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MADRAS RECORD OFFICE

Government of Madras

Public Works DEPARTMENT

G.O. No.	3 118	Press
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Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
2nd November 1874.*

Read the following letters:—

No. 28. From Colonel E. A. FOORD, R.E., Superintending Engineer, Bellary, to Colonel G. W. WALKER, R.E., Secretary to Government, Public Works Department, dated Bellary, 29th September 1874, No. 1,007.

WITH reference to the Order of Government of the 11th March 1873,

1 Estimate.

1 Report.

Plans as per list enclosed.

No. 769, I have the honor to forward

a supplemental estimate of Rupees

61,880 for completing the works con-

ected with the water-supply of the

Bellary Cantonment, known as the Alipore Tank Project. The statement showing work already performed and remaining to be performed under each head of the original sanction, called for in paragraph 3 of the above order, cannot now be furnished, as, prior to the receipt of the order, the work included in the supplemental estimate had been put in hand. A statement of the kind was forwarded with Colonel Bean's letter of the 26th November 1872, No. 1,979.

2. In the estimate now forwarded is included all work done since the date of Colonel Bean's letter, and all work that is still considered necessary for putting the tanks, channels, and other works in a perfectly efficient state. The various detailed estimates, of which this is the abstract, were prepared more than a year ago, and they and the plans which accompanied them were carefully examined by the late District Engineer, but he delayed forwarding them for the sanction of Government, as he wished to satisfy himself that nothing essential had been omitted, and to test the works that had been completed.

3. Government are aware that the works have been in progress during the last two years in anticipation of the sanction of the estimate. They are now completed, with the exception of rebuilding the revetments of Alipore and Fischer's tank, and some minor works. The worst parts of the Alipore revetment have already been rebuilt, and it is possible that the rebuilding of the whole of the remainder of the revetments of the two tanks may not be found necessary.

Last year the Fort ditch and the Pettah tank were supplied with water intercepted by the bank of Fischer's tank and the channel adjoining. This year the Alipore tank having received a supply in September 1873, the sluice was opened on the 11th of April, and Fischer's tank, the Native Infantry goontah, and the Fort ditch, and to a certain extent the Pettah tank, were filled. There is at present a depth of 16 feet of water on the floor of the sluice of the Alipore tank. No breaches occurred in the tank or channel banks last year or this.

4. The first two items in the supplemental estimate are for completing the anicut across the chuttrum nullah and the head sluice of the supply channel. All the works comprised in these two items have been carried out. Aprons with retaining walls have been added to the anicut. Sluice piers have been built, the floor and apron relaid, and shutters provided. The cost has been Rupees 3,063-13-3.

5. The next two items are for repairing and completing the supply channel from the head sluice to the Alipore tank. These works have been carried out at a cost of Rupees 10,530-10-4. The channel was originally badly laid out. In one part it was taken across low ground, and a nullah entered it at right angles.

The embankment at this part was never made high enough, or strong enough, and it was constantly being breached. To avoid the low ground, a new course has been cut for the channel for a length of $1\frac{1}{2}$ miles. The nullah has been diverted, and has now the same direction as the channel, at the place where it joins it. Stone revetments have been built across the old bed of the nullah, and also across the old channel at the point where the new channel leaves it. The side of the channel has also been revetted for a length of 400 yards to prevent erosion. About one-half of the channel originally cut has been abandoned, and the rest has been deepened and the slope rectified.

6. No. 3 is a large item of Rupees 18,757-8-2 for the repairs of the Alipore tank bund. This large expenditure is considered necessary owing to the faulty construction of the revetment in the first instance. The surface of the ground at the site of the tank is cotton soil. The bund is formed principally with this soil, and the revetment rests on it. It was, moreover, laid at an insufficient slope and without any backing. The consequence is that the swelling and contracting of the different portions of the revetment to slip. These portions have been rebuilt, and the probability is that the greater part of the original work will have to be rebuilt. The estimate provides for laying the first course of the revetment in the gravel which underlies the cotton soil, for using stones not less than 18 inches in depth, and for forming a gravel backing to the revetment. Parts of the revetment will have to be raised, and the old material will be used as far as available. The top of the tank bund has been gravelled.

7. The next three items (with Rupees 250, cost of lifting gear), amounting in all to Rupees 1,742-8-8, are for rebuilding the Alipore tank sluice. The sluice was originally built on the pattern of the ordinary irrigation sluice, and was found to be faulty, owing no doubt to imperfect workmanship. The front portion has been entirely rebuilt on a different plan, with wing walls in the tank, and the vent is closed by a sliding shutter which is raised by means of a screw.

8. The next four items, 9-12, amounting together to Rupees 12,266-6-4, are for alterations and improvements to the channel from Alipore tank to Fischer's tank. The necessity for this large outlay is due, as in the case of the channel leading to the Alipore tank, to a bad line having been selected for the first part of the channel. This being over low ground an embankment had to be formed for containing the water, and this embankment was constantly being breached. The water, moreover, swamped the village of Alipore, and the village has been rebuilt on higher ground. The fall of the channel was very irregular. The cutting of the new channel has necessitated the building a tunnel of three vents where it crosses the former tank, and the rebuilding of another tunnel, the floor of which was on too high a level.

9. Items 11 to 16 are for repairing the bank and calingulah of Fischer's tank, and for deepening and improving the channels from Fischer's tank to the Native Military Bazaar and to the Fort ditch. The bank of the tank is formed of every bad soil, and the revetment has been built without foundation or backing and has not retained its slope. Only a small portion of the revetment has given way as yet, but as there is a great probability of the whole slipping, provision has been

made for rebuilding it in a proper manner. The remaining items are for small works at the lower end of the supply channel.

No work is going on at present.

	RS.	A.	P.
The expenditure up to August from the supplemental estimate has been	32,907	8	2
Add expenditure, including Sapper labor, up to the end of 1871-72 — <i>Vide</i> G. O., No. 769, of 11th March 1873 ...	79,707	13	10
Total outlay on the work	1,12,615	6	0
Balance remaining of the supplemental estimate	28,972	7	10

Plans to illustrate the estimate and report are forwarded with this letter.

No. 29. From the same Officer, dated 2nd October 1874, No. 1,042.

No. 30. ORDER THEREON, 2nd November 1874, No. 3,118.

MILITARY WORKS, No. 1.

THE Alipore tank, otherwise called the Bellary Water-supply Project, was sanctioned for execution by G. O.,

No. 947, of the 26th March 1867, on an estimate for Rupees 69,300 forwarded by Lieutenant-Colonel A. S. Moberly, Superintending Engineer, 3rd Division. The project appears to have been investigated by Mr. Porter, Assistant Engineer, by whom also the estimate was framed, and it was subsequently revised by Lieutenant-Colonel Moberly.

