

# PLAN OF PROPOSED BARREN JACK STORAGE RESERVOIR

SCALE: 2 MILES TO 1 INCH

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SCHOOL  
OF  
ENGINEERING  
—  
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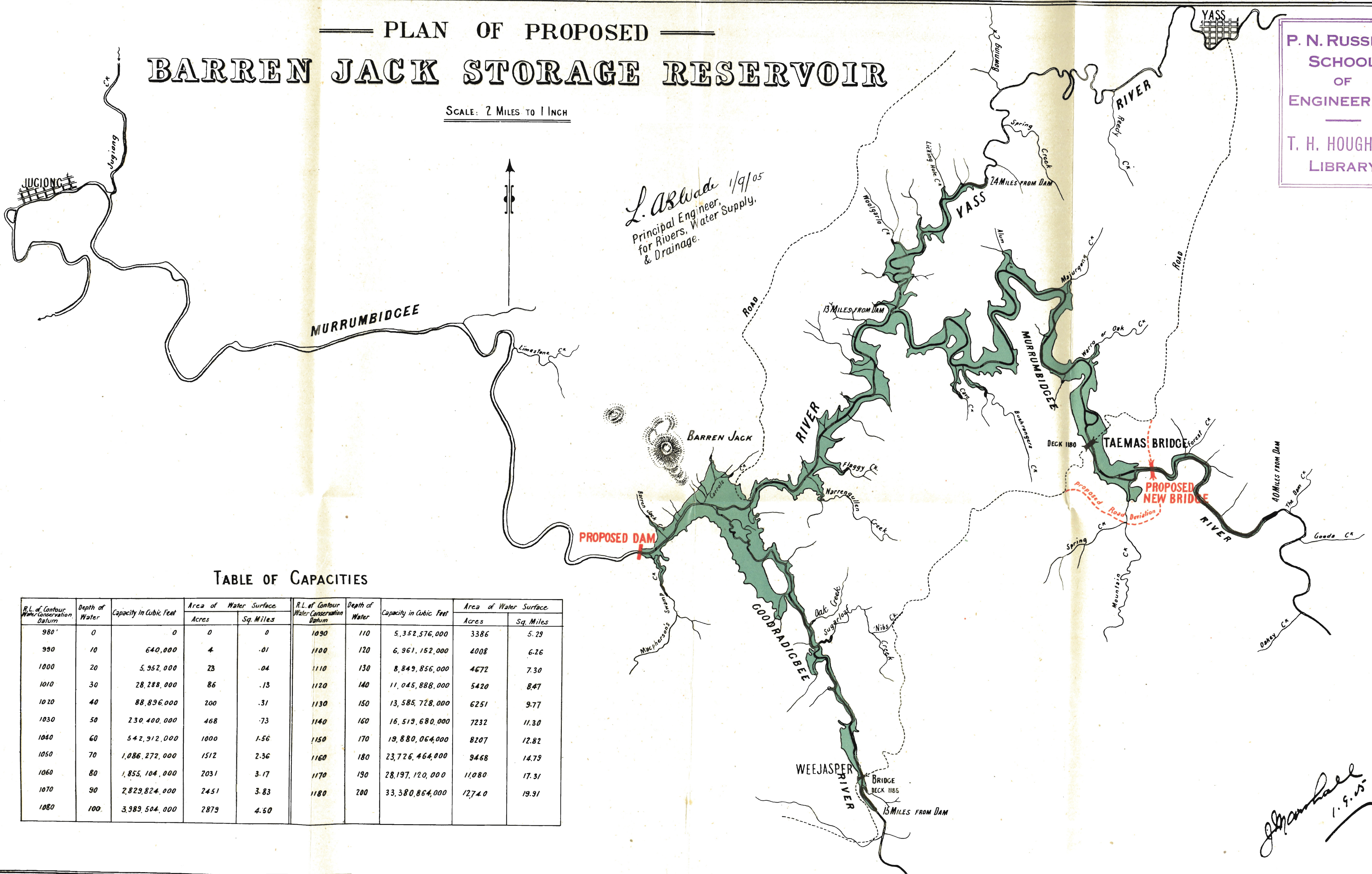


