Introductory Lectures on the FSU Methodologies
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05 – Estimation of Flood Growth Factors at Gauged and Ungauged Locations

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Presentation Structure

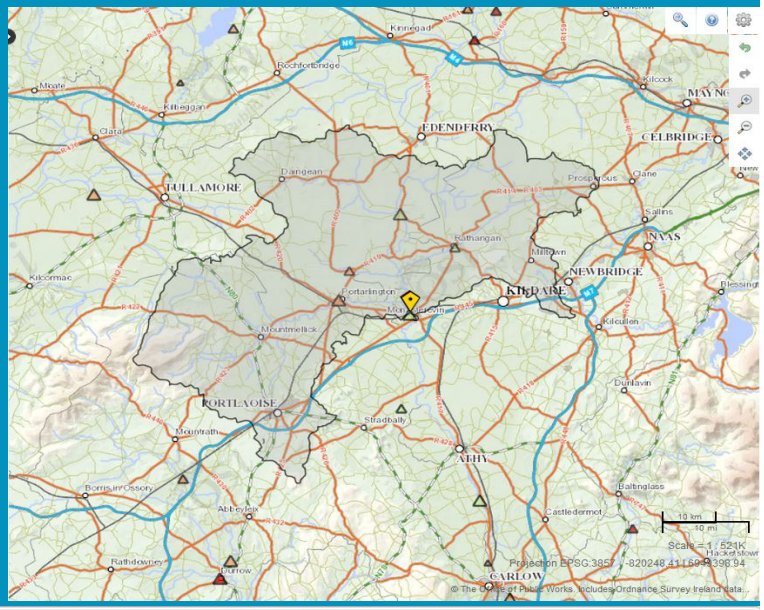
- ‘Single Site’ Flood Frequency Analysis
- Pooled Flood Frequency Analysis (ungauged locations)
- Combined Single Site/Pooled Flood Frequency Analysis

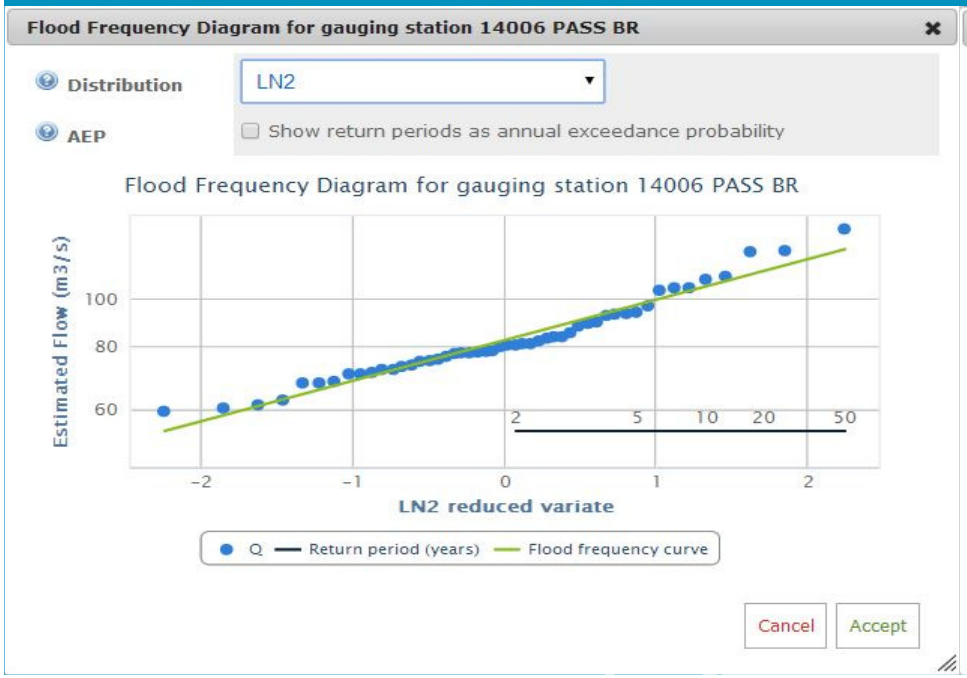
Three Categories for Growth Factor Estimation

- 'Single Site' Flood Frequency Analysis - Performed at a gauged location where the number of Amax years is greater than the target return period (N>T)
- Pooled Flood Frequency Analysis - Performed at ungauged locations
- Combined Single Site/Pooled Flood Frequency Analysis - performed at gauged locations where the number of Amax years is greater than the target return period (N<T)

