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MADRAS RECORD OFFICE

GOVERNMENT OF MADRAS

Revenue DEPARTMENT

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No. 590.

Read the following :—

No. 1,086-A.

MEMORANDUM.

THE Order of Government of the 4th December last, No. 3,411-A., directed the
Floods of 1874.

Nature and object of narrative required.

Chief Engineer for Irrigation to draw up
a narrative of the disasters caused by the
floods of September and October 1874,

showing the nature and extent of the damage done to each work and the conjectured
cost of emergent repair as well as of thorough renovation, or the provision of such works
as would guard against similar disasters in future. Accordingly the District Engineers
were called upon to supply the necessary information; and reports, more or less in detail,
having now been received, they are reviewed below. It is to be observed that the
estimates of the cost of renovation and improvement of existing works, as well as that
of providing new ones to prevent future disasters, depends on the information gained
by surveys, more or less extensive, which take time and which are not yet completed.

2. GANJAM.—The District Engineer, Ganjam, has supplied a detailed list* of the

Ganjam detailed list of works damaged.

* Appendix A.

irrigation works which were damaged by
flood.† It shows that the embankments
of one river, four channels, and thirty-
eight tanks were breached. Seven masonry
works on channels or tanks were destroyed
or damaged as well as three bridges. The cost of the emergent repairs will probably
not exceed Rupees 10,000, and that of
renewing the works, or providing new ones
where necessary, is estimated at Rs. 60,650.

† In October and November 1874.

Cost of repairs, Rupees 10,000.

Cost of improvements, Rupees 60,650.

It is certain that the latter is merely a

rough approximation, for there has been no time to consider carefully and one by one
the circumstances of each work and to make the necessary calculations on which alone
a reliable estimate could be framed.

It is stated that the damage by flood was greater during the year 1873 than in
1874, as the rainfall in the latter extended over a longer period than during the former
year, and that the damage now brought to notice was chiefly in the southern portion of
the district, where the freshes were higher than any within recollection.

3. In reference to the general condition of the irrigation work, the District

General condition of Irrigation Works in the
Ganjam District.

Engineer explains that few of the tanks
are provided with masonry works of any
kind, that river embankments have been

much neglected, and that the river and hill stream channels which have head sluices
are ill-provided with subsidiary arrangements, and are generally in bad condition.
There are 3,000 irrigation works on the register (exclusive of those in the Kameda
estate), many of which, however, are not worth keeping up. It is proposed, as a general
measure, to provide the more important works with rough escapes, sluices, &c. as cheaply
and quickly as possible.

4. Such measures based in every case on a clear knowledge of the conditions
and the return of revenue for the expenditure to be incurred are doubtless what are
required, but the works though numerous are for the most part of insignificant
individual importance, and their *raison d'être* depends on very economical conservatism.

5. VIZAGAPATAM.—The damage to works in the Vizagapatam district does not appear to have been of any great importance. As in Ganjam, those for irrigation are of a petty nature and the estimated cost of repairs only amounts to Rs. 7,000. The bursting of tanks caused injury to a number of roads, and to make this good Rupees 6,858 will be required. The whole outlay on account of floods in this district will apparently not exceed Rupees 14,000.

The District Engineer has hardly touched on the question of the measures required to prevent disasters in future except as regards damage to roads. In reference to this he suggests that all proprietors of tanks should be required to provide calingulahs, or that they should be held responsible for the consequences when they do not do so. Instructions have been issued on this subject to District Engineers, who are directed to examine into the circumstances of each private tank, to draw up the necessary instructions for putting them into a secure state, and also on the requisition of owners of tanks to prepare surveys, plans, and estimates for carrying out the necessary works, as well as to carry out the same at the cost of the persons concerned.

6. Allusion is made to the breaching of two irrigation channels for which repair estimates have been prepared, but it is probable that additional works are required for regulating the supply and thus avoiding a recurrence of the damage.

7. KISTNA.—The effect of the floods in the Kistna on the delta works was disastrous. The report of the District Engineer which describes the damage in detail will be found in the appendix.* The river rose on the 26th September 1874 to a height of 18 feet 3 inches above the crest of the anicut, which itself is 20 feet above the bed of the river. This is 11 inches higher than any previously recorded flood.

8. The Kistna river is confined to its course by embankments which extend on the eastern or left bank from a point some nine miles above the works at the head of the delta to the point of Divi, and on the western side from the head works to the sea. Both were breached at points below the anicut, and the flood water spreading over the delta on either side burst into and submerged the canals* which traverse it and filled and breached the tanks. There were numerous breaches in the canal banks, and a large quantity of silt was deposited on the main canal. The repairs immediately necessary will cost, it is estimated, Rupees 20,000, of which Rs. 30,000 will be required for the river embankments, Rupees 30,000 for the canals, and Rupees 10,000 for the removal of silt.

9. The measures necessary to guard against disaster in the future are to a certain extent indicated by a consideration of the circumstances noted during the continuance of the flood. The head works were nearly submerged, and it is proposed to raise them two feet. The river embankment above the anicut was in great danger of being overtopped. Those below were so. The Divi island embankment was also injured. It is proposed to raise all these from 2 to 3 feet at a cost of a lakh of Rupees. The villagers living on the land between the river embankment and the river bank itself, there is much reason to believe, cut the bank in several places when the river rose with a view to saving their own tenements, by allowing the water to spread and thus lowering its general level. It is proposed to induce these people to move to the outside of the embankments, by allowing them free building sites, thus giving them an interest in the preservation of the protective works.

10. NELLORE.—It was in the Nellore District, in the valley and delta of the Pennair river, that the effects of floods were most severely felt. A detailed account of the damage sustained by the various works of irrigation, the roads, &c., written by the District Engineer, will be found appended hereto. The river is confined to its course within narrow limits on the left or northern bank by high land as far as Sungam, a point 35 miles from the sea, below which spreads the northern delta. On the southern side the high ground extends several miles lower and prevents flood water from spreading to any great extent. It was therefore below these points on the river that the damage to the country chiefly occurred. The river commenced to rise on the 25th October, and attained its maximum height of 18 feet 4½ inches on the crest of the anicut at 8 o'clock on the morning of the 26th, continuing at that level till the evening, when it commenced to subside. The level reached was 2 feet 10½ inches above the highest flood previously recorded, but of course the afflux caused by the anicut must be taken into account.

11. The Nellore anicut which is placed across the Pennair, near the town of Nellore, was extensively injured. Its Nature of damage to works, southern bank, Nellore Anicut, was turned at its northern end, the wings were carried away and the body of the work adjoining was undermined and destroyed. Scour along the face caused a slight subsidence of another portion, and the rear slope was partly torn up and carried down the stream. The loose rubble upon subsided about 1½ feet throughout. The river embankment on the right side above the anicut was breached in three places, and the town of Nellore was flooded by the escaping water, houses and huts were destroyed, but no lives were lost. After sweeping through the town the water reached the western spoil bank of the Survapully channel, overtopped and carried part of it away and poured down the channel bed, which with the banks was much injured. The

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Flood bank between Narasimulucondah and the Nellore anicut also gave way, and this involved the overflow and breaching of the large Nellore tank.

12. On the north side of the river the results of the flood were similar. At Sungum a portion of the Gandaveram head sluice was destroyed, and the Pennair breached into the Duveru tank supply channel. Between Sungum and the sea 153 square miles of the northern delta were submerged, much property was destroyed, and crops were under water for several days. Thirty tanks were breached, the Cuddapah and the great northern road were cut and otherwise injured for miles, and the bridges partly destroyed. One rest-house was entirely swept away.

Above Sungum, on either bank, the roads to Cuddapah and the Somaishwaram gorge were partly washed away, and the embankments of a few tanks were breached.

A considerable quantity of land on the margin of the river was eroded.

13. The cost of the repairs immediately required is given in detail in the statements which accompany the District Engineer's report. It amounts to Rupees

Cost of repairs, Rupees 3,09,910.	
3,09,910 distributed as shown below—	
Tanks	Rs.
Embankments	57,400
Channels	9,000
Roads	32,050
Amount	46,500
	1,34,960

The charge for the anicut includes lengthening 450 feet at the northern end.

14. The works required to secure the delta from inundation are estimated to cost Rupees 2,89,000. They consist simply in the extension and raising of the existing river embankment on the south side, and the construction of a similar work on the north. Rupees 80,000 being allotted for the former, and Rupees 1,93,000 for the latter work. Rupees 2,000 are allowed for the planting of navel grass as a security against erosion. The embankment on the right bank of the river will be 22½ miles in length to the sea, from 10 to 8½ feet above the country and 4½ feet above flood level. That on the left bank from Sungum to the sea will be 33 miles in length, 10 feet above the country and from 2½ to 7 feet above flood level.

15. Kurnool.—There appears to have been exceptionally heavy rain in the Kurnool district during the months of July, September, and October, and tanks and roads sustained considerable injury. Twenty-seven of the former were breached and three damaged. The cost of the repairs is estimated at Rupees 22,000 for tanks and Rupees 20,450 for roads, and for preventive measures in regard to tanks, Rupees 50,000.

