

Public Works (1894) Department.

RAILWAY BRANCH.

G.O., No. 116-17-R

DATED 26th February

[Despatch Abstract.]

Flood Damages.

The proposals of the Chief Engr. S. J. Ry supported by the Joint Inspector on the — to the S. J. Ry during November 1893 approved with remarks, and the report — ordered to be forwarded to the Govt of India.

Indg the report on flood damages to S. J. Ry during November 1893

BACK PAPERS.

[illegible]

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

26TH FEBRUARY 1894, No. 116 R., PUBLIC WORKS.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read—the following paper:—

Report on flood damages to South Indian Railway during November 1893.

I beg to submit the following observations on certain parts of the line affected by the late floods (November 1893).

Main Line.

On the 23rd November 1893, at 214/6 miles, the approaches to a 30-foot girder bridge close to the river Vennar were scoured into to such an extent as to stop traffic by rail from the 23rd November to the 25th November 1893. At this point the railway runs nearly north and south crossing at right angles the natural drainage of the country on its way eastward

- 214/15 miles.

spans. This river, with probably other channels and tanks, breached its banks above the railway. The flood water of the ensuing inundation was intercepted between the south bank of the Vennar and the railway embankment and ponded into a corner, the outlet from which was the 30-foot

† 214/6 miles.

this bridge; eventually, relief was to some extent afforded by the water breaching through the river bank back into the Vennar.

The approaches were pitched with rough stone and the bridge is floored; the pitching was to a considerable extent washed away and the flooring damaged. The remedy will be, to more heavily and extensively protect the slopes of the railway embankment by rough stone pitching and to repair and strengthen the floor.

Main Line south of Trichinopoly and Erode Branch.

These two portions of the line are taken together, as the same floods crossed and damaged both.

In December 1884 floods occurred here so similar in their action and effects that the following description quoted from the report upon them is applicable to, and explanatory of, the floods in November last.

Main Line south of Trichinopoly.

"The damage to earthwork in the 251st, 252nd and 253rd miles was very great, the breaches aggregating 1,700 lineal feet. The line in these miles crosses the Korayar valley. The river itself is spanned by a bridge of five 30-foot spans on skew (28° 6' on square) at 251 miles 30 chains, and in addition to this there is a flood opening of 4-20 feet spans at 251-70 chains; very heavy local rainfall in the basin drained by this river caused the breaching of numerous tanks to the south of the line. I have a list containing the names of 53 tanks which are said to have gone in the Trichinopoly taluk alone, but a considerable number must have burst in Pudukota territory. About three-quarter of a mile to the south of the railway line, the trunk road to Madura crosses the Korayar by a bridge of five 30-foot skew arches 28 feet on the square. Between this and the line the east side of the river is embanked. Again, river is embanked. The west river bank is open. The road bridge was insufficient to pass the flood water, and the road was topped. The embankment was burst through south of the bridge; the public road was breached, and by this breach flood water got in at the back of the river embankment, and it was this that damaged the line to the east of the Korayar bridge between 250 miles 23 chains and 251 miles 28 chains. To prevent this it will be necessary that the river embankment be strengthened, and I do not recommend any additional waterway in this portion of the railway bank. To the west of the Korayar the stretch of low ground forming the valley of the river is interrupted close to the line by a small isolated rocky hill; by this the flood water from the river is divided, a portion going by the river, the remainder to the 4-20 feet bridge at 251 miles 60 chains. The damage to earthwork was so great and the interruption to traffic so serious extending to fifteen days. I recommend that additional waterway be given to the bridge over the Korayar and to the four 20-foot bridge; to the former an addition of three spans, the latter to be doubled."

Erode Branch west of Trichinopoly.

To continue the quotation from the report of 1884:—

"The line was injured here between the Trichinopoly Fort station E 252 miles and E 254 by the same flood that crossed the line in the 251st, 252nd and 253rd miles main line, but was added to by the flood in the Ariyavur and breaches in the Wiacondan channels.

