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Government of Madras

Public Works DEPARTMENT

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Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
11th August 1874.*

Read the following:—

No. 486-A.

No. 280. *Note by the Chief Engineer for Irrigation.*

THE District Engineer, North Arcot, has with his letter No. 805, of the 17th ultimo, re-submitted certain tank estimates, which had been returned* for

revision, and which are beyond the limits of local sanction.

Keelcembaukum Tank.—Estimate Rupees 3,580.

Of which the amount for repairs is Rupees 2,910, and the amount for a surplus weir of 90 feet crest Rupees 670.

Ayacut Area	...	...	...	...	...	Acres	161
Revenue	...	...	...	...	...	Rs.	880
Average Revenue	...	...	...	...	...	"	900

No expenditure has been incurred in the past four years. From the particulars given it would appear that the dimensions of the surplus weir have been designed with reference to the area of two square miles which ordinarily supply the tank, and that the catchment basins of eight tanks, which surplus into it, have not been fully taken into account, though sluices in the body wall of the surplus weir are intended to afford additional discharging power when necessary. What quantity they would discharge with the water in the tank at the maximum water level has not been stated, but assuming that the level of the water below would be 3 feet above the apron the total discharge would be as follows:—

Through the sluices about	...	...	1,340	cubic feet
Over the crest about	...	...	855	"
Total...			2,195	

or a little less than the maximum discharge from a drainage basin of eight square miles. As mentioned, however, by Captain Pennycuik, the co-operation of the villagers would be necessary to make the sluices of use, and it is certain that, however willing to work them, they could not take out the shutters on the occurrence of sudden floods unless they were trained to this duty; and even then it is more than probable that, before the shutters could be replaced, a great deal of the proper supply of the tank would be lost. Moreover, in any case year by year a great deal of wastage by leakage would be incurred, unless the leakage water can be led from the surplus weir into some of the irrigation channels. For these reasons it is considered that numerous vents, such as are shown in the design, are not to be relied on for the discharge of flood waters, and that only a few, say, four or five at most, should be provided for giving the means of lowering the tank water when necessary.

2. The District Engineer asks whether sluice shutters, revolving on a horizontal axis, cannot be designed to open and close of themselves by the action of the water. I will not say that such an arrangement is not feasible, but in this Presidency at least it has never been successfully worked out; the late Major Ryves gave much attention to the subject, and designed weir crest shutters, which theoretically appeared perfect, but practically they were useless, and after a trial of some years their removal from the works on which they had been fixed was found to be necessary. I know of no better kind of revolving shutters than those on a

vertical axis, designed by Mr. Dopping, and used on several irrigation works in North Arcot; they are easily worked, are not ill-adapted for sluices in waste weirs except that there must always be a good deal of leakage, and villagers would find no difficulty in working them, but they are not self-acting. At the Palar anicut under-sluices they have frequently been carried away, and they have occasioned also there incidental damage, but there the conditions are different; at the south head sluice of that anicut also they were fixed, but they are manifestly unsuited to regulating works.

3. On the whole, while not wishing to decide against the use of sluices in any case for the purpose of increasing the discharging power of surplus weirs, I am of opinion that generally they should not be relied on, and that in most cases but little, if any, saving will be effected by substituting them for either a corresponding length of escape crest, or for the supplemental escapes at the end of tank bunds for use in extraordinary floods, which generally or frequently need be nothing more than pavements a few feet wide.

4. The Keelvembaukum tank has no surplus weir, and it is necessary that one should be provided at once if the risk of the large outlay required on the bund being rendered useless is to be avoided. Consequently the weir estimated for may be sanctioned, and in its body wall four instead of thirteen sluices may be inserted, the rest of the crest being constructed as a body wall $2\frac{1}{2}$ feet thick at top and 3 feet at base, and its length being extended to 100 feet, which will make the cost about the same. The discharge may then be taken as 950 cubic feet a second. Captain Pennycuik should then ascertain as early as possible what the whole drainage basin, including those of the eight tanks, is, what the maximum flood discharge from this entire basin will be, what supplemental escapes for the Keelvembaukum tank are required, and how they can be most economically provided.

5. With regard to the way in which the earthworks are intended to be carried out as shown in the cross sections of the bund, it will be seen from paragraph 14 of Captain Pennycuick's letter that he considers there are reasons of considerable weight for placing the new earth outside rather than within the old bund; and when the latter is everywhere above maximum water level no doubt, with the precautions which he mentions, such an arrangement may often be preferable. In the present case, however, the old bund is in part lower than full tank level, and even the probability of some damage to the interior slope, if formed within its present line, is of less moment than the great risk of slips, and perhaps of breaches as a consequence, if the enlargement of the bund were effected by additions to the exterior only, as shown in the sections. Unfortunately there has been only too costly experience that stepping the old earthwork, and making up the additional section carefully, are of themselves not always a guarantee of stability.

