1927.

NEW ZEALAND.

REPORT OF ROYAL COMMISSION

APPOINTED TO INQUIRE INTO AND REPORT UPON

HARBOUR BOARD MATTERS AT NAPIER.

WELLINGTON.
BY AUTHORITY: W. A. G. SKINNER, GOVERNMENT PRINTER.
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REPORT—*continued.*

1927.

NEW ZEALAND.

NAPIER HARBOUR BOARD MATTERS

(REPORT OF ROYAL COMMISSION ON).

Presented to both Houses of the General Assembly by Command of His Excellency.

COMMISSION

TO INQUIRE INTO AND REPORT UPON HARBOUR BOARD MATTERS AT NAPIER.

CHARLES FERGUSSON, Governor-General.

To all to whom these presents shall come, and to JOHN SAXON BARTON, Esquire; ARTHUR CECIL MACKENZIE, Esquire; and JOHN BIGGAR WATERS, Esquire: Greeting.

WHEREAS it is provided by section two of the Commissions of Inquiry Act, 1908, that the Governor-General in Council may appoint any person or persons to be a Commission to inquire into and report upon, *inter alia*, any question arising out of the administration of the Government, or the working of any existing law, or regarding the necessity or expediency of any proposed legislation:

And whereas by the Napier Harbour Board Empowering and Loan Act, 1884, the Napier Harbour Board (hereinafter called "the Board") was duly authorized, subject to the provisions of the Harbours Act, 1878, to construct such harbour-works as should be by the Board considered necessary for the requirements of the Harbour of Napier, and the Board did, pursuant to such authority, duly proceed with the construction of the harbour-works known as the Breakwater Harbour at Napier:

And whereas by the Napier Harbour Board Empowering and Loan Act, 1914, the Board was, subject to the provisions of the Harbours Act, 1908, and of the said Act of 1914, duly authorized to construct such harbour-works as should by the Board be considered necessary for the requirements of the Harbour of Napier in and about the construction, completion, development, and improvement of the Inner Harbour portion of the said harbour, but has not, as required by the Harbours Act, 1908, submitted plans of the proposed works for the approval of the Governor-General in Council except in so far as relates to the reconstruction of certain existing works:

And whereas it appears to the Government that it is expedient to appoint a Commission to make inquiry into and report regarding the question as to whether the authority to construct wholly or in part the works specified in the Napier Harbour Board Empowering and Loan Act, 1914, should be continued in force and the work authorized in due course, or whether legislation should be enacted

to revoke the said authority, wholly or in part, and also to inquire into and report as to the most practicable scheme, having regard to all relevant considerations, for the construction of a harbour suitable for the requirements of the Hawke's Bay District:

And whereas a Bill intituled the Napier Harbour Board Empowering and Loan Bill, 1926, purporting to authorize the Board to reclaim certain areas of land therein described, was during the last session of Parliament introduced thereinto, but after consideration thereof was not allowed to proceed, and it is expedient that a Commission should be appointed to inquire into and report as to the necessity or expediency of the proposed legislation and as to the other matters hereinafter set out:

Now, therefore, I, General Sir Charles Fergusson, Baronet, Governor-General of the Dominion of New Zealand, in exercise of the hereinbefore-recited powers and of all other powers and authorities enabling me in this behalf, and acting by and with the advice and consent of the Executive Council of the said Dominion, do hereby appoint you, the said

JOHN SAXON BARTON,
ARTHUR CECIL MACKENZIE, and
JOHN BIGGAR WATERS

to be a Commission to inquire into and report upon the following questions:—

1. (*a*) Whether, in view of reports already furnished and of any further investigations which you may see fit to make, it is practicable to construct a harbour suitable for the requirements of the Napier Harbour Rating District as at present constituted (*a*) at the Inner Harbour, or (*b*) at the breakwater.
   (*b*) If so, which of such schemes you would recommend as providing the best and most suitable harbour from an engineering, navigational, and economic point of view.
   (*c*) Whether the expenditure of the money necessary to construct such a harbour, taking into account the amount already expended, can be justified from the financial and economic aspect.
   (*d*) Whether, taking into account all relevant considerations, it is advisable that such a harbour be constructed.
   (*e*) Whether, in view of all the circumstances, there is any other scheme which you can recommend in preference to those mentioned in paragraph (*a*) above, as providing for the said district the acccommodation and facilities required.
   (*f*) Whether the reclamation of the areas described in the First and Second Schedules to the Napier Harbour Empowering and Loan Bill, 1926, or any other areas within or adjacent to the Harbour of Napier and the lands vested in the Napier Harbour Board, should be authorized, and, if so, to what extent, and by what arrangement can any such reclamation be most economically and satisfactorily accomplished.
2. Whether at the present time, according to the working of the existing law (namely, the Harbours Act, 1923, and by-laws made thereunder), the port dues, berthage dues, wharfage dues, charges for labour and on goods, and other charges which the Board is empowered to levy, are imposed in a manner operating equitably as between different classes of ships, and as between the different parts of the harbour in which ships are or may be worked, and as between the different classes of persons liable pursuant to the Harbours Act, 1923, for payment of the said respective dues.
3. And generally to inquire into and report upon the premises and any matter arising thereout which may come under your notice in the course of your inquiries and which you consider should be investigated in connection therewith.

And with the like advice and consent I do hereby appoint you, the said

JOHN SAXON BARTON

to be the Chairman of the said Commission.

And you are hereby authorized to conduct any inquiry under these presents at such times and places as you deem expedient, with power to adjourn from time to time and place to place as you think fit, and to call before you and to examine on oath or otherwise such persons as you think capable of affording you information as to the matters aforesaid, and to call for and examine all such books, papers, writings, documents, and records as you deem likely to afford you the fullest information on any such matters:

And, using all due diligence, you are required to report to me, under your hands and seals, not later than the thirty-first day of August, one thousand nine hundred and twenty-seven, your opinion on the aforesaid matters.

And you are hereby strictly charged and directed that you shall not at any time publish or otherwise disclose, save to me in pursuance of these presents or by my direction, the contents or purport of any report so made or to be made by you.

And it is hereby declared that this Commission shall continue in full force and virtue although the inquiry be not regularly continued from time to time or place to place by adjournment.

And I further direct you, having regard to the local scope of this Commission, to consider what sums representing the whole or any portion of the costs of your inquiry should be borne by the Harbour Board and by the respective corporate bodies represented by the local authorities of any district lying wholly or partly within the Napier Harbour Rating District as now constituted, and any other corporate body or individual, or by any of them, and to make provision for citation of parties and orders for payment of costs accordingly pursuant to the powers conferred by the Commissions of Inquiry Act, 1908.

And, lastly, it is hereby further declared that these presents are issued under and subject to the provisions of the Commissions of Inquiry Act, 1908.

Given under the hand of His Excellency the Governor-General of the
[L.S.] Dominion of New Zealand, and issued under the Seal of that Dominion, this twenty-fifth day of July, one thousand nine hundred and twenty-seven.

G. JAS. ANDERSON,
Minister of Marine.

Approved in Council.

F. D. THOMSON,
Clerk of the Executive Council.

REPORT.

To His Excellency the Governor-General, Dominion of New Zealand.

MAY IT PLEASE YOUR EXCELLENCY,—

PART I.—PRELIMINARY.

We were each advised by letter during the month of July of our respective appointments to this Commission, and in due course we received Your Excellency's Warrant of appointment and the order of reference. We thereupon caused public notice of the appointment and of our intention of entering on the hearing of the matters embodied in the order of reference to be given. This notice took the form of advertisements setting out the time and the place of hearing, a brief outline of the scope of the inquiry, and an invitation to interested parties and persons, able by evidence to assist the Commission, to place themselves in communication with us. These advertisements were duly published in the newspapers, a list of which appears in Table A in the appendix hereto.

PART 2.—OPENING OF SITTINGS.

The place appointed for the sittings was the Council Chamber of the Napier Borough Council, and the Mayor of the borough very kindly placed his room at our disposal as an office where we could meet for our private conferences, and for our work whilst we were not actually in session. We arrived in Napier on Wednesday, the 3rd August, and the Commission was duly opened at 10.30 a.m. on Thursday, the 4th August, 1927. Each of us took his seat at the opening and was present throughout the whole of the sittings. On the inquiry being declared open at 10.30 a.m. on the 4th August the Chairman read Your Excellency's Warrant of appointment and the order of reference, and thereafter that document was left available for inspection by all responsible interested parties.

PART 3.—LEGAL ASSISTANCE.

Mr. A. Gray, K.C., appeared, with Mr. Grant, for the Napier Harbour Board, and Mr. H. B. Lusk appeared for the Marine Department, throughout the inquiry, and at the later stages, to put before the Commission also the views of the Napier Borough Council on the matter of land-reclamation.

Although the appearance of counsel is thus recorded it should be stated that the proceedings were not conducted in the ordinary way of litigation between contesting parties. Mr. Gray announced at the opening that his instructions from the Harbour Board were to call witnesses for the assistance of the Commission without respect to their standing in the matter of the parties which have arisen on the Harbour Board out of divergent views as to the best policy of harbour-construction. In pursuance of this policy Mr. Gray put forward as his first witness Mr. A. E. Jull, Chairman of the Harbour Board, a strong supporter of the Inner Harbour policy which commands the votes of the majority of the Harbour Board as at present constituted, and as his second witness Mr. P. F. Higgins, a member of the Harbour Board who just as strongly advocates the breakwater harbour policy, which is acceptable to the minority of the Harbour Board at present. Mr. Lusk made a statement on behalf of the Minister for Marine to the effect that there was nothing further from the Minister's wishes than that the Commission should be made the occasion of a personal conflict between persons holding different views, or that there should be any expressions of personal antagonism. The Minister desired him to say also that all questions of mistakes either of policy or administration should be avoided. If there had been any such mistakes, their realization would be to the benefit of the district, and no good purpose would be served by ventilating them now. It was for the good of the community that they should be allowed to rest.

PART 4.—REPORTING.

With the assistance of the Public Service Commissioner and the Justice Department, the services of the Clerk of the Magistrate's Court at Napier had been made available as Clerk to the Commission; whilst the services of Mr. Martin, of the Magistrate's Court at Napier, were placed at our disposal as a reporter to take a verbatim report of the evidence direct on the typewriter. This proved to be a satisfactory method of recording the evidence, and throughout Mr. Martin was able to take an accurate record at a speed representing the utmost of our ability to understand, assimilate, and collate the evidence. We think it right that we should here place on record the fact also that three local newspapers were represented at the inquiry throughout, and these papers all published the most excellent reports day by day of the proceedings. These reports were marked by fullness, clearness, and fairness, and we have every reason to believe that they stimulated and fed a marked public interest in the matter of the inquiry and the evidence tendered, and we believe that they have performed a most marked public service in making the constituents of the Napier Harbour Board better acquainted with the facts underlying the harbour problem than they have ever been before.

PART 5.—LENGTH OF SITTING.

The Commission, after a formal opening on Thursday, the 4th August, adjourned until 10 a.m. the next day, spending the remainder of the 4th August in a study of the topography and geography of the district and the existing state of the harbour-works. Beginning on Friday, the 5th August, at 10 o'clock, we sat continuously until Tuesday, the 13th September, at 5 p.m., when we formally adjourned the sittings to 2 p.m. on Monday, the 19th September, 1927, at the Conference-room of the Dominion Farmers' Institute at Wellington. At this time and place the evidence of two witnesses was taken, and Mr. A. Gray, K.C., for the Harbour Board, and Mr. H. B. Lusk for the Marine Department, addressed us on matters of law arising out of the order of reference and of the question of the incidence of the costs of the whole proceedings. We set out in Table B in the appendix a detailed list of the days and hours on which we sat at Napier and Wellington.

PART 6.—NUMBER OF WITNESSES, FORM OF EVIDENCE.

We heard in all forty-seven witnesses; we set out in Table C in the appendix hereto a list of these witnesses, giving opposite the name of each the representative capacity in which he appeared. Several of these witnesses were recalled subsequently to their first appearance, some of them being called more than twice. It is obvious that to preserve logical sequence it would have been better if this recalling could have been avoided, but in the very nature of the case and in the circumstances under which we sat it was unavoidable. Much of the evidence was highly technical, and most of this evidence was put forward by witnesses whose minds were made up in support of one or other of the rival harbour schemes. This meant that when such evidence was tendered one or other of the counsel engaged would require to cross-examine, and, in preparation for such cross-examination, to consult with his own expert witnesses. Furthermore, the engineering member of the Board of Commissioners required time to read and re-read the evidence of engineering witnesses and consider this evidence before considering himself able effectively to question such witnesses. We were anxious to avoid delay in unduly prolonging the hearing, and we therefore filled in the intervals by calling other witnesses. Further, many witnesses were called from Wellington, and they attended at Napier in answer to the Chairman's summons. It was not possible to time their arrivals with the stage of the proceedings where their evidence could be best fitted in to preserve logical sequence, whilst, on the other hand, we were strongly desirous of saving the expenditure of public money as much as possible by taking their evidence soon after their arrivals, and releasing them. Furthermore, as the case developed and more and more engineering and navigational evidence was brought out, the necessity of calling rebutting evidence arose, and counsel desirous of tendering this rebutting evidence had to rely on witnesses who had already appeared in the witness-box. These facts account for the admittedly disjointed record presented by the official record of the evidence, and it has undoubtedly added to our difficulty in grasping and assimilating the evidence, but it was in all the circumstances unavoidable. The official record of the evidence is contained on 626 typewritten sheets, and there was tendered in support of this evidence 177 exhibits, some of them being of a composite nature. A list of these exhibits appears as Table D in the appendix hereto.

The form of some of the evidence calls for a further explanation at this stage. After the Commission sat for a little over a fortnight it became apparent that the sittings would last much longer than was at first contemplated, and we therefore discussed the question of ways and means of hastening the process of taking evidence without running the risk of lessening its reliability and value. We therefore wrote to all public bodies who had notified us of their desire to be represented by witnesses at the hearing, and we framed and submitted to them questionnaires, endeavouring to direct the attention of these bodies and their witnesses to the points on which we particularly required information. We further requested that their answers to our questions should be set out in a typed form that would allow it to be incorporated, as originally typed, in our notes of evidence. By arrangement with counsel these typed statements were, as far as possible, accepted, and thus when these witnesses were called a few preliminary questions were put to them, and they then produced, read, and submitted their typewritten statements, and on these they were cross-examined and their answers recorded in the ordinary way. This proceeding involved members of the Commission in a great deal of evening work in framing questions, and in corresponding with prospective witnesses, but it had the advantage of keeping the attention of witnesses concentrated on the precise points at issue, and in saving a great deal of time when the witness was actually in the box.

PART 7.—STATUS OF ENGINEERING REPORTS.

Your Excellency's order of reference directed us in seeking an answer to the questions submitted to us to take into account published reports as well as oral evidence during our investigations, and we did so. The reports dealing with the various aspects of harbour problems and harbour-construction in Napier are very numerous, and they are spread in time over a period of half a century. We set out in Table E of the appendix a list of these reports, showing in each case the name and qualifications of the writer and the approximate date of his report. A complete set of these reports accompanies this report in the form of a single bound volume, identified by the endorsement "Commission's Exhibit No. 1." It will be seen from a perusal of the contents of this volume that we were faced with the task of studying and assimilating a large body of printed matter. This had to be read not once or twice, but, as the evidence tendered before the Commission threw new light on the subject-matter before us, introduced new factors, and opened up fresh points of view, it became necessary for us over and over again to go back to these reports and to make a prolonged study of them. This work had to be undertaken during the period in which we were sitting and receiving and recording evidence, and necessitated our working during practically the whole of our waking hours in the six weeks we were at Napier.

PART 8.—BRIEF HISTORY OF PORT TO ITS PRESENT STATE.

It appears that the first survey of the Ahuriri district was made in the year 1851. The tide at that date flowed in and out of the Ahuriri Lagoon through a natural channel, there being no moles or protective work. In these circumstances the position of the channel from time to time was variable, and its average depth and the position of its deepest channel were subject to constant fluctuations.

In 1862 Mr. Charles Weber was appointed Provisional Engineer for the district, and he was still in that position when, in 1876, the Napier Harbour Act, 1876, was passed, and he became the Resident Engineer to the newly formed Board. He held that position until March, 1879, and on severing his connection with the Board he made a report recording the progress to date in the construction of the port.

In 1873 Mr. McGregor had recommended a breakwater harbour to be built between the Bluff and the Eastern Spit. In 1875 Mr. Carruthers, the Colonial Engineer, had built a test timber groyne to test the question of travelling shingle as affecting the practicability of a breakwater. The result was to cause Mr. Carruthers to report against the construction of the breakwater and to recommend the development of the Inner Port. This work was persevered with when the Harbour Board came into existence in 1876, and between that year and 1878 the east and west piers were built to fix and protect the entrance channel, at a cost of £60,000. Some wharves had been built and some dredging done. Mr. Weber's last official act seems to have been the preparation of a memorandum containing data for the guidance of Sir John Coode, who had been asked to report on and recommend the harbour-works for Napier.

Sir John Coode, M.Inst.C.E., reported in March, 1880, and he joined with Mr. Weber in condemning McGregor's proposed breakwater harbour on the ground that it would inevitably become blocked with shingle and prove a failure. He recommended the extension of the eastern and western piers at the entrance by 400 ft. each, and a deepening of the entrance channel to 10 ft. below low water, spring tides, giving an estimate of the cost of that work, together with a supplementary estimate of the cost of a further instalment of work consisting of the extension by a further 400 ft. of each of the piers and the deepening of the channel to 12 ft.

After receiving Sir John Coode's report the Harbour Board called for competitive designs for the best method of providing a harbour for Napier. A Board of engineers in England was appointed to judge the designs and schemes, their fee being fixed at £600. They awarded the prize of £500 to Mr. W. W. Culcheth, of Victoria, Australia. In his report Mr. Culcheth, in outlining the proposed works for the Inner Harbour, named the third essential as "the maintenance of a depth of 20 ft. at low water in the channel between the moles and in the approaches thereto."

The minutes of the various meetings of the Board in 1882 disclose the extraordinary fact that in the opinion of the Board this design, which had cost £500 as prize-money and £600 as the fee to the English judges, did not meet the requirements of the Harbour Board district, as it contemplated an expected depth of 20 ft. only, and the Board regretted that in giving particulars "the class of vessels to be provided for was not more distinctly stated." No use, therefore, has ever been made of Mr. Culchet's reports and plans.

Mr. John Goodall, M.Inst.C.E., of Timaru, was next approached, and he was asked to prepare plans and specifications with estimate of cost of a harbour at the Bluff, and in January, 1884, Mr. Goodall made his report to the Napier Harbour Board.

The financial history of the Board at this date was that about £75,000 had been raised and spent on the Inner Harbour. Mr. Goodall in his report condemned the Inner Harbour scheme and recommended the construction of a breakwater at the Bluff. The distinguishing feature of his scheme was the carrying-out of the breakwater from the Bluff at an obtuse angle to the set of the waves of the prevalent seas, so that the waves would run along the wall and be reflected along the beach, the design being that when the breakwater was sufficiently far out the force of the reflected waves would be great enough to drive the shingle back from the works.

This plan was in February, 1884, approved, and legislation was promoted to authorize the construction of the Breakwater Harbour and the raising of the necessary money. The work was commenced in 1886, and in 1909 the breakwater was finished to its present state and condition, but by no means finished according to Mr. Goodall's design. The expenditure on it to that point was £443,840; that included the building of the breakwater and the Glasgow Wharf. In the twenty-five years 1884 to 1909 a further £2,730 had been spent on the Inner Harbour, so that in 1909 the position was—Amount spent on the Inner Harbour, £77,730; amount spent on the Breakwater Harbour, £443,840.*

As already pointed out, the breakwater was not finished according to Goodall's design, and it has continued to the present day in an unfinished state. That this is so is clearly traceable to the fact that the Board has from time to time vacillated between the Inner Harbour and the Breakwater Harbour proposals.

In 1894 a series of storms inflicted damage on the breakwater. On the 7th February, 1894, there occurred what has been described as a storm with a heavy south-easterly swell. This caused

* This amount (£443,840) includes certain sums spent on reclamation of land and on beach protection works, but it was not found practicable to separate these items during our inquiry. They have not been kept separate in the Board's accounts.

a rocking of the structure, crushing the top of the buttress and pushing down the lower part of it. On the 12th April, 1894, a hurricane blew from the north-east, the east, and south-east. Three seas were at times breaking simultaneously on the work. Some of the monoliths were fractured and others destroyed. On the 19th June a heavy south-easterly sea increased the damage to all parts of the structure. In two places portions of the monoliths were washed away, leaving the tops of the blocks appearing just above low water, whilst the monoliths at the end, for a distance of about 96 ft., were entirely destroyed and washed away. Messrs. C. Napier Bell and J. P. Maxwell, M's.Inst.C.E., were instructed to inspect and report on the damage, and the above description of the damage is taken from their report, which is dated 4th September, 1894. It should be noted that in 1894 the breakwater had been constructed only to the shore end of the second curve. Messrs. Bell and Maxwell further reported that although they thought it necessary to strengthen the exposed part of the structure they did not look upon the damage sustained as a serious failure of the work, and added that failure of much greater magnitude has been common in such structures elsewhere. They estimated the cost of repair at £19,000, and recommended the completion of the breakwater to the Auckland Rock, an addition of 1,450 lineal feet.

In May, 1906—that is, whilst the breakwater was still in course of construction, but nearly finished to its present stage—the Board communicated with Mr. J. W. Marchant, C.E., and asked him to report upon harbour-construction for Napier, and to supply plans, estimates, and details of his proposals. He was informed that the Board desired him to consider and report on the question whether the Breakwater Harbour or the Inner Harbour was the most likely to be permanently successful in respect of structure and efficiency as the harbour for the Hawke's Bay District. Mr. Marchant reported in July, 1906. He unhesitatingly condemned the Inner Harbour scheme, and recommended the completion of the breakwater scheme, of which he approved. He considered that the successful construction of the Inner Harbour required the building of a mole or breakwater 5,150 ft. in length to protect the entrance channel, and he considered that the annual cost of dredging and maintaining the full depth of water in the lee of this mole was a matter of conjecture. He concluded : " The completion of the breakwater, its enclosure and equipment, can be confidently recommended as against any project for forming a harbour at the Spit, for reasons stated." The Board adopted Mr. Marchant's recommendation, but on appealing to the ratepayers to sanction the necessary loan the proposal was defeated.

Shortly after this Mr. George Nelson, a member of the Institute of Mechanical Engineers, published a proposal for the improvement of the Inner Harbour, and seems to have spent much time, money, and energy in the furtherance of this project.

The Board, apparently unwilling to act on the advice of Mr. Goodall backed by the advice of Mr. Marchant, decided to get further expert opinion on the matter, and Messrs. J. P. Maxwell, M.Inst.C.E., Mr. Cyrus J. R. Williams, M.Inst.C.E., M.Am.Soc.C.E., and J. Blair Mason, C.E., were asked to report. Their instructions were to trace the history of the port from its inception, and make such local investigations and inquiries as they thought fit to enable them to properly consider and report on the question of the best location and system for construction of a harbour suitable for the Port of Napier and the district served by it, to estimate the cost of carrying out the necessary work and of maintaining the harbour when constructed. They completed their investigations and made a report, which is dated July, 1909. This report appears in the Commission's Exhibit No. 1, beginning at page 103.

These eminent harbour engineers are most emphatic in their condemnation of the Inner Harbour proposal. Like Mr. Marchant, they consider that the entrance channel would need a protective mole. They conclude : " Our final recommendation is that the Board should actively push on the completion of the Breakwater Harbour in accordance with Plan No. 2 attached to this report." Again the Harbour Board approached the ratepayers with the loan proposal to carry out this scheme, and again the proposal was turned down. The floodgates of controversy seem to have been opened about this time, and Mr. George Nelson is much in evidence as an advocate of the Inner Harbour scheme and the uncompromising opposer of the Breakwater Harbour. In September, 1909, the Harbour Board instructed that a letter be sent to Messrs. Maxwell, Williams, and Mason, asking for fuller information on certain points. In their reply Messrs. Maxwell, Williams, and Mason used the strongest and most uncompromising language that professional men writing on their professional subject could possibly employ in condemnation of the projected Inner Harbour scheme. They declared that the proposed entrance channel to the Inner Harbour, being an unprotected channel in the open ocean, was a proposition of the kind that needed only to be stated to display its own refutation on the very face of the statement, and they based this statement on reasons which they gave arising out of their observations of local conditions and their experience of the principles of harbour-construction. This, however, does not seem to have guided the Harbour Board to a conclusion—a state of things that we find the utmost difficulty in understanding and endeavouring to explain. To endeavour to explain it we can only refer to Mr. George Nelson's publication " The Napier Harbour Question," appearing in the Commission's Exhibit No. 1 as pages 43 to 94. Here are to be seen criticisms, offers, challenges, and newspaper correspondence, all apparently from laymen in matters of harbour-construction, and pouring scorn on the conclusions of the experienced engineers who, with a remarkable unanimity, had endeavoured to point the Board to a conclusion. The position is perhaps further explicable by facts which we shall refer to later on ; but it may be definitely stated here as a fact that collateral harbour advantages and the apparent excellencies that lie on the surface of a *prima facie* study of the question all favour the Inner Harbour proposals, whilst the defects seem to be those that require expert engineering and navigational experience to appreciate and state. Furthermore, there is a significant survey of the position in the evidence tendered before us of Mr. A. E. Jull on page 43 of the official evidence. Mr. Jull said in his evidence, " That portion of the district which is responsible for 84 per cent. of the payment of any rates has since 1911, and in

spite of any recommendations of engineers to the contrary, been steadfast in their adherence to the Inner Harbour proposal." It may be added at this point that this statement by Mr. Jull was not a chance remark, but an apparently well-considered statement made at a time when Mr. Jull was practically reading his evidence from carefully prepared notes.

After Messrs. Maxwell, Williams, and Mason's report had been put in in 1909 a state of stalemate seems to have been reached until July, 1911. In that year Mr. William Ferguson, M.Inst.C.E., of Wellington, was asked to visit Napier and advise the Harbour Board in its difficulties. On the 9th July, 1911, Mr. Ferguson attended a meeting of the Board at Napier, was instructed as to the Board's object in sending for him, and he answered questions and advised the Board as to what, in his opinion, should be done. A shorthand note was taken of all that proceeded at the meeting, and the full typewritten transcript is available, and appears as pages 119 to 137 in the Commission's Exhibit No. 1. The Chairman submitted two main questions to Mr. Ferguson at the beginning. They were—(1) Should the Board do dredging or other works necessary to secure data before seeking further professional advice to report on the respective merits of the two harbours? (2) If further dredging was recommended, should the Board buy or hire a dredge for that purpose?

Mr. Ferguson opened by expressing the opinion that the question of harbour-construction was not urgent, and that there was nothing to warrant the Board rushing into either works or schemes until it had all the data necessary to form a sound opinion. Mr. Ferguson states—

"I think you should wish to go easily, to wait until you are satisfied by expenditure in testing the various schemes as to which is suitable, and then, if you are still satisfied that it is wise to do it commercially, push on. At the present this is largely a matter of sentiment. You may get an Inner Harbour at a cost. It behoves you as business men to go easily—not niggardly, but to spend whatever is necessary to make the tests and then get a sound opinion and act upon it. What are the tests? The three engineers who reported, reported, I understand, that they did not approve of the Inner Harbour scheme because they felt certain that the dredging to form a channel in the open sea would be followed by a silting up, and I think they state that in heavy weather the channel would be liable to be obliterated and the port would be closed until it was reopened. This was simply a way of expressing their views, and I presume was not literally meant that a single storm would close the channel. As it is not a matter of grave urgency, I would spend a few thousand pounds in putting it to the test. It is not as if you had a huge city and the whole of its trade was in immediate risk because you are afraid of the silting of your harbours and you had to keep the trade open at all costs. You have carried on your trade successfully for many years, and I don't see why you cannot do so for some time to come. Hire or purchase a dredge and put it to work out in the open; dredge an area, certainly not less than 10 acres; carefully sound the area, not only 660 ft. square, but an equal distance all round it, and thus determine the nature of the bed of the ocean through dredging it; carefully sound again and find what variation, if any, exists in the surface of the ocean-bed after the dredging. Leave it for twelve months at least; sound it carefully again; if results are not conclusive perhaps it will be necessary to dredge again and sound again. Then you will have data which will show you whether the action of the sea is as stated by these three engineers (Hear, hear), whose opinion has to be listened to with every respect—whether it is as they say. If it silts up—and it is shown to be undoubted that it has entirely silted up—by the action of the sea, then you have your answer and it disposes of the question fairly well. If, on the other hand, it only silts up to a limited extent, you have data as to the expenditure you have to go to in annually dredging out that area."

As the result of that advice the Wellington harbour dredge "Whakarire" was chartered for three months, and on the 8th November, 1911, she arrived at Napier and started dredging that experimental patch of 10 acres to a depth of 34 ft. From that date to the 12th January, 1912, the "Whakarire" worked on that patch. In that time she dredged a patch 34 ft. deep and about 3 acres in extent—in all, that is—3 acres top superficial measurement, the hole being $1\frac{4}{5}$ acres at the bottom, the remaining $1\frac{1}{5}$ acres being accounted for by the slope of the sides. The dredgemaster's log in that period is almost one continuous record of difficulties and minor disasters. The experiment was then abandoned, as it was not possible to exceed the three-months charter, and in the opinion of the dredgemaster it would have taken at least nine months to dredge out the 10 acres. The dredgemaster in his evidence before this Commission stated that he had never before undertaken dredging in such an exposed part as the patch at Napier. Thereafter, soundings were taken by Mr. C. D. Kennedy, C.E., at the request of the Harbour Board and in accordance with Mr. Ferguson's advice. Mr. Kennedy's reports, seven in number, appear as pages 141 to 147 in the Commission's Exhibit No. 2. This experiment and the subsequent soundings provided data on most interesting and important problems in the matter of Inner Harbour construction. Firstly, there is the important evidence as to the practicability of dredging the entrance channel to the Inner Harbour in the open ocean, and this falls into two divisions—(*a*) Problems revealed by navigational and mechanical difficulties due to weather, seas, and ocean swell, and (*b*) problems revealed by the nature of the sea-bottom material as to its consistency and specific gravity and its suitability for suction dredging. Secondly, there is the evidence afforded by the soundings as to the effect of natural forces playing on the dredged patch. This includes all the evidence to be gleaned from Mr. Kennedy's soundings.

At this point again we come to a policy and course of action that we find hard to understand. The outstanding feature of this series of events at this stage is the important fact that Mr. Ferguson's excellent advice was not followed at all faithfully—in fact, what was done bears little resemblance to what Mr. Ferguson proposed. To begin with, Mr. Ferguson stipulated that a 10-acre patch at least should be dredged ("certainly not less than 10 acres," were Mr. Ferguson's words). He also said,

referring to the channel between the moles, "You should run a narrow cut through the boulder-bank—not a very wide one, but a deep one—say, to 33 ft. or 34 ft. at low water. You do not want to endanger the existing timber works, but such a cut as to show the nature of the bottom." Neither of these things was done. It is true that the reason is that the dredging-master tried to do the suggested work on the "patch" in the bay and found it physically impossible to do so in the conditions that obtained, while the navigating officer of the "Whakarire" refused to risk her in the channel between the moles. When he sought to work on the outer channel, wind, sea, and ocean swell operated to reduce the actual dredging-time to about 30 per cent. of the working-time, and to reduce seriously the efficiency of that dredging-time. As to dredging between the moles, the dredging-master in his evidence said most emphatically that he could not have dredged in the channel between the moles. The evidence shows that the dredging-master did his best, and is not to be blamed for the abandonment of the project; but these facts never seem to have been put before Messrs. Cullen and Keele when subsequently they were asked to report on the feasibility of opening and maintaining the outer channel.

Then again, Mr. Ferguson, at the beginning of his conference with the Board, was asked whether he would recommend dredging for the purpose of securing data *before the Board considered the question of seeking further professional advice* to report on the merits of the two harbours. His answer was "Yes," and he stated, "It is not a matter of grave urgency (that is, the building of your harbour). Dredge 10 acres at least; sound it again and again; leave it for *twelve months at least*, sound it carefully again; if results are not conclusive perhaps it will be necessary to dredge again and sound again."

Again the Board's policy of vacillation and intolerance of expert opinion seems to dictate its actions. Mr. Ferguson's excellent advice was given on the 9th July, 1911. The dredge "Whakarire" was chartered and began her work on the 8th November, 1911, and on the 20th December, 1911 the Board wrote to two Australian engineers, E. A. Cullen and T. W. Keele, Ms.Inst.C.E., asking them to visit Napier and advise the Board upon the best means to be adopted for carrying out certain improvements by dredging. They came, and on 14th March, 1912, they met the members of the Board at Napier, and were forthwith asked to enlarge the scope of their inquiry so as to embrace (*inter alia*) the feasibility of developing the Inner Harbour to accommodate ocean steamers *on the lines already proposed.* Mr. Jull in his evidence on page 8 described what took place in the following words: "*Mr. George Nelson's Inner Harbour scheme was also submitted to them.*" Thus less than eight months after receiving Mr. Ferguson's advice, and having in the meantime undertaken the sadly curtailed dredging experiment, the only lesson from which was that the dredge had experienced grave difficulties in trying to dredge on the site of the channel, the Board is back again at the old quest for an engineer or engineers who would approve the Inner Harbour "on lines already proposed" by Mr. George Nelson. There is no trace anywhere in the reports, correspondence, or the evidence tendered before us that Messrs. Cullen and Keele were ever informed of the experiences of the "Whakarire;" whilst the dredgemaster of the vessel, Mr. Martin, in giving evidence before us, said, "Messrs. Cullen and Keele did not in 1925 apply to me as to my dredging experiences. I saw them in 1912 and they asked me some questions about dredging in Napier. As far as I can recollect there was no very pointed reference; that was just a casual conversation." There is no evidence before us that Messrs. Cullen and Keele were ever informed of the important fact that the dredgemaster of the "Whakarire" had found the bottom of the sea on the point where he dredged to be composed of a fine sand, so light and fine that it came up in the buckets in a liquid mixture that tended to go overboard as fast as it was poured in to the dredge's hopper.

Messrs. Cullen and Keele reported in August, 1912. In brief, they reported that both harbour schemes, Inner and Breakwater, were practicable. They considered there was no proof of the sand-drift that Messrs. Maxwell, Williams, and Mason deemed to be a critical feature when considering the feasibility of cutting and maintaining the outer channel, and they concluded that it was feasible in the first place to dredge, and later, by dredging, to maintain, that channel at a depth that would allow ocean-going steamers to use it and enter the Inner Harbour thereby. Their conclusion was, "It will be seen therefrom that we consider that a satisfactory harbour can be obtained by developing the Inner Harbour on the lines indicated at the cost given in the estimates. We have also shown, as requested, what we consider should be done to complete the Outer Harbour scheme to an extent sufficient to satisfactorily meet the present and those future requirements that may reasonably be expected, and have furnished our estimates of the cost thereof."

Some correspondence then passed between the Board and Messrs. Cullen and Keele, and on the 20th November, 1912, a cable was sent to Messrs. Cullen and Keele in the following words: "*Although Harbour Board has arrived at decision* upon your report, they desire, for information of ratepayers, to whom proposals must finally be submitted, that you kindly give Board your straight-out opinion as to whether the breakwater or Inner Harbour is the better proposal for Board to adopt. Kindly cable joint reply.—JULL." On the 25th November Messrs. Cullen and Keele replied, "We advise adoption of Inner Harbour proposal in preference to breakwater scheme.—CULLEN AND KEELE." (The italics above are ours.)

The Board adopted this recommendation and the recommended scheme, and in 1914 a Bill was submitted to Parliament seeking authority to construct the Inner Harbour, and for that purpose to borrow £300,000. That Bill was passed, becoming the Napier Harbour Board Empowering and Loan Act, 1914. Messrs. Cullen and Keele's scheme included an embankment defining and enclosing the Inner Harbour on its south and western sides. The site of this embankment was agreed upon in consultation between them and the Harbour Board and the Engineer-in-Chief for Public Works for the Dominion. An agreement was arrived at whereby the embankment which was necessary for the Inner Harbour should be so placed as to situation, and so constructed, as to serve the purposes also of a railway embankment to carry the East Coast Railway northwards from Napier, and an embankment

roadway serving road traffic on the east coast north of Napier. Any conflict of interests that became apparent was settled by compromise, the Harbour Board agreeing to a construction that would carry the railway, and the Public Works Department agreeing to the embankment being thrown farther west than they contemplated or desired so as to allow the space included to be adequate for harbour purposes.

In 1914 the Great War began and put an end to all constructive works such as were in contemplation here. However, in 1917 the Board was authorized to raise £50,000 to be used for the construction of the embankment, and the £300,000 authorized for Inner Harbour purposes was reduced by that sum, leaving £250,000 available for the balance of the harbour-construction. The ultimate cost to the Board of this embankment, including the diversion to a point outside the Inner Harbour basin of the Tutaekuri River, was £84,274. That sum was the net cost to the Board after the Public Works Department had contributed its quota.

In 1920 it was considered by the Board that the time was opportune to proceed with the harbour-construction, and again the ratepayers were approached and asked to sanction the necessary loan to go on with the Inner Harbour scheme. In accordance with the authority contained in the 1914 Act a poll was taken and the proposal was approved, 3,013 voting for it and 636 voting against it. On the authority of the 1914 Empowering Act, and with the funds made available by the loans sanctioned by the ratepayers in 1920, the Board started a series of works that might be called either "repairs and replacements" on the one hand, or a piecemeal carrying-out of the Inner Harbour construction on the other hand. The building of the embankment that defined the south and west limits of the harbour, and the diversion of the Tutaekuri River, have already been referred to. In addition to these works the Board began the deepening of the channel between the moles by dredging from a jetty built for the purpose. They rebuilt the Nelson Quay (the northern side of the Iron Pot) in a new design and in more substantial materials, and the reconstruction of the Western Quay in concrete was embarked on.

In 1924 a petition was signed by about 1,100 persons, including the Mayors of Napier, Hastings, and West Waipawa. It recited the history from the petitioners' viewpoint of the Harbour Board's activities since the propounding of Mr. George Nelson's scheme in 1909, and submitted that the tremendous financial burden imposed upon them by the unsystematized and abortive expenditure that they had alleged in their petition should be no further increased; it asked for investigation of the breakwater proposals, and prayed that a Commission of Inquiry should be set up to investigate all the matters recited in the petition. This petition was presented to Parliament, and one of the immediate results seems to have been that the Minister of Marine sent the Engineer-in-Chief of the Public Works Department, Mr. F. W. Furkert, to Napier to investigate and report. Mr. Furkert carried out his instructions and reported to the Minister on the 23rd August, 1924. His report appears in the Commission's Exhibit No. 1 as pages 193 to 200.

In his report Mr. Furkert concluded with a recommendation in favour of the Breakwater Harbour. He assumed that there would be no difficulty in cutting the proposed outer channel of the Inner Harbour and in dredging that channel and the channel between the moles to a depth of 35 ft. He arrived at the conclusion, however, that the expense of these works would be much higher than the trade of the district would justify, and, further, that the cost of upkeep would be too great to contemplate, considering the resources of the territory; and, finally, that its use would always be attended by considerable and unjustifiable risks to shipping that would be expected to use it. On the other hand, having in view the history of the breakwater, and the work it had done and the shelter it had afforded to shipping in its unfinished condition, he recommended that the Board's attention and activities should be directed to the completion of that work. This report was made available to the Harbour Board, and after considering it the Harbour Board decided to obtain a further report from Messrs. Cullen and Keele. In November, 1924, they wrote to Messrs. Cullen and Keele and invited them to visit Napier again to investigate four questions, which were—(*a*) The probable cost of completing the Inner Harbour to give safe accommodation for four ocean liners and other vessels that require berthage; (*b*) the question of erecting a half-tide wall controlled by sluice-gates or otherwise; (*c*) the probable cost of completing the Breakwater Harbour to give safe accommodation for four ocean liners and other vessels that require berthage; (*d*) the extra cost of maintenance over the present cost of each proposal. It should be noted that the half-tide wall referred to in (*b*) above was a distinguishing feature of Mr. George Nelson's Inner Harbour scheme.

In February, 1925, a series of borings was taken in the Inner Harbour and Breakwater Harbour. This work was done by Mr. Richard Pengelly, a man accustomed to such work, whose services were placed at the disposal of the Harbour Board by the Public Works Department. Mr. Pengelly's instructions were to bore the outer and inner harbour for the purpose of seeing what the bottom was like at both places. This work was in progress when Messrs. Cullen and Keele arrived, in April, 1925, to commence their investigations. They were supplied with Pengelly's reports, and at their request further borings were made at points indicated by them. Mr. Pengelly was engaged on the borings for about eight months. He reported the results of his work weekly to the Secretary of the Harbour Board, and his reports were all filed by the Board, and a complete copy was placed before us at the hearing: it is recorded amongst the exhibits as No. 23. The main results of his work were—(1) He disproved the alleged existence of a rocky bottom to the Breakwater Harbour; (2) he proved that the bottom of the Inner Harbour and the outer channel was composed of material that could be fairly easily dredged; (3) he disclosed the existence of a bank of boulders in the entrance channel between the moles that would make dredging somewhat difficult at that point. This bank was not extensive in area, and the difficulties of lifting it by dredging were not great. He found that it was difficult to hold and use a moored vessel in the strong current between the moles and in the tidal rip just outside.

Messrs. Cullen and Keele arrived at Napier on the 22nd April, 1925, and they submitted their report on the 23rd November of the same year. They perused Mr. Furkert's report, and they made further investigations into the various factors that had to be considered before they could report. They reaffirmed their previous conclusion that the Inner Harbour as designed by them was practicable, that there were no great difficulties in the way of cutting and maintaining the entrance channel, but they clearly stated the opinion that the cost of maintenance and dredging of the channel might be expected to be considerable. They also reported on the Breakwater Harbour, and they outlined a scheme for that harbour, with estimates of costs, and they brought the whole to a conclusion in the form of a recommendation in answer to the Board's request that they should advise the Board which of the two harbour schemes they recommended for execution. Their answer is contained in the following words :—

"We are of opinion that the adoption of the Outer Harbour scheme, with one pier, which with the Glasgow Wharf will afford accommodation for four ocean liners, is to be preferred, and recommended accordingly. Briefly, our recommendation is based on the smaller initial capital outlay required for the Outer Harbour, whilst the difference in the estimated annual maintenance for the two schemes would represent if capitalized a further large difference."

As this recommendation is the opposite of their 1912 recommendation, it would naturally be expected that some explanation for the change in their views should be tendered, and this expectation is satisfied by the following statement which precedes the recommendation that we have quoted above. Messrs. Cullen and Keele say,—

"Shortly after submitting our report of 1912 we suggested, in reply to an inquiry from the Board, that the Inner Harbour appeared to offer a better prospect for successful execution than the Outer Harbour—an opinion based on the information then supplied to us respecting the strata in the bottom at the Outer Harbour—viz., that a large area of rock existed there which would have to be removed. The close survey of the strata which has been made this year by boring has shown that the rock formerly supposed to be there does not exist, and that the area, with the exception of a few small patches, down to 35 ft. below L.W.S. is free from rock. The strata, in the opinion of the officer in charge of the boring operations, will present no difficulty in dredging it or in driving piles into it. This survey has shown that what we considered to be a very serious objection to the successful execution of the Outer Harbour proposals does not exist in fact."

The boring referred to in the above paragraph was carried out by Mr. Pengelly, the expert at this work who had been supplied by the Public Works Department at the request of the Harbour Board. In effect, therefore, Messrs. Cullen and Keele have twice visited Napier and made most exhaustive inquiries, and they definitely recommend the Breakwater Harbour, and explain that their previous recommendation of the Inner Harbour had been based on a misconception entertained by them respecting the strata at the bottom of the Outer Harbour ; whilst in relation to the Inner Harbour they stress two disadvantages, the first being that the Inner Harbour would require the keeping in continuous commission of a large dredger, with all the expense that this involves, and the second being that the Outer Harbour was advantageous from a navigator's point of view inasmuch as it would be easier to enter during bad weather. The Board thereupon adopted Messrs. Cullen and Keele's breakwater proposal, and on the 12th January, 1926, a formal resolution recording such decision was passed and steps taken to procure the necessary legislation. In April, 1926, however, an election was held for the purpose of electing six members to represent the country districts. At this election all six members elected were declared supporters of the Inner Harbour, and they were elected by a large majority of the votes, and their accession to the Board meant that supporters of the Inner Harbour were in a majority. On the 8th June, 1926, motions were carried rescinding the previous decision to carry on with the Outer Harbour construction, and deciding instead to proceed with the construction of the Inner Harbour. Steps were taken to appoint consulting engineers and to undertake certain preliminary works that seemed to point to a continuance of the piecemeal construction of the Inner Harbour. In the meantime a Bill had been prepared for submission to Parliament intituled the Napier Harbour Board Empowering and Loan Bill. It recited the dearth of available lands to cope with the rapid expansion of the Town of Napier, and the existence of the Harbour Board's endowment lands, which, if reclaimed and levelled, would be available to meet that difficulty and would on the whole become a valuable source of revenue to the Board, and it went on to empower the Board to proceed with the filling-up, reclamation, and levelling of certain blocks of land which might be briefly described as the Awatoto Block, the 28-acre Block, the North and South Ponds, and part of the West Quay reclamation, and it gave a limited power to sell portions of some of those blocks. That Bill was remitted to a parliamentary Committee, which took evidence in the usual way. Both parties to the Inner Harbour dispute attended to give evidence, and the Committee recommended that the Bill be not proceeded with. The petitioners who had presented the petition to Parliament of 1924 again petitioned Parliament and asked that their original petition be revived. This recited the vacillations of policy that were apparent since the date of their previous petition, and they again asked for the appointment of a Commission of Inquiry. Whilst this was proceeding the expenditure upon the Inner Harbour, particularly in the form of reconstruction of the West Quay, had been continued, and questions have been raised between the Board and the Marine Department as to whether the requirements of the law as embodied in the Harbours Act have been complied with. In this connection there have been letters, telegrams, and interviews, and these gradually developed the position to which the petitions and the proceedings before the parliamentary Committee seemed inevitably to tend—namely, the appointment of a Commission of Inquiry, and this present Commission is the outcome of the position thus created.

