M.R.O. 1—77,003—3-6-37.

(1) Number of pages 48

(2) Date of repair 30.7.40

(3) Initials of the Referencer

MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.
Irrigation Branch

G.O. No. 406 Irrigation Press MS

Dated 24th June 1880.

Not to be folded or roughly handled

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

24th June 1880, No. 406 I.

Irrigation.
Account.

Read the following papers:—

No. 46. From Major H. R. MEAD, R.E., Superintending Engineer, Second Circle, to the Chief Engineer for Irrigation, dated Coimbatore, 30th April 1880, No. 33.

With reference to G.O., No. 374 I., dated 1st July 1879, calling for complete information on certain points regarding the Red Hills Tank and your last memorandum No. II/I.C.N., dated 12th April 1880, I have the honor to report that owing to the many changes of officers, &c., that, even now, the estimates are not complete. I think, however, it best for me to forward them in their present incomplete state, and request the immediate orders of Government on certain points, especially as I hope there is sufficient information to allow a decision being made.

2 Divisional Estimates.
2 Abstract do.
1 Sheet of Cross Section of Tank Bund.
1 Plan of Embankment.
1 Section of Puddle Wall.
5 Do of Borings (by banghy).

2. The estimates forwarded are not properly prepared and the specification is almost worthless; but I think they will enable us to judge approximately the cost of the measures proposed, and the following answers may be made to the four questions asked in G.O., No. 374 I., dated 1st July 1879:—

	Rs.
1*st*.—The cost of draining the rear portion of the bund with drains as shown in the plan and section	4,800
2*nd*.—Raising parapet wall of tank	800
3*rd*.—Repairing surplus sluice including ring bund	6,000
4*th*.—Constructing a puddle core through centre of bund and laying down with longitudinal and cross laterite sub-soil drains	48,000
To this may be added	
5*th*.—Constructing a berm in rear of the bund as shown in the sections	12,300

3. The 1st allows for 40 drains when the tank has been found to require them, 13 of these are south of the Pálár* sluice and 27 at and north of the slip of 77. They are on an average of 85 feet in length where the bund is very bad; it is proposed to carry them up at their inner ends perpendicularly to a length of from 9 to 16 feet. They extend from the foot of the bund to within 20 feet of its centre. They are to be 2 feet square filled with broken laterite stones covered with turf.

* Polal—J. M.

4. The 2nd item allows for raising a parapet 5,000 feet in length, 2 feet high, it is believed that the rate allowed Rs. 2 per cubic yard is not sufficient. The work is in progress.

5. *Repairs to the surplus sluice, Rs.* 6,100.—This work it is urged should be sanctioned and the work pressed on as fast as possible. Without this work in good order the level of the tank water cannot be found.

6. With regard to the puddle core, 3,800 feet in length, there has been much correspondence and many opinions expressed, the estimate is and can be only an approximation, and I would urge that a sum of say Rs. 1,000 should be sanctioned to allow a small piece being done as an experiment. I believe no similar work has been done before, and we have much to learn regarding the cost and practicability of the work.

7. The berm is proposed to be made to a level of 10 feet below Full Tank Level (46·3 above datum) and of breadths varying according to the height of bund, &c. There is no doubt but it would add greatly to the strength of the bund.

8. With regard to the rates allowed in the estimates, I can say but little. I believe the works can be done for the amounts entered, but that the cost of the puddle core, I consider, cannot be known until a piece is done experimentally.

9. I earnestly request that early orders may be issued regarding the works to be estimated for, and I trust when this is decided I may be able to have the estimates forwarded without delay and in a proper manner.

10. As requested in your memorandum under reply, I return the sections of the 56 wings that have been made with their positions marked in the plans. These sections show the urgent necessity for this important bund being attended to.

No. 105 I.

No. 46-A.

Note by the Chief Engineer for Irrigation.

THE Superintending Engineer's letter and its accompaniments have been submitted with reference to G.O., No. 374 I., 1st July 1879, in which complete information was called for on the cost of carrying out certain works to the Red Hills Tank, Madras Water Works and Irrigation Extension Project, with a view to the security of that important reservoir.

2. As mentioned by the Superintending Engineer the information given is not complete, and it may be added that the specification is useless and unintelligible in many parts, while in the estimates different and separate items of work are so mixed up as to make it very difficult, if not impracticable, to ascertain clearly what the several works are expected to cost. The Superintending Engineer has given an approximate abstract for the several works referred to in the Government Order.

3. The only new information regarding the circumstances of the bund of this tank which has been obtained in the interval is that evidenced by some borings which have been put down. These confirm the previous evidence obtained from the sections of the bund exhibited at the slips, which have on several occasions taken place, of the very mixed character of the material used in the formation of the embankment, and they show moreover that the old, as well as the new, part of the bund was constructed in a very unreliable manner. In two of the borings, Nos. 2 and 6, water was met with at 22 feet from the top of the bund, or at 50·25—22 = 28·25, and 52·69—22 = 30·69 reduced levels, corresponding to about 18 and 16 feet below full tank level, but the water in the tank at the time was rather more than 4 feet below F.T.L. At one bore, No. 6, the mud and water rose in the bore hole 11 feet, or to about 6 inches below the then water level in the tank, thus indicating that there was a very unsafe freedom of communication between the

46·31 F.T.L.
42·19
4·12

water in the tank and the interior of the bund. This shows that the soil of which the bund at this part is composed is highly porous. No. 6 bore was put down near one of the earlier slips. No. 4 bore is at the site of the slip of 1877, but of this no section has been submitted.

4. The above information shows very conclusively that a puddle core wall could not be inserted in the bund of this tank without first lowering the water-level in the tank very considerably. To what level it would have to be lowered cannot be determined beforehand, but it may be assumed that 10 feet below F. T. L. would be the highest possible level, and that not improbably 2 or 3 feet more of water would have to be run off to enable some parts of the work to be carried out. That there is subsoil leakage at any rate in many places is certain, but the water met with at bore No. 6 is not such leakage, and semi fluid material, like that found in this and No. 2 bore, was undoubtedly the cause of the slips which have from time to time occurred.

5. It is evident that the bund cannot be safe so long as its condition anywhere is such as it has been found to be in certain places, and in the opinion of the undersigned this embankment could not be made perfectly secure without the formation of a properly constructed bund inside the present bund, to carry out which work it would be necessary to empty the tank and to keep it empty for many months. The grounds of this opinion are the following:—Were a puddle core wall inserted in the present bund its effect would be to cut off all but subsoil leakage from all that part of the bund behind it, and such leakage would be disposed of by the drains which would be laid down at the same time. The front part of the bund would remain in its present condition and with some of it answering to the description noted on bore section No. 21, viz., of the consistency of butter. Settlements might at any time take place which might involve the rupture of the puddle wall and admit water to the rear part of the bund, and this would compromise the safety of the latter. It would matter but little were the front part of the bund merely porous, provided the soil were not soluble or convertible by water into a material unable to sustain pressure. All that can be said is that so far only at the slips of some six or seven years ago near the north end, that is near bore No. 2, has the front slope subsided, which was due to some of the subjacent material having slipped away or been squeezed out.