6. The District Engineer's Circular, No. 2,582 of the 18th November 1873, contains directions for the proper execution of earthworks, of which I entirely approve; and supposing the additional work referred to in figures 2 and 3 to be rightly located, the manner of its execution, as detailed in the latter figure, is perfectly correct.

Ayacut Area	...	...	...	...	...	...	Acres	235
" Revenue	...	...	...	...	...	...	Rs.	1,230
Average Revenue	...	...	...	...	...	...	"	1,206

No expenditure has been incurred on repairs in the last four years. The District Engineer states that the previous breaching of this tank is almost certainly due to the closing of the calingulahs, which are to be converted into surplus weirs by the removal of the dam stones and the formation of crests at full tank level. The total length of crest will be 102 feet, and no doubt this will be more than ample for the surplus from the one and a half square miles which ordinarily supply the tank. It is stated, however, that three tanks above surplus into it, and the drainage basins of these must likewise be considered. This should be done at once, and such additional means of disposing of surplus water as may be needed should be provided in the cheapest way that may be practicable.

Ayacut Area		Pennaveram Tank.—		Estimate Rupees		Acres	
Revenue	...	...	...	...	1,440	...	168
Average Revenue	...	...	...	...	...	...	Rs. 990
penditure has been incurred in the last four years						...	531

No expenditure has been incurred in the last four years.

The estimate is made up of—
Ordinary repairs

Minor New Works.	{ A Surplus Weir	...	...	Rs. 270	Rs. 1,050
	{ A Sluice	...	...	Rs. 120	
The Government has at present no surplus weir or calingulab					390

The tank has at present no surplus weir or calingulah. Its own drainage basin is one square mile, but a part of the surplus of the Sonapooram tank falls into it, and what the total basin, the flood waters of which do, or may, find their way into the Pennaveram tank, is, has not been stated; this must be ascertained and the surplus be provided for accordingly. The District Engineer estimates the discharging capacity of the weir, of 66 feet estimated for, at 662 cubic feet a second, or 10 cubic feet per foot of length. Probably, if the plan indicates the circumstances fairly, the depth of water on the rear apron would be about 18 inches, and, if so, the discharge would be about 423.5 cubic feet a second, an important difference. It will be well to make the surplus weir 100 feet long between the wings, when the discharge may be taken as 650 cubic feet a second. Whatever more means of discharge are required can then be provided for by supplemental escapes. The plan, a general one, does not correspond with the circumstances of this tank, the wings being 6 feet instead of $4\frac{1}{2}$ feet above full tank level, an addition of 80 Rupees will probably cover the increased cost of the greater length, and the estimate will then be Rupees 350.

9. *Serinthamungalum Tank.*

9. Serinthamungalum Tank.—Estimate Rupees 890.

	Rupees	Paisas	Acres
Ayacut Area	...	...	81
" Revenue	...	...	...
Average Revenue	...	...	...
Expenditure is shown on previous repairs. The estimate:	...	...	...
average revenue, but 56% less than the estimate.	...	...	...

No expenditure is shown on previous repairs. The estimate is more than five times the average revenue, but if the outlay should result in securing the full revenue, it will not be unprofitable. The estimate provides for—

Ordinary repairs	Acres	81
	R.	257
	"	170

Ordinary repairs	...	...	...	Rs. 570
Minor New Works.	{ A Surplus Weir 42 feet long	...	...	Rs. 220
	{ A Sluice	...	...	Rs. 100
Total				Rs. 890

The area from which the tank supply is derived is stated to be about half a square mile, added to which a part of the surplus of the Sonapooram tank is received. The maximum flood discharge to be disposed of is not less than 393 cubic feet a

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14th August 1874.*

second, and it may be much more, depending upon the water received from the Sonapooram catchment basin. It will be advisable to make the weir crest 60 feet long, and the estimate will then be about 265 Rupees instead of 220. It is probable that a supplemental escape will be required, and this should be settled.

10. *Arconum Tank*.—Estimate Rupees 1,910.

Ayacut Area	...	...	...	...	...	Acres	164
" Revenue	...	...	...	...	...	Rs.	560
Average Revenue	...	...	...	...	...	"	381

No expenditure has been incurred on repairs during the past four years. The estimate includes the following items, all of which may be classed as repairs:—

	RS.
Repairs to the band	1,625
Extending the escape	100
Repairing a sluice	85
Reconstructing a sluice	150

The catchment basin is reported to be $1\frac{1}{2}$ square miles, and the existing escape is proposed to be lengthened from 33 to 73 feet. The bund, which is to be $4\frac{1}{2}$ feet above full tank level, will be $2\frac{1}{2}$ feet above maximum water level. The amount of the estimate is very large compared with the revenue; but little of the bund is below M. W. L., and probably some reduction of cost may be made without affecting the efficiency of the tank. In the first place the top width of the bund may as a maximum be 6 feet instead of 9 feet; next there would appear to be facilities for constructing a second escape of about 120 feet in length at the opposite end to the present calingulah. If so, the intended top level of the bund might be lowered 1 foot or perhaps 18 inches, as with 150 feet altogether of escape 18 inches would be about the difference between F. T. L., and M. W. L., and a margin of 18 inches above this will suffice. The 80 feet additional length of escape will cost about 200 Rupees, and it would seem that by these modifications about 700 Rupees in earthwork and turfing may be saved, or a net saving of Rupees 500. It is recommended, therefore, that the estimate be reduced to Rupees 1,410.

