

Introductory Lectures on the FSU Methodologies
November/December 2014

06 - Creating a Hydrograph Shape

Fasil Gebre BSc MEngSc PhD MIEI



OPW
The Office of Public Works
Oifig na nObreacha Poiblí

Hydrology & Coastal Section

Presentation Structure

- Hydrograph Width Analysis – Gauged Locations
- Method of Flood Hydrograph Synthesis – Ungauged Locations

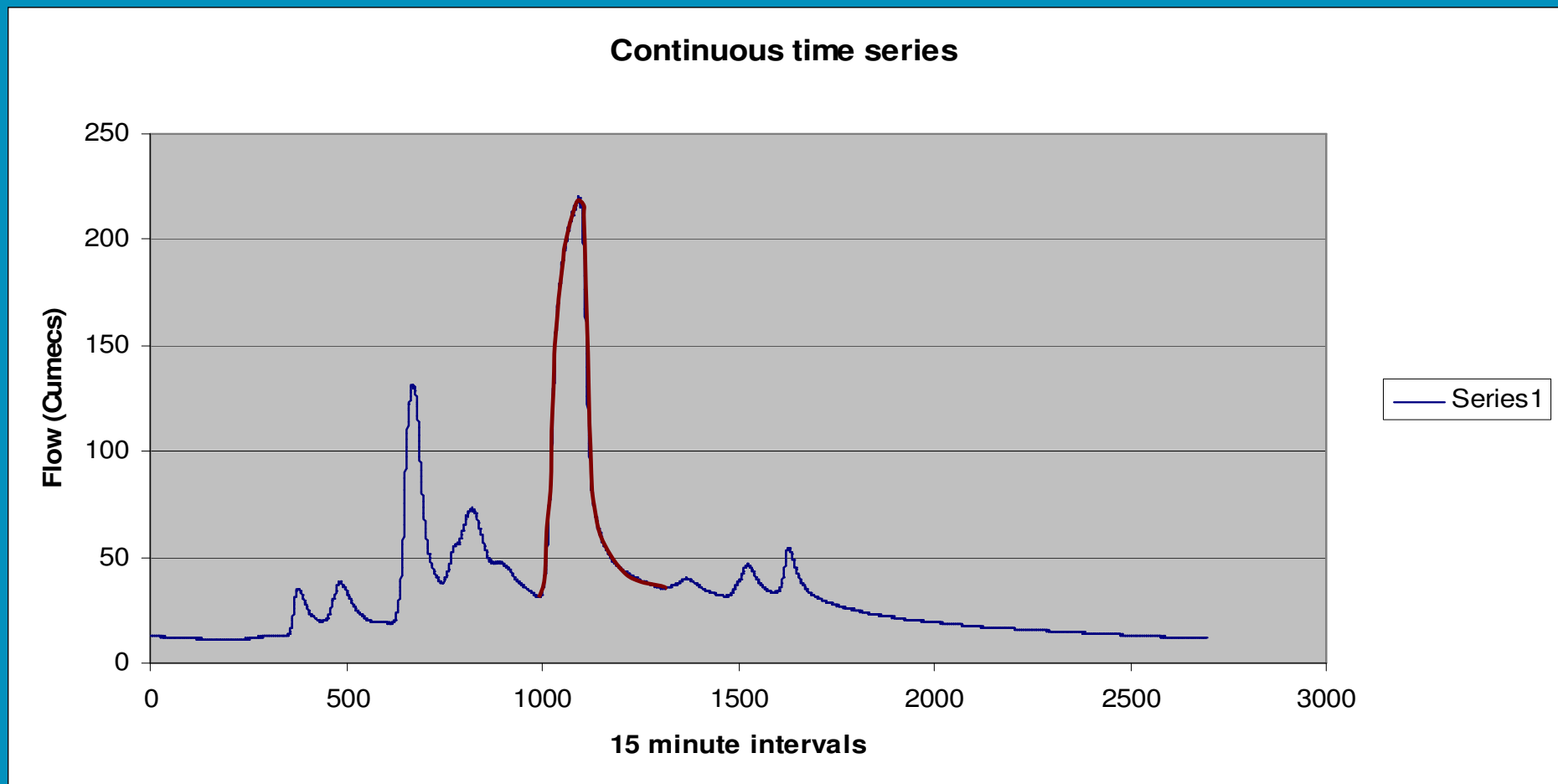


OPW
The Office of Public Works
Oifig na nObraíochtaí Poiblí

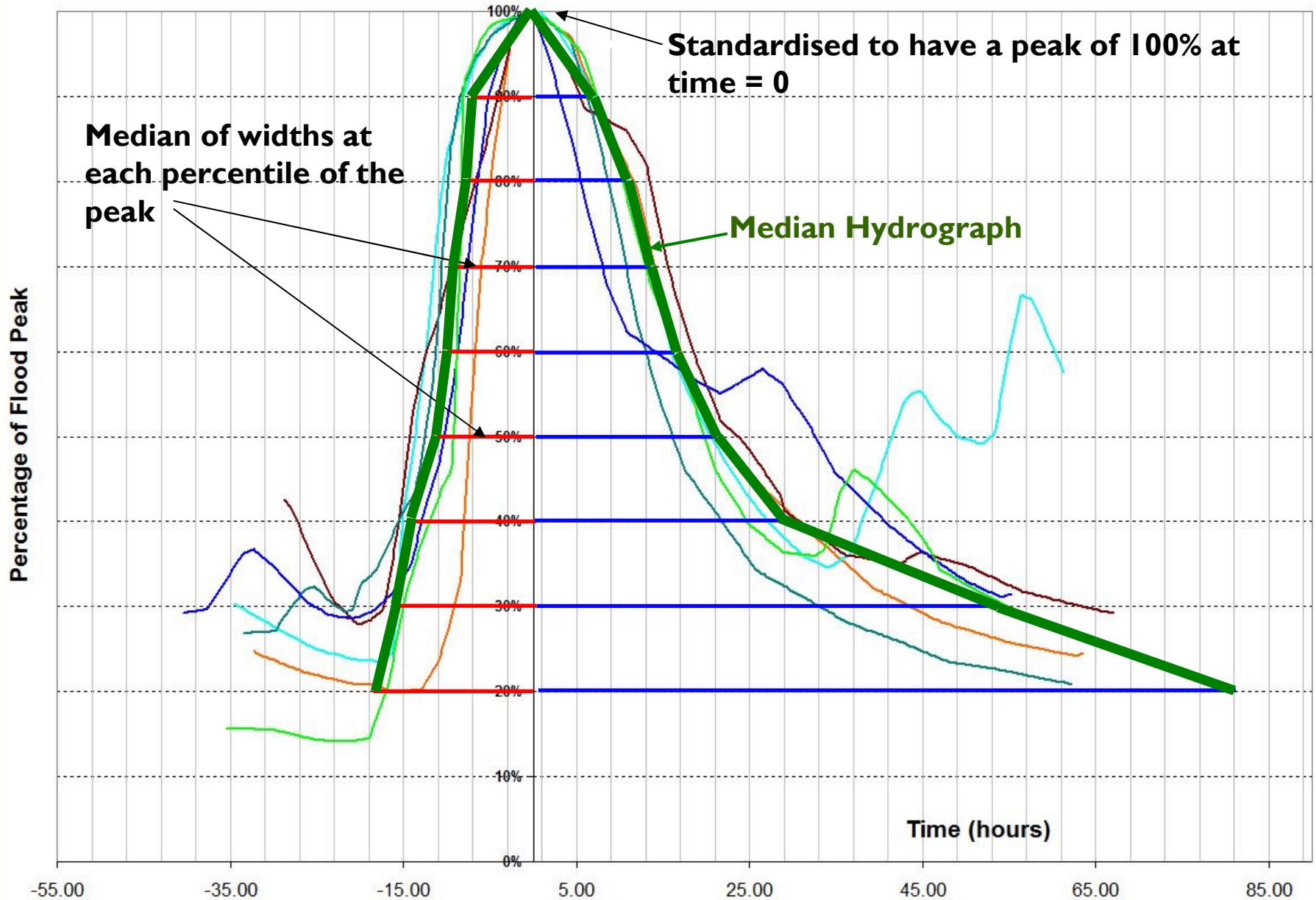
Hydrology & Coastal Section

Hydrograph Width Analysis – Gauged Locations

- Largest hydrographs were extracted from 89 A1 and A2 FSU stations and a 'median hydrograph' derived for each gauge

