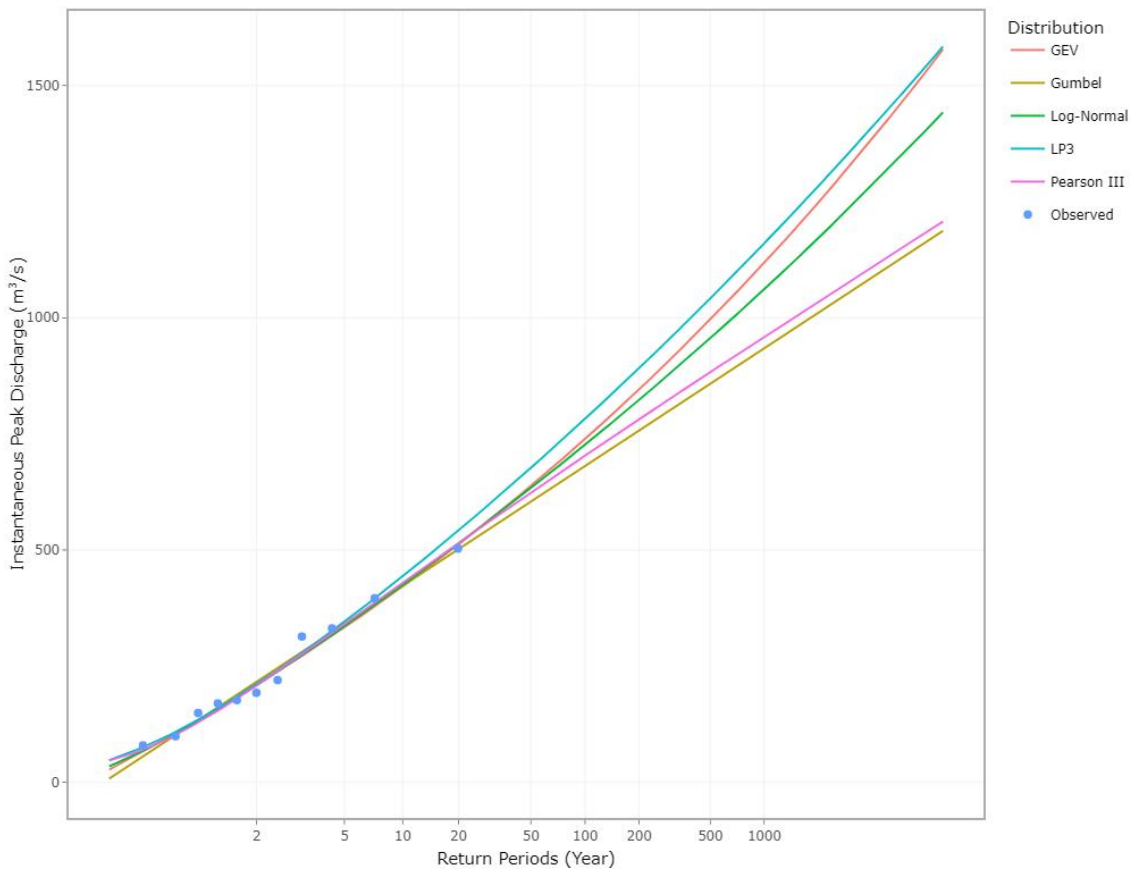
Station 32767 L-moments Fitted Frequency Distributions



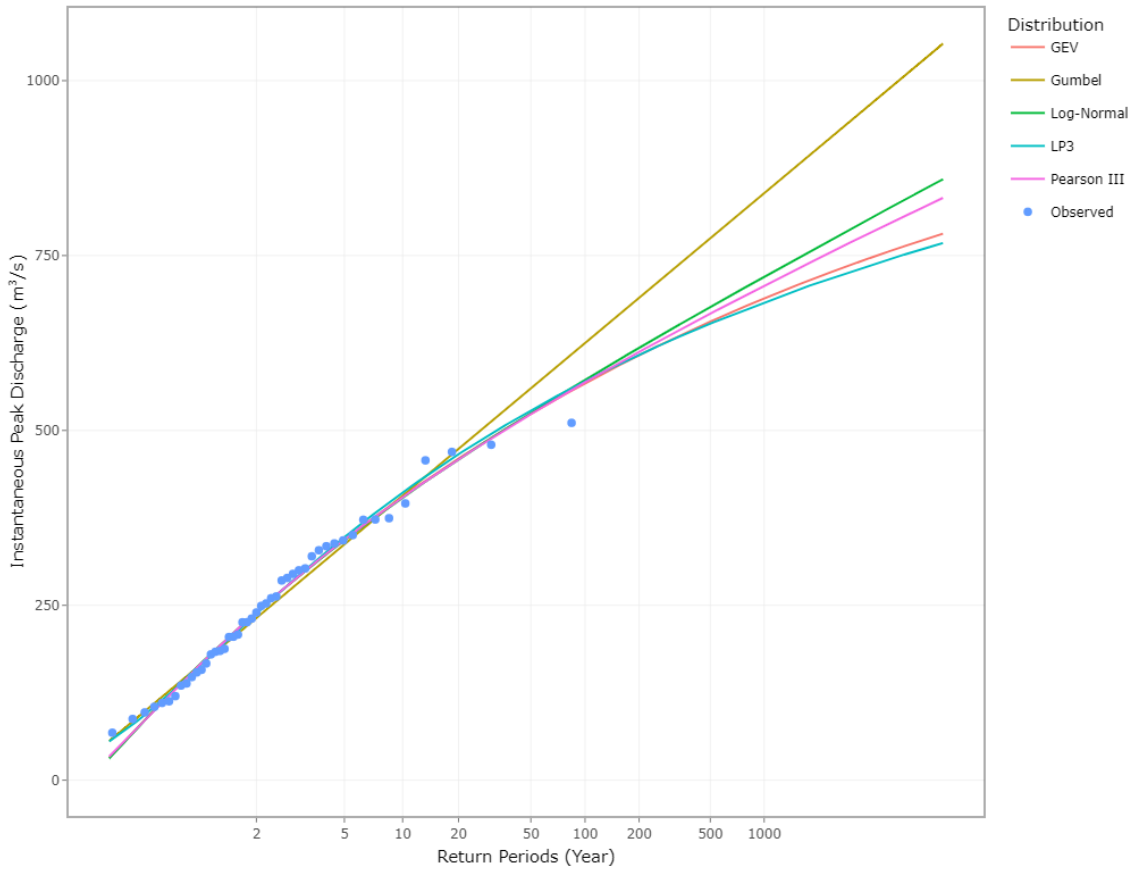
Station 33003 L-moments Fitted Frequency Distributions



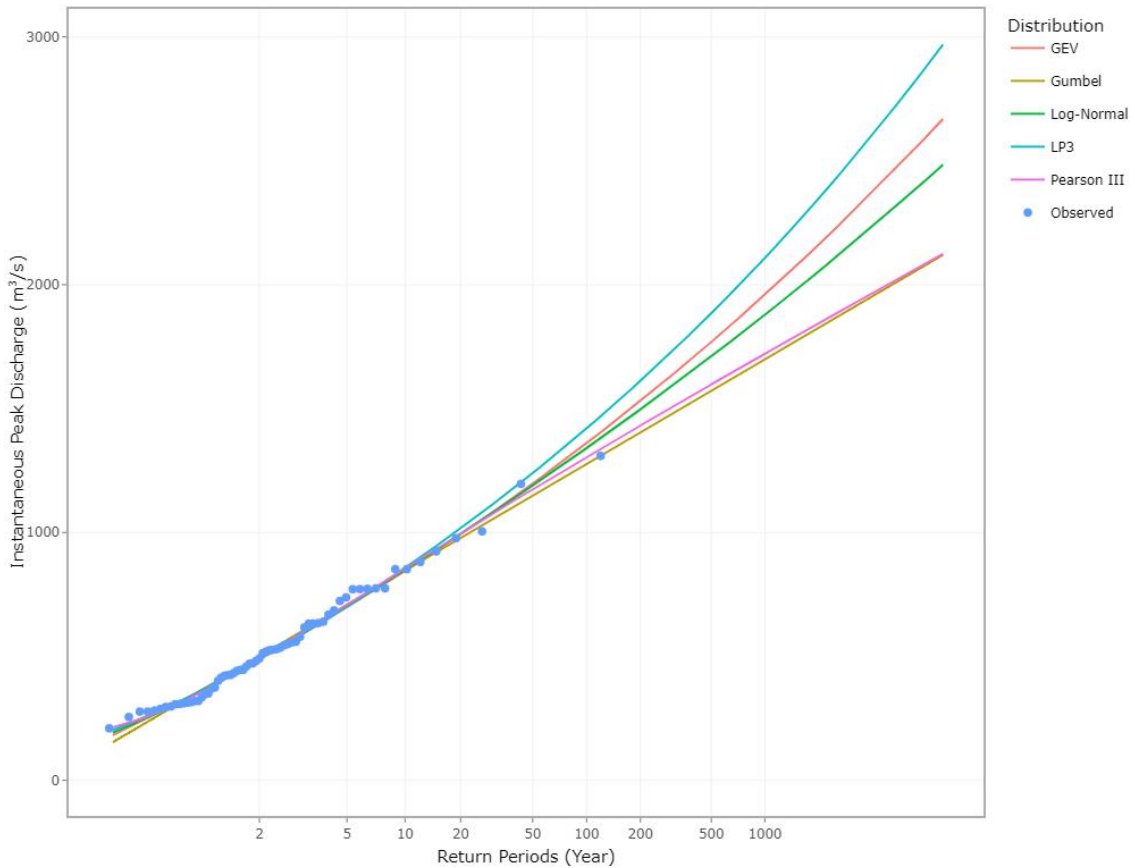
Station 33004 L-moments Fitted Frequency Distributions



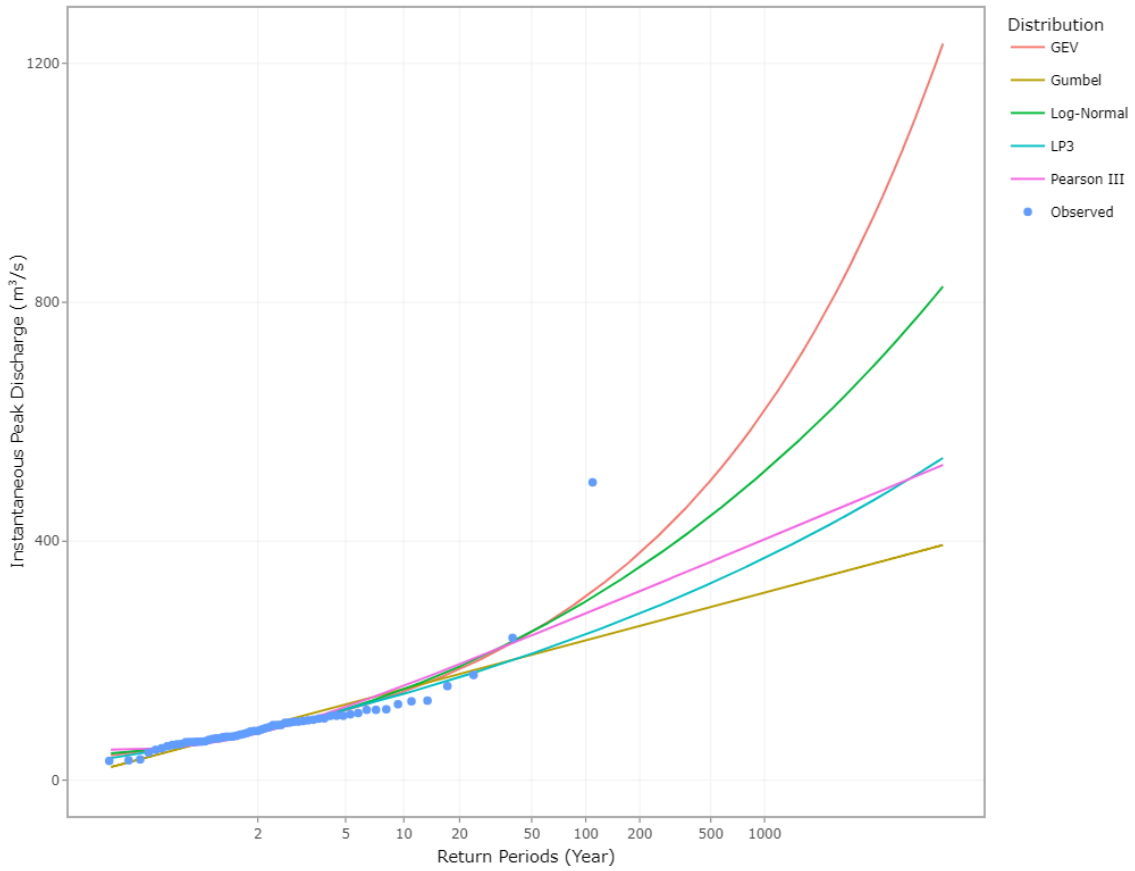
Station 33012 L-moments Fitted Frequency Distributions



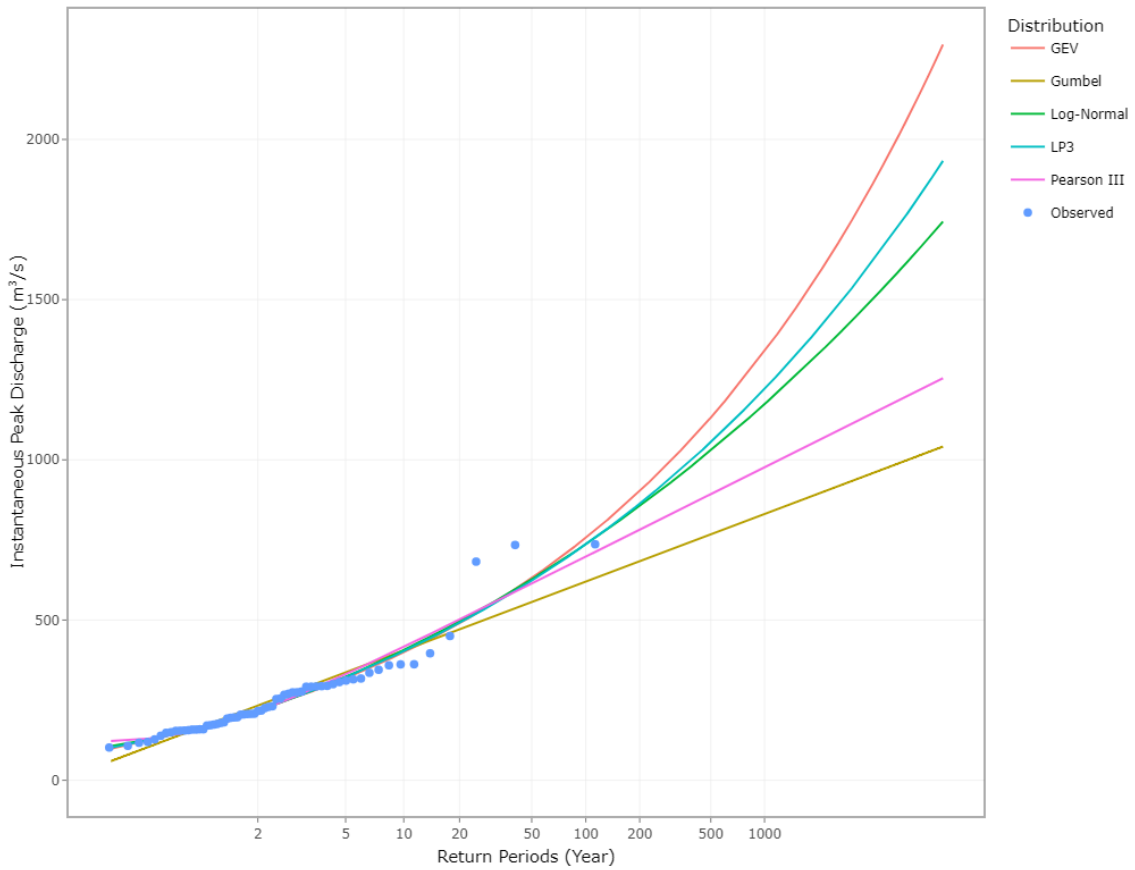
Station 33101 L-moments Fitted Frequency Distributions



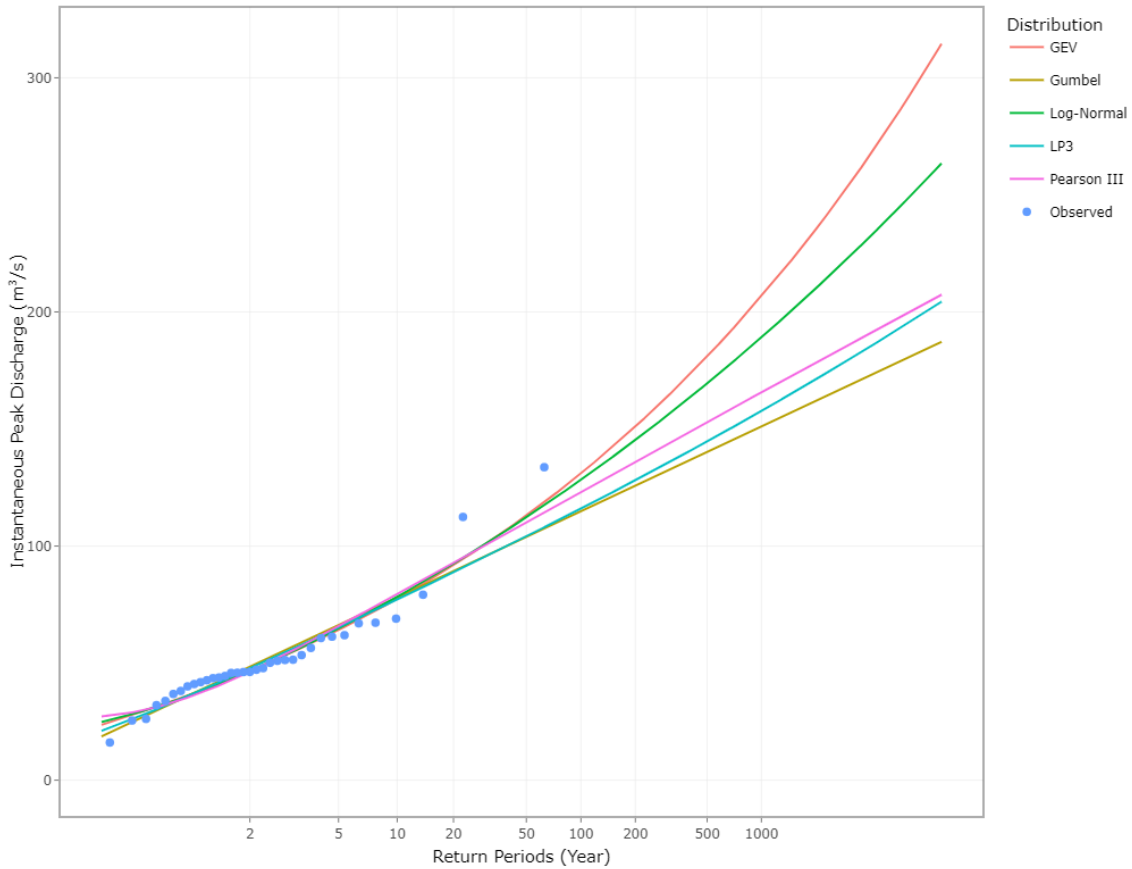
Station 33107 L-moments Fitted Frequency Distributions



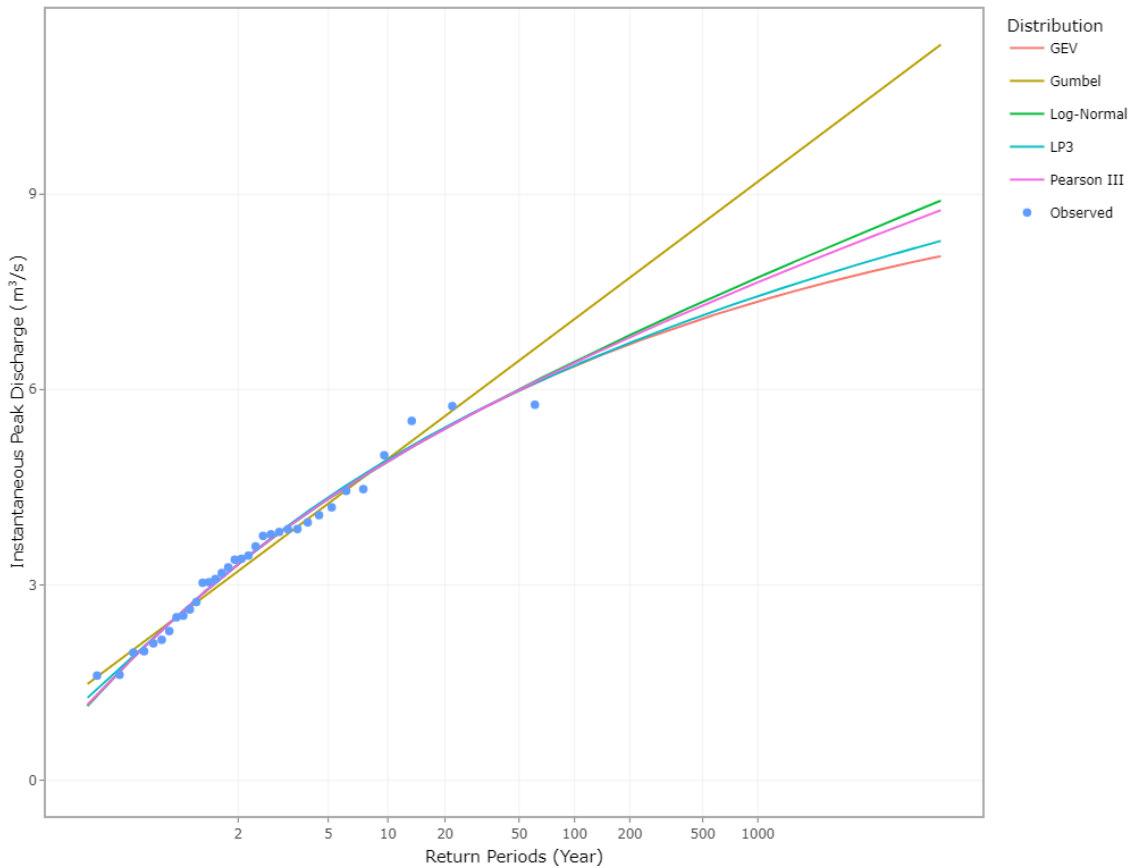
Station 33111 L-moments Fitted Frequency Distributions



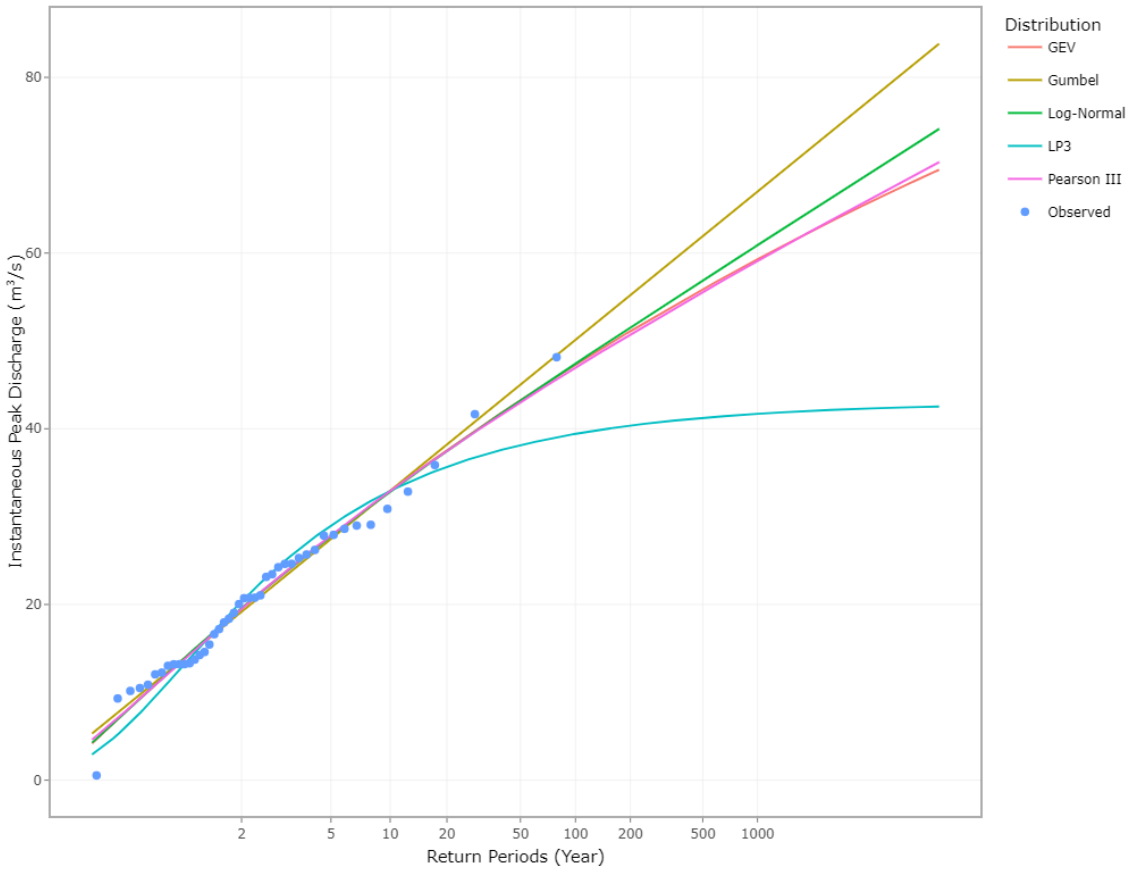
Station 33112 L-moments Fitted Frequency Distributions



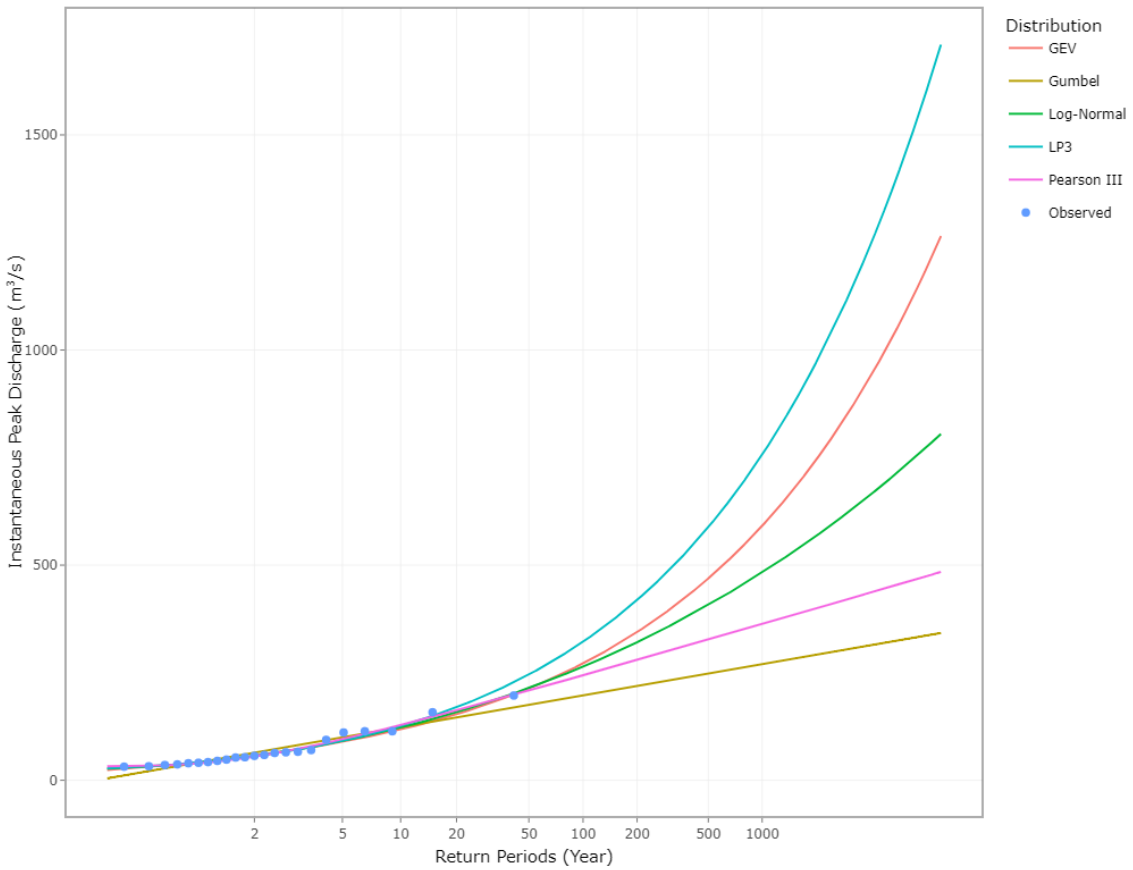
Station 33114 L-moments Fitted Frequency Distributions



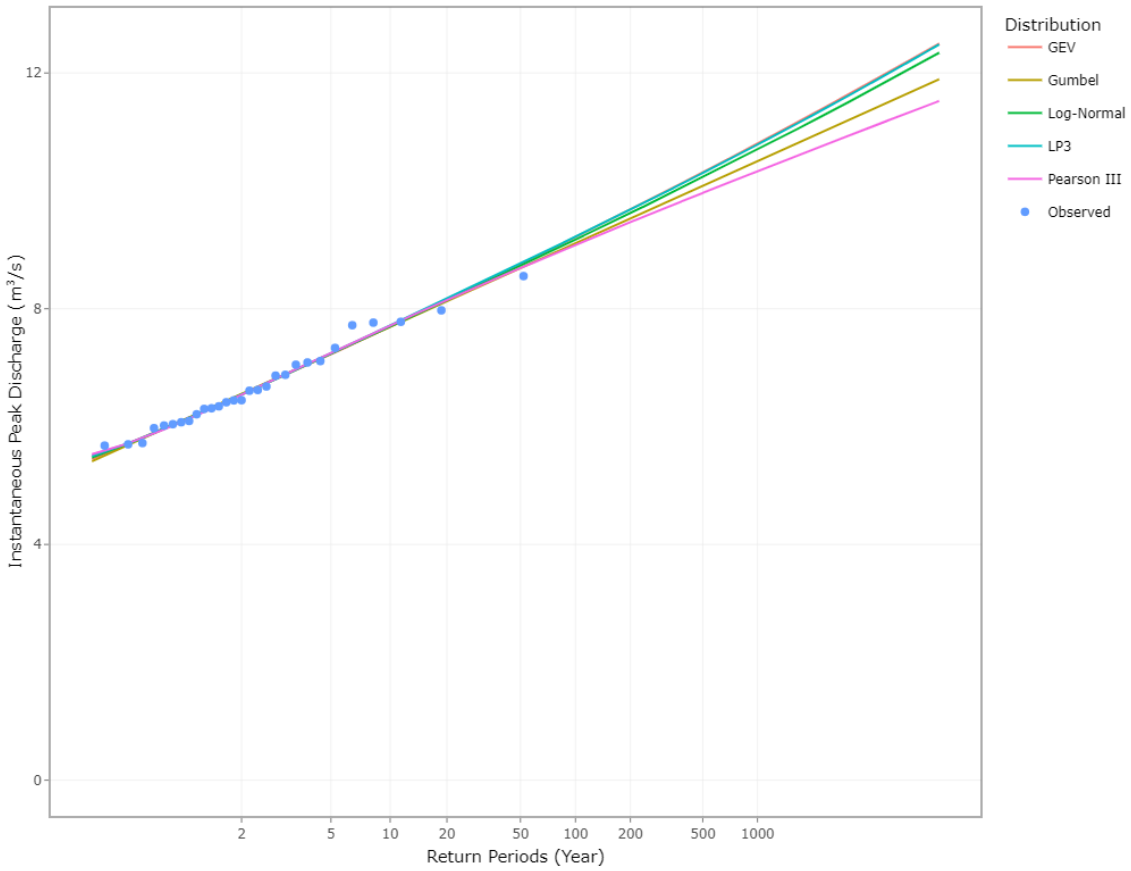
Station 33115 L-moments Fitted Frequency Distributions



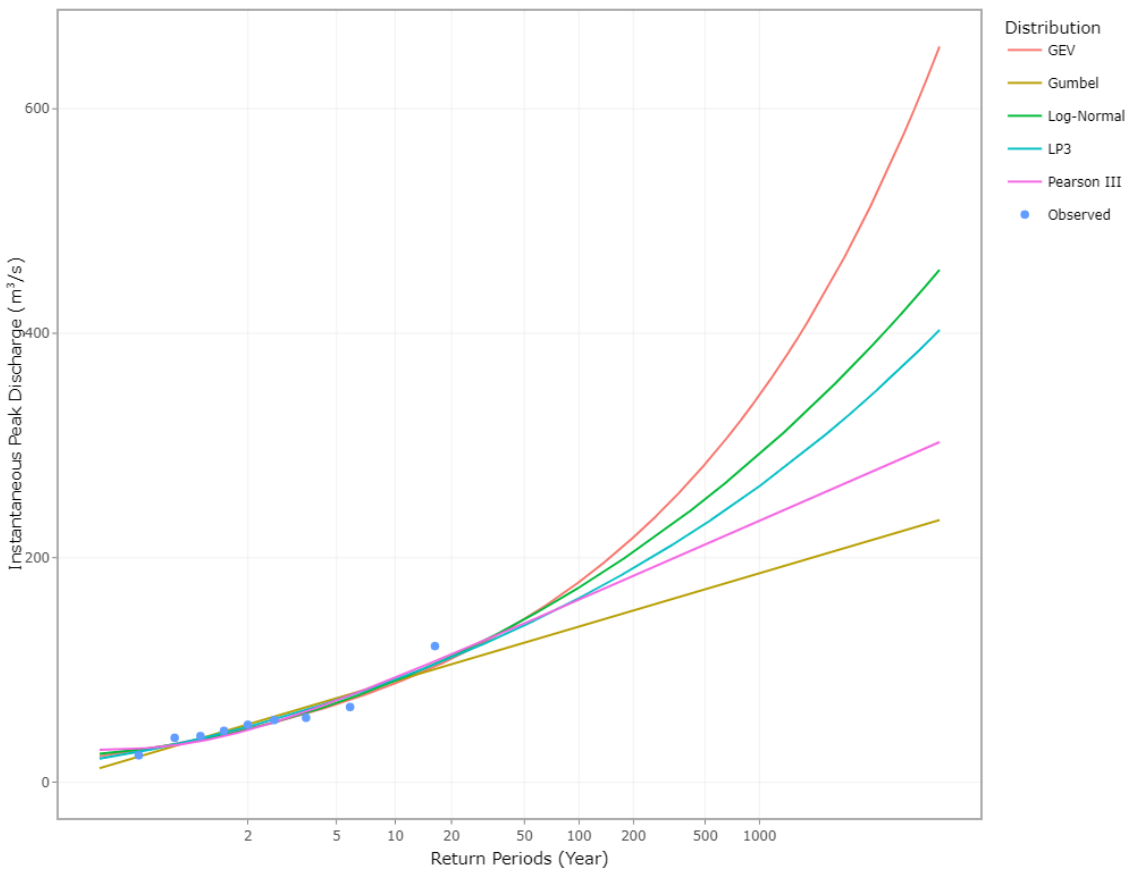
Station 33119 L-moments Fitted Frequency Distributions



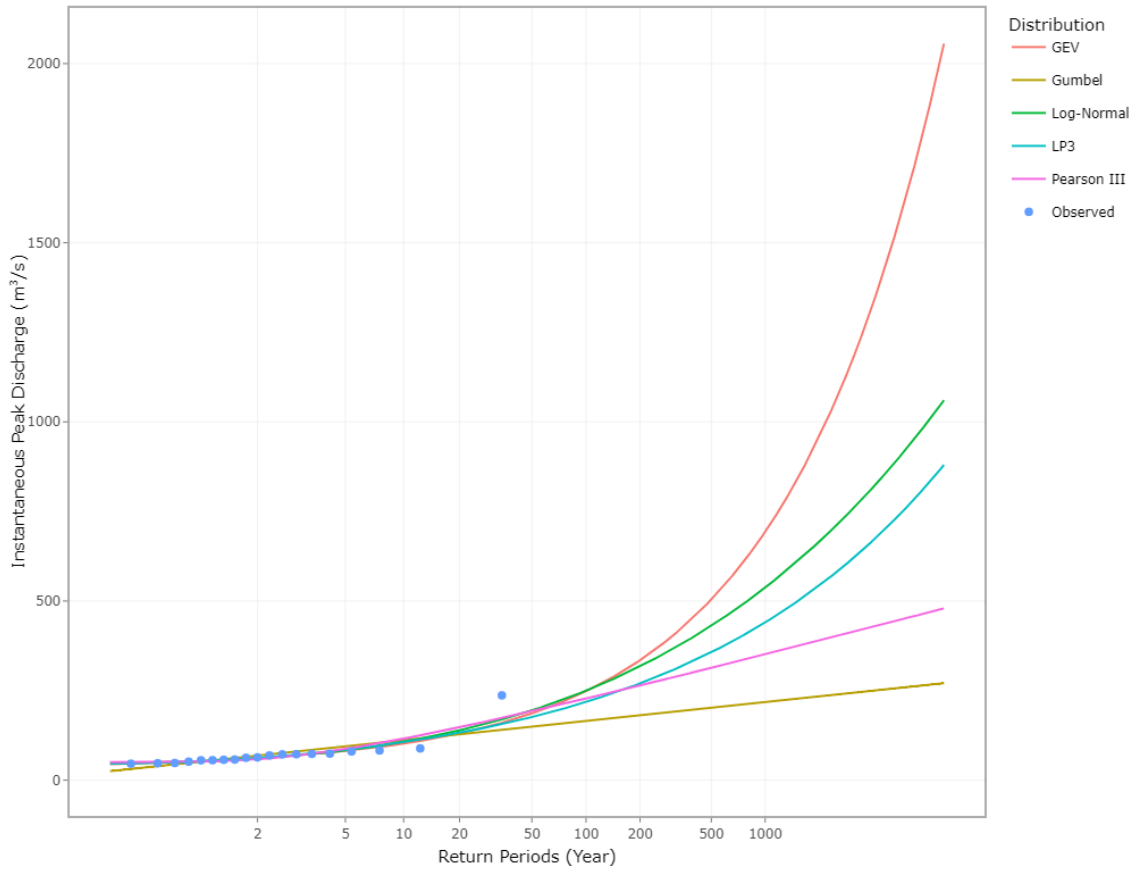
Station 33130 L-moments Fitted Frequency Distributions



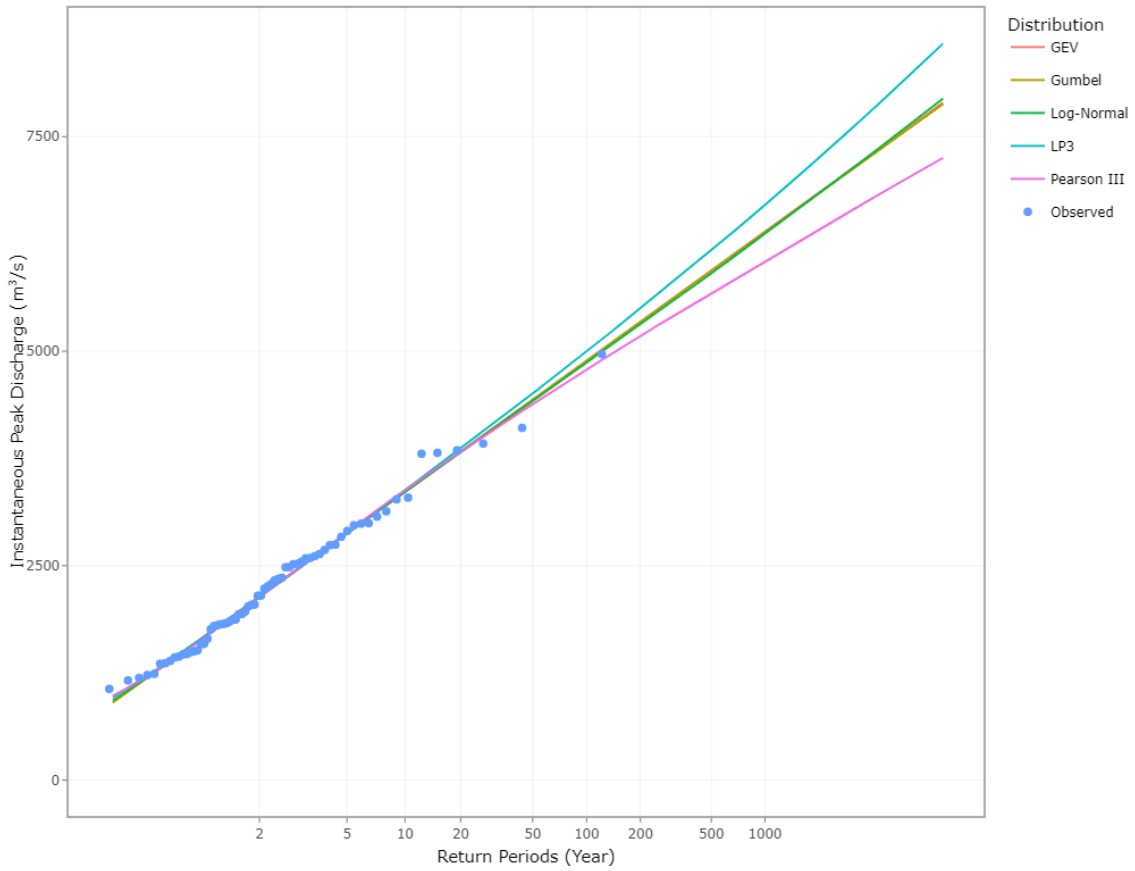
Station 33143 L-moments Fitted Frequency Distributions



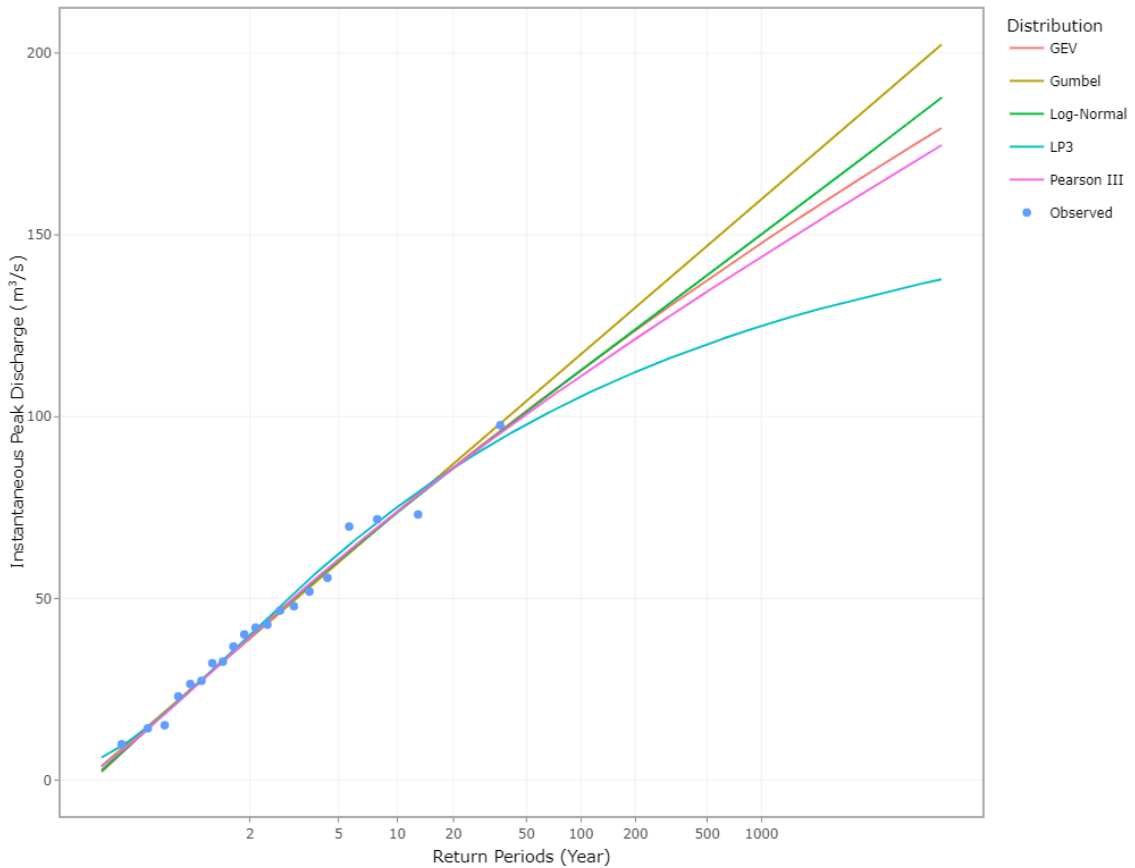
Station 33149 L-moments Fitted Frequency Distributions



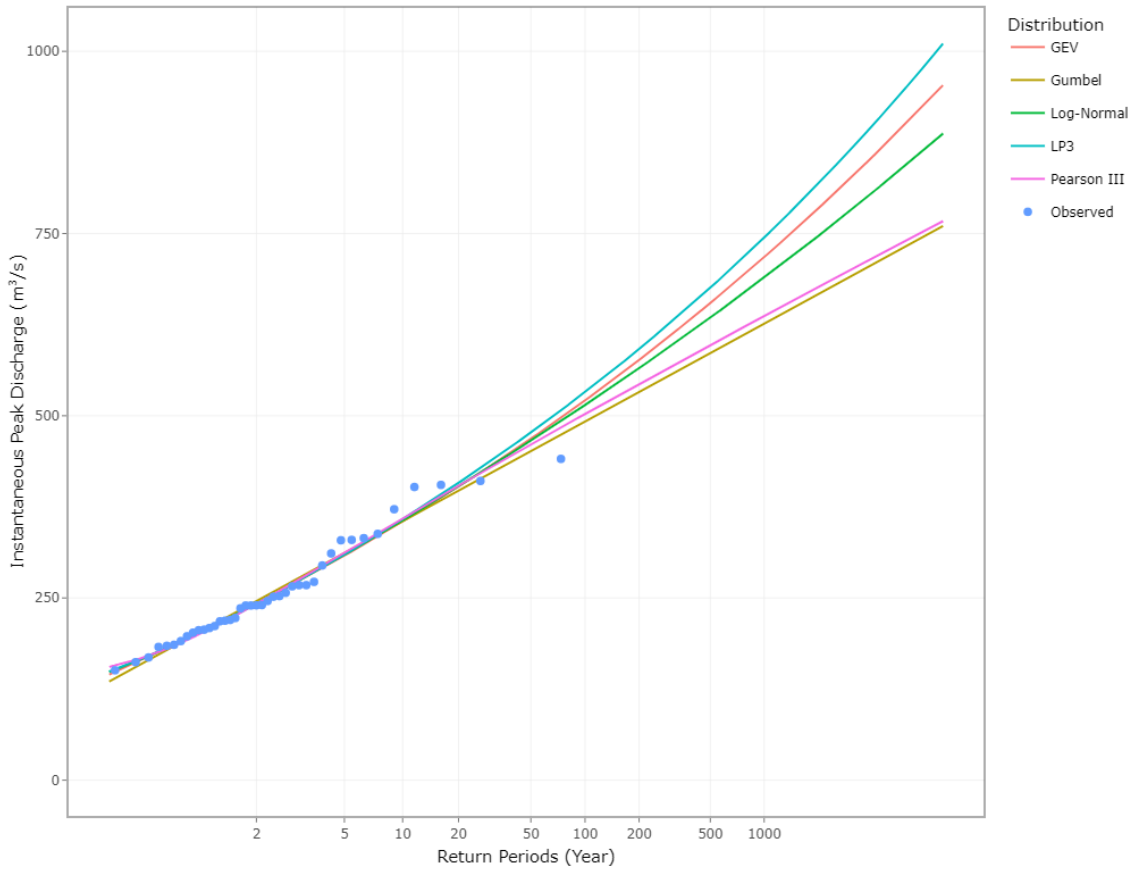
Station 33303 L-moments Fitted Frequency Distributions



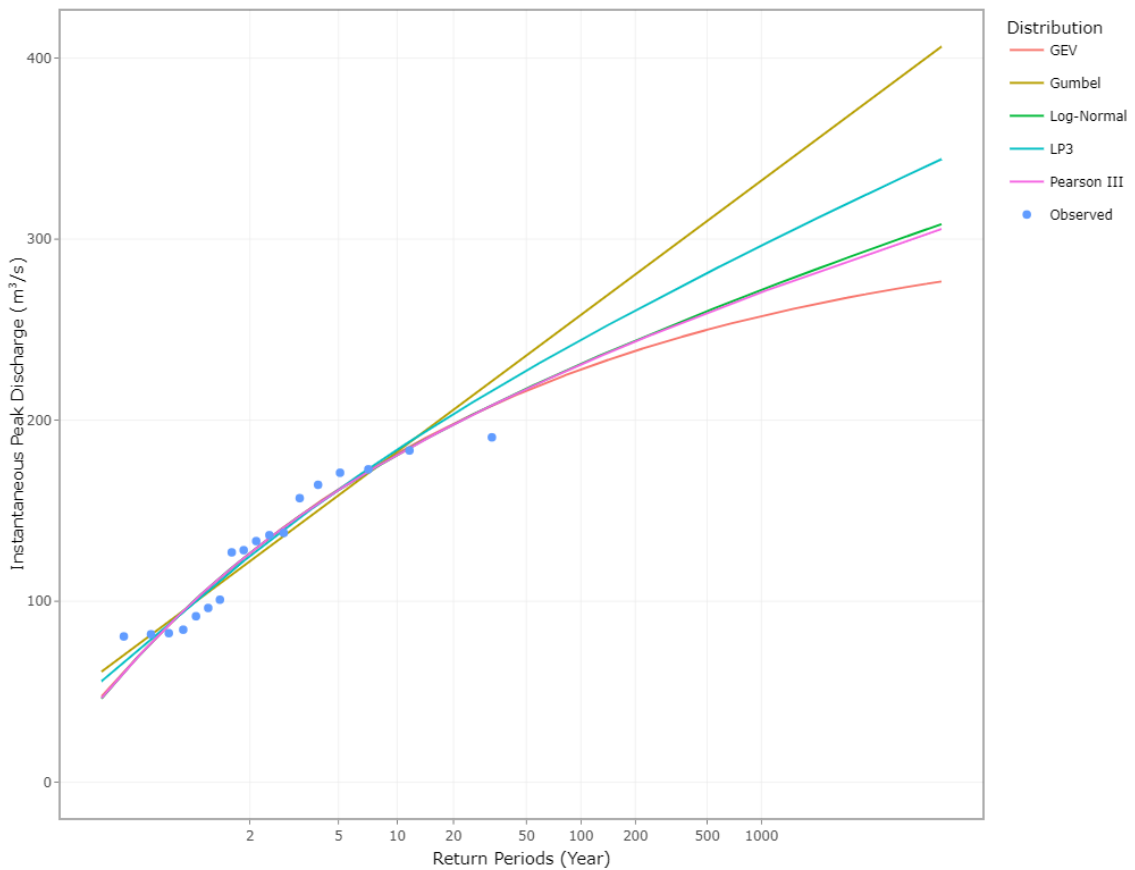
Station 33307 L-moments Fitted Frequency Distributions



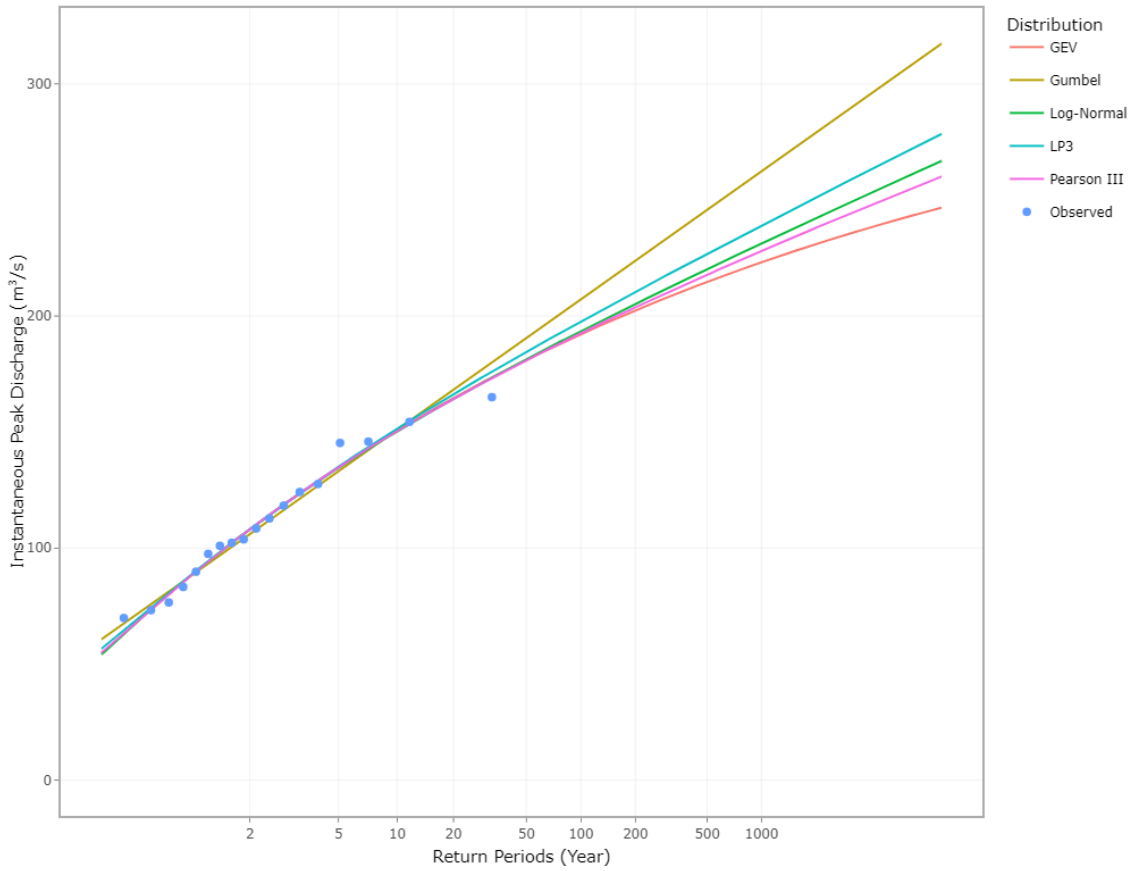
Station 33313 L-moments Fitted Frequency Distributions



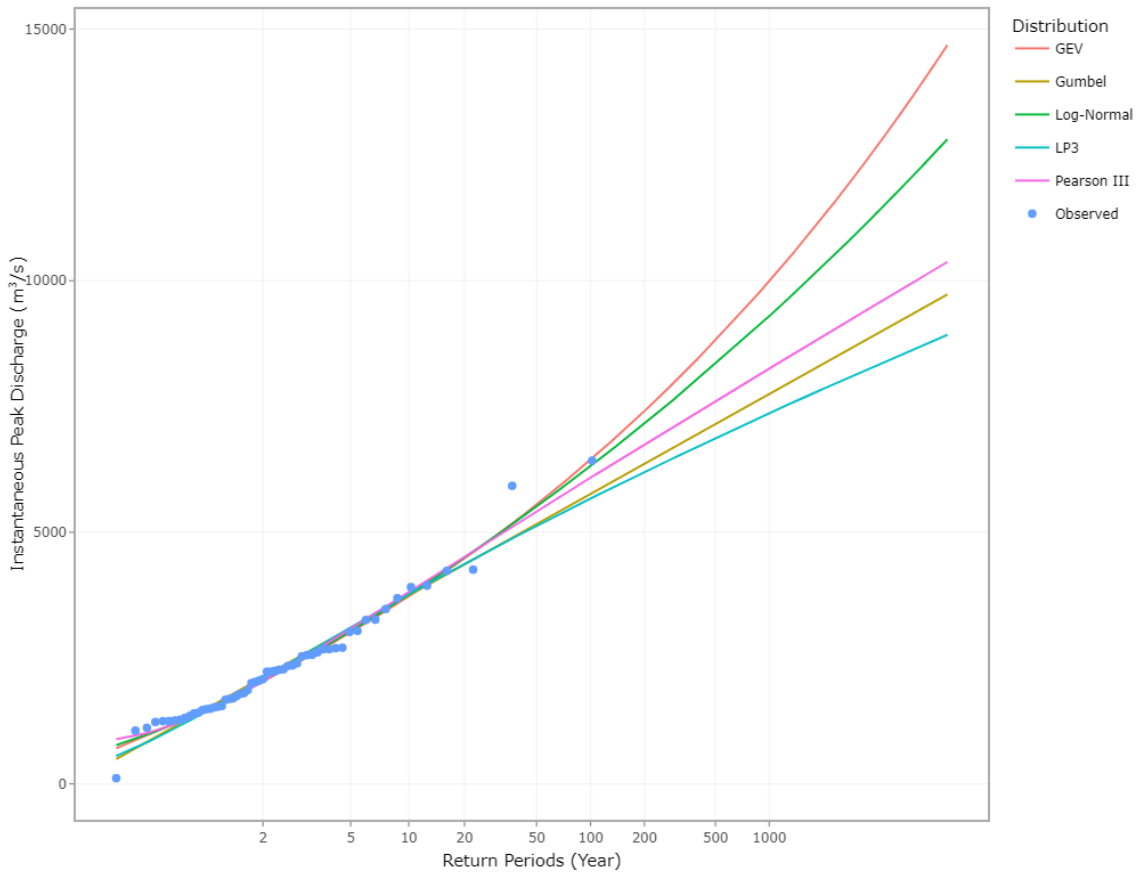
Station 33314 L-moments Fitted Frequency Distributions



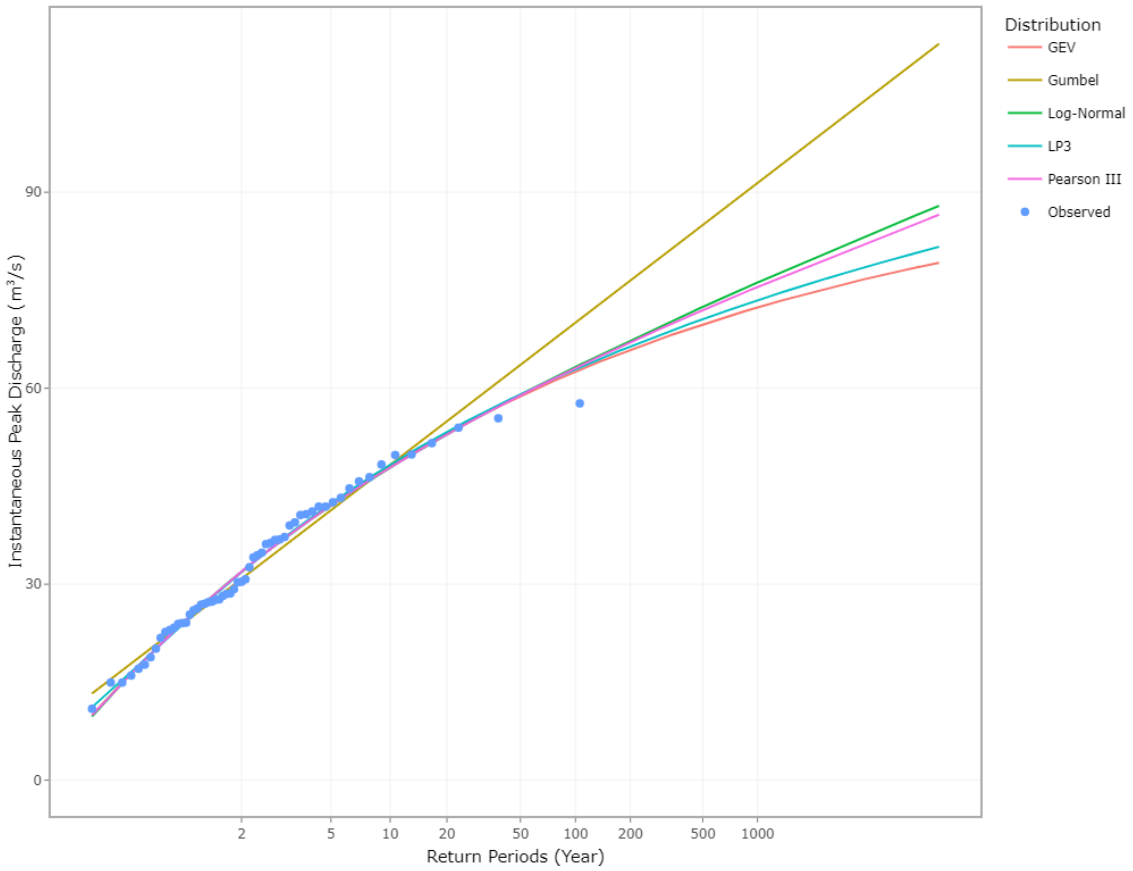
Station 33341 L-moments Fitted Frequency Distributions



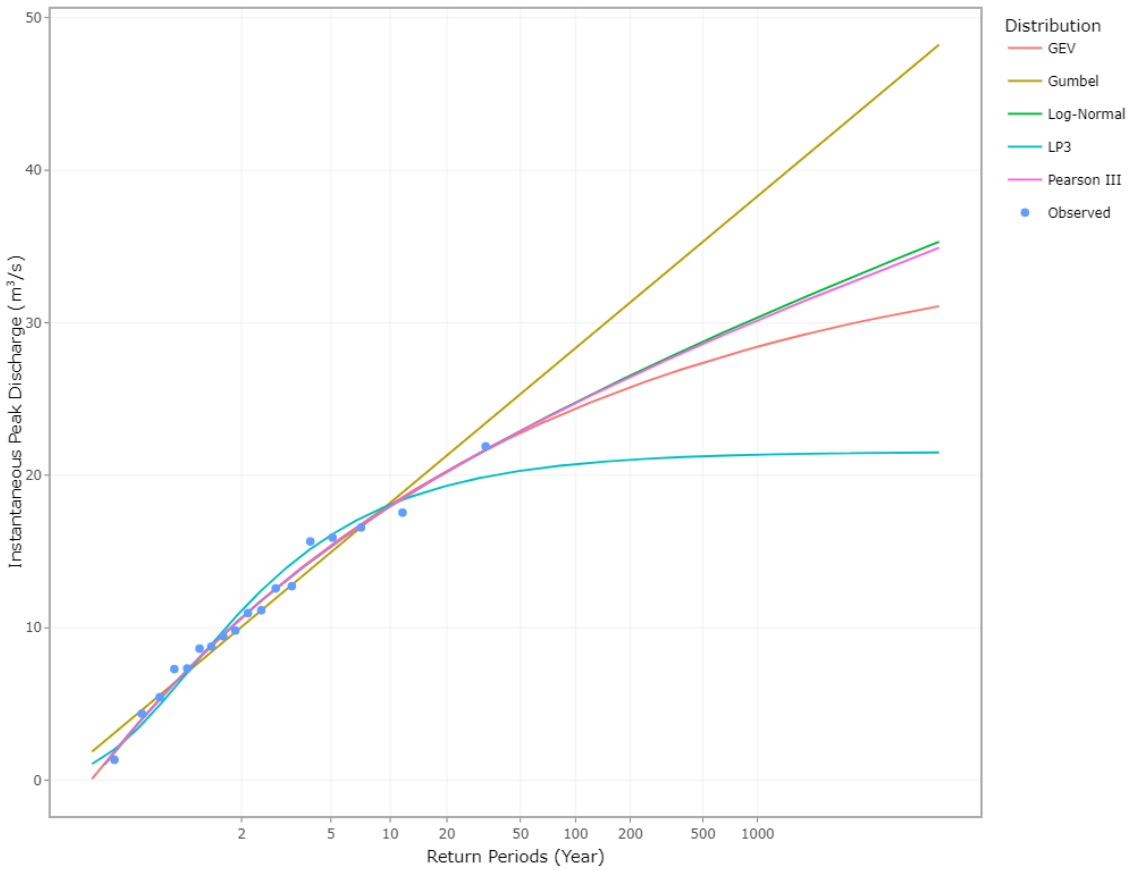
Station 33345 L-moments Fitted Frequency Distributions



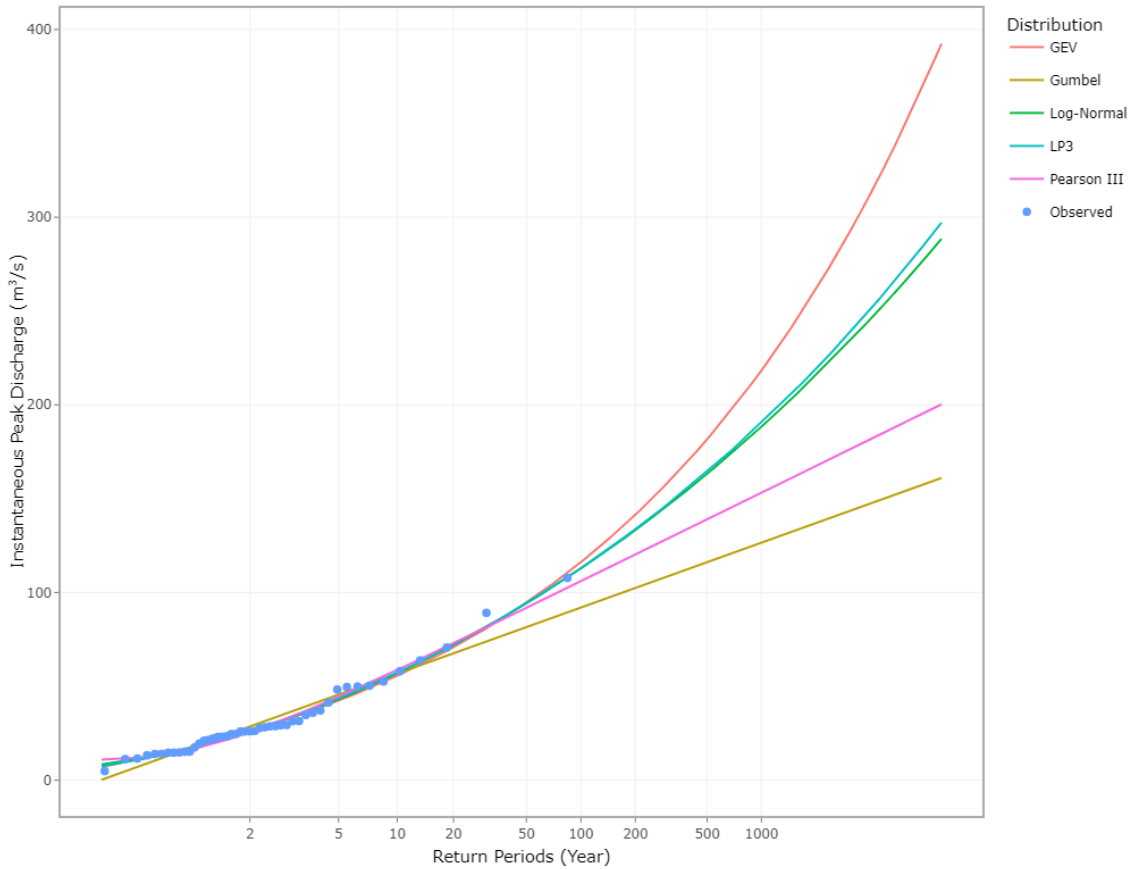
Station 33347 L-moments Fitted Frequency Distributions



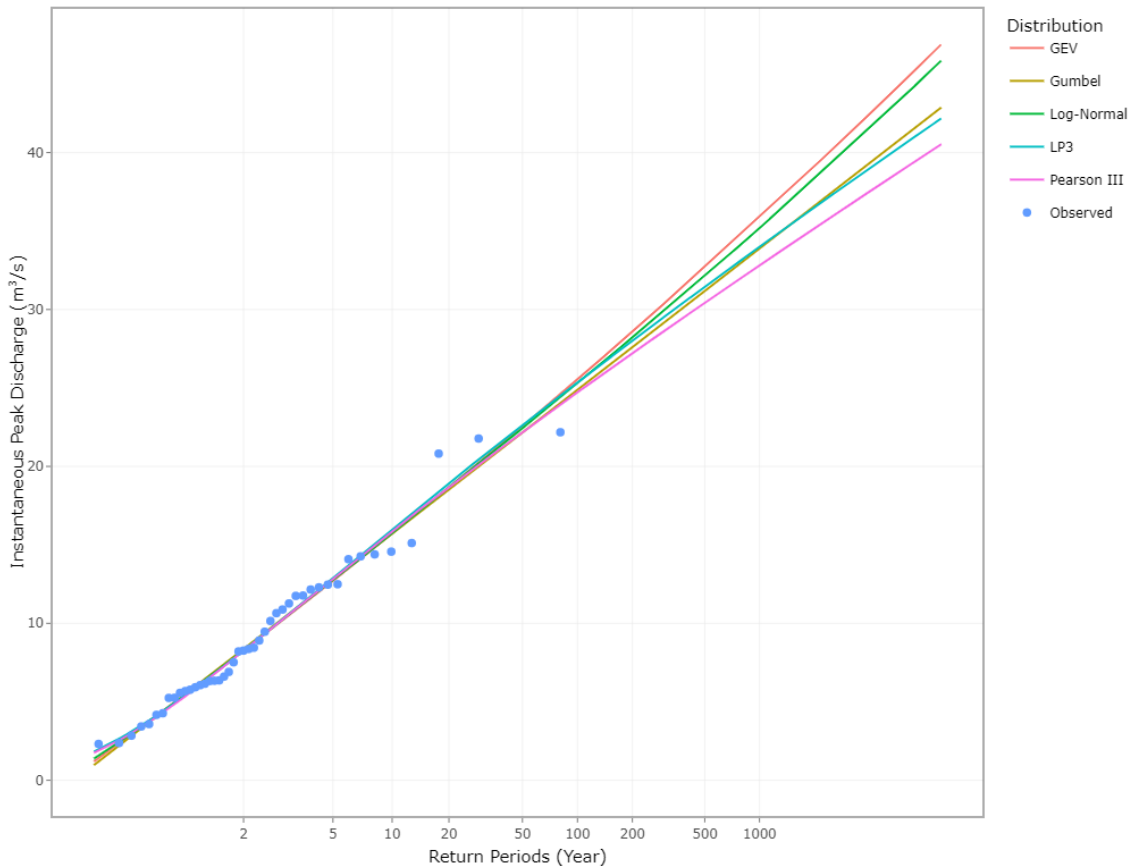
Station 33366 L-moments Fitted Frequency Distributions



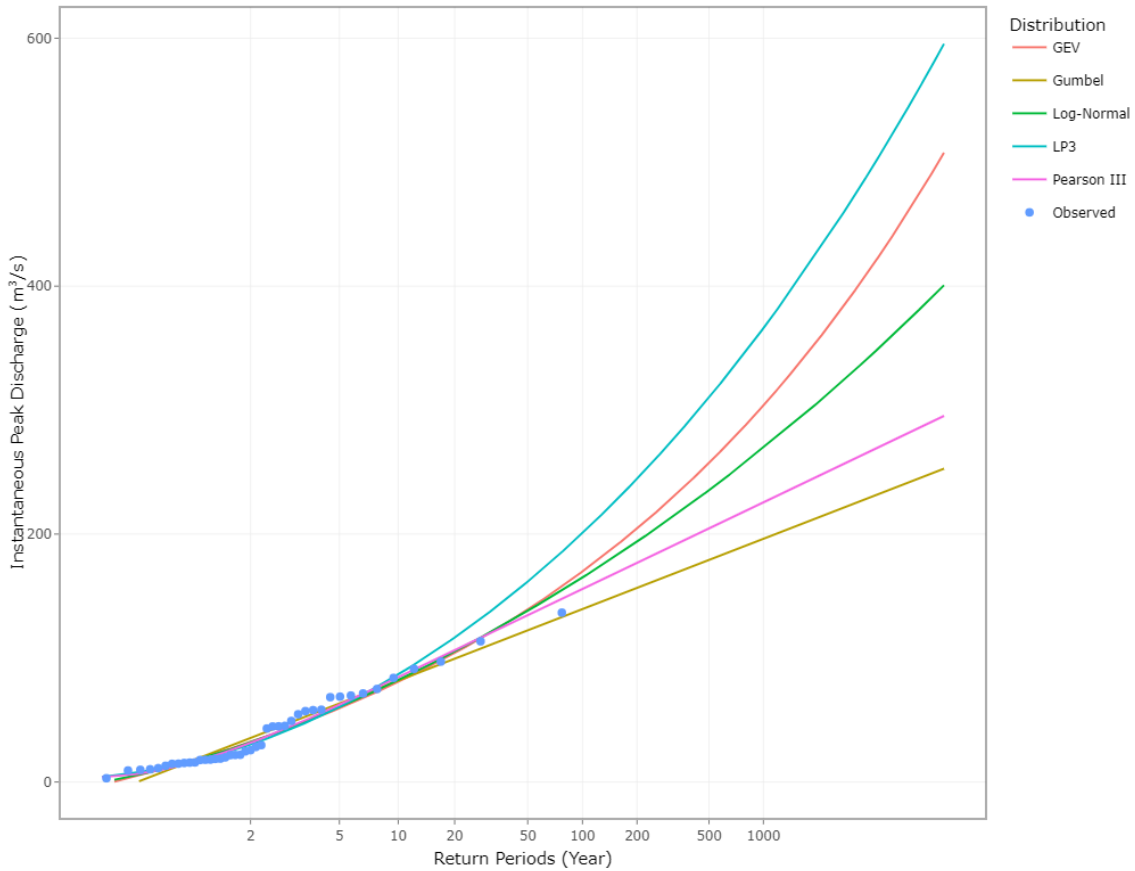
Station 33502 L-moments Fitted Frequency Distributions



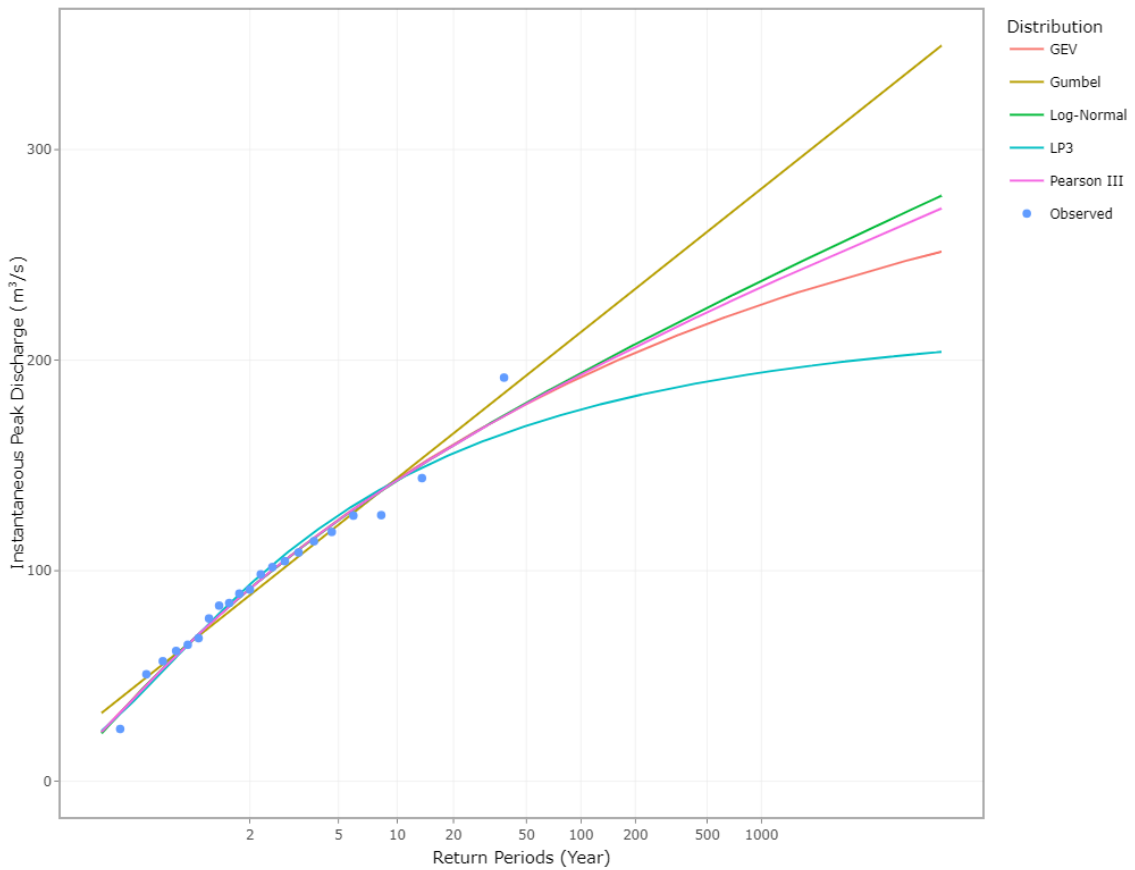
Station 1032501 L-moments Fitted Frequency Distributions



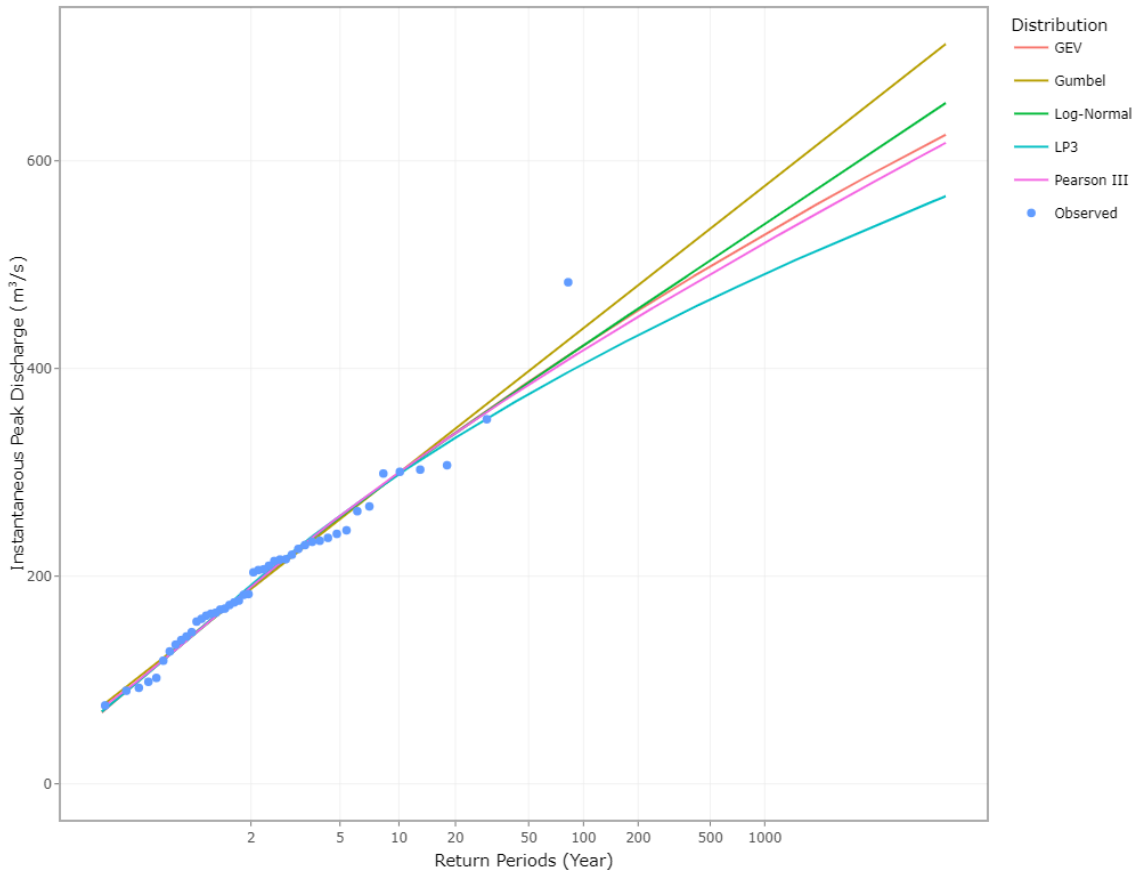
Station 1032504 L-moments Fitted Frequency Distributions



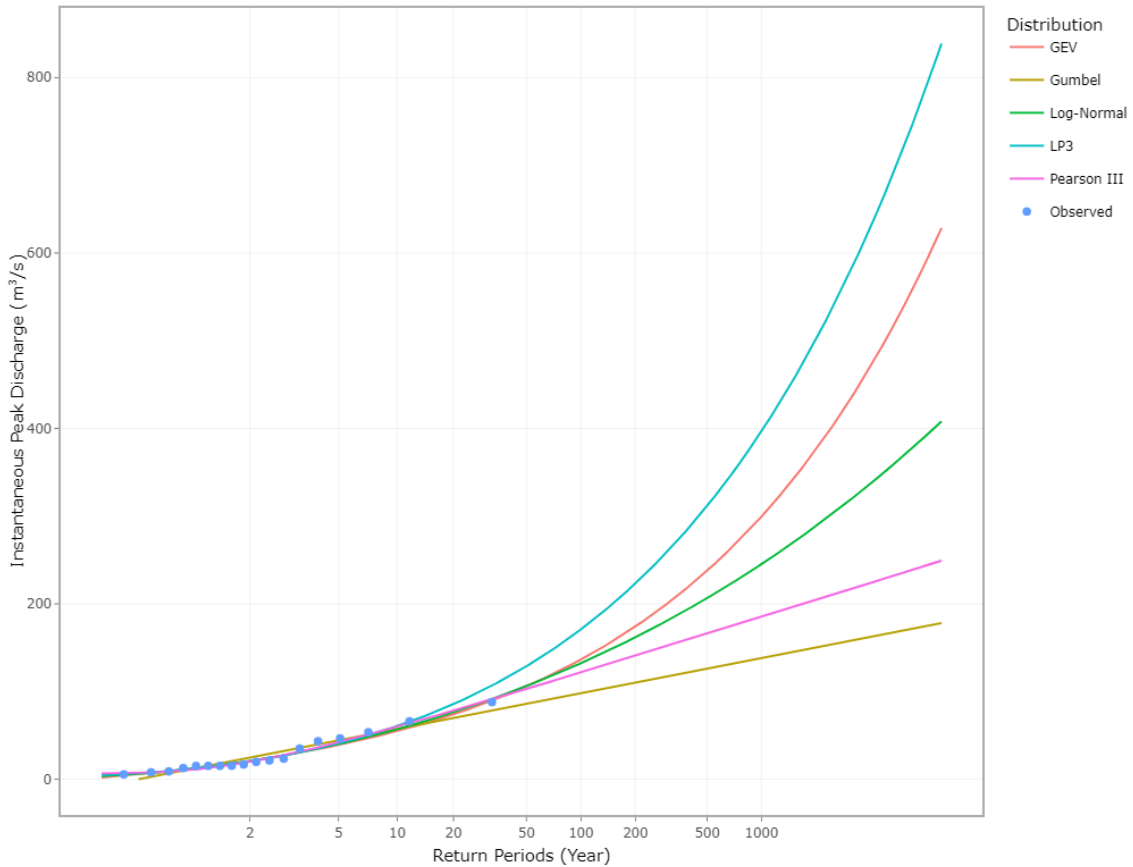
Station 1032517 L-moments Fitted Frequency Distributions



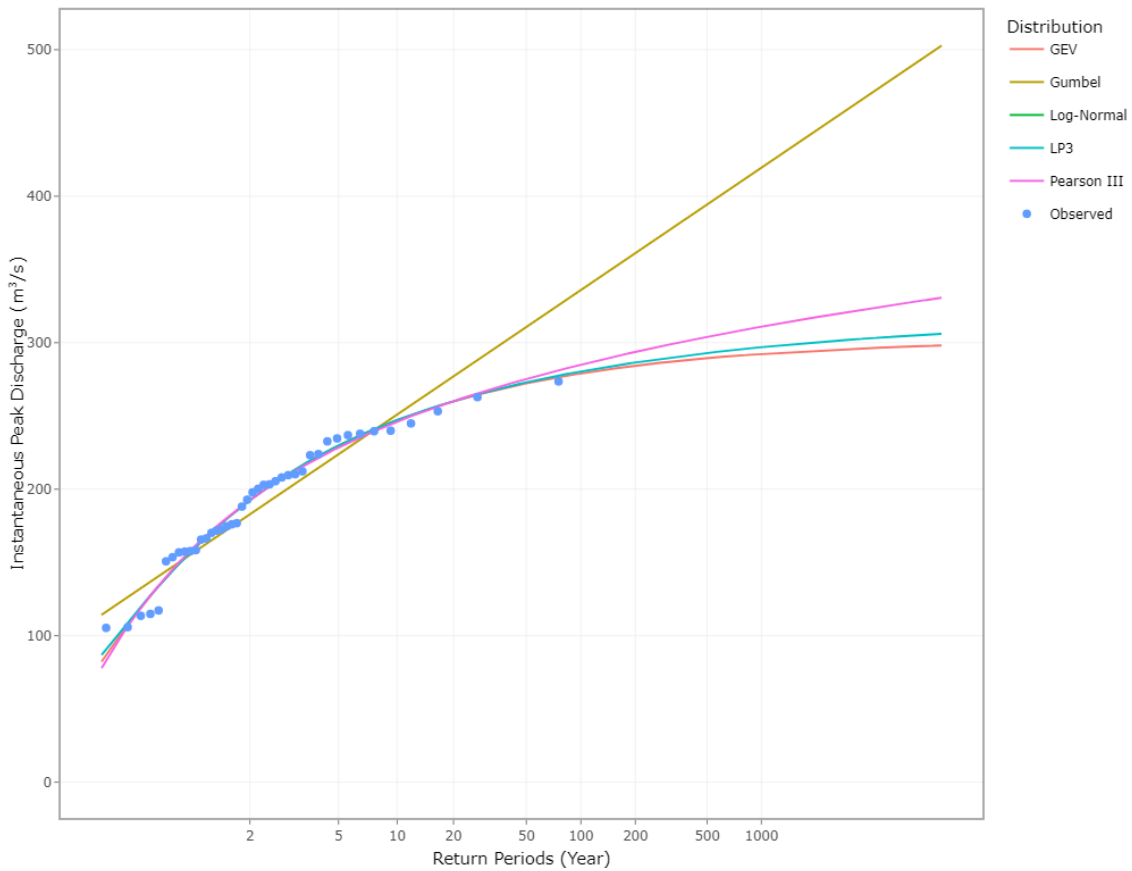
Station 1032518 L-moments Fitted Frequency Distributions



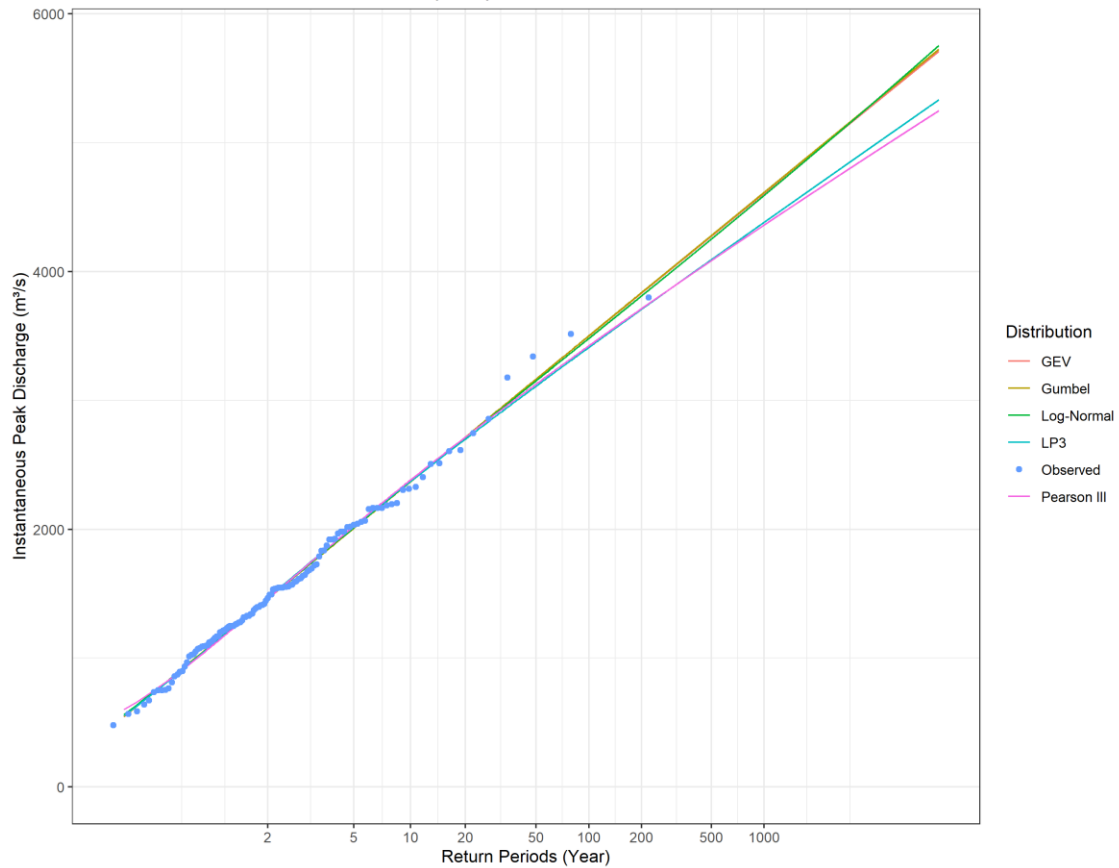
Station 1032542 L-moments Fitted Frequency Distributions



