

(1) Number of pages _____
(2) Date of repair _____
(3) Initials of the Referencer _____

MADRAS RECORD OFFICE.

Government of Madras.

DEPARTMENT.

G.O. No.	731	Press
		Mis.
13539	Dated 9th April	1872.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

No. 138. Read the following endorsement of the Acting Chief Engineer for Irrigation, dated Fort St. George, 13th March 1872, No. 118:—

From the Chief Engineer, to the Agent and Manager of the Madras Irrigation and Canal Company, dated Kurnool, 8th June 1871, No. 764.

In reference to G. O., No. 1,505, of 2nd instant, I have the honour to say that the subject of increase of calingulahs has been receiving attention and the areas to be drained have been examined afresh, and I am prepared to employ Mr. Browning, who knows thoroughly all those sections for which extra calingulahs are required except the fourth for which a scheme has been generally approved by Government to prepare and submit a full proposal for increase of calingulahs for the whole canal.

2. I believe that the formula in use on the Government canals in these cases is the following:—

Let n be the number of square miles the drainage of which passes over a particular calingulah.

D be the discharging power of that calingulah in cubic yards an hour, then $D = 75,000 n^{\frac{2}{3}}$.

I recommend that the calingulahs of this Company's canal be made sufficient to discharge double this quantity, *i. e.*, that the formula used be—

$$D = 150,000 n^{\frac{2}{3}},$$

and if Captain Ryves approves of this I will adopt it. This will require for a drainage area of 1 square mile a discharge equal to ... 1.8 inches rainfall an hour.

8 Square miles ... 0.9 inches.

27 „ „ ... 0.6 „

64 „ „ ... 0.45 „

and so on.

The general design for the calingulahs has already been sufficiently settled.

I shall be obliged if you will inform me as early as possible if this is approved of. I expect the total expense of alterations to be under a lakh of Rupees.

No. 258.

Copy forwarded to the Chief Engineer for Irrigation and Joint Secretary to Government, with a request that he will inform whether he approves of the mode suggested by Mr. Latham for enlarging calingulahs.

MADRAS,
12th June 1871.

(Signed) F. H. HENSLOWE,
Agent and Manager.

From the Acting Chief Engineer for Irrigation, to the Chief Engineer of the Madras Irrigation and Canal Company, dated Madras, 14th June 1871, No. 1.

I HAVE received from Mr. Henslowe a copy of your letter No. 764 to his address dated 8th instant.

2. The formula referred to by you as in use on the Government canals is one introduced by myself for use not only on the Godavery canals but generally in that and the Vizagapatam and Ganjam Districts.

3. I agree with you in thinking that the constant should be higher for the drainages you have to deal with, but consider that 100,000 would be high enough, and unless you are in possession of data proving that the discharge has in any instance been more than 100,000 $n^{\frac{2}{3}}$, I would

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

advise the adoption of that constant in fixing the hourly discharge to be provided for. I need hardly remind you that the formula should be applied to the area drained by each district in full although only one calingulah may be provided for a group of three or four such in falls; thus an escape weir to discharge the flood water from 8 square miles received by four district nullahs should by the proposed formula ($100,000 \times n^{\frac{2}{3}}$) be capable of discharging 634,000 cubic yards per hour, not 400,000.

From the Chief Engineer of the Madras Irrigation and Canal Company, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, dated Kurnool, 22nd June 1871.
No. 1.

YOUR No. 1 of 14th instant. I have the honour to state that there is no data existing to show that the discharge of rainfall of the lands in Kurnool and Cuddapah exceeds $100,000 \times n^{\frac{2}{3}}$ cubic yards an hour, n being the area in square miles.

Considering that though the fall of the country here is generally more, the rainfall is much less than on the coast. I see no reason for a larger constant than 100,000, and will have the plans prepared accordingly.

From the Acting Agent and Manager of the Madras Irrigation and Canal Company, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, dated Madras, 6th January 1872, No. 4.

Calingulahs.—I have the honour to forward the under-mentioned plans and estimates amounting to Rupees 60,000 for the enlargement of the calingulahs, and I request you will be so good as to submit them to the Government for sanction.

1 Sketch map to explain calingulah scheme.

1 Drawing showing proposed alteration of calingulahs in first four "sections."

1 Do. do.

1 Detailed estimate of cost.

1 Abstract do.

1 Appendix to do.

1 Table showing drainage into Canal and copy of Mr. Browning's letter No. 1,352, dated 21st December 1871.

From the Acting Chief Engineer, to the Agent and Manager of the Madras Irrigation and Canal Company, dated Kurnool, 21st December 1871, No. 1,352.

I HAVE the honour to submit a calingulah scheme for Government sanction and for the Board's approval.

