DIAGRAMS OF HUNTER RIVER FLOODS

Chief Engineer
Water Conservation & Irrigation
1 SEP 1913

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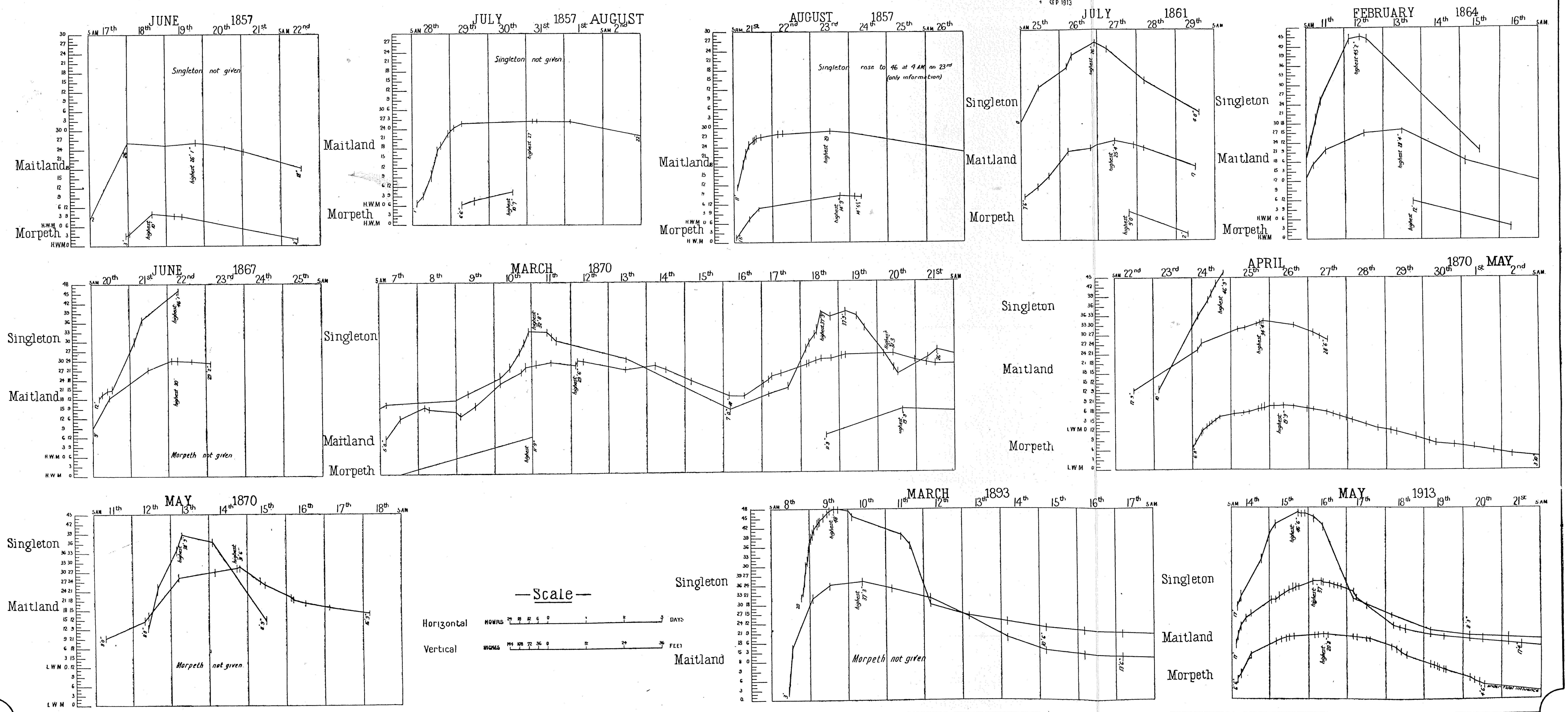
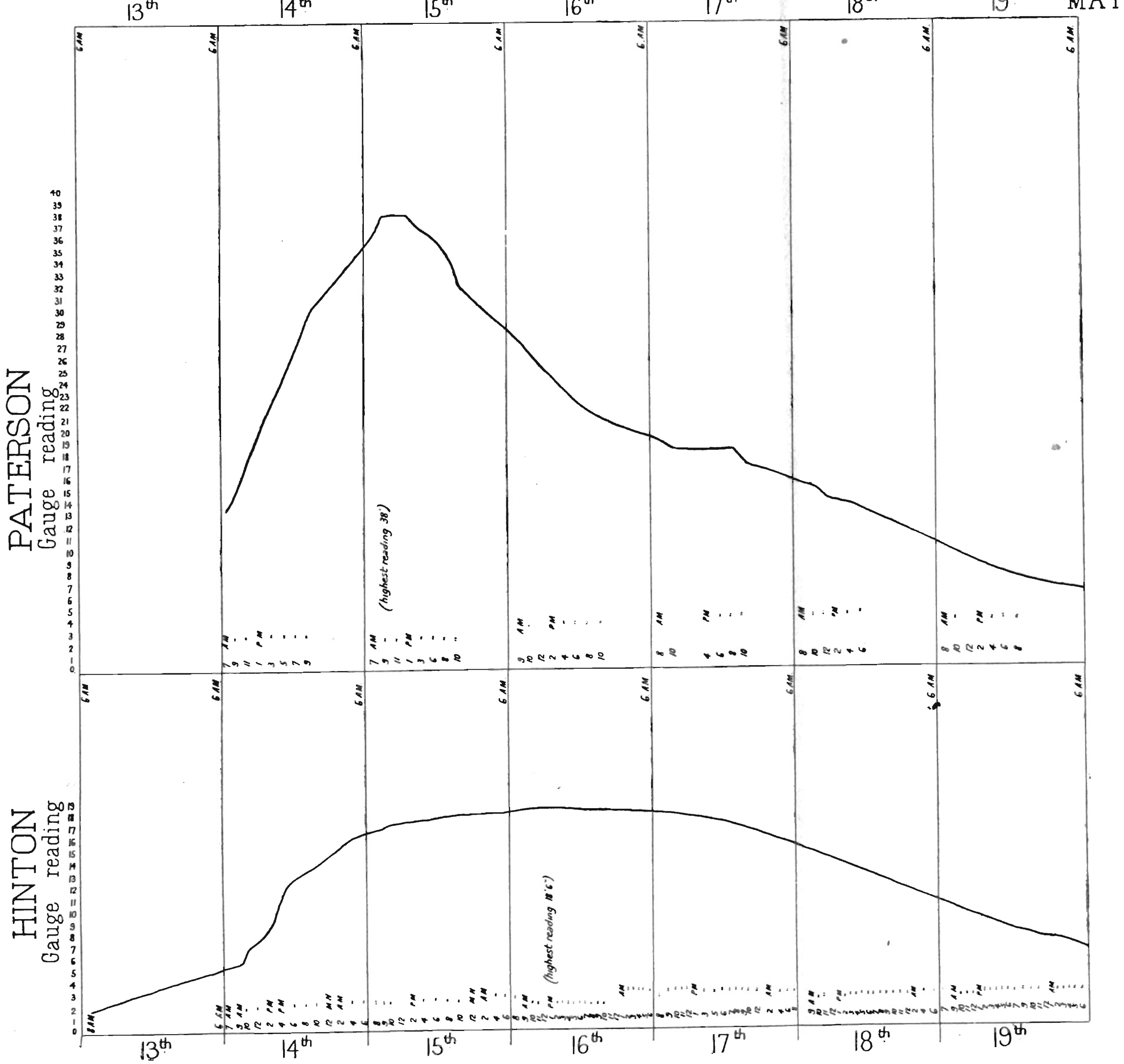