11. *Narasingapooram Tank*.—Estimate Rupees 780.

Ayacut Area	...	...	...	...	...	Acres	89
" Revenue	...	...	...	...	...	Rs.	262
Average Revenue	...	...	...	...	...	"	313

No expenditure has been incurred during the last four years.

The estimate provides for repairs, reconstruction of revetment and a sluice, and for lengthening the existing escape from 30 to 56 feet. The catchment basin is about one square mile and, as a pavement is all that is required, and as the discharge over this is less than that over a corresponding length of crest wall, and as by lengthening the escape some reduction in the height of the bund will be feasible, it will be better to make the escape 90 feet long altogether, and the bund may then be made 6 inches lower; the saving on earthwork and turving will probably cover the cost of the additional length of escape. Any addition to the revetment may for a petty tank of this kind, at which the soil appears to be good, be omitted.

• 367 cubic yards.

This item will then be about 98 instead of 278 Rupees. The total of the estimate will then be Rupees 600.

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14th August 1874.*

12. *Cotaramungalum Tank*.—Estimate Rupees 1,170.

Ayacut Area	...	...	...	...	Rupees 1,170
" Revenue	...	...	...	...	Acres 70
Average Revenue	...	...	...	...	Rs. 433
Expenditure in the past four years	...	...	...	...	" 402

Expenditure in the past four years—Rupees 80 in 1870-71.

The estimate provides for repairing the bund and lengthening a sluice...	RS.
Constructing a surplus Weir of 90 feet crest	840

This latter work will take the place of a much smaller one (27 feet) which has been washed away, and it may be considered therefore an entirely new work, and be built from the Minor New Works grant.

I do not think that a discharge of more than 6½ cubic feet a second per foot of length, of a surplus weir of the kind shown in the design, can be expected, and the drainage basin being one and a half square miles the flood discharge will be 737 cubic feet, and the length of weir required 115 feet; the extra 25 feet will cost about Rupees 60. Probably an equal, if not greater reduction may be made on the items for earthwork and turfing, *e. g.*, at the west sluice the bund would seem to be higher than is necessary and of ample section, so no addition need there be made. The total of the estimate may stand as submitted and it may be divided into—

Bund repairs, etc.	Rs.
New surplus Weir	780
Open channel from the Surnamuki	390

The open channel from the Surnamuki should be provided with a head sluice if such a work can be constructed near the head without danger of being turned.

13. *Thookivakum Large Tank.*—Estimate Rupees 390

13. *Thookivakum Large Tank*.—Estimate Rupees 1,275.

Ayacut Area	...	...	...	...	...	Acres	87
" Revenue	...	...	...	...	...	R.	625
Average Revenue	...	...	...	...	...	"	454

No expenditure on repairs has been incurred during the past four years.

The estimate provides for—

Repairs to Bund							R.
A surplus Weir 75 feet	..	..	..	..	..	..	980
Attachment basin is one and a quarter acres							295

The catchment basin is one and a quarter square miles, and the design for the weir being the same as for the Pennaveram tank, the discharge may be taken as $6\frac{1}{2}$ cubic feet for each foot of crest; and, the total being 653 cubic feet a second, the proper length of crest will be 100 feet, and 60 Rupees for the additional 25 feet must be added to the estimate which will then be Rupees 355.

14. *Thookivakum Small Tank*.—Estimate Rupees 970.

Ayacut Area ...						Acres
Revenue ...						30
Average Revenue ...						Rs. 251
The estimate provides for—						263.

The estimate provides for—

	RS.
Repairs to Bund	...
Building a surplus Weir 48 feet crest	740
the drainage basin is stated to be about half	230

The drainage basin is stated to be about half a square mile, and the maximum discharge therefrom will be about 394 cubic feet, so that the length of crest required will be 60 feet instead of 48 feet, and the weir will cost about 260 Rs. On the other hand, a margin of 18 inches above M. W. L. will be sufficient

for so small a tank, and the reduction of 1 foot will make a considerable difference in the amount required for earthwork and turfing. Only one cross section having been shown it is difficult to suggest what this reduction will amount to, but as far as can be judged one-third or, say, 240 Rupees, seems probable; the repair estimate will then be Rupees 500.