2. The Superintending Engineer, 3rd Division, in his letter No. 2,062, of the 6th February 1872, brought to the notice of Government that on water being passed through the supply-channels to the Bellary Cantonment defects were found to exist in their levels.

3. In the Administration Report for this division for 1871-72, it is stated that certain improvements to the work were absolutely necessary to complete it, and the revetment of the Alipore tank was particularly referred to as having shown signs of slipping.

4. The Superintending Engineer in his letter of the 13th September 1872, reports that a large expenditure will be necessary in reconstructing the Alipore tank revetment, strengthening the embankments of the supply-channels, and altering their direction as well as the slope given to them.

5. At this time the repairs to the tank were in progress, and in their Proceedings of the 4th October 1872, in connection with the above letter, the Government called on the Superintending Engineer for an estimate for completing the project satisfactorily, and for a report as to the causes of increased expenditure, and the names of the individuals responsible for bad work or incorrect levels.

6. The next record, which it will be useful to notice, is the report by Colonel J. Bean, R.E., then Superintending Engineer of the 3rd Division. This

No. 1,974, dated 26th November 1872.

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Officer having closely scrutinized all the papers and accounts connected with the project, forwarded a comparative statement showing—

- (1.)—The original amounts under the several sub-heads of the estimate of the project.
- (2.)—The expenditure actually incurred up to date against the several sub-heads.
- (3.)—The causes of increase or decrease of expenditure compared with estimate.
- (4.)—The value of work actually measured and calculated from rates alleged to have been paid to compare with the expenditure.

7. In general terms the result went to show that while a sum of Rupees 646, in excess of the original sanctioned estimate, had been expended, the work was far from being completed. In fact, as an instance, it was pointed out that in order to construct the Alipore tank revetment as originally designed a further outlay of Rupees 27,000 would be necessary.

8. Another point brought to notice by Colonel Bean's inquiries was that there had been an expenditure of Rupees 6,505 for which no work could be found. In detail it was shown that 5,352 cubic yards of stone revetment was the quantity existing at the Alipore tank, while 6,938 cubic yards had been charged for; that 720 cubic yards of revetment had been executed along the supply-channel from the chuttrum nullah; and that the cost at the supposed rate should have been Rupees 1,136, while the payments entered in the station book for this work were Rupees 3,548; that, finally, there was expenditure not clearly accounted for on the tank head sluice as well as anicut and its head sluice. But in addition to this a bill had been submitted by the Officer Commanding the Sappers for work done on the project and in the cantonment by men under his command, amounting to Rupees 9,802. As no proper account was kept, no separation can be made of the debit to the cantonment from that against the Alipore tank. Thus the whole sum stands to the debit of the project, the total outlay thus arrived at being Rupees 79,708.

9. In connection with the irregular expenditure commented on above, it should be noticed that excess payment was made of earthwork to the extent of 36,896 cubic yards, in consequence of erroneous measurements by a Non-commissioned Officer of Sappers in charge of the work.

10. Inquiry further showed that the rates paid for stone revetment and work in connection with it were very largely in excess of those in the estimate, which latter were quite insufficient, and that the allowance for sundries and contingencies was necessarily largely exceeded. A portion, therefore, of the anticipated excess expenditure necessary to complete the project could be legitimately accounted for, but the larger portion of this excess was due to defects in design, as noticed in the latter part of Colonel Bean's memorandum, which it will be necessary to allude to further on.

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11. On Colonel Bean's report, the Government authorized expenditure in carrying out the necessary repairs and alterations pending the submission of detailed estimates, etc., and allotments were made during the years 1872-73* and 1873-74† to the extent of Rs. 33,128, on which Rupees 38,908 have been expended up to the present date as against the awaited supplemental estimate.

* Rupees 12,628.
† „ 20,500.

12. Referring now to the letter of the District Engineer, quoted at the head of these Proceedings, and its enclosures, the amount of the estimate for the completion of the project in all its details now forwarded by that Officer is seen to be Rupees 61,880, and he states that this includes all expenditure subsequent to the date of Colonel Bean's report above referred to.

The total cost of the project will, therefore, be as follows:—

	RS.
Expenditure to the 26th November 1872	79,748
Supplemental Estimate	61,880
Total...	1,41,628

Consequently as against the original sanctioned cost of Rupees 69,300 the increase is Rupees 72,328.

13. The District Engineer reports that the statement showing work performed up to the end of November 1872, and remaining to be performed under Called for in G. O., 11th March 1873, No. 764. each sub-head of the estimate at that date, cannot be furnished, but it is not understood why the usual comparative statement has not been supplied showing the quantities, rates, and cost of work under the several sub-heads in the original estimate, and comparing these with the quantities, etc., of work actually performed from the commencement or remaining to be done, seeing that the data exist for this information and were used for Colonel Bean's report and accompaniment, or for the supplemental estimate now under review. Further, it would have been desirable to have had a profit and loss account, in which should have been entered the expenditure as far as it could be apportioned on work abandoned or condemned and the outlay unaccounted for, so that the Government would have been informed as to what proportion of the excess expenditure on the project was due to absolutely faulty design or execution or other irregularity, and what was merely to be attributed to undue lowness of rates or want of proper prevision in the framer of the original estimate.

14. Under present information it is only possible to make a rough approximation to the real amount of the profitless outlay, but it may be safely estimated at not less than Rupees 40,000, and is chiefly to be attributed to faulty alignment and grading of the supply-channels, rendering it necessary to abandon portions of them and to re-excavate others; faulty design and construction of the revetments of the tanks, nearly the whole of which have to be rebuilt, and badly constructed masonry works. In their Order of the 11th March 1873, No. 769, Government deferred expressing their opinion of the official conduct and capacity of the officers connected with the designing of the project originally, as well as its execution and

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supervision up to the period of cessation of operations in the beginning of 1872. It is evident that the work was planned, from one end to the other, with total disregard of the ordinary principles which should have regulated the design, and that its execution was also faulty and not creditable to the officers entrusted therewith. The Executive Engineer more immediately responsible having been removed from the department, and the Superintending Engineer for the time being having already been subjected to reduction in departmental rank for general mismanagement of his division, no further action on the part of the Government seems called for.