TABLE OF CAPACITIES

R.L. of Contour Water Conservation Datum	Depth of Water	Capacity in Cubic Feet	Area of Water Surface		R.L. of Contour Water Conservation Datum	Depth of Water	Capacity in Cubic Feet	Area of Water Surface	
			Acres	Sq. Miles				Acres	Sq. Miles
980'	0	0	0	0	1090	110	5,352,576,000	3386	5.29
990	10	640,000	4	.01	1100	120	6,961,152,000	4008	6.26
1000	20	5,952,000	23	.04	1110	130	8,849,856,000	4672	7.30
1010	30	28,288,000	86	.13	1120	140	11,045,888,000	5420	8.47
1020	40	88,896,000	200	.31	1130	150	13,585,728,000	6251	9.77
1030	50	230,400,000	468	.73	1140	160	16,513,680,000	7232	11.30
1040	60	542,912,000	1000	1.56	1150	170	19,880,064,000	8207	12.82
1050	70	1,086,272,000	1512	2.36	1160	180	23,726,464,000	9468	14.79
1060	80	1,855,104,000	2031	3.17	1170	190	28,197,120,000	11,080	17.31
1070	90	2,829,824,000	2451	3.83	1180	200	33,380,864,000	12,740	19.91
1080	100	3,989,504,000	2879	4.50					

*J. H. Marshall*  
1.9.05

**BARREN JACK RESERVOIR**

PERIOD 1903-1908

In supplying Irrigation requirements to Canals at Narrandera to Yanko Creek, and for Riparian interests.

REQUIREMENTS

2000 cusecs for Irrigation from September to April inclusive and 500 cusecs for Yanko Creek in June July & August for each year; and 300 cusecs provided for Riparian interests during whole period  
7% allowed for losses between Gundagai and off-take

NOTES Monthly Volumes that would flow naturally past Gundagai shown by fern Black line  
Total Volumes retained in Barren Jack Reservoir shown by dotted Black line  
Minimum Monthly Volumes that can be delivered at Canal off-take by the use of Barren Jack Reservoir shown by hatched Black lines

