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TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

Rev. DEPARTMENT

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GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

11th February 1879, No. 92 I.

Irrigation.

Read the following paper:—

No. 38.

No. 38 I.

THE following notes of inspection in Salem from 18th to 20th January 1879 are submitted for the information of Government:—

1. Inspection of the works lately under execution from Famine Relief Funds was undertaken with a view to ascertain the exact condition in which the works were left when expenditure from Famine Funds was stopped, and what further expenditure was absolutely necessary to prevent damage to the work already executed, also whether by the further expenditure of any reasonable amount the work done could be made profitable.

2. PENNAGOONDAPURAM TANK.—The first work visited was the *Pennagoondapuram tank*. The estimate for this tank has been completed and is now with the Superintending Engineer to whom instructions have been given regarding the additional information required when submitting his report with it. The amount is Rupees 56,713; up to the 31st December expenditure on the work had reached Rupees 53,448, and there is a sum of Rupees 4,526 still due to contractors for work done before that date which will be paid immediately, the total expenditure will then be Rs. 57,974
Deduct excess due to famine „ 25,387

Value of work done „ 32,587
Value of work to be done „ 34,126

Total Estimate „ 66,713

3. DESCRIPTION OF ESTIMATE.—The tank is an old native one, long since ruined, the bund being breached in three places; it has been so long abandoned that there is no tradition of there having been cultivation under it. The estimate provides for very considerably enlarging the old bund so as to enable the tank to hold nearly $5\frac{1}{2}$ millions of cubic yards, constructing an irrigation sluice to irrigate 1,300 acres at present, but ultimately 2,200 acres, and a waste weir of sufficient size to discharge the drainage from a catchment basin of 52 square miles and excavating an irrigation channel $7\frac{1}{2}$ miles in length. The top of the bund is intended to be 9 feet above full supply level and about $5\frac{1}{2}$ feet above maximum level.

4. STATE OF WORK ON 31ST DECEMBER 1878.—The earthwork has been completed to a height of 5 feet above full supply level except at No. 1 breach where it is only 3 feet above F.S.L. The sluice has been completed with the exception of the plug and shutter raising gear, and the weir is partly built, that is, the body wall is completed with the exception of coping and about 50 feet of the end. South wing is nearly completed, north wing not commenced, but excavation completed. Surplus channel excavation nearly done.

5. TANK BUND.—The work done appears generally satisfactory, the soil is very fair and is stated to have been watered and consolidated as the bund was raised; the rough stone revetment was fairly good but rather uneven, but the gravel backing or

at least that portion that was visible was not so good as it ought to be. It was stated that a puddle wall had been constructed at each of the three branches, and that in rear of these walls rough stone drains had been put in to carry water to the rear of the bund. The outfall of these drains had been blocked up however, and leakage was evidently finding its way under the bund in places, although the water level at present in the tank is 15 feet below full tank level. This leakage is said to be through the rocky soil below the bund and to have decreased since water rose to its present level, but in any case the drains must be opened out and left so as to discharge freely. Beyond the breach through which the river has lately discharged the leakage has soaked into low ground, apparently pits from which the soil for the bund was taken, at a few yards distance from the toe of the bund, and being unable to escape has formed a quagmire. This must be drained into the river bed, and a longitudinal stone drain parallel to the bund and discharging into the river should be put in on the tank side of these pits. The foot of the bund must everywhere be kept dry.

6. **SLUICE.**—The arrangements for raising the plugs of the sluice are not satisfactory and must be altered; the Superintending Engineer is giving attention to this subject. The plank shutter should have screw gearing; there will be a heavy head against it.

7. **WORK CONSIDERED ABSOLUTELY NECESSARY.**—The breaches in the bund having been closed, it is absolutely necessary that the bund should be raised to a safe height and the weir made efficient before heavy rain falls, and as it is quite possible that there may be sufficient rain as early as March to fill the tank, it is essential that the necessary work should be carried out immediately.

The necessary work is as follows:—

- To raise the bund throughout to 5 feet above full supply level or to + 43;
- To complete the revetment fully;
- To complete the body wall of weir to + 37;
- To complete wing walls of weir;
- To construct a rough stone apron 9 feet in width to weir;
- To put in drain mentioned above in rear of bund;

and cost is estimated at Rupees 1,815.