2. The works are designed in accordance with the recommendation contained in G. O., No. 1,059, of 18th April 1871, the new crest being placed 3 feet below ordinary full supply level.

3. I had intended to propose a self-acting shutter for the crests and have designed one which will act, but I am not yet certain that the disadvantages do not equal the advantages of the system, and I will give that matter further consideration before the shutters are required. In any case this will not affect the designs or estimates.

4. For the 4th Section I have adhered to the designs submitted formerly omitting the masked calingulah which is not required, only one or two unimportant alterations have been made in the estimate sent with these designs by Mr. Dodson. For example, the cost of shutters entered at Rupees 5 each by Mr. Dodson is now estimated at Rupees 20 each.

5. There is also a small alteration in the cost of pulling down old work.

6. The papers herewith sent are:—

(1.) A sketch map showing that part of the canal into which drainage enters.

(2.) Drawing showing calingulahs as built and as proposed to be altered in first four sections.

(3.) Drawing showing calingulahs as built and as proposed to be altered on the 7th Section, also showing the new calingulah work proposed.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

(4.) Detailed estimate of cost.

(5.) Abstract estimate of cost.

(6.) Appendix to estimate.

(7.) Table to accompany sketch map showing drainage into canal.

7. The above papers show the proposed works so fully that I do not think further explanation is required. I have been over the whole of these works myself and seen that they are adapted to the proposed change.

8. The calingulahs I may mention are so designed as to discharge the heaviest rainfall without allowing water to rise above full supply level.

8. The formula adopted being $D = 100,000 \times n^{\frac{2}{3}}$, n being the area drained in square miles, and D the discharge in cubic yards per hour. This formula gives a greater discharge than that used for the Godavery works, but was I believe said by Major Ryves to be a safe one to adopt for this scheme.

From the Acting Chief Engineer for Irrigation, to the Acting Agent and Manager of the Madras Irrigation and Canal Company, dated Fort St. George, 29th January 1872, No. 212.

I HAVE the honour to return the plans and estimate, etc., for the improvement of the calingulahs in the Company's Canal, with reference to the remarks made below, which I request you will transmit for the reply thereto of the Acting Chief Engineer.

2. It seems to me that the arrangements for closing and opening the bays or vents on the calingulah crests should be more completely worked out and detailed before the plans and estimates are submitted to Government. With the proposed masonry construction it is not clear how if planks are provided these are to be got at and hauled up, or how the contrary operation is to be performed if they are inserted in the position shown in the sections now sent, for the tow-path over-hangs them, especially in the calingulahs of the 1st to 6th Section. At No. 13 calingulah in the 24th mile lately remodelled, on the contrary the shutters rest on a projection which can be seen from the tow-path, and they can easily be reached. The narrowness of the existing body walls of the calingulahs which renders it necessary to corbel over the faces of the arches in order to obtain a sufficient width for the tow-path renders it impracticable to adapt to them in their present form shutters with screw gearing, and under the circumstances a self-acting shutter seems to be most suitable, if one can be devised which will act properly. Shutters and screws or detached planks to be raised singly by hand if adopted would, it seems to me, equally necessitate the widening of the calingulah crests; in the former case to obtain room at the top to fix the stands for the screws to work in as well as to bring the shutters under the screws, and in the latter to enable the planks to be reached at all times. The widening of the calingulahs would entail an addition to the amount of the present estimate, and it would seem therefore that all the details referred to should be well settled before a reliable one can be made.

3. No doubt the Acting Chief Engineer has calculated the discharges of the several calingulahs with a full heel and compared them with the drainage to be disposed of in each case. I should be glad to have this information distinguishing the quantity discharged by the under-sluices from that passing over the crest.

4. Attention is called to certain clerical errors in the estimate corrected in red in this office.

From the Acting Agent and Manager of the Madras Irrigation and Canal Company, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, dated Madras, 15th February 1872, No. 65.

With reference to your letter No. 212 of the 29th ultimo, commenting upon our Acting Chief Engineer's proposal for the enlarged calingulahs, I have the honour to hand you copy of a letter which I have received from that officer on the subject.

8 Drawings.
3 Estimates.

1 Table.
1 Note.

I return also the plans and estimates.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

From the Acting Chief Engineer, to the Acting Agent and Manager of the Madras Irrigation and Canal Company, dated Kurnool, 10th February 1872, No. 34.

Your No. 48 of 30th ultimo. I have the honour to return herewith the estimates and drawings of the proposed calingulahs, having carefully considered Captain Scott's recommendations and remarks thereon.

The different systems which could be adopted for the crest shutters are as follow :—

- (1.) Self-acting shutters.
- (2.) Shutters arranged so as to be visible from the tow-path.
- (3.) Shutters with screw raising gear.
- (4.) Shutters consisting of detached planks to be raised singly by hand.