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16. CUDDAPAH.—The effects of the floods in the Cuddapah district were serious. Rainfall excessive, May to October 1874.

The rainfall during the months from May to October was largely in excess of the average, and in fact exceeded the usual amount for the whole year. The tanks were all full by the end of September, and although the slight fall at the commencement of October did no harm, the downpour between the 20th and 26th of that month was for the most part at once surplused over the weir and discharged into the water courses, and channel-fed tanks were exposed to sudden in-rushes of water which in a number of instances sufficed to breach them. The following is a statement of the rainfall (during the period from the 20th to 26th October) which was the immediate cause of the damage.

Date.	JAMMAL- HABDOO.	PRODDA- TOLU.	BUDYATI.	STODUR.	PULLUM- PATT.	CUDDA- PAH.	POOLI- VANDULA.	ROTHA- CHOTTY.	YOTI- PAUD.	MADANA- PULLEY.	KODAIR.
	Battivari- pully.	Nandi- Jampett.	Budvati.	Went- mitta.	Pullum- patt.	Cudda- pah.	Yoti- pully.	Chaval- cheruvu.	Pestur.	Madana- pully.	Kodair.
20th	1.15	0.35	...	...	...	0.05	...	...	...	...	...
21st	...	0.25	0.05	...	...	0.05	...	...	...	...	0.25
22nd	...	2.00	0.15	...	...	0.05	...	...	...	...	0.15
23rd	1.00	1.10	3.85	3.50	5.25	2.45	0.05	0.11	1.00	2.55	0.20
24th	0.50	3.50	1.05	3.50	10.45	3.75	0.05	3.10	3.20	0.00	0.05
25th	1.40	0.50	3.10	6.50	7.25	5.00	1.50	5.00	5.50	3.40	3.00
26th	0.10	...	0.15	0.45	0.45	0.40	2.20	0.30	1.70	2.25	2.05
	5.15	7.70	9.25	14.35	24.03	12.35	6.30	10.61	12.10	10.25	5.40

The rivers fed by drainage, which ran rapidly off the already saturated country, rose to unprecedented heights and over-

Nature and extent of damage. flowed the banks natural or artificial. The railway which traverses the district was breached in several places, and the roads were

Hydrography of the district. flooded and injured. The Pennair river runs through the northern part of the Cuddapah District in a direction from north-west to south-east and is joined in its course by two considerable rivers, the Cheyair to the south and the Paupugace to the north; these receive the drainage of nearly the whole district. The tributaries of the Cheyair, viz., the Goojra, Poolunga, the Tanchoo, Baidoo and Nandayur Nadee, were

The Cheyair River. all in high flood, and the Cheyair rose accordingly. Its drainage area is about 2,200 square miles, and the valley in which it runs opens out about 4 miles above the point where the Madras Railway crosses it. Here it is embanked and the water broke through on both sides, on the north flooding the country for a mile in breadth, and on the south breaching the railway embankment. A mile below the railway bridge the hills close again on the river on the south side and confine it to its course for a short distance; but below this as far as Pennagalur, a distance of 12 miles from the bridge on the south side and down to Coorcentpully near the junction of the Cheyair and the Pennair on the north, the embankments have been almost entirely destroyed, the irrigation channels obliterated, and the tanks in the margin of the river breached.

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17. In the upland taluqs drained by the tributaries of the Cheyair already referred to, the Government tanks as a rule stood the strain on them well. The weirs and their aprons were damaged more or less by the large volume of water pouring over them, but this was no more than might have been expected. The Munnor Kitchema near Rajampett, the Chittoor tank about 9 miles north of Royachoty, and the Peddamir Chava Ayavari tank were however breached. In the first case the failure which involved the destruction of a portion of the railway was owing to the insufficient length of the surplus weir. In the second, the damage was caused by the breaching of seven small tanks above the large one, and in the third the bank gave way apparently on account of its faulty internal condition. In the accounts furnished mention is made of various other minor works in this part of the district which were injured or destroyed, but which it is unnecessary to notice here in detail.

18. The Pampagnee river in its course through the district of about 75 miles receives the drainage of the greater part of the Madanapully taluq and portions of the Kadai, Royachoty, Pulivendla and Cuddapah taluqs. Five small tanks in the Madanapully taluq were breached, and the weirs of thirteen were damaged. Damage on its course.

In the Kadai taluq a rough stone anicut across the river and the supply channel from it were injured. In the Cuddapah taluq the Pampagnee destroyed great part of the head sluice to the supply channel of the Canalapore tank, filled the channel with sand, breached the tank and carried away a travellers' bungalow on the left bank of the river. The Jammabudgee taluq, in the extreme north-west of the district, is traversed by the Pennair river. Here the Chintacotta tank burst. It had no surplus capacity and had never before been in need of one, but on this occasion the supply was in excess of its limit of safe capacity and the bank gave way. The discharge washed away the northwork of the railway more or less for a length of 4 miles. The Pennair was in high flood, and passing round the village of Chennor breached the trunk and below Padana the country was flooded, but little damage was done. The injury to works in the Peddamir and Budhal taluqs was of no great importance.

The Pennair river damage caused by it.

19. The District Engineer sums up the cost of repairing the damage at Rupees 30,400, distributed amongst the several taluqs as follows:—

	Rs.
Pulivendla	1,00,000
Yalmar	4,000
Chittoor	8,000
Royachoty	20,000
Kadai	3,000
Cuddapah	3,500
Jammabudgee	30,000

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But this, it is stated, only refers to irrigation works; the injury to Local Fund works is estimated at Rupees 30,000 in addition, and the amount allotted to the former does not include the outlay necessary for raising the Cheyair embankments and constructing head sluices so as to render them safe for the future. Surveys and estimates for this work are in progress. It is presumed that the estimate for the repairs to the other irrigation works is based on a consideration of their requirements, and that these again are calculated on the supposition that the works are to be made safe for the future.

20. BELLARY.—Although the rainfall at the latter end of October appears to have been very heavy in the Bellary District, the damage to the irrigation works was not remarkably great. Three of the largest tanks in the district, however, gave way at their calingulals, and a number of minor works sustained injury of lesser importance. All the necessary repairs could, it was stated, be executed from the current allotment.

21. CHINGLEPUT.—The District of Chingleput was visited with severe floods in 1874, and it had previously suffered from the same cause in 1872. The damage during the former year appears to have occurred chiefly in the month of October. An abstract of the list of injured works furnished by the District Engineer shows the following result:—

Summary of works injured.	Tanks breached	Rs.
	Supply or river irrigation channels breached	250
	Sluices, anicuts, or waste weirs destroyed or damaged	10
	River embankments breached or washed away	9

Cost of repairs, Rupees 98,598.
Improvements, Rupees 2,98,220.

The cost of repairs is estimated at Rupees 98,598, and that of securing the works against similar damage in future at Rupees 2,98,220.

The cost of repairs to roads is not included in the above estimate.

22. The principal streams draining the district commencing from the north are the Nannaveram, the Corteliat, and the Palur. The lesser independent lines of drainage to the sea being the Cooum and the Adyar. It is stated by the District Engineer that since the period of the great floods of 1857, the river embankments in the northern part of the district had been much neglected and tampered with for private purposes by the villagers, who cut gaps in them for irrigation purposes. The channels leading from the rivers are often unprovided with sluices at their heads to regulate the passage of the water, and this circumstance combined with the spill from the streams when in extraordinary flood over or through the embankments led to the overflowing and breaching of tanks, the destruction of waste weirs and channel banks, and, in fact, to most of the damage which is reported to have occurred. In other parts of the district the injury to tanks was the result of neglect of the bunds or masonry works, and the insufficiency of the

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same river at K. Saveran was turned. The Chinglopat taluk suffered chiefly in the neighbourhood of the Palar. The Madhantiam tanks are said to have been injured by the bursting of those in North Arcot, situated on the same drainage lines.

23. **North Arcot.**—The Palar river traverses the southern part of the North Arcot District. Its principal tributaries in this

Floods of October 1874.

part of its course are the Gomattam and

the Poiney on the north, and the Cheyur on the south. The district was visited with heavy rain at the end of October 1874, all these rivers were in high floods, and the damage to various works and to the

district was serious. Half of the large anicut across the Palar near Arcot was

carried away, and nearly the whole of the Poiney anicut disappeared. The similar work on the Cheyur was injured. The Poondy large tank near Wallajahpott was breached by the overflow from the Palar and the Poorsay tank, which is supplied by a channel from the Cheyur, was topped by the water which scoured away a considerable portion of the bank, without actually breaching it. One hundred and twenty works of minor importance were injured. The above refers to the damage to irrigation works, but others did not escape. The Palar

Palar bridge.

bridge between Vellore and the Railway

station gave way for a length of 230 yards. The Gomattam bridge, on the road from Vallamam to Chinglopat, was swept clear at its upper part. The arches and piers only remaining and the embanked approach was breached. The communication in

Communications.

the greater part of the district suffered severely owing to the overflow of the Palar and the rain. The District Engineer has not proposed any specific alterations to works, or any provision tending to greater security in the event of floods, but states that the embankment of the river is a matter for consideration. Some short embankments on the left side above the Palar anicut, which will prevent the head sluices being turned will, however, at once be carried out. The cost of repairs, Rupees 2,00,000 for irrigation works, and Rupees 1,00,000 for others.