15. The District Engineer's attention having been called to the rates entered in the estimate for earthworks, the usual average rate being $1\frac{1}{2}$ annas a cubic yard, paragraph 12 of his letter has been written in reply to the observations made. He rightly says that such work well and properly executed must cost rather more than earth "heaped up any how, with no attempt at consolidation except on the surface," but the objection is not to a somewhat higher, but to a very greatly enhanced, rate. On tanks with bunds of moderate height, such as most of these have, I think at any rate an average rate of $1\frac{1}{2}$ annas or 14 cubic yards the rupee instead of $1\frac{1}{2}$ annas the cubic yard should suffice. On the subject too of average rates (paragraph 13) I am unable to agree with Captain Pennycuik. It is a mistake to suppose that fixing rates for tanks or lengths when preparing estimates adds to the work to be done, the rates must be fixed for individual parts of the work some time or another, and trouble is saved rather than increased by doing this in the first instance. One rate ought certainly not to be paid for the work along a bund of perhaps half to three quarters of a mile in length, when lift, lead and soil probably all vary considerably, and undoubtedly no wudders or petty contractor would accept on average rate which did not err considerably in their favor. Again, petty superintendence if paid separately should not be included in the rates; it may, if so treated, very easily amount to even 20 per cent., or, say, a rate of $1\frac{1}{2}$ instead of $1\frac{1}{4}$ Annas. If, on the other hand, it be meant that petty contractor's or wudder's superintendence is so included, of course the only matter to be considered is whether, with reference to the particular circumstances, the rates are reasonable or otherwise. This superintendence would never amount to an increase of more than 1 pie a cubic yard, and generally much less.

The matter is a very important one. Perhaps at least one-half of the repair grant* of the North Arcot District is spent on earthworks, and if only 10; instead of 14 cubic yards a rupee be obtained on the average, the loss would amount to upwards of 14,000 Rupees.

16. With regard to the latter part of the District Engineer's letter, it is only necessary to remark that there is quite sufficient evidence in the case of North Arcot, as well as of other districts, to show that it is desirable that the way in which tanks are proposed to be dealt with should be reviewed, and that such a control as the present limiting rule affords should be exercised. It may be very true that, owing to the neglected state of irrigation works in North Arcot, the result of this rule may be that a larger proportion of estimates will have to be submitted for superior sanction therefrom than from other districts, and that some trouble will be thereby occasioned cannot be doubted, but this will be the consequence of past neglect, and if, as Captain Pennycuik mentions, the rule will practically require all, or nearly all, the repair estimates of tanks in his district to be submitted to Government, so far from this being a good reason for enlarging

the limit of local sanction, it is in itself strong evidence that the past administration has been very defective, and that for want of some such opportunity of ascertaining what was going on, as is now secured, this insufficient administration did not obtain such notice as might have led to improvement. Further, it appears to me that a proper revision of rates and a judicious determination of the requisite section to be given to tank bunds, in connection with long but cheap escape weirs, will bring hundreds of estimates within the limits of local sanction, which otherwise would require to be submitted to Government. The anomaly alluded to in the concluding sentence of the District Engineer's letter vanishes on examination. Captain Pennycuik quotes an average sanction for repairs against a maximum for Minor New Works. His powers of sanction may extend to Rupees 10,000 or even more for a single repair estimate, but to only Rupees 750 for a new work.

OOTACAMUND, (Signed) JOHN MULLINS, Lieut.-Colonel, R.E.,
8th July 1874. Chief Engineer for Irrigation.

No. 281. ORDER THEREON, 14th August 1874, No. 2,244.

IRRIGATION, No. 15.

THE following estimates for the repair and improvement of tanks in the North Arcot District are sanctioned:—

Repair Estimates.

	RS.
Keelvembaukum Tank	2,910
Keershaut do.	1,950
Pennaveram do.	1,050
Serinthamungalum do.	570
Arconum do.	1,410
Narasingapooram do.	600
Cotaramungalum do.	780
Thookivakum large do.	980
Do. small do.	500

Minor New Works Estimates.

Keelvembaukum Tank—Constructing a surplus Weir	670
Pennaveram Tank—Constructing a surplus Weir	350
Do. Do. a Sluice	120
Serinthamungalum Tank—Constructing a surplus Weir	265
Do. Do. a Sluice	100
Cotaramungalum Tank—Constructing a surplus Weir	365
Thookivakum large Tank—Constructing a surplus Weir	390
Do. small Tank—Constructing a surplus Weir	355
	260

2. The District Engineer's attention will be called to the remarks of the Chief Engineer for Irrigation, and, with regard to the subject of rates, the Government deem the right settlement of these a matter of the greatest importance; they rely upon Captain Pennycuik to exercise a very strict control over them, and when inspecting works to see that those entered in the estimates are not in excess of what the exact circumstance of the different parts of a work fully warrant. Average rates for earthworks should not be allowed, except when the circumstances of a considerable extent of work are so nearly similar as to render it

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unnecessary to vary the rates. Where the quantity of work to be done is so large, a difference of even 1 pie a cubic yard is of importance. The Government agree with the Chief Engineer for Irrigation in considering that inclusive rates are objectionable, and that petty superintendence should not be included therein. Similarly the requisite consolidation of earthwork should form a separate item, and that for the earthwork itself should provide only for excavation, and placing the earth in its proper position; the rate for this is determinable with accuracy with reference to the soil, lead and lift, and every member of the department, entrusted with the duty of preparing estimates, should understand exactly how such rates are to be determined. On the other hand, the charge for the water which may be essential sometimes to the proper execution of earthwork may vary considerably, not only on different tanks but on different parts of the same tank. The cost of consolidation or tamping should, it is thought, be fixed for different descriptions of soil.