Two systems of self-acting shutters were considered, one which was proposed by Mr. Gordon some time ago, and another devised by myself which acts ; but I think the disadvantages of a self-acting system are more than equal to its advantages ; upon our work it is so very necessary to have everything of the simplest possible design, and to avoid what may be easily put wrong by ignorant or mischievous persons. Any self-acting shutter will be liable to waste much water by leakage unless of finer workmanship than we can command without great cost.

2. If the shutters are arranged so as to be visible from the tow-path, as for example at calingulah 13, screw raising gear cannot be added without entirely altering the work and pulling down and re-building parts of the arches. Although we do not propose to use screw raising gear at present, we may add it hereafter, and therefore it is not advisable to adopt the design of calingulah 13.

Drawings 1 and 2 show how the calingulahs can be built on this system with a projecting crest.

If they were followed the extra cost would be Rupees 6,530, which, added to the present estimate of Rupees 60,000, would raise the total sanction required to Rupees 66,530. However, as I have said, I do not recommend the adoption of this plan.

3. Shutters with screw raising gear would be very convenient, but the cost of the gear will be considerable. It is not proposed to adopt it at present, though it may be added hereafter. The cost of raising gear would add about Rupees 46,000 to the present estimate ; therefore I abandon it.

4. If as I propose shutters consisting of detached planks to be raised singly are adopted the masonry will be built in such a way that screw raising gear can be added hereafter. Drawings 3 and 4 show how that will be done, both in the case of calingulahs on the upper sections and on Nundial Division.

In drawing No. 4 an iron hand rail is shown similar to that now on the tow-path over Ulloor aqueduct to economize room, but for the present, and until it is decided to add the raising gear, a light masonry parapet will be built.

Drawing No. 5 shows on a large scale the way in which the moveable planks will be arranged, and it also shows the hole for lifting gear which will be built in the arch work. It will be seen then that the calingulahs as proposed admit of the addition of screw raising gear hereafter, and I urge the adoption of that system.

The moveable planks will be easily worked. In fact, although in calingulah 13 the masonry of the crest projects beyond the tow-path the planks there have actually been worked since it was built in precisely the same way as they will be in these new calingulahs.

The shutters at calingulah 13 never have been either raised or lowered from the tow-path. With regard to the width of the tow-path left in drawings 3 and 4 I may as well say that I have tried it, and it is ample for the largest horse.

There is one slight alteration of dimension which I have made in plans and estimates, namely, the addition of one foot to the height of piers between the bays on the calingulahs of Nundial Division. The cost of this is only Rupees 220-8-0.

The mistakes which the Chief Engineer for Irrigation points out in the estimate are only writers' errors, as would be seen by a reference to the drawings. They do not exist in my office copy, nor I believe in the copy which went to the Board.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

The necessary corrections have again been made in the papers herewith returned, but as the changes somewhat disfigure the paper, I will prepare a new copy and forward it, I hope, by next post.

In the present scheme are embodied the works and estimate sanctioned in G. O., No. 1,089, of 18th April last, with the exception of the masked calingulah No. 3-A, which, as I explained in letter No. 1,352 of 21st December last, is not now required.

With reference to the 3rd paragraph of Captain Scott's letter, I have the honour to forward a copy of my draft notes made when preparing the estimate to fix the length of calingulahs required from point to point.

The land draining into canal is shown on the sketch map by a shade of red, and the areas in square miles are given thereon in blue figures.

A statement of the water which may be expected to flow off the land is given in the accompanying table calculated with the formula $D = 100,000 \times n^{\frac{2}{3}}$.

Where D = discharge in cubic yards per hour, and n = area in square miles.

With the above explanations and replies to Captain Scott's questions, I trust that these works will be at once sanctioned.

In any case if further information is needed I will most readily give it, but I must ask for sanction, or an advance on sanction of Rupees 10,000 at once to enable me to make arrangements for commencing these works, as the dry season will soon be over.

MADRAS IRRIGATION AND CANAL COMPANY.

NOTES ON CALINGULAH SCHEME, 1871.

Rules.

1. In paragraph 5 of G. O., No. 1,089, of 18th April 1871, Government propose calingulahs with crests placed 3 feet below ordinary water level with shutters in lengths of 8 feet or 10 feet.
2. According to Stoddard with a co-efficient of .667 there will, with 3 feet on crest, be a discharge of 2,502 cubic yards per hour per lineal foot, say 2,500, and make each bay = 8 feet, then each bay will discharge 20,000 cubic yards per hour.

Adjustment.

The first outlet is wanted at calingulah No. 1 for 937,000 yards per hour.