We complete the foregoing history by showing the respective amounts expended during different periods on Inner and Outer Harbour :—

	Inner.	Outer.
First period : 1876 to adoption of Goodall's plan for breakwater in 1884. Total to end of period	£70,000	Nil.
Source of the money expended : Loan of £75,000 authorized in 1875.		
Second period : 1884 to the propounding of Mr. George Nelson's scheme in 1909. Total to end of period (breakwater constructed to stage at which it stands in 1927)	£77,730	£443,840
Sources of the money expended—		
On breakwater—loan of £225,000 authorized in 1884 and £200,000 authorized in 1892.		
On Inner Harbour—£2,730, probably balance of 1875 loan and general surplus funds.		
Third period : 1909 to the passing of the 1914 Inner Harbour Empowering and Loan Bill, 1914. Total to end of period	£89,356	£446,000 (approx.)
Sources of the money expended—		
On breakwater—Very little expenditure ; probably out of general funds.		
On Inner Harbour—£12,600 expended. Probably out of any surplus cash available ; in 1923 a special loan of £13,000 was found necessary and was authorized "for repayment of antecedent liability as at 31st December, 1922."		
Fourth period : 1914 to the sanctioning by ratepayers of the £300,000 loan in 1920. Total to end of period	£140,343	£447,000 (approx.)
Sources of the money expended—		
On breakwater—As in third period.		
On Inner Harbour—£50,000 expended. Loan-money authorized to be raised without a poll, by the Napier Harbour Board Empowering and Vesting Act of 1917.		
Fifth period : 1920 to 1926. Total to end of period *	£270,468	£448,707
Sources of the money expended—		
On breakwater—As in third and fourth periods.		
On Inner Harbour—£131,000. Of this £125,000 was out of loan-money authorized by the 1914 Empowering and Loan Act, sanctioned by the poll of 1920, the balance out of general cash.		

The disposal of the foregoing sum of £125,000, together with £50,000 spent on repairs and renewals, making £175,000 in all, is shown in detail in the following table. The Empowering and Loan Act of 1914 (No. 14) authorized for Inner Harbour construction a loan of £300,000 for "construction, completion, development, and improvement of the inner harbour portion of the Napier Harbour" (sections 7 and 8). Section 8 : "Provided that out of this £300,000 the Board shall be entitled to expend £50,000 in and about repairing and renewing the West Quay and the Iron Pot Quay, rebuilding, reconstructing or strengthening such quays or the structures appertaining thereto respectively—including a new reclamation dredger." This sum of £50,000 is represented by the items marked † below.

	£	£
Of this sum of		300,000
there remains unborrowed the sum of		52,900
Borrowed		247,100
Out of this is expended—		
1. Inner Harbour and East Coast Railway embankment	84,349	
2. Rebuilding quays	†39,394	
3. Deepening portion of channel between moles	4,020	
4. West Quay extension	1,937	
5. Cargo-shed F	†5,454	
6. Cargo-shed B	†4,960	
7. Plant, steel-bars, cement, &c.	14,315	
8. Store shed	669	
(These figures are up to 30th September, 1926.)		
9. Labourer's shed additions (share)	†193	
10. Ferro-concrete piles and materials	15,047	
11. Borings (share)	944	
12. Port Ahuriri – West Shore ferry-landings	72	
13. Engineering Expenses and cost of living bonus	3,656	
14. Sundries	125	
		175,135
Balance, unexpended (on fixed deposit)		£71,965

* This includes the sum £84,000, the cost to the Board of the embankment.

PART 9.—PHYSICAL FEATURES OF DISTRICT AND NATURAL FORCES ARISING THEREFROM.

Physical Features.

The district to be covered by our present survey is shown on Map C in Commission's Exhibit No. 3, and is bounded thereon on the north, west, and south by a red line, and on the east by the sea. We desire, firstly, to draw attention to the coast-line from Cape Kidnappers to Whakariri, marked with the red letters "K" and "W" respectively. At both these points the coast presents a high-cliff formation. Napier lies about half-way between the two points, and the shaded portion on the map represents Scinde Island, a high eminence turning a cliff-face to the sea. Although Scinde Island is now a promontory rather than an island, it has undoubtedly been a true island in the past.

Running inland from a point a little west of Cape Kidnappers is a line of hills, and this line can be traced south-west for roughly 20 miles. Then with a turn of short radius they wheel to the north and can be traced to Whakariri. This line presents a rampart of hills enclosing the plain that lies between them and the sea, and in some places displaying a cliff-face on their seaward sides. This range of hills is shown on Map C by an irregular broken line in brown wash. The foot of the whole rampart undoubtedly marks what was the seashore at some time in the past. It is pierced by three rivers—firstly, the Tukituki, which merges a little to the west of where Havelock North now stands; secondly, the Ngaruroro, which comes through at a point marked "Fern Hill" on the map; and, thirdly, the Tutaekuri, emerging a little to the south-east of the present site of Taradale.

River Action.

The Tukituki River came from the south-west; it was and is a carrier of sand and shingle from an inexhaustible supply. This river drains an area of 977 square miles, its present discharge being estimated at 140,000 cubic feet per second. Heavy flooding takes place periodically, and the watershed is composed largely of old river-gravel deposits. The Ngaruroro drains an area of about 940 square miles, and its present discharge is estimated at 112,000 cubic feet per second. Heavy periodical floods also take place in this river, and, its watershed being in steep rocky country liable to slips, the river has been and is a bearer of shingle and sand. The Tutaekuri has, generally, similar characteristics to the Tukituki and Ngaruroro, but at the present time any shingle carried down by it is apt to be lodged in the Ahuriri Lagoon, silt only being carried to the Inner Harbour. In any case, whether shingle or sediment be discharged on the foreshore by this river through the Inner Harbour, its bearing as a possible supply likely to cause interference at the channel is not important, as the bulk of any shingle or sand from this source that does reach the sea must travel in a northerly direction, and therefore away from the harbour entrance. These three rivers, their water charged in varying degrees with silt, sand, and shingle, have, during probably thousands of years, gradually formed a delta, which now lies between the rampart of hills and the sea, varying in nature from the first built, and therefore the oldest-established portion, now well-grassed land at the foot of the hills, to the shingle-bank on the sea-front, which marks the latest line of formation. The process still goes on. The rivers tend continually to throw their spoil into the sea, and the sea tends to bank it up on the coast-line. This tends to form a bank of shingle enclosing a lagoon into which the river discharges, bursting its way through the enclosing boulder-bank by means of a variable channel. The lagoon becomes a siltation bed, which in the course of centuries becomes filled up higher and higher till at length the river cuts a defined channel through it, and then repeats the process of forming another bank, another lagoon, and in consequence another tract of land—formation by siltation. This process is in one aspect a fight between the land-forming habits of the rivers and land-limiting habits of the sea. Man has come on the scene, and has built a city and a harbour on the battle-line, enlisting the combatants as his allies at times, whilst at other times they mercilessly buffet and injure him and his works with a marked impartiality. The present coast-line is therefore nothing more than the present limit of the delta formed by the rivers.

Artesian Water-supply.

An interesting feature of this delta is the presence of artesian water which is freely tapped in and around Napier. The delta which we describe above overlies the old river-gravel beds, which are some 200 ft. below low water at the foreshore, and this old river-gravel bed is the source of Napier's artesian water-supply.

Littoral Features.

At the southern end of this coast-line stands Cape Kidnappers, the western extremity of a bold line of cliffs, from which erosion by the sea provides a source of the beach shingle and sand. A few miles north is the present mouth of the Tukituki, and there any supply of shingle and sand from the cliffs is augmented. Two miles farther north again is the mouth of the Ngaruroro, which carries its share of spoil to the sea, having at times to burst its way through the shingle-banks formed by the output of the Tukituki and the banking tendency of the sea. We have, therefore, from Kidnappers to Scinde Island a distance of about eighteen miles, a beach-line where the shingle is periodically being replenished, as it started on a northerly travel by wave-action and the northerly current in the sea which flows up this coast of the Island. The Tukituki and the Ngaruroro, to reach their present mouths, have to pass through many miles of comparatively flat land formed by their own delta of shingle and sand. On their journey over this delta to the sea they tend to build up their channels above the surrounding low areas, which in turn are continually being raised during flood periods by the deposit of silt.

At Scinde Island the coast-line turns at right angles to the west for one and a quarter miles, where the waters of the Tutaekuri River finally discharge into the sea, after passing through the Ahuriri Lagoon. The sediment from this river tends to settle in the lagoon, which, whether limited by its naturally formed boulder-banks or by man-made embankments, is in reality a huge settling-basin for shingle and silt. In the last few miles of its course the fall of the Tutaekuri is very slight, and as it is continually depositing in its bed, and raising the level of that bed, it tends to silt up its own channel. Floods occur from time to time, and at these times, particularly when the outlet of the river is hindered by banked-up seas, or bars of silt and shingle, the river eventually breaks its banks in an endeavour to get away to the sea by the shortest route. This has happened often enough to justify the description of the breakaway of this river at Meanee, to the mouth of the Ngaruroro, or to the "washout" at Waitangi as a settled habit. This is simply a continuation of the natural processes that have formed the rich flats. At the present time the Tutaekuri River discharges ordinarily through the lagoon, and the Inner Harbour basin, and the entrance channel, into the bay, and, as already pointed out, its sediment, in so far as it reaches the sea, tends to be carried by tidal currents to the north-west, and therefore clear of the harbour-works. It is proposed by the Hawke's Bay Rivers Board, in order to cure the evils of the periodical floods of the Tutaekuri to the farming and residential localities in and near Napier, to divert the Tutaekuri River permanently to the sea at the mouth of the Ngaruroro. When this is done the silt and other material carried to the sea will be discharged south of the Breakwater Harbour, and will become contributory to the problem of littoral drift in relation to the harbour-entrance.

Natural Forces.—Ocean Currents.

There is a bare reference in the foregoing to the ocean currents running from south to north, and sweeping round the bay from Kidnappers past Napier. The presence of this current may be taken as proved; it was so treated by all the engineers whose reports are comprised in Commission's Exhibit No. 1, and was dealt with in detail and in a most interesting form by Mr. J. P. Maxwell, M.Inst.C.E., in his evidence before the Commission (see pages 353 and 354 of the notes of evidence).

Littoral Drift.

It may be taken as proved that the ocean currents at Napier flow generally from south to north, and to some extent assist in the northerly trend of the littoral drift. The main factor, however, is the set of the heaviest prevailing seas, impinging upon the coast-line at a suitable angle. Easterly seas which strike parallel to the coast exert little, if any, effect upon the northerly trend of the littoral drift. Seas due to north and north-east winds will during the time they prevail force the littoral drift southwards; these winds at Napier do not last for long periods or cause the heaviest seas. The trend of the coast, however, between the entrance to the Tukituki River and Tangoio Point, being south-east, north, and north-north-east, is open to the heavy seas and heavy ocean ground-swell experienced on this part of the coast. These seas impinge on the beach at a most favourable angle, and are the main cause of the predominating northerly littoral drift. That the shingle travels is undeniable. On the line of beach we have described its travel is northwards from Kidnappers to Whakaari. Phenomena that can be attributed to this cause can be actually seen. Such an observation is recorded in the memoranda prepared by Mr. F. E. Saunders, Engineer of the Napier Harbour Board, in September, 1882, to accompany the conditions of competitive harbour-designs which were invited in that year. Mr. Saunders says:—

The question of travelling shingle was tested in 1875 by running out a groyne 200 ft. long at the point marked "A" on drawing No. 2A. The time occupied in erecting this groyne was about six weeks, and during this period the shingle was trapped by the groyne, and the bar remained good; but a few days after the completion of the groyne the shingle passed round the end, and the bar was again subject to the usual changes.

The arrest of this drift by the breakwater built at the Bluff at Napier is another proof of the existence of the drift. There is the further fact that the shingle where it is deposited on the beach at the mouth of the Tukituki is of large components, and might well be described as consisting of boulders; as it travels north by a kind of tacking motion up and down the beach, it is reduced in size by attrition, until by the time it reaches Whakariri it is reduced almost to sand. Its gradual reduction in size can be traced as one walks up the beach and takes note of the shingle.

Sea and Wave Drift.

It seems to be commonly accepted that sea and wave drift cause an agitation of the sea-bottom near the coast, and that when this action is more or less regular by the existence of ocean currents and a prevalent set of the waves, it offers a difficulty when it is proposed to cut a channel in the sea, exposed to these forces. In such circumstances the accepted opinion seems to be that these forces will tend to fill up and finally obliterate the channel.

Tidal Currents in and out of Lagoons.

Another natural force that must be taken into account as a factor in the problem of Inner Harbour construction is the tidal current generated by the alternate filling-in and discharging, by tidal action, of the harbour basin of the Ahuriri Lagoon. On the ebb tide the water races out through the channel between the moles at a speed estimated at 5 to 6 knots per hour at least. The influence of this outflow as a well-defined stream can be seen and felt quite half a mile out from the moles. The force of this stream of water issuing from the Inner Harbour has a strong scouring effect—

firstly, in the channel between the moles (where it is not paved by limestone boulders), and then on the bottom of outer channel. Such a force is relied on by harbour engineers to scour the entrance channel and keep it open. Messrs. Cullen and Keele say in their 1912 report:—

"It is a fundamental principle of marine engineering to encourage as large a body as possible of tidal water to enter an estuary and pass up to its furthest limit, thereby increasing the tidal range and gaining, with the addition of the upland water, the fullest scouring effect during the ebb tide."

This force after issuing from the harbour-entrance must be gradually weakened and finally overcome by the inertia of the water in the bay. The general tendency of the ebb tidal stream being approximately northerly, and the general tendency of the ocean current and wave-movements being westerly, the two streams must eventually merge and result in a north-westerly flow before the effluent current loses its force altogether. To the east and north of this effluent current, outside the Inner Harbour entrance, a spit has been formed of the sand forming a part of the littoral drift which passed round the north-east end of Scinde Island before the construction of the breakwater. The balance of the two contending currents has formed this sand into a bar having a minimum depth of 19 ft. at present. Considerable changes have taken place in this spit, illustrated by the contour plans 1855 to 1927, referred to in the immediately succeeding part of this report. The effluent stream might at times be stronger, as when it is augmented by flood-waters, and in such conditions its scouring influence would extend farther out and the bar would be pushed farther out to sea. On the other hand, the effluent stream might be weakened by alterations in the width of the exit channel, or the sand-movement might be accelerated and strengthened by storms, and in such conditions the bar may be driven in closer to shore. In considering these factors it should be recorded and considered that Hawke's Bay enjoys a great preponderance of fine weather, and that storms are of rare occurrence; but, on the other hand, it is subject to a continuous and heavy ocean swell, principally from the east, north-east, and south-east.

PART 10.—THE DEVELOPMENT OF THEORIES BASED ON THOSE PHYSICAL FEATURES AND NATURAL FORCES IN RELATION TO HARBOUR-CONSTRUCTION.

The Littoral Drift.

In all the reports and theories of the engineers on harbour matters at Napier the existence and influence of the littoral shingle-drift claims a great deal of attention. That this is so can hardly be wondered at, for it is a phenomenon that may be considered as proved, and it presents visible evidence and results, and its existence and effects are apparent to any observer. It is generally agreed that the breakwater has, since its construction, cut off the supply of shingle from the beach west and north of the Bluff. A sharp difference of opinion has, however, arisen as to whether or not there remains a sand-drift across the entrance of the Inner Harbour, constituting a serious difficulty in the task of cutting and maintaining the entrance channel.

Shingle Drift.

This drift of shingle up the coast—roughly, south to north from the Kidnappers to Scinde Island—turns with the coast-line to the west along the West Shore beach, and then again runs south to north up the Petane beach. An obvious deduction from this fact is that whenever an entrance to any harbour at or near Napier is contemplated this line of shingle-drift across the entrance to the harbour will be a factor to be dealt with, as tending to block the entrance.

In 1880, Sir John Coode in his report says:—

"The question . . . be decided . . . upon the broader principle of whether the entrance to any harbour running out from this shore, as proposed by Mr. McGregor, or otherwise, would not in the absence of backwater become so blocked by shingle after a time as to render the work practically useless. After carefully considering this feature of the case I am reluctantly compelled to express an opinion that such would be the result. The shingle travelling along the coast between the Tukituki and Napier Bluff would gather against the back of the protecting pier and turn round the curve or angle, would pass along the outer cant and be deposited in the entrance and under the lee of the westernmost works."

In the passage just quoted there is recognition of the irresistible nature of the shingle-drift when nothing but a protecting mole or wall is erected against it. There is also, it may be noted in the words, "in the absence of backwater," the origin of the idea that "backwash" might be a useful agency to assist to keep the work clear of shingle; but Sir John Coode does not seem to have put the ideas of the wall and backwater together as complementary features in a scheme designed to block the flow of shingle. It is not necessary to quote reports of all the other engineers on this matter of shingle-drift; it is sufficient to say that all recognize its existence and the menace it offers to harbour works.

In 1884 Mr. John Goodall, M.Inst.C.E., in his report advances a new theory which is a distinct step forward. He says:—

"When I first turned my attention to the practicability of a solid breakwater at Napier I considered it utterly impossible, for the reason that the quantity of shingle travelling appeared so great that any works begun would be overwhelmed by it before their completion. This idea was created by the prevailing and widespread opinions regarding the shingle that exists, and that have been freely used by such high authorities as Sir John Coode, Mr. Carruthers, and other engineers of note. But latterly my mind has been thoroughly disabused of such ideas. Works in opposition to the opinions of the

above-named engineers have been begun and are being carried out with vigour, and their final success is now certain. It has been found that by carrying out a mole to an obtuse angle to the set of the waves of the prevailing seas that the waves will run along the wall and will be reflected along the beach, and that when the mole is sufficiently far out that the force of the reflected waves or backwash will be great enough to drive the shingle back from the works. The shingle will then deposit along the beach behind the works instead of advancing to overwhelm them, and will in time form a valuable reclamation."

Mr. Goodall had already tested this theory at Timaru, and claimed that it had been a success there, where the problems to be met bore a close resemblance to those at Napier. His suggested scheme was adopted, and it was at his advice and to his designs that the breakwater was built. The angle at which the breakwater was thrown out from the Bluff was carefully planned so that it would meet the prevalent seas in such a way as to procure from them the maximum amount of power, in the form of backwash or reflected waves, to drive the shingle back. It may be said that the events since the breakwater was built have thoroughly justified Mr. Goodall's foresight and theory. Other engineers reporting on the work since that date have agreed that the angle at which the breakwater is thrown out is well chosen, and it may be taken as a proved fact that so far, after a test of over forty years, the breakwater has apparently stopped the flow of shingle at the point.

In 1925, in Messrs. Cullen and Keele's report, a further theory is advanced as to the effect of the breakwater, and they say :—

"The breakwater has been carried out at an obtuse angle to the set of the prevalent seas ; it now forms a complete bar to the further travel of the shingle to the north. The waves strike the wall with great force, and, running along it, are reflected towards the beach. An accumulation of the water from a succession of reflected waves causes it to head up in the bight to the seawards of the commencement of the breakwater, and a strong backwash and undertow is created which, running along a well-defined channel leading around the north face of the rock shoal, as shown by the contour-lines, draws down the shingle, which is again thrown back against the breakwater by the next incoming wave, the result being that the shingle is finally reduced by attrition to mud, which no doubt is carried away in suspension by an undercurrent which is generated in all bights and indentations along the coast, and running radially from the shore seawards, and is responsible for the main contour at those places."

Here we see two ideas put forward : the first is that the action of the seas which are diverted and thrown back by the breakwater is not only to check the northward drift of the shingle, but to create a veritable grinding-mill which grinds the shingle up into mud ; secondly, there is the theory that this mud is carried away in suspension by an undercurrent. The first of said theories—namely, that the breakwater converted the action of the strong seas into a shingle-grinding mill—is generally accepted, and from the appearance of the shingle at the bottom of the breakwater it may be taken as proved. The theory that the mud created by the final disintegration of the shingle is carried away to the sea was also put forward in the evidence before us by Messrs. R. W. and J. D. Holmes, and is a matter that must be considered at a later stage of this report.

Sand-drift.

The theory is also put forward that there is a drift northward of sand, not at first where it can be seen, but at some distance out where it cannot be seen. Messrs. Maxwell, Williams, and Mason in their report of 1909 say :—

"Since the construction of breakwater large accumulations of shingle have taken place along the beach in front of the town and the Bluff, and during heavy southerly weather it accumulates in the corner at the root of the breakwater and is driven over the wall there. There is no trace of shingle beyond the first cant of the breakwater, and indications are that nothing but fine sand is carried past the work, although it is probable that the accumulation south of the breakwater has not yet reached its limit, and that when it does the quantity passing will be larger than at present. This drift of sand around the breakwater, but for the opposition of the ebb currents from the Inner Harbour, would spread out towards the Petane beach. It now, no doubt, assists in forming the bar which is found about 3,000 ft. outside the moles at the entrance to the Inner Harbour, and on which the sea breaks during heavy weather. This has always existed to a certain extent, but has become more pronounced since the construction of the breakwater; the ebb tide, owing to the stoppage of the shingle drift, being now able to prevent its being spread out towards the beach, while the accumulations in the neighbourhood of the entrance have entirely disappeared owing to the stoppage of the supply of shingle. We examined the bottom by dredging with the Board's grab-dredge "J. D. O." from this bank inwards, and found the bottom is composed of sand from about 2,000 ft. from the end of the eastern mole ; thence inwards it is composed of shingle, increasing in size as we approach the entrance. . . . This sand-bar and sand-drift are, in our opinion, the critical features in connection with the proposal to establish an Inner Harbour suitable for the largest vessels."

In giving evidence before the Commission Mr. J. P. Maxwell again referred to this question. He said that he could see no other way of accounting for the large amount of material other than shingle which comes out of the rivers south of Napier, and he rejected the suggestion that they were carried out to sea, but maintained that they must be carried northwards in the ocean current. He referred, secondly, to the evidence afforded at Timaru by the presence of a belt of discoloured water parallel with and perhaps one-half mile out from the shore, but admitted that he had not seen the same phenomenon at Napier. He said that evidence of "making" on the Petane Beach as deposed by Mr. Furkert could be accepted as further evidence of the existence of the sand-drift.

This report was before Messrs. Cullen and Keele when they reported in 1912, and they took a contrary view. They said—

"Although we find no evidence in support of what appears to have been a commonly accepted theory of sand-drift, and do not believe that any drift exists as alleged, the surface wind during south-easterly winds not affecting the question, yet, &c."

When reverting to the same question in their report of 1925, Messrs. Cullen and Keele stated that by personal study they could find no evidence of sand-drift either in the form of causes which would lead them to expect the drift, or of indications of its results. After referring to the scouring out of the experimental hole dredged by the "Whakarire," they say:—

"It is impossible to reconcile the foregoing with the existence of the sand-drift along the coast, and in our opinion it offers conclusive evidence confuting the opinions expressed as to the existence of such sand-drift. . . . A sand-drift would certainly obliterate a cutting. As the small deep cut made has not been obliterated, or even altered appreciably in ten years after its side slopes fell in, the interesting theory must be given up."

Mr. Furkert in his report in 1924 referred to the proposed entrance channel to the Inner Harbour saying:—

"The agitation of the sea-bottom whenever there was rough weather, combined with the drift of sand up the coast, which (the breakwater notwithstanding) is still in progress, would cause a continual filling-up of this channel."

Messrs. R. W. and J. D. Holmes in giving evidence before the Commission took the same view of the matter as did Messrs. Cullen and Keele, and on the same grounds—namely, that they could find no positive evidence of sand-drift since the erection of the breakwater; secondly, that the deepening in the bay, and especially outside the entrance moles for the Inner Harbour, was irreconcilable with the theory of sand-drift. All engineers seem to be agreed that if this sand-drift is present it will offer a barrier to the maintenance of an entrance channel of much the same kind as would be offered by a travel of shingle.

Our Conclusions on the Question of Sand-drift.

We have had the benefit of being able to study and consider all these reports and also evidence bearing on this point that has not previously been assembled and put forward. This takes the form of certain soundings and contour maps covering a period of from 1855 to date.

Mr. Furkert, in giving evidence, produced as Exhibit No. 111 five plans which he had prepared showing the contours of the sandspit in the bay as they were in the years 1855, 1882, 1895, 1906, and 1927 respectively. We have had photographic reproductions of this exhibit prepared, and we show them as plans No. D1855 to D1927 in Commission's Exhibit No. 3. If these are examined it will be seen that drawn at right angles across the contour-lines is the centre-line of the proposed entrance channel to the Inner Harbour. If the 1855 map be examined it will be seen that at that date the 30 ft., 27 ft., 24 ft., and 22 ft. contours extended up to and across the centre-line to the east of the same. The 22 ft. contour extended to a distance of about 33 ft. to the east of this centre-line. The areas included in these contour-lines are shown in red hatching on plan D1855. If attention now be given to the map for the year 1882 (an interval of twenty-seven years) it will be noted that the 30 ft. and 27 ft. contours no longer exist on the centre-line, and that even the 24 ft. contour has been pushed over and is wholly on the western side of this line, whilst the 22 ft. contour, although still generally on the east side of the line, has a slight protrusion to the west, but has its maximum distance on that side of the centre-line reduced from 330 ft. to about 165 ft. On the 1855 map the width of the 22 ft. contour at the point where the centre-line cuts across it was 990 ft., but in 1882 the width is reduced to 660 ft. In the year 1927, after an interval of forty-five years since 1882, we find that the 22 ft., 24 ft., 27 ft., and 30 ft. contours have moved easterly, and a new 32 ft. contour, which did not even exist in 1855, has also appeared on the east of the centre-line, the distances to the east being respectively 22 ft., 785 ft.; 24 ft., 724 ft.; 27 ft., 620 ft.; 30 ft., 458 ft.; and 32 ft., 333 ft. It will be noticed that the new 32 ft. contour is now approximately where the 22 ft. contour was in 1855; the length along the centre-line between the south and north limits of the 22 ft. contour is now 2,722 ft. as against 990 ft. in 1855 or 660 ft. in 1882.

It will also be noticed that the north-west tongue of the spit, as indicated by the 22 ft. contour in 1855, was some 330 ft. west of the centre-line, and was in the year 1882 some 1,800 ft. west of same, and that in the year 1927 is only 1,155 ft. west of the centre-line. The elongation of this spit to the west during the period 1855-82, and the other alterations that we have described above were, no doubt, largely due to the construction of the eastern and western moles at the Inner Harbour entrance during 1876–78. To assist ourselves and readers of this report to a clear understanding of what has taken place on this spit, we have plotted cross-sections of the spit and prepared a comparative plan of these cross-sections at the three dates involved—viz., 1855, 1882, and 1927. In considering these it must be remembered that the breakwater was commenced in the year 1885. A comparison of these cross-sections shows that the area of this sandspit was very greatly increased during the period 1855-82. A plan of these cross-sections is included in Commission's Exhibit No. 3, and is marked "Plan No. E." On each of the plans of the spit is shown the line of the centre of the entrance channel, and this is the basic line of our cross-sections. Proceeding in an easterly direction from this base-line, we have laid cross-sectional lines at intervals of 5 chains, and these are numbered from 1 to 12. Proceeding in a westerly direction from the base-line we have also laid cross-sectional lines at a distance of 5 chains apart, and they are numbered 01 to 04, inclusive.

Now, if the section between the base-line and line No. 01, 5 chains west of the centre-line, be examined, it will be seen that the material deposited between 1855 and 1882 had been almost wholly removed by 1927; not only so, but some of the original 1855 bottom which had not been covered by the 1855–82 deposits is also removed. The following three sections covering the tract within lines

02, 03, and 04 proceeding westward show that the material deposited between 1855 and 1882 had been removed, and that a considerable area of deep water which existed in 1855 on the outer end of these sections had shoaled up from 6 ft. to 8 ft.

We now give our attention to the sectional lines travelling eastwards from the centre-line. Taking first the section between the centre-line and line No. 1, we note that a portion of the material deposited between 1855 and 1882 had been removed, and also that a very large area of the 1855 bottom had been deepened by about 11 ft. This deepening gradually worked eastwards for a distance of 65 chains from the centre-line. The material which had been deposited in the period 1855-82 had been removed, but otherwise there is little difference between the contours of 1855, 1882, and 1927. The foregoing figures and deductions refer to the sea-bottom from high-water mark out to the 24 ft. contour. Further, we find that between the 24 ft. contour and 36 ft. contour there has been a general deepening since 1906 to an extent of from 3 in. to 18 in., the chief exception to this being an area of 35 chains in width immediately north of the spit and in direct line with the Inner Harbour entrance. It is important to note that in the first period, 1855 to 1882, the material piled up between the centre-line and cross-sectional line 04 was much more than could be supplied by the material cut away from the area covered by the cross-sectional lines to the east of the centre-line. The inference seems irresistible that the surplus material was supplied by the littoral drift round the Bluff. The absence of any such accretion or piling-up since 1882 points, in our opinion, with equal clearness to the fact that the breakwater has cut off this source of supply.

Giving attention to the sea-bottom at the breakwater, we find that siltation has taken place on the eastern or seaward side to a width of some 12 chains, and on the western or sheltered side to a width of about 20 chains; the depth of siltation varying from nothing on the western edge to 10 ft. close under the breakwater. The soundings taken in 1906 and 1927 shown on the map of comparative soundings prepared by Messrs. Holmes and Son—Commission's Exhibit No. 3, Plan J—indicate a general deepening between the western edge of the sea-bottom of the shoal just referred to upon the sheltered side of the breakwater and the entrance to the Inner Harbour. In our opinion this also is evidence that the volume of the littoral drift indicated by the accretion which took place between 1855 and 1882 (shown in the comparative contours we have been describing) does not now exist. It should be noted also that the comparative contours of 1855, 1882, and 1927 show a general erosion between the breakwater shoaling and the eastern side of the entrance to the inner channel. Taking into account all the foregoing facts, we are of opinion that the present shoaling of the 1855 deep areas to the west of the Inner Harbour entrance and the shoaling to the north of the sandspit are not due to the drift of shingle or sand travelling around the breakwater, but are due to the erosion of the sea-bottom which has been taking place since 1882 between the breakwater and the Inner Harbour entrance, and possibly, to some extent, by detritus from the flood-waters of the Tutaekuri River. We would, however, point out that at some time in the future the drift around the breakwater may increase in volume, and this is a possibility that should not be lost sight of. This possibility demands that reasonable precautions should be taken when carrying out any proposed harbour improvements to allow for and mitigate its detrimental effects as far as possible.

Mr. Furkert in his evidence testified to accretion taking place at the present time along the Petane beach, and the cross-sectional plans put in by him afford evidence of this accretion. This is somewhat difficult to account for unless it is presumed that the gravel which is held up on the eastern side of the breakwater has been forced to continue its northerly travel in deep water and finally arrives on the Petane beach after a somewhat devious course. Mr. Furkert points out that a similar phenomenon actually takes place in Wellington across the harbour-entrance, and it is also well established that gravel is known to travel in deep water in the English Channel.

There is, however, another explanation, which we consider is most probably the correct one. It requires us to note, firstly, that the foreshore immediately west of the Inner Harbour entrance and for a short distance to the north is protected by the breakwater and the sandspit from heavy south-east and easterly seas, which have not the opportunity of impinging on the beach with the same effect as north-easterly seas. We then note further that this same portion of the foreshore is fully exposed to these north-easterly seas, the result being that the gravel-bank which existed in 1883 on the west side of the harbour-entrance has been cut out and washed in a south and easterly direction until it has met the ebb tidal currents issuing from the Inner Harbour. The net result of these conflicting forces is that the gravel and sand have been finally carried in a north-westerly direction, until they have ultimately been thrown on to the Petane beach, where it is no longer protected by the breakwater and sandspit, and where it has a less favourable trend for north-easterly seas to act upon. To preserve spit, town, and the Inner Harbour entrance, steps should be taken to protect this foreshore where it is now being denuded.

The original formation of the sandspit of 1855-82 was no doubt due to the selective effect of the ebb tide on the drift of sand and gravel as it passed from east to west of the Inner Harbour entrance. These tidal waters as they maintain velocity would hold the lighter material in solution and transport it, gradually precipitating it as the water lost its velocity, and thus forming the sandspit. We have already described the travel of shingle and gravel over the thirty miles of beach from Kidnappers to Whakaari, and the gradual reduction of the shingle in size, as the result of attrition, so by the time Whakaari is reached the material consists almost entirely of gravel the size of peas. The grinding that the gravel is subjected to along the foreshore reduces a large quantity of it to fine mud, which the tidal action and littoral current transport seaward, the discoloured water due to this cause being quite apparent for at least one mile from the foreshore.

We find no evidence of the travel of this mud across the Inner Harbour entrance, and are therefore of opinion that there is no reason to fear siltation from this source in connection with the harbour-works. The grinding process under present conditions results, firstly, in a considerable reduction in the possible volume of gravel and sand to be dealt with; secondly, the sea disposal of the resultant mud.

PART II.—A BRIEF GENERAL DESCRIPTION OF THE BREAKWATER HARBOUR.

(*a*) As to Locality.

The Breakwater Harbour is situated at the foot of a rocky eminence known as the Bluff, about a mile, via the Marine Parade, from the business centre of Napier. The coast, which in general is running nearly north-and-south, makes at this point a nearly rectangular turn to the west, and the breakwater runs out into the sea from the point of the angle. The exact position in relation to the town and the Inner Harbour can be seen by reference to the plan appearing as A in Commission's Exhibit No. 3, where the breakwater is shown at the bottom right-hand corner of the plan.

(*b*) As to Constructional Details.

The breakwater itself is to-day 2,830 ft. in length, and it is built to a height of 6 ft. above high water. It is built on a rubble foundation of concrete blocks (12 ft. by 6 ft. by 6 ft.) up to a height of 2 ft. above low water, and this is capped by a monolithic block of concrete made *in situ*. The base was originally protected from scour on weather side by an apron of large rubble blocks thrown in pell-mell; later, further protection was afforded by throwing in large concrete blocks deposited pell-mell. The breakwater is first thrown out from the shore in a north-easterly direction at an angle of 120° to the set of the prevalent south-east seas. This is designed to divert or reflect the seas, causing them to run in along this first cant of the breakwater and create a backwash that will drive the shingle back from the works and retard the shingle travelling from south of the breakwater. From seaward end of this first cant the breakwater turns in a more northerly direction and again in a north-westerly direction to enclose a basin and give protection from north-easterly seas. Inside this breakwater there is built a wharf, known as the Glasgow Wharf, about 580 ft. in length, which is used by vessels drawing up to 26 ft. There is also a breastwork wharf available for vessels drawing up to 18 ft. A railway-track serves both wharves, but the wharves have no vehicular road and no goods-sheds. A lithographic plan prepared to illustrate Mr. Furkert's 1924 report appears as Map B in Commission's Exhibit No. 3. On this map the existing works are outlined in red; the rest of the works sketched thereon indicate suggested future extensions. The photograph, Plan K, Commission's Exhibit No. 3, shows the present state of the breakwater. We wish to state that this photograph was chosen from a number of existing photographs as being the best and clearest of those submitted to us of the breakwater itself. The amount of shipping at the wharves on the occasion at which this was taken must, according to the evidence tendered to us, be considered as quite exceptional, and is probably the reason why this particular photograph was taken. We therefore, with this explanation, present it here as a good photograph of the breakwater and wharves.

(*c*) As in Relation to Existing Transport Facilities and Termini.

In the term "existing transport facilities" we would include roads, railways, and such buildings as warehouses, storehouses, and goods-sheds which have been erected as adjuncts to the system of cargo collection and distribution. The Breakwater Harbour is somewhat at a disadvantage in relation to existing transport facilities, particularly railway facilities. On the Plan A of Commission's Exhibit No. 3 we show, coloured in brown, the roads that completely encircle that part of the Napier Borough known as Scinde Island, which might now be well described as a rocky promontory from 200 ft. to 300 ft. high. From the Breakwater wharf, running nearly south along the sea-front, is the Marine Parade, which supplies the shortest route from the breakwater to the town, and also from and to Hastings and the country south of Napier. From the breakwater, running nearly in a westerly direction, is a road that runs parallel with the Harbour Board's railway and then turns in a south-westerly direction along the south-west face of Scinde Island. On the seaward side of this road, about 35 chains from the root of the breakwater, will be seen the Harbour Board's goods-shed known as the E shed. At the root of the breakwater there is at present practically no land available, and the road which skirts the angle of Scinde Island is at this point close up to the rocky sides of the Bluff, and any land required between, say, the junction of Byron Street and Marine Parade to the south of the breakwater and the point where the Harbour Board's railway begins to leave the sea front to the west of the breakwater will have to be made by reclamation. On the Plan A, Commission's Exhibit No. 3, a little to the south of the Iron Pot, on part of the Inner Harbour, will be seen the terminus of the Government railways. It is marked "Spit Railway-station." The Harbour Board's railway runs from there to the breakwater, and it is over this railway that goods arriving by rail are transported to the breakwater, a distance of about a mile. The Board's railway is of the same guage as the State railway, so that the Government rolling-stock can be used when it is desired or possible to avoid handling goods by transhipping them into the Board's trucks. The small strip of land bounded on the south by Hardinge Road, on the west by the eastern mole of the Inner Harbour entrance, and on the north by the sea-front, contains an area which has been set apart as the dangerous-goods area, and on this are erected oil-stores. (This area is shown lightly shaded in red on Plan A, Commission's Exhibit No. 3.) Various warehouses, general stores, and wool-stores are erected either facing or contiguous to the West Quay, which is shown on Plan A as a part of the Inner Harbour. The offices of the Harbour Board and the Port offices of the shipping companies are all situated close to the various quays that comprise the Inner Harbour.

The following table shows the distances from various points to the Breakwater Harbour:—

To Breakwater Harbour—	Approximate Feet.
Per road from Napier Railway-station, via Marine Parade, to Glasgow Wharf	14,300
Per railway from Napier Railway-station to E cargo-shed	17,300
Per railway from Napier Railway-station to Glasgow Wharf ..	19,800

(Note.—Shorter road route to Hastings and country south of Napier.)

PART II (*continued*).—A BRIEF GENERAL DESCRIPTION OF THE INNER HARBOUR.

(*a*) As to Locality.

The Inner Harbour is situated to the west of Scinde Island. Its entrance is shown on Plan A in Commission's Exhibit No. 3 already referred to. The proposed entrance channel, which is shown by stippling running out into the sea, leads the eye to the entrance moles, which may be identified by the cross-sectional line marked "B–B" which crosses it. The existing moles are shown as sketched by a thin continuous line. The heavy broken lines show the limits of the proposed channel after the suggested widening.

(*b*) As to Constructional Details.

On entering the Inner Harbour via this channel a bay on the left-hand side marked "Iron Pot" is noted. This is at present a most useful harbour for small craft. On its northern side there is the newly reconstructed Nelson Quay. At its eastern or landward end there are concrete steps and a launch-landing. On the southern side is the Jull Quay. Proceeding up the harbour from the mouth of the Iron Pot is to be observed the West Quay, where at present extensive reconstruction work is going on, the Quay being substantially rebuilt in concrete. This quay to the point indicated by the head of the bridge which runs across to the West Shore (it is marked "Bridge to be demolished") has a further 1,400 ft. of quay suitable for small vessels drawing up to 14 ft. or 15 ft. This is capable of being dredged to a depth of about 20 ft. At the present time the small bridge, to which attention has been called is the shortest and most convenient line of communication with the borough for residents on the West Shore, but it is in a bad state of repair, as is only natural seeing that the proposed Inner Harbour works contemplate the removal of this bridge.

The stippled channel to which we have already referred will be seen running into the Inner Harbour and skirting the proposed West Quay extension which forms part of the proposed Inner Harbour works as shown on the plan. Proceeding in a southerly direction on this line we come at 6,000 ft. from the Iron Pot to the embankment which forms the southern and western boundaries of the proposed Inner Harbour, running from a westerly to a northerly direction in a broad sweep. At a point just after this embankment has taken its northerly direction will be seen in a heavy black line the position of the heavy concrete railway-bridge, designed to allow the influx and efflux of tidal waters to the Ahuriri Lagoon. On the western side of the harbour and round the sweep of this embankment will be seen in broken outlines the suggested potentialities of the Inner Harbour in the matter of wharf-construction. We have already called attention to the road coloured brown which encircles Scinde Island. The land bounded by that road on one side and the sea-front of the Inner Harbour works on the other side is quite flat, and it will be noted that there are three areas, marked respectively "North Pond," "South Pond," and "West Quay Reclamation," which the Harbour Board intends to reclaim, a work which must be considered as naturally and economically incidental to any scheme of Inner Harbour construction.

In general terms, therefore, the Inner Harbour as now used and the proposed completed Inner Harbour can be described as an enclosed portion of the Ahuriri Lagoon connected with the sea by a protected channel. This is a tidal lagoon. The lagoon area at present comprises about 7,900 acres, and the openings to the bridge in the embankment to which we have already called attention are designedly left to preserve the scouring effect afforded by the filling and emptying of this lagoon twice daily by the tides. The entrance channel to the Inner Harbour has a choking effect on the tides, so that the tides in the Inner Harbour basin lag behind the tides in the outer bay. The bridge opening referred to also has a choking effect, so that the tides in the Ahuriri Lagoon proper lag behind the tides in the Inner Harbour basin. This is a phenomenon that will be dealt with more in detail in a later portion of this report, but it may be stated now by way of brief explanation that the tide continues to run into the Inner Harbour through the entrance channel for an hour and a half after high tide has occurred in the bay. It is then that slack water occurs at the entrance to the Inner Harbour, for it is only when the tide in the bay has fallen for an hour and a half after high tide that the sea-levels in the bay and in the Inner Harbour coincide. This period of slack water lasts about ten to twenty minutes. During the flood tide and the ebb tide, between these periods of slack water there is a very strong current between the moles which mark the entrance channel, reaching as high as 5 or 6 knots per hour. The current thus generated by the difference in the levels and directed by the moles to the entrance channel is felt for nearly a mile out in the bay, and affords a valuable scouring agency for keeping open the channel between the moles and any proposed entrance channel to the harbour. This phenomenon will also be referred to in greater detail at a later stage of this report.

The wharves surrounding the Iron Pot are in good condition, and, as will be seen by the Plan A, are served to some extent by railway facilities. At present wharves at the West Quay are undergoing reconstruction in a permanent form.

(*c*) As in Relation to Existing Transport Facilities and Termini.

Here again in the term "transport facilities" we include not only roads and railways, but buildings which are necessary adjuncts to traffic problems. The Inner Harbour is well placed in relation to existing cargo-sheds, stores, and railway. The road coloured brown skirting Scinde Island has already been referred to, and it shows as an arterial route between the Inner Harbour loading and unloading points and the Town of Napier. The position of the Spit Railway-station, the terminus of the Government railway at this point, has also been indicated, and it can be seen on Plan A near the Iron Pot. The railway connections between the West Quay and the Iron Pot can also be seen on the plan. The block of land shown between parallel lines of the Government railway and the West

Quay is occupied by wool and general stores and warehouses. It is from the West Quay that lighters are despatched with wool, meat, and general cargo to big steamers in the roadstead, and imports that require sorting are discharged at a shed adjacent to the Iron Pot. There is a great dearth of land in proximity of the Inner Harbour works, and such land as there is commands high prices as freehold, and high rentals as Harbour Board leaseholds. This position will be considerably relieved when the reclamation of the areas already referred to in this connection is accomplished. The arterial road to the city is in the main wider and therefore more commodious than the Marine Parade, which connects the Breakwater Harbour with the town, but, on the other hand, it carries, in parts, tramway traffic in competition with vehicular traffic. Goods and other traffic from Gisborne, Wairoa, and intervening districts, and all country north of Napier, would approach the town over the East Coast Road which shares the embankment with the railway. All vehicles using this road as an approach to Napier therefore enter at a point much nearer to the Inner Harbour and its facilities than they do to the Breakwater Harbour. The same comment is equally applicable to vehicles coming into the town on the Taradale Road.

It should perhaps be mentioned that the freezing-works shown on Plan A on the western side of the entrance channel to the Inner Harbour are now closed down, and the buildings, which are now owned by the Harbour Board, are to be demolished.

The following table shows the distances from various points to the Inner Harbour :—

To Inner Harbour—	Approximate Feet.
Per road from Napier Railway-station to West Quay	10,500
Per road from Napier Railway-station to south of Iron Pot ..	11,300
Per road from Napier Railway-station to north of Iron Pot ..	11,700
Per road from Napier Railway-station to shed at Iron Pot ..	12,200
Per railway from Napier station to Government Railway terminus at Iron Pot	11,000

The Roadstead Harbour.

The roadstead in which overseas vessels anchor to load and discharge their cargoes from a fleet of lighters may well be considered as an adjunct of the Inner Harbour as at present worked. The overseas vessels anchor in about 6 fathoms of water a little more than a mile out from the entrance to the Inner Harbour, and there they are served by a fleet of lighters, the property of Richardson and Co., Ltd., shipowners. These lighters carry cargo to and from the wharves of the Inner Harbour, and when not in use are berthed in the Inner Harbour.

One point on which practically all witnesses competent to speak on the matter were in agreement was that Hawke's Bay enjoys quite a large proportion of fine weather, and this is reflected in the comparative ease with which the working of vessels is carried out in the roadstead. Mr. McLeay, the managing director for Richardson and Co. deposed that the principal cause of delay in the roadstead was rain.

Some evidence was given which took the form of complaints against the lightering equipment and service, but we are of opinion that nothing serious in this direction can be considered proved. The work is seasonal, and it occasionally happens in the height of the wool season that there is a sudden concentration of overseas ships at Napier, and that the lightering fleet is not sufficient to give them all at one time the utmost despatch that they might require. Another complaint was against the age and alleged inefficiency of some of the lighters; but we think that not much ground for serious complaint exists. Mr. McLeay, the manager for Richardson and Co., Ltd., deposed—and we see no reason for not accepting his evidence—that the lighterage comprises not more than one-seventh of his company's business, and that it is not a lucrative portion of that business; it may be that in these circumstances the owners of the lighters are not too ready to scrap old plant and replace the units with newer and up-to-date vessels.

As was pointed out elsewhere, the chief exports from the port are wool and frozen meat, and practically the whole of this is loaded in the roadstead by means of the lighters. This service costs the exporting and importing interests the sum of about £30,000 per annum, a total which works out at an average cost of about 10s. per ton. Mr. McLeay's evidence was that his firm's fleet of lighters could work four vessels at once in the roadstead and give them reasonable despatch; under these circumstances three ships could work two hatches, while the remainder could work one hatch only. Typical vessels using the roadstead were anchored there during our sittings—viz., the s.s. "Tamaroa," 12,350 gross tons, which when deeply laden draws 33 ft., and the s.s. "Port Melbourne," 12,450 tons dead weight, drawing 30 ft. 3 in. As a general rule, however, Napier is not a final port of call, and overseas ships have to visit other New Zealand ports before departing for England, so that vessels of the class we mention above would seldom draw more than 25 ft. to 26 ft. when leaving Napier.