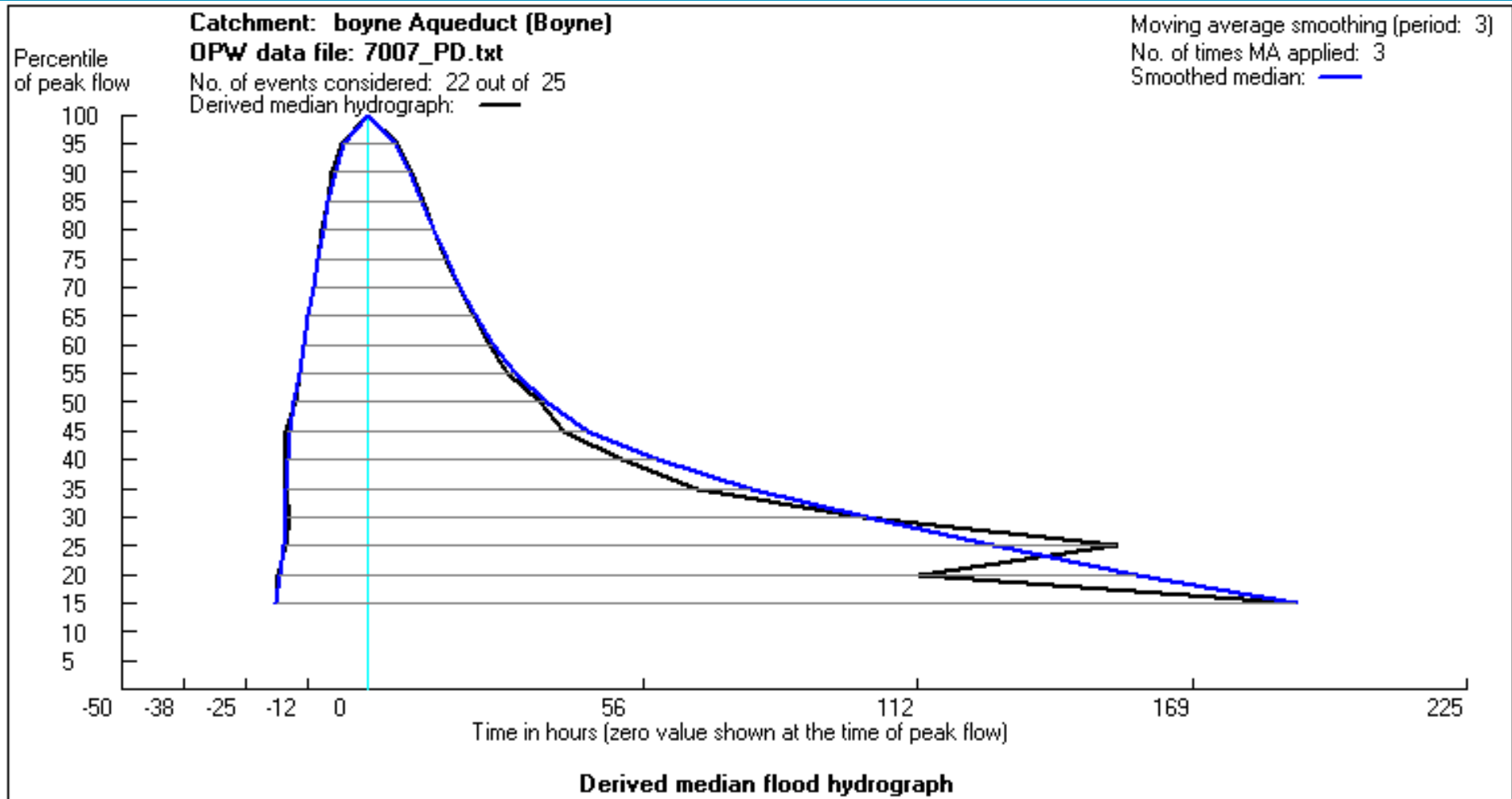


Hydrograph Width Analysis – Gauged Locations



Hydrograph Width Analysis – Gauged Locations

- At each gauge a ‘median hydrograph’ is derived
- Irregularities and kinks are smoothed or truncated