6. It may perhaps be assumed that the tank cannot be emptied and the water supply of Madras cut off for a long period in order to make a new bund inside the present one, while there would be very great difficulty in obtaining the soil required.* Moreover it will be desirable, if possible, to avoid having to lower the water-level very much, which, as above stated, (paragraph 4) must be done if a puddle wall is to be inserted. Now whatever may have to be done in this direction ultimately, in order to remove the causes of instability of the rear part of the bund, transverse drains under this portion of the bund will be essential, and it is possible that these will so far induce consolidation as to allow of a connecting longitudinal dry stone wall being inserted on the line of the inner ends of the drains which would have the effect of securing freedom from water of all the rear part of the bund, and so ensure its stability. The result would then be a fore part of the bund not much, if at all, altered in condition, and a rear part so arranged as to afford it adequate support; between this support in rear and the water pressure in front practically stability might be found to exist.

* Part would be got from present bund, but more would be needed.

The transverse drains may be commenced at once, as they will under any circumstances be beneficial. The cuttings made to insert them will furnish much additional information as to the character of the bund, and it may then be decided where and for what lengths the dry stone wall should be inserted. A specification for these transverse drains, for the partial drainage of the pool in rear of the bund so as to make and keep them efficient, as also for a dry stone wall, so far as this may be found necessary, is appended to this note.

7. In paragraph 3 of the Superintending Engineer's letter it is mentioned that 40 transverse drains are provided for in the estimate of Rs. 4,800. Even assuming that part of the 3,800 feet of bund needing to be dealt with is sufficiently provided with these drains at present, it is thought that it will be desirable to allow for 50

additional drains of this description. From the details laid down in pencil on the sections* it appears that their average length will be about 87 feet, which approximates to the 85 feet mentioned by Major Mead. From the way in which the estimate has been prepared it is somewhat difficult to make out how the sum of Rs. 4,800 has been arrived at, but the following items in the estimate of Rs. 24,000 appear to belong to this work :—

* Nos. 2 and 5 to 8, dated 27th March 1880.

	RS.
9,600 Cubic yards of excavation	
533⅓ Do. of laterite stone	900
Turfing	1,067
Planking	200
Pumping	1,000
... ...	1,000
	4,167
Sundries and superintendence	633
	4,800

The detailed estimate shows that the cuttings for the drains are to be 6 feet wide, which is just twice the width necessary or desirable. The rate Rs. 2 a cubic yard for mere lumps of laterite stone where laterite is abundant is excessive. The estimate for these drains will be about as follows :—

50 × 87 × 3 × 11 = 143,550 cubic feet excavation.
50 × 87 × 2 × 2 = 17,400 do. laterite stone.
50 × 87 × 3 = 13,050
50 × 87 × 4 = 17,400
30,450 square feet turf sods.
126,150 cubic feet refilling.
2 × 75 × 11 × ⅙ = 550 cubic feet planking.
50 × 3 × ⅓ × ⅓ = 16⅔ do. struts.
566⅔ do. wood-work for one drain.
1,700 do. do. for three drains.

	RS.	A.	P.
143,550 Cubic feet of excavation at As. 8 the 100	717	12	0
17,400 Do. of laterite at Rs. 6 the 100	1,044	0	0
30,450 Square feet of turf sods at As. 6 the 100	114	3	0
126,150 Cubic feet of refilling and tamping at As. 4 the 100 ...	315	6	0
1,700 Do. of wood-work at Rs. 2 a cubic foot ...	3,400	0	0
Contingencies and superintendence	408	11	0
	6,000	0	0

The rate for excavation includes the setting up of the planking and the shifting of the struts as required. No pumping can be required as the water met with will flow through the drain.

The planks will serve for the insertion of longitudinal drains or the dry stone wall, and supposing that 300 feet in length are undertaken at once about 600 cubic feet additional of wood-work will be needed. For a longitudinal drain laid at 23·00 or for a dry stone wall founded at 23·00, the cost per 100 feet will be as follows, the excavation being the same in both cases, and the top of the wall being assumed to be at 40·00 :—

Longitudinal Drain.

	RS.	A.	P.
100 × 3 × 22 = 6,600 cubic feet of excavation at As. 12 the 100.	49	8	0
100 × 2 × 2 = 400 cubic feet laterite stone at Rs. 6	24	0	0
100 × 7 = 700 square feet of turf sods at As. 6	2	10	0
6,200 Cubic feet of refilling and tamping at As. 4	15	8	0
Contingencies, &c.	6	6	0
	98	0	0

or say Re. 1 a running foot.

Dry Stone Wall.

	RS.	A.	P.
Excavation	49	8	0
100 × 2 × 18 = 3,600 cubic feet laterite stone at Rs. 6 ...	216	0	0
100 × 3 = 300 square feet turf sods at As. 6	1	2	0
3,000 Cubic feet refilling, &c., at As. 4	7	8	0
Contingencies	19	14	0
	294	0	0

or say Rs. 3 a running foot.

It may be assumed that 1,000 feet of longitudinal drain and 2,000 feet of dry stone wall may be needed, and if so the cost of the work will be—

	RS.	A.	P.
1,000 Feet of longitudinal drain	1,000	0	0
2,000 Do. of dry stone wall	6,000	0	0
600 Cubic feet of additional planking, &c.	1,200	0	0
	8,200	0	0

The wood-work would probably realise As. 12 a cubic foot when done with.

8. The water-level in the pool in rear of the bund must be kept down to 21·00 as a maximum, in order that the drains may be effective. In the estimate of Rs. 24,000 there is an item of Rs. 300 for cutting a channel for this purpose. In the specification it is called "open ditch," but there is no indication traceable of its alignment or levels. There is a detailed estimate which makes the quantity of excavation to be 51,809·35 cubic feet, so the rate becomes Rs. 1·727 the 100 cubic feet, and apparently sections have been taken though they have not been sent up. Were the bed of this cut at its head placed at 20·50 with the particulars given in the specification, viz. :—

Fall 17 feet a mile,
Bed width 4½ feet,
Side slopes 1½ to 1,

the discharge would be 3·33 cubic feet a second, and this would not be likely to prove sufficient. With the bed at 20·00 the discharge would be 12·30 cubic feet a second. This may be more than will be necessary, but if so the water-level will be merely reduced below 21·00, and this will be no disadvantage, so the cut may start at 20·00.

$v = 1{\cdot}27$ feet a second.
$v = 2{\cdot}05$ feet a second.

9. In connection with the transverse drains at the southern part of the bund, as mentioned in the appended specification, a drain parallel to the bund is required. This will be about 25 chains, or 1,650 feet in length, and the quantity of excavation will be—

660 × 14 average sectional area = 9,240
660 × 10 do. = 6,600
330 × 3 do. = 990
16,830 cubic feet at As. 8 a 100 = RS. 84 A. 2 P. 5

the cost of this drain will therefore not exceed Rs. 90.