Single Site Flood Frequency Analysis (N>T)

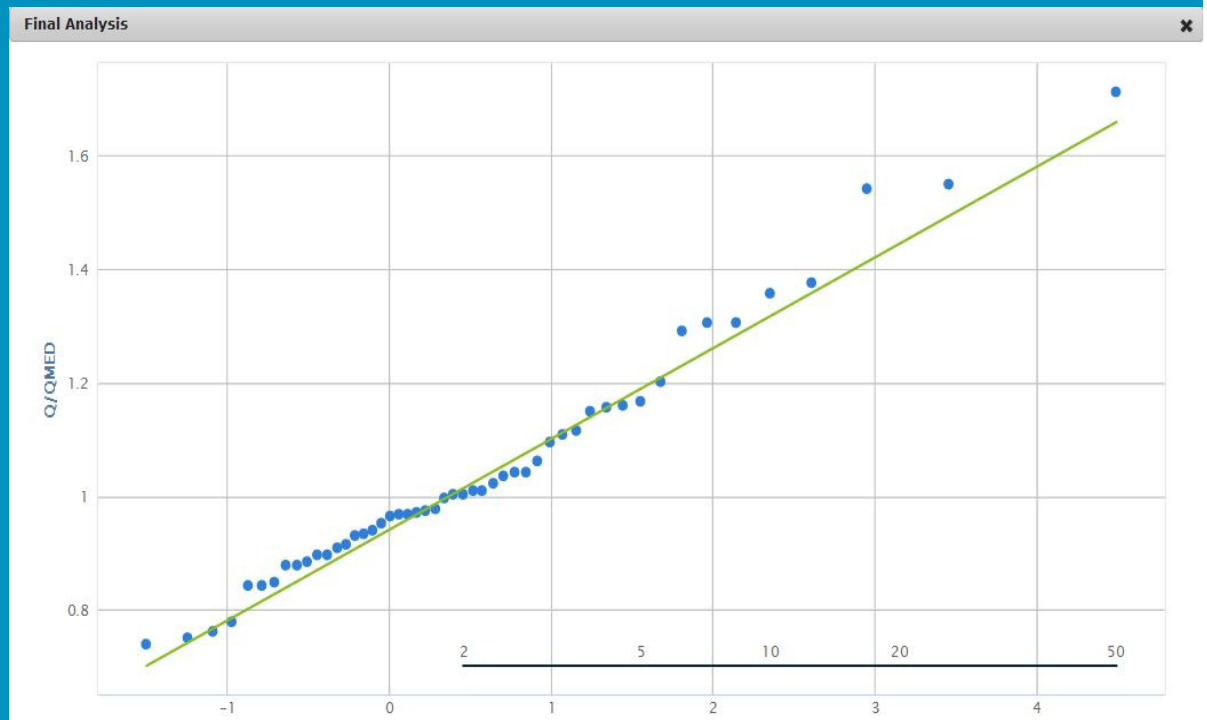
- T = 20, Target Return Period
- N = 40, years of Amax data
- Plot the gauged data on a Flood Frequency diagram (Q Vs T)
- Find the distribution that gives the best fit to the data (LN2 or EV1)





Single Site Flood Frequency Analysis (N>T)

- Flow values at the gauge are ranked in ascending order
- We then overlay different curves/distributions and see which fits the best
- The best fit curve/distribution is used to create the growth curve



Distribution: EV1

	t=1.3	t=2	t=5	t=10	t=20	t=30	t=50	t=100	t=200	t=500	t=1000
Growth Factors	0.88	1	1.18	1.3	1.42	1.48	1.56	1.68	1.79	1.93	2.04
Design Peak Flows (m^3/s)	70.66	80.26	94.79	104.41	113.63	118.94	125.58	134.53	143.44	155.21	164.1

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Pooled Flood Frequency Analysis (Ungauged Locations)