It was alleged by more than one witness that many vessels berth in the roadstead which could have been berthed in the Breakwater Harbour, but that they are prevented by the owners and the local agents from berthing at the Glasgow Wharf in the Breakwater Harbour. We were asked to draw the inference that this policy was adopted in some cases because the owners and agents were interested in the lightering company. We must find on the evidence tendered that this allegation is not proved. It was also alleged that shipping companies load the freight or goods consigned to Napier with an extra charge over and above freight, to cover discharge in the roadstead, and that this additional charge is levied in some cases where the ship might well and conveniently have been accommodated at the Glasgow Wharf in the Breakwater Harbour, and even in some cases where the discharging vessel has actually berthed at the Glasgow Wharf. This complaint relates chiefly to

vessels arriving from American ports. The evidence satisfied us that a legitimate grievance is disclosed here, but, seeing that the charges are levied and the policy which dictates the point at which the cargo is discharged is fixed by the owners of the vessels, we can make no finding as to the precise reasons or causes underlying this extra charge. We are satisfied, however, that there are influences which seem to operate to the discouragement of the use of the Breakwater Harbour even by steamers which, judging by their weight and draught, could conveniently berth in the Breakwater Harbour. One reason seems to be that the owners of the overseas vessels apparently consider that their vessels are safer working in the roadstead than they would be if berthed at the Glasgow Wharf, whilst the breakwater is in its present unfinished condition. In view of this unfinished condition of the breakwater it can hardly be suggested that this is an unreasonable attitude for owners to adopt.

The ultimate object of harbour-construction at Napier is clearly the abolition of lightering. The evidence satisfies us that nothing less than four overseas berths of sufficient size and with sufficient depth of water will be sufficient to eliminate lightering, even though there might be in the aggregate very few days in the year when all these berths would be required at once. The position is that when these big steamers do come to Napier they will require to be dealt with promptly and will not brook being kept waiting for a berth. Therefore the provision of only two overseas berths would be inadequate and unsatisfactory, both to shipowners and to exporters, and would necessitate the maintenance of lighters as a standby whenever more than two oversea boats were ready to load cargo.

PART 12.—PRACTICABILITY OF HARBOUR-CONSTRUCTION.

(*a*) At Inner Harbour, or (*b*) At the Breakwater.

We now approach the first of the questions set out on our order of reference. We are asked to inquire into and report whether, in view of reports already furnished and of our investigations, it is *practicable to construct a harbour* suitable for the requirements of the Napier Harbour Rating District as at present constituted, (*a*) at the Inner Harbour, or (*b*) at the breakwater. We are treating this question as an inquiry into the physical practicability of extending existing harbours, and we are answering it accordingly.

We view the words "suitable for the requirements of the Napier Harbour Rating District as at present constituted" as a qualification which directs our attention to the geographical features and position of the harbour district, and its potential as well as its present resources and requirements. In answering the question on this basis we *leave out of account* all financial and economic factors that must be weighed when we are answering the third question on our order of reference—viz., whether the expenditure of the money necessary to construct such a harbour can be justified from the financial and economic aspect. *We ask that all who read this report will bear this qualification in mind when reading the present answer.* Furthermore, we wish to say here, briefly, that before answering this question we have studied closely all the factors that, in our opinion, indicate "the requirements of the Napier Harbour Rating District as at present constituted." These factors will be marshalled and their bearing on the harbour problem discussed in our answers to the subsequent questions on the order of reference.

(*a*) Inner Harbour.

We answer Your Excellency's question in the affirmative We say, Yes, it is practicable to construct a harbour suitable for the requirements of the Napier Harbour Rating District as at present constituted, at the Inner Harbour. For the present purpose we look upon the Inner Harbour as divided into three parts. Firstly, there is the Inner Basin or Harbour itself, with its adjunct of wharves, embankments, training-walls, and other necessary appurtenances. The evidence satisfies us that by dredging the basin to a sufficient depth, by building the necessary wharves, embankments, and training-walls, and providing the required shore facilities, this portion of the harbour is quite practicable. None of the portions of the work thus described offer any great engineering or practical difficulties.

The second part of the Inner Harbour as a whole is the entrance channel between moles from the Iron Pot to the entrance into the bay. Such an entrance exists to-day, and it is quite practicable to widen it and deepen it as has been suggested, and neither of these works offers any great engineering or practical difficulties, and when done this channel would be a useful and adequate adjunct to the inner basin portion of the harbour.

The third part of this harbour as a whole is the outer channel cut from a point where the channel between the moles ends to a point out at sea where there is sufficient depth of water for vessels desiring to enter the channel. *A necessary adjunct to this channel, in our opinion, would be proper protective works such as are provided in other ports of the world where similar channels are used. These protective works must be sufficient to protect shipping passing through the channel, and to protect the channel itself from the natural forces which operate on an unprotected channel* in an open sea-bed. The provision of such protective works and the dredging and maintenance of such a protected channel, whilst comparatively costly when included in a provincial port, offer, in our opinion, no great engineering or practical difficulties, and this outer channel could be provided so that it would be an adequate and safe entrance to the other parts of the Inner Harbour as a whole.

Our opinion as to the practicability of this harbour accords with that of practically all the experts who have reported, and with the experience of ports built in similar or analogous situations and circumstances. It will be noted that those engineers who in the various reports have condemned the specific Inner Harbour or channel proposals submitted to them have agreed that a satisfactory Inner Harbour for overseas vessels, including an entrance channel, could "at a cost" be built on the site of the present Inner Harbour at Napier.

(*b*) Breakwater Harbour.

Again we answer Your Excellency's question in the affirmative. The evidence that we have heard satisfies us that it is practicable to construct a harbour suitable for the requirements of the Napier Harbour Rating District, as at present constituted, at the breakwater. Such a harbour as designed by Mr. Goodall consists of a basin at the foot of the north-western side of Scinde Island, enclosing a harbour of about 105 to 117 acres. The existing breakwater as shown on the lithographed Plan B of Commission's Exhibit No. 3, carried out to the Auckland Rock, which is shown on that plan, forms one of the enclosing arms of the harbour, whilst the mole outlined in green on the said Plan B, forms the other arm.

The other features of the harbour, if it is to be adequate, must be the presence of a swinging-basin sufficient for such overseas vessels as are likely to use the port, wharf and shed accommodation, and sufficient ground made by reclamation to accommodate such shore sheds and other buildings as are necessary to the working of the harbour. There must also be proper transport facilities in the way of access by road and rail for vehicular and railway waggons. There must be an entrance on a sailing-course on a line where sufficient depth can be given and maintained. We are quite satisfied that all these features are attainable, and that the attainment of none of them offers any great engineering or practical difficulty, and that such a harbour being provided would be a reasonably commodious, safe, and convenient harbour for the shipping of the port.

PART 13.—WHICH HARBOUR IS RECOMMENDED.

We now approach the second of the questions set out in Your Excellency's order of reference—viz., "If it is practicable to construct a suitable harbour at (*a*) the Inner Harbour, or at (*b*) the breakwater, which of such schemes would you recommend, as providing the best and most suitable harbour from an engineering, navigational, and economic point of view?"

We define the word "suitable" in this question as meaning a harbour (1) capable of admitting and harbouring in reasonable safety modern overseas liners drawing up to 26 ft., and (2) reasonably capable of being developed to accommodate vessels of greater draught when necessary.

Our answer to this question is that, taking into account the engineering, navigational, and economic factors that enter into the problem, weighing each in relation to the whole problem and to the other factors, we recommend the breakwater as providing the best and most suitable harbour. We propose now to marshall the facts and deductions that have led us to that decision, and we begin by pointing out that our conclusion accords with that of every engineer with experience of harbour-construction to whom the above question has been submitted.

When Mr. A. E. Jull, the present Chairman of the Napier Harbour Board, was giving evidence before us he was asked by Mr. Lusk, "How many engineers have reported in favour of a deep-water Inner Harbour?" Mr. Jull answered, "Six—Sir John Coode, Mr. James Abernethy, Sir John Hawkshaw, Mr. W. Culcheth, Messrs. Cullen and Keele, also Messrs. Bell and Scott." (For this question and answer see page 7, Notes of Evidence.)

There is no doubt that Mr. Jull, the Chairman of the Harbour Board, is the chief protagonist of the Inner Harbour scheme, and we therefore assume that the foregoing answer comprises the most inclusive list of engineers allegedly in favour of a deep-water Inner Harbour scheme that could be cited. We therefore propose to examine the claim that these engineers have reported in favour of a deep water Inner Harbour.

Sir John Coode: Report is dated 1880, described in opening paragraph as "Report on the works I should recommend in order to provide a suitable harbour for the port of Napier."

Recommendations: Inner Harbour; channel between piers to be deepened so as to have 10 ft. at low water; later, channel to be further improved by dredging to at least 12 ft. below L.W.S.T. At the time this report was written and this harbour planned, ocean liners of the dimensions and draught of those that now call at Napier had not even been thought of.

Mr. James Abernethy, Sir John Hawkshaw, Mr. W. Culcheth: We group these three engineers together. The first-named two were the English judges who awarded the Harbour Board's prize of £500 to the third named (Mr. W. Culcheth) for his report on harbour-construction at Napier. None of these gentlemen ever visited Napier. The information in the Culcheth report, and on which the judges made their award, is contained in a printed pamphlet which we have included in Commission's Exhibit No. 2, pages 1 to 5. It will be seen that this memorandum gives particulars of existing Inner Harbour works, and works in hand and proposed, and that it was accompanied by drawings of Port Ahuriri roadstead and harbour, and details of moles; also sections of borings in the inner lagoon. There is no mention or suggestion of the breakwater proposed in 1875 by Mr. McGregor. Mr. Culcheth, who, we repeat, never saw Napier, made a report, dated July, 1883, which he described as "a scheme for the improvement of the harbour." He states as one of the requirements, "To maintain depth of 20 ft. at low water in the channel between the moles and in the approaches thereto."

We include in Commission's Exhibit No. 3, as Plan F, a plan of comparative soundings from West Quay to the outer bar of the Inner Harbour. The black line at the top represents L.W.S.T.; the broken yellow line below it represents the depth of 12 ft., the maximum to which Sir John Coode proposed to dredge; the broken blue line next below that represents the 20 ft. depth to which Mr. Culcheth proposed to dredge; whilst the bottom line, a broken brown line, represents the 34 ft. depth to which Messrs. Cullen and Keele proposed to dredge to provide a channel for modern liners. The irregular lines in the corresponding respective colours represent the sea-bottom at various dates—*e.g.*, the yellow in 1878, when Sir John Coode reported; the blue in 1882, when Mr. Culcheth

reported; whilst the red irregular line indicates the sea-bottom in 1927. All of these are taken on the line of the channel entrance, including the channel between the moles. A study of these lines and comparative sections will show how specious is the claim that Sir John Coode and Mr. Culcheth report in favour of a deep-sea Inner Harbour.

Messrs. Bell and Scott: These men reported in 1884 on Mr. John Goodall's harbour (breakwater) scheme, and, whilst they had some criticism of Mr. Goodall's scheme on details of construction, their report was, on the whole, favourable to the scheme. We have been carefully through this report of Bell and Scott in a search for anything that might substantiate Mr. Jull's claim that the writers had reported in favour of a deep-water Inner Harbour, and we can find nothing to justify the claim.

Messrs. Cullen and Keele: These Australian engineers visited Napier in 1912 and again in 1925. They reported after each visit. In 1912 they recommended the Inner Harbour as against the Breakwater Harbour, and in 1925, in answer to the Napier Harbour Board's specific request that they should advise the Board which of the two harbour schemes they recommended, they definitely recommended the Breakwater Harbour. That is their final recommendation, made after their second visit to Napier, after further study of local conditions and with a further thirteen years' experience of the use of the breakwater at their disposal. They accompany their recommendation with the explanation that their previous recommendation was made under a misconception, based on misinformation on a material point. We therefore include Messrs. Cullen and Keele among the experienced harbour engineers who have recommended the Breakwater Harbour; we submit that no other course is either fair to them or reasonable as an indication of their considered opinion.

We find it hard to take Mr. Jull's answer seriously.

We submit the following list of qualified engineers with harbour experience who have definitely reported in favour of the Breakwater Harbour, as against the Inner Harbour as a harbour for overseas vessels: Mr. John Goodall, M.Inst.C.E.; Mr. F. W. Marchant, M.Inst.C.E.; Messrs. J. P. Maxwell, M.Inst.C.E.; Cyrus J. Williams, M.Inst.C.E.; and J. Blair Mason, C.E.; Messrs E. A. Cullen, M.Inst.C.E., and T. W. Keele, M.Inst.C.E.; Mr. F. W. Furkert, A.M.I.M.E., M.Inst.C.E.

We now desire to set out a statement of the reasoning by which we have arrived at the foregoing answer to the question put to us.

Inner Harbour or Breakwater Harbour from an Engineering Point of View.

Broadly stated, our conclusion on the matter of the claims of the Inner Harbour is that the Inner Harbour scheme stands condemned because it is based, as to one of its essential parts, on a work that transgresses a fundamental principle of marine engineering. The work which we refer to as an essential part of the Inner Harbour scheme is the outer entrance channel, extending approximately one mile out to sea from the entrance moles. This channel, lying as it does in what is practically the open ocean, is, we are fully satisfied, contrary to marine-engineering principles and practice, and, as it supplies the means of entrance to and egress from the Inner Harbour, its defects and weaknesses become the deciding factor in the scheme as a whole.

We wish to make it clear at this point that we are now speaking of the outer channel as planned and designed by Messrs. Cullen and Keele, and (with modifications) adopted by the Board, and their consulting engineers, Messrs. Holmes and Son. This is an unprotected channel without any mole or moles. In our answer to the immediately preceding question set out in paragraph 12 hereof, we stated that it was *practicable* to construct a harbour suitable for the requirements of the district, and we had in view then a harbour approached by a channel protected by moles, making it an artificially enclosed channel. Our finding that a harbour so constructed was practicable is in accord with the finding of, for instance, Mr. F. W. Marchant, M.Inst.C.E., in his report of 1906, on page 2, where he says, "*Given sufficient money*, there is no doubt that a useful harbour could have been made at the spit *on the lines now proposed*." His accompanying proposal included the formation of a breakwater or mole to protect the outer channel, on its eastern side. In principle, the unprotected channel proposed by Messrs. Cullen and Keele, and apparently adopted by Messrs. Holmes and Son, is adversely criticized by three such eminent Harbour engineers as J. P. Maxwell, Cyrus Williams, and J. Blair Mason in their report dated 1909. They say, "Even if it were practicable at a reasonable cost to cut an unprotected deep channel through this bar inwards, of which we have some doubt in the face of the fact that it is exposed to the heaviest seas, there is no doubt that in heavy weather it would be *liable to be obliterated*, wholly or in part, in which event the port would be closed until the channel reopened, which would be an intolerable inconvenience."

As to engineering practice, the knowledge of all expert witnesses before us and the records of harbour-construction throughout the world were searched for a parallel case, but no parallel case was forthcoming. Our attention was called to many channels cut through sand bars and banks, but in every case it was found that they were protected by the natural formation of the coast or by moles and breakwaters. Messrs. Holmes and Son, the Napier Harbour Board's consulting engineers, in their evidence referred to numerous harbours approached by channels. We pressed them for position, description, and details of one unprotected channel in any way comparable to that proposed at Napier, and consideration was eventually narrowed down to three which Mr. J. D. Holmes put forward—viz., Vizigapatam, in India; Brisbane, in Queensland; and Colon, at the entrance to the Panama Canal. At the close of Mr. Holmes's examination in chief, Vizigapatam seemed to be a parallel case. Under cross-examination, however, it was ascertained that the harbour is not yet constructed, and the records produced showed that after various reports had been obtained, some (the majority) recommending an outer breakwater harbour, and others an inner harbour, the last one on record was an inner-harbour project, the inner basin to be approached by a channel cut through a sand-bar. This is as far as the information goes, and therefore it affords no lesson or guidance for Napier. As to Brisbane, we suggest that a glance at a large-scale map of the coast of Queensland is sufficient to dissipate the suggestion

that it is a parallel case to Napier. The channel there is a protected channel, the coast being protected, in the first place, by the Great Barrier Reef, and Moreton Bay, from which the channel enters the river, being quite a protected bay. We refer to the evidence on this point of Captain A. H. Brown, who, speaking, with a knowledge of Brisbane Harbour, stated that from the entrance to Moreton Bay to the beginning of this channel is 60 miles by one route, and 30 miles by another, with land on one side and sandbanks on the other. There remains Colon. Mr. J. D. Holmes put this forward as a parallel case, and said in his evidence (see page 305, Notes of Evidence), "My point is that if captains of vessels navigate the entrance to the Panama Canal at Colon under the conditions that obtain there, there should be no difficulty about navigating the entrance to the Inner Harbour here. It is navigated at night as well as by day without the slightest difficulty. I cannot produce plans in Napier of this locality to submit to Commissioner A. C. Mackenzie."

We have been able to procure the plans that Mr. Holmes could not then produce, and we include as Maps G and H in Commission's Exhibit No. 3 plans of Colon Harbour and entrance, and plans of the proposed Napier Inner Harbour. In each case there is included, on a smaller scale, a general locality-plan. We call attention to the entrance channel at Colon, situated in Limon Bay, protected, firstly, by the coast-formation, and, secondly, by the West Breakwater and the East Breakwater. We call attention, secondly, to the plan of the proposed Inner Harbour at Napier, showing an utterly unprotected channel, and we propose to leave these plans and the quoted remark of Mr. J. D. Holmes without further comment.

One of the chief engineering problems related to the construction of this channel is that which requires all the conflicting facts and theories relating to the littoral drift and movements of the sea-bottom to be studied and reduced to a working theory. In this problem we have been guided by the engineering member of the Commission, and the result of his work has been incorporated in paragraph 10, "Development of Theories," where it appears under the subheading "Our Conclusions on the Question of Sand-drift." We beg leave here to refer Your Excellency again to that subheading, the contents of which enter into our consideration of the Inner Harbour problem from the engineering point of view. The contents of that subheading, "Conclusions on the Question of Sand-drift," also introduce and are related to the question of dredging the outer channel, with which we now propose to deal.

Dredging.

We are of opinion that the Board's consulting engineers have taken too optimistic a view of the possibilities and probabilities of cutting the outer entrance channel to the Inner Harbour by means of dredging, and of maintaining it in a workable condition by dredging. Mr. J. D. Holmes says (page 301, Notes of Evidence), "We intend using the dredge outside when possible, and inside at other times. There would be no loss of time under these circumstances."

We desire to call attention to this witness's evidence on pages 300 to 304 inclusive in the Notes of Evidence, as supporting our conclusion that he has taken the most optimistic view of every portion of this problem, and refused to admit any element of doubt into his calculations. He does not agree with the conclusions of engineers of experience like Messrs. J. P. Maxwell, Cyrus Williams, and J. Blair Mason; and he stated in answer to the Chairman that the warnings of these engineers on the matter of the practicability and safety of this outer channel did not even raise a doubt in his mind. He was referred to Messrs. Cullen and Keele's warnings that the cost of maintenance dredging on this outer channel when constructed would probably be high, and that it was that which made the cost of maintenance of Inner Harbour greater than the maintenance of the Outer Harbour, and that they had provided for the worst by allowing for the continuous use of the dredge, and he stated that he did not agree with that as a policy and did not think it necessary (see page 307, Notes of Evidence). He was referred to the evidence of his father, Mr. R. W. Holmes, to the effect that when the channel was cut no maintenance dredging would be necessary for three years, and was asked if he agreed with that. His answer was (see page 301), "I would not like to express an opinion on that; it is hard "to say—*there are so many unknown factors.*" He was then asked by the Chairman, "When an "engineer is advising a Harbour Board on a problem in which there are unknown factors which make it hard to say, what standard of care should be adopted in making the recommendation?" We desire to call particular attention to the answer which follows: "I think that the outer channel is absolutely safe; I do not think I have taken any risks."

We are of opinion that from the warnings given by the engineers we have referred to, and from the experience of the dredgemaster of the "Whakarire" (Mr. T. W. Martin) as to the practical difficulties experienced for a period of two months in trying to dredge at this point, and further that if he had to estimate the cost of dredging on that channel he would look upon it as a very difficult problem, and cost it accordingly (page 622, Notes of Evidence), a much more conservative estimate requires to be made in the matter of the cost of dredging this channel and keeping it open.

Our considered opinion is that whilst there is the bare possibility of all the uncertain factors working favourably and justifying Mr. Holmes's optimistic outlook, the probabilities of the case are that if the people of Hawke's Bay had been led into making this venture, including the purchase of a dredge to do this dredging, there would have been added one more to the list of expensive engineering fiascos on the coasts of the Dominion.

For a full detailed report on the whole question of dredging in relation to the Inner Harbour we beg leave to refer to a separate report of the engineering member of the Board, Mr. A. C. Mackenzie, appearing as Table F in the appendix. We hereby adopt that as part of our report.

With regard to the Breakwater Harbour, our conclusion, broadly stated, is that this scheme offers to the Napier Harbour Board district a feasible method of providing a reasonably good harbour for the accommodation of overseas vessels. This harbour will have its limitations; it will not be a first-class

port capable of being entered and left in any weather. It will not be a harbour of refuge for passing vessels in a storm, for there will be periods of storm when no vessel would approach the coast, let alone seek to enter this harbour. It is, however, capable of being constructed at a reasonable cost, as a harbour that under all ordinary conditions and at all states of the tide may be entered, used, and departed from by overseas vessels. It will, so constructed, be capable, in our opinion of affording shelter and facilities for working in most conditions of weather, although there will probably be times when, in view of approaching or developing bad weather, shipmasters will prefer to leave it and make for the open sea.

That these limitations exist are admitted by the most sanguine advocates of this harbour. We are favourably impressed by the service which this harbour has given during a period of forty years in an unfinished condition. We are of opinion that if it were completed by the extension of the breakwater, erection of the mole as designed, and by the erection of the new wharves with up-to-date facilities, by the deepening of berths and the reclamation of land to provide the necessary shore adjuncts, it will be a harbour that, in the words of the question before us, would be a suitable harbour, which we are prepared to recommend when the financial and economic factors make the work justifiable.

Inner and Breakwater Harbours from the Navigational Point of View.

Broadly stated, our conclusion is that from the navigational point of view the Inner Harbour scheme is wholly condemned, because it requires ships to enter a channel 600 ft. wide and approximately one mile long, as an entrance to the inner channel between the moles. This outer channel is situated in the open ocean, and is exposed to winds and seas that ships seeking to enter the channel would find mostly abeam. It is also subject to a more or less heavy ocean swell, which is apt to be experienced even under the most perfect weather conditions at Napier. More than one of the ships' captains who gave evidence before us called attention to the perfectly fine weather conditions obtaining in Napier on the day on which he was speaking, testifying at the same time to the fact that out in the bay at the entrance to the proposed channel there was a pronounced ocean swell, and adding that on that day and under these conditions he would not like to attempt to take his ship into the proposed Inner Harbour.

Under the heading of "Engineering," on page 38 of this report, we include a quotation from Messrs. Maxwell, Williams, and Mason's report of the year 1900. The closing words of the paragraph from which we took that extract referred to the navigational aspect of the same difficulty, and we now add them, viz.: "In addition there would be some difficulty in navigating large vessels along such a channel during heavy weather with the seas sweeping at a considerable angle across the channel and breaking off either side of it." This opinion, expressed by engineers in 1900, was amply supported and justified in 1927 by the evidence of many experienced mariners who appeared before us.

We desire also to call attention to the evidence of Mr. J. P. Maxwell as to the effect of this unprotected open channel as an exposed opening to the Inner Harbour. He says (see page 355), after giving particulars of the destruction of shipping by a heavy "range" in the harbour of Madras, "The mistake was an exposed opening to the harbour." He continued: "I am of the opinion that the proposed entrance to the Inner Harbour here consisting as it does of 600 ft. channel dredged into the open ocean, is a mistake. Anything that may be deduced from a channel 400 ft. across and 20 ft. in depth gives no basis for forecasting what may happen in the case of an entrance 600 ft. wide and 30 ft. deep. I say that seas will sweep in and shipping will not be able to use it under such conditions." Mr. Maxwell, in his description of what had happened at Madras Harbour, spoke of ships and wharves being severely damaged, and he adds (see page 359), "It was the range at Madras Harbour that caused the trouble there, owing to a big entrance opening to the open sea." On the same page he says, "There would be a big range in the Inner Harbour just as it was at Madras, when constructed as proposed. The ships in the harbour would be unmanageable when the channel was widened, owing to the fact that the deeper the water the greater the waves and the greater their velocity. The harbour would be a dangerous trap for any ship."

A summary of the evidence of the navigational witnesses has been prepared, and it appears as Table J in the appendix. A study of this evidence shows that there is an overwhelming preponderance of expert navigator's evidence to the effect that overseas liners will not, except under ideal conditions and at high water slack, use the outer channel of the Inner Harbour. More than one of the witnesses stated that his standard of care is the avoidance of all risks. One witness pointed out that a single ship, loaded with an average cargo, seeking to use the channel, represents a risk in one bottom of from £1,250,000 to £1,500,000, and stated that he would take no avoidable risks whatever. The standard of care indicated by these answers is precisely that which we expected of master mariners and Marine Superintendents of the shipping companies. It is evidence of a nature which has not, so far as we can ascertain, been obtained and put before the Harbour Board and its constituents at any earlier stage of the harbour controversy. It is impossible to overestimate the importance of this evidence, seeing that the value of a harbour as a whole depends upon the safety of its entrance. The only evidence we heard with a contrary tendency to the foregoing came from the Harbour Board's consulting engineers, who, instancing the standard of conduct of lifeboat crews, expressed the opinion that the navigating witnesses who appeared before this Commission had displayed undue caution.

The conclusion we draw from the whole of this evidence is that the entrance channel to the Inner Harbour would be apt to be looked upon with great disfavour by maritime authorities and deep-sea captains using the port of Napier.

Breakwater Harbour from Navigational Standpoint.

At the Breakwater Harbour there are at present two berths at which vessels of 26 ft. draught can be berthed, and also one berth suitable under fair-weather conditions for vessels drawing 18 ft. These berths are protected from the heaviest seas by a breakwater 2,830 ft. in length and having a general height of 6 ft. above high water. To complete the harbour the new works require one new pier for cargo-sheds. Then there is necessary the extension of the breakwater to the Auckland Rock, some 1,500 ft., and the construction of the western mole, about 4,000 ft. in length. There would then be necessary the dredging required to deepen the new berths to, say, 30 ft. This dredging would not be difficult work, and could proceed for the greater part of the year without interruption.

The approach to the Breakwater Harbour does not now require any dredging for vessels drawing 26 ft., nor will the approach require any dredging when the harbour is completed. It may, however, be anticipated that in the future some maintenance dredging would be required on the end of the breakwater.

The navigating witnesses were almost unanimous in the opinion that, when completed, this harbour could be entered with ease at almost any time of the day or night except when heavy weather was being experienced.

Summary of Navigational Evidence.

Summarizing the navigational evidence as it related to both harbours, we would set out the result as follows: The points to be considered are—

(*a*) *Practicability of entering either Harbour when completed, at any State of the Tide, under Fair or Moderate Weather Conditions.*—Under this heading the balance of evidence is overwhelmingly in favour of the Breakwater Harbour. The navigating witnesses were almost unanimous in the opinion that in the event of the proposed channel to the Inner Harbour being constructed and dredged to 34 ft. it could only be safely navigated by vessels drawing 26 ft. at high-water slack in moderately calm water and with the assistance of a tug, and that only one vessel could make use of the channel during any one period of slack water. With regard to the breakwater, overseas and coastal vessels drawing up to 26 ft. could make use of low-water slack for entering the harbour, whilst vessels of greater draught could enter as soon as the tide had risen sufficiently, and would not be hindered by tidal currents.

(*b*) *Practicability of entering or departing from either Harbour (when completed) at Night.*—Under this heading the balance of evidence is overwhelmingly in favour of the Breakwater Harbour.

(*c*) *Liability of Damage to Vessel or Interference with Working Cargo, due to Range.*—The evidence satisfies us at the present time that the class of vessels using the Inner Harbour are whilst in that harbour less liable to interference by range than are the class of vessels using the Breakwater Harbour while berthed in that harbour. In considering this point it must be remembered that the breakwater is in an unfinished state. Practically all the engineering and navigational witnesses were agreed that when the breakwater is completed out to the Auckland Rock, and the enclosure of the harbour-basin made complete by the building of the western mole, the trouble from range would be very greatly diminished. On the other hand there is strong evidence to the effect that if the entrance channel to the Inner Harbour were widened and deepened as proposed, and the sand-spit (which now forms a natural submarine breakwater) removed, there would be a considerable increase in the amount of range admitted to the Inner Harbour basin. Looking at each harbour as it would be if completed according to these plans, and comparing them in the matter of liability to range, we are of opinion that then the balance of evidence is in favour of the Breakwater Harbour on this point also.

(*d*) *Shelter afforded to Vessels when berthed.*—Here it is clear that the balance of evidence distinctly favours the Inner Harbour. Of two vessels of equal size safely berthed at, say, the suggested new pier in the Breakwater Harbour on the one hand, or one of the proposed new overseas berths in the Inner Harbour on the other hand, we think it is clear that the vessel in the Inner Harbour would be in more protected surroundings. This advantage in favour of the Inner Harbour must be taken into account, but it is of course obvious that the advantages attaching to a berth within a harbour are not attainable, while the disadvantages of the entrance channel tend to keep vessels out of that harbour. Furthermore, there still remains the question of range, considered in the immediately preceding paragraph.

Use of Tug.

If a tug is required we are satisfied from the evidence that towage charges will be an appreciable addition to the charges of the port. This question was put to most of the navigating witnesses, and their evidence shows that in regard to the Inner Harbour only one expressed the opinion that a tug would not be required. In relation to the Breakwater Harbour only two witnesses testified that they would require the services of a tug.

Inner or Breakwater Harbour from Economic Point of View.

Our conclusion on this matter, broadly stated, is that there is a great deal of difference from the economic point of view between the two harbours. The question of the cost of constructing, and the consequential annual interest charge, enters into this aspect of the question, and is dealt with in detail under the next succeeding paragraph, dealing with the question of whether or not the construction of the recommended harbour can be justified. We may say here briefly that we accept and agree with Cullen and Keele's conclusion that the Breakwater Harbour is to be recommended as requiring a smaller initial capital outlay and a smaller annual cost of maintenance. As to those economic considerations that are based on or related to such factors as transport facilities and the proximity of shore adjuncts, the balance of advantage lies at the present time in favour of the Inner

Harbour. We have, however, on this point two considerations to submit: The first is that, even as this balance of advantage stands at the present time, it does not nearly outweigh the preponderating tendency of the engineering and navigational aspects. In the second place, the present position can be largely altered, and the necessary facilities attached to the breakwater at a reasonable cost when other aspects of the whole problem justify the construction of that harbour.

We have stated above that we are satisfied that the Breakwater Harbour will require a smaller capital outlay than the Inner Harbour. We desire to comment on the figures and estimates supplied to us in evidence relating to the construction of the two harbour schemes which we were inquiring into. We expected, and we think we were reasonably entitled to expect, that in respect of each harbour we would be supplied with figures representing the best estimate that could be given of the cost of a definite harbour scheme. Our expectations were not realized. The estimates of costs given to us were not of the actual cost of a specified work, but so-called "comparative" costs prepared as propaganda in a party dispute on the merits of the rival harbours. More than once we pressed our requests for statements of actual cost of complete harbour requirements in each case, but our requests were not, and probably at the time of the disposal of witnesses after the inquiry was opened could not, be supplied. Our request was: "Take into account everything that is necessary to construct and equip the Inner Harbour according to the requirements and policy of the Harbour Board, and tell us what that will cost, take into account precisely the same details and requirements in relation to the Outer Harbour and tell us what the total cost would be." We expressed our readiness, when these figures were supplied to us, to listen to any explanations in the way of comparative adjustments or explanations that might tend to show where and why one scheme, starting from the point of view of the present condition of that harbour, might require more expenditure than the other at a given point, but the Board's consulting engineers did not supply us with what we wanted. As an instance of the point of view from which the evidence on questions of cost was tendered to us, we refer to Mr. J. D. Holmes's evidence (page 100, Notes of Evidence). He says there, "To bring the two schemes on to a basis on which it would be *fair to compare their costs*, we include the raising of the height of the breakwater by 10 ft. throughout its length, as recommended by Cullen and Keele's 1912 report, page 9, col. 1, paragraph 3; *so that the Outer Harbour would afford shelter comparable to that found in the Inner Harbour.*"

We wish it to be noted that there was no suggestion that the Harbour Board had ever considered the matter of raising the breakwater, and it was admitted that they had never instructed their consulting engineers to consider or estimate the cost of that work, and yet here we have an item of £223,000 added by the consulting engineers on their own initiative, the object being, to quote Mr. Holmes's own words, "to arrive at a basis on which it would be fair to compare." We cannot refrain from the comment that Mr. Holmes in his evidence announced himself as prepared strongly to recommend the Inner Harbour, and he stated under cross-examination that he could see no redeeming feature at all in the Breakwater Harbour. This being his attitude of mind towards the two schemes, we make no further comment on the fact that £223,000 is without instructions added to the cost of one of the schemes so that the comparison may be fair.

Again, at page 158 of the same witness's evidence (we preface this quotation with reference to the fact that the Breakwater Harbour at present possesses a wharf providing berths for two ships drawing up to 28 ft., whilst the Inner Harbour can accommodate nothing with a greater draught than 15 ft.): "I have allowed for two boats only at Inner Harbour because two are allowed for at Outer Harbour. Cullen and Keele's modified scheme was for four boats. I could not say what additions I would have to make to accommodate four boats; there would be extra dredging and wharving. In our modifications *we cut out two wharves, and altered the quay and the depth of dredging. We only did this for comparative purposes.*"

Here again we are apprised of the fact that an estimate is being put forward for a work that corresponds with nothing the Harbour Board had in view, and which the Board had never instructed the consulting engineers to estimate for. As is pointed out, Cullen and Keele's scheme was for four overseas berths at the Inner Harbour, and (a fact we are dealing with more fully later on), up to the point when this evidence was given there was no suggestion of any other policy than a four-berth Inner Harbour.

The Chairman protested again strongly at this point in the evidence and asked why the Commission should be required to take figures based on something that nobody contemplated, and work up from them to a cost of the harbour that was contemplated. The only answer is that which is apparent from the evidence—viz., that this is done for comparative purposes, and "to be fair" (obviously to the Inner Harbour scheme).

Again, Mr. R. W. Holmes in his evidence on page 216, discussing Cullen and Keele's 1925 estimates in relation to Holmes and Son's 1927 estimates, said: "The item given for the construction of a quay 2,600 ft. in length must be reduced to £114,000, as a *comparison* is now being made between additional accommodation for two ocean liners in the Breakwater Harbour, and the same number in the Inner Harbour." *To Chairman:* "I cannot say who gave instructions for estimates to be drawn up for two overseas berths at Inner Harbour." Again at page 95 of the evidence of Mr. J. D. Holmes: "The reference I made yesterday to the height of the breakwater was made in regard to the comparison of the amount of shelter provided to shipping between the Inner and Outer Harbour. *This is necessary when comparing the cost of the two schemes.* You cannot compare schemes unless the facilities and other conditions are comparable." Again, on some occasions items of cost were left out of both schemes, the explanation being that a certain thing in one harbour would balance the cost of the corresponding thing in the other harbour. The result of this is that we are left with very little assistance from the Board's consulting engineers in our endeavour to arrive at the cost of construction of either of the harbours as outlined by the engineering proposals that have been before the Board. This has increased our

difficulties in an endeavour to answer the question that is now before us. Furthermore, we got no assistance on the cost of maintenance of the two harbours. See Notes of Evidence, page 307 (on top of page). *The Chairman to Mr. J. D. Holmes:* "Have you prepared any estimate of the expected cost of maintenance of the harbours?" *Answer:* "No, I have not."

Another unsatisfactory feature of the case as prepared by and for the Harbour Board is related to what we have just been dealing with, and no doubt to some extent is accountable for the unsatisfactory nature of the estimates supplied to us. This unsatisfactory feature is that the Harbour Board had no definite scheme reduced to plans and specifications, but instead its requirements were measured by a shifting standard dictated by the fortunes of the rival schemes during the process of the inquiry.

We refer again to the evidence of Mr. J. D. Holmes on page 100. He said in answer to the Chairman, "We have estimates drawn up, but no complete written scheme and estimates have been drawn up. The scheme has never been submitted to the Board as complete. The figures were completed only last night. . ."

After the Commission had been sitting from the 4th to the 22nd August the Chairman called attention to the unsatisfactory features that we are now discussing. We call attention to the newspaper report appearing on page 49 of the *Hawke's Bay Herald* daily reports (Commission's Exhibit No. 4). Mr. R. W. Holmes was in the box. The Chairman stated that the Commission had had its difficulties enormously increased by the form in which this evidence was tendered, and said it was surely reasonable to say to the breakwater party, "Let us see your plans and specifications and say what it will cost," and it was surely reasonable enough to say the same thing to the Inner Harbour party. The Chairman said, further, that it seemed as though some of the figures had been brought into the evidence to score a point under the considerations of local controversy. Mr. Holmes interjected that he had attempted to place the harbours on an equal footing, and the Chairman replied, "We are not concerned with placing them on an equal footing; we are here to reply to the Minister as to what we consider the most practicable scheme, and we want to know the cost of that scheme."

We now quote from page 49, Commission's Exhibit No. 4:—

"The Chairman continued, there should have been an estimate put forward and we have not got it. I understood from Mr. Jull that the Board's scheme was to provide berths for four overseas vessels according to Cullen and Keele's modified scheme. Now we are told nothing about that scheme, and the only figures we have before us deal with a scheme for two ocean-going ships. The engineers estimates do not correspond with those quoted in the Board's policy. We have not yet had put forward any figures as to the scheme to which the Board has attached itself. What we have had is something quite different."

When the Commission met next morning the Chairman put forward a written request setting out the basis on which the Commission required a statement of the cost of an Inner Harbour scheme with provision for four berths in accordance with the Board's policy. The Chairman stated that the Commissioners did not see why they should be required to take figures relating to something else as a basis, and from that try to work up the cost of the harbour proposed by the Board. At this stage Mr. A. E. Jull, the Chairman of the Harbour Board, asked, through the Harbour Board's counsel, to be recalled. This was done. He was then asked (page 216, Notes of Evidence),

Is the Harbour Board's present policy a scheme for constructing an Inner Harbour with four ocean-going berths or two ocean-going berths?

Answer: It is for the construction of an Inner Harbour with two ocean-going berths, with facilities for expansion when needed.

Question by the Chairman: Has that policy ever been placed before the public of this rating district, and if so, when?

Answer: We have not published the policy of two or four or any number of berths.

Question by the Chairman: This, then, is the first public announcement of a two-berth Inner Harbour?

Answer: I do not remember any previous announcement of a two-berth harbour.

In commenting on this we wish to point out that on the 12th August Mr. J. D. Holmes, referring to Cullen and Keele's scheme as the basis for his estimates, said: "Their suggestion, as outlined in the 1925 report, was to extend the West Quay a sufficient distance to accommodate four berths, the length being 2,600 ft." Mr. A. E. Jull had already put in Cullen and Keele's 1925 report as the basis of the Board's policy, and the engineers in that report said, on page 4, col. 2, "It happens that the accommodation for four ocean liners and other vessels that require berthage which we are now asked to estimate the probable cost of, nearly corresponds in extent with that we proposed and illustrated formerly." Lower down in the same column they say, "This accommodation we fix at 2,600 lineal feet of quay, and our estimates are for that length."

The Secretary of the Harbour Board, Mr. J. P. Kenny, in answer to our question, "What do you understand to be the general policy of the Board?" replied: "The prosecution of the Inner Harbour as designed by Messrs. Cullen and Keele." When asked when he first heard of the suggestion of a two-birth Inner Harbour, he stated that it was when Mr. Jull made the pronouncement in the witness-box on the 23rd August.

The Harbourmaster of the Napier Harbour Board, Captain White-Parsons, in his evidence stated definitely that the harbour required berthage for four overseas liners. Mr. K. McLeay, an ex-member of the Harbour Board, and a member of the Inner Harbour League, stated that the first he had ever heard of a proposed two-berth Inner Harbour was Mr. Jull's pronouncement already referred to.

We are perfectly satisfied that Mr. Jull's pronouncement on the 23rd August was merely a tactical move to avoid placing before the Commission estimates including the cost of making four new overseas berths at the Inner Harbour. It may have been good tactics, in that if any step might be

successful in procuring the construction of the Inner Harbour as far as the provision of two berths for overseas vessels, the district would then be committed to the Inner Harbour scheme; but nevertheless it amply justifies our statement that the Harbour Board entered on this inquiry with no definite scheme reduced to plans and specifications, but with requirements measured by a shifting standard dictated by the fortunes of their scheme during the course of the inquiry.

At pages 234 and 235 the same tendency is shown in the evidence of Mr. R. W. Holmes:—

Questioned by the Chairman: Would not a statement of the Board's policy as to the amount of berthage required for the port's trade usually be the basis of an engineer's estimate of cost?

Answer: Certainly.

Question: The absence of such a statement leaves the estimates elastic and indefinite?

Answer: The Board would then leave the matter to the discretion of the engineers.

Question: In your son's evidence he said at page 100, "to bring the two schemes on to a basis in which it would be fair to compare their costs, we include the raising of the height of the breakwater by 10 ft. throughout its length." Were your instructions sufficiently elastic to enable you to include that figure of £223,000 without a statement of the Board's intentions in the matter of the height of the breakwater?

Answer: Yes.

Question: Have you ever since your appointment here been acquainted with the Board's policy as to the number of ocean-going berths required?

Answer: No.

Then again there was evidence and admissions of hurry and unpreparedness in the matter of these figures and estimates. It is only fair to the Board's consulting engineers that we point this out. Mr. J. D. Holmes said on page 90, "We have been pushed for time in respect to giving evidence before this Commission." At page 100 he says, "The statement which we are making, which was completed last night, has been prepared under instructions from the Harbour Board for this Commission and not for the Board." On page 149 he said, "I did not take into account labour costs, and work up from them; I took average cost per yard. If I had done so we would have been on the work for about two months instead of two weeks." In answer to an obvious question at this point he continued, "I would have more faith in my estimates if I had had the two months. The work of making up a whole case had been done in a fortnight."

Another feature of the estimates submitted by the engineers is that, having arrived at an engineering basis of the cost of one of the harbour schemes, they then purported to place a valuation of the land which was reclaimed as an incidental work, and *to deduct that value and call the net result the net cost of harbour-construction.* Thus, in connection with the Inner Harbour schemes, they arrive at a gross cost of £461,000; to that they add the estimated cost of roading reclaimed areas, £83,000, and subtract an estimated value of the reclaimed land, £276,000, and call the result, £268,000, *the net cost of the harbour.*

It may incidentally be pointed out that Mr. J. D. Holmes stated that the basis of this valuation was that a member of his staff *got it from somebody at the Harbour Board's offices, and that it was the selling value of the land.* This method of presentation did not trouble us to anything like the same extent as the other unsatisfactory features we called attention to, because we simply ignored the question of the land and the relative deduction from cost; but we would call attention to the probable effect on the public mind of this fallacious method of putting forward an estimate of engineering costs of a harbour. When this Board seeks to build a harbour it must borrow the full amount required to construct the harbour, and it must pay interest on the amount so borrowed. The value of the land reclaimed has no bearing whatever upon these two elements in the Harbour Board's problems. Where the reclaimed land will help will be when the rents it produces amount to more than interest upon the cost of reclaiming it. If and when that happens, the reclamations will be rendering some assistance to the Harbour Board in its finances. The extent to which assistance may be expected will be dealt with fully by us in that part of our report which deals with the question of reclamation.

We tender the foregoing explanation of the method adopted by the Board and some of its witnesses in supplying us with figures and estimates because two results flow naturally from the cause. One is that, even if we could reduce the Harbour Board's ill-defined and elastic proposals to a definite scheme, we cannot attach to it a reliable estimate of the cost of that scheme. The other is that this unsatisfactory feature of the evidence contributed largely to the length of the proceedings and the quantity of the work that we have had to perform. We have all, particularly the engineering member of the Commission, spent weary days trying from unsatisfactory materials to produce some stable and intelligible result in the form of estimates of cost. Most of that time would have been saved and the result would have been more satisfactory if the Harbour Board had come prepared with costs of a definite scheme, put forward on its merits as a scheme, and not as arithmetical arguments in a party dispute.

Economic Conditions as affecting Inner and Outer Harbour Development.

From an economic point of view the first consideration is naturally the capital cost of developing either harbour, and the subsequent annual cost of maintenance. Exact estimates for either scheme are (for reasons already given) not available, but the approximate figures as submitted by various engineers show that the capital cost of developing the Outer Harbour at the breakwater would be considerably less than the cost of developing the Inner Harbour. This statement is justified by figures put forward elsewhere, prepared by Mr. A. C. Mackenzie (Commissioner). The annual cost of maintenance in the case of the Inner Harbour would also exceed that of the Outer Harbour by the cost of the dredging necessary to maintain the outer channel from the entrance at the moles to deep water. This item for maintenance dredging is estimated to amount approximately to £10,368 per

annum, and it might even exceed this. This heavy annual charge is a most serious objection to the Inner Harbour scheme. It would—if the above estimate is correct—eat up all the rents produced by £207,000 worth of reclaimed lands.

As regards harbour layout and operation from the landward side, the Inner Harbour scheme presents some advantageous economic features. The site of the wharves is more immediately contiguous to existing warehouses and bulk stores, and also to the road and the State railway transport system. There is also land or ground which could be reclaimed in the vicinity, available for the future expansion of commerce and industry. Furthermore, the problem of haulage from warehouse to ship's side and *vice versa* is more easily handled, and the distance from half a mile to a mile less than it is in the case of the Outer Harbour; and, generally speaking, owing to the Inner Harbour having always been the main shipping-point both for roadstead and coastal trade, the present layout of both public and private facilities, which has grown up around that harbour, would require comparatively little adaptation to the working of the Inner Harbour as a deep-sea port.

On the other hand, the Outer Harbour is about a mile distant from the present bulk stores and warehouses. It has at its immediate base no land for the buildings, &c., and this space would require to be provided by reclamation from the sea-front. Even then such space would be probably so comparatively limited that it would require to be reserved rather for the use of the Harbour Board than for private enterprise. This is, however, perhaps not so essential, as it is apparent that, for many years to come, wool and other heavy goods will continue to be handled and warehoused in the existing stores situated close to the terminal point of the State railway.

These conditions entail continuous additional haulage to and from the wharves at the Outer or Breakwater Harbour and the State railway terminal or the bulk stores adjacent thereto, while in the case of cargo such as meat, which is railed direct from country loading-points to ship's side, there would be, in loading at the Outer Harbour, the disadvantage of one mile extra railage. There is certainly a set-off against this, in so far as merchants with business places in Napier and Hastings are concerned, as in such case the transport by road of goods from the Outer Harbour to and from their premises would be less than to and from the Inner Harbour, but the net cost of extra haulage to and from the Outer Harbour, as compared with the Inner Harbour, would probably amount to several thousands of pounds per annum.

