(1) பக்கங்களின் எண்ணிக்கை 26.

(2) புதுக்கித் திருப்பிய நாள் 6.1.92

(3) ஆதாரங்குறிப்பவர் சுருக்கொப்பம்

தமிழ்நாடு ஆவணக் காப்பகம்.

தமிழ்நாடு அரசு

P.W.D துறை

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அரசாணை எண்.
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அச்சகம்
பலவகை

நாள் : 28—7—1992 198 .

மடிக்கவோ கண்டபடி கையாளவோ கூடாது

13 Sheets

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2103/1

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—the following paper :—

Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George, dated India Office, London, 16th June 1892, No. 3 P.W.

I forward herewith, for the information of Your Excellency's Government, copy of a despatch* which I have recently addressed to the Government of India enclosing a report by Mr. F. N. Thorowgood on the measures which he proposes for improving the harbour of Vizagapatam.

* No. 27 of 16th June 1892 and enclosure. (The plans referred to in the enclosure have been sent to the Government of India.)

ENCLOSURES.

Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, 16th June 1892, No. 27 P.W.

With reference to my Public Works Despatch, No. 62, dated the 15th October 1891, I forward herewith, for your Excellency's consideration, copy of a report* which has been submitted to me by Mr. F. N. Thorowgood on the results of his investigations into the condition of the harbour at Vizagapatam.

* Report, dated 25th May 1892, and two plans.

2. The measures proposed by Mr. Thorowgood for the improvement of the port are (1) the construction of a groyne from the shore north of the river mouth; (2) the excavation of some reclaimed land, with the object of increasing the tidal capacity of the estuary; and (3) the dredging of the mouth of the channel. The total outlay involved in these improvements, which need not be carried out at once to the full extent proposed, is Rs. 6,11,271.

3. A larger scheme, estimated to cost Rs. 43,27,272, is also proposed by Mr. Thorowgood, with the object of forming a deep sea harbour, enclosed by piers constructed from the shore north and south of the entrance to the river.

4. I have to request that I may be furnished with your Excellency views, after consulting the Madras Government, on the suggestions made in this report. I have already, in a previous despatch, expressed my opinion that the connection of the port of Vizagapatam with the Indian railway system, on the construction of the East Coast Railway, will add new importance to the question of improving the harbour.

From F. N. THOROWGOOD, Esq., M. INST., C.E., to the Under-Secretary of State for India, dated Wimbledon, 25th May 1892.

[*Vizagapatam Harbour.*]

I have the honour to submit herewith my report upon forming a harbour at Vizagapatam, together with two plans (Nos. 1 and 2), in accordance with orders and instructions given in your letter of 8th October 1891, No. 1779 P.W.

2. *Arrival at Madras and Vizagapatam.*—I arrived at Madras on 25th November 1891, and at once reported myself to the Chief Secretary to Government, and had interviews with the Public Works Member of Council and Colonel Pennycuick, R.E., Chief Engineer, Public Works Department. I received a very large and most interesting batch of papers containing

all that had been written on the subject of Vizagapatam Harbour, commencing at the year 1858, together with plans and sections of the port and backwater. At Madras I was detained till 30th November, the coasting steamer being very late, so I arrived at Vizagapatam on the morning of 4th December.

3. *Previous opinions on the Harbour.*—I shall have to refer in some detail to the opinions of others who have advocated the construction of a harbour at this port, as the features of the coast are rather peculiar, and it is certainly curious to see what conflicting decisions have been arrived at. It is unnecessary for me to describe the town and situation of the port of Vizagapatam, as these are sufficiently indicated on Drawings Nos. 1 and 2. It differs, however, from any port on the Coromandel coast in this, that on the south side of the river mouth, instead of a low flat sandy shore, there are almost precipitous cliffs, reaching a maximum height of 580 feet above high water, the highest and boldest being known as the "Dolphin's Nose." This headland projects 1,500 feet eastward of the narrow entrance to the river or backwater, and thus protects it from the swell of the south-west monsoon. The water round this headland is deep, and more free from sand in suspension than is the case where the shore is low and flat.

4. *General features of Vizagapatam Port.*—At first sight it is impossible not to be struck with the natural advantages that the place possesses for making a harbour, the backwater offering a fine sheltered area hemmed in by hills, and capable of being made into docks, quays, wharves, &c., to accommodate a large trade. And it is absolutely distressing to see this fine backwater almost cut off from the sea by the long spit of sand which blocks the mouth, and is generally called the bar. On this sand spit or bar, except at high water, on the smoothest day, there is a constant and most dangerous surf ever breaking. (See Drawing No. 1.) The removal of this bar has been the problem on which so many opinions have been offered, and I am obliged to come to the conclusion that many of these opinions have been arrived at on insufficient evidence.

5. *Other opinions as to methods of improving Port.*—In September 1858 Lieutenant Virtue, R.E., reports to the Government of Madras that "the bar is formed by material brought down by the river, and is composed of soft mud, not of sand," and that "by means of a groyne of rough stone projecting seaward from the northern side of the river's mouth [illegible] the loose material of which the bar consists would be swept away."

6. Mr. E. T. Thomas, C.S., has taken a great interest in the port and he describes it in a memorandum to the Madras Government, 24th September 1872, as "the most natural and the most easily formed port on the East Coast Peninsula;" and further says, "if the bar were removed, the harbour would be made."

7. Captain Waters, Master Attendant at Vizagapatam, proposes in 1873 a groyne, 700 feet long, run out from the south side of the river as the only means to render Vizagapatam a safe port.

8. Major Beatty, R.E., has gone into the matter very fully, and his proposal was a groyne on each side of the river mouth. On the north side 1,200 feet long, and on the south (from the Dutch battery) 1,000 feet long.

9. In 1880 Major-General R. H. Sankey, R.E., investigated the matter very thoroughly, and has placed on record that he does not believe in the efficacy of any groynes to scour away the bar, which would probably only be thus put further out to sea, and that "we should not only incur useless outlay, but do perhaps irreparable mischief," by such works.

10. The late Captain I. H. Taylor, Master Attendant of the Madras Presidency, advocated no artificial works at Vizagapatam, because he believed that close beneath the surface of the sand or mud was hard, uncompromising rock. There are many other opinions and suggestions on record which need not be noticed, except one which I refer to in paragraph 36, viz., the proposal of Mr. W. J. Addis, submitted to the Secretary of State for India, 23rd November 1891, and handed to me by the Government of Madras.

11. I have carefully considered all that has already been put forward on the subject of this harbour, and I commenced my investigation without prejudice in any direction.