DIAGRAMS SHEWING HEIGHTS OF FLOOD IN VARIOUS RIVERS–1913

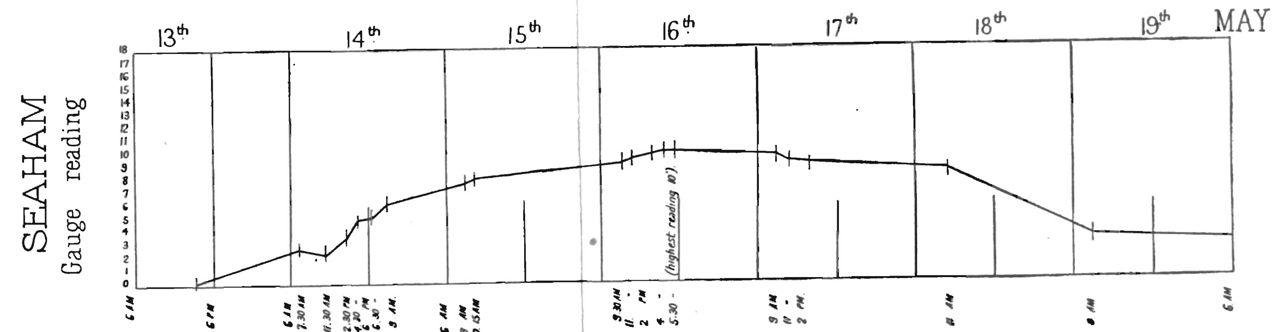
H. H. Dare
Chief Engineer
Water Conservation & Irrigation
1–SEP 1913