So far as the Government land is concerned, the flood will cause a considerable expenditure of Rupees 5,00,000, but this estimate takes no account of the injury and loss to the Zemindars or private estates, which consist of more than half the area of the district. It is stated to have been extensive, and that evidence of it is afforded by the unprecedented flood in the Gomattam river, which was caused by the sudden release of water as consequence of the breaching of numbers of private tanks. Appendix will give further particulars on this subject.

24. **South Arcot.**—The principal streams crossing the South Arcot District are the Pooniar or Palar and the Vellur.

The Pooniar and Vellur rivers.

Both are largely utilized for irrigation in the usual manner by means of works feeding artificial channels, which irrigate directly or through tanks and by other channels kept up by the native cultivators having their lands in the bed of the rivers, but unprotected by sluices. The Pooniar is also embanked at certain parts of its course, but the embankments, as in the case with

the Vellur, are in a state of disrepair. Unusual rainfall causing

an abnormally high flood in the Pooniar resulted naturally in considerable damage to these works which were on its course or connected with it. A cyclone which visited the

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district in May, and heavy rains in September and October, produced severally a catalogue of disasters. The Pooniar

Damage by cyclone of May 1874, and rains of September and October 1874.

anicut was damaged on the first occasion, as were also the supply channels leading from it, the head sluice on the north being completely destroyed. The repairs were interrupted and the damage was extended by freshes in September and October. The

Teruvady anicut on the Guddilum was also damaged by the cyclone. The Conyaur embankment on the Pooniar was in like manner washed away in May, breached again in September while repairs were in progress, and almost entirely destroyed again in October. The bridge across the Pooniar at Munjacoopum was seriously injured.

25. Of minor irrigation works the rain-fed tanks suffered not at all, but the heads

Rain-fed tanks escaped.

Supply channels from the Pooniar and channel-fed tanks injured.

of every channel along the Pooniar were more or less destroyed, and thirty-nine channel-fed tanks were breached. Almost the whole of the Pooniar river embank-

ments were washed away. The damages to roads are estimated at Rupees 80,000. In addition to the repairs essentially necessary, the District Engineer's recommendations involve the provision of head sluices to the river channels and the embankment of the Pooniar river from its mouth for a distance of 50 miles on either bank. The expenditure necessary or in prospect is summarized, below:—

Summary of expenditure required.

	Repairs.	Improvements.
	Rs.	Rs.
Irrigation works	2,00,000	35,000
Embankments	43,000	3,30,000
Bridges	80,000	...
Roads	3,32,000	3,65,000
Grand Total	6,97,000	

26. **SALEM.**—In the Salem District the damage by heavy rain in September and October 1874 was confined to the northern

Floods of September and October 1874. portion comprising the Oosoor and Tripatore ranges, and it was trifling in extent, ten tanks and two anicuts were breached. It is gathered from the District Engineer's report that the cost of repairs would not

exceed Rs. 2,000 and the improvements alluded to as necessary amount in the aggregate to about Rupees 1,500. This district however suffered seriously from previous floods, and a great deal of the damage done remains to be made good.

27. **TANJAVUR.**—The north-east monsoon burst in this district on the 26th November, and produced a flood in the

Flood in the Tambraparni.

Tambraparni, the principal river, which caused extensive damage. The rainfall on the 26th and 27th November varied at different localities from 12 to 6.5 inches. The rise in the river was somewhat less on the whole than on the occasion of the previously recorded inundation of 1869.

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The irrigation works deriving their supply of water from the river suffered in the usual manner and from the usual causes. Damage to irrigation works on the course of the river. Supply channels, whose heads were unprovided with sluices to regulate the influx of river water were flooded, breached and silted up, and the water finding its way into the tanks which these channels supplied in several instances caused their destruction also. The provision made for passing the drainage of the country across these channels proved in certain cases to be insufficient, and the channel banks were carried away in consequence.

As in the case of Kistna, the Chayari and the Palar, under similar circumstances, already described, the Tambrapurni overflowed its natural banks and breached the artificial embankments raised to confine it.

River embankments breached. These have proved to be both too low and too weak to withstand the stream brought to bear on them on such occasions. The water having once penetrated into the low lands adjacent to the river proceeded to find its way to lower levels, washing away roads and destroying channels and tanks in its course.

The details of the damage are fully described in the report of the District Engineer recorded under G. O. No. 250, of the 29th January 1875. And the further account appended hereto gives other particulars, and describes the measures which it is proposed to take to prevent similar disasters in future.

Appendix E. 28. There are two old irrigation channels of considerable importance which branch off from the river at points above the town of Tinnevely, and depend for their supply on native alicuts on the river. There is also one alicut just below the junction of the Chittaur with the Tambrapurni, 28 miles from the sea, and another recently completed at Streeviguntam about 15 miles from the sea. Both of these works feed channels on either bank of the river. The upper alicut, the Mardur Melakal channel on the west or right bank, and the Kilakal on the left bank. The lower work is connected with the north channel on the left bank and the south channel on the right. The river is at present embanked on both sides from Annur at the confluence to Munakari on the left bank, and Kurungkulam on the right bank, in about 18 miles from the sea.

Measures have already been taken to provide the five channels above Tinnevely with sluices, and the Mardur Melakal below it with head sluices. Generally it may be said that all these channels require considerable improvement. Their banks need in many cases to be raised to exclude river water, the surplus wells provided have proved often of insufficient length to pass off the drainage crossing them and extensions are required. In other cases they have been topped by the river flood and their action reversed, and there have resulted extensive breaches from these and similar causes. The non-existence of sluices to the Kodagan and Tinnevely channels caused the flooding of the head of the latter name and considerable damage to property. The same circumstances apply to the channels taking off from above the Mardur alicut, and in a less degree to the same channel from the Streeviguntam alicut.

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29. A number of tanks surplusing into each other, and, finally, across the channels above referred to and into the river, require attention. Some have been breached owing to insufficient provision of escapes. The river embankments require to be raised, strengthened, and extended, for they were not only breached where they now exist, but flood water escaped in other parts. It is proposed to carry them up on the left bank to the west of Sivalaperi, and on the right bank they will be raised from Kairangcolum to Annur to a height varying from 4½ to 6 feet above the flood level of 1874.

30. The expenditure which will be necessary to carry out the repairs and improvements to the works in the Tinnevely District is given in full detail in the accompaniment to the District Engineer's letter which will be found appended. It amounts to Rupees 2,20,840, of which Rupees 42,500 will have to be devoted to the first object and Rupees 1,78,340 to the second.

31. The reports from districts other than those above referred to show that they were not visited by rainfall or floods of an unusual character.

32. The foregoing narrative, compiled from the district reports, shows that there was considerable variation in the extent of the floods, and consequently in the damage sustained in the various districts, and in fact that it was only in the Kistna, Nellore, Cuddapah, Chingleput, North and South Arcot and Tinnevely Districts that extraordinary effects resulted.

33. The following is a summary of the cost of repairing the damages to irrigation and, as far as it has been ascertained, to other works in districts where there has been exceptional rainfall. The cost of the improvements to existing works or of such new constructions as are considered desirable is also stated:—

	Emergency Repairs to Irrigation Works.	Improvements to Irrigation Works required.	Damage to Banks, Bridges and Non-irrigation Works.	Total ascertained damages to Public Works.
	RS.	RS.	RS.	RS.
Ganjam	10,000	60,650	2,000	72,650
Vizagapatam	3,885	4,115	6,858	13,858
Kistna	90,000	1,02,000	18,120	2,10,120
Nellore	2,63,410	2,89,000	46,500	5,98,910
Kurnool	22,000	59,000	30,450	1,11,450
Cuddapah	1,80,400	1,20,000	30,000	3,30,400
Chingleput	98,308	2,98,220	...	3,96,528
Belary	...	Repairs executed out of current allotments.	...	...
North Arcot	2,03,000	Not stated.	1,43,000	3,55,000
South Arcot	2,09,600	3,65,000	1,23,000	6,97,600
Salem	2,000	1,500	...	3,500
Tinnevely	42,500	1,76,340	Not stated.	2,20,840
Total	11,29,793	14,77,825	4,02,928	30,10,546
		26,07,618		

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It will be observed that the total cost of the repairs to irrigation works is estimated at Rupees 11,20,723, and the proposed improvements will cost Rupees 14,75,825. The expenditure required on improvements is thus an outlay is foreshadowed of only partially exposed. Rupees 26,05,618 chargeable against the resources available for Public Works expenditure on irrigation works, and the bulk of this expenditure is confined to the requirements of seven districts only. It is a fact to be noticed also that the exceptional rainfall in most cases only affected portions of the districts referred to, and that consequently a mere percentage of the irrigation works was subjected to extraordinary strain. The deduction is that similar floods in other districts or in other portions of these same districts would demonstrate the need of more extended expenditure.