The Superintending Engineer has been instructed to put this work in hand at once, and if he is unable to provide the full amount required from savings on other works a grant will be made from the Reserve.

8. **IRRIGATION CHANNEL.**—The irrigation channel from the sluice is intended to be $7\frac{1}{2}$ miles in length; the area to be irrigated will be all on north side of the river, and it is stated that the channel will command more than the full acreage of the tank is intended to supply; the channel has already been excavated more than half a mile, and there are about 50 acres of cultivation under it now; the ryots came to meet us and begged that it might be extended another mile and they would then take up about 200 acres more land. It seems certain that the land will readily be taken up as soon as the channel is extended, and it is hoped that if funds are not available for some completion of the work next year arrangements may be made at all events for some extension of the channel.

9. **WORK YET TO BE DONE.**—The principal part of the work remaining to be done is the excavation of the channel and provision of masonry works for passing cross drainage. The tank bund has to be raised 4 feet or to + 47, which will be 9 feet above F.T.L. and $5\frac{1}{2}$ feet above M.T.L., and the weir level will be left raised 1 foot and a suitable apron of rough stone provided. As the work will be left the tank bund will be 6 feet above the existing weir level, and but 21 feet above M.F.L., so that it will be necessary to complete the bund to full height early next year, and this will cost about Rupees 1,400, which will have to be provided from next year's grant for irrigation. The weir may be allowed to remain at 1 foot below its ultimate level for the present, and the channel can only be completed when funds are available; but having been once started the ryots will no doubt extend their field channels, so that next year there will be some return for the expenditure incurred.

10. **BAROOR PROJECT.**—This project has been described in *Memorandum by the Chief Engineer for Irrigation* printed with G.O., No. 779 I, dated 4th October 1878. It may be divided into four parts—

1. The anicut across the Pooniari.
2. The irrigation channel as far as Baroor large tank.
3. Enlarging the Baroor tank.
4. Continuing the irrigation channel from the tank.

11. **EXPENDITURE INCURRED.**—Work to some extent has been done on the three first-named sections of the work, and so far as the accounts have yet been made up it appears that the total expenditure up to 31st December 1878 is Rupees 1,08,601, of which is due to Pamine about Rupees 40,000, balance chargeable to the work Rupees 68,601.

12. **ESTIMATE.**—The plans and estimates have been nearly completed in detail by Mr. Lowry, the Executive Engineer of the division; and considering the extent of his charge, which till lately included important relief works, it is creditable to him that they are so far advanced; there is no doubt that he has taken much pains and had had very heavy work. It is expected that the estimates will be completed by the end of February; but whether the compensation statement will be ready by that time cannot be said; the Tahsildar of Krishnagiri was at Baroor engaged on this work when we were there. Mr. Lowry has furnished the following figures which may be considered nearly accurate:—

	RS.
Amount of estimate	2,49,000
Deduct expenditure to 31st December 1878 chargeable to the work	68,600
Balance to complete	1,71,400

13. **ANICUT.**—On the anicut very little has been done since Colonel Mullins' Memorandum was written in October 1878; besides the work there mentioned the foundations of the head sluice for the Agaram channel on the right bank have been in great part taken out, and thus far money will have been wasted as the pit is sure to be filled in by floods; the revetment to the right flood bank has been nearly completed, and the work is very good, but the end of the bank must be protected with stone before floods come down. Limestone, broken stone for concrete, cutstone for coping, charcoal and firewood have to some extent been collected; a lime-kiln has been built and milestones put up. Delay to the work will only involve a trifling loss on firewood, but expenditure must be incurred in keeping watchmen and in repairing the buildings from time to time. There is no work now absolutely necessary.

14. **CHANNEL TO BAROOR TANK.**—The channel from the river to Baroor tank may perhaps be about three-fourths completed. Most of the earthwork in execution is completed, and for a considerable distance the banks have been made up and turfed and the grass is growing well; a great deal of rock blasting has been done, but there is still much to be done; all the inlets and outlets and under-tunnels have to be built, but much of the rock blasted from the channel will be of use in their construction; there is no work absolutely necessary, but there will be some expenditure caused by the work being delayed as the channel will become silted up, there being no proper inlets and outlets, and the banks will be partially destroyed. As soon as funds are available the channel should be opened and made complete from the head downwards, and it could then be used for irrigation.