10. The second item in the Superintending Engineer's letter is Rs. 800 for raising the dry stone parapet of the bund. The detailed estimate shows that for a length of 5,000 feet this parapet is to be raised 2 feet. Apparently the instructions at page 3 of the Proceedings of Madras Government, No. 374 I., 1st July 1879, have not been attended to or the raising would have been divided into two items of different heights. The Superintending Engineer considers the rate of Rs. 2 a cubic yard not sufficient, and he adds that the work is in progress, but no explanation is given. As the parapet should be of large stone carefully fitted, it is probable that a higher rate should be allowed, but on the other hand the quantity entered in the estimate is probably in excess of that required.

11. The third item is Rs. 6,000 for repairing the surplus sluices including ring bund. In the estimate the following items are to be found :—

		Rs.	A.	P.	Rs.	A.	P.
Ring bund—Revetment		740	0	0			
Do.	Earthwork backing	308	4	0			
Do.	Puddle wall	449	8	6			
					1,497	12	6
Sluices—Dismantling flooring		50	0	0			
	Concrete (Portland) bedding	1,080	0	0			
	Resetting flooring	100	0	0			
	Rebuilding broken piers	500	0	0			
	Earthwork	6	10	0			
	Brick masonry	22	8	0			
	New spears and gear	2,500	0	0			
					4,259	2	0
					5,756	14	6
Contingencies, &c.					243	1	6
					6,000	0	0

As regards the ring bund, as this is in existence and has been there for some time, it is not clear why this item has been included.

The specification which is without date says, "a ring bund will be constructed." Possibly the item is to cover expenditure already incurred, and, if so, this should have been explained.

With regard to the concrete the specification makes it 2 feet thick, but it is believed that there is nothing like this space between the flooring stones and the old laterite masonry below. It is further stated that there is to be a layer of concrete 4 feet wide and 2 feet deep in front of the sluice shutters. The intended arrangement should have been illustrated by a drawing, without which it cannot be clearly understood. As an excavation is to be made to a depth of 4 feet for laying down this concrete, it must be intended as a sort of front apron, and if so there can be no necessity for using Portland cement; it cannot in any way stop leakage through the old laterite masonry, and it is doubtful whether any such addition is required, but if it be desirable it should be made with concrete in hydraulic mortar, the cost of which will be about one-fourth that of Portland cement concrete.

The new gear must be designed on proper and complete calculations, and approved, before it is adopted, and a fair price must be allowed for the original gear. The spears must be supported by guides placed at about 13 feet above the sill of the sluice, and the lower part of these spears may with advantage be made of teak. All this should have been attended to long ago.

Apparently the further expenditure needed to put the sluices in good order, apart from the provision of suitable gear, will be under Rs. 1,500, and it is recommended that this work should be undertaken at once and charged to repairs. Until it is done the ring bund must be maintained, and it is liable to injury on the occurrence of gales from the south or south-west. The undersigned is of opinion that the sluices should be made efficient for the purpose originally intended, viz., for maintaining a command over the water-level of the reservoir, but in any case they should be repaired.

12. It is recommended that the idea of inserting a puddle core wall in the bund be postponed at any rate for the present. Its cost would be about Rs. 40,000 for a length of 3,800 feet or, say, Rs. 11 a foot-run.

13. That a berm would add to the security of the bund and tend to prevent slips may be admitted, but it is thought not to be desirable to spend Rs. 12,300, the 5th item of paragraph 2 of the Superintending Engineer's letter, on work of this description. It may perhaps, though hardly probably, be found advisable to construct such a berm in particular places after the transverse drains have been put in, but it is believed that the dry stone wall will be a more effective remedy wherever the bund, throughout any considerable part of its vertical section, is found to be

permeated by water. With such a wall the risk of slips in the rear slope will be obviated, as the rear part of the bund will be entirely cut off from leakage whether subsoil or other.

14. The papers have been received in too crude and confused a state to allow of regular sanction for the work proposed to be done to be accorded. To have returned them for revision would have involved considerable further delay, and between the present time and the setting in of the north-east monsoon much of the work ought to be completed. It is recommended therefore that the following provisional sanctions should be given pending the submission by the Superintending Engineer of properly prepared estimates and specifications, the former of which should of course show distinctly the expected cost of each item—

	Rs.
Original Works.	
(1) Parallel drain in rear of south part of bund	90
(2) Fifty transverse drains in bund	6,000
(3) Longitudinal drain and dry stone wall	8,200
(4) Channel to lower the water-level of pool in rear of bund to 21·00 ...	300
Total ...	14,590
Repairs.	
(1) Repairing ten vent surplus sluices	1,500

(Signed) JOHN MULLINS, Col., R.E.,
Chief Engineer for Irrigation.

OOTACAMUND,
2nd June 1880.

MADRAS WATER WORKS AND IRRIGATION EXTENSION PROJECT—RED HILLS TANK.

Specification of Drainage arrangements in rear of and under the rear part of the tank bund and of connected work.

Transverse drains.—These drains will start at the level of 21·00, at which level the sole of the drains at their outfall will throughout be fixed at all places at which there is a pool or lower ground in rear of the bund.

Where the ground level is higher than 21·00 a drain parallel to the bund will be cut along low ground not less than 30 feet from the toe of the rear slope with a fall of 1 foot* in 10 chains, starting with the level of 21·00 at the lower end. The head of this drain to have a width at bottom of 1 foot and side slopes of 1 to 1. The bottom width to increase by 6 inches at the end of every 10 chains, *i.e.*, at 10 chains from the head it will be $1\frac{1}{2}$ feet wide, at 20 chains 2 feet wide, and so on. The soles of the transverse drains at their outfall will be 0·50 foot above the bottom of the parallel drain. All open transverse drains to have a fall of 1 in 330.

* 8 feet in a mile.

All drains filled with stone to have a fall of 1 in 30. The transverse drains under the bund to be run into a line $22\frac{1}{2}$ feet from the rear face of the bund parapet. As the lengths and starting levels of these drains will vary, so will the sole level at the inner end.

2. *Excavations for transverse drains.*—These drains outside the toe of the bund to be $1\frac{1}{2}$ feet wide at bottom with side slopes of 1 to 1.

The cuttings into the bund to be at right angles to its alignment and to be 3 feet wide. Taking the rear slope as on the average 2 to 1, the cutting will be about 3 feet deep at 6 feet from its commencement and, so far, the sides may be left unsupported. All the cutting beyond this to be supported by close planking with struts or distance pieces at 6 feet apart horizontally or in the direction of the length of the plank, and vertically according to the circumstances.

The simplest arrangement will be to lay the planks parallel to the sole of the drain. As soon as about 30 feet in length of the cutting for a drain has been completed down to sole level, the stone for the drain should be laid in and hand-packed. This stone should be in irregular roundish lumps, 4 to 6 inches in diameter. Turf sods should be laid vertically at the sides, with the grass next the stone, and on removing

the planks the space left vacant should be filled in with good soil well tamped. The stone to be covered in with turf sods, grass downwards, and the bund reformed to section, the planks being removed one by one as the filling in progresses; the soil to be carefully tamped in 3 or 4 inch layers. The stone at the end of each length of drain thus formed to be protected from being obstructed by the earth by a plank placed vertically against the stone and edge of turf; this plank will be removed when the next length of stone is about to be laid down.