Taking the various economic factors into consideration, however, it is apparent that the higher capital cost and the heavier annual charge for maintenance in case of the Inner Harbour outweigh very considerably the lesser disadvantage of the extra cost of haulage to and from the breakwater. The disability of there being less space available at the Outer Harbour for stores and warehouses than at the Inner Harbour will be less seriously felt as time progresses, and transport and wharf facilities become better developed and more easily operated. It is impossible to lay out any large main port so that private bulk stores and warehouses shall all be close to the various wharves, and, taking the Inner and Outer Harbours at Napier as component parts of a general harbour scheme, and visualizing the expansion of the port in the more distant future, it is apparent that in time to come, the general layout of transport, warehouse, and harbour facilities will be quite as efficient and satisfactory as at any other main port in the Dominion. In fact, the eventual development of the port with the deep-sea wharves and overseas sorting-sheds at the breakwater, the road and railway transport system along the sea-front to the State railway-yards, and the bulk warehouses and stores adjacent both to these yards and to the coastal loading-berths at the Inner Harbour, with plenty of space in the background available for future industrial development, will be really a more compact and workable system than exists or can exist at most other main ports in the Dominion.

This will be more obvious if the ultimate position of Napier be compared with that of other main ports. The business centre of the city itself will be within a mile to a mile and a half from either the overseas or the coastal berths, with good access by road; and the various harbour facilities, both overseas and coastal, will impinge upon a sea-frontage of about a similar length, with sufficient space on the landward side for road and railway transport and for warehouse accommodation. In the matter of proximity and accessibility Auckland and Wellington are no better off; while Lyttelton, Dunedin, and Invercargill are much less favourably situated. From an economic point of view the problem of ultimate harbour-development at Napier on the lines indicated has distinctly attractive features.

PART 14.—CAN THE CONSTRUCTION OF THE RECOMMENDED HARBOUR BE JUSTIFIED FINANCIALLY AND ECONOMICALLY?

The next question submitted to us is, "Can the expenditure of the money necessary to construct such a harbour (taking into account the amount already expended) be justified from the financial and economic aspect?"

The words "such a harbour" mean the harbour which under the immediately preceding heading we have recommended—viz., the Breakwater (or Outer) Harbour. The words "to construct such a harbour (taking into account the amount already expended)" we take as meaning to complete the existing Breakwater Harbour in accordance with the general description which we gave in Part 12, when we decided that it was practicable to complete the Breakwater Harbour.

In round figures, the amount already expended upon the Breakwater Harbour is £448,000, and, again in round approximate figures, the cost of completing it according to the description adopted above, is £448,000. The factors to be taken into account in deciding whether this additional expenditure can be justified from the financial and economic aspect, and in the light of the above estimate of the cost of completion, are, on one side, (1) the extra interest charge involved, after

raising the necessary loan-money to complete the harbour; (2) the extra cost of maintenance of the completed and enlarged harbour; (3) the extra working-costs, including under this heading the cost of handling at the wharf and sheds the goods which at the present time are lightered in the bay: and, on the other side, (4) the extra revenue to be derived from the use of the completed and augmented harbour facilities; (5) the assistance to this direct harbour revenue which may be obtained from rates levied on land within the Harbour Board's province; and (6) the rents to be received from the Board's endowments, principally in the shape of reclaimed lands, as they will be as the Board's reclamation schemes proceed with the recommended harbour scheme. Another factor to be accounted for on the credit side is the saving of lighterage to the community, although this would not directly affect the Harbour Board or be recorded in its accounts. Finally, by way of fully defining the question before answering it, we place a time-limit on the scope of the question. We are not viewing it as a question whether eventually the completion of the harbour can be justified financially and economically, but as to whether now or in the near future—say, within a period of ten to fifteen years—the undertaking of this work can be justified. Our answer to Your Excellency's question is, "No." It is our opinion, after a perusal of all the evidence and taking into account all the foregoing factors, that from the financial and economic point of view the completion of the Breakwater Harbour cannot be justified now or in the immediate future. We proceed now to set out the considerations that have led us to this conclusion, and this requires us to make (1) an economic survey of the trade, industry, and resources of Hawke's Bay and surrounding districts, and (2) an analysis of the financial position of the Napier Harbour Board and the Harbour Rating District.

Economic Survey of the Trade, Industry, and Resources of Hawke's Bay.

(1) A trade analysis for the four years ending the 30th September, 1926, shows that Napier Harbour is the clearing-house for 216,633 tons of inwards and outwards cargo, the respective average quantities per annum being—134,330 tons inwards, 82,303 tons outwards; annual average trade of port, 216,633 tons. The harbour serves a population of 65,600 in Hawke's Bay, and about 22,200 in adjoining districts.

The area of production, indicated by the red boundary on the map appearing as Map I in Commission's Exhibit No. 3, is 6,860,000 acres, which is classified as follows: Pastoral lands, 4,500,000 acres; agricultural and grazing, 710,000 acres; unoccupied, 1,650,000 acres: total, 6,860,000 acres. It will be noted that the area occupied by the various towns is not represented in this classification, for the obvious reason that the total area so occupied is comparatively small, and a separate heading is not required for the purpose of the foregoing classification.

Exports (Actual).

(2) The principal exports from Hawke's Bay are meat and wool, and, taking the Harbour Board returns for the four years ending the 30th September, 1926, the average annual export trade in these products is—Wool and skins, 88,272 bales per annum; mutton and lamb, 901,680 carcasses per annum; beef, 4,933 tons per annum.

(3) In comparison with the four other main ports, Napier ranks third in volume of meat, wool, skins, and tallow combined, and fourth in the total volume of all exports, including dairying produce. The comparative figures showing the *average annual volume* (in tons) of pastoral produce shipped at main ports as compiled by the Government Statistician for a period of four years ending the 30th September, 1926, are as under:—

——	Wellington.	Auckland.	Lyttelton.	Napier.	Dunedin.
Meat	33,888	12,236	23,614	20,421	6,659
Wool	28,893	10,589	19,437	19,134	15,127
Skins and hides	4,882	4,854	948	1,180	3,743
Tallow	5,620	3,813	3,593	2,464	1,420
Dairy-produce	27,683	45,063	3,222	548	4,412
Total (in tons) ..	100,966	76,555	50,814	43,747	31,361

(4) Exports (Potential).

Fruitgrowing.

Climatic and soil conditions in certain parts of Hawke's Bay, notably near Hastings, are particularly favourable for apple and pear growing for export. The orchards are also well situated for internal trade, and a large business in fruit is carried on with other centres in the North Island. The output for exports in pears and apples last season was 50,000 cases, and in the course of the next two or three seasons is expected to reach a total of 150,000 cases per annum; while in the more distant future, when orchards just planted have come into full bearing, the total output will be very much larger. In fact, an optimistic calculation indicates that under favourable conditions the annual output might in eight or ten years reach a total of 500,000 cases. At present the whole of the fruit is shipped via Wellington under the auspices of the Fruit Control Board, but, as Hastings is only distant about fourteen miles by rail from the port of Napier, the Hawke's Bay fruitgrowers naturally look towards Napier as their ultimate shipping-point.

No doubt this objective may be eventually attained, but for some years to come it is evident that the advantages to be gained by concentrating fruit-shipments at Wellington, and thereby securing prompt despatch to the London market, outweigh any smaller benefits attainable by shipping via Napier, even if the facilities of that port were developed to the same extent as at Wellington. It has been suggested in evidence that the Napier Harbour Board should take into consideration the desirableness of erecting a suitable cool store for fruit, and thereby provide for the handling of the Hastings trade. Such provision would not, however, in the absence of berthing facilities for overseas ships, do away with the handicap of lightering fruit to vessels in the roadstead; and, in addition, the comparatively small shipments made at Napier would very frequently be delayed in despatch from New Zealand, as it would be only a rare occurrence for a steamer loading fruit to make Napier her final port of departure for London. The erection and maintaining of cool storage is therefore not within the region of practical Harbour Board politics at present, and may well be left in abeyance until Napier is in a position to provide an enclosed port and wharf loading for overseas steamers. Fruitgrowers meantime would, of course, have to put up with the longer railway journey to Wellington and the extra cost of freight; but against this they must take into consideration the value of prompt loading and despatch at Wellington to London, and the advantage to be gained from placing their fruit on the London market perhaps three or four weeks sooner than they could hope to do by shipping via Napier.

Evidence has been given as to the delays which occur in railway transit between Hastings and Wellington cool store; but there is no doubt that, as the Hastings output increased, the New Zealand Railway Department may be reasonably asked to furnish special through fruit-trains and a sufficient supply of ventilated fruit-wagons. When the time eventually arrives for shipping via Napier the Harbour will do well to confer not only with the Hawke's Bay Fruitgrowers' Association, but also with the Fruit Control Board, and to secure the co-operation of all parties in the arrangements in regard to cool storage and other facilities for loading fruit. A careful examination of capital and operating costs of cool storage and revenue to be derived therefrom will be, of course, necessary before embarking on the venture.

The following schedule shows the comparison of transport and shipping charges on fruit from Hastings via Wellington and Napier:—

Charges on Fruit from Hastings to F.O.B.

	Per Case.
	d.
Via Wellington (187 miles)—	
Railage at 30s. 3d. per ton weight	8·07
Cool storage	6
Wharfage, 1s. 6d. per ton measurement	0·72
Total	14·79
Via Napier (14 miles)—	
Railage at 6s. 5d. per ton weight	1·71
Lighterage at 10s., Storage at 1s., Wharfage at 2s. 9d. per ton measurement	6·6
Total	8·31

Difference, 6·48d. per case.

(4A) *Dairy-products.*

There seems to be no reason to anticipate any marked increase in shipments of dairy-produce via Napier. The tonnage for the last four years certainly shows a recent upward tendency, as is evidenced by the following record:—

Exports, Butter and Cheese.

——	1922–23.	1923–24.	1924–25.	1925–26.
Butter—	Tons.	Tons.	Tons.	Tons.
Overseas	Nil	49	450	939
Coastal	17	9	18	10
Cheese—				
Overseas	Nil	Nil	27	49
Coastal	52	41	24	24

The principal Hawke's Bay factories, however, lie on the border-line between Wellington and Napier, and the natural flow of the dairy trade from Dannevirke and the surrounding districts is towards Wellington, where the principal buying agencies are established, and where prompt despatch can be given to London and other overseas markets. Such factories as lie closer to Napier will doubtless continue to ship via that port, but the prospect of new factories springing up close to Napier is not apparent, and, all things considered, it would be too optimistic to expect a large increase in the volume of dairy-produce for shipment via Napier, even if that port were developed sufficiently to provide the same loading facilities as Wellington.

(4B) *Hemp.*

No evidence was tendered in regard to hemp-production in Hawke's Bay, but the Harbour Board returns show that the undernoted tonnage was transhipped at Napier from coastal boats to overseas vessels. This hemp is produced at mills situated at or near Wairoa and Waikokopu, and when sold to London is sent down the coast and transhipped at Napier. When, however, shipment is made to Australia, the hemp is sent coastwise to Wellington, and transhipped thence to one of the intercolonial steamers. The latter course was adopted in 1925–26, and this is the reason why no hemp was handled at Napier last year: 1922–23, 1,316 tons; 1923–24, 1,682 tons; 1924–25, 766 tons; 1925–26, Nil.

Apart from the question of Wairoa and Waikokopu hemp, however, we are informed by the Chief Hemp Grader that a scheme for utilizing the swamp lands at Lake Pokawa or Tehauke for flax-production is now in operation, and, as the country is well adapted for flax-growing, a considerable output may be expected. Further information given by hemp-exporters is to the effect that it is safe to say that in six years' time an output of from 1,000 to 2,000 tons per annum may be expected from Tehauke mills, while it is anticipated that if the results from the present areas are satisfactory other swamp lands will be brought into production in the same way. Hemp may therefore be looked upon as a potential export from Napier in the future; but it must always be remembered that so long as the present shipping-expenses at Napier, including lighterage, are on so high a scale the tendency will be for the hemp to be railed to Wellington in the same way as the bulk of the dairy produce.

(5) IMPORTS.

Napier is an active distributing centre, operating both by land and coastal routes. The area of consumption covered is practically the same as the area of production, except that certain outlying portions come within the competitive influence of the distributing trade from Gisborne, Auckland, and Wellington. These debatable areas are excluded from the whole area by a blue line, and within the restricted area thus delineated the population is estimated at 54,400 persons. (See Map I, Commission's Exhibit No. 3.) The purchasing-power, however, is high, as might be expected from the volume of exports, and the average tonnage of imports—viz., 134,330 tons for the four years 1922-26—is sufficient evidence of this. The following table shows a comparison of the volume of imports over a period of four years with those of other main ports, including both inwards cargo and transhipments:—

——	Napier.	Dunedin.	Lyttelton.	Wellington.	Auckland.
	Tons.	Tons.	Tons.	Tons.	Tons.
1922–23	114,429	157,221	269,950	1,039,639	1,205,972
1923–24	140,009	311,994	459,860	1,166,630	1,417,637
1924–25	133,504	349,331	511,403	1,366,573	1,572,627
1925–26	149,380	333,088	484,959	1,364,465	1,492,398
Totals ..	537,322	1,151,634	1,726,172	4,937,307	5,688,634
Average volume per annum	134,330	287,908	431,543	1,234,327	1,422,158

(6) INDUSTRIAL.

In common with other centres in the Dominion, Napier looks forward hopefully to the time when manufactures and industries can become sufficiently established to provide employment for a larger city population, which will in turn furnish a local market for a greater portion of the products of the soil. Unfortunately, these hopes can only be realized in the more distant future. Napier serves too small a population and is too near the large manufacturing centres of the Dominion to compete successfully at present in such industries as might have a chance of success. Furthermore, Hawke's Bay does not possess natural resources, such as mineral deposits, which lend themselves to successful industrial-establishment. For these reasons, therefore, it would be altogether too optimistic to take into account the growth of manufactures or industry as a practical factor in respect to harbour-development in the near future.

(7) PAST SHIPPING RECORDS.

An examination of the Harbour Board's records to ascertain the extent of shipping accommodated in the past, and the tendencies indicated by comparative figures, has also revealed useful information. It is noteworthy that there is no decided tendency for the number of vessels calling at the port to increase, although the tonnage accommodation has grown greater. Indeed, a remarkable fact is that in the matter of one class of vessel—viz., coastal and inter-colonial passenger steamers—there is a marked falling-off as compared with pre-war conditions; but this diminishing of trade is shown by other New Zealand ports, and is due to causes beyond the control of Hawke's Bay and its harbour officials and policy.

The following figures, taken from the Napier Harbour Board's Annual Report of 1926, illustrate the movements. We have extracted them from Exhibits No. 37, 38, 39, 62, and 63, to show the number of vessels, tonnage, and cargo landed or shipped at the Roadstead, Outer (Breakwater), and Inner Harbour.

PORT OF NAPIER: 1ST JULY, 1925, TO 30TH JUNE, 1927.

Roadstead (Exhibit No. 37).

Number of Vessels.	Net Tonnage registered.	Cargo landed. Tons.	Cargo shipped. Tons.
1	Under 1,000 tons		
3	From 2,000 to 3,000 tons		
16	From 3,000 to 4,000 tons		
14	From 4,000 to 5,000 tons	21,799	84,593
44	From 5,000 to 6,000 tons		
19	From 6,000 to 7,000 tons		
19	From 7,000 to 8,000 tons		
116			

Time occupied discharging and shipping, 251 days 20 hours 30 minutes.

Outer Harbour (at Breakwater).

Oversea Liners (Exhibit No. 38):—

Number of Vessels.	Net Tonnage registered.	Cargo landed. Tons.	Cargo shipped. Tons.
1	Under 1,000 tons		
15	From 2,000 to 3,000 tons		
29	From 3,000 to 4,000 tons	45,786	5,552
1	From 4,000 to 5,000 tons		
46			

Time occupied discharging and shipping, 183 days 21 hours 35 minutes.

Coastal and Intercolonial Vessels (at Breakwater), (Exhibit No. 62):—

Number of Vessels.	Net Tonnage registered.	Cargo landed. Tons.	Cargo shipped. Tons.
15	Under 500 tons		
9	From 500 to 1,000 tons		
12	From 1,000 to 1,500 tons	124,327	24,528
14	From 1,500 to 1,910 tons		

Time occupied discharging and shipping, 116 days 8 hours 31 minutes.

Inner Harbour.

	Cargo landed. Tons.	Cargo shipped. Tons.
Locally-owned Coastal Vessels (Exhibit No. 39):—		
From 8 to 100 tons register, 518 trips	15,648	23,734
	Inwards.	Outwards.
Coastal vessels (Exhibit No. 63), from 29 to 933 tons—337 trips	70,356	23,476

Summary.

	Cargo landed. Tons.	Cargo shipped. Tons.
Roadstead	21,799	84,593
Outer Harbour (Breakwater)	45,786	5,552
	124,327	24,528
Inner Harbour	15,648	23,734
	70,356	23,476
	277,916	161,883
Average for year	138,958	80,942
	Tons.	Tons.
NOTE.—Figures given by Napier Chamber of Commerce show this average as	140,005	87,826

Average Total Imports and Exports.—Per exhibits Nos. 37, 38, 39, 62, 63, 219,900 tons; per Napier Chamber of Commerce (pages 450–453), 227,831 tons; per Local Authorities Handbook, 1927 (page 380), 221,653 tons.

Population served (page 450, Notes of Evidence) is 87,742 : equals from 2·5 to 2·6 tons per head.

Adopting the population as given by the Government Statistician in Exhibit No. 151, and the total cargo handled as given by the Local Authorities Handbook, 1927, page 380, the following comparison can be made :—

Port.	Population per Government Statistician.	Cargo handled : Imports and Exports of Population.	Tons per Head.
		Tons.	
Napier	75,760	221,653	From 2·5 to 2·6
Dunedin	128,575	426,552	3·3
Lyttelton	181,900	697,971	3·83

(8) General.

Hawke's Bay and the adjoining territory is an exceptionally fine producing area for wool and meat. Dairying and fruitgrowing are quite successful in certain localities, but the province is pre-eminently wool and meat country, and commercially and industrially speaking is organized and operated on that basis. Climatic and physical conditions, particularly the occasional recurrence of dry years, militate against the successful working of small agricultural holdings except in certain favoured localities, and in view of this, and of the fairly staple prospects for wool and meat in the world's markets, it is reasonable to assume that in Hawke's Bay and the adjoining districts served by the Napier Harbour wool and meat will remain the dominant factors for years to come. Unfortunately, grazing and stock-rearing in such country, no matter how productive, does not call for anything like the same labour as agriculture or dairying in an area of the same size, therefore a rapid increase in population in the near future cannot be reasonably expected. Nevertheless, it is a fair assumption that with improved methods in stock-raising, increased productivity from the use of fertilizers, better grassing of pasture-lands, and the gradual subdivision of such of the larger holdings as are suitable for subdivision, a steady increase in production and in exports may be looked for. This, together with increased fruitgrowing and dairying in suitable localities, will lead gradually to a corresponding increase in population, and, as imports depend on exports and on the maintenance of a satisfactory standard of comfort, it is reasonable to assume that imports as well as exports will show a gradually rising tendency in the future. It must be remembered, however, that the purchasing-power of the community regulates imports, and this depends to a large extent on the *value* of exports, which in the case of wool and meat is in turn dependent on the course of the world's markets. It is conceivable, therefore, that a steadily increasing volume of exports might *not* produce an equivalent increase in the volume of imports. Given normal conditions, however, the future trade of the port should show a steady although not a rapid increase in volume.

(9) Economic Conclusion.

Amongst the main ports of the Dominion, Napier ranks fourth in outwards and fifth in inwards tonnage. The volume of trade has been fairly well handled in the past, and, in spite of the partially developed state of the harbour, there is very little evidence of undue delay in handling either exports or imports, and even at the height of the wool season steamer-loading in the roadstead has apparently been very prompt. As regards the Breakwater Harbour, there has been little delay or loss of time, either on account of weather conditions or because of insufficient wharf and railway facilities. It also appears that the present arrangements in respect to harbour and roadstead loading and discharge are sufficiently capable of expansion to take care of any gradual increase in trade for some years to come. Certain minor improvements in railway and sorting-shed accommodation are necessary, but on the whole the trade of the port has been carried on very efficiently, and the Harbour Board staff, and the shipping, stevedoring, and lightering companies and their employees are to be congratulated on the prompt and careful despatch given, especially to roadstead cargo, all of which requires double handling. It would no doubt be desirable to eliminate this double handling with all that it involves in labour and lighterage, but the port is certainly being effectively, although somewhat expensively, worked under present conditions, and can continue to be so worked for some considerable time to come. While, therefore, a change to more modern and economic methods is desirable, it is not immediately essential, and the heavy expenditure entailed by such a change cannot be justified on the ground of necessity, either from the present or the immediate trade future.

The question of whether the expenditure referred to would be justifiable from the financial aspect necessitates a careful examination of the financial position and resources of the Board and of the Hawke's Bay Rating District.

(10) Analysis of Financial Position.

In order to determine intelligently the present position, and the financial potentialities of the more immediate future, it is necessary to examine briefly assets and liabilities, revenue and expenditure, essential works either in progress or contemplated, also sources of income, and any other important factors relevant to financial issues, including the present capital costs of all harbour-works.

Assets.

Napier Harbour fixed assets and improvements consist of (*a*) the Inner Harbour and the Outer or Breakwater Harbour, with the accompanying wharves, sheds, and other facilities; (*b*) a railway-line of about 117 chains connecting the Outer Harbour with the New Zealand railway terminus at Port Ahuriri, together with engines and rolling-stock; (*c*) certain somewhat ancient dredges, and other harbour plant, stores, and materials, including a considerable stock of concrete piles, beach protective works, and office buildings and equipment. In addition to these harbour assets proper there is (*d*) real estate of various values, consisting of reclaimed lands and endowments vested in the Harbour Board. The particulars supplied on the last statement of the Board's accounts issued 30th September, 1926, page 20, and on the estimate for the current year ending 30th September, 1927, attached, may be summarized as follows:—

(11) Fixed Assets.

	1926 Valuation. £	1927 Valuation. £
Plant, buildings, and railway	41,352	40,915
Inner Harbour works	49,404	57,657
Outer Harbour works	258,041	255,075
Beach protection, stores, piles, &c.	28,102	24,243
Land	376,899	377,890
Reclamations and endowments	257,728	254,830
Totals	£634,627	£632,720

(12) Cash Assets.

The following statement shows the cash assets held at the close of the same periods:—

	Nine Months to 30th September, 1926. £	Twelve Months to 30th September, 1927 (estimated). £	
Fixed deposits	70,000	69,600	(loan-money)
Cash	622	3,500	,,
Investments	300	300	
Sundry debtors	16,925	16,680	(rates, rents, dues, &c.)
War Relief Fund investment	912	930	
Sinking Fund investment	105,252	114,400	
Cash assets	194,011	205,410	
Fixed assets (above)	634,627	632,720	
Total assets	£828,638	£838,130	

(13) Liabilities.

The liabilities on the above dates are shown as under:—

	At 30th September, 1926. £	At 30th September, 1927 (estimated). £
Loans	656,900	656,900
Overdraft	8,923	10,348
Sundry creditors	4,486	4,510
Unredeemed debentures	100	100
Deposits	345	171
	£670,754	£672,029

(14) Loans and Contingent Liabilities.

The outstanding features in regard to loans and contingent liabilities are the commitments for *loan renewals and contracts for works* at present in progress.

On the 1st January, 1928, loans Nos. 3, 5, 6, and 7, amounting to £446,000, will mature, which, less the estimated sinking funds in hand on that date, will necessitate the renewal of, say, £335,000 as per schedule attached (Exhibit 158). The loan indebtedness will then be as follows: Conversion loan, £335,000 (as above mentioned); No. 8 loan, £197,100 (Inner Harbour loan); No. 9 loan, £13,800 (repayment previous liability); Total loan debt as on 1st January, 1928, £545,900.

Out of No. 8 loan a sum of £69,600 has not yet been expended, but is held on deposit pending prosecution of works connected with the Inner Harbour. The liability in respect to these works is £37,884, or, if certain works should be completed in concrete instead of stone, £52,757.

Against the total estimated indebtedness of £545,900 an amount of £6,347 will have accrued in sinking fund by the 30th September, 1927, which leaves the net debt after the above-mentioned renewals have been effected at about £539,000.

(15) Essential Works in Progress or contemplated.

The following schedule sets forth the various items which require to be undertaken at both the Inner and Outer Harbours in order to bring the port into a state of reasonable efficiency :—

Schedule of Works: Inner and Outer Harbours, &c.

(16) Inner Harbour.

(*a*) Eastern mole (in progress)	.. ..	£14,084 (payable out of loan).
(*b*) Western mole (contemplated)	.. ..	8,500 (payable out of loan).
(*c*) West Quay (in progress)	.. ..	15,300 (presumably out of loan).
(*d*) J.D.O. dredge boiler (contemplated)	..	1,000 (proportion only).
		£38,884

(If first two items in concrete add £14,873, making £53,757.)

(17) Outer Harbour.

(*e*) Breakwater apron (contemplated)	.. .. ..	£1,500	
(*f*) Railway material (contemplated)	.. .. ..	595	
(*g*) E shed—addition, 70 ft. (contemplated)	.. .. ..	1,250	
(*h*) Electric runway (contemplated)	.. .. ..	400	
(*d*) J.D.O. dredge boiler (proportion only)	.. .. ..	1,500	
			£5,245
(Inner Harbour—above)	.. ..	..	38,884
Total expenditure required to secure efficiency	.. ..		£44,129

(18) Works in Progress.

Works in progess include (*a*) the contract for repairing and extending by 120 ft. the eastern mole at the Inner Harbour. Contract price plus engineering expenses is, if in stone, £14,084 ; if in concrete, £23,957. The other work in progress is (*c*) West Quay reconstruction : this is nominally being paid for out of revenue, but as the estimated receipts for the year ending 30th September, 1927, will probably fall short of the estimated expenditure by £930, the work which is being done on West Quay will probably have to be paid out of overdraft, and may have to be recouped eventually from loan-money.

(19) Works comtemplated.

These works (*b*, *d*, *e*, *f*, *g*, and *h*) are set forth in the foregoing schedule, and it is to be noted that the expenditure of £1,500 (*e*) for concrete blocks for the breakwater is urgently required, whilst another item that might be described as an urgent call is (*d*) for a new boiler for the J.D.O. dredge, estimated to cost about £2,500. In addition to these two items, it will be necessary to provide a certain amount of railway material, principally rails and sleepers, (*f*) £595, and to make an addition of 70 ft. to the E sorting-shed, estimated to cost (*g*) £1,250, together with an electric runway in the shed (*h*) £400. When these works at the Inner and Outer Harbour and on the railway have been carried out, together with the provision of a new boiler for the J.D.O. dredge, the harbour-works will have been brought into a reasonable state of working efficiency, and the subsequent maintenance charges should be materially reduced.

(20) Glasgow Wharf.

Repairs and reinstatements to this wharf have been in progress for some time. The Resident Engineer, Mr. George Huntley, reported to the Board on the 1st September, 1924, that the cost of repairing the timberwork of the Glasgow and Breakwater Wharves would amount to £5,848, and stated that if the repairs outlined by him were carried out it should not be necessary to spend more on the maintenance of these wharves for a number of years. These repairs have been in progress for some time, and the Glasgow Wharf is now in much better condition that it has been ; but according to the evidence of Mr. J. P. Kenny, the Secretary, a further sum of £3,000 per annum requires to be expended for the next three years before the wharf can be said to be in a really good condition. It is proposed to carry on this work, the cost of same being paid for out of the revenue.

(21) Revenue and Expenditure.

The following is a synopsis of revenue and expenditure (including depreciation) for the undernoted periods. The two last are of course, estimates, that for the twelve months ending the 30th September, 1927, being practically accurate, as the actual figures were available up to 31st July :—

——	Revenue.	Expenditure.	Deficit.
	£	£	£
Nine months to 30th September, 1926	74,539	82,627	8,088
Twelve months to 30th September, 1927	97,251	98,201	950
			Surplus
Twelve months to 30th September, 1928	104,058	95,783	8,275

The salient features are the excess of expenditure for the twenty-one months ending 30th September, 1927, and the estimated surplus for the twelve months ending the 30th September, 1928. Apart from interest on fixed deposits and sundry small items of revenue, the main sources of income are: Harbour revenue, rentals from reclaimed land and endowments, and rates; while expenditure is summarized under the headings of interest and sinking-fund charges, departmental expenses, plant, harbour-works, reclamation, depreciation, and sundries.

The following analysis of the revenue and expenditure for the three periods under review illustrates the movement, actual and estimated, of the various items of account:—

(22) Revenue.

——	Harbour Revenue.	Rentals.	Rates.	Interest.	Sundries.
	£	£	£	£	£
1926 (nine months)	51,145	5,998	14,731	2,412	252
1927 (estimated)	71,198	7,960	14,693	2,999	400
1928 (estimated)	78,708	8,000	14,750	2,200	400

(23) Expenditure.

——	Interest and Sinking Fund.	Depart-mental.	Plant.	Harbour-works.	Reclamation.	Depreciation.	Sundry.
	£	£	£	£	£	£	£
1926 (nine months)	39,081	16,509	2,844	10,997	1,225	6,555	5,416
1927 (estimated) ..	41,413	23,410	4,844	7,452	3,400	9,843	7,837
1928 (estimated) ..	37,058	27,065	4,950	8,500	1,350	7,780	9,080

(24) Comments on Revenue and Expenditure.

Owing to the change in the date of the financial year in accordance with the provisions of the Harbours Act, the accounts as closed on the 30th September, 1926, only cover a period of nine months. It is therefore impracticable, except by means of complicated calculations, to compare that period with succeeding years, and for purposes of comparison the estimates for the years 1927 and 1928 may be assumed to be sufficiently accurate. An analysis of these estimates shows a considerable movement under the various headings. Harbour revenue gives an increase of £7,510 for 1928, partly as the result of the operation of the new scale of dues and charges, and partly from the anticipated increase in trade. Interest on deposits, on the other hand, shows a decrease of £799, owing to the shrinkage in the amount of fixed deposits, due to the expenditure of loan-moneys. The other items—rentals, rates, and sundries—show little or no change. The net increase in revenue on the estimate of 1928 as compared with 1927 is £6,808.

On the expenditure side a considerable movement is foreshadowed during 1928 as against 1927. Interest and sinking-fund payments show a welcome decrease of £4,355, the result of the repayment of the loans maturing on the 1st January, 1928 (paragraph 14). Reclamation expenditure is lower by £2,050 and depreciation is less by £2,063 than in the preceding twelve months, largely owing to harbour-works and plant being brought into a better state of repair. These three decreases in expenditure total £8,468. On the other hand, department expenditure shows an increase of £3,655. This is largely due to the special expenses in connection with exchange and commission which will be incurred in paying off the loans maturing and arranging renewals of loan-money (paragraph 14).

Harbour-works are expected to increase by £1,048, and plant by £106, due to special repairs and replacements already referred to; and sundries will show an anticipated increase of £1,243 in comparison with 1927, owing to provision for cost of the present Commission of Inquiry. The increase in expenditure in department expenses, works, plant, and sundries for 1928 as against 1927 is £6,052, which deducted from the decrease of £8,468 in interest, reclamation, and depreciation shows a net decrease for the period of £2,416. This net decrease in expenditure, plus the net increase in revenue, makes up a total of £9,224, which, less the estimated loss of £950 in 1927, gives a surplus for 1928 estimated at £8,274.

(25) The general movement of revenue and expenditure is therefore apparently in the right direction, and *provided always* that the estimates for 1928 in regard to increased harbour revenue are reliable, the indications are that after the present repairs and replacements have been carried out and the harbour put into a good working condition, the Board (after providing for depreciation, and the usual maintenance charges on plant and harbour works, and the ordinary cost of administration) may in future look forward to an annual surplus.

(26) These annual surpluses should be devoted to building up reserve funds, available for further harbour-development. It is also recommended that the amount charged against revenue each year for depreciation of plant be represented by an actual fund, created by taking an equivalent amount out of cash each year and specially investing it. This is precisely what is done with the annual charge for Sinking Fund, and the reason is precisely the same. That reason is that if this course is

not adopted the amount charged against revenue becomes merged in the general assets and resources of the Board, and is therefore not available in ready cash when required to buy new plant or repay a loan, as the case may be. When the annual amount is invested as we suggest, a fund of ear-marked cash is available when new plant is required (Plant Depreciation Fund) or a loan falls due (Sinking Fund). These contingencies can then be met to the extent to which these funds exist, without having recourse to further borrowing or without embarassing the financial period in which the new plant is required.

(27) Sources of Revenue.

These are not particularly elastic. Wharfage charges, dues on ships, rentals from land, rates for harbour-improvement loans, have been exploited to the fullest extent, and, beyond the natural increase which may be expected from the general development of trade and settlement, it is difficult to see where any further improvement in revenue is to come from. The following is a brief examination of the various sources of revenue.

(28) Wharfage (Payable by Exporters and Importers).

The Napier charges are already so high that they compare most unfavourably with Wellington, which is the nearest competing port, and any further advance would not only penalize consignees and consignors, but would tend to drive trade to other shipping-points, and so react most unfavourably on the volume of trade handled at Napier.

(29) A brief comparison illustrates the difference on some of the principal lines:—

	Napier.	Wellington.
Outwards—	s. d.	s. d.
Mutton (per ton)	4 9	0 9
Lamb (per ton)	4 8	0 9
Wool (per bale)	1 8	0 7
Tallow (per ton)	3 9	1 3
Inwards—		
General goods (per ton, including labour)	4 0	4 0

(30) The estimates of harbour revenue for the years ending the 30th September, 1927 and 1928, include the following items as receipts from the Wharfage Department—1927, £58,209; 1928, £64,844—showing an estimated increase of £6,635 for wharfage. These estimates are based on the assumption that the present class of trade will continue at each harbour, and that the new berthage rates will not have the effect of causing certain overseas vessels, which have been in the habit of using the breakwater, to discharge in the roadstead, or to tranship their cargo at other ports. The estimates also anticipate a reasonable increase in the volume of trade.

(31) Charges and Dues (Payable by Shipowners).

Changes were made in the berthage rates on the 1st July, 1927. These changes do not appear to produce very much more revenue in the aggregate than formerly, as will be seen from the supplement to Exhibit No. 41; but the result of the incidence of the charge calculated at per ton of cargo is to place the Outer Harbour in a less favourable position than the Inner Harbour from the shipowners point of view. The relative figures are:—

	Cost per Ton of Cargo landed or shipped.	
	Old Scale.	New Scale.
	d.	d.
Outer Harbour	5·24	9·36
Inner Harbour	7·94	3·8

In the estimates of harbour revenue referred to in the previous paragraph the following items are included as showing receipts from the Harbour Department—1927, £12,989; 1928, £13,864—showing an estimated increase of £875 for 1928. If this charge is equitably spread over the total number of vessels using the port it does not appear likely to have any great adverse effect.

(32) Rentals from Land.

There is no doubt that ultimately the Napier Harbour Board will receive a very handsome income from this source. In 1902 the rentals received totalled £1,376, while in 1927 an income of £7,960 is anticipated from the same source. Unfortunately, however, the rental income seems to be comparatively stationary at present, and for the year 1928 is only expected to reach a net amount of about £8,000. Until further areas are reclaimed, subdivided, and leased, only a small increase from this source may be expected. The problem of reclamation will be fully dealt with separately, so that it is not necessary to enlarge upon this subject at present, beyond saying that for some considerable time it is apparent that no great assistance towards the Board's revenue can be reasonably expected from this source.

(33) Rates.

Hawke's Bay is a rating-area in connection with harbour loans, and the ratepayers in this way contributed £14,693 in 1927, and they are expected to supply a similar amount in 1928. The policy of the Board is, rightly, in the direction of reducing rates whenever possible, and in view of the burdens carried by both town and country ratepayers throughout the province it cannot be suggested that any advance in rates would be either wise or practicable.

(34) Harbour-improvement Rate.

This is a source of income which has been tried and abandoned, as it was found that the charge was passed on by the owners of the vessels to the owners of goods. It might be possible to impose a charge on imports, as is done in Wellington; but the province is already so heavily taxed, both directly and indirectly, for harbour facilities that the imposition of a harbour-improvement rate should only be resorted to as a last resource.

(35) Roadstead Cargo and Lighterage.

The question of roadstead loading and discharge for large overseas vessels, with the consequent burden of lighterage and double handling of cargo, is so important and so vital that it must be considered in any complete survey of the economic and financial position of Napier Harbour. At present nearly the whole of the wool and meat which is shipped at the Port of Napier is lightered to vessels in the roadstead, besides a good deal of general outwards cargo. A large quantity of inwards cargo is also handled in this way. The following return for the past two years supplies fuller particulars:—

	Cargo lightered.	
	Twelve Months ending 31st March, 1926.	Twelve Months ending 31st March, 1927.
General cargo inwards (tons)	13,880	9,120
General cargo outwards (tons)	4,277	4,077
Meat (tons)	18,450	18,748
Totals	36,697	31,945
Wool and hemp (bales)	81,696	89,535

(36) Evidence shows that the arrangements in respect to lightering are good and efficient. Several experienced witnesses affirmed that the loading and discharge of overseas steamers in the roadstead was as prompt, or nearly as prompt, as if the vessels had been working at a wharf; and, while this point is debatable, there is no doubt that lightering at Napier is an essential link under present conditions between land transport and sea transport, and that it is a public utility which it very effectively operated by private enterprise. The annual charge for lighterage amounts to abous £30,000 per annum, and under the existing conditions, and in view of the services rendered, it does not appear that the charge is unduly heavy, or that the lightering company is extracting an undue profit. There is no doubt, however, that the annual cost of lightering is borne either directly or indirectly by the population of Hawke's Bay and surrounding districts, and the possibility of eliminating this annual expenditure of £30,000 has constituted a very potent although somewhat misleading argument in the endeavours which have been made from time to time to induce the public to endorse plans for harbour-development.

(36A) Annual Revenue Accounts.

Our summary of the results of the revenue transactions of the Board for the period to the 30th September, 1926, and (estimated) for the year 1926–27 cannot be reconciled with the statement of the Chairman of the Board that, in addition to ordinary expenditure, the Board was out of revenue spending large sums on quay-construction and reclamation, and would even then finish up with a substantial surplus. (See Notes of Evidence, page 41.) The Chairman's statement is incorrect; he has fallen into the error of trying to ascertain the result of the year's working by reference to the cash-book only, without making all the adjustments necessary to eliminate items that do not relate to the year's revenue transactions. These include cash received on sale of capital assets; cash collected during the year as realization of last year's revenue, outstanding last balance-day; cash paid during the year in liquidation of last year's expenses, outstanding last balance-day. On the other hand, there must be added to the records contained in the cash-book the amount (*a*) of revenue belonging to the period but not yet collected; and (*b*) expenditure properly chargeable to the year's revenue accounts but not paid at balance-day; (*c*) the amount by which the working assets have depreciated during the period. All these adjustments have been properly and correctly made by the Secretary (including every penny of relevant items appearing in the cash-book), and the result appears on page 17 of the Board's published accounts for the nine months ended 30th September, 1926, under the heading, "Statement of Income and Expenditure for the Period 1st January, 1926, to 30th

September, 1926." The result is a deficiency of £8,087 for the period. The corresponding statement for the year ending 30th September, 1927, shows a deficiency of £950.

The Harbours Amendment Act, 1925, by section 4, makes the preparation and publication of a statement of income and expenditure for the year compulsory for the future. This is an excellent provision, and should make misleading errors of the above description more difficult and less excusable.

(37) Capital Cost of Harbour-works.

The instruction in the order of reference to "take into account the amount already expended" necessitates some inquiry in the cost of both the Inner Harbour and the Breakwater.

Inner Harbour.

Exhibit No. 161 shows (*a*) capital expended on the Inner Harbour up to and including 1884, when the breakwater was initiated; (*b*) capital expenditure on the Inner Harbour from 1885 to 1909 inclusive, or what may be termed the breakwater era; (*c*) capital expended on the Inner Harbour from 1909 to 1927, the Inner Harbour era: total expenditure, £270,468.

Outer (or Breakwater) Harbour.

The same exhibit shows (*d*) capital expenditure on the Outer Harbour from 1885 to 1909 inclusive; (*e*) capital expenditure from 1909 to 1927; total expenditure, £448,707.

(38) Schedule of Expenditure.

	£
Inner Harbour—	
(*a*) Up to and including 1884	75,000
(*b*) From 1885 to 1909 inclusive	2,730
(*c*) From 1910 to 31st July, 1927	192,738
	£270,468
Breakwater Harbour—	£
(*d*) 1885 to 1909	443,840
(*e*) 1910 to 31st July, 1927	4,867
	£448,707

(39) Valuation of Harbours.

The valuation of the respective works for 1926 and 1927, and the estimated valuation for 1928, are given as follows:—

——	1926 Valuation.	1927 Valuation.	1928 Estimated Valuation.
	£	£	£
Inner Harbour works	49,404	57,657	78,431
Outer Harbour works	258,041	255,075	252,165

(40) Inner Harbour Loan Expenditure.

Out of No. 6 and No. 8 loans (amounting to £247,100) a sum of £175,135 had been expended on Inner Harbour works up to the 30th September, 1926, and further expenditure on the Eastern Mole contract and Western Quay reconstruction has been going on since, while the Western Mole has still to be made good, so that by the 30th September, 1928, the total expenditure out of this loan-money will probably amount to £213,000.

Of the sum of £175,134 already spent, one item of £84,348 is the contribution of the Napier Harbour Board towards the cost of the Inner Harbour and East Coast Railway embankment. This money was spent in anticipation of the completion of the Inner Harbour scheme. The original intention of the Board was that their contribution should not exceed £50,000, but for various reasons which need not be recapitulated here the original estimate was much exceeded. Failing the development of the Inner Harbour as a deep-sea port, this sum of £84,348 is of no practical advantage or benefit to the Napier Harbour, and, as the Board is not treating it as an asset, it has practically been written off, and may be looked upon for Harbour Board purposes as unproductive capital expenditure not represented by any available asset.

Another item of capital expenditure which is at present a "frozen" asset, is the unduly large stock of concrete piles in hand. These piles were manufactured in anticipation of the development of the Inner Harbour, and, while they are being used up at the rate of about £5,000 worth per annum, the quantity on hand is very much in excess of immediate requirements and represents a capital investment which cannot be turned to any practical account in the near future, although there is no reason to suggest that the Board will not eventually be able to make good use of them. The same remarks apply to a lesser degree to stocks of steel and iron work on hand for the purpose of manufacturing further supplies of piles, &c.

(41) The present position is, therefore, that out of the sum of £247,100 borrowed in order to develop the Inner Harbour, a sum of £84,348 has already been, in effect, written off, and can be of no benefit if the Inner Harbour scheme is jettisoned; whilst at least £10,000 more is lying idle in the shape of piles and other materials, which can only be utilized by slow degrees. Fortunately, the balance of the loan-money has been profitably and usefully expended in putting the existing Inner Harbour works into good condition. Mr. Mackenzie has prepared an estimate of cost of completion, and this appears as Table G in the appendix.

(42) Outer Harbour Loan Expenditure.

The capital expenditure of £448,707 has been written down to about £255,000 in 1927, and will have been further written down to about £252,165 by 1928. Fortunately, there is no dead capital item to criticize in connection with the Breakwater Harbour. Successive Boards since 1909 have apparently pursued a cheeseparing policy in regard to the Breakwater Harbour, which has evidently been looked upon rather as an adjunct to the Inner Harbour than anything else. In consequence the breakwater itself has been to some extent starved, while the Glasgow Wharf had at one time been allowed to get into a state of disrepair approaching danger-point. (See Exhibit No. 93.) These defects have been remedied to some extent, but expenditure in respect to the Outer Harbour has never been lavish. The result is that there are no dead assets to comment on in connection with that scheme. On the other hand, there is a capital investment in good, useful harbour-works, which at present-day valuation stands at £255,000. These works, with the expenditure of perhaps £450,000 more, are capable at some future date of being converted into a satisfactory harbour for overseas vessels, and, taking all circumstances of the case into consideration, it is therefore essential that the breakwater, with the wharves and other facilities pertaining thereto, should be maintained in good and efficient working-condition, with a view to expansion when commercial and financial circumstances so warrant.

Mr. A. C. Mackenzie has prepared an estimate of the cost of completion of Breakwater Harbour, and this appears as Table H in the appendix.

(43) Financial Conclusion.

In view of the present financial position of the assets and liabilities and of the revenue and expenditure of the Napier Harbour Board, in conjunction with the capital costs of the present works and the probable expenditure necessary to bring these works into a state of efficiency, together with the important fact that none of the present sources of income are capable of producing any marked increase of revenue in the near future, it is evident that the Napier Harbour Board and the Hawke's Bay Rating District are in no condition to shoulder any further financial burden at present. It has been stated that the increased rentals to be obtained by reclaiming further areas of land would compensate for increased harbour expenditure, but a full exploration of this source of income, which will be dealt with separately, does not disclose any grounds for such optimism. Therefore it can be said without hesitation that the heavy expenditure required by a complete scheme of harbour development is not justifiable from the financial aspect.

Summary of Commercial and Economic Report.

(44) In reply to Question No. 1c—"Whether the expenditure of the money necessary to construct such a harbour (as referred to in the replies to Questions 1A and 1B), taking into account the amount already expended, can be justified from the financial and economic aspect"—and referring to the details furnished in the foregoing pages, and more particularly to paragraphs 8 and 42, we beg to summarize as follows:—

(45) In view of the fact that no rapid increase may be anticipated in the trade of the port, and that the corresponding revenue will only grow slowly, and, furthermore, that both inwards and outwards tonnage is being handled and can be handled effectively under existing conditions, there is no urgent necessity for the people of Hawke's Bay to rush into a further borrowing policy and a large expenditure on harbour development. Such a policy, entailing the raising of perhaps £450,000 and resulting in an addition to the present bill for interest and sinking fund of a further £27,000 per annum, could only be justified if some very considerable advantage, either financial or commercial, were to be gained.

(46) In time past the saving of lighterage has been held out as a compensating advantage in order to justify the expenditure required to provide an up-to-date harbour, but it will be apparent on reflection that no real saving could be effected in this way. The people of the Harbour rating area who are now paying £30,000 per annum for lighterage would merely be exchanging that burden for a similar burden in the shape of interest and sinking fund. The incidence of the burden would be shifted, but the community would in the long-run be no better off.

(47) From an economic and commercial point of view the time has not yet arrived for harbour development, no matter how desirable it may appear to provide an enclosed harbour and wharf loading for overseas ships, and the Harbour Board and the people of Hawke's Bay will therefore do well to proceed quietly on present lines for perhaps ten or even fifteen years before they even consider seriously the launching of a complete harbour-development scheme. In the meantime every effort should be made to carry on with economy, to inaugurate a prudent and helpful reclamation scheme, to reduce harbour charges and rates wherever such reduction is possible, and at the same time to build up reserve funds, so that when the production of the province and the trade of the port has sufficiently increased the Board may be in a sound financial position to undertake a carefully considered scheme of harbour development.