34. The disasters which have occurred have almost all originated from the over-Immediate cause of the disasters; the same flowing of the rivers, whose banks, natural generally or artificial, proved insufficiently high or strong to retain them. The irrigation or tank feeding channels leading from these rivers were in most cases unprovided with sluices to control the entry of flood water. They were submerged and destroyed, the tanks they fed were filled to excess, and being often ill-provided with escapes gave way, and their ruin led to that of others lower down. In short, the natural hydrography of the country has been largely interfered with, and an artificial drainage system has been established which does not provide for abnormal conditions, conditions which however recur untailingly at intervals more or less great. That the rainfall during the months of May to October 1874-75 was generally of a very exceptional character is shown by the following statement, which compares the average for the several districts with the fall during these months of 1875 :—

Rainfall, May to October 1874.

	RAINFALL IN SIX MONTHS, MAY TO OCTOBER.	
	Average of four years previous.	1874-75.
	Inches.	Inches.
Ganjam	39.02	41.90
Nizamabad	36.37	37.08
Kistna	23.52	32.60
Nellore	23.63	35.22
Chingleput	27.58	51.00
North Arcot	28.06	51.22
South Arcot	37.35	39.32
Bellary	21.13	33.09
Chidambaram	21.69	49.17
Kannur	23.96	48.59
Madras	28.09	38.34
Tambraparni	7.15	7.32

It is not at all probable that any arrangements which can be made will certainly and at all times prevent us from extraordinary floods. The histories of the Po, the Rhone, the Loire, and the Garonne and other rivers in Europe show how difficult it is to deal effectively with and control the drainage of a country, but much may be done to ameliorate matters, and as no branch of engineering are successful operations more

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immediately and largely productive of good than in that connected with the improvement of rivers.

35. The propositions made by the District Engineers in this direction involve General propositions of District Engineers for the construction of embankments or the extension of those already existing on the the improvement of rivers. courses of the Kistna, the Pennair, the Cheyair, the Palar, the Pooniar, and the Tambrapurni, and the provision of sluices to the heads of the channels taking off from these rivers for purposes of irrigation. The details of such embankments will depend, as will their successful application, on a careful study of the *regime* of the several rivers, their surface levels during flood at all points, and the effect of the proposed embankments themselves in increasing the flood level, a knowledge of the flood discharges is therefore necessary, and, considering the complications introduced by the bursting of embankments and the consequent expansion of the waterspread during the most critical period, it is by no means easy of attainment. The work to be done is extensive, and very careful adaptation of the means to the end is necessary in each case.

36. The improvement of the existing irrigation works. The provision of sluices Nature of improvements generally required to and escapes to tanks and of similar work irrigation works. to channels with the object of enabling them to pass the surplus drainage of the country has also been suggested, and works are being carried out while estimates for others are in course of preparation.

(Signed) JOHN MULLINS, Lieut.-Colonel, R.E.,

20th September 1875.

Chief Engineer for Irrigation.

APPENDIX A.

From Major H. SMALLEY, R.E., Officiating District Engineer, Ganjam, to Lieutenant-Colonel J. MULLINS, R.E., Chief Engineer for Irrigation, dated Camp at Bagada, 11th February 1876, No. 14.

With reference to G.O., dated 4th December 1874, No. 3,411-A,* I have the honor to report on the damages done to Irrigation Works in this district by the late heavy rains during October and November last, as follows, viz :—

	Estimated Cost of emergent Repairs.	Conjectured Cost for putting the Work into thorough order.
BHUVANESWAR TALUK.		
<i>River Embankments.</i>		
Bagada river embankment breached in three places, at Bellupada, Badupore and Loddapatty.	556	Rs. 10,000 for embanking the whole length in Government limits, partly new work, partly repairs.
<i>Channels.</i>		
1. Family branch of Jeyamangalam channel breached.	200	Rs. 3,000 for new sluices, extending weir, repairs to head sluice and tank.
2. Regulating sluice of Koracholy Tampara destroyed.	300	
3. Koracholy Tampara sluice foundations, undermined.	200	

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	Estimate Cost of emergent Repairs.	Conjecture Cost for putting the Work into thorough order.
<i>Tanks, breached.</i>		
1. Kodasinga Mansinghaya and Ambaghai...	176	Rs. 500 for weirs and sluices.
2. Bodabandho, Ramasageram, Goyye, Ghayi of Unpoova.	390	" 1,000 for do. do.
3. Deepaleghayi and Voora Cheroovoo of Karupadu.	82	" 500 for weirs, sluices, and repairs.
4. Bodabandho Hoz of Bandha and Bodabandho.	93	" 750 for head sluice, escape sluices, and repairs.
5. Rajaghai of Kodagoram.	43	" 200.
6. Jamboreo Cheroovoo of Manugapooram.	38	" 200.
7. Rajah Cheroovoo of Belligada.	33	" 200.
8. Hozo Tank of Lant.	102	" 1,000 for weir and sluices.
9. Hatha Nalla of Metherayi.	72	" 200.
10. Korta Cheroovoo and Channoy of Bendaha.	254	" 10,000 for repairs of Jayamungalam channel and river embankments.
11. Masaghai of Kovada.	21	
12. Raraghai of Deppenovpala.	77	Rs. 2,000 for repairing banks of whole stream in Government limits.
13. Pulmapooram gadda of Thalasagam.	123	
14. Durmapooram Godinghay.	60	Rs. 500 for weir, sluices, and repairs.
15. Ganga Sagaram and Hetta Sagaram of Bagala.	210	" 500.
16. Sanbandho of Soppaladara.	44	" 200.
17. Enah Sagaram of Nimmagali.	48	" 200.
18. Andansagaram of Bantala and Voomutia Bantala.	262	" 500.
19. Kuncheri Kora Kuncheswaraghai.	200	" 1,000 for improving weir and repairs.
20. Benaghai and Bavingham of Luchapada.		" 1,000 for weir and sluices.
21. Balikya, Tampala, and Mandota Cheroovoo of Buhligani.		" 1,000.
22. Boram, Bodapandho and Jambagandy-bandho.		" 500.
23. Kancheri Jalandaraghai.		" 300.
24. Tank of Bangulady.		" 300.
25. Tank of Balagadilly.		" 300.
26. Tank of Bagachery.		" 300.
27. Three tanks of Kulta.	500	" 1,000 for weir head sluice and repairs.
28. Bodabandho of Eka Cheroovoo.	180	" 200 for lowering weir and repairs.
<i>Canals, Tanks.</i>		
<i>Canals.</i>		
1. Nagarathuram channel and head breached.		Rs. 500 for revetments.
2. Norey canal and its branch dam, breached.		" 500 for head sluice and repairs.
3. Erye channel head sluice damaged.		" 600 for revetments.
<i>Aqueducts.</i>		
1. Luchapooram channel of Nagarathuram aqueduct, injured.		" 1,000 for rebuilding aqueduct.
2. Sagarangadla do.		" 200.

Estimates based on
one detail and the
other being done in
emergency.

Estimates based on
one detail and the
other being done in
emergency.

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	Estimate Cost of emergent Repairs.	Conjecture Cost for putting the Work into thorough order.
<i>Bridges.</i>		
1. Bridge of Kaliveram Dusi channel, injured.		Rs. 100.
2. Wooden bridge of Vunangy.		" 100.
3. Do. do. of Nelliparti Dusi channel.		" 100.
4. Turkapeta bridge, Dusi channel, head railings, fell down.		" 50.
<i>Tanks.</i>		
1. Ragoloo Cheroovoo of Borigavalsa, breached.		" 250.
2. Gangulavany Cheroovoo at Kaliveram, breached.		" 500.
3. Dasy Pedda Cheroovoo, breached.		" 500.
4. Tooloogu Mustakan Cheroovoo, breached.		" 250.
5. Tuticlam at Audavaram, breached.		" 250.
6. Ninda Cheroovoo of Chennapore, breached.		" 250.
7. Makivalsa Calingulah, damaged.		" 200.
8. Syrgam do.		" 200.
<i>KIMEDY ESTATE.</i>		
<i>Channel.</i>		
1. Butsiripooram Anicut channel, breached.	167	" 10,000 for completing project.
<i>Hill Streams.</i>		
1. Navagam Munipadigodda head sluice, damaged.	167	" 500 for revetments.
2. Calivagedda Calingulah damaged and breached at Jaepore.	134	" 500.
<i>Tanks, breached.</i>		
1. Kimedy Seetasagaram tank.	38	" 1,000 for improvements.
2. Theeroopoo Neelacantapatrany tank.	213	" 500.
3. Mahasingi Rajoo tank.	106	" 250.
4. Lathara Nalla tank.	208	" 500.
5. Tombore Sunnapaghayi tank.	176	" 500.
6. Saravacota Rungasagaram.	115	" 2,000 for subsidiary works.
7. Saravacota Gajapatisagaram tank.	44	" 200.
8. Varanasy Godalavany tank.	73	" 200.
9. Balada and Matala Cavulageddo.	148	" 400.
10. Sarvakota Godandapanasa Voora tank.	44	" 200.