15. **BAROOR TANK.**—The bund of the Baroor tank has made some progress. The west side or horn has been completed (the top of the tank should slope more decidedly to the rear), the west sluice has been built up to floor level, a gap being left in the bund to drain the tank; beyond the sluice the new bund has been constructed up to level of old bund and a good deal of revetment has been done, and the old east sluice has been partially demolished. The completed work is good, and the incomplete part of the bund is good work; the new soil has been thrown in front of the old bund, and where the bund is more than 8 feet high a puddle wall has been inserted. There is now no possibility of the work being completed before next monsoon, but if it is left as it is the cultivation under the old tank will be lost. It is therefore essential that the following work should be done:—Complete the west

sluice, and make up the bund at the gap to full height of old bank; make a temporary lead to the old east sluice, and on the high ridge beyond this sluice construct a temporary escape; the level of the escape should be about 5 feet below the top of the bank as left, and its length should be not less than 100 feet. The soil is rocky and the site favorable for an escape. The cost of doing this work has been estimated by the Superintending Engineer at 1,800 Rupees, and he has been instructed to carry it out. Besides this necessary expenditure the pay of the extra establishment employed under Mr. Lowry in preparing the plans and estimates for the project has to be provided for; this will amount, up to end of February, to Rupees 500; this sum, it is proposed, to provide from the Reserve.

16. The channel below the Baroor tank has not yet been commenced.

17. REMOVAL OF PUDDLE.—Before recommencing work on the tank it will be necessary to remove all the portions of the puddle wall which have been exposed to the air and are dried and cracked. It was seen only in its dry state, but it looked as if the clay was too pure and needed some admixture of sand; this point should be attended to when work is again commenced.

18. RECORD OF WORK DONE.—As the channel will have to be left in an incomplete state, all bench marks should at once be fixed permanently and their value distinctly recorded, and a plan and section should be prepared showing the exact state of the channel throughout and the work to be done in each furlong. Bench marks may conveniently be placed on milestones and quarter milestones and their value cut on the stone as well as recorded on the plan. The materials at site should be examined and stored so as to be easily watched, those perishable being disposed of if possible, and a careful account should be taken of them and all tools and stores on the work.

19. BLASTING ROCK.—It is probable that better arrangements may be made for blasting rock when the work is recommenced; the cost has been greater than it ought to be; the work requires skilled supervision, and it appears could be employed for the purpose it would probably be found that some saving would be made; as the work was carried out it was impossible to provide the necessary supervision.

20. BAROOR SMALL TANK.—The new weir to the enlarged tank will discharge into a drainage which at present supplies the Baroor small tank, and if this tank is to be kept up another large weir to discharge into the river will be necessary. It would seem to be the better arrangement to give up the small tank, and to carry the surplus from the large tank through it to the river by means of an embankment on the east side. The greater part of the small tank bed could then be cultivated and it will be commended, as well as the land at present irrigated under it, by the large tank. Before the tank is completed this subject should receive consideration, otherwise the small tank will be destroyed the first time the new tank overflows. The drainage which falls into the small tank should be diverted into the large tank.

21. SUPPLY OF WATER AVAILABLE.—Since Colonel Mullins visited the work it does not seem that any additional information has been obtained regarding the supply of water available in the river, and it is to be regretted that while the work was in progress the river was not carefully gauged, a gauge rod was observed near the site of the proposed anicut, but the record was not forthcoming. It might be difficult at the site of the anicut to measure accurately the discharge of the river, but some point might have been selected where it could have been measured, and the record of the floods compared with the rainfall would have been some guide to what may be expected of the river. On the 22nd January Mr. Lowry said he had never observed the water in the river to be lower, and then two small irrigation channels, one on either side of the river, were discharging sufficient for the cultivation, so far as could be judged by rough measurement, of at least 200 acres each, and there were two separate streams of water passing down the river. The supply would be probably altogether sufficient for the cultivation of 1,500 acres. It seems, on the whole, that the anticipations with regard to the water-supply are likely to be realized, and that the project is one which is likely to be remunerative and of great benefit to the country. The Superintending Engineer will, when submitting the estimates, give all the information that is available on this subject, and it can then be more fully considered.