"The Korayar, after passing the main line, joins the Ariyavur to the south of the Wiacondan channel, and the flood water of both rivers passes over the channel by means of the Puttur weir; from that point they take the name of Kudamurutti which crosses the Erode branch by a bridge of seven 30-foot spans. For the protection of Trichinopoly the east side of the river is embanked. This bank was breached and was the cause of the damage to the line at the Fort station and in its immediate neighbourhood. Between the Fort station and the embankment of the Kudamurutti, there are two bridges—one of two 20-foot girders and another of two 15-foot girders—but

§ In November 1893, the water rose 3 feet above rail level in the Fort station. these were not sufficient and the water rose 18 inches over rail level at the station and topped rails as far as 252 miles 36 chains. To

the west of the Kudamurutti the line was breached from the inability of the Kudamurutti bridge to pass the flood water. The line here follows very closely the Cauvery embankment, in

|| Afterwards rebuilt.

railway bridge, kept back the water to some extent, but the latter also was insufficient and the line was topped at E 253 miles 18 chains where the level of rail is 3 feet lower than at the bridge. The damage to the line

¶ In November 1893 the damage extended to E 254.

between E 253 miles 40 chains and 48 chains. The quantity of water passing over the Puttur weir was 50,000 cubic feet per second. The interruption to traffic on the branch was of no

•• In 1893 duration from 23rd November to 9th December.

long duration, from evening of December 18th to morning of December 23rd when the traffic was resumed. The Public Works Department propose to lower the south embankment of the Cauvery to the west of the road bridge down to level of road for a length of 300 feet. This would suit the Railway Company well, for the additional waterway, I consider should be given, can be provided opposite this outlet into the Cauvery. The discharge from Kudamurutti bridge is about 23,000 cubic feet per second; so that, to pass the water that was discharged over the Puttur weir alone, we should have to more than double the bridge. I propose to run rail level from the west end of the Kudamurutti bridge to opposite the position the Public Works Department propose to cut down the Cauvery bund and then to give a bridge of 300 lineal feet of waterway."

The measures adopted after lengthened consideration of all the circumstances connected with these 1894 floods were—

On the Main Line.

To double the waterway of the Korayar bridge adding 5 to the then existing 5-30 feet girder spans forming the non-existing aggregate of 10-30 feet span, to add 4-25 feet spans to the waterway of the 4-20 feet girder bridge at 251/15.

It was considered that this addition to the waterway under the railway would provide for the maximum discharge of rainfall from the area drained and that, if it should prove unequal to contend with any future bursting of tanks, the remedy would be, to lower the line on to a causeway across which all such abnormal flushes would flow away with but short of any interruption to traffic on the railway.

On the Erode branch the proposals to provide additional waterway was abandoned, on the Public Works Department deciding not to lower the river Cauvery embankment; because, to have given the waterway without lowering the river bank would have established in flood time a dangerous flow of water to the north of, and between, the railway embankment and the Cauvery bund. It was further considered doubtful whether the expense of a bridge of 300 feet long would be justifiable to meet a contingency which might come upon us only once in 15 or 20 years. All things considered, it was decided not to provide additional waterway, the cost of which would be considerable and its efficiency against similar flood damage doubtful.

The floods in November last swept over the railway across the public road and breached through the river bank into the Cauvery sweeping away, in their course, some of the buildings and works of the lately-begun Trichinopoly water-works.

I do not know what measures the Public Works Department intend to adopt in dealing with the river Cauvery at this point. If they carry out the old proposal to lower the bank so as to let the drainage of the country flow unobstructed into the river, our policy will be, to lower the railway on to a causeway and allow high floods to cross in the manner proposed for the 253rd mile of the main line south of the Korayar. The subject will be further reported upon after learning the proposals of the Public Works Department with reference to this locality.

Negapatam Branch.

The breaches and wash-over between miles N 235 and N 237 were caused by the bursting of the bank of one of the large irrigation channels to the north of the railway.