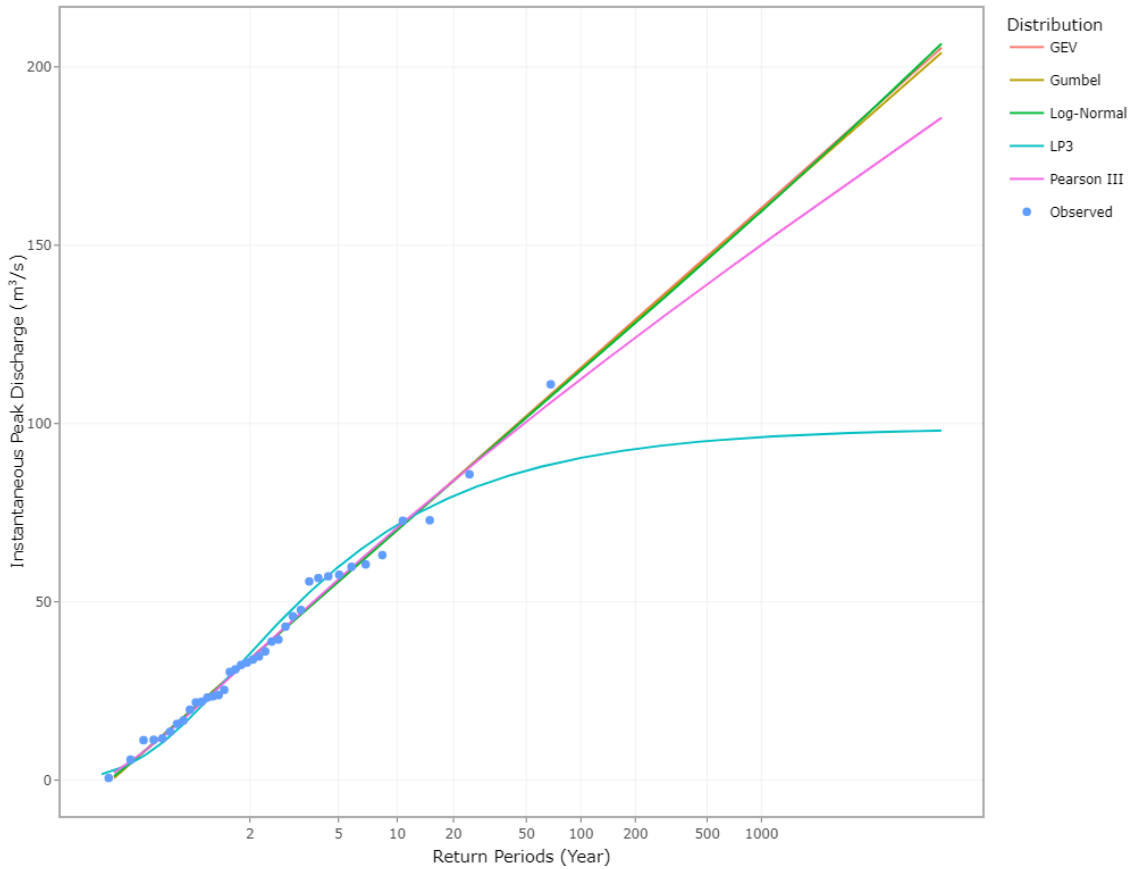
Station 1032555 L-moments Fitted Frequency Distributions



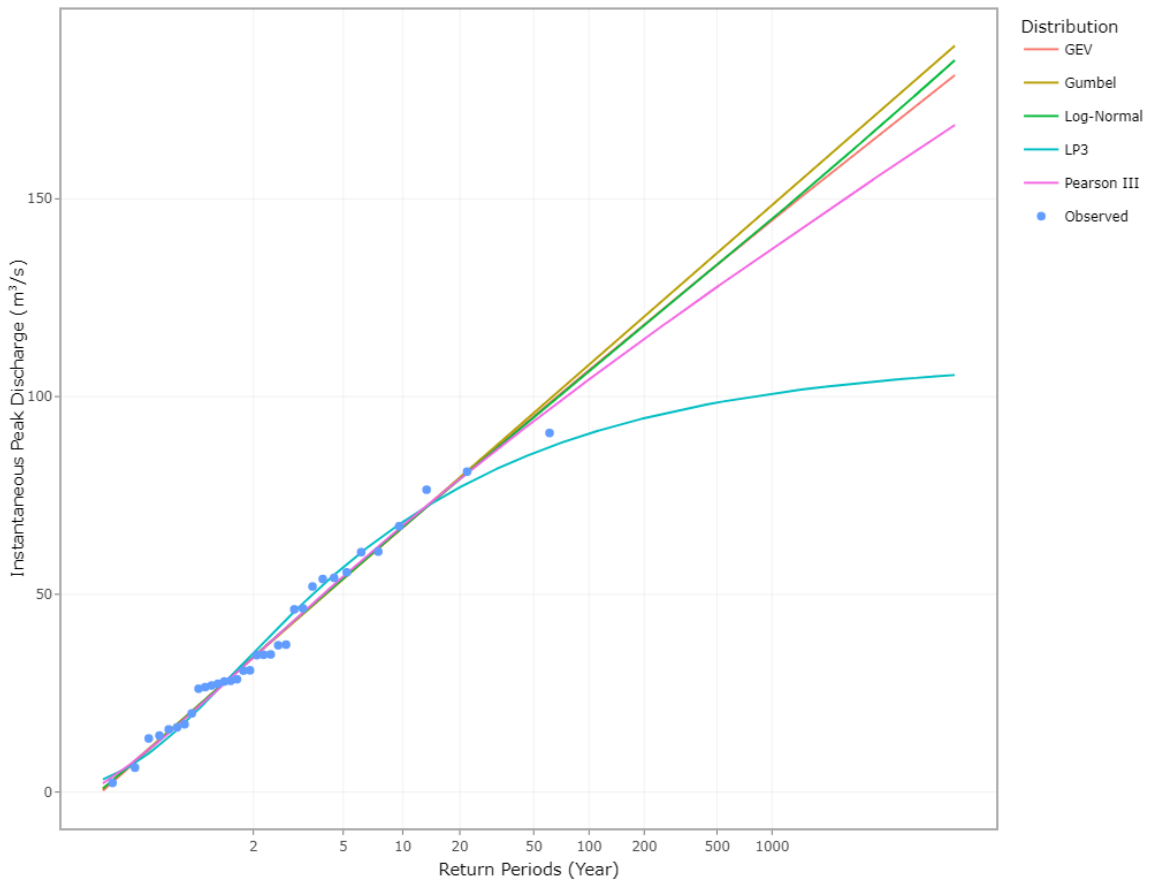
Station 1032560 L-moments Fitted Frequency Distributions



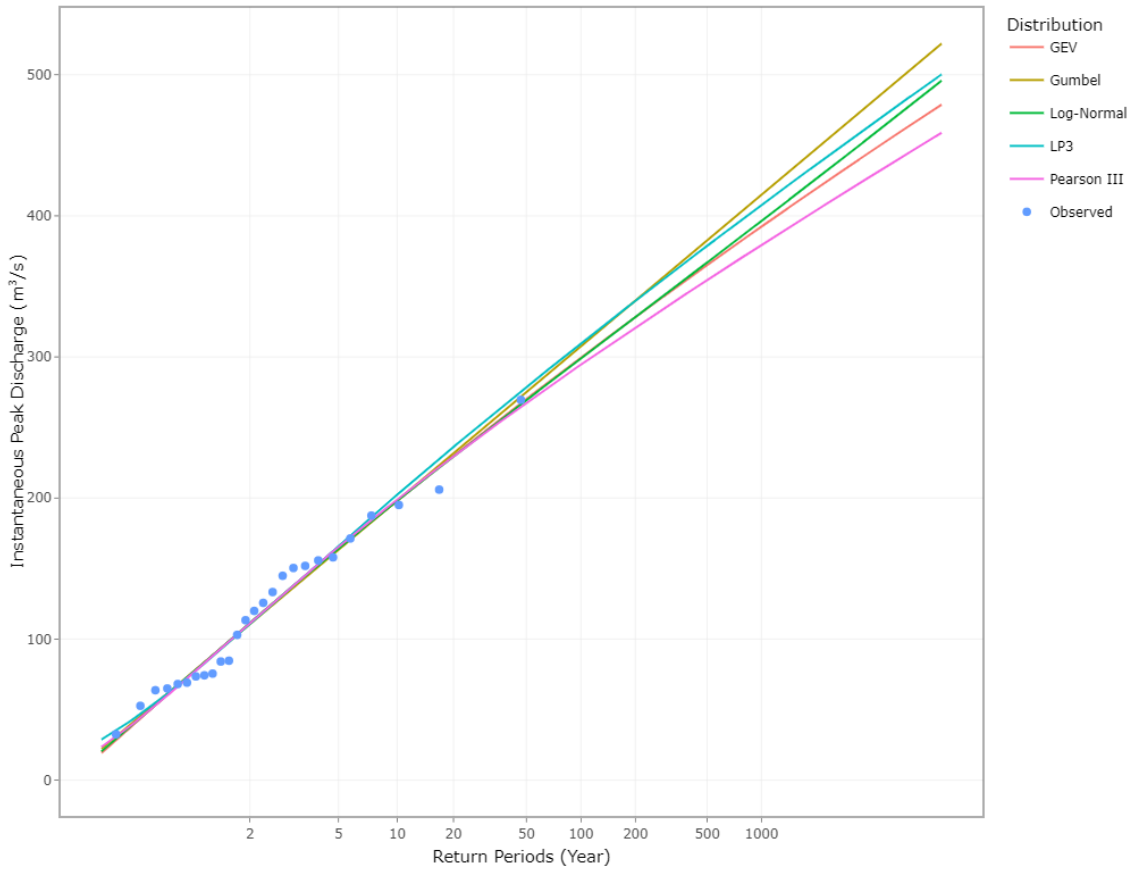
Station 1032561 L-moments Fitted Frequency Distributions



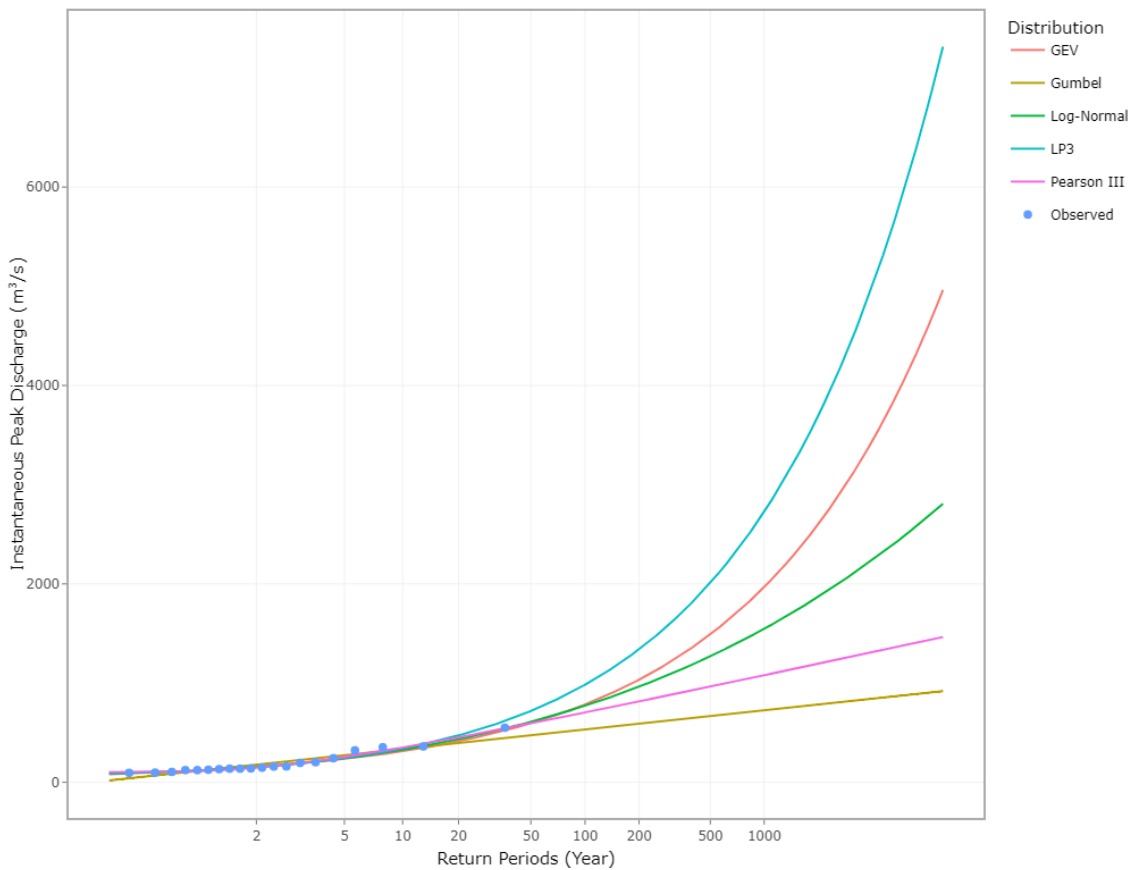
Station 1032564 L-moments Fitted Frequency Distributions



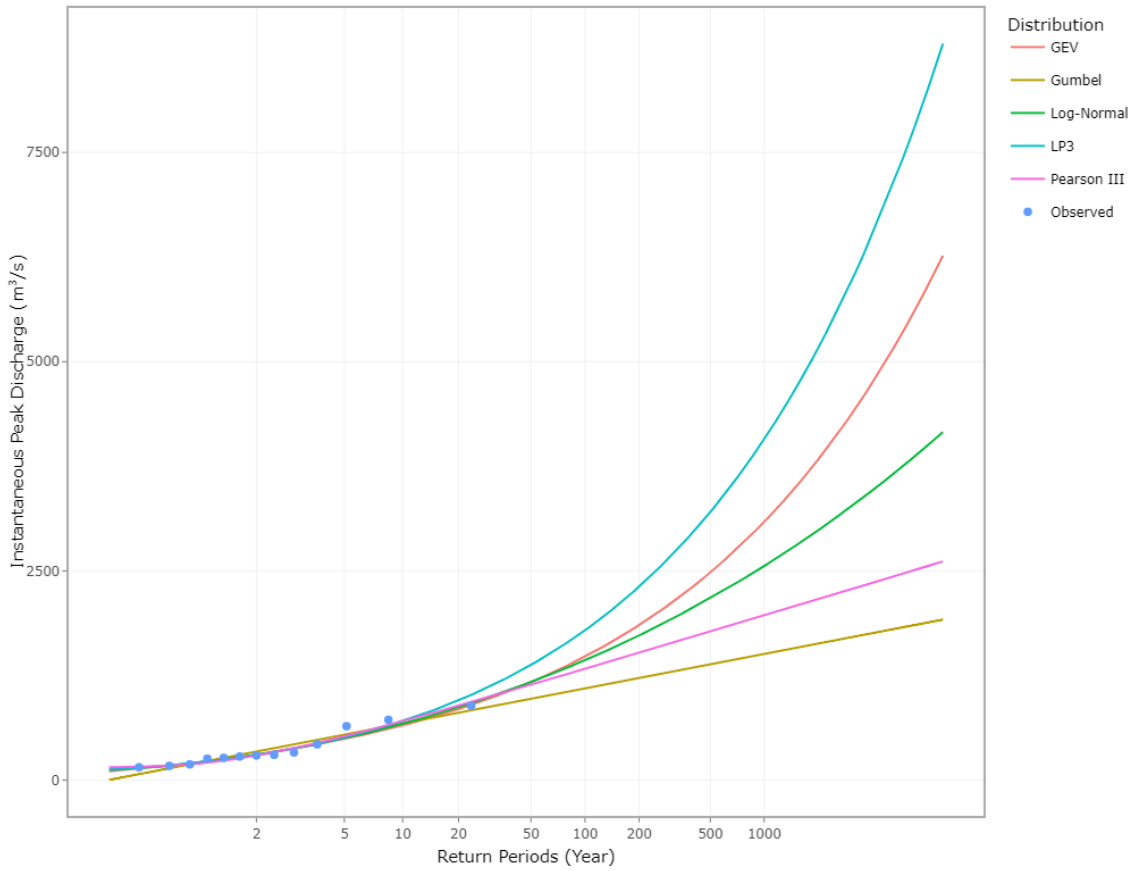
Station 1032591 L-moments Fitted Frequency Distributions



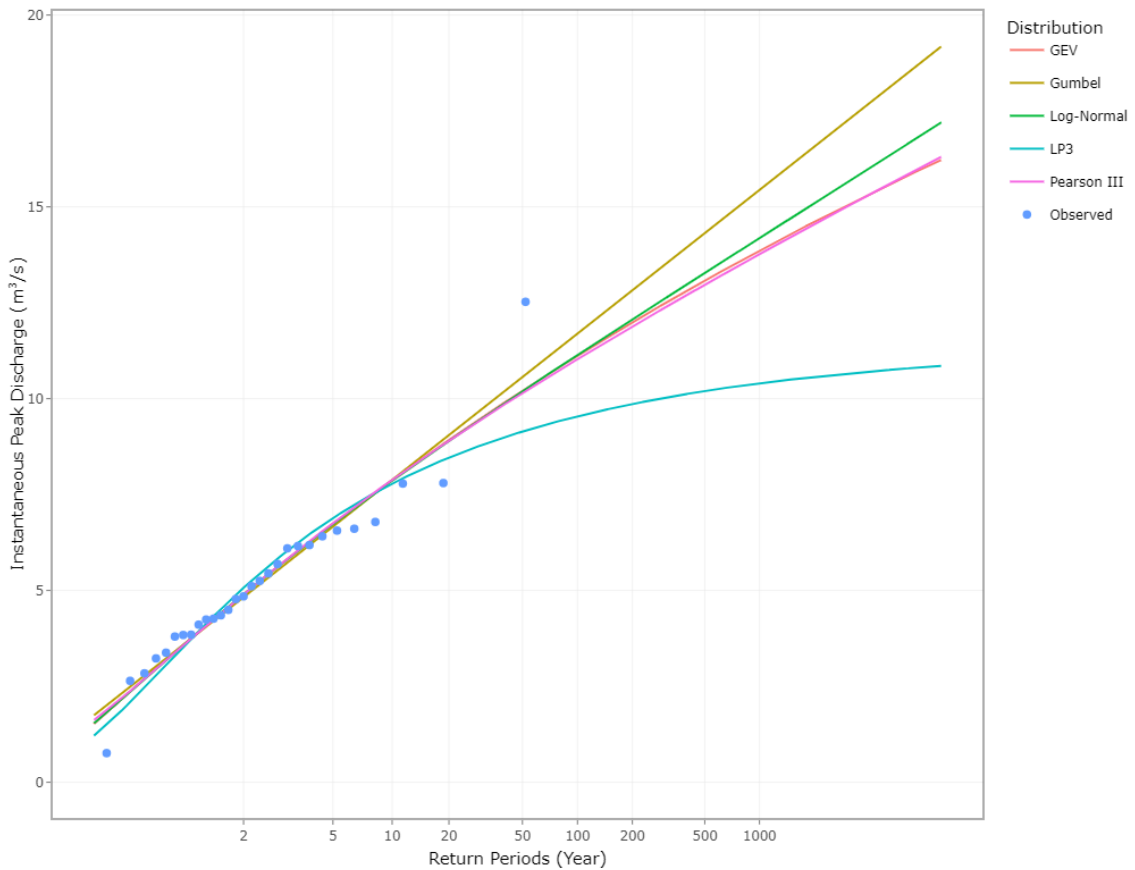
Station 1033153 L-moments Fitted Frequency Distributions



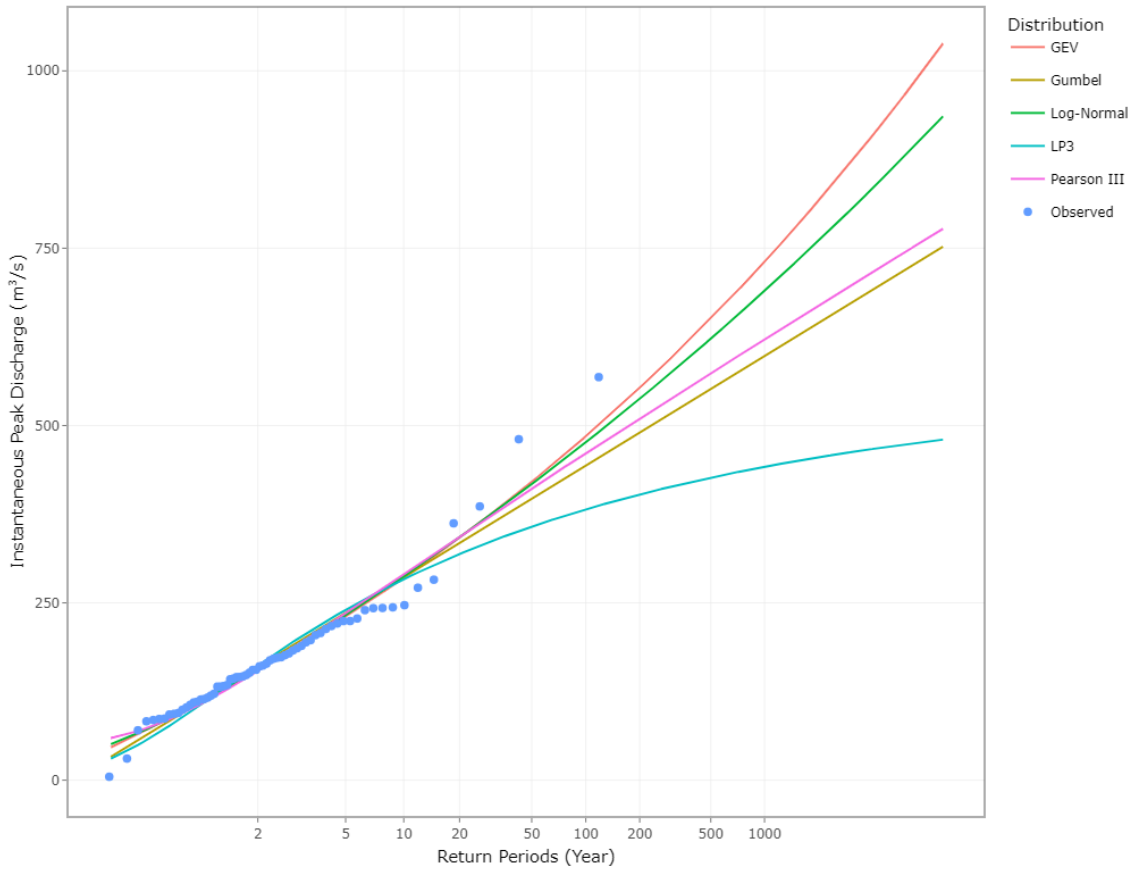
Station 1033154 L-moments Fitted Frequency Distributions



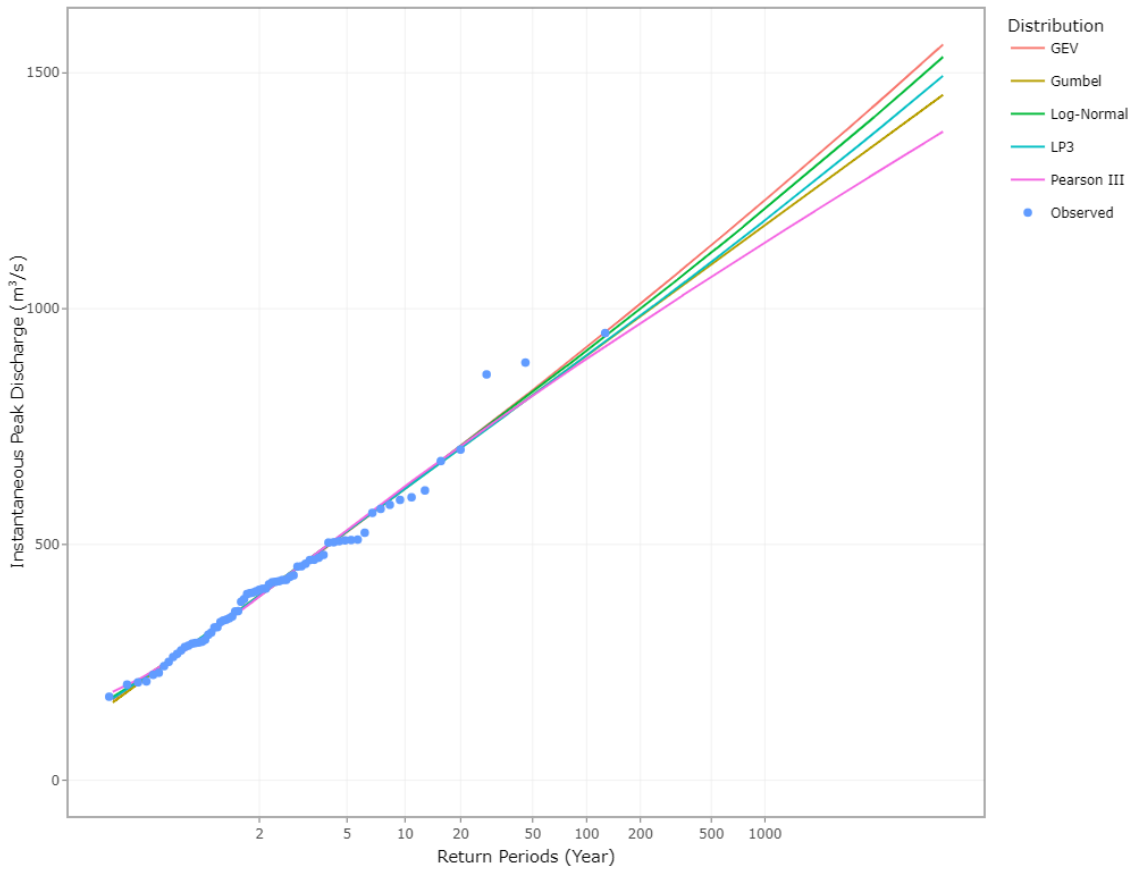
Station 1033363 L-moments Fitted Frequency Distributions



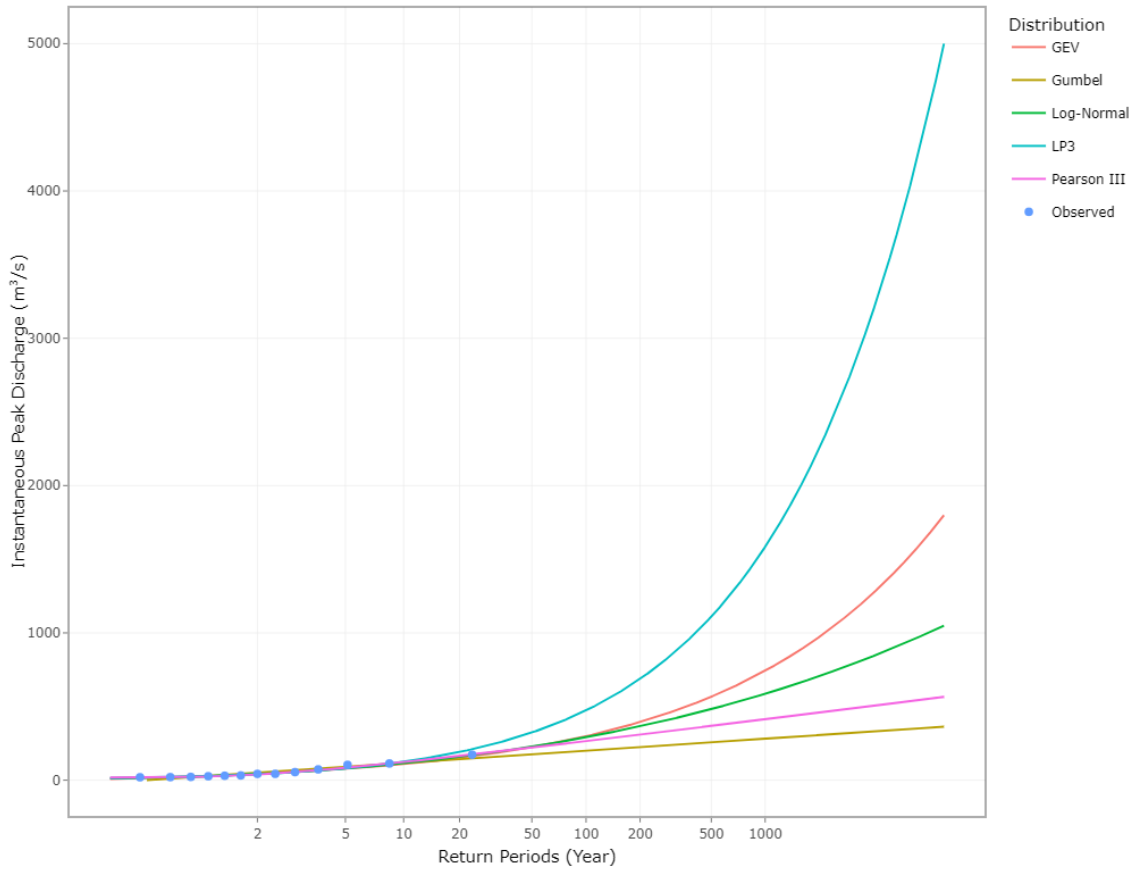
Station 1132508 L-moments Fitted Frequency Distributions



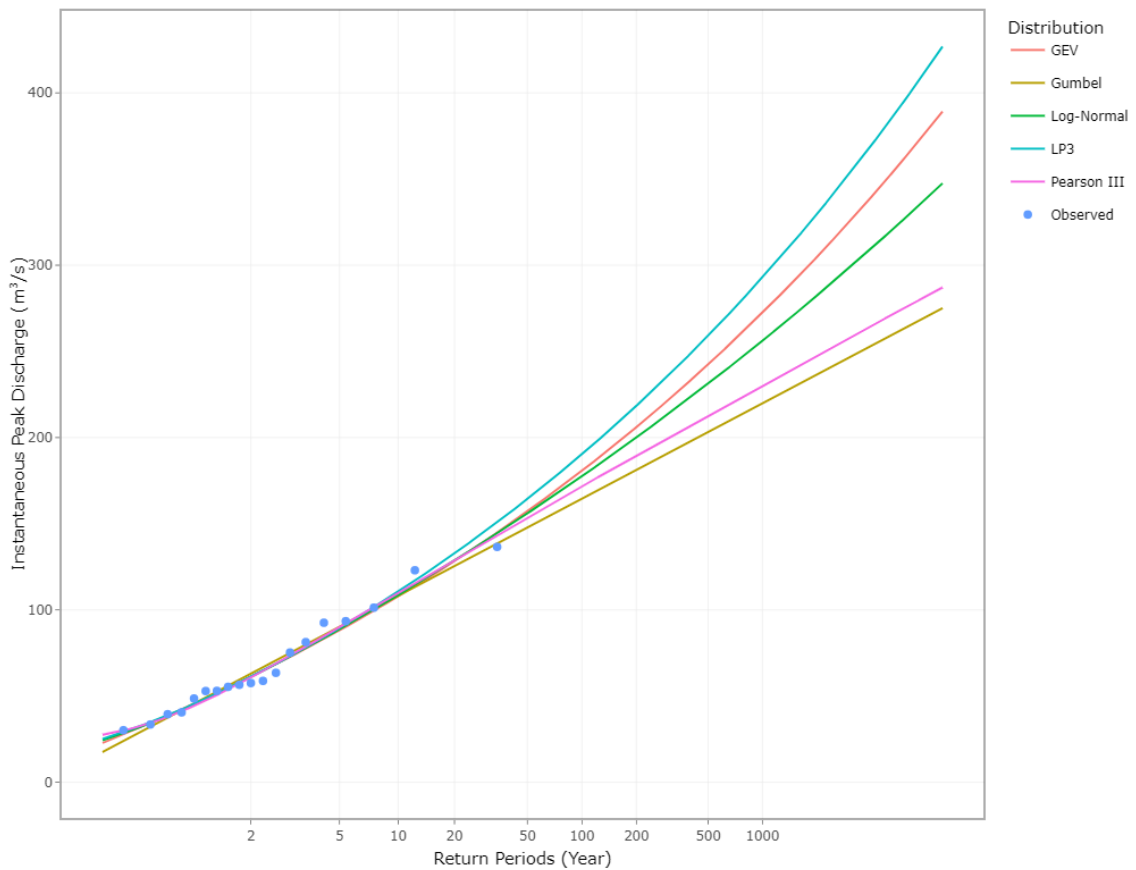
Station 1132511 L-moments Fitted Frequency Distributions



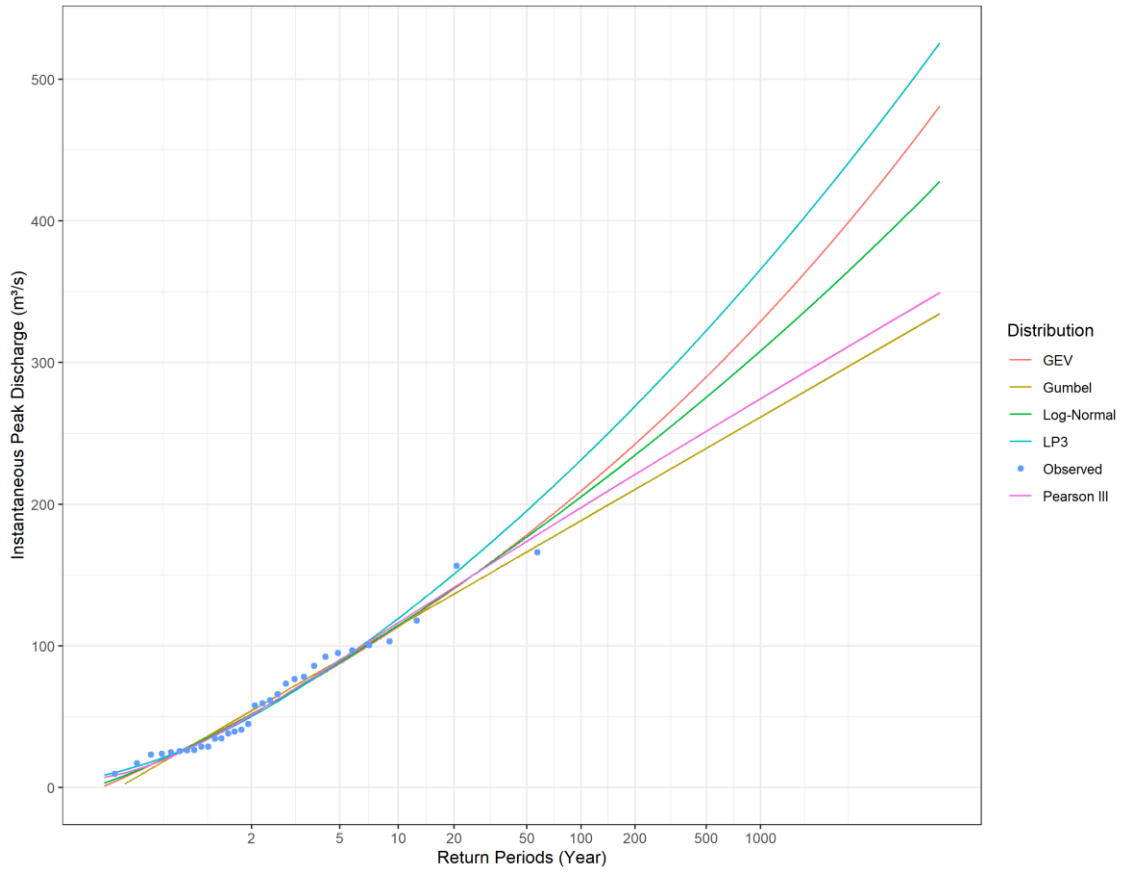
Station 1132517 L-moments Fitted Frequency Distributions



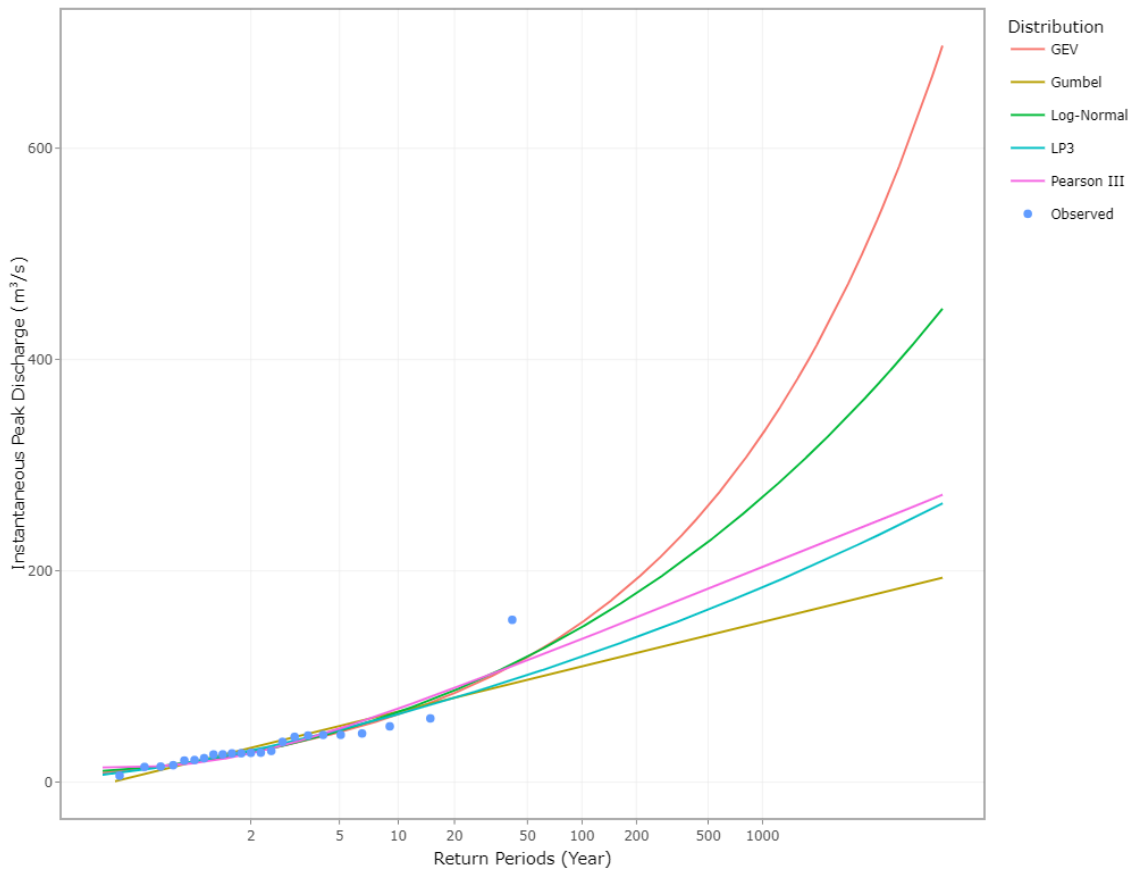
Station 1132519 L-moments Fitted Frequency Distributions



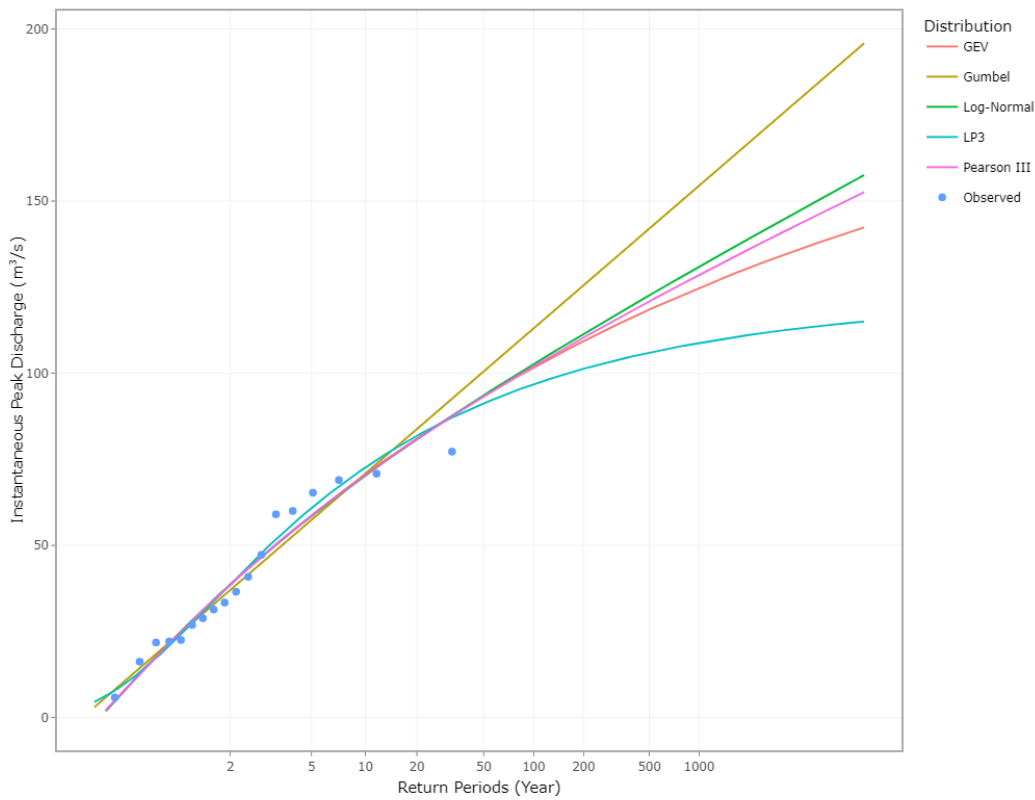
Station 1132523 L-moments Fitted Frequency Distributions



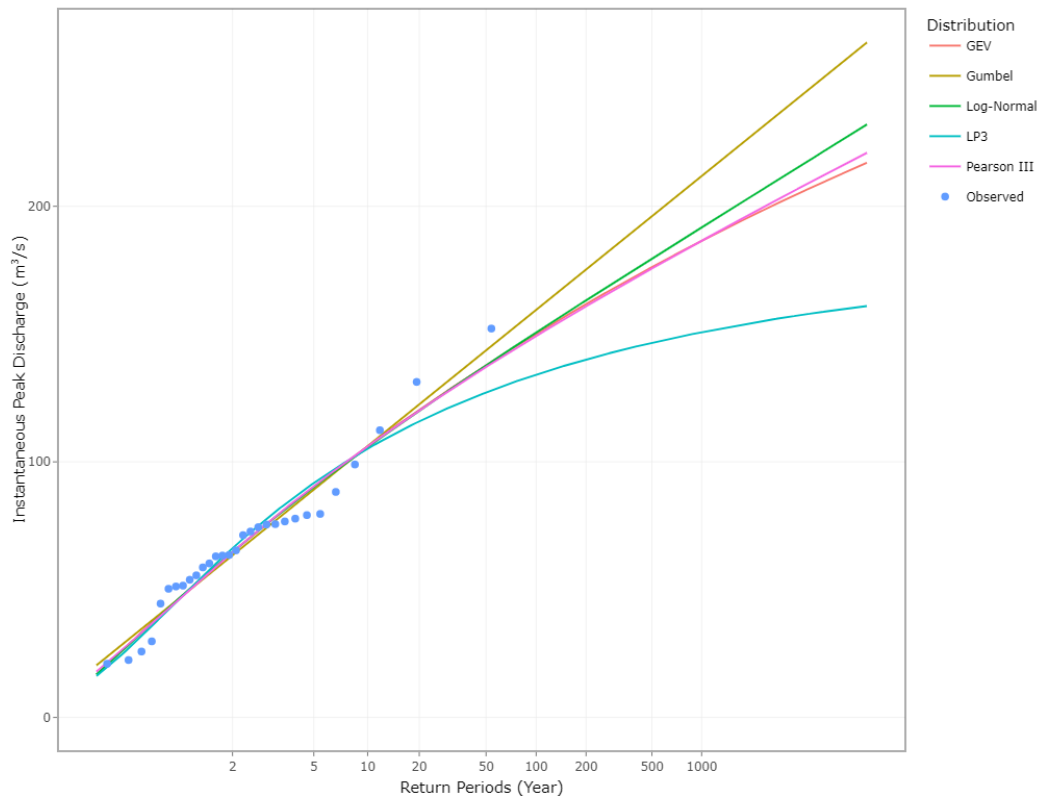
Station 1232561 L-moments Fitted Frequency Distributions



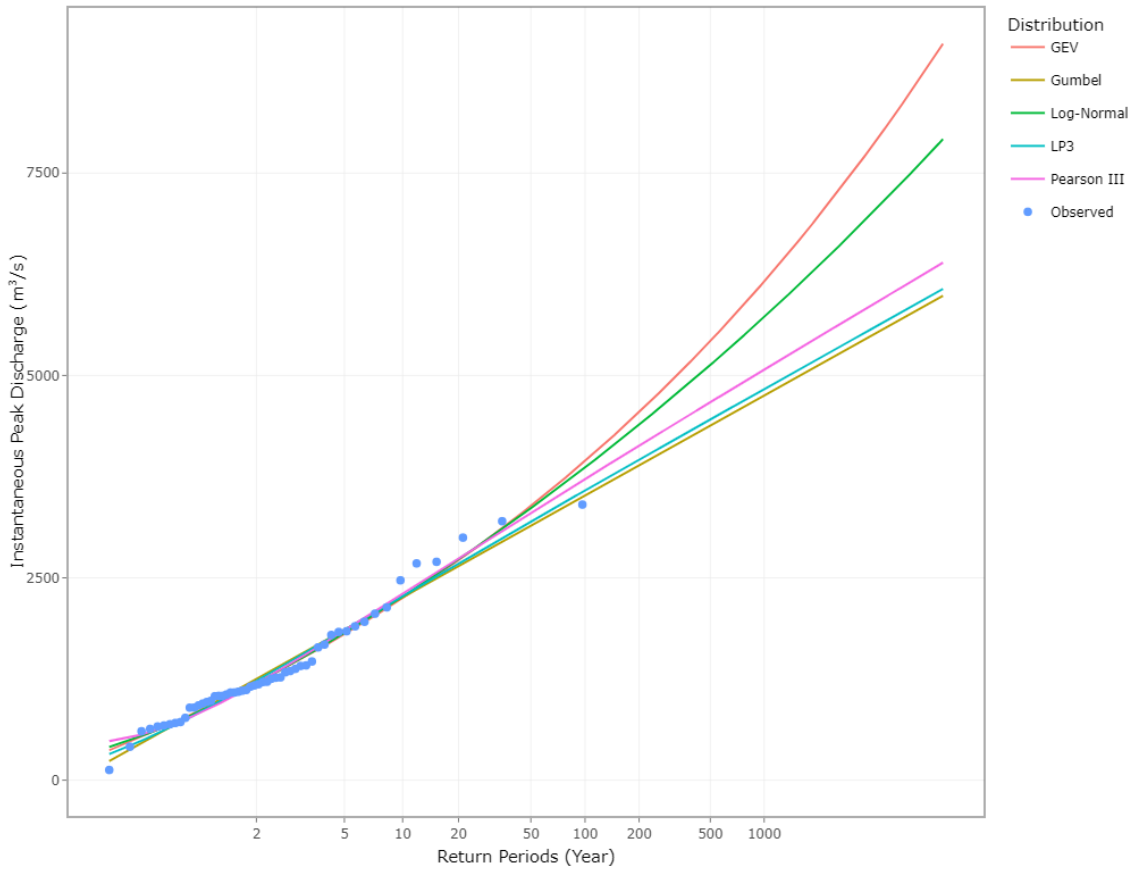
Station 1232563 L-moments Fitted Frequency Distributions



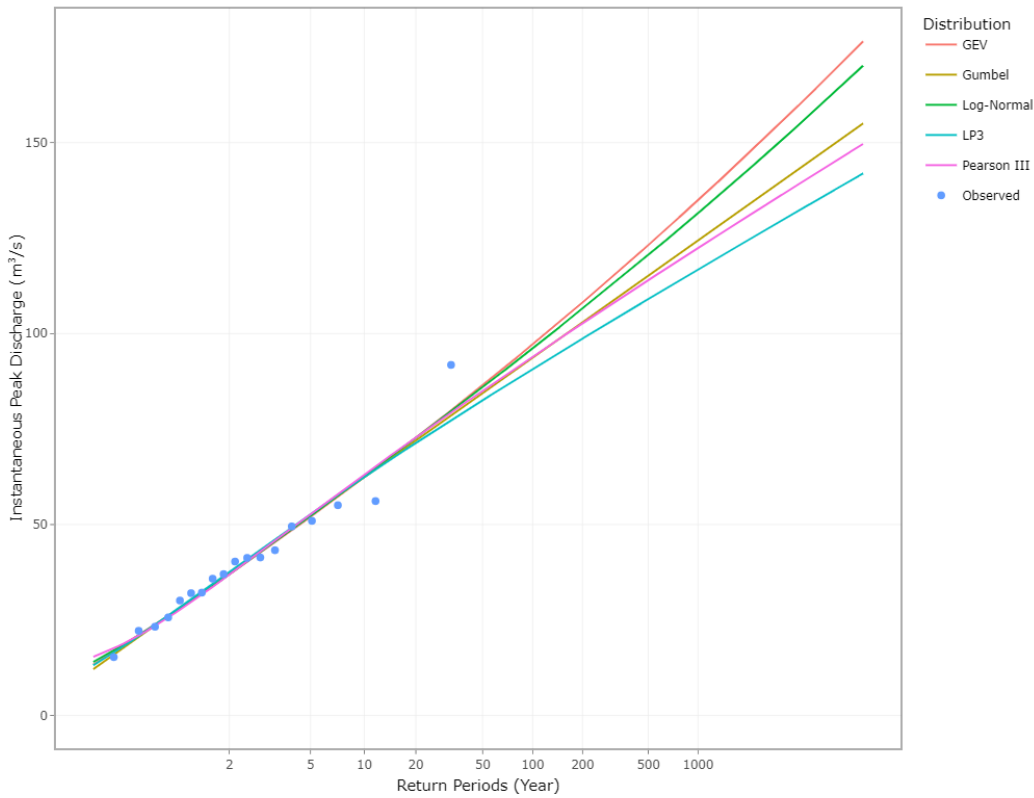
Station 1232564 L-moments Fitted Frequency Distributions



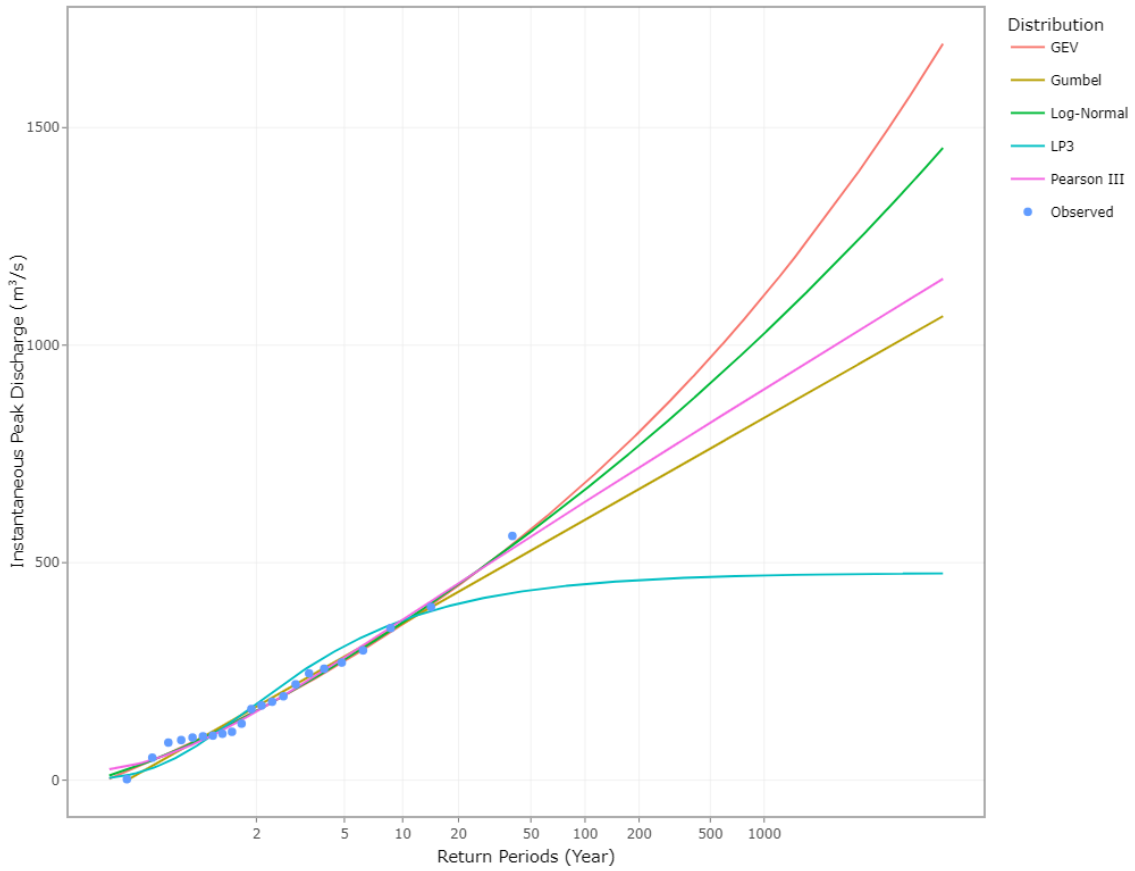
Station 1232566 L-moments Fitted Frequency Distributions



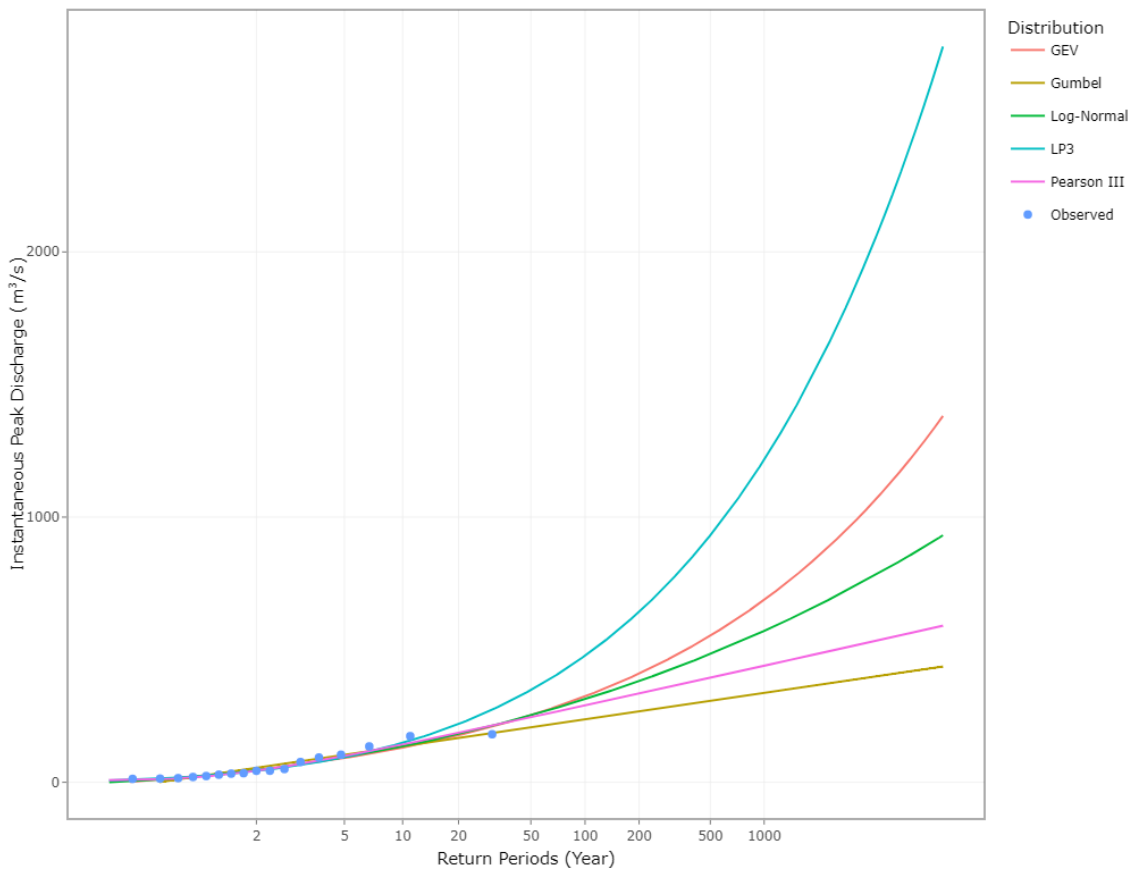
Station 1232581 L-moments Fitted Frequency Distributions



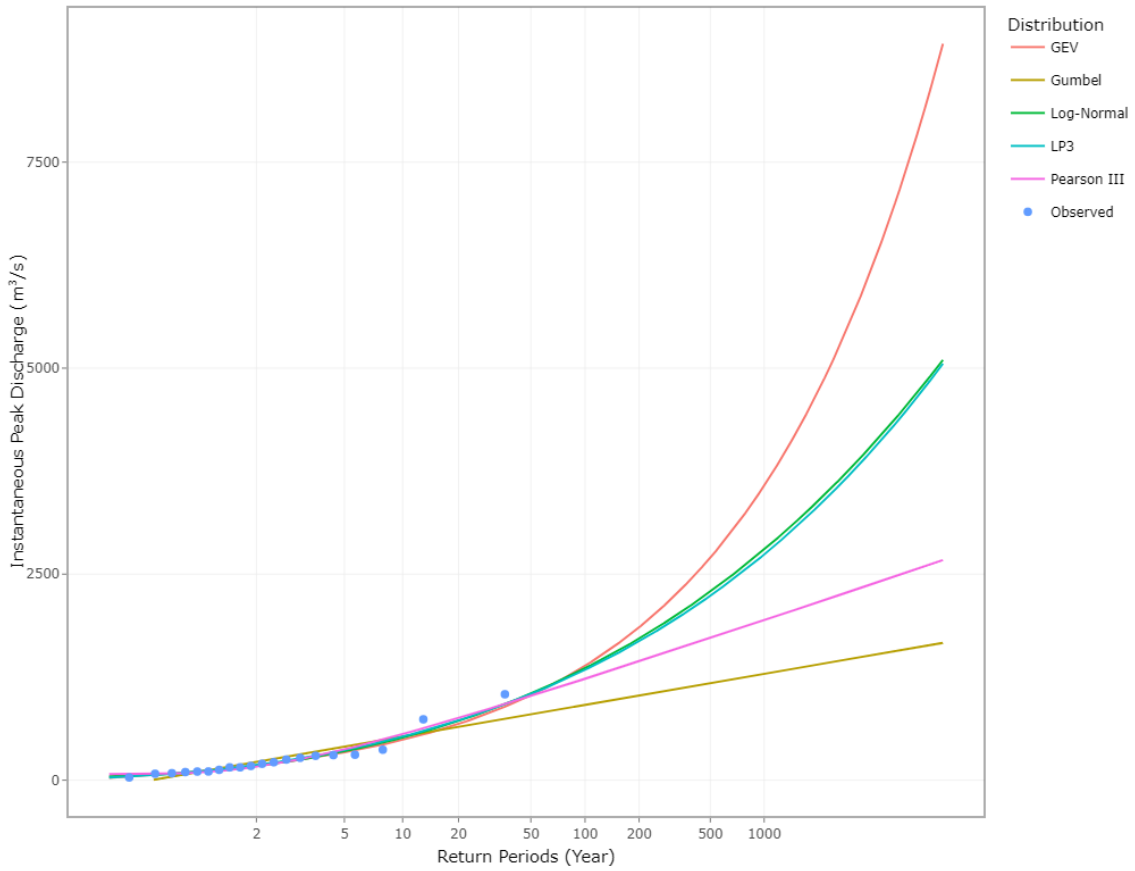
Station 1332518 L-moments Fitted Frequency Distributions



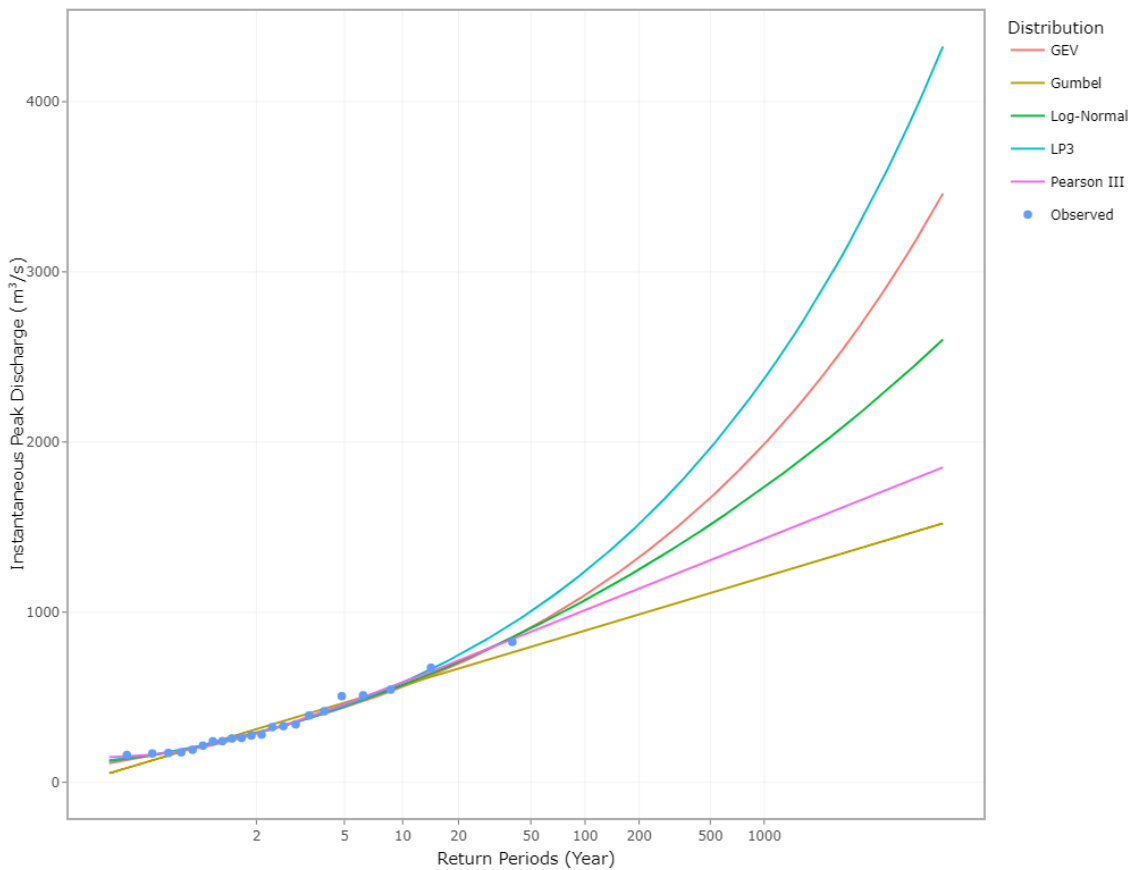
Station 1332556 L-moments Fitted Frequency Distributions



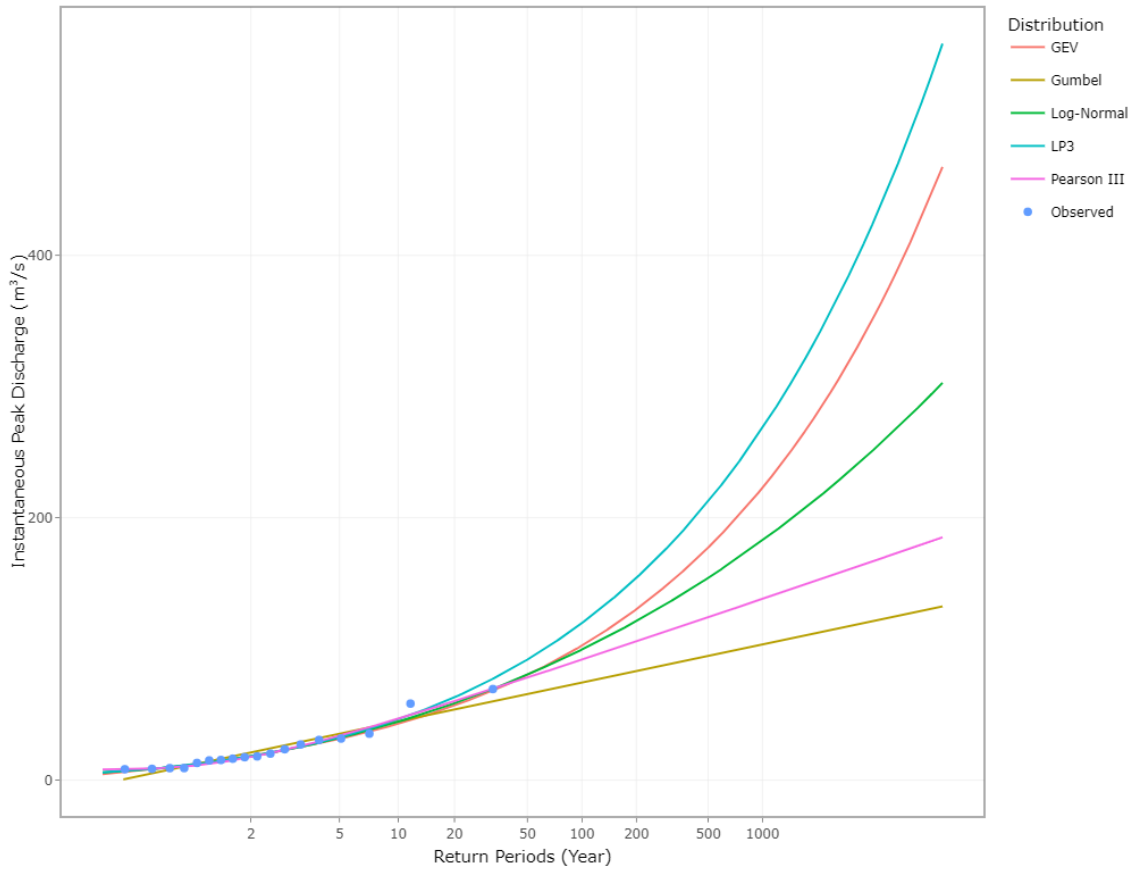
Station 1425006 L-moments Fitted Frequency Distributions



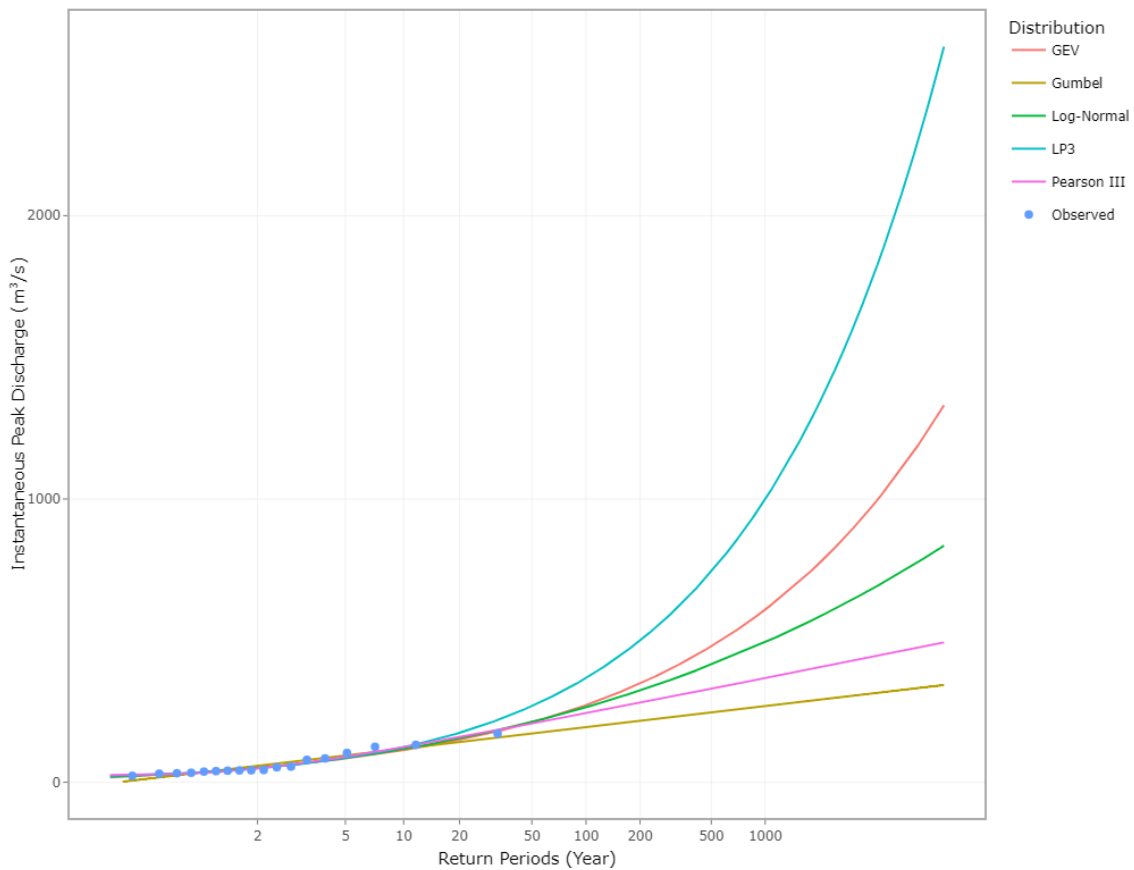
Station 1425101 L-moments Fitted Frequency Distributions



Station 1432003 L-moments Fitted Frequency Distributions



Station 1432008 L-moments Fitted Frequency Distributions



Station 2232510 L-moments Fitted Frequency Distributions

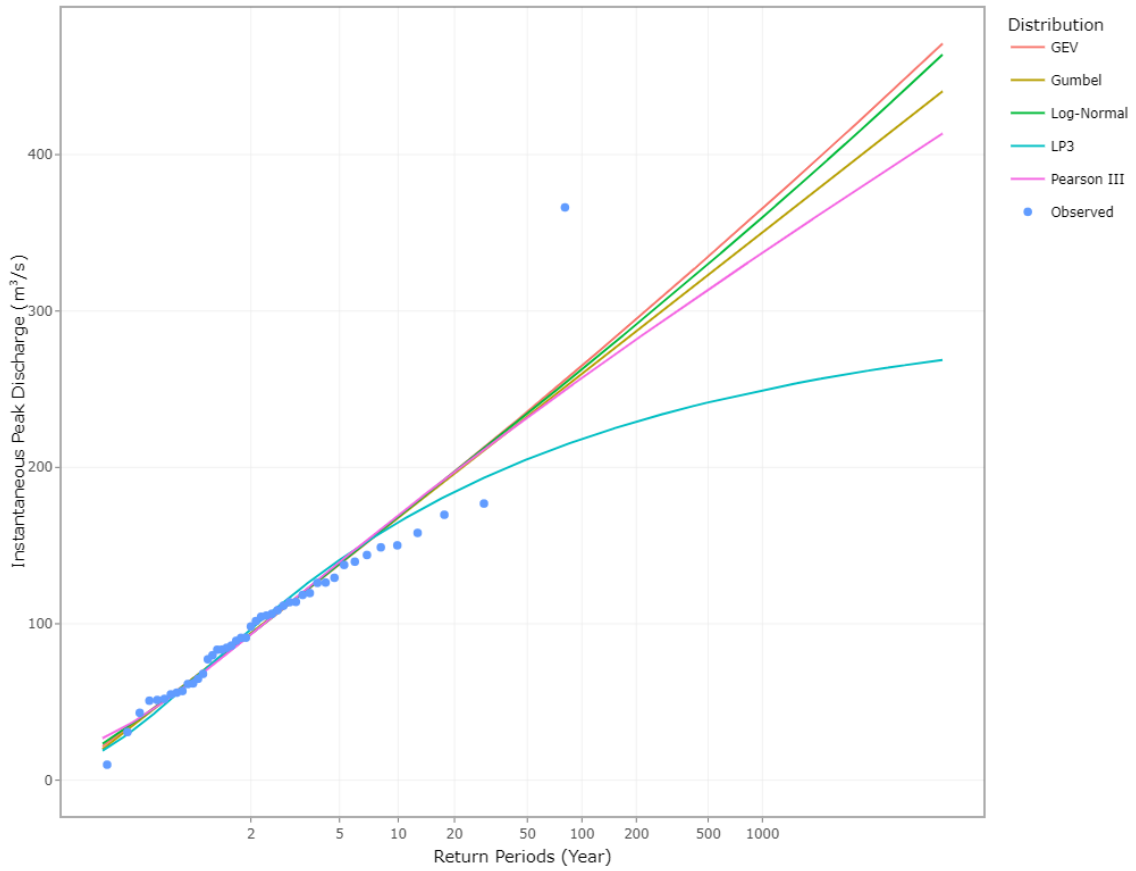


Figure B-1: Plots of fitted distributions at each site.

## Appendix C At-site goodness of fit results

**Table C-1: At-site goodness of fit statistics for 14 distributions per site.**

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
25110	Owahanga at Owahanga Station	Exponential	355.4	357.9	382.8	0.205
		Gamma	357.3	361.1	378.9	0.194
		GEV	357.4	361.1	376.5	0.190
		Gen. Logistic	357.4	361.1	381.2	0.198
		Gen. Normal	357.4	361.1	381.5	0.200
		Gen. Pareto	355.4	357.9	383.6	0.205
		Gumbel	359.4	364.4	381.2	0.199
		Kappa	355.5	358.1	389.8	0.209
		Normal	357.4	361.1	381.9	0.201
		Pearson III	361.4	367.7	381.5	0.200
		Wakeby	357.4	361.1	381.9	0.201
		Weibull	357.4	361.1	381.2	0.198
		Log-Normal	358.0	361.8	396.3	0.211
		LP3	355.3	357.8	381.6	0.202
32001	Manakau at Gleesons Rd	Exponential	93.4	94.4	20.0	0.156
		Gamma	93.3	94.2	19.9	0.158
		GEV	95.2	96.6	19.9	0.157
		Gen. Logistic	95.1	96.6	19.7	0.163
		Gen. Normal	95.2	96.6	19.9	0.159
		Gen. Pareto	95.3	96.7	20.2	0.151
		Gumbel	93.2	94.1	19.8	0.161
		Kappa	97.3	99.2	20.2	0.151
		Normal	93.1	94.1	19.9	0.157
		Pearson III	95.2	96.6	19.9	0.159
		Wakeby	99.3	101.7	20.2	0.151
		Weibull	95.2	96.6	20.0	0.157
		Log-Normal	95.2	96.6	19.9	0.159
		LP3	95.2	96.7	20.0	0.169
32106	Ohau at Rongomatane	Exponential	553.6	557.3	183.7	0.158
		Gamma	553.2	556.8	182.7	0.159
		GEV	555.3	560.8	183.2	0.157
		Gen. Logistic	555.3	560.8	183.3	0.155

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		Gen. Normal	555.3	560.8	183.0	0.158
		Gen. Pareto	555.2	560.7	182.1	0.160
		Gumbel	553.2	556.8	182.9	0.159
		Kappa	557.2	564.6	182.8	0.158
		Normal	553.2	556.9	184.2	0.160
		Pearson III	555.2	560.7	182.7	0.158
		Wakeby	559.2	568.4	182.1	0.160
		Weibull	555.2	560.7	182.5	0.159
		Log-Normal	555.3	560.8	183.0	0.158
		LP3	555.6	561.0	185.6	0.164
32302	Hokio at Lake Horowhenua	Exponential	58.2	59.0	5.4	0.197
		Gamma	58.1	58.9	5.4	0.198
		GEV	60.1	61.3	5.3	0.188
		Gen. Logistic	60.1	61.3	5.3	0.180
		Gen. Normal	60.1	61.3	5.4	0.192
		Gen. Pareto	60.2	61.4	5.4	0.201
		Gumbel	58.1	58.9	5.4	0.198
		Kappa	62.2	63.8	5.4	0.198
		Normal	58.1	58.9	5.5	0.205
		Pearson III	60.2	61.4	5.4	0.197
		Wakeby	64.2	66.2	5.4	0.201
		Weibull	60.2	61.4	5.4	0.198
		Log-Normal	60.1	61.3	5.4	0.192
		LP3	60.4	61.6	5.6	0.225
32503	Manawatu at Weber Rd	Exponential	1000.0	1004.5	564.7	0.119
		Gamma	999.8	1004.3	561.2	0.119
		GEV	1001.8	1008.5	564.7	0.118
		Gen. Logistic	1001.8	1008.6	566.4	0.116
		Gen. Normal	1001.8	1008.5	563.7	0.118
		Gen. Pareto	1001.8	1008.5	558.8	0.120
		Gumbel	999.8	1004.3	562.9	0.119
		Kappa	1003.8	1012.8	564.2	0.118
		Normal	1000.2	1004.7	567.4	0.119
		Pearson III	1001.8	1008.5	561.6	0.119
		Wakeby	1005.8	1017.0	564.3	0.118
		Weibull	1001.8	1008.5	560.6	0.119

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
32504	Manawatu at Hopelands	Log-Normal	1001.8	1008.5	563.7	0.118
		LP3	1001.8	1008.5	564.3	0.122
		Exponential	537.7	540.8	750.3	0.168
		Gamma	537.7	540.8	748.3	0.161
32529	Tiraumea at Ngaturi	GEV	539.6	544.4	749.2	0.162
		Gen. Logistic	539.6	544.4	747.9	0.159
		Gen. Normal	539.6	544.4	749.0	0.163
		Gen. Pareto	539.6	544.4	746.8	0.164
		Gumbel	537.7	540.9	749.8	0.160
		Kappa	541.6	547.9	749.1	0.162
		Normal	537.9	541.0	757.6	0.158
		Pearson III	539.6	544.4	748.1	0.163
		Wakeby	544.2	552.1	724.5	0.137
		Weibull	539.6	544.4	747.4	0.163
		Log-Normal	539.6	544.4	749.0	0.163
		LP3	539.6	544.4	748.7	0.166
		Exponential	871.4	875.8	300.2	0.156
		Gamma	871.1	875.5	297.9	0.153
		GEV	873.0	879.7	299.6	0.153
		Gen. Logistic	873.1	879.7	300.5	0.152
Gen. Normal	873.0	879.7	299.1	0.153		
Gen. Pareto	873.0	879.6	296.4	0.154		
Gumbel	871.0	875.5	298.6	0.153		
Kappa	875.1	883.9	300.1	0.153		
Normal	871.3	875.7	300.3	0.153		
Pearson III	873.0	879.6	298.2	0.154		
Wakeby	877.1	888.1	301.2	0.154		
Weibull	873.0	879.6	297.6	0.154		
Log-Normal	873.0	879.7	299.1	0.153		
LP3	873.0	879.6	298.8	0.154		
32547	Manawatu at Moutoa	Exponential	457.8	461.1	226.9	0.180
		Gamma	457.4	460.6	216.6	0.172
		GEV	459.5	464.3	214.6	0.171
		Gen. Logistic	459.5	464.3	214.7	0.167
		Gen. Normal	459.5	464.4	215.0	0.170

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		Gen. Pareto	459.5	464.3	212.7	0.174
		Gumbel	457.4	460.6	220.4	0.175
		Kappa	461.5	467.9	214.4	0.172
		Normal	457.4	460.6	216.1	0.172
		Pearson III	459.5	464.3	214.7	0.171
		Wakeby	463.4	471.5	210.6	0.180
		LP3	459.4	464.3	213.4	0.169
32557	Mangaone at Milson Line	Exponential	560.0	563.9	78.9	0.126
		Gamma	559.8	563.8	78.5	0.131
		GEV	561.8	567.7	78.8	0.128
		Gen. Logistic	561.8	567.8	79.0	0.126
		Gen. Normal	561.8	567.7	78.7	0.129
		Gen. Pareto	561.8	567.8	78.1	0.132
		Gumbel	559.9	563.8	78.7	0.132
		Kappa	563.8	571.7	78.8	0.129
		Normal	560.1	564.1	79.3	0.136
		Pearson III	561.8	567.8	78.5	0.130
		Wakeby	565.8	575.7	78.8	0.129
		Weibull	561.8	567.8	78.4	0.130
		Log-Normal	561.8	567.7	78.7	0.129
		LP3	561.8	567.8	78.2	0.132
		32563	Oroua at Kawa Wool	Exponential	680.0	684.1
		Gamma	679.4	683.5	175.9	0.116
		GEV	681.4	687.5	176.4	0.114
		Gen. Logistic	681.4	687.6	177.1	0.112
		Gen. Normal	681.4	687.5	176.2	0.114
		Gen. Pareto	681.4	687.5	174.5	0.117
		Gumbel	679.4	683.5	176.4	0.115
		Kappa	683.4	691.6	176.9	0.113
		Normal	679.5	683.5	176.8	0.119
		Pearson III	681.4	687.5	175.9	0.115
		Wakeby	685.4	695.6	177.5	0.113
		Weibull	681.4	687.5	175.5	0.116
		Log-Normal	681.4	687.5	176.2	0.114
		LP3	681.4	687.5	175.7	0.116
32564	Pohangina at Piripiri	Exponential	147.1	148.2	118.4	0.108

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		Gamma	146.8	148.0	117.9	0.103
		GEV	148.8	150.5	118.0	0.105
		Gen. Logistic	148.7	150.4	116.9	0.104
		Gen. Normal	148.8	150.5	117.8	0.104
		Gen. Pareto	148.9	150.6	119.3	0.108
		Gumbel	146.8	147.9	117.6	0.101
		Kappa	150.8	153.1	118.8	0.107
		Normal	146.8	147.9	118.1	0.107
		Pearson III	148.8	150.5	117.9	0.104
		Wakeby	152.9	155.7	119.1	0.107
		Weibull	148.8	150.5	118.3	0.104
		Log-Normal	148.8	150.5	117.8	0.104
		LP3	148.8	150.5	118.4	0.118
32576	Pohangina at Mais Reach	Exponential	757.9	761.9	437.0	0.170
		Gamma	757.6	761.6	435.1	0.174
		GEV	759.7	765.7	437.5	0.169
		Gen. Logistic	759.7	765.8	437.8	0.167
		Gen. Normal	759.7	765.7	436.9	0.170
		Gen. Pareto	759.6	765.6	434.2	0.172
		Gumbel	757.6	761.6	435.9	0.173
		Kappa	761.6	769.7	435.2	0.172
		Normal	757.7	761.7	439.7	0.176
		Pearson III	759.6	765.7	435.4	0.171
		Wakeby	763.6	773.6	434.2	0.172
		Weibull	759.6	765.6	435.0	0.171
		Log-Normal	759.7	765.7	436.9	0.170
		LP3	760.4	766.4	446.7	0.175
32590	Koputaroa at Tavistock Rd	Exponential	108.4	110.0	11.6	0.249
		Gamma	108.5	110.0	11.6	0.253
		GEV	110.5	112.8	11.5	0.243
		Gen. Logistic	110.6	112.9	11.4	0.239
		Gen. Normal	110.4	112.8	11.5	0.246
		Gen. Pareto	110.4	112.7	11.6	0.250
		Gumbel	108.5	110.1	11.6	0.253
		Normal	108.6	110.1	11.8	0.258

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
32702	Rangitikei at Mangaweka	Pearson III	110.4	112.7	11.6	0.249
		Wakeby	114.6	118.5	11.5	0.232
		Weibull	110.4	112.7	11.6	0.249
		Log-Normal	110.4	112.8	11.5	0.246
		LP3	110.5	112.8	11.5	0.253
		Exponential	1042.4	1046.9	742.3	0.173
		Gamma	1046.8	1051.3	744.0	0.176
		GEV	1043.6	1050.3	750.8	0.169
		Gen. Logistic	1043.6	1050.3	751.4	0.167
		Gen. Normal	1043.8	1050.5	748.6	0.171
		Gen. Pareto	1044.3	1051.0	742.7	0.173
		Gumbel	1046.0	1050.4	745.8	0.175
		Normal	1048.3	1052.8	756.9	0.177
		Pearson III	1044.3	1051.0	742.5	0.173
		Wakeby	1047.1	1058.3	755.6	0.166
32703	Rangitikei at Onepuhi	Weibull	1044.3	1051.0	742.6	0.173
		Log-Normal	1043.8	1050.5	748.6	0.171
		LP3	1046.1	1052.8	736.9	0.167
		Exponential	328.4	330.6	701.8	0.162
		Gamma	328.6	330.7	706.6	0.160
		GEV	330.5	333.7	695.5	0.162
		Gen. Logistic	330.5	333.8	690.8	0.159
		Gen. Normal	330.4	333.7	699.6	0.163
		Gen. Pareto	330.4	333.7	701.5	0.164
		Gumbel	328.5	330.7	706.0	0.159
		Kappa	332.4	336.8	701.5	0.164
		Normal	328.7	330.8	717.8	0.165
		Pearson III	330.4	333.7	701.9	0.164
		Wakeby	334.4	339.9	701.5	0.164
		Weibull	330.4	333.7	701.9	0.164
Log-Normal	330.4	333.7	699.6	0.163		
LP3	330.6	333.9	718.8	0.173		
32708	Rangitikei at Springvale	Exponential	139.7	140.5	230.5	0.128
		Gamma	139.5	140.3	229.6	0.135
		GEV	141.5	142.7	229.9	0.139
		Gen. Logistic	141.4	142.6	227.5	0.136

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
32715	Porewa at Tututotara	Gen. Normal	141.5	142.7	229.4	0.138
		Gen. Pareto	141.6	142.8	232.1	0.140
		Gumbel	139.5	140.3	228.9	0.133
		Normal	139.5	140.3	229.8	0.141
		Pearson III	141.5	142.7	229.6	0.138
		Wakeby	145.5	147.5	231.0	0.136
		Weibull	141.5	142.7	230.3	0.138
		Log-Normal	141.5	142.7	229.4	0.138
		LP3	141.5	142.7	229.8	0.152
		Exponential	253.3	256.0	31.0	0.142
		Gamma	254.0	256.8	31.1	0.139
		GEV	255.5	259.6	30.9	0.135
		Gen. Logistic	255.6	259.7	30.8	0.130
		Gen. Normal	255.4	259.5	31.0	0.138
		Gen. Pareto	255.4	259.5	31.0	0.140
		Gumbel	254.0	256.8	31.1	0.139
		Kappa	257.5	263.0	30.9	0.133
Normal	254.5	257.2	31.6	0.145		
32739	Tutaenui at Hammond St	Pearson III	255.4	259.5	31.0	0.140
		Wakeby	264.0	270.8	29.1	0.126
		Weibull	255.4	259.5	30.9	0.140
		Log-Normal	255.4	259.5	31.0	0.138
		LP3	255.7	259.8	30.7	0.134
		Exponential	387.3	391.0	24.1	0.197
		Gamma	387.5	391.3	24.0	0.195
		GEV	389.3	394.9	24.2	0.193
		Gen. Logistic	389.3	394.9	24.2	0.190
		Gen. Normal	389.3	394.9	24.2	0.195
		Gen. Pareto	389.3	394.9	24.1	0.197
		Gumbel	387.7	391.4	24.1	0.194
		Kappa	391.3	398.8	24.2	0.193
		Normal	388.2	391.9	24.4	0.195
		Pearson III	389.3	394.9	24.1	0.197
		Wakeby	393.3	402.6	24.1	0.197
		Weibull	389.3	394.9	24.1	0.197
Log-Normal	389.3	394.9	24.2	0.195		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
32760	Rangitikei at McKelvies	LP3	389.5	395.1	24.0	0.190
		Exponential	271.1	273.0	519.6	0.158
		Gamma	271.0	272.8	522.7	0.158
		GEV	273.0	275.8	516.3	0.153
		Gen. Logistic	273.0	275.8	512.7	0.147
		Gen. Normal	273.0	275.8	517.8	0.155
		Gen. Pareto	273.0	275.9	520.6	0.160
32763	Rangitikei at Pukeokahu	Gumbel	271.0	272.8	520.5	0.157
		Kappa	275.0	278.8	518.3	0.155
		Normal	271.0	272.8	527.2	0.160
		Pearson III	273.0	275.9	519.4	0.157
		Wakeby	277.0	281.7	515.4	0.152
		Weibull	273.0	275.9	519.6	0.158
		Log-Normal	273.0	275.8	517.8	0.155
		LP3	273.1	276.0	525.3	0.166
		Exponential	341.6	344.1	303.7	0.196
		Gamma	341.5	344.0	303.5	0.194
		GEV	343.5	347.3	302.7	0.192
		Gen. Logistic	343.5	347.3	301.6	0.188
		Gen. Normal	343.5	347.3	302.8	0.193
		Gen. Pareto	343.5	347.3	302.7	0.197
32767	Hautapu at Alabaster's	Gumbel	341.5	344.0	303.3	0.194
		Normal	341.5	344.1	306.1	0.196
		Pearson III	343.5	347.3	302.8	0.195
		Wakeby	347.5	353.8	306.0	0.193
		Weibull	343.5	347.3	302.7	0.195
		Log-Normal	343.5	347.3	302.8	0.193
		LP3	343.5	347.3	304.1	0.198
		Exponential	514.3	518.2	57.8	0.196
		Gamma	517.3	521.2	58.0	0.204
		GEV	515.2	521.0	58.4	0.186
		Gen. Logistic	515.4	521.2	58.2	0.184
		Gen. Normal	515.1	520.9	58.4	0.188
		Gen. Pareto	515.3	521.1	58.1	0.191
		Gumbel	517.4	521.2	58.3	0.204