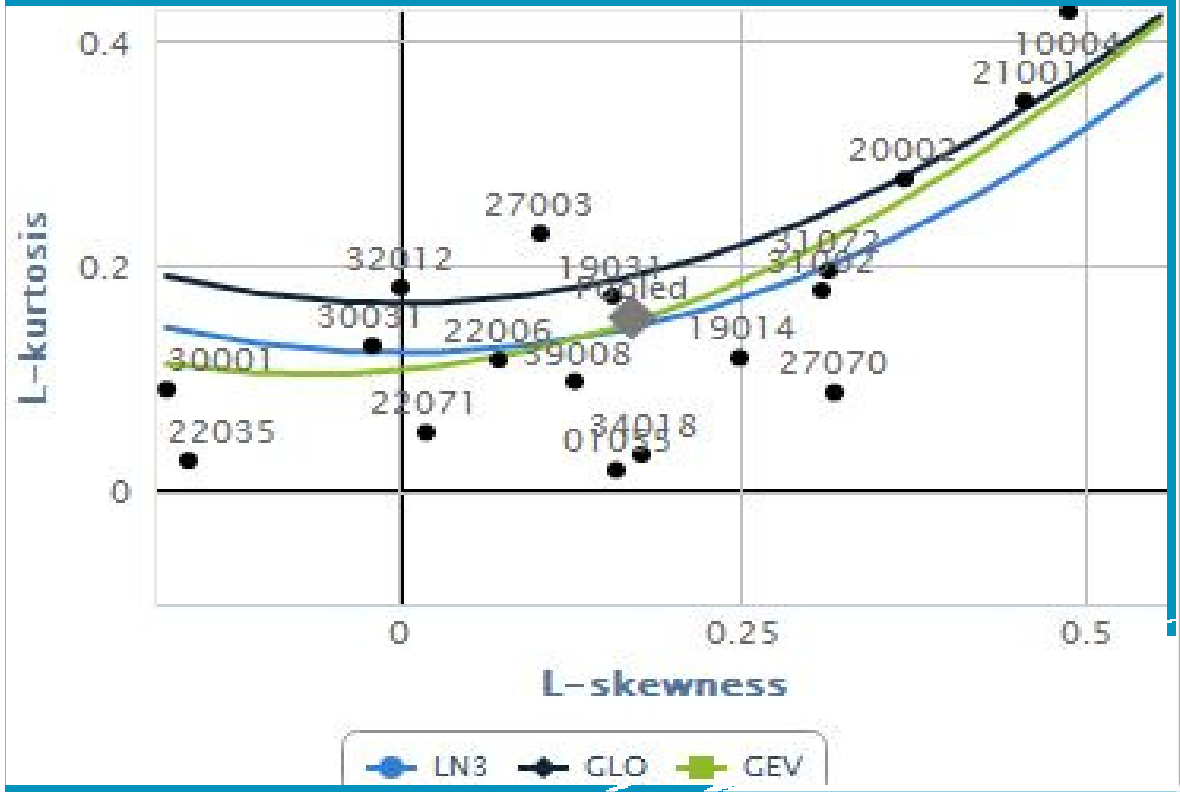
- No Gauge – We must use information from hydrologically similar gauged locations
- AREA, SAAR and BFIsoil are used to form a pooling group of the most hydrologically similar catchments. (5T rule applied)