Scales: Horizontal 0 6 12 24 36 Hours; Vertical 0 3 6 12 24 Feet

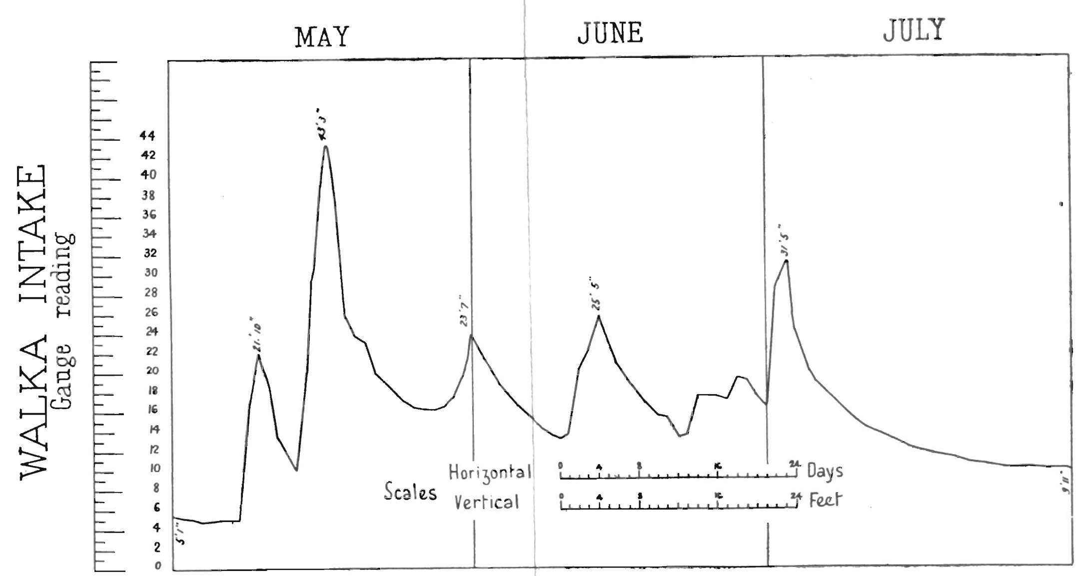
PATERSON RIVER



WILLIAMS RIVER



HUNTER RIVER



the quantity of water which broke out. Of late years also several of the river bends have been cut through below West Maitland, thus reducing the length of the channel between West Maitland and Morpeth, as stated by Mr. Darley in 1901, from 15¾ miles to 6 miles, and giving a quicker discharge for the river between those points.

The scope of this paper does not include Flood Prevention, for which many schemes have been formulated, but in passing it may be noted that the heights of floods in the Maitland Valley is largely influenced by the fact of whether the Paterson and Williams Rivers are also in flood at the same time. It has been observed that the first flood wave to reach Maitland is due to the waters from the Wollombi Brook and other streams between the junction of the Goulburn and Hunter Rivers and Maitland. This water reaches Maitland well ahead of that from the more distant portions of the catchment, and if, after passing Morpeth, it meets the flood waters of the Paterson and Williams, the lower river becomes gorged before the main body of the flood passes Maitland.

In the May flood the Paterson River at Paterson commenced to rise early in the morning of the 14th, and by 9 a.m. on the 15th had reached its maximum of 38 feet, a rise of 24 feet 6 inches in 24 hours (Plate 4).

At Hinton the maximum height of 18 feet 6 inches was reached at 1 p.m. on 16th, but a large body of water had come down before then, the river standing at 16 feet 6 inches on the gauge so far back as 6 a.m. on the 15th May (Plate 4).

At Seaham, on the Williams, a short distance above its junction with the Hunter, the highest reading was 10 feet at 5.30 p.m. on 16th, but here also the river was high on the morning of the 15th May.