PART 15. SHOULD THE INNER HARBOUR LEGISLATION OF 1914 BE REVOKED?

Our order of reference, after submitting seven specific questions to us, requires us generally to inquire into and report upon the premises, and any matters arising thereout which may come under our notice in the course of our inquiries and which we consider should be investigated in connection therewith.

Prior to the setting-out of the seven questions referred to a number of matters are premised in the form of recitals, and are therefore the premises into which we are to inquire and upon which we are to report. One of these recitals appears in the following words: "Whereas by the Napier Harbour Board Empowering and Loan Act, 1914, the Board was, subject to the provisions of the Harbours Act, 1908, and of the said Act of 1914, duly authorized to construct such harbour-works as should by the Board be considered necessary for the requirements of the Harbour of Napier in and about the construction, completion, development, and improvement of the Inner Harbour portion of the said harbour. . . . And whereas it appears to the Government that it is expedient to appoint a Commission to make inquiry into and report regarding the question as to whether the authority to construct wholly or in part the works specified in the Napier Harbour Board Empowering and Loan Act, 1914, should be continued in force and the work authorized in due course, or whether legislation should be enacted to revoke the said authority wholly or in part. . . . ." The works specified in the Napier Harbour Board Empowering and Loan Act, 1914 (which we shall hereafter refer to as "the said Act") comprise, firstly, the construction, completion, and development of the Inner Harbour; secondly, the repair and renewal of certain parts of the existing Inner Harbour; and, thirdly, certain reclamation works; and these authorities are contained respectively in sections 7, 8, and 14.

The whole question of reclamation and our recommendations in relation thereto will be found contained in Part 18 of this report. We propose now to give attention to the question of whether or not the authority to construct wholly or in part the work specified in sections 7 and 8 of the said Act should be continued in force and the work authorized in due course, or legislation should be enacted to revoke the said authority.

We have in earlier portions of this report, in answer to certain of Your Excellency's specific questions, answered that in our opinion the Inner Harbour scheme of the Napier Harbour Board was not the best and most suitable harbour from an engineering, navigational, and economic point of view, and further, that, in our opinion, the expenditure of further sums of money on harbour development at Napier cannot be justified from the financial and economic aspect.

We are of opinion that it follows as a logical sequel to these answers that the authority contained in section 7 of the said Act should be revoked. We are further of opinion that the expenditure of any sums that have so far been spent in the exercise of the powers thereby created should be ratified and validated notwithstanding the revocation of the said authority. Of the sum which the 1914 Act authorized to be raised — viz., £300,000 — the Harbour Board has raised in all £247,100, leaving unborrowed the sum of £52,900, and we recommend that the authority to borrow that sum be revoked. Of the sum of £247,100, the sum of £175,135 had been expended up to the 30th September, 1926, leaving at that date a sum of £71,965 unexpended.

The Board had entered into certain undertakings for renewal and extension of its existing wharf facilities at the Inner Harbour, and the reconstruction of the eastern and western moles at the entrance channel to that harbour, at an estimated cost of £37,884. We also recommend in Part 16 hereof that the sum of £3,745 be expended upon putting the existing works at the Breakwater Harbour in a state of good repair and efficiency; also that £2,500 be spent on a new boiler for the Board's dredge J.D.O. These works total £44,129 (see Exhibits Nos. 96 and 97). This sum expended out of the above balance of £71,965 leaves loan-moneys in hand £27,836, less probably some portion of the loan-money spent since the 30th September, 1926, not included in the above repair and renewal items. We recommend that the Board be authorized to expend the said loan-moneys in hand on the said repair and replacement works, and that the balance be invested as a Reserve Fund available for future harbour-works when authorized.

As to the power to expend £50,000 on certain repairs and renewals bestowed by the proviso to section 8 of the said Act, the position is that these powers have been exercised and exhausted, and no recommendation is necessary. On page 17 of our report will be found a table of expenditure showing the details of the expenditure of the whole of the £50,000 authorized to be raised by the said proviso to section 8. This sum of £50,000 is included in the sum of £175,135 mentioned above as having been expended.

The Chairman of the Harbour Board, Mr. A. E. Jull, when giving evidence, referred to the matter of the Commission being asked to make a recommendation on the present subject-matter. Mr. Jull said (see page 42, Notes of Evidence), "It must be remembered that any proposal to repeal legislation authorizing a local authority to do certain work, particularly when that local authority have had the acquiescence of the people, who will be called upon to become responsible for that expenditure—that such a suggestion is, as far as I know, without precedent in this country, and will evoke, I undertake to say, violent opposition from all local authorities in the country, as it would mean practicallya substitution of bureaucratic control for local Government."

We cannot see that any such principle as is urged by Mr. Jull is at stake. Parliament in good faith, acting on certain information, gave the power. If Parliament follows our recommendation it will, equally in good faith, and, we submit confidently, on later and much more accurate information, revoke the authority. To our minds the proposition is self-evident that any legislating assembly may and should do so, and we do not propose to labour the point. We do, however, suggest that if the constituents of the Harbour Board are in any way aggrieved, and if the correction of an original mistake proves expensive, the blame would lie neither at the door of the Legislature which originally gave and subsequently revoked the authority, nor at the door of this Commission, which honestly and confidently recommended the repeal of the legislation in question, but at the door of those persons whose actions and words had led their constituents to become supporters of an unsound proposal. If our recommendation to repeal the legislative authority in question is without precedent in this country, we are prepared to stand by it as a better precedent than many that stand crystallized in the form of unjustifiable and unproductive monuments to the unwise expenditure of public money.

PART 16.—ADVISABILITY OF CONSTRUCTING HARBOUR.

The next question submitted is, "Whether, taking into account all relevant considerations, it is advisable that such a harbour be constructed?" We define "constructed" in this connection as meaning "completed or developed." We have in the immediately preceding paragraph answered that the expenditure of the money necessary to construct the recommended harbour cannot be justified from the financial and economic point of view. We know of no aspects of the whole problem that dominate the financial and economic aspects, and we are therefore of opinion that our answer to this question follows as a matter of course on that given to the immediately preceding question. Our answer is that it is not advisable that such a harbour be constructed now or in the immediate future.

PART 17.—IS THERE ANY ALTERNATIVE SCHEME?

The next question to which we must address ourselves is in the following words: "In view of all the circumstances, is there any other scheme which you can recommend in preference to those mentioned and compared in Part 12 hereof—viz., a completed Inner Harbour scheme or a completed breakwater scheme?"

It seems to us that there are two ways in which we may interpret this question. One way would be to consider the evidence with a view to answering the question, "Is there any harbour scheme quite distinct from the breakwater or Inner Harbour schemes which is worth consideration and can be put forward for recommendation?" A bare reference was made, for instance, on one or two occasions in the course of the evidence to a deep-sea harbour site near Cape Kidnappers; whilst further brief references were made to an Inner Harbour quite distinct from that which we have discussed in our foregoing paragraphs, in that its entrance channel, as to direction and other details, was quite different from that recommended by Messrs. Cullen and Keele. We may briefly dismiss this possible aspect of the question. No such scheme is at the present time so seriously before the Napier Harbour Board or the ratepayers of that Harbour Board's district as to be considered within the scheme of practical politics; we collected no evidence designed to lead to a conclusion on any such scheme, and we answer that from this point of view we have no recommendation to make.

The question, however, is capable of a second interpretation, which may be stated thus: "Has the Commission any recommendation which it can put forward as an alternative to constructing a complete Breakwater Harbour at the present time?" or, in other words, seeing that the Commission has advised that the construction of the recommended Harbour is not justifiable financially or economically, does the Commission recommend that the harbour district and its elected representatives do nothing?

Our answer to this question, in whichever form it may be taken, is that we recommend that the Harbour Board enter upon a policy of putting its existing facilities into a state of efficiency with a view to procuring the most effective service and the utmost returns from a composite harbour scheme, comprising a roadstead for the largest vessels, the breakwater harbour for such large vessels as require its use, and the Inner Harbour for vessels drawing up to 15 ft.

We are quite satisfied that it is nothing but the unfortunate intrusion of party spirit into the constitution and deliberations of the Board, resulting in a state of settled warfare between parties, that has led to the inner and breakwater portions of Napier Harbour facilities being pitted against each other as rival harbours. We are satisfied that common-sense, business insight, and experience of what is being done in harbour construction and administration in other parts of the world unite in pointing out the Inner and Breakwater Harbours as complementary parts of a comprehensive scheme of harbour operations. In our opinion, the present state of the harbour controversy, with local partisans holding the views that have been put before us with a fervour that may almost be described as fanatical, would be ludicrous if it had not been fraught with such unsatisfactory results to the people of the district.

The true issues have been very much clouded by the partisan spirit invoked, and by sectional aims and ambitions, but we are confident that the view we have here expressed is one which will appeal to any unbiased and intelligent observer who takes the trouble to make a careful examination of the present problem.

We are satisfied that the results of the party dispute which, particularly since the year 1909, has so strongly influenced the Board's policy have been to cloud the judgment of members of the Harbour Board, to clog their energies and divert them from useful deliberation, to cause them to allow harbour-works to fall into a state of quite serious disrepair and inefficiency, and to bring the valuable reclamation policy of the Board to a standstill. Furthermore, the evidence has raised in our minds more than a suspicion that there are aspects of the administrative side of the Board's work where inefficient methods and faulty organization have been tolerated and allowed to continue longer than they would have been had it not been that their existence and results tended to lend weight to some of the theories and claims of the dominant party on the Harbour Board at the time. In this connection we are satisfied that these tendencies have operated to the discouragement of a most efficient and loyal staff, the members of which seem nevertheless to have rendered excellent service to the Board. In support of the foregoing statements we would refer to the points which we have in mind—viz., the lack of maintenance work on the breakwater by the failure to supply renewal concrete blocks placed pell-mell at points that were becoming weakened; the serious state of disrepair at the Glasgow Wharf which has existed at times and which now seems to be amended only to the point of the minimum standard of safety; and, thirdly, the inefficient existing arrangements for loading and discharging general cargo at and from the Glasgow Wharf.

We recommend, therefore, that for the period of the next ten years the Harbour Board should, after having made a close and careful survey of its financial position, seek to consolidate that position. Time is necessary to disclose the effect of recent alterations in the tariff of harbour dues. It is quite apparent that for the current year and for some years past the annual revenue expenditure of the Board exceeds and has exceeded its income for the corresponding periods, and the whole system has therefore been run at an annual loss. It should, therefore, in our opinion, be the immediate financial concern of the Board to make up this leeway and bring out the result of its revenue operations on the correct side. It should as soon as possible undertake the work of putting the existing facilities in a state of good repair and efficiency.

We have obtained from the Secretary of the Harbour Board (see Exhibit No. 96) an estimate of the cost of putting the Inner Harbour into a state of good repair and reasonable efficiency for its present-day work. We have checked this carefully, and we believe that it is a good and reliable estimate. The Secretary brings the amount out at £39,000; the details of this are shown on Exhibit No. 96. We submitted the same question in relation to the Breakwater Harbour, and we were supplied with an estimate (Exhibit No. 97) prepared by the Secretary, showing the amount to be £5,300. We believe this to be an accurate and safe estimate. By the expenditure of these sums, and by devoting to the question of improving the industrial, mechanical, and administrative sides of the Board's work the energy which in the past has been dissipated in partisan warfare, we believe the Board can improve its revenue with its existing facilities, undertake a useful policy of reclamation, and thus build up reserves which will comparatively quickly put it in a position to consider a further constructive policy.

It is true that this policy will in the meantime leave the Napier Harbour with the necessity of using lighters for the bulk of its export trade. This is inevitable, however, and any disappointment that may arise therefrom is not due to our recommendation, which is made after fully considering all the facts, but must be laid at the door of those who in the past have made promises wholly incapable of fulfilment. The people of the district by printed pamphlets issued in 1920, when they were urged to sanction the loan for the Inner Harbour scheme, were invited to "Vote for Inner Harbour Loan . . . The harbour with no rates." In a summary of advantages printed on the same pamphlet the ratepayers were told that the Inner Harbour "would not cost the ratepayers one shilling"; that the land reclaimed alongside the shipping "will more than pay the total cost"; that "all shipping will gladly avail itself of the Inner Harbour; there will be no need to urge them to make use of it"; that "all the lighterage charges can be saved by a small expenditure of £250,000 on the Inner Harbour, and that land-rents will pay the interest." As against this the evidence satisfies us, and we believe that it will satisfy any intelligent ratepayer who will take the trouble to study it—(1) That in the financial period ending 30th September, 1926, after taking credit for rates, £14,731, the Harbour Board's outgoings exceeded its revenue for the period by £8,087; (2) that for the year ending 30th September, 1927, after taking credit for rates. £14.693, the year's working expenditure exceeds the year's revenue, according to the Secretary's estimate prepared at the end of August; (3) that the construction of the harbour would have involved an annual interest charge at least equivalent to the annual lighterage charge; (4) that for ten years to come, at least, the income from the reclaimed lands will produce little, if any, more than interest on the cost of reclamation; (5) that, at best, the Inner Harbour would have been a tidal basin into which only one overseas ship could pass either in or out at each slack water of high tide, and then only if favourable conditions existed at the mouth of the channel; whilst (6) at the worst, marine superintendents would forbid altogether the use of the Inner Harbour by their company's ships.

There is, therefore, little room to doubt that if the Inner Harbour were built in accordance with the Harbour Board's plans, the district would be required to carry (1) a considerable portion of the present cost of lighterage, (2) interest on the cost of construction of the harbour, (3) a heavy annual charge for maintenance dredging, and (4) the old burden of harbour rates. That part of our report which deals with "Reclamations" shows to what extent the harbour accounts may expect relief from rents from reclaimed lands.

PART 18.—INCIDENCE OF HARBOUR DUES.

Question No. 2 submitted to us by the order of reference is whether at the present time, according to the working of the existing law, the port dues, berthage dues, wharfing dues, charges for labour, charges on goods, and other charges which the Board is empowered to levy are imposed in a manner operating equitably as between different classes of ships, different parts of the harbour, and different classes of persons liable for payment of the said respective dues.

Some evidence was led before us touching recent changes in the rates of berthing dues and of the basis on which those rates were charged. The most recent alteration, which came into operation from the 1st July, 1927, imposes on all vessels other than lighters, a flat rate of 3d. per ton register per trip for the first day, and 1d. per ton register per trip for each day or part of a day after the first day. (See Exhibit No. 40.) For lighters the rate is 3d. per ton register per trip.

These were applied by witnesses to specific ships that habitually use the Napier Harbour, for the purpose of showing how, as compared with past rates, the charges tended to decrease the amount levied for berthage on smaller vessels and increase it on the larger vessels, and it was suggested that this would tend to discourage the bigger vessels from using the Breakwater Harbour, and force them to the roadstead. On the other hand, it was suggested by the Chairman and other officials of the Harbour Board that it was by no means certain that it would tend to force ships into the roadstead, and that the new scale was designed to make a more equitable charge on ships in accordance with the services rendered by the Harbour Board. Typical instances were: S.s. "Kamo," 725 tons—on berthage rates prior to 1st July, 1927, staying two days and discharging 725 tons of cargo, total berthage paid £16 12s. 3d., equivalent to 6·8d. per ton; under new rates, on the same basis, total berthage paid £12 1s. 8d., equivalent to 5d. per ton. S.s. "Kaiwarra," 1,847 tons—on berthage rates prior to 1st July, 1927, staying five days, discharging 1,847 tons, total berthage paid £17 6s. 4d., equivalent to 2½d. per ton; under new rates, on the same basis, total berthage paid £53 17s. 6d., equal to 7·8d. per ton. A lighter loading 60 tons per trip—Berthage at 3d. per ton equals 15s. per trip, or 1·8d. per ton.

We are not prepared to express an opinion as to how this new charge will operate, but we see no evidence that the alteration in the scale is anything but a legitimate exercise of the Harbour Board's right to cast its scale of charges on what, in the exercise of the discretion and knowledge of members of the Board, seems to be an equitable and proper basis. It may be that experience will show that the higher charges will discourage the bigger vessels from berthing at the wharves, and that will quickly reflect itself in reduced revenue for the Harbour Board. We have no doubt that, if this happens, the Harbour Board will be quick to recognize and remedy the position.

A considerable amount of evidence was also tendered in relation to the amount of the charges for labour, and the incidence of those charges; but, in our opinion the evidence tendered by the Harbour Board justified the nature and incidence of those charges according to present conditions.

No other evidence touching on the subject-matter of the question now before us was tendered to us. Our answer is, therefore, that according to the evidence tendered to us the various harbour dues and charges enumerated in the question are at the present time, and according to the existing law, imposed in an equitable manner as between the different interests enumerated in the question.

PART 19.—THE RECLAMATION PROBLEM.

Our order of reference, paragraph 1 (*f*), requires us to inquire and report upon: "Whether the reclamation of the areas described in the First and Second Schedules to the Napier Harbour Empowering and Loan Bill, 1926, or any other areas within or adjacent to the Harbour of Napier and the lands vested in the Napier Harbour Board should be authorized; and, if so, to what extent, and by what arrangement can any such reclamation be most economically and satisfactorily accomplished?"

The areas described in the said First and Second Schedules are the Awatoto Block, 28-acre Block, North and South Ponds, and part of West Quay Reclamation Block. (See Plan A, Commission's Exhibit No. 3.)

We are of opinion that the authority sought in the said Bill should be withheld, on the ground that the policy underlying it is related to and dictated by the Board's Inner Harbour policy, which we have reported against in the foregoing portion of our report.

We are of opinion that all the said areas should be reclaimed, but that the whole problem of reclamation should now be reconsidered, and that in deciding which areas should be reclaimed first, and what methods should be adopted, a comprehensive view should be taken covering all areas, all methods, and the interests of all public bodies affected by the problem.

We set out our views on these matters in the following pages, and we set out our recommendation at the end of this part.

General Description of Areas.

The Legislature has vested in the Napier Harbour Board certain landed endowments in the form of areas of land contiguous to Napier. In general, these might be described as low-lying tidal areas capable of being converted into arable and habitable areas by reclamation. Some of these areas have been reclaimed; a notable instance is the portion of the Borough of Napier known as Napier South, the whole of which has been reclaimed and is now a very closely settled residential area. On Plan A, Commission's Exhibit No. 3, we show the principal areas that are now awaiting reclamation, and on the map we have coloured them so that they may be so distinguished and referred to. Firstly, there are two small areas coloured brown and marked respectively "North Pond" and "South Pond,"

the respective areas being 38 acres and 22 acres, or 60 acres in all. To the south of this is a small block, coloured red, and it is known as the 28-acre Block, and is so marked on the Map A. There is another much larger block, known as the Richmond Block, containing 722 acres; it appears coloured green on Map A. Next we call attention to the Awatoto Block, which contains 590 acres, and appears coloured yellow. Also there is the McDonald Block, containing 700 acres, coloured puce on Map A. Finally, there is a parcel of land known as the West Quay Reclamation Block. Its locality is shown on Map A, where it appears close to the South Pond, lying to the south-west of that area; it is covered in black stippling, and there is printed on this parcel of land, "About 73 acres of land being reclaimed." We shall refer to this hereinafter as the "West Quay reclamation."

Methods of Reclamation.

We have in the terms of the question submitted to us to consider by what arrangement any such reclamation could be most economically and satisfactorily accomplished. This may be the most convenient place to point out that the engineers and other experts who gave evidence before us on this problem described three different methods of reclamation that could possibly be adopted to make these lands habitable. The first was described by the witnesses as the "siltation method," and this is a term which we shall adopt herein for the purpose of description of the method. It consists in directing the natural processes by which the whole delta, of which these low-lying reclaimed areas are a part, has been formed. The process is to lead the waters of the silt-laden rivers over the land into prepared siltation basins. Napier South was reclaimed in this way. We shall not further refer to this method, because all the witnesses were agreed that this method would be slow, uncertain, costly, and altogether too risky under existing conditions. For instance, Mr. O. N. Campbell, Chief Drainage Engineer, in a report to the Hon. the Minister of Lands on this subject in 1925, speaking of the siltation method, says, "It would be practically impossible to elevate this land by this method above, say, the 22 ft. contour. Lands below this contour could, no doubt, be elevated to this level by the method, but the process would be slow and the cost much higher than is popularly imagined, and, moreover, the risk of damage to already settled lands would be too great."

A second method is to reclaim by suction dredging. Where this method is used there must be installed a dredging plant capable of dredging by suction the sand and silt deposits in the rivers and in the areas adjoining those which it is sought to reclaim, and depositing on the area which is being reclaimed, raising the level of this area to the required height. Mr. Campbell, in the report already referred to, describes this as an ideal method for the areas under review, stating that the sand and silt deposits would be excellent material for economical removal by this method. This method also has the collateral advantage in that it can be economically put into operation as an adjunct to some other scheme—*e.g.*, dredging a harbour, or cleaning out a silted up river-bed, or widening or straightening a river.

The third method described to us is known as the dewatering method. This is described most fully and is advocated in Messrs. Hay and Rochfort's report to the Harbour Board (Exhibit 44). The method can be most conveniently described by directing attention to the Awatoto Block, which appears coloured yellow on Map A. It may be stated that the average level of this block is low-lying. The first step towards reclaiming it by the dewatering method is to erect a retaining-wall or levee around it of sufficient height and strength to keep out flood-water from the contiguous rivers and areas. A draining-basin is then excavated at the lowest point, which in this case would be near the site of the High School, which will be seen marked at the northern end of the Awatoto Block on Map A. At the site of this drainage-excavation a pump-station is erected with an automatically-controlled, electrically-operated pump. This pumps the water over the levee, in this case into the sea and drains are cut through the block leading all surface water to the draining-point. This method is quicker than either of the other two, and is the cheapest; it has the disadvantage that the inhabitants of the area are living on a low level surrounded by an embankment, and are liable to dangers of seepage, burst banks, and failure of the pumping plant.

We desire here to point out that the areas we have been describing are not wholly lagoon-beds or swamps, but are areas which stand at the present time at various stages of natural reclamation. The North Pond and South Pond are tidal lagoons, and require an average of about 8 ft. of filling to raise them to the level of the surrounding areas. The 28-acre Block is almost completely reclaimed. The suction dredging-method has been employed here, and not a great deal of work is required to complete the reclamation of this area and get it ready for subdivision and roading. The McDonald, the Richmond, and the greater part of the Awatoto Block presented during the time that we were at Napier a rather swampy and waterlogged appearance, but we were assured and believe that in the summer-time these blocks are mostly quite dry, and large areas of them are leased for grazing and agricultural purposes. Furthermore, it should be pointed out that parts of the Richmond Block and practically the whole of the McDonald Block are what are known as salt areas, and they cannot be considered as completely reclaimed until the salt is washed out of the land, and this is likely to be a lengthy and somewhat costly process.

This completes a somewhat rapid survey of the material which forms the subject-matter of our present inquiry.

Conflicting Interests.

We now desire to call attention to the fact that there are at least four different points of view from which the reclamation problem at Napier may be studied, and each of these was put to us in the course of the inquiry. Two of these points of view are peculiar to the Harbour Board, whilst one of them may be described as the point of view of the Napier Borough Council, and one as the point of view of

the Hawke's Bay Rivers Board. As these represent conflicting interests and ideals, it can be readily understood that they tend to complicate the reclamation problem; whilst, as if there were not sufficient complications in the matter, it was made perfectly clear to us that the feelings and interests raised by the Harbour Board dispute lay athwart the whole question.

One point of view which we have ascribed to the Harbour Board relates only to those areas which are close to the proposed Inner Harbour basin—namely, the North and South Ponds and the West Quay reclamation block. The fate of these blocks has been bound up with that of the Inner Harbour scheme; for the adoption of that scheme meant as a natural corollary that these areas could be most advantageously and economically reclaimed by using the spoil from the Inner Harbour basin; and, further, when they were reclaimed they would have a special value by being adjacent to the Inner Harbour wharves. With these considerations governing the matter the position has arisen that although the Harbour Board agrees that these areas are crying out for reclamation, and that more land is sadly needed to supply the needs of a growing population in Napier, nothing has been done for many years. The presence of these areas near the proposed inner basin and their high potential value when reclaimed have been used as arguments in favour of the Inner Harbour scheme. It is not surprising to find, therefore, that the Harbour Board as at present constituted, with a majority in favour of Inner Harbour construction, has placed the reclamation of these three areas in the very forefront of its programme, and hence we find the power to reclaim them included in the 1926 Bill. It may also be described as good tactics to be able to say to Napier, as the Harbour Board has said, in effect, "You need land, do you? Very well; support our Inner Harbour policy and you will immediately and cheaply obtain the benefit of the reclamation of the North and South Ponds, which can be used for residential purposes."

There is a second point of view, which on some of the evidence tendered to us we may well ascribe to the Harbour Board. It is that it has valuable endowments in these sites capable of being made into habitable lands, and it looks to the income from these, first to assist in the financing of the harbour, and ultimately to provide what has been promised to the district—namely, a free harbour. This policy carried out in accordance with ordinary commercial instincts would require that the Harbour Board should be careful not to glut the market, and it should therefore keep behind rather than in advance of the requirements of Napier, and so keep up the high price of land, and consequently the high rents obtained for small building allotments. The result of this policy, whether it has been consciously pursued or more or less passively taken advantage of, is shown in evidence tendered to us, which proved that Napier is the most densely populated borough or town in the Dominion. Mr. O. N. Campbell's report to the Minister of Lands dated 1925, which we have already called attention to, shows the population statistics relating to the fourteen largest towns and boroughs in New Zealand, and disclosed that Napier, with 977 persons per 100 acres, was from point of density second only to Auckland, the figures being—Auckland, 1,003; Napier, 977; the next highest being Christchurch, 763. Later figures along the same lines were put before us at the hearing by Mr. J. A. Oldham, president of the Real Estate Institute of Napier, and his figures show that Napier now enjoys the unenviable reputation of being the most densely populated town; its relation to Auckland in this respect being disclosed in the respective figures 1,100 and 1,055 persons per 100 acres. In concluding his evidence on this point Mr. Oldham said: "The area made available for residential purposes by reclamation during the last twenty-five years is 213 acres adjoining the borough and 3 acres at the port, or an average of $8\frac{3}{5}$ acres per annum. Since 1912 only 10 acres have been provided by the Harbour Board for residential purposes, or an average of less than $\frac{3}{4}$ acre per annum." The evidence submitted to us on this point by a number of witnesses confirmed what we could see whenever we walked through the residential parts of Napier—namely, that the average allotment is less than $\frac{1}{8}$ acre; and, furthermore, we learned that the ground-rent paid for a section of 18 to 20 perches at the most recent auctioning of residential blocks by the Harbour Board is about £6 or £7 per annum. These prices are paid for sections without borough facilities, left in a comparatively rough state, just as they were on the completion of the filling operations. We visited one such site, the history of which had been related to us. A small house was being built on this allotment by the lessee who had taken over from the successful bidder at the Harbour Board's auction sale and had paid £100 premium for the privilege. These facts show the extreme land-hunger that exists in Napier. We consider that the evidence given by several witnesses to the effect that Napier had been starved for land, and had been deprived of population which was driven to Hastings and other surrounding towns, amply proved their assertions, whilst Mr. J. A. Oldham's statement that the Harbour Board had put only 10 acres of residential land on the market in fifteen years was uncontradicted.

Effect on Housing Conditions.

The effect of this on housing conditions in the poorer parts of Napier is shocking. Mr. G. F. Clapcott, the Borough Engineer, in his evidence (see page 491) gives some striking figures. He takes, for instance, an area facing Hardinge Road, in the strip between the North Pond and the sea (see Map A, Commission's Exhibit No. 3). Dealing with forty-four houses, he submits the following: Average frontage of section, 33·35 ft.; average size of section, 2,864 square feet, or 10·5 perches (Napier Boroughs limit is now 5,445 square feet, or 20·4 perches). The average size of these residential allotments is therefore $\frac{1}{16}$ acre. On this area stand forty-four houses, containing 197 rooms in all. A census of these houses revealed 191 occupants—approximately one occupant per room.

Mr. Clapcott referred to two other areas in the same locality presenting the same features. In one of them the figures relate to an aggregate frontage of 21 chains, and the average size of the allotments was $\frac{1}{21}$ acre, and the average number of occupants in the residences erected thereon was 3·47 persons.

In relation to Emerson Street, in the same locality, Mr. Clapcott deposed : " Without going into particulars, this is a very closely populated area, as a large majority of shopkeepers live on the premises or otherwise let the upper portion of the building as flats. Owing to the land in this area being valued at from £100 to £200 per foot, the greater part of the sections are occupied with the business portion of the building, leaving the residential portion with little or no yard-space, and being two-storied structures with the usual outlook of a lean-to roof."

We express ourselves as being deeply shocked by this state of things, and when considered in conjunction with Mr. Oldham's evidence to the effect that in the last fifteen years only 10 acres of residential land has been reclaimed and put on the market, it constitutes a grave indictment of the Harbour Board's inactivity in the matter of reclamation. Figures showing the high rentals which the Harbour Board is receiving for small residential and business blocks in this locality were put before us for the purpose of sustaining the high potential values of the unreclaimed portions. With all the strength of purpose and vigor of utterance of which we are capable, we urge that the reckoning is not complete until the effect of these awful housing conditions on the physical, mental, and moral equipment of the people is taken into account. We trust that Your Excellency's Advisers will take adequate steps to see that this evil is remedied as far as possible and that its recurrence is made impossible.

Napier's Requirements.

We come now to a point of view which we have ascribed to the Borough Council. We have partly anticipated it by our comments in the immediately preceding paragraph. The Napier Borough requires land for its natural expansion ; evidence placed before us shows that the requirements in this direction might be placed at about 130 building sections per annum. The city is entirely surrounded by the Harbour Board's endowments, and is in this matter at the mercy of the Harbour Board, which has in the last fifteen years supplied on an average of six sections per annum. The result of this is that the Napier Borough Council is continually being applied to by residents for permission to subdivide the already small allotments into which the town is divided, so that further dwellings may be erected. Mr. William George Martin, a member of the Napier Borough Council, was deputed by that body to give evidence on this matter. He produced a copy of a plan showing the proposed subdivision of a parcel of land containing 29·23 perches. The proposal was to subdivide it into four allotments, and on each erect a residence with out-buildings. This application, we were informed, was refused by the Borough Council ; but the mere fact that it was made shows the scarcity of available building-land from which Napier is suffering. The interests of the Borough of Napier will obviously be best served by a policy which will remove this scarcity and which will place land on the market at a price that will enable a citizen of moderate means to secure a building allotment and build a home. Land-hunger is inevitably associated with high rents.

The Napier Borough Council is interested in an aspect other than the rate at which the Board's endowments are to be put on the market, and that is the situation of any blocks made available, in relation to the existing lay-out of the borough. There have been conferences between the borough and Harbour Board, which unfortunately have led to no satisfactory result so far, and the borough puts forward the claim that the shape to be assumed by the town, the layout of drainage and transport facilities, and convenience of general access are all matters of the most vital importance to the borough. To bring the precise point of view forward in the form of a concrete example it may be pointed out that the area which the Harbour Board proposes to reclaim first of the total area comprised in the McDonald, Richmond, and Awatoto Blocks is a small portion of 35 acres near the High School, at the apex of the triangle which the Awatoto Block represents. This area lies just beyond the site of the High School—that is, farther away from the town than the High School. The borough representatives point out that this is a longitudinal extension of the residential portion of the town, and that this complicates the problems of access, transport, and drainage. They therefore suggest that the portion of the Richmond Block contiguous to Napier South should first be reclaimed, thus giving a compactness to the city that would not be present if the Harbour Board's proposal is carried out. It was not made clear to us why the Board preferred to offer first the 35-acre patch on the Awatoto Block, except that, as it had decided to go on with the dewatering scheme, this was the easiest block to dewater, and the one that could most quickly be made ready by that method of reclamation. There may be some reason in that, although, in our opinion, it is quite outweighed if the matter is to be looked at from the point of the greatest good to the greatest number of people, on the considerations put forward by the Borough Council. Furthermore, it does seem to us that the attitude of the Harbour Board is quite unreasonable. Our view of the matter is that with these endowments in its hands the Harbour Board is a trustee for the district, and should view the potentialities of these sites as a trust to be administered, as far as it is reasonably consistent with the Board's financial requirements, to secure the highest possible benefit to the borough on which it so largely depends. In his report to the Minister of Lands in 1925, Mr. O. N. Campbell, dealing with this matter, said : " The responsibility for the provision of land rests with the Harbour Board, who absolutely control the situation, and if these lands should succeed in realizing only the bare cost of reclamation, the Board should proceed with the work as a public duty." With that proposition we are in full accord.

The question has, however, been put to the borough representatives, and it was actually put to them at the inquiry before us, in the following form : " What right has the Borough Council to dictate to the Harbour Board how it shall use its endowments ? " The spirit behind this question seems to us to throw some light on the position that has arisen, and the inability of the parties concerned to come to any amicable arrangement.

The Hawke's Bay Rivers Board.

Fourthly, there is the point of view of the Rivers Board. This body is constituted under the Rivers Board Act of 1908, and exercises powers given to it by the Hawke's Bay Rivers Act of 1919. There is an area of 73,740 acres within the jurisdiction of this Board, and part of the Borough of Napier is comprised in that area. The Rivers Board's main function is to formulate and carry into effect schemes for flood-prevention throughout the district, and it has power to borrow and power to levy rates. This Board has, as part of its general scheme, the diversion of the waters or part of the overflow waters of the Tutaekuri, so as to carry them into the open sea south of Napier. Under section 17 of its Empowering Act it may, in case its river-works safeguard the property or works of the Napier Harbour Board, require that Board to contribute to the cost of those works. The Tutaekuri River is the chief menace to the Awatoto and Richmond Blocks, and it is against its possible encroachments that the levees referred to are to be erected. When the matter is under consideration, or when any scheme is designed to remove the menace of the Tutaekuri, it might be expected that the Harbour Board and the Rivers Board would have no difficulty in acting in co-operation. This, however, has not proved to be the case. The position is complicated further by the fact that the constituents of the Rivers Board, spread over a comparatively large district, are, except for those in and about Napier, not particularly interested in any scheme relating to the Tutaekuri, but may be, for instance, more interested in the vagaries of the Tukituki or Ngaruroro Rivers. The trouble is, therefore, that the Rivers Board finds itself unable to raise any loan, for the interest of its constituents is sectional, and there is no general unifying interest that will obtain a sufficient authority to raise a loan for carrying out a work that in the nature of things will be local in its benefits. A fairly well defined scheme for the diversion of the Tutaekuri from the point of Meanee eastwards to the sea has been formulated, and it is estimated that it will cost £90,000, but the Chairman of the Board stated that they are not able to get the ratepayers to sanction the loan. The Rivers Board criticizes adversely the Harbour Board's suggestion that it should build levees along the banks of the Tutaekuri north of the spot at which the Rivers Board proposes eventually to divert the river. The Chairman of the Rivers Board put the matter before us thus: "The Harbour Board is prepared to spend £24,000 on levees around the blocks which they propose to dewater. They say they must do that to provide against the menace of the Tutaekuri; but if they would fall into line with us and assist financially we can divert the Tutaekuri and those levees will not be necessary. Futhermore, we say that then the menace will be removed permanently and effectively, whereas the need of the levees is admittedly temporary, and their efficiency is doubtful." To this the Harbour Board replies that it has little or no faith in the Rivers Board. And so again a position of stalemate is reached between two public bodies.

We have so far sketched the main factors that have to be considered in approaching an answer to the questions which Your Excellency has submitted to us concerning reclamation.

Reclamation as Propaganda.

It will be noted that in this our report we are treating harbour construction and reclamation as entirely separate problems, although in each division of our report there appear certain references to the bearing of the other subject-matter at points where the schemes are related. We propose now to present briefly our views of the precise relation of the two subjects; but before doing so we propose to deal with the method of presenting these related problems which appears to have been adopted by the Harbour Board in the past, and which was certainly put before us at the hearing. That method consisted in looking upon the Harbour Board's endowments which were capable of being reclaimed as a kind of lucky-bag into which the Board could dip for large sums to recoup them the expense of harbour-construction. This aspect is apparent in the electioneering pamphlet (Exhibit 51) issued in 1920 which we have already referred to, when the ratepayers' sanction to the Inner Harbour loan was sought. Under the heading of "Advantages of the Inner Harbour" we read, "It will NOT cost the ratepayers A SHILLING. The land reclaimed alongside the shipping will MORE THAN PAY THE TOTAL COST." (The capitals in these sentences are as they appeared in the pamphlet.)

This same method was adopted even by the Board's consulting engineers when they were engaged in the otherwise prosaic task of submitting engineers' estimates of cost. Thus Holmes and Son's estimates, presented to us at the hearing, gave details of Inner Harbour construction, set out detailed costs of the harbour, then subtracted the sum of £290,000 as value of land reclaimed and called the result the *net cost* of construction of the harbour! When it is considered that expenditure on the harbour-construction would mostly take the form of payment in cash for materials and labour, and that this cash could be provided only by borrowing at current rates of interest, whilst, on the other hand, the endowments consisted largely of semi-swamp lands which have still to be reclaimed, and which the Board does not (as a general policy) propose to sell, it will be seen how specious is this method of presenting the case. Interest on the loan-moneys required to construct the harbour begins to run immediately the money is raised, and no assistance can be given by the endowment until the land is reclaimed, subdivided, roaded, and let, and then the full extent of the relief it can give to the harbour will be afforded by the rents it will produce, which may be applied to assist in payment of the interest on the loans.

The specious presentation we have referred to would deceive no one who took the trouble to think about the matter, but there is no doubt that it is an *ad captandem* form of argument that might be expected to appeal to a public of sporting instincts, and it certainly savours more of the methods of the art-union promoter than those of the business man. The limit to which this misleading form of presentation might be carried is perhaps illustrated by a statement which during our sittings at Napier appeared in the daily press in a large two-column precis of some of the evidence of Mr. R. W.

Holmes, the senior partner in the firm of Holmes and Son, Consulting Engineers to the Board. Mr. Holmes had revised and reduced some of the costs of construction put forward by his son at an earlier stage, and he further stated that, after hearing evidence concerning the reclamations, he desired also to increase the value of land which his firm used as a deduction from the gross cost of construction of the harbour in order to arrive at what they called the net cost, and the result of the figures he then used was to reduce the so-called net cost to £170,000, and he stated the Board now had £124,000 in hand, so that it would only be necessary to raise £46,000 plus value of reclaimed land, which would be an extremely valuable asset. This is the statement which was presented in a two-column precis of Mr. Holmes's evidence in the following words: "From what was stated by Mr. Latham on Wednesday concerning reclamation, Mr. Holmes revised his estimates of the cost of constructing a two-berth Inner Harbour, bringing it down to £170,000—only £46,000 more than the loan-money now in hand for the purpose."

The real truth is (and we have searched in vain through all the utterances of the Harbour Board for any presentation at any time of this aspect of the matter) that in the ordinary way the Harbour Board must raise by way of loan the full gross amount required for harbour-construction, and must pay interest and sinking fund amounting to at least 6 per cent. on that. The assistance to be sought for from the reclaimed lands is the ability of those lands to produce, by way of rents, an annual sum in excess of interest on the cost of reclamation.

We have prepared, and propose to present under this present part of our report, detailed figures showing, on the evidence of witnesses put forward by the Board, the expected cost of reclamation and the expected returns from these reclaimed areas; and we find that for the next decade very little assistance could be given to harbour finance by the returns from reclaimed land.

The productivity in the way of rent of the different blocks varies considerably, and one of the large blocks must for nearly twenty years after its reclamation is commenced be considered as a liability rather than an asset. We refer to the McDonald Block, of 700 acres, which comprises only what have been described as salt lands, and which must be put through a tedious and comparatively expensive process of sweetening before it will have any letting-value.

Costs of Reclamation.

There is one further aspect of this matter to which we desire to refer. We submit that in principle it is correct that when a public body such as a Harbour Board is carrying out two revenue-producing public works—viz., the construction of a harbour and reclamation of land—it should in its accounts keep correct records of the cost of each of these works. This involves the principle that when any process such as excavation, which provides rock for harbour-construction and spoil for filling in reclamation areas, is undertaken, the best possible basis for apportionment of that cost between the two schemes should be adopted. This is especially important where loans are raised under statutory authority to proceed with reclamation work as distinct from harbour-construction, and *vice versa*. But, apart from this aspect, we believe that the soundness of the principles we submit must be apparent. One argument in favour of it is that it is impossible now to ascertain from the Harbour Board's past records the exact cost of building the breakwater to date, and the exact cost of reclamation to date, because these have been mixed in the accounts of the past, and the items cannot now be dissected accurately. The Board has therefore lost, for comparative purposes, when undertaking new work, part of the value of its existing records.

The method adopted by the Board's consulting engineers is described, and its attempted justification put forward, in the following formula: "When we are quarrying spoil for stone for a breakwater, or dredging harbour basin to get the required depth, we would have to dispose of the spoil if we had no use for it, and in doing so would charge the whole cost of disposition of the spoil to the harbour-works. When, therefore, as in the present case, we can at no additional expense use the spoil for the purposes of reclamation, we still charge the whole cost of excavating or dredging, as the case may be, and disposal of the soil, against harbour-works, and view the reclaimed land *as a gift*, to be brought into account *at its selling-value*, as a deduction to arrive at the net cost of construction of the harbour."

Our submission is that this method is one of those things which needs only to be stated to carry its refutation on its face. The Harbour Board is the custodian of public funds, and should keep the best records possible of the directions in which it has expended those funds. It is also a semi-trading concern, collecting revenue from two forms of public service, in the acquisition of which it has sunk public moneys; and our submission is that it should keep the best records possible of the cost of acquisition of the equipment and assets which makes these services possible. We submit that if, for instance, a land-drainage authority had to clear and improve a large swamp area that was covered in parts with flax, and was required to do this by making the best possible disposal of this flax as a waste and useless product, the total cost, including the cost of disposal of the flax, would be charged up as cost of the drainage project. If, however, the body was entrusted with the power at the same time of running a flax-mill to utilize the flax, we contend that it should apportion its costs, and keep accounts of the flax-mill approximating as nearly as possible to those kept by flax-mills run by private enterprise. This would involve apportioning the cost of getting the flax as nearly as possible at the point of actual cutting of the flax.

Methods of Reclamation discussed.

We propose now to deal with the relative desirability of the different methods of reclamation put before us. We have already stated that the siltation method is rejected by all the witnesses and expert advice put before us, and we have no more to say under that heading.

Dewatering Method.—This method is recommended by Messrs. Hay and Rochfort, who, in May, 1926, reported to the Harbour Board on the subject of reclamation. Their recommendation has been adopted, and this method was put forward by the Harbour Board as its scheme for dealing with the Awatoto, Richmond, and eventually with the McDonald Block. It proposes to start with the Awatoto Block and, utilizing embankments that at the present time exist around a large proportion of the boundary of this block, to construct levees to a height of about 2 ft. above expected flood levels, and then to establish a pumping-station at the lowest point somewhere near the High School, and drain the block to that point, pumping the water over the eastern levee into the sea. The Board would next take the Richmond Block, complete the levees and erect the pumping-station, and then, as land is required, subdivide and road it to borough requirements. In the meantime, and to the extent to which these blocks are not subdivided, it is proposed to let them for grazing, agricultural, and small-farm purposes. The arguments in favour of this method are that, firstly, it is quicker, and secondly, that it is much cheaper, than the method of filling by suction dredging, and both of these advantages may be considered as having being proved to exist. It is, however, only fair to Messrs. Hay and Rochfort to point out that they qualify their recommendation of the dewatering method in the following words: "It is obvious that the most businesslike way to remove the flood risk from the Harbour Board endowments and the whole of the district is to carry out the comprehensive scheme of river-control for the Tutaekuri first mentioned; but if there is no hope of getting relief from the operations of the River Board, the third [*i.e.*, dewatering] method would be justifiable."

The views of the Borough Council on this aspect of the matter were put forward by its Engineer, Mr. G. F. Clapcott, who in relation to the reclamation of areas for residential purposes favours the method of raising the level of the ground by suction dredging, discharging the dredged material through pipes on to the land, and thus building it up. Furthermore, the Borough Council is strongly convinced that the portions of the Richmond Block contiguous to Napier South should be made available for residential purposes before any portion of the Awatoto Block is so treated. Mr. Clapcott prepared a plan of a proposed subdivisional scheme relating to a block that would be approached by a bridge across the Tutaekuri at the point where Kennedy Road in Napier South runs into St. George's Drive, and entering on the Richmond Block at the point marked "Thornton's Boat-shed." The arguments adduced by Mr. Clapcott and other opponents of the dewatering scheme may be summarized as follows: (1) Under the dewatering scheme the land is left at so low a level that subsoil-water will be continually present at about 1 ft. below the surface, and that it will be impossible satisfactorily to drain residential areas under these conditions. (2) The area will be dependent for all time for the efficiency of its surface-draining on the pumping-plant, and that it is just when a combination of abnormal circumstances, such as flood, storms, and high seas, make the maintenance of this pumping most essential that it is likely to be put out of action by those very same natural forces. This aspect of the matter was referred to by Mr. C. D. Kennedy, a qualified engineer with a great deal of experience of this problem in the Napier district. He is an advocate of the dewatering system. He says (see page 342, Notes of Evidence), "With regard to the dewatering scheme I agree that it is the best practicable scheme, but there is one possible drawback which must not be overlooked that would arise in heavy spring tides in easterly weather with seas piling up on the beach. There would in such circumstances be a considerable amount of seepage, and this would have to be coped with. It would mean a little extra pumping-power. The drain suggested would probably catch it and hold it, but the extra pumping-power would be necessary. It would be wise to consider that such a storm and heavy rain coming at once, there would be a combination of adverse conditions." (3) There is always the danger of the levees breaking and swamping the lands on which people have been enticed to erect their homes. (4) The levees erected to keep out flood-waters must be continually raised, as the river tends to raise its own bed by the deposit of silt (see pages 9, 19 of this report, under heading "Physical Features of District and Natural Forces arising therefrom.") There are now places in the district where this process has gone on until the bed of the river is actually some feet higher than the surrounding ground. (5) From a consideration of the foregoing reasons, and also from sentimental reasons, there will always be a prejudice by residents of the district against erecting their residences on a dewatered area. (6) In view of the existence and powers of the Hawke's Bay River Board, it is probable that in the not-distant future the waters of the Tutaekuri will be wholly diverted to the sea at a point south of the Awatoto and Richmond Blocks, and that when this is done the erection of the levees will represent a useless expenditure, and that therefore it would be better to take a more comprehensive view of the whole problem and work with the Rivers Board in procuring an early diversion of the river. Conversely, (7) areas raised by deposition of silt and spoil, being higher, are more easily and effectively drained, and are therefore healthier. (8) Cost of pumping leaves a perennial charge against the land, whereas under the other method—when the original loan is wiped out by sinking fund—the land is free of reclamation charges.