22. KILCOOPUM EXTENSION.—The original intention of the estimate was to continue the bund of the Baroor tank across a spur and another valley, called the Kilcoopum valley. It appears that this extension would be costly and would not add considerably to the storage, while it would destroy some extent of existing irrigation. It has therefore been thought advisable by the officers in charge of the work to give up the extension and to carry the bund up the spur, instead of across it, till the necessary level is reached. The abandonment of the Kilcoopum extension should, it is considered, be deemed settled.

23. PROPOSED KISTNAGHERY RESERVOIR.—The site of the proposed dam on the Pooniaur and of the escape was visited. Little if any additional information beyond that recorded in G.O., F.R. No. 883, dated 9th April 1878, has been collected, and nothing useful can be done till an officer with a proper establishment can be detailed for the investigation.

24. SITE OF DAM.—The site for the bund appears a very favorable one, but a thorough examination of the bed of the river must be made before it can be said that it is possible to construct a dam. Rock will probably be found at no great distance below the sandy bed of river in which at places it crops up, but the rock must be sound and without fissures throughout. The soil in the neighbourhood is not suitable material of which to construct a high bund; in fact it could hardly be worse, and so far as it is known no clay is available except from a distance of upwards of a mile. Stone is available in any quantity on the spot, limestone close at hand, and there is an unlimited supply of fuel almost within the water-spread of the tank; it therefore would appear that a masonry dam would be suitable, and probably concrete faced with stone would be the best and cheapest material to make it of.

25. ESCAPE.—The site selected for an escape is a saddle about three miles north of the site of dam. Major Pennycuik states that levels have been taken up the course of every drainage to the south of the river to 150 feet above the bed of the river, but no other saddle has been approached and the selected site is the only one available. It is a very good one, rock crops out in several places, and there is a sufficient length to form a proper escape at about 110 feet above the bed of the river, with a moderate depth of water going over. The escape would be about two miles from the town of Kistnagherry, and the surplus would pass down the valley to the south of the town, returning to the Pooniaur some miles below the site of dam. In this valley however are three tanks and some considerable extent of cultivation most of which would have to be sacrificed. In his rough estimate of the cost of the works Major Pennycuik includes compensation for this irrigation, but it is a serious matter and if by any means the valley can be spared it should be.

26. ALTERNATIVE ESCAPE.—The weather was so wet when we visited the site of the dam the rocks on either side could not be examined. It may be possible however to provide an escape of some length at one end of the dam, and it certainly would be feasible if the dam were built of masonry to construct surplus sluices in it at such a level that water could be discharged with a velocity which would be harmless to the work. It is believed that if the general objections to discharging the river through the dam are waived, a scheme may be worked out which will enable the surplus to be discharged directly into the river at a not unreasonable cost. If this is done, the height of the saddle at which it is proposed to make the escape will not measure the high water level of the reservoir; a comparatively inexpensive bank there would enable the level to be raised by several feet.

27. IRRIGATION.—So far as can be learned there is on one if not on both sides of the river below the site of the dam a very considerable extent of land available for irrigation, and that the whole extent which ordinarily could be irrigated might be irrigated direct from the reservoir, the surplus water falling back into the Pooniaur, where it would be caught by the Nedingul anicut which will supply the Baroor tank.

28. IMPROVEMENT OF THE COUNTRY.—This part of the Salem district is, with the exception of a small strip alongside the river which is irrigated by small channels taken off the river, almost a barren waste, the contrast between the part under the influence of river water and the rest of the country being very striking. The improvement that would be effected by the storage of sufficient water to irrigate

4,000 acres would be of such inestimable value to the country, that the project should not be looked at as an investment of capital for the direct returns that it will pay. The work will, there is every reason to believe, give a sufficient direct return to pay interest on capital and leave a considerable margin of profit, and it will also protect a considerable extent of this thinly-populated country from famine, and act as a flood moderator and prevent damage now not infrequently caused by inundation. These advantages are, it is thought, sufficient to warrant the expenditure necessary for completely investigating the project and preparing the necessary plans and estimates.

29. **MARANDAHALLI PROJECT.**—This project also is described in Colonel Mullins' memorandum printed with G.O., No. 779 I., dated 14th October 1878. Nothing more is known of the river and the site for the anicut than when that memorandum was written, and it is understood that very little work has been done since that time. The place has been extremely unhealthy both for the coolies and the engineering staff employed, and the work has been frequently interrupted in consequence.