There are three of these channels in this neighbourhood crossed by the railway, viz., the Pamaniar, 5-30 feet girder spans, and the Korayar 5-30 feet girder span both on the 237th mile, and the Vennar 9-30 feet girder span on the 239th mile. The damage done in 1884 was line breached immediately to the west of the Korayar, whereas in November last the breaches were made just west of the Pamaniar. The remedy here would appear to be in the more efficient embanking of the river crossed by the railway which are under the charge of the Public Works Department. The line cannot be lowered on to a causeway in the manner suggested for the breaches south of Trichinopoly, because we are tied to heights sufficient to carry the railway over the large irrigation channels in this neighbourhood, and to provide extra waterway sufficient to carry off such floods as the line is subject to here, the cost would be prohibitory. The proposals of the Public Works Department to deal with the difficulty will be ascertained.

Nellore Branch.

So far as ascertained, the damages here, as elsewhere, were due to breaching tank and channel bunds. At the Venkatagiri and Vendodu breaches the floods crossed the line from east to west, and investigation will be made as to whether the levels of the line and the waterway provided in it are sufficient to meet the maximum drainage of the country, exclusive of floods from breaching tanks.

In the valley between Gudur and Manobolu stations, the floods crossed from west to east and there can be no reasonable doubt that the railway provision of bridges is more than ample to serve the natural drainage of the country. In this valley the embankment stands from 15 to 20 feet high with an aggregate of 3,880 lineal feet of waterway, even the enormous volume of water sent against the railway bank by bursting tanks in November 1893 was nearly accommodated by the railway bridges, for the embankment was nowhere topped by the water and but one clear breach of no great width was made.

* Under 100 feet in width.

I estimate that a body of water not less than 3,880 lineal feet by 12 feet deep, with a velocity of about 10 feet per second, swept across the railway when the flood was at its maximum, giving a discharge of 465,600 cubic feet per second.

The damage to the railway was caused chiefly by the flood water heading up against the embankment and percolating and tunnelling through the inferior alkaline soil of which it is formed in this locality.

Some of the rough stone flooring of the bridges on the slopes of their approaches were considerably disturbed and damaged, but the bridges themselves are uninjured.

The public road which, in some places, runs parallel and near to the railway was seriously damaged, considerable portion being completely washed away, so that for weeks there were no means of communication by road or rail.

General.

The cause of all this devastation and wide-spread destruction to village and farm, railway and road, and the loss of human life which unfortunately occurred in several localities is to be traced chiefly to bursting tanks and channels. The bursting of tanks is due in great measure to the evil practice of land-owners and cultivators greedy to utilize the utmost capacity of their tanks, closing temporarily the waste weir (calingulas) of their tanks with stones and turf, whereby the water is ponded up to a dangerously high level leaving no margin in case of sudden heavy rainfall. A weir, to be of real value as a safety valve against over-filling a tank, ought to be adapted to discharge any quantity of water flowing into the tank above what is requisite to maintain a safe high water level, and it ought not to be permissible to obstruct the weir or to dam up the water to higher than this safe level. I believe that Government have done and are doing much to enforce this principle, but it would appear that more drastic measures than hitherto are necessary to bring the responsibility home to land-owners and others and to teach them that they are not at liberty to pond up without safeguards great volumes of water to the risk of their neighbour lives and property. There are a great number of large tanks some of, I believe, miles in extent in the country lying to the west of the line in the Manobolu valley, and it is said to have been through the bursting of many of these tanks that the Gudur-Manobolu part of the railway and public road was so seriously damaged.

An abstract of the damages specified in this note is appended and the estimated cost of repairing the breaches is as follows:—

	RS.
Main Line, 252/253 miles	10,552
Nellore Branch	35,000
Erode Branch	4,505
Negapatam Branch	2,000
Total	52,057

TRICHINOPOLY,
26th December 1893.

(Signed) DAVID LOGAN,
Chief Engineer.

APPENDIX A.

ABSTRACT of flood damages sustained by the Railway in November 1893.