This requires 47 vents @ 8 =	...	...	...	...	376
46 Piers @ 3 =	...	...	...	...	138
				Total length...	514

At calingulah No. 1 there is	...	...	...	...	223 of crest,
And	...	...	...	...	76 of pillar.
				Total length...	299

This will give 27 openings @ 8 =	...	...	...	...	216
26 Piers @ 3 =	...	...	...	...	78
					294

There remain 20 openings @ 8 =	...	...	...	...	160
19 Piers @ 3 =	...	...	...	...	57
					217 to be made

at calingulah No. 2, which is 302 feet long.
The next outlets wanted are 9th to 17th mile for 580,000 cubic yards or 29 vents.

(1.) Place 10 vents at calingulah No. 3.	...	...	...	...	80
10 @ 8 =	...	...	...	...	27
9 @ 3 =	...	...	...	...	107

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

3. The narrowing of the tow-path for traffic, which the final completion of the project by the addition of stands and screws would entail, is also I consider a defect, and it further suggests itself that a tow rope in its passage along the calingulah would be liable to catch and be hampered by the iron standards.

4. Taking all the above into consideration, I should certainly be inclined to favour the second arrangement mentioned in Mr. Browning's letter, where the crest wall of the calingulah is thickened and the planks are placed in advance of the arches and are visible from the tow-path. The lower portions of the piers are extended to hold the planks, and as they may be built up to any height, there is no obstacle to the addition of screw lifting gear at any future time. The gear might be carried on timber beams in pairs with a space between them sufficient to allow of the shutter passing up to the shoulder of the stand, which could thus be placed at a small height above the level of the water, and the screw would be worked by men standing on the beams clear of the water.

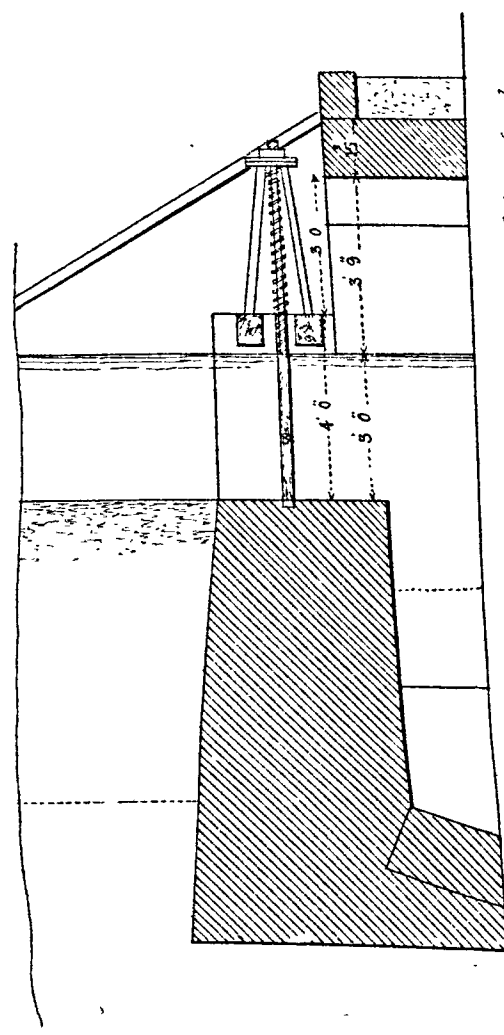
Of course the grooves for the plank must be vertical instead of slanting, as shown in drawing No. 1 forwarded with the letter above alluded to. It would be sufficient if the shutter when raised cleared the water at full supply level by 1 foot. I should be glad if the Chief Engineer would state whether he can suggest any objections to the arrangement as sketched above and shown in the margin in outline.

5. The statement of calingulah discharges which I requested in my previous letter might be furnished is not exactly replaced by the calculations supplied, and I should feel obliged if the columns in the accompanying statement are filled up. I presume some of the calingulahs which it is not proposed to alter have scouring sluices and that the gear will be retained. The discharges of these are, therefore, required.

From the Agent and Manager of the Madras Irrigation and Canal Company, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, dated Madras, 5th March 1872, No. 82.

Alteration of Calingulahs.—With reference to your letter No. 241 of 23rd ultimo, I have the honour to hand you for information copy of a letter which I have received from the Acting Chief Engineer upon this subject, and I trust that the delay in submitting a new estimate will be no bar to an early sanction for the prosecution of the work.

From the Acting Chief Engineer for Irrigation, to the Acting Agent and Manager of the Madras Irrigation and Canal Company, dated Kurnool, 29th February 1872, No. 110.
I have the honour to acknowledge the receipt of your letter No. 91 of 26th instant, enclosing copy of one from the Acting Chief Engineer for Irrigation.