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic		
33003	Turakina at SH3	Normal	519.2	523.0	59.4	0.209		
		Pearson III	515.4	521.2	58.0	0.192		
		Wakeby	520.1	529.8	57.5	0.181		
		Weibull	515.3	521.1	58.1	0.192		
		Log-Normal	515.1	520.9	58.4	0.188		
		LP3	516.5	522.3	57.6	0.190		
		Exponential	191.8	193.4	172.6	0.111		
		Gamma	191.5	193.0	171.0	0.112		
		GEV	193.5	195.8	171.2	0.115		
		Gen. Logistic	193.4	195.7	169.8	0.113		
		Gen. Normal	193.4	195.8	170.8	0.114		
		33004	Turakina at Otairi	Gen. Pareto	193.5	195.8	172.5	0.117
				Gumbel	191.5	193.0	170.7	0.111
Kappa	195.5			198.6	172.3	0.116		
Normal	191.4			193.0	170.9	0.116		
Pearson III	193.4			195.8	170.9	0.114		
Wakeby	197.5			201.3	171.9	0.114		
Weibull	193.5			195.8	171.3	0.114		
Log-Normal	193.4			195.8	170.8	0.114		
LP3	193.5			195.8	171.3	0.125		
Exponential	454.2			457.3	323.6	0.206		
Gamma	454.7			457.7	324.5	0.214		
GEV	456.2			460.8	323.5	0.196		
Gen. Logistic	456.3			460.8	321.9	0.194		
Gen. Normal	456.2			460.8	325.2	0.198		
Gen. Pareto	456.2			460.8	324.5	0.200		
Gumbel	454.8			457.8	325.6	0.215		
Kappa	458.2			464.3	324.2	0.198		
Normal	455.2	458.2	331.0	0.221				
Pearson III	456.2	460.7	324.5	0.202				
Wakeby	460.2	467.8	324.5	0.200				
Weibull	456.2	460.7	324.8	0.202				
Log-Normal	456.2	460.8	325.2	0.198				
LP3	456.4	461.0	334.7	0.204				
33012	Turakina at O'Neills	Exponential	581.3	585.0	225.6	0.075		
		Gamma	580.2	583.9	222.5	0.069		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
33101	Whangaehu at Kauangaroa	GEV	582.1	587.7	222.3	0.072
		Gen. Logistic	582.2	587.7	222.7	0.070
		Gen. Normal	582.1	587.7	222.3	0.072
		Gen. Pareto	582.1	587.6	221.3	0.074
		Gumbel	580.3	584.0	222.8	0.068
		Kappa	584.1	591.5	221.8	0.073
		Normal	580.1	583.8	222.7	0.074
		Pearson III	582.1	587.7	222.3	0.072
		Wakeby	586.1	595.3	221.7	0.073
		Weibull	582.1	587.7	222.0	0.072
		Log-Normal	582.1	587.7	222.3	0.072
		LP3	582.2	587.7	222.4	0.076
		Exponential	923.9	928.3	447.7	0.123
Gamma	923.1	927.5	444.7	0.122		
33107	Whangaehu at Karioi	GEV	925.2	931.8	446.3	0.122
		Gen. Logistic	925.3	931.9	447.5	0.120
		Gen. Normal	925.2	931.8	445.7	0.122
		Gen. Pareto	925.1	931.7	442.3	0.123
		Gumbel	923.1	927.5	445.5	0.122
		Kappa	927.1	936.0	443.7	0.122
		Normal	923.2	927.6	448.5	0.122
		Pearson III	925.2	931.8	444.6	0.122
		Wakeby	929.1	940.2	443.4	0.122
		Weibull	925.2	931.8	443.8	0.122
		Log-Normal	925.2	931.8	445.7	0.122
		LP3	925.6	932.2	451.3	0.128
		Exponential	692.7	696.9	95.1	0.192
		Gamma	701.3	705.6	95.6	0.185
		GEV	691.3	697.6	96.4	0.192
		Gen. Logistic	691.6	697.9	96.3	0.190
		Gen. Normal	691.3	697.6	96.2	0.195
Gen. Pareto	692.2	698.5	95.6	0.194		
Gumbel	700.1	704.3	95.8	0.186		
Normal	704.2	708.5	97.5	0.184		
Pearson III	692.5	698.9	95.3	0.195		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
33111	Mangawhero at Ore Ore	Wakeby	697.0	707.6	95.6	0.175
		Weibull	692.3	698.7	95.4	0.195
		Log-Normal	691.3	697.6	96.2	0.195
		LP3	711.0	717.4	92.0	0.156
		Exponential	795.8	800.1	229.7	0.139
		Gamma	797.6	801.9	229.8	0.144
		GEV	797.7	804.2	231.4	0.137
		Gen. Logistic	797.7	804.2	231.5	0.136
		Gen. Normal	797.8	804.2	230.9	0.138
		Gen. Pareto	797.9	804.4	229.3	0.139
		Gumbel	797.2	801.5	230.3	0.143
		Kappa	799.7	808.3	231.5	0.137
		Normal	798.4	802.7	233.3	0.147
		Pearson III	797.9	804.3	229.5	0.138
		Wakeby	801.8	812.5	230.4	0.135
		Weibull	797.9	804.3	229.4	0.139
Log-Normal	797.8	804.2	230.9	0.138		
LP3	797.9	804.3	230.4	0.137		
33112	Tokiahuru at Whangaehu Junction	Exponential	319.4	322.5	39.4	0.188
		Gamma	320.3	323.4	39.4	0.190
		GEV	321.6	326.3	39.4	0.186
		Gen. Logistic	321.7	326.4	39.4	0.183
		Gen. Normal	321.6	326.3	39.4	0.187
		Gen. Pareto	321.6	326.3	39.2	0.189
		Gumbel	320.1	323.2	39.4	0.189
		Normal	320.6	323.7	39.8	0.192
		Pearson III	321.6	326.3	39.3	0.188
		Wakeby	325.4	333.2	40.4	0.179
		Weibull	321.6	326.3	39.2	0.189
		Log-Normal	321.6	326.3	39.4	0.187
		LP3	322.4	327.1	38.9	0.182
33114	Waitangi at Tangiwai	Exponential	107.3	110.4	2.2	0.087
		Gamma	106.6	109.7	2.2	0.078
		GEV	108.6	113.2	2.2	0.078
		Gen. Logistic	108.6	113.2	2.2	0.078

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
33115	Mangaetoroa at School	Gen. Normal	108.6	113.2	2.2	0.078
		Gen. Pareto	108.6	113.1	2.2	0.078
		Gumbel	106.7	109.7	2.2	0.080
		Kappa	110.6	116.7	2.2	0.078
		Normal	106.6	109.6	2.2	0.078
		Pearson III	108.6	113.2	2.2	0.078
		Wakeby	112.6	120.2	2.2	0.076
		Weibull	108.6	113.2	2.2	0.078
		Log-Normal	108.6	113.2	2.2	0.078
		LP3	108.6	113.2	2.2	0.081
		Exponential	323.2	326.7	18.0	0.102
		Gamma	322.5	326.1	17.7	0.088
		GEV	324.5	329.9	17.8	0.089
		Gen. Logistic	324.6	329.9	17.8	0.087
		Gen. Normal	324.5	329.9	17.8	0.089
		Gen. Pareto	324.5	329.9	17.6	0.092
		Gumbel	322.6	326.1	17.8	0.086
		Kappa	326.5	333.7	17.8	0.089
		Normal	322.5	326.1	17.8	0.094
		Pearson III	324.5	329.9	17.7	0.089
Wakeby	328.5	337.5	17.8	0.088		
Weibull	324.5	329.9	17.7	0.090		
33119	Makotuku at Raetihi	Log-Normal	324.5	329.9	17.8	0.089
		LP3	324.6	329.9	17.9	0.086
		Exponential	240.7	243.0	75.1	0.238
		Gamma	240.9	243.1	75.6	0.240
		GEV	242.8	246.2	74.1	0.226
		Gen. Logistic	242.8	246.3	73.6	0.222
		Gen. Normal	242.8	246.2	74.8	0.232
		Gen. Pareto	242.8	246.2	74.9	0.234
		Gumbel	240.9	243.2	75.7	0.240
		Kappa	244.8	249.3	75.0	0.235
		Normal	241.0	243.3	77.1	0.244
		Pearson III	242.8	246.2	75.2	0.237
		Wakeby	246.8	252.4	74.9	0.234
		Weibull	242.8	246.2	75.2	0.236

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic		
33130	Whangaehu at Mangaio Tunnel	Log-Normal	242.8	246.2	74.8	0.232		
		LP3	243.5	246.9	78.5	0.248		
		Exponential	68.5	71.2	1.4	0.127		
		Gamma	67.9	70.7	1.4	0.141		
		GEV	70.0	74.1	1.4	0.135		
		Gen. Logistic	70.0	74.1	1.4	0.133		
		Gen. Normal	70.0	74.1	1.4	0.135		
		Gen. Pareto	70.0	74.1	1.4	0.138		
		Gumbel	68.0	70.7	1.4	0.136		
		Kappa	72.0	77.5	1.4	0.137		
		Normal	67.9	70.7	1.4	0.142		
		Pearson III	70.0	74.1	1.4	0.136		
		Wakeby	74.0	80.9	1.4	0.138		
		Weibull	70.0	74.1	1.4	0.136		
		Log-Normal	70.0	74.1	1.4	0.135		
33143	Mangawhero at Hagleys	LP3	70.1	74.2	1.4	0.136		
		Gamma	88.3	88.6	46.3	0.237		
		GEV	90.7	91.3	44.0	0.203		
		Gen. Logistic	91.0	91.6	43.6	0.195		
		Gen. Normal	90.5	91.0	44.6	0.210		
		Gen. Pareto	90.3	90.9	45.2	0.217		
		Gumbel	88.3	88.7	46.0	0.234		
		Normal	88.3	88.7	46.9	0.251		
		Pearson III	90.2	90.8	45.4	0.220		
		Wakeby	99.5	100.5	40.9	0.134		
		Weibull	90.3	90.8	45.4	0.219		
		Log-Normal	90.5	91.0	44.6	0.210		
		LP3	90.3	90.9	45.3	0.232		
		33149	Mangawhero at Pakihi Rd Br	Exponential	202.6	204.5	60.3	0.273
				Gamma	204.8	206.7	61.5	0.277
GEV	206.3			209.1	58.1	0.241		
Gen. Logistic	207.2			210.1	57.7	0.237		
Gen. Normal	203.6			206.4	59.5	0.257		
Gen. Pareto	204.3			207.1	58.9	0.253		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
33303	Whanganui at Te Rewa	Gumbel	204.5	206.4	61.2	0.276
		Normal	205.2	207.1	62.7	0.280
		Pearson III	202.2	205.0	60.6	0.270
		Wakeby	208.3	213.0	58.9	0.253
		Weibull	202.5	205.3	60.3	0.266
		Log-Normal	203.6	206.4	59.5	0.257
		LP3	206.6	209.5	58.1	0.250
		Exponential	1108.1	1112.6	1591.0	0.090
		Gamma	1107.1	1111.5	1575.3	0.096
		GEV	1109.2	1115.8	1578.5	0.093
		Gen. Logistic	1109.2	1115.9	1584.3	0.090
		Gen. Normal	1109.1	1115.8	1577.2	0.093
		Gen. Pareto	1109.1	1115.8	1564.3	0.096
		Gumbel	1107.2	1111.6	1578.5	0.093
		Kappa	1111.1	1120.0	1572.9	0.094
		Normal	1107.1	1111.6	1584.3	0.098
33307	Whanganui at Headwaters	Pearson III	1109.1	1115.8	1575.0	0.094
		Wakeby	1113.1	1124.2	1571.5	0.094
		Weibull	1109.1	1115.8	1571.5	0.094
		Log-Normal	1109.1	1115.8	1577.2	0.093
		LP3	1109.3	1115.9	1585.0	0.095
		Exponential	184.6	186.6	43.7	0.111
		Gamma	184.3	186.3	43.5	0.110
		GEV	186.3	189.3	43.5	0.110
		Gen. Logistic	186.3	189.3	43.3	0.106
		Gen. Normal	186.3	189.3	43.4	0.110
		Gen. Pareto	186.3	189.3	43.5	0.113
		Gumbel	184.3	186.3	43.4	0.109
		Kappa	188.3	192.3	43.4	0.110
		Normal	184.3	186.3	43.7	0.112
		Pearson III	186.3	189.3	43.5	0.110
		Wakeby	190.3	195.3	43.6	0.110
Weibull	186.3	189.3	43.5	0.110		
Log-Normal	186.3	189.3	43.4	0.110		
LP3	186.3	189.3	43.4	0.120		
33313	Ohura at Tokorima	Exponential	471.6	475.1	140.9	0.157

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic		
33314	Ohura at Nihoniho	Gamma	471.1	474.5	140.2	0.153		
		GEV	473.2	478.4	140.3	0.153		
		Gen. Logistic	473.2	478.4	140.3	0.151		
		Gen. Normal	473.2	478.4	140.2	0.154		
		Gen. Pareto	473.2	478.3	139.7	0.155		
		Gumbel	471.1	474.6	140.2	0.153		
		Kappa	475.2	482.1	140.1	0.154		
		Normal	471.1	474.6	141.0	0.154		
		Pearson III	473.2	478.3	140.1	0.154		
		Wakeby	477.2	485.7	139.7	0.155		
		Weibull	473.2	478.3	139.9	0.154		
		Log-Normal	473.2	478.4	140.2	0.154		
		LP3	473.4	478.5	141.7	0.160		
		Exponential	185.6	187.4	75.0	0.130		
		Gamma	185.2	187.0	74.4	0.148		
		GEV	187.2	189.9	74.5	0.150		
		Gen. Logistic	187.2	189.8	73.9	0.150		
		Gen. Normal	187.2	189.9	74.3	0.150		
		Gen. Pareto	187.2	189.9	75.2	0.148		
		33341	Mangaroa at Ohura Town Br	Gumbel	185.3	187.0	74.3	0.144
				Kappa	189.3	192.8	75.5	0.147
				Normal	185.2	187.0	74.4	0.151
Pearson III	187.2			189.9	74.4	0.150		
Wakeby	191.2			195.7	75.2	0.148		
Weibull	187.2			189.9	74.6	0.149		
Log-Normal	187.2			189.9	74.3	0.150		
LP3	187.3			189.9	74.8	0.150		
Exponential	175.0			176.8	56.0	0.097		
Gamma	174.6			176.3	55.6	0.102		
GEV	176.6			179.2	55.6	0.101		
Gen. Logistic	176.5			179.2	55.2	0.105		
Gen. Normal	176.6			179.2	55.5	0.102		
Gen. Pareto	176.6			179.3	55.9	0.099		
Gumbel	174.6			176.4	55.5	0.101		
Kappa	178.6	182.2	55.8	0.100				

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
33345	Whanganui at Pipiriki	Normal	174.5	176.3	55.6	0.102
		Pearson III	176.6	179.2	55.6	0.102
		Wakeby	180.6	185.1	55.8	0.099
		Weibull	176.6	179.3	55.7	0.101
		Log-Normal	176.6	179.2	55.5	0.102
		LP3	176.6	179.3	55.7	0.101
		Exponential	967.4	971.5	2133.0	0.152
		Gamma	967.6	971.7	2120.5	0.143
		GEV	969.4	975.5	2134.4	0.147
		Gen. Logistic	969.4	975.5	2140.1	0.145
		Gen. Normal	969.4	975.5	2130.1	0.147
		Gen. Pareto	969.4	975.5	2110.4	0.147
		Gumbel	967.5	971.6	2126.2	0.143
		Kappa	971.4	979.5	2136.9	0.147
		Normal	968.0	972.1	2141.9	0.141
		Pearson III	969.4	975.5	2121.5	0.147
Wakeby	973.4	983.6	2140.9	0.148		
Weibull	969.4	975.5	2117.5	0.146		
Log-Normal	969.4	975.5	2130.1	0.147		
LP3	969.5	975.6	2132.7	0.138		
33347	Whanganui at Te Porere	Exponential	457.0	461.2	22.8	0.087
		Gamma	455.5	459.6	22.3	0.100
		GEV	457.4	463.7	22.3	0.101
		Gen. Logistic	457.5	463.8	22.4	0.099
		Gen. Normal	457.4	463.7	22.3	0.101
		Gen. Pareto	457.4	463.6	22.1	0.103
		Gumbel	455.7	459.8	22.4	0.096
		Kappa	459.4	467.7	22.2	0.102
		Normal	455.4	459.6	22.3	0.102
		Pearson III	457.4	463.7	22.3	0.101
		Wakeby	461.4	471.8	22.3	0.102
		Weibull	457.4	463.6	22.3	0.101
		Log-Normal	457.4	463.7	22.3	0.101
		LP3	457.5	463.7	22.3	0.104
		33366	Matarawa at Diversion	Exponential	113.7	115.4
Gamma	113.3			115.1	10.1	0.094

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		GEV	115.3	117.9	10.1	0.097
		Gen. Logistic	115.2	117.9	10.1	0.095
		Gen. Normal	115.3	117.9	10.1	0.096
		Gen. Pareto	115.3	118.0	10.1	0.098
		Gumbel	113.3	115.1	10.1	0.093
		Kappa	117.3	120.8	10.1	0.097
		Normal	113.3	115.0	10.1	0.098
		Pearson III	115.3	117.9	10.1	0.096
		Wakeby	119.3	123.8	10.2	0.098
		Weibull	115.3	117.9	10.1	0.096
		Log-Normal	115.3	117.9	10.1	0.096
		LP3	115.3	117.9	10.1	0.106
33502	Kai Iwi at Handley Rd	Exponential	420.2	423.9	37.0	0.204
		Gamma	420.6	424.3	36.9	0.207
		GEV	422.2	427.8	37.1	0.200
		Gen. Logistic	422.2	427.8	37.1	0.198
		Gen. Normal	422.2	427.8	37.1	0.202
		Gen. Pareto	422.2	427.7	36.9	0.204
		Gumbel	420.7	424.4	37.1	0.207
		Kappa	424.2	431.6	37.1	0.200
		Normal	421.2	424.9	37.5	0.211
		Pearson III	422.2	427.7	37.0	0.204
		Wakeby	426.2	435.5	37.4	0.202
		Weibull	422.2	427.7	37.0	0.204
		Log-Normal	422.2	427.8	37.1	0.202
		LP3	422.2	427.8	37.4	0.206
1032501	Kumeti at Te Rehunga	Exponential	274.2	277.8	9.5	0.110
		Gamma	273.7	277.3	9.4	0.122
		GEV	275.7	281.1	9.4	0.120
		Gen. Logistic	275.7	281.1	9.4	0.117
		Gen. Normal	275.7	281.1	9.4	0.120
		Gen. Pareto	275.7	281.1	9.4	0.123
		Gumbel	273.7	277.3	9.4	0.121
		Kappa	277.7	284.9	9.4	0.122
		Normal	273.7	277.3	9.5	0.128

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic		
1032504	Tamaki at Water Supply Weir	Pearson III	275.7	281.1	9.4	0.121		
		Wakeby	279.7	288.7	9.4	0.122		
		Weibull	275.7	281.1	9.4	0.122		
		Log-Normal	275.7	281.1	9.4	0.120		
		LP3	275.7	281.2	9.5	0.123		
		Exponential	422.1	425.7	59.2	0.185		
		Gamma	421.9	425.4	59.1	0.190		
		GEV	424.0	429.3	59.2	0.184		
		Gen. Logistic	424.0	429.3	59.1	0.182		
		Gen. Normal	424.0	429.3	59.2	0.186		
		Gen. Pareto	424.0	429.2	59.1	0.189		
		Gumbel	421.9	425.4	59.2	0.196		
		Kappa	425.9	433.0	58.9	0.191		
		Normal	422.0	425.5	59.9	0.203		
		Pearson III	424.0	429.3	59.1	0.188		
		Wakeby	428.0	436.8	59.1	0.189		
Weibull	424.0	429.2	59.1	0.188				
Log-Normal	424.0	429.3	59.2	0.186				
1032517	Tokomaru at Quarry	LP3	426.3	431.6	62.4	0.183		
		Exponential	214.0	216.0	71.1	0.107		
		Gamma	213.7	215.8	70.3	0.095		
		GEV	215.7	218.8	70.4	0.094		
		Gen. Logistic	215.6	218.8	70.3	0.092		
		Gen. Normal	215.6	218.8	70.3	0.094		
		Gen. Pareto	215.7	218.8	70.1	0.096		
		Gumbel	213.7	215.8	70.4	0.095		
		Normal	213.6	215.7	70.4	0.094		
		Pearson III	215.7	218.8	70.3	0.094		
		Wakeby	219.7	224.9	70.6	0.091		
		Weibull	215.7	218.8	70.3	0.094		
		Log-Normal	215.6	218.8	70.3	0.094		
		LP3	215.6	218.8	70.0	0.094		
		1032518	Makakahi at Hamua	Exponential	532.5	536.1	146.6	0.114
				Gamma	532.2	535.9	145.1	0.100
GEV	534.2			539.7	145.3	0.101		
Gen. Logistic	534.2			539.7	145.8	0.101		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1032542	Makino at Reids Line	Gen. Normal	534.2	539.7	145.2	0.101
		Gen. Pareto	534.2	539.7	143.9	0.100
		Gumbel	532.2	535.8	145.4	0.103
		Normal	532.3	535.9	145.8	0.098
		Pearson III	534.2	539.7	145.1	0.101
		Wakeby	538.2	547.3	145.8	0.101
		Weibull	534.2	539.7	144.7	0.100
		Log-Normal	534.2	539.7	145.2	0.101
		LP3	534.3	539.8	144.2	0.097
		Exponential	166.4	168.2	40.7	0.243
		Gamma	166.4	168.2	40.7	0.246
		GEV	168.4	171.1	39.9	0.234
		Gen. Logistic	168.5	171.2	39.6	0.231
		Gen. Normal	168.5	171.1	40.4	0.237
		Gen. Pareto	168.5	171.1	40.5	0.239
		Gumbel	166.4	168.2	40.9	0.251
		Kappa	170.5	174.1	40.7	0.241
		Normal	166.5	168.2	41.7	0.257
		Pearson III	168.5	171.2	40.7	0.240
1032555	Mangatainoka at Larsons Br	Wakeby	172.5	176.9	40.5	0.239
		Weibull	168.5	171.2	40.7	0.240
		Log-Normal	168.5	171.1	40.4	0.237
		LP3	169.4	172.1	42.9	0.249
		Exponential	440.5	444.0	89.3	0.091
		Gamma	439.4	442.9	86.8	0.072
		GEV	441.4	446.6	86.5	0.074
		Gen. Logistic	441.5	446.7	86.8	0.073
		Gen. Normal	441.4	446.6	86.6	0.074
		Gen. Pareto	441.4	446.6	86.1	0.074
		Gumbel	439.6	443.1	87.5	0.074
		Kappa	443.4	450.4	86.5	0.074
		Normal	439.4	442.9	86.6	0.073
		Pearson III	441.4	446.6	86.6	0.074
		Wakeby	445.4	454.1	86.6	0.073
Weibull	441.4	446.6	86.6	0.073		
LP3	441.4	446.6	86.4	0.077		

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1032560	Manawatu at Teachers College	Exponential	1933.0	1938.6	1201.7	0.108
		Gamma	1931.8	1937.4	1185.9	0.106
		GEV	1933.7	1942.1	1190.4	0.105
		Gen. Logistic	1933.8	1942.2	1199.5	0.105
		Gen. Normal	1933.7	1942.1	1189.1	0.105
		Gen. Pareto	1933.8	1942.3	1173.2	0.106
		Gumbel	1931.7	1937.3	1190.5	0.105
		Kappa	1935.7	1947.0	1194.3	0.105
		Normal	1932.0	1937.6	1192.4	0.106
		Pearson III	1933.7	1942.1	1186.3	0.105
		Wakeby	1937.7	1951.8	1193.9	0.105
		Weibull	1933.7	1942.2	1182.2	0.106
		Log-Normal	1933.7	1942.1	1189.1	0.105
		LP3	1933.7	1942.1	1186.5	0.105
1032561	Makino at Rata St	Exponential	352.7	356.0	46.6	0.106
		Gamma	352.2	355.5	46.3	0.108
		GEV	354.2	359.1	46.3	0.108
		Gen. Logistic	354.2	359.1	46.3	0.106
		Gen. Normal	354.2	359.1	46.3	0.108
		Gen. Pareto	354.2	359.1	46.0	0.110
		Gumbel	352.2	355.5	46.3	0.108
		Kappa	356.2	362.7	46.2	0.109
		Normal	352.1	355.4	46.5	0.112
		Pearson III	354.2	359.1	46.2	0.109
		Wakeby	358.2	366.4	46.3	0.109
		Weibull	354.2	359.1	46.2	0.109
		Log-Normal	354.2	359.1	46.3	0.108
		LP3	354.1	359.1	45.8	0.113
1032564	Makino at Boness Rd	Exponential	308.7	311.8	42.3	0.150
		Gamma	308.2	311.3	41.9	0.152
		GEV	310.2	314.8	41.9	0.153
		Gen. Logistic	310.2	314.8	41.9	0.150
		Gen. Normal	310.2	314.8	41.9	0.153
		Gen. Pareto	310.2	314.7	41.7	0.155

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		Gumbel	308.2	311.3	41.9	0.152
		Kappa	312.2	318.3	41.9	0.153
		Normal	308.1	311.2	42.0	0.155
		Pearson III	310.2	314.8	41.9	0.153
		Wakeby	314.1	321.8	40.9	0.165
		Weibull	310.2	314.8	41.8	0.153
		Log-Normal	310.2	314.8	41.9	0.153
		LP3	310.1	314.7	41.7	0.157
1032591	Makuri at Tuscan Hills	Exponential	287.4	289.9	111.0	0.137
		Gamma	287.0	289.5	110.3	0.151
		GEV	289.0	292.7	110.3	0.152
		Gen. Logistic	288.9	292.7	110.0	0.151
		Gen. Normal	289.0	292.7	110.2	0.152
		Gen. Pareto	289.0	292.7	110.2	0.153
		Gumbel	287.0	289.5	110.3	0.150
		Kappa	291.0	296.0	110.3	0.153
		Normal	286.9	289.4	110.8	0.158
		Pearson III	289.0	292.7	110.3	0.152
		Wakeby	293.0	299.2	110.2	0.153
		Weibull	289.0	292.7	110.2	0.152
		Log-Normal	289.0	292.7	110.2	0.152
		LP3	289.1	292.9	111.2	0.153
1033153	Whangaehu at Aranui	Exponential	250.1	252.1	200.1	0.269
		Gamma	250.4	252.4	202.0	0.278
		GEV	252.3	255.3	194.5	0.253
		Gen. Logistic	252.5	255.5	192.9	0.251
		Gen. Normal	252.1	255.1	198.1	0.255
		Gen. Pareto	252.1	255.1	197.7	0.256
		Gumbel	250.4	252.4	202.3	0.279
		Kappa	254.1	258.1	199.2	0.258
		Normal	250.6	252.6	206.5	0.285
		Pearson III	252.1	255.1	200.4	0.260
		Wakeby	256.1	261.1	197.7	0.256
		Weibull	252.1	255.1	200.1	0.258
		Log-Normal	252.1	255.1	198.1	0.255
		LP3	252.8	255.8	210.7	0.259

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1033154	Mangawhero at Raupiu Road	Exponential	181.2	182.4	409.5	0.264
		Gamma	181.2	182.3	412.4	0.271
		GEV	183.2	184.9	398.9	0.255
		Gen. Logistic	183.3	185.0	395.0	0.252
		Gen. Normal	183.2	184.9	403.9	0.258
		Gen. Pareto	183.2	184.9	406.9	0.260
		Gumbel	181.2	182.3	412.3	0.273
		Kappa	185.2	187.5	407.6	0.261
		Normal	181.2	182.3	419.4	0.280
		Pearson III	183.3	185.0	409.0	0.262
		Wakeby	187.2	190.1	406.9	0.260
		Weibull	183.3	185.0	408.6	0.261
		Log-Normal	183.2	184.9	403.9	0.258
		LP3	183.6	185.3	422.8	0.271
1033363	Matarawa at City Branch	Exponential	129.2	131.9	4.0	0.120
		Gamma	129.2	132.0	4.0	0.105
		GEV	131.2	135.3	4.0	0.106
		Gen. Logistic	131.2	135.3	4.0	0.104
		Gen. Normal	131.2	135.3	4.0	0.105
		Gen. Pareto	131.2	135.3	3.9	0.106
		Gumbel	129.2	131.9	4.0	0.107
		Normal	129.3	132.0	4.0	0.104
		Pearson III	131.2	135.3	4.0	0.105
		Wakeby	135.2	142.0	4.0	0.107
		Weibull	131.2	135.3	4.0	0.105
		Log-Normal	131.2	135.3	4.0	0.105
		LP3	131.4	135.5	4.0	0.097
		1132508	Oroua at Almadale Slackline	Exponential	787.9	792.3
Gamma	789.0			793.3	168.0	0.113
GEV	790.2			796.8	169.2	0.113
Gen. Logistic	790.1			796.7	170.0	0.111
Gen. Normal	790.3			796.9	168.8	0.113
Gen. Pareto	790.6			797.1	166.8	0.114
Gumbel	788.8			793.1	168.6	0.113
Normal	789.7			794.0	169.8	0.114

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1132511	Mangatainoka at Pahiatua Town Bridge	Pearson III	790.4	797.0	168.0	0.114
		Wakeby	794.0	804.9	171.4	0.115
		Weibull	790.5	797.0	167.6	0.114
		Log-Normal	790.3	796.9	168.8	0.113
		LP3	792.2	798.8	166.1	0.099
		Exponential	921.2	925.7	297.3	0.114
		Gamma	920.9	925.4	294.7	0.102
		GEV	922.8	929.6	295.6	0.103
		Gen. Logistic	922.8	929.6	296.9	0.103
		Gen. Normal	922.8	929.6	295.2	0.103
		Gen. Pareto	922.9	929.7	292.1	0.103
		Gumbel	920.8	925.3	295.4	0.103
		Kappa	924.8	933.8	296.6	0.103
		Normal	921.1	925.6	296.8	0.102
		Pearson III	922.8	929.6	294.6	0.103
1132517	Kiwitea at Haynes Line	Wakeby	926.8	938.1	296.3	0.104
		Weibull	922.8	929.6	293.8	0.103
		Log-Normal	922.8	929.6	295.2	0.103
		LP3	922.8	929.6	294.3	0.103
		Exponential	139.5	140.7	80.9	0.235
		Gamma	139.5	140.7	81.2	0.239
		GEV	141.7	143.4	77.5	0.221
		Gen. Logistic	141.8	143.5	76.8	0.220
		Gen. Normal	141.6	143.3	79.0	0.224
		Gen. Pareto	141.6	143.3	79.2	0.224
		Gumbel	139.5	140.7	81.7	0.245
		Kappa	143.7	146.0	81.5	0.229
		Normal	139.5	140.7	83.5	0.253
		Pearson III	141.6	143.3	80.5	0.227
		1132519	Kahuterawa at Johnstons Rata	Wakeby	145.6	148.4
Weibull	141.6			143.3	80.3	0.226
Log-Normal	141.6			143.3	79.0	0.224
LP3	142.8			144.5	87.0	0.240
Exponential	186.0			187.9	56.3	0.187
Gamma	185.7			187.6	56.3	0.198

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
		GEV	187.8	190.6	56.0	0.192
		Gen. Logistic	187.7	190.6	55.6	0.190
		Gen. Normal	187.8	190.6	56.1	0.192
		Gen. Pareto	187.8	190.7	56.4	0.195
		Gumbel	185.7	187.6	56.2	0.197
		Kappa	189.8	193.6	56.2	0.193
		Normal	185.7	187.6	56.7	0.203
		Pearson III	187.8	190.6	56.2	0.193
		Wakeby	191.8	196.6	56.4	0.195
		Weibull	187.8	190.6	56.2	0.193
		Log-Normal	187.8	190.6	56.1	0.192
		LP3	188.0	190.8	57.0	0.198
1132523	Kiwitea at Strathspey Farm	Exponential	329.8	332.8	75.8	0.148
		Gamma	329.5	332.5	75.5	0.157
		GEV	331.6	336.0	75.5	0.154
		Gen. Logistic	331.5	335.9	75.3	0.153
		Gen. Normal	331.6	336.0	75.5	0.155
		Gen. Pareto	331.5	335.9	75.5	0.157
		Gumbel	329.5	332.4	75.6	0.160
		Kappa	333.5	339.4	75.4	0.158
		Normal	329.5	332.4	76.3	0.167
		Pearson III	331.6	336.0	75.5	0.156
		Wakeby	335.5	342.9	75.5	0.157
		Weibull	331.5	335.9	75.5	0.156
		Log-Normal	331.6	336.0	75.5	0.155
		LP3	332.2	336.6	77.7	0.152
1232561	Raparapawai at Jackson Rd	Exponential	224.5	226.7	46.3	0.213
		Gamma	225.4	227.7	46.5	0.220
		GEV	226.7	230.1	46.0	0.204
		Gen. Logistic	227.1	230.6	45.7	0.202
		Gen. Normal	226.3	229.7	46.3	0.206
		Gen. Pareto	226.2	229.6	46.3	0.208
		Gumbel	225.7	228.0	46.7	0.222
		Normal	226.3	228.5	47.6	0.228
		Pearson III	226.0	229.4	46.4	0.210

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1232563	Mangapapa at Troup Road	Wakeby	233.7	239.4	44.5	0.192
		Weibull	226.0	229.4	46.4	0.209
		Log-Normal	226.3	229.7	46.3	0.206
		LP3	229.0	232.4	45.0	0.212
		Exponential	164.8	166.5	42.1	0.120
		Gamma	164.4	166.2	41.8	0.128
		GEV	166.4	169.0	41.7	0.131
		Gen. Logistic	166.3	169.0	41.5	0.134
		Gen. Normal	166.3	169.0	41.7	0.131
		Gen. Pareto	166.4	169.1	42.0	0.132
		Gumbel	164.4	166.2	41.7	0.130
		Kappa	168.4	172.0	42.0	0.132
		Normal	164.3	166.1	41.8	0.133
		Pearson III	166.4	169.0	41.7	0.131
		Wakeby	170.4	174.8	42.0	0.132
		Weibull	166.4	169.0	41.8	0.130
Log-Normal	166.3	169.0	41.7	0.131		
1232564	Manga-Atua at Hopelands Rd	LP3	166.4	169.1	42.0	0.141
		Exponential	290.5	293.3	55.7	0.182
		Gamma	290.4	293.2	55.1	0.174
		GEV	292.4	296.6	55.2	0.174
		Gen. Logistic	292.4	296.6	55.3	0.172
		Gen. Normal	292.4	296.6	55.2	0.174
		Gen. Pareto	292.4	296.6	54.8	0.175
		Gumbel	290.4	293.2	55.2	0.175
		Normal	290.4	293.2	55.4	0.174
		Pearson III	292.4	296.6	55.2	0.174
		Wakeby	296.4	303.4	55.6	0.168
		Weibull	292.4	296.6	55.1	0.174
		Log-Normal	292.4	296.6	55.2	0.174
1232566	Manawatu at Upper Gorge	LP3	292.5	296.7	54.6	0.169
		Exponential	863.4	867.4	1320.1	0.171
		Gamma	863.3	867.2	1311.0	0.170
		GEV	865.2	871.2	1319.5	0.169
		Gen. Logistic	865.2	871.2	1322.0	0.167

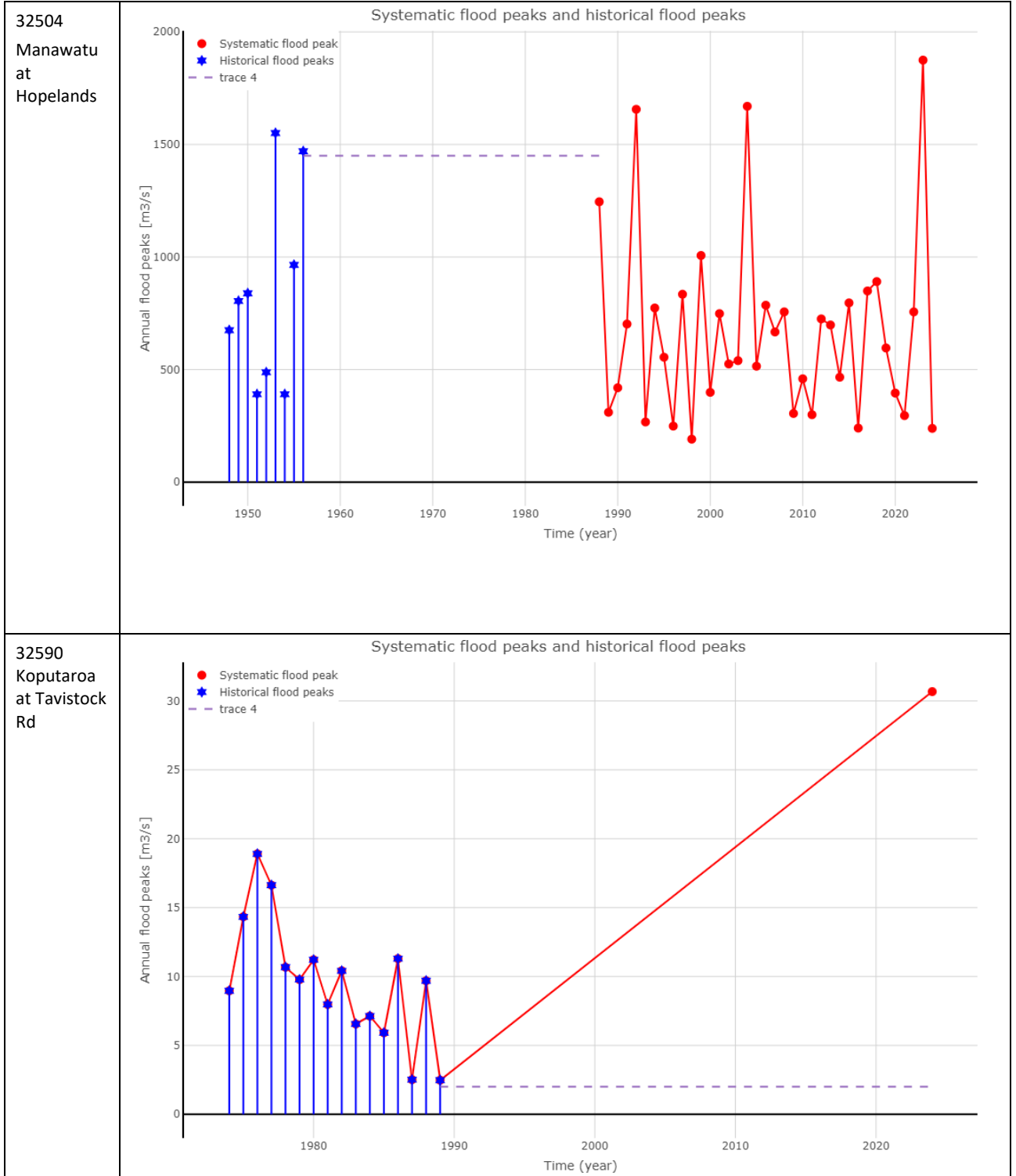
Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1232581	Oruakeretaki at SH2(Napier)	Gen. Normal	865.2	871.2	1317.3	0.170
		Gen. Pareto	865.2	871.1	1306.4	0.171
		Gumbel	863.2	867.2	1314.3	0.170
		Kappa	867.2	875.2	1322.1	0.168
		Normal	863.5	867.4	1322.3	0.170
		Pearson III	865.2	871.2	1312.7	0.170
		Wakeby	869.2	879.1	1306.4	0.171
		Weibull	865.2	871.2	1310.4	0.170
		Log-Normal	865.2	871.2	1317.3	0.170
		LP3	865.2	871.2	1317.5	0.168
		Exponential	156.6	158.4	31.8	0.144
		Gamma	156.6	158.4	31.8	0.144
		GEV	158.6	161.3	31.7	0.142
		Gen. Logistic	158.6	161.3	31.6	0.137
		Gen. Normal	158.6	161.3	31.7	0.142
		Gen. Pareto	158.6	161.2	31.8	0.147
		Gumbel	156.6	158.4	31.8	0.143
		Normal	156.6	158.4	32.0	0.147
		Pearson III	158.6	161.3	31.7	0.143
		Wakeby	162.8	167.3	31.0	0.122
Weibull	158.6	161.3	31.7	0.144		
1332518	Mangatoro at Mangahei Road	Log-Normal	158.6	161.3	31.7	0.142
		LP3	158.6	161.3	31.5	0.146
		Exponential	279.4	281.6	241.9	0.133
		Gamma	279.3	281.5	241.4	0.136
		GEV	281.3	284.6	240.9	0.133
		Gen. Logistic	281.3	284.6	239.7	0.133
		Gen. Normal	281.3	284.6	241.2	0.134
		Gen. Pareto	281.3	284.6	241.6	0.135
		Gumbel	279.3	281.5	241.7	0.140
		Kappa	283.3	287.7	241.1	0.134
		Normal	279.3	281.5	244.2	0.148
		Pearson III	281.3	284.6	241.4	0.134
		Wakeby	285.3	290.8	242.7	0.133
		Weibull	281.3	284.6	241.4	0.134

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1332556	Tamaki at Stephensons	Log-Normal	281.3	284.6	241.2	0.134
		LP3	281.3	284.6	239.9	0.149
		Exponential	187.7	189.4	100.2	0.235
		Gamma	187.7	189.3	100.2	0.236
		GEV	189.6	192.1	98.3	0.228
		Gen. Logistic	189.6	192.1	97.4	0.225
		Gen. Normal	189.7	192.2	99.3	0.230
		Gen. Pareto	189.7	192.2	99.9	0.232
		Gumbel	187.6	189.3	100.7	0.243
		Kappa	191.9	195.2	101.2	0.237
		Normal	187.6	189.3	102.4	0.250
		Pearson III	189.7	192.2	100.2	0.233
		Wakeby	193.7	197.9	99.9	0.232
		Weibull	189.7	192.2	100.1	0.233
1425006	Waihi at S.H.52	Log-Normal	189.7	192.2	99.3	0.230
		LP3	191.7	194.2	108.9	0.241
		Exponential	279.4	281.4	399.2	0.245
		Gamma	279.6	281.6	399.9	0.244
		GEV	281.7	284.7	390.1	0.225
		Gen. Logistic	282.0	285.0	387.1	0.218
		Gen. Normal	281.3	284.3	396.2	0.237
		Gen. Pareto	281.3	284.3	395.6	0.238
		Gumbel	280.0	282.0	403.7	0.242
		Normal	280.3	282.3	412.1	0.244
		Pearson III	281.1	284.1	400.0	0.248
		Wakeby	286.1	291.1	385.4	0.215
		Weibull	281.2	284.1	399.5	0.246
		1425101	Owahanga at Branscombe Bridge	Log-Normal	281.3	284.3
LP3	281.2			284.2	400.1	0.250
Exponential	293.0			295.1	323.1	0.177
Gamma	292.8			295.0	324.4	0.181
GEV	294.9			298.2	320.5	0.172
Gen. Logistic	294.9			298.2	318.4	0.168
Gen. Normal	294.9			298.2	322.0	0.174

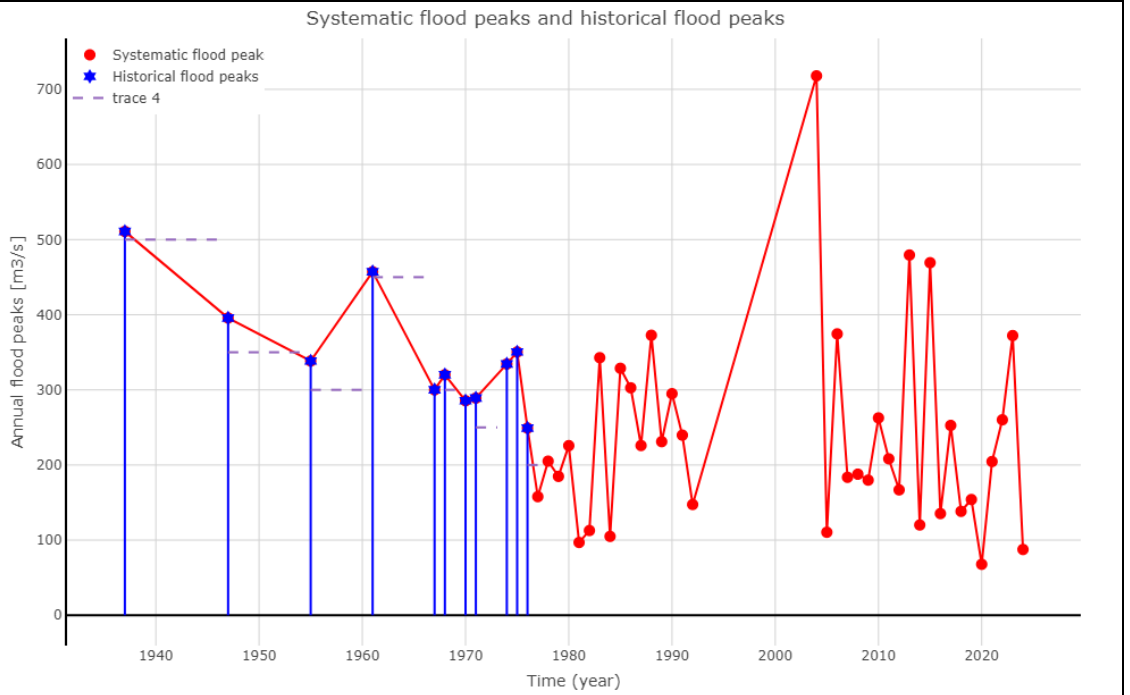
Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
1432003	Manakau at S.H.1 Bridge	Gen. Pareto	294.9	298.2	323.2	0.178
		Gumbel	292.8	295.0	324.2	0.181
		Kappa	296.9	301.3	323.3	0.178
		Normal	292.9	295.1	329.0	0.188
		Pearson III	294.9	298.2	323.0	0.177
		Wakeby	298.9	304.4	323.2	0.178
		Weibull	294.9	298.2	323.0	0.177
		Log-Normal	294.9	298.2	322.0	0.174
		LP3	295.4	298.7	332.9	0.188
		Exponential	155.8	157.5	29.7	0.188
		Gamma	155.8	157.6	29.9	0.193
		GEV	157.8	160.5	29.2	0.181
		Gen. Logistic	157.9	160.6	28.9	0.178
		Gen. Normal	157.8	160.4	29.5	0.184
		Gen. Pareto	157.8	160.4	29.6	0.185
		Gumbel	155.8	157.6	30.0	0.196
		Kappa	159.8	163.3	29.5	0.184
		Normal	155.9	157.7	30.5	0.202
		1432008	Waikawa at North Manakau Road	Pearson III	157.8	160.5
Wakeby	161.8			166.2	29.6	0.185
Weibull	157.8			160.5	29.7	0.186
Log-Normal	157.8			160.4	29.5	0.184
LP3	158.1			160.8	30.7	0.195
Exponential	188.9			190.7	75.5	0.248
Gamma	188.9			190.6	75.9	0.256
GEV	190.9			193.6	73.9	0.239
Gen. Logistic	191.0			193.6	73.3	0.239
Gen. Normal	190.9			193.6	74.8	0.240
Gen. Pareto	190.9			193.6	75.1	0.242
Gumbel	188.9			190.7	76.1	0.259
Kappa	193.0			196.6	76.0	0.247
Normal	188.9			190.7	77.4	0.266
Pearson III	191.0			193.6	75.5	0.244
Wakeby	194.9			199.4	75.1	0.242
Weibull	191.0			193.6	75.5	0.244
Log-Normal	190.9			193.6	74.8	0.240

Site	Site name	Distribution	AIC	BIC	RMSE	KS_Statistic
2232510	Tokomaru at Riverland Farm	LP3	192.2	194.9	80.5	0.249
		Exponential	492.0	495.7	99.2	0.101
		Gamma	493.1	496.7	98.5	0.093
		GEV	494.8	500.2	98.9	0.094
		Gen. Logistic	494.8	500.2	99.2	0.093
		Gen. Normal	494.9	500.3	98.7	0.094
		Gen. Pareto	495.1	500.5	97.7	0.094
		Gumbel	492.9	496.5	98.8	0.094
		Normal	493.6	497.2	99.4	0.093
		Pearson III	494.9	500.3	98.5	0.094
		Wakeby	498.9	508.0	98.3	0.089
		Weibull	495.0	500.4	98.2	0.094
		Log-Normal	494.9	500.3	98.7	0.094
		LP3	496.8	502.2	96.5	0.079

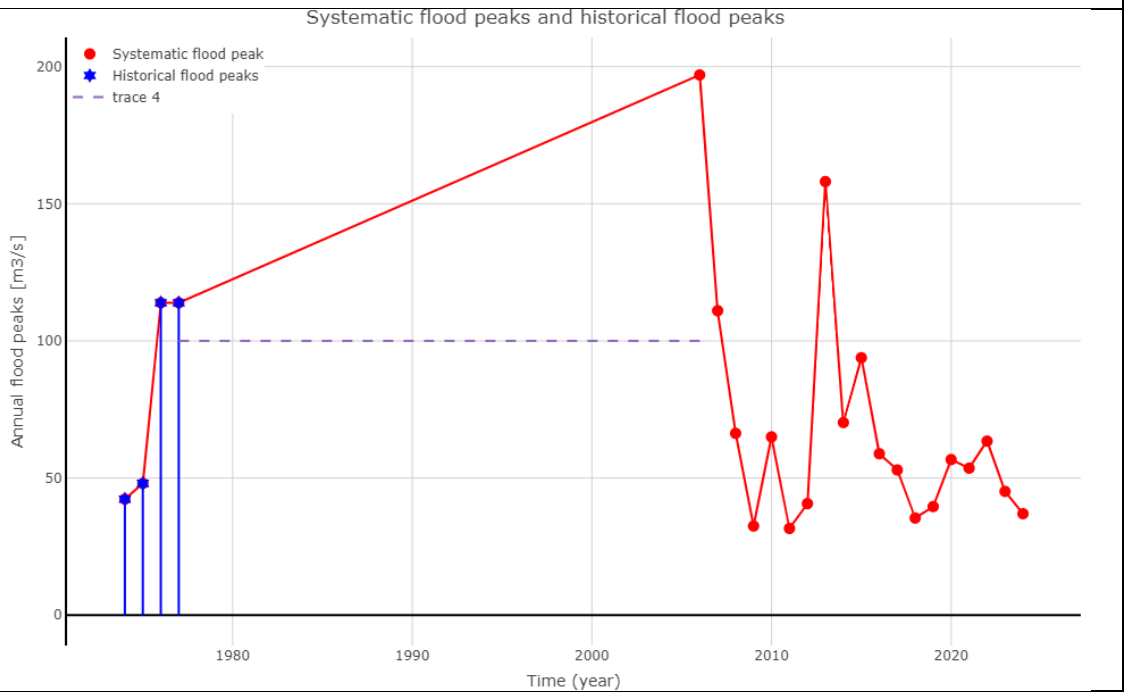
## Appendix D Sites with historical information and systematic records



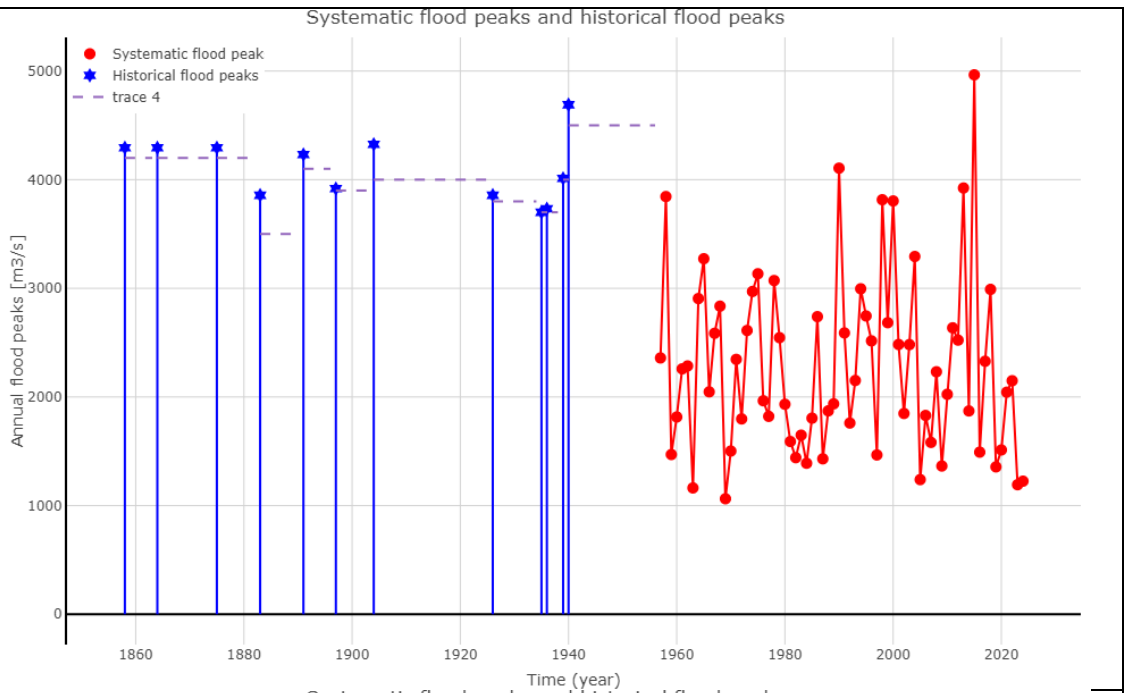
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Turakina at  
O'Neills



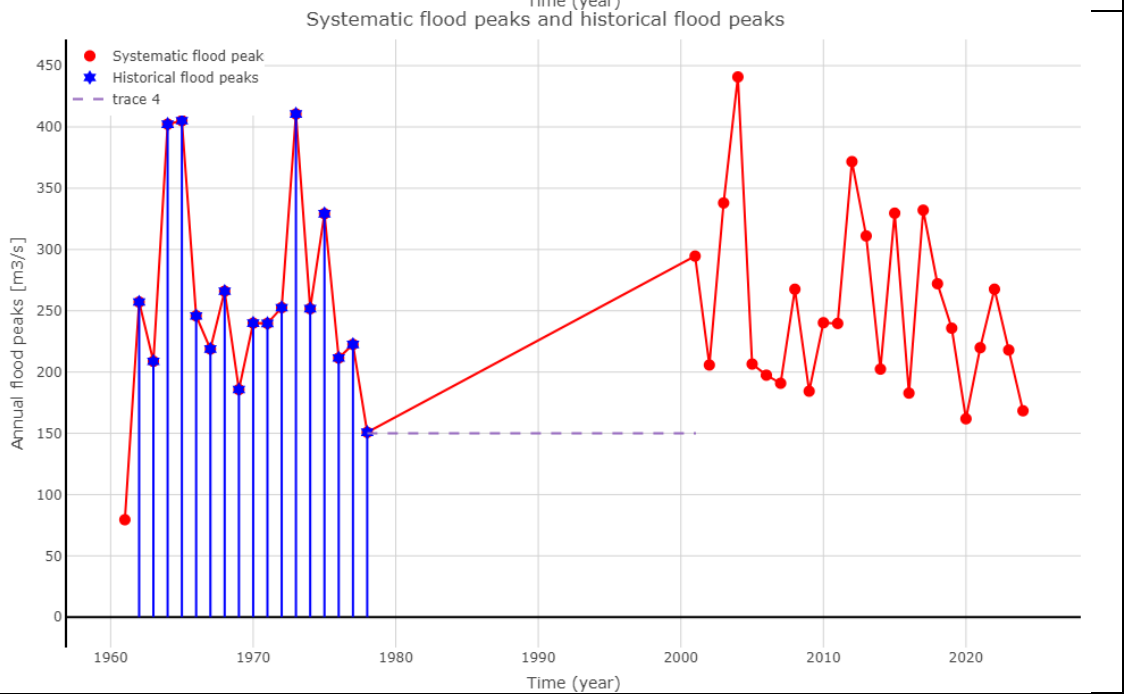
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Makotuku at  
Raetihi



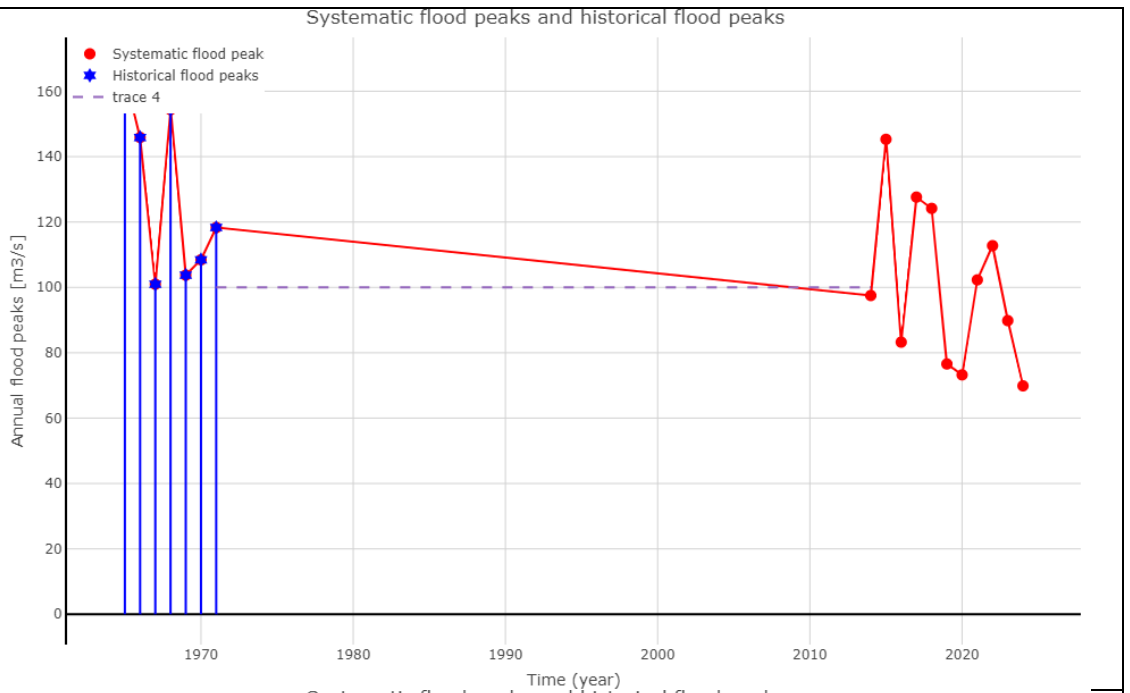
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Whanganui at Te Rewa



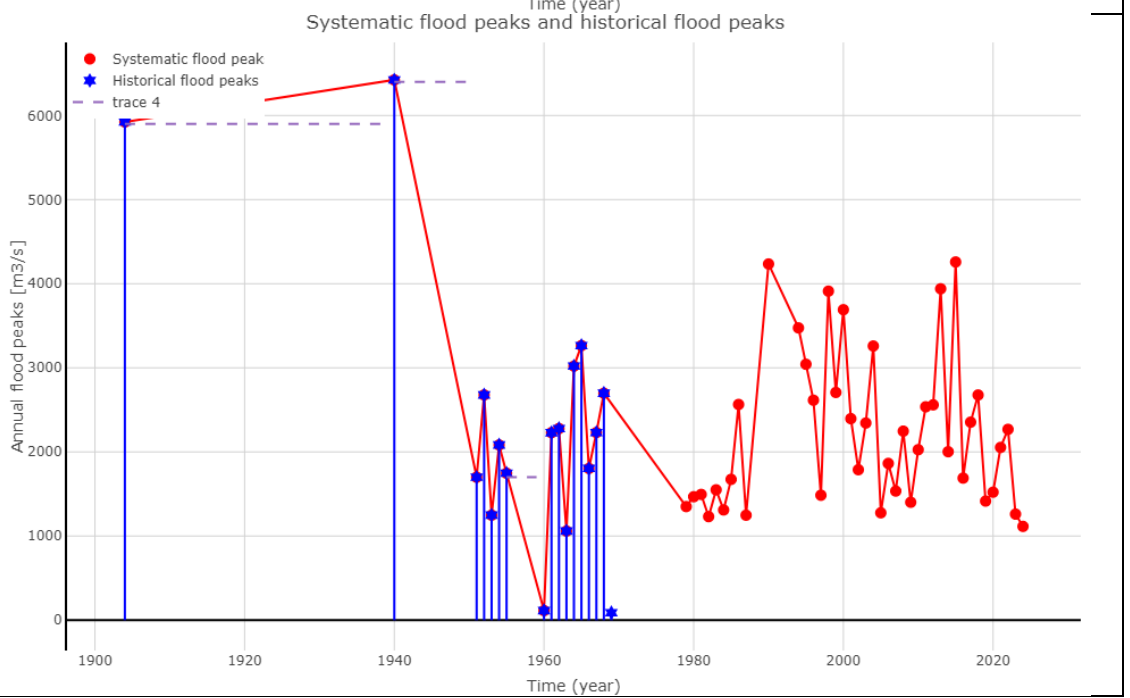
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Ohura at Tokorima



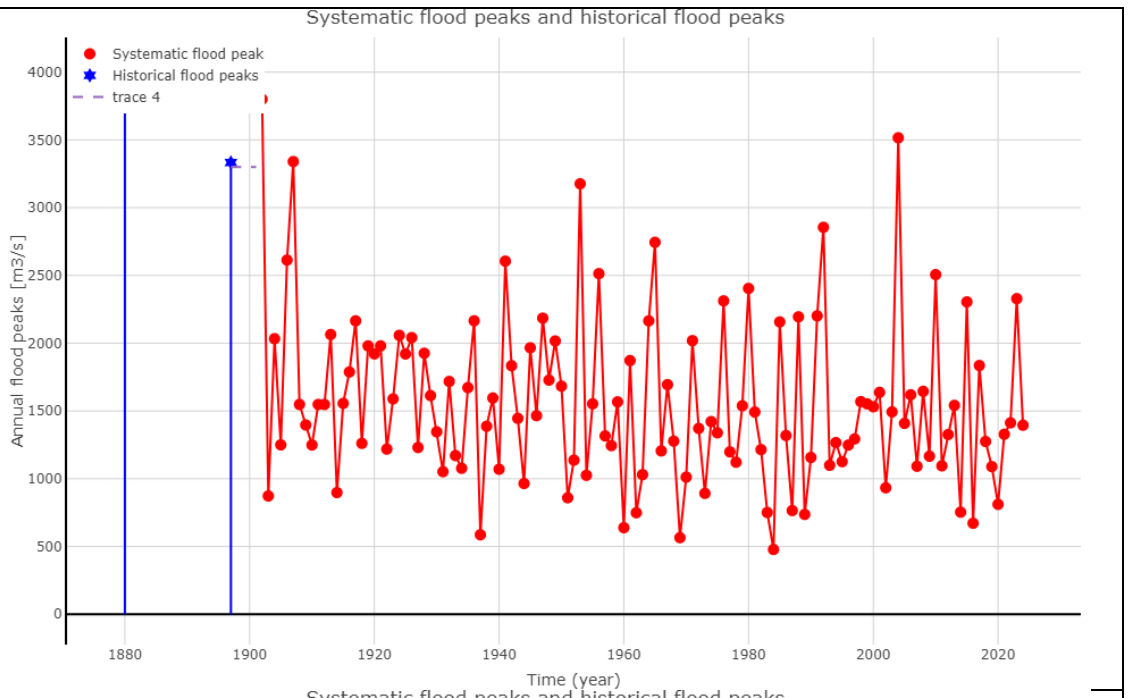
33341  
Mangaro  
a at  
Ohura  
Town Br



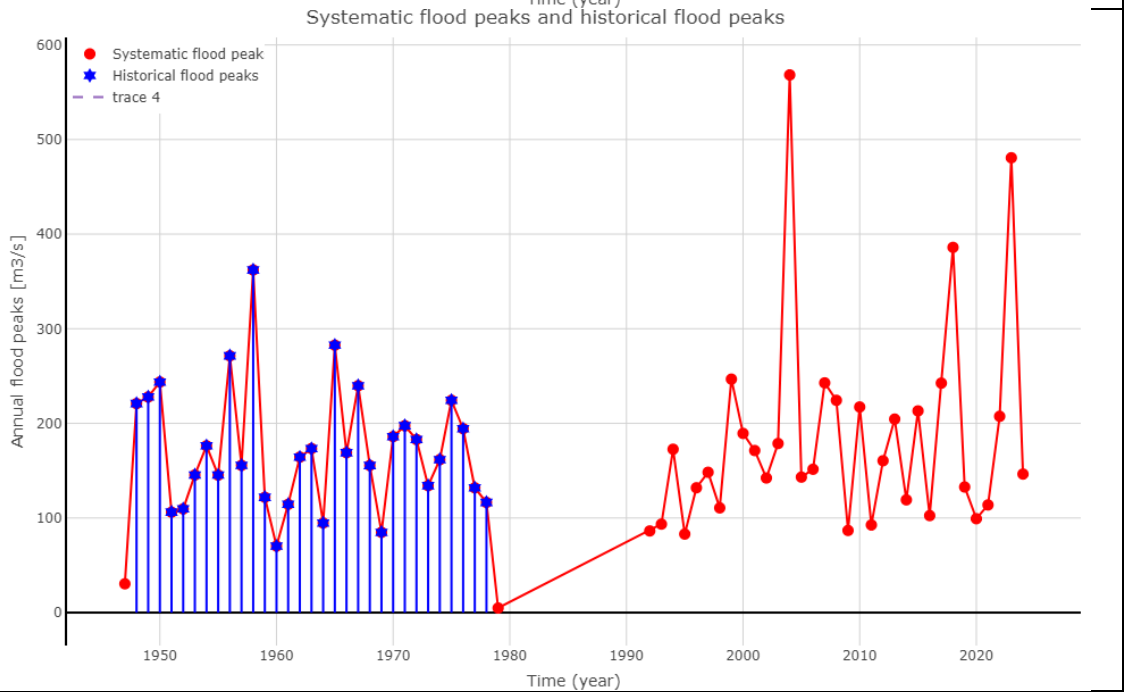
33345  
Whangan  
ui at  
Pipiriki



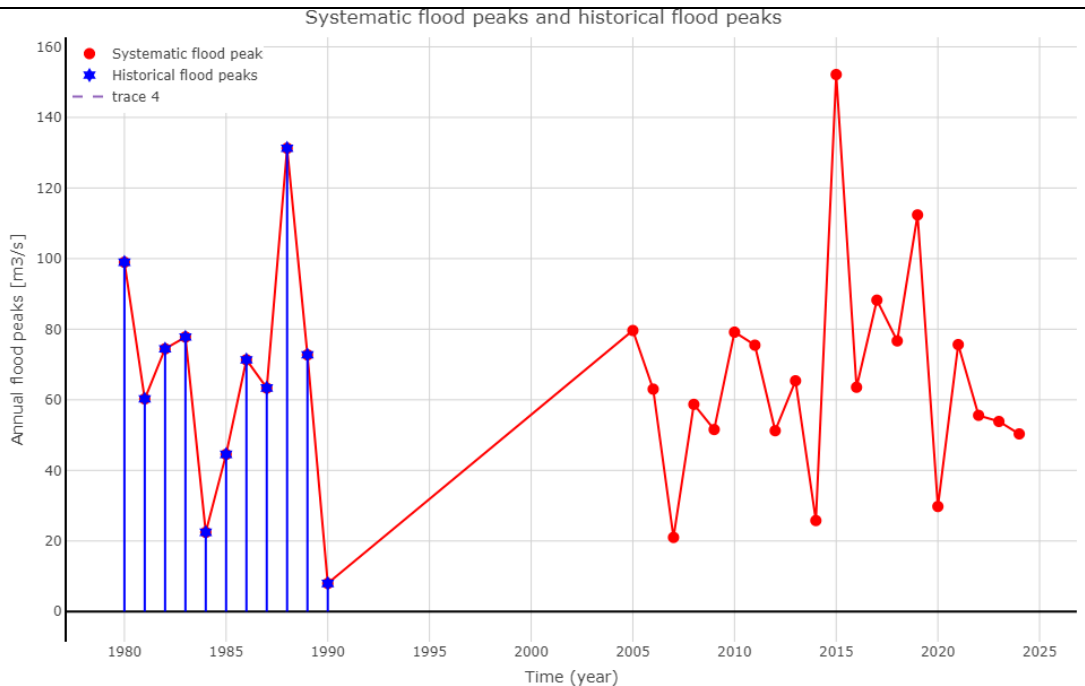
1032560  
 Manawatu at  
 Teachers College



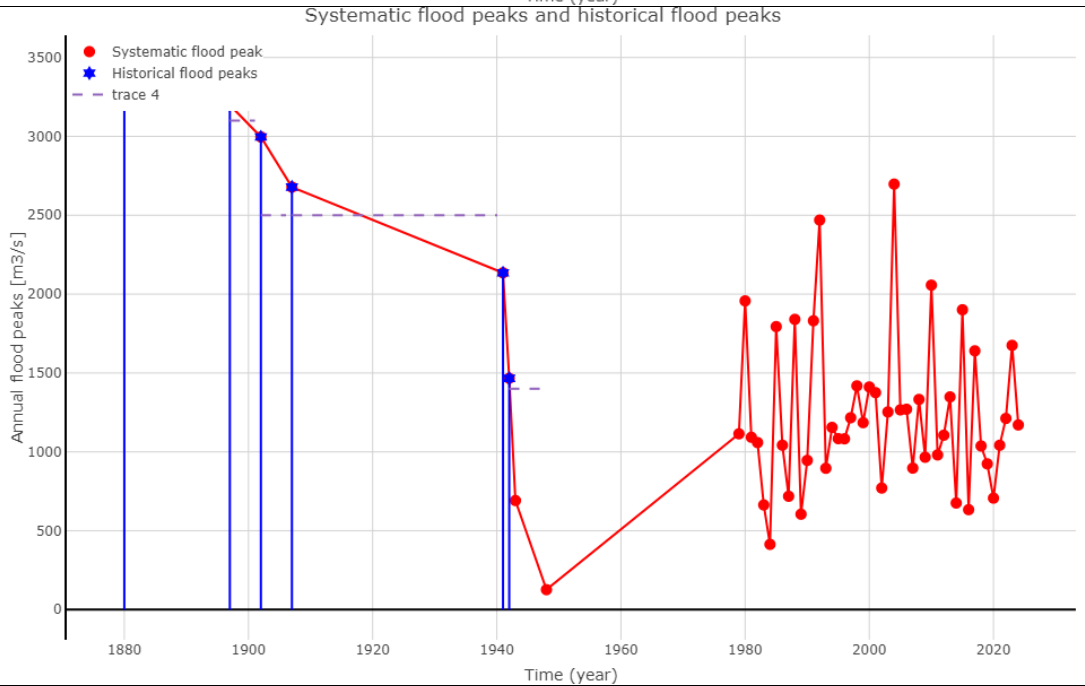
1132508  
 Oroua at  
 Almadale  
 Slackline



1232564  
Manga-  
Atua at  
Hopeland  
s Rd



1232566  
Manawat  
u at  
Upper  
Gorge



## Appendix E Flood frequency results for sites with historical information

**Table E-1: Flood frequency results for sites with historical data.**

Site number	Site name	Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
32504	Manawatu at Hopelands	2	0.5	587.0	504.0	670.0
		5	0.8	901.0	795.0	1060.0
		10	0.9	1133.3	1009.1	1383.5
		25	0.96	1458.2	1268.1	1963.4
		50	0.98	1724.3	1457.4	2567.3
		75	0.9867	1887.8	1557.9	2990.5
		100	0.99	2011.5	1627.1	3355.4
		200	0.995	2322.1	1798.8	4388.0
		500	0.998	2773.5	1998.3	6135.3
32590	Koputaroa at Tavistock Rd	2	0.5	1.8	-1.0	4.2
		5	0.8	10.3	7.8	13.6
		10	0.9	15.0	12.4	19.5
		25	0.96	19.9	17.3	26.8
		50	0.98	23.1	20.3	33.3
		75	0.9867	24.7	21.8	37.0
		100	0.99	25.8	22.9	39.9
		200	0.995	28.1	25.1	46.6
		500	0.998	30.7	27.2	57.4
33012	Turakina at O'Neills	2	0.5	240.9	215.5	263.2
		5	0.8	346.0	317.9	380.4
		10	0.9	413.1	381.0	465.7
		25	0.96	494.9	454.2	587.4
		50	0.98	553.7	501.7	691.8
		75	0.9867	586.6	527.7	754.3
		100	0.99	610.4	545.7	804.3
		200	0.995	665.3	585.2	930.0
		500	0.998	735.5	632.2	1119.4
33119	Makotuku at Raetihi	2	0.5	52.1	45.2	59.2
		5	0.8	76.4	65.7	92.2
		10	0.9	99.4	83.0	135.5
		25	0.96	139.9	109.4	238.3
		50	0.98	181.3	131.3	376.5
		75	0.9867	210.8	143.8	491.2
		100	0.99	235.2	153.3	597.3
		200	0.995	305.5	178.2	965.1

		500	0.998	432.7	215.6	1837.8
		1000	0.999	563.9	246.6	2968.5
33303	Whanganui at Te Rewa	2	0.5	2288.7	2101.4	2468.8
		5	0.8	3073.9	2855.7	3301.9
		10	0.9	3567.7	3342.6	3849.4
		25	0.96	4162.3	3890.3	4656.4
		50	0.98	4584.2	4241.6	5328.4
		75	0.9867	4819.0	4411.2	5740.1
		100	0.99	4987.2	4526.7	6073.6
		200	0.995	5373.3	4775.4	6851.7
		500	0.998	5860.7	5029.5	8037.4
		1000	0.999	6213.2	5188.1	9015.3
33313	Ohura at Tokorima	2	0.5	208.3	185.8	229.8
		5	0.8	298.3	276.8	326.6
		10	0.9	344.1	322.8	380.1
		25	0.96	389.8	369.1	441.8
		50	0.98	416.8	395.5	489.2
		75	0.9867	430.1	407.3	513.6
		100	0.99	438.9	414.9	532.2
		200	0.995	457.1	428.3	575.4
		500	0.998	476.2	440.6	631.0
		1000	0.999	487.8	446.5	667.9
33341	Mangaroa at Ohura Town Br	2	0.5	87.2	79.4	92.6
		5	0.8	107.8	100.4	118.5
		10	0.9	125.5	118.6	150.3
		25	0.96	153.9	136.8	219.3
		50	0.98	180.3	151.7	297.4
		75	0.9867	198.0	160.9	357.3
		100	0.99	212.1	167.8	415.9
		200	0.995	250.6	185.0	624.6
		500	0.998	314.2	210.0	1099.2
		1000	0.999	374.3	228.7	1708.6
1032560	Manawatu at Teachers College	2	0.5	1475.3	1387.4	1574.7
		5	0.8	2050.7	1934.7	2209.6
		10	0.9	2439.4	2290.2	2693.1
		25	0.96	2938.8	2715.4	3375.4
		50	0.98	3316.2	3010.3	3965.0
		75	0.9867	3535.5	3178.1	4331.6
		100	0.99	3696.4	3298.9	4604.4
		200	0.995	4080.5	3560.6	5302.5
		500	0.998	4596.1	3896.5	6374.3
		1000	0.999	4992.6	4129.4	7264.7
1132508	Oroua at Almadale Slackline	2	0.5	160.9	149.6	175.8
		5	0.8	232.7	216.6	257.8
		10	0.9	280.4	259.5	316.8
		25	0.96	340.8	311.5	398.8

		50	0.98	385.8	348.9	465.6
		75	0.9867	411.7	370.2	504.6
		100	0.99	430.6	385.3	535.2
		200	0.995	475.3	418.1	611.1
		500	0.998	534.4	459.9	720.5
		1000	0.999	579.3	490.8	809.4
1232564	Manga-Atua at Hopelands Rd	2	0.5	65.1	56.7	74.6
		5	0.8	92.2	83.6	106.3
		10	0.9	107.8	98.9	127.2
		25	0.96	125.2	115.0	157.8
		50	0.98	136.6	125.1	182.2
		75	0.9867	142.6	130.0	195.9
		100	0.99	146.8	133.0	206.2
		200	0.995	156.0	139.6	233.2
		500	0.998	166.7	146.9	268.7
		1000	0.999	173.9	150.9	297.1
1232566	Manawatu at Upper Gorge	2	0.5	1243.7	1119.0	1382.7
		5	0.8	1846.7	1704.4	2064.3
		10	0.9	2256.1	2079.5	2546.3
		25	0.96	2784.6	2525.9	3269.5
		50	0.98	3185.8	2840.8	3888.9
		75	0.9867	3419.6	3008.9	4293.6
		100	0.99	3591.4	3128.9	4590.6
		200	0.995	4002.8	3382.7	5377.1
		500	0.998	4557.4	3702.4	6535.6
		1000	0.999	4985.8	3922.4	7497.6

## Appendix F At-sites historical values

**Table F-1: At-site historical values (m<sup>3</sup>/s) .**

Year	32504	32590	33012	33119	33301	33313	33341	33345	1032560	1132508	1232564	1232566
1989											72.7	
1988		9.7									131.3	
1987		2.5									63.3	
1986		11.3									71.3	
1985		5.9									44.5	
1984		7.1									22.5	
1983		6.6									77.8	
1982		10.4									74.4	
1981		8.0									60.3	
1980		11.2									99.0	
1979		9.8										
1978		10.7				150.8				116.4		
1977		16.6		113.9		222.5				131.9		
1976		18.9	249.1	113.9		211.5				194.4		
1975		14.3	350.4	48.0		329.2				224.3		
1974		9.0	334.5	42.3		251.7				161.7		
1973						410.5				134.1		
1972						252.6				182.9		
1971			289.1			239.7	118.3			197.5		
1970			285.5			239.9	108.4			186.0		
1969						185.7	103.8	88.7		84.8		
1968			320.1			266.0	154.4	2697.7		155.5		
1967			300.1			218.8	101.0	2230.7		239.8		
1966						245.9	145.9	1803.6		169.0		
1965						405.1	165.0	3264.4		282.6		
1964						402.3		3019.9		94.7		
1963						208.8		1059.2		173.3		
1962						257.1		2277.8		164.3		
1961			457.2			79.5		2228.8		114.4		
1960								113.5		70.3		
1959										121.9		
1958										362.1		
1957										155.7		
1956	1469.7									271.4		
1955	964.8		338.4					1746.5		145.3		

Year	32504	32590	33012	33119	33301	33313	33341	33345	1032560	1132508	1232564	1232566
1954	390.7							2082.6		176.3		
1953	1550.6							1248.1		145.4		
1952	488.2							2677.4		109.6		
1951	390.7							1699.2		106.2		
1950	838.6									243.7		
1949	804.9									227.9		
1948	674.9									220.9		
1947			395.6							30.5		
1942												1466.2
1941												2135.0
1940					4689.0			6423.1				
1939					4011.0							
1937			510.8									
1936					3732.0							
1935					3700.0							
1926					3856.0							
1907												2678.4
1904					4325.0			5923.9				
1902												2996.6
1897					3917.0				3333.0			3199.3
1891					4231.0							
1883					3856.0							
1880									3980.0			3404.8
1875					4293.0							
1864					4293.0							
1858					4293.0							

# Appendices to Flood Frequency in Horizons Region Report of March 2025

*Prepared for Horizons Regional Council*

*July 2025*

Prepared by:  
Shailesh Singh

For any information regarding this report please contact:




Shailesh Singh  
Hydrologist  
Hydrological Modelling Group  
+64 3 343 7898  
shailesh.singh@niwa.co.nz

National Institute of Water and Atmospheric Research  
PO Box 8602  
Riccarton  
Christchurch 8440

Phone +64 3 348 8987

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## Appendix A      Owahanga at Owahanga Station 25110

**Table A-1:      General information about the site.**

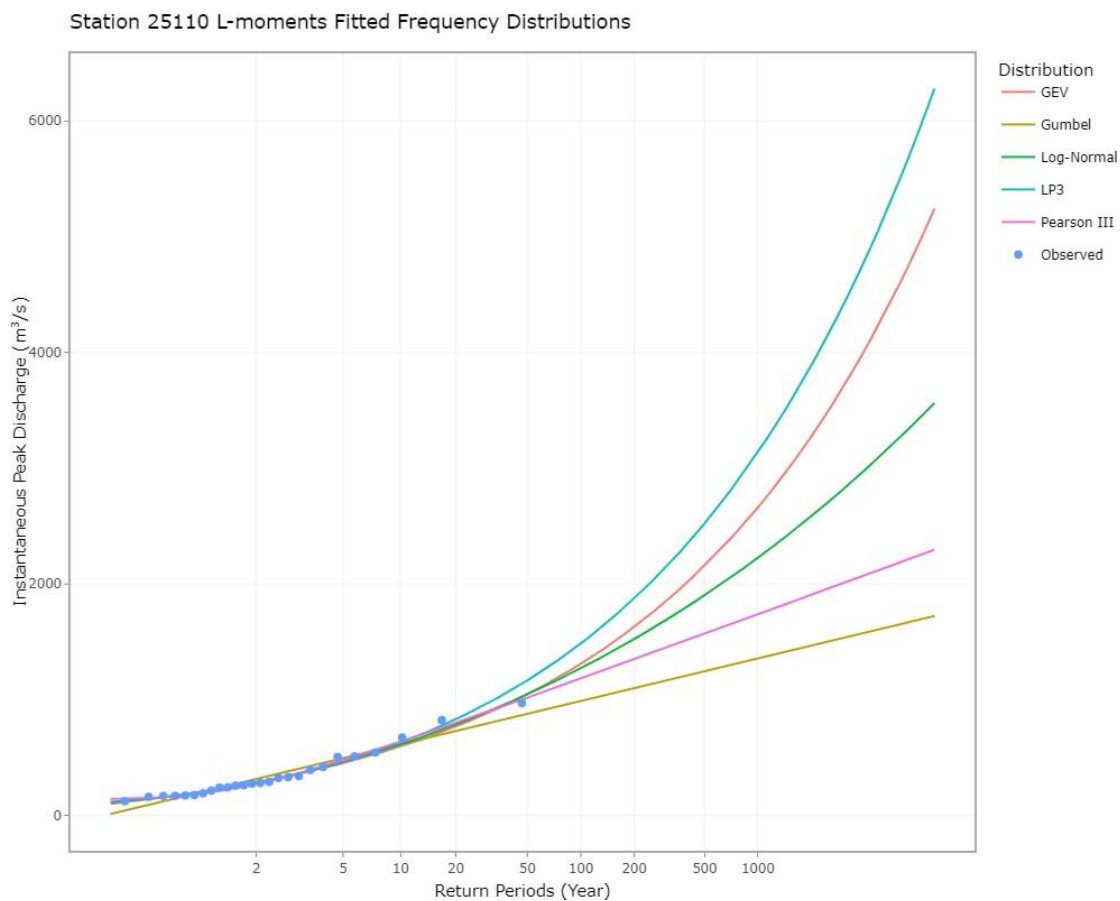
Site Details	
Start (records)	22-Jun-1997
End (records)	11-May-2024
Catchment area (km <sup>2</sup> )	341
Latitude	-40.630793
Longitude	176.302447
Record length (yrs)	26
Minimum (m <sup>3</sup> /s)	122
Maximum (m <sup>3</sup> /s)	971
Median (m <sup>3</sup> /s)	277
Mean (m <sup>3</sup> /s)	348
Standard Deviation (m <sup>3</sup> /s)	212
Coefficient of Variation	0.609

**Table A-2:      Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	14/02/2023	970.8	1	46.6
2018	8/03/2018	824.8	2	16.7
2004	16/02/2004	673.2	3	10.2
2008	30/07/2008	544.4	4	7.3
2012	20/03/2012	511.2	5	5.7
2013	12/07/2013	506.1	6	4.7
2000	7/10/2000	417.3	7	4
2001	15/08/2001	392.4	8	3.5
2005	20/07/2005	340.3	9	3.1
2006	6/07/2006	330	10	2.7

**Table A-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	283.0	314.7	279.8	279.8	274.1
5	0.8	451.0	495.2	460.5	462.9	478.2
10	0.9	596.0	614.7	613.4	629.5	638.4
25	0.96	829.0	765.7	845.1	904.7	853.6
50	0.98	1050.0	877.7	1045.9	1166.3	1018.1
75	0.9867	1190.0	942.8	1174.7	1345.3	1114.7
100	0.99	1310.0	988.9	1271.4	1485.5	1183.5
200	0.995	1630.0	1099.7	1523.7	1874.8	1349.7
500	0.998	2160.0	1245.8	1902.2	2522.6	1570.2
1000	0.999	2660.0	1356.3	2225.6	3136.8	1737.5



**Figure A-1: Visual of different fitted distribution for the site.**

**Table A-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	355.4	357.9	382.8	0.205
Gamma	357.3	361.1	378.9	0.194
GEV	357.4	361.1	376.5	0.190
Gen. Logistic	357.4	361.1	381.2	0.198
Gen. Normal	357.4	361.1	381.5	0.200
Gen. Pareto	355.4	357.9	383.6	0.205
Gumbel	359.4	364.4	381.2	0.199
Kappa	355.5	358.1	389.8	0.209
Normal	357.4	361.1	381.9	0.201
Pearson III	361.4	367.7	381.5	0.200
Wakeby	357.4	361.1	381.9	0.201
Weibull	357.4	361.1	381.2	0.198
Log-Normal	358.0	361.8	396.3	0.211
LP3	355.3	357.8	381.6	0.202

## Appendix B Manakau at Gleasons Rd 32001

**Table B-1: General information about the site.**

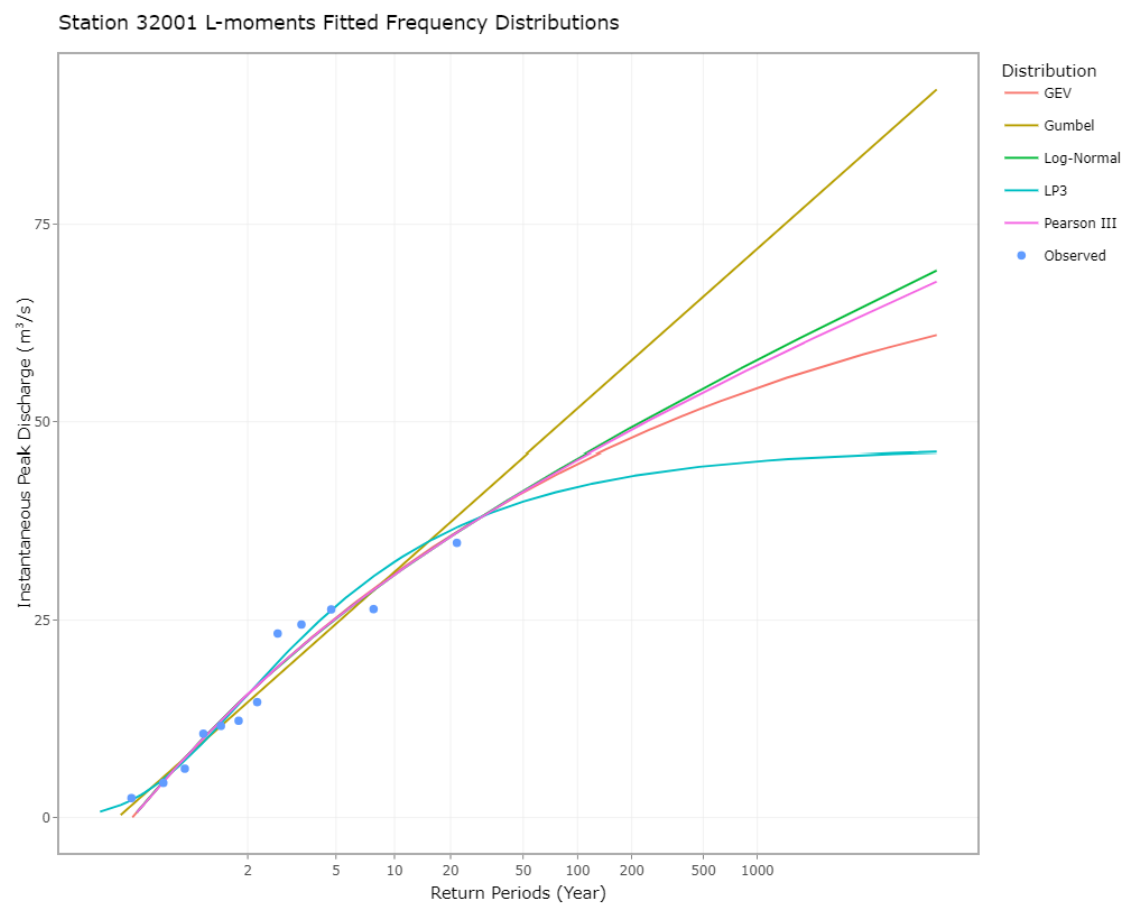
<b>Site Details</b>	
Start (records)	23-Nov-1978
End (records)	11-May-1989
Catchment area (km <sup>2</sup> )	16.8
Latitude	-40.630793
Longitude	176.302447
Record length (yrs)	12
Minimum (m <sup>3</sup> /s)	2.5
Maximum (m <sup>3</sup> /s)	34.8
Median (m <sup>3</sup> /s)	13.4
Mean (m <sup>3</sup> /s)	16.5
Standard Deviation (m <sup>3</sup> /s)	10.3
Coefficient of Variation	0.626

**Table B-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
1984	25/11/1984	34.8	1	21.6
1986	4/10/1986	26.4	2	7.8
1982	21/12/1982	26.4	3	4.7
1980	20/01/1980	24.5	4	3.4
1985	23/12/1985	23.3	5	2.7
1979	12/04/1979	14.6	6	2.2
1988	24/08/1988	12.3	7	1.8
1983	4/11/1983	11.6	8	1.6
1981	3/06/1981	10.6	9	1.4
1987	15/06/1987	6.2	10	1.3

**Table B-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	15.6	14.6	15.6	15.6	15.6
5	0.8	25.3	24.5	25.2	26.8	25.3
10	0.9	30.9	31.1	30.7	32.4	30.8
25	0.96	37.1	39.4	37.1	37.4	37.0
50	0.98	41.2	45.6	41.4	40.0	41.3
75	0.9867	43.3	49.2	43.8	41.2	43.6
100	0.99	44.8	51.7	45.5	41.9	45.3
200	0.995	48.0	57.8	49.3	43.2	49.0
500	0.998	51.8	65.8	54.2	44.5	53.7
1000	0.999	54.3	71.9	57.8	45.1	57.1



**Figure B-1: Visual of different fitted distribution for the site.**

**Table B-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	93.4	94.4	20.0	0.156
Gamma	93.3	94.2	19.9	0.158
GEV	95.2	96.6	19.9	0.157
Gen. Logistic	95.1	96.6	19.7	0.163
Gen. Normal	95.2	96.6	19.9	0.159
Gen. Pareto	95.3	96.7	20.2	0.151
Gumbel	93.2	94.1	19.8	0.161
Kappa	97.3	99.2	20.2	0.151
Normal	93.1	94.1	19.9	0.157
Pearson III	95.2	96.6	19.9	0.159
Wakeby	99.3	101.7	20.2	0.151
Weibull	95.2	96.6	20.0	0.157
Log-Normal	95.2	96.6	19.9	0.159
LP3	95.2	96.7	20.0	0.169