Raising Land by Deposit of Spoil.—This method is preferred by Mr. O. N. Campbell, whose report (Exhibit No. 42) we have already referred to. He says on the first page of that report (dated 1925), "As the total area of Harbour Board endowment lands is only 2,045 acres, the Board need not consider the question of development of these lands for any other than residential purposes. Land for this purpose must obviously be freed from all danger of serious flooding, and it is therefore preferable that it should be elevated to a point above the maximum flood level." Later on he says, "The reclamation should be carried out by suction dredging, for which the area is an ideal one. The sandy silt deposits would be excellent material for economical removal by this method."

Mr. G. F. Clapcott, the Borough Council's Engineer, strongly advocated, in relation to residential areas, the adoption of this method of raising by depositing spoil, and he gave details, which will later appear in our estimates and conclusions, of his methods and estimated cost of reclamation by this method.

As to the 28-acre Block and the North and South Ponds, and the West Quay reclamation, it is agreed that they can most conveniently and economically be reclaimed by building them up with spoil pumped in by adjacent silt-bearing areas.

Treatment of Salt Lands.

Practically the whole of the McDonald Block and parts of the Richmond Block are permeated with salt deposited by the sea when these areas were daily flooded by the tides, and we have a great deal of evidence about the processes and amount of work required to sweeten this land and make it productive. Mr. J. McDonald, a farmer of many years' experience of a farm adjoining the McDonald Block, was pessimistic about the prospects of ever converting the McDonald Block into farm areas. His evidence in brief is that he has tried every known method without success and without prospect of success being in sight.

Mr. C. D. Kennedy, whom we believe to be as well qualified as any person in the district to speak on the subject, took a more hopeful view. We refer to his evidence on this point on pages 344 and 345 of the Notes of Evidence. He says, "If you carry your drainage to a low-enough point under the dewatering scheme it is possible to bring the land in as farming-land. The drainage is essential." The artesian water-supply which is available here must be used, and the water must be flooded more than once, the object being to wash the salt into the drains and so carry it away. It must be ploughed deeply and well pulverized to allow the rains to permeate it, and that again would tend to carry the salt to the drains. He continues: "I have so treated a small area which at the beginning would grow nothing, and I eventually got a crop of barley from it. I do not represent this is a quick process; it would take years to get the land into a condition to produce a crop. I have had no experience in flooding a large area. . . With the most energetic measures in ploughing, liming, &c., it would be possible to get this land into cultivation in four or five years. For ordinary commercial purposes it would take nine or ten years. There is not much initial value in the land. I consider that the value, say, at the end of ten years, would be sufficient to give an initial value to the land. If the Board drained and cut up this area it could expect very little, if any, return from it for, say, twenty years. Eventually it would rank with the best land in the district. . . Hay and Rochfort's estimate of cost of reclaiming McDonald's Block is £28,000. If that is correct, or whatever the correct amount may be, the Board must face the prospect of paying interest on that amount for ten years before it begins to get a return." Mr. G. F. Clapcott also gives evidence of his experience and knowledge of reclamation work on a somewhat similar area at Invercargill. We refer to his evidence on this point contained in a letter addressed to the Chairman of this Commission and appearing as Exhibit No. 131. We think the evidence on this point given by Mr. C. D. Kennedy is reliable, and sets out a reasonable basis on which the Harbour Board may base its expectations in relation to the McDonald Block. We would summarize this into a statement that when the Harbour Board commences the reclamation of this block it must face an initial expenditure of nearly £30,000, and that the amount so expended will carry interest but produce no income for at least ten years. Thereafter for another ten years it is probable that any benefit derivable from the land will have to be allowed to the parties that in the initial ten years have undertaken the work and expense of sweetening the block. If the interest on this money were capitalized during this period of twenty years, the effect would be, approximately, to double the cost. Another way of looking at the problem is that when the McDonald Block is reclaimed the interest on the cost of reclamation at 6 per cent. will wholly absorb the returns from about £36,000 worth of other reclaimed areas. It is clear, then, that, in the words of Mr. A. E. Jull, Chairman of the Harbour Board, when recalled on the last day of our sitting, "The McDonald Block is in the future."

Conclusions.

We now propose to draw these various considerations to stated conclusions and recommendations, and in doing so we propose to take a comprehensive view of the whole problem. Our recommendation in the matter of harbour policy cuts out from our considerations the dominating influence of Inner Harbour construction as a deciding factor in the question of what areas shall be first reclaimed and what methods shall be adopted to reclaim them. We are viewing the matter of reclamation as a problem being considered by a Harbour Board whose policy for a decade is the restoration to complete efficiency of its existing harbour facilities and the consolidation of its financial position. From this point of view it becomes necessary to consider the activities (actual and potential) of the Hawke's Bay River Board. We are satisfied that a scheme based on the erection of levees as a temporary expedient of dewatering the Awatoto and Richmond Blocks, as a cheaper method, is, in view of the defects of the dewatering system and the prospect of the ultimate diversion of the Tutaekuri, a short-sighted and wasteful method, and we recommend that, along lines which we shall indicate later, the immediate requirements for the expansion of the residential portions of Napier should be supplied by adopting the method of building up the levels by dredged spoil.

Order in which Blocks should be reclaimed.

We are of opinion that the 28-acre Block should first be reclaimed, and we are satisfied that this can be done promptly and at very little expense. Mr. C. D. Kennedy says, at Page 341, "The 28-acre Block wants very little. In my opinion a few weeks' work pumping would complete it—pumping in silt. It could be made ready for occupation in three months from completion—that is, roaded, channels, &c. With drainage, it would take six months. This block could easily be connected with

borough sewerage and drainage system. Assuming proper equipment and a vigorous policy, the 28-acre Block could be got ready in nine months from the start quite easily. The Harbour Board have the equipment in hand to undertake this work with the exception that a new pontoon would be required; the machinery is intact." We accept the evidence of this competent witness without reserve, and base the foregoing recommendation on it. Practically all the witnesses who referred to this point agreed with Mr. Kennedy on it.

With regard to the North and South Ponds, we agree that eventually they must be reclaimed, and that when reclaimed they will afford valuable residential and industrial sites. We do not, however, share the views of Mr. A. E. Jull that they are more desirable as residental sites than the areas near to Napier South—that is, the areas on the other side of Scinde Island. We agree with him that if in the existing state of land-hunger they were reclaimed they would be rapidly taken up, but that would be not so much an indication of their real value as building-sites as a further demonstration, if it were needed, of the deplorable state of things which has led residents to seek to subdivide small sections into four building allotments. In fact, we expect that some of the dominant party's enthusiasm for the North and South Ponds as residential areas will vanish if our recommendations as to a harbour-construction policy are adopted.

Next after the recommendation of the 28-acre Block, we are strongly of opinion that the utmost consideration should be shown to the representations of the Napier Borough Council. A glance at Map A (Commission's Exhibit No. 3), noting the general shape of the present residential part of Napier comprising Scinde Island and Napier South, will convince any reasonable person that extension of the borough over on to the Richmond Block should precede its extension by the subdivision of the northern point of the Awatoto Block. An advantage of the method of reclaiming by raising the level is that portions of a block such as the Richmond Block can be dealt with in areas large enough to allow for the adoption of town-planning ideals, and yet small enough to avoid large amounts of expenditure in advance of the possibilities of the land being taken up. We think the suggestion that areas of about 50 acres at a time should be put in hand by this method is a good one. As for the reclamation of the West Quay Block, it can hardly be suggested that this is a residential area. Its reclamation is closely related to the construction works going on and anticipated at the West Quay of the Inner Harbour, and we think that the requirements and methods in this direction may be left to the Harbour Board as a part of its policy in relation to the Inner Harbour.

We have more than once in the course of this report, when a certain aspect of the reclamation problem was put before us, expressed the opinion that for a decade at least the reclaimed lands cannot be expected to do much more than pay interest on the cost of reclamation. We have more than once, on the other hand, called attention to the freely expressed belief of the dominant party on the Harbour Board in the potential value of these lands. We agree that there is a potential value, but we submit that the potential value should be studied and assessed on business lines, and that extravagant values and statements should be avoided.

Potential Values of Reclaimed Land.

It cannot be denied that these lands will in the more distant future possess a value in excess of their present-day value, or of their probable value ten years hence, but we think that their future potential value is not nearly as great as some of the representations we heard might lead us to believe. We submit that there are two ways in which these potential values may be realized. One is by the value of land generally so increasing in the borough and its environs that the rents of all residential blocks will be raised at the periodical renewals of the leases and revaluations of the rentals; another way is by the growth of the business and residential area of Napier causing the surrounding areas to be subdivided into residential allotments and thus leading to a larger proportion of the Board's endowments producing suburban rents instead of rural rents. It seems to us that there are limits to the operation of both these tendencies. The present average ground-rent of a 26-perch section is about £7 per annum, and in a typical block of such sections which we inspected the class of dwelling now being erected thereon is worth on an average about £800 (see page 250, Notes of Evidence). We suggest that on that basis the ground-rental and interest on cost of buildings taken together constitute an annual charge upon the householder which is just about as high as it is possible to go without becoming excessive. It is not apparent, therefore, how the Board can expect much increase in these suburban rentals from householders of that class.

It is not easy to see how the Harbour Board can for many years expect much increase in these rents, unless it comes as part of a very general increase in the cost of living, in which case the benefit to the Board will tend to be offset by the increase in its own cost of administration. Secondly, the values of land in the outlying townships, Hastings, Taradale, and Greenmeadows, will always tend to have a steadying effect on land-values in Napier. We have already referred to the evidence of experts in the matter, which convinced us that one of the results of the land-hunger and high rents in Napier had been to cause prospective residents in Napier to settle in Hastings, and to travel backwards and forwards daily to their businesses in Napier. Present-day motor transport tends to annihilate distance and to facilitate the growth of outlying residential areas, and this inevitably governs the rate of advance in the valuations of residential areas nearer the business centres.

Mr. J. H. Oldham gave evidence (see page 596) that sections situated within one and a half to two miles radius from the chief post-office in Hastings could be obtained at from £120 to £150 per quarter-acre section. Taking £135 as the average of those two prices, and calculating 5 per cent. on the capital value (5 per cent. being the basis on which the Napier Harbour Board rentals are fixed), we have an annual value of £6 15s. for a ¼-acre section of natural soil in pleasant surroundings, and

close to Hastings, and reasonably close to Napier. Mr. Oldham also deposed that a similar section within a half-mile radius of the Taradale Post-office would command from £75 to £100 per section. Taking the higher of these two figures, we have an annual value of £5 per annum. We are of opinion that the existence of ¼-acre sections at Hastings and Taradale at annual values of £6 15s. and £5 respectively, considered in relation to £7 for a ⅙-acre section of reclaimed land, will have a steadying effect on values at Napier, especially when a reasonable policy of reclamation at a rate sufficient to appease the present land-hunger is in operation.

Expenses of Reclamation.

There is no disguising the fact that the reclamation of the Harbour Board's endowments at Napier will be quite an expensive proceeding. The figures which we shall submit show that the primary cost is considerable, and that the Board's endowments in reality consist not of land, but of sites capable of being converted into dry land, as the term is ordinarily understood, at the expenditure of considerable sums of money. Furthermore, when 100 acres of land, for instance, has been reclaimed, 20 per cent. of it becomes non-producing at once by being appropriated to reserves and roads; and the cost of roading has been estimated by Messrs. Hay and Rochfort at £200 per acre over the gross area. Thus, taking the 100-acre block again for illustrative purposes, the cost of survey, subdivision, and roading on that estimate would be £20,000. This cost, plus the cost of reclamation, must be spread over the net area of 80 acres. Again, loan-money to carry out the reclamation work must be raised in advance of the actual work of construction, and interest on these loans during construction and up to the point of time when the land can first be offered to intending residents adds considerably to the cost of the land. Legal costs, printing, advertising, and auctioneers' charges are also appreciable. These factors must be kept carefully in view when studying the figures which we submit later, showing the probable position of the Harbour Board after a decade of a progressive reclamation policy.

Recommendation.

We now approach the precise question submitted to us by Your Excellency in relation to the reclamation problem. The recitals which introduce our order of reference include a reference to the Napier Harbour Board Empowering and Loan Bill, 1926, and its introduction into Parliament in that year, and recites, "but after consideration thereof was not allowed to proceed, and it is expedient that a Commission should be appointed to inquire into and report as to the necessity or expediency of the proposed legislation." And the subsequent question contained in the order of reference is "Whether the reclamation of the Awatoto Block, the 28-acre Block, North and South Ponds Block, and a part of West Quay reclamation should be authorized, and, if so, to what extent and by what arrangement can such reclamation be most economically and satisfactorily accomplished?"

Briefly stated, we are of opinion that the Bill in question should not be allowed to proceed, for we are convinced of the expediency of repealing the proposed legislation. The evidence satisfies us that the Board's proposals to reclaim immediately the North and South Ponds and part of the West Quay reclamation were part and parcel of the Inner Harbour scheme, and were dictated by a policy of consolidating that scheme and committing the district to it by the prosecution of every work that was either in itself a partial construction of that harbour, or the committal of the district to a policy and to forms of expenditure that bound the district to the Inner Harbour scheme for all time.

As we have reported against the adoption of that Inner Harbour scheme, we are of opinion that these reclamation authorities, in so far as they are incidental to that Inner Harbour scheme, should be reconsidered. We set out the following principles which in our opinion govern the whole matter, and submit that the future policy must be based on the best reconciliation possible between these principles where they appear to conflict.

(1) The Harbour Board, while it is entrusted with the duties and responsibilities bestowed upon it as a Harbour Board, should have its right to its endowments preserved intact.
(2) While the primary use of these endowments is to assist the Board in its financial problems, a very strong secondary consideration is that it should use them so as to conserve and further the interests of the Borough of Napier, which is one of the most important constituents of the Harbour Board.
(3) Any reclamation undertaken should be part of a comprehensive policy which contemplates the ultimate reclamation and protection of the whole of the Board's endowments.
(4) No authority to reclaim any part of the lands should be bestowed until the relation of the part proposed to be reclaimed to the whole comprehensive policy of reclamation has been made clear.
(5) No authority to reclaim should be bestowed until it is made clear that the Harbour Board is giving reasonable consideration to the wishes and rights of the Napier Borough Council, the Hawke's Bay Rivers Board, and any other public bodies which may be interested.

It seems to us that before any progress can be made in the matter of reclamation a working scheme governed by and consistent with these principles must be evolved. The question submitted to us in Part 1 (*f*) of our order of reference—"By what arrangement can such reclamation be most economically and satisfactorily accomplished?" would probably justify an attempt on our part to

outline a definite and detailed scheme of reclamation. We think, however, that, for two reasons, we should not attempt to do so. The first is that the comprehensive scheme that we have recommended for adoption cannot be formulated until it is known precisely what the policy of the Hawke's Bay Rivers Board is in relation to the Tutaekuri River. The second reason is that any scheme we suggest would have to be carried out by the Harbour Board in conjunction with, at least, the Rivers Board and the Napier Borough Council, and it would be as unwise as it would be difficult to attempt to coerce or restrain those self-governing bodies in relation to this work.

If the Harbour Board recognizes the reasonableness and fairness of the principles that we have outlined above, we would like to see it entrusted with the task of endeavouring to put those principles into operation, with the co-operation of the other Boards interested and affected. If the problem is approached with a desire to meet the present needs of the district along the lines suggested by the foregoing principles, such a scheme should be successful. If, on the other hand, the will to carry out such a scheme is not present, any scheme formulated by us at the present juncture for adoption and enforcement in the future would not be likely to succeed, and the position will then be met by Your Excellency's Advisers.

We were informed that the Rivers Board has appealed to the Minister of Public Works for the appointment of an independent engineer to advise it in the adoption of a scheme for the protection of the district from river troubles, and we understand that this appointment has been made. We were informed that the Borough Council and Harbour Board have, prior to our sitting, met in conference to discuss reclamation in relation to Napier's needs. We suggest that these conferences be reopened, and that co-operation with the Rivers Board in the light of their latest expert advice and this report be sought, and that an endeavour be made along these lines to submit to Your Excellency's advisers a comprehensive scheme.

In connection with our inquiry into harbour matters we had to deal with specific projects designed and to some extent carried out in the past, and in the very nature of things our recommendations had to take the form of approval or censure, direction, and restraint. We went to the district as three quite disinterested and, we trust, reasonable men, and we have dealt with the harbour problem in the light of the evidence we heard and according to the best of our ability and knowledge, and with a sincere desire to help the district in its difficulties. We believe that we have under that heading tendered advice which is in the best interests of the district.

In regard to the problem of reclamation, however, we are dealing with a scheme of another nature; it lies in the future, and can now be formulated and dealt with in a comprehensive way without the complications and distractions of the harbour dispute, if our advice on the former matter is followed.

We would therefore prefer to end this portion of our report on a note of appeal. We understand that, in accordance with Your Excellency's usual practice, the matter of this report will be made known to the people of the district affected by it, and we wish, Sir, through you and by this procedure, to make an appeal to the interested parties to unite in an endeavour to deal with this present matter in a comprehensive and reasonable way for the good of the district as a whole. May we close this portion of our report with the hope that the present recommendation, which comes from three wholly disinterested men desirous of serving the province, should be accepted as a basis on which the interested local bodies should work together.

We desire to recommend definitely that the authority to complete the reclamation of the 28-acre Block should be preserved, or granted, as the case may be, and that, if desired, the cost of so doing should be paid out of the unexpended loan-moneys which in Part 14 (*a*) of our report we suggested should be held in reserve for harbour-works. We are further of opinion that, in accordance with the desire of the Napier Borough Council, the next portion of the Board's endowments to be reclaimed should be that portion of the Richmond Block which lies across the Tutaekuri River from St. George's Road, Napier South. We recommend that a portion of that block, to the extent of, say, 50 acres at least, in accordance with the plans of the borough's Engineer, should be undertaken as soon as possible, and that the balance of the unexpended loan-moneys referred to in Part 14 (*a*) hereof should be authorized to be spent on this work. Thereafter, our recommendation is that the formulation and approval of a plan of reclamation in accordance with the principles we have enunciated above should be left to the Harbour Board, and to Your Excellency's executive and administrative officers, in accordance with the provisions of the Harbours Act.

We append a statement prepared from figures supplied by Messrs. Hay and Rochfort in Exhibit No. 44, and from the evidence of Mr. G. F. Clapcott, setting out the aggregate cost of reclamation along lines consistent with their respective schemes. This statement contemplates the reclamation of 500 acres of the Richmond Block, and 60 acres of the North and South Ponds, by pumping silt to raise the level of the lands, and the reclamation of the Awatoto Block and the rural portion of the Richmond Block by the dewatering method. These methods, may, of course, require to be modified in accordance with the decision arrived at by the Rivers Board, and if so the effect will be, of course, to tend to modify or vary the statement of cost. The figures representing the aggregate cost of reclamation purport to show the position arrived at at the end of, say, a ten-years programme, when the blocks there set out have been fully reclaimed and occupied. We accompany it by a statement of the expected aggregate rentals from those reclaimed lands at the end of that period.

The progressive system of reclamation and the gradual settlement of the lands will, of course, proceed concurrently. We submit, however, that in carrying out such a scheme there would be no point short of completion at which the position would be better than it is at the point represented by our figures—viz., the point when the blocks are wholly reclaimed and wholly revenue-producing.

AGGREGATE COST OF RECLAMATION AT THE COMPLETION OF A COMPREHENSIVE SCHEME COVERING, SAY, TEN YEARS.

	£	£
(1) Amounts already spent—		
Out of breakwater loans (see Exhibit No. 148)	22,000	
1912 reclamation loan	30,000	
		52,000
(NOTE: It is certain that more than this has been spent out of loan-money on reclamation, but the exact amount cannot be obtained.)		
(2) To be expended (Hay and Rochfort's dewatering scheme and estimates (Exhibit No. 44) modified to co-ordinate with Mr. G. F. Clapcott's scheme in relation to the Richmond Block)—		
(*a*) 28-acre Block—		
Cost of completing reclamation	2,900	
Cost of surveying, roading, &c.	4,800	
		7,700
(Deducting reserves and roads leaves 19½ acres net, or 117 allotments.)		
(*b*) Richmond Block, 722 acres.		
Deduct suburban *500* acres (to be raised by pumping).		
Rural .. 222 acres at £27 per acre (Exhibit No. 44, page 6)		5,994
(*c*) Awatoto Block (all rural), 590 acres at £12 10s. per acre (Exhibit No. 44, page 6)		7,375
(*d*) Reclaiming by pumping silt (Hay and Rochfort's scheme (Exhibit No. 46)—		
North Ponds, 550,000 cub. yd. at 1s.	27,500	
South Ponds, 265,000 cub. yd. at 10d., 60 acres	11,040	
Roading, £200 per acre over all	12,000	
	50,540	
Less cost of dredge (included in Mr. Clapcott's figures)	7,000	
		43,540
(Deducting roads and reserves leaves 37 acres net, or 185 lots.)		
(*e*) G. F. Clapcott's estimates (page 489, evidence)—		
Richmond Block, 500 acres, suburban—		
Reclaiming banks, dredge, &c.	107,000	
Roads, bridges, &c.	78,000	
		185,000
(Deducting 170 acres for reserves and roads leaves 330 acres, or 1,930 allotments.)		
Total cost		£301,609

Annual charges: (*a*) Interest and sinking-fund charges, £18,000 per annum; (*b*) cost of operating pumping-stations.

AGGREGATE RENTALS FROM RECLAIMED LANDS WHEN RECLAMATION OF AWATOTO, RICHMOND, 28-ACRE BLOCKS, AND THE NORTH AND SOUTH PONDS ARE RECLAIMED AND FULLY LET.

	£
Awatoto Block: Rural—590 acres at £3 per acre	1,770
28-acre Block: Residential—117 allotments at £7 per lot	819
Richmond Block—	
Rural—222 acres at £3 per acre	666
Residential—1,980 lots at £7 each	13,860
Ponds: Residential—185 lots at £6	1,110
	18,225
Plus present rentals, £8,000 (less any rents now received from any of the above blocks)	8,000
Aggregate rental (subject to above deduction)	£26,225

NOTE.—These statements must be considered in the light of the following considerations:—

Cost of reclamation (1) Must be *kept within estimates* if the above result is to be attained; (2) must be loaded with interest on loans during reclamation and period of land standing unlet; cost of advertising and letting; (3) contribution to Hawke's Bay Rivers Board must be contemplated as an addition to cost. (See section 17, Hawke's Bay Rivers Act, 1919.)

Increased rentals from blocks let for industrial and other special sites will tend to better the position, but against this must be considered the possibility of some areas being taken by public bodies at cost or at low rentals.

PART 20.—ALLEGED NON-SUBMISSION OF PLANS OF PROPOSED WORK.

HAS THE HARBOURS ACT, 1923, SECTIONS 168 TO 171, BEEN COMPLIED WITH?

In the recitals introducing our order of reference there appears, "And whereas by the Napier Harbour Board Empowering and Loan Act, 1914, the Board was, subject to the provisions of the Harbours Act, 1908, and of the said Act of 1914, duly authorized to construct such harbour-works as should, by the Board, be considered necessary . . . in and about the construction, completion, and development . . . of the Inner Harbour portion of the said harbour, but has not, as required by the Harbours Act, 1908, submitted plans of the proposed works for the approval of the Governor-General in Council, except in so far as relates to the reconstruction of certain existing works."

Amongst the questions submitted to us is the following, viz.: "Generally to inquire into and report upon the premises and any matter arising thereout which may come under your notice in the course of your inquiries, and which you consider should be investigated in connection therewith."

It is premised by the recital quoted above that the Board has, in breach of the Harbours Act, failed to submit to the Governor-General in Council plans of works which it has undertaken in the direction of constructing and developing the Inner Harbour. This allegation was, at the hearing before us, denied by the Chairman of the Harbour Board, and, according to the documentary evidence, is questioned by the Harbour Board. It seems to us, therefore, to be a matter into which we should inquire and on which we should make a finding.

The relevant provisions of the Harbours Act (now Act No. 40 of 1923) are in sections 5 and 168 to 171, inclusive. In section 5 appears a definition of "harbour-works." Firstly, there is a definition in general terms, in the words "any works for the improvement, protection, management, or utilization of a harbour"; and, secondly, there is an enumeration of the various works and structures that usually form part of a harbour and its equipment.

There is no general inherent power in Harbour Boards to construct harbour-works, but by sections 168, 169, and (in special cases) section 179 Harbour Boards may, in the manner therein prescribed, obtain authority to construct harbour-works. Section 168 prescribes that, in the case of four major harbour-works—viz., (1) reclamation of land from sea or harbour waters, (2) graving-docks, (3) docks, and (4) breakwaters—no construction shall be entered on except under the authority of a special Act of Parliament. There is a proviso to this subsection which has no application to the present case. The applicant for such special Act must deposit at the office of the Marine Department a plan . . . prepared by a licensed surveyor, showing all tidal waters coloured blue, and the extent of the land sought to be obtained for the purpose of the said Act.

Section 169 provides that with respect to harbour-works other than those referred to in section 168 (*i.e.*, other than the four major harbour-works enumerated above) no Board shall commence or . . . construct such works without the sanction of the Governor-General in Council first obtained in the manner cited in a succeeding section.

These two sections between them cover all possible harbour-works that any Harbour Board might wish to construct, and they prescribe the source of the authority that must be obtained before the work is undertaken. In the case of the four works described above as major works the authority must be an enactment of the Legislature; in all other cases it must be the sanction of the Governor-General in Council.

Section 171 then prescribes the procedure that must precede the actual commencement of the making or construction of the harbour-work. It enacts that the constructing authority shall deposit at the office of the Marine Department a plan in duplicate of the whole work, showing all the details of the proposed work and the mode in which it is proposed the same shall be carried out. It provides further that if it appears to the Governor-General in Council that the proposed work will not be or tend to the injury of navigation he may approve the deposited plan.

It is, we think, clear that the restriction placed on the actual commencement of works by section 171 applies to all or any harbour works or work, whether it is the construction of, for instance, a breakwater under the authority of a special Act of Parliament obtained under the provisions of section 168, or, say, the building of a jetty under the authority of the Governor-General in Council obtained under the provisions of section 169. No matter which source of authority the constructing Board relies on, it must, before commencing the actual construction, lodge a plan showing details of the proposed work and the mode in which it is to be carried out, and procure the approval of that plan by the Executive Council. It may be noted that in the case of a breakwater, for instance, the approval of the detailed plans and specifications would be the approval by the Executive of detailed plans of a work already authorized in general terms by the Legislature; whilst in the case of a jetty the minute of the Executive's approval of the detailed plans would be, at the same time and by the same act, the granting of the sanction which by section 169 is the basis of the authority to undertake the work. This distinction, however, does not affect, in our opinion, the universal application of section 171 to all classes of harbour-works.

In the present case the Napier Harbour Board, being desirous of embarking on the construction of its Inner Harbour according to the plans (more or less modified) described in and accompanying Messrs. Cullen and Keele's 1912 report, sought legislative authority by a Bill, and obtained it when that Bill became the Napier Harbour Board Empowering and Loan Act (No. 14, Local) of 1914. That Act provides that it shall be lawful for the Board (subject to the provisions of the Harbours Act, 1908) to construct such works as are defined by the words "harbour works" in that Act as shall be considered necessary for the requirements of the Harbour of Napier in and about the construction, completion, development, and improvement of the Inner Harbour portion of the said harbour. The Act then bestowed on the Board power to borrow, subject to the provisions of the Harbours Act, up

to £300,000, to be applied in and about the construction, execution, and carrying-out of the works above described. The Act referred to—No. 14, Local, of 1914—was a special Act within the meaning of the Harbours Act, 1908, and the Harbour Board, when applying for such Act, complied with the provisions of the Harbours Act (now section 168, referred to above) by depositing a plan, prepared by a licensed surveyor, showing all tidal waters coloured blue, and the extent of the land sought to be obtained for the purpose of the said special Act. A copy of that plan, described as M.D. No. 4057, was produced to us as Exhibit No. 124.

The Harbour Board has, since the passing of its 1914 Empowering and Loan Act, undertaken certain works that fall within the general description of "Harbour-works" in and about the construction, completion, development, and improvement of its Inner Harbour scheme—viz., the building of a boundary embankment, a deepening of the entrance of the inner entrance channel, and a rebuilding in concrete of certain piers and quays. The Marine Department contends that before commencing any of this work, as a part of the Inner Harbour construction authorized by the Act of 1914, the Board should, in compliance with section 171, have deposited with the Department a plan of the whole work, showing all the details of the proposed work and the mode in which it is proposed the same shall be carried out. It is common ground that the Harbour Board has not deposited such a plan. The Harbour Board submits, in reply, that, as to parts of the work in question, it has acted under special sanctions, and with the full knowledge and approval of the Executive of the Dominion; and as to the remainder that it has from time to time submitted plans of the portions of work it proposed to immediately embark on, and has obtained Orders in Council approving of such works. It further submits that this method of procuring from time to time piecemeal permits only of portions of a whole harbour scheme accords with the Department's interpretation and administration of the Act in the past, and that such practice is a sufficient compliance with the Harbours Act, 1923.

The application of the law to the Acts of the Napier Harbour Board since 1914 is complicated by the peculiar circumstances governing those actions and the nature of the works undertaken. We shall refer later to the position thus created, but for the present we propose to deal with the general principle raised by the respective contentions of the Marine Department and the Harbour Board. We are of opinion that when a special Act empowers a Harbour Board to carry out a certain work, that work is in its entirety a "whole work" within the meaning of section 171, and before the Harbour Board, pursuant to its empowering Act, *commences* the making or construction of the work it must, to comply with its statutory duties, deposit a plan in duplicate of the whole work, showing all the details of the proposed work and the mode in which it is proposed the same shall be carried out. We are of opinion that it commences the making or construction of the work when it commences the making or construction of any portion of the whole work. It is a question of fact, to be decided fairly and reasonably on a consideration of all the circumstances, whether any particular work commenced by a Harbour Board is a "harbour-work" complete in itself, or a portion of a general scheme which is, on a view of the Board's policy and authorities, a "whole work" within the meaning of section 171 of the Harbours Act. It is, we think, quite clear that the plan deposited under section 168 with the application for a special Act cannot be viewed as a plan that also meets the requirements of section 171. The first plan (section 168) is a surveyor's plan, indicating the position of tidal works in relation to the proposed harbour-works, and showing the areas affected. The second plan (section 171) is an engineer's plan, showing details of the proposed work and the mode in which it is proposed to construct the work. Furthermore, we think that it is equally clear that the work *as a whole* must be laid before and considered by the Department and be submitted for the approval of the Governor-General in Council, and that the Governor-General in Council is entitled and expected, when the plan is submitted for approval, to see each portion not as a separate work, but in its true setting as a part of a whole work. If any object-lesson is necessary to point to the wisdom and necessity of such a provision in the Harbours Act, we think that it will be found in the methods, actions, and expenditures of the Napier Harbour Board. If, in the opinion of the legal advisers of the Governor-General in Council, there should be any doubt as to our interpretation of the law on this present point, we strongly recommend that the doubt should be removed by legislation, so that the policy and practice of piecemeal construction of a harbour be made impossible for the future.

We come now to a consideration of the problem raised by the application of the law to the actions since 1914 of the Napier Harbour Board. We wish briefly to refer again to the Act (No. 14, Local) of 1914. By section 7 the Board was empowered to carry out "harbour-works" in the construction of its Inner Harbour, and this includes, *inter alia* (*vide* interpretation clause, section 5, Harbours Act), the building of an embankment, and the undertaking of dredging to deepen a channel.

By section 8, the Board is entitled, out of the loan-money thereby authorized, to repair and renew its quays and structures appertaining thereto, and to purchase the necessary material and a new reclamation dredger. By section 14, the Board was empowered to fill up and reclaim certain lands.

The Board's harbour scheme, based on Cullen and Keele's 1912 report and plans, required the building of an embankment to define and enclose the Inner Harbour, and also to connect Port Ahuriri with the West Shore. It was quite apparent that this embankment could, and should, be constructed so that it would serve to carry the East Coast Road and Railway north of Napier, and by conference between Cullen and Keele, the Harbour Board, the Public Works Department, and the Hawke's Bay County Council it was agreed that it should be so constructed. Agreements were entered into between, firstly, the Harbour Board and the Minister of Public Works, and, secondly, the Harbour Board and the Hawke's Bay County Council. These agreements were validated by and incorporated into the Port Ahuriri – West Shore Road and Railway Act, 1914, an Act which authorized the three parties to the agreements "to construct and use a combined road and railway embankment and bridge across the Inner Harbour at Port Ahuriri from Port Ahuriri to West Shore." It was under the authority and provisions of this Act that the Board constructed the embankment in question in accordance with

plans lodged with the Public Works Department, marked "P.W.D. 35187." The Harbour Board considers, and submits through its counsel, that the authority given by the Port Ahuriri–West Shore Road and Railway Act, 1914, was a sufficient authority, and relieved it of the necessity of depositing plans and seeking approval of the Governor-General in Council under section 171 of the Harbours Act, 1908. With this contention we agree. We think it is a reasonable view to have taken, and, seeing that the Port Ahuriri–West Shore Road and Railway Act, 1914, is not a special Act under the Harbours Act, but a special legislative authority to build a certain work under special circumstances, we think also that that view is correct in law. We think the special authority of the Port Ahuriri – West Shore Railway Act lifts the building of this embankment out of the category of general harbour-works which are governed by the provisions of the Harbours Act.

As to the dredging-work authorized by Order in Council following on the deposit in May, 1923, by the Harbour Board of its plan M.D. 5652, we consider that it is proved that this was a piece of experimental dredging of the channel between the moles of the entrance to the Inner Harbour. We are satisfied that it was undertaken as experimental dredging, and that on that basis it was approved as a separate and complete piece of "harbour-work." It therefore does not tend to strengthen the submission (otherwise sufficiently proved) that it has been the Department's practice in the past to sanction piecemeal plans of harbour-construction.

We now approach the question of quay-construction. The Act (No. 14, Local) of 1914 authorizes this work under two distinct sections—*i.e.*, under section 7 as construction of the Inner Harbour, and under section 8 as repairs and renewals of the then-existing quays. The Board has since then embarked on and completed works that fall clearly within section 8 as renewals of quays and structures. It has also embarked on the construction of quays in concrete, on the lines of the West Quay, that are equally clearly an instalment of the construction of the Inner Harbour according to Cullen and Keele's report and plans. Inextricably mixed with work under this latter heading is some work that might in fairness be described as renewals of quays existing in 1914. We cannot say precisely just where the line between these two classes of work is to be drawn, but we can and do say that that line has indisputably been crossed, and that work has been undertaken that constitutes a fairly substantial instalment of quays constructed in part realization of Cullen and Keele's plans. No plan of the whole work of which this is a part has ever been *submitted*. This, in our opinion, constitutes a breach of section 171 of the Harbours Act as interpreted by us above. We are aware of the fact, which we find to be proved as a fact, that in the past the Department seems to have accepted and approved plans of portions of works without necessarily requiring plans of the whole work; but, in our opinion, that has no bearing on the question before us. That question is the interpretation of section 171 of the Harbours Act, and, where a statutory provision is as clear as we hold that section to be, departmental practice cannot be invoked to assist in its interpretation. At the same time, we think it is reasonable that in considering our attitude, and the Department's attitude to the position of the Harbour Board in this matter of this breach of its statutory duties, the past practice of the Department should be taken into account. It must be assumed that in the past the Department's officers at least acquiesced in the view which the Napier Harbour Board now puts forward, and in those circumstances we think that the Board must be excused for its lapses in this connection. The important point is that such a position should not be allowed to arise again.

There now remains the proposed purchase of the dredge "Kaione." The evidence adduced at the hearing made it quite clear to us that the Board sought to acquire this dredge for the purpose of using her in the prosecution of Cullen and Keele's scheme of Inner Harbour construction. The letter of the Chairman (Mr. A. E. Jull) of the Board to the Minister for Marine, under date 4th June, 1927, leaves no room for doubt on that point. We are therefore of opinion that the expenditure of £35,000 to £40,000 on that proposed purchase would be an expenditure on the work of construction of the Inner Harbour, and is incidental to the dredging-work. In nearly all the engineers' estimates of cost of dredging for harbour-construction submitted to us the cost of the necessary equipment, including dredges, is included in the unit cost of dredging. The proposed purchase of this dredge is therefore, we hold, an initial step in the work of dredging, and therefore a part of the harbour constructional work, and should not be the subject of a piecemeal approval, but should be considered in relation to the whole work. It should not, *a fortiori*, be permitted without authority, and the question raised by the Chairman of the possibility of the Board purchasing it out of revenue is, in our opinion, wholly beside the present point. Section 171 makes no distinction between harbour-works constructed out of loan-moneys and those constructed out of revenue.

PART 21.—A PROPOSED REFUND BY STATE TO HARBOUR BOARD OF PART COST OF RAILWAY AND ROAD EMBANKMENT.

It was suggested by Mr. A. E. Jull, Chairman of the Harbour Board, in the course of his evidence that if as a result of this Commission the Inner Harbour is not to be completed, the Harbour Board should be recouped for its expenditure on the embankment which now carries the East Coast Railway and road. The basis of this claim is that the embankment is of much heavier construction that it would have been had the Harbour Board built it for its own purposes merely as a harbour boundary, and that if now the harbour is not to be proceeded with the embankment is of no use to the Harbour Board.

We are not prepared to make any such recommendation, as we cannot see any just basis for it. Mr. R. W. Holmes, who was at that time Engineer-in-Chief of the Public Works Department, made it clear in his evidence that the embankment was pushed further back than it would otherwise have been, so as to enclose a larger area for harbour purposes, and this made it more costly to the Public Works Department.

It may be very unfortunate from the point of view of the Harbour Board that this money is sunk and gone, but we can see no principle at all on which it can be suggested that their loss should be shared by the State. We have, therefore, no recommendation to make.

PART 22.—CONSTITUTION OF HARBOUR BOARD AND REPRESENTATION THEREON.

Your Excellency's order of reference requires us to report on any matter arising out of the foregoing premises which might come under our notice in the course of our inquiries and which we consider should be investigated.

One matter which we were asked to report on, and on which evidence was adduced, is a matter comprised in the Napier Harbour Board Empowering and Loan Bill of 1926, appearing in section 4, the marginal note to which is, "Alteration of constitution of the Board." We were asked to hear evidence in support of the proposal therein contained—viz., that the number of members to be elected as representing the Borough of Hastings should be increased from one to two.

We are of opinion that if the constitution of the Harbour Board is to be continued as it is at present, either with or without the presence of non-elective members on the Board, a good case has been made out for the increase by one member in the number of representatives for Hastings, and we are of opinion that this proposal should be given effect to.

We were also asked to consider the question of making a recommendation to the effect that no further non-elective members to the Board should be appointed by the Governor-General. No evidence was placed before us touching the principle on which in certain cases non-elective members are nominated to a Harbour Board by the Governor-General, and we do not feel qualified to make any recommendation in the absence of a knowledge of that principle. Taking the view we have taken of the past and present policy of the Board, we are inclined to think that the presence of the Government nominees on this Board in the past has had a steadying and beneficial effect. We think we should, however, place on record that evidence was given of a resolution passed unanimously at a Harbour Association Conference in 1918. That resolution was to the effect that "the Conference affirms the opinion that the principle of Government nominees on the Harbour Boards is unsound."

There is, however, a larger aspect of this matter that we desire to deal with. We are unanimously of opinion that the matters brought to light in this inquiry reveal a fundamental weakness in the constitution of the bodies by which harbour affairs are governed. We have in the case of the Napier Harbour Board a Board of eleven elective and two nominative members. The elected members represent a comparatively large district, comprising two fairly large boroughs, a number of small towns, and a large rural population. The elective members are elected according to more than one standard of qualification in the electors, and there is no attempt to preserve a reasonable relation between voting-powers and financial responsibility. The policies of different portions of the Board have been taken up on party lines, and all the worst features of party government have been introduced into the controversy that has been engendered. The facts governing the subject-matter of the dispute are technical and professional, and the carrying-out of the various policies involves the expenditure of large sums of public money. Yet so well organized has been the party spirit, and so successful the propaganda, that in the words of Mr. Jull (page 43, Notes of Evidence), "That portion of the district which is responsible for 84 per cent. of payment of any rates has since 1911, *and in spite of any recommendations of engineers to the contrary* been steadfast in their adherence to the Inner Harbour proposal."

We think it shows an inherent weakness in the system that a policy involving the expenditure of a large sum of money for the creation of what should be a permanent and elaborate unit in the transport system of the Dominion can be carried through, almost to fruition, on a popular vote obtained from such a constituency by such propaganda as appears in Exhibit No. 51, read in the light of the history of the port at Napier.

From a national aspect all harbours are part of a composite Dominion transport system. They are really complementary to the roads and railways of the country, although occasionally their interests may conflict with land transport. Furthermore, the development or operation of ports which are bad, either in the navigational or financial sense, inevitably tends to raise the general flat rates for overseas transport to and from the Dominion, and to penalize in that way the whole of the country by raising the general cost of living. For these national reasons we submit that all harbour-development schemes should be carefully scrutinized by expert and unbiased advisers at the initial stage, and especially before the question of shouldering the financial risk is put to payers of rates or dues. We are of opinion that the records of harbour development in this country demonstrate that only by some such methods of supervision can both local and national interests be effectively safeguarded.

In the electioneering pamphlet which we have already referred to (Exhibit 51) there appears the statement, "Napier is crowded with amateur engineers who can predict all kinds of difficulties to any harbour scheme"—and this statement is probably true. It is equally true that in Napier, as in other towns in New Zealand which are in difficulties in the matter of harbour-construction, there is no lack of amateur engineers who can put forward attractive schemes of harbour-construction, and who are very impatient of the adverse criticism of men who have spent their lives studying the problems of harbour-construction. We think that this national problem should be dealt with in a comprehensive way. We do not feel competent, after having made a close study of the affairs of one New Zealand harbour, to formulate the precise remedy, but the principles we are advocating have some precedent in various measures of safeguarding community interests, as, for instance, in the provisions of the Town-planning Act.

Contract Prices and Day Labour.

Another matter which we considered should to some extent be investigated in the course of our inquiry, and on which much evidence was tendered, had relation to the cost of construction in concrete of certain works undertaken by the Harbour Board. This evidence took the form of testimony by various contractors of experience as to the cost per cubic yard of making concrete blocks. We also took evidence on the same subject-matter from representatives of public bodies—viz., the Engineer-in-Chief of Public Works; the Engineer of the Napier Borough Council, and (speaking from his cost records) the Secretary of the Napier Harbour Board. There was a great discrepancy between the prices of these two classes of witnesses. For instance, Mr. Furkert deposed he was able to make a cubic yard

of concrete at a minimum price at which, according to the same specifications, private contractors alleged they were quite unable to turn out a cubic yard of concrete. The cross-examination of some of the private contractors left no doubt whatever in our minds that they had been extremely liberal in their estimates of the details of cost, and that the prices they arrived at were decidedly high. We make no finding on any individual prices or figures submitted to us, but we recommend very strongly that the Napier Harbour Board, as custodian of public money, should, before accepting any contract involving such work, require close inquiry to be made as to the prospects of doing the same work at a much lower cost by day labour under the supervision of its own foreman and officers.

PART 23.—COSTS OF THIS INQUIRY.

We have been further directed by Your Excellency to consider what sums representing the whole or any portion of the costs of our inquiry should be borne by the Harbour Board, and by the respective corporate bodies represented by the local authorities of any district lying wholly or partly within the Napier Harbour Rating District as now constituted, and any other corporate body and individual, or by any of them, and in consideration of this matter we were directed by Your Excellency to have regard to the local scope of the Commission.

We have given due consideration to this matter, and we have had the benefit of being addressed on the point by counsel for the Harbour Board (Mr. A. Gray, K.C.) and counsel for the Marine Department (Mr. H. B. Lusk). In our opinion, the whole of the costs of the inquiry should be borne by the Napier Harbour Board. We are of opinion that the appointment of this Commission and the conduct of the hearing was necessary, and that the said necessity arose entirely through the actions and policy of the Board; and, further, that the result of the inquiry is to the benefit of the Harbour Board and its constituents.

In this connection we refer to the brief history of the Board set out in Part No. 8 of this report; to the vacillations of policy shown therein; to the numerous costly reports obtained, only to be rejected and scrapped whilst the Board resumed its search for an engineer who would give an answer agreeable to the Board; also to the Board's inaction in the matter of reclamation for a period of approximately twenty-five years—an inaction that has inflicted great hardship and injustice on the residents of Napier.

The costs will be comparatively high, and we regret that they must be visited on those who find the revenue of the Napier Harbour Board, but on no principle of fairness can we justify to ourselves the suggestion that any other body or person should be visited with a portion of them.

We beg to hand to Your Excellency herewith an order for payment of costs in accordance with the above, for transmission to Your Excellency's Minister for Marine.

PART 24.—HARBOUR BOARD OFFICIALS AND STAFF.

Our inquiry at Napier involved the officials and staff of the Harbour Board in a great deal of work. Much of this had to be done at high pressure, and it was in most cases associated at some stage with the ordeal of examination and cross-examination in the witness-box, and we wish to express our appreciation of the manner in which all concerned performed their duties.

It was suggested by counsel for the Harbour Board, when we were addressed on the matter of costs, that we might make a recommendation that an allowance should be made to the Chairman of the Board, Mr. A. E. Jull, in recognition of the fact that during the six weeks covered by the inquiry he was in constant attendance, living at Napier during that period, and devoting all his time and energies to the presentation of the case. We fully recognize those facts. We have not agreed with Mr. Jull's views, we have not been able to endorse his policy, but those facts do not prevent us from recognizing that Mr. Jull, as representative and champion of the majority party of the Harbour Board, sacrificed all his time and energy for six weeks, and presented the case of that party with vigour, with a great deal of ability, and, above all, in an excellent spirit. While recognizing all this, however, we do not think that we should make the suggested recommendation. If it were made in favour of the representative of the majority party, it must in fairness be made also in favour of Mr. P. F. Higgins, the representative of the minority party. He also displayed a great deal of ability in putting his facts and views before us, and it was not suggested that we should recommend an allowance to him. Both are elected members of a local body, and there are obvious objections to recommending payments for services rendered in the advocacy of policies for such bodies.

As to the work of the clerical and working staff of the Harbour Board, we feel constrained to place on record our appreciation of this. Particular mention must be made of the Secretary, Mr. J. P. Kenny; his energy and ability were beyond praise. We submitted numerous questions to Mr. Kenny (see Exhibits 95 to 100 and 147 to 162), and the preparation of the answers to these must have involved days and nights of work, the bulk of which in the matter of organization and co-ordination must have fallen on Mr. Kenny, and not once did his intelligent ability, his knowledge of his subject, or his courtesy fail him. We have no doubt that the remuneration of the staff for all this extra work will receive attention from the Harbour Board. It may assist the Board in assessing a just recompense to Mr. Kenny if we place on record our belief, firstly, that Mr. Kenny's energy and ability reduced the expenses of the Commission by the cost of fourteen days' sitting, and, secondly, that if his secretarial knowledge had not been supplemented by a good grip of accountancy principles it would probably have necessitated our requiring the services and report of a public accountant. We beg to recommend a special remuneration of £100 to Mr. Kenny.