(True Extract.)

Lieut. Colonel, R.E.,

Joint Secretary to Government.

To the District Engineer, North Arcot.
.. Chief Engineer for Irrigation.
.. Officiating Controller of Public Works Accounts.

Exd. S. T. Austin

Spare Copies

No 486-A
Note by the Chief Engineer for Irrigation

The District Engineer, North Arcot, has with his letter, No 805 of the 17th Ultimo, resubmitted certain Tank estimates, which had been returned for revision, and which are beyond the limits of local sanction.

Kulvembankum Tank. Estimate Rupus 3580

of which the amount for repairs is Rupus 2910
and ———— for a surplus weir
of 90 feet crest — 670

By acent area Acres 161

— revenue Rupus 880

average — do — 900

No expenditure has been incurred in the last 4 years. From the particulars given it would appear that the dimensions of the surplus weir have been designed with reference to the area of 2 square miles which ordinarily supply the Tank, and that the catchment basins of 8 Tanks, which surplus into it, have not been fully taken into account, though sluices in the body wall of the surplus weir are intended to afford additional discharging

discharging power when necessary
what quantity they would dis-
charge with the water in the
tank at the maximum ^{water} level
has not been stated, but assuming
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the total discharge would be as follows
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Total 2195

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to be necessary. I know of no better kind of revolving shutters than those on a vertical axis designed by Mr. Dopping and used on several irrigation works in North India: they are easily worked, are not illadapted for sluices in waste weirs, except that there must always be a good deal of leakage, and villagers would find no difficulty in working them, but they are not self-acting. At the Palar ancient undersluices they have frequently been carried away, and they have occasioned also there incidental damage, but there the conditions are different; at the South head sluice of that ancient also they were fixed, but they are manifestly unsuited to regulating works.

3. On the whole, while not wishing to decide against the use of sluices in any case for the purpose of increasing the discharging power of surplus weirs, I am of opinion that

that generally they should not be relied on, and that in most cases but little, if any, saving will be effected by substituting them for either a corresponding length of escape crest, or the supplemental escapes at the end of tank bunds for use in extraordinary floods, which generally or frequently need be nothing more than pass-ways a few feet wide.

4. The Kulvembakuram Tank has no surplus weir, and it is necessary that one should be provided at once if the risk of the large outlay required on the bund being rendered useless is to be avoided. Consequently the weir estimated for may be sanctioned, and in its body wall 4 instead of 13 sluices may be inserted, the rest of the crest being constructed as a body wall $2\frac{1}{2}$ feet thick at top and 3 feet at base, and its length being

being extended to 100 feet which will make the cost about the same - The discharge may then be taken as 950 cubic feet a second - Captain Penmycick should then ascertain, as early as possible, what the whole drainage basin, including those of the 8 Tanks, is, what the maximum flood discharge from this entire basin will be, what supplemental escapes for the Keelvenbankum tank are required, and how they can be most economically provided.

5. With regard to the way in which the earthworks are intended to be carried out, as shown in the cross sections of the bund, it will be seen from para 14 of Captain Penmycick's letter that he considers there are reasons of considerable weight for placing the new earth outside rather than within the old bund: and when the latter is
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6. The District Engineer's Circular No 2582 of the 18th November 1873, contains directions for the proper execution of earthworks of which I entirely approve,
and,

and, supposing the additional work referred to in figures 2 & 3 to be rightly located, the manner of its execution, as detailed in the latter figure, is perfectly correct.

7. Neershaut Tank. Estimate Rupes 1950

Hyant area acres 235

— do — Revenue — Rupes 1230

Average — do — — 1206

No expenditure has been incurred on repairs in the last 4 years.

The District Engineer states that the previous breaching of this tank is almost certainly due to the closing of the calingulahs which are to be converted into surplus weirs by the removal of the dam stones and the formation of crests at full tank level. The total length of crest will be 102 feet, and no doubt this will be more than ample for the surplus from the $1\frac{1}{2}$ square miles which ordinarily supply the tank. It is stated however that 3 tanks above surplus into it

it and the drainage basins of these must likewise be considered. This should be done at once, and such additional means of disposing of surplus water, as may be needed, should be provided in the cheapest way that may be practicable.