It will be seen, therefore, that in the May flood there was a large body of water in the lower river before the crest of the flood passed Maitland.

With regard to the influence of these rivers upon previous floods, the following information has been abstracted from Mr. Moriarty's Report:—

With regard to the floods of February, July and August, 1864. no information is given.

Flood of August, 1857.—Reached maximum at Maitland, Sunday, 23rd August, at sundown. "The Paterson had come down bank high on Friday (21st) morning before the Hunter, and broke over Phœnix Park and Dunmore."

Flood of June, 1857.—"The Hunter, the Paterson and the Williams were all in flood about the same time."

July, 1857.—"The flood attained its greatest height at Morpeth earlier than it did at West Maitland. This is, I think, to be attributed to the backing up of the Hunter by the Paterson in the early part of the flood."

July, 1861.—"This flood, which rose with unusual rapidity, subsided almost as quickly. This perhaps is in some measure attributable to the rain having ceased to fall heavily after Saturday morning, as well as to the circumstance of the Paterson and Williams being but slightly flooded, thus allowing the waters of the Hunter to drain off more rapidly than they would have done had they been pent up by the backwater of those rivers, as occurred in some of the former floods."

August, 1861.—"A considerable amount of damage was also caused by this flood to the residents of the Paterson and Williams, on both of which the alluvial flats were flooded."

June, 1864.—"On this occasion both the Williams and Paterson were in flood. . . . . . . The Paterson rose with a rapidity never know before."

June, 1867.—"Paterson in high flood."

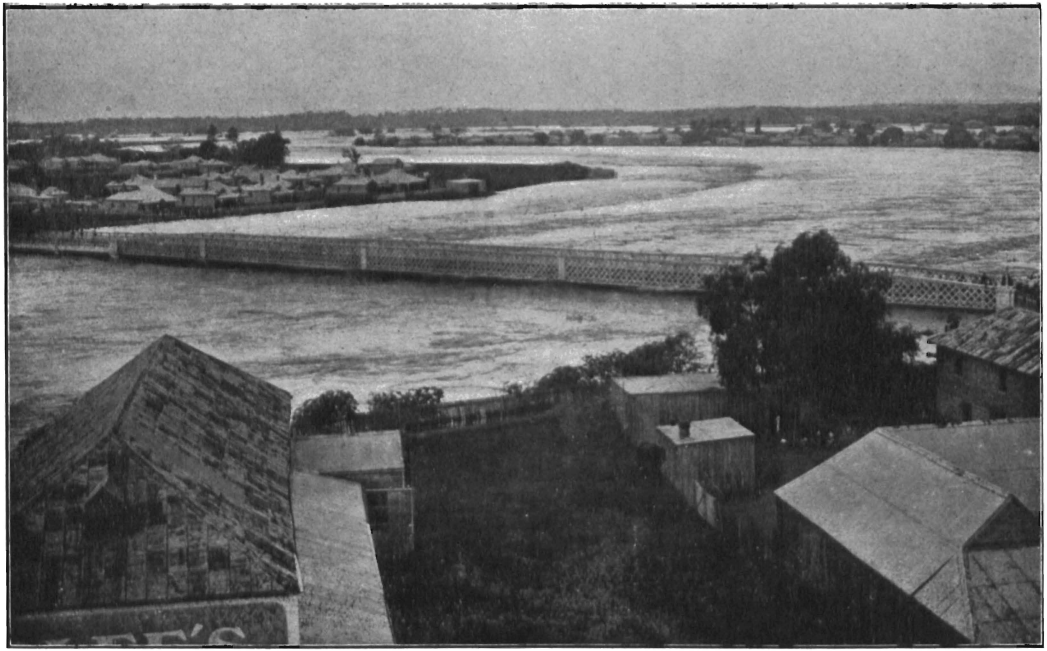
Another important consideration affecting the height of the floods at Maitland is the fact of whether the Upper Hunter and Goulburn Rivers are both in high flood at the same time. In the May flood, while the Hunter was a raging torrent at Muswellbrook, the flood in the Goulburn was only moderate. The gauge readings at Rosemount, on the Goulburn, a short distance above the junction of the two rivers, were at 8.30 a.m. on 14th May, 3 feet; at 8.30 a.m. on 15th, 22 feet; at 8.30 a.m. on 16th, 10 feet. The river then receded steadily to normal level.

In the Cockfighter Creek (or Wollombi Brook), on the other hand, the flood was reported to have been higher at Bulga than in the 1893 flood.