30. **COMPONENT PARTS OF THE PROJECT.**—The project may be divided into the following parts:—

1. Anicut.
2. Supply channel to Sangambasavan tank.
3. Enlarging Sangambasavan tank.
4. Channels from do.
5. Enlarging Jairy Talab tank.
6. Channels from Jairy Talab.

It was contemplated to supply other tanks below the Jairy Talab as far as Dharmapuri tank, but apparently no survey has been made beyond a short distance below the Jairy Talab.

31. **ESTIMATE.**—An approximate estimate amounting to Rupees 1,50,000 was sanctioned in G.O., No. 345 I., dated 24th September 1877, but detailed estimates have not yet been worked out. Lieutenant de Villenil, R.E., was understood to be preparing these estimates, but his time must have been almost entirely taken up in superintending the work, and his health suffered very considerably, so that comparatively little was done beyond levelling the supply channel and contouring the Sangambasavan tank, and the drawings forthcoming are so incomplete that it will be a most difficult matter to work out the estimates. It is quite impossible that the Divisional Officer, Mr. Lowry, should, however willing, do the work, and if it is to be done satisfactorily, a special officer with one or two surveyors will have to be employed for the purpose.

32. **COST OF WORK.**—The accounts have not been made up, and accurate figures to show the expenditure chargeable to the work cannot be ascertained. The approximate figures given are as follow:—

	rs.
Expenditure to 31st December 1878	2,66,000
Defect excess due to famine not less than	1,23,000
Balance chargeable to the work	82,400

and it seems probable that to complete the project would entail a further expenditure of 1½ lakhs.

33. **ANICUT.**—No work has been done to the anicut, two rough lime kilns are built, a small quantity of firewood and limestone has been collected, and a few cut stones have been prepared.

34. **SUPPLY CHANNEL TO SANGAMBASAVAN TANK.**—A great deal of work has been done to the supply channel; up to the point at which it falls into the old supply channel, about three-fourths of the work has been done; there is still, however, a good deal of blasting rock to be done, and an inlet and outlet have to be built. The sides of the excavation have been left in many places vertical, and there is sure to be a good deal of soil washed into the channel during next rains, but this cannot be prevented except at a considerable expenditure.

35. **SANGAMBASAVAN TANK.**—The principal part of the work done is on the Sangambasavan tank, about 4 millions cubic feet. Excavation of all sorts has been done against estimate of about 5½ millions cubic feet, and 200,000 cubic feet puddle wall have been built, besides stone revetment to the height of the new bund across the greater part of the old tank. The revetment of the old tank bund has been removed, and the earth stands at a slope of less than ½ to 1, its height above top of new bund which is placed in front of it being about 8 feet, and the old sluice has been blocked up, so that the old tank has been rendered useless, and there is no possibility of completing the new one for a considerable time even if funds could be provided for it. The ayacut under the old tank is 339 acres, and the assessment provided for it. The Superintendent Engineer has been requested to estimate the cost Rupees 1,565. The Superintendent Engineer has been requested to estimate the cost of re-opening the sluice, revetting the inside face of the old bund with stone collected for the new revetment, and opening a rough escape at the west end of the bund, to see if it will be possible to save the existing cultivation next season.

36. **CHANNELS FROM SANGAMBASAVAN TANK.**—No work has been done to these channels.

37. **JAIRY TALAB TANK.**—A very insignificant quantity of earthwork at the west end of this tank bund has been done.

38. **CHANNELS FROM JAIRY TALAB TANK.**—Excavation of this channel was referred about a mile has been carried out in part; the alignment of this channel was referred to in Colonel Mullins' memorandum above quoted, and probably since he saw the work a little more earthwork has been done. It can now be seen that the rocky cutting will be so formidable an undertaking that it will probably be more economical to revert to the old alignment, or at all events to select a line where less excavation will be needed.

39. **MATERIALS AT SITE.**—There are materials, building stone, limestone, &c., both on the supply channel and at the Sangambasavan tank, and a variety of tools and stores, some of considerable value, two bungalows near the tank, and many sheds. To prevent loss complete lists must be at once made out, the material stored on the work, and the tools and stones sent to some locality where they can be used. One of the bungalows should be kept up as a rest-house, the other demolished, and all the huts which are falling to pieces and apparently valueless should be burnt. The extreme unhealthiness of the localities on which the huts were built should not be forgotten, and if the work is taken up again no huts should be allowed to the west of the tank bund. The remarks made in paragraph 18 on recording the work done and fixing bench marks should be attended to here.

