

“THE RIVER MURRAY WATERS SCHEME.”

By

H. H. DARE, M.E., M.Inst.C.E.

(A Paper read before the Sydney University Engineering Society,  
on October 22nd, 1919.)

In August, 1903, Mr. R. T. McKay delivered a very interesting lecture before this Society upon “The Murray River, Irrigation and Navigation,” describing the Murray River and its tributaries. Mr. McKay was the professional Secretary of the Interstate Royal Commission which dealt with the River Murray proposal in 1902, and in his lecture he referred to the resolutions arrived at by that Commission, of which Mr. J. Davis, M.Inst.C.E., was Chairman.

A summary of the history of the various proposed Interstate agreements was given in a speech delivered at the laying of the foundation stone for the Blanchetown lock and weir in June, 1915, when the Hon. Crawford Vaughan, then Premier of South Australia, stated that:

“As early as 1887 a Royal Commission was appointed by the South Australian Government, with the Hon. J. H. Howe as Chairman, to consider the question of the allocation of the waters of the Murray between New South Wales, Victoria, and South Australia. This Commission was merged into an Interstate Commission in 1902 to make a full inquiry and report ‘concerning the conservation and distribution of the waters of the Murray and its tributaries for the purposes of irrigation, navigation, and water supply.’ That Commission recommended the construction of storage works at Cumberoona and Lake Victoria, and weirs at the Murray Mouth, the cost of which should be borne in equal shares by the three States, and a weir and headworks at Bungowannah, to be paid for by New South Wales and Victoria in equal shares. The recommendation also included a first instalment of a complete locking scheme, from Blanchetown to Wentworth (which it was suggested the Federal Government might be induced to carry out), and the appointment of a permanent Commission to control the waters of the Murray and its tributaries. Further agreements were drawn up in 1903, 1906, and 1907; but it was not until 1908 that finality seemed to be reached, when the Premiers of the three States signed an agreement that was to be submitted to the various Parliaments for approval. The measure passed the second reading of the South Australian Parliament, but unfortunately was not proceeded with in

New South Wales and Victoria. The 1908 agreement provided for the appointment of a permanent River Murray Commission to control everything concerning the Murray waters, that the Lake Victoria storage works and two locks and weirs in the Murray should be constructed and paid for in equal shares by the three States, and that a total yearly volume of sixty thousand million cubic feet of water should be delivered at the boundary of South Australia, subject only to reduction in years of low discharge. It was not until 1910 that authorisation was given to the Murray Works Act, under which the William R. Randell Lock was now being constructed. That measure also authorised the construction of the Lake Victoria Works, and two weirs and locks in the Murray, subject to the consent of the States of New South Wales and Victoria, and also the construction of a system of locks and weirs from Blanchetown to the boundary. In order to carry out this great undertaking South Australia engaged the services of Major Johnston, of the Corps of Engineers, United States Army, and through the courtesy of the United States Government, he was allowed to visit South Australia. It was upon Major Johnston's plans, reports, and estimates that this work was being carried out. In 1911 an agreement was arrived at between the three States, under which authority was given to South Australia to proceed with the Lake Victoria scheme, subject to the consent of the Parliaments of New South Wales and Victoria. The fate of this agreement was like that of its predecessors. . . . In 1913 the last agreement was born. Three States and the Commonwealth adopted the role of godfather to this lusty infant."

The agreement referred to by Mr. Vaughan was that arrived at by the three States interested and the Commonwealth, following upon the report in July, 1913, of the Interstate Conference of Engineers, Messrs. E. M. de Burgh, J. S. Dethridge, and Graham Stewart, Ms.Inst.C.E., appointed in 1911 by New South Wales, Victoria and South Australia to report and make such recommendations as "will, in their opinion, be essential or conducive to a settlement by agreement . . . of the question of the River Murray and its tributaries."

#### INTERSTATE ENGINEERS' REPORT.

This Report is a most important document, since it formed the basis upon which the agreement ultimately arrived at was based, and brief reference will be made to some of the principal conclusions arrived at.