15. The following are the items which are described in the District Engineer's letter as constituting the supplemental estimate:—

	Rs.
Completing the anicut across the chuttrum nullah and the head sluice to the supply channel	3,064
Completing the supply channel from the chuttrum nullah to the Alipore tank	10,530
Repairing the Alipore tank bund	18,758
Rebuilding the Alipore tank sluice	1,742
Alterations and improvements to the channel for Alipore tank to Fischer's tank	12,267
Repairing the bank and calingulah of Fischer's tank and deepening Fort ditch channel	9,810
Sundry small works	1,126
Sundries and superintendence	4,583
Total...	61,880

The whole of the above are stated to have been completed under provisional sanction, with the exception of the rebuilding of the revetment at the Alipore and Fischer's tanks and some minor works.

The annexed statement shows in a comparative form the originally estimated cost of the items above enumerated, the amounts expended to the date of the investigation into the accounts, and the additional expenditure provided for in supplemental estimate:—

Item of Work.	Original Estimate.	Expended to 2nd November 1872.	Supplemental Estimate.	Total estimated outlay.	Excess over original estimate.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	
1. Anicut across chuttrum nullah and head sluices	3,574	3,894	3,064	6,958	3,384	
2. Supply channel from chuttrum nullah to Alipore tank	8,207	11,414	10,530	21,944	13,737	
3. Alipore tank and masonry works	44,803	48,782	20,500	69,282	24,479	
4. Channel from Alipore tank to Fischer's tank	4,777	12,267	12,267	12,267	7,490	
5. Fischer's tank and supply channel to Fort ditch and distributing channel	4,000	626	10,936	11,562	7,562	The expenditure from Famine Relief Funds would properly be an addition to the excess.
Superintendence and sundries	3,939	10,335	4,583	14,918	10,979	
Sapper labor which cannot be distributed.	...	4,697	...	4,697	4,637	
Total...	69,300	79,748	61,880	1,41,628	72,328	

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16. In paragraph 10 of Colonel Bean's report of the 26th November 1872, which has already been noticed, some description is given of the hydraulic conditions with which the project had to deal. The failure of the works was, in a great measure, caused by an entire want of consideration of those conditions, or at any rate, if they were thought about, very erroneous deductions were arrived at. Under these circumstances, it would be satisfactory to the Government to be furnished with an outline of the calculations on which the alleged sufficiency of the present estimate for making the works thoroughly secure is based, but no information of this character is given in the report of the Superintending Engineer.

17. In regard to the chuttrum nullah stream, whence the main water-supply is derived, it would be desirable to record the maximum flood discharge, the relative levels of highest flood (under the influence of the anicut), that of the sluice wing walls, and the banks and ground immediately in connection with these works. To show, in short, that there is no danger of the works being turned, for the possibility of such a contingency is referred to by Colonel Bean.

18. In reference to the supply-channel to the Alipore tank, information seems particularly called for as to the amount of the maximum cross drainage which will be intercepted in its length of nearly two miles, and its capacity to carry away such drainage without danger of breaching. The slope of the bed, 8.26 feet per mile, is for a water-way of such area enormous; the discharge at full supply level, the velocity generated, and the nature of the soil, are points to which no doubt full consideration has been given in reference to the question of regulating the fall, but an allusion to them in the Superintending Engineer's report to Government would have been satisfactory.

19. The Alipore tank new supply is under control so far as regards the chuttrum nullah stream, but apparently not so as regards the drainage of the country cut off by the channel just noticed. The new conditions of this tank seem to call for investigation as regards the discharging capacity of the calingulah in relation to the new catchment area. Doubtless it has received this attention, but seeing that the original calculations for the project, if any were made, have been so falsified by results, some notice of the subject is now desirable.

20. Information on the subjects referred to will be awaited, but the Government will not on this account now delay their sanction to the estimate forwarded.

21. The Superintending Engineer should report what proportion of the unexpended balance of the estimate it is desirable to lay out during the current year, and whether he is prepared to recommend a transfer of repair funds to the desired extent.

(True Extract.)

(Signed) G. W. WALKER, Colonel, R.E.,

Secretary to Government.

To the Superintending Engineer, Bellary.

.. Officiating Controller of Public Works Accounts.

.. Military Department.

Exd. S. T. Austin.

Spare Copies

Alipore Project.

Improvements to Anicut and Head Sluice

Estimate Rupees 3063-13-5.

Anicut.

1st The apron, in rear of the anicut, not extending far enough up the bed of the Chutthum Vagu, the force of the water, passing over the anicut, scoured away the bed of the skullah, thereby exposing the whole of the foundations to the retreating wall at the end of the apron, seriously damaging the same.

It is now proposed to extend the present apron, 30 feet in two steps, so as to decrease the fall of the water from the top of the existing apron, the lower portion to be on a level with the bed of the Vagu, and as a further precaution against scour, the top soil of the skullah being loose sand, it is proposed to remove loose sand &c. down to ~~the~~ hard gravel, for a breadth of 6 feet, substituting good gravel, well watered and tamped.

The

2. The foundations of retaining walls to apron will extend for a depth of 3 feet into firm gravel, and the site for apron will be cleared of all loose soil, down to hard ground below, on which will be laid good gravel, in layers of 6", well tamped, up to 1.5 of the top of the retaining walls, above which, a granite stone apron, well packed, will be laid.

Head Sluice

1. This work was never completed, the wing walls and flooring, only having been built. The slabs, together with the apron in rear, has to be removed and relaid, owing to the slabs &c. having been disturbed from their places, by the flow of water down the channel.

2. The Head Sluice is to have 5 Vents, each 4 feet broad, and 5.5 in height, to be closed, when required, by planks 6x3, sliding in grooves cut in the covering and flooring slabs. Blocks of granite 9x9, extending across the Vents, mid way, in order to guide the planks &c.

3. The cutwaters to be of dressed stones, all other parts of ordinary masonry.

Supply Channel from Head Sluice to Tank

Amount of Estimate Rupees 10500-10-4

1st The Estimate provides for cutting a new piece of supply channel, at alipore, $1\frac{1}{4}$ mile long, commencing from the point, at which, the highest water mark leaves the cutting in the old supply channel from the Chittomni Hillahs (marked D. on accompanying sketch) and on to the Alipore Tank. The channel will be in cutting throughout, the breadth, at the bottom, being 20 feet, with side slopes of $1\frac{1}{2}$ to 1. Average depth 5 feet, with a fall of 8.26 per mile. A bund will be constructed at "D." to turn the water into the new channel, as also across the jungle stream, at the points marked "E." & "F." on the sketch, the bund at "E." is required, merely to pass the water that comes down from the Chittomni

14. Kullah across; - the Course
of the jungle stream itself, having
been diverted, by the bund built at
'F', and the water made to flow
easily into the main channel, instead
of being allowed to come down
at right angles, thus causing
a breach, which has always been
the case hitherto.