12. *Bar removed by heavy floods.*—The bar or sand spit is occasionally removed by heavy rains, and I find an undoubted record of a series of soundings taken a few months after the cyclonic storm of 1876, on which is shown a channel from the Dutch battery up to the bridge (called now Turner's bridge, as shown on the Drawings Nos. 1 and 2), with from 18 to 27 feet of water at low-water throughout. It is most important to bear this in mind, as where there was in 1877 a depth of 16 to 18 feet at low-water there now stands the "Sand Island" shown plainly in Drawing No. 1. This "Sand Island" was formed mostly while I was at Vizagapatam.

13. But these scourings out by heavy rain are uncertain, and there has been no such action now for more than three years. The present state of the river mouth is most lamentable, being one mass of broken water, through which I can from experience state it is not only disagreeable, but very dangerous to pass. Yet this present state of things may go on for a further indefinite period and be a serious obstacle to any trade.

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14. I have therefore come to the conclusion that in submitting any design for improving the port, the river Maonderu (as I find it called on former plans) must be regarded only as a tidal backwater, and the question of rainfall or catchment area may be disregarded, except in so far as to suggest no work that may be damaged by one of these heavy rain floods.

15. As a matter of fact the river is tidal for a distance of nearly eight miles from the mouth, and it is to the tidal ebb and flow that we must look for the active force moving sand outward or inward. The scour of a heavy rain is an occasional event which must not be reckoned on if a useful harbour is desired.

16. In his letter to Sir Juland Danvers, dated 8th July 1891, Sir A. M. Rendel says, speaking of the river at Vizagapatam, "small as its forces are, the river seems even now to be only just unable to cope with those of the sea, for the depth on the bar diminishes from its deepest to its shallowest limit but slowly." Nothing can better represent the truth of this than the survey I have lately made, and which I shall have to refer to in detail. With everything against it, the river has still been able to maintain an exit to the sea through which boats can pass at high water.

17. *Conflicting opinions about Bar.*—My first aim on arrival was to try to ascertain, first, what was the cause of the bar; secondly, from what source did the material composing it come; and thirdly, was it easily moved from its position. With regard to the last point it is evident that conflicting opinions had been held many years ago, for I find that the District Engineer, writing officially on 9th March 1859, says, "that there is strong evidence that the depth of water on the bar has not varied, nor has its size and position during the recollection of the oldest inhabitant," while on 8th March 1871, Major Beatty, R.E., writes making proposals "in order to remedy the constant fluctuations that the bar is subject to, both with regard to the depth of water upon it and the position of the deep channel." I therefore approach the matter of the so-called bar with much caution, but with the belief that the conclusions I draw are correct.

18. *Sand supply to the Bar.*—I find that the chief source of sand supply is due to wave action during the period from October to February, when the wind and littoral current are both from the north of east. If there were no river at all the sand would be heaped up against the rocky coast on the south side of the mouth of the estuary. By reference to the detailed survey of December 1891, on Drawing No. 1, it will be seen that the one-fathom line (one-fathom below low-water spring tides) runs out as a spit of sand for a distance of 640 feet to the east of the old Dutch battery. Before the state of the sea would permit me to take any soundings, I observed this state of things by frequently ascending the Dolphin's Nose headland and looking at the sand through the clear water at flood tide. A careful survey confirms the opinion I inclined to from more ocular observation.

19. There is also another source of sand supply to the so-called bar, and that is a movement of sand when the southerly winds set in from seaward in towards shore. This I believe to be common to all ports on the Coromandel coast, and at Madras it was very conspicuous during the construction of the harbour piers.

20. The sand in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand, and as a matter of fact it became extremely difficult at this spot to get a survey of the bottom of the sea which might be called accurate for two consecutive days during the time of general change of wind from north to south.

21. *Fresh-water springs disturb sand.*—This extreme mobility of the sand I find to be very greatly due to the fact that the bottom of the sea is pierced by numerous fresh-water springs, which when intercepted on shore by wells form the water-supply of the place. Of these wells there are no less than 22 within one eighth mile of high-water mark, and in one mile of coast, and the level of the surface of water in them all is about the same at the same minute of time, being about three feet above low-water level. These springs, when not intercepted, percolate up from the sandy bottom of the sea and render the sand very unstable, as may be plainly seen at such times as the water is smooth and clear.

22. These two sources of sand-supply, one from the north, due mostly to wave action, and one directly towards shore, also mostly due to wave action on the sea bottom, form the serious obstruction known as the bar.

23. By again referring to Drawing No. 1, it will be seen that in February 1892, on repeating the survey of the sand spit with wind and current from the south, the contour line of one-fathom is driven backward a distance of 320 feet. I therefore come to the conclusion that the bar is and always has been caused by sand brought, as I have suggested, during the north-east monsoon, and afterwards flattened back over the mouth in the south-west monsoon.

24. The direction of the crests of the breaking waves hardly varies at all, being throughout the year as indicated on Drawing No. 1. I am supported in this belief by some most useful information given me by Captain Winckler, for many years Master Attendant at Vizagapatam, and now at Cochin.

25. *Currents outside mouth of river.*—With regard to tidal and littoral currents outside the mouth of the harbour, they vary so much and so frequently, but always with so low a velocity, that I think they may be passed over. I have shown on Drawing No. 1 how, on two days in February, the ebb tide, as observed with floats sunk very deep, took two quite opposite directions, the velocity, however, was never more than 44 feet per minute. In the Bay of Bengal the flood tide comes from the south, yet I found in December, with a northerly wind, the current at flood tide set distinctly towards the south, as recorded on drawing No. 2. On several occasions I have been unable to detect any current in seven-fathom water when the tide has been running rapidly into or out of the river. I therefore discard currents, outside the immediate neighbourhood of the river mouth, as having no general effect on the sand spit or bar.

26. *Evil done by the reclamation work.*—There seems to be no doubt whatever that the depth of water in the river and its mouth within the one-fathom line has diminished since the year 1870, when the reclamation of some swamp land was commenced. To quote Major Beatty, R.E., again, on 24th December 1873, he writes to the Collector of Vizagapatam,—"that from the date when the bunds for reclaiming were constructed, the bar has been rising at an average of two feet per annum;" and, indeed, it is impossible to doubt that the excluding of 2½ square miles of lands from the tide, even if this area were only covered to a depth of six inches, would make a serious difference in the scour of the tide at the mouth of the estuary, for it would cut off nearly 38 million cubic feet of water. In March 1874 Colonel W. Farewell, Deputy Chief Engineer, Public Works Department, wrote on this subject,—"there can be no doubt that the deterioration of the harbour is due to the reduction of the tidal estuary . . . . . that Government should repossess themselves of the swamps so essential to the existence of the harbour." And Major-General Sankey, R.E., drew serious attention to this in his note of 13th August 1880 to the Madras Government.