Contributions.—The proportions of contributions at that date by each State to the flow of the River Murray, as deduced from averages of all stream gaugings, was determined for various stations, as under:

- (a) At Jingellic. Average annual flow as gauged, 1,728,000 acre feet. Percentage contributions, N.S.W. 66.4 per cent.; Victoria 33.6 per cent.
- (b) At Albury. Average annual flow 3,432,000 acre feet. The Mitta Mitta and Kiewa Rivers, rising in Victoria, join the Murray above Albury. Percentage contribution, New South Wales 34.6 per cent.; Victoria 65.4 per cent.
- (c) At Torrumbarry (about 50 miles below Echuca). Average annual flow, 4,859,000 acre feet. The Ovens, Broken, Goulburn and Campaspe Rivers, all rising in Victoria, join the Murray between Albury and Torrumbarry. Percentage contribution, New South Wales 16.7 per cent.; Victoria 83.3 per cent.
- (d) At Mildura. Average annual flow, 7,472,000 acre feet. The Murrumbidgee River, with its tributary the Tumut, rising in New South Wales, and the Loddon River, rising in Victoria, join the Murray between Torrumbarry and Mildura. Percentage contribution, New South Wales 39.1 per cent.; Victoria 60.9 per cent.
- (e) At Lake Victoria. Average annual flow, 13,440,000 acre feet. The Darling River, in proportion, 64 per cent. to Queensland and 36 per cent. to New South Wales, joins the Murray River between Mildura and Lake Victoria. Percentage contribution, New South Wales 38.4 per cent.; Victoria 45.8 per cent.; Queensland 15.8 per cent.

Losses by Evaporation and Percolation.—After a study of the actual losses obtained from gaugings on several sections of the main river, and its tributaries, it was concluded that “for present purposes an average of the losses by percolation and evaporation might be taken as .0003 per unit of volume, per mile of river.”

Losses in storages were roughly estimated as 4 feet in depth per annum in the Upper Murray Storage, 6 feet in Lake Victoria, and 9 feet in the river from Lake Victoria to the mouth, disregarding the expansion of the river into Lakes Alexandrina and Albert.

Storages.—It was shown that from examination of a typical diagram of flow, e.g., at Albury, the natural river flow is in most years sufficient for irrigation requirements from August to December inclusive, but that there would be a shortage in the months January to April, so that to make the fullest possible use of the waters of the River Murray System, regulation by storages is necessary. Such storages would not only make good the shortage during the latter part of the irrigating season, but would also be beneficial in allowing for the use

of a much greater quantity of the natural flow during the earlier period. It was not considered possible, however, to provide for the conditions obtaining during abnormal droughts such as 1902-03.

The 1902 Royal Commission proposed a storage on the Upper Murray of 582,000 acre feet. The Interstate Engineers arrived at the conclusion that this should be increased to 1,000,000 acre feet, and that "such a storage, with the aid of the natural flows of the Mitta and Kiewa Rivers, would enable a regulated flow of 240,000 acre feet a month for the nine months August to April inclusive, to be maintained at Albury."

Extent of Regulation Considered Practicable in Existing Circumstances.—Under a previous Interstate agreement it had been decided that South Australia's share of the flow should be delivered at a weir to be constructed below the off-take of Frenchman's Creek for the purpose of diverting water into Lake Victoria. The Engineers' conclusions as to the extent of regulation practicable on the main river and its principal tributaries are most important, and are quoted in full as under:

"In general, it may be said, that the object of storage is to conserve the flood discharge to supplement the low discharge of the same year. Its economic limits are determined by such periods of low flow as that from the year 1896 to the year 1899 inclusive.

"The following is a statement of the regulated flows that would be made available—subject to some diminution in such abnormally dry seasons as 1902-03—as the result of existing works, works under construction, and works suggested by this Conference for construction:—

1. At Albury by the storage at Cumbaroona, on the Upper Murray, of 1,000,000 acre feet, and by the natural flow of the Mitta and Kiewa Rivers. . . . .	240,000
2. In the Goulburn, at Murchison, by the construction of further reservoirs, to make a total storage of 720,000 acre feet . . . . .	126,000
3. In the Murrumbidgee, at Berembled, by the Burrinjuck Storage, of 766,000 acre feet, and the natural flow of the Tumut River . . . . .	120,000
4. At the outlet from Lake Victoria by the Lake Victoria Storage of 500,000 acre feet in conjunction with the flow of the River Murray . . . . .	114,000
5. The natural summer flows of the Ovens, Broken, and Campaspe Rivers . . . . .	26,000
<b>Total,</b>	<b>626,000</b>

“It may be found desirable and financially practicable to extend works for regulation to other tributaries, as development of settlement demands a greater water supply, but the cost of these per unit regulated will be considerably higher than that of any of the works now suggested.”