Estimates not received from the Range Officer, but the work being carried out on emergency.

2. The damage done to the Irrigation Works in this district by the last rains has not been so great as in last year, the rain having fallen during a longer period. The damages done have been chiefly to works near the coast. The river freshes in the north of the district were not severe, but in the south they were higher than known within recollection. The rainfall on the coast was higher in the northern than in the southern portion of the district. A very small percentage of the tanks is provided with masonry works of any kind; very few have both sluices and escapes or head sluices. River embankments generally have been much neglected hitherto. The river channels that have head sluices are altogether deficient in subsidiary arrangements, and are quite out of regimen. The hill stream channels are in the same condition.

3. There are about 3,000 Irrigation Works in the Irrigation register, exclusive of Kimedy, and to supply all these with regulating works would take an immense time, besides which many of them are not worth keeping up. The only thing to be done seems to provide rough, but strong, escapes, sluices, &c., as cheaply and quickly as possible to the more important works beginning inland and working towards the east.

APPENDIX B.

From Major J. O. HASBUD, R.E., Superintending Engineer, 1st Division, Kistna, to
Lieutenant-Colonel J. MULLENS, R.E., Chief Engineer for Irrigation, dated
Masulipatan, 11th January 1875, No. 136.

With reference to G. O. No. 3,411-A, dated 4th December 1874, I have the honor to report
on the floods of September 1874, as follows:—

The flood occurred from the 26th to 29th September 1874 at a time of the year when the
river is generally low and the freshes of the
south-west monsoon are supposed to be over;
the registers of former years show that there is usually a lull between the south-west and north-
east monsoons, and during this interval the
river is liable to fall so low that there is a
difficulty in taking off a sufficient supply for irrigation, the last few years, however, have been
exceptions to this rule.

2. On the 23rd night the river stood at a little over 6 feet on the crown of the anicut, the
water rose steadily all the 24th, and on the
evening of that day was 14 feet 9 inches above
the anicut; on the 25th morning it was 13 feet 11 inches. Evening 13 feet, 26th morning 13 feet
8 inches. Evening 19 feet 5 inches the maximum
registered; it remained at about this height for
a considerable time, the registers showing 19 feet 2 inches. On 27th evening and all the 28th the
same height; on the 29th morning it had fallen to 13 feet 10 inches, and by evening to 17 feet
8 inches. 30th morning to 15 feet 5 inches, and after that it fell steadily till the 10th October,
when it was below 4 feet on the anicut. The crest
of the anicut is 20 feet above deep bed of river.

3. The season for high freshes is usually in July and August, and the greatest heights
registered since the anicut was built was 17 feet
3 inches above the crest of anicut; this height
was attained in July 1859 and August 1868.
Before the anicut was constructed, however, in July 1853, a very heavy flood occurred which was
registered at 37 feet 9 inches, or 17 feet 9 inches
above the present level of the anicut. I calcu-
late that the level of the water would have been
raised very little more than 3 inches by the construction of the anicut, or that the flood of 1853
was equivalent to a flood of 18 feet 6 inches above
the anicut. The flood of 1874 was, therefore,
14 inches above the highest flood previously recorded.

4. The damage done to the head works was very trifling, though the water rose about
6 inches above the roadway of the bridge over
the head sluices to the Eastern Delta and
the workshop yard was partly
submerged and water entered the District Engineer's Office. To guard against danger from high
floods in future, I think the head sluices and
upper walls of locks should be raised 2 feet,
which would give a margin of about 1 foot 6 inches above highest flood level, and allow for even a
heightened than 23 feet on the other, as the parapet walls are very massive and would withstand,
so they did the flood's considerable pressure. The probable cost of this raising the head works of
both deltas would be Rupees 2,000, and may be
included in the estimates for fitting the head
sluices with screw gearing.

5. The danger to the head works consisted in the heavy pressure from difference of level
above and below the sluices, and the tremendous velocity with which water was passing through
some of the sluices. To relieve the pressure, I raised the water in the main canal, Eastern Delta,

Silt in Main Canal.
Cost of clearing, Rupees 10,000.

as high as I could safely, and thereby took in a
vast amount of silt which was principally
deposited in the main canal, and which will

cost Rupees 10,000 at least to remove; the main canal having been widened to nearly full width,
while the channels below are still of insufficient width, the deposit of silt was unavoidable. In
the Western Delta, where the main canal is not so wide, the silt was carried on and has not caused
an unusual deposit. To equalize the rush of water on the rear floor of sluices, I endeavored to
raise the shutters of all vents slightly; but, as there is at present no proper lifting gear, the shutter
became unmanageable under a head of about 14 feet, and the rush in rear of some of the vents
was very great. I do not think any damage has been done to the doors, but until the water is
let out of the canals I cannot be certain on this point.

6. The leakage through the joints of the masonry of head works was considerable in places,
but no stones were displaced; the leakage through the bank between river and canal which
extended more or less for 4 miles was more serious, but did not increase in proportion to the
height; in fact, after the first day of the high flood, it seemed to me that the leaks were puddling
themselves, and I was not apprehensive of the bank giving way. It is, however, I think desirable
that a puddle wall should be constructed near the
front face of the bank for 1,000 yards below the
head sluices.

7. The damage done to Irrigation Works will be described separately for each delta, and
the injuries to each delta to channels and to river embankments also separately referred to. The
cause of all the damage was the suppling of the
river embankments, and the effect was felt
principally in the upper portions of the delta near the points where the river embankments first
branched.

These points were a little above Walloor in the Eastern Delta, and nearly opposite in the
Western Delta, the country here being nearly
30 feet above H. W. mark, the surface of the
water had an immense fall, and the flood swept over great portions of the delta; below this the head
of water being less, the breaches were less extensive until near the sea in the Old Island where the
water was nearly level, and the banks were probably injured more by the wash than anything else.

8. Above the anicut the river is embanked only on the east side from Bezeral to the
Condapalli hills near Elurampatam, a distance of
9 miles; this embankment was not breached
fortunately, and its preservation is due to the
exertions made by the villagers, who were
washed out from their houses inside the bank and were encamped outside; all that I could do was
to send up Gymnasts and Muzums, leaving to the villagers to find the labor, which they did, as, had
the bank given away, they would have been in a very dangerous position. The water rose to the
top of the bank, and was kept in by placing nets on the low parts; had the bank given way, the
Older canal must have been breached and a great part of the country towards the Ocean flooded.

On the west side of the river there is no embankment, and here the water spread to within a
few miles of Chittoor swamping several villages.
To protect these villages in very high floods it
would be necessary to raise an embankment for
probably about 20 miles, but I am not certain that the work would be appreciated even by the
villagers who suffered this time, as any moderate flood would do them no harm and measure the
lands which are cultivated exclusively with dry crops.

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Eastern Delta.—The Irrigation Works in the Eastern Delta that have suffered most are the Masulipatam canal and West Side channel. The water after bursting the river embankment near Walloor, topped the west bank of canal and ran below Kaniapadi to below Walloor, and cut some very deep breaches through west bank of the canal also breached about 2 miles above Veeranki lock. The water which first breaches flooded the country up to the Pullaroor filled and breached tank, and filled up the large hollow on the east of the canal near Inampadi, through the canal to Inammudi, Oratoor, and Kaniapadi on its way back towards the river, the lower part of the Sullapali Zemindari. Some of these breaches were 30 feet or more over the flood submitted, and extended through both the canal and tanks. Lower down the canal the water again breached into canal and out again, and over the Sullapagaram aqueduct side walls, but the damage done below was not of the water inside and outside the canal being much the same. It is estimated that the repairs to these works will cost Rupees 20,000. Several of the tanks in District have also the water and spread over the whole country, and the necessary repairs to these breaches also to the minor channels into which the water found its way are

Western Delta.—In the Western Delta the bank channel, the Nizampatam canal, and the lakemly channel suffered severely, the heaviest breaches being those first made in the lakemly nearly opposite Walloor. In the first 20 miles of this channel there were some of them of great width and depth. Below this, though the breaches were very bad at intervals. The river water backed up the bank channel opened at Kaniapadi, and flowed down the Nizampatam canal, but there damage was done by water coming into the Commamere channel and the Jagerlamoodly escape channels. At Kaniapadi, the river bank being carried away, the water ran directly through and flooded the country up to the Nizampatam canal, then breached into lakemly places between Inampadi and Nizampatam and found its way into the lakemly. The breaches were all ring barbed with stones quickly as possible, and many of the lakemly are dry, so no earth is practicable. Asimate estimates have not therefore been yet made, but the repair of first 3 miles of bank channel has been estimated at Rupees 13,450, and the total repairs will probably cost Rupees 30,000.