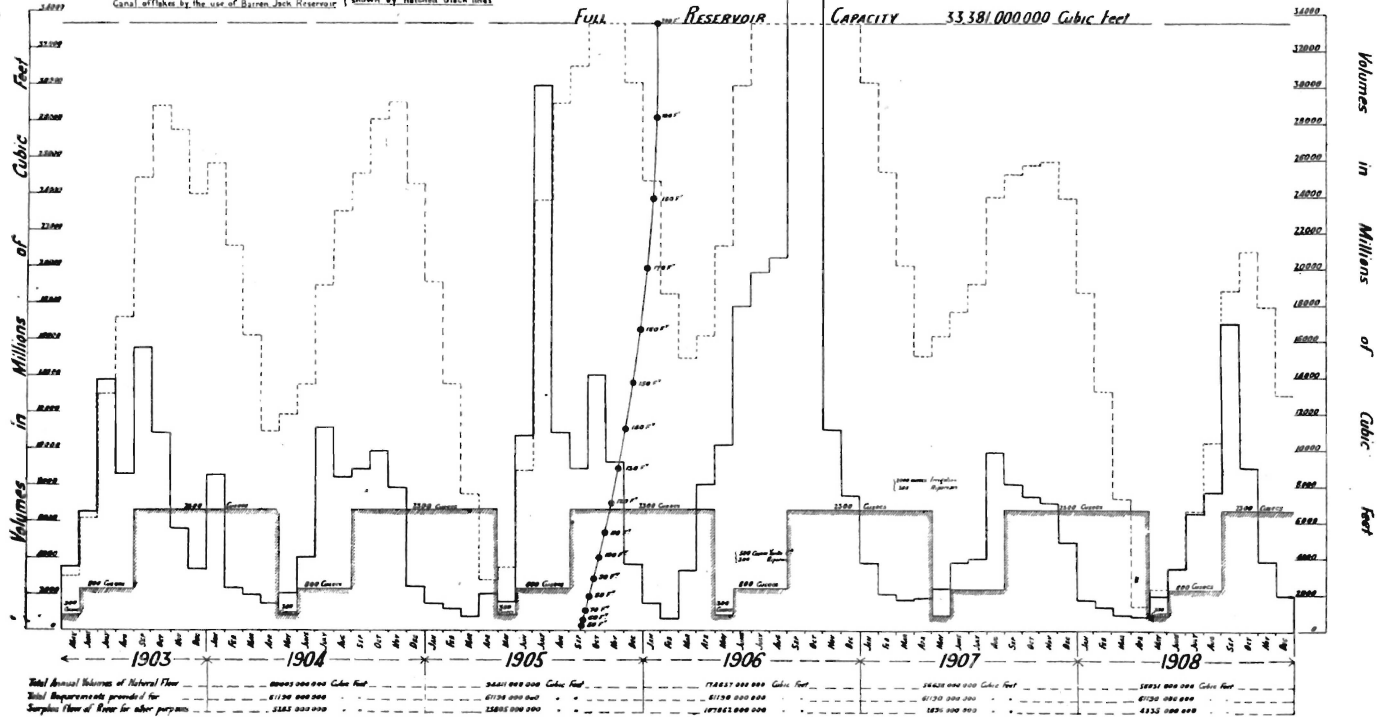


PLATE 3.



volume of flow that it must also be disregarded in arriving at an estimate of the possibilities of the Murrumbidgee River for irrigation purposes. The maximum yearly volume that could be supplied from the Murrumbidgee catchment with a system of regulation by storage reservoirs would be an amount equal to about 95,000 million cubic feet. This would require the construction of an additional storage on the Tumut River of similar capacity to that just described at Barren Jack, if investigation shewed that a suitable and economical site was available. Such a storage would serve to regulate the low flows of 1896-8 inclusive, and would afford, in addition, storage to tide over such years as 1903-8 inclusive. Any attempt to increase the yearly volumes that could be supplied beyond this amount would not be economically justifiable. It will be noted that the increase to the irrigation supply of 50 per cent. indicated is afforded only by increasing the storage by 100 per cent. It is a question for future consideration, contingent on the irrigation policy to be pursued as a result of further experience and also contingent on the terms of any agreement that may in the future be come to with the other riparian States regarding the volumes that are to be afforded to them from the Murray, whether such storage be constructed on the Tumut River in order to afford further volumes of water for irrigation in this State, or whether the surplus waters, as indicated, shall be allowed to pass on to the other riparian States, to satisfy the volumes that may be allotted to them and that must be supplied from the catchment area of the Murray situated within the State of New South Wales.

#### SILTING OF STORAGE RESERVOIRS.

The only cause that might operate to decrease the efficiency of the Barren Jack storage and, therefore, cause any alteration to the estimated behaviour, as indicated on the diagram, would be the possible decrease in capacity by the deposition in the still water of the reservoir of the suspended material carried by the various streams entering it. The percentage rate of decrease in capacity will depend upon the following two factors—the average yearly silt load of the stream, and the capacity of the storage compared to the average annual volumes of silt-laden water passing through it. The table (Appendix C) gives the result of investigations in the United States into the silt loads of various streams and the estimated periods required to effect a reduction of 10 per cent. in storages of various capacities as compared to the annual volumes of water passing through them. The measurement of the suspended silt in the Murrumbidgee waters has been carried on concurrently with the measurement of the flow. Data is, however, still incomplete, but it is considered the Barren Jack storage approximates to a rather

shorter period than example 6 of that table, where the capacity of the storage is equal to an average of 25 per cent. of the annual flow.