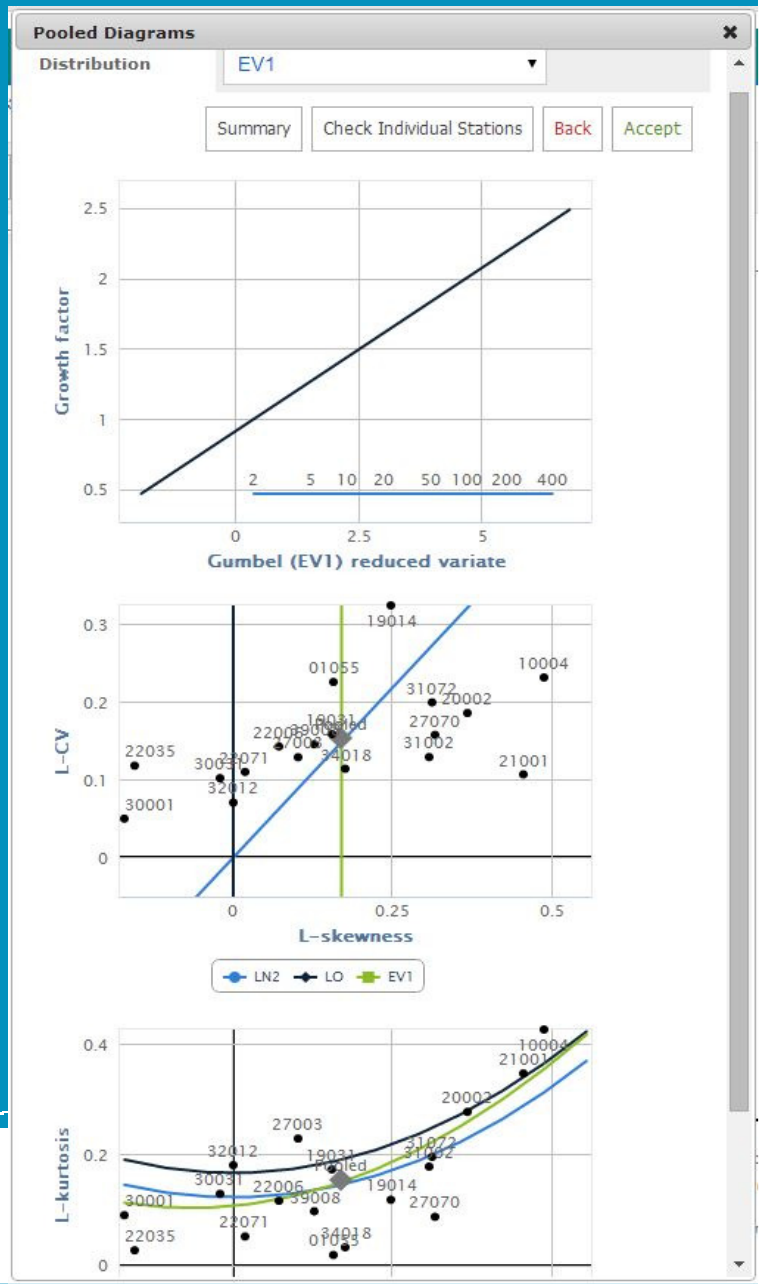
Station	Euclidean DIST(ij)	# years in FSU database	Cumulative # station-years
31072	1.317	26	26
21001	1.482	25	51
22071	2.45	31	82
22035	2.454	14	96
19014	2.633	45	141
32012	2.669	24	165
19031	2.822	9	174
39008	3.091	33	207
01055	3.105	9	216
30001	3.16	18	234
27070	3.293	29	263
20002	3.392	31	294
27003	3.4	47	341
34018	3.403	27	368
10004	3.469	14	382
30031	3.518	24	406
22006	3.571	51	457
31002	3.604	26	483
10002	3.68	46	529
20006	3.749	25	554
16013	3.805	33	587
35073	3.817	30	617
33070	4.02	28	645
39009	4.029	33	678
25158	4.114	18	696

Legend: Pooled Auxiliary Selected

Pooled Flood Frequency Analysis (Ungauged Locations)

- L-moment ratios for each gauge are calculated
- Weighted average of L-moment ratios is then calculated
- Weighted average L-moment ratio is plotted on standard L-moment ratio diagram (grey diamond)