River embankment, Western Delta. breached in several places after having been topped in two places by the water, and in other places it seems to be beyond doubt that it was carried away by the villagers who were living on the river banks, and was thought that by allowing the water to spread the depth about their villages would decrease. The principal breaches are at Walloor where the water first entered the Delta near Kaniapadi, Erodi, and at Erodi which has lately been raised, and the wash also greatly, the slopes being cut away in places. It is estimated that it will cost Rupees 20,000 to put the river bank in order.

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12. The river embankment, Western Delta, breached in some places about Vallabhapuram, where the bank canal joins it, and from this point the description of bank canal applies to it over and above what it will cost to close the breaches for the purpose of re-opening the canal to full supply, the cost of making up the river bank will probably amount to Rupees 10,000.

13. To repair the damage done to channels in both Deltas will, therefore, cost Rupees 50,000, and to restore the river embankment Rupees 30,000, besides which clearing the silt brought in will cost about Rupees 10,000.

Repairs to channels of both deltas—			
	...	...	Rs.
Silt cost	...	...	50,000
River banks	...	...	30,000
Silt	...	...	10,000
<hr/>			

Measures to prevent future damage.

River embankments raised 3 feet above level taken in comparison of last year.

Bank above flow water raised 3 feet, also bank raised over

the island of Diery; these last should be carefully maintained, as if the river water is confined within banks above Diery, the surface in a heavy flood will be so high that, in case a breach occurred, the top of the river embankment would be the only dry land in the whole island. The cost of making up the embankments may be estimated at Rupees 1,00,000.

15. The earth required for making up the embankments will be chiefly provided from the excavation and widening of the bank channel. The estimates for which will, it is hoped, soon be sanctioned, the river embankment can be more carefully maintained as the canal bank than when separate, and when the canal in the Eastern Delta is commenced, the bank will be taken over from the Zemindars who have hitherto claimed it.

16. The most dangerous places on the embankments are at or near villages where the bank gets worn down by people and cattle encroaching, and these are worst where the villages are situated within the river embankment, the villagers not being interested in keeping up the bank, and as mentioned above in some cases actually cutting the bank with the object of reducing the flood. The Revenue authorities are endeavoring to persuade the villagers inside the bank to move to the outside by giving land for buildings, and I hope that in time all villages will be protected by the bank, and the people will then be interested in preventing breaches.

APPENDIX C

Description of the great flood in the Pannar in October 1874, and the damages caused by it within the limits of the Madras District.

The Pannar flows the district of the Sengamuram taluk, which is 62 miles from the sea, and descends a well-defined valley until the western extremity of the northern delta is reached at Sengamur, a village 32 miles east of the Sengamuram taluk. From this village the continuation of the country on the left bank of the Pannar is decidedly fertile and therefore, subject to severe inundations during high floods in the river. This remark does not, however, apply to the right bank of the Pannar for several miles east of Sengamur as the country in those parts, so far as I have seen, like that on both banks of the Pannar west of Sengamur, does

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19. On the Cuddapah road east of Sangam, one masonry culvert was destroyed, and one wing of the Vazone channel bridge collapsed from the effects of the flood.

20. West of Sangam, on the left bank of the Pennair, the flood swept across the 22nd, 23rd, 24th and 25th miles of the Cuddapah road. The stock of road metal on the 22nd and 23rd miles was carried away, and within the limits of the 24th and 25th miles the road breached in several places.

21. On the right bank of the Pennair a few tanks and river channels breached between the Somaishwaram gorges and the head of the Southern Delta at Narsimmoondah. In this section the 46th, 47th and 48th miles of the road from Nellore to the Somaishwaram gorges were partly washed away, and a deal of land on the margin of the Pennair was lost by erosion and amalgamated with that river.

22. From the accompanying statements it will be observed that Rupees 3,09,910* will probably be required to repair the damages done, and that a further expenditure of Rupees 2,89,000 will be necessary to preserve the valley of the Pennair from inundation during a similar or somewhat greater flood than that of October last. The proposed outlay is no doubt considerable, but it is small in comparison with the public and private interests at stake and the general welfare of the people in the Northern and Southern Deltas of the Pennair.

Nellore,
26th March 1876.

(Signed) R. SMITH,
District Engineer, Nellore.

APPENDIX D.

From Captain J. PENNYQUICK, R.E., District Engineer, North Arcot, to Lieutenant-Colonel J. MOLLAINE, R.E., Chief Engineer for Irrigation, dated Vellore, 23rd January 1875, No. 3,928.

In accordance with your memorandum, No. 1,033, of 12th ultimo, I have the honor to report as follows regarding the damage done by the floods of October last, and the probable cost of repairing the works injured, so far as can be at present ascertained:—

1. Of individual Irrigation Works damaged the most important are—

1. The anicut across the Palar near Arcot.
2. Do. do. the Poiney river.
3. Do. do. the Cheyaur.
4. The Poondy large tank near Wallajahpet.
5. The Poondy tank on the road from Wandewash to Trivatore.

6. The anicut was 2,000 feet in length, and of this nearly half or 1,200 feet have been washed away. The anicut gave way first near the middle of its length, apparently owing to the destruction of a portion of the first apron, leaving the rear of the body wall without support. Through the breach this caused an extraordinary lateral scour took place, and the front of the body wall was undermined. The wall has since fallen upstream except for a short length near the middle of the breach. The flood rose to a level 9 inches above the previously recorded maximum (that of Aug. 1872), and would doubtless have risen higher still but for the anicuts having given way. The cost of repairing this work cannot be accurately estimated as yet, as it will depend to a great extent on the quantity of material, especially cut-stone, which may be required. It is believed that Rupees 1,40,000 is as near an approximation as can be made at present. The revenue under the anicut is stated by the Collector to be Rupees 1,59,643.

7. The destruction here has been more complete even than in the case of the Palar anicut, the anicut having been completely carried away from end to end, nothing being left but the under sluices on each flank. It is difficult to understand why this anicut should have given way,

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as the water did not rise to within a foot of the level of the flood of May 1872. It is certain that there was nothing wrong with the apron, and I have sought in vain for any satisfactory explanation of the damage.

As nearly as can be judged at present, the cost of restoration will be about Rupees 60,000; the revenue under the anicut is Rupees 72,000.

8. The damage in this case has been comparatively slight, the road embankment leading up to the anicut having given way before the floods attained their full height, which, however, was 3 feet above the previously recorded maximum. The channel has been damaged in several places; the cost of repair is estimated at about Rupees 6,000.

9. This tank breached by the overflow of the Palar, bringing an entirely abnormal quantity of water into it; it was in good order, and its escapes are ample under ordinary conditions.

The water from the tank breached two smaller tanks lower down, as well as the Cauveripauk and Mahindravady ancient channels. The tank has already been repaired and is now almost full, and measures will be taken to prevent a repetition of any disaster of this kind by a proper embankment to the river above the anicut. It may be mentioned here that this is only one out of numerous instances of damage to both public and private property from the overflow of the Palar and Cheyaur rivers, and that the proper embankment of these rivers is a matter of the highest importance. The estimate for the repair of the Poondy tank itself is Rupees 3,450, and the repair of the damage done to the works below it will cost about Rupees 7,000.

10. This tank the largest in the Wandewash taluk is the terminal tank of the Cheyaur main channel. It was not actually breached, owing to the road from Trivatore to Wandewash running along the bund which was therefore of unusual width and metalled on the top. The bund was, however, topped nearly from end to end, and reduced to a perilously small thickness in many places. The cost of repair is estimated by the Range Officer at Rupees 7,000, but no detailed estimate has yet been made.

11. Of minor works, the total number injured is about 120, the largest number being, as usual, in the Wandewash taluk, where sixty tanks have been more or less injured; these works are, however, of but small importance, and in most cases the injuries are not very great. It is believed that Rupees 25,000 will cover the cost of repairs to these works.

12. The total extent of damage done to Irrigation Works may be summed up as follows:—

	Rs.
Palar anicut	1,20,000
Poiney do.	61,000
Cheyaur do.	6,000
Poondy tank	11,000
Poondy do.	7,000
Minor works	25,000
Total	2,09,000

13. It is not quite clear whether this report is intended to include works other than these of irrigation, but it will probably be expedient that it should do so. The communications have suffered very severely in almost all parts of the district, excepting the Vellore and Arcot taluks, the most important work injured being the bridge over the Palar near Vellore.

14. This bridge originally consisted of forty-two arches of 45 feet span, of which sixteen have fallen, and two more are so injured that they will have to come down. In addition to the reconstruction of the fallen arches, it will be necessary to construct protective works similar to those under construction for the Railway bridges in the district, as the foundations of this bridge pier are so manifestly insufficient that without some additional protection the disaster is sure to recur. As yet it has not been found practicable to make a complete estimate of the cost of restoring the bridge, but I believe that Rupees 125,000 will be very near the truth.

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12. The bridge over the Gorattam river on the road from Palmanair to Bangalore has been damaged in a very remarkable manner, the flood having risen to a height of 14 feet above the roadway, and completely carried away everything on one half of the bridge, except the buttresses and piers, leaving a breach at 150 feet in length in the approach embankment. I have since visited the site, and it certainly appears almost incredible that the bridge should have stood, as it has done, without a crack in any arch or pier. The cost of repair is estimated at Rupees 2,400.