We have the honour to be, Your Excellency's obedient servants,

JOHN S. BARTON, Chairman.
A. C. MACKENZIE, M.Inst.C.E., Commissioner.
JOHN B. WATERS, Commissioner.

Dated at Wellington, this 29th day of September, 1927.

APPENDIX TO REPORT.

TABLE A.—LIST OF NEWSPAPERS IN WHICH NOTICE OF SITTINGS WAS ADVERTISED.

Hawke's Bay Herald, Napier; *Daily Telegraph*, Napier; *Hawke's Bay Tribune*, Hastings; *Waipukurau Press*; *Waipawa Mail*.

TABLE B.—DAYS ON WHICH SITTINGS WERE HELD.

AT NAPIER.

Friday, 5th August, 1927—10 a.m. to 5 p.m.
Saturday, 6th August—10 a.m. to 12.20 p.m.
Monday, 8th, to Friday, 12th August—10 a.m. to 4.30 p.m.
Monday, 15th, to Friday, 19th August—10 a.m. to 4.30 p.m.
Monday, 22nd, to Friday, 26th August—10 a.m. to 4.30 p.m.
Monday, 29th August, to Friday, 2nd September—10 a.m. to 4.30 p.m.

AT NAPIER—*continued.*

Monday, 5th September—10 a.m. to 5 p.m.
Tuesday, 6th, to Friday, 9th September—9.30 a.m. to 5 p.m.
Saturday, 10th September—9.30 a.m. to 12.30 p.m.
Monday, 12th September—9.30 a.m. to 5 p.m.
Tuesday, 13th September—9 a.m. to 5 p.m.

AT WELLINGTON.

Monday, 19th September—2 p.m. to 4.40 p.m.
(Hearing declared closed.)

TABLE C.—WITNESSES WHO APPEARED BEFORE COMMISSION.

Name of Witness.	Description.
1. Jull, A. E.	Chairman of Napier Harbour Board.
2. Higgins, P. F.	Member of Napier Harbour Board.
3. Earney, H. D.	Wharfinger, Napier Harbour Board.
4. Pengelly, R.	Boring expert, Public Works Department.
5. Holmes, J. D.	Of Holmes and Son, Harbour Board's consulting engineers.
6. Hartman, Captain W. H.	Captain of s.s. "Tamaroa."
7. Chatfield, Captain S. A.	Captain of s.s. "Kaituna."
8. Waller, Captain Wm.	Harbourmaster, New Plymouth.
9. Worrall, Captain L. C. H.	Retired master mariner.
10. Edwin, Captain A. M.	Coastal pilot, New Zealand.
11. Collins, Captain H.	Harbourmaster, Nelson, New Zealand.
12. Nicholson, Duncan	Builder; foreman carpenter for Harbour Board.
13. White-Parsons, Captain H.	Harbourmaster, Napier.
14. Holmes, R. W.	Of Holmes and Son, Harbour Board's consulting engineers.
15. Robertson, A. M.	Member of executive of Fruitgrowers' Association.
16. Brown, Captain A. H.	Captain of s.s. "Port Melbourne."
17. Chudley, Captain T. H.	Marine Superintendent, of Shaw, Savill, and Albion Co., Ltd.
18. Olphert, Captain W.	Marine Superintendent, of New Zealand Shipping Co., Ltd.
19. Foster, Captain P. J.	Marine Superintendent, of Union Steamship Co., Ltd.
20. Rochford, Guy	Licensed Surveyor.
21. Latham, G. A.	Building contractor.
22. McLeay, K.	Shipping and lighterage company manager.
23. McDonald, J.	Farmer.
24. Canby, F. S.	Manager of meat-freezing company.
25. Kenny, J. P.	Secretary, Napier Harbour Board.
26. Allen, William R.	Shoremaster for Richardson and Co., Ltd.
27. Furkert, F. W.	Engineer-in-Chief, Public Works Department.
28. Hollis, Captain Hugh	Marine Superintendent, Commonwealth and Dominion Line.
29. Kennedy, C. D.	Civil engineer.
30. Maxwell, J. P.	Civil engineer.
31. Martin, T. W.	Dredgemaster, Wellington Harbour Board.
32. Oldham, J. H.	President Land Agents' Association, Napier.
33. Harvey, William	Member Land Agents' Association, Napier.
34. Godfrey, G. C.	Secretary for Marine.
35. Hobson, H.	Chemist; president Napier Chamber of Commerce.
36. Russell, A. C.	Chairman Waipukurau County Council, and representing two other local bodies.
37. Kelly, George	Chairman Hawke's Bay Wool-brokers' Association.
38. Maddison, G. H.	Mayor of Hastings.
39. Clapcott, G. F.	Engineer for Borough of Napier.
40. Miller, J. H.	Chairman Hawke's Bay Rivers Board.
41. Pulley, C. F.	Contractor.
42. Morse, C. O.	Contractor.
43. McMillan, D. N.	Contractor.
44. Northe, W. E.	Contractor.
45. Brooks, E. S.	Contractor.
46. Martin, William G.	Member Napier Borough Council.
47. Ferguson, A. H.	Clerk to Hawke's Bay County Council.

TABLE D.—LIST OF EXHIBITS.

Exhibit No.

1. Book of various reports.
2. Sir John Coode's plan.
3. Mr. Culcheth's plan.
4. Extract from minute-book of that period, 1882.
5. Goodall's plans (in five parts).
6. Marchant's report.
7. Marchant's plan.
8. Nelson's report and plan (printed pamphlet).
9. Maxwell, Williams, and Mason's report.
10. Transcript of oral report, Mr. Ferguson.
11. Kennedy's report on soundings.
12. Finch's report on soundings.
13. Plan of Kennedy's soundings.
14. Cullen and Keele's report, 1912.
15. Cullen and Keele's plans (three).
16. Questions to, and answers by, Cullen and Keele.
17. Cable to Cullen and Keele, and their reply.
18. Plan submitted under Harbour Act, with application for special Act, 1914.
19. Furkert's report, 1924.
20. Plan with Mr. Furkert's report, with graphs (five sheets).
21. Cullen and Keele's 1925 report.
22. Cullen and Keele's plans (three).
23. Plan of borings supplied to Cullen and Keele: Ground plan by Pengelly; individual reports on each bore by Pengelly; graphs and plans (twelve in all).
24. Minutes as to Mr. Keele's advice. . . . checking borings.
25. Extract from p. 530, minute-book, 4/5/25.
26. Plans of soundings by Holmes and Son, 1927.
27. Letter, Harbour Board to Marine Department, and reply to Board, 14/4/26.
28. Comparative lighterage and wharfage costs.
29. Return cost of labour on general cargo at breakwater shed.
30. Statement of charges by New Zealand Railways for haulage and delivery charges at various ports in New Zealand.
31. Dissection of total costs, Wellington to Dannevirke and Napier to Dannevirke.
32. Railway rates.
33. Statement valuation and population, rating district.
34. Dredging return covering seventeen years.
35. Statement of published accounts for 1923.
36. Statement of published accounts for 1926.
37. Return showing liners using roadstead for two years.
38. Return showing liners using breakwater for two years.
39. Return showing coastal boats and liners using Inner Harbour.
40. Return showing berthage rates, 1924 to 1/7/1927.
41. Return showing amount of aggregate berthage paid, cargo landed and shipped, and cost per ton.
42. Report by D. N. Campbell (on reclamation).
43. Plan accompanying Campbell's report.
44. Report by Hay and Rochfort of 8/5/26 (on reclamation).
45. Five plans (*a*), (*b*), (*c*), (*d*), and (*e*) accompanying Exhibit No. 44 (on reclamation).
46, 46A. Report of Hay and Rochfort of 4/10/26 (on reclamation).
47. Report by Holmes and Son (on reclamation).
48. Report by George Nelson, June, 1922 (on reclamation).
49. 1927 Empowering and Loan Bill.
50. List of vessels drawing 20 ft. or upwards.
51. Election propaganda sent out by Board in 1920.
52. Copy of letter to P. F. Higgins, 18/7/24, from Secretary, Harbour Board.
53. Set of shipping documents
54. Bills of lading, showing alteration of destination.
55. Two bundles of letters (seven letters, 2/3/26 to 1/10/26, and ten letters, 2/3/26 to 3/8/26), put in by P. F. Higgins.
56. Copies letters, Harbour Board and Canadian Government Marine Board.
57. Lists of soundings at Inner Harbour (ten bundles, April, 1924, to June, 1927).
58. Return of quarrying-costs.
59. Report of C. D. Kennedy on the flooding problem.
60. Return of cargo imported, 1/7/25 to 31/6/27.
61. Cost of handling cargo at breakwater.

Exhibit No.

62. Return of coastal and intercolonial vessels at breakwater, two years, 1/7/25 to 30/6/27.
63. Return of coastal and intercolonial vessels at Inner Harbour.
64. Comparative statements, charges various Harbour Boards.
65. Statement, charges various New Zealand ports on vessels, 2,321 tons net register.
66. Locality map of Hawke's Bay.
67. Litho map showing coloured shoal patch near breakwater.
68. Report of Holmes and Son to Harbour Board on shoaling.
69. Photograph (1887) of West Shore.
70. Plan showing shore-line at various periods.
71. Jar of material from bore 85 or 86.
72. Tin of sample of bottom at Whakariri patch.
73. Blue-print plan accompanying Cullen and Keele's 1925 report.
74. Plans of Glasgow Wharf (five plans).
75. Particulars of reclaimed sections offered for sale (see Chairman's report for 1926).
76. Piece of rock from foundation of breakwater.
77. Plan of borings by Holmes and Son—Inner Harbour; two plans.
78. Plan of subdivision of suggested early reclamation.
79. Plan of leases for sale by auction, 22/12/24.
80. Blue-print, breakwater, showing reclamation area for leasing (it accompanied Cullen and Keele's 1925 (report)).
81. Large plan of Napier Harbour.
81. (*a*), (*b*), (*c*), (*d*), (*e*), (*f*), (*g*), (*h*). Supplementary plans.
82. Report, Dominion Royal Commission on Harbours.
83. Three jars material from soundings—bore 41-38 and one unidentified.
84. Statement of areas to be reclaimed, and estimated values.
85. Plan of dredging by Browning crane.
86. Sample of bottom where blasting was required.
87. Correspondence *re* silt in Breakwater Harbour.
88. Return of accidents (both harbours).
89. Statement of Fruitgrowers' Association.
90. Plans, Mr. Napier Bell, accompanying his report of December, 1899.
91. Plan of Brisbane Harbour entrance.
92. Copies of minutes of Harbour Board.
93. Report of engineer *re* state of breakwater wharf.
94. List of loadings in roadstead; time occupied: (*a*), (*b*), (*c*), (*d*), (*e*), (*f*), (*g*), (*h*) attached (McLeay's return).

95 to 99 (inclusive). General questions submitted to and answered by Board's Secretary.

100. Photograph of breakwater in a storm.
101. Blue-print of tide-levels.
102. Plan of soundings.
103. Plan of roadstead.
104. Plan of soundings on beacon line.
105. Plan of soundings (west beach) on roadstead.
106. River diagram prepared by Mr. Furkert.
107. Tracing from Exhibit No. 26.
108. Graphs made up from soundings.
109. Plan of cross-sections, West Beach.
110. Rough graph showing ratio of increase of siltation.
111. (*a*), (*b*), (*c*), (*d*), (*e*) contour maps (underwater).
112. Tracing from Admiralty chart, Napier Harbour.
113. Diagram showing depths water on bar (nineteen years).
114. Diagram showing tidal levels.
115. Wind diagram (three years).
116. Tracing of Admiralty chart, Colon Harbour.
117. (*a*), (*b*). List of ports visited by Mr. Furkert.
118. Tide-table for August, 1927, at Napier.
119. Longitudal and lateral sections over dredged patch.
120. Sketch of type of cutter for dredge.
121. Tracing, comparative sections of outer channels.
122. (*a*), (*b*). Mr. Furkert's estimates of costs.
122½. Land-agent's plan.
123. Marine Department Report, 1924.
124. Plan No. 4057, submitted to Marine Department.
125. Letter, 4/6/27, Harbour Board to Auditor-General (bound in with notes).
126. Map showing Napier Harbour district.
127. Reclamation plan, showing pumping-stations.
128. Subdivision plans, Richmond Block.

TABLE D.—LIST OF EXHIBITS—*continued.*

Exhibit No.
129. History of Napier Harbour legislation (put in by Mr. Gray).
130. List of towage fees in New Zealand.
131. Letter from Mr. Clapcott to Commission.
132. Hay and Rochfort's file *re* Awatoto water-levels.
133. Return showing levels and flood-levels, Awatoto Block.
134/135. Graphs showing variations in areas of contours of shingle-bar.
136. Cross-sections showing losses and gains, Petane Beach (sixteen sheets in all).
137. Map of rivers, Board district.
138. Letter, Harbour Board to Minister, 17/9/26.
139. Report *re* "Canadian Challenger."
140. Report *re* complaints of delay, certain ships.
141. Various bills of lading.
142. Return showing discharge of five vessels.
143. Return comparative working of gangs, Napier and Lyttelton.
144. Return showing population, rates, and representatives.
145. Estimated cost making 30-ton block, concrete (Morse).
146. Estimated cost of 30-ton concrete blocks (Brooks).

Exhibit No.
147-162. General questions submitted to and answered by Board's Secretary.
163. Proposed subdivision of town lots (Borough Council).
164. Cost of new wharf, Outer and Inner Harbour.
165. Letter, Harbour Board Secretary to Minister of Marine, 26/8/24.
166. Copy resolution, Harbour Board, 26/9/24.
167. Correspondence between Harbour Board Engineer and Engineer-in-Chief, P.W.D.
168. Plan M.D. 5652.
169. Plan M.D. 5679 and 5847.
170. History of suffrage provisions, Napier Harbour Board.
171. Return showing size of B and F sheds at Inner Harbour.
172. Return of annual expenditure on Inner Harbour, 1910 to 1927.
173. Return of number of men on mould-work.
174. Reports on breakwater construction.
175. Return showing cost per lineal foot of breakwater.
176. Dredgemaster's report on "Whakariri" dredging in 1911.
177. Schedule of charges, Wellington Harbour Board.

TABLE E.—LIST OF PRINTED REPORTS STUDIED BY THE COMMISSION AND NOW COMPRISED IN COMMISSION'S EXHIBIT No. 1.

	Date of Report.
1. Report on Napier Harbour, by John McGregor	1875
2. Report on Napier Harbour, by C. H. Weber, Engineer to Harbour Board	1879
3. Report on Napier Harbour, by Sir John Coode, C.E.	1880
4. Report (competitor and prize-winner) by W. W. Culcheth, C.E., F.M.S.	1883
5. Report on Breakwater Harbour, by John Goodall, M.Inst.C.E.	1884
6. Report on Mr. Goodall's breakwater scheme, by Messrs. Napier Bell and Scott	1884
7. Reply to Napier Bell and Scott's criticism, by John Goodall, M.Inst.C.E.	1884
8. Report and recommendation by Nautical Commissioners	1892
9. Memorandum upon Report No. 8 by J. T. Carr, Engineer to Napier Harbour Board	1892
10. Report on damage to breakwater, and completion of harbour, by C. Napier Bell, M.Inst.C.E., and J. P. Maxwell, M.Inst.C.E.	1894
11. Report on Inner Harbour dredging problem, by C. Napier Bell, M.Inst.C.E.	1899
12. Reply by C. Napier Bell to criticisms of his report No. 11 above	1900
13. Report on dredging and encroaching silt, Inner Harbour, by C. Napier Bell, M.Inst.C.E.	1900
14. Report on harbour accommodation at Napier, by F. W. Marchant, M.Inst.C.E.	1906
15. "The Napier Harbour Question," by George Nelson, M.I.Mech.E. Undated, but it collects and incorporates various documents dated 1906 to 1910, and some dated by months only	..
16. Report on Napier Harbour for vessels of deep draught, by Messrs, J. P. Maxwell, M.Inst.C.E., Cyrus J. A. Williams, M.Inst.C.E., M.Am.Soc.C.E., and J. Blair Mason, C.E.	1909
17. Transcript of shorthand notes of conference between William Ferguson, M.Inst.C.E., and the Napier Harbour Board members, 19th July	1911
18. Reports, eight in number, from 15th January, 1912, to 7th August, 1913, by Mr. C. D. Kennedy, C.E., regarding the experimental patch dredged by the "Whakariri" in 1911–12	1912
19. Report on proposed Inner and Outer Harbours at Napier, by E. A. Cullen, M.Inst.C.E., and T. W. Keele, M.Inst.C.E.	1912
20. Correspondence by letter and cablegram between Harbour Board and Messrs. Cullen and Keele, arising out of Report No. 19	1912
21. Report by Mr. F. W. Furkert, M.Inst.C.E., A.M.I.M.E., on the proposed Inner and Breakwater Harbours	1924
22. Report by Messrs. Cullen and Keele (Ms.Inst.C.E.) on Inner and Breakwater Harbours at Napier	1925

TABLE F.—MR. A. C. MACKENZIE'S REPORT ON DREDGING.

As far as the Inner Harbour is concerned, the dredging of the outer approach channel is the crux of the situation. The channel designed by Cullen and Keele (see Exhibit 21, page 5) is to have a bottom width of 600 ft. and to give a depth of 35 ft. at low water. The Napier Harbour Board's Plan A (Commission's Exhibit 3), issued in 1919, shows this depth as 34 ft.

Taking points along the centre-line, the depth of dredging required and the length of channel are as follows :—

Distance from End of Eastern Mole.	Depth to obtain 34 ft.	Depth to obtain 35 ft.		Distance from End of Eastern Mole.	Depth to obtain 34 ft.	Depth to obtain 35 ft.		
Ft.	Ft. in.	Ft. in.		Ft.	Ft. in.	Ft. in.		
0	16 0	17 0		2,970	3 3	4 3		
165	17 0	18 0		3,300	11 0	12 0		
330	15 0	17 0		3,630	14 6	15 6		
660	10 6	11 6		3,960	12 0	13 0	Spit.	
990	9 0	10 0		4,290	10 0	11 0		
1,320	6 0	7 0		4,620	6 6	7 6		
1,650	4 9	5 9		4,950	5 3	6 3		
1,980	3 0	4 0		5,280	2 6	3 6	XX	
2,310	2 3	4 3		5,610	0 6	1 6		
2,640	2 3	4 3		390	Nil.	Nil.		

As we proceed seaward from the eastern mole the present slopes of the sea-bed show a fall of 1 ft. in 94 ft.; then there is a further fall of 1 ft. in 198 ft.; between this point and the beginning of the sandspit, a distance of 1,815 ft., the fall is 1 ft. in 257 ft.; the south side of the sandspit rises for a short distance on a gradient of 1 ft. in 82 ft., and then rises sharply on a gradient of 1 ft. in 37 ft.; from the top of the sandspit, which is 3,630 ft. from the east mole, it falls seaward upon a gradual slope of 1 ft. in 157 ft.

In estimating the quantity of material to be removed by dredging from this channel the batter of the side slopes on the eastern and western sides must be assumed, as it would obviously be wrong to estimate only for a channel 600 ft. in width with plumb sides, similar to a railway-cutting through tough rock. In an ordinary road and railway cutting through sand provision has to be made for the flattening of the slopes due to the prevailing winds, more particularly if the strong winds blow across the road or railway. On the lee side the slopes may become flatter by the sand forming the top of the cutting being blown away from the centre-line. The effect, however, on the weather side is possibly for the top of the cutting to be reduced by the sand being blown into or beyond the road; and also other sand well on the weather side may be transported and deposited in or beyond the original cutting. In the channel under consideration we have a fine sand saturated with water subjected to the transporting-power of very heavy seas running across the channel. The seas, in rough weather, when approaching the sandspit are said to be at least 15 ft. in height, so that by the time they arrive at the sandspit, where the depth of water at the top is only 19 ft., they have become waves of translation with an abundance of transporting-power. It will be noticed that the outer (or sea) side of this spit has, under the conditions it is subjected to, assumed a comparatively flat slope of 1 ft. in 157 ft. The question is as to whether the side slopes of the channel can safely be left at a steeper slope without incurring heavy maintenance dredging. We would point out that to provide for slopes of 1 in 157 the width at the shallowest part of the spit would be 600 ft. at the bottom and some 5,040 ft. at the top, which would result in practically the whole of the spit being removed.

We here set out some relevant extracts from the various engineers' reports and evidence.

Messrs. Maxwell, Williams, and Mason in their reply of the 19th October, 1909, addressed to the Secretary of the Napier Harbour Board (see Exhibit 8, page 34), express their opinions as follows: "The question [asked by the Secretary] suggests that the underlying idea is that a channel something like a cutting in solid material on dry land, with defined slopes, can be made. No such simple conditions are, however, involved." The conditions are—(1) The open ocean subject to the greatest recorded seas, due to a vast reach and the greatest ocean depths off the coast; (2) about 4,000 ft. of continuous sand-drift to get through for a depth of 35 ft. (the distance in 1927 is 5,808 ft.); (3) the natural inclination of the sandy bottom, apparently about 1 in 200, more or less, varying with the weather.

Sir John Coode, M.Inst.C.E., in his report of 1880 does not deal with dredging an entrance channel outside the moles, and suggests dredging between the moles only to a depth of 12 ft. below low water.

Mr. W. Culcheth, M.Inst.C.E., in his report of 1883 provides for only dredging between the moles to a depth of 20 ft. at low water, no dredging being required outside the moles.

Mr. J. Goodall, M.Inst.C.E., in his report of 1884 does not deal with dredging an approach channel, as he suggested a breakwater harbour.

Messrs. Bell and Scott in their report upon Mr. Goodall's scheme do not deal with dredging an approach channel to the Inner Harbour, as they approved of Mr. Goodall's breakwater scheme.

Messrs. Bell and Maxwell in their report of 1894 do not deal with dredging an approach channel, as this report is principally concerned with damage to the breakwater by storms in 1894.

Mr. C. Napier Bell in his report of 1899 on dredging only refers to dredging between the moles to a depth of 19 ft. below low water, and also for a distance of 900 ft. seaward. Mr. C. Napier Bell in his report of 1900 deals only with dredging and reclamation within the entrance between the moles.

Mr. Marchant, M.Inst.C.E., in his report of 1906 provides a mole on the east side of his proposed entrance channel, the mole to extend in line with the existing eastern mole and to terminate in 27 ft. of water; the channel to be dredged to a depth of 27 ft. on the lee side of the proposed new mole; the bottom of channel to be 400 ft. wide. He states that the annual cost of maintaining this full depth of water under the lee of breakwater (mole) is a matter of conjecture, and states that is would probably cost not less than £4,000 a year. In referring to the assistance to be anticipated by the lagoon scour, he states it is certain that under the lee of such a breakwater (mole) there will be some deposit which must be removed by dredging, allowing to the current all the scouring-power of which it is capable (see Exhibit 6, page 1). The important point in Mr. Marchant's provision of a mole is that he considered it absolutely necessary to protect the approach channel on the eastern side against accretion, and the attendant heavy maintenance costs, and the possibility of serious shoaling after completion.

Mr. George Nelson, M.I.Mech.E., in 1909 submitted a scheme to the Napier Harbour Board for an Inner Harbour, in which he states in relation to the dredging of the approach channel: "According to Mr. Marchant's survey of 1906, the 5-fathom line is 75 chains distant, measured due north off the eastern pier-head. So as to give access to the proposed harbour for vessels of the largest size it would be necessary to dredge a channel out to this line. The material is, no doubt, Tutaekuri silt, ideal stuff for suction dredge to handle. In 1906 the average depth of water between the pier-head and the 5-fathom line was 23 ft. at low water; a channel through this 7 ft. deep, so as to give a depth of 30 ft. at low water, with an average bottom width of 400 ft., and its banks sloped down to a batter of 10 to 1, would cost under £20,000. The formation of this channel presents no difficulty whatever." (See Exhibit 8, page 9 or page 11.) The quantity to be dredged he estimated at 770,000 cubic yards. To enable the Commissioners to guage the value of Mr. George Nelson's opinion upon harbour matters, seeing that his qualifications are those of a mechanical engineer, Mr. R. W. Holmes, who recently retired from the position of Engineer-in-Chief of Public Works, was asked whether Mr. Nelson had experience

in the design, construction, or maintenance of harbour works. Mr. Holmes reply was that, as far as he was aware, Mr. George Nelson had no practical experience in harbour construction and maintenance. (See Notes of Evidence, page 266.) It will be noted that Mr. Nelson is quite wrong in his statement that the spit is composed of silt, and that the formation of the channel would present no difficulty whatever. (See evidence of T. W. Martin, dredge superintendent, page 359 *et seq.*)

Messrs. Cullen and Keele in their 1912 report (see Exhibit 14, page 3) comment upon the dredging through the sandspit, and contend that there is no evidence of sand-drift, and that the sand is coarser than that occurring off the breakwater and the beach south thereof, and that they find upon examining records of previous surveys that the present conditions of the bottom off the moles, as shown by contours of equal depth and soundings generally, are unchanged outside the 3-fathom (18 ft.) contour since the date of the first survey in 1855.

In regard to sand-drift, the evidence submitted to your Commission shows that the spit has altered its shape considerably, as shown by a comparison of the plans showing the contours of equal depths in 1855, 1882, 1895, 1906, and 1927. We submit that these alterations can only be due to sand-movement, and that the movement of this sand will continue and cause siltation in the channel, unless an Inner Harbour improvement scheme included the provision of moles designed to protect the sand-spit from the effects of cross-currents of heavy seas or a heavy ocean swell. In regard to the sand the spit is formed of being coarse, this was not borne out by the sample of fine sand submitted for our inspection by Mr. J. D. Holmes as having been recently dredged from the spit by the grab dredge "J.D.O." This sample was also stated by Mr. T. W. Martin to be similar to that he had dredged up in 1911 with the ladder dredger "Whakarire." In this connection we use the words "movement of sand" as distinct from littoral sand-drift. In conclusion, Messrs. Cullen and Keele say, "We fully recognize the heavy breaking seas there would tend to fill in the cutting on the sides, and that some maintenance dredging may always be necessary; favourable factors are that the bottom consists of heavy and compact dark sand, and that big breaking seas are not of frequent occurrence"; and they continue that, in their opinion, it is feasible to dredge and maintain an entrance channel. Their estimated cost for dredging the channel to a depth of 35 ft. is £12,900, and that the annual maintenance would cost £7,276 (see Exhibit 14, page 6). In their 1925 report they give the estimated cost of dredging as £25,310, and the cost of maintenance dredging £13,500, less cost of maintenance to quays and cargo-sheds (say, £1,500), leaving cost of maintenance dredging £12,000 per year.

Mr. F. W. Furkert, M.Inst.C.E., Engineer-in-Chief of Public Works, in his report of 1924 deals with the question as follows: "It would be a comparatively easy task to dredge material such as exists along the line of this cut, but the amount to be removed would be very much greater than indicated simply by a consideration of the proposed length and cross-sections. Assuming the channel to have been dredged, its maintenance would involve considerable expense." (See Exhibit 19, page 6.)

Mr. R. W. Holmes, M.Inst.C.E., in his evidence on page 194, points out the difficulty in getting a full load with the use of a suction dredge, and estimates that it is necessary to dredge twice as much as the contents of the hopper before it becomes full. (This will necessarily increase the cost of dredging.) Mr. Holmes, however, recommends the use of a suction dredge fitted with a cutter in preference to a ladder bucket dredge, and concludes (page 195), "In view of the large scouring action which has of recent years taken place outside the Inner Harbour not only in the deep hole but also along towards the west shore, I have not the slightest hesitation in saying that once a channel is opened through the bar, that the scour from the Inner Harbour combined with the action of the propellers of vessels using that channel will keep it permanently open." On page 211, Mr. R. W. Holmes, states, "It is anticipated that the sides of the dredged channel will fritter down and some of the sea-bed will drift across." The removal of such material from the channel will come under two headings—one of purely maintenance and the other of construction—and he continued that the point at which he would consider construction dredging would cease would be the point where the mariners considered they had a sufficient width and depth of channel for navigation in ordinary weather. In regard to the width of channel required in ordinary weather, the evidence of the navigation experts is that they would require the full bottom width of 600 ft. Mr. Holmes's contention is that you could leave the sides on a steep side slope, allowing the sides to fritter away and lodge in the channel, reducing the original 600 ft. width. This accretion he would remove by dredging and charge to maintenance. Your Commissioners do not agree with this suggestion. On page 266, Notes of Evidence, Mr. Holmes states that a batter of 1 in 5 in the construction of the outer channel would be sufficient, and that the charge of doing same would be charged to capital, and further states that he would not expect any maintenance expenditure on 600 ft. channel in the first three years.

Mr. J. D. Holmes, M.Inst.C.E., Ass.M.I.Mech.E. (page 94), produced sample of material taken from the vicinity of the area dredged by the "Whakarire." On page 104 Mr. Holmes gives the quantity of material to be dredged from the outer channel to a depth of 34 ft. as 985,000 cubic yards at 1s. 3d.—£61,500. Page 301: Batter of slopes in channel taken as 1 in 3. Page 310: Mr. Holmes states that he thinks there is a general tendency for the whole sea-bottom to erode away in a westerly direction over the patch between the breakwater and the Inner Harbour channel.

Messrs. Holmes and Son consider that the "Kaione" suction dredger fitted with the cutter-head would be suitable for dredging through the sandspit, and would be able to work more continuously than a ladder bucket dredger such as the "Whakarire." They therefore have recommended the Harbour Board to purchase the "Kaione."

Mr. J. P. Maxwell, M.Inst.C.E., in giving evidence before your Commission (page 355) expresses the opinion that to dredge the proposed channel through the spit is a mistake, as he considers it will allow the seas to sweep in, and the shipping would not be able to use it under such conditions. He further states that he could not indicate the extent to which silting might occur, but undoubtedly the easterly drift would tend to shallow it to the same depth as surrounding area. On page 356 he states

that he does not think it would be possible to maintain such a trench, and that it would fill up again if not dredged out, which would be a troublesome matter. He does not agree with Mr. Holmes, sen., that maintenance dredging would not be required for three years after completion, and further states that his main objection is that it is inviting a calamity to make such a channel and invite shipping into it. Page 358: He says, "When I reported in 1909 I condemned the idea of an approach channel in the open sea. I have the same idea now. Nothing would induce me to change my mind in respect to the Inner Harbour. The effect of a wider and deeper opening would be to let sea of greater velocity into the Inner Harbour. If the channel was kept of uniform depth right through, the waves would not decrease as they reached the harbour."

Mr. T. W. Martin, Mech.Eng., and dredge superintendent to the Wellington Harbour Board, recounted his experiences with the dredge "Whakarire" when she was employed upon dredging an experimental patch of some 3 acres on the sandspit in 1911, which was started on 8th November and worked until 6th January, 1912. The material dredged during that period—approximately for two months—was 33,450 cubic yards. Upon numerous occasions the mooring-chains parted, and a good deal of delay took place, the dredge not being able to work, owing to the range and high winds. During the first day's dredging the tumbler-bushes were broken, and later on damage was done to the main gear mitre-wheel which necessitated a new wheel being sent for and fitted (see pages 359–364). Page 368: "Would not like to undertake the dredging of channel with 'Kaione.'" Page 364: "The tube is worse than the bucket, because it is rigid. I would say a bucket dredge was not the best for a job like the patch." Page 366: "It was hard work dredging with bucket dredger in patch." Page 622: "You would want actual experience there before you could express an opinion how any dredger would work." Page 623: "As I found things at Napier, I do not think that I could successfully load up a hopper. I would require to have a long stretch of experimental work to find out how I could best work a dredger—that is, any dredger—on the patch. I say the sand would never let me fill the hopper more than half to three-quarters full; three-quarters would be the maximum. That would increase the cost per load."

Summary of Experts' Opinions.

Maxwell, Williams, and Mason: "We say that even if it were practicable to cut this channel, there is no doubt that in heavy weather it would be liable to be obliterated wholly or in part. It is quite impossible to estimate the cost of maintaining an unprotected channel through a sand-bar when, as stated, the channel is liable on occasions to wholly disappear." They consider a protecting mole would be required estimated to cost £120,000.

Mr. Marchant considers that a protecting mole on the eastern side of the channel would be required. On the estimate he gives of £206,000 for moles, the portion to protect the channel would in 1906 have cost £124,266, and the estimated cost of dredging would have been not less than £4,000 per year.

Mr. George Nelson states that the formation of the channel presents no difficulty whatever, and gives the quantity to be removed as 770,000 cubic yards.

Messrs. Cullen and Keele in their 1912 report state that they fully recognize that heavy breaking seas would tend to fill in the cutting, and that some maintenance dredging may always be necessary; but they consider it feasible to dredge and maintain an entrance channel. Estimated cost to dredge same to 35 ft., £12,900; annual cost of maintenance, £7,276. In their 1925 report they give the cost of dredging as £25,310, and annual cost of maintenance £12,000 per year.

Mr. Furkert in his 1924 report considers that it would be a comparatively easy task to dredge the channel, but that its maintenance would involve considerable expense.

Mr. R. W. Holmes considers that it would be difficult to get a full load (thereby increasing the cost), and that he has not the slightest hesitation in saying that, once the channel is open through, no maintenance dredging would be required for three years; the side slope he suggested being 1 in 5.

Mr. J. D. Holmes adopts a side slope of 1 in 3, and estimates the quantity of material to be dredged at 98,500 cubic yards and the cost at £61,500.

Messrs. Holmes and Son consider that the "Kaione" would be a suitable dredge for this work.

Mr. J. P. Maxwell considered that the channel, when dredged, would tend to shallow to the same depth as the surrounding area, and that he does not agree with the suggestion that no maintenance would be required for three years; and that he considers that the dredging of such a channel is inviting a calamity to shipping.

Mr. T. W. Martin, dredge superintendent, after having two months' experience with the "Whakarire" on dredging the site of this proposed channel, stated that he would require to have a long stretch of experimental work to find out how he could best work a dredge there—that is, any class of dredge.

Your Commission is of the opinion that the evidence of the experts examined is unanimous, that it is feasible to dredge the channel to a depth of 34–35 ft.

In regard to maintenance, the following five witnesses considered that maintenance dredging would be required of a costly nature: Maxwell, Williams, and Mason; Mr. Marchant; Cullen and Keele; Mr. Furkert; and J. P. Maxwell. R. W. Holmes considered that no maintenance dredging would be required for three years. The following either did not express an opinion or would not commit themselves on this subject: G. Nelson, J. D. Holmes, T. W. Martin.

In regard to the quantity of material to be removed, the following side slopes were suggested as a basis of calculation: 1 in 3, 1 in 5, 1 in 10, and 1 in 200. On these figures the widths of channel where the water is shallowest would be, taking depths of cutting as 14 ft. 6 in. to obtain 34 ft. of water,—

	1 in 3. Ft.	1 in 5. Ft.	1 in 10. Ft.	1 in 200. Ft.
Top width	687	747	890	6,400
Bottom	600	600	600	600
Average	644	674	759	3,500

We are of the opinion that to avoid the danger of an inconvenient amount of siltation taking place after the desired width of 600 ft. has been obtained and during the construction of the channel, and also subsequently to avoid constant maintenance dredging, the side slopes would have to be not less than 1 in 40. The quantity of material to be removed to provide for this at a depth of 34 ft. at low water would be 1,673,198 cubic yards. We use Mr. Holmes's unit price of 1s. 3d., which under the circumstances we do not consider high. The resultant cost would be £104,575.

However, in conclusion, we would say that, in our opinion, moles are required, as the only sure and safe way to protect a dredge employed upon constructing the channel, to economize in width of channel required, to reduce to a minimum possible maintenance dredging, to ensure the channel always remaining navigable, to protect the Inner Harbour from inconvenient range, to facilitate navigation of the channel by large vessels, and to allow of the present entrance being opened sufficiently to reduce the velocity so that vessels drawing at least 26 ft. could enter or leave at any stage of the tide, day or night. To afford this measure of protection these moles would have to extend into 34 ft. of water, they would be some 6,000 ft. long, and so placed that they would dissipate the range before it reached the Inner Harbour entrance. The approximate cost of these moles would be £500,000, plus the cost of dredging whatever width of channel is finally decided upon.

Dredging between Moles.

The moles protecting the present entrance channel to the Inner Harbour are 400 ft. apart, and the velocity of the tidal current between high and low water and slack water varies from nil to from 5 to 6 knots. The channel is 1,450 ft. long, and the least depth at low water is 15 ft. From approximately the north end of the freezing-works to the end of the west mole, about 800 ft., the borings taken by Mr. Pengelly show that from the present bottom, 15 ft. to 18 ft. below low water, the material to be dredged to provide 34 ft. or 35 ft. of water largely consists of boulders and some shingle. From the north end of the Iron Pot to the north end of the freezing-works the borings show some 5 ft. of shingle overlaying silt.

The chief difficulty in dredging this channel is that the velocity of the current precludes a dredge from being moored without the mooring-chains extending the whole width across the channel, rendering it useless for navigation by any boat or vessel. Mr. Pengelly states (on page 85) that to keep his boring-punt in position he had to use five moorings. Sometimes one and at other times two of these were fixed on shore (page 82). He mentions that his anchors dragged, and that, in his opinion, it would be very difficult indeed to hold a dredge of any size in the channel between the moles. Mr. Pengelly (on page 80) stated that the boulders would be up to about 1 ton in weight. Mr. T. W. Martin, dredge superintendent, was examined in reference to dredging the channel between the moles. On page 370 he states that the captain of the "Whakarire" refused to come in close to the pier-heads at the Inner Harbour unless at slack water; and on page 371, in reply to the Chairman, he stated, "if leaving the moorings in the channel with load, the lines would have to be slipped ashore; if chains used, you could slip and get away in twenty minutes. (Dredge-chains could not be used in this channel.) It depends upon the tide as to the time taken to pick up moorings again; it might take all day or a week to pick up moorings with a 6-knot current. I do not know how I could do it."

Mr. Nicholson, foreman and leading carpenter to the Napier Harbour Board, described the attempt made by the Board about 1922 to dredge this channel with a grab dredge erected on a timber pier which extended towards the centre of channel at right angles to the eastern mole. The result of the experiment was a hole 10 ft. deep by 80 ft. by 108 ft. The outer edge of this hole when dredging was discontinued was about 138 ft. out from the west mole. On page 166 Mr. Nicholson stated that he believed that the reason the work was stopped was that it interfered with navigation.

Your Commissioners consider that the class of dredge required to remove the boulders, which form some four-sevenths of the whole of the dredging required, is a powerful grab or ladder bucket dredge, and that unless the dredging were delayed until the contemplated widening has taken place the entrance to the Inner Harbour would have to remain closed during the dredging operations. Quite recently, when the Porpoise Rock was being removed in the Tamar River, Launceston, the "Loongana" and other passenger-vessels between Melbourne and Launceston had to be diverted during the time the rock's removal was in progress. The velocity of the current at the Porpoise Rock is 7 knots.

To dredge this channel to 34 ft., having a bottom width of 300 ft. and side slopes of 1 in 2·5, as shown on Cullen and Keele's plan, and using Mr. J. D. Holmes's unit price of 2s. per cubic yard (for which figure we think it possible the work could be done), the quantity of material to be removed would be 429,629 cubic yards, and the cost £42,963. Mr. J. D. Holmes estimates the cost of this dredging at £46,175.

In addition to the dredging, one mole has to be built 100 ft. from its present position. Some 400 ft. of the new slopes on each side of the channel will require protecting with stonework, as the borings show that the last 15 ft. of the dredging is through silt. We estimate the cost of these works, using the contract price the Board is now paying for stone—viz., £1 14s. 1d. per cubic yard—at—

Mole, £34,000; protecting slope, £4,000: total, £38,000. Mr. J. D. Holmes estimates the cost of mole and protection at £26,300. Neither our estimate nor, presumably, Mr. Holmes's, makes provision for extending the mole seawards, as suggested by Mr. Holmes, to form wave-traps to reduce the range in the Inner Harbour when the channel between the moles is widened.

DREDGING BASIN FOR INNER HARBOUR SOUTH OF THE IRON POT.

Messrs. Cullen and Keele provide for dredging out a basin 1,000 ft. wide. In considering the length to be dredged, we would point out that the work now in progress of reconstructing the wharf along the West Quay provides for the possibility of dredging only to a depth of 20 ft. below low water. Therefore to obtain a minimum depth of 30 ft. required for oversea vessels drawing some 26 ft., practically the whole of the dredging will have to be done on the south side of the old timber bridge, where a great deal of the area to be dredged is dry at low water and the remainder only has about 1 ft. 6 in. depth of water at low tide. (See Exhibit 77, borings by Hay and Rochfort.) Adopting the evidence that four berths will be required if lightering is eliminated, a minimum length of 2,400 ft. will be required. We estimate that the quantity of material to be dredged, giving a uniform depth of 30 ft. below low water at the berths and 26 ft. in the basin, as 2,700,000 cubic yards. Mr. J. D. Holmes, for two berths, makes this figure 1,221,600, which at his original estimated unit cost of 1s. equals £61,080. Before stating our estimated cost for this work we wish to point out that as some of the area is dry at low water, and that the greater portion of it has only a depth of 1 ft. 6 in. at low water, a dredger that can cut its own floatation would be required. The dredger "Kaione" as at present fitted is not suitable for this work, and before she could efficiently deal with same the whole area would have to be dredged to a depth of some 15 ft.—1,300,000 cubic yards. Unless the dredge were built on shore and launched into a specially prepared pond on the south side of the bridge, the only available starting-point would be on the north side of the timber bridge at the south end of West Quay. The depositing of this excavated material in the North or South Pond would be a troublesome and expensive undertaking, as, in addition to a shore pipe-line, which to fill the South Pond, even, would be some 1,600 ft., there would have to be a floating pipe-line up to a 1,000 ft. in length. Two other alternatives offer themselves; one is to fill the hopper of the dredge and then steam into the Iron Pot and discharge the material into the North Pond, and the other is to steam out to sea and discharge the material. As the Iron Pot would be a most awkward place to get into and out of during the flood and ebb tides, and as the cost of the disposal of this material for reclamation purposes by the pumping schemes cannot be estimated with any reasonable degree of accuracy, we must adopt the unit cost for depositing at sea; this we consider would be 1s. 3d. per cubic yard. For the remainder of the work to be done by the "Kaione" or other suitable dredger we use Mr. Holmes's original unit price of 1s. per yard. We therefore estimate the cost of this portion of the work at 1,400,000 cubic yards at 1s., £70,000; and 1,300,000 cubic yards at 1s. 3d., £81,250: total, £151,250.

In regard to the Breakwater Harbour the dredging is a simple matter, more particularly as it would not be necessary to do it until the breakwater was extended and the western mole completed. To provide 30 ft. at the berths and 26 ft. elsewhere, Mr. Holmes estimates that the quantity to be removed is 300,000 cubic yards, at a cost of £18,700. Our estimate for this depth is 317,185 cubic yards at 1s. 3d.—£19,824.

Inner Harbour.—Cost of dredging.

	Mr. Holmes.	Commissioners.
	£	£
Outer channel	61,500	104,575
Between moles	46,175	42,963
Basin	61,080	151,250
	£168,755	£298,788

Note that the above does not in either case include the cost of moles, or protecting sides of channel, or wave-trap. Neither does it include the dredging to the north-west of tide-deflector from West Bridge to harbour-entrance included in Cullen and Keele's scheme and estimated by Mr. Holmes at £42,500.

TABLE G.—MR. A. C. MACKENZIE'S ESTIMATED COST TO COMPLETE THE INNER HARBOUR AND PROVIDE FOUR BERTHS FOR OVERSEA VESSELS DRAWING 26 FT.

The following estimates are not submitted with any degree of assurance that they correctly represent the ultimate total cost of the Inner Harbour scheme as outlined by Messrs. Cullen and Keele. I have neither had the material nor the time to go into this matter in sufficient detail. Furthermore, by the time the whole of the evidence had been submitted the Commissioners were of the opinion that the financial position of the Board would not warrant its undertaking extensive harbour improvements for some years to come. It is therefore apparent that by the time a constructional programme could be adopted present-day estimates would be of little value. I am, however, confident that the various works estimated for would not at the present time, in the matter of cost, vary seriously from the amount of my estimate. The works I have estimated for are as outlined in the plan issued by the Harbour Board in the year 1919—*i.e.*, Plan A in Commission's Exhibit 3. I have adopted four berths for overseas vessels, and have provided for dredging the channel to 34 ft. to accommodate vessels drawing 26 ft. With the exception of the estimated cost of dredging, the cost of mole, and protecting 800 ft. of the channel between the moles, I have adopted Mr. J. D. Holmes's estimates for his two-berth scheme in arriving at my cost for four berths. The estimates I give are principally useful as a comparison in the cost of a

four-berth scheme at the Inner Harbour, as against a two-berth scheme at the Inner Harbour or the completion of the Breakwater Harbour.

In evidence Mr. Holmes stated (on page 104) that his unit costs included plant. Messrs. Cullen and Keele in their 1925 report do not include the plant in their dredging-costs, but they estimate the dredging, plant, and pipe-lines at £98,300, which at Mr. Holmes's estimate of 3,518,350 cubic yards to be dredged (including the quantity behind deflectors) would absorb 0·5617 of 1s. per yard of his unit prices. The average of the unit prices adopted by Mr. Holmes is about 1s. 3d. Deducting the unit cost of plant—viz., 0·56 of 1s.—leaves 0·7 of 1s., or approximately 8½d. per cubic yard to pay for all costs of dredging, including interest, sinking fund, and repairs to plant. Under the Napier conditions I am satisfied that the works cannot be done at this price. In my estimates I have not included any cost of plant. My unit prices include the cost of dredging, interest, sinking fund, and repairs to plant. The unit prices I have adopted are—Dredging at outer channel, 1s. 3d. per cubic yard; between moles, 2s. per cubic yard; basin, 1s. and 1s. 3d. per cubic yard.

Messrs. Cullen and Keele's scheme, 1912 and 1925, provide for a tide-deflector and dredging on the north side of same. We have seen no detailed designs for this, so have included Mr. Holmes's estimated cost. Forming and making roads Mr. Holmes includes under reclamation. For comparative purposes I provide an amount in each estimate to cover this item, and also for railways, which Mr. Holmes does not mention.