Planks successively moveable to be used at first
Without stands or screw gearing

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

2. The arrangement proposed by Captain Scott is a very good one and can be adopted; I have, therefore, the honour to beg that the scheme may now be sanctioned with an addition of Rupees 6,530 to the estimate already submitted by me as explained in paragraph 3 of my letter No. 84 of 10th instant.

3. The table which Captain Scott requires shall be prepared, but I may mention that the notes I sent show the whole arrangement, for the existing emptying sluices were intentionally omitted from the calculations.

See in original.

4. I will prepare a new estimate showing details according to the altered scheme and it shall be submitted without delay, but as I am now leaving Kurnool for the lower end of canal, and I may be out in camp for a month, I beg that Government sanction may now be obtained.

With reference to the above correspondence, I beg now to recommend that Government should accord sanction to the general scheme drawn up by the Acting Chief Engineer of the Company for the improvement of the system of calingulahs for the discharge of surplus water from the Main Canal, at an estimated cost of Rupees 66,530, debitable to Capital.

2. The estimate now forwarded includes the cost of the necessary alteration of certain calingulahs in the first four sections, and in the seventh section of the canal the amount to be expended in each section being as under:—

				RS.
1st Section,	four calingulahs altered	...	...	9,710
2nd "	{ one calingulah do.	...	...	7,920
	{ one do. new	...	...	6,690
3rd "	three calingulahs altered	...	...	19,650
4th "	{ three do.	...	...	16,030
	{ two do. do.	...	...	
7th "	{ two do. new	...	...	60,000

Referring, however, to the communication last received from the Acting Chief Engineer, it will be seen that he concurs in the advisability of adopting the construction suggested by me for the altered works, and that this will increase the above estimate by Rupees 6,530, making the total amount Rs. 66,530 as mentioned in the preceding paragraph.

3. It will be recollected that in G. O., No. 1,089, of the 18th April 1871, reference is made to an estimate for the re-modelling of the surplus discharge works of the 4th Section then before Government, and sanction is given for the execution of the work the cost of which was computed at Rupees 31,977. This project has since been revised and is incorporated in the general one now submitted for approval. The considerable reduction in this portion of the estimate has been caused by the omission of a new calingulah formerly proposed to be built in the 58th mile, but no longer considered necessary. Practically therefore the additional expenditure for which authority is now requested is limited to Rupees 34,553.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

4. The subject of the requirements of the canal in the shape of works for the discharge of surplus water to ensure it against injury during extraordinary floods is one which has already been very fully discussed in previous correspondence* and reports to Government, and their order above referred to lays down clearly the general principles on which the project now under review should be based. These appear to have been kept in view by the Acting Chief Engineer of the Company, whose proposals, if carried out, will, in all probability, free the canal from any possibility of accumulating water to a greater extent than that assigned as the safe limit. This limit is now considered to coincide with that of "full supply" in the canal, which means a depth above the normal bed level of 8 feet in the first three sections, 9 feet in the fourth, and 6 feet in the seventh section, and as the crests of the calingulahs originally built stood universally at the level which was assumed by the water when the canal was running full, it was obvious that to provide for the condition laid down, the calingulahs must be lowered and a sufficient length of crest be provided, so that the maximum discharge necessary during extraordinary floods should be obtained without its being necessary for the water to rise above the level referred to. It was at the same time essential that means should be provided for retaining the canal water at its proper level under ordinary circumstances, and the construction of the calingulahs in bays with grooves into which shutter or planks could be inserted to close these up to that level was the only arrangement possessing the requisite adaptability to the varying states of the water supply.

5. The primary consideration in determining the extent of the alterations required to the existing calingulahs and the additional works of that nature which had to be provided was the maximum discharge into the canal which might be expected as the result of extraordinary rainfall on the land whose drainage water passes appear to be very scanty and untrustworthy; but as in August 1870 observation had fully established the fact that the flood which damaged the canal in that month had been the result of a fall of twelve inches in twelve hours, it seemed necessary to provide for a rate of discharge which, taking into consideration the local circumstances, should be considered to correspond with this rainfall. Following the suggestion of the late Captain Ryves, the Chief Engineer has adopted for the purpose of computing this an empirical formula which had been found to answer in the case of the Godavery canals with the difference only of a higher constant adapted to the more rapid fall of the ground in the Kurnool District.