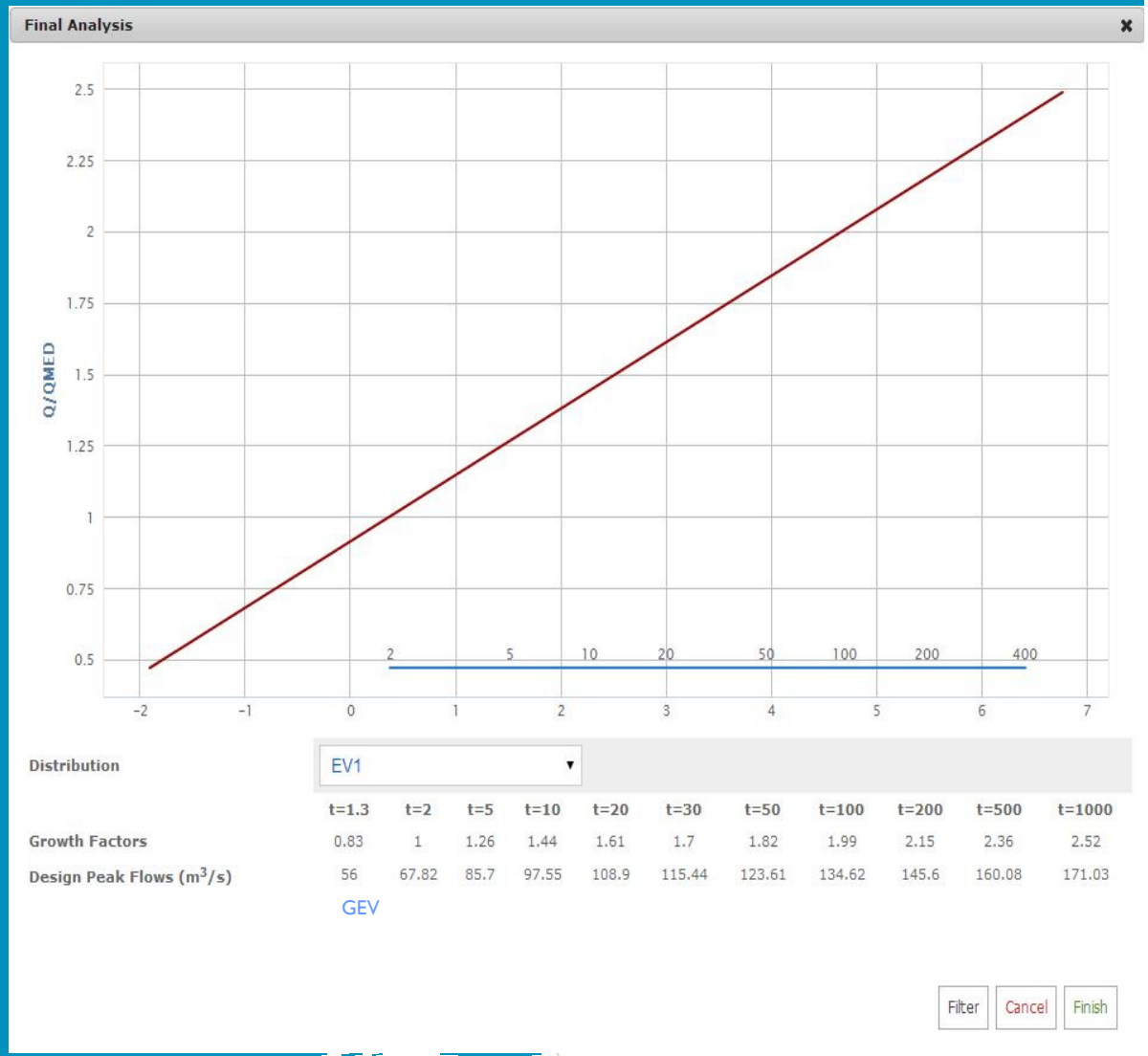




Pooled Flood Frequency Analysis (Ungauged Locations)

- For Ungauged Locations, the GEV or GLO distribution usually provide the best fit

- The pooled L-moment ratio values are substituted into the equation for the chosen distribution to produce the growth curve