The work on the bunds, to be of the
same quality and description, as the
new work on the Alipore Tank Bund.
Provision is also made in the
Estimate, for deepening that portion
of the old channel, in cutting, between
the head works, and the point at
which, the new channel branches off,
so as to give the bed of the channel
a uniform fall throughout.

This work, with the exception of a little
"pitching", required at the lowest
cutting, was completed before the
monsoon set in last year (1873/4)
when the Tank received a full supply.

Improvements &c. to Tank Bund

Amount of Estimate Rupees 18,459-4-0
The building of the Tank was

* Official Office
1874.

① The remaining
portion of the water
was known into
the large, Bunder
Pettah Tank.
During the month
of June, Alipore
Bund received a
fresh supply & at
the present time
water is standing
15.7 feet above the
floor of the sluice -
1 1/2 Million C. yards.

Commenced in 1865-66; but the
work has not yet been completed.
No water was stored prior to 1873,
when 18 feet of water was kept in
the tank, from September 1873, to April
1874, which, owing to the supply in
Bellary falling short, and at the
request of the Military authorities,
was passed down the Channel
to the Cantonment, filling the
Native Infantry, Goontah and the
Fort Ditch Tank; the principal
Reservoirs for storing potable water
in Bellary. ②

In the beginning of 1872, it was
found, that owing to the faulty
construction of the bund, the
stone facing had, in many parts,
given way, partly from being
thrust out by the swelling of the
earth, at the back of the pavement,
after being saturated with water,
and partly from the fact of its being
built on black Cotton soil, which
after getting wet, allowed the stone
facing to slip; it was then
deemed necessary, to rebuild
3 different portions of the pavement.

6. of an aggregate length of 945 feet:—
Subsequently, in the beginning of 1843,
the stone facing began to show
further signs of slipping, in several
places, when the accompanying
revised Estimate, for rebuilding the
greater portion of the remaining revetment,
was ordered to be prepared by the
District Engineer, as also for raising
the stone facing, in low places, to a
height of 3 feet above the crest of the
Calingulak, with 1 foot of gravel, well
watered and tamped, above it, as per
accompanying Longitudinal Section.

After the old revetment has
been taken down, the old earthwork
of the bund, will be cut down in steps
of 3 or 4 feet in height, for a breadth
of 10 feet to receive the new gravel
and earth backing.

The foundation trenches will be dug
down to a depth of 1 foot in firm
gravel, the bottom of the trench
being cut perpendicular to the front
slope of the revetment, to receive
the stone facing.

The old revetment, which was of Stone Facing
granite stone, was built in a very
loose manner, the front stones
were about $18 \times 8 \times 4$, and were for

the most part built in the revetment
as "stretchers" backed with a quantity
of smaller pieces of stone.
It is now proposed, to rebuild the
revetment, in the following manner:—
No stone to be less than 18 long by
12 broad, and from 4 to 6 in
thickness, to be built in the bund as
"headers", or having their longest side
running into the bund, and to be
closely packed together, the front
having a slope of 1 to 1, the old
stone at site, being used for about
 $\frac{1}{3}$ of the height of revetment.

Tamped Earth
+ gravel
Backing

At each course of the revetment
riser, a backing of gravel 2.6 in
breadth, will be laid in horizontal
layers, well watered and tamped,
the gravel used, to be carefully sifted
and freed from large stones and
earth by sifting, if necessary.

Above the stone facing, the bund
will be raised for a height of 1 foot,
with gravel, well watered and tamped,
spread for the whole breadth of the
bund.

The Section of the bund shows how
the work is to be carried out.

Improvements to Alipore Tank Sluice

Amount of Estimate Rs 1742-8-8.
The old Sluice was found to leak excessively and was regulated by plug holes. The Head and a portion of the Tunnel was removed and rebuilt by Mr. Fraser, and a rectangular Vent with wing walls substituted.

The work was carried out as follows:

1. The foundations extend into hard gravel, and rest on a bed of concrete 1 thick.
2. The masonry is of the best description. Consisting of large sized granite stones, up to the level of the foundation, the remainder being of hammer dressed Stone or Chumam. — Round Stones, at intervals of 3 feet, being used throughout the work.
3. The Sluice Shutter is made to slide up and down, in grooves cut in upright blocks of granite, three line dressed, and all parts of the Face walls, for a height of 6 feet, are of fair dressed stone, to allow the Shutter to slide freely. — Slabs have been placed on the top of Wings & face

- walls, as a coping.
4. In the floor, at the junction of old and new work, a granite block extends across the Vent.
 5. That portion of the tunnel, which has been rebuilt, is covered with granite blocks 1.6×1.6 .
 6. The area of the new rectangular Vent is $2.5 \times 3 = 7.5$ Sq. feet. That of the old portion, having a semicircular top, is $3 \times 2.5 \times \frac{3 \times 1.54}{2} = 11.475$ Sq. ft.

Improvements to the Discharge Channel from Alipore to Fishers Tank

Amount of Estimate Rs 12,266-6-4

The old discharge Channel from Alipore to Fishers Tank, was excavated as a famine work, during the year 1866/67, but was never properly completed, the first piece of Channel, from the Tank to the Tunnel on the Dharwad Road, being nearly for its whole length, in Embankment, and consequently a source of expenditure as it was continually breaching, add to which, the Channel for 3900 feet was lower than any other portion, the remainder having only a very slight fall to Fishers Tank.

From the objections given above

1. The channel are same for this is in cutting.
2. If

2. The Line is more direct being about 100 feet shorter than the old one.

3. Give uniform fall from the Tank. The piece of the old Channel, near the Tank sluice, retained, being part in cutting and part in re-vestment. It is proposed to face it with stone on both sides for its whole length, with the usual gravel.

It is proposed to build a granite
stone apron in continuation of
the floor of the River, on the
bed of the Channel, which is of a loose

11.
description of soil, being scoured
away by the flow of water through
the sluice. The site for the apron,
after being excavated to a depth
of $4\frac{1}{2}$ feet, so as to reach hard soil
good gravel, will then be laid in for
a depth of 1.6 well watered and tamped
on which will be built the granite
stone apron. It is absolutely
necessary to carry the foundation
to the apron, down to the depth
mentioned above, which is lower than
the foundation of the sluice, in part,
the subsoil being a very soft description
of earth, called "boudoo", on which
the bank built for a great portion
of its length. Tests.