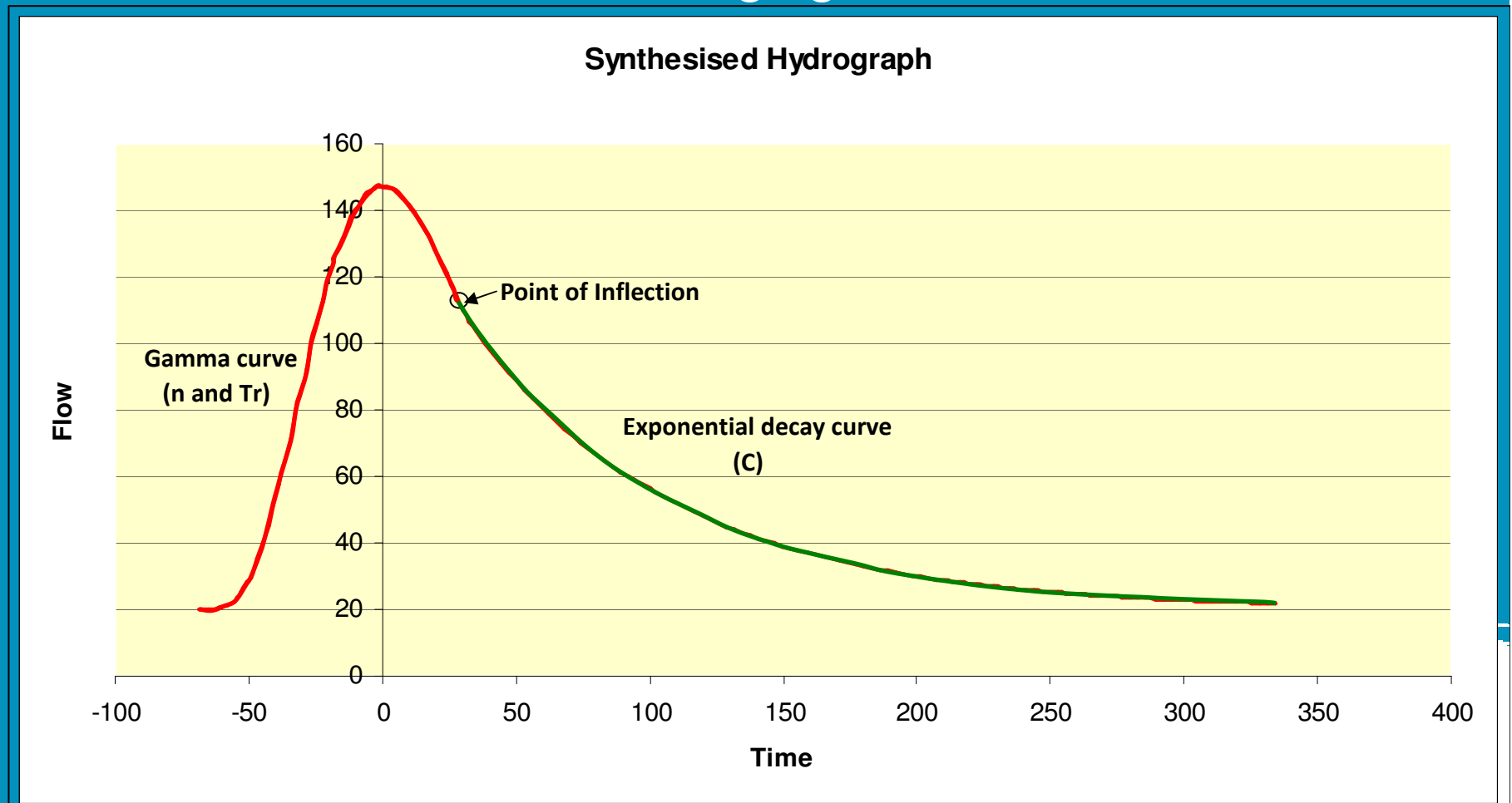
Hydrograph Width Analysis – Gauged Locations

- A Gamma curve and an Exponential recession curve are fitted to the smoothed median hydrograph
- To Plot the Gamma Curve we require two parameters
 - ‘ n ’ - the Shape parameter and
 - ‘ T_r ’ - the Translation parameter
- To Plot the exponential recession curve we require one parameter
 - ‘ C ’ is the recession parameter