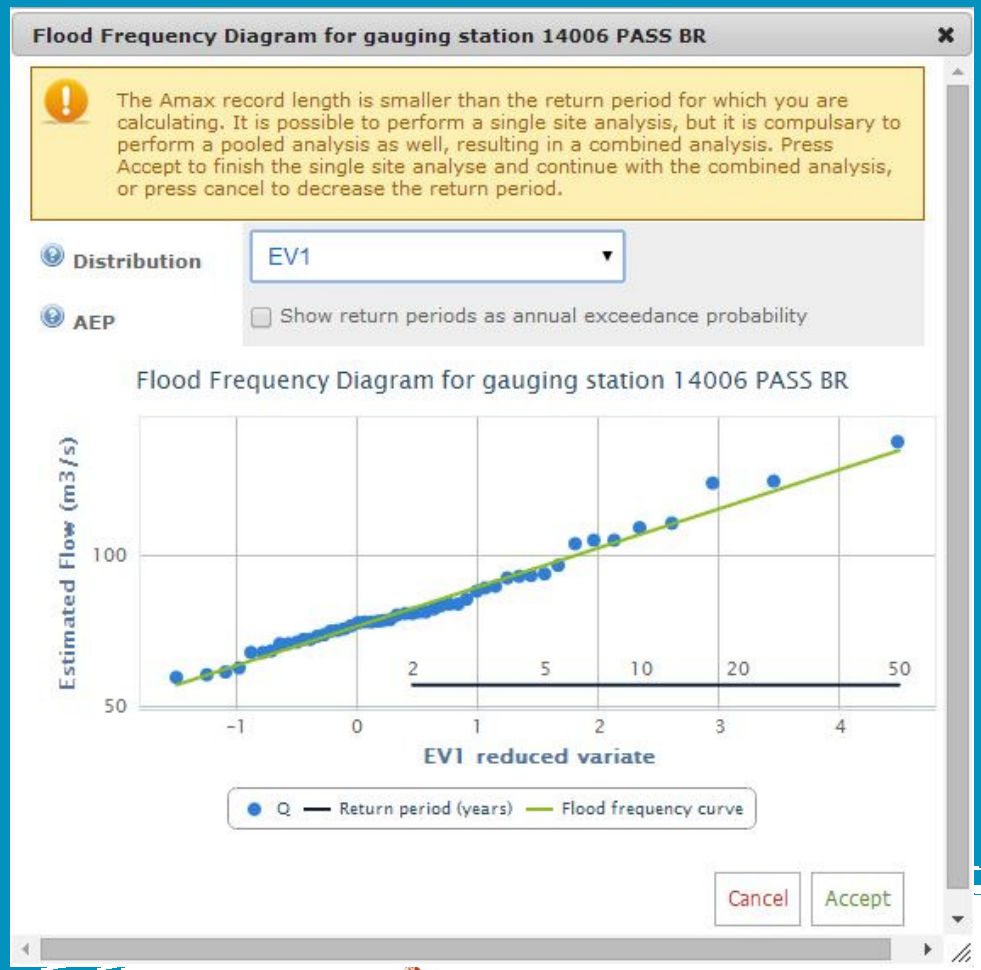


	t=1.3	t=2	t=5	t=10	t=20	t=30	t=50	t=100	t=200	t=500	t=1000
Growth Factors	0.83	1	1.26	1.44	1.61	1.7	1.82	1.99	2.15	2.36	2.52
Design Peak Flows (m^3/s)	56	67.82	85.7	97.55	108.9	115.44	123.61	134.62	145.6	160.08	171.03

GEV

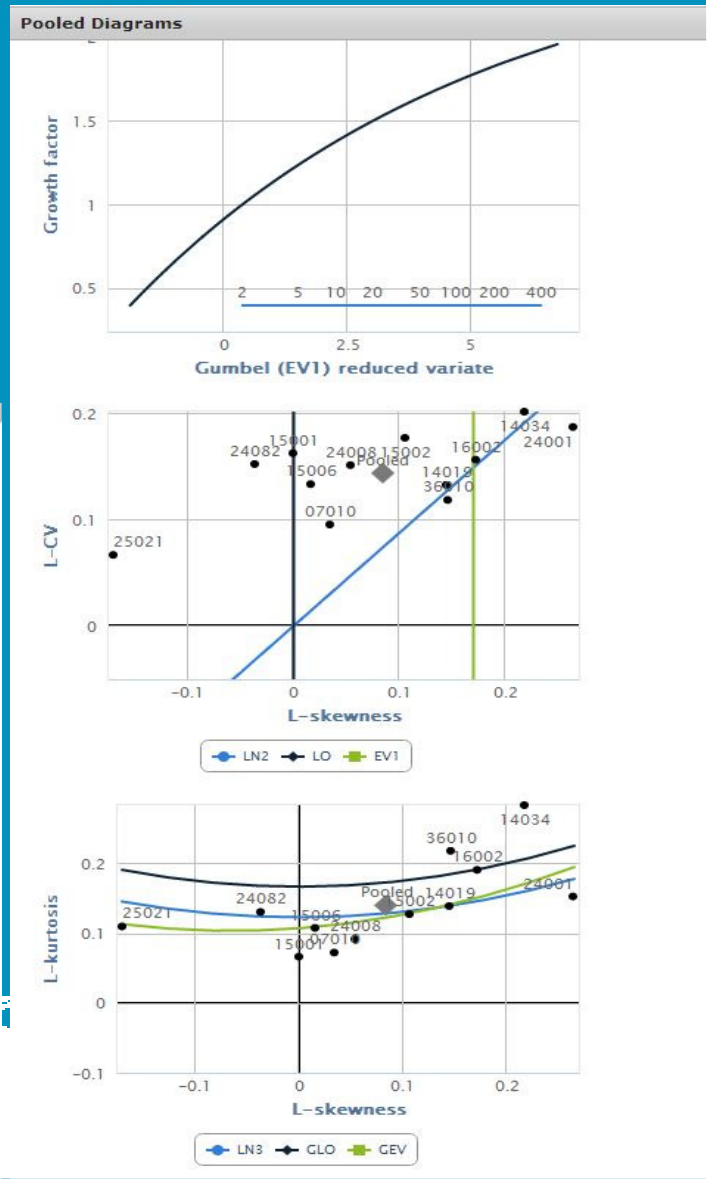
Combined Single Site/Pooled Flood Frequency Analysis