#### ACCESS TO BARREN JACK SITE.

Prior to the preparation of the preliminary design and estimate of cost of a storage dam, certain information is required to be obtained in the field. A copy of the draft instructions of the Irrigation and Drainage Branch of the Public Works Department regarding these points is given in Appendix E. The first question that had to be considered was that of access, and the comparative efficiency and economy of road and railway facilities had to be weighed.

The site selected for the construction of the reservoir wall at Barren Jack was not accessible by existing roads. A third of the distance from the railway was covered by the main Southern Road, which was in fairly good order for heavy traffic; another third was covered by roads partially formed and in bad condition; the remaining third would have had to be covered by the construction of a new road. An investigation into the comparative methods of road and railway access on the lines indicated in Appendix E showed that the construction of a railway—all things being considered—would be the more economical course to pursue.

Several routes were investigated, and ultimately one was selected leaving the Main Southern Railway at Goondah, and reaching the dam site via Carroll's Creek in a distance of 27 miles. The class of railway to be constructed was to meet the requirements of the conveyance of about 50,000 tons of cement to the work during construction, the whole of the plant to and from the works that would be used for the construction of the dam wall, all material, etc., such as timber, that would be used in connection with the works, all supplies for the use of the workers, as no access would be afforded by road, and also a very large amount of firewood for boiler purposes in connection with the working of the plant. It was decided to construct a line of a 2 feet gauge, having minimum curves of  $1\frac{1}{2}$  chain radius, and a ruling gradient of 1 in 25 against the load. The route selected for the first 18 miles after leaving the Main Southern Railway at Goondah follows the natural surface of the country, and will not involve heavy earth-work; the last 9 miles down Carroll's Creek winds round the sides of a rugged and precipitous gorge involving heavy rock cuttings until the dam site is reached. It has been found on survey that the ruling grade can be reduced to 1 in 30 against the load.

#### BARREN JACK-GOONDAH RAILWAY.

This railway, being the first of the narrow gauge type to be constructed over such a length in this country, the design



proposed is worthy of description. It should be borne in mind that it is to be laid down for temporary purposes only and is, therefore, to be built practically to meet the requirements of a contractor. The formation widths are to be 8 feet 6 inches in cuttings, and 10 feet in embankment; the design of beam bridges to be uniform in type, the superstructure consisting of two 14in. x 14in. ironbark girders, with a span of 14 feet; where more than one opening is necessary 14in. x 14in. corbels to be provided in addition; these are set on piers constructed of local round timber, bedded on sills. Culverts to be of local round timber, openings 1 to 2 feet in width being spanned by the rail alone. In the case of an insufficiency of headroom, the rail to be supported in a 10in. x 3in. channel iron, in spans of 2 to 4 feet; where there is sufficient headroom, rails to be carried on round timbers. Culverts under deep embankments in the hillside country to be done away with as far as possible by carrying the water from the gullies along a contour drain, and discharging through the solid ground at the end of the embankment at a suitable place. The permanent way to be of 30 lb. B.S. rails on hewn sleepers 8in. x 4in. x 5ft., spaced 2 feet apart, or at the rate of 2,640 to the mile, fastened with dog spikes 3½in. x ½in., at the rate of 3,170 lbs. per mile; cheek rails to be placed on the 1½ and 2 chain curves; the slack between the rails on 1½ chain curves to be ½ inch. The rail joints to be staggered, and rails bedded flat on the sleepers. A transition of 90 links to be given on reverse curves 1½ chain radius and 100 links for curves 2 chains radius. The line to be ballasted at the rate of 900 cubic yards per mile. The rolling-stock proposed to be supplied will have cylindrical tyres on the wheels to run on the flat-bedded rails, and locomotives will have a total weight of 11½ tons, on four wheels, with a wheel base of 4 feet, a tractive force of 4,151 pounds; the trucks will be 10 and 15 tons, having a tare of 3.3 and 5.0 tons respectively. The locomotives will be constructed with a removable back to the cab, so that, if required, they can be coupled back to back, and worked with one crew, practically as an articulated engine of 23 tons weight, which should then be capable of drawing a gross load of 80 tons, or a nett load of about 60 tons. All rolling-stock is to be fitted with the Westinghouse brake. The cost of trans-shipping cement from main line railway trucks is estimated to be not more than 5d. per ton; the total cost of haulage on the narrow gauge line should not exceed 2d. per ton mile.