DAMAGE CAUSED BY FLOOD.

Although the May flood rose to within a few inches of the 1893 flood, the damage to the town of West Maitland, and to the district generally was much less than in the 1893 flood. On the present occasion the levees on the Bolwarra side, above the town held, and the residences on the opposite side of the river, in the vicinity of Belmore Bridge, were saved from inundation.

At Morpeth, the 1913 flood was nearly 5 feet lower than the 1893 flood, while so far as could be ascertained after careful enquiry, there was a difference between the two floods of over 10 feet (Appendix B) at Luskintyre Bridge and Elderslie Bridge, which are situated between West Maitland and Singleton. Elderslie Bridge was in existence in 1893, but Luskintyre Bridge has been built since then. The levels of the 1913 flood were connected at both bridges with the known levels of the railway line by Engineer-Surveyor Granter, who states that he has no reason to doubt



FLOOD AT BELMORE BRIDGE.

the information furnished by residents as to the relative heights of the floods. Taken in conjunction with the fact that the recent current meter gaugings at Walka show a marked diminution in the average velocity over that previously measured at the same place, the evidence points to a possible constriction in the river channel in the vicinity of Maitland, causing a heaping up of the water at that place. This suggestion should, however, be received with caution, inasmuch as though at Singleton and Maitland, the height of the two floods was nearly the same, there may have been some difference in the conditions, affecting the height at the two bridges referred to, and also at Morpeth.

Although generally not so severe as in 1893, the damage was very serious. A great extent of country was flooded, and in a number of houses the water stood for days, while on the farms many acres of lucerne land were swept by the flood waters, which deposited in some instances large deposits of sand. At Oakhampton the rush of the waters following on the breaking of the embankments completely wrecked five houses and undermined and damaged others. At Price's farm, on the Pig Run, the hayshed, together with a large area of land was swept away. The gas supply was cut off in the town, owing to the inundation of the Gasworks. The railway line was damaged in the vicinity of Maitland, where the signals were also washed down, and the water rose over the platform of West Maitland Railway Station to the level of the third step leading up from the platform. Beyond Singleton a long length of permanent way was washed out. Railway and mail traffic to and from the North were suspended at mid-day on the 15th May, and it was not until the evening of the 18th that a steamer from Morpeth brought the first load of passengers and mails to Newcastle, while it was about five days later before through traffic on the railway was resumed.

DISCHARGE OF FLOOD.

The discharge of previous floods has been estimated by various authorities as under:—

Year	Authority	Locality	Max. Discharge in Cusecs
1857	Moriarty	Singleton	129,330
,,	,,	Belmore Bridge	91,729
,,	,,	Pitnacree Bridge	35,600
,,	Napier Bell	Above Cummins' Dam	150,000
1870	,,	,,	200,000
1893	,,	,,	250,000
,,	Price	Woodlands near Denman	234,000
,,	,,	Singleton	150,000

An estimate by Engineer-Surveyor French of the May flood places the maximum discharge at Belmore Bridge as 182,100 cusecs., to which must be added a volume estimated at 24,680 cusecs. passing under Long Bridge, or 206,780 cusecs in all.

Mr. French was fortunately at West Maitland when the flood was at its height and commenced gauging from Belmore Bridge at 10 a.m. on 16th May. The current meter used was of the Amsler Laffon type, weighted with 30lb. of lead. The river was then at about 37 feet on the gauge on the town side, and the water surface was broken into waves which piled high up against the bridge cylinders, and frequently washed on to the deck. Due doubtless to the influence of the bend in the river the water was 2.12 feet higher at the West Maitland abutment than on the other side, thus giving a cross slope in the river surface.

The handrail on the downstream footway of the bridge was marked out in 33 feet lengths (Plate 5) and the meter suspended at each point to depths below the surface, varying from 6 inches to 5 feet. To go lower was impracticable, owing to the high velocity of the current and danger from floating logs. After applying a correction, found by experiment, for the sag of the meter from the vertical due to the current, it was estimated that the maximum surface velocity at any point was about 17.88 feet per second. This velocity varied at the different points, and the average surface velocity throughout the whole cross section was 15.24 feet per second. The discharge was obtained by multiplying each 33 feet area of cross section by the mean velocity for that section, and applying a co-efficient of .85, representing the ratio of the mean velocity for the whole depth to the mean surface velocity.