8. Pinnaveram Tank. Estimate Rupes 1440

Hyant area acres 168

— do — revenue Rupes 990

Average — do — — 531

No expenditure has been incurred in the last 4 years.

The estimate is made up of

Ordinary repairs — Rupes 1050

Minor new works — { a surplus weir — 270
a sluice — 120 } 390

The tank has at present no surplus weir or calingulah. Its own drainage basin is 1 square mile, but a part of the surplus of the Sonapooram tank falls into it, and what the total basin, the flood waters of which do, or may find their way into the Pinnaveram tank, is, has not been stated; this must be ascertained and the surplus be provided for

for accordingly. The District Engineer estimates the discharging capacity of the weir, of 66 feet estimated for, at 662 cubic feet a second or 10 cubic feet per foot of length. Probably, if the plan indicates the circumstances fairly, the depth of water on the rear apron would be about 18 inches; and, if so, the discharge would be about 423.5 cubic feet a second, an important difference. It will be well to make the surplus weir 100 feet long between the wings, when the discharge may be taken as 650 cubic feet a second. Whatever more means of discharge are required can then be provided for by supplemental escapes. The plan, a general one, does not correspond with the circumstances of this tank, the wings being 6 feet instead of $4\frac{1}{2}$ feet above full tank level. an addition of 80 Rupees will probably cover the increased cost of the greater length, and the estimate will then be Rupees 350.

7. Printhamungalam Tank - Estimate.
Rupees 890

Adjacent area. Acres 81

— revenue Rupees 257

— average — 170

Expenditure is shown on previous repairs

The estimate is more than 5 times the average Revenue, but if the outlay should result in securing the full revenue, it will not be unprofitable. The estimate provides for

Ordinary repairs Rupees 570

Minor new works.	{	a surplus weir	42 feet long -	220	
		a sluice -			

The area from which the tank supply is derived is stated to be about $\frac{1}{2}$ a square mile, added to which a part of the surplus of the Sonapuram Tank is received. The maximum flood discharge to be disposed of is not less than 393 cubic feet a second, and it may be much more, depending upon the water received from the Sonapuram catchment basin. It will be advisable to make the weir crest 60 feet long and the estimate will then be about 265 Rupees instead of 220. It is probable that a supplemental escape will be required, and this should be settled.

10. Bromur Tank - Estimate Rupees 1910

Adjacent area Acres 104

— revenue Rupees 560

— average — 381

No expenditure has been incurred on repairs during the past 4 years. The estimate includes the following items, all of which may be classed as repairs.

Repairs to the bund Rupees 1625
Extending the escape — 100
Repairing a sluice — 35
Reconstructing a sluice — 150

The catchment basin is reported to be $1\frac{1}{2}$ square miles, and the existing escape is proposed to be lengthened from 33 to 73 feet. The bund, which is to be $4\frac{1}{2}$ feet above full tank level, will be $2\frac{1}{2}$ feet above maximum W.L. The amount of the estimate is very large compared with the revenue; but little of the bund is below M.W.L. and probably some reduction of cost may be made without affecting the efficiency of the tank. In the first place, the top width of the bund may as a maximum be 6 feet instead of 9 feet. Next there would appear to be facilities for constructing a second escape of about 120 feet in length at the opposite end to the present calingulah. If so the

the intended top level of the bund might be lowered 1 foot or perhaps 18 inches as with 150 feet altogether of escape 18 inches would be about the difference between F.T.L. and M.W.L., and a margin of 18 inches above this will suffice. The 80 feet additional length of escape will cost about 200 Rupees, and it would seem that by these modifications about 700 Rupees in earthwork and turfing may be saved, or a net saving of Rupees 500. It is recommended therefore that the estimate be reduced to Rupees 1410.

11 Narasingapuram Tank. Estimate Rupees
786.
Adjacent area acres 80
— revenue Rupees 292
Average — do — 313.

No expenditure has been incurred during the last 4 years. The estimate provides for repairs, reconstruction of revetment and a sluice and for lengthening the existing escape from 30 to 56 feet. The catchment basin is about 1 square mile and, as a pavement is all that is required, & as the discharge over this is less than

than that over a corresponding length of crest wall, and, as by lengthening the escape some reduction in the height of the bund will be feasible, it will be better to make the escape 90 feet long altogether, and the bund may then be made 6 inches lower: the saving on earthwork and turping will probably cover the cost of the additional length of escape. Any addition to the revetment may for a petty tank of this kind, at which the soil appears to be good, be omitted. This item will then be about 98 ^{+367 cubic yards} instead of 278 Rupees. The total of the estimate will then be Rupees 600.

12. Gotaramungalam Tank Estimate Rs 1170

Agent area acres 70.

— revenue Rupees 433.

Average do — 402

Expenditure in the past 4 years Rupees 80 in 1870-71.