The new piece of Channel will have an average sectional area of 64 Square feet, the soil being black cotton, gravel, and decomposed granite.

grants,
A Tunnel of 3 Vents each $4 \times 4\frac{1}{2}$,
will be built over the Channel where
it crosses the Dhavara Road.
Two strong bunds, will be thrown
across the Channel at the points
where it leaves and rejoins the old
one, as shown on the Section.
The line of Channel from the point
marked "R" on the Longitudinal
Section, is added to, the only

12. improvements necessary being deepening and widening; the excavation may be in earth, gravel and granite rocks - the latter of which forms no inconsiderable item in the Estimate. The Channel again crosses the Shavva Road over which a new Tunnel of 3 Vents each $5 \times 4 \times 5$ is to be built, the floor of the old one not being low enough.

The old Channel, as shown on Longitudinal Section, ends abruptly just before reaching the pined Goontah, allowing the water to spread considerably in the Goontah, before flowing down the piece of made Channel to Fishers Tank. This line has been slightly deviated from a small piece of the old Channel abandoned and a new Channel, of an average depth of 2 feet, cut through the bed of the Goontah, on to the made Channel to Fishers Tank: - the water, by regulating the sluice, can be confined within the lip of the Channel for its whole length. The remainder of the Channel into Fishers Tank, requires deepening, this portion of the Channel is partly in cutting and partly in embankment the latter of which is in tolerable order.

Repairing and improving Fishers Tank Bend, and Channel to the Native Infantry Goontah.

13. Amount of Estimate Rupees 6974-11-1
This Tank is situated about mid-way between the Alipus Tank and the Fort Ditch Reservoir and receives the water from Alipus Tank, prior to its passing down the Channel to the Native Infantry Goontah and Fort Ditch: - water is also stored here, average depth 2 feet, for the use of Sepoys &c being in the Western portion of the Infantry Lines.

This tank appears to have been built in the same faulty manner as the one at Alipus, the Stone pavement shows signs of slipping for its entire length, owing to want of foundation, and in some places it is built nearly perpendicular. It will be necessary to remove and rebuild the whole of the Stone facing, with gravel and earth backing, well watered and tamped, a description of which is given in the Report for repairs to the Alipus Tank Bend. The foundations to extend one foot into hard gravel at a slope of 1 to 1.

Minor improvements to the two Calingulaks of this Tank, as per accompanying Sketch, have been estimated for. Vnf. Strengthening Body.

14. walls. repairing aprons etc.

When this Tank is full, the water backs up the Channel from Alipore Tank, for about 10,000 feet, shown on Longitudinal Section, by a thick blue line.

The Supply channels to the Fort Ditch Reservoir, and Native Infantry Tank branch off from the East end of this Tank, nearly at right angles to each other; the level of the sluice floor to the Fort Ditch Channel is 3.30 feet below the crest of the West Calingula and 3.53 above the deepest part of the Tank.

Channel to Native Infantry Goontah
Amount of Estimate Rs. 45/- 14-10

This Channel is in cutting for a length of about 200 feet and for the remainder of the distance the water flows over the low ground in a natural drainage Channel into the Tank.

The Supply sluice to this Channel is built about 1571 feet up the Channel from the Tank to the Vent having a sectional area of 15 feet.

This Channel is to be deepened for a length of about 200 feet with an average bottom breadth of 3 feet. the cutting for the greater portion being through rock (granite).

15. The fall of the channel for a length of 1571 feet is 1.24 feet per mile. from thence for a length of 780 feet, the fall is 8.06 feet per mile. and the remaining portion, where the water flows over the natural surface of the ground, has a fall of 53.7 feet per mile.

Fort Ditch Channel
Amount of Estimate Rs. 2935-7-11
This Channel leaves Fischer's Tank at the same point as the Channel to the Goontah and at right angles to it. the Channel runs north, through the Cantonment of Buxary, after which it turns in an easterly direction and runs into the Fort Ditch, which is the principal Reservoir for storing good water in Buxary.

The Channel is in cutting for nearly its whole length and is flanked on both sides for a considerable portion:— a protecting wall of stone in Chumam is built for a length of about 900 feet, where the Channel runs parallel with the road. The Channel has a fall of 3.49 feet per mile.

The Estimate provides for deepening the Channel, for a length of about 4750 feet, removing and rebuilding 3 tunnels, the floors of which are too high; pulling down and rebuilding

The cutting, for the most part, is through gravel, decomposed granite and rock.

2
 Sub: Engineering
 Mr. R. K. R. R. R.

Ed Arnold

25. 2. 28

J. H. 62/14

Survey (2) of the Channel from
the Chittown Mounds to the Alipon
tanks and of the Channel from the
Alipon tank to Fischer's tank and
Port-Ditch.

Longitudinal Sections 14/ of Chan-
nels from Chuttham Nullah to Ali-
pore tank and from Mipore tank
to Mischor's tank and Fort Detch.

Plan of Ancient and New Mexico
Longitudinal Section of Mexico and

1. Cross Section of Miferson tank bank
Plan of tank Service.
Longitudinal Section of Fischer's tank

District Engineer's Office
 Bellary 29th September 1894

From
 The District Engineer
 Bellary
 To
 The Secy to Government
 P.W. Department

Enclosures
 1. Estimate
 1. Report
 1. Plans as per
 List enclosed
 Sir,
 With reference to the Order of
 Government of the 11th March 1893 No. 769
 I have the honor to forward a Supple-
 mental Estimate of Rs. 61,880.00.0.
 for completing the works connected with
 the water Supply of the Bellary Can-
 -toriment, known as the Mepore Tank
 Project. The Statement, showing work
 already performed and remaining to be
 performed, under each head of the original
 Sanction

P. G. 27 and 28
 13. 10. 28

P. M. 462/94

Sd/-
 District Engineer
 Bellary

E A and Co. Secy
 District Engineer
 Bellary

Funds found and drawn to the
 District Engineer's Office.

Sanctions called for in para 3 of the above order, cannot now be furnished, as prior to the receipt of the Order, the work included in the Supplemental Estimate had been put in hand. A Statement of the kind was forwarded with Colonel Bean's letter of the 26th November. Printed in the L. C. Gazette.
1842. No. 1979.

2. In the Estimate now forwarded is included all work done since the date of Colonel Bean's letter and all work that is ^{still} considered necessary for putting the tanks, channels, and other works in a perfectly efficient state. The various detailed Estimates, of which this is the Abstract, were prepared more than a year ago, and they and the plans which

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which accompanied them were carefully examined by the late District Engineer, but he delayed forwarding them for the Sanction of Government, as he wished to satisfy himself that nothing essential had been omitted, and to test the works that had been completed.

3. Government are aware that the works have been in progress during the last two years, in anticipation of the Sanction of the Estimate. They are now completed, with the exception of rebuilding the revetments of Mepore and Fischer's tank, and some minor works. The worst parts of the Mepore revetment have already been rebuilt, and it is possible that the rebuilding of the whole of the remainder of the revetments

renewals of the two tanks may not
be found necessary.