Hydrograph Width Analysis – Gauged Locations

- These shape, translation (location) and recession parameters are used to construct the 'characteristic hydrograph' for each FSU station – and can be calculated at gauges



Flood Hydrograph Synthesis - Ungauged Locations

- Similar to QMED, the shape parameters can be estimated for ungauged locations using PCDs:

$$n = 3.86 BFI^{0.96} FARL^{2.98}$$

$$Tr = 54.98 BFI^{1.32} (1+ALLUV)^{-13.08} (1+ARTDRAIN)^{-3.70} S1085^{-0.20}$$

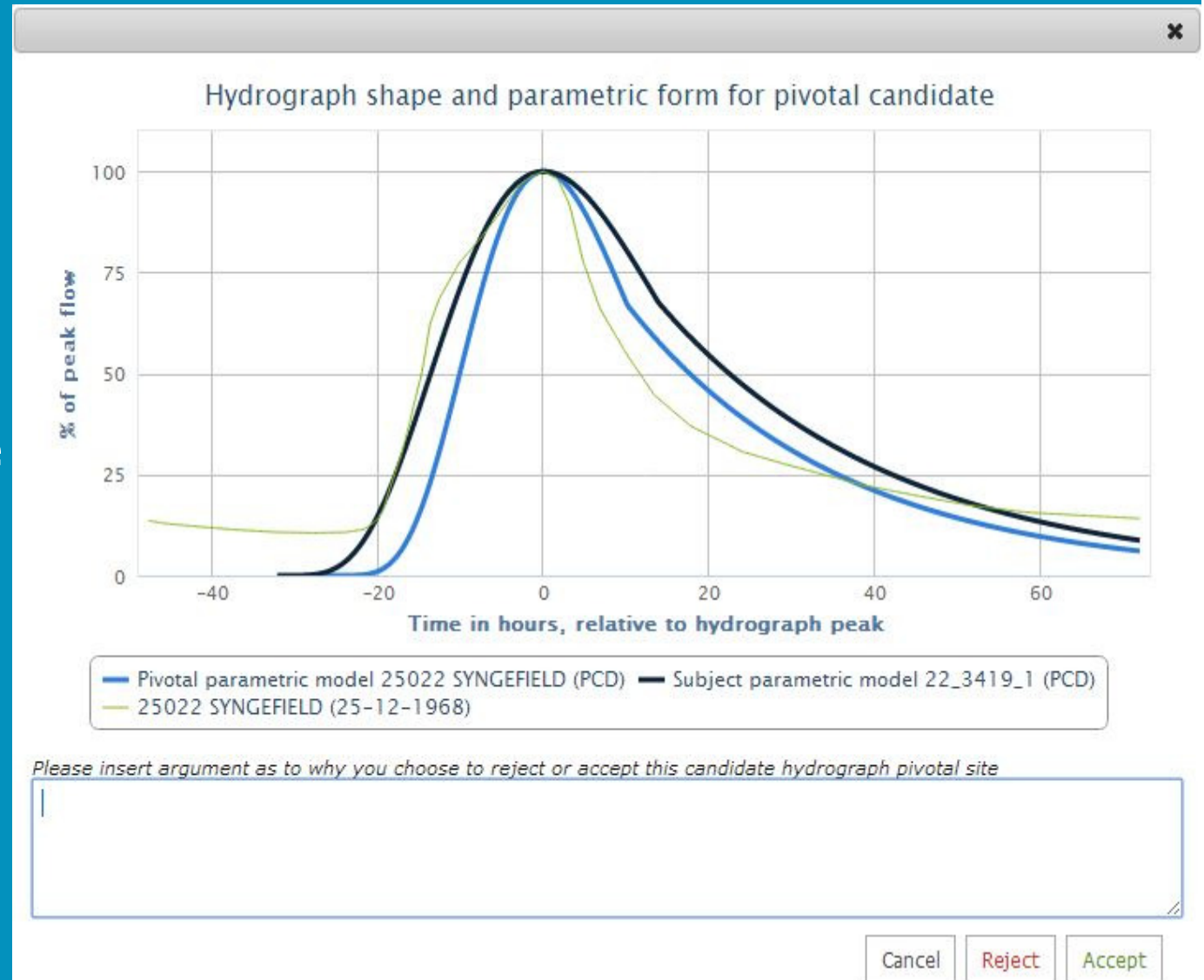
$$C = 310.75 BFI^{3.44} FARL^{-4.88}$$

- Choose a hydrologically similar Pivotal Site
- The hydrograph shape parameters (from PCDs) at the Pivotal Site are 'adjusted' to achieve a best fit curve to the observed data for that site
- This 'pivotal site adjustment' is then applied to the hydrograph shape parameters (from PCDs) at the Subject Site