The estimate provides for repairing the bund and lengthening a sluice Rupees 840

Constructing a surplus weir of 90 feet crest — 330

This

This latter work will take the place of a much smaller one (27 feet) which has been washed away, and it may be considered therefore an entirely new work and be built from the minor new works grant.

I do not think that a discharge of more than $6\frac{1}{2}$ cubic feet a second per foot of length, of a surplus weir of the kind shown in the design, can be expected, and the drainage basin being $1\frac{1}{2}$ square miles the flood discharge will be 737 cubic feet, and the length of weir required 115 feet; the extra 25 feet will cost about 60 Rupees. Probably an equal if not greater reduction may be made on the items for earthwork & turping e.g. at the West sluice the bund would seem to be higher than is necessary and of ample section, so no addition need there be made. The total of the estimate may stand as submitted and it may be divided into

Bund repairs &c Rupees 780

New surplus weir — 390

The open channel from the Surnamukki should

should be provided with a head sluice, if such a work can be constructed near the head without danger of being turned.

13. Thookivakum Large Tank Estimate
Rupees 1275

Area — acres 87
— revenue — Rupees 625
Average — — — 454

No expenditure on repairs has been incurred during the past 4 years.

The estimate provides for

Repairs to bund Rupees 980
A surplus weir 75 feet — 295

The catchment basin is $1\frac{1}{4}$ square miles, and the design for the weir being the same as for the Punnarum Tank the discharge may be taken as 6 cubic feet for each foot of crest; and, the total being 653 cubic feet a second, the proper length of crest will be 109 feet and 60 Rupees for the additional 25 feet must be added to the estimate which will then be Rupees 355.

14. Thookivakum small Tank Estimate
Rupees 970

Area — acres 30
— revenue — Rupees 251
Average — — — 263

The

The estimate provides for
Repairs to bund Rupees 740
Building a surplus weir 48 feet crest — 230

The drainage basin is stated to be about $\frac{1}{2}$ a square mile, and the maximum discharge therefrom will be about 394 cubic feet, so that the length of crest required will be 66 feet instead of 48 feet, and the weir will cost about 260 Rupees. On the other hand a margin of 18 inches above M.W.L. will be sufficient for so small a tank, and the reduction of 1 foot will make a considerable difference in the amount required for earthwork and turping. Only one cross section having been shown, it is difficult to suggest what this reduction will amount to, but as far as can be judged $\frac{1}{3}$ or say 240 Rupees seems probable. The repair estimate will then be Rupees 500.

15. The District Engineer's attention having been called to the rates entered in the estimate for earthwork

work, the usual average rate being $1\frac{1}{2}$ annas a cubic yard, para 12 of his letter has been written in reply to the observations made. He rightly says that such work well and properly executed must cost rather more than earth "heaped up any how with no attempt at consolidation except on the surface"; but the objection is not to a somewhat higher, but to a very greatly enhanced, rate. On tanks with bunds of moderate height such as most of these have, I think at any rate an average rate of $1\frac{1}{4}$ annas or 14 cubic yards the Rupee instead of $1\frac{1}{2}$ annas the cubic yard should suffice. On the subject too of average rates (para 13) I am unable to agree with Captain Purnycunt. It is a mistake to suppose that fixing rates for tanks or lengths when preparing estimates adds to the work to be done: the rates must be fixed for individual parts of the work some time or another, and trouble is saved rather than increased by doing this in the first instance. The rate ought certainly

certainly not to be paid for the work along a bund of perhaps half to three quarters of a mile in length, when lift, lead and soil probably all vary considerably, and undoubtedly no waddes or petty contractors would accept an average rate which did not err considerably in their favour. Again petty superintendence, if paid separately, should not be included in the rates: it may, if so treated, very easily amount to even 20 per cent, or say a rate of $1\frac{1}{2}$ instead of $1\frac{1}{4}$ annas. If on the other hand it be meant that petty contractors or waddes superintendence is so included, of course the only matter to be considered is whether, with reference to the particular circumstances, the rates are reasonable or otherwise. This superintendence would never amount to an increase of more than 1 pie a cubic yard, and generally much less. The matter is a very important one. Perhaps at least one half of the repair grant of the North West District is spent on earthwork, and

Ruppes 120,000

and if only $10\frac{2}{3}$ instead of 14 cubic yards a rupee be obtained on the average, the loss would amount to upwards of 14,000 Rupees.