## Appendix C Ohau at Rongomatane 32106

**Table C-1: General information about the site.**

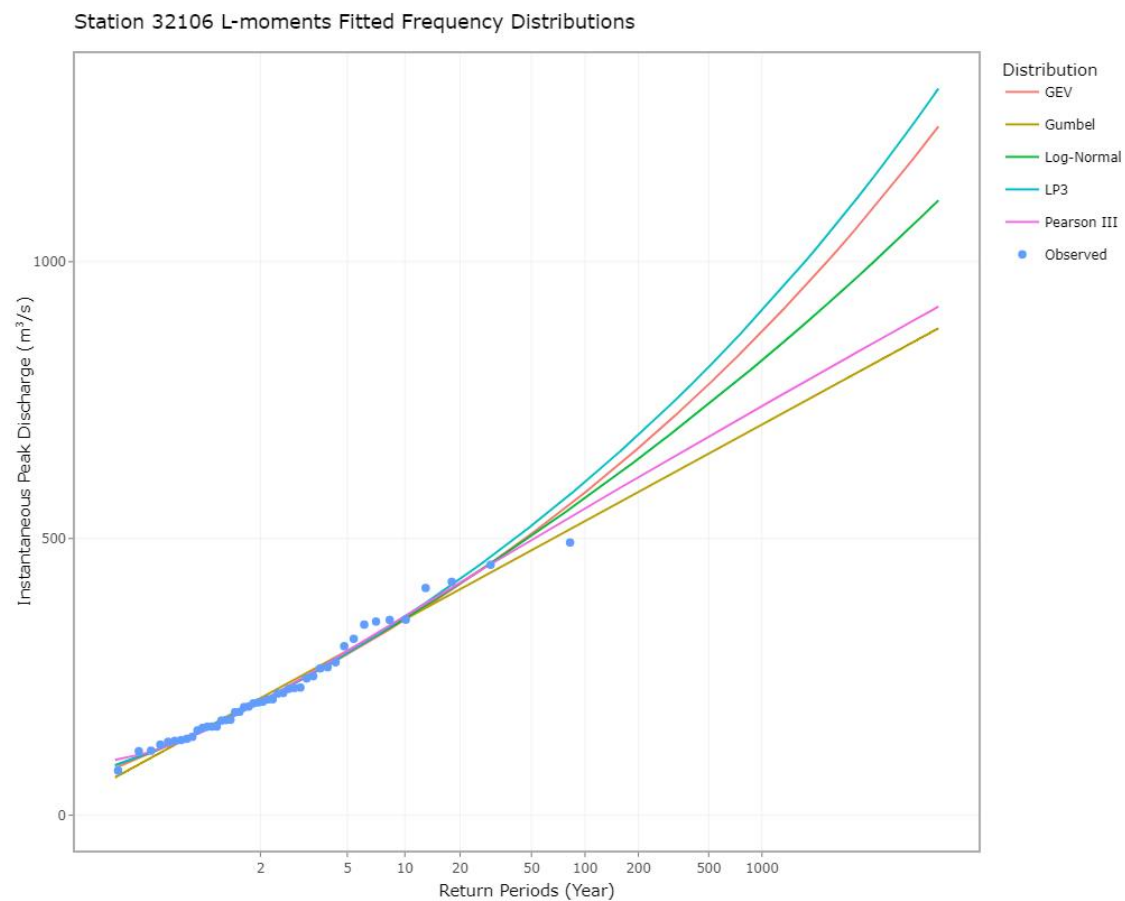
Site Details	
Start (records)	14-Jul-1978
End (records)	7-Feb-2024
Catchment area (km <sup>2</sup> )	105
Latitude	-40.663439
Longitude	175.332677
Record length (yrs)	46
Minimum (m <sup>3</sup> /s)	80.6
Maximum (m <sup>3</sup> /s)	493
Median (m <sup>3</sup> /s)	204
Mean (m <sup>3</sup> /s)	227
Standard Deviation (m <sup>3</sup> /s)	95.7
Coefficient of Variation	0.421

**Table C-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1986	4/10/1986	492.7	1	82.4
2005	6/01/2005	452.5	2	29.6
2008	8/01/2008	421.7	3	18
1993	20/11/1993	410.5	4	13
2000	1/10/2000	353.3	5	10.1
2010	6/09/2010	352.9	6	8.3
1990	13/03/1990	349.9	7	7
2021	27/06/2021	344.4	8	6.1
1998	28/10/1998	318.7	9	5.4
2015	19/06/2015	305.4	10	4.8

**Table C-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	205.7	211.5	205.2	205.0	204.4
5	0.8	290.6	297.2	292.7	293.3	296.6
10	0.9	352.8	353.9	355.4	358.8	359.7
25	0.96	438.8	425.5	439.3	449.5	439.2
50	0.98	508.6	478.7	504.9	523.2	497.4
75	0.9867	551.6	509.6	544.4	568.7	530.9
100	0.99	583.2	531.4	573.0	602.1	554.5
200	0.995	663.3	584.0	644.1	687.1	610.8
500	0.998	778.6	653.3	742.9	809.9	684.2
1000	0.999	873.5	705.7	821.7	911.6	739.1



**Figure C-1: Visual of different fitted distribution for the site.**

**Table C-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	553.6	557.3	183.7	0.158
Gamma	553.2	556.8	182.7	0.159
GEV	555.3	560.8	183.2	0.157
Gen. Logistic	555.3	560.8	183.3	0.155
Gen. Normal	555.3	560.8	183.0	0.158
Gen. Pareto	555.2	560.7	182.1	0.160
Gumbel	553.2	556.8	182.9	0.159
Kappa	557.2	564.6	182.8	0.158
Normal	553.2	556.9	184.2	0.160
Pearson III	555.2	560.7	182.7	0.158
Wakeby	559.2	568.4	182.1	0.160
Weibull	555.2	560.7	182.5	0.159
Log-Normal	555.3	560.8	183.0	0.158
LP3	555.6	561.0	185.6	0.164

## Appendix D Hokio at Lake Horowhenua 32302

**Table D-1: General information about the site.**

<b>Site Details</b>	
Start (records)	1-May-2013
End (records)	19-Jun-2024
Catchment area (km <sup>2</sup> )	48
Latitude	-40.60587
Longitude	175.237291
Record length (yrs)	11
Minimum (m <sup>3</sup> /s)	1.4
Maximum (m <sup>3</sup> /s)	10.7
Median (m <sup>3</sup> /s)	4.4
Mean (m <sup>3</sup> /s)	4.4
Standard Deviation (m <sup>3</sup> /s)	3
Coefficient of Variation	0.667

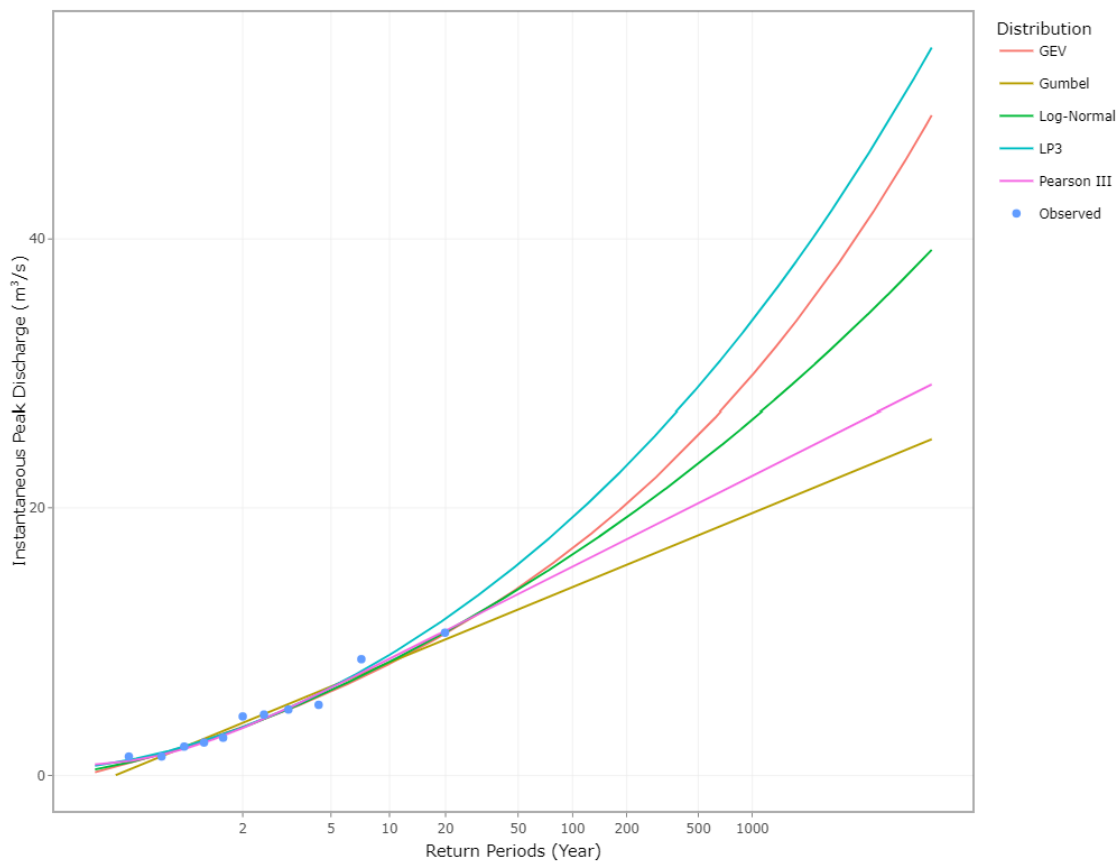
**Table D-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
2015	22/06/2015	10.7	1	19.9
2021	15/12/2021	8.7	2	7.1
2019	23/08/2019	5.3	3	4.3
2022	23/08/2022	4.9	4	3.1
2016	23/12/2016	4.6	5	2.4
2017	3/01/2017	4.4	6	2
2018	25/07/2018	2.8	7	1.7
2020	25/12/2020	2.5	8	1.5
2023	23/04/2023	2.2	9	1.3
2014	14/08/2014	1.4	10	1.2

**Table D-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	3.6	3.9	3.6	3.6	3.6
5	0.8	6.3	6.7	6.4	6.6	6.6
10	0.9	8.4	8.5	8.5	9.0	8.7
25	0.96	11.4	10.7	11.5	12.7	11.5
50	0.98	14.0	12.4	13.9	15.8	13.6
75	0.9867	15.7	13.4	15.4	17.8	14.8
100	0.99	17.0	14.1	16.5	19.3	15.7
200	0.995	20.3	15.8	19.3	23.2	17.7
500	0.998	25.4	17.9	23.3	29.0	20.4
1000	0.999	29.8	19.6	26.6	33.9	22.4

Station 32302 L-moments Fitted Frequency Distributions



**Figure D-1: Visual of different fitted distribution for the site.**

**Table D-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	58.2	59.0	5.4	0.197
Gamma	58.1	58.9	5.4	0.198
GEV	60.1	61.3	5.3	0.188
Gen. Logistic	60.1	61.3	5.3	0.180
Gen. Normal	60.1	61.3	5.4	0.192
Gen. Pareto	60.2	61.4	5.4	0.201
Gumbel	58.1	58.9	5.4	0.198
Kappa	62.2	63.8	5.4	0.198
Normal	58.1	58.9	5.5	0.205
Pearson III	60.2	61.4	5.4	0.197
Wakeby	64.2	66.2	5.4	0.201
Weibull	60.2	61.4	5.4	0.198
Log-Normal	60.1	61.3	5.4	0.192
LP3	60.4	61.6	5.6	0.225

## Appendix E Manawatu at Weber Rd 32503

**Table E-1: General information about the site.**

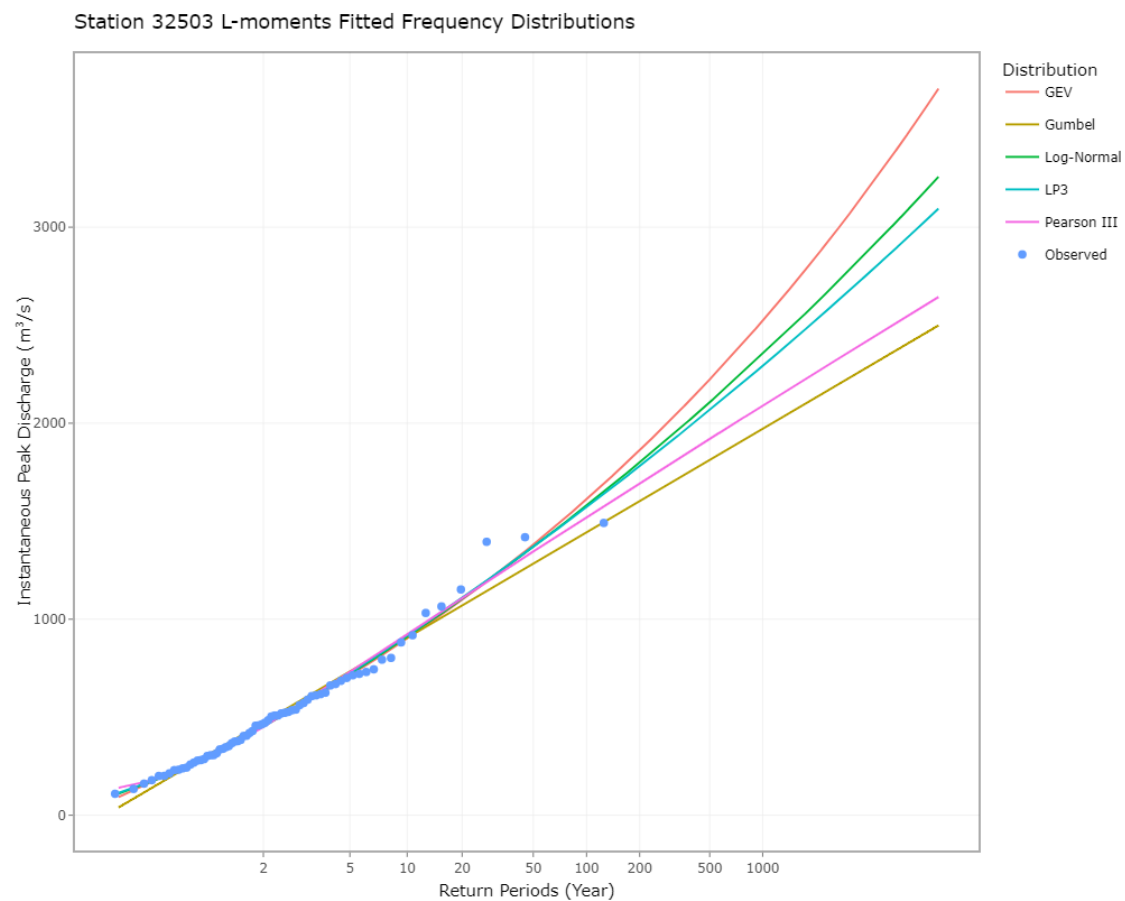
Site Details	
Start (records)	3-Jan-1955
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	713
Latitude	-40.239468
Longitude	176.116379
Record length (yrs)	70
Minimum (m <sup>3</sup> /s)	109.3
Maximum (m <sup>3</sup> /s)	1491.2
Median (m <sup>3</sup> /s)	467.6
Mean (m <sup>3</sup> /s)	522.1
Standard Deviation (m <sup>3</sup> /s)	299.1
Coefficient of Variation	0.573

**Table E-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	1491.2	1	125.2
1992	22/07/1992	1418.4	2	44.9
2023	14/02/2023	1394.9	3	27.4
1988	2/09/1988	1151.7	4	19.7
1965	17/03/1965	1065.2	5	15.4
1956	14/07/1956	1031.8	6	12.6
1985	27/07/1985	918.1	7	10.7
1999	29/11/1999	881.7	8	9.3
1997	3/06/1997	802.6	9	8.2
1971	4/05/1971	793.7	10	7.3

**Table E-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	454.9	473.8	453.3	455.2	450.7
5	0.8	711.9	733.4	718.6	724.1	730.8
10	0.9	901.3	905.2	909.8	916.4	923.6
25	0.96	1165.2	1122.3	1167.0	1171.6	1167.0
50	0.98	1380.4	1283.3	1369.1	1369.0	1345.6
75	0.9867	1513.7	1376.9	1491.1	1487.0	1448.6
100	0.99	1611.9	1443.2	1579.6	1571.9	1521.0
200	0.995	1861.7	1602.5	1799.6	1780.9	1694.1
500	0.998	2223.2	1812.6	2106.7	2067.5	1920.0
1000	0.999	2522.9	1971.4	2352.2	2292.6	2089.2



**Figure E-1: Visual of different fitted distribution for the site.**

**Table E-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	537.7	540.8	750.3	0.168
Exponential	1000.0	1004.5	564.7	0.119
Gamma	999.8	1004.3	561.2	0.119
GEV	1001.8	1008.5	564.7	0.118
Gen. Logistic	1001.8	1008.6	566.4	0.116
Gen. Normal	1001.8	1008.5	563.7	0.118
Gen. Pareto	1001.8	1008.5	558.8	0.120
Gumbel	999.8	1004.3	562.9	0.119
Kappa	1003.8	1012.8	564.2	0.118
Normal	1000.2	1004.7	567.4	0.119
Pearson III	1001.8	1008.5	561.6	0.119
Wakeby	1005.8	1017.0	564.3	0.118
Log-Normal	1001.8	1008.5	563.7	0.118
LP3	1001.8	1008.5	564.3	0.122

## Appendix F Manawatu at Hopelands 32504

**Table F-1: General information about the site.**

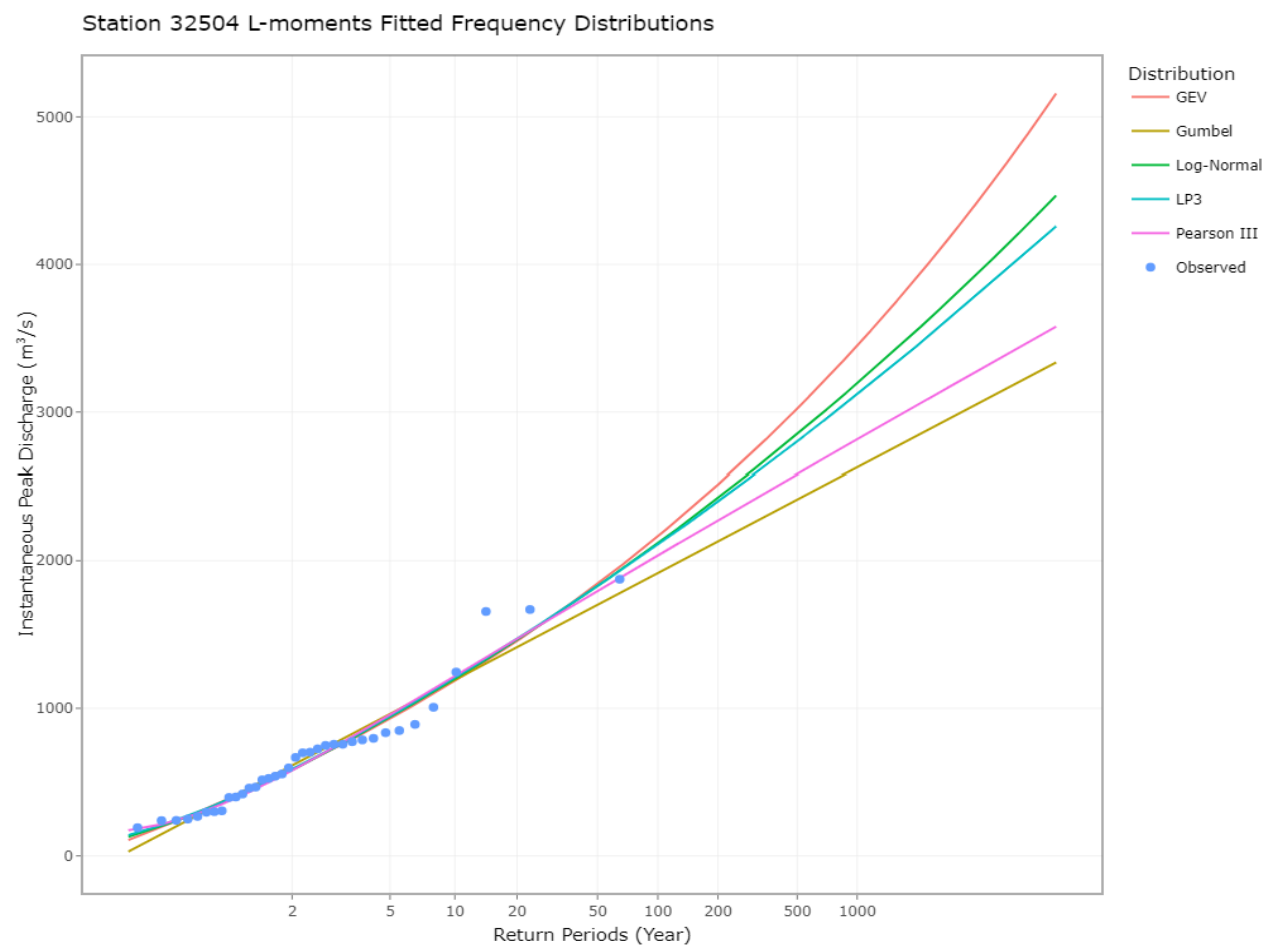
Site Details	
Start (records)	12-Dec-1947
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	1247
Latitude	-40.358857
Longitude	175.962862
Record length (yrs)	36
Minimum (m <sup>3</sup> /s)	190.9
Maximum (m <sup>3</sup> /s)	1874.7
Median (m <sup>3</sup> /s)	631.6
Mean (m <sup>3</sup> /s)	677.6
Standard Deviation (m <sup>3</sup> /s)	405.9
Coefficient of Variation	0.599

**Table F-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	14/02/2023	1874.7	1	64.5
2004	16/02/2004	1669.6	2	23.2
1992	22/07/1992	1656.1	3	14.1
1988	3/09/1988	1245.5	4	10.1
1999	29/11/1999	1006.9	5	7.9
2018	13/06/2018	891	6	6.5
2017	13/07/2017	849.3	7	5.5
1997	3/06/1997	834.7	8	4.8
2015	21/06/2015	796.4	9	4.2
2006	6/07/2006	785.9	10	3.8

**Table F-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

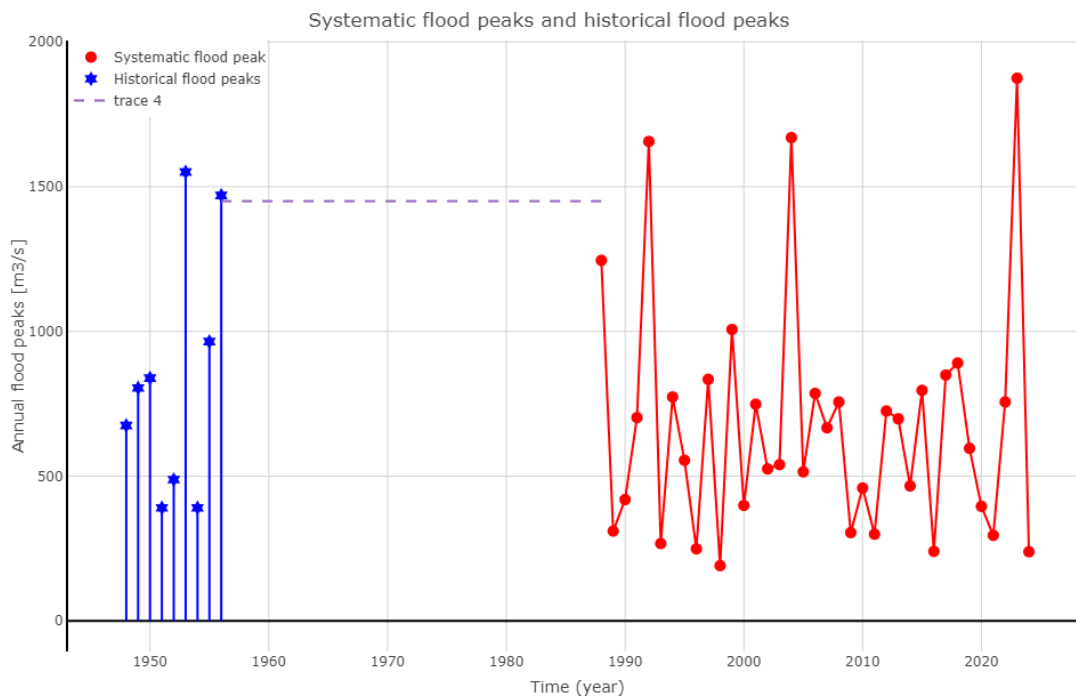
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	585.1	612.8	582.7	585.7	578.9
5	0.8	930.0	961.8	939.6	946.0	956.9
10	0.9	1186.7	1192.8	1199.2	1206.6	1219.0
25	0.96	1547.3	1484.8	1550.7	1555.8	1551.0
50	0.98	1843.9	1701.4	1828.5	1828.0	1795.4
75	0.9867	2028.6	1827.3	1996.8	1991.3	1936.4
100	0.99	2165.1	1916.4	2119.0	2109.2	2035.7
200	0.995	2514.3	2130.6	2423.9	2400.5	2273.1
500	0.998	3023.9	2413.2	2851.2	2802.1	2583.3
1000	0.999	3449.6	2626.8	3194.1	3119.1	2815.8



**Figure F-1: Visual of different fitted distribution for the site.**

**Table F-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	537.7	540.8	750.3	0.168
Gamma	537.7	540.8	748.3	0.161
GEV	539.6	544.4	749.2	0.162
Gen. Logistic	539.6	544.4	747.9	0.159
Gen. Normal	539.6	544.4	749.0	0.163
Gen. Pareto	539.6	544.4	746.8	0.164
Gumbel	537.7	540.9	749.8	0.160
Kappa	541.6	547.9	749.1	0.162
Normal	537.9	541.0	757.6	0.158
Pearson III	539.6	544.4	748.1	0.163
Wakeby	544.2	552.1	724.5	0.137
Weibull	539.6	544.4	747.4	0.163
Log-Normal	539.6	544.4	749.0	0.163
LP3	539.6	544.4	748.7	0.166



**Figure F-2: Historical information and systematic records.**

**Table F-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	587.0	504.0	670.0
5	0.8	901.0	795.0	1060.0
10	0.9	1133.3	1009.1	1383.5
25	0.96	1458.2	1268.1	1963.4
50	0.98	1724.3	1457.4	2567.3
75	0.9867	1887.8	1557.9	2990.5
100	0.99	2011.5	1627.1	3355.4
200	0.995	2322.1	1798.8	4388.0
500	0.998	2773.5	1998.3	6135.3
1000	0.999	3149.1	2148.4	7793.5

**Table F-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1956	1469.7
1955	964.8
1954	390.7
1953	1550.6
1952	488.2
1951	390.7
1950	838.6
1949	804.9
1948	674.9

## Appendix G Tiraumea at Ngaturi 32529

**Table G-1: General information about the site.**

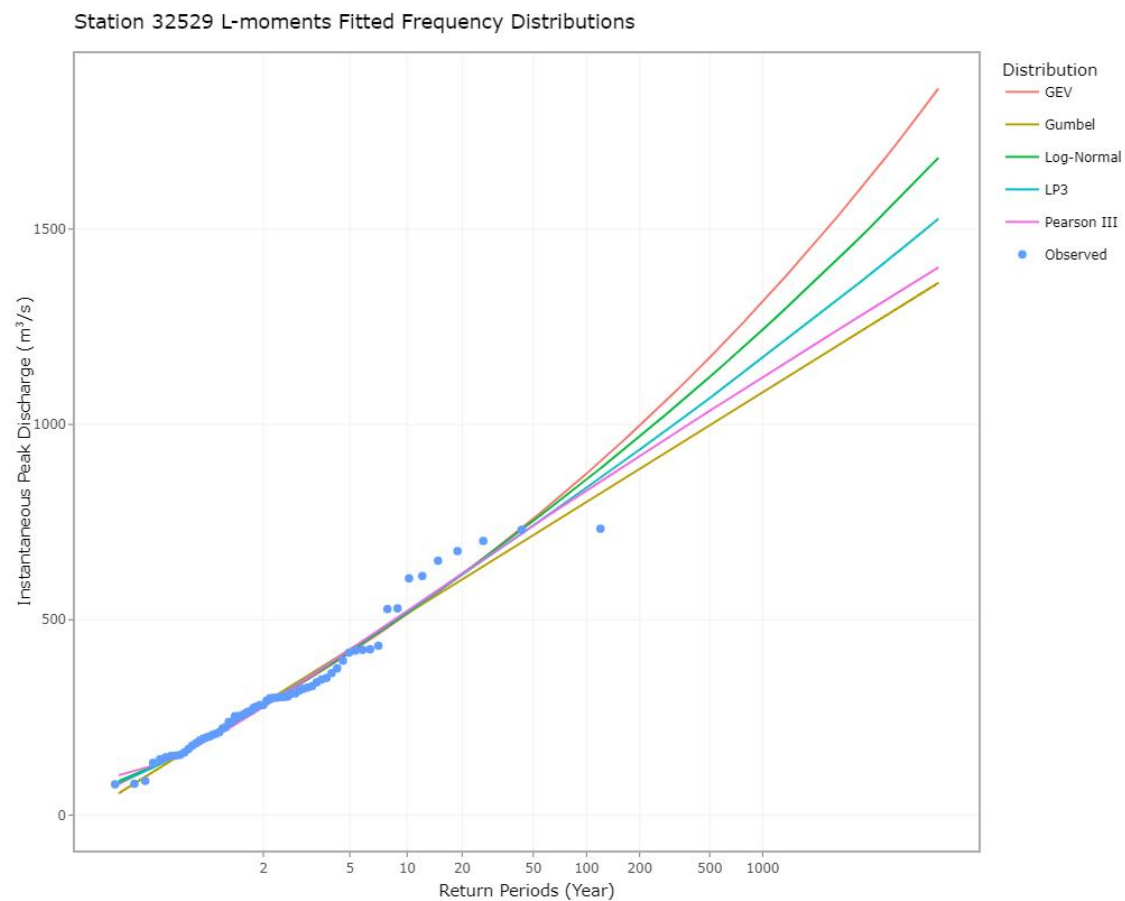
Site Details	
Start (records)	12-May-1958
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	266
Latitude	-40.436111
Longitude	175.79173
Record length (yrs)	67
Minimum (m <sup>3</sup> /s)	78.9
Maximum (m <sup>3</sup> /s)	733.1
Median (m <sup>3</sup> /s)	282.1
Mean (m <sup>3</sup> /s)	312.2
Standard Deviation (m <sup>3</sup> /s)	157.4
Coefficient of Variation	0.504

**Table G-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1991	11/04/1991	733.1	1	119.9
2004	16/02/2004	730.5	2	43
2017	13/07/2017	701.8	3	26.2
1961	3/09/1961	675.8	4	18.9
1992	23/07/1992	651.3	5	14.7
1980	11/04/1980	612.1	6	12.1
1985	27/07/1985	606.1	7	10.2
2013	12/07/2013	529.3	8	8.9
2023	15/02/2023	527.7	9	7.8
1964	25/10/1964	433.7	10	7

**Table G-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	278.3	286.6	277.6	280.2	276.5
5	0.8	415.3	424.5	418.4	422.0	424.2
10	0.9	514.4	515.8	518.1	519.6	524.5
25	0.96	650.0	631.1	650.3	645.6	650.0
50	0.98	758.8	716.7	753.1	741.0	741.7
75	0.9867	825.4	766.4	814.7	797.3	794.5
100	0.99	874.1	801.6	859.2	837.4	831.5
200	0.995	996.9	886.2	969.3	935.3	919.9
500	0.998	1171.6	997.9	1121.7	1067.5	1035.0
1000	0.999	1314.0	1082.3	1242.6	1169.9	1121.0



**Figure G-1: Visual of different fitted distribution for the site.**

**Table G-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	871.4	875.8	300.2	0.156
Gamma	871.1	875.5	297.9	0.153
GEV	873.0	879.7	299.6	0.153
Gen. Logistic	873.1	879.7	300.5	0.152
Gen. Normal	873.0	879.7	299.1	0.153
Gen. Pareto	873.0	879.6	296.4	0.154
Gumbel	871.0	875.5	298.6	0.153
Kappa	875.1	883.9	300.1	0.153
Normal	871.3	875.7	300.3	0.153
Pearson III	873.0	879.6	298.2	0.154
Wakeby	877.1	888.1	301.2	0.154
Weibull	873.0	879.6	297.6	0.154
Log-Normal	873.0	879.7	299.1	0.153
LP3	873.0	879.6	298.8	0.154

## Appendix H Manawatu at Moutoa 32547

**Table H-1: General information about the site.**

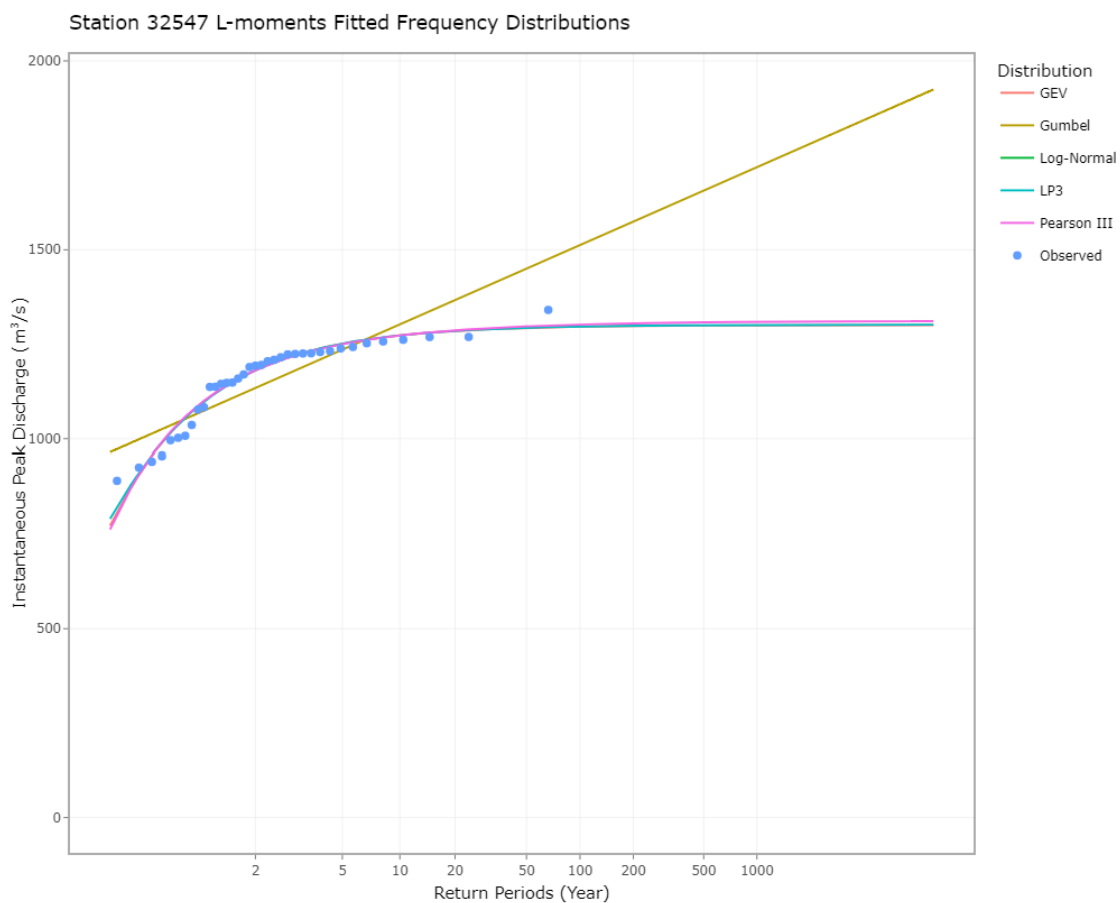
Site Details	
Start (records)	7-Mar-1988
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	5374
Latitude	-40.491441
Longitude	175.372522
Record length (yrs)	37
Minimum (m <sup>3</sup> /s)	891.2
Maximum (m <sup>3</sup> /s)	1340.8
Median (m <sup>3</sup> /s)	1193.3
Mean (m <sup>3</sup> /s)	1153.1
Standard Deviation (m <sup>3</sup> /s)	112.4
Coefficient of Variation	0.097

**Table H-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	1340.8	1	66.3
1994	16/11/1994	1269.3	2	23.8
2006	25/10/2006	1269.1	3	14.5
1988	25/07/1988	1261.8	4	10.4
2021	28/06/2021	1257.3	5	8.1
1992	16/02/1992	1252.6	6	6.7
2010	19/09/2010	1242.7	7	5.7
2003	29/09/2003	1238.9	8	4.9
2013	12/07/2013	1232	9	4.3
1998	21/10/1998	1229.3	10	3.9

**Table H-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	1181.3	1134.3	1181.1	1181.2	1180.9
5	0.8	1251.7	1235.5	1251.0	1251.7	1250.2
10	0.9	1273.5	1302.6	1273.5	1273.6	1273.3
25	0.96	1287.9	1387.3	1289.0	1287.9	1290.0
50	0.98	1293.4	1450.1	1295.5	1293.6	1297.4
75	0.9867	1295.4	1486.7	1298.1	1295.7	1300.4
100	0.99	1296.5	1512.5	1299.6	1296.9	1302.2
200	0.995	1298.3	1574.7	1302.1	1298.9	1305.3
500	0.998	1299.6	1656.7	1304.2	1300.3	1308.0
1000	0.999	1300.1	1718.7	1305.1	1300.9	1309.3



**Figure H-1: Visual of different fitted distribution for the site.**

**Table H-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	457.8	461.1	226.9	0.180
Gamma	457.4	460.6	216.6	0.172
GEV	459.5	464.3	214.6	0.171
Gen. Logistic	459.5	464.3	214.7	0.167
Gen. Normal	459.5	464.4	215.0	0.170
Gen. Pareto	459.5	464.3	212.7	0.174
Gumbel	457.4	460.6	220.4	0.175
Kappa	461.5	467.9	214.4	0.172
Normal	457.4	460.6	216.1	0.172
Pearson III	459.5	464.3	214.7	0.171
Wakeby	463.4	471.5	210.6	0.180
LP3	459.4	464.3	213.4	0.169

## Appendix I      Mangaone at Milson Line 32557

**Table I-1:      General information about the site.**

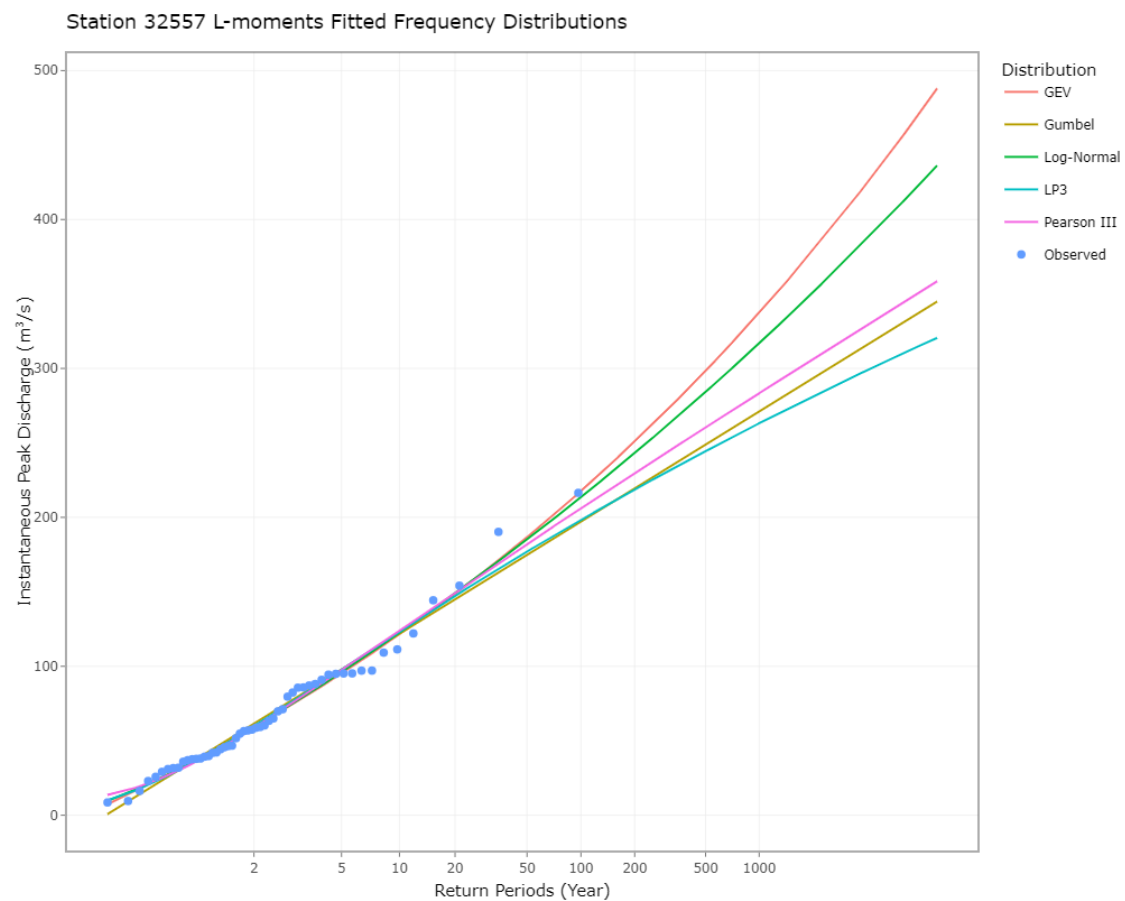
<b>Site Details</b>	
Start (records)	29-Jan-1971
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	154
Latitude	-40.318908
Longitude	175.602069
Record length (yrs)	54
Minimum (m <sup>3</sup> /s)	8.6
Maximum (m <sup>3</sup> /s)	216.5
Median (m <sup>3</sup> /s)	58.1
Mean (m <sup>3</sup> /s)	68.3
Standard Deviation (m <sup>3</sup> /s)	41.9
Coefficient of Variation	0.615

**Table I-2:      Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
1976	1/06/1976	216.5	1	96.6
2004	16/02/2004	190.3	2	34.7
2015	21/06/2015	154.1	3	21.1
1988	24/07/1988	144.3	4	15.2
1980	19/10/1980	122.1	5	11.9
2010	6/09/2010	111.4	6	9.7
2001	15/08/2001	109.2	7	8.3
1998	21/10/1998	97.1	8	7.2
2017	13/07/2017	97.1	9	6.3
1994	16/11/1994	95.2	10	5.7

**Table I-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	59.2	61.5	59.0	59.8	58.7
5	0.8	95.2	97.8	96.1	98.2	97.7
10	0.9	121.5	121.9	122.5	123.6	124.3
25	0.96	157.6	152.3	157.7	154.8	157.6
50	0.98	186.7	174.8	185.2	177.0	182.1
75	0.9867	204.6	187.9	201.7	189.5	196.1
100	0.99	217.7	197.2	213.6	198.3	206.0
200	0.995	250.9	219.5	243.2	218.7	229.6
500	0.998	298.4	248.9	284.2	244.5	260.3
1000	0.999	337.3	271.1	316.9	263.2	283.3



**Figure I-1: Visual of different fitted distribution for the site.**

**Table I-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	560.0	563.9	78.9	0.126
Gamma	559.8	563.8	78.5	0.131
GEV	561.8	567.7	78.8	0.128
Gen. Logistic	561.8	567.8	79.0	0.126
Gen. Normal	561.8	567.7	78.7	0.129
Gen. Pareto	561.8	567.8	78.1	0.132
Gumbel	559.9	563.8	78.7	0.132
Kappa	563.8	571.7	78.8	0.129
Normal	560.1	564.1	79.3	0.136
Pearson III	561.8	567.8	78.5	0.130
Wakeby	565.8	575.7	78.8	0.129
Weibull	561.8	567.8	78.4	0.130
Log-Normal	561.8	567.7	78.7	0.129
LP3	561.8	567.8	78.2	0.132

## Appendix J Oroua at Kawa Wool 32563

**Table J-1: General information about the site.**

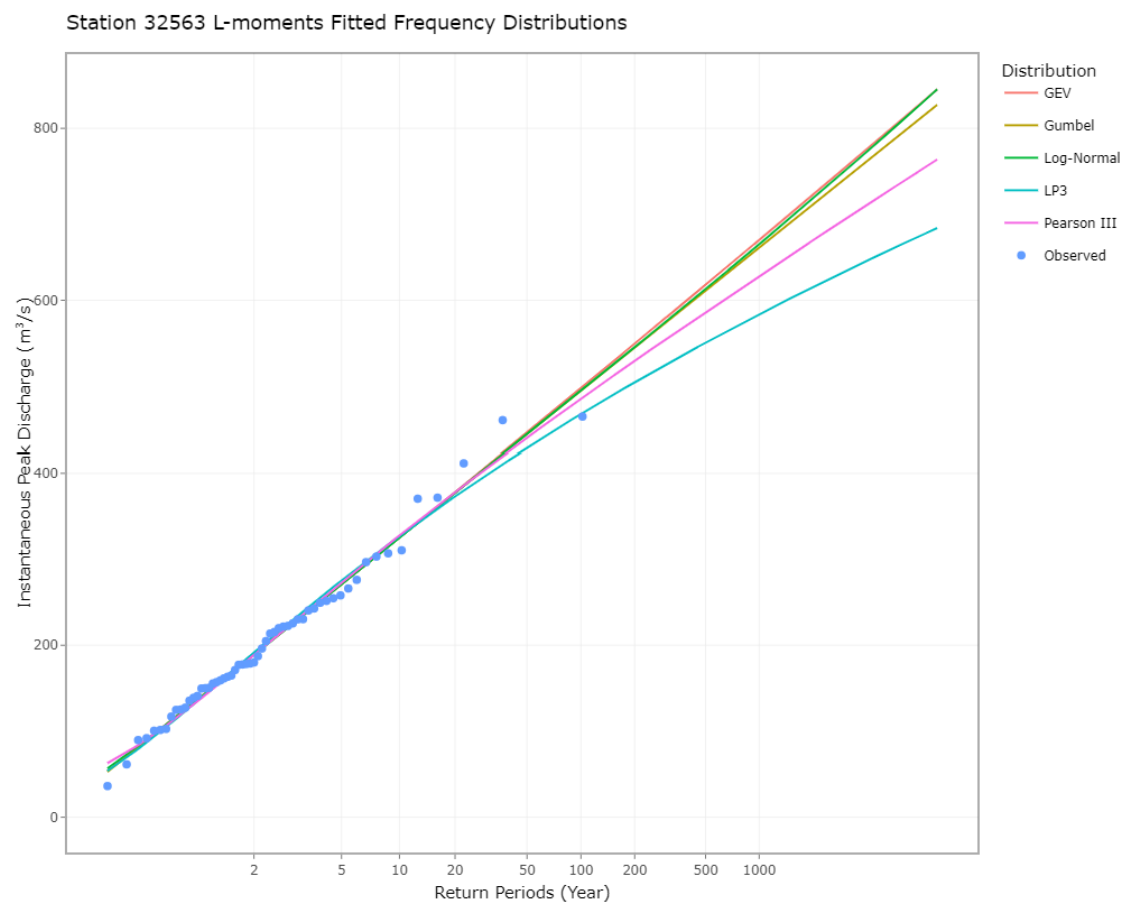
<b>Site Details</b>	
Start (records)	3-Feb-1967
End (records)	1-Apr-2024
Catchment area (km <sup>2</sup> )	570
Latitude	-40.243018
Longitude	175.570925
Record length (yrs)	57
Minimum (m <sup>3</sup> /s)	36.2
Maximum (m <sup>3</sup> /s)	464.7
Median (m <sup>3</sup> /s)	180
Mean (m <sup>3</sup> /s)	204.8
Standard Deviation (m <sup>3</sup> /s)	91.3
Coefficient of Variation	0.446

**Table J-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
2023	14/02/2023	464.7	1	102
2015	20/06/2015	460.6	2	36.6
1988	2/09/1988	411.6	3	22.3
1992	22/07/1992	371.7	4	16
2018	12/06/2018	370.5	5	12.5
1999	29/11/1999	310.5	6	10.3
1985	27/07/1985	307	7	8.7
1976	29/06/1976	303.2	8	7.6
2010	6/09/2010	296.7	9	6.7
1980	11/04/1980	276.1	10	6

**Table J-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	189.2	189.6	189.2	191.6	188.9
5	0.8	270.9	271.3	271.7	275.4	273.6
10	0.9	325.4	325.4	325.8	326.9	327.8
25	0.96	394.7	393.8	393.9	387.2	393.4
50	0.98	446.4	444.5	444.3	428.8	440.3
75	0.9867	476.6	474.0	473.8	451.9	467.0
100	0.99	498.0	494.8	494.7	467.8	485.6
200	0.995	549.6	545.0	545.3	504.7	529.5
500	0.998	618.2	611.2	613.0	550.7	586.2
1000	0.999	670.3	661.2	665.2	583.7	628.2



**Figure J-1: Visual of different fitted distribution for the site.**

**Table J-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	680.0	684.1	177.9	0.107
Gamma	679.4	683.5	175.9	0.116
GEV	681.4	687.5	176.4	0.114
Gen. Logistic	681.4	687.6	177.1	0.112
Gen. Normal	681.4	687.5	176.2	0.114
Gen. Pareto	681.4	687.5	174.5	0.117
Gumbel	679.4	683.5	176.4	0.115
Kappa	683.4	691.6	176.9	0.113
Normal	679.5	683.5	176.8	0.119
Pearson III	681.4	687.5	175.9	0.115
Wakeby	685.4	695.6	177.5	0.113
Weibull	681.4	687.5	175.5	0.116
Log-Normal	681.4	687.5	176.2	0.114
LP3	681.4	687.5	175.7	0.116

## Appendix K Pohangina at Piripiri 32564

**Table K-1: General information about the site.**

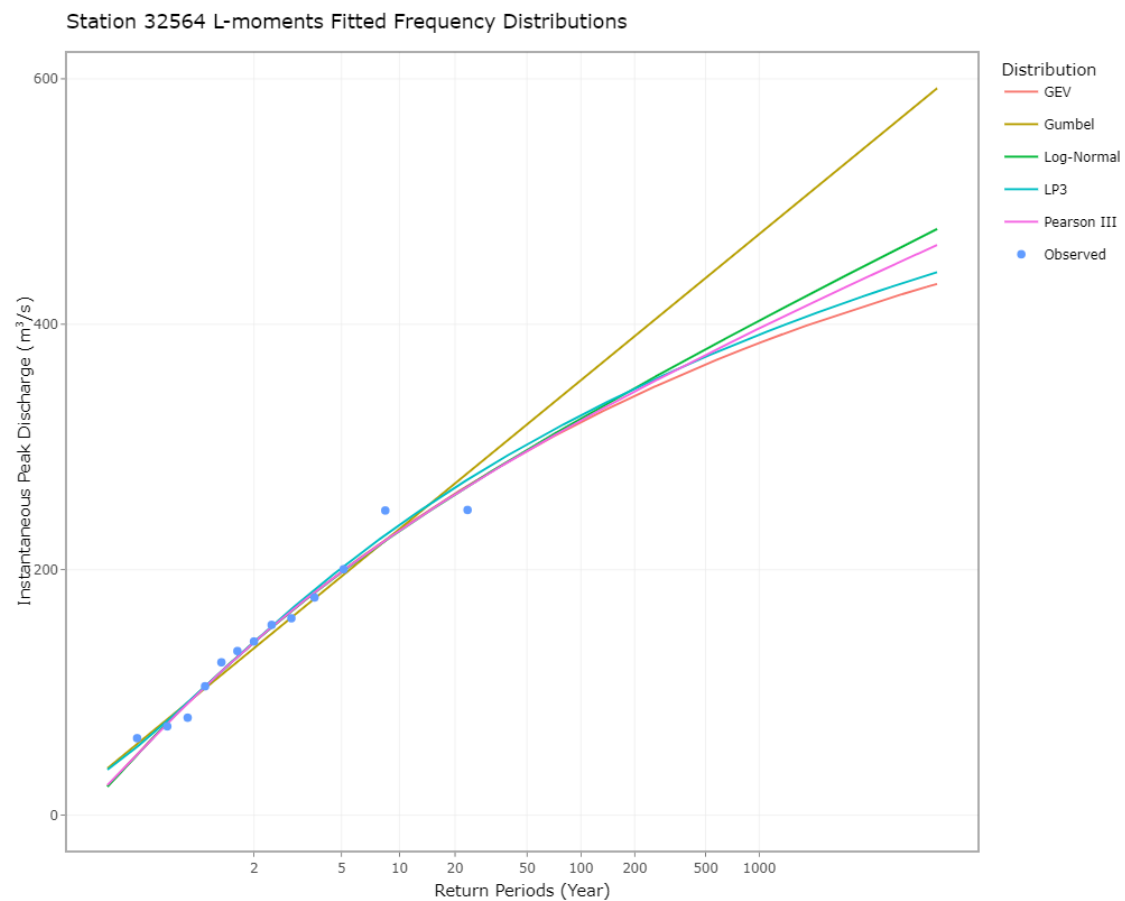
Site Details	
Start (records)	1-Jul-2012
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	88.9
Latitude	-40.052151
Longitude	175.9401
Record length (yrs)	13
Minimum (m <sup>3</sup> /s)	62.7
Maximum (m <sup>3</sup> /s)	248.7
Median (m <sup>3</sup> /s)	141.5
Mean (m <sup>3</sup> /s)	146.9
Standard Deviation (m <sup>3</sup> /s)	60.8
Coefficient of Variation	0.414

**Table K-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	14/02/2023	248.7	1	23.4
2017	13/04/2017	248.3	2	8.4
2018	12/06/2018	200.4	3	5.1
2013	25/09/2013	177.4	4	3.7
2015	9/04/2015	160.5	5	2.9
2022	24/03/2022	155.1	6	2.4
2014	17/04/2014	141.5	7	2
2024	21/05/2024	133.7	8	1.7
2016	8/07/2016	124.5	9	1.5
2012	5/07/2012	105.1	10	1.4

**Table K-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	140.7	136.0	141.0	141.2	140.9
5	0.8	198.5	194.5	197.9	201.3	198.3
10	0.9	232.4	233.2	231.5	236.5	231.8
25	0.96	271.0	282.1	270.5	276.0	270.3
50	0.98	296.8	318.4	297.6	302.2	296.8
75	0.9867	310.8	339.5	312.8	316.3	311.5
100	0.99	320.3	354.4	323.3	325.9	321.6
200	0.995	341.7	390.3	348.1	347.5	345.2
500	0.998	367.3	437.7	379.6	373.6	375.0
1000	0.999	384.7	473.5	402.9	391.5	396.6



**Figure K-1: Visual of different fitted distribution for the site.**

**Table K-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	147.1	148.2	118.4	0.108
Gamma	146.8	148.0	117.9	0.103
GEV	148.8	150.5	118.0	0.105
Gen. Logistic	148.7	150.4	116.9	0.104
Gen. Normal	148.8	150.5	117.8	0.104
Gen. Pareto	148.9	150.6	119.3	0.108
Gumbel	146.8	147.9	117.6	0.101
Kappa	150.8	153.1	118.8	0.107
Normal	146.8	147.9	118.1	0.107
Pearson III	148.8	150.5	117.9	0.104
Wakeby	152.9	155.7	119.1	0.107
Weibull	148.8	150.5	118.3	0.104
Log-Normal	148.8	150.5	117.8	0.104
LP3	148.8	150.5	118.4	0.118

## Appendix L Pohangina at Mais Reach 32576

**Table L-1: General information about the site.**

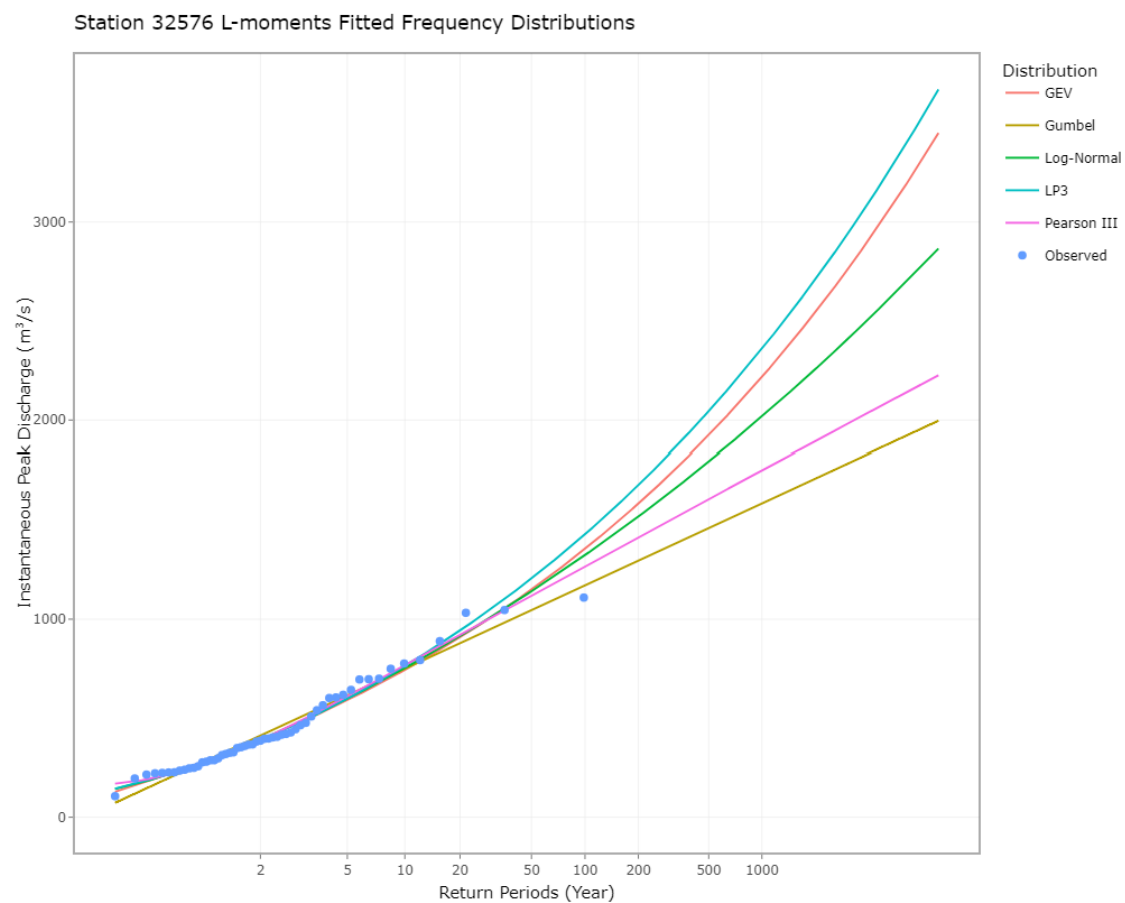
Site Details	
Start (records)	10-Jun-1969
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	471
Latitude	-40.22457
Longitude	175.783
Record length (yrs)	55
Minimum (m <sup>3</sup> /s)	106.3
Maximum (m <sup>3</sup> /s)	1109.1
Median (m <sup>3</sup> /s)	386.5
Mean (m <sup>3</sup> /s)	450
Standard Deviation (m <sup>3</sup> /s)	230.6
Coefficient of Variation	0.512

**Table L-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	1109.1	1	98.4
1992	22/07/1992	1046.3	2	35.3
2023	14/02/2023	1032.1	3	21.5
1988	2/09/1988	889.2	4	15.5
2018	12/06/2018	793.5	5	12.1
1971	4/05/1971	776.1	6	9.9
1999	29/11/1999	749.7	7	8.4
1985	27/07/1985	699.7	8	7.3
1975	12/03/1975	697	9	6.4
1980	10/04/1980	695.6	10	5.8

**Table L-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	585.1	612.8	582.7	585.7	578.9
5	0.8	930.0	961.8	939.6	946.0	956.9
10	0.9	1186.7	1192.8	1199.2	1206.6	1219.0
25	0.96	1547.3	1484.8	1550.7	1555.8	1551.0
50	0.98	1843.9	1701.4	1828.5	1828.0	1795.4
75	0.9867	2028.6	1827.3	1996.8	1991.3	1936.4
100	0.99	2165.1	1916.4	2119.0	2109.2	2035.7
200	0.995	2514.3	2130.6	2423.9	2400.5	2273.1
500	0.998	3023.9	2413.2	2851.2	2802.1	2583.3
1000	0.999	3449.6	2626.8	3194.1	3119.1	2815.8



**Figure L-1: Visual of different fitted distribution for the site.**

**Table L-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	757.9	761.9	437.0	0.170
Gamma	757.6	761.6	435.1	0.174
GEV	759.7	765.7	437.5	0.169
Gen. Logistic	759.7	765.8	437.8	0.167
Gen. Normal	759.7	765.7	436.9	0.170
Gen. Pareto	759.6	765.6	434.2	0.172
Gumbel	757.6	761.6	435.9	0.173
Kappa	761.6	769.7	435.2	0.172
Normal	757.7	761.7	439.7	0.176
Pearson III	759.6	765.7	435.4	0.171
Wakeby	763.6	773.6	434.2	0.172
Weibull	759.6	765.6	435.0	0.171
Log-Normal	759.7	765.7	436.9	0.170
LP3	760.4	766.4	446.7	0.175

## Appendix M Koputaroa at Tavistock Rd 32590

**Table M-1: General information about the site.**

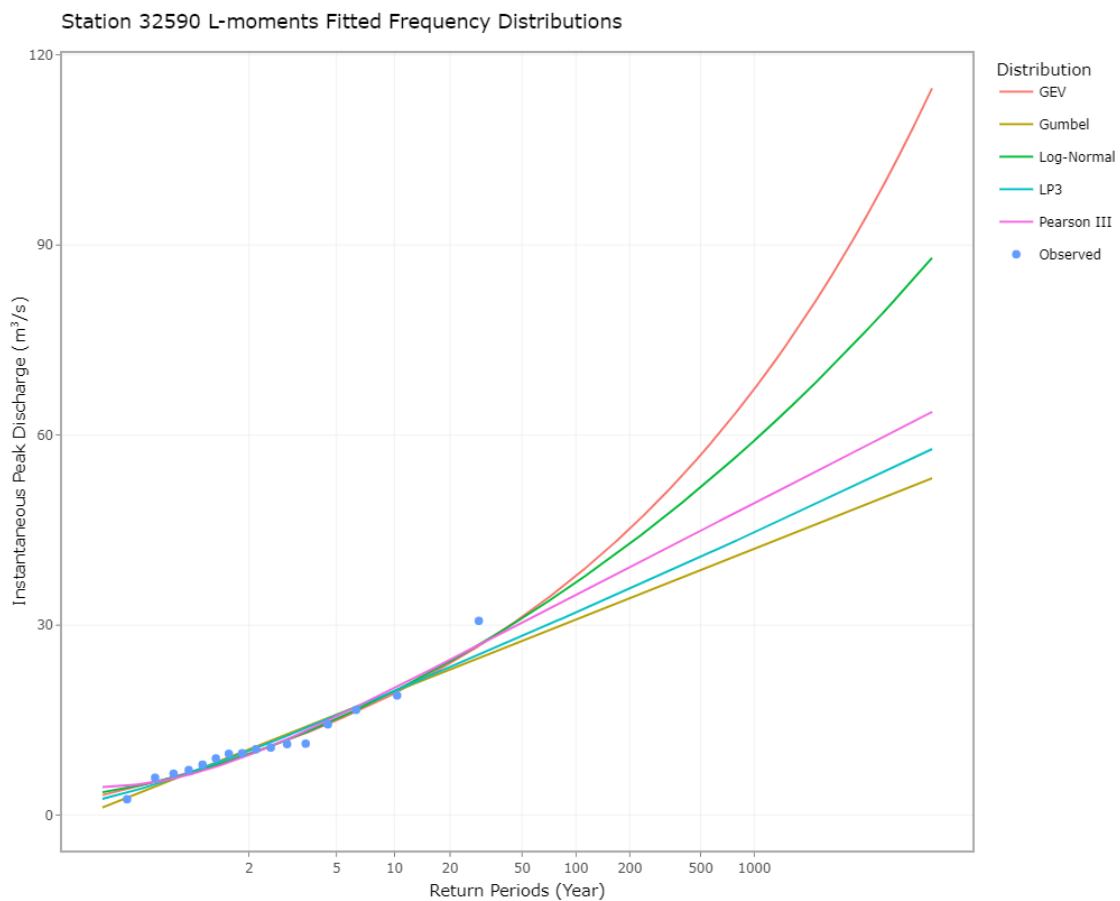
Site Details	
Start (records)	11-Jan-1974
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	21.4
Latitude	-40.596676
Longitude	175.337444
Record length (yrs)	16
Minimum (m <sup>3</sup> /s)	2.5
Maximum (m <sup>3</sup> /s)	30.7
Median (m <sup>3</sup> /s)	10.1
Mean (m <sup>3</sup> /s)	11.4
Standard Deviation (m <sup>3</sup> /s)	6.5
Coefficient of Variation	0.572

**Table M-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2024	29/08/2024	30.7	1	28.8
1976	20/12/1976	18.9	2	10.3
1977	3/01/1977	16.6	3	6.3
1975	28/08/1975	14.3	4	4.5
1986	4/10/1986	11.3	5	3.5
1980	23/01/1980	11.2	6	2.9
1978	12/07/1978	10.7	7	2.5
1982	26/12/1982	10.4	8	2.1
1979	26/12/1979	9.8	9	1.9
1988	14/09/1988	9.7	10	1.7

**Table M-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

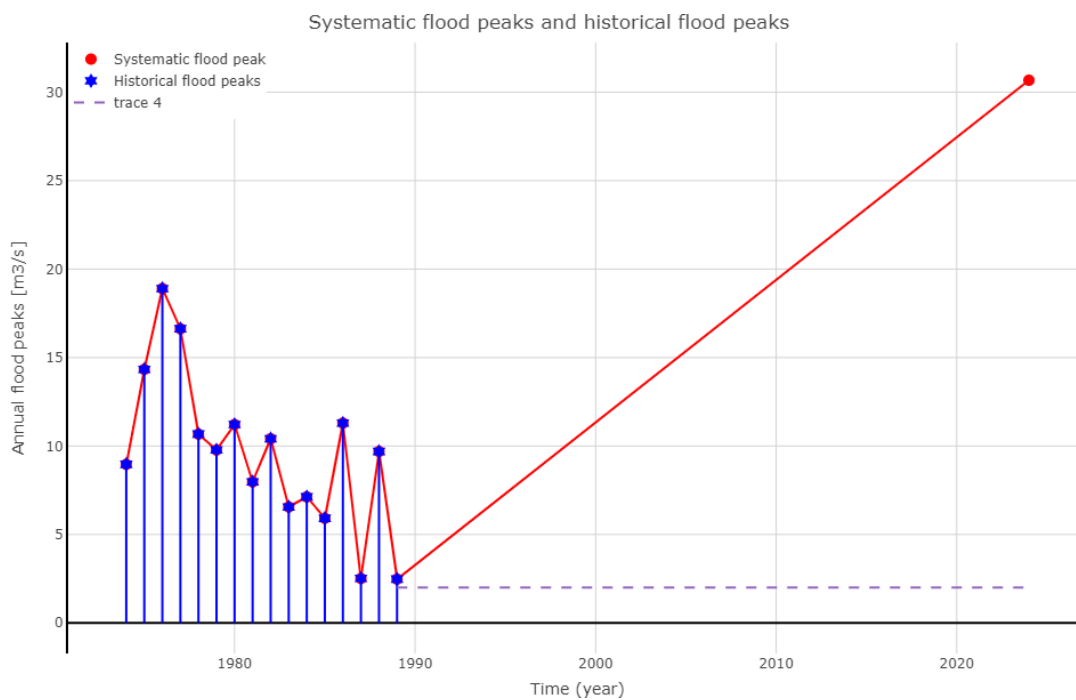
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	9.7	10.4	9.6	10.1	9.5
5	0.8	15.0	15.9	15.2	15.8	15.6
10	0.9	19.2	19.5	19.6	19.6	20.1
25	0.96	25.6	24.1	25.9	24.6	26.0
50	0.98	31.3	27.5	31.1	28.3	30.4
75	0.9867	35.0	29.5	34.3	30.5	32.9
100	0.99	37.8	30.9	36.7	32.0	34.8
200	0.995	45.2	34.3	42.9	35.8	39.1
500	0.998	56.9	38.7	51.7	40.8	44.9
1000	0.999	67.2	42.0	59.1	44.7	49.2



**Figure M-1: Visual of different fitted distribution for the site.**

**Table M-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	108.4	110.0	11.6	0.249
Gamma	108.5	110.0	11.6	0.253
GEV	110.5	112.8	11.5	0.243
Gen. Logistic	110.6	112.9	11.4	0.239
Gen. Normal	110.4	112.8	11.5	0.246
Gen. Pareto	110.4	112.7	11.6	0.250
Gumbel	108.5	110.1	11.6	0.253
Normal	108.6	110.1	11.8	0.258
Pearson III	110.4	112.7	11.6	0.249
Wakeby	114.6	118.5	11.5	0.232
Weibull	110.4	112.7	11.6	0.249
Log-Normal	110.4	112.8	11.5	0.246
LP3	110.5	112.8	11.5	0.253



**Figure M-2: Historical information and systematic records.**

**Table M-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	1.8	-1.0	4.2
5	0.8	10.3	7.8	13.6
10	0.9	15.0	12.4	19.5
25	0.96	19.9	17.3	26.8
50	0.98	23.1	20.3	33.3
75	0.9867	24.7	21.8	37.0
100	0.99	25.8	22.9	39.9
200	0.995	28.1	25.1	46.6
500	0.998	30.7	27.2	57.4
1000	0.999	32.4	28.7	66.7

**Table M-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1988	9.7
1987	2.5
1986	11.3
1985	5.9
1984	7.1
1983	6.6
1982	10.4
1981	8.0
1980	11.2
1979	9.8
1978	10.7
1977	16.6
1976	18.9
1975	14.3
1974	9.0

## Appendix N Rangitikei at Mangaweka 32702

**Table N-1: General information about the site.**

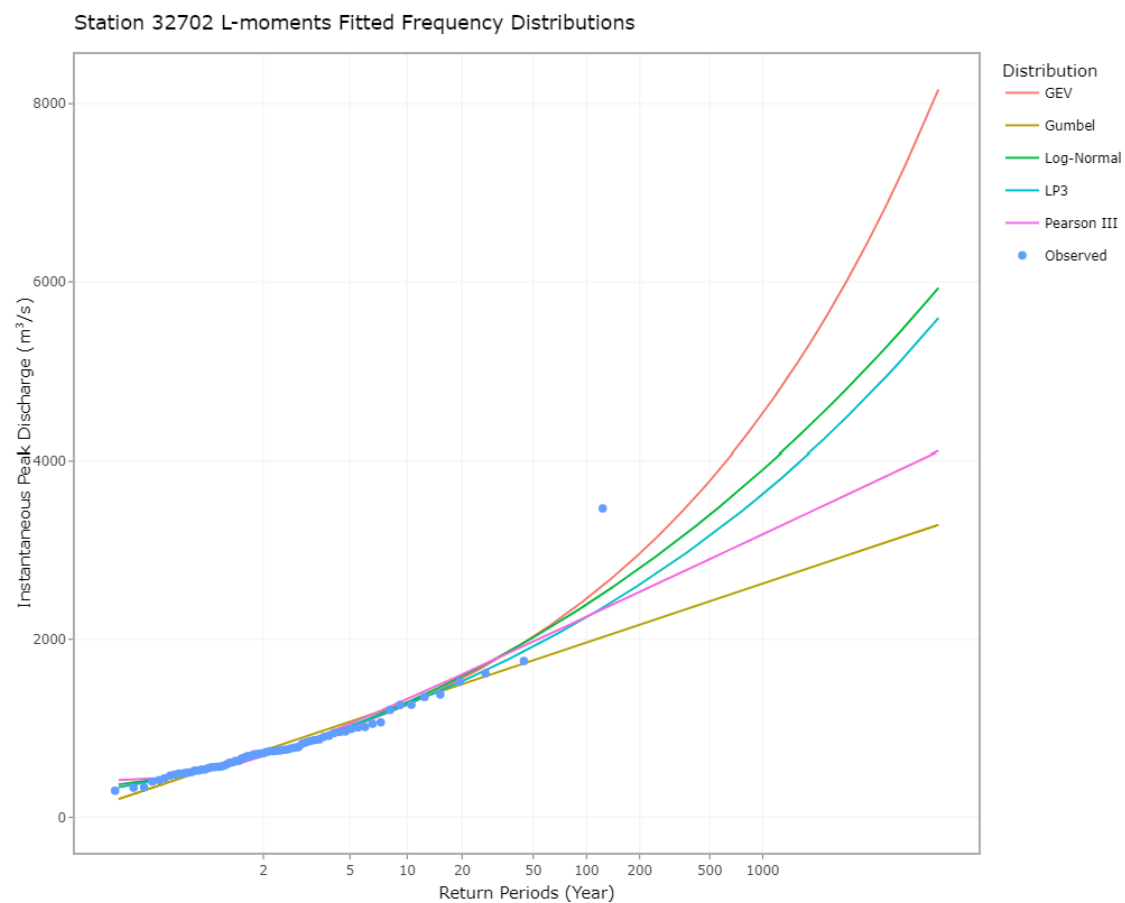
Site Details	
Start (records)	22-Jul-1955
End (records)	9-Apr-2024
Catchment area (km <sup>2</sup> )	2787
Latitude	-39.809424
Longitude	175.808108
Record length (yrs)	69
Minimum (m <sup>3</sup> /s)	300.2
Maximum (m <sup>3</sup> /s)	3469
Median (m <sup>3</sup> /s)	721.1
Mean (m <sup>3</sup> /s)	810.4
Standard Deviation (m <sup>3</sup> /s)	444.1
Coefficient of Variation	0.548

**Table N-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1958	24/02/1958	3469	1	123.4
2004	16/02/2004	1756.2	2	44.3
2023	14/02/2023	1617.4	3	27
2018	12/06/2018	1523.4	4	19.4
2013	15/10/2013	1380.2	5	15.2
2008	30/07/2008	1352.2	6	12.4
1992	22/07/1992	1265.5	7	10.5
1967	3/02/1967	1263.1	8	9.1
1965	18/03/1965	1206.4	9	8.1
1999	29/11/1999	1068	10	7.2

**Table N-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	700.4	750.0	695.1	708.1	686.8
5	0.8	1008.8	1075.0	1023.7	1022.1	1051.6
10	0.9	1265.6	1290.1	1291.6	1266.5	1328.8
25	0.96	1665.6	1562.0	1686.4	1620.0	1696.1
50	0.98	2028.5	1763.7	2021.0	1918.0	1974.4
75	0.9867	2270.2	1880.9	2232.5	2106.7	2137.3
100	0.99	2456.4	1963.9	2390.1	2247.7	2252.9
200	0.995	2962.2	2163.3	2796.7	2613.5	2531.6
500	0.998	3776.3	2426.5	3396.6	3160.6	2900.1
1000	0.999	4525.3	2625.3	3901.2	3628.8	3179.1



**Figure N-1: Visual of different fitted distribution for the site.**

**Table N-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	1042.4	1046.9	742.3	0.173
Gamma	1046.8	1051.3	744.0	0.176
GEV	1043.6	1050.3	750.8	0.169
Gen. Logistic	1043.6	1050.3	751.4	0.167
Gen. Normal	1043.8	1050.5	748.6	0.171
Gen. Pareto	1044.3	1051.0	742.7	0.173
Gumbel	1046.0	1050.4	745.8	0.175
Normal	1048.3	1052.8	756.9	0.177
Pearson III	1044.3	1051.0	742.5	0.173
Wakeby	1047.1	1058.3	755.6	0.166
Weibull	1044.3	1051.0	742.6	0.173
Log-Normal	1043.8	1050.5	748.6	0.171
LP3	1046.1	1052.8	736.9	0.167

## Appendix O Rangitikei at Onepuhi 32703

**Table O-1: General information about the site.**

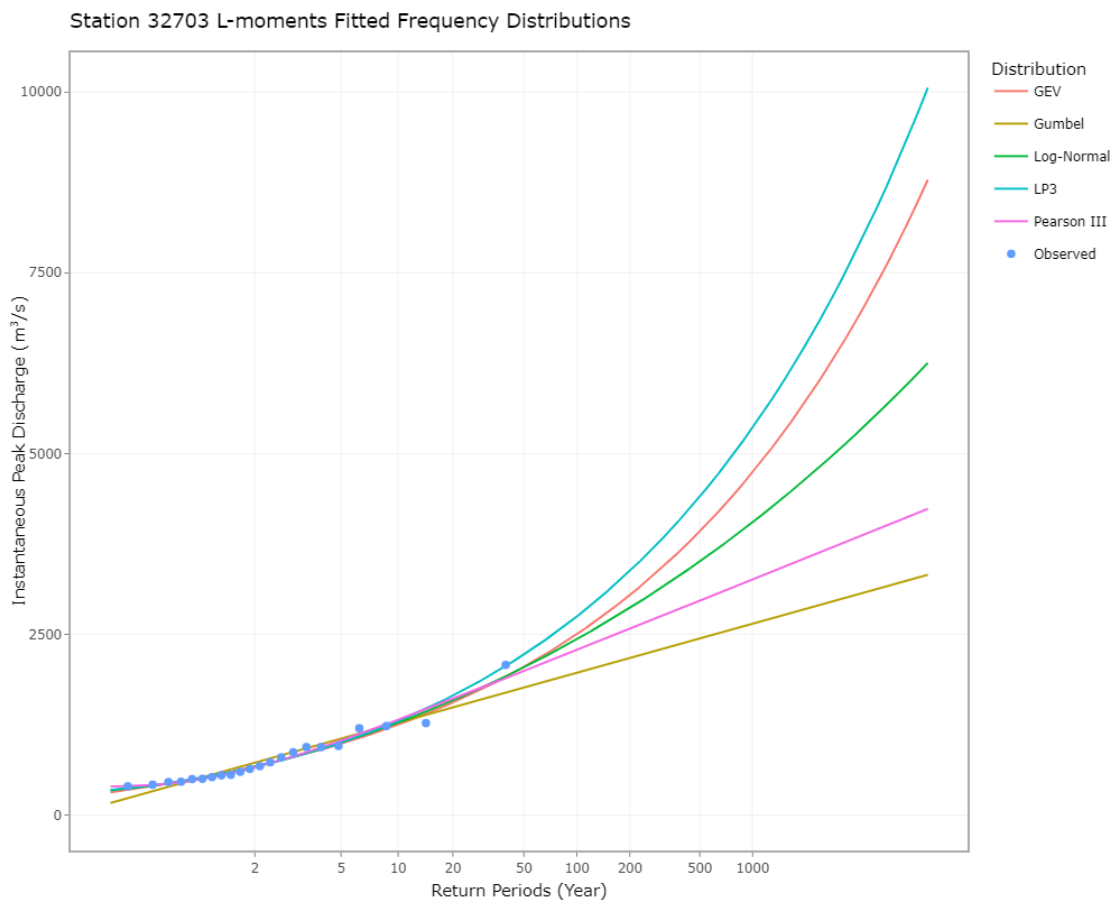
Site Details	
Start (records)	19-Feb-2002
End (records)	9-Apr-2024
Catchment area (km <sup>2</sup> )	3420
Latitude	-40.079567
Longitude	175.463842
Record length (yrs)	22
Minimum (m <sup>3</sup> /s)	398.5
Maximum (m <sup>3</sup> /s)	2077.7
Median (m <sup>3</sup> /s)	658.4
Mean (m <sup>3</sup> /s)	787.1
Standard Deviation (m <sup>3</sup> /s)	394.4
Coefficient of Variation	0.501

**Table O-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	2077.7	1	39.5
2023	14/02/2023	1272.9	2	14.2
2013	15/10/2013	1232.2	3	8.6
2008	31/07/2008	1201.9	4	6.2
2015	21/06/2015	956.8	5	4.9
2011	24/01/2011	942.1	6	4
2018	13/06/2018	941.7	7	3.4
2010	19/09/2010	869.3	8	2.9
2007	18/07/2007	799.3	9	2.6
2003	4/10/2003	731.1	10	2.3

**Table O-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	671.9	725.2	666.2	665.7	657.0
5	0.8	986.2	1058.3	1002.0	1004.9	1031.9
10	0.9	1250.8	1278.8	1279.2	1302.7	1319.8
25	0.96	1667.3	1557.5	1691.3	1779.8	1703.1
50	0.98	2049.1	1764.2	2043.3	2221.2	1994.3
75	0.9867	2305.0	1884.4	2266.9	2518.1	2164.9
100	0.99	2503.1	1969.4	2433.9	2748.4	2286.1
200	0.995	3044.3	2173.8	2866.3	3378.6	2578.6
500	0.998	3924.0	2443.6	3507.7	4404.7	2965.8
1000	0.999	4741.4	2647.4	4050.0	5358.3	3259.1



**Figure O-1: Visual of different fitted distribution for the site.**

**Table O-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	328.4	330.6	701.8	0.162
Gamma	328.6	330.7	706.6	0.160
GEV	330.5	333.7	695.5	0.162
Gen. Logistic	330.5	333.8	690.8	0.159
Gen. Normal	330.4	333.7	699.6	0.163
Gen. Pareto	330.4	333.7	701.5	0.164
Gumbel	328.5	330.7	706.0	0.159
Kappa	332.4	336.8	701.5	0.164
Normal	328.7	330.8	717.8	0.165
Pearson III	330.4	333.7	701.9	0.164
Wakeby	334.4	339.9	701.5	0.164
Weibull	330.4	333.7	701.9	0.164
Log-Normal	330.4	333.7	699.6	0.163
LP3	330.6	333.9	718.8	0.173

## Appendix P Rangitikei at Springvale 32708

**Table P-1: General information about the site.**

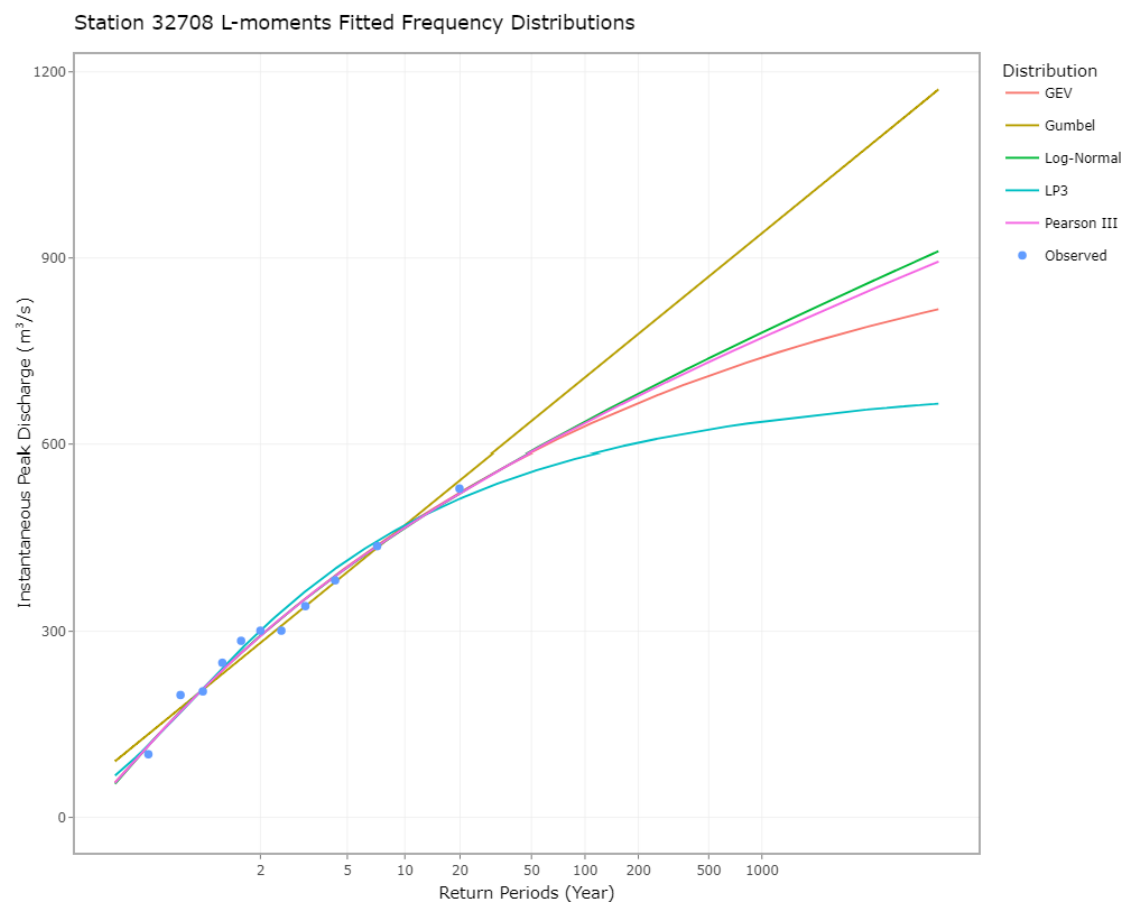
<b>Site Details</b>	
Start (records)	27-Sep-1963
End (records)	2-May-1974
Catchment area (km <sup>2</sup> )	583
Latitude	-39.4781735
Longitude	176.038788
Record length (yrs)	11
Minimum (m <sup>3</sup> /s)	101.8
Maximum (m <sup>3</sup> /s)	530.1
Median (m <sup>3</sup> /s)	301
Mean (m <sup>3</sup> /s)	302.6
Standard Deviation (m <sup>3</sup> /s)	119.2
Coefficient of Variation	0.394

**Table P-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
1964	11/03/1964	530.1	1	19.9
1967	12/08/1967	437.3	2	7.1
1966	26/04/1966	382.2	3	4.3
1972	5/03/1972	340.6	4	3.1
1970	17/09/1970	301.1	5	2.4
1965	7/11/1965	301	6	2
1971	1/06/1971	284.7	7	1.7
1968	29/06/1968	249.3	8	1.5
1969	18/12/1969	203.2	9	1.3
1973	11/01/1973	197.3	10	1.2

**Table P-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	292.5	281.4	292.9	301.3	292.9
5	0.8	404.5	395.5	403.1	414.6	403.6
10	0.9	468.8	471.0	466.7	471.0	467.1
25	0.96	540.3	566.5	539.5	525.6	539.3
50	0.98	587.1	637.3	589.5	556.9	588.4
75	0.9867	612.1	678.4	617.3	572.2	615.6
100	0.99	628.9	707.6	636.6	582.0	634.3
200	0.995	666.4	777.6	681.4	602.3	677.6
500	0.998	710.1	870.0	738.2	623.6	732.0
1000	0.999	739.4	939.8	779.6	636.4	771.4



**Figure P-1: Visual of different fitted distribution for the site.**

**Table P-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	139.7	140.5	230.5	0.128
Gamma	139.5	140.3	229.6	0.135
GEV	141.5	142.7	229.9	0.139
Gen. Logistic	141.4	142.6	227.5	0.136
Gen. Normal	141.5	142.7	229.4	0.138
Gen. Pareto	141.6	142.8	232.1	0.140
Gumbel	139.5	140.3	228.9	0.133
Normal	139.5	140.3	229.8	0.141
Pearson III	141.5	142.7	229.6	0.138
Wakeby	145.5	147.5	231.0	0.136
Weibull	141.5	142.7	230.3	0.138
Log-Normal	141.5	142.7	229.4	0.138
LP3	141.5	142.7	229.8	0.152
Gen. Normal	141.5	142.7	229.4	0.138

## Appendix Q Porewa at Tututotara 32715

**Table Q-1: General information about the site.**

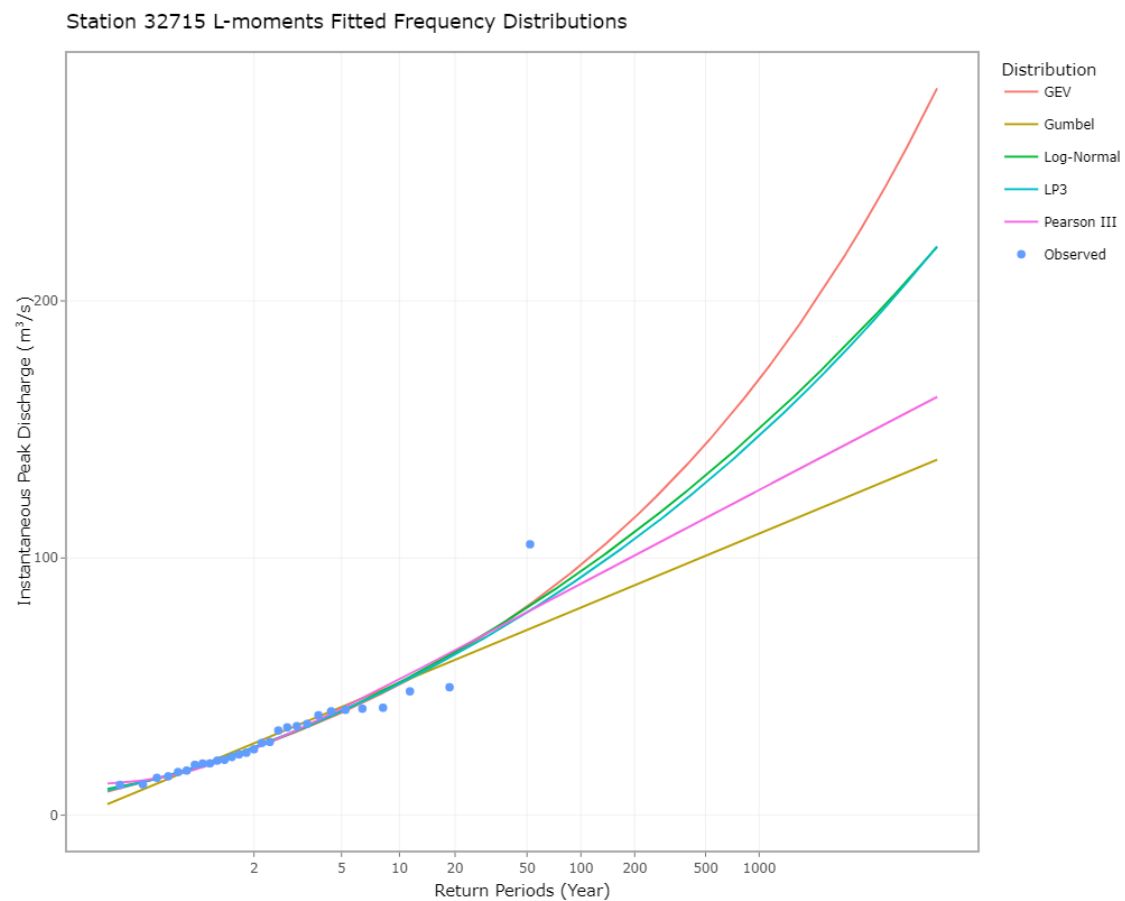
Site Details	
Start (records)	25-Mar-1963
End (records)	30-Jul-1991
Catchment area (km <sup>2</sup> )	111
Latitude	-40.02690044
Longitude	175.4744698
Record length (yrs)	29
Minimum (m <sup>3</sup> /s)	11.8
Maximum (m <sup>3</sup> /s)	105.4
Median (m <sup>3</sup> /s)	25.6
Mean (m <sup>3</sup> /s)	30.6
Standard Deviation (m <sup>3</sup> /s)	18
Coefficient of Variation	0.59