Last year the Fort Ditch and the
Pottah tanks were supplied with water
intercepted by the bank of Fischer's
tank and the Channel adjoining. This
year, the Mipoor Tank having re-
ceived a supply in September 1843, the
Sluice was opened on the 11th of April,
and Fischer's tanks, the Native In-
fantry Gountah and the Fort Ditch,
and to a certain extent the Pottah
tanks, were filled. There is at present
a depth of 16 feet of water on the floor
of the Sluice of the Mipoor tank.
No breaches occurred in the tanks
or Channel banks, last year or this.

The

4. The first two items in the Sup-
plementary Estimate are for completing
the Aqueduct across the Chuttrun
Nullah and the Head Sluice of the
Supply Channel. All the works com-
prised in these two items have been
carried out. Aprons with retaining
walls have been added to the Aqueduct.
Sluice piers have been built, the floor
and Apron raised and Shutters provided.
The cost has been Rupees 3063¹³/₄.

5. The next two items are for re-
framing and completing the Supply
Channel from the Head Sluice to
the Mipoor Tank. These works have
been carried out at a cost of Rs. 10530¹⁰/₄.
The Channel was originally badly
land

laid out. In one part it was taken
across low ground and a nullah entered
it at right angles. The embankment
at this part was never made high e-
nough or strong enough, and it was
constantly being breached. To avoid
the low ground, a new course has been
cut for the Channel for a length of
1 1/4 Miles. The nullah has been diverted,
and has now the same direction as the
Channel, at the place where it joins it.

Stone revetments have been built
across the old bed of the Nullah and
also across the old Channel at the
point where the new Channel leaves
it. The side of the Channel has also
been revetted for a length of two yards
to prevent erosion. About one half

4
of the Channel originally cut has
been abandoned, and the rest has been
deepened and the Slope rectified.

6. No 5 is a large sum of Rs. 18457.82 for
for the repairs of the Shipora Tank. The
sum. This large expenditure is considered
necessary owing to the faulty construction
of the revetment in the first in-
stance. The surface of the ground at the
side of the Tank is Cotton soil. The
bank is formed principally with this
soil, and the revetment rests on it. It
was moreover laid at an insufficient
Slope and without any backing. The
consequence is that the swelling and
contracting of the soil caused portions
of the revetment to slip. These portions
have been rebuilt, and the probability
is that the greater part of the original
work

work will have to be rebuilt. The Est-
imate provides for laying the first ^{How the work}
course of the revetment in the gravel ^{is done}
which underlies the Cotton soil, for ^{the work is}
using stones not less than 18 inches
in depth, and for forming a gravel backing
to the revetment. Parts of the revet-
ment will have to be raised, and the
old Material will be used as far as
available. The top of the tank bund
has been gravelled.

7. The next three items (with Rs. 250
Cost of lifting gear) amounting in
all to Rs. 142, 8, 8 are for re-
building the Alipore tank sluice.

The Sluice originally built was of
the pattern of the ordinary irrigation
sluice, and was found to leak, owing
no

5
18
no doubt to imperfect workmanship.
The front portion has been entirely
rebuilt on a different plan, with ^{should}
Wing walls in the tank, and the ^{stone}
vent is closed by a Sliding Shutter ^{ba-}
which is raised by means of a screw. ^{ate}
8. The next four items 9-12 a- ^{ing}
mounting together to Rs. 1226, 6, 4 ^{order}
are for alterations and improvements ^{may}
to the Channel from Alipore tank ^{and}
to Fischer's tank. The necessity for ^{the}
this large outlay is due, as in the ^{is}
case of the Channel leading to the
Alipore Tank, to a bad line having
been selected for the first part of
the Channel. This being over low
ground an Embankment had to
be formed for retaining the water ^{and}

and this embankment was constantly being breached. The water moreover, swamped the village of Mepore, and the Village has been rebuilt on higher ground. The fall of the Channel was very irregular. The new Channel is entirely in cutting and is more direct than the former one. The cutting of the new Channel has necessitated the building of a tunnel of three vents where it crosses the Dhanwan Road, and the rebuilding of another tunnel, the floor of which was on too high a level.

9. Items 13 to 16 are for repairing the bank and Catchment of Fischer's tank, and for deepening and improving

the Channel from Fischer's tank to the Native Infantry Cantonment and to the Fort Ditch. The bank of the tank is formed of very bad soil and the revetment has been built without foundation or backing and has not sufficient slope. Only a small portion of the revetment has given away as yet, but as there is a great probability of the whole slipping, provision has been made for rebuilding it in a proper manner. The remaining items are for small works at the lower end of the Supply Channel. No work is going on at present.

The Expenditure up to August from the Supplemental Estimate has been Rs. 32,907, 8, 2. Add

R. 1. 1. 1.

Add Expenditure, including
Sapper Labor, up to the end
of 1871/72 - Vids by O. M.
769 of 11th March 1873. Rs. 79,707.13.10

Suppl. Est.
61000
79707
121158
112615
28972

Total Outlay on the work Rs. 112615.6.0
Balance remaining of the
Supplemental Estimate } Rs. 28,972.7.10

Plans to illustrate the Estimate
and Report are forwarded with this
letter.

I have the honor to be
Sir
Your most Obedt. Servant

E A Ford Col. R.E.
District Engineer
Bengal

47/10/73

J. F. Ingram

P.W. 1846. 45 Depart.
 W. of 1st for 1st
 From No. 6162.

The Dist. Engineer
Bellary

To The Surg. to Govt.
 P.W.D.

No. 1007
 Dated 27

Recd 2nd Sept 1846.
 Plans sent by Enr. 14.
 14 Aug 1846. 11 Places sent.
 Submits Supplemental Estimate

for completing the
 Allpore Tank Project
 No. 3118-2-15-74

1028
 21/10/46 2 Oct 74 2.25

4885-20/10/74
 4885-20/10/74
 4885-20/10/74

District Engineer's Office
 Bellary 2nd October 1846

No. 1062.

From The District Engineer
Bellary

To The Chief Engineer
 P.W.D.

at Bellary.

C No. 6162
 sent to Govt on
 the 2nd Oct.

Sir Referring to the Under Secy's
 Memorandum No. 440 dated 24
 September 1846. I have the honor to
 state that the Plans and Estimates
 connected with the Bellary water
 Supply Project, were dispatched on
 the 30th ultimo with my letter No.
 1007 dated 29th Idem.