Mileage.	Particulars.	Date on which traffic is interrupted.	Date on which traffic was resumed.	Proposals for dealing with similar floods.
	<i>Main Line.</i>	1893.	1893.	
M. V.P. 214 6	Deep scour behind north-east wing, and slightly lesser ones behind the south-east and south-west wings of 1-30 feet girder bridge at 214 M. 6 T.P.	23rd November.	25th November.	Caused by heavy rains and bursting of channel banks. <i>Remedy.</i> —To heavily pitch slopes of approaches to bridge.
Between 250 6 and 252 4	Line breached at intervals ..	23rd ..	9th December.	To lower the line on to a causeway across which abnormal floods would flow away with short interruption to traffic.
	<i>Nellore Branch.</i>			
Between B 302 6 and B 308 9 B 321 7 and B 323 3	Line breached at intervals ..	7th November. 7th ..	25th Nov. 3rd Dec.	Remedy is to have tanks more securely embanked and to have their weirs or calingulas properly regulated.
	<i>Negapatam Branch.</i>			
Between N 235 14 and N 236 9	Line breached at intervals ..	24th November.	1st December.	Better regulation of rivers and more securely embanking them.
	<i>Erode Branch.</i>			
Between E 252 3 and E 255 19	Line breached at intervals ..	23rd November.	8th December.	Further report will be submitted after learning the proposals of the Public Works Department with reference to this locality.

TRICHINOPOLY,
26th December 1893.

(Signed) DAVID LOGAN,
Chief Engineer.

NOTE on an inspection of restored portions of South Indian Railway line at miles 214, 250-252, 235-237 (Negapatam branch), 252-255 (Erode branch).

During the latter portion of November 1893 considerable breaches occurred in the railway embankment at the above-mentioned mileages. These have already been fully reported upon by the Chief Engineer of the South Indian Railway Company.

The inspection of the restored portions of line was made on the 13th December, after traffic had been resumed, in company with Mr. Rice, Resident Engineer, Trichinopoly. On the date of the inspection, on all the breached sections the work of restoration was still going on; the way and works were, however, sufficiently restored to admit of the running of trains at reduced speeds with safety to the public using them.

The work remaining to be done consisted of completion of slopes and formation in embankments, ballasting, packing, lifting, &c.

The speed of all trains over the breached portions was limited to 5 miles per hour and speed boards and hand signal men provided where necessary.

I am of opinion that sufficient precautions had been taken to ensure the safety of the public and that the line where it had been restored was fit for the passage of trains at a speed of 5 miles an hour.

21st January 1894.

(Signed) H. W. BENNETT,
Offg. Dy. Consulting Engineer.

Remarks by the Senior Government Inspector of Railways.

The breaches were due to the great rainfall and the bursting of tanks which concentrated the flood water on the railway bank; the provision of extra waterway is a matter of doubtful efficacy seeing that the railway have no means of ensuring the safety of the tank embankments, and it is therefore not suggested by the Railway Engineers and I agree with them. The causeway will probably entail some interruption to traffic during the monsoons, but it has successfully worked elsewhere and I recommend it. No claim for damage can lie against private proprietors of tanks.

MADRAS,
22nd January 1894.

(Signed) F. R. UPCOTT,
Senior Government Inspector.

ORDER—dated 26th February 1894, No. 116 R., Public Works.

The proposals of the Chief Engineer, South Indian Railway, supported by the Government Inspector, are approved, but the Superintending Engineer, Public Works Department, should be consulted before any definite action be taken. The report will be forwarded to the Government of India.

[Here enter No. 117 R., dated 26th February 1894.]

(True Extract.)

(Signed) F. R. UPCOTT,
Joint Secy. to Govt., P.W.D.,
Railway Branch.

To the Chief Engineer, Public Works Department.
„ Chief Engineer for Irrigation.
„ Agent, South Indian Railway, through the
Consulting Engineer for Railways.
„ Local and Municipal Department.

RAILWAY.

Govt. of {1894} Madras. PUBLIC WORKS.

Dated February, 26th.

Recd.

Encl.