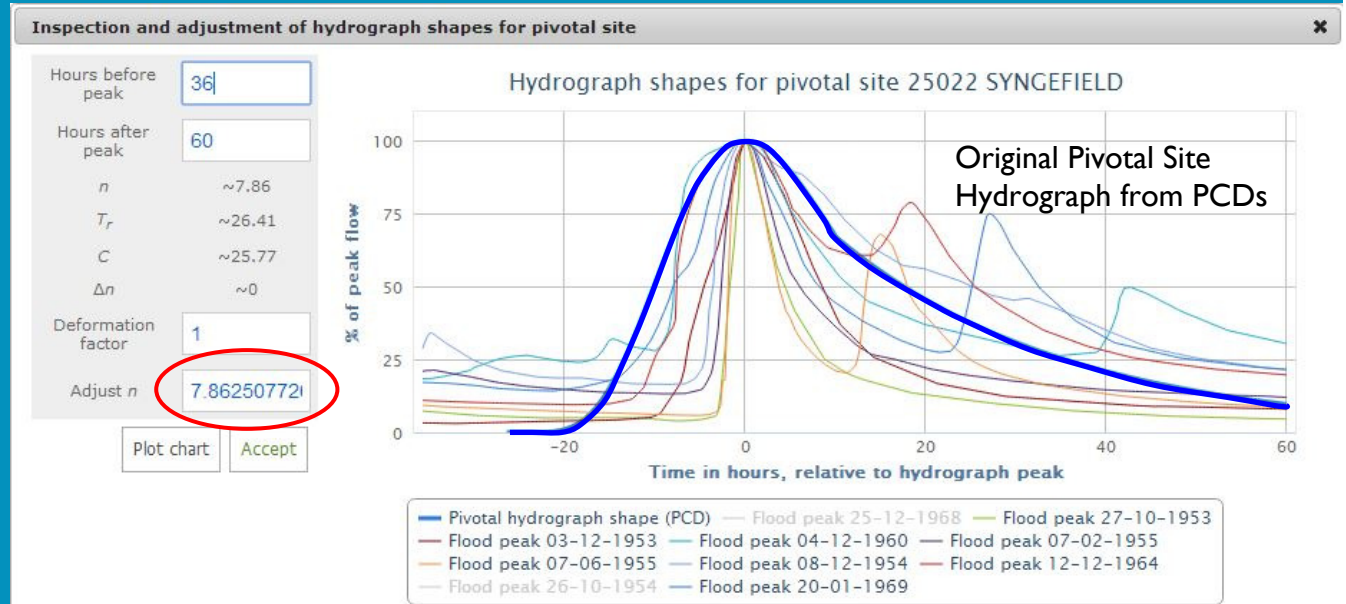
Flood Hydrograph Synthesis – Ungauged Locations

- First select a Hydrograph Pivotal Site
- The Portal suggests some candidates based on hydrological similarity