I have the honor to be
 Sir
 Your most Obedt. Servant
 EA mil. Enr. P.W.D.
 Dist. Engineer Bellary

1874/75

P.M.D.
Proceedings of the Madras Government
Read the following.

From the Capt. J. M. Mier } (M.E. No. 1007 d/29th Sept. 1874)
Bellary } (F.B. No 1042-9 2 & 4 1874)
do do

Alipore Tank & Bellary Water Supply Project
3118

The Alipore Tank,
otherwise called the Bel-
lary Water Supply Pro-
ject was sanctioned for
execution by G. O. No. 947 of
the 26th March 1867 on an
estimate for Rs 69,300 for-
warded by Lieut. Col.
A. S. Moberly Superin-
tending Engineer 3rd Div.
The Project appears to
have

M
21/10

1 Nov 1874

J. M. Mier, Esq. M.A.
M. S. Mier, Esq.
J. M. Mier, Esq.

The Secy. General

Alipore

To
The Secy. General

M. S.

M. S.

Secy. 5th District

Superintendent

Superintendent

Superintendent

Superintendent

Ch. 29
No. 3118-2-11-74

have been investigated
by Mr. Porter Assistant
Engineer by whom also
the estimate was framed,
and it was subsequently
revised by Lieut. Col. Moberly.

2. The Suptg. Engineer
3. D^r in his letter no. 2062 of
the 6th February 1872 brought to
the notice of Govt. that on
water being passed through
the supply channels to the
Bellary Cantonment defects
were found to exist in
their levels.

3. In the Administra-
tion Report for this Division
for 1871-72 it is stated
that certain improve-
ments to the work

were absolutely neces-
sary to complete it &
the revetment of the Ali-
port Tank was particularly
by referred to as having
shown signs of slipping.

4. The Superintending
Engineer in his letter of
the 13th September 1872 re-
ports that a large ex-
penditure will be neces-
sary in reconstructing
the Aliport Tank revetment,
strengthening the embank-
ments of the supply chan-
nels and altering their
direction as well as the
slope

Slope given to them.

5 At this time the repairs to the taul were in progress, and in their Proceedings of the 4th October 1872 in connection with the above letter the Govt. called on the Superintending Engineer for an estimate for completing the project satisfactorily and for a report as to the causes of increased expenditure and the names of the individuals responsible for bad work or incorrect levels.

N. 1974 d/26. Nov. 1872.

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6. The next record which it will be useful to notice is the report by Col. J. Bran R. J. the Superintending Engineer of the 3rd Division.

This officer having closely scrutinized all the papers and accounts connected with the project forwarded a comparative statement showing

1. The original amounts under the several subheads of the estimate of the project.
2. The expenditure actually incurred up to date against the several subheads.
3. The causes of increase

or decrease of expenditure
compared with estimate.

4. The value of work ac-
tually measured and
calculated from rates
alleged to have been paid
to compare with the ex-
penditure.

7. In general terms
the result went to show
that while a sum of
Rs. 646 in excess of the
original sanctioned
estimate had been ex-
pended the work was
far from being com-
pleted. In fact as an
instance it was pointed
out that in order to
construct the Calipore
Tauf

Tauf revetment as
originally designed a
further outlay of Rs.
27,000 would be neces-
sary.

8. Another point
brought to notice by Col.
Brans inquiries was
that there had been
an expenditure of Rs.
6505 for which no work
could be found. In de-
tail it was shown that
5352 Cubic yards of stone
revetment was the
quantity existing at
the Report Tauf

Charged	Cub. yds.	Rs.
Measured	6938	14,892
	5352	value 11,404
		Difference Rs. 3488

by 30 cub. yards had
been charged for, that
720 Cub. yds. of revet-
ment had been expen-
ded along the supply
channel from the Chist-
rum Nullah and
that the cost at the
supposed rate should
have been Rs 1136 while
the payments entered
in the Station book
for this work were Rs
3548, that finally there
was expenditure not
clearly accounted for
in the Tank head sluice
as

12
No
as well as ancient and
its head sluice - But
in addition to this a bill
had been submitted by
the Officer Commanding
the Sappers for work done
on the project and in
the cantonment by men
under his command.
amounting to Rs 9,002.
As no proper account
was kept, no separation
can be made of the debt
to the cantonment from
that against the Alipore
Tank. Thus the whole
sum stands to the debit
of.

of the Project the
total outlay thus ar-
rived at being Rs. 79708

9. In connection
with the irregular ex-
penditure committed
on above it should
be noted that excess
payment was made
of earth work to the
extent of — 36896 Cub.
yards in consequence of
erroneous measurements
by a Non Commissioned
Officer of Sappers in
charge of the work.

10. Inquiry further
showed that the rates
paid for stone revet-
ment and work in
connection with it were
very largely in excess
of those in the estimate
which latter were quite
insufficient and that
the allowance for stone-
dries and contingencies
was necessarily largely
exceeded. A portion there-
fore of the anticipated
excess expenditure ne-
cessary to complete the
project

project could be legi-
timately accounted
for, but the larger
portion of this excess
was due to defects in
design as noticed in
the latter part of Col.
Brain's Memorandum
which it will be ne-
cessary to allude to
further on.

11. On Col. Brain's re-
port, the Government
authorized expenditure
in carrying out the
necessary repairs and

* \$12628
x \$20500

alterations pending the
the submission of de-
tailed estimates ^{to} ⁶
and allotments were
made during the years
1872-73 & 1873-74 to the
extent of No. 33,128 on
which No. 38908 have
been expended up to
the present date as against
the awaited supplement-
al estimate.

12. Referring now to
the letter of the B. Engineer
quoted at the head of
these proceedings and
its inclosures the amount
of

of the estimate for the
completion of the project
in all its details now
forwarded by that of-
ficer is seen to be Rs. 61880
and he states that this
includes all expenditure
subsequent to the date
of Col. Brans report
above referred to.

The total cost of the project
will therefore be as fol-
lows

Expenditure to the 26 th Novr 1872	Rs. 79,748
Supple. Estimate -	61880
<u>Total</u>	<u>141,628</u>

Consequently
as against the original

sanctioned cost of Rs. 69,300
the increase is Rs. 72,328.