Should much water be met with as the cutting progresses, the drain should be laid in with stone, and the bund reformed over it in shorter lengths, say of 10 feet, so as not to leave any greater length open at one time than can be quickly closed and completed, should the adjacent soil show signs of being washed out by the water. The width of the cutting being only 3 feet it is probable that the face of the bund at its end, which may be cut at a slope of $\frac{1}{4}$ to 1, will stand without support, but preparations must be made for supporting it by short pieces of plank, with cleats fastened to the side planking if necessary. All the planks will be 2 inches thick, so these planks for the face should be 2 feet $7\frac{1}{2}$ inches long, and wedges should be driven between the ends and the side planking to hold the short planks until the cleats have been fixed.

3. *Longitudinal dry stone wall.*—On the completion of cutting for a tranverse drain, it will be seen what the nature of the bund at this point is, as also whether water finds its way through only at the bottom or at points above the level of the drain. It will then be determined whether a longitudinal dry stone wall is to be inserted or not. If this be ordered the excavations for it will be made in lengths of 10 or 12 feet at a time, on either side of the head of the transverse drain, commencing from the top of the bund, with a lining of close planking on either side of the trench and struts. The trench to be 3 feet wide down to the level of the surface of the natural soil or ground level, below which a width of 2 feet will suffice. The bottom of the wall to be laid at 23·00 except where original ground level is reached at a higher level, in which case it will be not less than 2 feet below ground level, the exact depth being determined from the nature of the soil which, if porous, will necessitate the excavation being carried lower. The wall will be in some cases founded lower than the head of the transverse drain. The dry stone wall will not be a necessity where the bund above the level of the transverse drain is water-tight, and its height may be according to circumstances, viz., to the level at which the bund is good and watertight. It may therefore be anything from the 2 feet of a simple longitudinal drain to that which would approximate to F.T.L. Generally it may be considered unlikely that it will need to be carried much above the surface of the old bund, but in all cases it should cut off from the bund in rear all water passages, so that the rear of the bund may be left dry and stable.

4. *Order of execution of Work.*—The longitudinal open drain in rear of the bund must be completed before the transverse drains having an outfall thereinto are commenced.

The transverse drains into the bund must be formed before a longitudinal drain or a longitudinal dry stone wall is put in because the transverse drains are required to carry off all water tapped or met with in excavating for the L. drain or dry stone wall. The excavations for these latter are to be so arranged as to afford uninterrupted drainage to the transverse drains on either side. Care to be taken that the heads of the transverse drains are not choked by silt from the excavations.

5. *Drainage of pool in rear of bund.*—Arrangements are to be made by an outfall channel to keep the water-level down to 21·00 as a maximum, and to this end the sole of the outfall channel at its head must not be higher than 20·50 and it may have to be lower. On the plan (tracing) dated 2nd September 1879 of the tank there is a drainage from the pool marked, but there is nothing to indicate that it is effective, and it is not shown as running into any channel which would carry the water away.

OOTACAMUND,
2nd June 1880.

(Signed) JOHN MULLINS, Col., R.E.,
Chief Engineer for Irrigation.

No. 47. ORDER THEREON, 24th June 1880, No. 406 I.

IN accordance with the recommendations made by the Chief Engineer for Irrigation in the foregoing note, provisional sanction is given for carrying out the drains to improve the stability of the bund of the Red Hills Tank, Madras Water Works and Irrigation Extension Project, at a cost approximately estimated at Rs. 14,590.

2. The Superintending Engineer will arrange for the early submission of regular estimates for the whole of the work shown in the note to be required, including the raising of the dry stone parapet and the improvement of the gear of the surplus sluices in the waste weir.

3. The Superintending Engineer must take care that in future estimates are prepared and submitted in a proper manner, so as to show clearly the probable cost of each separate item; and that the specifications are drawn up so as to be both easily intelligible and an adequate guide in carrying out the work. Funds will be appropriated from the provision made for this project in the budget, item No. 15, and this provisional sanction has been registered as No. 9 I. of 1880-81.

4. The repair of the surplus sluices is approved, and an estimate for this work can be sanctioned by the Superintending Engineer in due course. The Superintending Engineer will give attention to paragraph 11 of the foregoing note in connection with this repair.

(True Extract.)

Ag. Under Secy. to Govt., P.W.D.,
Irrigation Branch.

To the Superintending Engineer, Second Circle.
" Chief Engineer for Irrigation.
" Examiner of Public Works Accounts.

Exd. E. C. Shunker.
Spare Copies

IRRIGATION.
ACCOUNT.

Govt. of {1880} Madras.

PUBLIC WORKS.

To

THE SUPERINTENDING ENGINEER,
SECOND CIRCLE,

&c., &c., &c.

Dated June, 24th.

Issued

Recd. *Encl.*

G. O., 24th June 1880, No. 406 I.

JUNE.

Nos. 46-47.

Red Hills Tank, Madras Water Works and Irrigation Extension Projects.—According provisional sanction to an approximate estimate for carrying out the drains required to improve the stability of the bund of the — and directing the early submission of regular estimates.

P. W. DEPARTMENT.

READ the following :—

Note by the Chief Engineer for Irrigation
R- 105 - I dated 2nd June 1880

FOR ORDERS.

Lt Col Chief Engineer for Irrigation
4/6 Joint Secretary to Govt.
P. W. Irrigation Branch

I agree but should like to know whether the backing for the bund on the outside will be sufficient thickness of earth - after the pressure ceases

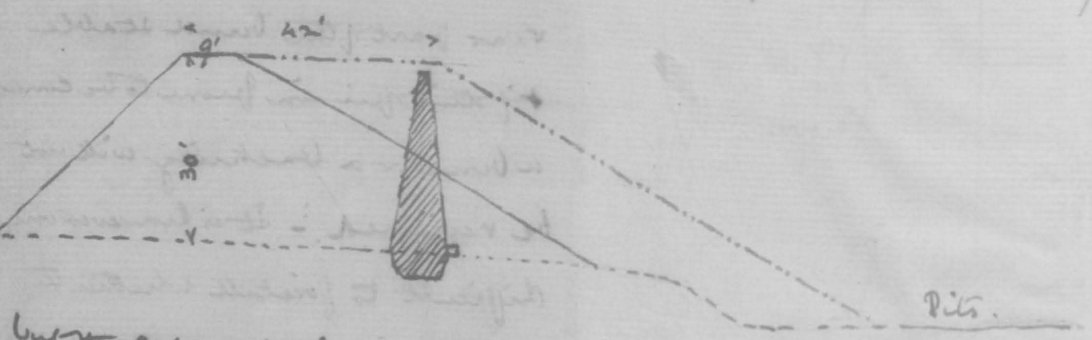
I accept the Ch: E's recommendations. The letter seems fully essentially correct for provisional sanction

GB 17/6

In the papers received from the Superintending Engineer there was an item of Rupees 12,300 for a raised berm in rear of the bund, and this would have an effect in the same direction as a backing or increase

of section of the bund at the back. The argument in the note by the Chief Engineer for J is that the drains will make the rear part of the bund stable, if this opinion proves to be correct a berm or a backing will not be required - It is however very difficult to foretell whether the drains will be completely intercepted or not: they may be fully so as regards the water traversing the bund above ground level, but not so in the case of the water percing through the porous laterite soil on which part of the bund (it is not known exactly how much) stands.
Additions to the rear part of the bund can be made at any future time if found desirable by extending the transverse drains across the base of such addition There is not room however in many places for any very considerable addition as the cuttings from which the soil for the present bund was taken are but a few feet from the toe of

the rear slope. Had there been room it might have been feasible to reform the bund immediately



but the cost would be very great because the quantity of earth would be large and it would have to be brought from a considerable distance. Also it would be difficult to secure the stability of the toe of a rear slope running down into the pits, the drainage of which down to the bottom would not be easy.