6. The formula in question gives discharges varying with the area drained: for a drainage area of 5 square miles the depth supposed to run off in twenty-four hours is about 16 inches, for 10 square miles 13 inches, for 20 square miles 10 inches, and so on, and there is every reason to believe that this allowance representing the necessary discharging power of the calingulahs will be found sufficient. The following statement gives the particulars of the several catchment basins draining into the canal, the discharge from each computed by the formula noticed above, and the numbers of the calingulahs which are to be altered or built to pass the drainage to the lower side of the canal.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

$$D = 100,000 \sqrt[3]{N^2}, \text{ where } D = \text{discharge in cubic yards per hour. } N = \text{drainage area in square miles.}$$

Position of Catchment Basin—Mileage on Canal.		Drainage area in square miles.	Discharge in cubic yards per hour.	Total to be distributed.	Altered Calingulah Discharges.		Remarks.
From miles.	To miles.				Nos. of calingulah.	Cubic yards per hour.	
1st to 4th Section.							
0	6	16.4	645,000	937,000	1	540,000	Culvert No. 12 takes 100,000 cubic yards in addition. Already re-constructed. New calingulah at Poodoor.
6	8	5.0	292,000		2	400,000	
9	17	14.0	580,000	580,000	3	200,000	
18	19	2.2	169,000	312,000	9	380,000	
19	22	3.8	243,000		12	320,000	
23	25	28.4	931,000	931,000	13	1,100,000	
25	35	10.0	464,000	464,000	New	464,000	
36	42	3.0	208,000	672,000	18	280,000	
42	43	10.0	464,000		19	400,000	
43	45	6.6	352,000	352,000	20	360,000	
45	46	2.2	169,000	2,520,000	2	560,000	
46	51	6.5	319,000		.		
51	54	6.4	345,000		3	620,000	
54	60	13.8	575,000	2,071,000	4	1,260,000	
60	62	35.6	1,082,000				
7th Section.							
97	98	38.0	1,130,000	2,071,000	6	490,000	Includes discharge of under-sluiques. Two new calingulahs.
99	101	29.0	941,000		9	424,375	
Total...				8,842,000	New	1,160,000	
					Total	8,958,375	

7. The discharges possible to be procured through the under-sluiques which are constructed in many of the calingulahs, twenty-four in number, belonging to the first four sections of the canal have not been taken into account as limiting the length of crest necessary for the altered calingulahs. If this is borne in mind and it is at the same time recollected that any rise of the canal water above the full supply level will bring into action all the unaltered calingulahs whose crests are now at that level, it will be obvious that when the proposed re-construction has been effected, sufficient provision will have been made for all probable contingencies, provided always that a proper degree of vigilance is exercised, and that the vents are manipulated with reasonable expedition.

*Proceedings of the Madras Government, Public Works Department,
9th April 1872.*

8. The Acting Chief Engineer proposes to prepare and forward a new estimate, etc., showing the details of the alterations to the selected calingulahs as finally decided on in correspondence with this office, but as it is desirable that the work should be commenced at once, I deem it better to forward the documents as they stand. The form of the re-modelled works has been shown in section in drawing A. accompanying, which has been prepared here. The masonry of the existing works will be removed to a proper depth and re-built, the breast-wall over which the water flows being widened so as to afford room for a platform in advance of the tow-path, and below it, which is to be divided by piers, with grooves into bays 6 to 8 feet in length. These will be closed by detached planks which can be inserted or removed by hand, and one by one. The top of the breast-wall will in every case be 3 feet below the level of the water when the canal is full. The 3 feet of water above the breast-wall will be retained by the planks above mentioned, and the tow-path will be carried, as before, on arches, its width remaining unaltered.

9. The present estimate does not provide for shutters and screw lifting gear, but the design admits of the addition being made at any future time without alteration of the masonry. The Chief Engineer estimates the cost of the apparatus at Rupees 46,000. This would be a serious addition to the outlay and one not necessary in the present condition of the canal, which renders it imperatively necessary to limit the supply of water carried in it to a depth below even the masonry crest of the proposed calingulahs. There is no doubt that for a considerable time at any rate the regulation of the supply can be effectively carried out with the means now proposed.

10. In the sections of the canal not included in the present project its alignment is either on the water-shed line of the country, or else full provision has already been made for disposing of the cross drainage, and in either case additional works are not required.

(Signed) A. deC. SCOTT, Captain, R.E.,
For Acting Chief Engineer for Irrigation.

No. 139.

ORDER THEREON, 9th April 1872, No. 937.

IRRIGATION, No. 8.

UNDER the explanations afforded in these papers the Government sanction the proposed scheme for improving the system of calingulahs for the discharge of surplus water from the Madras Irrigation and Canal Company's Main Canal, at an estimated outlay of Rupees 66,530, chargeable to Capital.

(True Extract.)

(Signed) J. CARPENDALE, Colonel, R.E.,
Secretary to Government.

To the Acting Chief Engineer for Irrigation.
" Agent and Manager of the Madras Irrigation and Canal Company.

Ed. E. C. Shunker.

No. 118.

