

direction for 500 feet, would thence curve to the eastward until, at its outer end, it pointed N.N.W., leaving a distance or clear water-way of 200 feet between it and the southern work; the total length of the northern arm *C. to D.* would be 1,500 feet. The width of 200 feet for the entrance has been determined after due consideration of all the conditions of the case.

The south breakwater would terminate in 12 feet at low water, or 21 feet at high water of spring tides; whilst, in the case of the northern arm, the depths would be 9 feet and 18 feet respectively, which latter would represent the depths that could be relied upon as available for navigation on completion of the piers to the full extent above described. The channel in the entrance would be subject to some temporary reduction in depth, say, to the extent of 2 feet, after heavy on-shore gales, but the normal depths above-named would be speedily restored on the recurrence of settled weather. It will thus be evident that, subject as the entrance would be to the temporary reduction of depth just explained, training piers of less length would fail to afford such an approach to the Waitara as would be desirable if any material improvement is to be effected.

Although the data available here as to the physical features of the river, and the coast immediately adjoining thereto, are amply sufficient for determining the principle on which the external works of improvement should be based, and also for indicating with certainty the proper lines for and extent of these works, the information now at hand does not suffice to enable me to determine with reasonable confidence upon the best mode of construction for these works, or to frame an estimate of their cost.

If, however, it should be contemplated to proceed with these outer piers, now or hereafter, I would suggest that the matter should be placed in the hands of the Colonial Marine Engineer, in order that the requisite data may be procured in the locality, and an estimate framed by him, founded upon such mode of construction as he may consider best, having regard to the character and prices of the materials available, and the nature of the bottom along the lines of the two arms.

#### *Internal Works.*

The works for the improvement of the river channel, taken in the order of their importance, are: (1.) The training banks on either side just within the coast line, marked respectively *E, F,* and *G, H,* on Drawing No. 2, the former measuring 1,200 feet in length, and the latter 800 feet; the low-water distance, or breadth of channel, being 200 feet. These banks would consist of rubble stone deposited as *pierres perdues*, and brought up to 3 feet above the level of high water of ordinary spring tides. The spaces between the outer ends of these embankments and the inner ends of the external training breakwaters, if and when the latter were constructed, would form wave-basins, which would be found very advantageous in absorbing any undulations that might enter between the breakwaters. Prior to the commencement of the training bank on the north side, the point of the shingle-spit should be excavated down to the level of low water of spring tides, and the remainder, which the strength of the currents may not suffice to scour, should be removed by a small dredger, if such can be procured, or by some other appliance suitable for the purpose. (2.) Reverting to the isolated shingle-bank, mentioned in the early part of this report as existing about half-a-mile below the bridge, I have to recommend that a small half-tide training bank, 650 feet in length, be constructed on the curved line shown in red on Drawing No. 2, thereby directing the whole force of the outgoing and incoming currents into the main channel, and thus utilizing their scouring effects to the greatest practicable extent at the smallest possible cost.

The construction of this training bank will necessitate the protection by fagoting of the south bank of the river, between *X.* and *Y.* on the drawing, being a length of 1,200 feet. As explained in the note on the drawing, the execution of this fagoting should precede that of the training bank. (3.) In order to stop the back-channel, between the island and the north bank of the river, a barrier bank 180 feet in length should be constructed as shown. This work would further aid in concentrating the scour of the currents in the main river course.

I estimate the cost of the foregoing internal works as follows, namely:—

Two training banks (marked <i>E, F,</i> and <i>G, H,</i> on plan) just within the entrance, together with the removal of the shingle-spit to the extent crossed by red lines	£ 12,250
Curved half-tide training bank, about half-a-mile below the bridge, together with fagoting on south bank, from <i>X.</i> to <i>Y.</i> , also barrier-bank from the island to the north bank of the river	1,510
Total	£13,760

#### *River Channel.*

With a view to an increase of the tidal volume, and also to effect an improvement in the navigation to and from the wharves below the bridge, I have laid down on the plan and section, Drawing No. 2, lines indicating the position and depth of the new channel, the formation of which would, I apprehend, require some assistance from dredging. It will be seen that along the south bank, from the bridge to the point *X.*, a distance of 1,200 yards, the line I have adopted corresponds with that previously laid down by Mr Blackett.