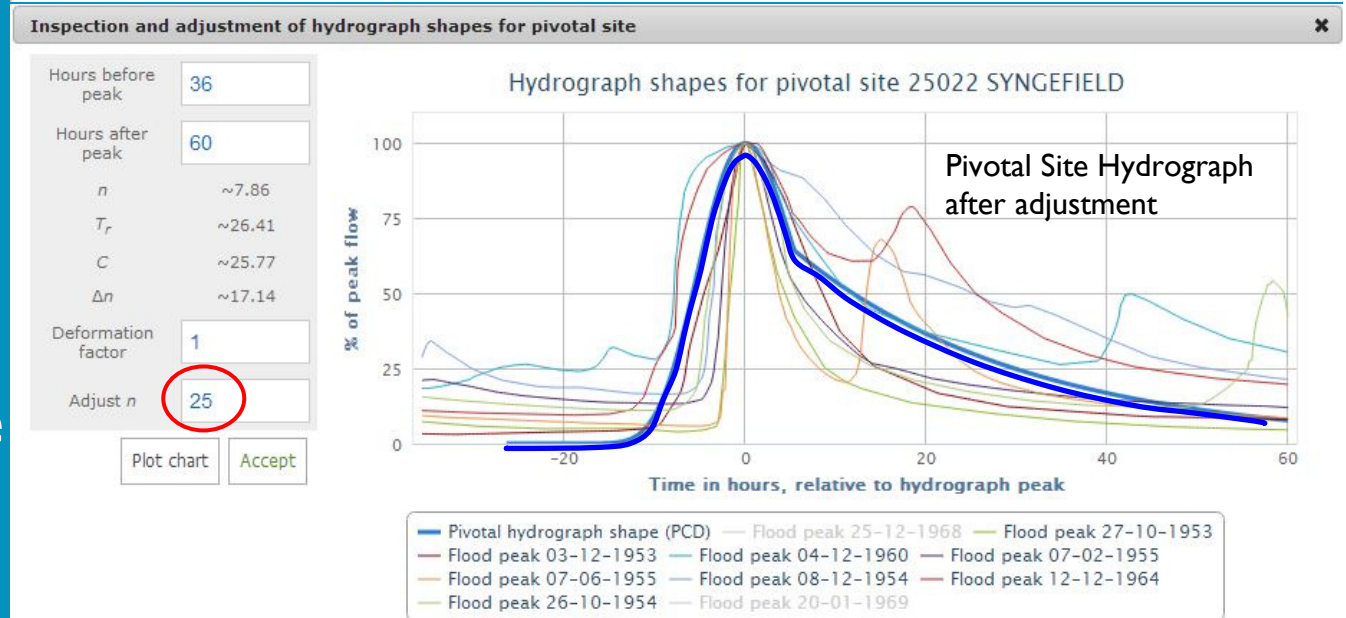


Flood Hydrograph Synthesis – Ungauged Locations

- Then adjust the shape at the Pivotal Site, so that it is representative of all the hydrographs at that site



- The magnitude of this adjustment is recorded by the Portal



Flood Hydrograph Synthesis – Ungauged Locations

- The same adjustment that is made at the Pivotal Site is transferred to the Subject Site

Transfer of characteristic hydrograph to the subject site

Adopted hydrograph	AdjustedPCD hydrograph
Original n	~ 6.43
Original T_r	~ 32.23
Original C	~ 28.37
Deformation factor	~ 1
Deformed T_r	~ 32.23
Δn	~ 18.57
Adjusted n	~ 25