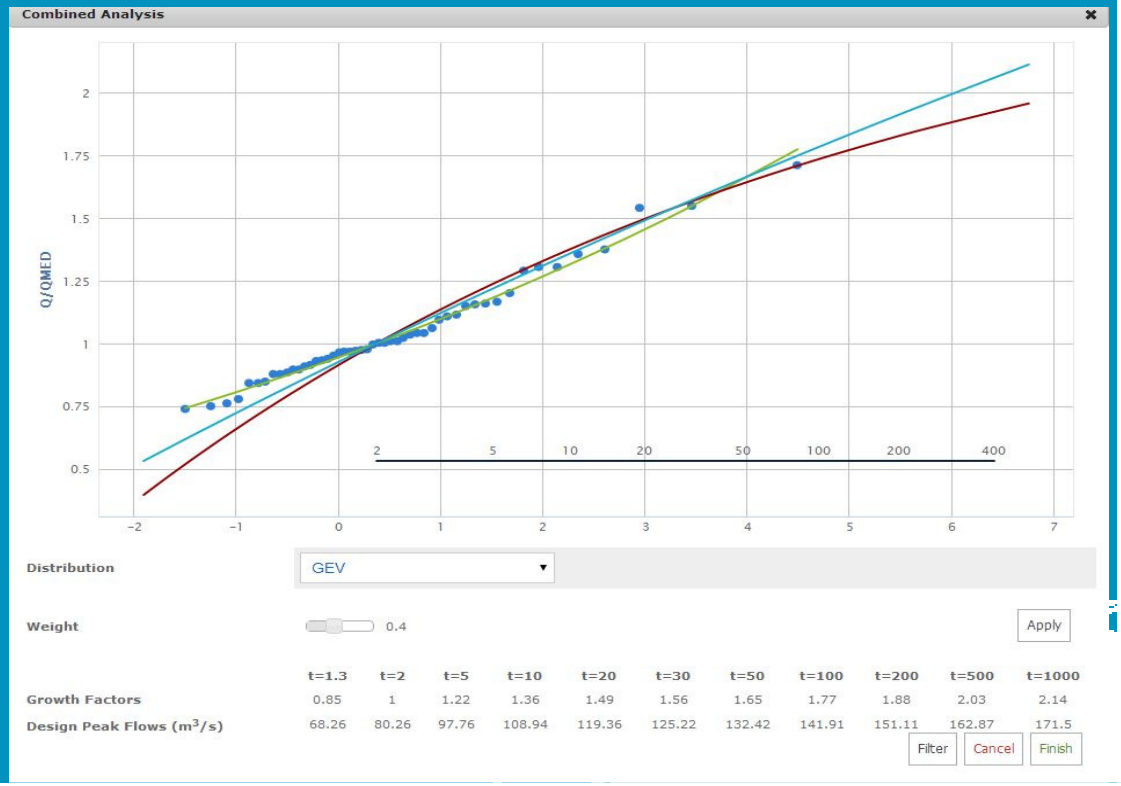
- Used where the record length at the gauge is much less than the required return period
- Example: 14006 Pass Bridge
- N = 40 years of Amax data
- T = 100, Target Return Period
- T>N, so combined analysis may be used



Combined Single Site/Pooled Flood Frequency Analysis

- Next, Pooled Analysis is performed
- Weighting is applied to L-Moments for the At-site Analysis based on N/T
- Weighting = N/T = 40/100 = 0.4





	t=1.3	t=2	t=5	t=10	t=20	t=30	t=50	t=100	t=200	t=500	t=1000
Growth Factors	0.85	1	1.22	1.36	1.49	1.56	1.65	1.77	1.88	2.03	2.14
Design Peak Flows (m^3/s)	68.26	80.26	97.76	108.94	119.36	125.22	132.42	141.91	151.11	162.87	171.5