27. As will be seen later on, I do not advocate handing the reclaimed swamp back again to the tide, because in the last 18 years, by cultivating portions of it, by using it for grazing buffaloes, by occasional flooding and silting, the level of the general area is hardly appreciably below high-water spring tides, as found by numerous levels and sections I had taken upon it. But I most strongly advocate some measures for increasing the tidal capacity of the river, and this to be done by excavating into the reclaimed land.

28. *Borings on the Bar.*—Much anxiety seems to be felt at Madras as to whether there is rock to be found in such positions as to prevent the forming of a harbour, and I have no doubt that locally disappointment was caused by my inability to take borings on the bar. As a matter of fact this is impossible without most elaborate and costly plant, such as the occasion did not justify my demanding.

29. *Rock.*—The question of rock in the backwater (except where the rock can be seen) need not be considered, as the soundings after the storm of 1876 already referred to in paragraph 12 sets that at rest. From two borings I took, shown on Drawing No. 1, it is very evident that there is nothing in the way of rock to prevent the making of an excellent harbour with 18 feet of water at low-water. I certainly discovered a solitary rock or boulder at three fathoms deep (at low-water spring tides) off the entrance of the river (marked *r* on Drawing No. 1), but by probing down round it two or three feet deeper I got no more rock, so I think it to be an isolated stone.

30. *Proposals to improve the Harbour. Dredging.*—Having now briefly described the state of affairs at Vizagapatam, I venture to put forward my proposals for improving the port. I first strongly urge the use of a sand-pump dredger to clear a channel as shown in Drawing No. 1, with a depth of 10 feet at low-water, and to dredge away the sand island, which is doing such harm to the port. The application of dredging has been found so beneficial to the neighbouring port of Cocanada (similarly hampered by silt from the north) that I would very strongly recommend the use of a dredger at Vizagapatam, to be worked during the smooth season, to remove the present obstructions to traffic, which are truly distressing to see. I do not put the cost of this dredger down in the estimate for a harbour, as I have good reason to believe the port of Cocanada are willing to share the cost of a dredger with Vizagapatam, and allow the machine to work at the latter port in January and February. I simply wish to draw attention to what I believe to be the simplest and most direct way of improving the port at present, so as to be better able to carry on its trade. The dredger "Wenlock" was to have been sent from Tuticorin to Vizagapatam while I was there, but it had to go to Bombay for repairs, and so could not have arrived at Vizagapatam till the smooth season had passed.

31. The dredger when working should remove the point of sand at the river mouth, and indicated on the plan as "point to be removed." The removing of this point seems to me to be of great importance, as the very narrow channel at that place produces at spring tides an abnormal velocity of flood tide (nearly always aided by wind and wave), amounting to as much as 208 feet per minute. This rapid tide through a sandy channel carries material with it, and ultimately forms and increases the sand island inside.

32. The ebb tide is retarded by wind and wave and does not achieve so great a velocity as the flood, but I often measured 180 feet a minute by observation, and by calculation from the present tidal capacity of the backwater passing through the narrow section of exit the result would be 176 feet per minute.

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33. *Cost of dredging.*—To dredge a channel as shown on Drawing No. 1 from near the two-fathom line at sea up to and beyond Sand Island, with a minimum depth of 10 feet at low-water, would involve the removal of about 28,000 cubic yards of sand, at a cost of not less than Rs. 14,000. A very heavy rain flood might do more than this without any expenditure at all, but who can say when the next heavy flood will come, and what is to be done if it be postponed for two years more? In the Appendix A to this Report I give a detailed estimate of work to be done, so arranged that this sum of Rs. 14,000 may be included or omitted.

34. *Construction of a groyne.*—The only work of actual construction that I propose is a groyne, not less than 1,420 feet long, from the low-water line, as shown on both plans in red colour; and I should prefer to extend it 130 feet further, at an additional cost of Rs. 35,675, to ensure no sand passing round the end of it. The position and direction of this groyne have been carefully considered, and I do not think that any other situation or direction would attain the desired two-fold object of keeping back sand from the river mouth and allowing sufficient beaching ground for waves to break upon. A good extent of beaching ground is absolutely necessary, and while the proposed position of the groyne affords this, it at the same time will interrupt many of the breakers which now disperse themselves on the shore near the ice house.

35. *Construction of groyne.*—The first 870 feet of the groyne, and the whole of its base, I propose to form with large rubble stone taken from one of the neighbouring hills. The outer 550 feet is to be surmounted with a wall of concrete blocks, 24 feet in width, similar in size and shape to those used at Madras Harbour subsequent to the year 1885. I do not think that any less substantial work should be attempted in so exposed a situation, and there is evidently not a long enough period of smooth water to justify an attempt at building with concrete *in situ*. I have supposed that to build this concrete wall plant will be available at a low cost from Madras, as indeed is hinted by Sir Alexander Rendel in his letter of 8th July 1891. The concrete blocks can be made at the spot indicated in Drawing No. 1 as "site for concrete block ground." Stone can be brought easily by the Railway to the site of the groyne and to the block ground at a rate of less than one anna per ton per mile, and excellent sharp coarse sand is obtainable along the shore.

36. *Mr. Addis' scheme.*—If a solid groyne or pier were run out straight to sea from the corner of the river mouth, as indicated in the design of Mr W. J. Addis, referred to in paragraph 10, the result would, I fear, be to convey the breakers right up to the Port Office of Vizagapatam, and to undermine the railway now under construction.

37. *Excavation of the reclaimed land.*—To add to the tidal capacity of the estuary, I propose to cut away the foreshore at the reclaimed land eventually right up to the inner bund on the south side of the reclamation. This, however, may be done by instalments, and need not be undertaken as a whole to begin with. In Appendix A I give two estimates, one for the whole excavation, and one for half of the ultimate quantity proposed to be moved. This excavation is to be carried to ordinary low-water level by Cooly labour. If a dredger is available subsequently, the water may be deepened in place by degrees, and gradually the shore may be used as a landing place for cargo. But the first object is to add to the tidal capacity of the estuary by removing land that lies between high and low-water level the subsequent deepening being a matter for future consideration. The material excavated is to be levelled up on the reclaimed land within the bund.

38. *Tidal capacity of estuary.*—I calculate the present tidal capacity at spring tides of the estuary at only 67 million cubic feet, and this calculation agrees almost exactly with what should be the capacity theoretically according to a formula which proportions the tidal ebb and flow to the low-water section at a river's mouth. By excavating into the foreshore, as shown on Drawing No. 2 to the full extent, an addition of over 19 million cubic feet will be achieved, or nearly one third more. But this will be at a cost of Rs. 1,93,200. But half this amount of excavation might be carried out at first at a cost of Rs. 96,000, and the result watched The whole work may be progressive, and in the estimates in Appendix A, I endeavour to make this clear.