**Table Q-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1991	11/04/1991	105.4	1	52
1976	29/06/1976	49.8	2	18.7
1967	3/02/1967	48.2	3	11.4
1979	25/08/1979	41.8	4	8.2
1974	4/07/1974	41.4	5	6.4
1980	19/10/1980	41	6	5.2
1970	22/08/1970	40.4	7	4.4
1965	4/03/1965	38.9	8	3.9
1975	16/06/1975	35.5	9	3.4
1971	22/10/1971	34.6	10	3

**Table Q-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	26.2	28.0	26.0	26.4	25.8
5	0.8	39.9	42.1	40.4	40.4	41.4
10	0.9	50.8	51.4	51.6	51.1	52.9
25	0.96	67.1	63.3	67.6	66.3	67.8
50	0.98	81.2	72.0	80.7	78.9	78.9
75	0.9867	90.4	77.1	88.8	86.7	85.4
100	0.99	97.4	80.8	94.8	92.5	90.0
200	0.995	115.8	89.4	110.1	107.4	101.0
500	0.998	144.3	100.9	132.1	129.2	115.5
1000	0.999	169.5	109.5	150.3	147.5	126.5



**Figure Q-1: Visual of different fitted distribution for the site.**

**Table Q-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	253.3	256.0	31.0	0.142
Gamma	254.0	256.8	31.1	0.139
GEV	255.5	259.6	30.9	0.135
Gen. Logistic	255.6	259.7	30.8	0.130
Gen. Normal	255.4	259.5	31.0	0.138
Gen. Pareto	255.4	259.5	31.0	0.140
Gumbel	254.0	256.8	31.1	0.139
Kappa	257.5	263.0	30.9	0.133
Normal	254.5	257.2	31.6	0.145
Pearson III	255.4	259.5	31.0	0.140
Wakeby	264.0	270.8	29.1	0.126
Weibull	255.4	259.5	30.9	0.140
Log-Normal	255.4	259.5	31.0	0.138
LP3	255.7	259.8	30.7	0.134

## Appendix R Tutaenui at Hammond St 32739

**Table R-1: General information about the site.**

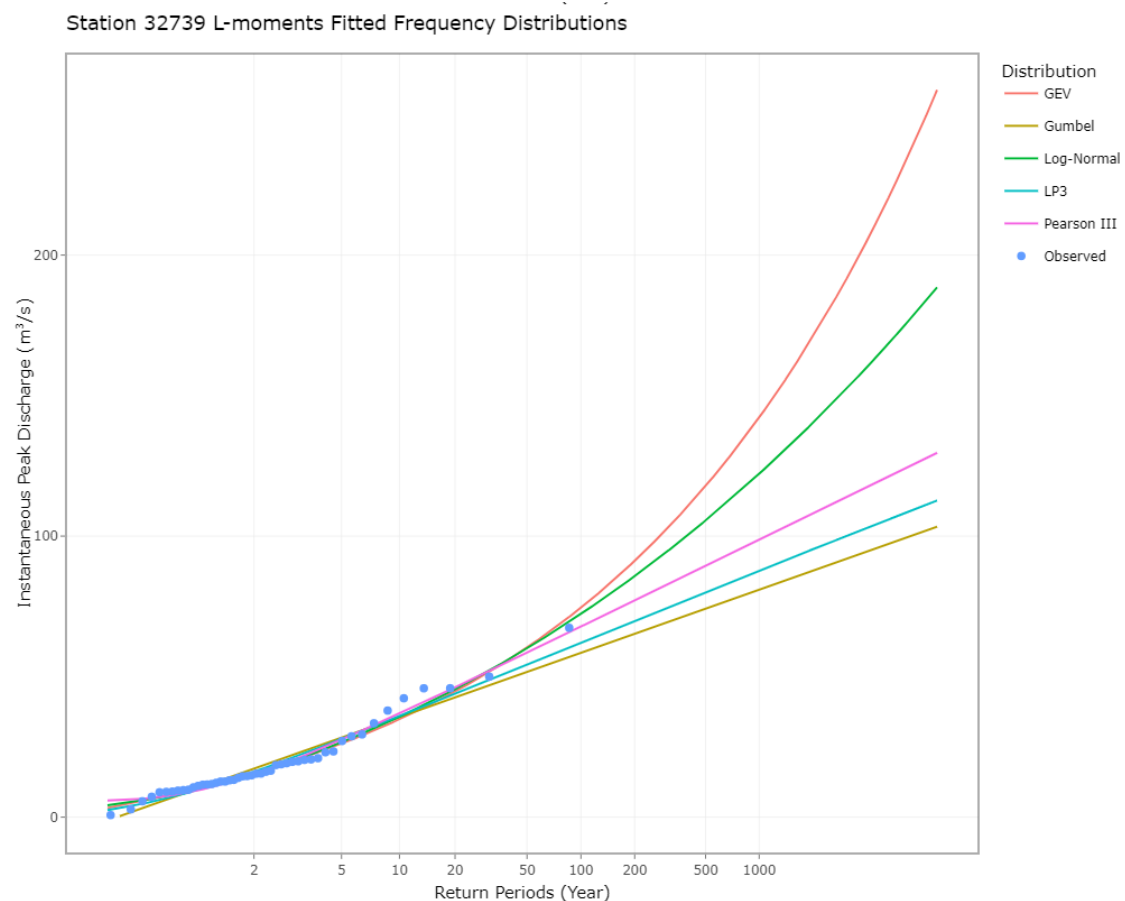
<b>Site Details</b>	
Start (records)	30-Mar-1968
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	51
Latitude	-40.06777
Longitude	175.382489
Record length (yrs)	48
Minimum (m <sup>3</sup> /s)	0.7
Maximum (m <sup>3</sup> /s)	67.4
Median (m <sup>3</sup> /s)	15.2
Mean (m <sup>3</sup> /s)	19.3
Standard Deviation (m <sup>3</sup> /s)	13.2
Coefficient of Variation	0.686

**Table R-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
2004	16/02/2004	67.4	1	85.9
2010	6/09/2010	50	2	30.8
2015	20/06/2015	45.9	3	18.8
1991	26/07/1991	45.9	4	13.5
1976	29/06/1976	42.3	5	10.6
2023	21/05/2023	37.9	6	8.7
1980	19/10/1980	33.4	7	7.3
1971	22/10/1971	29.4	8	6.4
1979	25/08/1979	28.8	9	5.6
1994	16/11/1994	27.1	10	5

**Table R-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	15.6	17.3	15.5	16.2	15.2
5	0.8	26.1	28.3	26.6	27.8	27.6
10	0.9	34.8	35.6	35.7	36.0	36.9
25	0.96	48.3	44.8	48.9	46.6	49.2
50	0.98	60.4	51.7	60.1	54.4	58.5
75	0.9867	68.4	55.7	67.1	59.0	64.0
100	0.99	74.5	58.5	72.3	62.2	67.8
200	0.995	91.2	65.2	85.8	70.0	77.1
500	0.998	117.8	74.2	105.6	80.1	89.4
1000	0.999	142.2	80.9	122.1	87.8	98.7



**Figure R-1: Visual of different fitted distribution for the site.**

**Table R-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	387.3	391.0	24.1	0.197
Gamma	387.5	391.3	24.0	0.195
GEV	389.3	394.9	24.2	0.193
Gen. Logistic	389.3	394.9	24.2	0.190
Gen. Normal	389.3	394.9	24.2	0.195
Gen. Pareto	389.3	394.9	24.1	0.197
Gumbel	387.7	391.4	24.1	0.194
Kappa	391.3	398.8	24.2	0.193
Normal	388.2	391.9	24.4	0.195
Pearson III	389.3	394.9	24.1	0.197
Wakeby	393.3	402.6	24.1	0.197
Weibull	389.3	394.9	24.1	0.197
Log-Normal	389.3	394.9	24.2	0.195
LP3	389.5	395.1	24.0	0.190

## Appendix S Rangitikei at McKelvies 32760

**Table S-1: General information about the site.**

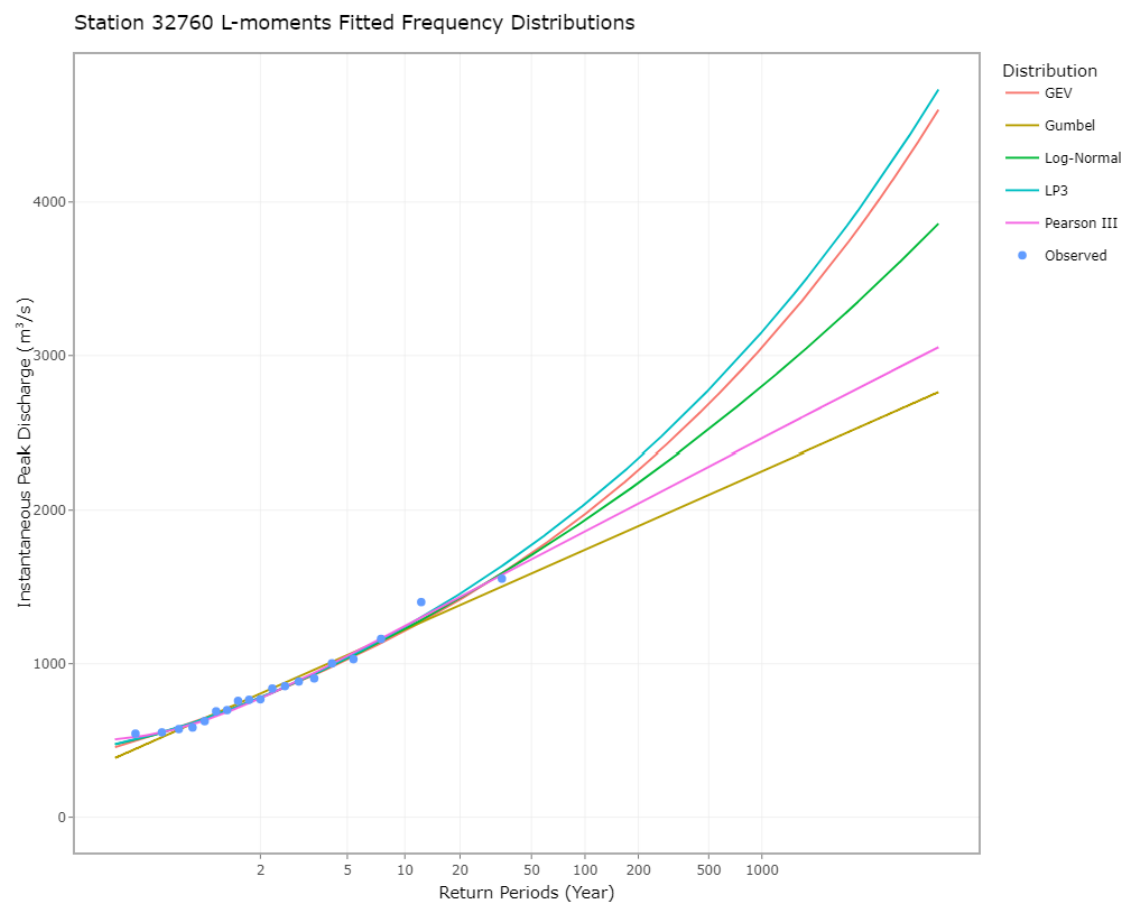
Site Details	
Start (records)	15-Jun-2006
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	3895
Latitude	-40.297027
Longitude	175.274093
Record length (yrs)	19
Minimum (m <sup>3</sup> /s)	544.5
Maximum (m <sup>3</sup> /s)	1553.8
Median (m <sup>3</sup> /s)	768.3
Mean (m <sup>3</sup> /s)	852
Standard Deviation (m <sup>3</sup> /s)	279.5
Coefficient of Variation	0.328

**Table S-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	21/06/2015	1553.8	1	34.1
2013	16/10/2013	1401.2	2	12.3
2023	14/02/2023	1161.4	3	7.5
2018	13/06/2018	1029.5	4	5.4
2008	31/07/2008	1002.3	5	4.2
2017	13/05/2017	904.2	6	3.4
2010	19/09/2010	884	7	2.9
2022	14/06/2022	853.9	8	2.5
2011	24/01/2011	838.2	9	2.2
2021	15/12/2021	768.3	10	2

**Table S-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	780.3	805.4	778.0	779.6	774.4
5	0.8	1026.1	1056.1	1034.3	1039.4	1049.1
10	0.9	1214.8	1222.2	1226.6	1240.5	1244.2
25	0.96	1487.7	1431.9	1492.9	1529.6	1494.3
50	0.98	1718.3	1587.6	1707.3	1772.3	1680.0
75	0.9867	1864.7	1678.0	1838.8	1925.4	1787.6
100	0.99	1974.1	1742.0	1934.9	2039.7	1863.5
200	0.995	2258.6	1895.9	2176.8	2335.5	2045.4
500	0.998	2685.3	2099.0	2520.4	2776.6	2284.0
1000	0.999	3051.5	2252.5	2799.7	3153.4	2463.4



**Figure S-1: Visual of different fitted distribution for the site.**

**Table S-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	271.1	273.0	519.6	0.158
Gamma	271.0	272.8	522.7	0.158
GEV	273.0	275.8	516.3	0.153
Gen. Logistic	273.0	275.8	512.7	0.147
Gen. Normal	273.0	275.8	517.8	0.155
Gen. Pareto	273.0	275.9	520.6	0.160
Gumbel	271.0	272.8	520.5	0.157
Kappa	275.0	278.8	518.3	0.155
Normal	271.0	272.8	527.2	0.160
Pearson III	273.0	275.9	519.4	0.157
Wakeby	277.0	281.7	515.4	0.152
Weibull	273.0	275.9	519.6	0.158
Log-Normal	273.0	275.8	517.8	0.155
LP3	273.1	276.0	525.3	0.166

## Appendix T Rangitikei at Pukeokahu 32763

**Table T-1: General information about the site.**

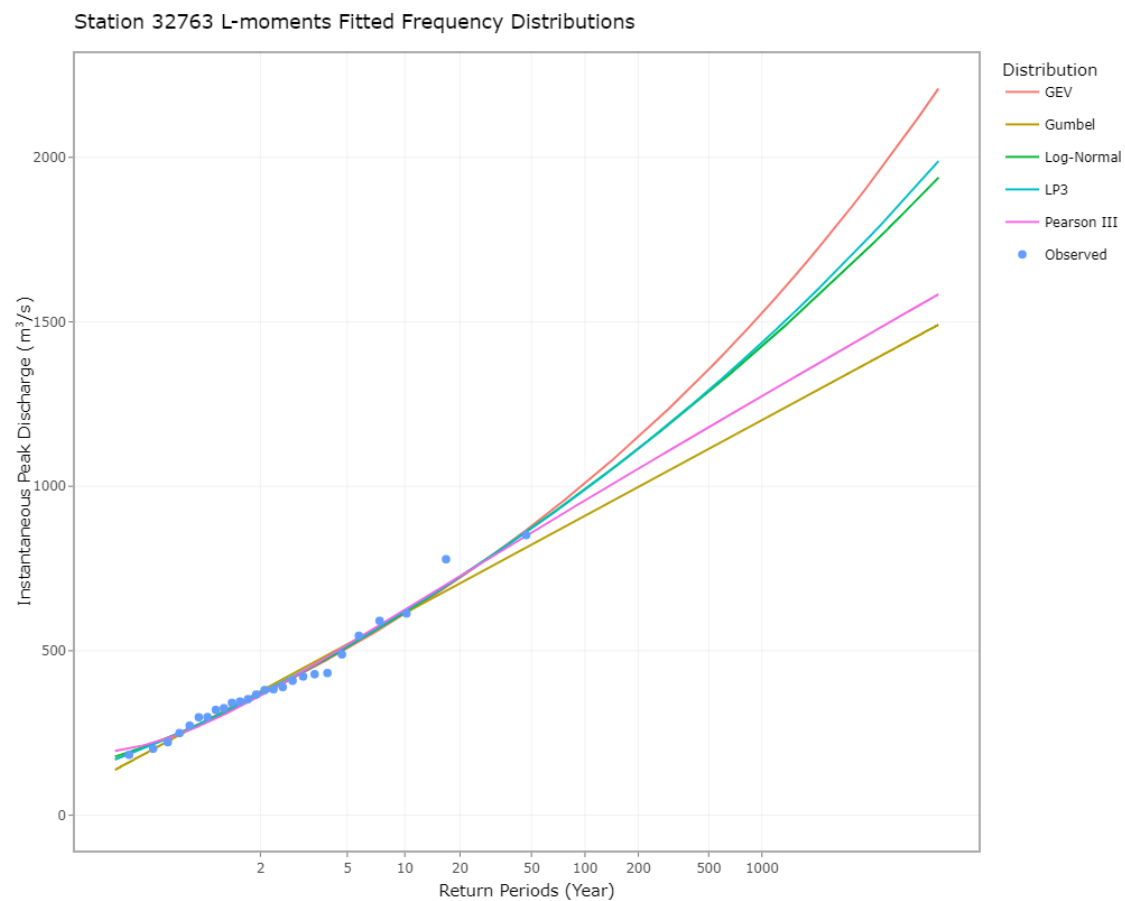
Site Details	
Start (records)	16-Mar-1999
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	769.8
Latitude	-39.627651
Longitude	176.044245
Record length (yrs)	26
Minimum (m <sup>3</sup> /s)	183.6
Maximum (m <sup>3</sup> /s)	851.7
Median (m <sup>3</sup> /s)	373.7
Mean (m <sup>3</sup> /s)	403.5
Standard Deviation (m <sup>3</sup> /s)	162.5
Coefficient of Variation	0.403

**Table T-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2003	4/10/2003	851.7	1	46.6
2004	29/02/2004	778.2	2	16.7
2011	23/01/2011	613.4	3	10.2
2000	2/10/2000	590.9	4	7.3
1999	11/11/1999	545.5	5	5.7
2018	5/01/2018	488.8	6	4.7
2013	15/10/2013	432.2	7	4
2001	7/12/2001	428.7	8	3.5
2008	7/10/2008	421.7	9	3.1
2023	29/01/2023	408.8	10	2.7

**Table T-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	366.0	377.0	365.0	369.1	363.5
5	0.8	507.2	519.8	511.0	514.4	518.0
10	0.9	611.9	614.3	616.9	618.7	624.8
25	0.96	758.7	733.8	759.9	759.9	760.0
50	0.98	879.0	822.4	872.7	871.9	859.4
75	0.9867	953.8	873.9	941.0	940.2	916.7
100	0.99	1009.1	910.4	990.6	990.0	957.1
200	0.995	1150.1	998.0	1114.1	1115.0	1053.6
500	0.998	1355.3	1113.6	1286.9	1292.3	1179.6
1000	0.999	1526.2	1201.0	1425.4	1436.6	1274.1



**Figure T-1: Visual of different fitted distribution for the site.**

**Table T-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	341.6	344.1	303.7	0.196
Gamma	341.5	344.0	303.5	0.194
GEV	343.5	347.3	302.7	0.192
Gen. Logistic	343.5	347.3	301.6	0.188
Gen. Normal	343.5	347.3	302.8	0.193
Gen. Pareto	343.5	347.3	302.7	0.197
Gumbel	341.5	344.0	303.3	0.194
Normal	341.5	344.1	306.1	0.196
Pearson III	343.5	347.3	302.8	0.195
Wakeby	347.5	353.8	306.0	0.193
Weibull	343.5	347.3	302.7	0.195
Log-Normal	343.5	347.3	302.8	0.193
LP3	343.5	347.3	304.1	0.198

## Appendix U Hautapu at Alabaster's 32767

**Table U-1: General information about the site.**

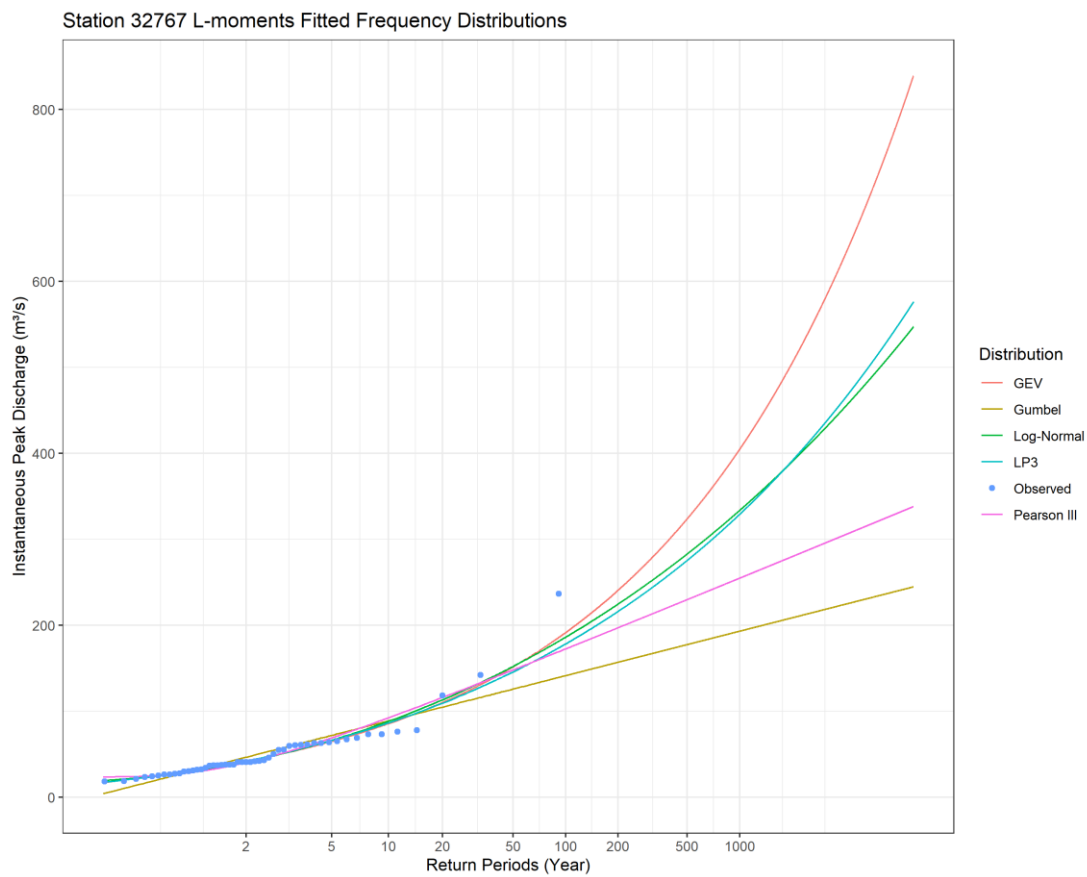
Site Details	
Start (records)	02-May-1963
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	267
Latitude	-39.659064
Longitude	175.782256
Record length (yrs)	51
Minimum (m <sup>3</sup> /s)	18.2
Maximum (m <sup>3</sup> /s)	236.6
Median (m <sup>3</sup> /s)	40.8
Mean (m <sup>3</sup> /s)	51.3
Standard Deviation (m <sup>3</sup> /s)	35.5
Coefficient of Variation	0.691

**Table U-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	236.6	1	91.3
2013	15/10/2013	142.2	2	32.8
2006	7/07/2006	118.2	3	20.0
1967	29/12/1967	77.9	4	14.4
2001	25/05/2001	76.2	5	11.2
2010	19/09/2010	73.4	6	9.2
2007	28/07/1985	73.2	7	7.8
2011	23/07/1992	69.2	8	6.8
2015	2/09/1988	67.3	9	6.0
2024	15/07/1998	65.3	10	5.3

**Table U-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	41.8	46.6	41.3	42.2	40.3
5	0.8	65.1	72.0	66.4	66.2	69.2
10	0.9	85.6	88.8	88.4	86.4	92.4
25	0.96	119.4	110.0	122.2	117.7	123.8
50	0.98	151.7	125.8	152.1	145.8	148.1
75	0.9867	174.0	135.0	171.5	164.2	162.4
100	0.99	191.5	141.4	186.2	178.3	172.5
200	0.995	240.7	157.0	224.7	216.1	197.2
500	0.998	324.2	177.6	283.2	275.7	229.9
1000	0.999	404.9	193.1	333.7	329.2	254.8



**Figure U-1: Visual of different fitted distribution for the site.**

**Table U-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	514.3	518.2	57.8	0.196
Gamma	517.3	521.2	58.0	0.204
GEV	515.2	521.0	58.4	0.186
Gen. Logistic	515.4	521.2	58.2	0.184
Gen. Normal	515.1	520.9	58.4	0.188
Gen. Pareto	515.3	521.1	58.1	0.191
Gumbel	517.4	521.2	58.3	0.204
Normal	519.2	523.0	59.4	0.209
Pearson III	515.4	521.2	58.0	0.192
Wakeby	520.1	529.8	57.5	0.181
Weibull	515.3	521.1	58.1	0.192
Log-Normal	515.1	520.9	58.4	0.188
LP3	516.5	522.3	57.6	0.190

## Appendix V Turakina at SH3 33003

**Table V-1: General information about the site.**

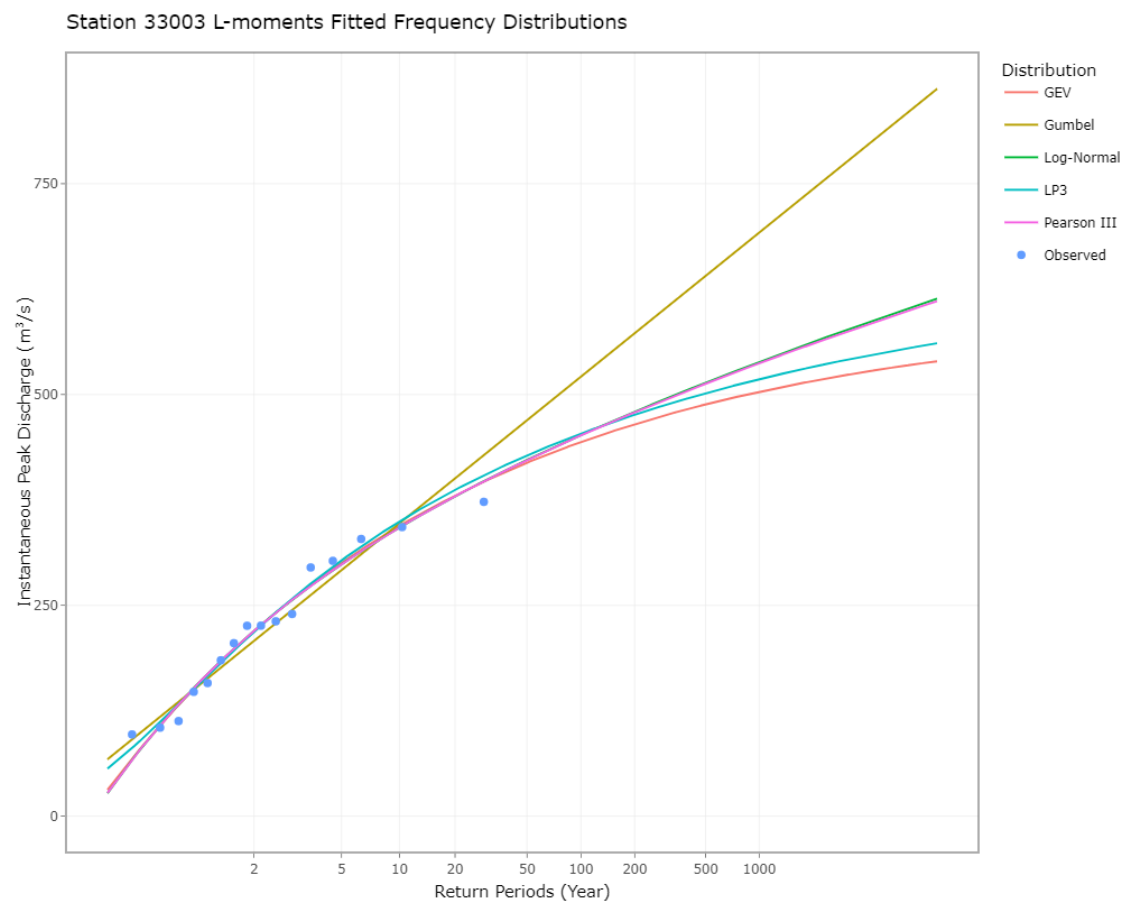
Site Details	
Start (records)	2-Feb-1977
End (records)	24-Jun-1992
Catchment area (km <sup>2</sup> )	803
Latitude	-40.03312122
Longitude	175.208783
Record length (yrs)	16
Minimum (m <sup>3</sup> /s)	96.9
Maximum (m <sup>3</sup> /s)	372.7
Median (m <sup>3</sup> /s)	225.8
Mean (m <sup>3</sup> /s)	223.4
Standard Deviation (m <sup>3</sup> /s)	87
Coefficient of Variation	0.39

**Table V-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1988	3/09/1988	372.7	1	28.8
1983	21/05/1983	342.8	2	10.3
1985	28/07/1985	328.7	3	6.3
1986	27/07/1986	302.7	4	4.5
1990	11/03/1990	294.9	5	3.5
1991	10/08/1991	239.7	6	2.9
1989	26/05/1989	231.1	7	2.5
1987	11/04/1987	225.9	8	2.1
1980	10/07/1980	225.8	9	1.9
1978	21/10/1978	205.1	10	1.7

**Table V-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	219.3	207.8	219.7	218.5	219.7
5	0.8	300.3	291.7	298.7	303.4	298.8
10	0.9	344.2	347.2	342.2	349.4	342.3
25	0.96	390.4	417.4	390.4	397.7	390.3
50	0.98	419.1	469.5	422.5	427.7	422.2
75	0.9867	434.0	499.8	440.0	443.3	439.7
100	0.99	443.7	521.2	452.0	453.5	451.6
200	0.995	464.8	572.7	479.7	476.0	479.0
500	0.998	488.2	640.6	513.9	501.5	512.8
1000	0.999	503.1	692.0	538.5	518.1	537.0



**Figure V-1: Visual of different fitted distribution for the site.**

**Table V-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	191.8	193.4	172.6	0.111
Gamma	191.5	193.0	171.0	0.112
GEV	193.5	195.8	171.2	0.115
Gen. Logistic	193.4	195.7	169.8	0.113
Gen. Normal	193.4	195.8	170.8	0.114
Gen. Pareto	193.5	195.8	172.5	0.117
Gumbel	191.5	193.0	170.7	0.111
Kappa	195.5	198.6	172.3	0.116
Normal	191.4	193.0	170.9	0.116
Pearson III	193.4	195.8	170.9	0.114
Wakeby	197.5	201.3	171.9	0.114
Weibull	193.5	195.8	171.3	0.114
Log-Normal	193.4	195.8	170.8	0.114
LP3	193.5	195.8	171.3	0.125

## Appendix W Turakina at Otairi 33004

**Table W-1: General information about the site.**

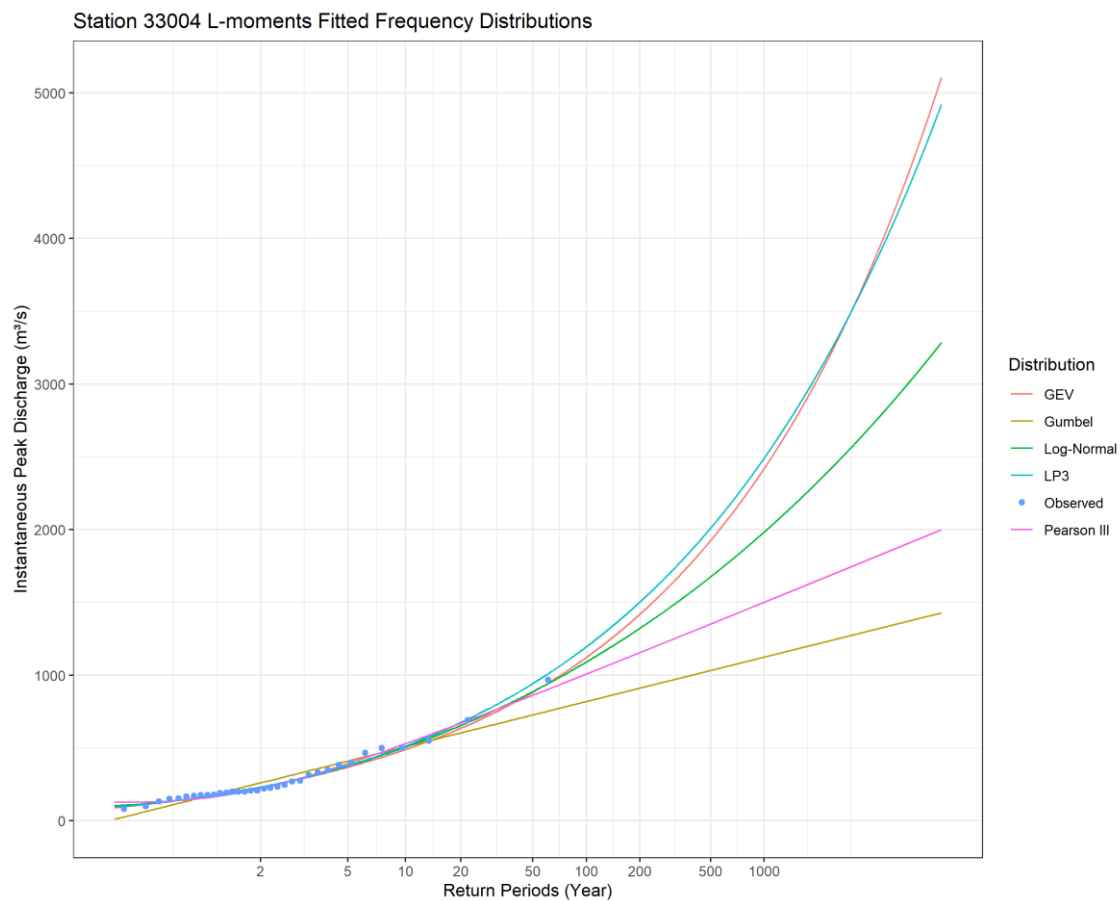
Site Details	
Start (records)	9-Apr-1991
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	507
Latitude	-39.854483
Longitude	175.496604
Record length (yrs)	34
Minimum (m <sup>3</sup> /s)	79.4
Maximum (m <sup>3</sup> /s)	968.1
Median (m <sup>3</sup> /s)	214.2
Mean (m <sup>3</sup> /s)	288.2
Standard Deviation (m <sup>3</sup> /s)	184.2
Coefficient of Variation	0.639

**Table W-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	968.1	1	60.9
2013	15/10/2013	691.7	2	21.9
2001	16/12/2001	549.5	3	13.3
2015	20/06/2015	503.3	4	9.6
2006	7/07/2006	500.4	5	7.5
1998	15/07/1998	466.9	6	6.1
2017	14/07/2017	396.1	7	5.2
2003	28/09/2003	383.8	8	4.5
1992	22/07/1992	346.6	9	4.0
2023	21/05/2023	331.3	10	3.6

**Table W-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	231.4	260.4	228.1	230.4	222.4
5	0.8	367.7	409.9	376.0	379.2	392.4
10	0.9	489.0	508.9	505.7	513.5	530.0
25	0.96	689.6	634.0	707.4	734.0	717.6
50	0.98	882.7	726.8	886.3	942.3	862.1
75	0.9867	1016.3	780.7	1002.5	1084.3	947.4
100	0.99	1121.8	818.9	1090.4	1195.3	1008.2
200	0.995	1418.9	910.6	1322.4	1502.5	1155.4
500	0.998	1925.6	1031.7	1676.1	2010.8	1351.3
1000	0.999	2419.0	1123.2	1982.7	2490.3	1500.3



**Figure W-1: Visual of different fitted distribution for the site.**

**Table W-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	454.2	457.3	323.6	0.206
Gamma	454.7	457.7	324.5	0.214
GEV	456.2	460.8	323.5	0.196
Gen. Logistic	456.3	460.8	321.9	0.194
Gen. Normal	456.2	460.8	325.2	0.198
Gen. Pareto	456.2	460.8	324.5	0.200
Gumbel	454.8	457.8	325.6	0.215
Kappa	458.2	464.3	324.2	0.198
Normal	455.2	458.2	331.0	0.221
Pearson III	456.2	460.7	324.5	0.202
Wakeby	460.2	467.8	324.5	0.200
Weibull	456.2	460.7	324.8	0.202
Log-Normal	456.2	460.8	325.2	0.198
LP3	456.4	461.0	334.7	0.204

## Appendix X Turakina at O'Neills 33012

**Table X-1: General information about the site.**

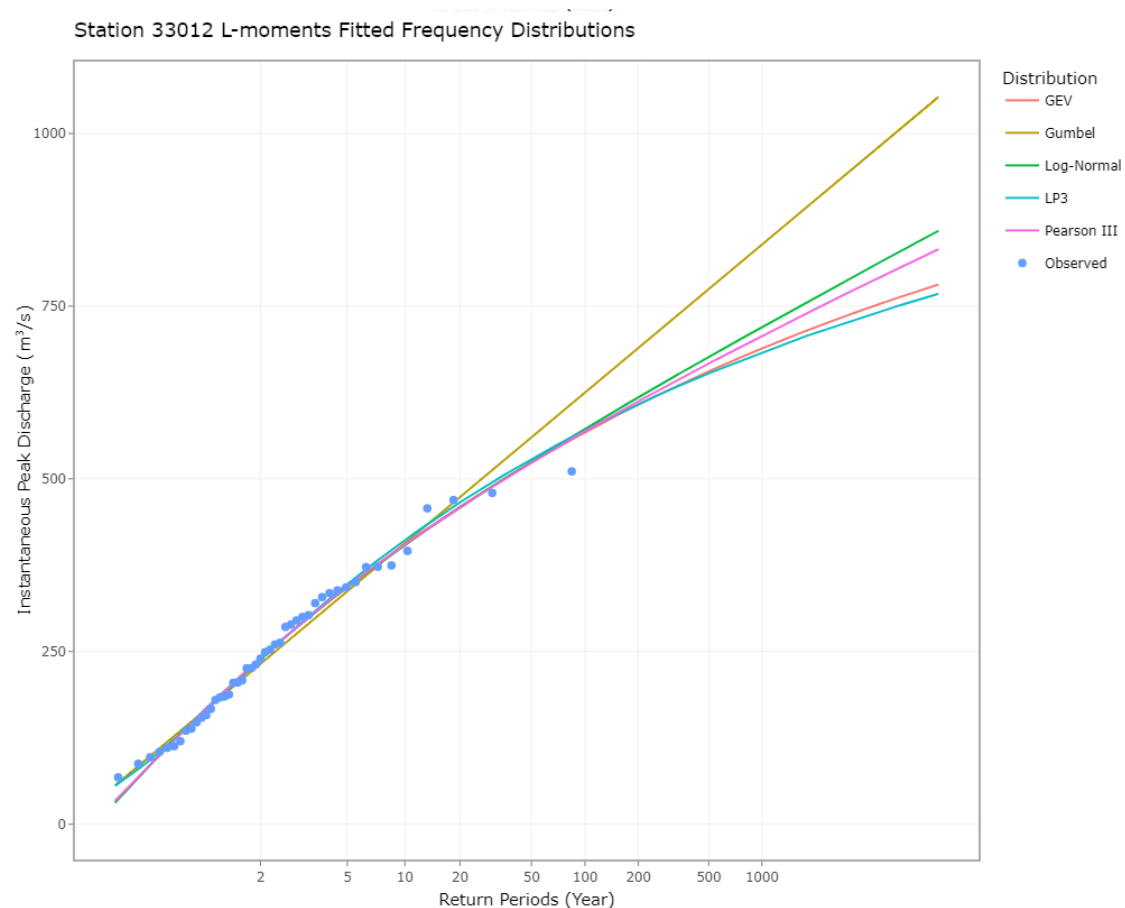
Site Details	
Start (records)	22-Dec-1934
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	845
Latitude	-40.025721
Longitude	175.233331
Record length (yrs)	47
Minimum (m <sup>3</sup> /s)	67.8
Maximum (m <sup>3</sup> /s)	510.8
Median (m <sup>3</sup> /s)	239.7
Mean (m <sup>3</sup> /s)	251.5
Standard Deviation (m <sup>3</sup> /s)	112.1
Coefficient of Variation	0.446

**Table X-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1937	1/01/1937	510.8	1	84.1
2013	16/10/2013	479.5	2	30.2
2015	21/06/2015	469.3	3	18.4
1961	6/08/1961	457.2	4	13.2
1947	1/01/1947	395.6	5	10.3
2006	7/07/2006	374.5	6	8.5
1988	3/09/1988	372.7	7	7.2
2023	21/05/2023	372.3	8	6.2
1975	16/06/1975	350.4	9	5.5
1983	21/05/1983	342.8	10	4.9

**Table X-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

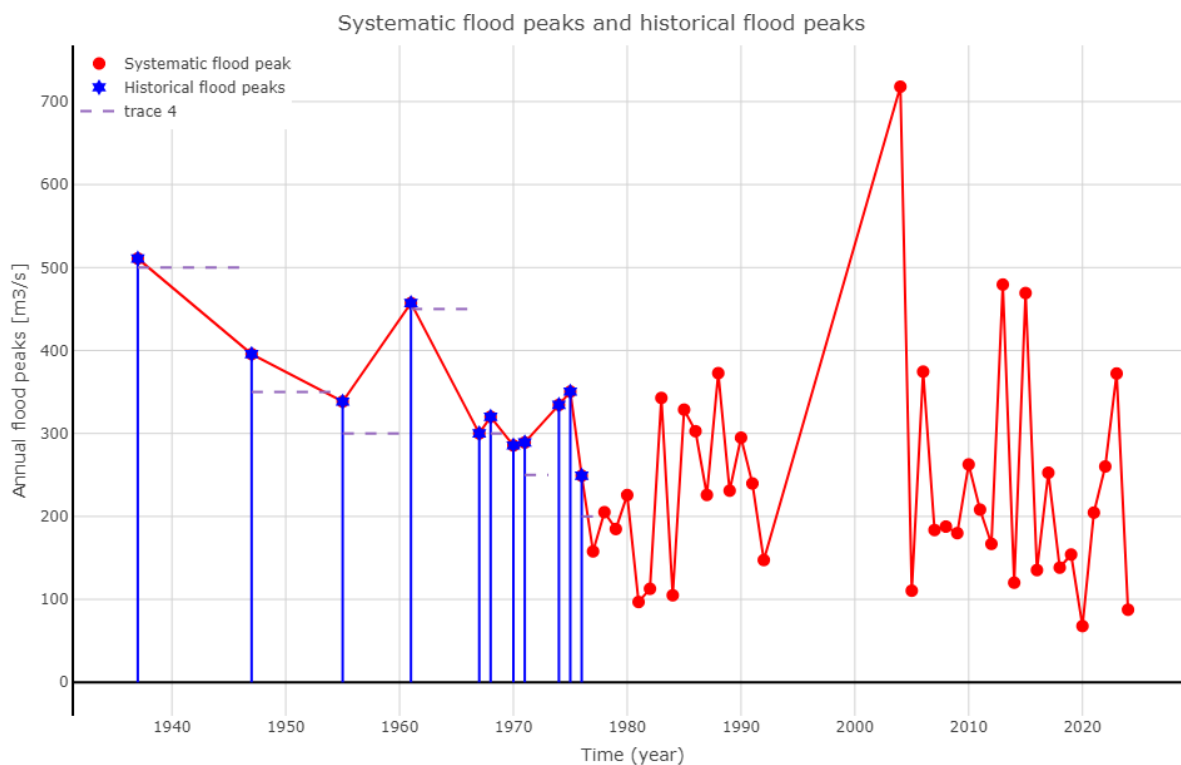
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	239.8	231.9	240.2	238.4	240.1
5	0.8	343.8	337.2	343.0	347.6	343.7
10	0.9	405.6	406.8	404.0	411.2	404.7
25	0.96	476.2	494.8	475.3	482.1	474.9
50	0.98	523.9	560.1	525.0	528.6	523.3
75	0.9867	549.8	598.1	552.9	553.5	550.2
100	0.99	567.4	624.9	572.3	570.3	568.8
200	0.995	607.5	689.5	618.0	608.0	612.2
500	0.998	655.6	774.7	676.5	652.8	667.0
1000	0.999	688.7	839.1	719.7	683.3	706.9



**Figure X-1: Visual of different fitted distribution for the site.**

**Table X-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	581.3	585.0	225.6	0.075
Gamma	580.2	583.9	222.5	0.069
GEV	582.1	587.7	222.3	0.072
Gen. Logistic	582.2	587.7	222.7	0.070
Gen. Normal	582.1	587.7	222.3	0.072
Gen. Pareto	582.1	587.6	221.3	0.074
Gumbel	580.3	584.0	222.8	0.068
Kappa	584.1	591.5	221.8	0.073
Normal	580.1	583.8	222.7	0.074
Pearson III	582.1	587.7	222.3	0.072
Wakeby	586.1	595.3	221.7	0.073
Weibull	582.1	587.7	222.0	0.072
Log-Normal	582.1	587.7	222.3	0.072
LP3	582.2	587.7	222.4	0.076



**Figure X-2: Historical information and systematic records.**

**Table X-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	240.9	215.5	263.2
5	0.8	346.0	317.9	380.4
10	0.9	413.1	381.0	465.7
25	0.96	494.9	454.2	587.4
50	0.98	553.7	501.7	691.8
75	0.9867	586.6	527.7	754.3
100	0.99	610.4	545.7	804.3
200	0.995	665.3	585.2	930.0
500	0.998	735.5	632.2	1119.4
1000	0.999	786.8	664.1	1281.8

**Table X-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1976	249.11
1975	350.43
1974	334.46
1971	289.08
1970	285.5
1968	320.07
1967	300.07
1961	457.19
1955	338.43
1947	395.64
1937	510.82

## Appendix Y Whangaehu at Kauangaroa 33101

**Table Y-1: General information about the site.**

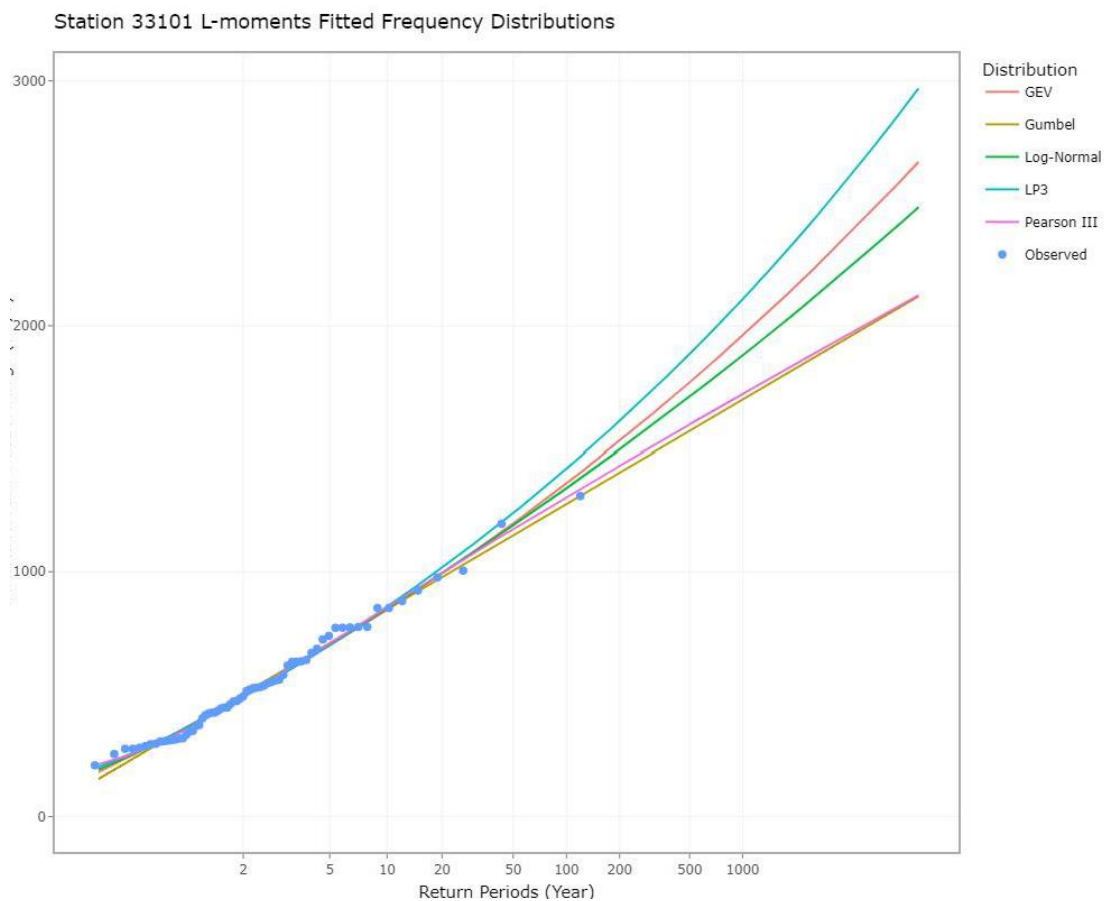
Site Details	
Start (records)	01-Feb-1891
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	1917
Latitude	-39.925771
Longitude	175.27568
Record length (yrs)	67
Minimum (m <sup>3</sup> /s)	209.7
Maximum (m <sup>3</sup> /s)	1309.1
Median (m <sup>3</sup> /s)	491.7
Mean (m <sup>3</sup> /s)	539.5
Standard Deviation (m <sup>3</sup> /s)	232.2
Coefficient of Variation	0.43

**Table Y-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	21/06/2015	1309.1	1	119.9
2004	16/02/2004	1195.9	2	43
2013	15/10/2013	1004.6	3	26.2
1897	1897-04-15	977	4	18.9
1936	3/02/1936	923.3	5	14.7
2006	7/07/2006	880.8	6	12.1
1940	25/02/1940	852	7	10.2
1904	1/05/1904	852	8	8.9
1891	1891-02-01	774.6	9	7.8
1998	21/10/1998	774.6	10	7

**Table Y-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	491.2	500.9	490.5	487.2	489.0
5	0.8	698.0	708.5	702.0	701.1	709.7
10	0.9	844.7	845.9	849.0	856.8	857.3
25	0.96	1041.9	1019.6	1041.5	1069.5	1040.8
50	0.98	1197.4	1148.4	1189.3	1239.5	1174.0
75	0.9867	1291.5	1223.2	1277.4	1343.6	1250.4
100	0.99	1359.8	1276.2	1340.7	1419.7	1304.1
200	0.995	1530.1	1403.6	1496.5	1611.4	1431.7
500	0.998	1768.5	1571.7	1710.5	1884.8	1597.5
1000	0.999	1959.6	1698.7	1878.9	2108.2	1721.2



**Figure Y-1: Visual of different fitted distribution for the site.**

**Table Y-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	923.9	928.3	447.7	0.123
Gamma	923.1	927.5	444.7	0.122
GEV	925.2	931.8	446.3	0.122
Gen. Logistic	925.3	931.9	447.5	0.120
Gen. Normal	925.2	931.8	445.7	0.122
Gen. Pareto	925.1	931.7	442.3	0.123
Gumbel	923.1	927.5	445.5	0.122
Kappa	927.1	936.0	443.7	0.122
Normal	923.2	927.6	448.5	0.122
Pearson III	925.2	931.8	444.6	0.122
Wakeby	929.1	940.2	443.4	0.122
Weibull	925.2	931.8	443.8	0.122
Log-Normal	925.2	931.8	445.7	0.122
LP3	925.6	932.2	451.3	0.128

## Appendix Z Whangaehu at Karioi 33107

**Table Z-1: General information about the site.**

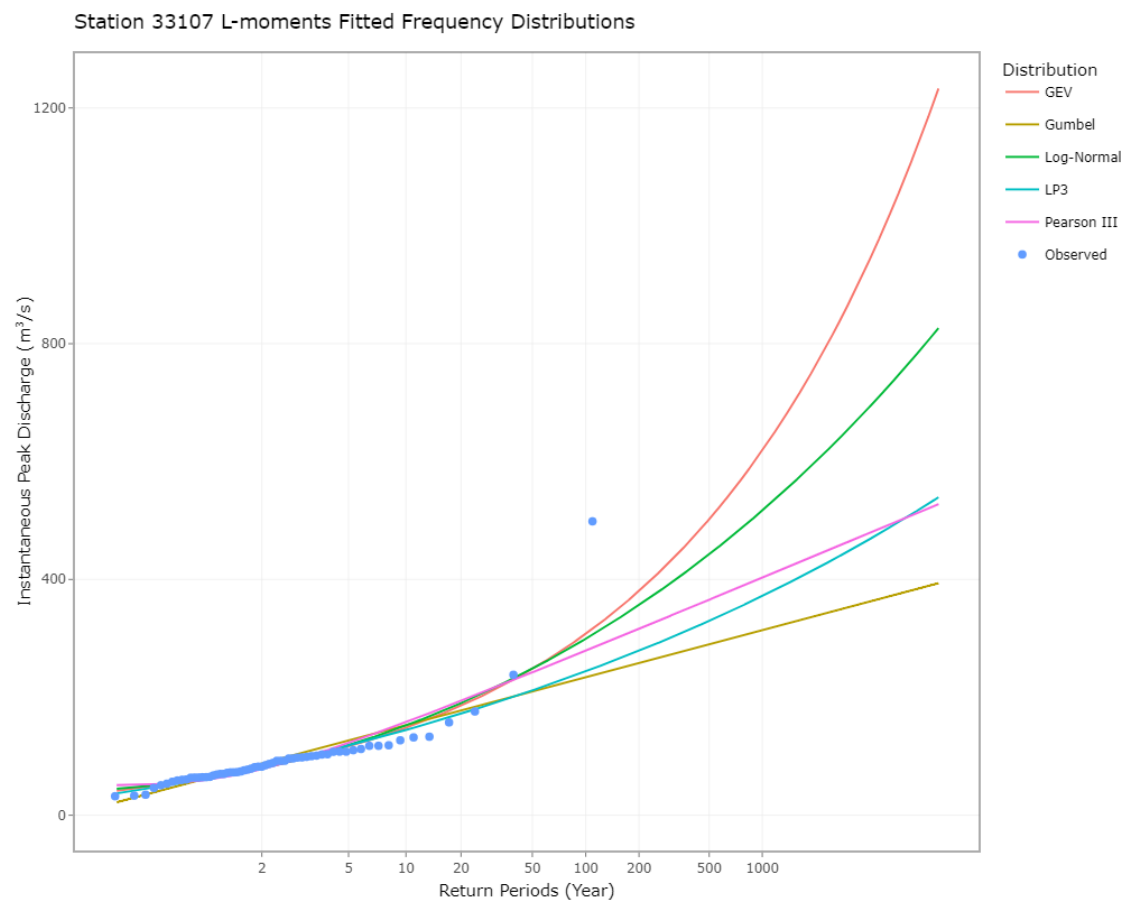
Site Details	
Start (records)	1-Nov-1962
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	338
Latitude	-39.501504
Longitude	175.464357
Record length (yrs)	61
Minimum (m <sup>3</sup> /s)	32.2
Maximum (m <sup>3</sup> /s)	498.6
Median (m <sup>3</sup> /s)	82.4
Mean (m <sup>3</sup> /s)	94.9
Standard Deviation (m <sup>3</sup> /s)	62.7
Coefficient of Variation	0.66

**Table Z-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2007	18/03/2007	498.6	1	109.1
1995	25/09/1995	238.3	2	39.2
2011	23/01/2011	176	3	23.9
2013	15/10/2013	157.5	4	17.2
2000	2/10/2000	133.2	5	13.4
1994	8/11/1994	132	6	11
2004	16/02/2004	127.1	7	9.3
1967	12/08/1967	118.6	8	8.1
1998	9/07/1998	117.8	9	7.1
1964	11/03/1964	117.8	10	6.4

**Table Z-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	80.5	87.6	79.7	82.7	78.3
5	0.8	116.7	126.8	118.8	118.3	122.8
10	0.9	148.3	152.8	152.3	144.7	158.1
25	0.96	199.7	185.6	203.7	181.6	205.8
50	0.98	248.3	210.0	248.6	211.7	242.4
75	0.9867	281.6	224.1	277.5	230.3	263.9
100	0.99	307.7	234.1	299.3	244.0	279.3
200	0.995	380.3	258.2	356.5	279.0	316.3
500	0.998	502.2	290.0	442.7	329.7	365.6
1000	0.999	618.9	314.0	516.8	371.8	403.0



**Figure Z-1: Visual of different fitted distribution for the site.**

**Table Z-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	692.7	696.9	95.1	0.192
Gamma	701.3	705.6	95.6	0.185
GEV	691.3	697.6	96.4	0.192
Gen. Logistic	691.6	697.9	96.3	0.190
Gen. Normal	691.3	697.6	96.2	0.195
Gen. Pareto	692.2	698.5	95.6	0.194
Gumbel	700.1	704.3	95.8	0.186
Normal	704.2	708.5	97.5	0.184
Pearson III	692.5	698.9	95.3	0.195
Wakeby	697.0	707.6	95.6	0.175
Weibull	692.3	698.7	95.4	0.195
Log-Normal	691.3	697.6	96.2	0.195
LP3	711.0	717.4	92.0	0.156
Exponential	692.7	696.9	95.1	0.192

## Appendix AA Mangawhero at Ore Ore 33111

**Table AA-1: General information about the site.**

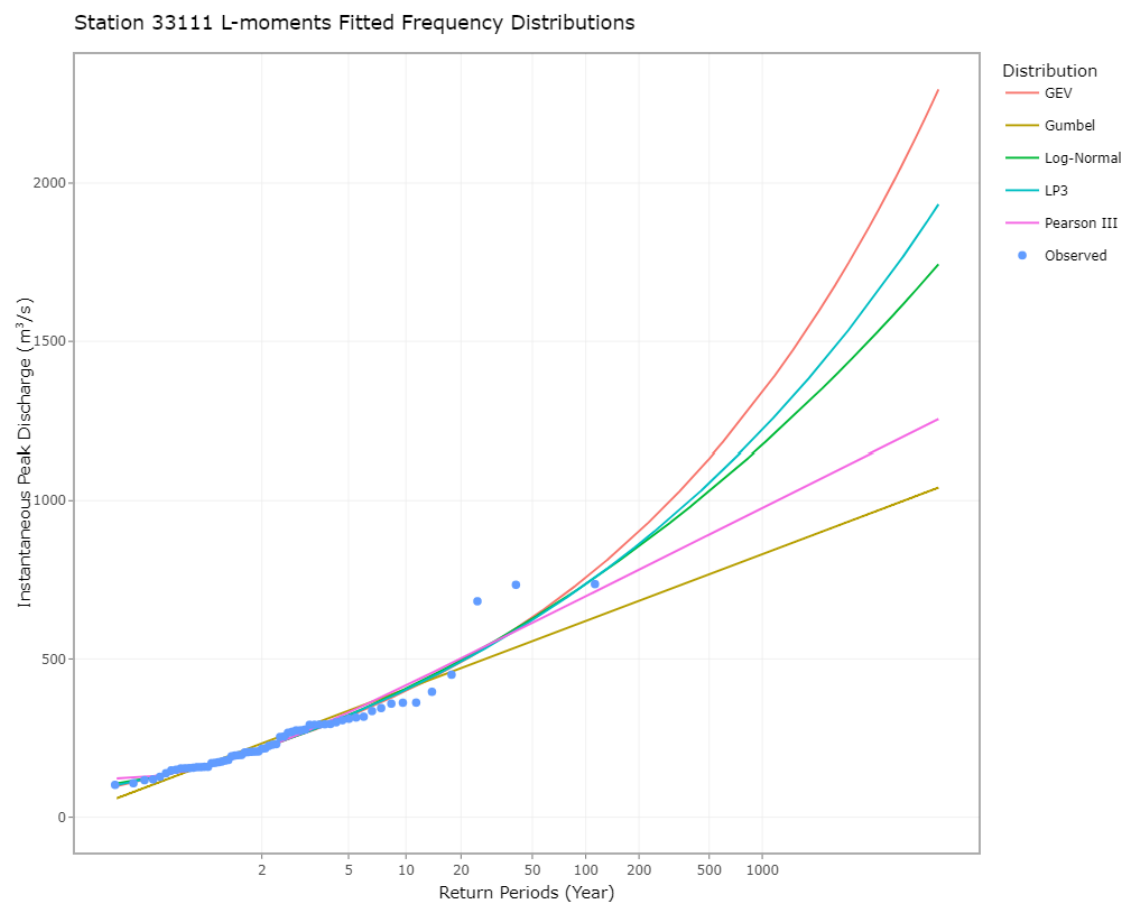
Site Details	
Start (records)	7-May-1962
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	506
Latitude	-39.568125
Longitude	175.264769
Record length (yrs)	63
Minimum (m <sup>3</sup> /s)	102.2
Maximum (m <sup>3</sup> /s)	736.6
Median (m <sup>3</sup> /s)	216.1
Mean (m <sup>3</sup> /s)	252.4
Standard Deviation (m <sup>3</sup> /s)	130.5
Coefficient of Variation	0.517

**Table AA-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	20/06/2015	736.6	1	112.7
2013	15/10/2013	734.3	2	40.5
2004	16/02/2004	682.4	3	24.7
1998	15/07/1998	450.3	4	17.7
2006	7/07/2006	396.3	5	13.8
1974	4/07/1974	362.1	6	11.4
1968	7/12/1968	361.7	7	9.6
2000	2/10/2000	358.8	8	8.3
1975	29/08/1975	344.9	9	7.4
2003	28/09/2003	335.4	10	6.6

**Table AA-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	219.0	233.1	217.6	219.4	215.4
5	0.8	318.6	336.7	322.9	321.7	330.8
10	0.9	399.3	405.3	406.4	402.7	416.6
25	0.96	522.1	492.0	527.0	521.5	529.1
50	0.98	631.0	556.3	627.5	622.9	613.7
75	0.9867	702.3	593.7	690.3	687.7	663.1
100	0.99	756.8	620.1	736.9	736.3	698.0
200	0.995	902.6	683.7	856.0	863.3	782.2
500	0.998	1132.0	767.6	1029.5	1055.3	893.2
1000	0.999	1338.4	831.0	1173.9	1221.3	977.1



**Figure AA-1: Visual of different fitted distribution for the site.**

**Table AA-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	795.8	800.1	229.7	0.139
Gamma	797.6	801.9	229.8	0.144
GEV	797.7	804.2	231.4	0.137
Gen. Logistic	797.7	804.2	231.5	0.136
Gen. Normal	797.8	804.2	230.9	0.138
Gen. Pareto	797.9	804.4	229.3	0.139
Gumbel	797.2	801.5	230.3	0.143
Kappa	799.7	808.3	231.5	0.137
Normal	798.4	802.7	233.3	0.147
Pearson III	797.9	804.3	229.5	0.138
Wakeby	801.8	812.5	230.4	0.135
Weibull	797.9	804.3	229.4	0.139
Log-Normal	797.8	804.2	230.9	0.138
LP3	797.9	804.3	230.4	0.137

## Appendix BB Tokiahuru at Whangaehu Junction 33112

**Table BB-1: General information about the site.**

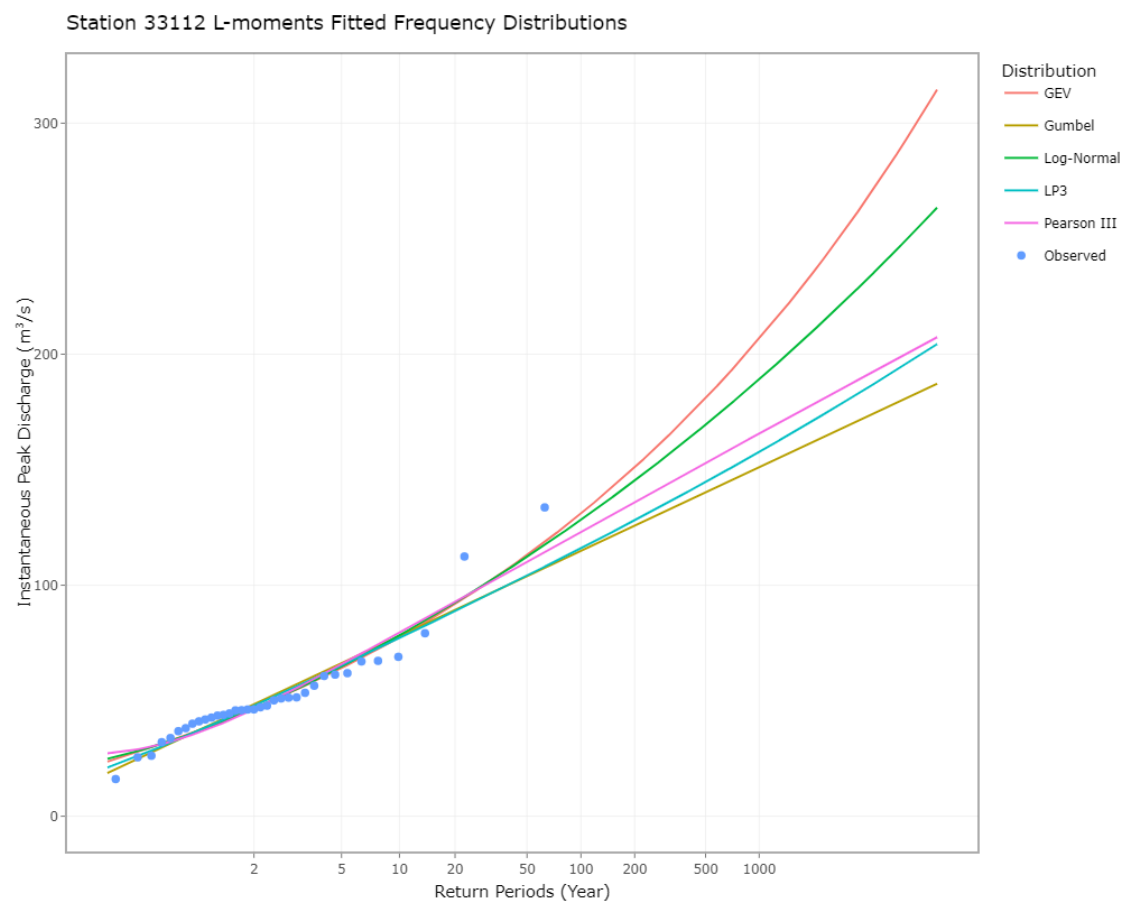
Site Details	
Start (records)	13-Aug-1979
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	220
Latitude	-39.496033
Longitude	175.46165
Record length (yrs)	35
Minimum (m <sup>3</sup> /s)	16.1
Maximum (m <sup>3</sup> /s)	133.7
Median (m <sup>3</sup> /s)	46.2
Mean (m <sup>3</sup> /s)	51.8
Standard Deviation (m <sup>3</sup> /s)	22.2
Coefficient of Variation	0.429

**Table BB-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2013	15/10/2013	133.7	1	62.7
2011	23/01/2011	112.4	2	22.5
2021	17/07/2021	79.2	3	13.7
2015	20/06/2015	69	4	9.9
2007	18/03/2007	67.3	5	7.7
2014	3/08/2014	67	6	6.3
1986	26/07/1986	61.9	7	5.4
2017	21/07/2017	61.3	8	4.6
1991	9/08/1991	60.7	9	4.1
2010	1/10/2010	56.5	10	3.7

**Table BB-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	46.7	48.5	46.5	47.7	46.3
5	0.8	64.2	66.2	64.7	65.3	65.8
10	0.9	77.5	78.0	78.3	77.2	79.6
25	0.96	96.8	92.9	97.1	92.5	97.2
50	0.98	113.1	103.9	112.3	104.1	110.4
75	0.9867	123.4	110.3	121.5	111.0	117.9
100	0.99	131.1	114.9	128.3	116.0	123.3
200	0.995	151.0	125.8	145.3	128.1	136.1
500	0.998	181.0	140.2	169.5	144.7	153.0
1000	0.999	206.6	151.1	189.1	157.7	165.6



**Figure BB-1: Visual of different fitted distribution for the site.**

**Table BB-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	319.4	322.5	39.4	0.188
Gamma	320.3	323.4	39.4	0.190
GEV	321.6	326.3	39.4	0.186
Gen. Logistic	321.7	326.4	39.4	0.183
Gen. Normal	321.6	326.3	39.4	0.187
Gen. Pareto	321.6	326.3	39.2	0.189
Gumbel	320.1	323.2	39.4	0.189
Normal	320.6	323.7	39.8	0.192
Pearson III	321.6	326.3	39.3	0.188
Wakeby	325.4	333.2	40.4	0.179
Weibull	321.6	326.3	39.2	0.189
Log-Normal	321.6	326.3	39.4	0.187
LP3	322.4	327.1	38.9	0.182
Gen. Logistic	321.7	326.4	39.4	0.183

## Appendix CC Waitangi at Tangiwai 33114

**Table CC-1: General information about the site.**

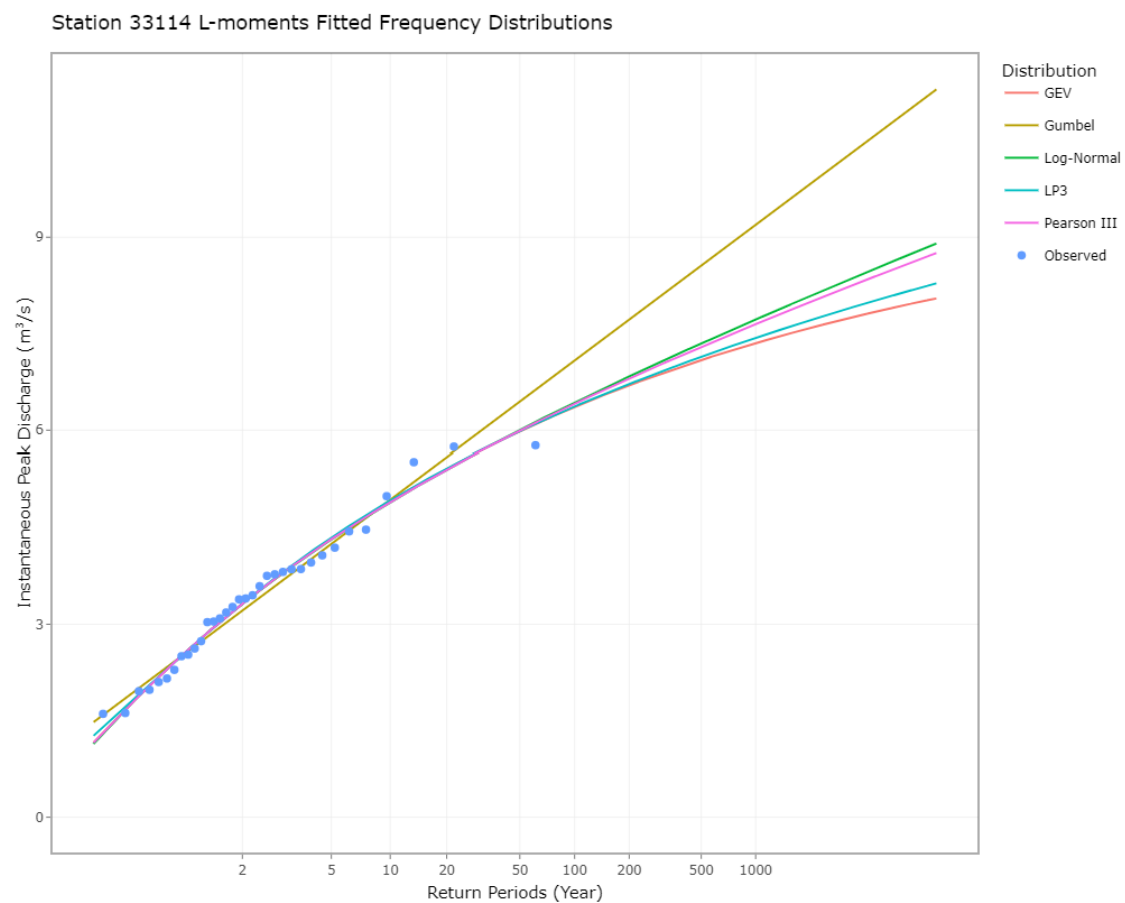
Site Details	
Start (records)	22-Nov-1967
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	59
Latitude	-39.478728
Longitude	175.575925
Record length (yrs)	34
Minimum (m <sup>3</sup> /s)	1.6
Maximum (m <sup>3</sup> /s)	5.8
Median (m <sup>3</sup> /s)	3.4
Mean (m <sup>3</sup> /s)	3.4
Standard Deviation (m <sup>3</sup> /s)	1.1
Coefficient of Variation	0.326

**Table CC-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1968	7/12/1968	5.8	1	60.9
2024	10/09/2024	5.7	2	21.9
1967	28/12/1967	5.5	3	13.3
1972	15/06/1972	5	4	9.6
1988	2/09/1988	4.5	5	7.5
1971	4/12/1971	4.4	6	6.1
1985	28/07/1985	4.2	7	5.2
1976	12/01/1976	4.1	8	4.5
1977	21/01/1977	4	9	4
2017	21/07/2017	3.9	10	3.6

**Table CC-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	3.3	3.2	3.3	3.3	3.3
5	0.8	4.3	4.3	4.3	4.4	4.3
10	0.9	4.9	4.9	4.9	4.9	4.9
25	0.96	5.6	5.8	5.6	5.6	5.6
50	0.98	6.0	6.4	6.0	6.0	6.0
75	0.9867	6.2	6.8	6.3	6.2	6.2
100	0.99	6.4	7.1	6.4	6.4	6.4
200	0.995	6.7	7.7	6.8	6.7	6.8
500	0.998	7.1	8.6	7.4	7.1	7.3
1000	0.999	7.4	9.2	7.7	7.4	7.7



**Figure CC-1: Visual of different fitted distribution for the site.**

**Table CC-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	107.3	110.4	2.2	0.087
Gamma	106.6	109.7	2.2	0.078
GEV	108.6	113.2	2.2	0.078
Gen. Logistic	108.6	113.2	2.2	0.078
Gen. Normal	108.6	113.2	2.2	0.078
Gen. Pareto	108.6	113.1	2.2	0.078
Gumbel	106.7	109.7	2.2	0.080
Kappa	110.6	116.7	2.2	0.078
Normal	106.6	109.6	2.2	0.078
Pearson III	108.6	113.2	2.2	0.078
Wakeby	112.6	120.2	2.2	0.076
Weibull	108.6	113.2	2.2	0.078
Log-Normal	108.6	113.2	2.2	0.078
LP3	108.6	113.2	2.2	0.081

## Appendix DD Mangaetoroa at School 33115

**Table DD-1: General information about the site.**

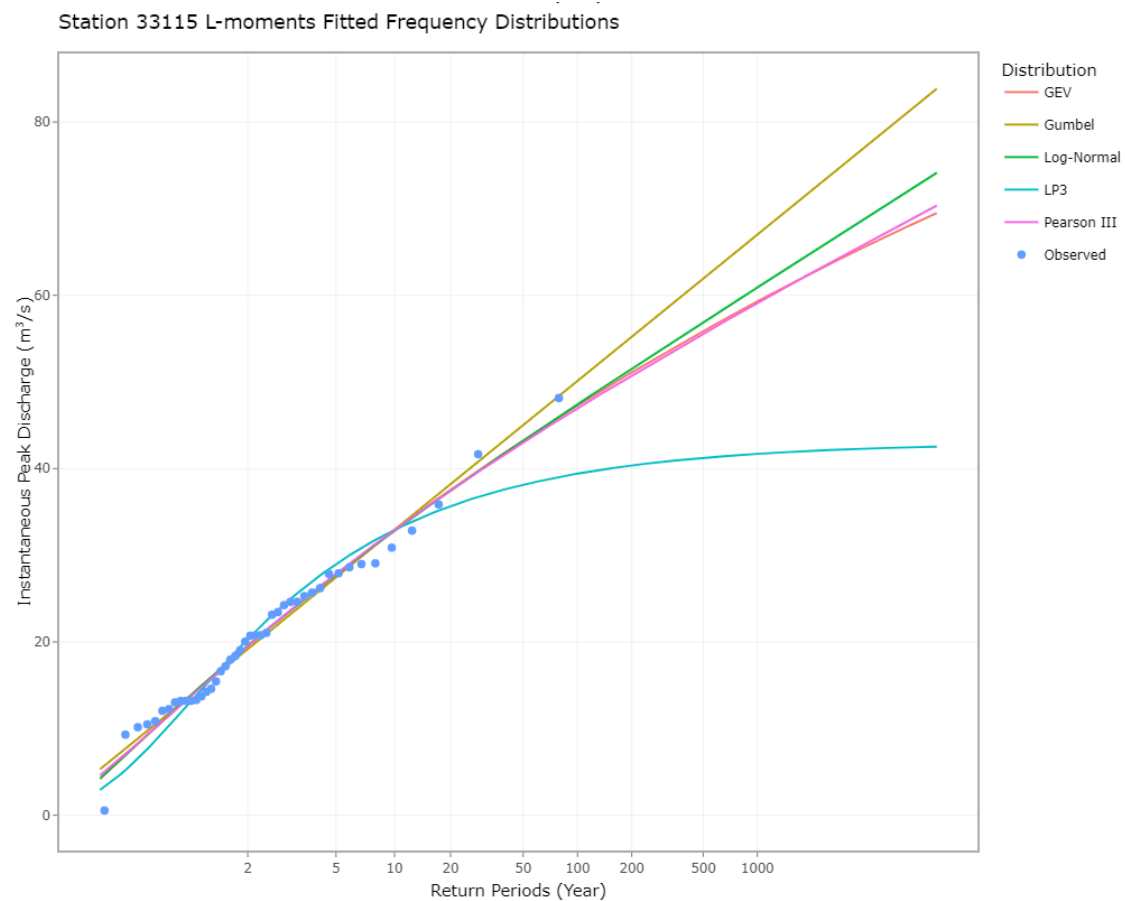
Site Details	
Start (records)	30-Dec-1968
End (records)	30-Sep-2011
Catchment area (km <sup>2</sup> )	33.2
Latitude	-39.44463135
Longitude	175.2271071
Record length (yrs)	44
Minimum (m <sup>3</sup> /s)	0.5
Maximum (m <sup>3</sup> /s)	48.1
Median (m <sup>3</sup> /s)	20.4
Mean (m <sup>3</sup> /s)	20.7
Standard Deviation (m <sup>3</sup> /s)	9.1
Coefficient of Variation	0.441

**Table DD-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	48.1	1	78.8
1998	21/10/1998	41.7	2	28.3
1990	10/03/1990	35.9	3	17.2
1999	16/05/1999	32.8	4	12.4
1976	30/04/1976	30.9	5	9.7
2003	27/11/2003	29.1	6	7.9
1995	7/09/1995	29	7	6.7
1975	29/08/1975	28.6	8	5.8
2011	23/01/2011	27.9	9	5.2
1979	8/05/1979	27.8	10	4.6

**Table DD-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	19.5	19.2	19.6	20.3	19.6
5	0.8	27.8	27.5	27.8	29.0	27.9
10	0.9	32.9	32.9	32.8	32.9	32.9
25	0.96	39.0	39.9	38.9	36.4	38.9
50	0.98	43.3	45.0	43.2	38.1	43.0
75	0.9867	45.6	48.0	45.7	38.9	45.3
100	0.99	47.3	50.1	47.4	39.4	47.0
200	0.995	51.1	55.2	51.5	40.4	50.8
500	0.998	55.9	61.9	56.9	41.2	55.6
1000	0.999	59.3	67.0	60.9	41.7	59.1



**Figure DD-1: Visual of different fitted distribution for the site.**

**Table DD-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	323.2	326.7	18.0	0.102
Gamma	322.5	326.1	17.7	0.088
GEV	324.5	329.9	17.8	0.089
Gen. Logistic	324.6	329.9	17.8	0.087
Gen. Normal	324.5	329.9	17.8	0.089
Gen. Pareto	324.5	329.9	17.6	0.092
Gumbel	322.6	326.1	17.8	0.086
Kappa	326.5	333.7	17.8	0.089
Normal	322.5	326.1	17.8	0.094
Pearson III	324.5	329.9	17.7	0.089
Wakeby	328.5	337.5	17.8	0.088
Weibull	324.5	329.9	17.7	0.090
Log-Normal	324.5	329.9	17.8	0.089
LP3	324.6	329.9	17.9	0.086

## Appendix EE Makotuku at Raetihi 33119

**Table EE-1: General information about the site.**

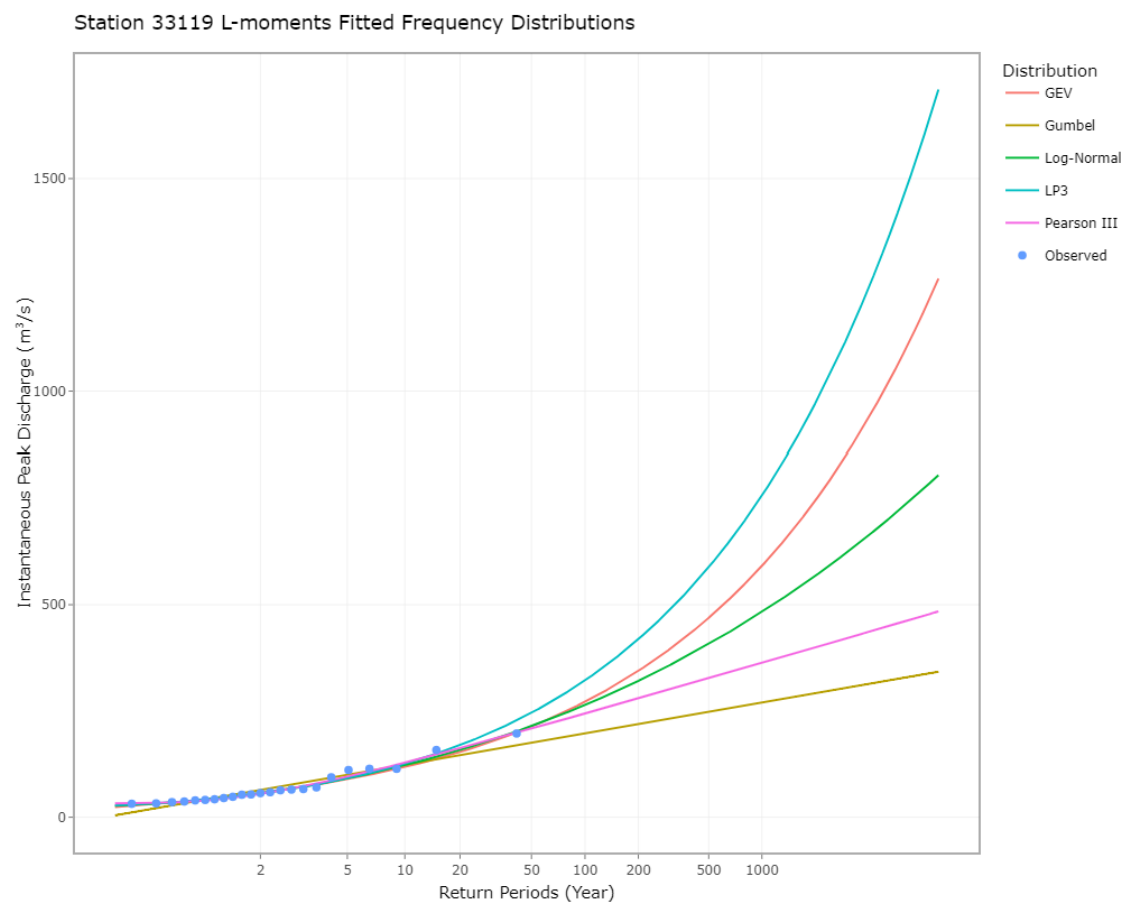
Site Details	
Start (records)	31-Oct-1974
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	62
Latitude	-39.422132
Longitude	175.281733
Record length (yrs)	23
Minimum (m <sup>3</sup> /s)	31.6
Maximum (m <sup>3</sup> /s)	197
Median (m <sup>3</sup> /s)	56.7
Mean (m <sup>3</sup> /s)	70.7
Standard Deviation (m <sup>3</sup> /s)	42.5
Coefficient of Variation	0.601

**Table EE-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2006	30/11/2006	197	1	41.3
2013	15/10/2013	158.1	2	14.8
1976	29/06/1976	113.9	3	9
1977	20/01/1977	113.9	4	6.5
2007	18/03/2007	111	5	5.1
2015	20/06/2015	93.9	6	4.2
2014	3/08/2014	70.2	7	3.5
2008	7/10/2008	66.3	8	3.1
2010	6/09/2010	65	9	2.7
2022	2/06/2022	63.5	10	2.4

**Table EE-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

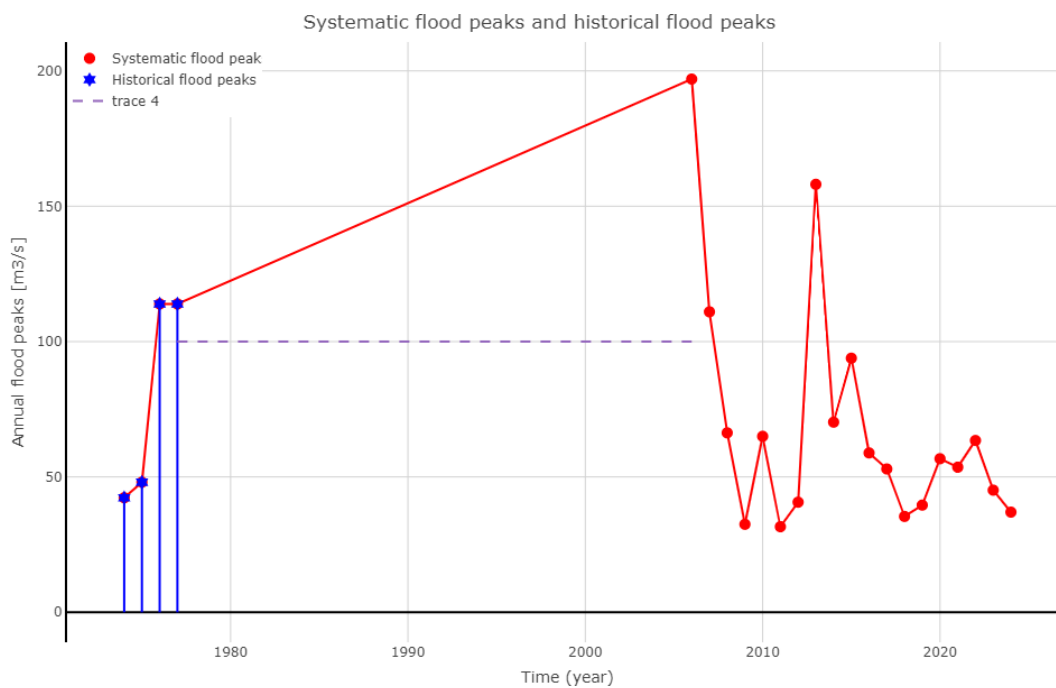
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	57.0	64.1	56.2	56.0	54.8
5	0.8	89.4	99.8	91.4	91.7	95.4
10	0.9	118.4	123.4	122.5	126.1	128.5
25	0.96	166.6	153.2	171.1	186.0	173.8
50	0.98	213.4	175.3	214.5	245.9	208.7
75	0.9867	245.8	188.2	242.7	288.2	229.3
100	0.99	271.6	197.3	264.2	322.0	244.0
200	0.995	344.3	219.2	320.8	418.9	279.7
500	0.998	469.0	248.1	407.5	588.2	327.2
1000	0.999	591.3	269.9	482.9	756.8	363.3



**Figure EE-1: Visual of different fitted distribution for the site.**

**Table EE-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	240.7	243.0	75.1	0.238
Gamma	240.9	243.1	75.6	0.240
GEV	242.8	246.2	74.1	0.226
Gen. Logistic	242.8	246.3	73.6	0.222
Gen. Normal	242.8	246.2	74.8	0.232
Gen. Pareto	242.8	246.2	74.9	0.234
Gumbel	240.9	243.2	75.7	0.240
Kappa	244.8	249.3	75.0	0.235
Normal	241.0	243.3	77.1	0.244
Pearson III	242.8	246.2	75.2	0.237
Wakeby	246.8	252.4	74.9	0.234
Weibull	242.8	246.2	75.2	0.236
Log-Normal	242.8	246.2	74.8	0.232
LP3	243.5	246.9	78.5	0.248



**Figure EE-2: Historical information and systematic records.**

**Table EE-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	52.1	45.2	59.2
5	0.8	76.4	65.7	92.2
10	0.9	99.4	83.0	135.5
25	0.96	139.9	109.4	238.3
50	0.98	181.3	131.3	376.5
75	0.9867	210.8	143.8	491.2
100	0.99	235.2	153.3	597.3
200	0.995	305.5	178.2	965.1
500	0.998	432.7	215.6	1837.8
1000	0.999	563.9	246.6	2968.5