W. 4. 19/6

FOR ORDERS.

As per the same in the further note

19/6

Attach to original of para sent down to Secretary

21/6

Recd 19.6.80. Std 21.6.80 — Cir 5.6.80 Std 19.6.80.
V.h. Shedbolme

Superintending Engineers Office
2nd Circle. Coimbatore 30th April 1880.

No. 33

From The Superintending Engineer
Second Circle

To The Chief Engineer
for Irrigation.

Sir

Encls: 12
2 Dft Estimates
2 Abstt: Estimates
1 sheet of Cross section of Tank bund.
1 Plan of embankment.
1 section of Pattabandi
5 Dft of bunds

With reference to Gr. O., No. 374 I dated 1st July 1879 calling for complete information on certain points regarding the Red Hills Tank and your Memorandum No. II/1C.N dated 12th April 1880 I have the honor to report that owing to many changes of officers &c. &c. that even now the estimates are not complete. I think, however, it best for me to forward them in their present incomplete state and request the immediate orders of Government on certain points especially as I hope there is sufficient information to allow a decision being made.

2. The Estimates forwarded are not properly prepared and the specification is almost worthless but I think they will enable us to judge approximately the cost of the measures proposed and the following answers may be made to the questions asked in Gr. O., No. 374 I dated 1st July 1879.

* By Banks

1st

(1st) The cost of draining the rear portion of the bund with drains as shewn in the plan and section ____ Rs 4,800.

(2nd) Raising parapet wall of tank ____ 800.

(3rd) Repairing surplus sluice including Ring bund ____ 6,000.

(4th) Constructing a puddle core through centre of Bund and laying down with longitudinal and cross Laterite sub-soil drains ____ 48.000

To this may be added:

(5th) Constructing a Berm in rear of the bund as shown in the sections ____ 12,300.

3. The (1st) allows for 40 drains when the tank has been found to require them 13 of these are south of the Palar Sluice and 27 at and North of the slip of 17. They are on an average of 85 feet in length where the bund is very bad, it is proposed to carry them up at their inner ends perpendicularly to a length of from 9 to 16 feet. They extend from the foot of the bund to within 20 feet of its centre. They are to be 2 feet square filled with broken laterite stones covered with turf.

4. The (2nd) item allows for raising a parapet 5,000 feet in length, 2 feet high, it is believed that the rate allowed Rs 2 per cubic yard is not sufficient. The work is in progress.

5. Repairs to the Surplus Sluices Rs 6,100; this work it is urged should be sanctioned and the work pressed on as fast as possible. Without this work in good order the level of the tank water

Cannot

Cannot be found.

6. With regard to the puddle core 3,800 feet in length there has been much correspondence and many opinions expressed, the estimate is and can be only an approximation and I would urge that of sum of say Rs 1,000 should be sanctioned to allow a small piece being done as an experiment. I believe no similar work has been done before and we have much to learn regarding the cost and practicability of the work.

7. The berm is proposed to be made to a level of 10 feet below Full Tank Level (46·3 above Datum) and of breadths varying according to the height of bund 4c. There is no doubt but it would add greatly to the strength of the bund.

8. With regard to the rates allowed in the estimates, I can say but little, I believe the works can be done for the amounts entered, but that the cost of the puddle core, I consider, cannot be known until a piece is done experimentally.

9. I earnestly request that early orders may be issued regarding the works to be estimated for and I trust when this is decided, I may be able to have the estimates forwarded without delay and in a proper manner.

10. As requested in your Memo. under reply I return the sections of the 5 borings that have been made with their positions marked in the plans. These sections show the urgent necessity

for

for this important work being attended to.
I have the honor to be
Sir
Your Most Obedient Servt.

Capt. Major R.E.
Superintending Engineer 2nd.

From

The Supg Engineer,
Second Circle.
P.W.D.
25 JUN 80
No. 1668

Dated 30th
Rec'd 2nd April 1880.

No: 33.

Encls: 12

Red Hills Tank:—

Reporting on the points called for in G.O. No: 374 I of 1st July 1879, regarding—

From Superintending Engineer, 2nd Circle, No 33 - 30th April 1880

No 105

Note by the Chief Engineer for Irrigation.

Encls 5

The Superintending Engineer's letter and its accompaniments have been submitted with reference to G.O. No 374-I 1st July 1879, in which complete information was called for on the cost of carrying out certain works to the Red Hills Tank, Madras Water Works and Irrigation Extension project, with a view to the security of that important reservoir.

2. As mentioned by the Superintending Engineer the information given is not complete, and it may be added that the Specification is useless, and unintelligible in many parts, while in the estimates different and separate items of work are so mixed up as to make it very difficult, if not impracticable, to ascertain clearly what the several works are expected to cost. The Superintending Engineer has given an approximate abstract for the several works referred to in the G.O.

3. The only new information regarding the circumstances of the bund of this tank which has been obtained in

the interval is that evidenced by some borings which have been put down. These confirm the previous evidence obtained from the sections of the bund exhibited at the slips, which have on several occasions taken place, of the very mixed character of the material used in the formation of the embankment, and they show moreover that the old as well as the new part of the bund was constructed in a very unreliable manner. In two of the borings, Nos 2 and 6, water was met with at 22 feet from the top of the bund, or at 50.25 – 22 = 28.25, and 52.69 – 22 = 30.69 reduced levels, corresponding to about 18 and 16 feet below full tank level; but the water in the tank at the time was rather more than 4 feet below F.T.L. At one bore, No 6, the mud and water rose in the bore hole 11 feet, or to about 6 inches below the then water level in the tank, thus indicating that there was a very unsafe freedom of communication between the water in the tank and the interior of the bund. This shows that the soil of which the bund at

46.31 F.T.L
42.19
4.12

this part is composed is highly porous. No 6 bore was put down near one of the earlier slips. No 4 bore is at the site of the slip of 1877, but of this no section has been submitted.

4. The above information shows very conclusively that a puddle core wall could not be inserted in the bund of this tank without first lowering the water level in the tank very considerably. To what level it would have to be lowered cannot be determined beforehand, but it may be assumed that 10 feet below F.T.L would be the highest possible level, and that not improbably 2 or 3 feet more of water would have to be run off to enable some parts of the work to be carried out. That there is subsoil leakage at any rate in many places is certain, but the water met with at bore No 6 is not such leakage, and semifluid material, like that found in this and No 2 bore, was undoubtedly the cause of the slips which have from time to time occurred.