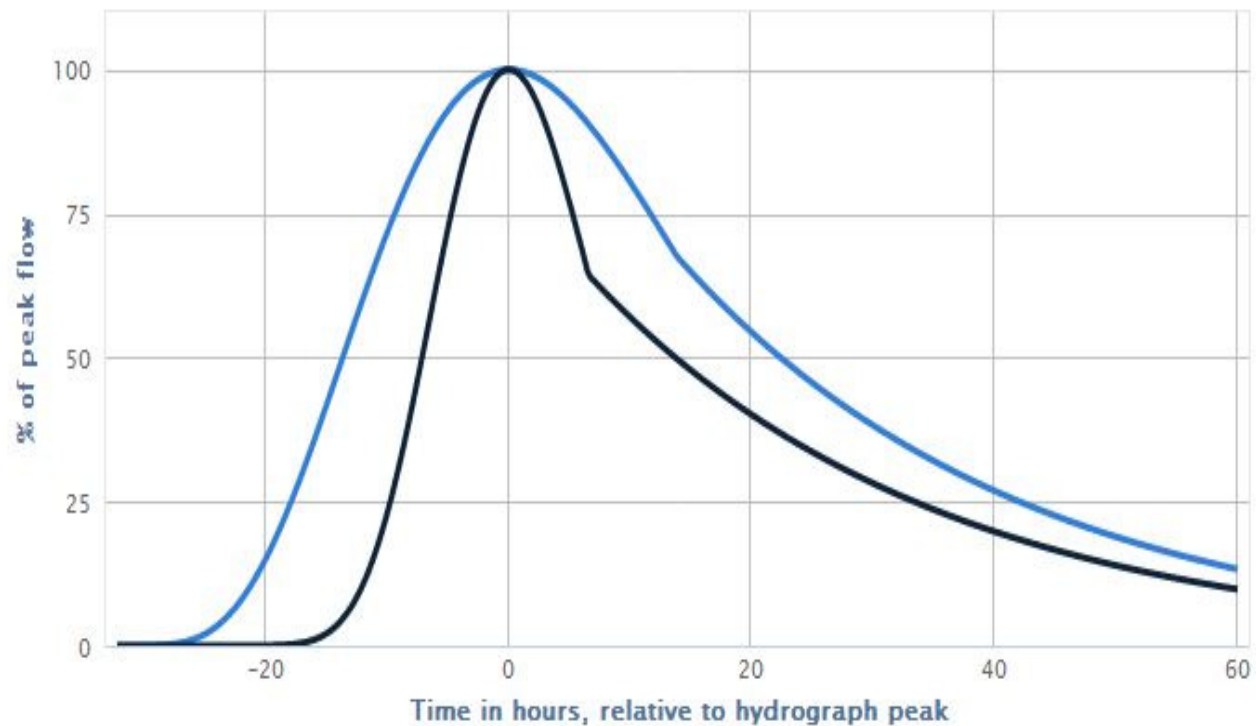
Adjusted estimate ▼

Deformation factor

Plot chart

Accept

Original and adjusted hydrograph shapes for subject site 22_3419_1



— Original hydrograph shape 22_3419_1 (PCD) — Adjusted hydrograph shape 22_3419_1 (PCD)

Flood Hydrograph Synthesis – Ungauged Locations

- Final Reporting of Design Hydrograph Shape
- Hydrograph ordinates are scaled up by Q_T

Completing the flood estimation

Characteristic hydrographs

Click on one of the buttons to show the hydrograph for that return period

Hours relative to peak	T=5	T=10	T=25	T=50	T=100	T=200
-32.23	0	0	0	0	0	0
-32	0	0	0	0	0	0
-31	0	0	0	0	0	0
-30	0	0	0	0	0	0
-29	0	0	0	0	0	0
-28	0	0	0	0	0	0
-27	0	0	0	0	0	0
-26	0	0	0	0	0	0
-25	0	0	0	0	0	0
-24	0	0	0	0	0	0
-23	0	0	0	0	0	0
-22	0	0	0	0	0	0
-21	0.01	0.01	0.01	0.01	0.01	0.01
-20	0.02	0.02	0.03	0.03	0.03	0.03
-19	0.06	0.07	0.08	0.09	0.1	0.11
-18	0.17	0.19	0.22	0.25	0.27	0.29
-17	0.41	0.47	0.54	0.6	0.65	0.7
-16	0.9	1.03	1.19	1.3	1.42	1.54
-15	1.8	2.05	2.37	2.6	2.83	3.06
-14	3.32	3.78	4.36	4.79	5.21	5.64
-13	5.68	6.46	7.45	8.19	8.92	9.65
-12	9.1	10.36	11.95	13.13	14.3	15.47
-11	13.76	15.67	18.07	19.85	21.62	23.38
-10	19.73	22.46	25.9	28.46	30.99	33.52
-9	26.94	30.66	35.37	38.86	42.32	45.77
-8	35.18	40.04	46.19	50.74	55.27	59.77
-7	44.11	50.2	57.9	63.61	69.28	74.93
-6	53.24	60.6	69.89	76.79	83.63	90.45
-5	62.07	70.64	81.48	89.51	97.49	105.44
-4	70.05	79.72	91.95	101.02	110.03	119
-3	76.71	87.3	100.69	110.63	120.49	130.31
-2	81.67	92.95	107.21	117.79	128.28	138.75
-1	84.7	96.4	111.19	122.16	133.04	143.89
0	85.7	97.55	112.51	123.61	134.62	145.6
1	84.74	96.45	111.24	122.21	133.11	143.96
2	81.98	93.31	107.62	118.24	128.78	139.28
3	77.71	88.44	102.01	112.07	122.06	132.01
4	72.24	82.22	94.84	104.19	113.48	122.73

Design hydrograph for subject site 22_3419_1, T=100

— Design hydrograph for subject site 22_3419_1, T=100

Finish