**Table EE-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1977	113.9
1976	113.9
1975	48.0
1974	42.3

## Appendix FF Whangaehu at Mangaio Tunnel 33130

**Table FF-1: General information about the site.**

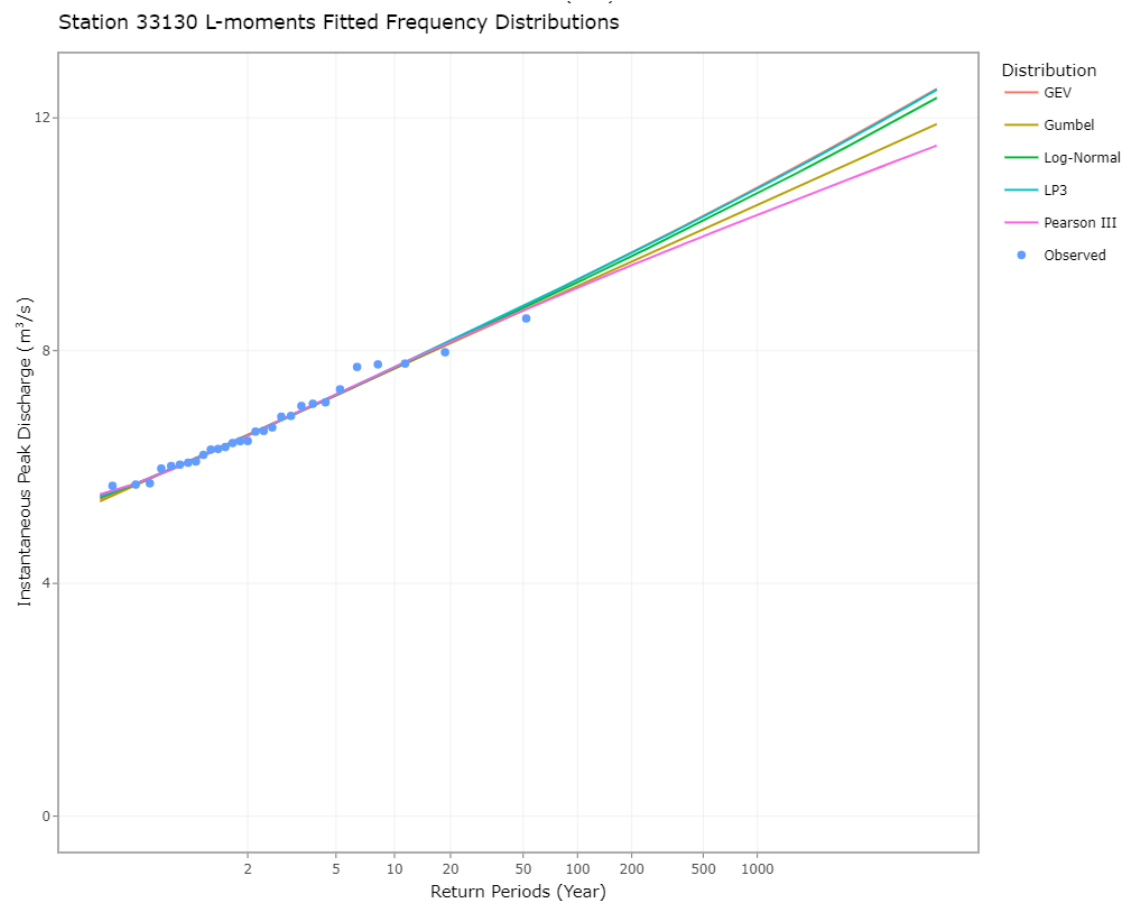
Site Details	
Start (records)	10-Jul-1979
End (records)	29-Mar-2007
Catchment area (km <sup>2</sup> )	72
Latitude	-39.38183841
Longitude	175.7219878
Record length (yrs)	29
Minimum (m <sup>3</sup> /s)	5.7
Maximum (m <sup>3</sup> /s)	8.6
Median (m <sup>3</sup> /s)	6.4
Mean (m <sup>3</sup> /s)	6.7
Standard Deviation (m <sup>3</sup> /s)	0.7
Coefficient of Variation	0.111

**Table FF-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1998	21/10/1998	8.6	1	52
2005	25/03/2005	8	2	18.7
2003	21/05/2003	7.8	3	11.4
1991	7/08/1991	7.8	4	8.2
1999	17/01/1999	7.7	5	6.4
2001	25/05/2001	7.3	6	5.2
1986	25/07/1986	7.1	7	4.4
1989	3/01/1989	7.1	8	3.9
2006	30/11/2006	7.1	9	3.4
2004	15/02/2004	6.9	10	3

**Table FF-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	6.5	6.6	6.5	6.5	6.5
5	0.8	7.2	7.2	7.2	7.2	7.3
10	0.9	7.7	7.7	7.7	7.7	7.7
25	0.96	8.3	8.3	8.3	8.3	8.3
50	0.98	8.8	8.7	8.7	8.8	8.7
75	0.9867	9.0	8.9	9.0	9.0	8.9
100	0.99	9.2	9.1	9.2	9.2	9.1
200	0.995	9.7	9.5	9.6	9.7	9.5
500	0.998	10.3	10.1	10.2	10.3	10.0
1000	0.999	10.8	10.5	10.7	10.8	10.3



**Figure FF-1: Visual of different fitted distribution for the site.**

**Table FF-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	68.5	71.2	1.4	0.127
Gamma	67.9	70.7	1.4	0.141
GEV	70.0	74.1	1.4	0.135
Gen. Logistic	70.0	74.1	1.4	0.133
Gen. Normal	70.0	74.1	1.4	0.135
Gen. Pareto	70.0	74.1	1.4	0.138
Gumbel	68.0	70.7	1.4	0.136
Kappa	72.0	77.5	1.4	0.137
Normal	67.9	70.7	1.4	0.142
Pearson III	70.0	74.1	1.4	0.136
Wakeby	74.0	80.9	1.4	0.138
Weibull	70.0	74.1	1.4	0.136
Log-Normal	70.0	74.1	1.4	0.135
LP3	70.1	74.2	1.4	0.136

## Appendix GG Mangawhero at Hageleys 33143

**Table GG-1: General information about the site.**

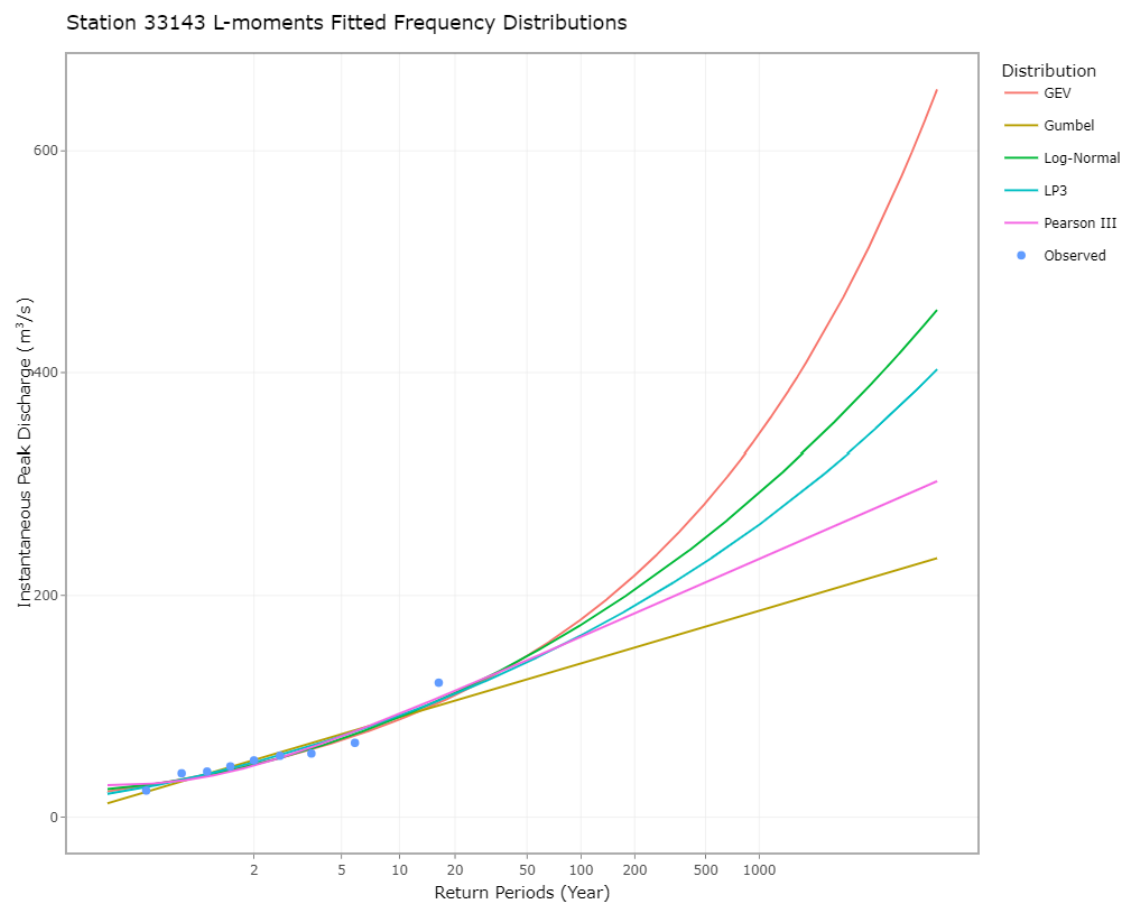
Site Details	
Start (records)	8-Apr-1999
End (records)	15-Oct-2013
Catchment area (km <sup>2</sup> )	71
Latitude	-39.409835
Longitude	175.387452
Record length (yrs)	9
Minimum (m <sup>3</sup> /s)	24.1
Maximum (m <sup>3</sup> /s)	121.3
Median (m <sup>3</sup> /s)	51.2
Mean (m <sup>3</sup> /s)	55.9
Standard Deviation (m <sup>3</sup> /s)	27.4
Coefficient of Variation	0.491

**Table GG-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2013	15/10/2013	121.3	1	16.3
2004	16/02/2004	67.1	2	5.8
2000	2/10/2000	57.5	3	3.6
2006	7/07/2006	55.4	4	2.6
1999	16/05/1999	51.2	5	2
2003	3/10/2003	45.8	6	1.6
2002	29/09/2002	41.2	7	1.4
2001	25/05/2001	39.6	8	1.2
2005	8/10/2005	24.1	9	1.1
2013	15/10/2013	121.3	1	16.3

**Table GG-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	47.6	51.6	47.2	49.5	46.5
5	0.8	69.5	74.9	70.7	73.2	72.9
10	0.9	88.1	90.3	90.3	91.5	93.3
25	0.96	117.8	109.9	119.7	117.8	120.7
50	0.98	145.3	124.3	145.1	139.8	141.6
75	0.9867	163.9	132.8	161.3	153.7	153.8
100	0.99	178.4	138.7	173.5	164.0	162.5
200	0.995	218.1	153.0	205.0	190.6	183.6
500	0.998	283.5	171.9	252.1	230.2	211.5
1000	0.999	344.9	186.2	292.2	263.8	232.6



**Figure GG-1: Visual of different fitted distribution for the site.**

**Table GG-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Gamma	88.3	88.6	46.3	0.237
GEV	90.7	91.3	44.0	0.203
Gen. Logistic	91.0	91.6	43.6	0.195
Gen. Normal	90.5	91.0	44.6	0.210
Gen. Pareto	90.3	90.9	45.2	0.217
Gumbel	88.3	88.7	46.0	0.234
Normal	88.3	88.7	46.9	0.251
Pearson III	90.2	90.8	45.4	0.220
Wakeby	99.5	100.5	40.9	0.134
Weibull	90.3	90.8	45.4	0.219
Log-Normal	90.5	91.0	44.6	0.210
LP3	90.3	90.9	45.3	0.232

## Appendix HH Mangawhero at Pakihi Rd Br 33149

**Table HH-1: General information about the site.**

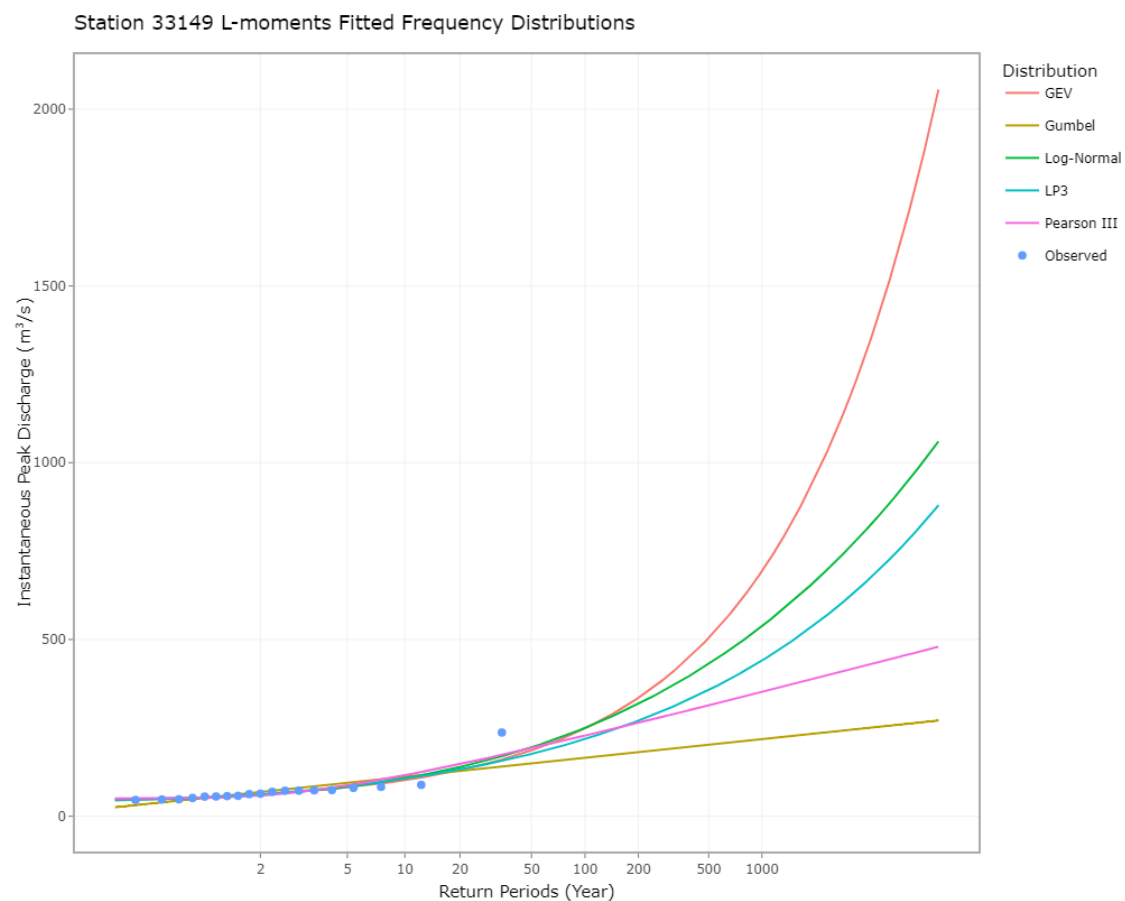
Site Details	
Start (records)	28-Mar-2006
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	139
Latitude	-39.431742
Longitude	175.324206
Record length (yrs)	19
Minimum (m <sup>3</sup> /s)	45.9
Maximum (m <sup>3</sup> /s)	236.7
Median (m <sup>3</sup> /s)	63.7
Mean (m <sup>3</sup> /s)	73.4
Standard Deviation (m <sup>3</sup> /s)	41.5
Coefficient of Variation	0.565

**Table HH-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2013	15/10/2013	236.7	1	34.1
2015	20/06/2015	88.6	2	12.3
2007	17/10/2007	82.9	3	7.5
2006	7/07/2006	80.2	4	5.4
2014	3/08/2014	74	5	4.2
2016	24/07/2016	73.3	6	3.4
2008	7/10/2008	72.4	7	2.9
2010	6/09/2010	72.1	8	2.5
2022	2/06/2022	69	9	2.2
2023	11/01/2023	63.7	10	2

**Table HH-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	61.2	68.6	60.2	61.7	58.2
5	0.8	81.3	94.5	83.1	84.7	87.2
10	0.9	102.2	111.6	107.4	106.2	115.9
25	0.96	142.3	133.3	151.1	142.0	158.4
50	0.98	186.6	149.4	195.0	176.3	192.6
75	0.9867	220.2	158.7	225.7	199.8	213.2
100	0.99	248.3	165.3	249.9	218.4	228.1
200	0.995	334.8	181.2	317.7	270.1	264.5
500	0.998	504.2	202.2	430.9	356.9	313.6
1000	0.999	693.0	218.1	537.4	440.3	351.4



**Figure HH-1: Visual of different fitted distribution for the site.**

**Table HH-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	202.6	204.5	60.3	0.273
Gamma	204.8	206.7	61.5	0.277
GEV	206.3	209.1	58.1	0.241
Gen. Logistic	207.2	210.1	57.7	0.237
Gen. Normal	203.6	206.4	59.5	0.257
Gen. Pareto	204.3	207.1	58.9	0.253
Gumbel	204.5	206.4	61.2	0.276
Normal	205.2	207.1	62.7	0.280
Pearson III	202.2	205.0	60.6	0.270
Wakeby	208.3	213.0	58.9	0.253
Weibull	202.5	205.3	60.3	0.266
Log-Normal	203.6	206.4	59.5	0.257
LP3	206.6	209.5	58.1	0.250

## Appendix II Whanganui at Te Rewa 33303

**Table II-1: General information about the site.**

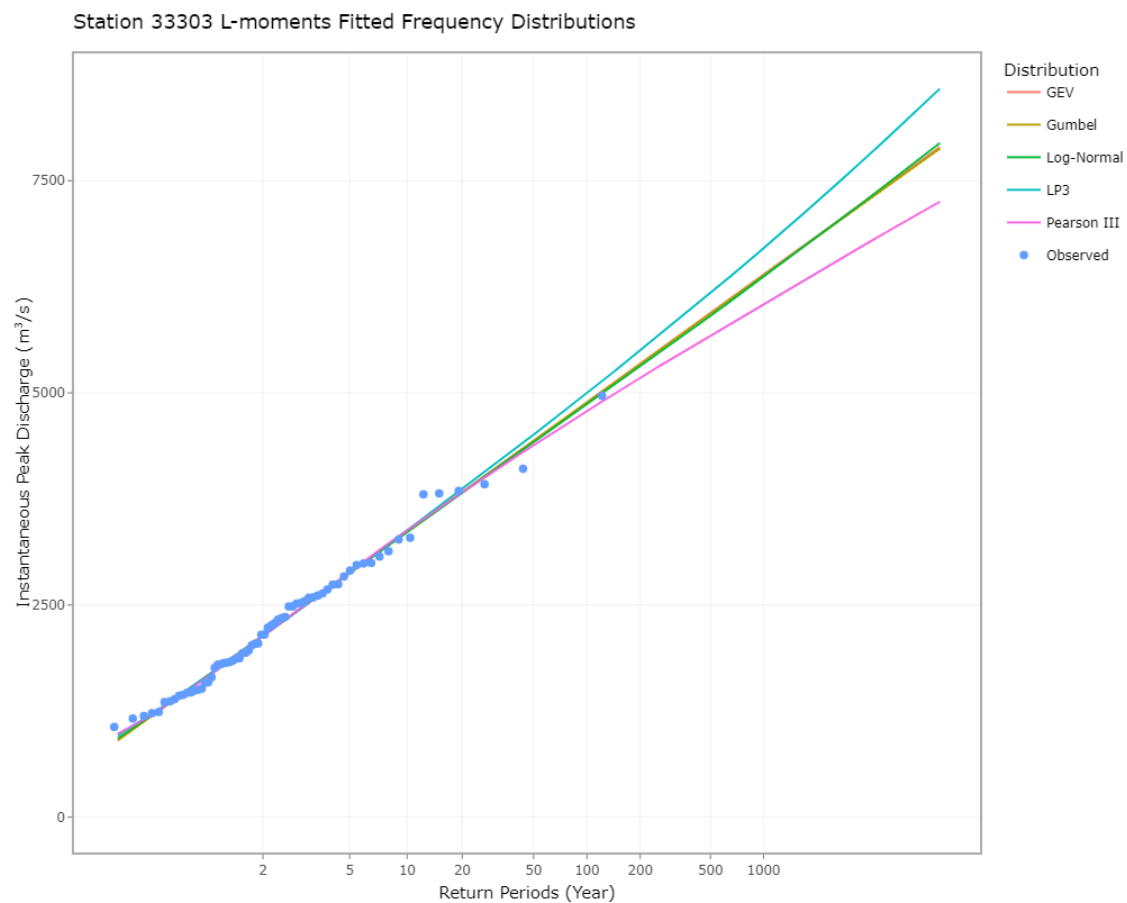
Site Details	
Start (records)	13-Feb-1891
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	6643
Latitude	-39.769392
Longitude	175.16185
Record length (yrs)	68
Minimum (m <sup>3</sup> /s)	1063.0
Maximum (m <sup>3</sup> /s)	4965.0
Median (m <sup>3</sup> /s)	2150.4
Mean (m <sup>3</sup> /s)	2274.6
Standard Deviation (m <sup>3</sup> /s)	811.9
Coefficient of Variation	0.357

**Table II-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	21/06/2015	4965	1	121.6
1990	10/03/1990	4105.8	2	43.7
2013	15/10/2013	3923.2	3	26.6
1958	25/02/1958	3844.6	4	19.1
1998	29/10/1998	3815.4	5	14.9
2000	3/10/2000	3804.1	6	12.3
2004	16/02/2004	3292.9	7	10.4
1965	8/11/1965	3272.4	8	9
1975	29/08/1975	3133.9	9	8
1978	13/11/1978	3071.5	10	7.1

**Table II-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

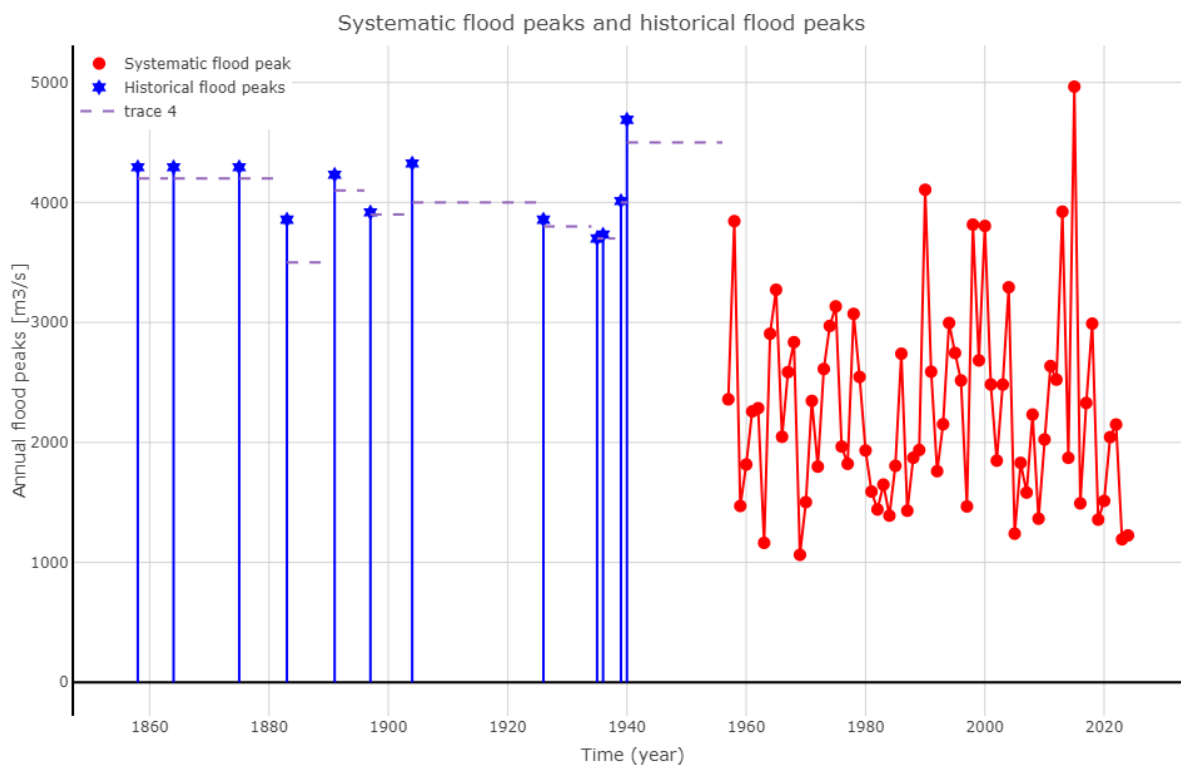
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	2137.5	2137.8	2137.4	2130.7	2134.9
5	0.8	2873.5	2873.8	2879.4	2879.5	2896.1
10	0.9	3361.1	3361.1	3363.9	3381.5	3380.4
25	0.96	3977.6	3976.8	3970.0	4023.6	3966.1
50	0.98	4435.2	4433.6	4418.1	4508.0	4383.5
75	0.9867	4701.3	4699.1	4678.9	4793.7	4620.4
100	0.99	4889.7	4887.0	4863.9	4998.0	4785.8
200	0.995	5342.7	5338.7	5311.1	5497.2	5176.6
500	0.998	5940.8	5934.7	5908.2	6175.5	5679.7
1000	0.999	6393.0	6385.1	6366.6	6704.9	6052.1



**Figure II-1: Visual of different fitted distribution for the site.**

**Table II-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	1108.1	1112.6	1591.0	0.090
Gamma	1107.1	1111.5	1575.3	0.096
GEV	1109.2	1115.8	1578.5	0.093
Gen. Logistic	1109.2	1115.9	1584.3	0.090
Gen. Normal	1109.1	1115.8	1577.2	0.093
Gen. Pareto	1109.1	1115.8	1564.3	0.096
Gumbel	1107.2	1111.6	1578.5	0.093
Kappa	1111.1	1120.0	1572.9	0.094
Normal	1107.1	1111.6	1584.3	0.098
Pearson III	1109.1	1115.8	1575.0	0.094
Wakeby	1113.1	1124.2	1571.5	0.094
Weibull	1109.1	1115.8	1571.5	0.094
Log-Normal	1109.1	1115.8	1577.2	0.093
LP3	1109.3	1115.9	1585.0	0.095



**Figure II-2: Historical information and systematic records.**

**Table II-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	2288.7	2101.4	2468.8
5	0.8	3073.9	2855.6	3301.9
10	0.9	3567.6	3342.6	3849.3
25	0.96	4162.3	3890.3	4656.4
50	0.98	4584.2	4241.6	5328.4
75	0.9867	4819.0	4411.2	5740.1
100	0.99	4987.2	4526.7	6073.6
200	0.995	5373.3	4775.4	6851.7
500	0.998	5860.7	5029.5	8037.4
1000	0.999	6213.2	5188.1	9015.3

**Table II-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1940	4689.0
1939	4011.0
1936	3732.0
1935	3700.0
1926	3856.0
1904	4325.0
1897	3917.0
1891	4231.0
1883	3856.0
1875	4293.0
1864	4293.0
1858	4293.0

## Appendix JJ Whanganui at Headwaters 33307

**Table JJ-1: General information about the site.**

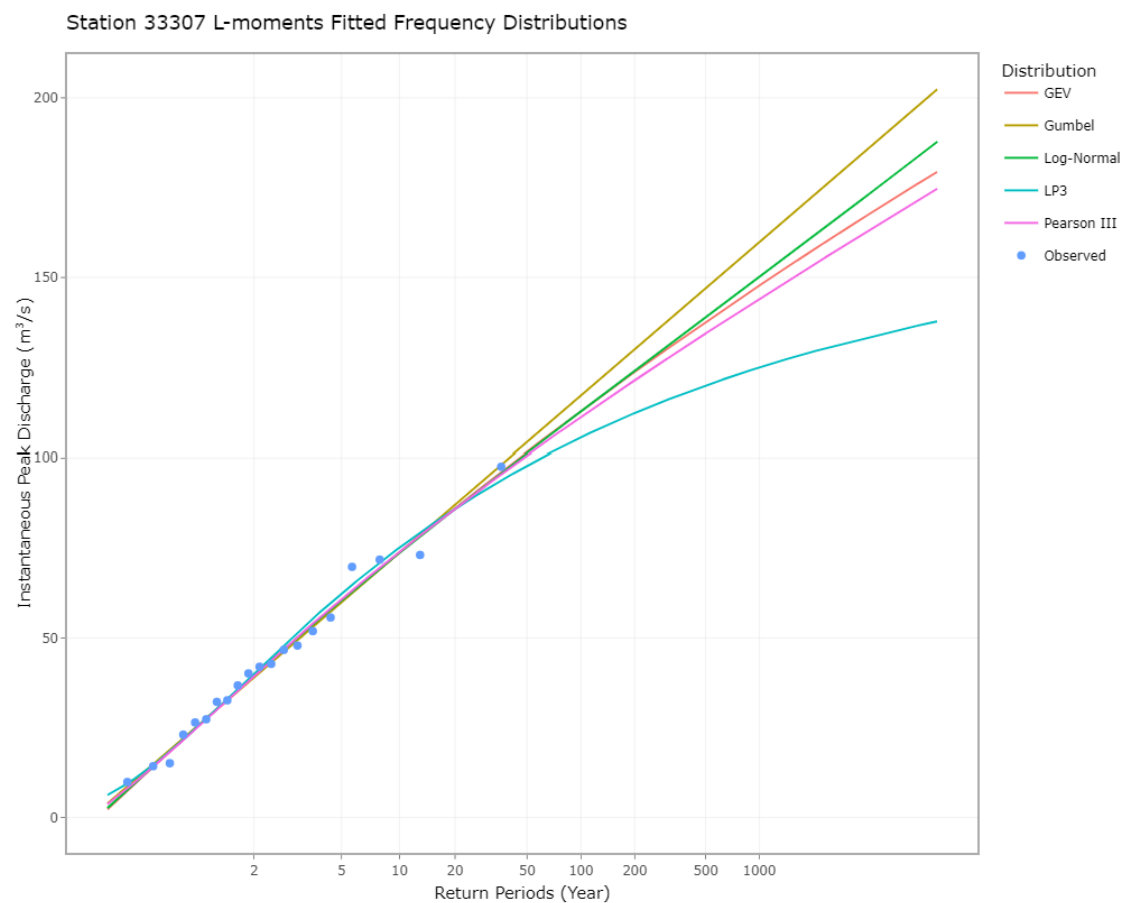
Site Details	
Start (records)	2-Dec-1959
End (records)	1-Nov-1978
Catchment area (km <sup>2</sup> )	81.3
Latitude	-39.00644021
Longitude	175.5941355
Record length (yrs)	20
Minimum (m <sup>3</sup> /s)	9.9
Maximum (m <sup>3</sup> /s)	97.6
Median (m <sup>3</sup> /s)	41
Mean (m <sup>3</sup> /s)	42.9
Standard Deviation (m <sup>3</sup> /s)	22.5
Coefficient of Variation	0.524

**Table JJ-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1961	20/01/1961	97.6	1	35.9
1973	11/01/1973	73.1	2	12.9
1964	10/01/1964	71.8	3	7.9
1967	2/02/1967	69.8	4	5.7
1966	26/04/1966	55.7	5	4.4
1977	28/06/1977	51.9	6	3.6
1971	14/05/1971	47.9	7	3.1
1960	16/02/1960	46.7	8	2.7
1965	7/11/1965	42.8	9	2.4
1968	7/12/1968	42	10	2.1

**Table JJ-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	39.5	39.0	39.6	40.2	39.5
5	0.8	60.4	59.9	60.5	62.3	60.8
10	0.9	73.7	73.8	73.6	75.1	74.0
25	0.96	90.0	91.3	89.7	89.0	89.6
50	0.98	101.6	104.3	101.4	97.9	100.7
75	0.9867	108.2	111.8	108.1	102.5	106.9
100	0.99	112.8	117.2	112.8	105.6	111.2
200	0.995	123.7	130.0	124.0	112.3	121.4
500	0.998	137.6	147.0	138.8	119.9	134.4
1000	0.999	147.7	159.8	150.1	124.9	144.0



**Figure JJ-1: Visual of different fitted distribution for the site.**

**Table JJ-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	184.6	186.6	43.7	0.111
Gamma	184.3	186.3	43.5	0.110
GEV	186.3	189.3	43.5	0.110
Gen. Logistic	186.3	189.3	43.3	0.106
Gen. Normal	186.3	189.3	43.4	0.110
Gen. Pareto	186.3	189.3	43.5	0.113
Gumbel	184.3	186.3	43.4	0.109
Kappa	188.3	192.3	43.4	0.110
Normal	184.3	186.3	43.7	0.112
Pearson III	186.3	189.3	43.5	0.110
Wakeby	190.3	195.3	43.6	0.110
Weibull	186.3	189.3	43.5	0.110
Log-Normal	186.3	189.3	43.4	0.110
LP3	186.3	189.3	43.4	0.120

## Appendix KK Ohura at Tokorima 33313

**Table KK-1: General information about the site.**

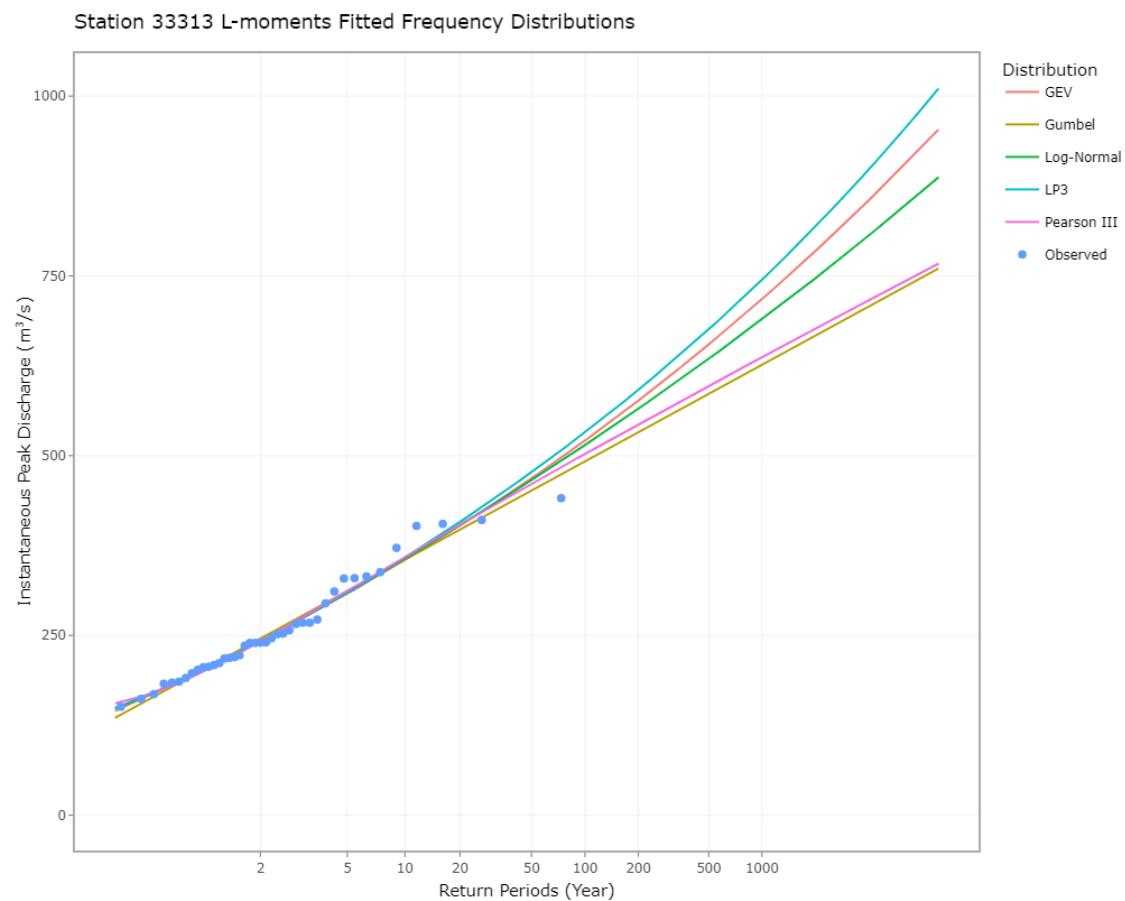
Site Details	
Start (records)	7-Sep-1961
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	668
Latitude	-38.917504
Longitude	175.032384
Record length (yrs)	41
Minimum (m <sup>3</sup> /s)	150.8
Maximum (m <sup>3</sup> /s)	440.8
Median (m <sup>3</sup> /s)	239.9
Mean (m <sup>3</sup> /s)	258
Standard Deviation (m <sup>3</sup> /s)	73
Coefficient of Variation	0.283

**Table KK-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	29/02/2004	440.8	1	73.4
1973	17/09/1973	410.5	2	26.4
1965	8/11/1965	405.1	3	16.1
1964	12/03/1964	402.3	4	11.6
2012	17/07/2012	371.7	5	9
2003	4/10/2003	338	6	7.4
2017	5/04/2017	332.1	7	6.3
2015	21/06/2015	329.6	8	5.4
1975	30/08/1975	329.2	9	4.8
2013	16/10/2013	311.1	10	4.3

**Table KK-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

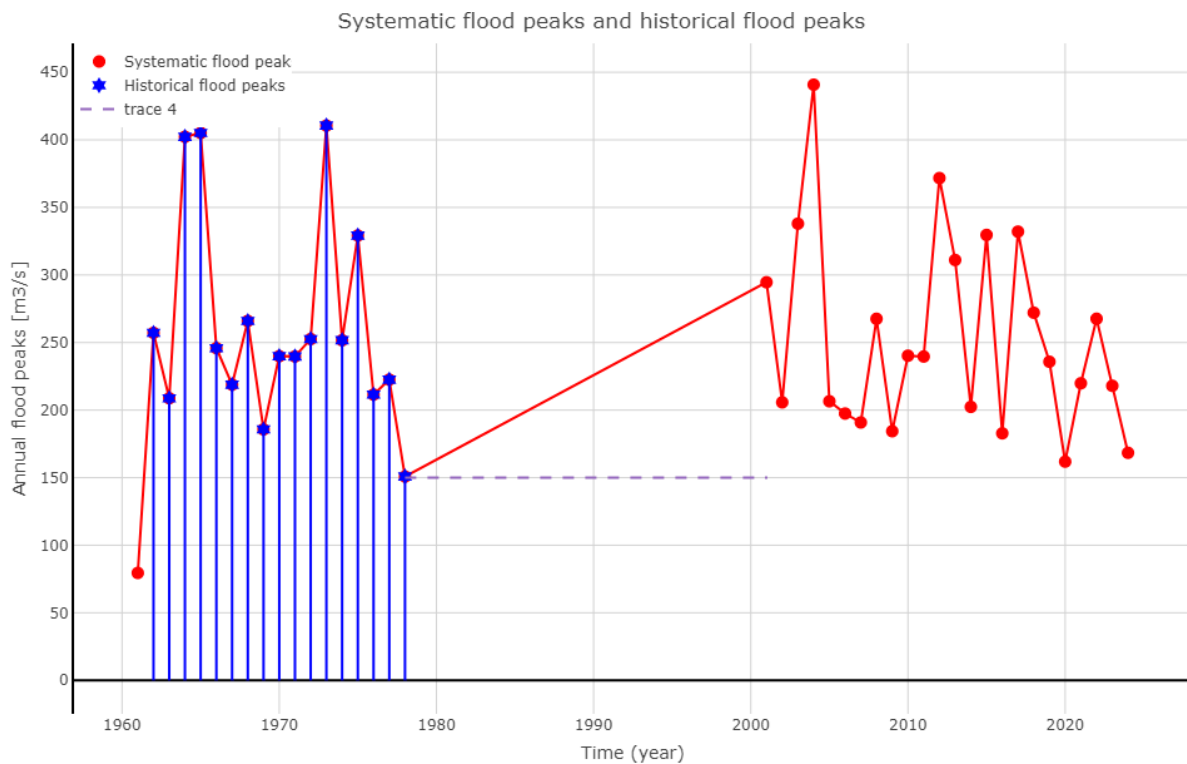
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	242.4	245.7	242.1	241.9	241.6
5	0.8	308.0	311.7	309.4	309.6	311.9
10	0.9	354.9	355.3	356.4	358.3	359.1
25	0.96	418.2	410.5	418.2	424.4	418.0
50	0.98	468.4	451.4	465.8	477.0	460.8
75	0.9867	498.9	475.2	494.2	509.1	485.3
100	0.99	521.1	492.1	514.7	532.5	502.6
200	0.995	576.6	532.5	565.2	591.5	543.7
500	0.998	654.7	585.9	634.6	675.7	597.1
1000	0.999	717.6	626.3	689.4	744.4	636.9



**Figure KK-1: Visual of different fitted distribution for the site.**

**Table KK-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	471.6	475.1	140.9	0.157
Gamma	471.1	474.5	140.2	0.153
GEV	473.2	478.4	140.3	0.153
Gen. Logistic	473.2	478.4	140.3	0.151
Gen. Normal	473.2	478.4	140.2	0.154
Gen. Pareto	473.2	478.3	139.7	0.155
Gumbel	471.1	474.6	140.2	0.153
Kappa	475.2	482.1	140.1	0.154
Normal	471.1	474.6	141.0	0.154
Pearson III	473.2	478.3	140.1	0.154
Wakeby	477.2	485.7	139.7	0.155
Weibull	473.2	478.3	139.9	0.154
Log-Normal	473.2	478.4	140.2	0.154
LP3	473.4	478.5	141.7	0.160



**Figure KK-2: Historical information and systematic records.**

**Table KK-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	208.3	185.8	229.8
5	0.8	298.3	276.8	326.6
10	0.9	344.1	322.8	380.1
25	0.96	389.8	369.1	441.8
50	0.98	416.8	395.5	489.2
75	0.9867	430.1	407.3	513.6
100	0.99	438.9	414.9	532.2
200	0.995	457.1	428.3	575.4
500	0.998	476.2	440.6	631.0
1000	0.999	487.8	446.5	667.9

**Table KK-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1978	150.8
1977	222.5
1976	211.5
1975	329.2
1974	251.7
1973	410.5
1972	252.6
1971	239.7
1970	239.9
1969	185.7
1968	266.0
1967	218.8
1966	245.9
1965	405.1
1964	402.3
1963	208.8
1962	257.1
1961	79.5

## Appendix LL Ohura at Nihoniho 33314

**Table LL-1: General information about the site.**

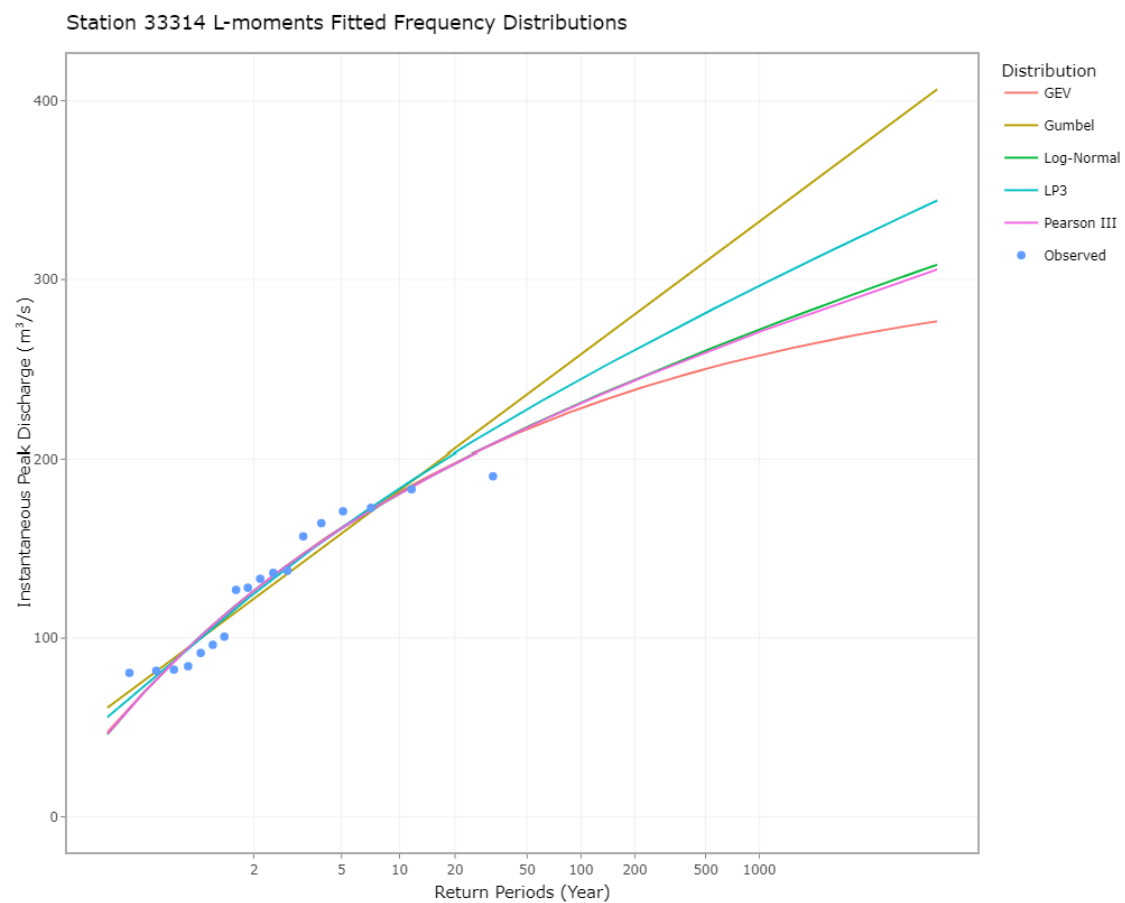
Site Details	
Start (records)	17-May-2007
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	334
Latitude	-38.785835
Longitude	175.043836
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	80.5
Maximum (m <sup>3</sup> /s)	190.5
Median (m <sup>3</sup> /s)	130.7
Mean (m <sup>3</sup> /s)	128.8
Standard Deviation (m <sup>3</sup> /s)	38
Coefficient of Variation	0.295

**Table LL-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2012	16/07/2012	190.5	1	32.4
2011	24/01/2011	183.3	2	11.6
2023	29/01/2023	172.9	3	7.1
2008	8/10/2008	171	4	5.1
2015	21/06/2015	164.3	5	4
2013	15/10/2013	156.9	6	3.3
2024	29/01/2024	137.7	7	2.8
2022	3/06/2022	136.5	8	2.4
2017	12/05/2017	133.2	9	2.1
2010	7/09/2010	128.2	10	1.9

**Table LL-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	126.5	122.1	126.6	124.9	126.6
5	0.8	161.9	158.5	161.3	161.6	161.4
10	0.9	181.6	182.6	180.8	183.7	180.9
25	0.96	202.8	213.1	202.7	209.5	202.6
50	0.98	216.3	235.7	217.5	227.4	217.3
75	0.9867	223.3	248.9	225.6	237.4	225.3
100	0.99	228.0	258.2	231.2	244.4	230.8
200	0.995	238.3	280.5	244.1	260.7	243.5
500	0.998	249.9	310.0	260.3	281.3	259.3
1000	0.999	257.5	332.3	272.0	296.4	270.7



**Figure LL-1: Visual of different fitted distribution for the site.**

**Table LL-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	185.6	187.4	75.0	0.130
Gamma	185.2	187.0	74.4	0.148
GEV	187.2	189.9	74.5	0.150
Gen. Logistic	187.2	189.8	73.9	0.150
Gen. Normal	187.2	189.9	74.3	0.150
Gen. Pareto	187.2	189.9	75.2	0.148
Gumbel	185.3	187.0	74.3	0.144
Kappa	189.3	192.8	75.5	0.147
Normal	185.2	187.0	74.4	0.151
Pearson III	187.2	189.9	74.4	0.150
Wakeby	191.2	195.7	75.2	0.148
Weibull	187.2	189.9	74.6	0.149
Log-Normal	187.2	189.9	74.3	0.150
LP3	187.3	189.9	74.8	0.150

## Appendix MM Mangaroa at Ohura Town Br 33341

**Table MM-1: General information about the site.**

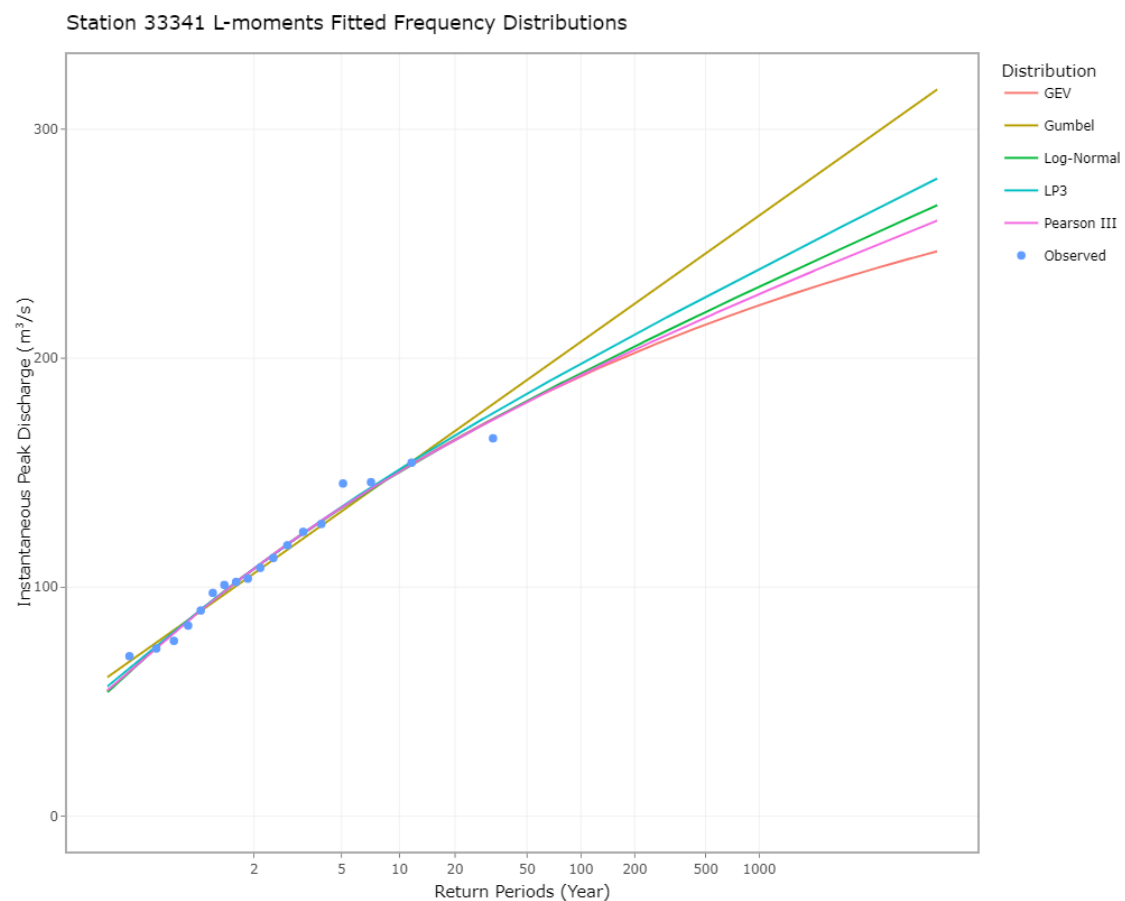
Site Details	
Start (records)	9-May-1965
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	182
Latitude	-38.840006
Longitude	174.981691
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	69.9
Maximum (m <sup>3</sup> /s)	165
Median (m <sup>3</sup> /s)	106.1
Mean (m <sup>3</sup> /s)	111.1
Standard Deviation (m <sup>3</sup> /s)	28.3
Coefficient of Variation	0.255

**Table MM-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	1965	7/11/1965	165	1
2004	1968	7/12/1968	154.4	2
1992	1966	6/12/1966	145.9	3
1988	2015	20/06/2015	145.3	4
1999	2017	4/04/2017	127.6	5
2018	2018	15/05/2018	124.2	6
2017	1971	25/02/1971	118.3	7
1997	2022	27/07/2022	112.8	8
2015	1970	30/09/1970	108.4	9
2006	1969	7/05/1969	103.8	10

**Table MM-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

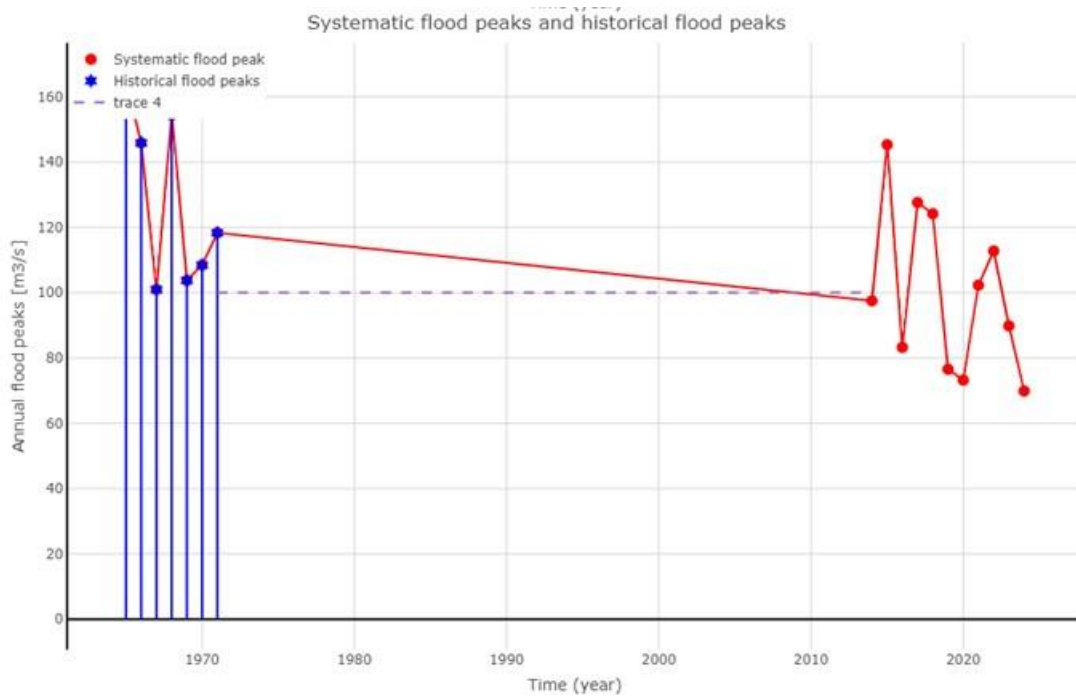
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	108.1	106.0	108.2	108.1	108.2
5	0.8	134.9	133.1	134.6	135.1	134.8
10	0.9	150.7	151.0	150.3	151.5	150.5
25	0.96	168.8	173.7	168.6	170.9	168.5
50	0.98	181.0	190.5	181.3	184.6	180.9
75	0.9867	187.7	200.3	188.5	192.3	187.8
100	0.99	192.2	207.2	193.5	197.7	192.6
200	0.995	202.4	223.8	205.2	210.4	203.7
500	0.998	214.7	245.7	220.2	226.8	217.8
1000	0.999	223.1	262.3	231.2	239.0	228.0



**Figure MM-1: Visual of different fitted distribution for the site.**

**Table MM-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	175.0	176.8	56.0	0.097
Gamma	174.6	176.3	55.6	0.102
GEV	176.6	179.2	55.6	0.101
Gen. Logistic	176.5	179.2	55.2	0.105
Gen. Normal	176.6	179.2	55.5	0.102
Gen. Pareto	176.6	179.3	55.9	0.099
Gumbel	174.6	176.4	55.5	0.101
Kappa	178.6	182.2	55.8	0.100
Normal	174.5	176.3	55.6	0.102
Pearson III	176.6	179.2	55.6	0.102
Wakeby	180.6	185.1	55.8	0.099
Weibull	176.6	179.3	55.7	0.101
Log-Normal	176.6	179.2	55.5	0.102
LP3	176.6	179.3	55.7	0.101



**Figure MM-2: Historical information and systematic records.**

**Table MM-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	87.2	79.4	92.6
5	0.8	107.8	100.4	118.5
10	0.9	125.5	118.6	150.3
25	0.96	153.9	136.8	219.3
50	0.98	180.3	151.7	297.4
75	0.9867	198.0	160.9	357.3
100	0.99	212.1	167.8	415.9
200	0.995	250.6	185.0	624.6
500	0.998	314.2	210.0	1099.2
1000	0.999	374.3	228.7	1708.6

**Table MM-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1971	118.3
1970	108.4
1969	103.8
1968	154.4
1967	101.0
1966	145.9
1965	165.0

## Appendix NN Whanganui at Pipiriki 33345

**Table NN-1: General information about the site.**

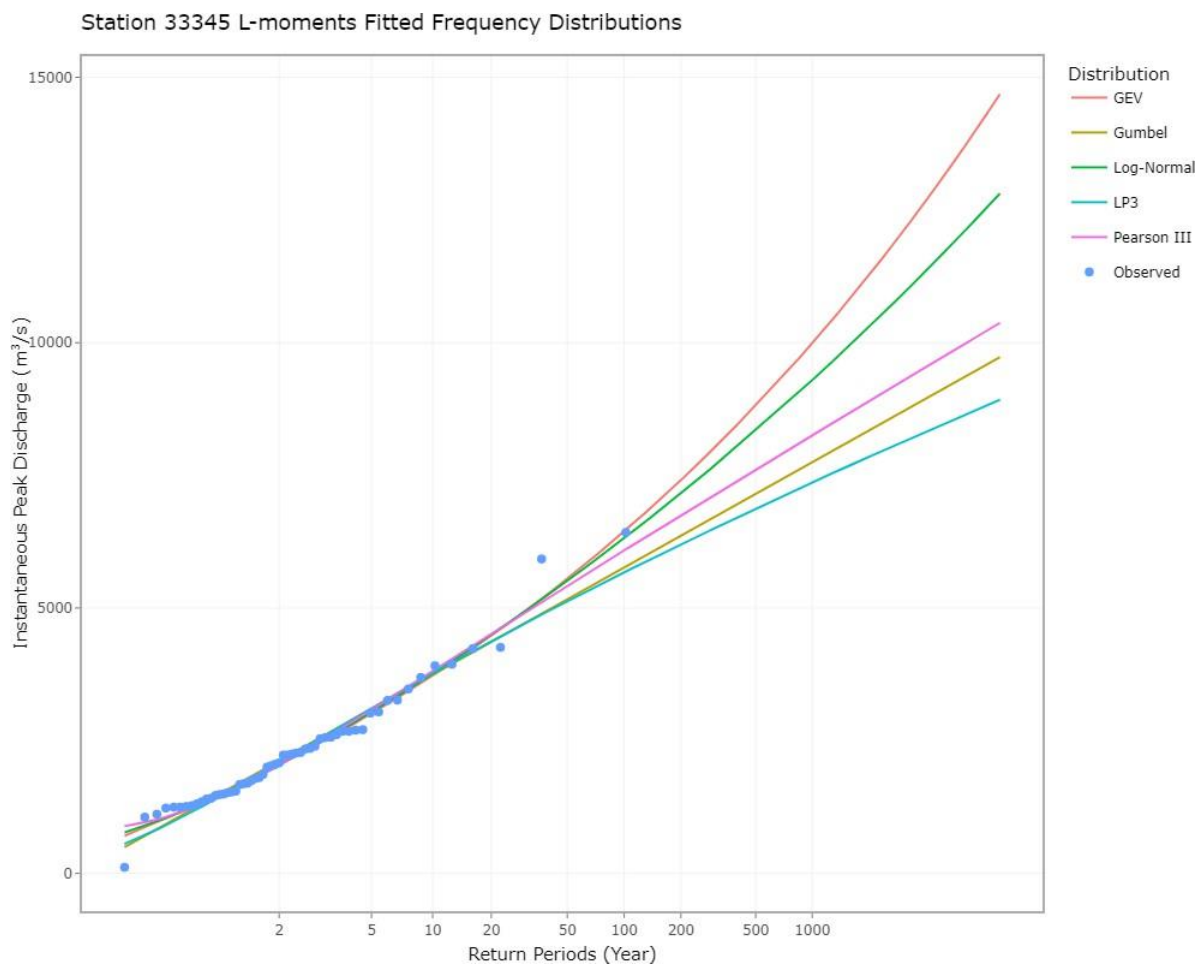
Site Details	
Start (records)	25-May-
End (records)	18-Apr-
Catchment area (km <sup>2</sup> )	6138
Latitude	-39.478766
Longitude	175.04341
Record length (yrs)	57
Minimum (m <sup>3</sup> /s)	113.5
Maximum (m <sup>3</sup> /s)	6423.1
Median (m <sup>3</sup> /s)	2082.6
Mean (m <sup>3</sup> /s)	2304
Standard Deviation (m <sup>3</sup> /s)	1141.8
Coefficient of Variation	0.496

**Table NN-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1940	25/02/1940	6423.1	1	102
1904	25/05/1904	5923.9	2	36.6
2015	20/06/2015	4258.4	3	22.3
1990	10/03/1990	4234.8	4	16
2013	15/10/2013	3939.7	5	12.5
1998	29/10/1998	3911.5	6	10.3
2000	2/10/2000	3690.8	7	8.7
1994	8/11/1994	3474.7	8	7.6
1965	8/11/1965	3264.4	9	6.7
2004	29/02/2004	3259.3	10	6

**Table NN-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

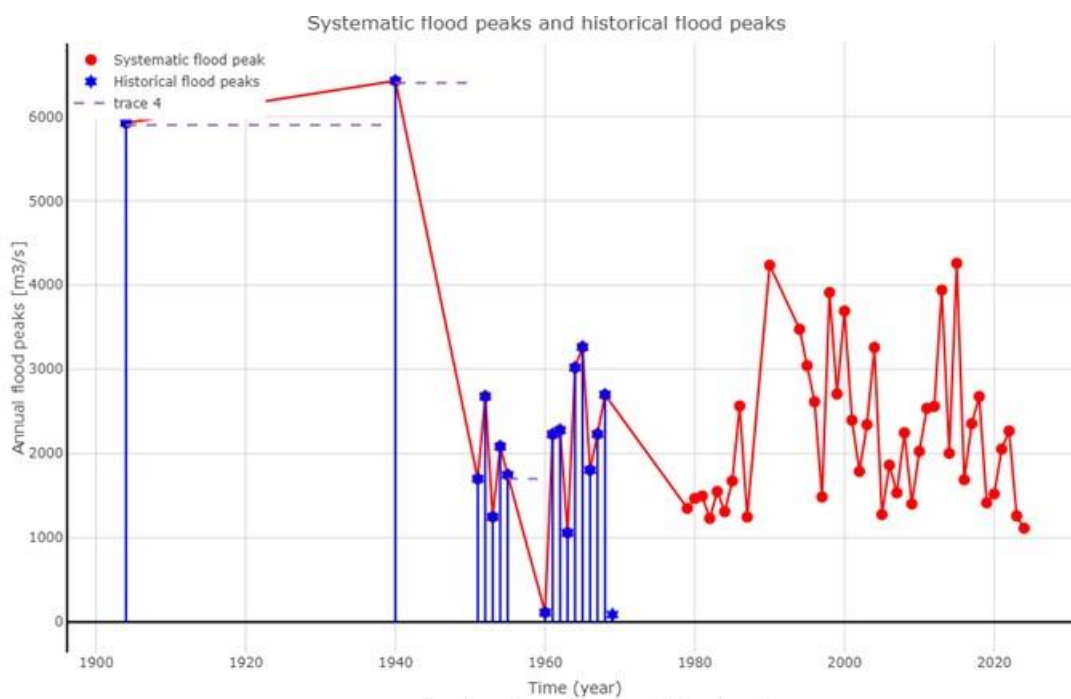
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	2047.1	2122.9	2040.6	2094.2	2030.2
5	0.8	3010.6	3097.4	3037.0	3114.5	3084.8
10	0.9	3726.1	3742.7	3760.3	3768.9	3814.9
25	0.96	4729.5	4558.0	4738.3	4562.4	4738.8
50	0.98	5552.8	5162.8	5509.9	5127.8	5418.5
75	0.9867	6065.0	5514.4	5977.1	5448.2	5810.6
100	0.99	6443.2	5763.2	6316.3	5671.5	6086.7
200	0.995	7409.4	6361.4	7161.8	6197.5	6746.4
500	0.998	8816.8	7150.6	8345.3	6870.3	7608.4
1000	0.999	9990.4	7747.0	9294.3	7364.3	8254.4



**Figure NN-1: Visual of different fitted distribution for the site.**

**Table NN-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	967.4	971.5	2133.0	0.152
Gamma	967.6	971.7	2120.5	0.143
GEV	969.4	975.5	2134.4	0.147
Gen. Logistic	969.4	975.5	2140.1	0.145
Gen. Normal	969.4	975.5	2130.1	0.147
Gen. Pareto	969.4	975.5	2110.4	0.147
Gumbel	967.5	971.6	2126.2	0.143
Kappa	971.4	979.5	2136.9	0.147
Normal	968.0	972.1	2141.9	0.141
Pearson III	969.4	975.5	2121.5	0.147
Wakeby	973.4	983.6	2140.9	0.148
Weibull	969.4	975.5	2117.5	0.146
Log-Normal	969.4	975.5	2130.1	0.147
LP3	969.5	975.6	2132.7	0.138



**Figure NN-2: Historical information and systematic records.**

**Table NN-5: Historical values for the site.**

<b>Year</b>	<b>Values (m<sup>3</sup>/s)</b>
1969	88.7
1968	2697.7
1967	2230.7
1966	1803.6
1965	3264.4
1964	3019.9
1963	1059.2
1962	2277.8
1961	2228.8
1960	113.5

## Appendix OO Whanganui at Te Porere 33347

**Table OO-1: General information about the site.**

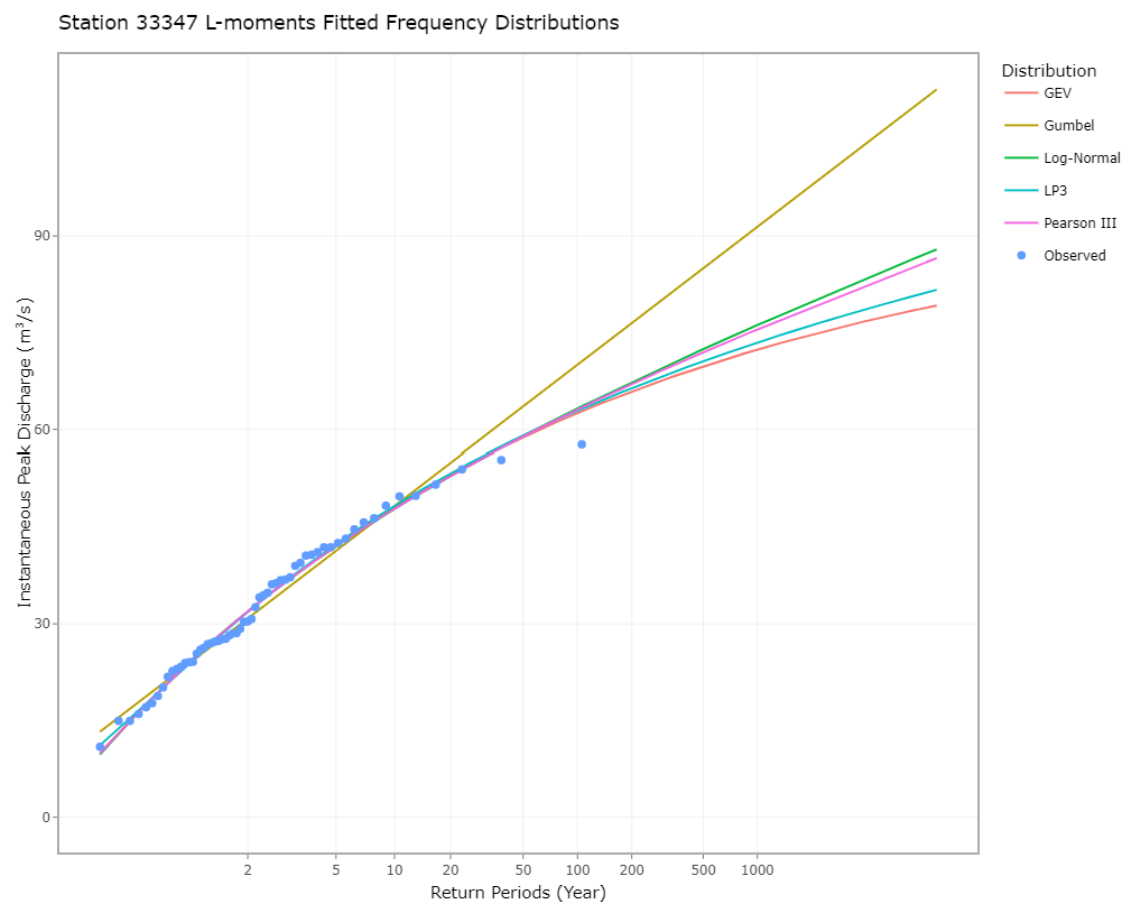
Site Details	
Start (records)	13-Jan-1966
End (records)	8-Jul-2024
Catchment area (km <sup>2</sup> )	28.2
Latitude	-39.04393788
Longitude	175.5920473
Record length (yrs)	59
Minimum (m <sup>3</sup> /s)	10.9
Maximum (m <sup>3</sup> /s)	57.7
Median (m <sup>3</sup> /s)	30.4
Mean (m <sup>3</sup> /s)	32.8
Standard Deviation (m <sup>3</sup> /s)	11.2
Coefficient of Variation	0.341

**Table OO-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2016	19/01/2016	57.7	1	105.6
2018	27/01/2018	55.4	2	37.9
2009	12/02/2009	54	3	23.1
1990	9/03/1990	51.6	4	16.6
2013	22/09/2013	49.9	5	13
1967	2/02/1967	49.8	6	10.6
1989	3/01/1989	48.3	7	9
1996	1/12/1996	46.4	8	7.8
2001	7/12/2001	45.7	9	6.9
2006	30/11/2006	44.7	10	6.2

**Table OO-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	31.9	30.8	31.9	31.9	31.9
5	0.8	42.2	41.3	42.0	42.4	42.1
10	0.9	48.1	48.3	47.9	48.3	47.9
25	0.96	54.5	57.1	54.5	54.8	54.5
50	0.98	58.8	63.6	59.0	59.1	58.9
75	0.9867	61.0	67.4	61.5	61.4	61.4
100	0.99	62.5	70.0	63.3	62.9	63.1
200	0.995	65.9	76.5	67.3	66.4	67.0
500	0.998	69.8	85.0	72.4	70.6	71.9
1000	0.999	72.4	91.4	76.2	73.5	75.5



**Figure OO-1: Visual of different fitted distribution for the site.**

**Table OO-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	457.0	461.2	22.8	0.087
Gamma	455.5	459.6	22.3	0.100
GEV	457.4	463.7	22.3	0.101
Gen. Logistic	457.5	463.8	22.4	0.099
Gen. Normal	457.4	463.7	22.3	0.101
Gen. Pareto	457.4	463.6	22.1	0.103
Gumbel	455.7	459.8	22.4	0.096
Kappa	459.4	467.7	22.2	0.102
Normal	455.4	459.6	22.3	0.102
Pearson III	457.4	463.7	22.3	0.101
Wakeby	461.4	471.8	22.3	0.102
Weibull	457.4	463.6	22.3	0.101
Log-Normal	457.4	463.7	22.3	0.101
LP3	457.5	463.7	22.3	0.104

## Appendix PP Matarawa at Diversion 33366

**Table PP-1: General information about the site.**

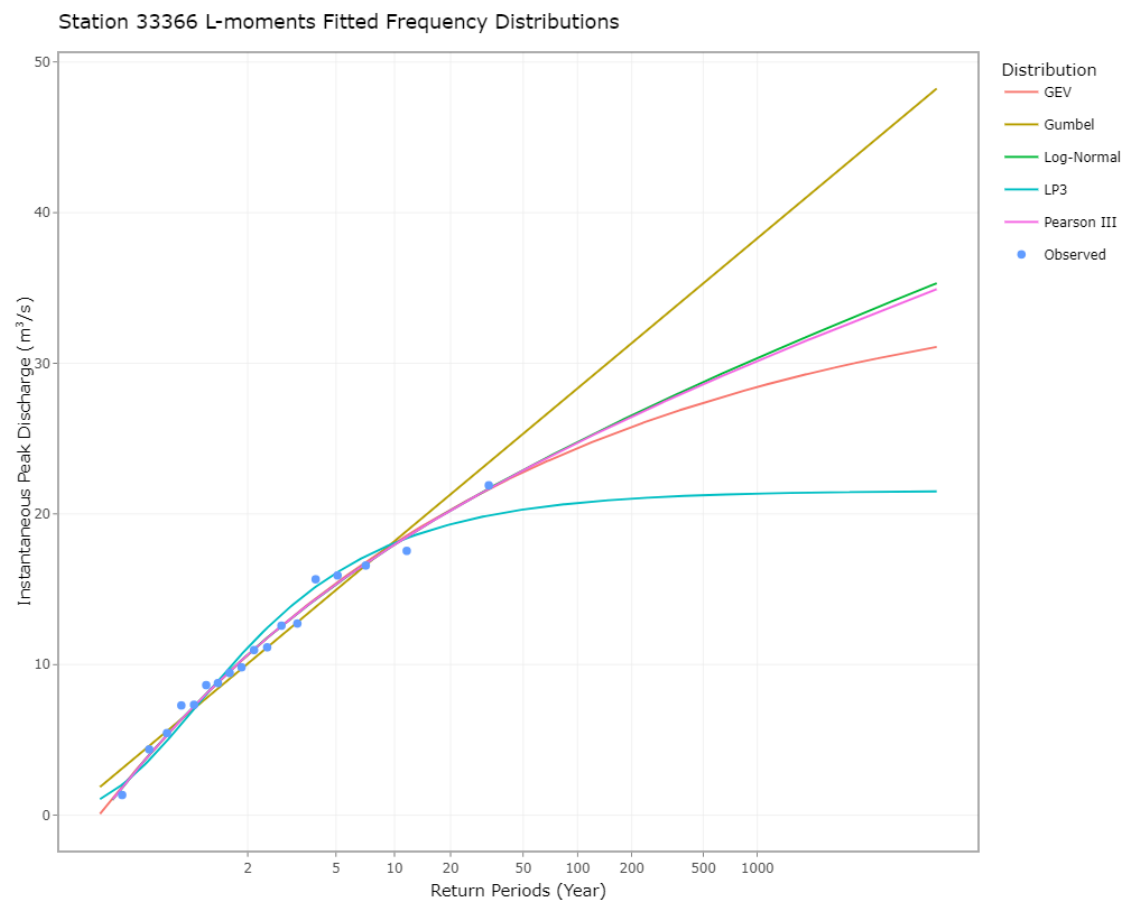
<b>Site Details</b>	
Start (records)	13-May-1977
End (records)	14-Jan-1994
Catchment area (km <sup>2</sup> )	NA
Latitude	-39.916565
Longitude	175.097506
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	1.3
Maximum (m <sup>3</sup> /s)	21.9
Median (m <sup>3</sup> /s)	10.4
Mean (m <sup>3</sup> /s)	11
Standard Deviation (m <sup>3</sup> /s)	5.2
Coefficient of Variation	0.471

**Table PP-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
1992	16/08/1992	21.9	1	32.4
1988	25/07/1988	17.5	2	11.6
1979	25/08/1979	16.6	3	7.1
1991	26/07/1991	15.9	4	5.1
1986	26/07/1986	15.7	5	4
1993	22/11/1993	12.7	6	3.3
1978	21/07/1978	12.6	7	2.8
1990	20/03/1990	11.1	8	2.4
1989	18/10/1989	11	9	2.1
1980	17/08/1980	9.8	10	1.9

**Table PP-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	10.6	10.1	10.7	11.1	10.7
5	0.8	15.4	15.0	15.3	16.1	15.3
10	0.9	18.1	18.2	18.0	18.1	18.0
25	0.96	20.9	22.3	20.9	19.6	20.9
50	0.98	22.8	25.3	22.9	20.3	22.9
75	0.9867	23.7	27.1	24.0	20.6	24.0
100	0.99	24.4	28.3	24.8	20.7	24.7
200	0.995	25.8	31.3	26.5	21.0	26.5
500	0.998	27.4	35.3	28.8	21.2	28.6
1000	0.999	28.4	38.3	30.3	21.4	30.2



**Figure PP-1: Visual of different fitted distribution for the site.**

**Table PP-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	113.7	115.4	10.2	0.097
Gamma	113.3	115.1	10.1	0.094
GEV	115.3	117.9	10.1	0.097
Gen. Logistic	115.2	117.9	10.1	0.095
Gen. Normal	115.3	117.9	10.1	0.096
Gen. Pareto	115.3	118.0	10.1	0.098
Gumbel	113.3	115.1	10.1	0.093
Kappa	117.3	120.8	10.1	0.097
Normal	113.3	115.0	10.1	0.098
Pearson III	115.3	117.9	10.1	0.096
Wakeby	119.3	123.8	10.2	0.098
Weibull	115.3	117.9	10.1	0.096
Log-Normal	115.3	117.9	10.1	0.096
LP3	115.3	117.9	10.1	0.106

## Appendix QQ Kai Iwi at Handley Rd 33502

**Table QQ-1: General information about the site.**

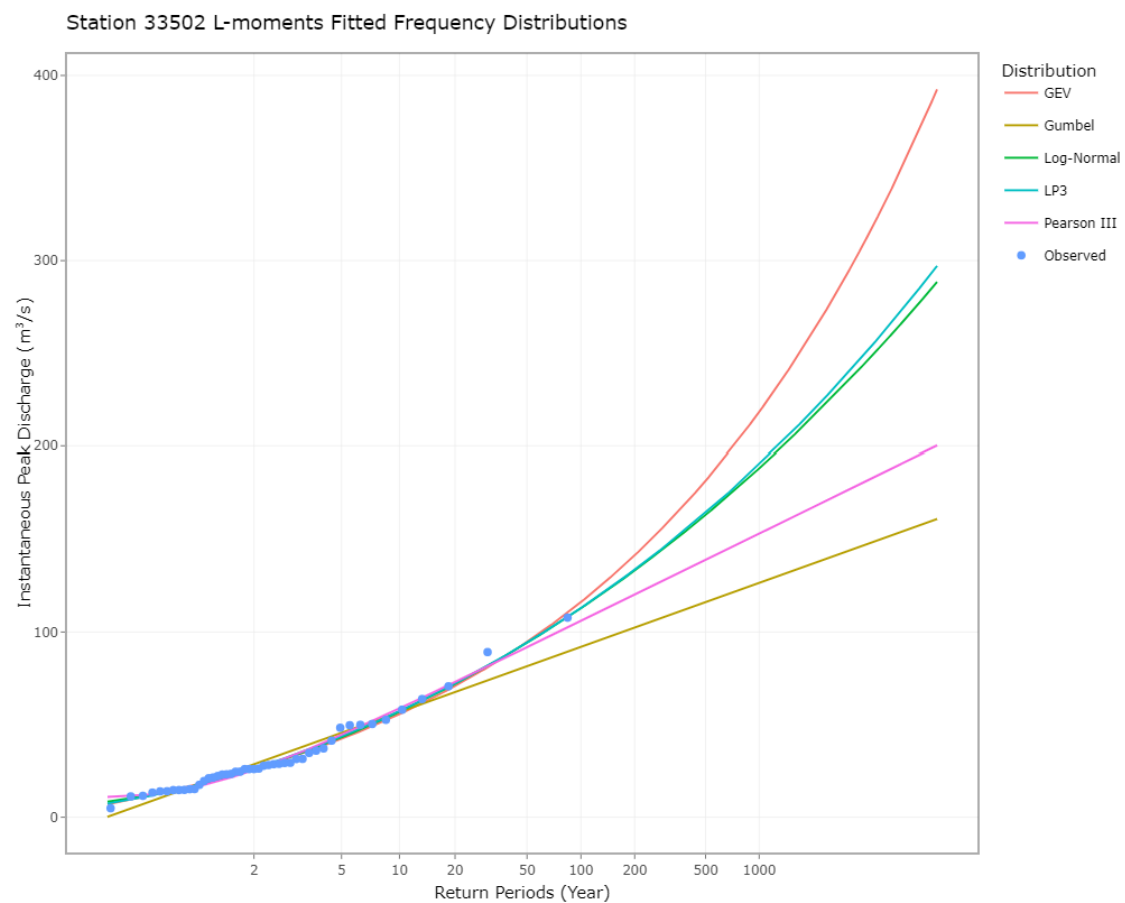
Site Details	
Start (records)	5-Apr19-78
End (records)	26-Mar-2024
Catchment area (km <sup>2</sup> )	187
Latitude	-39.878956
Longitude	174.903171
Record length (yrs)	47
Minimum (m <sup>3</sup> /s)	4.9
Maximum (m <sup>3</sup> /s)	107.8
Median (m <sup>3</sup> /s)	26
Mean (m <sup>3</sup> /s)	31.8
Standard Deviation (m <sup>3</sup> /s)	20.5
Coefficient of Variation	0.645

**Table QQ-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	20/06/2015	107.8	1	84.1
2006	24/10/2006	89.2	2	30.2
2004	16/02/2004	70.7	3	18.4
1999	29/11/1999	63.8	4	13.2
2011	24/01/2011	58.1	5	10.3
2010	6/09/2010	52.6	6	8.5
1978	20/04/1978	50.3	7	7.2
2013	15/10/2013	49.9	8	6.2
1998	21/10/1998	49.7	9	5.5
2023	21/05/2023	48.3	10	4.9

**Table QQ-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	26.1	28.6	25.9	26.3	25.5
5	0.8	42.3	45.6	43.1	43.6	44.5
10	0.9	55.7	56.8	57.0	57.3	58.8
25	0.96	76.2	71.0	77.2	77.4	77.6
50	0.98	94.7	81.6	94.2	94.3	91.8
75	0.9867	106.9	87.7	104.9	105.0	100.1
100	0.99	116.2	92.0	112.8	113.0	106.0
200	0.995	141.5	102.4	133.3	133.7	120.2
500	0.998	181.7	116.2	163.3	164.3	139.0
1000	0.999	218.3	126.6	188.3	190.4	153.2



**Figure QQ-1: Visual of different fitted distribution for the site.**

**Table QQ-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	420.2	423.9	37.0	0.204
Gamma	420.6	424.3	36.9	0.207
GEV	422.2	427.8	37.1	0.200
Gen. Logistic	422.2	427.8	37.1	0.198
Gen. Normal	422.2	427.8	37.1	0.202
Gen. Pareto	422.2	427.7	36.9	0.204
Gumbel	420.7	424.4	37.1	0.207
Kappa	424.2	431.6	37.1	0.200
Normal	421.2	424.9	37.5	0.211
Pearson III	422.2	427.7	37.0	0.204
Wakeby	426.2	435.5	37.4	0.202
Weibull	422.2	427.7	37.0	0.204
Log-Normal	422.2	427.8	37.1	0.202
LP3	422.2	427.8	37.4	0.206

## Appendix RR Kumeti at Te Rehunga 1032501

**Table RR-1: General information about the site.**

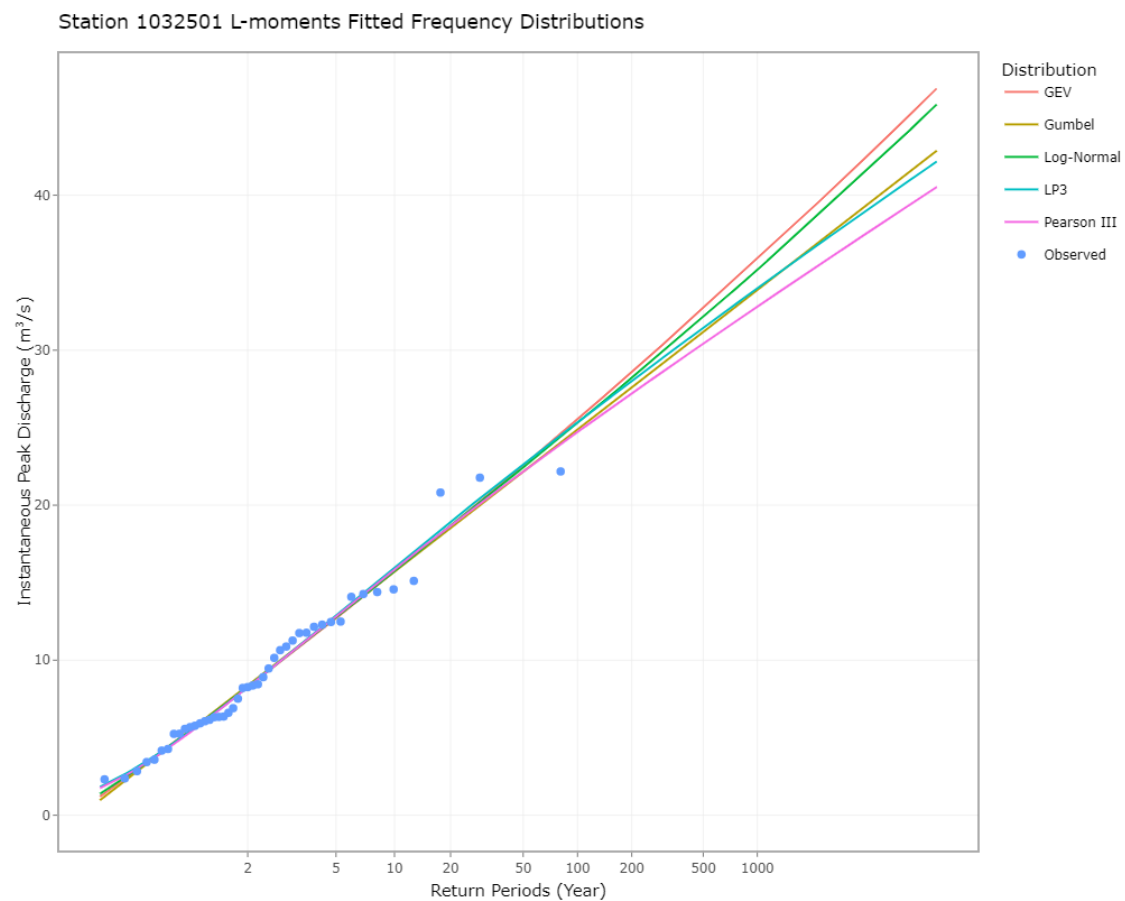
Site Details	
Start (records)	20-Aug-1980
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	15.6
Latitude	-40.22011818
Longitude	176.0125869
Record length (yrs)	45
Minimum (m <sup>3</sup> /s)	2.3
Maximum (m <sup>3</sup> /s)	22.2
Median (m <sup>3</sup> /s)	8.3
Mean (m <sup>3</sup> /s)	9.2
Standard Deviation (m <sup>3</sup> /s)	4.9
Coefficient of Variation	0.533

**Table RR-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	22.2	1	80.6
2015	20/06/2015	21.8	2	28.9
2017	5/04/2017	20.8	3	17.6
1988	2/09/1988	15.1	4	12.7
2018	8/03/2018	14.6	5	9.9
1999	29/11/1999	14.4	6	8.1
1992	22/07/1992	14.3	7	6.9
2000	10/04/2000	14.1	8	6
2010	6/09/2010	12.5	9	5.3
2011	23/01/2011	12.5	10	4.7

**Table RR-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	8.3	8.4	8.3	8.3	8.3
5	0.8	12.7	12.8	12.8	12.9	12.9
10	0.9	15.7	15.7	15.8	16.0	15.9
25	0.96	19.6	19.4	19.6	19.9	19.5
50	0.98	22.6	22.2	22.4	22.6	22.2
75	0.9867	24.3	23.8	24.1	24.2	23.7
100	0.99	25.6	24.9	25.3	25.4	24.7
200	0.995	28.6	27.6	28.2	28.0	27.2
500	0.998	32.7	31.2	32.1	31.4	30.4
1000	0.999	35.9	33.9	35.2	34.0	32.8



**Figure RR-1: Visual of different fitted distribution for the site.**

**Table RR-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	274.2	277.8	9.5	0.110
Gamma	273.7	277.3	9.4	0.122
GEV	275.7	281.1	9.4	0.120
Gen. Logistic	275.7	281.1	9.4	0.117
Gen. Normal	275.7	281.1	9.4	0.120
Gen. Pareto	275.7	281.1	9.4	0.123
Gumbel	273.7	277.3	9.4	0.121
Kappa	277.7	284.9	9.4	0.122
Normal	273.7	277.3	9.5	0.128
Pearson III	275.7	281.1	9.4	0.121
Wakeby	279.7	288.7	9.4	0.122
Weibull	275.7	281.1	9.4	0.122
Log-Normal	275.7	281.1	9.4	0.120
LP3	275.7	281.2	9.5	0.123

## Appendix SS Tamaki at Water Supply Weir 1032504

**Table SS-1: General information about the site.**

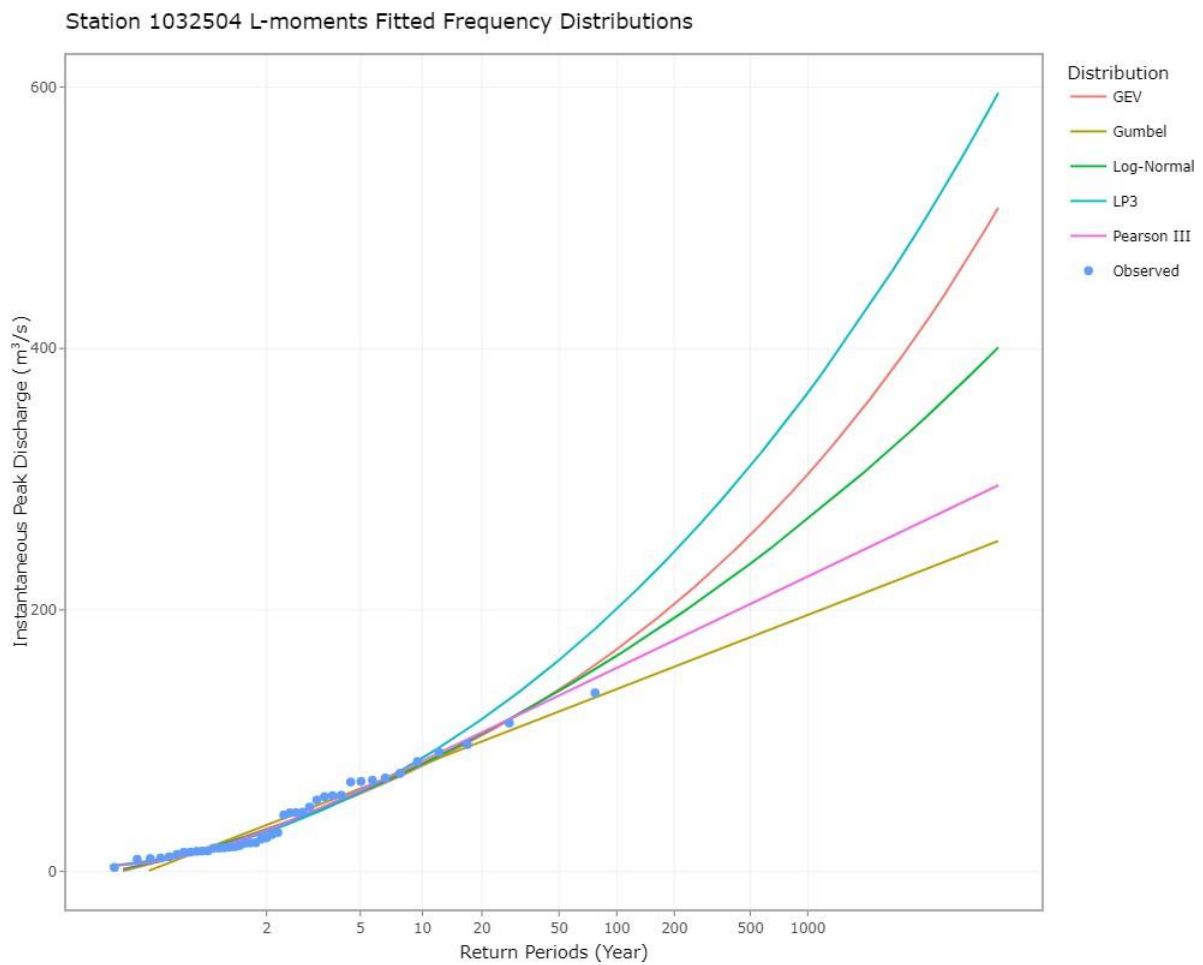
Site Details	
Start (records)	17-Nov-
End (records)	27-Sep-
Catchment area (km <sup>2</sup> )	31.6
Latitude	-40.165184
Longitude	176.063633
Record length (yrs)	43
Minimum (m <sup>3</sup> /s)	3
Maximum (m <sup>3</sup> /s)	136.6
Median (m <sup>3</sup> /s)	25.7
Mean (m <sup>3</sup> /s)	40.7
Standard Deviation (m <sup>3</sup> /s)	31.5
Coefficient of Variation	0.776