#### PROVISION FOR PASSING FLOOD-WATERS DURING CONSTRUCTION OF DAM WALL, BARREN JACK STORAGE.

The provision to be made for passing the flow of the river during construction of the dam wall will consist in the first

instance of concrete diversion dams across the river channel above and below the site, coupled together by an excavated diversion channel on the right bank of the river. The dimensions of these concrete diversion walls will be respectively:—

	Upper Wall.	Down-stream Wall.
Length .. ..	210ft.	183ft.
Maximum Height ..	36ft.	32ft.
Top Width .. ..	4ft.	4ft.
Base Width .. ..	17ft.	16ft.

The diversion channel to connect these two walls will be 423 feet long, 30 feet wide, and 15 feet deep, partly excavated and partly formed by a concrete retaining wall. Before the construction of the concrete diversion dams is put in hand, it will be necessary to divert the river flow through the diversion channel by means of a rough dam constructed of heavy rubble and staunches with fine gravel, sand and clay. The diversion dams and channel, as so designed, will be capable of passing a volume of about 8,000 cubic feet per second. This will be sufficient to deal with the small freshets during the early days of the construction of the work, and allow the foundations to be put in and the lower levels of the dam wall carried up.

Further provision will then be made by a tunnel through the dam wall itself, 20 feet wide, 20 feet high, with a semi-circular roof. This tunnel is estimated to discharge 15,800 cubic feet per second, with a velocity of 45 feet per second, under a head of 70 feet. This will enable heavy freshets to be dealt with after the diversion channel has been closed. In addition to the above tunnel, four lines of 4 feet 6 inches diameter cast iron pipes will be carried through the body of the dam for the purpose of dealing with flood-waters after the 20 feet tunnel has been closed, and also to draw off a portion of the supplies for irrigation purposes after the completion of the construction of the wall. It is proposed that, so soon as the construction of the wall has been carried up to R.L. 1070, the 20 feet tunnel is to be filled with concrete and water retained within the storage in order to afford a supply at an early date to the first settlers on the irrigable lands under the canal. The only means of dealing with flood-waters after this stage has been reached will be by means of the four lines of 4 feet 6 inch pipes. It is more than probable that these pipes will not be sufficient on all occasions during the construction to pass floods and that, therefore, portion of the flood-water must be passed at times over the crest of the wall. The work will be so arranged that the upper levels of the wall will be completed during the summer months, when there is no danger of floods occurring. The lower levels of the dam wall, which may be subject to such overflows, will have sufficient excess strength at this stage to withstand their impact and vibration without damage.

### PROVISION FOR DRAWING SUPPLIES FROM BARREN JACK STORAGE.

In order to draw off supplies for irrigation purposes after the completion of the dam wall, and also for the purpose of handling floods during construction, each line of 4 feet 6 inch pipes will be provided at their up-stream end with a heavy cast iron brattice running on rollers on the up-stream face of the dam, and operated from a crane overhead. In addition, each line of pipes will be provided with two sluice valves at its down-stream end, giving a 4 feet clear opening, and spaced 15 feet apart between centres. The brattices and sluice valves will give a perfect control over these pipes, both during and after construction, and will enable any stoppage from drift timber or other cause to be dealt with. It is possible that in the future the stored water may be used for the development of electric power, and it is partly with this view that the second valve has been placed at the down-stream end of each pipe.

It is proposed to make provision for the discharge of a maximum volume of 3,000 cubic feet per second through the dam after completion for the supply of maximum irrigation and other requirements. These four lines of 4 feet 6 inch pipes will be capable of passing that volume, at a velocity of 47 feet per second, under a head of 73.25 feet over their inverts.