Extent of Irrigation Possible with Above Regulation.—  
It was estimated that, allowing for a mean irrigation period of nine months, the total annual quantity available for diversions for irrigation, after providing for losses, etc., would be 4,779,000 acre feet as under:—

Total of regulated flows as above . . . . .	626,000	
Less Allowance for—		
Riparian stock and domestic supply . . . . .	10,000	
Evaporation and percolation ..	80,000	
Lockage requirements in South Australia . . . . .	5,000	
	<hr/>	95,000
		<hr/>
		531,000
		<hr/>

Nine months by 531,000 equals 4,779,000 ac. ft. per annum.

Deduct losses between points of diversion and the irrigable lands 40 per cent. . . . .	1,911,600	ditto.
	<hr/>	

Nett volume delivered at the irrigators' fields. . . . .	2,867,400	ditto.
	<hr/>	

Allowing for a use of 2 acre feet of water, this quantity would provide for the irrigation of, in round figures, 1,400,000 acres, or nearly six times the area then under irrigation in the three States.

The approximate estimates of irrigable land along the Murray and its tributaries, as furnished by the three States, was much larger than this figure, viz., 7,400,000 acres.

Assuming that existing works, including the Murrumbidgee Irrigation Scheme, when in full operation, would provide water for the irrigation of 600,000 acres, there would remain 800,000 acres yet to be selected for irrigation in the three States, for which works of distribution would be required.

Conclusions.—Certain unanimous conclusions were arrived at by the Engineers, but Mr. Graham Stewart was in disagreement with the other members as to the basis of the suggested agreement between the three States.

I do not propose to traverse further the Engineers' report, but will now describe briefly the principal provisions of the agreement, based upon this report, which was eventually arrived at.

#### RIVER MURRAY WATERS ACT.

Works.—On 31st January, 1917, the River Murray Waters Act came into force. This Act provides for:—

- (1) The provision of a storage on the Upper Murray.
- (2) The provision of a storage at Lake Victoria.
- (3) The construction of 26 weirs and locks from Blanchetown, in South Australia, to Echuca; and
- (4) The construction of 9 weirs and locks on the Murrumbidgee River from its junction with the Murray to Hay; or, alternatively, on the Darling River, from its junction with the Murray upstream, involving an equivalent expenditure.

The total estimated cost of the above works, as set out in the agreement embodied in the Act, is £4,663,000, of which the Commonwealth will provide a sum, limited by statute to £1,000,000, and the balance will be provided by the States of New South Wales, Victoria, and South Australia in equal shares.

The Act provides that, so far as is reasonably practicable, the Lake Victoria Works shall be completed within four years, the Upper Murray Storage works within seven years, and all other works within twelve years after the agreement comes into effect.

Commission.—The River Murray Commission, which administers the Act, consists of one Commissioner from each of the States, with a Commonwealth Commissioner as President. The first Meeting of the Commission was held on 14th February, 1917, with Senator F. J. Lynch as President, and Messrs. H. H. Dare, M.Inst.C.E., J. S. Dethridge, M.Inst.C.E., and Graham Stewart, M.Inst.C.E., representing the three States interested. Subsequently, upon the resignation of Senator Lynch in August, 1917, the Honorable W. A. Watt acted as President for a short period, and latterly, since 28th March, 1918, the Honorable L. E. Groom, Federal Minister for Works and Railways, has presided, while, since the death of Mr. Graham Stewart in 1918, South Australia has been represented by Mr. J. H. O. Eaton. Mr. T. Hill, M.V.I.E., acts as Deputy Commissioner for the Commonwealth.

Responsibilities of Commission.—The responsibility for constructing the various works does not rest with the Commission, but with the "Constructing Authorities," the Minister for

Public Works in New South Wales, the State Rivers and Water Supply Commission in Victoria, and the Commissioner of Public Works in South Australia.

Various duties are, however, assigned to the Commission. Among others to—

- (a) Carry on “an effective and uniform system” of stream gauging of the River Murray, and of such of its tributaries as the Commission deems necessary to determine the volume of flow at various points in the channels, and losses therefrom, and the volume of all diversions, whether natural or artificial.
- (b) Deal with matters of finance, collecting from the three States and the Commonwealth their shares of the estimated expenditure for each year, and remitting to the States the funds required for the works to be carried out.
- (c) Approve of the general schemes of works, as submitted by the States, and of designs and estimates for such works, with or without alterations or additions.
- (d) Order and direct in point of time the order in which works are to be constructed, and the rate of progress of same, and method and extent of the maintenance to be carried out by the States.
- (e) Collect tolls and apportion same to the States.