39. *Cost of the different works.*—At present, for the full work proposed, including dredging and excavating, the cost would be Rs. 6,11,271, as shown in Appendix A (1). Or if the dredging be postponed, and only half what I propose be excavated, the total would be Rs. 4,78,541. See Appendix A (3). If the groyne alone be built, and no addition made to the tidal capacity by excavation, the cost would be Rs. 3,62,751. See Appendix A (4).

40. *Pier on the south side not wanted.*—There is one more point in this scheme that I ought not to pass over, and that is the necessity or otherwise for a short pier on the south of the river mouth. I have given this most careful consideration, especially as such a work was mentioned by Sir Alexander Rendel in his letter of 8th July 1891. I found by close examination on the spot that the line of broken water hardly varies at all in direction in either monsoon, and is as indicated on my Drawing No. 1. Further, I find that the old Dutch battery, close to the water's edge on the south corner of the river mouth, is only built of bricks and mortar, and it is impossible to believe that this would have stood so many years if it were attacked by heavy seas. I have, therefore, arrived at the conclusion that no work on the south side is necessary

for a small inner harbour. If any further work be required, it will be the extension by 100 or 150 feet of the northern groyne.

41. *Comparative surveys of* 1883 *and* 1892.—Another point I wish to call special attention to is this:—It has sometimes been urged by many who have taken up the question of a harbour at Vizagapatam, that any work short of a very large one will be sure to silt up. My belief is that never until now has the matter been thoroughly considered, and I think it will be admitted that we can now see that the sand trouble at the river mouth is very local, and is covered by my proposed groyne of 1,420 feet from low-water. On Drawing No. 2 I have shown the contour lines at sea taken from Commander Falle's exquisite survey of 1883, and in my own survey of 1892. I have, as nearly as I could, followed Commander Falle's traversing lines. So we have, I may say, for the first time, two accurate surveys at nine years interval, showing that in this interval, and with the bar now in an extremely bad condition, there is practically no change whatever in depth from the nine-fathom to the one-fathom contour. With the bottom of the sea so constant as this, I do not fear that the groyne now proposed will silt up or do otherwise than keep the river mouth clear.

42. *Deep Harbour*.—I have now to refer very briefly to a larger design shown in blue lines on Drawing No. 2. This gives a magnificent outer harbour with a 900 feet entrance in nearly nine-fathom water, and with a distance of 2,100 feet shoreward under cover of the south pier up to the four-fathom line. And, with regard to this design, it must be borne in mind that the bar is not the only obstacle for working cargo at Vizagapatam, but that the ground swell often interferes with discharging cargo from ships.

43. If this larger plan were to be carried out, there would be safe anchorage for certainly 20 ships in the outer harbour, and the backwater might then be converted into docks and quays, which would compare favourably with any port in India, except Bombay. The groyne thrown out for the smaller design would be extended as shown for the larger one, and I again suppose that cranes and plant from Madras might be utilized here. In this case I would propose a railway along the foot of the Dolphin's Nose headland, and a concrete block ground on the plateau above the Dutch battery, with a wire rope incline down to the railway [illegible]. I give in Appendix B an estimate of the cost of this, which of course is great, amounting to Rs. 43,27,272.

44. In conclusion, I should like to be permitted to record my thanks to all those with whom I came in contact officially during my stay at Vizagapatam, which ended on 22nd February 1892. To Mr. Willock, to Mr. F. B. Walker, Chief Engineer of the East Coast Railway, and his staff, to Captain Woodhouse, Port Officer, and to Mr. Gardiner, of the firm of Stuart, Hall, & Co., my thanks are specially due for having given me all assistance possible, and indeed more than I ought to have expected.

APPENDIX A.—Estimate of cost of the four alternative plans for improving harbour, referred to in Report and Drawings Nos. 1 and 2.

	Rs.
(1) The full work proposed:—	
Groyne—	
Rubble stone in commencement and in base to end of groyne, 70,338 tons at Rs. 1-8-0	1,05,507
Concrete blocks in outer portion, 7,822 cubic yards at Rs. 10-8-0	82,131
Setting ditto in position, 7,822 cubic yards at Rs. 2-8-0	19,555
Excavation in swamp to full extent,—	1,93,200
19,320,000 cubic feet at Rs. 10 per 1,000 cubic feet	14,000
Dredging mouth of channel,—	
28,000 cubic yards at 8 annas	4,14,393
	80,000
Add plant and preliminary work	15,000
Block ground	5,09,393
	50,939
Contingencies at 10 per cent.	50,939
Establishment and office at 10 per cent.	
Total for whole plan (1) ...	6,11,271
(2) Work as above omitting dredging and proportional part of contingencies, &c.	5,94,471
(3) Work as above (1), omitting dredging, and only doing half proposed excavation	4,78,541
(4) Construction of groyne alone	3,62,751

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APPENDIX B.—Estimate for Deep Sea Harbour referred to in paras. 41 and 42 of Report.

	Rs.
Plant and preliminary work, supposing cranes are available from Madras	1,50,000
Approach to south pier	28,560
Block ground and incline, south side	30,000
Additional to north block ground	15,000
Complete south pier, 3,300 feet at Rs. 500 per foot	16,50,000
" north pier, 3,465 feet at Rs. 500 per foot	17,32,500
	36,06,060
Add contingencies, 10 per cent.	3,60,606
Establishment and office, 10 per cent.	3,60,606
Total cost ...	43,27,272

ORDER—dated 28th July 1892, No. 2103 W., Public Works.

Recorded.

2. The orders of the Government of India will be awaited.

(True Extract.)

Major, R.E.,
Under-Secy. to Govt., P.W.D.

To the Superintending Engineer, I Circle.
" Consulting Engineer for Railways.
" Marine Department.

Exd. J. P. Oliver.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1892} Madras.

PUBLIC WORKS.

Dated July, 28th.

Read. *Encl.*

G.O., 28th July 1892, No. 2103 W.

JULY.

Harbour of Vizagapatam

Report by Mr. F. N. Thorowgood on the measures which he proposes for improving the —, recorded with remarks.

2103
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2

India Office,
London, 16th June 1892.

Public Works,
No. 27.

To His Excellency The Most Honourable The Governor General of India in Council.

Report by Mr. F. N. Thorowgood on Vizagapatam Harbour.

My Lord Marquis,

With reference to my Public Works Despatch, No. 62, dated the 15th October 1891, I forward herewith, for your Excellency's consideration, copy of a report* which has been submitted to me by Mr. F. N. Thorowgood on the results of his investigation into the condition of the harbour at Vizagapatam.