Called for in G.O. 11 March 1874-13. The D. Engineer
reports that the Statement
showing work performed up to
the end of November
1872 and remaining to
be performed under each
subhead of estimate at
that date cannot be fur-
nished but it is not
understood why the usual
comparative Statement
has not been supplied
showing the quantities, rates,
and cost of work under the
several subheads in the ori-
ginal estimate and com-
paring these with the quan-
tities of work actually
performed from the com-
mencement.

commencement or re-
maining to be done. Seeing
that the data exist for
their information and
were used for Col. Braun's
report and accompani-
ment or for the suppli-
mental estimate now
under review. Further it
would have been desirable
to have had a profit &
loss account in which
should have been entered
the expenditure as far as
it could be apportioned
on work abandoned or
condemned and the out-
lay unaccounted for
so that the Government
would have been inform-
ed as to what proportion

proportion of the excess
expenditure on the project
was due to absolutely faulty
design or execution or
other irregularity and
what was merely to be at-
tributed to undue lowness
of rates or want of proper
provision in the framing
of the original estimate.

14. Under present in-
formation it is only possible
to make a rough approxi-
mation to the real amount
of the profitless outlay but
it may be safely estimated
at not less than \$40,000
and is chiefly to be attri-

buted to faulty alignment
and grading of the sup-
ply

supply channels rendering
it necessary to abandon
portions of them and to
reexcavate others - faulty
design and construction
of the revetments of the
Levee nearly the whole
of which have to be re-
built and badly con-
structed masonry works.
In their order of the 11th
March 1873 his 769 Govt.
deferred expressing their
opinion of the official
conduct and capacity
of the Officers connected
with the designing of the
project originally as well
as its execution & super-
vision up to the period
of

of cessation of operations
in the beginning of 1872.
It is evident that the work
was planned from one end
to the other, with total dis-
regard of the ordinary
principles which should
have regulated the design
and that its execution was
also faulty and not cre-
ditable to the Officers in-
trusted therewith. The
Executive Engineer more
immediately responsible
having been removed from
the Dept. and the Super-
intending Engineer for the
time being having already
been subjected to reduction
in Departmental rank
for general mismanage-
ment

must any amount of
his Division no further
action on the part of
the Govt. seems called
for.

15. The following are
the items which are des-
cribed in the S. P. M. S.
letter as constituting the
supplemental estimate.

Completing the ament across the Chutrum
Mullah and the H. S. Sluice to the sup-
ply Channel — Rs. 3064

Completing the supply Channel from
the Chutrum Mullah to the Alipore
Tank — " 10530

Repairing the Alipore Tank Bund — " 18758

Rebuilding the — do — Sluice — " 1742

Alterations & improvements to the
Channel for Alipore Tank to
Fischer's Tank — " 12267

Repairing the bank and Calugalah
of Fisher's Tank and deepening
Foot ditch Channel — " 9810

56171

32
Sundry small works — 1126
Sundries & Superintendence — 4583
Total Rs. 61880

The whole of the above are
stated to have been com-
pleted under provisional
sanction with the exception
of the rebuilding of the re-
servement at the Alipore
and Fischer's Tanks and
some minor works.

The annexed statement
shows in a comparative
form the originally esti-
mated cost of the items
above enumerated, the a-
mounts expended to date
of the investigation into the
accounts, and the additional

expenditure provided for
in the supplemental esti-
mate -

Item of work	Original estimate		Supplemental estimate		Remarks
	1872	1873	1872	1873	
1. Amount across Chuttram chullah & K. Lucco	3574	3094	3064	6058	3384
2. Supply channel from Chuttram chullah to Alipore tank	8207	11414	10530	21044	13737
3. Alipore tank and Mason- ry work	44003	48702	20500	69202	24479
4. Channel from Alipore tank to Fuchers tank	4777	12267	12267	12267	7490
5. Fuchers tank & supply chan- nel to Fort Detah & Distributing channel	4000	626	10938	11562	7562
Superintendence Sundries	3939	10335	4583	14918	10979
Supper labours which cannot be distributed		4697	"	4697	4697
Total	69300	79748	61800	141628	72320

16. In para 10 of Col.
Brown's report of the 26th
November 1872 which has
already been noticed.
Some description is given
of the hydraulic condi-
tions with which the pro-
ject had to deal. The failure
of the works was in a great
measure caused by an
entire want of considera-
tion of those conditions
or at any rate if they were
thought about, very errone-
ous deductions were ar-
rived at. Under these
circumstances it would
be satisfactory to the Govt.
to be furnished with an
outline

outline of the calculations on which the alleged sufficiency of the present estimate for making the works thoroughly secure is based, but no information of this character is given in the report of the Engineer.

17. In regard to the Chuttrum Nullah stream whence the main water supply is derived it would be desirable to record the maximum flood discharge, the relative

21 20
relative levels of highest flood (under the influence of the Ament), that of the sluice wing walls, and the banks and grounds immediately in connection with these works. To show in short that there is no danger of the works being turned for the possibility of such a contingency is referred to by Col. Beem.

18. In reference to the supply channel to the Alipore Tank information seems particularly called for as to the amount

maximum
of the cross drainage
which will be intercepted
in its length of nearly
2 miles and its capaci-
ty to carry away such
drainage without danger
of breaching. The slope
of the bed 8.26 ft. per
mile is for a water way
of such area enormous;
the discharge at full
run-off level, the veloci-
ty generated and the
nature of the soil are
points to which no
doubtful consideration
has

has been given in reference
to the question of regu-
lating the fall, but an
allusion to them in the
District Engineer's report
to Govt. would have
been satisfactory.

19. The Alipore Tank
new supply is under con-
trol so far as regards the
Chuttrum Nullah Stream,
but apparently not as
regards the drainage of
the country cut off by the
Channel just noticed.
The new conditions of the
tank seem to call for in-
vestigation as regards the

discharging capacity of
the calingulah in relation
to the new catchment
area. Doubtless it has
received this attention
but seeing that the origi-
nal calculations for the
project if any were made,
have been so falsified
by results some notice
of the subject is now de-
sirable.

20. Information on
the subjects referred to
will be awaited but
the Govt. will not on
this account now delay

their sanction to the esti-
mate forwarded.

21. The Lt. Engineer should
report what proportion
of the unexpended ba-
lance of the estimate
it is desirable to
be ~~can~~ lay out during
the current year ^{and} ~~in order~~
whether he is of
opinion that an allotment may
be made ~~if practicable~~
a transfer of repairs
later in the year.

Done to the
extent, Adms.
G.W.

To the J. C. Bellamy
" Controller with H. Estimate
" Military Dept
" Civil Dept 7/10/74.

6162
6223
Govt. of 1874

PUBLIC WORKS.

To the Superintending Engineer
Bellary

W. G. M.

Dated

Recd.

Encl. 1/2

G. 2^d Naut. No. 3118

Nov. 1880

Bellary Water supply
Project - The ~~revised~~
supplemental Estimate
of Rs. 61,880 for the
completion of the works
connected with the water
supply of the Bellary
Sanitation sanctioned &
information on certain
subjects ~~not~~ awaited