The area of the cross section of flood was 14,054 square feet, the mean surface velocity 15.24 feet per second, and the mean velocity 12.95 feet per second.

With regard to the overflow which passed under Long Bridge, no meter observations were made, but soundings were taken from the upstream side of Long Bridge at 20 feet intervals, and the velocity estimated approximately by noting the speed of passing debris.

Another observation was made between 2 p.m. and 5 p.m. on the same day, which gave an estimated discharge of 169,910 cusecs, or 194,590 cusecs, including overflows.

RUN OFF FROM CATCHMENT.

Taking the period from 7 a.m. on 14th May to 9 a.m. on 22nd May, during which the Walka gauge readings advanced from 19 feet to 43 feet 3 inches, and back to 19 feet, the total estimated flood discharge amounted to about 41,240,000,000 cubic feet. This is equivalent to 2½ inches mean depth over the whole catchment of 7,090 square miles, and as the average rainfall over the catchment during the same period was 6 inches, this represents a run off of 42 per cent. This is equivalent to 29 cusecs per square mile of catchment. which coincides very closely with the run off per square mile given by Mr. R. E. Horton, in the "Engineering Record" of 12th April, 1913, for the larger New York streams during the recent disastrous floods in the United States, viz.:—

Stream	Locality	Drainage Area Square Miles	Max Discharge	Cusecs Per Square Mile
Hudson River	Mechanicsville	4,500	120,000	26.7
Mohawk River	Cohoes	3,472	98,970	28.5

CO-EFFICIENT IN KUTTER'S FORMULA.

An approximation has been made to the co-efficient N to be allowed in Kutter's formula when the flood was at its maximum. Taking the Walka gauging site, which is situated between Belmore Bridge and Cummins' Dam, the following obtain:—

Slope S = .00069
Area of Waterway = 17,889 square feet
Wetted perimeter = 936 feet
Ratio R = 19.1
Taking N = .03 the discharge by formula is 178,000 cusecs., which coincides very nearly with 182,100 cusecs, as gauged at Belmore Bridge.

PLAN OF FLOODED AREA.

As soon as it was possible to reach Maitland, Mr. Shute, Engineer in Charge of Surveys and River Gauging, proceeded to obtain information as to the maximum flood heights in the Maitland Valley, and a plan has been prepared showing the extent of the flooded area.

Sketches have also been furnished showing the breaches in Cummins' Dam and the Oakhampton embankments, and information in connection therewith, supplied by Mr. E. Nash, Inspector, Maitland District, for the Hunter District Water Supply and Sewerage Board, and Mr. T. P. Davies, District Works Officer, Newcastle.

In addition to these two gentlemen, the author wishes to express his indebtedness to Messrs. Shute, French and Granter for information supplied, and to Mr. J. Davis, M.Inst. C.E., Director General of Public Works. for lantern slides of photographs made by Mr. J. Degotardi, Government Photographer. Also to Mr. L. A. B. Wade, M.Inst. C.E., Commissioner for Water Conservation and Irrigation, for permission to contribute this paper to the Society.

APPENDIX A.

TABLE SHEWING

Current Meter Observations taken on Hunter River and Tributaries, May to August, 1913.