2. The measures proposed by Mr. Thorowgood for the improvement of the port are (1) the construction of a groyne from the shore north of the river mouth; (2) the excavation of some reclaimed land, with the object of increasing the tidal capacity of the estuary; and (3) the dredging of the mouth of the channel. The total outlay involved in these improvements, which need not be carried out at once to the full extent proposed, is Rs. 6,11,271.

3. A larger scheme, estimated to cost Rs. 8,27,272, is also proposed by Mr. Thorowgood, with the object of forming a deep sea harbour, enclosed by piers constructed from the shore north and south of the entrance to the river.

4. I have to request that I may be furnished with your Excellency views, after consulting the Madras Government, on the suggestions made in this report. I have already, in a previous Despatch, expressed my opinion that the connection of the port of Vizagapatam with the Indian railway system, on the construction of the East Coast Railway, will add new importance to the question of improving the harbour.

I have the honour to be,
My Lord Marquis,
Your Lordship's most obedient humble Servant,
(Signed) CROSS.

* Report, dated 25th May 1892, and two plans.

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ENCLOSURE.

Wimbledon,
25th May 1892.

Sir,

Vizagapatam Harbour.

I have the honour to submit herewith my report upon forming a harbour at Vizagapatam, together with two plans (Nos. 1 and 2), in accordance with orders and instructions given in your letter of 8th October 1891, No. 1779, P. W.

2. *Arrival at Madras and Vizagapatam.*—I arrived at Madras on 25th November 1891, and at once reported myself to the Chief Secretary to Government, and had interviews with the Public Works Member of Council and Colonel Pennycuick, R.E., Chief Engineer, Public Works Department. I received a very large and most interesting batch of papers containing all that had been written on the subject of Vizagapatam Harbour, commencing at the year 1858, together with plans and sections of the port and backwater. At Madras I was detained till 30th November, the coasting steamer being very late, and I arrived at Vizagapatam on the morning of 4th December.

3. *Previous opinions on the Harbour.*—I shall have to refer in some detail to the opinions of others who have advocated the construction of a harbour at this port, as the features of the coast are rather peculiar, and it is certainly curious to see what conflicting decisions have been arrived at. It is unnecessary for me to describe the town and situation of the port of Vizagapatam, as these are sufficiently indicated on Drawings Nos. 1 and 2. The coast differs, however, from any port on the Coromandel coast in this, that on the south side of the river mouth, instead of a low flat sandy shore, there are almost precipitous cliffs, reaching a maximum height of 536 feet above high water, the highest and boldest being known as the "Dolphin's Nose." This headland projects 1,500 feet eastward of the narrow entrance to the river or backwater, and thus protects it from the swell of the south-west monsoon. The water round this headland is deep, and more free from sand in suspension than is the case where the shore is low and flat.

4. *General features of Vizagapatam Port.*—At first sight it is impossible not to be struck with the natural advantages that the place possesses for making a harbour, the backwater offering a fine sheltered area hemmed in by hills, and capable of being made into docks, quays, wharves, &c., to accommodate a large trade. And it is absolutely distressing to see this fine backwater almost cut off from the sea by the long spit of sand which blocks the mouth, and is generally called the Bar. On this sand spit or bar, except at high water, on the smoothest day, there is a constant and most dangerous surf ever breaking. (See Drawing No. 1.) The removal of this bar has been the problem on which so many opinions have been offered, and I am obliged to come to the conclusion that many of these opinions have been arrived at on insufficient evidence.

5. *Other opinions as to methods of improving Port.*—In September 1858 Lieutenant Vertue, R.E., reports to the Government of Madras that "the bar is formed by material brought down by the river, and is "composed of soft mud, not of sand," and that, "by means of a groyne "of rough stone projecting seaward from the northern side of the "river's mouth, . . . the loose material of which the bar consists "would be swept away."

6. Mr. E. T. Thomas, C.S., has taken a great interest in the port, and he describes it in a Memorandum to the Madras Government, 24th September 1872, as "the most natural and the most easily formed port "on the East Coast Peninsula;" and further says, "if the bar were "removed, the harbour would be made."

7. Captain Waters, Master Attendant at Vizagapatam, proposes in 1873 a groyne 700 feet long run out from the *south* side of the river as the only means to render Vizagapatam a safe port.

8. Major Beatty, R.E., has gone into the matter very fully, and his proposal was a groyne on each side of the river mouth. On the north side 1,200 feet long, and on the south (from the Dutch Battery) 1,000 feet long.

9. In 1880 Major-General R. H. Sankey, R.E., investigated the matter very thoroughly, and has placed on record that he does not believe in the efficacy of any groynes to scour away the bar, which would probably only be thus put further out to sea, and that "we "should not only incur useless outlay, but do perhaps irreparable "mischief," by such works.

10. The late Captain A. H. Taylor, Master Attendant of the Madras Presidency, advocated no artificial works at Vizagapatam, because he believed that close beneath the surface of the sand or mud was hard, uncompromising rock. There are numerous other opinions and suggestions on record which need not be noticed, except one which I refer to in paragraph 36, viz., the proposal of Mr. W. J. Addis, submitted to the Secretary of State for India, 23rd November 1891, and handed to me by the Government of Madras.

11. I have carefully considered all that has already been put forward on the subject of this harbour, and I commenced my investigation without prejudice in any direction.

12. *Bar removed by heavy rains.*—The bar or sand spit is occasionally removed by heavy rains, and I find an unpublished record of a series of soundings taken a few months after the cyclonic storm of 1876, on which is shown a channel from the Dutch battery up to the bridge (called now Turner's Bridge, as shown on the Drawings Nos. 1 and 2), with from 18 to 27 feet of water at low water throughout. It is most important to bear this in mind, as where there was in 1877 a depth of 16 to 18 feet at low water there now stands the "Sand Island" shown plainly in Drawing No. 1. This "Sand Island" was formed mostly while I was at Vizagapatam.

13. But these scourings out by heavy rain are uncertain, and there has been no such action now for more than three years. The present state of the river mouth is most lamentable, being one mass of broken water, through which I can from experience state it is not only disagreeable, but very dangerous to pass. Yet this present state of things may go on for a further indefinite period and be a serious obstacle to any trade.

14. I have therefore come to the conclusion that in submitting any design for improving the port, the River Maonderu (as I find it called on former plans) must be regarded only as a tidal backwater, and the question of rainfall or catchment area may be disregarded except in so far as to suggest no work that may be damaged by one of these heavy rain floods.

15. As a matter of fact the river is tidal for a distance of nearly eight miles from the mouth, and it is to the tidal ebb and flow that we must look for the active force moving sand outward or inward. The scour of a heavy rain is an occasional event which must not be reckoned on if a useful harbour is desired.