13. With the exception of the two works abovementioned, the roads which have suffered most have been those near the Cheyam in the Wandewash taluk and those between Arcot, Raniyett and the Palar rivers; these have all been greatly injured by the overflow of the Palar and Cheyam rivers. Estimates have already been received for nearly all the repairs necessary to roads, great promptitude having been shown (especially in the Wallajah and Polur Ranges) in the preparation and submission of estimates.

14. Making allowance for a few estimates still to be received, it is believed that the total cost of repairing damages to communications will be nearly as follows:—

	Rs.
Palar bridge	125,000
Minor works in Wallajah Range	6,000
Chittoor Range	5,000
Wallajah do.	1,000
Polur do.	9,000
Total	1,46,000

15. In addition to the public works of the district, the Irrigation Works of the great Zamindaries, which occupy more than half its area are known to have suffered severely. I have asked the Collector to communicate to me any information he may receive from the different Zamindars, but at present we know very little about works of this class. It is known, however, that the utterly unimproved state of the Gorattam river, which injured the road and Railway bridge, was caused in great measure by the breaching of tanks in the Poonganoor Zamindari.

APPENDIX E

From J. W. RUNDALL, Esq., District Engineer, Tinnevely, to Lieutenant-Colonel J. BULLOCK, Esq., Chief Engineer for Irrigation, dated Nallamall, 6th March 1875, No. 187.

I have the honor to acknowledge your memorandum, No. 1,032, of the 11th December 1874, to report further on the floods of November last in this district, especially with regard to the measures necessary to prevent recurrence, under similar circumstances, of the damage to works which then occurred.

My letter No. 142 of the 10th November 1874 contains a history of the damage done, and I have nothing to add to that except to state here, for the future of this Yerca Syphon sluice reported as broken, that this is incorrect; but that the number of small tanks in the Nanganam and Nanganam taluqs, of the Palar and Cheyam rivers, which were breached was considerably more than I had originally supposed, and that the cost of repairing injured works, especially as regards the Palar bridge, has been estimated by me.

All the measures now under the immediate necessity to prevent future accidents, according to the views of the Public Works Department, are mentioned in my previous letter.

A. KODAGAN CHANNEL.—The damage to this channel was comparatively small. The head sluice will be completed in two months, and then the chance of flood damage will be lessened. One weir exists between the Kotam river passing through this channel just below the large town of Chittabandur. The present escape (called Anjanathagan) consists of a long weir furnished with 12 vents, with some of channel bed level. The length of the weir crest (which

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is unprovided with dam stones) is 283 feet, part of it is above full supply level. The vents are not of equal size, but aggregate 644 feet in length. Two of the vents only which are of modern construction are provided with shutters; the others are closed with boughs and turf. All are stated to have been opened the day the heavy rain commenced. Repairs are required to the old vents, the eastern wing requires raising, and a wing wall should be built at the western end. As after every flood there is a considerable deposit of sand in the channel just below this weir, it would be advisable to put two powerful sluices a little further down the channel where there is a suitable site. The Cannadian channel below the Anjanathagan receives the drainage of about 30 square miles which enters at various points, but the surplusage works are generally sufficient.

B. KODAGAN CHANNEL.—The flood at the Aryamagapuram anicut was 3.35 feet higher than from information derived from the Channel Monitors we had assumed the maximum

Paragraph 7.

flood to be when sending in the design for the head sluice. An extra flood bank on the left of the channel is therefore necessary, and will be included in a revised estimate for the head sluice. The right bank of the channel also requires raising for some distance below the head sluice. The first old surplusage work in this channel is topped during high floods, and should be built up to river flood level. The next escape is at Milakallur; this is supposed to pass the water from the Olet on which the new tank sanctioned in G. O., No. 3,124, dated 11th November 1874, is to be formed; but, as breaches are of constant occurrence, it is evident that the escape has not at present sufficient surplusage power. It now consists of three vents each 5 feet by 5 feet; four extra vents can be added each 5 feet by 5 feet, and, as the available head will be about 2½ feet, this will probably suffice.

6. The next escape is at 6 ¾ miles, and discharges into the river below the Pailavur anicut. This is a long wall on different levels; it should be improved by cutting down the higher parts to full supply level and raising the lower portions to the same.

7. Beyond this work any surplus from the Kodagan channel has to pass through the Tinnevely channel also.

8. The Karisolkulam surplus enters the channel immediately to the north of Pettah at 12½ miles. The proposed arrangements for dealing with this drainage will hereafter be described.

9. The Kodagan channel from its 11th mile up to the Chutrum Pathukulam tank into which it finally enters has a rocky bed with a very small fall. The bed fall cannot be altered, but the banks require raising to 9 feet above bed level.

10. PACHIEM CHANNEL.—Here also the information as to previous flood level was inaccurate, and the flood bank will have to be

Paragraphs 8 and 9.

carried up much further than was provided in the original estimate, as well as raised much higher. The river when in flood tops the first surplusage work on this channel, which must therefore be built up or removed. The next two escapes require but little alteration, as not much drainage enters the channel till the Pachiam is reached.

11. The Pachiam drains about 110 square miles. Allowing, as directed in paragraph 8 of your inspection notes, for 2 feet going over the escape and for fifteen under sluices 6 feet by 4 feet, the length of weir crest required to discharge the probable flood would be 1,032 feet. It will be difficult to arrange for this length. I would, therefore, suggest 2½ feet over the escape, being allowed, where 7½ length of weir crest will suffice. Detailed plans and estimates will be prepared and submitted for your approval.

12. Below the Pachiam, the breaches in this channel were innumerable, and with the Pachiam floods disposed of and Tambacorum floods excluded the existing escapes will doubtless be found sufficient.

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13. **TINNEVELLY CHANNEL.**—The river rose to within 1 foot of the top of the bank in several places in the first 3 miles of this channel, and raising it therefore required. The crest of the first escape is below river flood level; this work can be removed after the construction of the proposed head sluice. The second escape weir requires partial reconstruction and alteration. The third surplus work (Shanthimathur) requires an extra vent and alteration of crest. The surplus from the Sathiamalai tank (supplied by Kodagan channel) enters a little above this work and causes frequent breaches. This escape is built on rock and the extra vent can easily be put in.

14. The other extra surplus works required on this channel are in connection with the diversion of the Karachalam Offa floods. An Overseer is now engaged in taking levels for this scheme and, as soon as possible, the details will be worked out and submitted for orders. Until the levels have been completed, I am unable to state what would be the most feasible and economical arrangement. Under any circumstances the scheme will be costly, and it will involve the construction of bridges over Roads Nos. XII., VII., and XXIII., and the reconstruction of the Chattram Putnakulam calingulah.

15. **MARDUR KILAKAL.**—The surplus escapes on this channel can remain as they are. The Thiragudi calingulah is sufficient to pass the discharge of the 80 square miles which drain into the channel at this point, when once the Ponnagudi series of tanks have been put into proper order and provided with efficient escapes. If the present Niraucken establishment employed under the Revenue Department were efficient, extra hands would not be required to work the tanks in the calingulah (paragraph 4 of your note printed with G. O. of the 29th January 1875). The question of detachments for the channel is one on which I propose to address you separately.

16. A rather considerable flood drainage about 30 square miles enters this channel just above the Vellur tank. This and the Tanker tank are almost one, being separated only by a low calingulah, and it is very desirable that as much as possible of the flood water entering the channel should be passed on into the river by the present western calingulah of the Vellur tank, and prevented from passing on into the Ponnagudi tank, from which the only line for surplus is through the Kodagan tank, and so through the long convoluted irrigation under the latter tank. The Tanker tank surplus enters the Kodagan tank south of the Kodagan head sluice, and does not pass over the calingulah alongside of the works as stated in paragraph 20 of your inspection notes. The Niraucken establishment passes over the calingulah.

17. The Vellur western calingulah has at present 17 feet effective length, and this work should be strengthened to last with a head of 10 feet at full tank level. There is a second effective length about 10 feet which should be strengthened, the Vellur and Tanker tanks which requires considerable repair. The water from these tanks enters the Sreevignanam south channel. At the junction which may be well served with a crest at 4 inches above full supply. It would thus pass over the tank and escape directly. An additional area of 20 square miles drains direct into the Vellur tank. It is not a great distance past the Kodagan, but if the larger surplus entering from the Vellur could be passed on into the river direct the smaller quantity from this area may be passed through the Kodagan and the surplus channel without danger. The banks of the Vellur tank require to be raised to allow 3 feet to pass over its western embankment with safety. Levels have been taken, and estimates for this are under preparation.

18. The bridge over the Ponnagudi and Aramugamungalam (Vellur western) escape channels on Road No. XII. will require reconstruction to considerable additional waterway. The Ponnagudi eastern channel will have to be reconstructed on both sides and connected with the river at Kodagan. A large work of this nature from Ponnagudi westwards will require to be taken over the river, and has been taken over and estimates are under preparation.