**Table SS-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	14/02/2023	136.6	1	77
2004	16/02/2004	113.5	2	27.6
2017	5/04/2017	97.1	3	16.8
2000	10/04/2000	91.3	4	12.1
1999	2018	8/03/2018	84	5
2018	2011	23/01/2011	75	6
2017	2022	24/03/2022	71.5	7
1997	2015	20/06/2015	69.7	8
2015	2014	17/04/2014	68.8	9
2006	1988	2/09/1988	68.4	10

**Table SS-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	32.3	35.5	32.0	30.2	31.5
5	0.8	59.4	63.3	60.4	60.7	62.2
10	0.9	80.7	81.8	82.2	86.8	84.5
25	0.96	112.1	105.1	113.0	126.8	113.3
50	0.98	139.2	122.4	138.1	161.7	134.7
75	0.9867	156.6	132.4	153.6	184.0	147.2
100	0.99	169.8	139.5	165.0	200.8	156.1
200	0.995	204.4	156.6	193.9	244.6	177.2
500	0.998	257.4	179.1	235.4	310.2	205.1
1000	0.999	303.8	196.2	269.5	366.1	226.1



**Figure SS-1: Visual of different fitted distribution for the site.**

**Table SS-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	422.1	425.7	59.2	0.185
Gamma	421.9	425.4	59.1	0.190
GEV	424.0	429.3	59.2	0.184
Gen. Logistic	424.0	429.3	59.1	0.182
Gen. Normal	424.0	429.3	59.2	0.186
Gen. Pareto	424.0	429.2	59.1	0.189
Gumbel	421.9	425.4	59.2	0.196
Kappa	425.9	433.0	58.9	0.191
Normal	422.0	425.5	59.9	0.203
Pearson III	424.0	429.3	59.1	0.188
Wakeby	428.0	436.8	59.1	0.189
Weibull	424.0	429.2	59.1	0.188
Log-Normal	424.0	429.3	59.2	0.186
LP3	426.3	431.6	62.4	0.183

## Appendix TT Tokomaru at Quarry 1032517

**Table TT-1: General information about the site.**

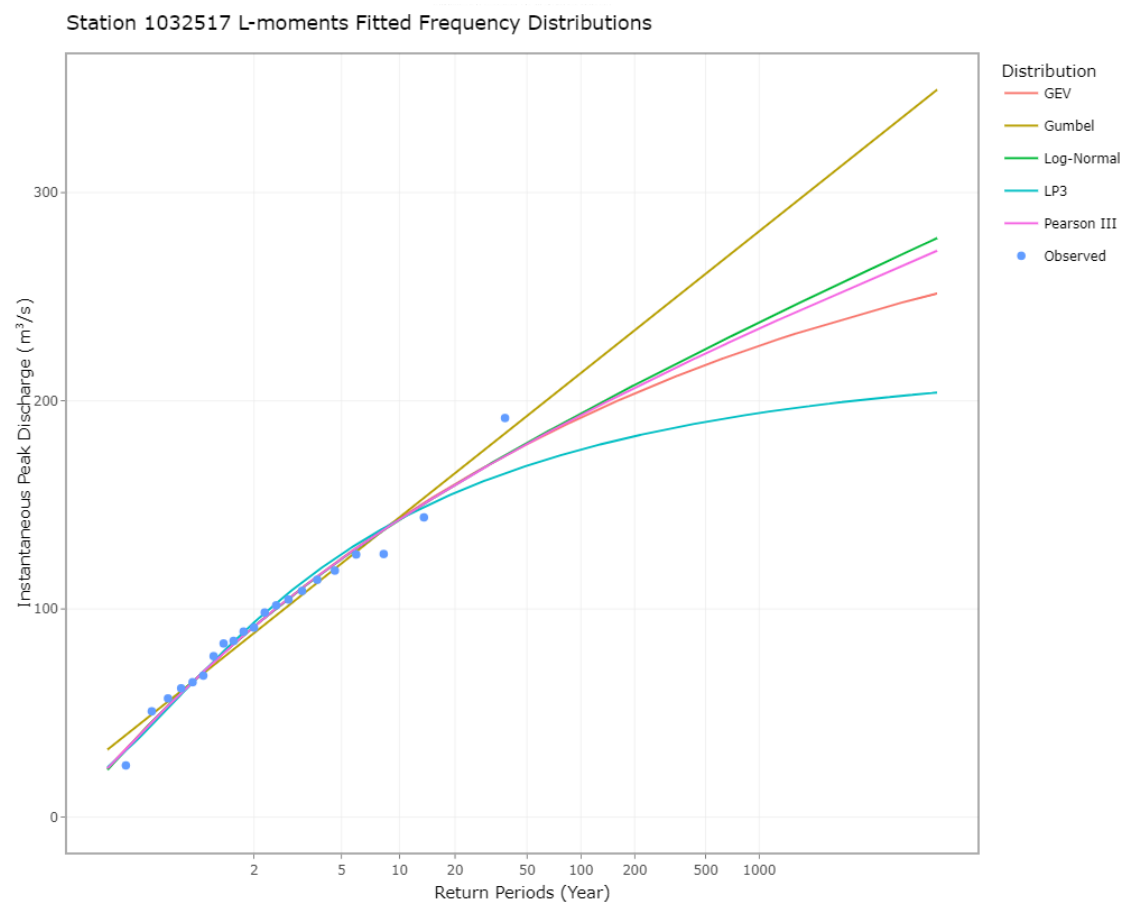
Site Details	
Start (records)	13-Dec-1979
End (records)	11-Mar-1998
Catchment area (km <sup>2</sup> )	56.6
Latitude	-40.489114
Longitude	175.524867
Record length (yrs)	21
Minimum (m <sup>3</sup> /s)	24.8
Maximum (m <sup>3</sup> /s)	191.7
Median (m <sup>3</sup> /s)	91
Mean (m <sup>3</sup> /s)	94.6
Standard Deviation (m <sup>3</sup> /s)	36.5
Coefficient of Variation	0.386

**Table TT-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2008	8/01/2008	191.7	1	37.7
1990	10/03/1990	144	2	13.5
1991	28/11/1991	126.4	3	8.3
1993	2/06/1993	126.2	4	5.9
1985	23/01/1985	118.4	5	4.6
1979	26/12/1979	114	6	3.8
1981	3/06/1981	108.7	7	3.2
1982	26/12/1982	104.5	8	2.8
1986	4/10/1986	101.7	9	2.5
1995	21/03/1995	98.3	10	2.2

**Table TT-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	91.4	88.4	91.5	93.5	91.5
5	0.8	124.3	121.8	123.9	126.4	124.1
10	0.9	143.4	144.0	142.9	143.0	143.0
25	0.96	164.9	172.0	164.7	159.3	164.6
50	0.98	179.2	192.7	179.7	168.8	179.4
75	0.9867	186.8	204.8	188.2	173.5	187.5
100	0.99	192.0	213.3	194.0	176.6	193.2
200	0.995	203.6	233.9	207.6	183.0	206.3
500	0.998	217.3	261.0	224.9	189.9	222.7
1000	0.999	226.5	281.4	237.6	194.1	234.7



**Figure TT-1: Visual of different fitted distribution for the site.**

**Table TT-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	214.0	216.0	71.1	0.107
Gamma	213.7	215.8	70.3	0.095
GEV	215.7	218.8	70.4	0.094
Gen. Logistic	215.6	218.8	70.3	0.092
Gen. Normal	215.6	218.8	70.3	0.094
Gen. Pareto	215.7	218.8	70.1	0.096
Gumbel	213.7	215.8	70.4	0.095
Normal	213.6	215.7	70.4	0.094
Pearson III	215.7	218.8	70.3	0.094
Exponential	214.0	216.0	71.1	0.107
Wakeby	219.7	224.9	70.6	0.091
Weibull	215.7	218.8	70.3	0.094
Log-Normal	215.6	218.8	70.3	0.094
LP3	215.6	218.8	70.0	0.094

## Appendix UU Makakahi at Hamua 1032518

**Table UU-1: General information about the site.**

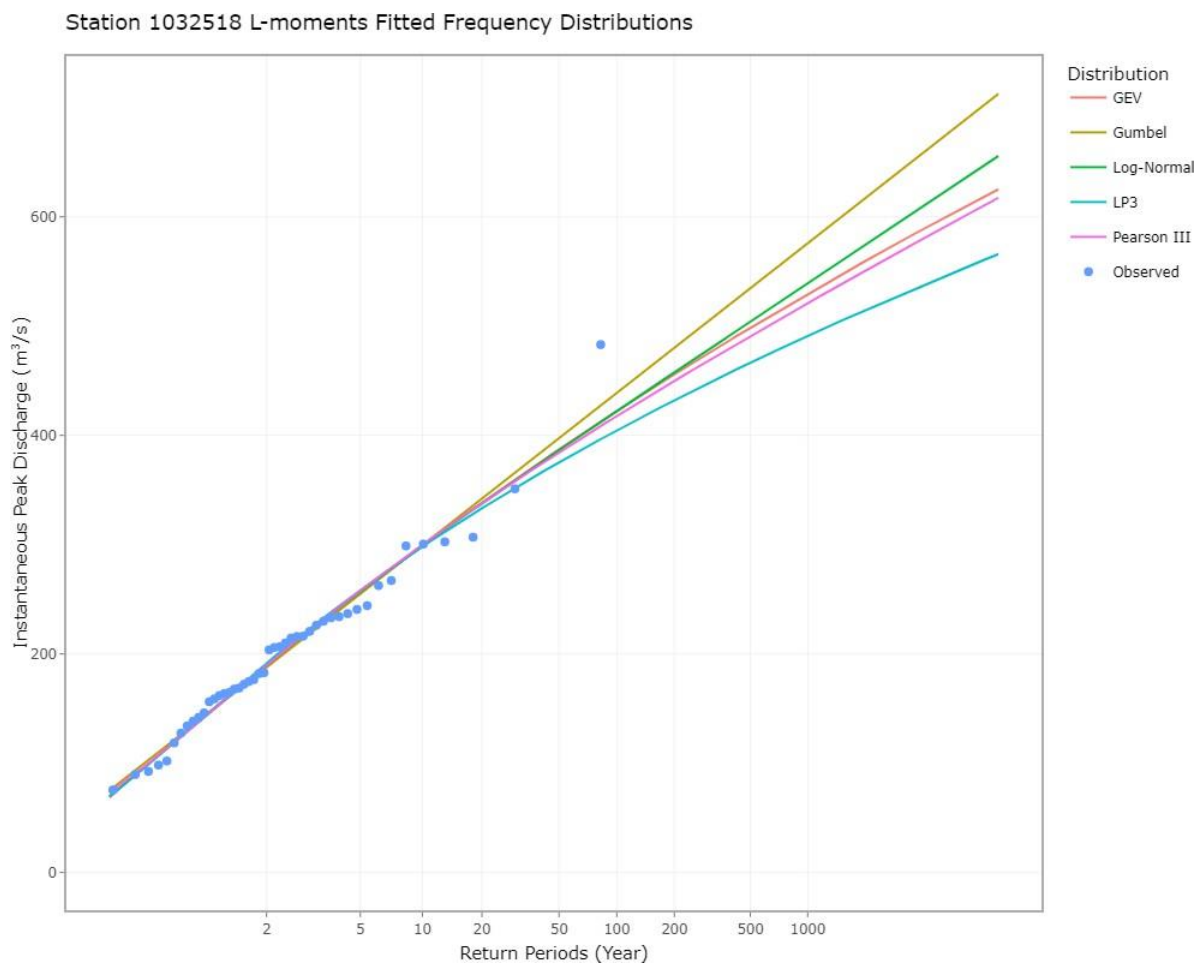
Site Details	
Start (records)	19-Dec-1979
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	158
Latitude	-40.565174
Longitude	175.745106
Record length (yrs)	46
Minimum (m <sup>3</sup> /s)	75.5
Maximum (m <sup>3</sup> /s)	483.1
Median (m <sup>3</sup> /s)	193.2
Mean (m <sup>3</sup> /s)	200.1
Standard Deviation (m <sup>3</sup> /s)	76.2
Coefficient of Variation	0.381

**Table UU-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2000	9/10/2000	483.1	1	82.4
2010	6/09/2010	351.1	2	29.6
1998	21/10/1998	306.8	3	18
2023	22/04/2023	302.6	4	13
1988	6/10/1988	300.5	5	10.1
2004	16/02/2004	298.8	6	8.3
1996	30/06/1996	267.2	7	7
2012	3/03/2012	262.5	8	6.1
2024	18/08/2024	244.2	9	5.4
2015	20/06/2015	240.7	10	4.8

**Table UU-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	189.8	187.6	189.9	191.5	189.8
5	0.8	256.9	254.9	256.9	258.3	257.9
10	0.9	299.3	299.4	298.9	298.1	299.8
25	0.96	350.6	355.7	349.8	343.9	349.5
50	0.98	387.1	397.4	386.5	375.3	384.4
75	0.9867	407.8	421.7	407.5	392.6	404.0
100	0.99	422.2	438.9	422.3	404.6	417.7
200	0.995	455.9	480.2	457.6	432.1	449.8
500	0.998	498.6	534.6	503.9	466.5	490.8
1000	0.999	529.6	575.8	538.8	491.1	521.0



**Figure UU-1: Visual of different fitted distribution for the site.**

**Table UU-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	532.5	536.1	146.6	0.114
Gamma	532.2	535.9	145.1	0.100
GEV	534.2	539.7	145.3	0.101
Gen. Logistic	534.2	539.7	145.8	0.101
Gen. Normal	534.2	539.7	145.2	0.101
Gen. Pareto	534.2	539.7	143.9	0.100
Gumbel	532.2	535.8	145.4	0.103
Normal	532.3	535.9	145.8	0.098
Pearson III	534.2	539.7	145.1	0.101
Exponential	538.2	547.3	145.8	0.101
Wakeby	534.2	539.7	144.7	0.100
Weibull	534.2	539.7	145.2	0.101
Log-Normal	534.3	539.8	144.2	0.097
LP3	532.5	536.1	146.6	0.114

## Appendix VV Makino at Reids Line 1032542

**Table VV-1: General information about the site.**

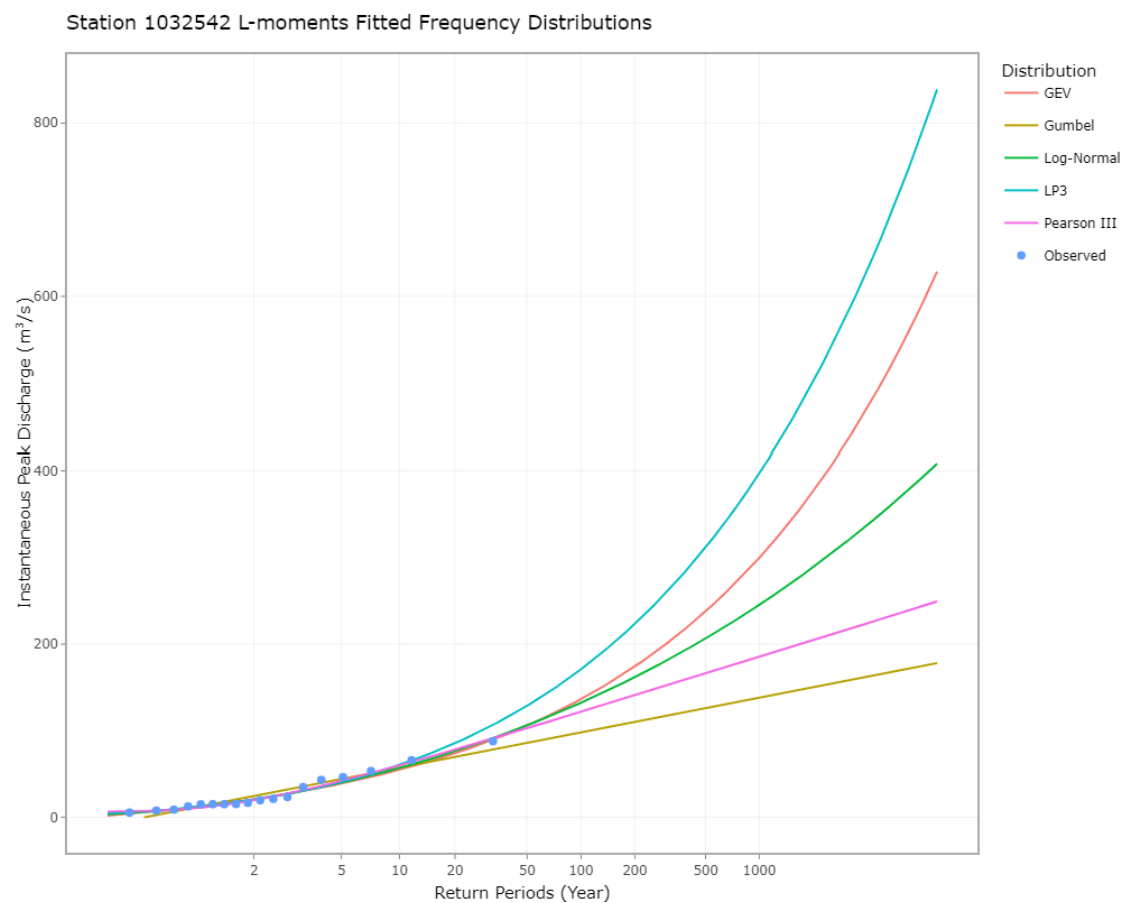
Site Details	
Start (records)	11-Feb-1987
End (records)	30-Sep-2004
Catchment area (km <sup>2</sup> )	41.1
Latitude	-40.19594
Longitude	175.580886
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	5.6
Maximum (m <sup>3</sup> /s)	88
Median (m <sup>3</sup> /s)	18.3
Mean (m <sup>3</sup> /s)	28.4
Standard Deviation (m <sup>3</sup> /s)	22.7
Coefficient of Variation	0.799

**Table VV-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	88	1	32.4
2001	15/08/2001	66	2	11.6
1988	25/07/1988	53.6	3	7.1
1999	29/11/1999	46.6	4	5.1
1994	16/11/1994	43.3	5	4
1998	21/10/1998	35	6	3.3
2002	30/09/2002	23.5	7	2.8
1991	11/04/1991	21.4	8	2.4
2000	11/09/2000	19.8	9	2.1
1995	18/09/1995	16.8	10	1.9

**Table VV-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	21.0	24.7	20.6	20.4	19.9
5	0.8	39.1	44.4	40.1	40.9	42.2
10	0.9	55.0	57.4	57.1	60.8	60.1
25	0.96	81.0	73.8	83.2	95.1	84.4
50	0.98	105.9	86.0	106.2	128.8	103.0
75	0.9867	123.0	93.1	121.1	152.3	114.0
100	0.99	136.5	98.2	132.3	170.9	121.9
200	0.995	174.2	110.2	161.8	223.2	140.8
500	0.998	237.9	126.1	206.6	311.7	166.0
1000	0.999	299.4	138.2	245.3	396.7	185.2



**Figure VV-1: Visual of different fitted distribution for the site.**

**Table VV-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	166.4	168.2	40.7	0.243
Gamma	166.4	168.2	40.7	0.246
GEV	168.4	171.1	39.9	0.234
Gen. Logistic	168.5	171.2	39.6	0.231
Gen. Normal	168.5	171.1	40.4	0.237
Gen. Pareto	168.5	171.1	40.5	0.239
Gumbel	166.4	168.2	40.9	0.251
Normal	170.5	174.1	40.7	0.241
Pearson III	166.5	168.2	41.7	0.257
Exponential	168.5	171.2	40.7	0.240
Wakeby	172.5	176.9	40.5	0.239
Weibull	168.5	171.2	40.7	0.240
Log-Normal	168.5	171.1	40.4	0.237
LP3	169.4	172.1	42.9	0.249

## Appendix WW Mangatainoka at Larsons Br 1032555

**Table WW-1: General information about the site.**

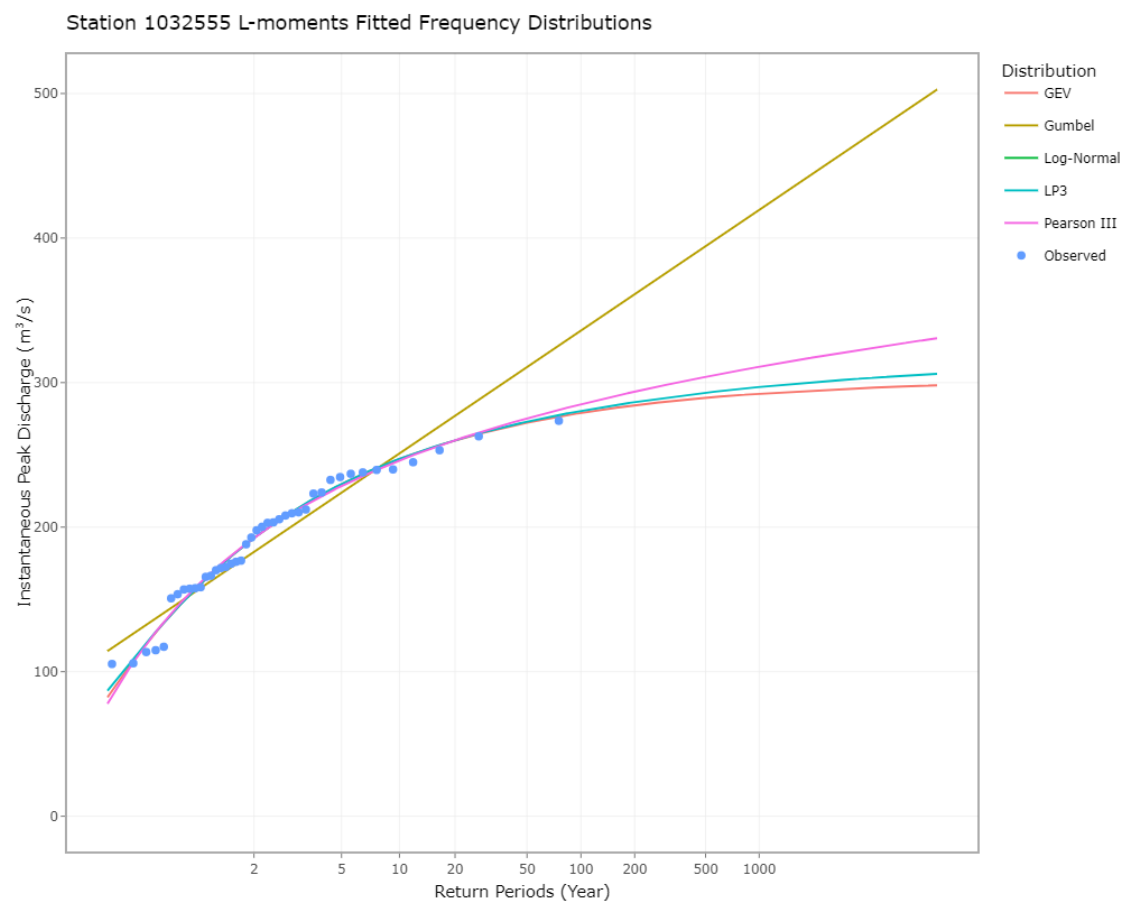
Site Details	
Start (records)	20-Jul-1983
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	57.3
Latitude	-40.640362
Longitude	175.610986
Record length (yrs)	42
Minimum (m <sup>3</sup> /s)	105.3
Maximum (m <sup>3</sup> /s)	273.6
Median (m <sup>3</sup> /s)	195.3
Mean (m <sup>3</sup> /s)	190.5
Standard Deviation (m <sup>3</sup> /s)	43.6
Coefficient of Variation	0.229

**Table WW-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	12/02/2004	273.6	1	75.2
2000	30/09/2000	262.8	2	27
2015	18/10/2015	253.2	3	16.5
1994	14/11/1994	244.9	4	11.8
2010	6/09/2010	239.9	5	9.2
1998	6/09/1998	239.6	6	7.6
2005	6/01/2005	237.9	7	6.4
2020	8/12/2020	236.9	8	5.6
2001	26/01/2001	234.6	9	4.9
2024	18/08/2024	232.7	10	4.4

**Table WW-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	192.4	182.8	NA	192.5	192.5
5	0.8	229.7	223.8	NA	229.9	228.4
10	0.9	247.2	251.0	NA	247.3	246.1
25	0.96	263.4	285.3	NA	263.7	264.1
50	0.98	272.2	310.7	NA	273.0	275.3
75	0.9867	276.4	325.5	NA	277.5	281.1
100	0.99	279.0	336.0	NA	280.4	285.0
200	0.995	284.3	361.2	NA	286.5	293.7
500	0.998	289.5	394.4	NA	293.0	304.0
1000	0.999	292.4	419.4	NA	296.9	310.9



**Figure WW-1: Visual of different fitted distribution for the site.**

**Table WW-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	440.5	444.0	89.3	0.091
Gamma	439.4	442.9	86.8	0.072
GEV	441.4	446.6	86.5	0.074
Gen. Logistic	441.5	446.7	86.8	0.073
Gen. Normal	441.4	446.6	86.6	0.074
Gen. Pareto	441.4	446.6	86.1	0.074
Gumbel	439.6	443.1	87.5	0.074
Normal	443.4	450.4	86.5	0.074
Pearson III	439.4	442.9	86.6	0.073
Exponential	441.4	446.6	86.6	0.074
Wakeby	445.4	454.1	86.6	0.073
Weibull	441.4	446.6	86.6	0.073
Log-Normal	441.4	446.6	86.4	0.077
LP3	440.5	444.0	89.3	0.091

## Appendix XX Manawatu at Teachers College 1032560

**Table XX-1: General information about the site.**

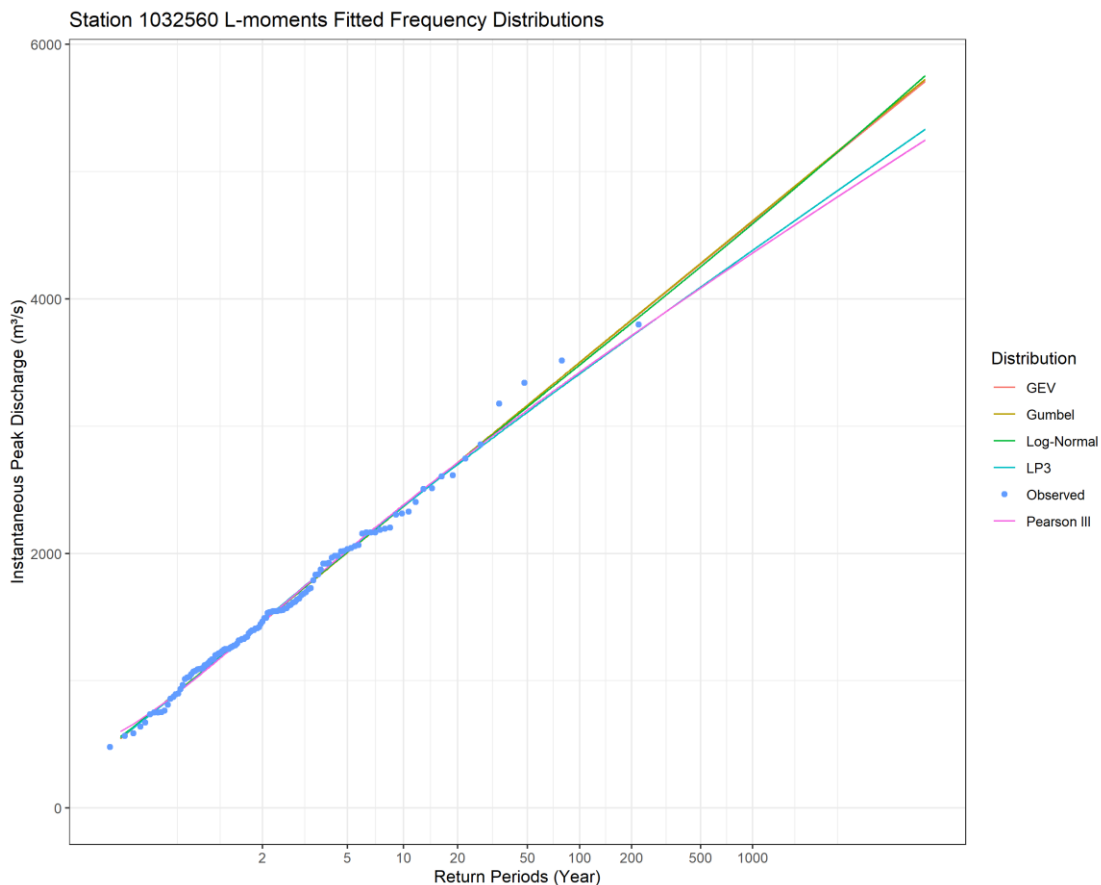
Site Details	
Start (records)	14-Jun-1902
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	3900
Latitude	-40.373288
Longitude	175.62773
Record length (yrs)	123
Minimum (m <sup>3</sup> /s)	477.7
Maximum (m <sup>3</sup> /s)	3800.0
Median (m <sup>3</sup> /s)	1465.3
Mean (m <sup>3</sup> /s)	1563.2
Standard Deviation (m <sup>3</sup> /s)	614.8
Coefficient of Variation	0.393

**Table XX-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1902	14/06/1902	3800.0	1	219.9
2004	16/02/2004	3515.3	2	78.9
1907	2/05/1907	3340.0	3	48.1
1953	28/01/1953	3176.2	4	34.6
1992	23/07/1992	2855.0	5	27.0
1965	18/03/1965	2744.5	6	22.1
1906	18/07/1906	2613.1	7	18.8
1941	5/05/1941	2605.2	8	16.3
1956	15/07/1956	2513.3	9	14.4
2010	7/09/2010	2505.8	10	12.9

**Table XX-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

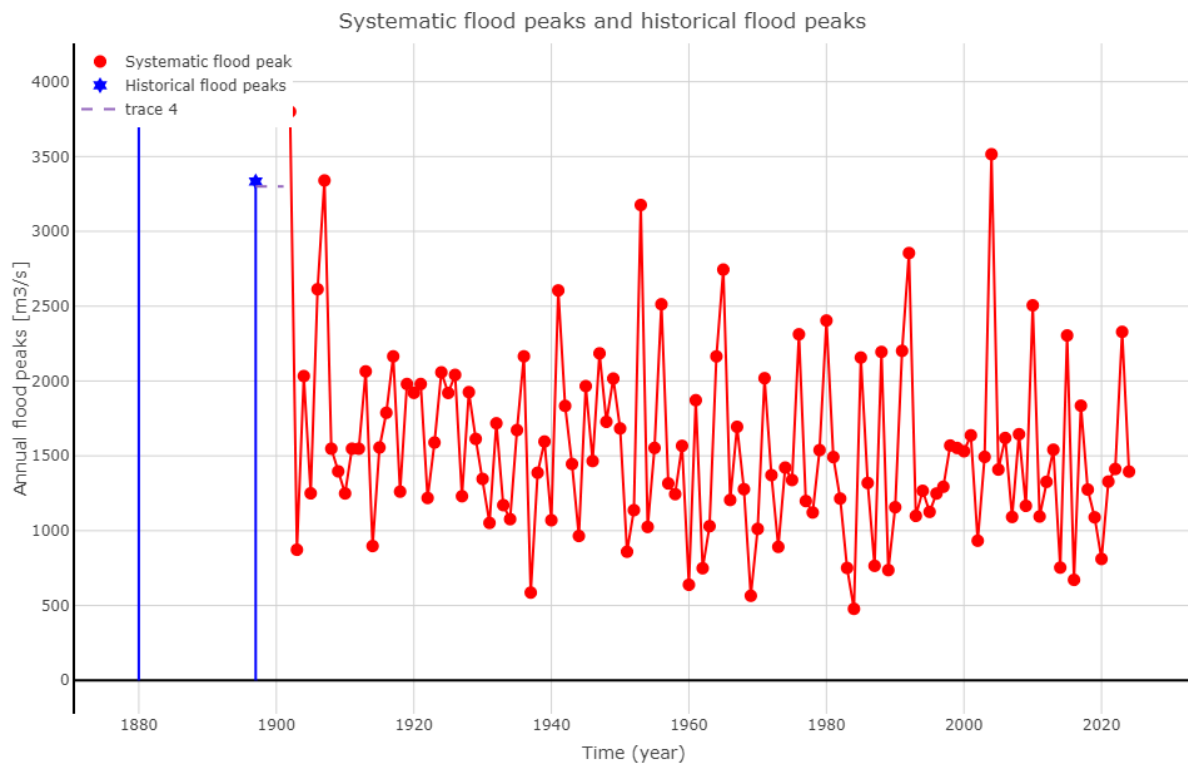
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	1462.0	1461.7	1462.0	1468.5	1460.2
5	0.8	2008.4	2008.1	2012.7	2021.1	2024.9
10	0.9	2369.8	2369.8	2371.7	2372.7	2383.8
25	0.96	2826.1	2826.9	2820.4	2801.6	2817.5
50	0.98	3164.3	3166.0	3151.8	3110.9	3126.5
75	0.9867	3360.8	3363.1	3344.6	3287.8	3301.8
100	0.99	3499.8	3502.6	3481.4	3412.0	3424.2
200	0.995	3833.8	3838.0	3811.7	3707.8	3713.3
500	0.998	4274.2	4280.4	4252.6	4093.1	4085.4
1000	0.999	4606.7	4614.8	4590.8	4381.9	4360.7



**Figure XX-1: Visual of different fitted distribution for the site.**

**Table XX-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	1592.2	1597.5	1143.5	0.101
Gamma	1590.8	1596.1	1128.2	0.096
GEV	1592.8	1600.7	1131.9	0.097
Gen. Logistic	1593.0	1600.8	1139.3	0.096
Gen. Normal	1592.8	1600.7	1130.9	0.096
Gen. Pareto	1592.8	1600.7	1117.2	0.096
Gumbel	1590.8	1596.1	1132.3	0.097
Normal	1594.8	1605.3	1133.0	0.097
Pearson III	1590.9	1596.1	1133.7	0.096
Exponential	1592.8	1600.7	1128.6	0.096
Wakeby	1596.8	1610.0	1133.6	0.097
Weibull	1592.8	1600.7	1125.1	0.096
Log-Normal	1592.8	1600.7	1130.9	0.096
LP3	1592.8	1600.7	1131.2	0.098



**Figure XX-2: Historical information and systematic records.**

**Table XX-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	1475.3	1387.4	1574.7
5	0.8	2050.7	1934.7	2209.6
10	0.9	2439.4	2290.2	2693.1
25	0.96	2938.8	2715.4	3375.4
50	0.98	3316.2	3010.3	3965.0
75	0.9867	3535.5	3178.1	4331.6
100	0.99	3696.4	3298.9	4604.4
200	0.995	4080.5	3560.6	5302.5
500	0.998	4596.1	3896.5	6374.3
1000	0.999	4992.6	4129.4	7264.7

**Table XX-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1897	3333.0
1880	3980.0

## Appendix YY Makino at Rata St 1032561

**Table YY-1: General information about the site.**

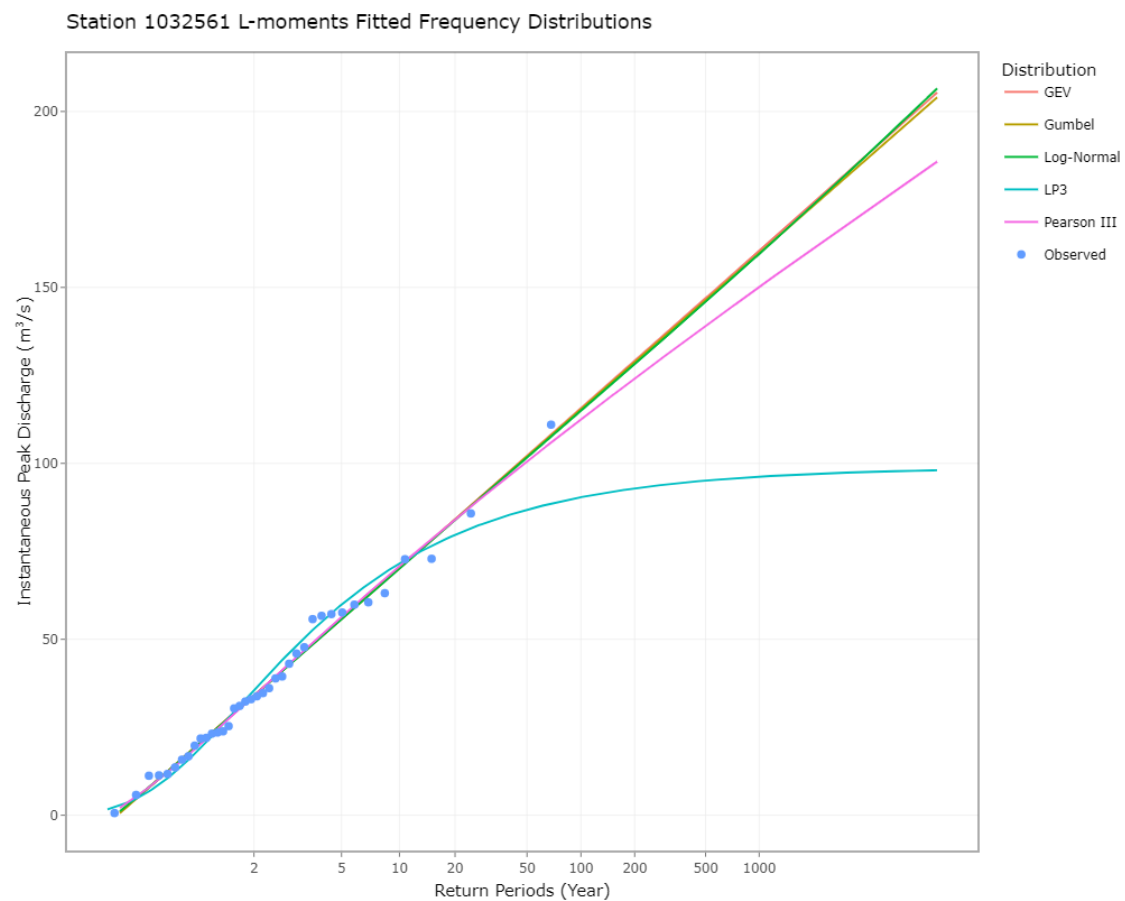
Site Details	
Start (records)	23-Dec-1986
End (records)	21-Mar-2024
Catchment area (km <sup>2</sup> )	63.8
Latitude	-40.231629
Longitude	175.556384
Record length (yrs)	38
Minimum (m <sup>3</sup> /s)	0.6
Maximum (m <sup>3</sup> /s)	111
Median (m <sup>3</sup> /s)	33.4
Mean (m <sup>3</sup> /s)	38
Standard Deviation (m <sup>3</sup> /s)	23.9
Coefficient of Variation	0.629

**Table YY-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	111	1	68.1
2001	15/08/2001	85.8	2	24.4
2015	20/06/2015	72.9	3	14.9
2021	15/12/2021	72.8	4	10.7
1999	29/11/1999	63.1	5	8.4
1994	16/11/1994	60.5	6	6.9
1998	21/10/1998	59.8	7	5.8
2023	21/05/2023	57.6	8	5
2010	6/09/2010	57.2	9	4.5
2017	13/07/2017	56.7	10	4

**Table YY-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	34.0	34.0	34.0	35.5	33.9
5	0.8	55.8	55.8	55.9	59.8	56.4
10	0.9	70.2	70.2	70.3	71.6	70.8
25	0.96	88.5	88.4	88.3	81.7	88.2
50	0.98	102.1	102.0	101.6	86.8	100.6
75	0.9867	110.0	109.8	109.3	89.0	107.6
100	0.99	115.6	115.4	114.8	90.4	112.5
200	0.995	129.1	128.7	128.1	92.9	124.1
500	0.998	146.9	146.4	145.9	95.1	139.0
1000	0.999	160.4	159.7	159.5	96.2	150.1



**Figure YY-1: Visual of different fitted distribution for the site.**

**Table YY-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	352.7	356.0	46.6	0.106
Gamma	352.2	355.5	46.3	0.108
GEV	354.2	359.1	46.3	0.108
Gen. Logistic	354.2	359.1	46.3	0.106
Gen. Normal	354.2	359.1	46.3	0.108
Gen. Pareto	354.2	359.1	46.0	0.110
Gumbel	352.2	355.5	46.3	0.108
Normal	356.2	362.7	46.2	0.109
Pearson III	352.1	355.4	46.5	0.112
Exponential	354.2	359.1	46.2	0.109
Wakeby	358.2	366.4	46.3	0.109
Weibull	354.2	359.1	46.2	0.109
Log-Normal	354.2	359.1	46.3	0.108
LP3	354.1	359.1	45.8	0.113

## Appendix ZZ Makino at Boness Rd 1032564

**Table ZZ-1: General information about the site.**

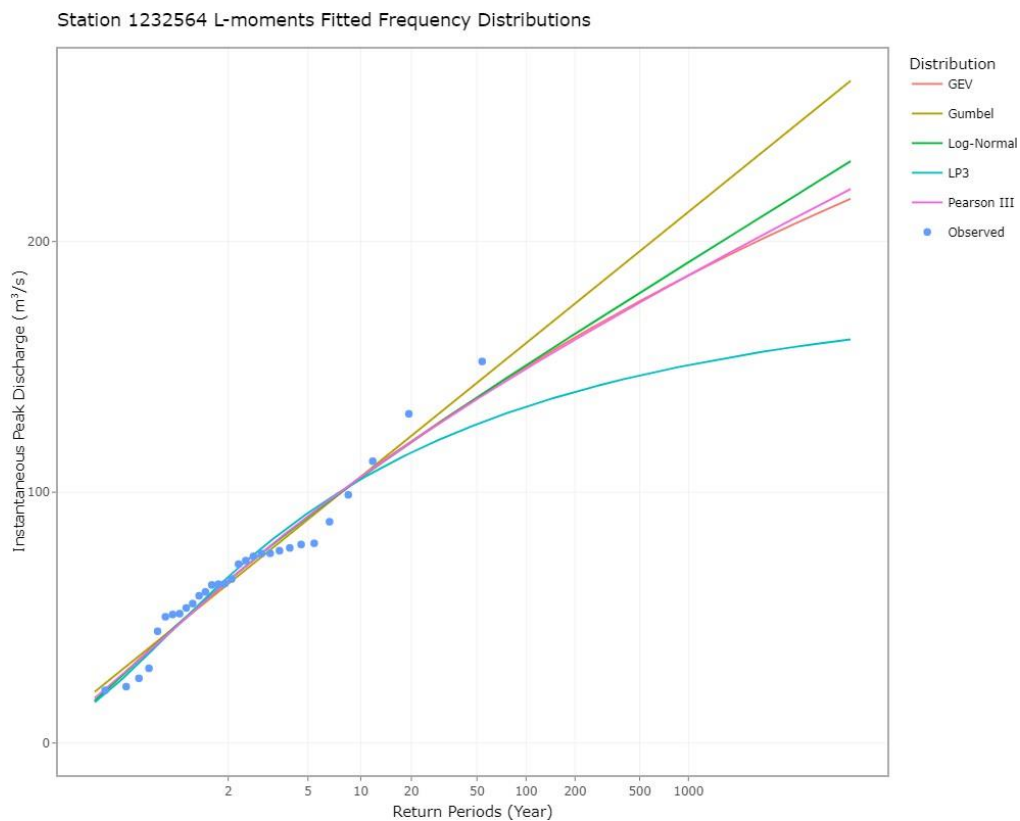
Site Details	
Start (records)	19-Dec-1991
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	138.8
Latitude	-40.257383
Longitude	175.532662
Record length (yrs)	34
Minimum (m <sup>3</sup> /s)	2.3
Maximum (m <sup>3</sup> /s)	90.8
Median (m <sup>3</sup> /s)	32.7
Mean (m <sup>3</sup> /s)	37.7
Standard Deviation (m <sup>3</sup> /s)	21.5
Coefficient of Variation	0.57

**Table ZZ-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	90.8	1	60.9
2015	20/06/2015	81	2	21.9
2021	16/12/2021	76.4	3	13.3
2010	6/09/2010	67.2	4	9.6
2001	15/08/2001	60.8	5	7.5
1998	21/10/1998	60.7	6	6.1
2022	13/06/2022	55.6	7	5.2
2013	15/10/2013	54.2	8	4.5
1994	16/11/1994	53.9	9	4
2006	24/10/2006	52	10	3.6

**Table ZZ-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
		34.2	34.0	34.2	35.2	34.2
2	0.5	34.2	34.0	34.2	35.2	34.2
5	0.8	54.0	53.9	54.1	56.9	54.5
10	0.9	67.0	67.0	67.0	68.3	67.4
25	0.96	83.2	83.6	82.9	79.4	82.8
50	0.98	95.0	95.9	94.7	85.7	93.8
75	0.9867	101.9	103.0	101.4	88.8	100.0
100	0.99	106.7	108.1	106.2	90.7	104.4
200	0.995	118.3	120.2	117.8	94.6	114.6
500	0.998	133.3	136.3	133.2	98.5	127.7
1000	0.999	144.6	148.4	144.9	100.8	137.4



**Figure ZZ-1: Visual of different fitted distribution for the site.**

**Table ZZ-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	308.7	311.8	42.3	0.150
Gamma	308.2	311.3	41.9	0.152
GEV	310.2	314.8	41.9	0.153

Gen. Logistic	310.2	314.8	41.9	0.150
Gen. Normal	310.2	314.8	41.9	0.153
Gen. Pareto	310.2	314.7	41.7	0.155
Gumbel	308.2	311.3	41.9	0.152
Normal	312.2	318.3	41.9	0.153
Pearson III	308.1	311.2	42.0	0.155
Exponential	310.2	314.8	41.9	0.153
Wakeby	314.1	321.8	40.9	0.165
Weibull	310.2	314.8	41.8	0.153
Log-Normal	310.2	314.8	41.9	0.153
LP3	310.1	314.7	41.7	0.157

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## Appendix AAA Makuri at Tuscan Hills 1032591

**Table AAA-1: General information about the site.**

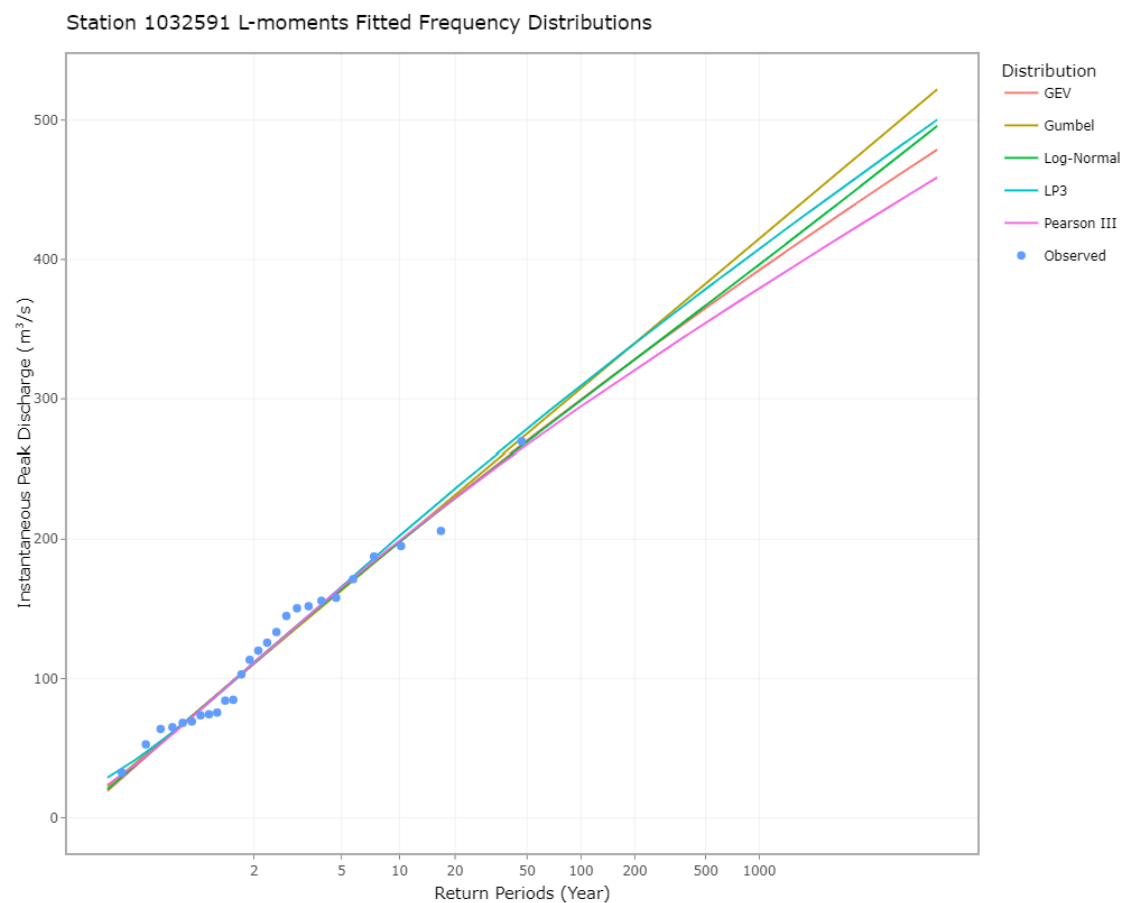
Site Details	
Start (records)	9-Dec-1999
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	136.2
Latitude	-40.52366
Longitude	175.931148
Record length (yrs)	26
Minimum (m <sup>3</sup> /s)	32.5
Maximum (m <sup>3</sup> /s)	269.6
Median (m <sup>3</sup> /s)	116.7
Mean (m <sup>3</sup> /s)	120.4
Standard Deviation (m <sup>3</sup> /s)	56.9
Coefficient of Variation	0.472

**Table AAA-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	269.6	1	46.6
2018	12/06/2018	206	2	16.7
2023	14/02/2023	195.1	3	10.2
2017	14/04/2017	187.6	4	7.3
2000	7/10/2000	171.3	5	5.7
2019	13/06/2019	157.9	6	4.7
2024	18/08/2024	155.8	7	4
2001	15/08/2001	151.9	8	3.5
2008	30/07/2008	150.4	9	3.1
2003	9/06/2003	144.9	10	2.7

**Table AAA-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	111.6	110.6	111.6	110.7	111.5
5	0.8	164.3	163.3	164.4	166.2	165.4
10	0.9	198.2	198.2	198.1	202.3	198.9
25	0.96	239.9	242.3	239.3	246.7	239.1
50	0.98	270.2	275.0	269.4	278.6	267.4
75	0.9867	287.4	294.1	286.7	296.8	283.4
100	0.99	299.5	307.5	298.9	309.6	294.6
200	0.995	328.2	339.9	328.2	339.8	320.8
500	0.998	365.1	382.6	366.9	378.7	354.5
1000	0.999	392.3	414.9	396.3	407.6	379.3



**Figure AAA-1: Visual of different fitted distribution for the site.**

**Table AAA-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	287.4	289.9	111.0	0.137
Gamma	287.0	289.5	110.3	0.151
GEV	289.0	292.7	110.3	0.152
Gen. Logistic	288.9	292.7	110.0	0.151
Gen. Normal	289.0	292.7	110.2	0.152
Gen. Pareto	289.0	292.7	110.2	0.153
Gumbel	287.0	289.5	110.3	0.150
Normal	291.0	296.0	110.3	0.153
Pearson III	286.9	289.4	110.8	0.158
Exponential	289.0	292.7	110.3	0.152
Wakeby	293.0	299.2	110.2	0.153
Weibull	289.0	292.7	110.2	0.152
Log-Normal	289.0	292.7	110.2	0.152
LP3	289.1	292.9	111.2	0.153

## Appendix BBB Whangaehu at Aranui 1033153

**Table BBB-1: General information about the site.**

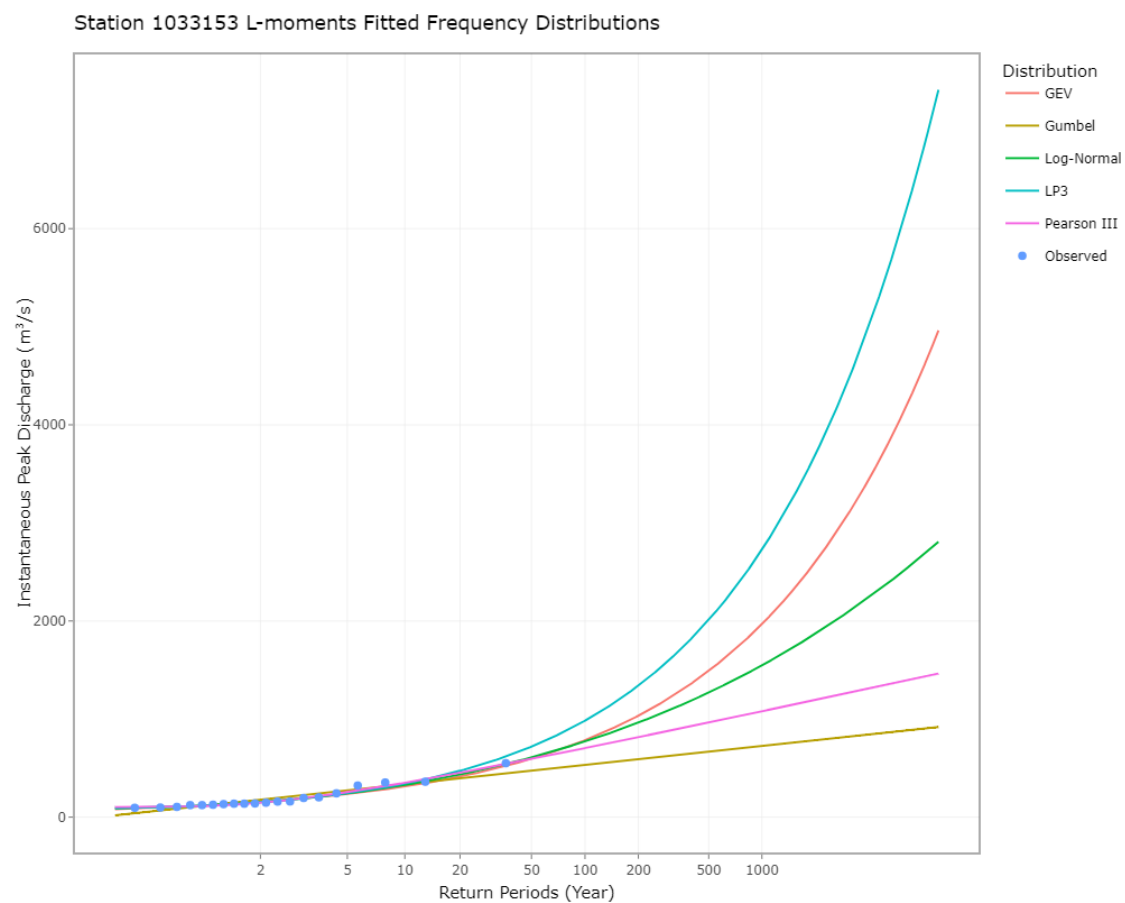
Site Details	
Start (records)	24-May-2005
End (records)	26-Sep-2024
Catchment area (km <sup>2</sup> )	797
Latitude	-39.715543
Longitude	175.420336
Record length (yrs)	20
Minimum (m <sup>3</sup> /s)	95
Maximum (m <sup>3</sup> /s)	550
Median (m <sup>3</sup> /s)	143.3
Mean (m <sup>3</sup> /s)	195.3
Standard Deviation (m <sup>3</sup> /s)	116.6
Coefficient of Variation	0.597

**Table BBB-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2007	18/03/2007	550	1	35.9
2013	15/10/2013	361.1	2	12.9
2006	7/07/2006	353	3	7.9
2015	20/06/2015	322	4	5.7
2011	11/07/2011	242.4	5	4.4
2022	2/06/2022	202.2	6	3.6
2017	5/04/2017	195.3	7	3.1
2008	7/10/2008	159.9	8	2.7
2023	15/02/2023	158.5	9	2.4
2018	5/01/2018	147.3	10	2.1

**Table BBB-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	154.7	177.7	151.8	151.0	146.3
5	0.8	235.5	272.7	241.6	243.7	254.7
10	0.9	313.4	335.5	328.1	341.2	350.8
25	0.96	452.3	415.0	472.8	524.0	486.9
50	0.98	595.7	473.9	608.9	719.6	594.1
75	0.9867	699.9	508.2	700.5	864.5	658.0
100	0.99	784.7	532.4	771.4	983.9	703.8
200	0.995	1034.1	590.7	963.8	1340.8	815.3
500	0.998	1490.8	667.6	1270.3	2011.0	964.8
1000	0.999	1967.6	725.8	1547.0	2726.4	1079.1



**Figure BBB-1: Visual of different fitted distribution for the site.**

**Table BBB-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	250.1	252.1	200.1	0.269
Gamma	250.4	252.4	202.0	0.278
GEV	252.3	255.3	194.5	0.253
Gen. Logistic	252.5	255.5	192.9	0.251
Gen. Normal	252.1	255.1	198.1	0.255
Gen. Pareto	252.1	255.1	197.7	0.256
Gumbel	250.4	252.4	202.3	0.279
Normal	254.1	258.1	199.2	0.258
Pearson III	250.6	252.6	206.5	0.285
Exponential	252.1	255.1	200.4	0.260
Wakeby	256.1	261.1	197.7	0.256
Weibull	252.1	255.1	200.1	0.258
Log-Normal	252.1	255.1	198.1	0.255
LP3	252.8	255.8	210.7	0.259

## Appendix CCC Mangawhero at Raupiu Road 1033154

**Table CCC-1: General information about the site.**

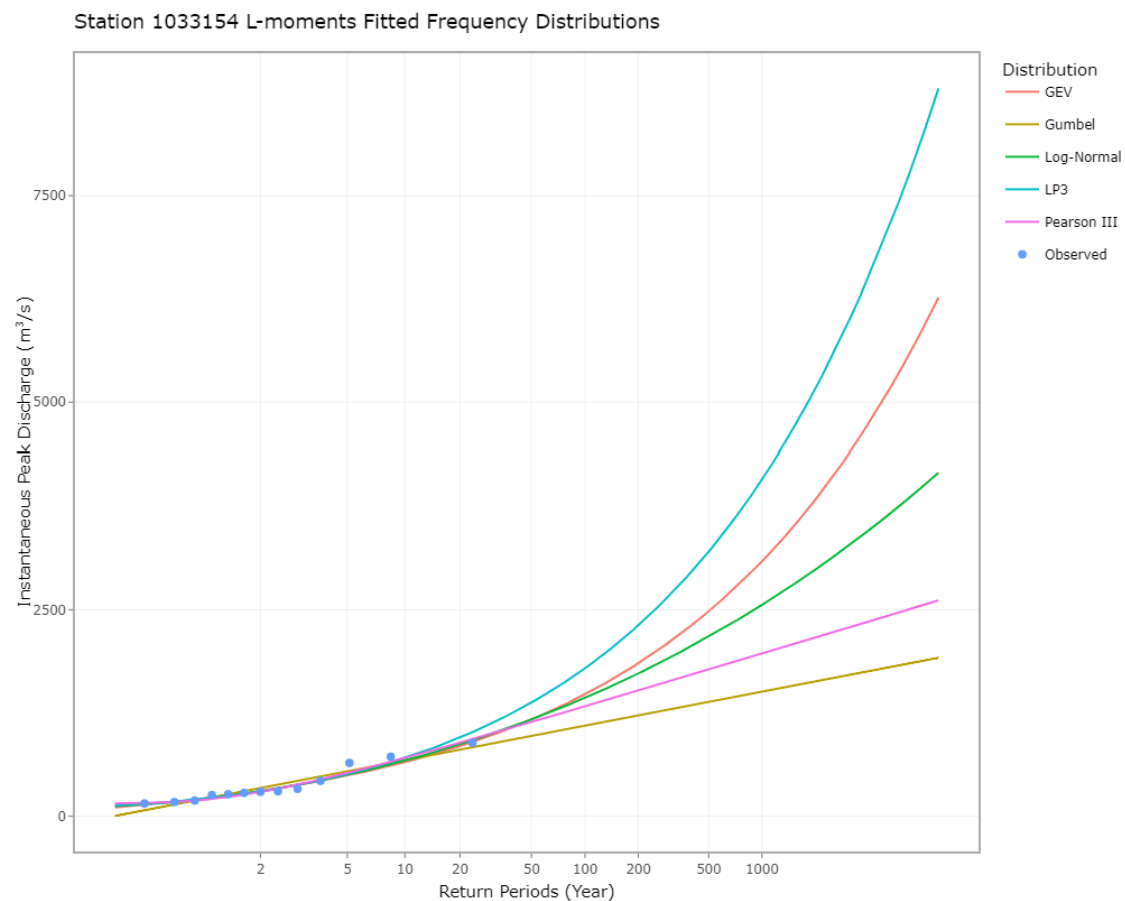
Site Details	
Start (records)	16-Feb-2004
End (records)	30-Sep-2016
Catchment area (km <sup>2</sup> )	676
Latitude	-39.700278
Longitude	175.331133
Record length (yrs)	13
Minimum (m <sup>3</sup> /s)	154.1
Maximum (m <sup>3</sup> /s)	888.2
Median (m <sup>3</sup> /s)	295.6
Mean (m <sup>3</sup> /s)	379.4
Standard Deviation (m <sup>3</sup> /s)	229.3
Coefficient of Variation	0.604

**Table CCC-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	888.2	1	23.4
2015	20/06/2015	721	2	8.4
2013	15/10/2013	645.2	3	5.1
2006	7/07/2006	428.2	4	3.7
2011	23/01/2011	331.2	5	2.9
2014	3/08/2014	302.3	6	2.4
2010	6/09/2010	295.6	7	2
2008	7/10/2008	283	8	1.7
2007	17/10/2007	266.7	9	1.5
2016	24/07/2016	256.6	10	1.4

**Table CCC-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	304.9	341.9	300.8	301.2	293.8
5	0.8	491.6	544.0	502.2	509.9	523.1
10	0.9	654.5	677.8	675.2	707.3	705.1
25	0.96	919.6	846.8	940.1	1045.0	951.3
50	0.98	1170.5	972.2	1171.9	1376.3	1140.0
75	0.9867	1342.2	1045.1	1321.4	1607.8	1251.1
100	0.99	1477.0	1096.7	1434.0	1791.6	1330.2
200	0.995	1852.4	1220.8	1729.1	2311.5	1521.6
500	0.998	2482.5	1384.4	2174.8	3203.4	1775.8
1000	0.999	3086.3	1508.1	2557.9	4074.2	1968.9



**Figure CCC-1: Visual of different fitted distribution for the site.**

**Table CCC-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	181.2	182.4	409.5	0.264
Gamma	181.2	182.3	412.4	0.271
GEV	183.2	184.9	398.9	0.255
Gen. Logistic	183.3	185.0	395.0	0.252
Gen. Normal	183.2	184.9	403.9	0.258
Gen. Pareto	183.2	184.9	406.9	0.260
Gumbel	181.2	182.3	412.3	0.273
Normal	185.2	187.5	407.6	0.261
Pearson III	181.2	182.3	419.4	0.280
Exponential	183.3	185.0	409.0	0.262
Wakeby	187.2	190.1	406.9	0.260
Weibull	183.3	185.0	408.6	0.261
Log-Normal	183.2	184.9	403.9	0.258
LP3	183.6	185.3	422.8	0.271

## Appendix DDD Matarawa at City Branch 1033363

**Table DDD-1: General information about the site.**

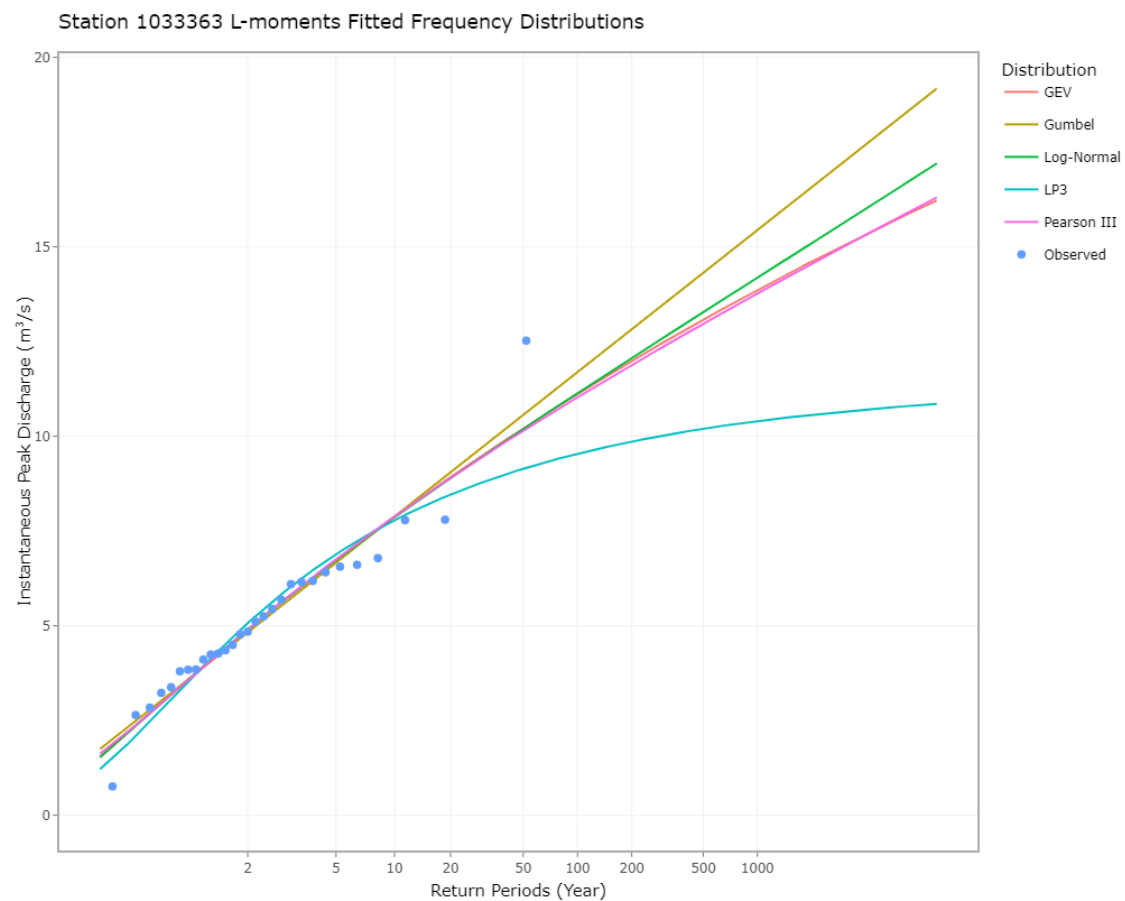
Site Details	
Start (records)	28-Nov-1995
End (records)	6-Jun-2024
Catchment area (km <sup>2</sup> )	71.1
Latitude	-39.916694
Longitude	175.090489
Record length (yrs)	29
Minimum (m <sup>3</sup> /s)	0.8
Maximum (m <sup>3</sup> /s)	12.5
Median (m <sup>3</sup> /s)	4.8
Mean (m <sup>3</sup> /s)	5.2
Standard Deviation (m <sup>3</sup> /s)	2.1
Coefficient of Variation	0.412

**Table DDD-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2023	3/02/2023	12.5	1	52
2004	16/02/2004	7.8	2	18.7
2015	20/06/2015	7.8	3	11.4
2021	16/12/2021	6.8	4	8.2
1998	21/10/1998	6.6	5	6.4
2006	7/07/2006	6.6	6	5.2
1997	15/10/1997	6.4	7	4.4
2005	21/12/2005	6.2	8	3.9
2022	17/05/2022	6.2	9	3.4
1999	29/11/1999	6.1	10	3

**Table DDD-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	4.9	4.8	4.9	5.1	4.9
5	0.8	6.7	6.7	6.7	6.9	6.8
10	0.9	7.9	7.9	7.9	7.8	7.9
25	0.96	9.2	9.4	9.2	8.7	9.2
50	0.98	10.2	10.6	10.2	9.1	10.1
75	0.9867	10.7	11.2	10.8	9.4	10.7
100	0.99	11.1	11.7	11.1	9.5	11.0
200	0.995	12.0	12.8	12.1	9.9	11.9
500	0.998	13.1	14.3	13.3	10.2	13.0
1000	0.999	13.9	15.4	14.2	10.4	13.8



**Figure DDD-1: Visual of different fitted distribution for the site.**

**Table DDD-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	129.2	131.9	4.0	0.120
Gamma	129.2	132.0	4.0	0.105
GEV	131.2	135.3	4.0	0.106
Gen. Logistic	131.2	135.3	4.0	0.104
Gen. Normal	131.2	135.3	4.0	0.105
Gen. Pareto	131.2	135.3	3.9	0.106
Gumbel	129.2	131.9	4.0	0.107
Normal	129.3	132.0	4.0	0.104
Pearson III	131.2	135.3	4.0	0.105
Wakeby	135.2	142.0	4.0	0.107
Weibull	131.2	135.3	4.0	0.105
Log-Normal	131.2	135.3	4.0	0.105
LP3	131.4	135.5	4.0	0.097
Exponential	129.2	131.9	4.0	0.120

## Appendix EEE Oroua at Almadale Slackline 1132508

**Table EEE-1: General information about the site.**

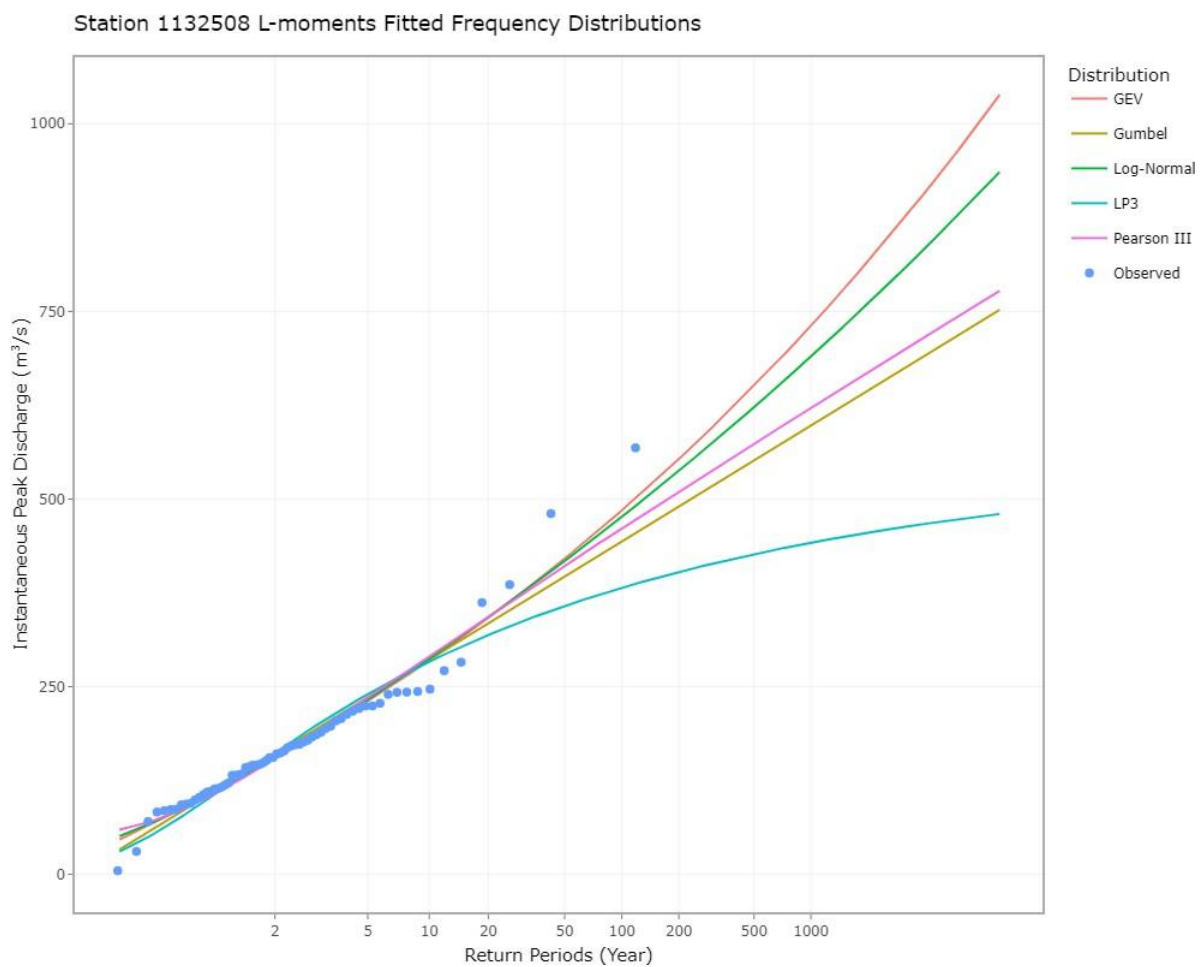
Site Details	
Start (records)	21-Aug-1947
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	293
Latitude	-40.173415
Longitude	175.659903
Record length (yrs)	66
Minimum (m <sup>3</sup> /s)	4.8
Maximum (m <sup>3</sup> /s)	568.3
Median (m <sup>3</sup> /s)	158.1
Mean (m <sup>3</sup> /s)	174.1
Standard Deviation (m <sup>3</sup> /s)	92.5
Coefficient of Variation	0.531

**Table EEE-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	568.3	1	118.1
2023	14/02/2023	480.7	2	42.4
2018	12/06/2018	386	3	25.8
1958	12/05/1958	362.1	4	18.6
1965	18/03/1965	282.6	5	14.5
1956	15/07/1956	271.4	6	11.9
1999	29/11/1999	246.7	7	10.1
1950	2/07/1950	243.7	8	8.7
2007	18/07/2007	242.8	9	7.7
2017	14/04/2017	242.5	10	6.9

**Table EEE-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

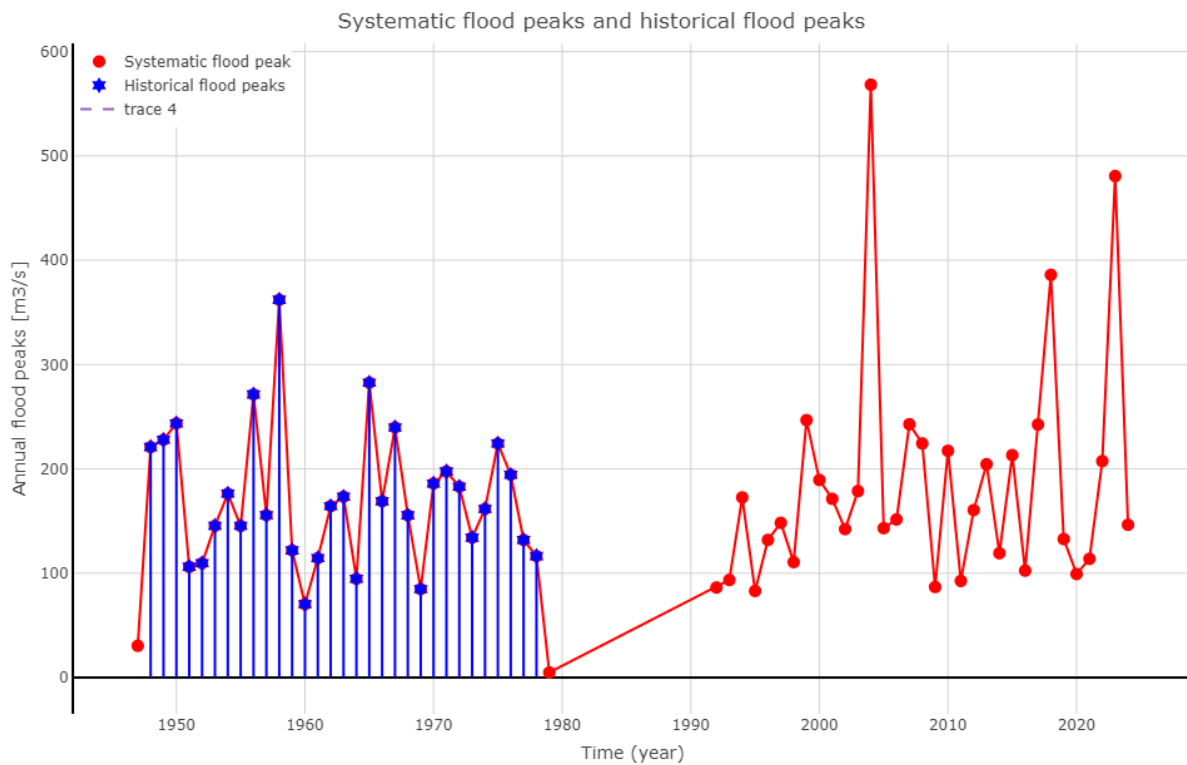
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	155.3	160.0	154.9	162.2	154.2
5	0.8	230.6	235.9	232.4	240.0	235.6
10	0.9	285.3	286.1	287.4	283.3	291.0
25	0.96	360.4	349.6	360.6	329.1	360.5
50	0.98	420.8	396.7	417.6	357.5	411.2
75	0.9867	457.8	424.1	451.8	372.2	440.4
100	0.99	484.9	443.5	476.5	381.9	461.0
200	0.995	553.3	490.0	537.7	402.9	509.9
500	0.998	651.0	551.5	622.5	426.6	573.7
1000	0.999	730.9	597.9	689.9	441.8	621.4



**Figure EEE-1: Visual of different fitted distribution for the site.**

**Table EEE-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	787.9	792.3	169.2	0.120
Gamma	789.0	793.3	168.0	0.113
GEV	790.2	796.8	169.2	0.113
Gen. Logistic	790.1	796.7	170.0	0.111
Gen. Normal	790.3	796.9	168.8	0.113
Gen. Pareto	790.6	797.1	166.8	0.114
Gumbel	788.8	793.1	168.6	0.113
Normal	789.7	794.0	169.8	0.114
Pearson III	790.4	797.0	168.0	0.114
Wakeby	794.0	804.9	171.4	0.115
Weibull	790.5	797.0	167.6	0.114
Log-Normal	790.3	796.9	168.8	0.113
LP3	792.2	798.8	166.1	0.099
Exponential	787.9	792.3	169.2	0.120



**Figure EEE-2: Historical information and systematic records.**

**Table EEE-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	160.9	149.6	175.8
5	0.8	232.7	216.6	257.8
10	0.9	280.4	259.5	316.8
25	0.96	340.8	311.5	398.8
50	0.98	385.8	348.9	465.6
75	0.9867	411.7	370.2	504.6
100	0.99	430.6	385.3	535.2
200	0.995	475.3	418.1	611.1
500	0.998	534.4	459.9	720.5
1000	0.999	579.3	490.8	809.4

**Table EEE-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1978	116.4
1977	131.9
1976	194.4
1975	224.3
1974	161.7
1973	134.1
1972	182.9
1971	197.5
1970	186.0
1969	84.8
1968	155.5
1967	239.8
1966	169.0
1965	282.6
1964	94.7
1963	173.3
1962	164.3
1961	114.4
1960	70.3
1959	121.9
1958	362.1
1957	155.7
1956	271.4

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<b>Year</b>	<b>Values (m<sup>3</sup>/s)</b>
1955	145.3
1954	176.3
1953	145.4
1952	109.6
1951	106.2
1950	243.7
1949	227.9
1948	220.9
1947	30.5

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## Appendix FFF Mangatainoka at Pahiatua Town Bridge 1132511

**Table FFF-1: General information about the site.**

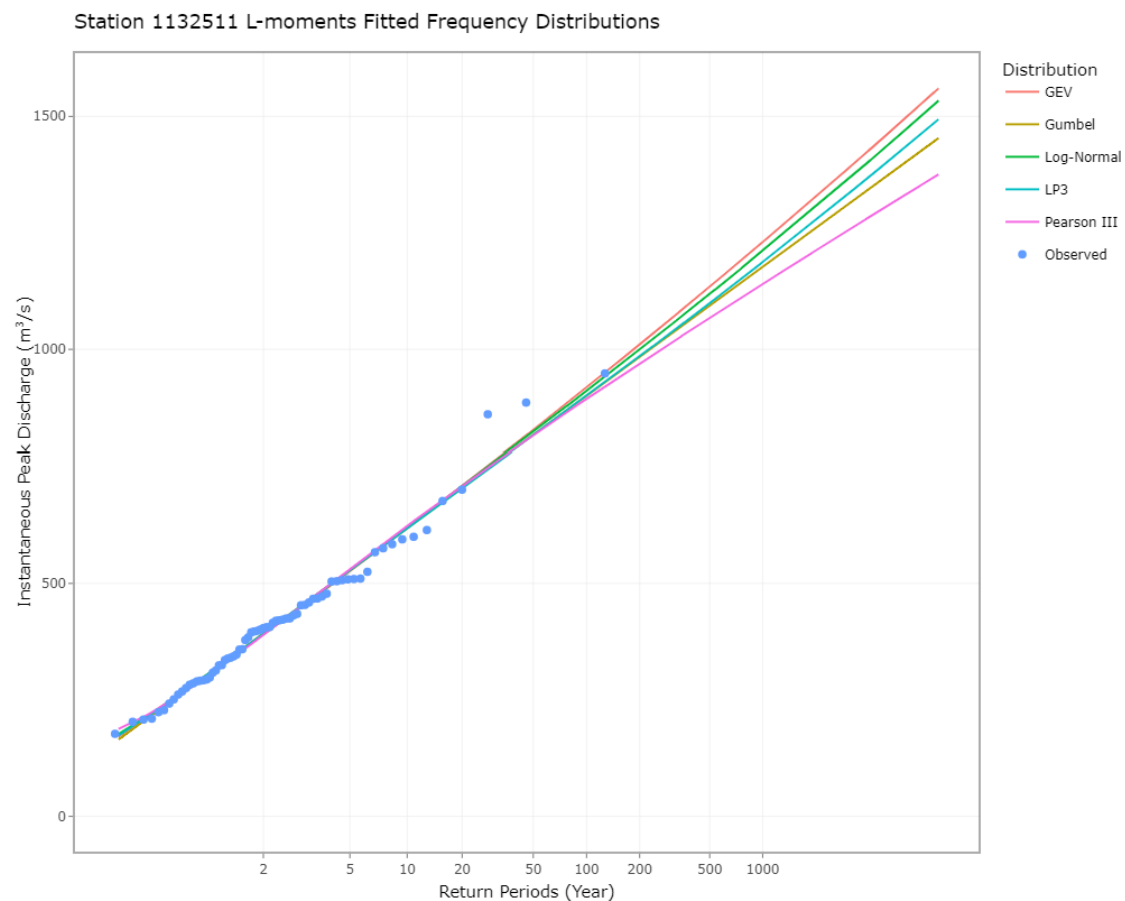
Site Details	
Start (records)	1-Jan-1954
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	395
Latitude	-40.449566
Longitude	175.83121
Record length (yrs)	71
Minimum (m <sup>3</sup> /s)	177.2
Maximum (m <sup>3</sup> /s)	948.3
Median (m <sup>3</sup> /s)	404.1
Mean (m <sup>3</sup> /s)	417.8
Standard Deviation (m <sup>3</sup> /s)	155.1
Coefficient of Variation	0.371

**Table FFF-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2010	6/09/2010	948.3	1	127
1964	25/10/1964	885.8	2	45.6
2000	9/10/2000	860.6	3	27.8
2004	28/09/2004	701.2	4	20
2005	6/01/2005	676.9	5	15.6
2023	22/04/2023	614.6	6	12.8
2024	18/08/2024	600.1	7	10.8
1955	26/02/1955	594.6	8	9.4
2015	20/06/2015	584.1	9	8.3
1988	24/08/1988	575.5	10	7.4

**Table FFF-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	390.4	392.6	390.2	392.0	389.6
5	0.8	526.3	528.5	527.9	528.4	531.6
10	0.9	618.4	618.5	619.7	618.2	623.4
25	0.96	737.3	732.3	736.2	731.5	735.5
50	0.98	827.4	816.6	823.4	815.7	815.9
75	0.9867	880.4	865.7	874.5	865.0	861.6
100	0.99	918.3	900.4	911.0	900.1	893.7
200	0.995	1010.5	983.8	999.6	985.1	969.5
500	0.998	1134.6	1093.9	1119.0	1099.2	1067.5
1000	0.999	1230.3	1177.1	1211.4	1187.3	1140.2



**Figure FFF-1: Visual of different fitted distribution for the site.**

**Table FFF-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	921.2	925.7	297.3	0.114
Gamma	920.9	925.4	294.7	0.102
GEV	922.8	929.6	295.6	0.103
Gen. Logistic	922.8	929.6	296.9	0.103
Gen. Normal	922.8	929.6	295.2	0.103
Gen. Pareto	922.9	929.7	292.1	0.103
Gumbel	920.8	925.3	295.4	0.103
Kappa	924.8	933.8	296.6	0.103
Normal	921.1	925.6	296.8	0.102
Pearson III	922.8	929.6	294.6	0.103
Wakeby	926.8	938.1	296.3	0.104
Weibull	922.8	929.6	293.8	0.103
Log-Normal	922.8	929.6	295.2	0.103
LP3	922.8	929.6	294.3	0.103

## Appendix GGG Kiwitea at Haynes Line 1132517

**Table GGG-1: General information about the site.**

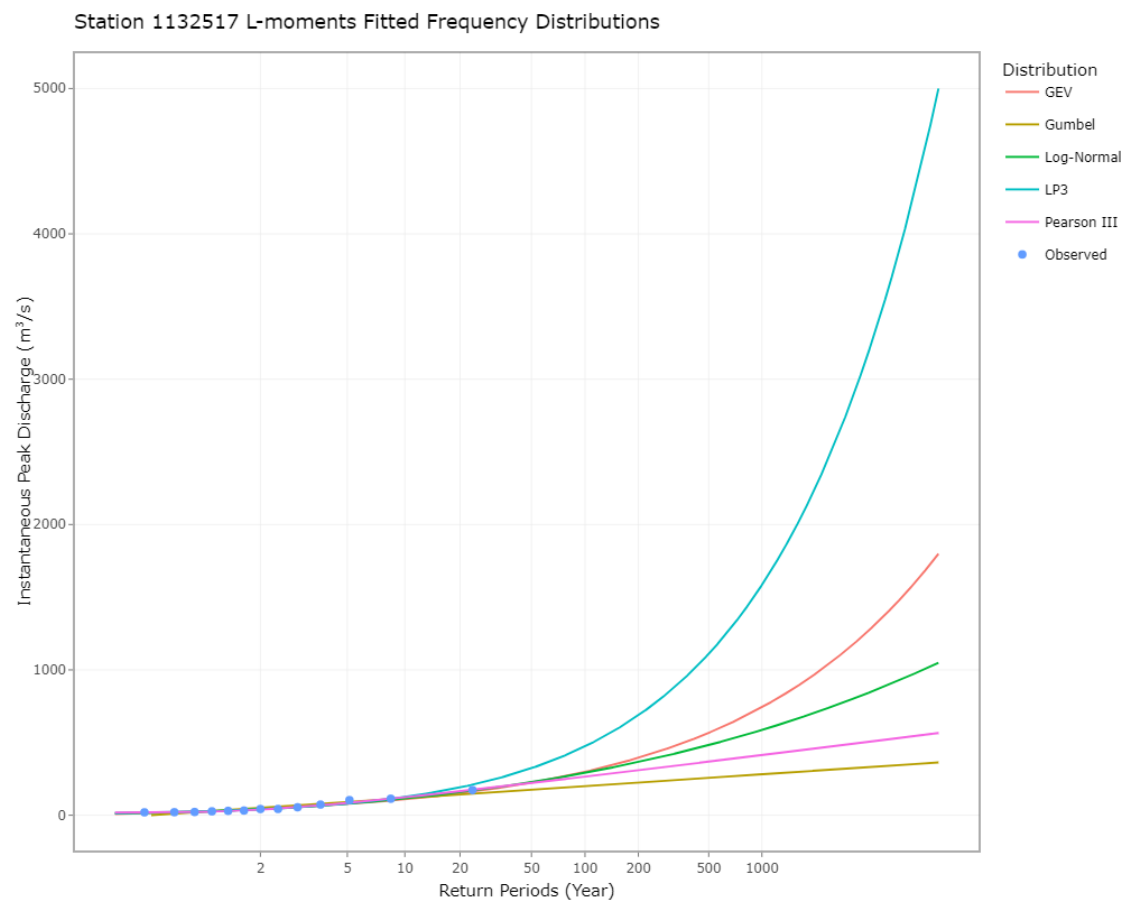
<b>Site Details</b>	
Start (records)	9-Aug-2005
End (records)	1-Aug-2017
Catchment area (km <sup>2</sup> )	165
Latitude	-40.088761
Longitude	175.657754
Record length (yrs)	13
Minimum (m <sup>3</sup> /s)	19.8
Maximum (m <sup>3</sup> /s)	172.9
Median (m <sup>3</sup> /s)	42.6
Mean (m <sup>3</sup> /s)	58.1
Standard Deviation (m <sup>3</sup> /s)	46.2
Coefficient of Variation	0.795