16. In his letter to Sir Juland Danvers, dated 8th July 1891, Sir A. M. Rendel says, speaking of the river at Vizagapatam, "Small as its "forces are, the river seems even now to be only just unable to cope "with those of the sea, for the depth on the bar diminishes from its "deepest to its shallowest limit but slowly." Nothing can better represent the truth of this than the survey I have lately made, and which I shall have to refer to in detail. With everything against it, the river has still been able to maintain an exit to the sea through which boats can pass at high water.

17. *Conflicting opinions about Bar.*—My first aim on arrival was to try to ascertain, first, what was the cause of the bar; secondly, from what source did the material composing it come; and thirdly, was it easily moved from its position. With regard to the last point, it is evident that conflicting opinions had been held many years ago, for I find that the District Engineer, writing officially on 9th March 1859, says, "that there is strong evidence that the depth of water on the bar "has not varied, nor has its size and position during the recollection of "the oldest inhabitant," while on 8th March 1871, Major Beatty, R.E., writes making proposals "in order to remedy the constant fluctuations "that the bar is subject to, both with regard to the depth of water upon "it and the position of the deep channel." I therefore approach the matter of the so-called bar with much caution, but with the belief that the conclusions I draw are correct.

18. *Sand supply to the Bar.*—I find that the chief source of sand supply is due to wave action during the period from October to February, when the wind and littoral current are both from the north of east. If there were no river at all the sand would be heaped up against the rocky coast on the south side of the mouth of the estuary. By reference to the detailed survey of December 1891, on Drawing No. 1, it will be seen that the one fathom line (one fathom below low water spring tides) runs out as a spit of sand for a distance of 640 feet to the east of the old Dutch battery. Before the state of the sea would permit me to take any soundings, I observed this state of things by frequently ascending the Dolphin's Nose headland and looking at the sand through the clear water at flood tide. A careful survey confirms the opinion I inclined to from mere ocular observation.

19. There is also another source of sand-supply to the so-called bar, and that is a movement of sand when the southerly winds set in from seaward in towards shore. This I believe to be common to all ports on the Coromandel coast, and at Madras it was very conspicuous during the construction of the harbour piers.

20. The sand in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand, and as a matter of fact it became extremely difficult at this spot to get a survey of the bottom of the sea which might be called accurate for two consecutive days during the time of general change of wind from north to south.

21. *Fresh-water springs disturb sand.*—This extreme mobility of the sand I find to be very greatly due to the fact that the bottom of the sea is pierced by numerous fresh-water springs, which when intercepted on shore by wells form the water-supply of the place. Of these wells there are no less than 22 within one eighth mile of high-water mark, and in one mile of coast, and the level of the surface of water in them all is about the same at the same minute of time, being about three feet above low-water level. These springs, when not intercepted, percolate up from the sandy bottom of the sea and render the sand very unstable, as may be plainly seen at such times as the water is smooth and clear.

a). These two sources of sand-supply, one from the north, due mostly to wave action, and one directly towards shore, also mostly due to the bar.

23. By again referring to Drawing No. 1, it will be seen that in February 1872, on repeating the survey of the sand spit with wind and current from the south, the contour line of one fathom is driven backward a distance of 320 feet. I therefore come to the conclusion that the bar is and always has been caused by sand brought, as I have suggested, during the north-east monsoon, and afterwards flattened back over the mouth in the south-west monsoon.

24. The direction of the crests of the breaking waves hardly varies at all, being throughout the year as indicated on Drawing No. 1. I am supported in this belief by some most useful information given me by Captain Winckler, for many years Master Attendant at Vizagapatam, and now at Cochin.

25. *Currents outside mouth of River.*—With regard to tidal and littoral currents outside the month of the harbour, they vary so much and so frequently, but always with so low a velocity, that I think they may be passed over. I have shown on Drawing No. 1 how, on two days from the south, yet I found in December, with a [illegible] the ebb tide, as observed with floats sunk very deep, took current at flood tide set distinctly towards the south, as recorded in Drawing No. 2. On several occasions I have been unable to detect any current in 7-fathoms water when the tide has been running rapidly into or out of the river. I therefore discard currents, outside the immediate neighbourhood of the river mouth, as having no general effect on the sand spit or bar.

26. *Evil done by the reclamation work.*—There seems to be no doubt whatever that the depth of water in the river and at its mouth within the one-fathom line has diminished since the year 1870, when the reclamation of some swamp land was commenced. To quote Major Beatty, R.E., again, on 24th December 1873, he writes to the Collector of Vizagapatam,—"that from the date when the bunds for reclaiming "were constructed, the bar has been rising at an average of two feet "per annum;" and, indeed, it is impossible to doubt that the tide, even if this area were only of 2½ square miles of land from the tide, would make a serious difference in the covered to a depth of six inches, would cut off scour of the tide at the mouth of the estuary, for it would cut off nearly 38 million cubic feet of water. In March 1874 Colonel W. Farewell, Deputy Chief Engineer, Public Works Department, wrote on this subject,—"there can be no doubt that the deterioration of the "harbour is due to the reduction of the tidal estuary, . . . that "Government should repossess themselves of the swamp, so essential "to the existence of the harbour." And Major-General Sankey, R.E., drew serious attention to this in his note of 13th August 1880 to the Madras Government.

27. As will be seen later on, I do not advocate handing the reclaimed swamp back again to the tide, because in the last 18 years, by cultivating portions of it, by using it for grazing buffaloes, by occasional flooding and silting, the level of the general area is hardly appreciably below high-water spring tides, as found by numerous levels and sections taken upon it. But I most strongly advocate some measures creasing the tidal capacity of the river, and this to be done by ing into the reclaimed land.

28. *Borings on the Bar.*—Much anxiety seems to be felt at Madras as to whether there is rock to be found in such positions as to prevent the forming of a harbour, and I have no doubt that locally disappointment was caused by my inability to take borings on the bar. As a matter of fact this is impossible without most elaborate and costly plant, such as the occasion did not justify my demanding.

29. *Rock.*—The question of rock in the backwater (except where the rock can be seen) need not be considered, as the soundings after the storm of 1876 already referred to in paragraph 12 sets that at rest. From two borings I took, shown on Drawing No. 1, it is very evident that there is nothing in the way of rock to prevent the making of an excellent harbour with 18 feet of water at low water. I certainly discovered a solitary rock or boulder at three fathoms deep (at low-water spring tides) off the entrance of the river (marked *r* on Drawing No. 1), but by probing down round it two or three feet deeper I got no more rock, so I think it to be an isolated stone.