In addition to these 4 feet 6 inch pipes, it is proposed to insert a pair of "Stoney" sluices at a higher level for the purpose of drawing off the bulk of the irrigation supplies. It will be noted by an inspection of the table attached to Plate II., setting out the capacities of the storage at various levels, that the bulk of the stored water is contained in the upper levels. It has, therefore, been decided to place the "Stoney" sluices at about R.L. 1050. They are to be designed so as to pass 3,000 cubic feet per second, under a head of 55 feet over the sill.

The above and the following details of the proposed design and construction of the dam wall are illustrated in Plates IV., V., and VI.

### DESIGN OF BARREN JACK DAM WALL.

The dam wall itself will be curved in plan to a radius of 1,200 feet, measured at the up-stream face. The question of whether dam walls of this character should be built straight or curved in plan has been much debated. The consensus of opinion, vide Proceedings, Institution of Civil Engineers, Vol. 172, appears to be in favour of curving to a large radius. In this particular case at Barren Jack the location selected for the wall and the conformation of the granite rock, which will form the foundations, is such that the planning of the wall to a curve does not involve any greater quantity of material in construction, and is no more expensive than a straight wall would be. It has, therefore, all things considered, been deemed



# PLAN & ELEVATION OF DAM

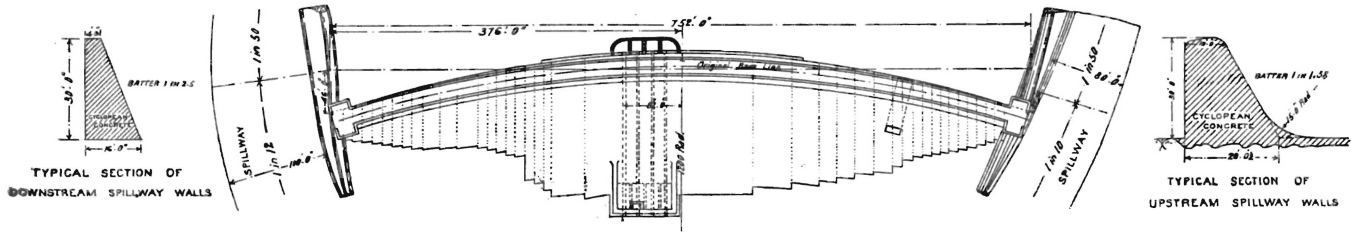
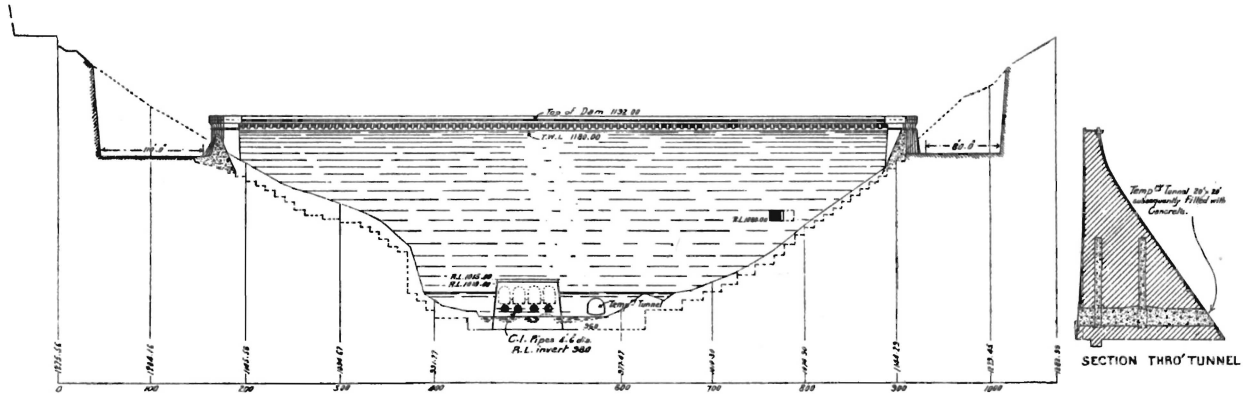


PLATE 4.