G.O., 26th Feb. 1894, No. 116 R.

FEBRUARY.

Flood Damages

The proposals of the Chief Engineer, South Indian Railway, supported by the Government Inspector, on the — to the South Indian Railway during November 1893, approved with remarks, and the report ordered to be forwarded to the Government of India.

REPORT ON FLOOD DAMAGES TO SOUTH INDIAN RAILWAY DURING NOVEMBER 1893.

I beg to submit the following observations on certain parts of the line affected by the late floods (November 1893).

Main Line.

On the 23rd November 1893, at 214/6 miles, the approaches to a 30-foot girder bridge close to the river Vennar were scoured into to such an extent as to stop traffic by rail from the 23rd November to the 25th November 1893. At this point the railway runs nearly north and south crossing at right angles the natural drainage

• 214/15 miles.

of the country on its way eastward towards the sea. It also crosses the river Vennar by a bridge of 6-50 feet spans. This river, with probably other channels and tanks, breached its banks above the railway. The flood water of the ensuing inundation was intercepted between the south bank of the Vennar and the railway embankment and ponded into a corner,

† 214/6 miles.

the outlet from which was the 30-foot bridge,† and it was the resulting scour that tore away parts of the approaches to this bridge; eventually, relief was to some extent afforded by the water breaching through the river bank back into the Vennar.

The approaches were pitched with rough stone and the bridge is floored; the pitching was to a considerable extent washed away and the flooring damaged. The remedy will be, to more heavily and extensively protect the slopes of the railway embankment by rough stone pitching and to repair and strengthen the floor.

Main Line south of Trichinopoly and Erode Branch.

These two portions of the line are taken together, as the same floods crossed and damaged both.

In December 1884 floods occurred here so similar in their action and effects that the following description quoted from the report upon them is applicable to, and explanatory of, the floods in November last:—

Main Line south of Trichinopoly.

“The damage to earthwork in the 251st, 252nd and 253rd miles was very great, the breaches aggregating 1,700 $\pm$ lineal feet. The line in these miles crosses the Korayar valley. The

1 The length affected in November 1893 was about 1,800 lineal feet.
2 Since enlarged to 10-30 feet spans.
3 Since enlarged to 8-20 feet spans and 4-25 feet spans and now aggregating 260 lineal feet.

river itself is spanned by a bridge of five 30-foot spans on skew (28' 6" on square) at 251 miles 30 chains, and in addition to this there is a flood opening of 4-20 feet $\parallel$ spans at 251-70 chains; very heavy local rainfall in the basin drained by this river caused the breaching of numerous tanks to the south of the line. I have a list containing the names of 53 tanks which are said to have gone in the Trichinopoly taluk alone, but a considerable number must have burst in Pudukota territory. . . . About three-quarter of a mile to the south of the railway line, the trunk road to Madura crosses the Korayar by a bridge of five 30-foot skew arches 28 feet on the square. Between this and the line the east side of the river is embanked. Again, south of the public road to a rocky hill about one-fourth of a mile distant, the same side of the river is embanked. The west river bank is open. The road bridge was insufficient to pass the flood water, and the road was topped. The embankment was burst through south of the road bridge; the public road was breached, and by this breach flood water got in at the back of the river embankment, and it was this that damaged the line to the east of the Korayar bridge between 250 miles 29 chains and 251 miles 2- chains. To prevent this it will be necessary that the river embankment be strengthened, and I do not recommend any additional waterway in this portion of the railway bank. To the west of the Korayar the stretch of low ground forming the valley of the river is interrupted close to the line by a small isolated rocky hill; by this the flood water from the river is divided, a portion going by the river, the remainder to the 4-20 feet bridge at 251 miles 60 chains. The damage to earthwork was so great and the interruption to traffic so serious extending to fifteen days I recommend that additional waterway be given to the bridge over the Korayar and to the four 20-foot bridge; to the former an addition of three spans, the latter to be doubled.”

Erode Branch west of Trichinopoly.