**Table GGG-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
2015	20/06/2015	172.9	1	23.4
2017	14/07/2017	113.5	2	8.4
2013	11/07/2013	103.9	3	5.1
2012	17/08/2012	73.3	4	3.7
2010	18/09/2010	54.7	5	2.9
2005	18/12/2005	43	6	2.4
2006	7/07/2006	42.6	7	2
2007	18/07/2007	32.2	8	1.7
2009	27/10/2009	30	9	1.5
2011	14/07/2011	26.8	10	1.4

**Table GGG-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	41.6	50.7	40.5	39.7	38.5
5	0.8	76.5	90.7	79.0	80.0	84.2
10	0.9	109.3	117.2	114.9	125.8	123.4
25	0.96	166.3	150.6	173.6	218.2	178.3
50	0.98	223.9	175.5	227.7	323.7	221.2
75	0.9867	265.1	189.9	263.7	405.2	246.7
100	0.99	298.3	200.1	291.4	474.1	264.9
200	0.995	394.7	224.6	365.7	687.3	309.3
500	0.998	567.1	257.0	482.5	1110.1	368.6
1000	0.999	743.1	281.5	586.5	1584.1	413.8



**Figure GGG-1: Visual of different fitted distribution for the site.**

**Table GGG-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	139.5	140.7	80.9	0.235
Gamma	139.5	140.7	81.2	0.239
GEV	141.7	143.4	77.5	0.221
Gen. Logistic	141.8	143.5	76.8	0.220
Gen. Normal	141.6	143.3	79.0	0.224
Gen. Pareto	141.6	143.3	79.2	0.224
Gumbel	139.5	140.7	81.7	0.245
Kappa	143.7	146.0	81.5	0.229
Normal	139.5	140.7	83.5	0.253
Pearson III	141.6	143.3	80.5	0.227
Wakeby	145.6	148.4	79.2	0.224
Weibull	141.6	143.3	80.3	0.226
Log-Normal	141.6	143.3	79.0	0.224
LP3	142.8	144.5	87.0	0.240

## Appendix HHH Kahuterawa at Johnstons Rata 1132519

**Table HHH-1: General information about the site.**

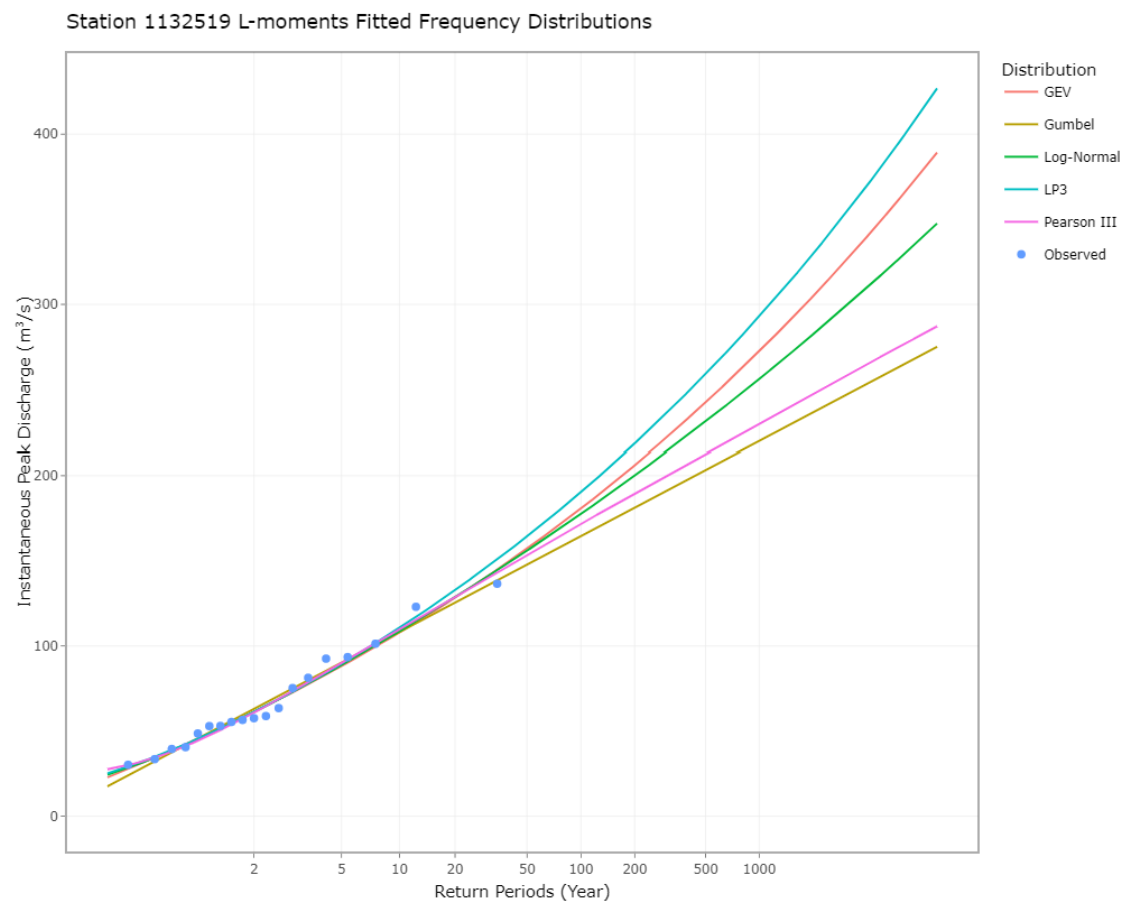
Site Details	
Start (records)	30-Apr-2005
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	36.45
Latitude	-40.449068
Longitude	175.621642
Record length (yrs)	19
Minimum (m <sup>3</sup> /s)	30.2
Maximum (m <sup>3</sup> /s)	136.6
Median (m <sup>3</sup> /s)	57.6
Mean (m <sup>3</sup> /s)	68.1
Standard Deviation (m <sup>3</sup> /s)	29.7
Coefficient of Variation	0.436

**Table HHH-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2009	27/12/2009	136.6	1	34.1
2008	8/01/2008	123	2	12.3
2006	29/09/2006	101.3	3	7.5
2010	6/09/2010	93.5	4	5.4
2007	18/03/2007	92.6	5	4.2
2024	18/08/2024	81.3	6	3.4
2021	27/06/2021	75.3	7	2.9
2015	20/06/2015	63.5	8	2.5
2011	13/07/2011	58.8	9	2.2
2018	25/12/2018	57.6	10	2

**Table HHH-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	61.2	63.0	61.1	61.1	60.8
5	0.8	88.2	90.2	88.8	89.5	90.0
10	0.9	107.9	108.2	108.7	110.7	110.0
25	0.96	135.1	130.9	135.2	140.3	135.2
50	0.98	157.2	147.8	156.0	164.4	153.7
75	0.9867	170.8	157.6	168.5	179.4	164.3
100	0.99	180.8	164.5	177.6	190.4	171.7
200	0.995	206.1	181.2	200.0	218.4	189.6
500	0.998	242.5	203.2	231.3	259.1	212.8
1000	0.999	272.4	219.9	256.2	292.9	230.2



**Figure HHH-1: Visual of different fitted distribution for the site.**

**Table HHH-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	186.0	187.9	56.3	0.187
Gamma	185.7	187.6	56.3	0.198
GEV	187.8	190.6	56.0	0.192
Gen. Logistic	187.7	190.6	55.6	0.190
Gen. Normal	187.8	190.6	56.1	0.192
Gen. Pareto	187.8	190.7	56.4	0.195
Gumbel	185.7	187.6	56.2	0.197
Kappa	189.8	193.6	56.2	0.193
Normal	185.7	187.6	56.7	0.203
Pearson III	187.8	190.6	56.2	0.193
Wakeby	191.8	196.6	56.4	0.195
Weibull	187.8	190.6	56.2	0.193
Log-Normal	187.8	190.6	56.1	0.192
LP3	188.0	190.8	57.0	0.198

## Appendix III    Kiwitea at Strathspey Farm 1132523

**Table III-1:    General information about the site.**

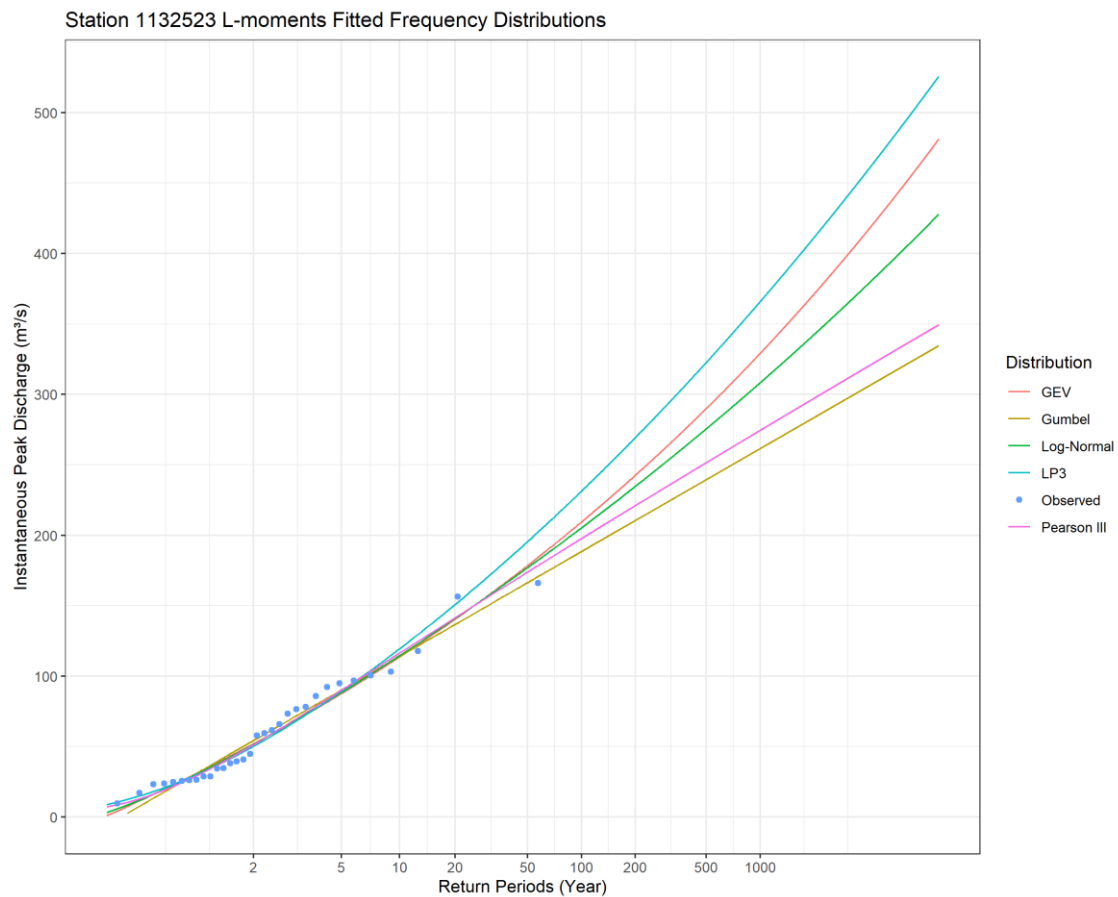
<b>Site Details</b>	
Start (records)	5-Nov-1976
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	239
Latitude	-40.157574
Longitude	175.639927
Record length (yrs)	32
Minimum (m <sup>3</sup> /s)	9.7
Maximum (m <sup>3</sup> /s)	166.1
Median (m <sup>3</sup> /s)	51.4
Mean (m <sup>3</sup> /s)	61.1
Standard Deviation (m <sup>3</sup> /s)	39.7
Coefficient of Variation	0.651

**Table III-2:    Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
1988	2/09/1988	166.1	1	57.4
1992	22/07/1992	156.4	2	20.6
1979	25/08/1979	117.8	3	12.5
2023	21/05/2023	103.1	4	9.0
1998	21/10/1998	100.4	5	7.0
2017	14/07/2017	96.7	6	5.8
1994	16/11/1994	94.9	7	4.9
1991	11/04/1991	92.3	8	4.2
1983	20/05/1983	85.7	9	3.8
1990	20/03/1990	78.1	10	3.4

**Table III-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	52.0	54.3	51.8	50.3	51.4
5	0.8	87.6	90.2	88.4	89.3	90.0
10	0.9	113.6	114.0	114.6	119.4	116.4
25	0.96	149.4	144.0	149.6	161.4	149.5
50	0.98	178.4	166.3	176.9	195.4	173.8
75	0.9867	196.3	179.3	193.3	216.1	187.8
100	0.99	209.4	188.4	205.2	231.3	197.6
200	0.995	242.5	210.4	234.7	269.2	221.0
500	0.998	290.1	239.5	275.6	322.8	251.6
1000	0.999	329.1	261.5	308.2	365.8	274.4



**Figure III-1: Visual of different fitted distribution for the site.**

**Table III-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	329.8	332.8	75.8	0.148
Gamma	329.5	332.5	75.5	0.157
GEV	331.6	336.0	75.5	0.154
Gen. Logistic	331.5	335.9	75.3	0.153
Gen. Normal	331.6	336.0	75.5	0.155
Gen. Pareto	331.5	335.9	75.5	0.157
Gumbel	329.5	332.4	75.6	0.160
Kappa	333.5	339.4	75.4	0.158
Normal	329.5	332.4	76.3	0.167
Pearson III	331.6	336.0	75.5	0.156
Wakeby	335.5	342.9	75.5	0.157
Weibull	331.5	335.9	75.5	0.156
Log-Normal	331.6	336.0	75.5	0.155
LP3	332.2	336.6	77.7	0.152

## Appendix JJJ Raparapawai at Jackson Rd 1232561

**Table JJJ-1: General information about the site.**

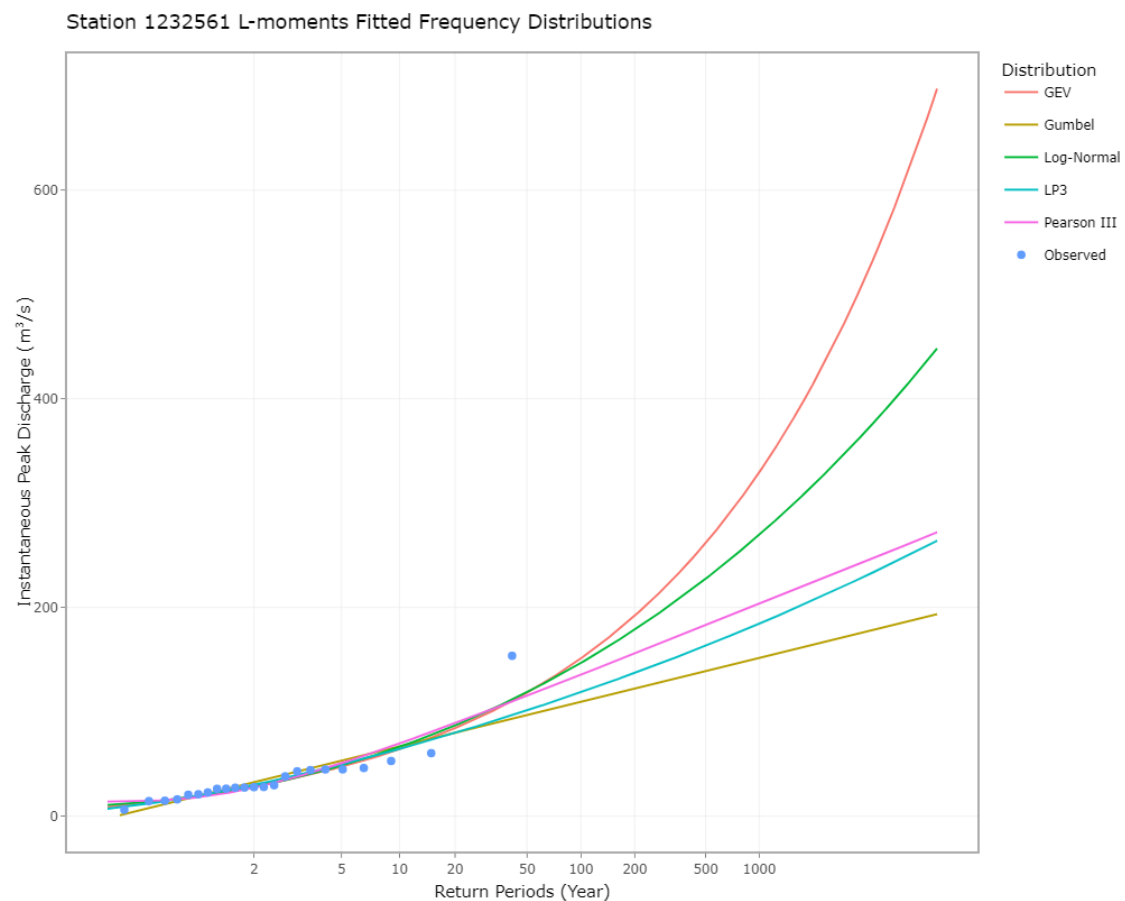
Site Details	
Start (records)	20-Dec-2002
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	73.4
Latitude	-40.322873
Longitude	175.995426
Record length (yrs)	23
Minimum (m <sup>3</sup> /s)	6.1
Maximum (m <sup>3</sup> /s)	153.7
Median (m <sup>3</sup> /s)	27.8
Mean (m <sup>3</sup> /s)	36.3
Standard Deviation (m <sup>3</sup> /s)	29
Coefficient of Variation	0.797

**Table JJJ-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	153.7	1	41.3
2015	21/06/2015	60.4	2	14.8
2017	5/04/2017	52.8	3	9
2012	6/07/2012	46.1	4	6.5
2006	6/07/2006	44.8	5	5.1
2010	6/09/2010	44.8	6	4.2
2019	13/06/2019	44.1	7	3.5
2008	30/07/2008	42.9	8	3.1
2023	14/02/2023	38.1	9	2.7
2013	11/07/2013	29.6	10	2.4

**Table JJJ-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	28.5	32.5	28.1	29.9	27.3
5	0.8	47.3	53.1	48.5	49.6	50.7
10	0.9	64.1	66.8	66.4	64.4	69.7
25	0.96	91.7	84.1	94.2	84.9	95.6
50	0.98	118.3	96.9	118.8	101.3	115.5
75	0.9867	136.7	104.3	134.8	111.4	127.2
100	0.99	151.2	109.6	146.9	118.8	135.6
200	0.995	192.1	122.3	178.8	137.2	155.9
500	0.998	261.7	139.0	227.4	163.3	182.8
1000	0.999	329.4	151.6	269.6	184.5	203.4



**Figure JJJ-1: Visual of different fitted distribution for the site.**

**Table JJJ-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	224.5	226.7	46.3	0.213
Gamma	225.4	227.7	46.5	0.220
GEV	226.7	230.1	46.0	0.204
Gen. Logistic	227.1	230.6	45.7	0.202
Gen. Normal	226.3	229.7	46.3	0.206
Gen. Pareto	226.2	229.6	46.3	0.208
Gumbel	225.7	228.0	46.7	0.222
Kappa	226.3	228.5	47.6	0.228
Normal	226.0	229.4	46.4	0.210
Pearson III	233.7	239.4	44.5	0.192
Wakeby	226.0	229.4	46.4	0.209
Weibull	226.3	229.7	46.3	0.206
Log-Normal	229.0	232.4	45.0	0.212
LP3	224.5	226.7	46.3	0.213

## Appendix KKK Mangapapa at Troup Road 1232563

**Table KKK-1: General information about the site.**

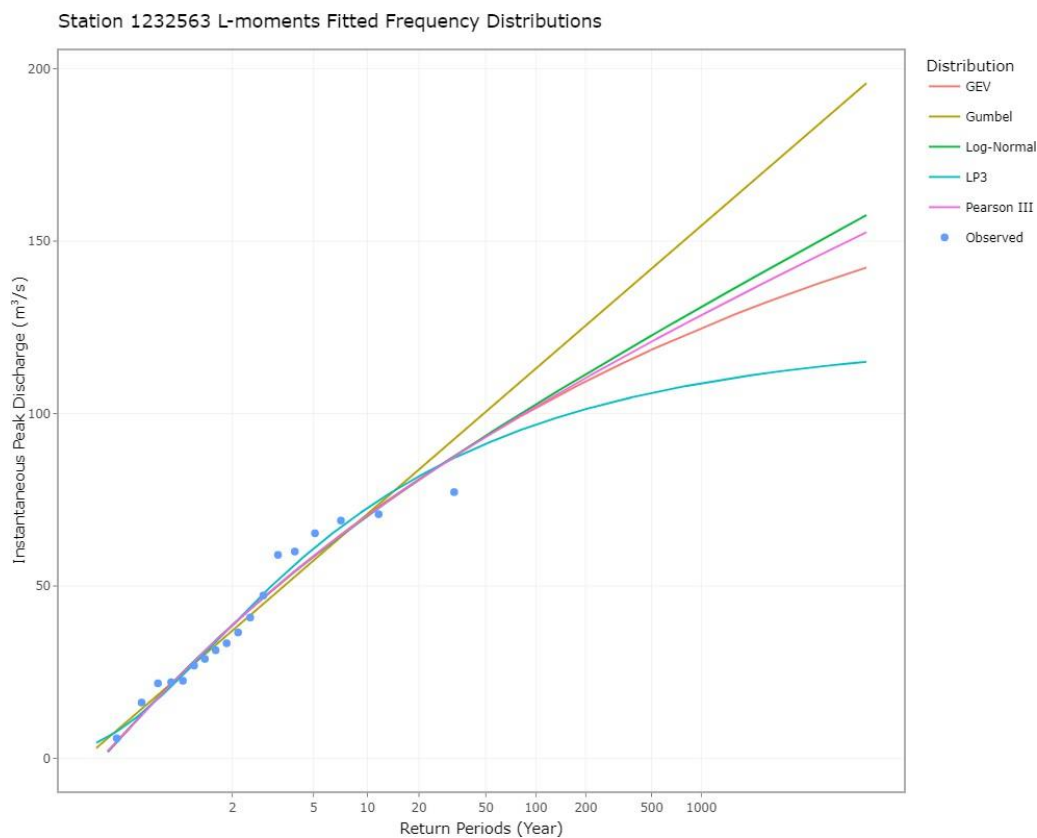
Site Details	
Start (records)	19-Dec-2007
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	33.419
Latitude	-40.340157
Longitude	175.84664
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	5.8
Maximum (m <sup>3</sup> /s)	77.2
Median (m <sup>3</sup> /s)	35
Mean (m <sup>3</sup> /s)	40.8
Standard Deviation (m <sup>3</sup> /s)	21.3
Coefficient of Variation	0.522

**Table KKK-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2013	15/10/2013	77.2	1	32.4
2015	20/06/2015	70.8	2	11.6
2017	5/04/2017	69	3	7.1
2016	27/08/2016	65.3	4	5.1
2011	24/11/2011	60	5	4
2010	6/09/2010	59	6	3.3
2018	8/03/2018	47.2	7	2.8
2009	18/11/2009	40.9	8	2.4
2014	10/12/2014	36.5	9	2.1
2008	5/10/2008	33.4	10	1.9

**Table KKK-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	38.6	37.1	38.7	38.8	38.7
5	0.8	58.7	57.4	58.5	60.9	58.7
10	0.9	70.6	70.9	70.3	72.6	70.4
25	0.96	84.2	87.9	84.0	84.4	84.0
50	0.98	93.3	100.5	93.6	91.3	93.3
75	0.9867	98.3	107.9	98.9	94.6	98.4
100	0.99	101.7	113.0	102.7	96.8	102.0
200	0.995	109.3	125.5	111.4	101.3	110.4
500	0.998	118.5	142.0	122.6	106.0	120.9
1000	0.999	124.8	154.5	130.9	108.8	128.5



**Figure KKK-1: Visual of different fitted distribution for the site.**

**Table KKK-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	164.8	166.5	42.1	0.120
Gamma	164.4	166.2	41.8	0.128
GEV	166.4	169.0	41.7	0.131
Gen. Logistic	166.3	169.0	41.5	0.134
Gen. Normal	166.3	169.0	41.7	0.131
Gen. Pareto	166.4	169.1	42.0	0.132
Gumbel	164.4	166.2	41.7	0.130
Kappa	168.4	172.0	42.0	0.132
Normal	164.3	166.1	41.8	0.133
Pearson III	166.4	169.0	41.7	0.131
Wakeby	170.4	174.8	42.0	0.132
Weibull	166.4	169.0	41.8	0.130
Log-Normal	166.3	169.0	41.7	0.131
LP3	166.4	169.1	42.0	0.141

## Appendix LLL Manga-Atua at Hopelands Rd 1232564

**Table LLL-1: General information about the site.**

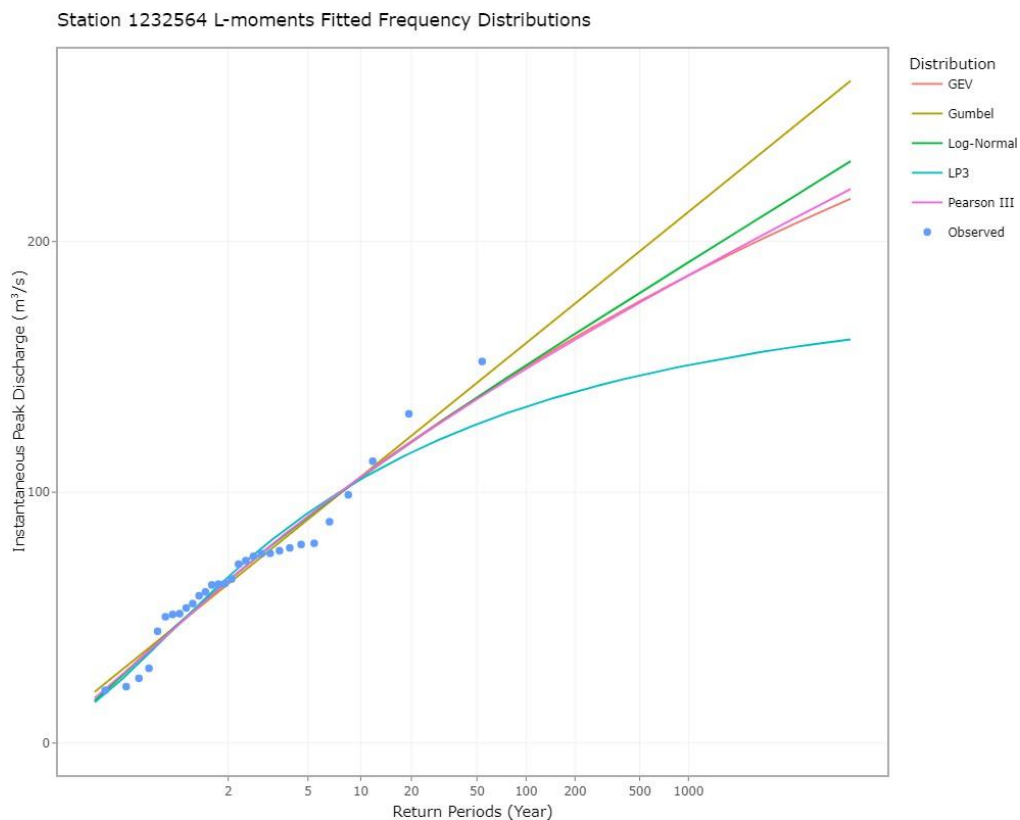
Site Details	
Start (records)	28-Feb-1980
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	55
Latitude	-40.332033
Longitude	175.919298
Record length (yrs)	30
Minimum (m <sup>3</sup> /s)	21
Maximum (m <sup>3</sup> /s)	152.2
Median (m <sup>3</sup> /s)	64.5
Mean (m <sup>3</sup> /s)	68.2
Standard Deviation (m <sup>3</sup> /s)	29.1
Coefficient of Variation	0.427

**Table LLL-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	20/06/2015	152.2	1	53.8
1988	19/06/1988	131.3	2	19.3
2019	13/06/2019	112.4	3	11.8
1980	9/04/1980	99	4	8.5
2017	5/04/2017	88.2	5	6.6
2005	5/10/2005	79.6	6	5.4
2010	6/09/2010	79.2	7	4.6
1983	20/05/1983	77.8	8	4
2018	8/03/2018	76.7	9	3.5
2021	14/09/2021	75.6	10	3.2

**Table LLL-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

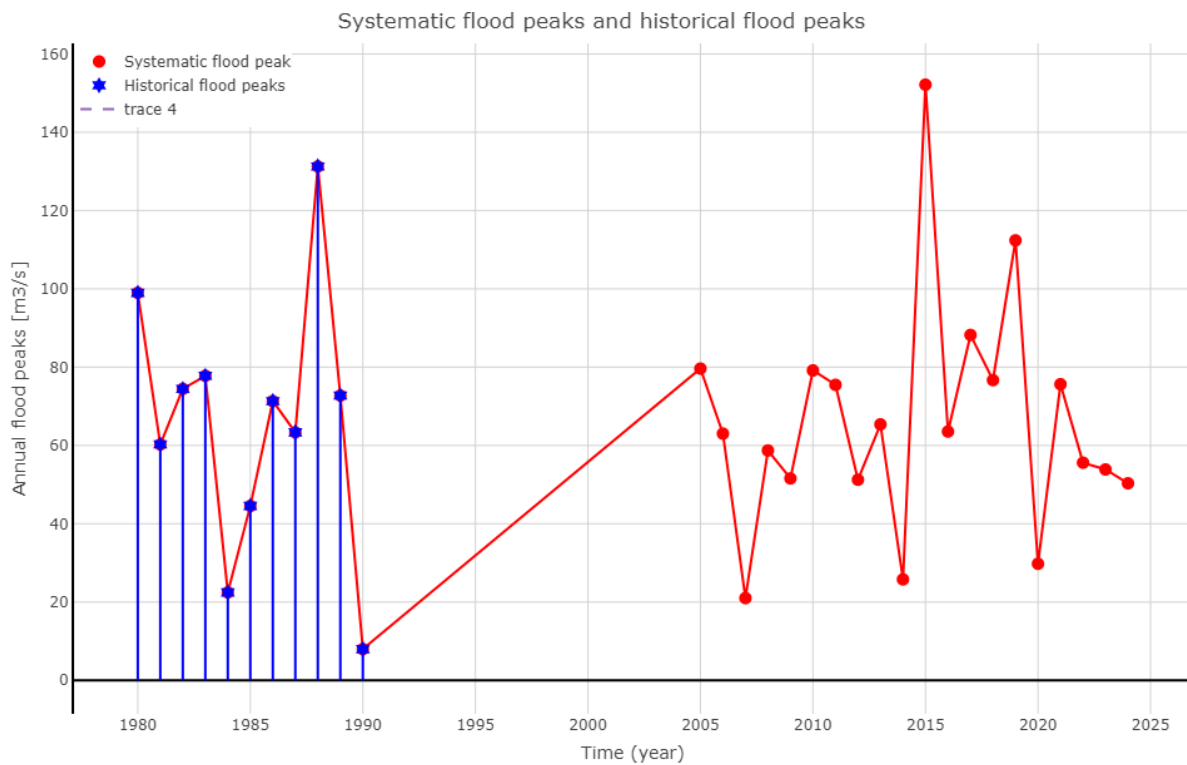
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	64.7	63.4	64.7	66.2	64.7
5	0.8	90.3	89.1	90.2	91.7	90.5
10	0.9	106.0	106.2	105.8	105.2	106.1
25	0.96	124.8	127.7	124.5	118.9	124.4
50	0.98	137.8	143.6	137.8	127.2	137.1
75	0.9867	145.1	152.9	145.3	131.4	144.3
100	0.99	150.1	159.5	150.6	134.1	149.2
200	0.995	161.7	175.3	163.2	140.1	160.9
500	0.998	176.2	196.1	179.5	146.6	175.7
1000	0.999	186.5	211.8	191.7	150.8	186.5



**Figure LLL-1: Visual of different fitted distribution for the site.**

**Table LLL-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	290.5	293.3	55.7	0.182
Gamma	290.4	293.2	55.1	0.174
GEV	292.4	296.6	55.2	0.174
Gen. Logistic	292.4	296.6	55.3	0.172
Gen. Normal	292.4	296.6	55.2	0.174
Gen. Pareto	292.4	296.6	54.8	0.175
Gumbel	290.4	293.2	55.2	0.175
Normal	290.4	293.2	55.4	0.174
Pearson III	292.4	296.6	55.2	0.174
Wakeby	296.4	303.4	55.6	0.168
Weibull	292.4	296.6	55.1	0.174
Log-Normal	292.4	296.6	55.2	0.174
LP3	292.5	296.7	54.6	0.169
Exponential	290.5	293.3	55.7	0.182



**Figure LLL-2: Historical information and systematic records.**

**Table LLL-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	65.1	56.7	74.6
5	0.8	92.2	83.6	106.3
10	0.9	107.8	98.9	127.2
25	0.96	125.2	115.0	157.8
50	0.98	136.6	125.1	182.2
75	0.9867	142.6	130.0	195.9
100	0.99	146.8	133.0	206.2
200	0.995	156.0	139.6	233.2
500	0.998	166.7	146.9	268.7
1000	0.999	173.9	150.9	297.1

**Table LLL-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1989	72.7
1988	131.3
1987	63.3
1986	71.3
1985	44.5
1984	22.5
1983	77.8
1982	74.4
1981	60.3
1980	99.0

## Appendix MMM Manawatu at Upper Gorge 1232566

**Table MMM-1: General information about the site.**

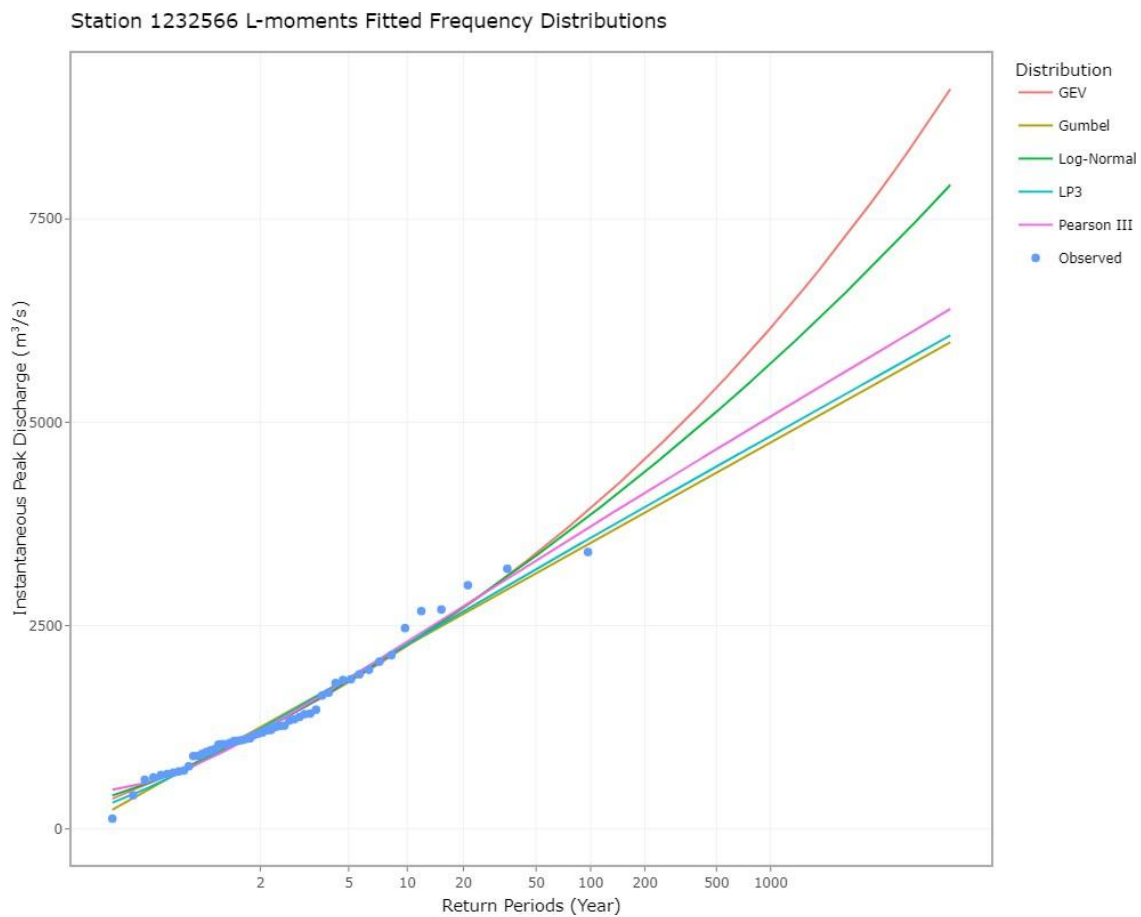
Site Details	
Start (records)	20-Mar-1880
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	3231
Latitude	-40.331849
Longitude	175.818031
Record length (yrs)	54
Minimum (m <sup>3</sup> /s)	126.1
Maximum (m <sup>3</sup> /s)	3404.8
Median (m <sup>3</sup> /s)	1177.9
Mean (m <sup>3</sup> /s)	1363.4
Standard Deviation (m <sup>3</sup> /s)	696.3
Coefficient of Variation	0.511

**Table MMM-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
1880	1880-03-20	3404.8	1	96.6
1897	1897-04-17	3199.3	2	34.7
1902	14/06/1902	2996.6	3	21.1
2004	16/02/2004	2697.5	4	15.2
1907	2/05/1907	2678.4	5	11.9
1992	23/07/1992	2469.3	6	9.7
1941	4/05/1941	2135	7	8.3
2010	6/09/2010	2056.8	8	7.2
1980	11/04/1980	1957	9	6.3
2015	21/06/2015	1900.9	10	5.7

**Table MMM-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

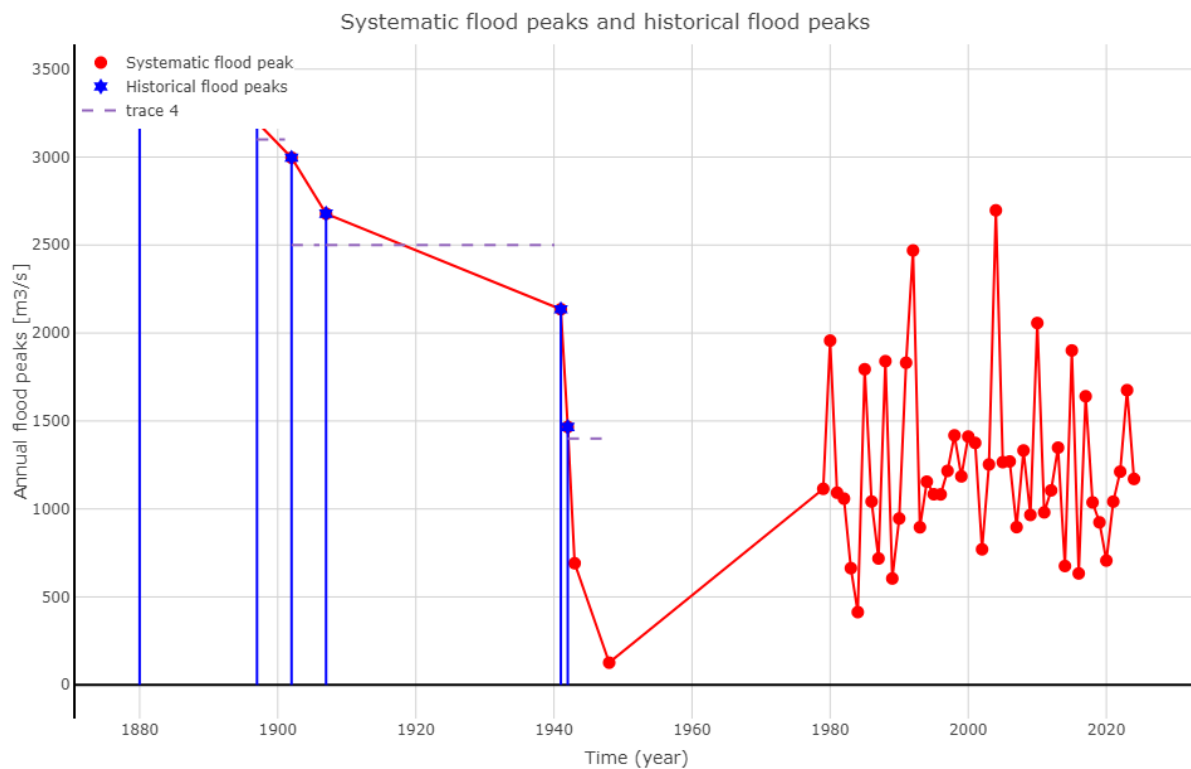
Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	1203.2	1250.7	1199.1	1225.8	1192.6
5	0.8	1802.9	1857.3	1819.4	1858.6	1849.3
10	0.9	2248.5	2259.0	2270.0	2280.4	2304.1
25	0.96	2873.9	2766.5	2879.6	2809.0	2879.9
50	0.98	3387.5	3143.0	3360.7	3197.2	3303.6
75	0.9867	3707.0	3361.9	3652.1	3421.5	3548.0
100	0.99	3943.2	3516.7	3863.7	3579.8	3720.2
200	0.995	4546.5	3889.1	4391.3	3958.6	4131.5
500	0.998	5425.9	4380.4	5130.1	4455.9	4669.0
1000	0.999	6159.7	4751.6	5722.6	4830.4	5071.8



**Figure MMM-1: Visual of different fitted distribution for the site.**

**Table MMM-4: At-site goodness of fit statistics.**

Distribution	AIC	BIC	RMSE	KS_Statistic
Exponential	863.4	867.4	1320.1	0.171
Gamma	863.3	867.2	1311.0	0.170
GEV	865.2	871.2	1319.5	0.169
Gen. Logistic	865.2	871.2	1322.0	0.167
Gen. Normal	865.2	871.2	1317.3	0.170
Gen. Pareto	865.2	871.1	1306.4	0.171
Gumbel	863.2	867.2	1314.3	0.170
Kappa	867.2	875.2	1322.1	0.168
Normal	863.5	867.4	1322.3	0.170
Pearson III	865.2	871.2	1312.7	0.170
Wakeby	869.2	879.1	1306.4	0.171
Weibull	865.2	871.2	1310.4	0.170
Log-Normal	865.2	871.2	1317.3	0.170
LP3	865.2	871.2	1317.5	0.168



**Figure MMM-2: Historical information and systematic records.**

**Table MMM-5: Flood frequency results for the site with historical data.**

Return Period (years)	Probability of Non-Exceedance	Flood Peak Estimate (m <sup>3</sup> /s)	Flood Peak Estimate 5%-tile (m <sup>3</sup> /s)	Flood Peak Estimate 95%-tile (m <sup>3</sup> /s)
2	0.5	1243.7	1119.0	1382.7
5	0.8	1846.7	1704.4	2064.3
10	0.9	2256.1	2079.5	2546.3
25	0.96	2784.6	2525.9	3269.5
50	0.98	3185.8	2840.8	3888.9
75	0.9867	3419.6	3008.9	4293.6
100	0.99	3591.4	3128.9	4590.6
200	0.995	4002.8	3382.7	5377.1
500	0.998	4557.4	3702.4	6535.6
1000	0.999	4985.8	3922.4	7497.6

**Table MMM-6: Historical values for the site.**

Year	Values (m <sup>3</sup> /s)
1942	1466.2
1941	2135.0
1907	2678.4
1902	2996.6
1897	3199.3
1880	3404.8

## Appendix NNN Oruakeretaki at SH2(Napier) 1321581

**Table NNN-1: General information about the site.**

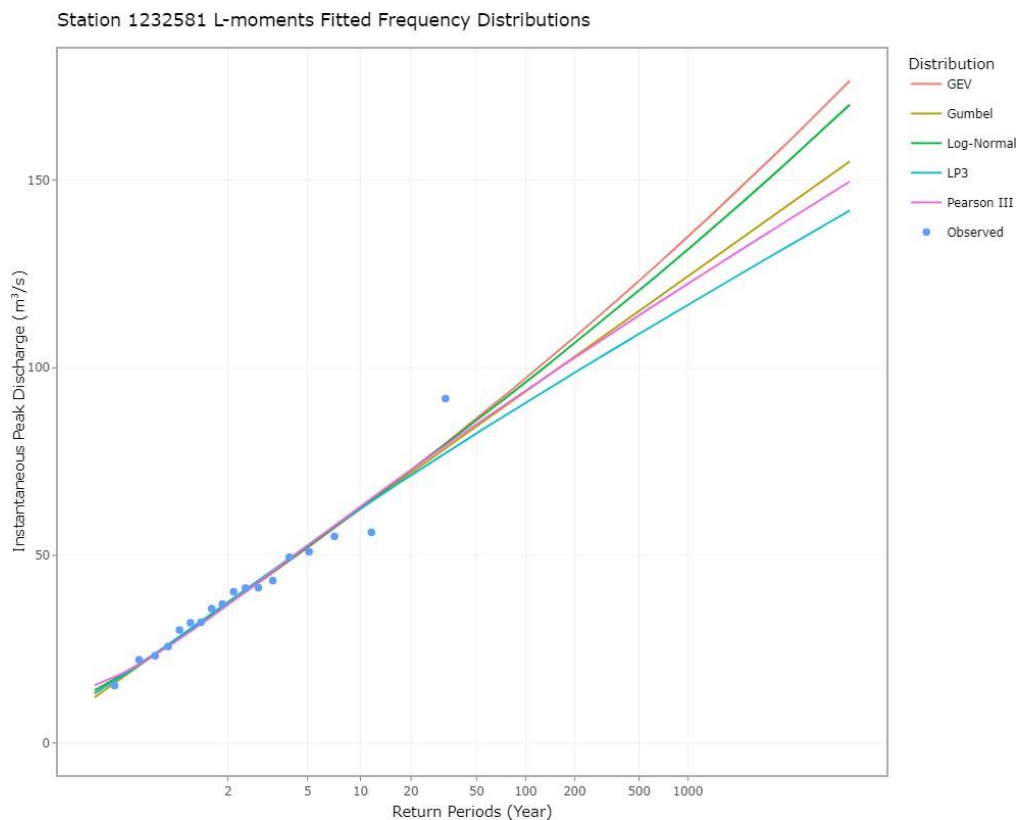
Site Details	
Start (records)	18-Sep-2007
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	54
Latitude	-40.253423
Longitude	176.03234
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	15.3
Maximum (m <sup>3</sup> /s)	91.8
Median (m <sup>3</sup> /s)	38.7
Mean (m <sup>3</sup> /s)	40.2
Standard Deviation (m <sup>3</sup> /s)	17.2
Coefficient of Variation	0.429

**Table NNN-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2010	18/09/2010	91.8	1	32.4
2012	1/08/2012	56.1	2	11.6
2015	20/06/2015	55.1	3	7.1
2011	24/11/2011	51	4	5.1
2008	5/10/2008	49.5	5	4
2009	29/12/2009	43.3	6	3.3
2019	13/06/2019	41.4	7	2.8
2013	28/11/2013	41.3	8	2.4
2017	5/04/2017	40.3	9	2.1
2007	11/10/2007	37	10	1.9

**Table NNN-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	37.0	37.4	36.9	37.7	36.9
5	0.8	52.0	52.5	52.3	52.8	52.7
10	0.9	62.4	62.4	62.6	62.4	63.1
25	0.96	76.0	75.1	75.9	74.1	75.8
50	0.98	86.5	84.4	86.0	82.6	85.0
75	0.9867	92.7	89.8	91.9	87.4	90.3
100	0.99	97.2	93.7	96.2	90.7	94.0
200	0.995	108.2	103.0	106.5	98.7	102.7
500	0.998	123.2	115.2	120.6	109.1	114.0
1000	0.999	134.9	124.4	131.5	116.8	122.4



**Figure NNN-1: Visual of different fitted distribution for the site.**

**Table NNN-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	156.6	158.4	31.8	0.144
Gamma	156.6	158.4	31.8	0.144
GEV	158.6	161.3	31.7	0.142
Gen. Logistic	158.6	161.3	31.6	0.137
Gen. Normal	158.6	161.3	31.7	0.142
Gen. Pareto	158.6	161.2	31.8	0.147
Gumbel	156.6	158.4	31.8	0.143
Kappa	156.6	158.4	32.0	0.147
Normal	158.6	161.3	31.7	0.143
Pearson III	162.8	167.3	31.0	0.122
Wakeby	158.6	161.3	31.7	0.144
Weibull	158.6	161.3	31.7	0.142
Log-Normal	158.6	161.3	31.5	0.146
LP3	156.6	158.4	31.8	0.144

## Appendix 000 Mangatoro at Mangahei Road 1332518

**Table 000-1: General information about the site.**

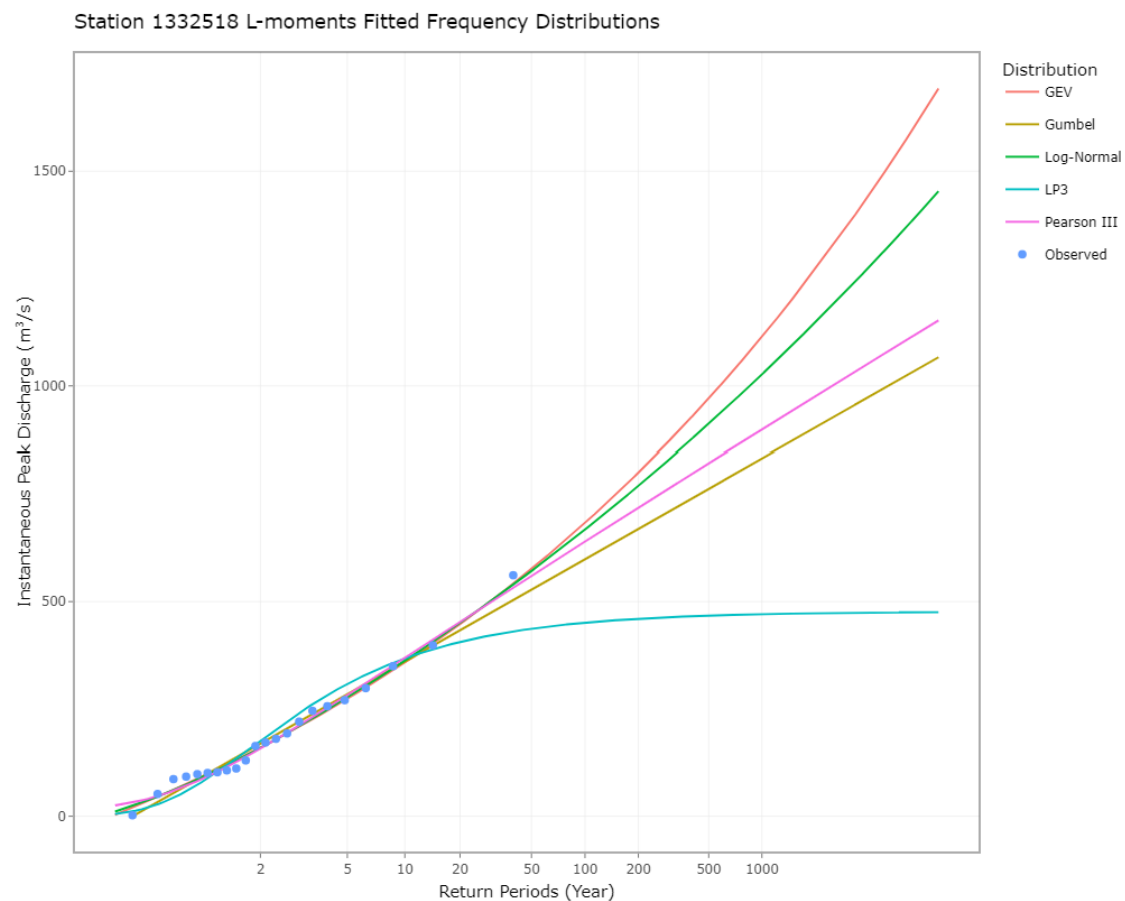
Site Details	
Start (records)	15-Dec-2003
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	209
Latitude	-40.244679
Longitude	176.189531
Record length (yrs)	22
Minimum (m <sup>3</sup> /s)	2.2
Maximum (m <sup>3</sup> /s)	561.4
Median (m <sup>3</sup> /s)	167.7
Mean (m <sup>3</sup> /s)	190.5
Standard Deviation (m <sup>3</sup> /s)	129.1
Coefficient of Variation	0.678

**Table 000-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2006	6/07/2006	561.4	1	39.5
2004	16/02/2004	398.2	2	14.2
2005	21/10/2005	349.7	3	8.6
2007	18/07/2007	298.4	4	6.2
2023	14/02/2023	270.4	5	4.9
2018	12/06/2018	256.2	6	4
2017	13/07/2017	245.5	7	3.4
2008	30/07/2008	220.4	8	2.9
2022	23/09/2022	192.9	9	2.6
2012	5/07/2012	180.4	10	2.3

**Table OOO-3:Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	159.7	169.1	158.9	176.8	157.6
5	0.8	273.3	284.1	276.5	308.1	282.3
10	0.9	358.1	360.3	362.3	367.5	369.1
25	0.96	477.7	456.5	478.9	415.2	479.1
50	0.98	576.3	527.8	571.2	436.8	560.1
75	0.9867	637.8	569.3	627.2	445.8	606.9
100	0.99	683.4	598.7	667.9	450.9	639.9
200	0.995	800.2	669.3	769.5	460.0	718.7
500	0.998	971.1	762.4	912.2	467.3	821.7
1000	0.999	1114.3	832.8	1026.8	470.7	898.9



**Figure OOO-1: Visual of different fitted distribution for the site.**

**Table 000-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	279.4	281.6	241.9	0.133
Gamma	279.3	281.5	241.4	0.136
GEV	281.3	284.6	240.9	0.133
Gen. Logistic	281.3	284.6	239.7	0.133
Gen. Normal	281.3	284.6	241.2	0.134
Gen. Pareto	281.3	284.6	241.6	0.135
Gumbel	279.3	281.5	241.7	0.140
Kappa	283.3	287.7	241.1	0.134
Normal	279.3	281.5	244.2	0.148
Pearson III	281.3	284.6	241.4	0.134
Wakeby	285.3	290.8	242.7	0.133
Weibull	281.3	284.6	241.4	0.134
Log-Normal	281.3	284.6	241.2	0.134
LP3	281.3	284.6	239.9	0.149

## Appendix PPP Tamaki at Stephenson's 1332556

**Table PPP-1: General information about the site.**

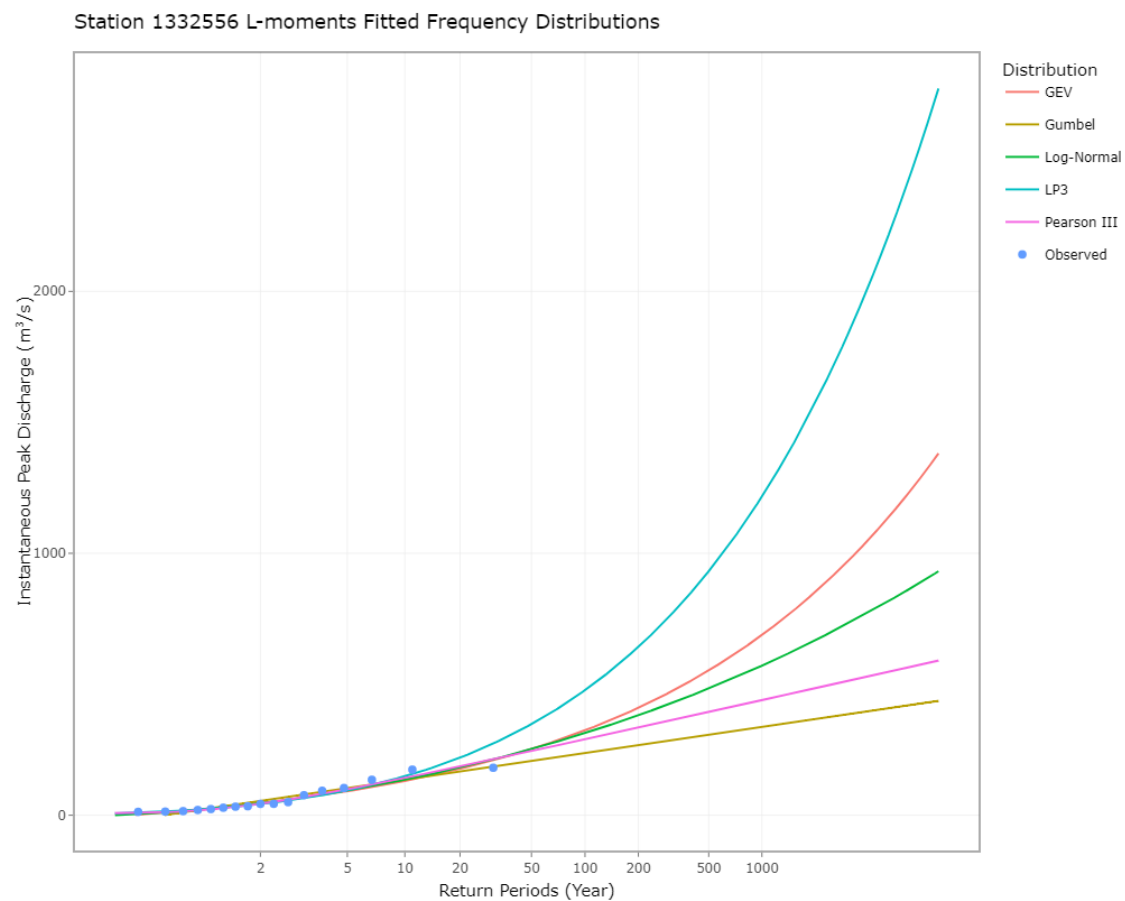
Site Details	
Start (records)	16-Dec-2003
End (records)	27-Sep-2024
Catchment area (km <sup>2</sup> )	53.051
Latitude	-40.245353
Longitude	176.064906
Record length (yrs)	17
Minimum (m <sup>3</sup> /s)	12.8
Maximum (m <sup>3</sup> /s)	181.2
Median (m <sup>3</sup> /s)	43.3
Mean (m <sup>3</sup> /s)	63.7
Standard Deviation (m <sup>3</sup> /s)	55.2
Coefficient of Variation	0.867

**Table PPP-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2004	16/02/2004	174	2	11
2011	23/01/2011	135.3	3	6.7
2012	8/01/2012	103.9	4	4.8
2010	18/09/2010	93.4	5	3.8
2013	11/07/2013	76.4	6	3.1
2014	18/04/2014	50	7	2.6
2005	18/03/2005	43.5	8	2.3
2006	6/07/2006	43.3	9	2
2004	16/02/2004	174	2	11
2007	18/07/2007	34.3	10	1.8

**Table PPP-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	46.1	54.6	45.1	42.5	43.6
5	0.8	91.7	103.5	94.2	94.8	99.0
10	0.9	131.0	135.9	135.6	148.9	142.3
25	0.96	194.0	176.9	198.3	247.2	200.6
50	0.98	252.8	207.3	252.6	347.8	245.1
75	0.9867	292.8	225.0	287.4	419.6	271.2
100	0.99	323.9	237.5	313.6	477.3	289.8
200	0.995	410.1	267.5	381.7	642.7	334.8
500	0.998	552.8	307.2	483.8	931.4	394.4
1000	0.999	687.8	337.1	571.0	1216.3	439.7



**Figure PPP-1: Visual of different fitted distribution for the site.**

**Table PPP-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	187.7	189.4	100.2	0.235
Gamma	187.7	189.3	100.2	0.236
GEV	189.6	192.1	98.3	0.228
Gen. Logistic	189.6	192.1	97.4	0.225
Gen. Normal	189.7	192.2	99.3	0.230
Gen. Pareto	189.7	192.2	99.9	0.232
Gumbel	187.6	189.3	100.7	0.243
Kappa	191.9	195.2	101.2	0.237
Normal	187.6	189.3	102.4	0.250
Pearson III	189.7	192.2	100.2	0.233
Wakeby	193.7	197.9	99.9	0.232
Weibull	189.7	192.2	100.1	0.233
Log-Normal	189.7	192.2	99.3	0.230
LP3	191.7	194.2	108.9	0.241

## Appendix QQQ Waihi at S.H.52 1425006

**Table QQQ-1:General information about the site.**

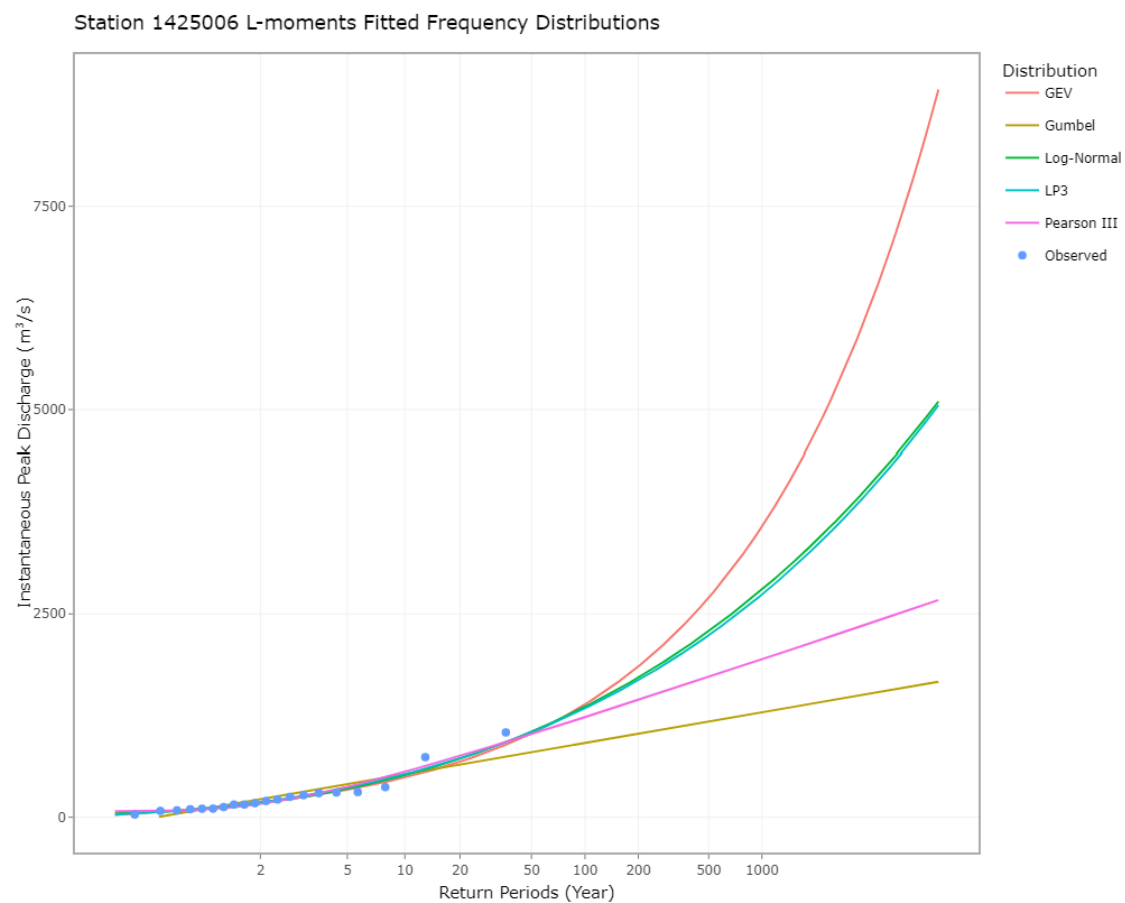
<b>Site Details</b>	
Start (records)	19-Apr-2005
End (records)	29-Jul-2024
Catchment area (km <sup>2</sup> )	128.9
Latitude	-40.43556
Longitude	176.29171
Record length (yrs)	20
Minimum (m <sup>3</sup> /s)	33.2
Maximum (m <sup>3</sup> /s)	1042.7
Median (m <sup>3</sup> /s)	185.9
Mean (m <sup>3</sup> /s)	255.6
Standard Deviation (m <sup>3</sup> /s)	240.8
Coefficient of Variation	0.942

**Table QQQ-2:Top 10 peak flows for the site and its Gringorten plotting positions.**

<b>Year</b>	<b>Date</b>	<b>Inst. Peak Discharge (m<sup>3</sup>/s)</b>	<b>Rank</b>	<b>Plotting positions (years)</b>
2023	14/02/2023	1042.7	1	35.9
2018	8/03/2018	738.4	2	12.9
2008	30/07/2008	370.1	3	7.9
2012	5/07/2012	309.1	4	5.7
2022	25/03/2022	304.2	5	4.4
2013	28/11/2013	295.7	6	3.6
2017	13/07/2017	271.2	7	3.1
2006	14/07/2006	250.3	8	2.7
2019	13/06/2019	217.9	9	2.4
2010	19/09/2010	199.1	10	2.1

**Table QQQ-3:Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	177.7	221.2	172.3	182.9	162.2
5	0.8	337.2	406.4	348.9	363.8	373.8
10	0.9	489.1	529.1	516.5	528.8	558.5
25	0.96	757.0	684.0	793.7	796.8	818.4
50	0.98	1030.5	799.0	1052.0	1044.8	1022.4
75	0.9867	1227.7	865.8	1224.9	1210.7	1143.9
100	0.99	1387.5	913.1	1358.2	1338.6	1230.8
200	0.995	1854.3	1026.8	1718.3	1685.4	1442.3
500	0.998	2700.0	1176.8	2288.1	2237.9	1725.6
1000	0.999	3573.3	1290.1	2799.0	2738.5	1942.1



**Figure QQQ-1: Visual of different fitted distribution for the site.**

**Table QQQ-4:At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	279.4	281.4	399.2	0.245
Gamma	279.6	281.6	399.9	0.244
GEV	281.7	284.7	390.1	0.225
Gen. Logistic	282.0	285.0	387.1	0.218
Gen. Normal	281.3	284.3	396.2	0.237
Gen. Pareto	281.3	284.3	395.6	0.238
Gumbel	280.0	282.0	403.7	0.242
Kappa	280.3	282.3	412.1	0.244
Normal	281.1	284.1	400.0	0.248
Pearson III	286.1	291.1	385.4	0.215
Wakeby	281.2	284.1	399.5	0.246
Weibull	281.3	284.3	396.2	0.237
Log-Normal	281.2	284.2	400.1	0.250
LP3	279.4	281.4	399.2	0.245

## Appendix RRR Owahanga at Branscombe Bridge 1425101

**Table RRR-1: General information about the site.**

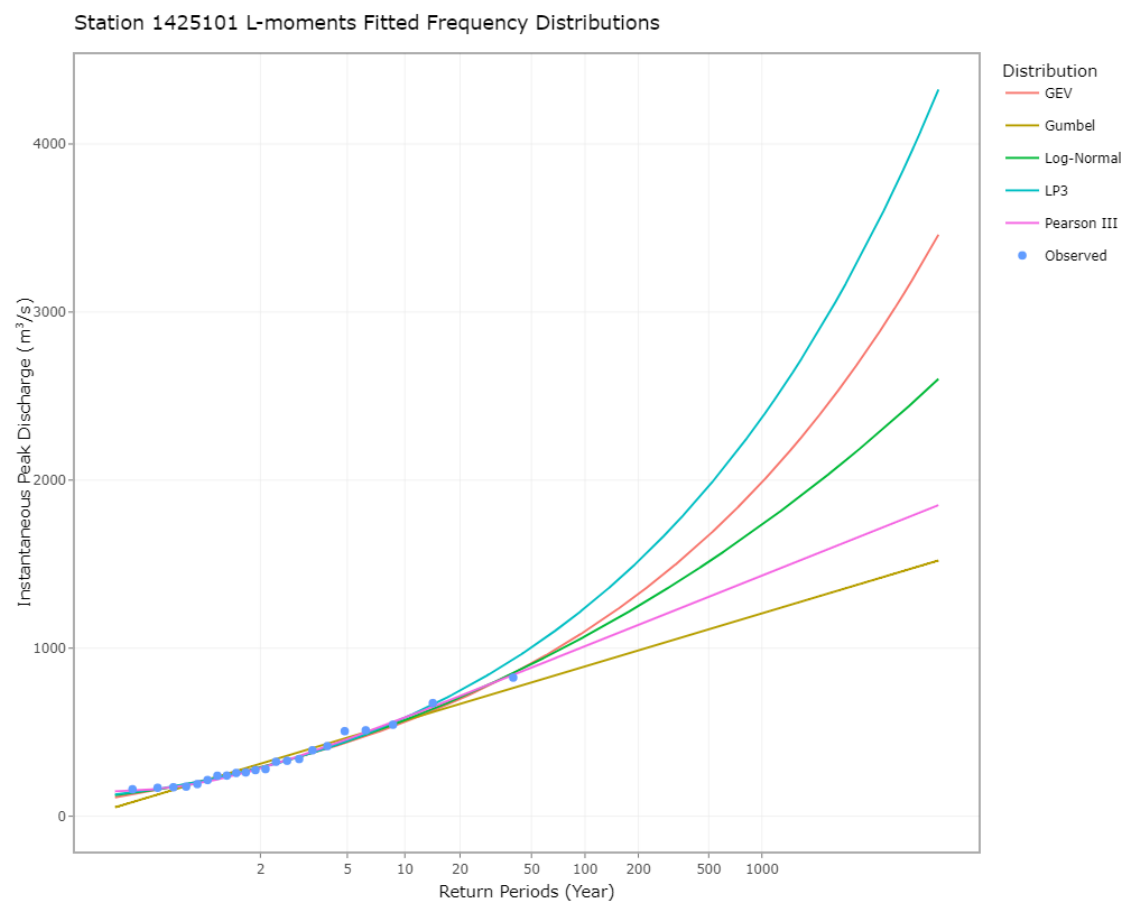
Site Details	
Start (records)	22-Jun-1999
End (records)	11-May-2021
Catchment area (km <sup>2</sup> )	313.3
Latitude	-40.630793
Longitude	176.302447
Record length (yrs)	22
Minimum (m <sup>3</sup> /s)	160.5
Maximum (m <sup>3</sup> /s)	824.8
Median (m <sup>3</sup> /s)	277.3
Mean (m <sup>3</sup> /s)	341.1
Standard Deviation (m <sup>3</sup> /s)	175.7
Coefficient of Variation	0.515

**Table RRR-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2018	8/03/2018	824.8	1	39.5
2004	16/02/2004	673.2	2	14.2
2008	30/07/2008	544.4	3	8.6
2012	20/03/2012	511.2	4	6.2
2013	12/07/2013	506.1	5	4.9
2000	7/10/2000	417.3	6	4
2001	15/08/2001	392.4	7	3.4
2005	20/07/2005	340.3	8	2.9
2006	6/07/2006	330	9	2.6
2015	23/09/2015	324	10	2.3

**Table RRR-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	290.8	312.3	288.6	287.3	285.2
5	0.8	439.5	467.3	446.1	447.9	458.2
10	0.9	560.6	569.9	571.5	586.3	587.1
25	0.96	745.4	699.6	753.0	804.9	756.4
50	0.98	909.7	795.8	904.7	1004.3	883.9
75	0.9867	1017.7	851.8	999.8	1137.2	958.3
100	0.99	1100.3	891.4	1070.2	1239.7	1011.0
200	0.995	1321.8	986.5	1250.6	1517.5	1137.9
500	0.998	1671.3	1112.0	1514.0	1963.3	1305.4
1000	0.999	1986.8	1206.9	1733.4	2371.5	1432.0



**Figure RRR-1: Visual of different fitted distribution for the site.**

**Table RRR-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	293.0	295.1	323.1	0.177
Gamma	292.8	295.0	324.4	0.181
GEV	294.9	298.2	320.5	0.172
Gen. Logistic	294.9	298.2	318.4	0.168
Gen. Normal	294.9	298.2	322.0	0.174
Gen. Pareto	294.9	298.2	323.2	0.178
Gumbel	292.8	295.0	324.2	0.181
Kappa	296.9	301.3	323.3	0.178
Normal	292.9	295.1	329.0	0.188
Pearson III	294.9	298.2	323.0	0.177
Wakeby	298.9	304.4	323.2	0.178
Weibull	294.9	298.2	323.0	0.177
Log-Normal	294.9	298.2	322.0	0.174
LP3	295.4	298.7	332.9	0.188

## Appendix SSS Manakau at S.H.1 Bridge 1432003

**Table SSS-1: General information about the site.**

Site Details	
Start (records)	3-May-2006
End (records)	10-Apr-2024
Catchment area (km <sup>2</sup> )	16
Latitude	-40.72438
Longitude	175.211655
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	8.3
Maximum (m <sup>3</sup> /s)	69.5
Median (m <sup>3</sup> /s)	17.8
Mean (m <sup>3</sup> /s)	23.8
Standard Deviation (m <sup>3</sup> /s)	16.9
Coefficient of Variation	0.709

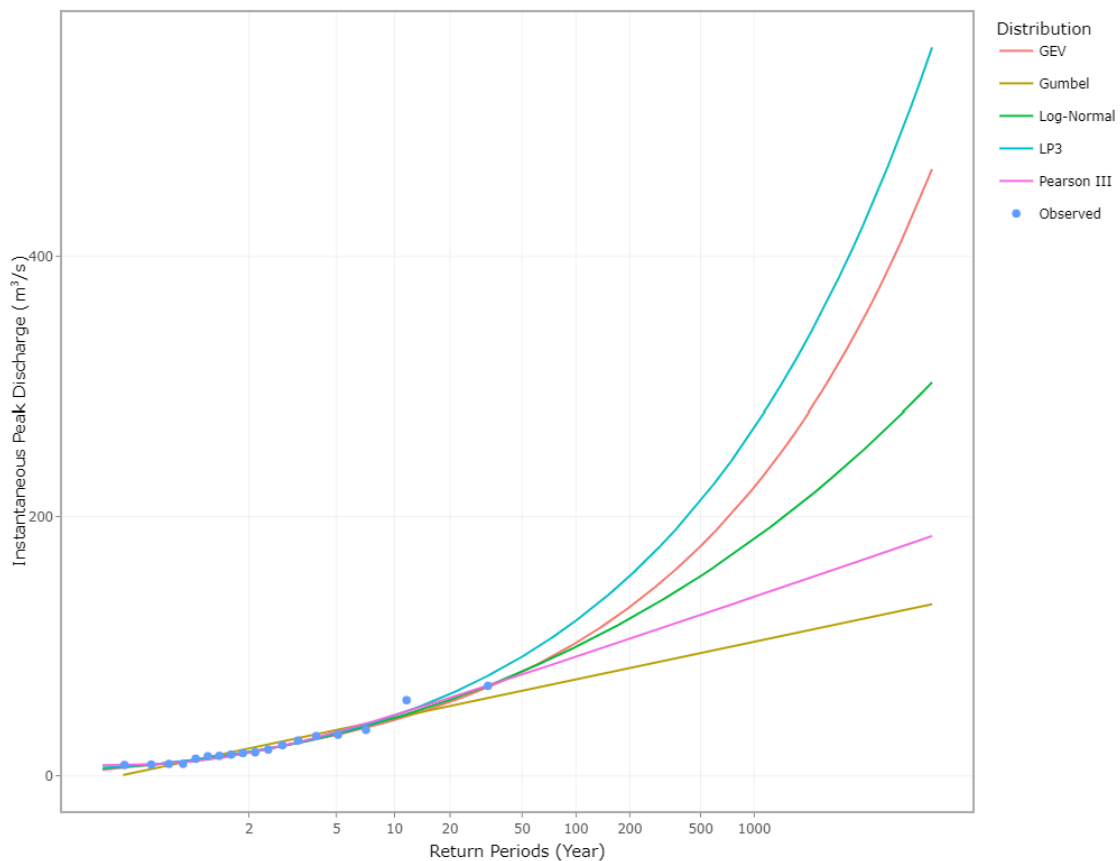
**Table SSS-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2015	19/06/2015	69.5	1	32.4
2008	8/01/2008	58.4	2	11.6
2018	22/02/2018	35.5	3	7.1
2014	10/12/2014	31.7	4	5.1
2009	29/12/2009	30.7	5	4
2017	9/09/2017	27.2	6	3.3
2021	27/06/2021	23.6	7	2.8
2006	17/11/2006	20.2	8	2.4
2011	26/05/2011	18.1	9	2.1
2019	17/07/2019	17.5	10	1.9

**Table SSS-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	18.4	21.1	18.1	18.2	17.6
5	0.8	31.5	35.4	32.3	32.7	33.8
10	0.9	43.0	44.8	44.6	46.4	46.8
25	0.96	62.0	56.8	63.6	69.5	64.5
50	0.98	80.2	65.6	80.4	91.9	78.2
75	0.9867	92.7	70.8	91.3	107.5	86.2
100	0.99	102.6	74.4	99.6	119.8	91.9
200	0.995	130.3	83.2	121.3	154.2	105.8
500	0.998	177.2	94.7	154.2	212.4	124.2
1000	0.999	222.7	103.5	182.6	268.3	138.2

Station 1432003 L-moments Fitted Frequency Distributions



**Figure SSS-1: Visual of different fitted distribution for the site.**

**Table SSS-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	155.8	157.5	29.7	0.188
Gamma	155.8	157.6	29.9	0.193
GEV	157.8	160.5	29.2	0.181
Gen. Logistic	157.9	160.6	28.9	0.178
Gen. Normal	157.8	160.4	29.5	0.184
Gen. Pareto	157.8	160.4	29.6	0.185
Gumbel	155.8	157.6	30.0	0.196
Kappa	159.8	163.3	29.5	0.184
Normal	155.9	157.7	30.5	0.202
Pearson III	157.8	160.5	29.7	0.186
Wakeby	161.8	166.2	29.6	0.185
Weibull	157.8	160.5	29.7	0.186
Log-Normal	157.8	160.4	29.5	0.184
LP3	158.1	160.8	30.7	0.195

## Appendix TTT Waikawa at North Manakau Road 1432008

**Table TTT-1: General information about the site.**

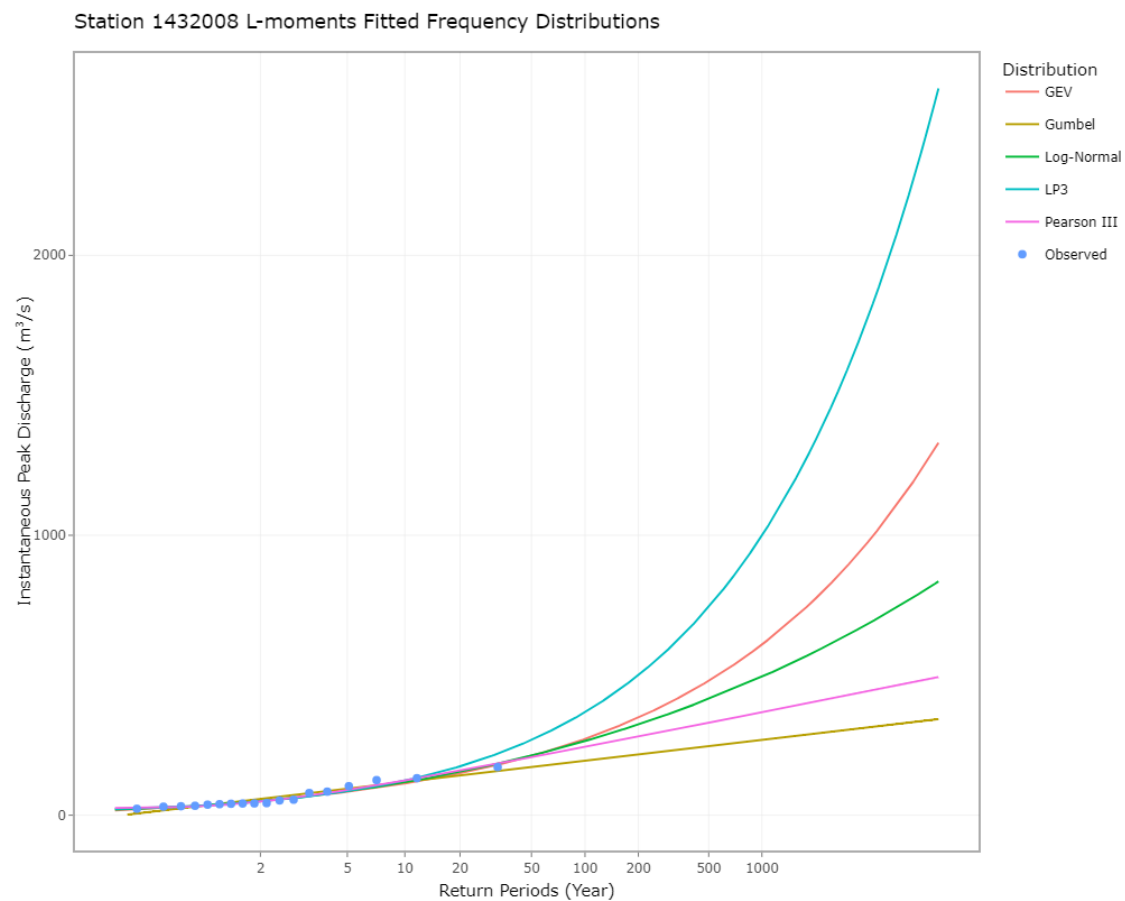
Site Details	
Start (records)	18-May-2006
End (records)	12-Mar-2024
Catchment area (km <sup>2</sup> )	28
Latitude	-40.707742
Longitude	175.233597
Record length (yrs)	18
Minimum (m <sup>3</sup> /s)	22.9
Maximum (m <sup>3</sup> /s)	171.6
Median (m <sup>3</sup> /s)	42.6
Mean (m <sup>3</sup> /s)	64.9
Standard Deviation (m <sup>3</sup> /s)	42.3
Coefficient of Variation	0.652

**Table TTT-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2022	14/05/2022	171.6	1	32.4
2021	7/12/2021	132.2	2	11.6
2015	19/06/2015	125.3	3	7.1
2008	8/01/2008	103.7	4	5.1
2023	26/03/2023	84.1	5	4
2020	23/09/2020	79.3	6	3.3
2019	17/11/2019	55.3	7	2.8
2009	27/12/2009	52.8	8	2.4
2014	10/12/2014	43.1	9	2.1
2010	6/09/2010	42.1	10	1.9

**Table TTT-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	50.7	58.1	49.8	48.8	48.3
5	0.8	83.7	94.7	85.8	85.8	90.0
10	0.9	113.5	118.9	117.8	123.9	124.2
25	0.96	163.3	149.4	168.1	194.4	171.0
50	0.98	211.8	172.1	213.2	268.9	207.2
75	0.9867	245.7	185.3	242.7	323.4	228.6
100	0.99	272.5	194.6	265.0	368.1	243.9
200	0.995	348.7	217.1	324.2	500.3	280.9
500	0.998	480.1	246.7	415.2	743.9	330.3
1000	0.999	609.5	269.0	494.6	998.9	367.8



**Figure TTT-1: Visual of different fitted distribution for the site.**

**Table TTT-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	188.9	190.7	75.5	0.248
Gamma	188.9	190.6	75.9	0.256
GEV	190.9	193.6	73.9	0.239
Gen. Logistic	191.0	193.6	73.3	0.239
Gen. Normal	190.9	193.6	74.8	0.240
Gen. Pareto	190.9	193.6	75.1	0.242
Gumbel	188.9	190.7	76.1	0.259
Kappa	193.0	196.6	76.0	0.247
Normal	188.9	190.7	77.4	0.266
Pearson III	191.0	193.6	75.5	0.244
Wakeby	194.9	199.4	75.1	0.242
Weibull	191.0	193.6	75.5	0.244
Log-Normal	190.9	193.6	74.8	0.240
LP3	192.2	194.9	80.5	0.249

## Appendix UUU Tokomaru at Riverland Farm 2232510

**Table UUU-1: General information about the site.**

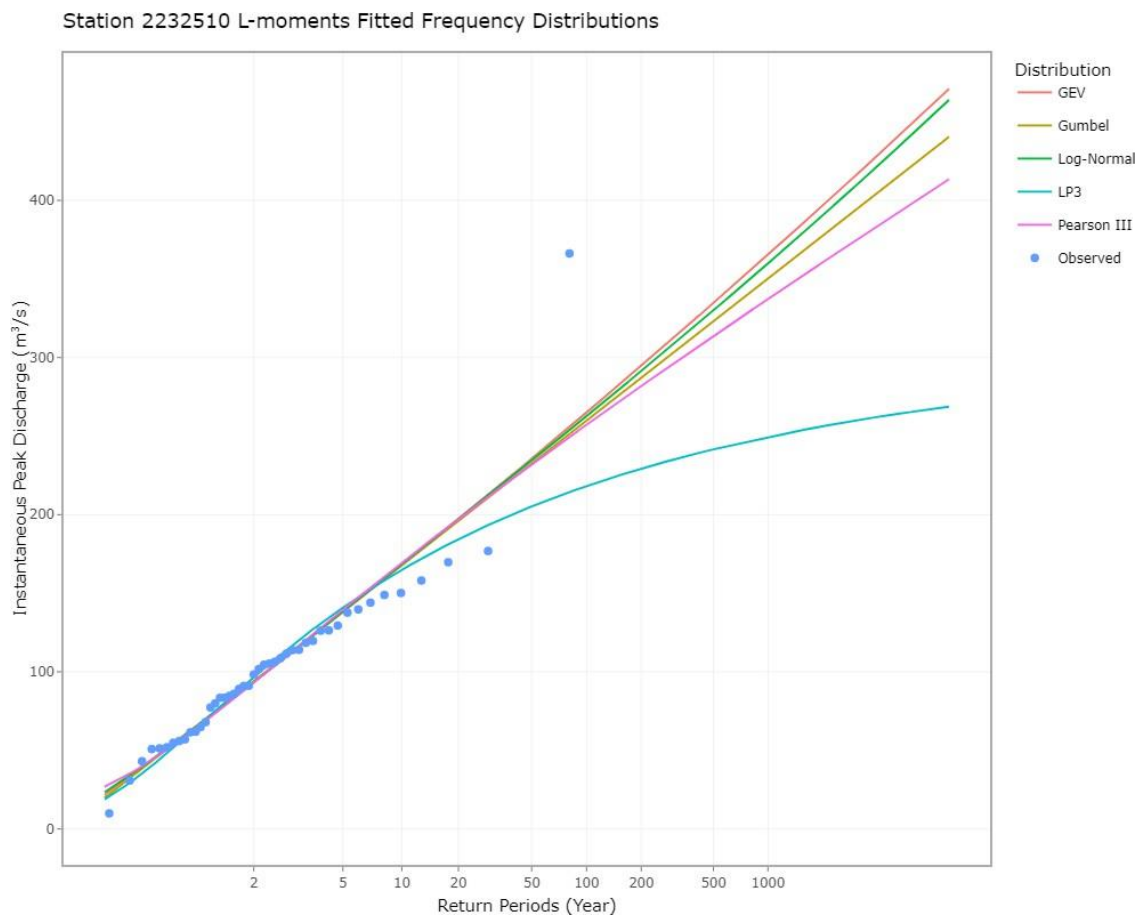
Site Details	
Start (records)	13-Dec-1979
End (records)	25-Sep-2024
Catchment area (km <sup>2</sup> )	57.5
Latitude	-40.484278
Longitude	175.498726
Record length (yrs)	45
Minimum (m <sup>3</sup> /s)	9.9
Maximum (m <sup>3</sup> /s)	366.3
Median (m <sup>3</sup> /s)	98.3
Mean (m <sup>3</sup> /s)	102.3
Standard Deviation (m <sup>3</sup> /s)	55.3
Coefficient of Variation	0.541

**Table UUU-2: Top 10 peak flows for the site and its Gringorten plotting positions.**

Year	Date	Inst. Peak Discharge (m <sup>3</sup> /s)	Rank	Plotting positions (years)
2008	8/01/2008	366.3	1	80.6
2021	27/06/2021	176.9	2	28.9
2000	29/12/2000	169.7	3	17.6
2009	27/12/2009	158.1	4	12.7
2004	1/12/2004	150.2	5	9.9
2024	18/08/2024	148.9	6	8.1
1990	10/03/1990	144	7	6.9
1998	21/10/1998	139.7	8	6
2020	27/09/2020	137.6	9	5.3
2010	6/09/2010	129.4	10	4.7

**Table UUU-3: Fitted distributions for the site.** (Recommended Distribution, highlighted in red).

Return Period (years)	Probability of Non-Exceedance	GEV (m <sup>3</sup> /s)	Gumbel (m <sup>3</sup> /s)	Log-Normal (m <sup>3</sup> /s)	LP3 (m <sup>3</sup> /s)	Pearson III (m <sup>3</sup> /s)
2	0.5	93.4	94.1	93.4	96.6	93.2
5	0.8	137.8	138.5	138.3	140.8	139.5
10	0.9	167.8	167.8	168.2	164.9	169.4
25	0.96	206.4	205.0	206.1	189.9	205.8
50	0.98	235.6	232.5	234.4	205.2	231.9
75	0.9867	252.8	248.6	250.9	213.1	246.8
100	0.99	265.0	259.9	262.7	218.2	257.2
200	0.995	294.8	287.1	291.4	229.3	281.8
500	0.998	334.7	323.1	330.1	241.6	313.6
1000	0.999	365.5	350.3	359.9	249.4	337.2



**Figure UUU-1: Visual of different fitted distribution for the site.**

**Table UUU-4: At-site goodness of fit statistics.**

<b>Distribution</b>	<b>AIC</b>	<b>BIC</b>	<b>RMSE</b>	<b>KS_Statistic</b>
Exponential	492.0	495.7	99.2	0.101
Gamma	493.1	496.7	98.5	0.093
GEV	494.8	500.2	98.9	0.094
Gen. Logistic	494.8	500.2	99.2	0.093
Gen. Normal	494.9	500.3	98.7	0.094
Gen. Pareto	495.1	500.5	97.7	0.094
Gumbel	492.9	496.5	98.8	0.094
Normal	493.6	497.2	99.4	0.093
Pearson III	494.9	500.3	98.5	0.094
Wakeby	498.9	508.0	98.3	0.089
Weibull	495.0	500.4	98.2	0.094
Log-Normal	494.9	500.3	98.7	0.094
LP3	496.8	502.2	96.5	0.079
Gen. Normal	494.9	500.3	98.7	0.094



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