From the Agent and Manager Madras Irrigation Canal Company
To the Chief Engineer for Irrigation. No. 255 dated 12th June 1871

From the Chief Engineer for Irrigation } No. 14 dated 14th June 1871
To the Chief Engineer M. S. H. C. }

From the Chief Engineer M. S. H. C. } No. 1 dated 22nd June 1871
To the Chief Engineer for Irrigation }

From the Agent and Manager } No. 4 dated 6th July 1872
To the Chief Engineer for Irrigation }

From the Chief Engineer for Irrigation } No. 212 dated 29th July 1872
To the Agent and Manager }

From the Agent and Manager } No. 65 dated 15th Feb 1872
To the Chief Engineer for Irrigation }

From the Chief Engineer for Irrigation } No. 241 dated 23rd Feb 1872
To the Agent and Manager }

From the Agent and Manager } No. 2 dated 5th March 1872
To the Chief Engineer for Irrigation }

Enclosure 28. The reference is the above correspondence I beg

5 Letters in original
3 Copies of letters. It is recommended that Government should record
7 Plans.
4 Estimates.

Sanction to the general scheme drawn up by the Acting Chief Engineer of the Company for the improvement of the system of calingulahs for the discharge of surplus water from the Main Canal, at an estimated cost of Rs. 66,530, debitable to Capital.

2. The estimate now forwarded includes the cost of the necessary alteration of certain Catingulabs in the first four sections and in the seventh section of the Canal. This amount to be expended in each section being as under.

1st Section	four Catingulabs altered	Rs 9710
2nd Section	one do do	7920
	one do new	
3rd Section	three do altered	6590
4th Section	three do do	19650
7th Section	two do do	16030
	two do new	
		60000

referring however to the communication last received from the Acting Chief Engineer, it will be seen that he concurred in the advisability of adopting the construction suggested by me for the altered works and that this will increase the above estimate by Rs 6530 making the total amount 66530 as mentioned in the preceding para.

3. It will be recollected that in G.O. 1089 of the 18th April 1871 reference was made to an estimate for the

erecting of the surplus discharge works of the 4th Section then before Government and sanction is given for the execution of the work the cost of which was computed at Rs 31977. This project has since been revised and is incorporated in the general one now submitted for approval. The considerable reduction in this portion of the estimate has been caused by the omission of a new Catingulab formerly proposed to be built in the 58th mile but no longer considered necessary. Practically therefore the additional expenditure for which authority is now requested is limited to Rs 34553.

4. The subject of the requirements of the Canal in the shape of works for the discharge of surplus water is under consideration against injury during extraordinary floods it has already been very fully detailed in

Proceedings of Govt En. D. 22 March 1871
 18th April 1871 This order above referred to lays down clearly the general principles in which the project now under review should be carried out. It appears to have been kept in view by the Acting Chief Engineer of the Company whose proposal is carried out with in all probability free the Canal from any possibility of accumulating water to a

6. The formula in question gives discharge varying with the area drained as a drainage area of 500 miles. The depth supposed to run off in 24 hours is about 16 inches for 10 sq miles 13 inches for 20 sq miles and so on and there is every reason to believe that this allowance representing the necessary discharging power of the Catungulals will be found sufficient.

The following statement gives the particulars of the several catchment basins draining into the Canal, the discharge from each computed by the formula noticed above and the numbers of the Catungulals which are to be altered or built to pass the drainage to the lower side of the Canal.

Statement

D = 100000 $\sqrt{F}$ where F discharge in Cub yds per hour. A drainage area in sq miles

Position of Catchment basins - Mileage on Canal from miles	Grainy discharge in Cub yds per square mile hour	Total discharge to be distributed	Remarks
0 to 6	16.4 645000	387000	1 540000
6 to 8	5.0 242000		2 480000
9 to 17	14.0 580000	580000	3 200000
18 to 19	2.2 169000	312000	4 350000
19 to 22	3.5 243000		5 350000
23 to 25	23.4 931000	931000	6 350000
25 to 35	10.0 464000	464000	7 350000
36 to 42	5.0 208000	672000	8 350000
42 to 43	10.0 464000	352000	9 350000
43 to 45	6.6 352000		10 350000
45 to 48	2.2 169000		11 350000
48 to 51	6.5 324500		12 350000
51 to 54	6.4 345000	252000	13 350000
54 to 60	13.8 575000		14 350000
60 to 62	35.6 1082000		15 350000
62 to 97	35.0 430000		16 350000
97 to 99	29.0 444000		17 350000
99 to 101			18 350000
Total		8842000	Total 8958375