To continue the quotation from the report of 1884:—

"The line was injured here between the Trichinopoly Fort station E 252 miles and E 254 by the same flood that crossed the line in the 251st, 252nd and 253rd miles main line, but was added to by the flood in the Ariyavur and breaches in the Wiacondan channels.

"The Korayar, after passing the main line, joins the Ariyavur to the south of the Wiacondan channel, and the flood water of both rivers passes over the channel by means of the Puttur weir; from that point they take the name of Kudamurutti which crosses the Erode branch by a bridge of seven 30-foot spans. For the protection of Trichinopoly the east side of the river is embanked. This bank was breached and was the cause of the damage to the line at the Fort station and in its immediate neighbourhood. Between the Fort station and the embankment of the Kudamurutti, there are two bridges—one of two 20-foot girders and another of two 15-foot girders—but

* In November 1893, the water rose 3 feet above rail level in the Fort station.

these were not sufficient and the water rose 18 inches* over rail level at the station and topped rails as far as 252 miles 36 chains. To the west of the Kudamurutti the line was breached from the inability of the Kudamurutti bridge to pass the flood water. The line here follows very closely the Cauvery embankment, in

† Afterwards rebuilt.

which there is a bridge over the Kudamurutti of six 30-foot arches, two of which have fallen. This bridge, having less waterway than the railway bridge, kept back the water to some extent, but the latter also was insufficient and where the level of rail is 3 feet lower than the line was topped at E 253 miles 18 chains

‡ In November 1893 the damage extended to E 254.

between E 253 miles 40 chains and 48 chains. The quantity of water passing over the Puttur weir was 50,000 cubic feet per second. The interruption to traffic on the branch was of no

§ In 1893 duration from 23rd November to 9th December.

long duration, § from evening of December 18th to morning of December 23rd when the traffic was resumed. The Public Works Department propose to lower the south embankment of the Cauvery to the west of the road bridge down to level of road for a length of 300 feet. This would suit the Railway Company well, for the additional waterway, I consider should be given, can be provided opposite this outlet into the Cauvery. The discharge from Kudamurutti bridge is about 23,000 cubic feet per second; so that, to pass the water that was discharged over the Puttur weir alone, we should have to more than double the bridge. I propose to run rail level from the west end of the Kudamurutti bridge to opposite the position the Public Works Department propose to cut down the Cauvery bund and then to give a bridge of 300 lineal feet of waterway.

The measures adopted after lengthened consideration of all the circumstances connected with these 1884 floods were—

On the Main Line.

To double the waterway of the Korayar bridge adding 5 to the then existing 5-30 feet girder spans forming the non-existing aggregate of 10-30 feet span, to add 4-25 feet spans to the waterway of the 4-20 feet girder bridge at 251/15.

It was considered that this addition to the waterway under the railway would provide for the maximum discharge of rainfall from the area drained and that, if it should prove unequal to contend with any future bursting of tanks, the remedy would be, to lower the line on to a causeway across which all such abnormal flushes would flow away with but short of any interruption to traffic on the railway.

On the Erode branch the proposals to provide additional waterway was abandoned, on the Public Works Department deciding not to lower the river Cauvery embankment; because, to have given the waterway without lowering the river bank would have established in flood time a dangerous flow of water to the north of, and between, the railway embankment and the Cauvery bund. It was further considered doubtful tiugency which might come upon us only once in 15 or 20 years. All things considered, it was decided not to provide additional waterway, the cost of which would be considerable and its efficiency against similar flood damage doubtful.

The floods in November last swept over the railway across the public road and breached through the river bank into the Cauvery sweeping away, in their course, some of the buildings and works of the lately-begun Trichinopoly water-works.

I do not know what measures the Public Works Department intend to adopt in dealing with the river Cauvery at this point. If they carry out the old proposal to lower the bank so as to let the drainage of the country flow unobstructed into the river, our policy will be, to lower the railway on to a causeway and allow high floods to cross in the manner proposed for the 253rd mile of the main line south of the Korayar. The subject will be further reported upon after learning the proposals of the Public Works Department with reference to this locality.