Date 1913	Site	Height	Rise or Fall During Observation	Observer
		ft. in.		
May 16th	Belmore Bridge, West Maitland	37 0	Staty.	French
,, ,,	,,	37 0	Fell 6 in.	,,
,, 21st	Walka Pumping Station, West Maitland	19 9½	,, 1½ in.	Williams
,, 22nd	,,	18 10	,, 2 in.	,,
,, ,,	,,	18 6	,, 1 in.	,,
,, 23rd	,,	18 1	,, 1½ in.	,,
,, 24th	,,	17 4	,, 1¼ in.	,,
,, 26th	,,	16 1½	Rose ½ in.	French
,, ,,	,,	16 2	,, ½ in.	,,
,, 27th	,,	15 10½	Fell ½ in.	,,
,, 28th	,,	16 10½	Rose 3 in.	,,
,, ,,	,,	17 4½	,, 1½ in.	,,
,, 30th	,,	20 0	,, 3 in.	,,
,, ,,	,,	20 6	,, 4 in.	,,
,, 31st	,,	23 7½	Fell 1½ in.	,,
June 2nd	,,	20 4	,, 1 in.	,,
,, ,,	,,	19 7½	,, 1½ in.	,,
,, 3rd	,,	18 3½	,, 1½ in.	,,
,, 5th	,,	16 0½	,, ¾ in.	Granter
,, 8th	,,	13 7	,, ½ in.	,,
,, 10th	,,	14 0½	Rose 3 in.	,,
,, 13th	,,	25 2½	Fell 5½ in.	,,
,, 14th	,,	22 11	,, 2½ in.	,,
July 11th	,,	13 9½	,, ¼ in.	,,
,, 12th	,,	13 4	,, 1 in.	,,
,, 14th	,,	12 5½	,, ½ in.	,,
,, 16th	,,	11 10	,, ½ in.	,,
,, 22nd	,,	10 5½	Staty.	,,
,, 24th	Walka Pumping Station, West Maitland	10 2	,,	,,
,, ,,	,,	10 2	,,	,,
,, 26th	,,	10 1½	Fell ¼ in.	,,
,, 30th	,,	10 0½	,, ½ in.	,,
,, 31st	,,	9 11	,, ½ in.	,,
Aug. 2nd	,,	9 7½	Staty.	,,
,, 4th	,,	9 4	Fell ½ in.	,,
,, 5th	,,	9 1½	Staty.	,,
,, 6th	,,	9 1½	,,	,,
,, 7th	,,	9 0	,,	,,

APPENDIX A—*Continued.*

Hunter River at Morpeth.

Date 1913		Site	Height ft.	in.	Rise or Fall during Observation	Observer
June	17th	At Morpeth	2	11	Fell 2½ in. Rose 3 in.	Granter
,,	18th	,,	3	3	Fell ½ in.	,,
July	1st	,,	14	2⅛	Rose and Fell 1 in.	,,
,,	2nd	,,	15	11½	Rose 1½ in. Fell ½ in.	,,
,,	3rd	,,	9	1	Fell 10½ in.	,,
,,	4th	,,	5	2	Staty.	,,
,,	4th	,,	4	11	Fell 2 in.	,,

Hunter River at Singleton.

Date 1913		Site	Height ft.	in.	Rise or Fall during Observation	Observer
May	20th	At Singleton	7	11½	Fell 1 in.	French
July	2nd	,,	16	1	,, 2 in.	,,
,,	3rd	,,	11	2	,, 3 in.	,,
,,	3rd	,,	10	7	,, 5 in.	,,
,,	4th	,,	9	0	,, 1 in.	,,
,,	4th	,,	8	10	,, ½ in.	,,
,,	30th	,,	4	0	Staty.	Williams
,,	31st	,,	3	11	Fell ¼ in.	,,
,,	31st	,,	3	10½	,, ¼ in.	,,
Aug.	1st	,,	3	10	,, ½ in	,,
,,	1st	,,	3	9½	,, ¼ in.	,,
,,	2nd	,,	3	9	,, ¼ in.	,,
,,	4th	,,	3	7½	Staty.	,,
,,	7th	,,	3	4½	,,	French

Hunter River at Muswellbrook.

Date 1913		Site	Height ft.	in.	Rise or Fall during Observation	Observer
July	21st	At Muswellbrook	4	0¼	Staty.	Granter
,,	30th	,,	3	11	Fell ¼ in.	Shute
Aug.	1st	,,	3	9½	Staty.	,,
,,	2nd	,,	3	7½	,,	,,
,,	4th	,,	3	7	,,	,,

Hunter River at Moonan.

Date 1913		Site	Height ft.	in.	Rise or Fall during Observation	Observer
May	27th	At Moonan	3	1	Staty.	Williams
,,	28th	,,	2	10	,,	,,
,,	30th	,,	3	4½	Rose ½ in.	,,
,,	30th	,,	3	11	Fell 1 in.	,,
,,	30th	,,	3	9	,,	,,

APPENDIX A—*Continued.*

Goulburn River at Rosemount.

Date 1913		Site	Height ft.	Height in.	Rise or Fall during Observation	Observer
May	23rd	At Rosemount	2	1½	Staty.	Granter
,,	26th	,,	1	9	Rose 1 in.	,,
,,	27th	,,	1	8½	Staty.	,,
,,	27th	,,	1	8¼	,,	,,
,,	28th	,,	1	9½	,,	,,
,,	28th	,,	1	9½	,,	,,
,,	30th	,,	3	8	Fell 1 in.	,,
,,	30th	,,	3	7½	Rose ½ in	,,
,,	31st	,,	4	2	Rose 3 in.	,,
July	31st	,,		5½	Staty.	Shute
Aug.	1st	,,		5	Fell ¼ in.	,,
,,	2nd	,,		5	Staty.	,,
,,	3rd	,,		5	,,	,,

Wollombi Brook at Warkworth.