10 to 4th Section

11 to 12th Section

13 to 14th Section

15 to 16th Section

17 to 18th Section

19 to 20th Section

21 to 22nd Section

23 to 24th Section

25 to 26th Section

27 to 28th Section

29 to 30th Section

31 to 32nd Section

33 to 34th Section

35 to 36th Section

37 to 38th Section

39 to 40th Section

41 to 42nd Section

43 to 44th Section

45 to 46th Section

47 to 48th Section

49 to 50th Section

51 to 52nd Section

53 to 54th Section

55 to 56th Section

57 to 58th Section

59 to 60th Section

61 to 62nd Section

63 to 64th Section

65 to 66th Section

67 to 68th Section

69 to 70th Section

71 to 72nd Section

73 to 74th Section

75 to 76th Section

77 to 78th Section

79 to 80th Section

81 to 82nd Section

83 to 84th Section

85 to 86th Section

87 to 88th Section

89 to 90th Section

91 to 92nd Section

93 to 94th Section

95 to 96th Section

97 to 98th Section

99 to 100th Section

7. The discharge possible to be procured through the ~~under sluice~~ ^{sluices} which are constructed in many of the Calingulabs, ~~twenty-four in number~~, belonging to the first four sections of the canal have not been taken into account as limiting the length of crest necessary for the altered Calingulabs. If this is borne in mind and it is at the same time recollected that any rise of the canal water above the full supply level will bring into action all the unaltered Calingulabs whose crests are now at that level: it will be obvious that when the proposed reconstruction has been effected, sufficient provision will have been made for all probable contingencies provided always that a proper degree of vigilance is exercised and that the vents are manipulated with reasonable expedition.

8. The Acting Chief Engineer proposed to prepare and forward a new estimate ~~to~~ ^{showing the} details of the alterations to the selected Calingulabs as finally decided on in correspondence with this Office but as it is desirable that the work should be commenced at once, I deem it better

to forward the documents as they stand. The form of the remodelled works has been shown in section in drawing A. accompanying which had been prepared here. The masonry of the existing works will be removed to a proper depth and rebuilt - the breast wall over which the water flows being widened so as to afford room for a platform in advance of the tow path, and below it, which is to be divided by piers, with grooves into bays 6 to 8 feet in length. These will be closed by detached planks which can be inserted or removed by hand & one by one. The tops of the breast wall will in every case be 3 feet below the level of the water when the canal is full. The three feet of water above the breast wall will be retained by the planks above mentioned in the tow path will be carried as before on arches, its width remaining unaltered.

The present estimate does not provide for a limited and screw lifting gear, but the design admits of the addition being made at any future time without alteration of the masonry. The Chief Engineer estimates the cost of the apparatus at

R46000. This would be a serious addition to the outlay
 and not necessary in the present condition of
 the Canal which renders it imperatively necessary
 to limit the supply of water carried in it to a
 depth below even the maximum crest of the proposed
 Calingulab. There is no doubt that for a considerable
 time at any rate the regulation of the supply can
 be effectively carried out with the means now proposed.

10. In the sections of the Canal not included
 in the present project its alignment is either
 on the water table line of the country or else full provision
 has already been made for disposing of the crop
 drainage, and in either case additional works are
 not required.

Adel. Loto.

Office of the Ch. Eng. for India 3
 Fort St. George 13 Mar: 72 for Asst. Ch. Eng. for India.

To The Secretary to Government.

P. W. Department

C. M. P.
 H. P.

1109

25

P. W. 1872 Report
No 118
No 1337.

From
The Dy. Eng. for Dist.

To The Secy to Govt.

P.W. D.

Dated 13th March

Recd. 15th 1872.

Encls: 21.

Submits Plans and
Estimates for enlargement
of a tributary of the.

No. 24 of 1871 & recom-

mends that sanction

might be accorded

to the same.

No 937-9th April 72

No 138

to 25 March 72 R. 27.

Public Works Department

No 937.

Proceedings of the Madras Government

Read the following

From
The Dy. Chief Engineer
for Irrigation
H.C. No 118 of 18th March 72

Under the explanations
afforded in these papers the
Government sanction the pro-
posed scheme for improving
the arable of Calingulahs
for the discharge of surplus
water from the Madras Ir-
rigation & Canal Company's
Main Canal at an es-
timated outlay of Rs 86,530
chargeable to Capital.

Signature

21

To
Chief Eng. for Irrigation
Agent & Manager of H.C. Co.
3rd March 72
Dated 13/4/72

C/12/337

Govt. of 1872 Madras.

PUBLIC WORKS.

To *Theriz. Kiliy Cuz*
for irrigation

Dated

Recd.

Encl

G. O. 9 April 1872 No. 937.

Nos.

1387/139

Cannigalaks. The proposed
scheme for improving the
system of Cannigalaks for
the discharge of surplus
water from the master
of the main canal at
an outlay of Rs. 55,530
chargeable to Capital
Expenditure.