Negapatam Branch.

The breaches and wash-over between miles N 235 and N 237 were caused by the bursting of the bank of one of the large irrigation channels to the north of the railway.

There are three of these channels in this neighbourhood crossed by the railway, viz., the Pamaniar, 5-30 feet girder spans, and the Korayar 5-30 feet girder span both on the 237th mile, and the Vennar 9-30 feet girder span on the 239th mile. The damage done in 1884 was line breached immediately to the west of the Korayar, whereas in November last the breaches were made just west of the Pamaniar. The remedy here would appear to be in the more efficient embanking of the river crossed by the railway which are under the charge of the Public Works Department. The line cannot be lowered on to a causeway in the manner suggested for the breaches south of Trichinopoly, because we are tied to heights sufficient to carry the railway over the large irrigation channels in this neighbourhood, and to provide extra waterway sufficient to carry off such floods as the line is subject to here, the cost would be prohibitory. The proposals of the Public Works Department to deal with the difficulty will be ascertained.

Nellore Branch.

So far as ascertained, the damages here, as elsewhere, were due to breaching tank and channel bunds. At the Venkatagiri and Vendodu breaches the floods crossed the line from east to west, and investigation will be made as to whether the levels of the line and the waterway provided in it are sufficient to meet the maximum drainage of the country, exclusive of floods from breaching tanks.

In the valley between Gudur and Manobolu stations, the floods crossed from west to east and there can be no reasonable doubt that the railway provision of bridges is more than ample to serve the natural drainage of the country. In this valley the embankment stands from 15 to 20 feet high with an aggregate of 3,880 lineal feet of waterway, even the enormous volume of water sent against the railway bank by bursting tanks in November 1893 was nearly accommodated by the railway bridges,

* Under 100 feet in width.

for the embankment was nowhere topped by the water and but one clear breach of no great* width was made.

I estimate that a body of water not less than 3,880 lineal feet by 12 feet deep, with a velocity of about 10 feet per second, swept across the railway when the flood was at its maximum, giving a discharge of 465,600 cubic feet per second.

The damage to the railway was caused chiefly by the flood water heading up against the embankment and percolating and tunnelling through the inferior alkaline soil of which it is formed in this locality.

Some of the rough stone flooring of the bridges on the slopes of their approaches were considerably disturbed and damaged, but the bridges themselves are uninjured.

The public road which, in some places, runs parallel and near to the railway was seriously damaged, considerable portion being completely washed away, so that for weeks there were no means of communication by road or rail.

General.

The cause of all this devastation and wide-spread destruction to village and farm, railway and road, and the loss of human life which unfortunately occurred in several localities is to be traced chiefly to bursting tanks and channels. The bursting of tanks is due in great measure to the evil practice of land-owners and cultivators greedy to utilize the utmost capacity of their tanks, closing temporarily

the waste weir (calingulas) of their tanks with stones and turf, whereby the water is ponded up to a dangerously high level leaving no margin in case of sudden heavy rainfall. A weir, to be of real value as a safety valve against over-filling a tank, ought to be adapted to discharge any quantity of water flowing into the tank above what is requisite to maintain a safe high water level, and it ought not to be permissible to obstruct the weir or to dam up the water to higher than this safe level. I believe that Government have done and are doing much to enforce this principle, but it would appear that more drastic measures than hitherto are necessary to bring the responsibility home to land-owners and others and to teach them that they are not at liberty to pond up without safeguards great volumes of water to the risk of their neighbour lives and property. There are a great number of large tanks some of, I believe, miles in extent in the country lying to the west of the line in the Manobolu valley, and it is said to have been through the bursting of many of these tanks that the Gudur-Manobolu part of the railway and public road was so seriously damaged. An abstract of the damages specified in this note is appended and the estimated cost of repairing the breaches is as follows:—

Main Line, 252/253 miles	Rs.
Nellore Branch	10,552
Erode Branch	35,000
Negapatam Branch	4,595
	2,000
Total	52,057

TRICHINOPOLY,
26th December 1893.