5. It is evident that the bund

cannot be safe so long as its condition any where is such as it has been found to be in certain places, and in the opinion of the undersigned this embankment could not be made perfectly secure without the formation of a properly constructed bund inside the present bund, to carry out which work it would be necessary to empty the tank and to keep it empty for many months. The grounds of this opinion are the following. Were a puddle core wall inserted in the present bund its effect would be to cut off all but subsoil leakage from all that part of the bund behind it, and such leakage would be disposed of by the drains which would be laid down at the same time. The front part of the bund would remain in its present condition and with some of it answering to the description noted in Bore Section №2, viz of the consistency of butter. Settlements might at any time take place which might involve the rupture of the puddle wall, and admit water to the rear part

part of the bund, and this would compromise the safety of the latter. It would matter but little were the front part of the bund merely loose, provided the soil were not soluble, or convertible by water into a material unable to sustain pressure. All that can be said is that, so far, only at the slips of some 6 or 7 years ago near the North end, that is near Bore №2, has the front slope subsided, which was due to some of the subjacent material having slipped away or been squeezed out.

6. It may perhaps be assumed that the tank cannot be emptied, and the water supply of Madras cut off for a long period in order to make a new bund inside the present one; while there would be very great difficulty in obtaining the soil required. Moreover it will be desirable, if possible, to avoid having to lower the water level very much which as above stated (para 4), must be done if a puddle wall is to be inserted. Now whatever may have to be done in this direction ultimately, in order to remove the

× part would be got from present bund but more would be needed

causes of instability of the rear part of the bund, transverse drains under this portion of the bund will be essential, and it is possible that these will so far induce consolidation as to allow of a connecting longitudinal dry stone wall being inserted on the line of the inner ends of the drains which would have the effect of securing freedom from water of all the rear part of the bund, and so ensure its stability. The result would then be a fore part of the bund not much, if at all, altered in condition, and a rear part so arranged as to afford it adequate support; between this support in rear and the water pressure in front practically stability might be found to exist.

The transverse drains may be commenced at once, as they will under any circumstances be beneficial. The cuttings made to insert them will furnish much additional information as to the character of the bund, and it may then be decided where and for what lengths, the dry stone wall should be inserted. A specification

for these transverse drains, for the partial drainage of the pool in rear of the bund so as to make and keep them efficient; as also for a dry stone wall, so far as this may be found necessary, is appended to this note.

7. In para 3 of the Superintending Engineer's letter it is mentioned that 40 transverse drains are provided for in the Estimate of Rupees 4,800. Even assuming that part of the 3800 feet of bund needing to be dealt with is sufficiently provided with these drains at present, it is thought that it will be desirable to allow for 50 additional drains of this description. From the details laid down in pencil on the sections it appears that their average length will be about 87 feet, which approximates to the 85 feet mentioned by Major Mead. From the way in which the Estimate has been prepared it is somewhat difficult to make out how the sum of Rupees 4,800 has been arrived at but the following items in the Estimate of Rupees 24,000 appear to belong to this work.

Nos 2 and 5 to 8 dated 27th March 1880.

9,600 cubic yards of excavation — 900
533⅓ — do — of Laterite stone — 1,067
Turfing — 200
Planking — 1,000
Pumping — 1,000
4,167
Sundries and superintendence 633
4800

The detailed estimate shows that the cuttings for the drains are to be 6 feet wide, which is just twice the width necessary or desirable. The rate 2 Rupees a cubic yard for mere lumps of laterite stone, where laterite is abundant, is excessive. The estimate for these drains will be about as follows:-

50×87×3×11 = 143,550 cubic feet excavation
50×87×2×2 = 17,400 — do — laterite stone
50×87×3 = 13050
50×87×4 = 17400 30,450 square feet turf sods
126,150 cubic feet refilling
2×75×11×1/6 = 550 cubic Feet. Planking
50×3×1/3×1/3 = 16⅔ " Struts
566⅔ — " — wood work for 1 drain
1,700 — " — do — for 3 drains

143,550 C. Feet of Excavation at 8 annas the 100 — 717. 12. 0
17,400 — " — of Laterite at 6 Rupees — do — 1044. —
30,450 square feet of turf sods at 6 annas do 114. 3. 0
126,150 C. Feet of refilling & tamping at 4 — " — do 315. 6. 0
1,700 cubic Feet wood work at 2 Rupees a C. Foot 3400. —
Contingencies and superintendence 408. 11. 0
6000. 0. 0

The

The rate for excavation includes the setting up of the planking, and the shifting of the struts as required. No pumping can be required as the water met with will flow through the drain.

The planks will serve for the insertion of longitudinal drains or the dry stone wall, and supposing that 300 feet in length are undertaken at once about 600 cubic feet additional of wood work will be needed. For a longitudinal drain laid at 23.00 or for a dry stone wall founded at 23.00, the cost per 100 feet will be as follows the excavation being the same in both cases, and the top of the wall being assumed to be at 40.00

Longitudinal drain

100×3×22 = 6,600 cubic feet of excavation at 12 annas the 100 — 49. 8. 0
100×2×2 = 400 Cubic Feet Laterite stone at 6 Rupees — 24. 0. 0
100×7 = 700 square feet of turf sods at 6 annas — 2. 10. 0
6,200 Cubic Feet of refilling & tamping at 4 annas — 15. 8. 0
Contingencies &c — 6. 6. 0
98. 0. 0

or say one Rupee a running foot.

Dry stone wall.

Excavation — 49. 8. 0
100×2×18 = 3600 Cubic Feet Laterite stone at 6 Rupees — 216. 0. 0
100×3 = 300 Square feet turf sods at 6 annas — 1. 2. 0
3000 C. Ft. refilling &c at 4 annas — 7. 8. 0
Contingencies — 19. 14. 0
294. 0. 0

or. Say 3 Rupees a running foot.

It may be assumed that 1,000 feet of longitudinal drain and 2,000 feet of dry stone wall may be needed, and if so the cost of the work will be

1,000 feet of longitudinal drain	1,000. 0. 0
2,000 do of dry stone wall	6,000. 0. 0
600 cubic feet of additional planking	1,200. 0. 0
	8,200. 0. 0

The wood work would probably realize 12 annas a cubic foot when done with.

8. The water level in the pool in rear of the bund must be kept down to 21.00 as a maximum, in order that the drains may be effective. In the estimate of Rupees 24,000 there is an item of 300 Rupees for cutting a channel for this purpose. In the Specification it is called "open ditch" but there is no indication traceable of its alignment or levels. There is a detailed estimate which makes the quantity of excavation to be 5,809.35 Cubic feet, so the rate becomes 1.727 Rupees the 100 Cubic feet, and apparently sections have been taken though they have not been sent up. Were the bed of this cut at its head placed at 20.50 with the particulars given in the specification viz

Fall 17 feet a mile
Bed width 4½ feet
Side slopes 1½ to 1

V = 1.27 feet a second. the discharge would be 3.33 cubic feet a second and this would not be likely to prove sufficient. With the bed at 20.00 the discharge

V = 2.05 feet a second. would be 12.30 cubic feet a second. This may be more than will be necessary but if so the water level will be merely reduced below 21.00, and this will be no disadvantage, so the cut may start at 20.00.