Distribution of Waters.—The Act provides that the following distribution of the waters shall be made, but not until the Lake Victoria and Upper Murray Storage Works are completed, or declared by the Commission to be effective for the purposes of the agreement, or the expiration of a period of seven years from the time the agreement comes into effect (31st January, 1917), whichever first happens.

The flow of the River Murray at Albury will then, including the natural or regulated flows of all tributaries above Albury, as regulated by the Upper Murray Storage, be shared equally by New South Wales and Victoria, subject to reduction on account of any diversions either State may make from streams above Albury.

Below Albury, New South Wales and Victoria will each have the full use of all tributaries, with the right to divert, store and use the flows thereof.

Both of above provisions are subject to a specified contribution towards the share allotted to South Australia. The proportion of the contributions by New South Wales and Victoria for this purpose, and for town supply, domestic and stock supply, and other uses, is arrived at by determining the

ratio which "the mean natural flow of the tributaries of each State below Albury, measured at the points of affluence with the River Murray, with half the actual mean flow at Albury, added in each case, bear to each other."

The minimum quantity to be allowed to pass to South Australia is to be sufficient to fill Lake Victoria once, and in addition to maintain, with the aid of the water returned from Lake Victoria, a regulated supply at the Lake Victoria outlet of the following volumes:—

	Acre Ft.
In January, February, November, and December . . . . .	134,000
In March, September and October . . . . .	114,000
In April, May and August . . . . .	94,000
In June and July . . . . .	47,000

South Australia may also be allotted a further supply after the utilisation for irrigation by New South Wales of 1,957,000, and by Victoria of 2,219,000 acre feet per annum.

Provided that in years of unusual drought the Commission may vary the provisions of the agreement respecting the amounts of water to be used by the various States.

In the case of the Lake Victoria Storage, the Act provides that New South Wales shall have the reasonable use of the water in the Lake by occupiers of an area of 200,000 acres in the vicinity of the Lake for stock and domestic purposes.

### STREAM GAUGINGS.

Before proceeding to a general description of the action taken regarding the various works covered by the River Murray Waters Act, a brief reference will be made to the methods adopted for estimating the discharge of the main river and its tributary streams. The importance of stream gauging data, extending over long periods, cannot be over estimated when determining upon such matters as the capacity of the Upper Murray Storage, and the regulated flow to be anticipated therefrom. Fortunately the collection of this data has been in progress for a number of years, and the Engineers, in framing their report, were able to form a fairly accurate idea of the discharge of the main river at different points, and the relative contributions thereto of the two States, as set out above.

The estimated discharge at Albury, where records have been kept for 34 years, has varied from about 900,000 acre feet in 1902, to about 10,500,000 acre feet in 1917, or sufficient, after deducting the flow of the Kiewa River, to fill the

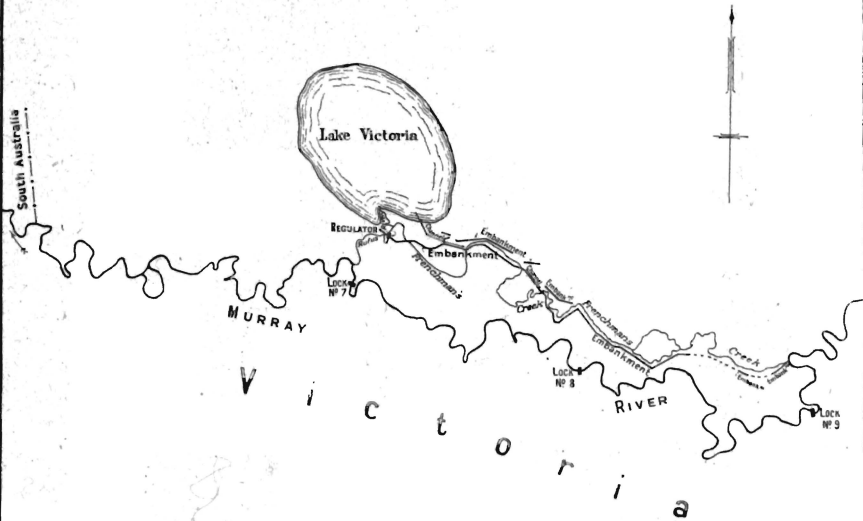


# MURRAY RIVER

## LAKE VICTORIA STORAGE



New South Wales



### PLAN OF LOCK & WEIR

— SOUTH AUSTRALIA —