(Signed) DAVID LOGAN,
Chief Engineer.

APPENDIX A.

ABSTRACT of flood damages sustained by the Railway in November 1893.

Mileage.	Particulars.	Date on which traffic is interrupted.	Date on which traffic was resumed.	Proposals for dealing with similar floods.
M. T.P.	Main Line.	1893.	1893.	
214 6	Deep scour behind north-east wing, and slightly lower ones behind the south-east and south-west wings of 1-30 feet girder bridge at 214 M. & T.P.	23rd November.	25th November.	Caused by heavy rains and bursting of channel banks. Remedy.—To heavily pitch slopes of approaches to bridge.
Between 250 5 and 252 4	Line breached at intervals	23rd "	9th December.	To lower the line on to a causeway across which abnormal floods would flow away with short interruption to traffic.
Between B 302 5 and B 308 0	Nellore Branch.			
B 321 7 and B 323 3	Line breached at intervals	7th November.	25th Nov. 3rd Dec.	Remedy is to have tanks more securely embanked and to have their weirs or calingulas properly regulated.
Between N 225 14 and N 234 9	Negapatam Branch.			
	Line breached at intervals	24th November.	1st December.	Better regulation of rivers and more securely outflanking them.
Between E 252 3 and E 254 10	Erode Branch.			
	Line breached at intervals	23rd November.	8th December.	Further report will be submitted after learning the proposals of the Public Works Department with reference to this locality.

TRICHINOPOLY,
26th December 1893.

(Signed) DAVID LOGAN,
Chief Engineer.

Note on an inspection of restored portions of South Indian Railway line at miles 214, 250-252, 235-237 (Negapatam branch), 252-255 (Erode branch).

During the latter portion of November 1893 considerable breaches occurred in the railway embankment at the above-mentioned mileages. These have already been fully reported upon by the Chief Engineer of the South Indian Railway Company.

The inspection of the restored portions of line was made on the 13th December, after traffic had been resumed, in company with Mr. Rice, Resident Engineer, Trichinopoly. On the date of the inspection, on all the breached sections the work of restoration was still going on; the way and works were, however, sufficiently restored to admit of the running of trains at reduced speeds with safety to the public using them.

The work remaining to be done consisted of completion of slopes and formation in embankments, ballasting, packing, lifting, &c.

The speed of all trains over the breached portions was limited to 5 miles per hour and speed boards and hand signal men provided where necessary.

I am of opinion that sufficient precautions had been taken to ensure the safety of the public and that the line where it had been restored was fit for the passage of trains at a speed of 5 miles an hour.

(Signed) H. W. BENNETT,
Offg. Dy. Consulting Engineer.

21st January 1894.

Remarks by the Senior Government Inspector of Railways.

The breaches were due to the great rainfall and the bursting of tanks which concentrated the flood water on the railway bank; the provision of extra waterway is a matter of doubtful efficacy seeing that the railway have no means of ensuring the safety of the tank embankments, and it is therefore not suggested by the Railway Engineers and I agree with them. The causeway will probably entail some interruption to traffic during the monsoons, but it has successfully worked elsewhere and I recommend it. *No claim for damage can be against private proprietors of tanks.*

(Signed) F. R. UPCOTT,
Senior Government Inspector.
MADRAS,
22nd January 1894.

Order.—Dated 26th July 1894 No 116 R. P.W.D. works. The proposals of the Chief Engineer supported by the Govt. Inspector, are approved, but the Chief Engineer P.W.D. should be consulted before any definite action be taken. The report will be forwarded to Govt. of India.—(True Extract) F. R. Upcott

*To Chief Engineer P.W.D.
— do — for Sanitation
to Agent S. S. P. for E.R.
No Local interest in this*

End. C. A. Menimamy.
Spare Copies

[Here enter No 117 R dated 26th July 94]
DESPATCHED
MAR 94
Forwarded
(By) F. R. Upcott.
Sent Secy to Govt. P.W.D. Ry Bd