July	30th	At Warkworth	2	6½	Staty.	French
Aug.	1st	,,	2	4½	Fell ½ in.	,,
,,	4th	,,	2	1	Staty.	,,
,,	5th	,,	2	0½	Fell ½ in.	,,
,,	6th	,,	1	11¾	Fell ¼ in.	,,

Fal Brook at Camberwell.

July	31st	At Camberwell	2	6	Staty.	French
Aug.	2nd	,,	2	4¾	,,	,,
,,	4th	,,	2	4	,,	,,
,,	6th	,,	2	3	,,	,,

APPENDIX B.

MAXIMUM HEIGHT OF FLOODS.

Reduced to Datum of Zero of Gauges Existing May, 1913, and also to Water Conservation Datum.

	1820.		1857		1870.		1893.		1913.	
	Gauge Height.	R.L.	Gauge Height.	R.L.	Gauge Height.	R.L.	Gauge Height.	R.L.	Gauge Height.	R.L.
Singleton	58 ft. above Summer level (Moriarty)	..	46 ft. above Summer level (Moriarty)	..	46ft. 9in. above Summer level (Moriarty)	..	47 ft. 7 in.	136.62	46 ft. 6 in.	135.54
Elderslie Bridge..	..	..	..	..	..	..	..	106.15	..	95.03
Luskintyre Bridge	..	..	..	..	..	..	..	82.87	..	72.72
Belmore Bridge ..	40 ft. 4 in. † above L.W.M. (Govt. Astronomer)	35.09 (Napier Bell)	29 ft. above H.W.M. (Moriarty)	30.25	34 ft. 4 in. above L.W.M. (Moriarty)	32.46	37 ft. 3 in.*	35.39	37 ft. 0 in.	35.14
Pitnacree Bridge	..	..	..	20.13	..	..	28 ft. 0 in.	25.43	..	..
Morpeth	..	..	14 ft. 9 in. above H.W.M. (Moriarty)	15.55	19 ft. 9 in. above L.W.M. (Moriarty)	16.05	24 ft. 6 in.	21.25	20 ft. 2 in.	16.86
Green Rocks ..	..	..	..	11.57	..	10·86	..	17.14	14 ft. 0 in.	13.88
Raymond Terrace			7 ft. 10 in. above H.W.M. (Moriarty)	7.82	7 ft. 7 in. above H.W.M. (Moriarty)	..	..	..	9 ft. 9 in.	14.35
Hexham	..	..	..	5.18	..	5.27	..	10.64	..	..

* This is the figure obtained by Mr. French from Mr. Nash, Inspector, Hunter District Water Supply and Sewerage Board. Mr. Wilkie, Gauge Reader, Belmore Bridge, states that in 1893 the flood was 2 feet higher than in 1913 In Mr. Napier Bell's Report the height is given as 37 feet. In the above Table Mr. Napier Bell's figures have been modified on the basis of 37 feet 3 inches.

Figures for 1820 to 1893 are based on Reports of Mr. Moriarty and Mr. Napier Bell.

† The Government Astronomer, in 1893 Rain and River Observations, states that the 1820 flood was 3 feet 10½ inches higher at West Maitland than in the 1893 flood. Mr. Moriarty states that the height of the 1820 flood at West Maitland was 40 to 41 feet on the gauge in use in 1868. Mr. Napier Bell gives the height of the 1820 flood, as 0.05 feet lower than in 1893.

Reduced Level of Zero of Gauges Referred to Low Water Spring Tides, Newcastle.

Singleton Gauge, R.L., 93.76 above L.W.S.T., N.
Maitland ,, ,, 2.86 ,, ,, ,,
Walka ,, ,, 0.35 ,, ,, ,,
Morpeth ,, ,, 1.41 ,, ,, ,,

Green Rocks Gauge, R.L., 4.60 above L.W.S.T., N.
Raymond Terrace ,, ,, 4.60 ,, ,, ,,
Hexham ,, ,, 4.60 ,, ,, ,,

To reduce to Water Conservation Datum deduct 4.72 from L.W.S.T., N values.