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19. **MARDUR KILAKAL.**—The river banks will probably have to be carried up from Sreevignanam to the west of Sivalapert. The levels for these banks have been taken and the details are being worked out.

20. The drainage entering the Mardur Kilakal near its head comes principally from the Kalavur tank into which about 8 square miles drain. The calingulah of this tank requires lengthening.

21. The Manalvari or sand sluice in the Kilakal at 2½ miles from the head requires to have its wings rebuilt and raised.

22. I find that it will not be practicable to make use of the ruined calingulah (referred to in paragraph 22 of my letter) as a surplus work. The river floods at this point rise to 6 feet or 7 feet above channel full supply level. The land drainage must therefore be carried on down the channel to the next escape at 4½ miles. This work will have to be considerably increased in size, and the details will be worked out. The next escape at Manakret probably requires to be increased, as a considerable amount of land drainage enters the channel immediately above it from off the range of hills east of Valanad.

23. When the river floods are excluded from the channel by a sufficient embankment west of the head sluice, the channel can carry 300,000 cubic yards per hour of land drainage up to the escape at 4½ miles, as the right bank is both high and strong. It was the river flood from above the head sluice which was the principal cause of the breaches.

24. The Sreevignanam Periakulam has an ample calingulah, as also have the Perur and Shovelly tanks. The Perungulam (last of the series) is provided with sluices capable of discharging about 100,000 cubic yards per hour (750 cubic feet per second) at full tank level, but it is desirable, I think, to provide for extra surplus power here, as there was a breach (though a small one) in the tank in 1869, which, however, might have been more serious had not the Sreevignanam Periakulam and Perur tanks breached in many places. It would be advisable to add an escape weir 100 feet long at 1 foot below full tank level. In this case the banks of the surplus channel will require raising for about 1½ miles above the point where the surplus joins the Sreevignanam north channel.

25. The bridge and calingulah will require altering and should have five instead of three spans of 4 feet. This and the Aramugamungalam dam 2½ miles farther on will be able to discharge at least 1,000 cubic feet per second, and the Aramugamungalam tank calingulah over 300 feet in length can discharge this quantity without endangering the tank. The surplus then passes through an old channel of considerable size into a salt creek south of Pulayakaval village.

26. **SREEVIGNANAM NORTH CHANNEL.**—The reconstruction of the siphon sluice at Yendi and the alteration of the bridge and calingulah are the only works required in this channel.

Memorandum, No. 101, of the 11th February 1875. Your orders to give the former a waterway of 100 square feet will be carried out. The bridge and calingulah alterations have been referred to them; the masonry apron and water wings for this work will, as directed in paragraph 38 of your inspection notes, be estimated for.

27. **SREEVIGNANAM SOUTH CHANNEL.**—The floods did not show that any extra works are required in this channel and its tanks. The improvement of the Kodagan bank and calingulah, as directed in paragraph 20 of your inspection notes, will receive attention.

28. On the north side of the river the embankment will have to be commenced from the west of Sivalapert village and carried on continuously to the Mardur Kilakal sluice. From this to Mardur the Kilakal bank should, if possible, be utilized as the river bank. The objections to this are, first, that a few villages would be to some extent swamped, but this has always been so; secondly, that about 1 mile of the Ponnagudi road will be swamped at every high flood. I am just going over the ground, and as there is a bank along the river

...shall be able to settle the matter next week, and will report further.
Streenvigundam there is an existing bank which requires improvement.

Streenvigundam both banks will require raising. The embankments, as carried
...feet above the supposed flood level of 1869. An uniform slope (24
Streenvigundam to the west of Aatur being assumed. These banks were nearly
...flood both at Streenvigundam and Aatur village; but still raising will be
...of water which passed through the breaches above Streenvigundam and
...Tampel and Sertakuvuithan would, had the breaches not occurred,
...level very considerably at and below Aatur and to a less extent at other

...the bank should be made 4 1/2 feet and 6 feet, respectively, above 1874
...and Aatur, and 4 1/2 feet to the west of Streenvigundam. Observa-
...of the flood in various places have been recorded, and from these the bank
...lined. Your instructions on this point are solicited.

...is impossible to put a wall or core of clay in the bank as suggested by you, for
...lined. The best protection seems to be that all additional earth for widening
...be made of the bank.

...the already commenced the removal of pudagay plantations. Unless
...are a labor to effect removal of the trees as was originally bestowed on their
...it is not likely to be as quickly carried out as it should be. The Revenue
...and the planting of these trees, seem backward to destroy their own
...removal of them then should, I think, be insisted on.

...many trees in the bed of the river, and their growth was encouraged

...are also stopped the Government's conservation of sand. Considerable
...have to be spent annually in removing and rearing up growing sand from the
...Rivers. About 5000 per year for the next five years will probably be required
...from Streenvigundam and Aatur.

...statements prepared showing approximately the cost of carrying out the
...work contemplated and also for effecting improvements to the various breached
...is not mentioned in detail. The following shows the approximate amount

	Rs.
Streenvigundam	5,180
Streenvigundam, to the west of Aatur	51,600
Streenvigundam, to the west of Aatur	1,14,100
Streenvigundam, to the west of Aatur	25,500
Streenvigundam, to the west of Aatur	15,500
Streenvigundam, to the west of Aatur	9,040
Total	2,01,220

...the Government of Madras are entered, the sum of Rs. 201,220 has not been

Nos. 591 & 592.

ORDER THEREON, 29th September 1875, No. 2,780.

IRRIGATION, No. 54.

The Government have from time to time had information placed before them which has indicated that the rivers and Irrigation Works of this Presidency were in a state ill adapted to stand the strain arising from heavy rainfall. In even good monsoons of a not unusually severe character there has generally been a long list of damages of a more or less important character. After, however, a series of comparatively dry years, 1872 was the first in which a storm in May and very heavy rain on the setting in of the north-east monsoon showed very clearly that of the vast numbers of tanks on which so much of the cultivation in most districts depends, very many were incapable of holding out under such emergencies; while inundations, which to a great extent are preventable, caused widespread destruction of crops and property, both public and private. District Officers, as a rule, had not then recognized, the radical defects of the Irrigation Works generally, the greater number of which are of native construction, and were adapted by their builders only to seasons moderate in character, while for the most part the effect of connected works upon each other, as in the case of groups of tanks, had been altogether ignored by their constructors. The Irrigation Department took measures, however, for the more intelligent treatment of Irrigation Works generally, and though these could not affect materially the character of the work done in 1872-73, their effect has been already felt wherever the instructions obtained prompt attention. Consequently in 1874 the tanks were in far too many cases, notwithstanding large outlay on repairs during the interval, but little better calculated to be safe under severe strain than before.

2. The essential requirements of Irrigation Works and the conditions of safety having now, however, been recognized, and District Officers having been fully instructed as to their proper treatment, it will be expected and required that in every case damage from preventable causes will in the future be guarded against to the utmost extent possible with the means which Government may be able to place at the disposal of the officers concerned.

3. The urgent need of additional funds, especially for Minor New Works, under which head means of disposing of surplus water must be provided, has after full inquiry and consideration been admitted by Government, and the necessary representations have been made to the Government of India, who have in their letter as

No. 314 A. L. dated 21st Jan 1876.

4. The papers now reviewed show that the mere repair of damage sustained by Irrigation Works from the floods of one year in a few districts will cost upwards of Rs. 2,00,000, and measures are necessary to remedy apparent defects and

per margin called for further information on some points, and this is now being collected.

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in the list, it is known from more recent reports that the fresh of 1875 was a cause of serious and imminent danger to the delta, and that precautionary measures must be taken at the earliest possible moment to avert such a calamity as any general breaching of the flood banks would undoubtedly be.

5. Formerly but little was known of the state and needs of Irrigation Works, and, in the absence of information, but little could be done to introduce improved management, and unfortunately much of the money spent on mere repairs proved useless. Now that attention has been called to the subject; that the direction and extent in which action is required have been generally ascertained; that at least so far as the means of making investigations necessary to the determination of details provision has been made; and that funds both for repairs and improvements equally essential have to some extent already, and will doubtless to a greater extent ere long be made available, it is absolutely necessary to the credit of all concerned that every year should show a marked reformation in the state of the works, and that all the work that may be carried out should be such as will tend to the ultimate complete security of all works which are so circumstanced as to allow of this object being attained. River conservancy, the regulation of the heads of river channels, the repair of and provision of surplus works for tanks, &c., all need steady and continuous attention, and in each and all of these cases the first thing is to ascertain clearly all causes of danger, and then the most effective and most economical way of removing them.

6. The subject of this order being very intimately connected with the grants under Agricultural Ordinary, a copy of these Proceedings will be forwarded to the Government of India in continuation of those of the 17th February last, No. 436.

(True Extract.)

Major-General R.E.
Secretary to Government

To the Chief Engineer for Irrigation,
Public Works Department,
To District Engineers

Edw. C. Stanley

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CHIEF OF BUREAU
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