9. In connection with the transverse drains at the Southern part of the bund, as mentioned in the appended Specification, a drain parallel to the bund is required. This will be about 25 chains, or 1,650 feet, in length and the quantity of excavation will be

660 x 14	average sectional area	= 9240
660 x 10	do	= 6,600
330 x 3	do	= 990
		16830 C.ft. at 8 annas a 100 = Rp. 2.5

the cost of this drain will therefore not exceed 90 Rupees.

10. The second item in the Superintending Engineer's letter is Rupees 800 for raising the dry stone parapet of the bund. The detailed estimate shows that for a length of 5,000 feet this parapet is to be raised 2 feet. Apparently the instructions at page 3 of the Bulg. No. 374-I. 1st July 1879 have not been attended to or the raising

would have been divided into 2 items of different heights. The Superintending Engineer considers the rate of Rupees 2 a cubic yard not sufficient, and he adds that the work is in progress, but no explanation is given. As the parapet should be of large stone carefully fitted it is probable that a higher rate should be allowed, but on the other hand the quantity entered in the estimate is probably in excess of that required.

11. The third item is Rupees 6,000 for repairing the surplus sluices including ring bund. In the estimate the following items are to be found.

Ring bund -	Revetment	Rs 740.	
"	Earthwork backing	" 308.4.0	
"	Puddle wall	" 449.8.6.	1,497.12.6.
Sluices -	Dismantling flooring	" 50.—	
	Concrete (Portland) bedding	1,080.—	
	Resetting flooring	100.—	
	Rebuilding broken piers	500.—	
	Earthwork	6.10. "	
	Brick masonry	22.8. "	
	New sperrs & gear	2,500.—	
			4259.2.0
			5756.14.6
	Contingencies &c		243.1.6
			6,000.0.0

As regards the ring bund, as this is in existence and has been there for sometime, it is not clear why this item has been included.

The Specification which is without date says "A ring bund will be constructed." Possibly the item is to cover expenditure already incurred and if so this should have been explained.

With regard to the concrete the Specification makes it 2 feet thick, but it is believed that there is nothing like this space between the flooring stones and the old laterite masonry below. It is further stated that there is to be a layer of concrete 4 feet wide and 2 feet deep in front of the sluice shutters. The intended arrangement should have been illustrated by a drawing, without which it cannot be clearly understood. As an excavation is to be made to a depth of 4 feet for laying down this concrete, it must be intended as a sort of front apron and if so there can be no necessity for using Portland Cement; it cannot in any way stop leakage through the old laterite masonry and it is doubtful whether any such addition is required, but if it be desirable it should be made with concrete in hydraulic mortar, the cost of which will be about one fourth

that of Portland Cement concrete.

The new gear must be designed on proper and complete calculations, and approved, before it is adopted, and a fair price must be allowed for the original gear. The spears must be supported by guides placed at about 13 feet above the sill of the sluice, and the lower part of these spears may with advantage be made of teak. All this should have been attended to long ago.

Apparently the further expenditure needed to put the sluices in good order, apart from the provision of suitable gear, will be under 1500 Rupees, and it is recommended that this work should be undertaken at once and charged to repairs. Until it is done the ring bund must be maintained, and it is liable to injury on the occurrence of gales from the South or South-West. The undersigned is of opinion that the sluices should be made efficient for the purpose originally intended, viz for maintaining a command over the water level of the reservoir, but in any case they should be repaired.

12. It is recommended that the idea of inserting a puddle core wall in the bund

be postponed at any rate for the present. Its cost would be about 40,000 Rupees for a length of 3,800 feet or say 11 Rupees a foot run.

13. That a berm would add to the security of the bund and tend to prevent slips may be admitted, but it is thought not to be desirable to spend Rupees 12,300, the 5th Item of para 2 of the Superintending Engineer's letter, on work of this description. It may perhaps, though hardly probably, be found advisable to construct such a berm in particular places after the transverse drains have been put in, but it is believed that the dry stone wall will be a more effective remedy wherever the bund, throughout any considerable part of its vertical section, is found to be permeated by water. With such a wall the risk of slips in the rear slope will be obviated, as the rear part of the bund will be entirely cut off from leakage whether subsoil or other.

14. The papers have been received in too crude and confused a state to allow of regular sanction for the work proposed to be done to be accorded. To have returned them for revision would have

involved considerable further delay, and between the present time and the setting in of the North-East monsoon much of the work ought to be completed. It is recommended therefore that the following provisional sanctions should be given pending the submission by the Supg. Engineer of properly prepared estimates and specifications, the former of which should of course show distinctly the expected cost of each item.

Original Works

(1) Parallel drain in rear of South part of bund.	90-0-0
(2) 50 Transverse drains in bund	6000-0-0
(3) Longitudinal drain + dry stone wall	8200-0-0
(4) Channel to lower the water level of pool in rear of bund to 21.00	300-0-0
Total Rupees	14,590-0-0

Repairs

(1) Repairing 10 vent surplus sluices	1500-0-0

Ootacamund
2 June 1880

Underlined Colonel R.E.
Chief Engineer for Irrigation

To.
The Joint Secretary to Govt
P.W.D. Irrigation
Branch

Jwl.

Madras Water Works and Irrigation Extension project

Red Hills Tank

Specification of drainage arrangements in rear of and under the rear part of the Tank bund, and of connected work.

1. Transverse drains. These drains will start at the level of 21.00, at which level the sole of the drains at their outfall will throughout be fixed at all places at which there is a pool or lower ground in rear of the bund.

Where the ground level is higher than 21.00 a drain parallel to the bund will be cut along low ground not less than 30 feet from the toe of the rear slope, with a fall of 1 foot in 10 chains, starting with the level of 21.00 at the lower end. The head of this drain to have a width at bottom of 1 foot and side slopes of 1 to 1. The bottom width to increase by 6 inches at the end of every 10 chains i.e. at 10 chains from the head it will be 1½ feet wide at 20 chains 2 feet wide and so on. The soles of the transverse

* 8 feet in a mile.

drains at their outfall will be 0.50 feet above the bottom of the parallel drain.
All open transverse drains to have a fall of 1 in 330.
All drains filled with stone to have a fall of 1 in 30. The transverse drains under the bund to be run into a line 22½ feet from the rear face of the bund parapet. As the lengths and starting levels of these drains will vary so will the sole level at the inner end.

2. Excavations for transverse drains.
These drains outside the toe of the bund to be 1½ feet wide at bottom with side slopes of 1 to 1.
The cuttings into the bund to be at right angles to its alignment, and to be 3 feet wide. Taking the rear slope as on the average 2 to 1 the cutting will be about 3 feet deep at 6 feet from its commencement and, so far, the sides may be left unsupported. All the cutting beyond this to be supported by close planking with struts or distance pieces at 6 feet apart horizontally or in the direction of the length of the plank, and vertically according to the circumstances.