16. With regard to the latter part of the District Engineer's letter, it is only necessary to remark that there is quite sufficient evidence in the case of North Arcot, as well as of other Districts, to show that it is desirable that the way in which tanks are proposed to be dealt with should be revised, and that such a control as the present limiting rule affords should be exercised. It may be very true that, owing to the neglected state of irrigation works in North Arcot, the result of this rule may be that a larger proportion of estimates will have to be submitted for superior sanction therefrom than from other Districts, and that

that some trouble will be thereby occasioned cannot be doubted, but this will be the consequence of past neglect; and if, as Captain Pennycook mentions, the rule will practically require all or nearly all the repair estimates of Tanks in his District to be submitted to Government, so far from this being a good reason for enlarging the limit of local sanction, it is in itself strong evidence that the past administration has been very defective, and that for want of some such opportunity of ascertaining what was going on, as is now secured, this inefficient administration did not obtain such notice as might have led to improvement. Further it appears to me that a proper revision of rates, and a judicious determination of the requisite section to be given to Tank funds, in connection with
long

long but cheap escape weirs,
will bring hundreds of estimates
within the limits of local
sanction, which otherwise would
require to be submitted to Go-
vernment. The anomaly alluded
to in the concluding sentence
of the District Engineer's letter
vanishes on examination. Cap-
tain Purneyrick quotes an
average sanction for repairs
against a maximum for
minor new work. His powers
of sanction may extend to Ru-
pees 10,000 or even more for
a single repair estimate, but
to only Rupees 750 for a new
work.

Ootacamund Wm. Mullins Lt Col R.E.
8th July 1874
Chief Engineer for Irrigation

To
The Secretary to Govt. M. D.

P. W. 1874 Sept.
 No. 4504

From

The Chief Engr.
 for Irrigation

Dated 8 July 1874
 Recd. 21st —

No. 486A

23 Enclaves received from the
 Ch. Engr. J. M. R. S. and
 to the Dist. Engr. for the
 P. W. C. S. 1092: 1/75

Submitting
 correspondence and
 estimates for the re-
 -pair & improvements
 to Tanks in the North
 Arcot District.

G.O. No 2244-14-8-74.

No. 280

Public Works Department
 Proceedings of the Madras Government
 From the Dy. M. S. (H. & Co 96 dated 14th April 1874)
 to the Chief Engr. for Irrigation (H. & Co 805 dated 17th June 1874)
 (H. & Co 17 dated 8 July 1874)
 2244

The following esti-
 mates for the repair
 and improvement
 of Tanks in the
 North Arcot District
 are sanctioned.

Repair estimates

Kelvenbakkum Tank.	Rupes 2,910
Kurshant ————— do —————	1,950
Punaveram ————— do —————	1,050
Serinthamungalam — do —————	570
Arconum ————— do —————	1410
Karasengapooram — do —————	600
Cotaramungalam — do —————	780
Thookivattum Large — do —————	980
———— do ————— small — do —————	500

Minor new works estimates

Kelvenbakkum Tank.		Rupes 670
constructing a surplus weir }		
Punaveram Tank.		
Constructing a surplus weir —	350	
———— do ————— a sluice —	120	470

Serinthamungalam Tank.

Constructing a surplus weir. 265

do a sluice. 100. 365

Cotaramungalam Tank.

Constructing a surplus weir. 390

Phookivakurum Large Tank

constructing a surplus weir. 355

Phookivakurum small Tank

constructing a surplus weir. 260.

2. The District Engineer's attention will be called to the remarks of the Chief Engineer for Irrigation; and, with regard to the subject of rates, the Government deem the right settlement of these a matter of the greatest importance; they rely upon Captain Pennycook to exercise a very strict control over them, and when inspecting works to see that those entered in

in the estimates are not in excess of what the exact circumstances of the different parts of a work fully warrant. Average rates for earthworks should not be allowed, except when the circumstances of a considerable extent of work are so nearly similar as to render it unnecessary to vary the rates. Where the quantity of work to be done is so large, a difference of even 1 pie a cubic yard is of importance. The Government agree with the Chief Engineer for Irrigation in considering that inclusive rates are objectionable, and that petty

petty superintendence
should not be included
therein. Similarly the
requisite consolidation
of earthwork should
form a separate item,
and that for the
earthwork itself should
provide only for exca-
vation and placing
the earth in its pro-
per position: the rate
for this is determi-
nable with accuracy
with reference to the
soil, lead, lift, and
every member of the
Department, entrusted
with the duty of
preparing estimates,
should understand
exactly how such
rates are to be de-
termined. On the
other hand the
charge for the water
which

which may be essen-
tial sometimes to
the proper execution
of earthwork may
vary considerably,
not only on different
tanks but on different
parts of the same
tank. The cost of
consolidation or tamp-
ing should, it is
thought, be fixed
for different des-
criptions of soil.

Good

To The D. E. North India
--- Chief Engr for India
--- Controlling Mr. A. S. Smith A. E. S.
S. Engrs Dept 24/7/74

Gobt. of 1874 Madras.
PUBLIC WORKS.

22



The Dist. Engr.
Rush Creek.

Vertraut

4209.

Encl.

G. O. L. R. 1974, No. 2244

Kos. 250-261

I must admit that the
letter causes me an un-
pleasant regard his reck-
lessness in the matter of ex-
penditure.

Estimate of the
cost of improvement
of the
Bain Banks, New York
City of the
suburb of the

280-281.

Case 16/1/14 RD 17/1/14