30. *Proposals to improve the Harbour. Dredging.*—Having now briefly described the state of affairs at Vizagapatam, I venture to put forward my proposals for improving the port. I first strongly urge the use of a sand-pump dredger to clear a channel as shown in Drawing No. 1, with a depth of 10 feet at low water, and to dredge away the sand island, which is doing such harm to the port. The application of dredging has been found so beneficial to the neighbouring port of Cocanada (similarly hampered by silt from the north) that I would very strongly recommend the use of a dredger at Vizagapatam, to be worked during the smooth season, to remove the present obstructions to traffic, which are truly distressing to see. I do not put the cost of this dredger down in the estimate for a harbour, as I have good reason to believe the port of Cocanada are willing to share the cost of a dredger with Vizagapatam, and allow the machine to work at the latter port in January and February. I simply wish to draw attention to what I believe to be the simplest and most direct way of improving the port at present, so as to be better able to carry on its trade. The dredger "Wenlock" was to have been sent from Tuticorin to Vizagapatam while I was there, but it had to go to Bombay for repairs, and so could not have arrived at Vizagapatam till the smooth season had passed.

31. The dredger when working should remove the point of sand at the river mouth, and indicated on the plan as "point to be removed." The removing of this point seems to me to be of great importance, as the very narrow channel at that place produces at spring tides an abnormal velocity of flood tide (nearly always aided by wind and wave), amounting to as much as 208 feet per minute. This rapid tide through a sandy channel carries material with it, and ultimately forms and increases the sand island inside.

32. The ebb tide is retarded by wind and wave and does not achieve so great a velocity as the flood, but I often measured 180 feet a minute by observation, and by calculation from the present tidal capacity of the backwater passing through the narrow section of exit the result would be 176 feet per minute.

33. *Cost of dredging.*—To dredge a channel as shown on Drawing No. 1 from near the two-fathom line at sea up to and beyond Sand Island, with a minimum depth of 10 feet at low water, would involve the removal of about 28,000 cubic yards of sand, at a cost of not less than Rs. 14,000. A very heavy rain flood might do more than this without any expenditure at all, but who can say when the next heavy flood will come, and what is to be done if it be postponed for two years

more? In the Appendix A to this Report I give a detailed estimate of work to be done, so arranged that this sum of Rs. 14,000 may be included or omitted.

34. *Construction of a groyne.*—The only work of actual construction that I propose is a groyne, not less than 1,420 feet long, from the low-water line, as shown on both plans in red colour; and I should prefer to extend it 130 feet further, at no additional cost of Rs. 35,675, to ensure no sand passing round the end of it. The position and direction of this groyne have been carefully considered, and I do not think that any other situation or direction would attain the desired twofold object of keeping back sand from the river mouth and allowing sufficient beaching ground for waves to break upon. A good extent of beaching ground is absolutely necessary, and while the proposed position of the groyne affords this, it at the same time will interrupt many of the breakers which now disperse themselves on the shore near the ice house.

35. *Construction of groyne.*—The first 870 feet of the groyne, and the whole of its base, I propose to form with large rubble stone taken from one of the neighbouring hills. The outer 550 feet is to be surmounted with a wall of concrete blocks, 24 feet in width, similar in size and shape to those used at Madras Harbour subsequent to the year 1885. I do not think that any less substantial work should be attempted in so exposed a situation, and there is evidently not a long enough period of smooth water to justify an attempt at building with concrete *in situ*. I have supposed that to build this concrete wall plant will be available at a low cost from Madras, as indeed is hinted by Sir Alexander Rendel in his letter of 8th July 1891. The concrete blocks can be made at the spot indicated in Drawing No. 1 as "site for concrete block ground." Stone can be brought easily by the railway to the site of the groyne and to the block-yard at a rate of less than one anna per ton per mile, and excellent sharp coarse sand is obtainable along the shore.

36. *Mr. Addis' scheme.*—If a solid groyne or pier were run out straight to sea from the corner of the river mouth, as indicated in the design of Mr. W. J. Addis, referred to in paragraph 10, the result would, I fear, be to convey the breakers right up to the Port Office of Vizagapatam, and to undermine the railway now under construction.

37. *Excavation of the reclaimed land.*—To add to the tidal capacity of the estuary, I propose to cut away the foreshore of the reclaimed land eventually right up to the inner bund on the south side of the reclamation. This, however, may be done by instalments, and need not be undertaken as a whole to begin with. In Appendix A I give two estimates, one for the whole excavation, and one for half of the ultimate quantity proposed to be moved. This excavation is to be carried to ordinary low-water level by Cooly labour. If a dredger is available subsequently, the water may be deepened in places by degrees, and gradually the shore may be used as a landing place for cargo. But the first object is to add to the tidal capacity of the estuary by removing land that lies between high and low water level, the subsequent deepening being a matter for future consideration. The material excavated is to be levelled up on the reclaimed land within the bund.

38. *Tidal capacity of estuary.*—I calculate the present tidal capacity at spring tides of the estuary at only 67 million cubic feet, and this calculation agrees almost exactly with what should be the capacity theoretically according to a formula which proportions the tidal ebb and flow to the low-water section at a river's mouth. By excavating into the foreshore, as shown on Drawing No. 2 to the full extent, an addition of over 19 million cubic feet will be achieved, or nearly one third more. But this will be at a cost of Rs. 1,93,200. But half this amount of excavation might be carried out at first at a cost of Rs. 96,000, and the result watched. The whole work may be progressive, and in the estimates in Appendix A I endeavour to make this clear.

39. *Cost of the different works.*—At present, for the full work proposed, including dredging and excavating, the cost would be Rs. 6,11,271, as shown in Appendix A (1). Or if the dredging be postponed, and only half what I propose be excavated, the total would be Rs. 4,78,541. See Appendix A (3). If the groyne alone be built, and no addition made to the tidal capacity by excavation, the cost would be Rs. 3,62,751. See Appendix A (4).

40. *Pier on the south side not wanted.*—There is one more point in this scheme that I ought not to pass over, and that is the necessity or otherwise for a short pier on the south of the river mouth. I have given this most careful consideration, especially as such a work was mentioned by Sir Alexander Rendel in his letter of 8th July 1891. I found by close examination on the spot that the line of broken water hardly varies at all in direction in either monsoon, and is as indicated on my Drawing No. 1. Further, I find that the old Dutch battery, close to the water's edge on the south corner of the river mouth, is only built of bricks and mortar, and it is impossible to believe that this would have stood so many years if it were attacked by heavy seas. I have, therefore, arrived at the conclusion that no work on the south side is necessary for a small inner harbour. If any further work be required, it will be the extension by 100 or 150 feet of the northern groyne.