The simplest arrangement will be to lay the planks parallel to the sole of the drain. As soon as about 30 feet in length of the cutting for a drain has been completed down to sole level, the stone for the drain should be laid in and hand packed. This stone should be in irregular roundish lumps, 4 to 6 inches in diameter.
Turf sods should be laid vertically at the sides, with the grass next the stone, and on removing the planks the space left vacant should be filled in with good soil well tamped. The stone to be covered in with turf sods, grass downwards, and the bund reformed to section, the planks being removed one by one as the filling in progresses; the soil to be carefully tamped in 3 or 4 inch layers. The stone at the end of each length of drain thus formed to be protected from being ~~thus~~ obstructed by the earth by a plank placed vertically against the stone and edge of turf; this plank will be removed when the next length of stone is about to be laid down.
Should much water be met with as the cutting progresses, the drain should

above the level of the drain. It will then be determined whether a longitudinal dry stone wall is to be inserted or not. If this be ordered the excavations for it will be made in lengths of 10 or 12 feet at a time, on either side of the head of the transverse drain, commencing from the top of the bund, with a lining of close planking on either side of the trench and struts. The trench to be 3 feet wide down to the level of the surface of the natural soil or ground level below which a width of 2 feet will suffice. The bottom of the wall to be laid at 23.00 except where original ground level is reached at a higher level, in which case it will be not less than two feet below ground level, the exact depth being determined from the nature of the soil which, if porous, will necessitate the excavation being carried lower. The wall will be in some cases founded lower than the head of the transverse drain. The dry stone wall will not be a necessity where the bund above the level of the transverse drain is watertight and its height may be according to circumstances

laid in with stone, and the bund reformed over it in shorter lengths, say of 10 feet, so as not to leave any greater length open at one time than can be quickly closed and completed, should the adjacent soil show signs of being washed out by the water. The width of the cutting being only 3 feet it is probable that the face of the bund at its end, which may be cut at a slope of ¼ to 1, will stand without support, but preparations must be made for supporting it by short pieces of plank, with cleats fastened to the side planking, if necessary. All the planks will be 2 inches thick, so these planks for the face should be cut 2.7½ inches long, and wedges should be driven between the ends and the side planking to hold the short planks until the cleats have been fixed.

3. Longitudinal dry stone wall. On the completion of cutting for a transverse drain, it will be seen what the nature of the bund at this point is, as also whether water finds its way through only at the bottom or at points above

the

viz to the level at which the bund is good
and watertight. Stony may therefore be anything from the 2 feet
of a simple longitudinal drain to that
which would approximate to F.T.L.
Generally it may be considered unlikely
that it will need to be carried much
above the surface of the old bund,
but in all cases it should cut off
from the bund in rear all waterpassages,
so that the rear of the bund maybe
left dry and stable.

4. Order of execution of work. The longi-
tudinal open drain in rear of the bund
must be completed before the transverse
drains having an outfall thereinto
are commenced.
The transverse drains into the bund
must be formed before a longitudinal
drain or a longitudinal dry stone wall
is put in because the transverse drains
are required to carry off all water tapped
or met with in excavating for the L. drain
or dry stone wall. The excavations for these
latter are to be so arranged as to
afford uninterrupted drainage to the
transverse drains on either side. Care
to be taken that the heads of the transverse
drains are not choked by silt from

the excavations.

5. Drainage of pool in rear of bund. Arrange-
ments are to be made by an outfall
channel to keep the water level down
to 21.0s as a maximum, and to this end
the sole of the outfall channel at its
head must not be higher than 20.50
and it may have to be lower. On the
plan (tracing) dated 2 September 1879
of the tank there is a drainage from
the pool marked, but there is nothing
to indicate that it is effective, and it
is not shown as running into any
channel which would carry the water
away.

Estacapment
2nd June 1880

Executive Engineer
Chief Engineer for Irrigation

P.W.D.
25 JUN 80
No. 406

£4 – 13 – 8

Cir 25.6.80
P.R. Sheil 26 June

No 406 of 24 June/80 P.W.D.

In accordance with the recommendations made by the Chief Engineer for I in the foregoing Note, provisional sanction is given for the carrying out of the drains to improve the stability of the bund of the Red Hills Tank, Madras Water Works & Irrigation extension project, at a cost approximately estimated at Rupees 14,590.

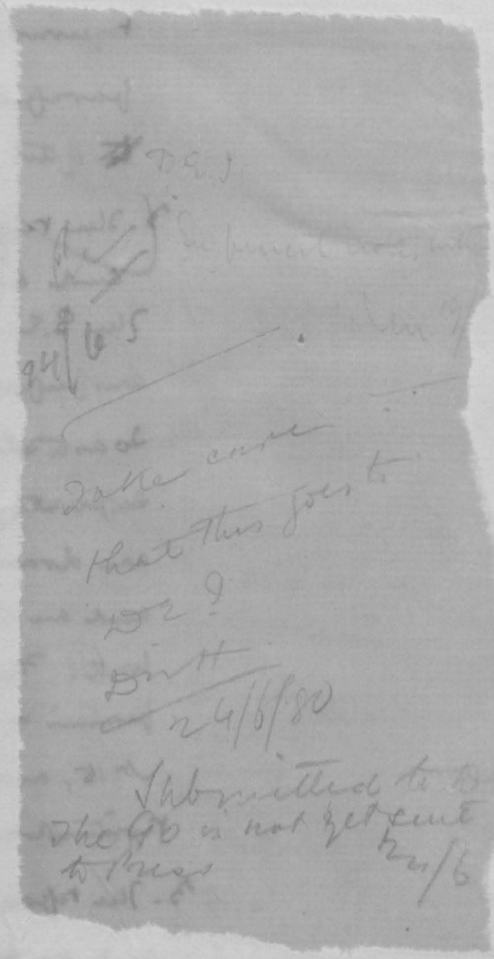
2. The Superintending Engineer will arrange for the early submission of regular estimates for the works shown in the Note to be required, including the raising of the dry stone parapet and the improvement of the flat [illegible] of the surplus sluices in the waste weir.

3. The repair of the surplus sluices is approved and an estimate for this work can be sanctioned. The S.E. must take care that in future estimates are prepared and submitted in a proper manner so as to show clearly the probable cost of each separate item; and that the specifications are drawn up so as to be both easily intelligible and an adequate guide in carrying out the work. Funds will be appropriated from the provision under Tank Projects in the Budget, Item No. 15, and this provisional sanction has been registered as No. 90 of 1880-81.

Forwarded
Ch Supt for I. with 14 sheets
Exec Engr Reads & Edgar
dy. 19/6/80 & 7/7/80

Please take
the first with the
revised estimate
for Project (second
in line – Chinnur
Tank) for which
Government Sanction
[illegible] quoting
this G.O.

S.R. 2nd Supt dups 24/6
Circled



11/7/29 Bill

Govt. of (1880) Madras.

PUBLIC WORKS.

To

Dated

Issued

Recd.

Encl.

G. O., 24 June 1880, No. 4061.

Nos. 46 to 47

Red Hills Tank, Madras Water Works, & Sanitation Extension Projects.

Accordg provisional sanction to an approximate estimate for carrying out the works required to improve the stability of the bund of the ——— & diverting the early outlets of certain tanks.

4/1/4

Ref. 4/7/30