40. **WORK TO BE DONE.**—There is no question here of providing a small sum for emergent work, but the Superintendent Engineer's estimate of the cost of making the old Sangambasavan tank available for existing irrigation next season will be awaited and funds allotted then if possible. It seems that the work hitherto done might best be utilized, first, by fitting the Sangambasavan tank to hold its usual supply of water; second, by clearing to proper level a certain width say 15 feet of the supply channel from the site of anicut to the junction with old supply channel and fitting it to carry a depth of 2 feet of water; third, by making either a rough head sluice, or by building a portion of the head sluice which has been already designed, to be subsequently added to; fourth, by constructing a rough stone dam with the face stones only set in cement 2 feet in height across the river, the bed of which is understood to be rock near the surface. The supply to the Sangambasavan tank could thus be improved and the work done to form the new tank would not suffer much, and should the tank discharge surplus the water would find its way by a natural drainage to the Jairy Talab tank, one weir of which could, if necessary, be extended.

41. **EXPECTED RESULTS FROM THE PROJECT.**—There is no further information available on which to judge the merits of the project than when the approximate estimates were submitted. Nothing is known of the supply of water available in the river, and the insignificant size of the drainage basin does not warrant sanguine anticipations. Arrangements should be at once made for gauging the river, and the project may be found if not a remunerative an advantageous one if carried out.

on a small scale. The work done on the supply channel and the Sangambasavan tank will be in great measure thrown away if these works are not completed, and their completion will entail the construction of the anicut, but there are some doubts as to the advisability of enlarging the Jairy Talab tank, the proposed addition of 10 feet to the height of the bund would cause submergence of some valuable bund, and the bund is already a high one, of black soil apparently, and the raising would be expensive. If the investigation is completed, it may be found advisable to complete the first three works named in the project and then allow whatever water may be available after supplying the Sangambasavan tank to find its way by the natural drainages from tank to tank providing only for them efficient escapes. The available storage might not suffice for the available supply in a wet year, but in ordinary years it is believed that none of the water which could be taken from the river would be allowed to run to waste.

FORT ST. GEORGE,
7th February 1879.

(Signed) J. O. HASTED, Lt.-Col., R.E.,
Ag. Chief Engineer for Irrigation.

To the Joint Secretary to Government, Public Works Department, Irrigation Branch.

No. 99. ORDER THEREON, 11th February 1879, No. 92 I.

UNTIL complete estimates for the Pennageondipuram, Baroor and Marandahalli Projects are submitted, the Government cannot decide to what extent it will be advisable to prosecute the works. It is hoped that the Executive Engineer with the aid of the establishment placed at his disposal will be able shortly to submit the estimates for the two former projects, and the Chief Engineer, Department Public Works, will arrange, as soon as practicable, to place at the disposal of the Superintending Engineer, Fourth Circle, the services of an officer for the completion of the estimates for the Marandahalli Project. The good work hitherto done by Mr. Lowry, the Executive Engineer in charge of the Division, is noticed with satisfaction.

2. The instructions given by the Acting Chief Engineer for Irrigation as to the work immediately to be carried out are approved, and a sum of Rupees 3,000 will be at once placed at the disposal of the Superintending Engineer from the reserve for this work. The Superintending Engineer will prepare estimates for the work suggested in paragraph 40 of the memorandum under reference, and also for such work as will enable the Baroor channel to be utilized to some extent.

3. The remarks made by the Acting Chief Engineer for Irrigation regarding the careful measurement and record of work done will receive attention. All tools, furniture, &c., should be disposed of as directed in G.O., Revenue Department, No. 116, dated 17th January 1879.

4. The investigation of the Kistnagherry Reservoir Project will receive further attention when the services of a special officer can be made available.

(True Extract.)

For asst.

Lt.-Col., R.E.,
Ag. Joint Secy. to Govt., P.W.D.,
Irrigation Branch.

To the Superintending Engineer, Fourth Circle.
" Chief Engineer, Public Works Department.
" Chief Engineer for Irrigation.
" Revenue Department.

Exd. C. Howarth and E. C. Shunker.

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