41. *Comparative Surveys of 1883 and 1892.*—Another point I wish to call special attention to is this:—It has sometimes been urged by many who have taken up the question of a harbour at Vizagapatam, that any work short of a very large one will be sure to silt up. My belief is that never until now has the matter been thoroughly considered, and I think it will be admitted that we can now see that the sand trouble at the river mouth is very local, and is covered by my proposed groyne of 1,420 feet from low water. On Drawing No. 2 I have shown the contour lines at sea taken from Commander Falle's exquisite survey of 1883, and in my own survey of 1892. I have, as nearly as I could, followed Commander Falle's traversing lines. So we have, I may say, for the first time, two accurate surveys at nine years interval, showing that in this interval, and with the bar now in an extremely bad condition, there is practically no change whatever in depth from the nine-fathom to the one-fathom contour. With the bottom of the sea so constant as this, I do not fear that the groyne now proposed will silt up or do otherwise than keep the river mouth clear.

42. *Deep Harbour.*—I have now to refer very briefly to a larger design shown in blue lines on Drawing No. 2. This gives a magnificent outer harbour with a 900 feet entrance in nearly nine fathom water, and with a distance of 2,100 feet shoreward under cover of the south pier up to the four-fathom line. And, with regard to this design, it must be borne in mind that the bar is not the only obstacle for working cargo at Vizagapatam, but that the ground swell often interferes with discharging cargo from ships.

43. If this larger plan were to be carried out, there would be safe anchorage for certainly 20 ships in the outer harbour, and the back-water might then be converted into docks and quays, which would compare favourably with any port in India, except Bombay. The groyne thrown out for the smaller design would be extended as shown

for the larger one, and I again suppose that cranes and plant from Madras might be utilized here. In this case I would propose a railway along the foot of the Dolphin's Nose headland, and a concrete block ground on the plateau above the Dutch battery, with a wire rope incline down to the railway along the shore. I give in Appendix B an estimate of the cost of this, which of course is great, amounting to Rs. 43,27,272.

44. In conclusion, I should like to be permitted to record my thanks to all those with whom I came in contact officially during my stay at Vizagapatam, which ended on 22nd February 1892. To Mr. Willock, to Mr. F. B. Walker, Chief Engineer of the East Coast Railway, and his staff, to Captain Woodhouse, Port Officer, and to Mr. Gardiner, of the firm of Stuart, Hall, & Co., my thanks are specially due for having given me all assistance possible, and indeed more than I ought to have expected.

I have, &c.,
F. N. THOROWGOOD,
M. Inst. C. E.

The Under Secretary of State
for India.

Enclosure in above.

Appendix A.

Estimate of Cost of the four alternative Plans for improving Harbour, referred to in Report and Drawings Nos. 1 and 2.

	Rs.
(1.) The full work proposed :—	
Groyne,—	
Rubble stone in commencement and in base to end of groyne, 70,338 tons at Rs. 1. 8	1,05,507
Concrete blocks in outer portion, 7,822 cubic yards at Rs. 10. 8	82,131
Setting ditto in position, 7,822 cubic yards at Rs. 2. 8	19,555
Excavation in swamp to full extent,—	
19,320,000 cubic feet at Rs. 10 per 1,000 cubic feet	1,93,200
Dredging mouth of channel,—	
28,000 cubic yards at 8 annas	14,000
	4,14,393
Add plant and preliminary work	80,000
Block ground	15,000
	5,09,393
Contingencies at 10 per cent.	50,939
Establishment and office at 10 per cent.	50,939
Total for whole plan (1)	Rs. 6,11,271
(2.) Work as above, omitting dredging and proportional part of contingencies, &c.	5,94,471
(3.) Work as above (1), omitting dredging, and only doing half proposed excavation	4,78,541
(4.) Construction of groyne alone	3,62,751

Appendix B.

Estimate for Deep Sea Harbour referred to in paragraphs 41 and 42 of Report.

	Rs.
Plant and preliminary work, supposing cranes are available from Madras	1,50,000
Approach to south pier	28,560
Block ground and incline, south side	30,000
Additional to north block ground	15,000
Complete south pier, 3,300 feet at Rs. 500 per foot	16,50,000
,, north pier, 3,465 feet at Rs. 500 per foot	17,32,500
	36,06,060
Add contingencies, 10 per cent.	3,60,606
Establishment and office, 10 per cent.	3,60,606
Total cost	Rs. 43,27,272

No 3.

Public Works.

16th June 1892.

Four copies of
Letter to the Govt. of India
No 27, and Enclosure.

E. I.
Pub 7268/92

No 3

Four copies of India Public Works Despatch No 27 and enclosure dated 16 June 1892.

Referred to in Public Works Despatch to Madras No 3. dated 16th June 1892

747. Despatch from the Right Hon'ble the Secretary of State for India

India Office,
London, 16th June 1892.

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Public Works,
No.3.

TO HIS EXCELLENCY THE RIGHT HONOURABLE THE GOVERNOR
IN COUNCIL, FORT St. GEORGE.

My Lord,

I forward herewith for the information of Your Excellency's Government copy of a Despatch which I have recently addressed to the Government of India enclosing a report by Mr. F.N. Thorowgood on the measures which he proposes for improving the harbour of Vizagapatam.

I have the honour to be,

My Lord,

your Lordship's most obedient humble Servant,

No.27 of 16th June 1892 and enclosure.

(The plans referred to in the enclosure have been sent to the Government of India).

P. W. CURRENT No. 7268

Sour No 2.

Public Works.

16th June 1892.

Encls 7 (2 s.c)

Rec'd: 19.7.92

Letter to Govt St. George

No 3.

Recd. 8 July 92

No 2103.W. dd 28 July 1892.

25 July

Rec'd 19 July

Recorded.

2. The orders of the Govt. of India will be awaited.

2787.w dd 23 oct 1891
2982.w dd 16 Nov 1891

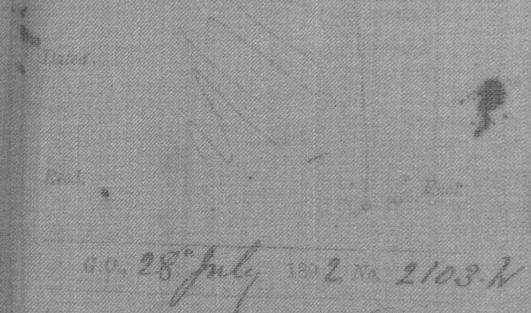
Sd. I Circle
C.E. for Rys
Irrigation Dept

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No 726

Govt. of 1892 Madras.

PUBLIC WORKS.



G.O. 28th July 1892 No. 2103-N

Harbour of Vizagapatam

Report by Mr. S. L. Thorowgood on the measures which he proposes for improving the ——, recorded with remarks.

5-3-21

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F 28/7

J.C.B.