

We are of opinion that with a dredger of this character, of the working of which we have results of ample practical experience before us, there should be no difficulty in raising and depositing, as described above, 1,000 to 1,400 tons of sand per diem, thereby maintaining the depth in the harbour unimpaired, and leaving an ample margin of time for contingencies and repairs.

Such a dredger would be furnished with sufficient power to steam to the colony, and would be quite seaworthy for the voyage.

It would, after being put together complete, and tested at the maker's works in Holland, be equipped for the voyage to New Plymouth.

We estimate the cost of a pump-hopper dredger of the character described, delivered at New Plymouth ready for work, at about £11,000. The cost of working and maintaining this craft—viz., wages of crew, fuel, stores, repairs, &c.—may be put down at about £4,500 per annum, and at least twelve months would be required for construction and delivery at New Plymouth.

The first cost and working charges of the pump dredger will compare favourably with the estimated outlay on the rubble groin from Mikotahi to the Lion Rock, and thence to Moturoa, together with the plant and contingencies for the entire works, amounting to £77,000, as previously estimated.

Taking the annual working charges as £4,500, and the quantity raised as, say, 200,000 tons, and allowing for interest and depreciation on plant, we should have an average cost of about 7d. per ton of sand raised and deposited, which agrees with the actual rate, as shown by the working of a pump hopper-dredger under somewhat more unfavourable conditions in one of the colonies.

*Periodical Soundings.*—We entertain considerable doubt as to the alleged extensive growths of sand for some distance seaward of the breakwater, and to the north-east thereof, as described in the Chief Surveyor's memorandum of 30th March, 1889. Upon comparing sections plotted from the soundings on Mr Jones's survey of 1877 with the soundings taken by Mr Humphries in March last, we have arrived at the conclusion that some of the differences which have been attributed to deposits of sand are due to discrepancies in sounding, which are to some extent inevitable when fixing the position of isolated depths over such a large area as that of the original survey.

It is most important that this matter should be cleared up, and we therefore recommend that soundings be taken every six months over the standard lines indicated on the annexed trace, and numbered from 1 to 21. The manner in which these soundings should be taken is described in a note on the trace. The result should be plotted in section form, so that the changes produced may be clearly seen therefrom. Cases might be quoted in which similar allegations of deposits have upon investigation proved to be entirely due to discrepancies in soundings.

With regard to the existence of a spit, and a high bank immediately at the back of the breakwater, there can, of course, be no doubt or question.

*As to the Source from which the Sand comes.*—From Mr Blair's memorandum it appears that the breakwater was completed in May, 1887 to its present length of 1,950ft. Sand was then just beginning to show at the commencement of the curve, 1,400ft. out from the shore. It edged gradually along the back of the breakwater and in September, 1887 after about six weeks of continuous south-west weather, it appeared at the end of the structure.

At first the sand formed a small spit in line with the breakwater, then it moved gradually round to about the direction which it at present occupies.

We have no doubt that the sand, both in the spit and at the back of the breakwater, was derived from the sea-bed and foreshores west of Mikotahi, and more particularly from the great accumulations on the shore and in the sandhills south of Pokoroa.

The sand from these sources, stirred up during south-west gales, would be carried northward, in suspension by wave-action, and by the north-easterly current, which, according to the *New Zealand Pilot*, runs at fully a knot and a half per hour after south-west gales, a velocity sufficient to transport and carry northward large quantities of sand when violently agitated by the sea. Moreover the prevailing winds and heaviest seas are from the south-west.

*Temporary Relief.*—The most recent information shows that the southern point of the spit is gradually working across towards the Hawea wreck, and closing the approach to the wharf. Some relief in this respect may be afforded by the employment of the grab dredging-crane now on the works in the removal of the sand from the southern extremity of the spit, where the machine could be more advantageously employed, than in an attempt to form and keep open a channel through the spit itself.

We would therefore strongly recommend that this dredging-crane be applied forthwith, and kept continuously employed at this spot until the pump-dredger above described has been brought into operation.

*Conclusion.*—In our opinion, the proposed outlay on the pump hopper-dredger, and its maintenance and upkeep, would be fully justified under the circumstances. Its adoption would not be associated with operations of an experimental character, and satisfactory results can be confidently looked for from its employment. It cannot fail to maintain the depth in the harbour, notwithstanding the movements of sand which have been shown to be in operation, a similar assurance could not be given under any other treatment or mode of procedure.

The works as completed, if kept free from the incumbrance of sand, would afford excellent accommodation for discharging and loading such vessels as trade between the provincial ports, and we therefore strongly recommend that the mode of procedure we have put forward for adoption be approved.

We have, &c.,

JOHN COODE.

JOHN BLACKETT.

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