	J. D. Holmes: Two Berths. £	Commissioners: Four Berths. £
Dredging outer channel	61,500	104,575
Dredging between moles	46,175	42,963
Dredging basin	61,080	151,250
Dredging north of tide-deflector	42,500	42,500
Rebuilding and removing mole	26,300	34,000
Protecting banks between moles	..	4,000
Quay-wall	81,200	162,400
Cargo-sheds	19,800	39,600
Cranes	4,000	8,000
Concrete floors, sheds of quay	10,000	20,000
	2 berths	4 berths
Buoys	1,000	1,000
Roads, at back of wharf only	9,000	18,000
Railways, at back of wharf only	2,500	5,000
Moles to reduce range	40,000	40,000
Mole to tide-deflectors	23,600	23,600
	428,655	696,888
Contingencies, 5 per cent.	21,433	34,844
	£450,088	£731,732
Cost per berth	£225,044	£182,933

Or, correcting what we consider is an underestimate by Mr. Holmes for dredging and mole, the totals become—

	£	£
Total cost	598,908	731,732
Cost per berth	299,454	182,933

It will be seen that the estimate of Mr. F. W. Furkert, Engineer to the Public Works, who only provides for two cargo-sheds and cement floors for same, is £660,000. By adding the cost of two additional cargo-sheds and floors to same, plus roads and railways, his total cost, exclusive of dredging plant, is £708,800. This is in close agreement with my estimate. I am of the opinion that, including plant, an approximate estimate of the cost of this work may be taken as £830,032. My opinion is, further, that if these works were carried out the port may at any time be closed owing to the silting of the Outer Channel wholly or in part, and that, at the best, overseas vessels drawing 26 ft. could only enter or leave the port in moderate weather, during daylight, at high-water slack tide, and would require the assistance of a tug to do so.

In estimating the annual overhead charges I have adopted the following rates: Interest on capital, 5½ per cent.; Sinking fund, ½ per cent.; Renewals, 1 per cent.; Maintenance, 2¾ per cent. As I have provided for interest and sinking fund and repairs in my unit cost of dredging, the additional annual charge will be—

	£	£
Dredging—		
Maintenance dredging: £341,288 at 2¾ per cent.	9,385	
Renewals of plant: £98,300 at 1 per cent.	983	
		10,368
Wharves, sheds, and structures—		
Interest: £731,732 at 5½ per cent.	40,245	
Sinking fund: £731,732 at ½ per cent.	3,658	
Renewals: £731,732 at 1 per cent.	7,317	
Maintenance: £731,732 at 2¾ per cent.	20,123	
		71,343
		£81,711

TABLE H.—Mr. A. C. MACKENZIE'S ESTIMATE OF COST OF COMPLETION OF BREAKWATER.

BREAKWATER.

The following are the estimated costs submitted for our consideration for the completion of the Breakwater Harbour:—

F. W. Furkert (23rd August, 1924).—Completion of breakwater over the Auckland Rock, the ending being in 35 ft. of water; height, 6 ft. above H.W. or about one-half the extension proposed by Cullen and Keele in their 1912 report. The construction of the western mole, leaving a width at entrance of 600 ft.; one new jetty, 550 ft. long by 180 ft., providing two berths, with two cargo-sheds; dredging between jetties and to form a swinging-basin to a depth of 30 ft.; reclamation on foreshore (see Exhibit 21, page 8)—£400,000.

Cullen and Keele (23rd November, 1925).—Completion of breakwater over Auckland Rock, 1,550 ft., as against some 2,880 ft. proposed in 1912. Thus, accepting the lengths suggested by Mr. Furkert, height as at present, 6 ft. above H.W.; western mole, 3,800 ft. long (about similar lengths to Mr. Furkert's), entrance 600 ft. wide; reclamation; dredging, 31 ft. generally, with 35 ft. at berths; two jetties, 500 ft. long, 178 ft. wide, with cargo-sheds on each side 350 ft. by 35 ft.; shed on reclamation, 200 ft. by 60 ft.—£511,009, which is exclusive of engineering contingencies and plant. Similar to above, with one pier and two sheds, and shed on reclamation, also exclusive of engineering contingencies and plant—£393,082.

F. W. Furkert (September, 1927). Deposed to by Mr. Furkert as a safe estimate—

	£
Completion of breakwater	185,000
West mole	85,000
Wharf, 600 ft. by 200 ft., with shed	120,000
Dredging	50,000
Reclamation	10,000
	£450,000

J. D. Holmes (August, 1927). See evidence, page 101

	£
Extension of breakwater, 1,550 ft., 6 ft. above H.W.	386,800
West-mole construction	330,000
Wharf, 550 ft. by 200 ft., with approach 664 ft.	161,000
Cargo-shed, 300 ft. by 170 ft.	7,600
Four cranes	4,000
Reclamation-wall, 2,900 ft. (22½ acres)	12,000
Dredging basin to 26 ft., berths to 30 ft.	18,700
Removal of Auckland Rock	3,400
Removal of other rock	2,000
Engineering contingencies	47,500
	973,000

(Note.—On page 101 Mr. Holmes makes the total £983,000.)

Extra not provided for by Mr. Holmes on page 101—

	£	
Dredging to 31 ft.—		
Per A. C. Mackenzie	24,000	
Per J. D. Holmes	18,700	
	5,300	
Extra removing portion of Auckland Rock to provide 34 ft.	7,500	
		12,800
		985,800
Mr. J. D. Holmes's estimate for raising breakwater 10 ft.		223,000
		£1,208,800

A. C. Mackenzie's Estimate.

To complete the Breakwater Harbour and to provide four berths for overseas vessels drawing 26 ft., I consider the following work would have to be done: Extend the present breakwater 1,550 ft., either with concrete blocks as at present or in stone, whichever is cheaper. The height to remain as it is at present—*i.e.*, 6 ft. above H.W. Construct the west mole; length, about 3,800 ft. Construct a new wharf 600 ft. by 178 ft. Provide two cargo-sheds on wharf, 400 ft. by 35 ft., with roadway between sheds and 4 ft. below deck-level. Provide two railway-lines in front of sheds and one at back of each shed on roadway. Provision to be made for cranes in case they are required. Provide wall for reclamation somewhat as shown on Cullen and Keele's 1925 plan, about 2,900 ft. long (see Plan B, Commission's Exhibit 3). Provide for dredging between wharves and swinging-basin to 31 ft. below low water. Remove portion of the Auckland Rock at entrance to 34 ft. and other rock in enclosed area to 31 ft. As the trawlers and small coastal vessels are well provided for at the Inner Harbour, which

will provide more room than required if the main portion of the lightering is eliminated by the completion of the breakwater, I do not make any provision for them in my estimate for Breakwater Harbour extension.

It will be noticed that a large discrepancy in the estimates submitted is occasioned by Mr. J. D. Holmes having thought fit to make provision in his estimates for raising the whole of the breakwater a further 10 ft. above H.W., or 16 ft. in all. The following is a short summary upon this subject of the opinion of the designer of the breakwater, John Goodall, M.Inst.C.E., and other eminent civil engineers, who have undoubtedly had years of experience in the design, construction, and maintenance of harbour-works:—

J. Goodall (1884), says: "In this section is shown in plain lines the superstructure of the breakwater, &c., surmounted by a parapet wall of concrete, &c. The cost of the latter is not included in the estimate, as it will not be advisable for years, until the work has thoroughly subsided, to attempt to build the parapet wall." (See Extract 1, page 16.)

Messrs. Bell and Scott in their report of May, 1884, state: "We consider the height of the breakwater—namely, 6 ft. above H.W.—is not sufficient for the safety of ships inside, &c., and that it will be found necessary sooner or later to raise a parapet to keep heavy seas from sweeping over the works." (See Extract 1, page 18.)

J. Goodall in his report of May, 1884, in reference to Messrs. Bell and Scott's suggestion that the breakwater must be raised sooner or later, points out that the 6 ft. height was designed for economy, and that a low breakwater without a parapet did not require so wide a base. (See Extract 1, page 20.)

Messrs. C. Napier Bell and J. P. Maxwell reported in 1894 upon the damage to the breakwater in the severe storm which took place in February, 1894, and were particularly asked to advise means to prevent further damage and to advise as to future construction. They considered that the width of the concrete was ample, and to protect same from further damage recommended piling heavy masses of rubble blocks up to high water. This was done. They go on to state, "Although we think it necessary to thus strengthen the exposed part of the structure, we do not look upon the damage sustained as a serious failure, &c. There is no alternative, now that a great extent of the structure is built, but to continue the design as we find it, &c. We consider that the best method of expending the money in hand, so as to make the works as complete as possible, is to finish the breakwater to the Auckland Rock (see Exhibit 1, page 26). The recommendation for these repairs and the extension of the breakwater as designed—*i.e.*, 6 ft. above high water—have been carried out, but the breakwater is still some 1,200 ft. from the Auckland Rock."

Mr. F. W. Marchant in his report of 1906 recommends the completion of the breakwater, and says, "There is no doubt whatever about the complete stability of the work as it is now being constructed, &c. No suggestion can be offered for improvement of either design or detail or in the manner of working-operations." (See Exhibit 6, page 2.) He, however, goes on to state, "In order to render the water in the enclosed areas as calm as possible a parapet along the first cant of the breakwater and the piling-up of more blocks on the wave-breaker on the second cant would almost entirely stop any water breaking over into the harbour." (See Exhibit 6, page 3.)

Messrs. Maxwell, Williams, and Mason in their report dated July, 1909, recommended the completion of the breakwater upon the lines upon which it was then constructed, which they point out had proved quite adequate for the purpose. (See Exhibit 9, page 6.)

Messrs. Cullen and Keele in their 1912 report recommended that the breakwater should be raised 10 ft. (See Exhibit 14, page 9.) In their 1925 report they evidently reconsidered this matter, as in Exhibit 21, pages 6 and 7, they state, "We recommend that the type of section for the extension should be the same as that of the existing breakwater. The latter appears to have stood the exposure well without any serious injury from wave-stroke, &c. It consists of a rubble foundation brought up to a level of about 19 ft. below low water, on which concrete blocks are built up in a rectangular section 25 ft. wide* to a height of 30 ft.—*i.e.*, to 6 ft. above high water, spring tide, with a wave-breaking apron of large stones and concrete blocks on its seaward side."

Mr. Furkert in his evidence on page 325(?) points out that Messrs Cullen and Keele modified their 1912 recommendation, and in their 1925 report adopted 6 ft. as the height of the breakwater above high water; also, on page 526, in referring to his own estimate he states, "I worked approximately to Cullen and Keele's latest plan in taking out the quantities in regard to the breakwater and mole. I did not think it necessary to take the moles 6 ft. above high-water mark, and made reductions in quantities accordingly, &c. I think I allowed 2ft. 6 in. above high water for the moles."

From the foregoing it will be seen that Mr. Goodall, the designer of the breakwater, had most excellent reasons for not including the provision of a parapet—at least, for many years. Therefore, prior to the laying of the foundation stone in 1887, the only engineers of standing who thought a parapet should be provided were Messrs. Bell and Scott, which, in their opinion, was required for the safety of ships. Up to 1894 the Gladstone Wharf had been constructed and the second cant of the breakwater was in progress. In February, 1894, a storm damaged the breakwater, and Messrs. Bell and Maxwell, who were commissioned to report (1) on the present condition of the works, (2) to devise means to prevent further damage, (3) to advise as to future construction, do not recommend the addition of a parapet. In 1906 Mr. Marchant recommended a parapet to render the water in the enclosed area as calm as possible and to stop any waves breaking over into the harbour. Messrs. Maxwell, Williams, and Mason in their report of 1909 do not recommend a parapet; and finally Mr. Furkert in his 1924 report and Messrs. Cullen and Keele in their 1925 report do not recommend the construction of a parapet. Since the breakwater was used by shipping we have only Mr. Marchant and

* NOTE.—This should be 36 ft. wide.—A.C.M.

Mr. J. D. Holmes who consider a parapet necessary; and as Mr. Marchant only advises it to prevent seas coming over and to provide calm water, and as the evidence tendered to your Commission was that seas coming over the breakwater did not cause rough water, we are left with Mr. J. D. Holmes as the only advocate in 1927 for the provision of a parapet. I am of the opinion that as the Breakwater Harbour has now been in use for thirty years, and that as no serious damage to vessels has taken place, that there is no justification for the inclusion of the additional cost of a parapet in Mr. J. S. Holmes's estimate, and therefore eliminate same from further consideration.

The greatest discrepancy between Mr. J. D. Holmes and Mr. Furkert's evidence are their respective estimates of the west mole. I have taken out the quantity of rock required in accordance with Cullen and Keele's 1925 plan, and find that after deducting 40 per cent. for voids and adding 10 per cent. for loss in settlement, 180,000 solid cubic yards would be required. At Mr. Holmes's estimate of £330,000 this works out at £1 16s. 8d. per cubic yard.

Mr. J. D. Holmes (page 102 of evidence) mentions that Cullen and Keele's estimate of £49,690 equals a unit cost of 4s. 4d. per cubic yard. The £49,690 therefore represents 229,515 cubic yards, which must be taken as Mr. Holmes's estimate of the quantity of stone required. On page 102 he states that he adopted 15s. as his unit cost. I would point out that 229,515 cubic yards at 15s. equals £172,136, and not £330,000 as given by Mr. J. D. Holmes on page 101 and included in his estimate.

Mr. Furkert states that Mr. Clapcott, Borough Engineer of Napier, informed him that local quarries near the Bluff were supplying the Council with spalls at 4s. 6d. per yard. Mr. Furkert considers that even if stone had to be brought fifty miles by water the cost would not exceed 12s. per cubic yard.

Mr. Furkert suggests that there is no necessity to construct this mole to a greater height than 2 ft. 6 in. above high water. See his evidence, page 526. This will reduce the quantity required to 140,000 solid cubic yards, which at his estimate of £85,000 equals 12s. 0·14d., which agrees very closely with his unit price of 12s. as per his evidence, page 375.

Messrs. Hay and Rochfort estimate the cost of stone from the Lighthouse Reserve at 4s. (see Exhibit 46, page 2). Mr. J. P. Kenny, Secretary to the Board, in Exhibit 155, gives the cost of rubble as 5s. 6d. per cubic yard. Adopting Messrs Hay and Rochfort's estimate that 20 per cent. of the bluff at the Lighthouse Reserve would be stone (see Exhibit 46, page 2), and also that the height of the bluff at the base of the breakwater is 300 ft., about 2 acres would be required to supply the 180,000 cubic yards of stone required, and the surplus spoil would almost complete the reclamation of the North and South Ponds, which, per Hay and Rochfort, require 815,000 cubic yards.

The cubic yards in 2 acres, 300 ft. deep, equal 968,000. 180,000 cubic yards required for the moles leave 788,000 for reclamation purposes. As 2 acres can readily be made available on the outskirts of the Bluff Reserve, and as the foundations for the present breakwater were obtained from this source, I see no adequate reason for looking elsewhere for the stone required for the construction of the west mole. After allowing for all contingencies, such as somewhat confined working-space, and the selection and reserving of the larger stones for the western face of the mole, I am of the opinion that 10s. a yard is an ample price to allow for obtaining the stone required and placing it in the mole. My estimate for this portion of the work 6 ft. above high water, as designed by Cullen and Keele, is therefore £90,000. In the event of its being decided to adopt Mr. Furkert's suggestion of reducing the height to 2 ft. 6 in. above high water, the estimated cost could be reduced to £70,000.

I note that in Mr. J. D. Holmes's detail of estimate of his £330,000 for the mole he provides for the expenditure of £225,000 for a concrete apron, for which I can see no justification, as the whole of this mole on the lee side of the breakwater is well protected from the heaviest seas.

Extension of Breakwater.

In regard to Mr. J. D. Holmes's estimate for the extension of the breakwater at £386,800 he gives the following details:—

	£
Breakwater extension, 1,550 lineal feet (at present level)—	
Concrete in cap: 43,000 cubic yards at £2 15s.	118,000
Concrete in blocks: 72,000 cubic yards at £2 15s.	198,000
Rubble in foundation: 59,000 cubic yards at £1	59,000
20 per cent. allowance for loss: 11,800 cubic yards at £1	11,800
	£386,800

In the first place, I do not agree with the quantities adopted by Mr. Holmes. I estimate that to extend the breakwater 1,550 ft., with concrete cap and blocks and ballast foundation, the following materials are required: Concrete cap to breakwater, 20,000 cubic yards; concrete blocks in breakwater, 42,000 cubic yards; concrete blocks, wave-breaker, 18,000 cubic yards; ballast foundation, 45,000 cubic yards.

The next question is as to why Mr. Holmes should adopt £2 15s. a cubic yard as the unit price of his concrete, when the Board's Secretary gives the actual price of concrete as made by the Board's employees with their existing plant at £1 8s. 6½d. per cubic yard (see Exhibit 155), or placed in position £1 11s. 0½d. See Mr. Furkert's evidence, page 373. To justify his price Mr. Holmes referred to tenders which had recently been received by the Board, the lowest price price being £2 18s. 9d.; also, to support Mr. Holmes's estimate, the Board tendered the evidence of several contractors, whose prices for concrete placed in the moulds ranged from £1 19s. 6d. per cubic yard to £2 4s. 11d. Dealing in detail with the price of £2 4s. 11d. per yard, it is made up as follows (cost of cement in store, £5 14s. per ton): Shingle, 4s. 3d. per cubic yard of

concrete; sand, 3s.; cement, £1 2s. 2d.; mixing and placing in moulds, 4s.; erection of moulds, 2s. 6d.; cost of plant, 4s.; overhead, 5s.: total, £2 4s. 11d.

I would point out that under the Harbour Board's specification (page 33) the sand and gravel required would be supplied by the Board at the cost to the contractor of 3s. per cubic yard. To comply with the specification for a 1-2¼-5 mix the materials required would be—Cement, 1·22 barrels; sand, 0·40 cubic yards; shingle, 0·90 cubic yards. The sand and gravel would therefore cost the contractor 1·3 × 3s. = 3·9s., or say 4s. per cubic yard of concrete, as against the 7s. 3d. included in the price of £2 4s. 11d. Taking the cement at £5 14s. per ton, and assuming that six casks go to 1 ton, the cost per cask equals 19s. and the cement required £1 3s. 2d.

In Exhibit 173 Mr. Kenny shows that two drivers and about ten labourers are required to operate the Board's mixing plant, fill the moulds, and place the spalls. Allowing £1 per day for driver and 16s. for labourer, and that the output is 83 yards per day, as shown in Exhibit 173, the cost of labour per yard is 2s. 4·9d., and not 4s. as included in the price of £2 4s. 11d. It should be noted that the price of 2s. 4·9d. includes fixing moulds and placing spalls. This eliminates a further item of 2s. 6d. per yard included by the contractor. In reference to the 4s. included in the £2 4s. 11d. for cost of plant, I would point out that the Board specify in their printed conditions that the plant required for the completion of the breakwater will be hired to the contractor at the following rates: Browning crane—4 hours or less £1 5s.; eight hours or less, £2 10s.; sixteen hours or less, £3 15s.: concrete-mixer, 10s. per day: steam winch and boiler, 15s. per day: dredge "J.O.D.," £2 per hour. The total quantity of concrete required is—concrete in cap, 20,000 cubic yards; concrete in blocks, 42,000 cubic yards; concrete in wave-breaker, 18,000 cubic yards: Total, 80,000 cubic yards. An output of 83 yards per day, $\frac{80000}{83} = 964$.

The only items which can be properly charged to concrete mixing and placing are the concrete-mixer, and possibly the steam winch and boiler. Presuming that these would be required for the whole of the 964 days, the cost to the contractors would be £1,205 ÷ 80,000 = 3·61d. However, to cover the cost of repairs to moulds, &c., we include 1s., as against the 4s. included in the cost of £2 4s. 11d. It is interesting to note that the estimate of 4s. for plant in 80,000 cubic yards would give the contractors a gross return of £16,000. Including overhead, my estimate of the cost of a cubic yard of concrete in the moulds, is—

	£	s.	d.
Shingle and sand	0	4	0
Cement	1	3	2
Mixing, erecting moulds, cleaning moulds, placing concrete and spalls	0	2	5
Hire of plant	0	1	0
	1	10	7
Overhead and insurance, 10 per cent.	0	1	5
	1	12	0
Less 20 per cent. for spalls	0	6	4·8
	1	5	7·2
Spalls at 5s. 6d. per yard at 20 per cent.	0	1	1·2
	1	6	8·4
Contingencies allowance	0	2	3·6
Per cubic yard	£1	9	0

Allowing 2s. 6d. per cubic yard for placing, Mr. J. D. Holmes's price, in moulds, would be £2 12s. 6d. per cubic yard; contractor's price, £2 4s. 11d.; Mr. Furkert's price, £1 10s.; Mr. Kenny's price, £1 8s. 6½d.: A. C. Mackenzie, £1 9s.

Adopting my own quantities and a rate of, say, £1 10s., I estimate the cost of extending the breakwater at

	£
Concrete in cap: 20,000 cubic yards at £1 10s.	30,000
Concrete in blocks in position: 42,000 cubic yards at £1 12s. 6d. ..	68,250
Concrete blocks in wave-breaker: 18,000 cubic yards at £1 12s. 6d. ..	29,250
Rubble foundation: 45,000 cubic yards at 12s.	27,000
	£154,500

As against Mr. J. D. Holmes's £386,800.

Wharf Construction and Improvements.

Messrs. Cullen and Keele's recommendation is for one wharf 600 ft. by 187 ft., with two cargo-sheds 350 ft. by 35 ft. Messrs. Cullen and Keele estimate the cost of wharf and cargo-sheds at about £97 per 100 square feet of wharf area, and Mr. Furkert at £100 per 100 square feet of wharf area; Mr. J. D. Holmes at about £162 per 100 square feet of wharf area. In my estimate I have adopted £120 per 100 square feet of wharf area, which also covers the cost of two sheds as recommended by Messrs. Cullen and Keele. The high price included by Mr. Holmes is probably due to his having adhered to the contract price for concrete already quoted.

Wharf and cargo-sheds, 600 × 187 = 1,122 squares at £120 = £134,640.

Cranes.

Four cranes are provided for in Mr. Holme's estimate. Messrs. Cullen and Keele and Mr. Furkert did not provide for same. However, if they are necessary at the Inner Harbour, it appears to me that they are necessary at the breakwater, so I provide £4,000 for this item.

Reclamation.

For Messrs. Cullen and Keele, to provide 3½ acres, £3,985; Mr. Furkert provides acres, £10,000; Mr. J. D. Holmes provides for 22½ acres, £12,000. As I see no purpose in spending capital in reclaiming land at the breakwater until it is required, I adhere to Messrs. Cullen and Keele's area of 3½ acres, which are required for a convenient approach to the wharves. The sea face would consist of a ballast mole, which I estimate will cost £6,000.

Dredging.

As I have estimated the dredging for the Inner Harbour for the requirements of vessels drawing 26 ft., and in that case allowed for a depth at the berths of 30 ft. and in the basin 26 ft., I am allowing in the case of the breakwater for a depth at the berths and in the swinging-basin at 31 ft. throughout. I estimate the quantity to be removed as 384,000 cubic yards, which at 1s. 3d. equals £24,000.

Auckland Rock, removal to 34 ft.; As there is no sufficient information available to check the quantities, I include the amount provided by Mr. Holmes—£10,900.

Removal other rock to, say, 21 ft., £2,750.

Breakwater Extension, £154,500; west mole, £90,000; wharf and sheds, £134,640; cranes, £4,000; reclamation mole, £6,000; dredging, £24,000; removing part of Auckland Rock, £10,900; removing other rock, £2,750; contingencies at 5 per cent., £21,340: total, £448,130.

A comparison of the estimates for the completion of the Breakwater Harbour are:—

	£
Cullen and Keele (23rd November, 1925)—	
Including one new wharf	393,082
Including two new wharves	511,009
F. W. Furkert (23rd August, 1927)—	
Including one wharf	400,000
Including one wharf (safe estimate)	450,000
J. D. Holmes—	
Including one wharf	973,000
Including one wharf and additional dredging to 31 ft.	985,800
Including one wharf and raising breakwater 10 ft.	1,208,800
A. C. Mackenzie (29th September, 1927)—	
Including one wharf	448,130

In regard to plant required, the items included in Messrs. Cullen and Keele's 1925 estimate are as follows: Hopper dredge, £65,000; two steam rock-drills, £5,000: total £70,000.

I would point out that the reclamation of the North and South Ponds would not require any pipe-line, power-house, or motors and pumps for boosting, as provided in Messrs. Cullen and Keele's estimates for the Inner Harbour, as the surplus material excavated from the Bluff in obtaining the stone required for the mole, foundations for breakwater, and reclamation moles would be deposited from trucks.

In regard to a dredge, I estimate the material to be removed at 384,000 cubic yards. This quantity would not fully employ a dredge such as the "Kaione" for twelve months' dredging, including pumping on shore, so the Board's obvious policy would be to hire a suitable dredge, for which in my unit cost, I have provided, over and above Mr. J. D. Holme's estimate for operating the dredge; a sum of £8,065 per year, a portion of which will provide for hire. As this work when once completed would not necessitate an expensive dredge forming part of the Board's permanent plant, I do not make any provision in my estimates for maintenance for a sea-going suction or bucket dredge. As it is possible that some maintenance dredging will be required after completion of the Breakwater Harbour, and for the purchase of one rock-drilling plant, I provide a sum of £20,000, which, plus the sale price of the "J.D.O.," should be sufficient to purchase a larger second-hand grab dredge and drilling plant. In estimating the annual overhead charges I have adopted similar rates to those I used in connection with the Inner Harbour. I have provided for the hire of dredges, including interest and depreciation, under the unit cost of dredging. As the Board already have the plant required for the construction of the breakwater, the annual additional charge will be—

	£
Dredging—	
Maintenance: 24,000 yards at 3¾ per cent.	900
Net plant, interest, sinking fund, and general: £20,000 at 7 per cent.	1,400
	2,300
Breakwater, mole, wharf, &c.: £448,130 at 10¼ per cent.	45,933
	£48,233

TABLE J.—SHORT SUMMARY OF NAVIGATION EXPERTS' EVIDENCE.

Witness.	Inner Harbour.	Breakwater Harbour.
W. H. Hartman, master s.s. "Tamaroa." Trading to New Zealand for past twenty-seven years. (See Evidence, pages 112, 113, 114, 115, 116, and 117.)	With big vessel would wait for slack water before navigating channel; tug necessary at flood and ebb tides, and possibly at slack water; harbour safe; velocity of current no detriment; when entering subjected to beam sea and wind; if strong wind or heavy sea would wait outside or inside; consider range would not be increased by widening channel between moles; subsequently considered would be increased	No difficulty in navigating; enter head-on in easterly weather; prefer breakwater; 1,300 ft. swinging-basin sufficient; tug required; safe harbour; vessel would not lay so steady; bound to get range, which will be less when harbour completed; owners will not allow him to use present unfinished Breakwater Harbour.
S. A. Chatfield, master s.s. "Kaituna." Trading here a good deal. (Pages 118, 119, and 120.)	No difficulty in bringing the "Kaituna," drawing 17 ft. 6 in., into the present Inner Harbour at high water; velocity of current between moles, 6 to 7 knots	Never had to leave breakwater; have been there several times.
W. Waller, Harbourmaster, New Plymouth. Experience since 1874; a great deal of experience on this coast. (Pages 121, 122, and 123.)	Would wait for slack water before navigating proposed channel; would not work proposed channel at night; proposed Inner Harbour more sheltered than Breakwater Harbour; current at end of moles would tend to deflect vessel's course; beam sea would tend to force vessel on to side of channel	Worked present breakwater for five years; never had to leave owing to bad weather; consider there would be no difficulty in entering harbour when completed.
L. C. H. Worrall, captain; retired from Union Steamship Co. Retired twelve months ago; experience since 1876. (Pages 123, 124, and 125.)	In big seas would not attempt to take large vessel in, even with tug; considers it would not be advisable to work channel at night; a tug would be required in calm weather; the current at end of moles would deflect vessel	Worked breakwater; never had trouble; have been alongside in S.E. seas; never had to go past breakwater; thinks complete harbour would be a success; Breakwater Harbour decidedly safer; no trouble from range.
A. M. Edwin, master, coastal pilot. Been at sea thirty-six years; worked Napier weekly for two years. (Pages 125, 126, and 127.)	Difficult to navigate entrance to Inner Harbour; could only work it at slack water once in twenty-four hours; a tug would be required	Worked breakwater; occasionally broke things up (springs); stayed in all weather; prefers Breakwater; can enter and leave at any state of tide; when swell too big worked under lee of breakwater.
H. Collins, Harbourmaster, Nelson. Twenty years Harbourmaster at Nelson; before that 2nd and 3rd officer Union Steamship Co. (Pages 127, 128, 129, 130, 131, 132, and 133.)	Entrance quite safe with moderate breeze; channel could be worked at night; no tug required; prefers Inner Harbour; 7-knot current dangerous; 2 to 3 knots not dangerous; currents caused by tide-deflector increase risk; always be a certain amount of range	Swinging-basin 1,300 ft. big enough; considers height of breakwater not sufficient.
H. White-Parsons, Harbourmaster, Napier. Harbourmaster at Napier for thirteen years; total of thirty-five years' experience at sea. (Pages 167, 168, 170, 171, 172, 173, 174, 175, and 176.)	Would bring vessels in at high and low water slack; doubts if channel could be worked at night; a tug would be required; beam sea and wind; would not take vessel in if there was a range; considerable range in harbour at present	During thirteen years as Harbourmaster have not had an accident; when harbour completed no difficulty in entering during reasonable N.E. weather; only 3 per cent. per year have had to leave owing to bad weather; during strong easterlies easier to enter breakwater; during heaviest seas, range at present from 3 ft. to 3 ft. 6 in., then not safe to berth; if completed, consider it would be satisfactory in every respect; in all but abnormal weather no difficulty in entering. Maximum draught of vessel berthed to date, 26 ft. 3 in.; if harbour completed as proposed, no necessity for vessels to leave breakwater owing to bad weather; by using the breakwater considers saving to vessel, as against working the roadstead, up to 40 per cent.
H. Brown, master of s.s. "Port Melbourne," 12,450 tons. Trading to Napier since 1904. (Pages 206, 207, 208, 209, and 210.)	In ordinary weather no difficulty in working proposed channel; would work in moonlight; would require a tug; prefers the more sheltered aspect	His owners will not allow him to use the present Breakwater Harbour; he would require a tug; Breakwater Harbour more easily affected by bad weather.
T. H. Chudley, marine superintendent, Shaw, Savill, and Albion Co. At sea actually thirty years, ashore thirteen years; holds master's certificate; trading to New Zealand since 1891. (Pages 223, 224, 225, and 226.)	Doubtful; could only be worked at top of high water, and then would require smooth water and no more than moderate breeze; would require two tugs; heavy swell would cause vessel to roll and draw extra 2 ft.; prefer lightering in bay to entering proposed Inner Harbour or completed Breakwater Harbour	Could use breakwater Harbour at any state of the tide; entrance satisfactory considering prevailing winds; swinging-basin 1,300 ft. satisfactory; sees no reason why ocean-going vessels should not use Breakwater Harbour when completed; of the two completed harbours, prefers Breakwater, but would prefer lightering in bay to using either.

TABLE J.—SHORT SUMMARY OF NAVIGATION EXPERTS' EVIDENCE—*continued.*

Witness.	Inner Harbour.	Breakwater Harbour.
Wybrant Olphert, marine superintendent, N.Z. Shipping Co. Thirty-six years' experience with N.Z. Shipping Co.; prior to present appointment in command. (Pages 229, 230, and 231.)	Does not like proposed channel; considers 600 ft. too narrow; would not work channel at night; channel would only be used once per day; considers the use of a tug the first essential	Considers breakwater entrance easier and safer to work; does not consider tug would be required; not much in favour of either harbour.
R. J. Foster, marine superintendent, Union Steamship Co. Thirty years at sea and seven ashore; great deal of experience with Napier. (Pages 232 and 233.)	Would not care to work channel unless under perfect conditions, not at night; would not like to bring Union Co. vessels in under any condition	Had worked Breakwater Harbour a lot, and never had to put to sea owing to range, &c.; sometimes it was hard to hang on; prefers breakwater, as easier means of escape in bad weather.
H. Hollis, marine superintendent, Commonwealth and Dominion Co. Master for line 1902–16; at sea since 1889; frequently in port of Napier. (Pages 334, 335, 336, 337, 338, and 339.)	Considers navigating proposed channel safe at H.W. slack if moderate wind, not too much sea; would not work channel at night; would require one tug. During August, 1927, vessels could only enter once per day on twenty-seven days and twice on four days	Once vessels inside completed harbour very good indeed; his company's vessels do not use the present Breakwater Harbour; when harbour completed range will be reduced; range is not caused by seas if they come over the breakwater.

TABLE K.—PLANS AND MAPS COMPRISED IN COMMISSION'S EXHIBIT No. 3.

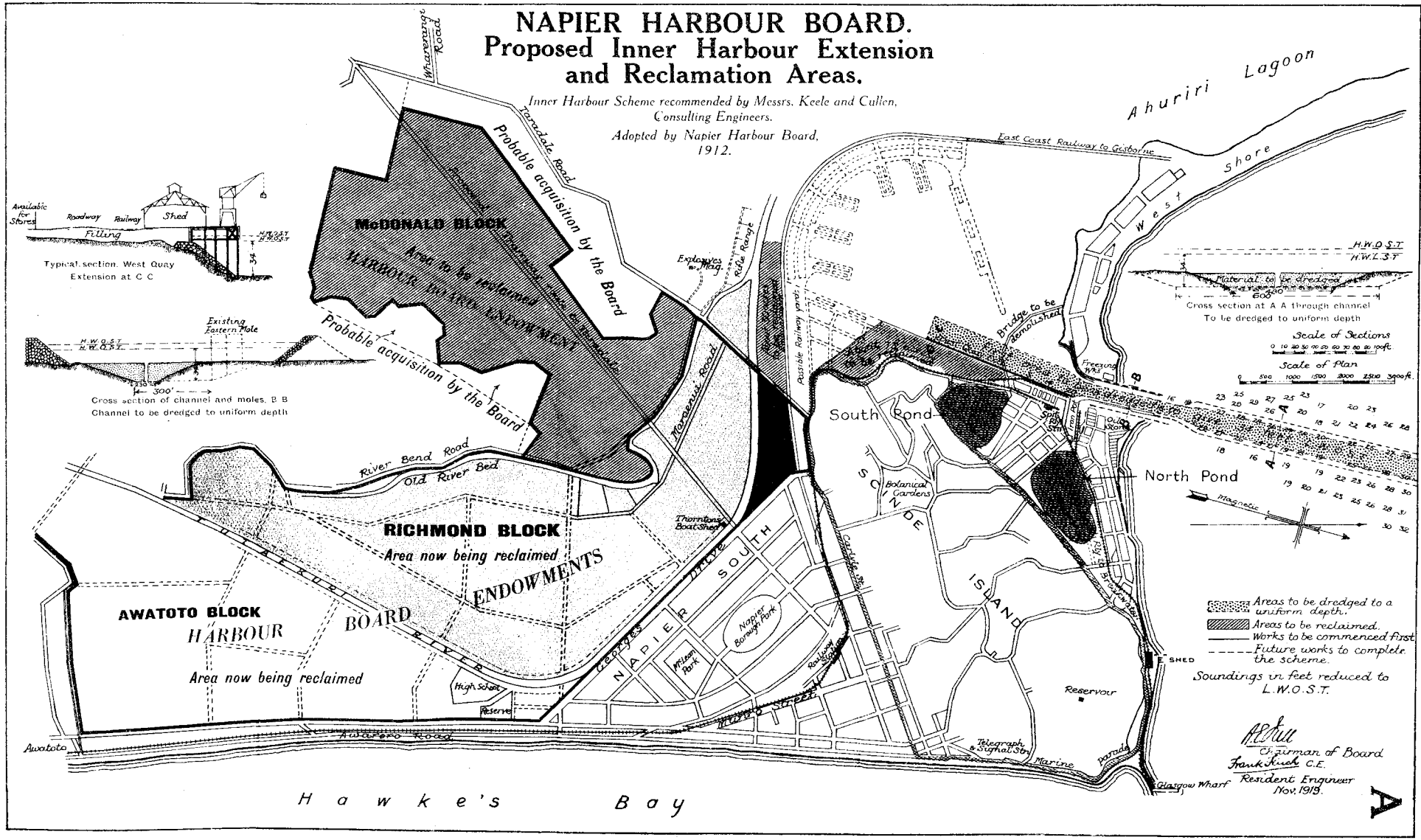
(*a*) Litho plan of Napier Harbour and reclamation areas.
(*b*) Litho from Furkert's report.
(*c*) Locality-map, Napier—Kidnappers to Whakariri.
(*d*) 1855 to 1927—Five contour plans.
(*e*) Cross-sectional plan based on Plans D1855 to D1927.
(*f*) Sectional depths and sea-bottom, 1880 to 1925.
(*g*) Plan of Colon Harbour.
(*h*) Plan of Napier Harbour.
(*i*) Map of trading-area of Napier Harbour Board District (by Chamber of Commerce).
(*j*) Holmes 1906–27 soundings in red and black.
(*k*) Photograph of breakwater.
(*l*) Cullen and Keele's plan, 1925.
(*m*) Plan M.D. 5652. Plan of proposed dredging by Browning crane.
(*n*) Plan of soundings, "Whakarire," 10-acre patch, 1911.
(*o*) Longitudinal section through 10-acre patch.
(*p*) Relative tidal diagram, Inner Harbour and outer bay.
(*q*) Plan showing comparative contours at West Shore, indicating erosion.
(*r*) Plan, Napier Harbour Board reserves.

Approximate Cost of Paper.—Preparation, not given; printing (550 copies), £90.

By Authority: W. A. G. SKINNER, Government Printer, Wellington.—1927.

Price 1s. 6d.]

TABLE I.—SHORT SERVICE OF XANTHOS TYPES: RUNNING TIMES.


NAPIER HARBOUR BOARD.
Proposed Inner Harbour Extension and Reclamation Areas.
Inner Harbour Scheme recommended by Messrs. Keele and Cullen, Consulting Engineers.
Adopted by Napier Harbour Board, 1912.
Marewa Road
Taradale Road
Probable acquisition by the Board
McDONALD BLOCK
Area to be reclaimed
HARBOUR ENDOWMENTS
Probable acquisition by the Board
Existing Eastern Mole
300'
Cross section of channel and moles. B B
Channel to be dredged to uniform depth
Available for Stores
Roadway
Railway
Shed
Filling
Typical section. West Quay Extension at C C
Explosives Mag.
Ride Range
Marewa Road
River Bend Road
Old River Bed
RICHMOND BLOCK
Area now being reclaimed
ENDOWMENTS
AWATOTO BLOCK
HARBOUR
BOARD
Area now being reclaimed
Thorntons Boat Shed
Botanical Gardens
Napier Borough Park
Wilson Park
High School Reserve
Tennyson Street
Awatoto Road
Awatoto
Hawke's Bay
East Coast Railway to Gisborne
Ahuriri Lagoon
West Shore
Bridge to be demolished
South Pond
North Pond
Freezing Wks
Oil Stores
Reservoir
Telegraph & Signal Stn
Marine Parade
Glasgow Wharf
Material to be dredged
Cross section at A A through channel
To be dredged to uniform depth
Scale of Sections
Scale of Plan
Areas to be dredged to a uniform depth.
Areas to be reclaimed.
Works to be commenced first
Future works to complete the scheme.
Soundings in feet reduced to L.W.O.S.T.
Chairman of Board
Resident Engineer
Nov. 1919.
A

A

B
NAPIER HARBOUR
PLAN SHOWING
PROPOSED COMPLETION
OF
BREAKWATER HARBOUR
(ACCOMPANYING MR. FURKERT'S REPORT)
SCALE OF FEET
0
500
1000
1500
2000
2500
AHURIRI
ROADSTEAD
SCINDE ISLAND
Approximate Sailing Course
Direction of Heaviest Seas
Auckland Rock
To Perio Bluff N 16° E from Napier Bluff 2½m
End of Existing Breakwater
Dotted lines indicate Outline of Breakwater as proposed by Messrs Kinnear & Cullum 23/8/1912
SWINGING BASIN
SIGNAL STATION
PROPOSED GOODS SORTING YARD FOR NEW RECLAMATION
INNER HARBOUR
IRON POT
35 Contour
10 Contour

SCIENCE ISLAND
SUBURBAN
COMMUTATION
SUBURBAN
HARBOUR

HAWKE BAY

W

K

C

Scale of Miles
1 ½ 0 1 2 Miles

D—1

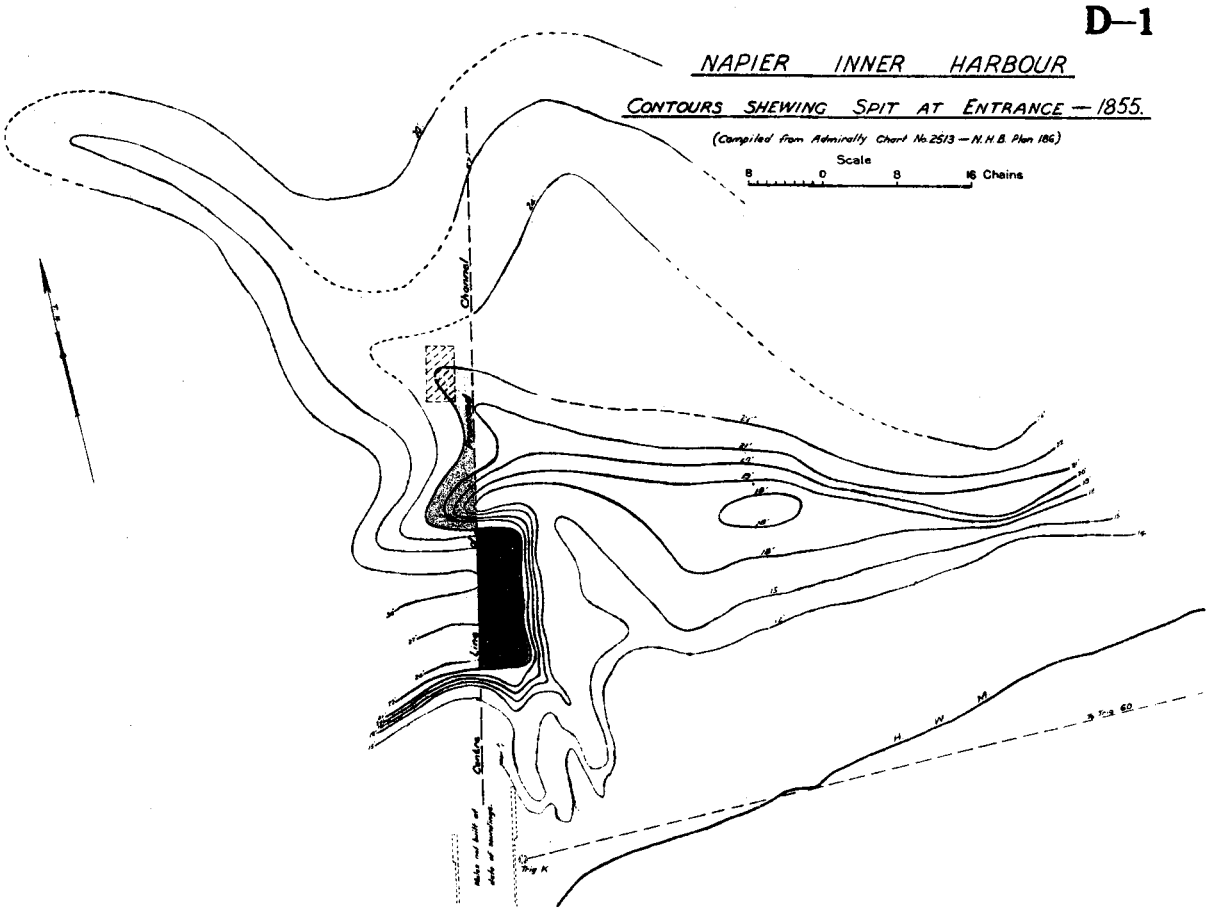
NAPIER INNER HARBOUR

CONTOURS SHEWING SPIT AT ENTRANCE — 1855.

(Compiled from Admiralty Chart No. 2513 — N.H.B. Plan 186)

Scale

8 0 8 16 Chains



D—2

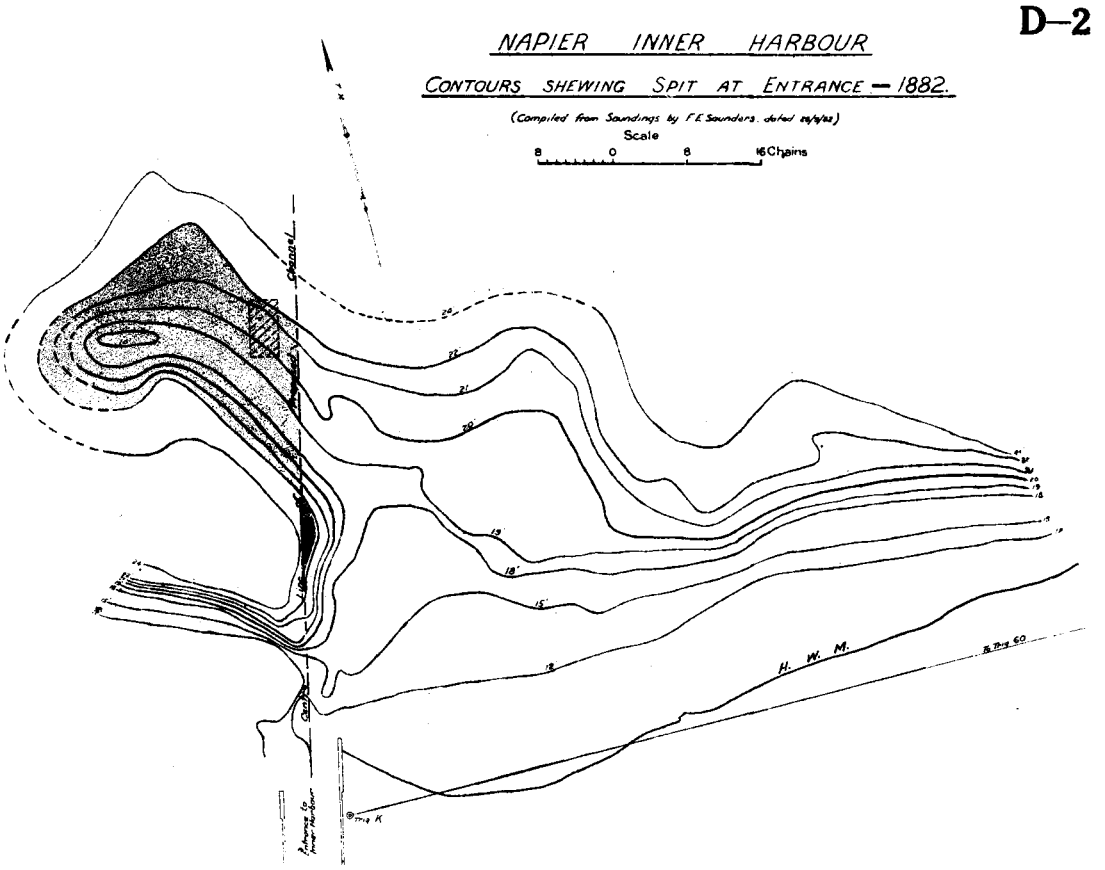
NAPIER INNER HARBOUR

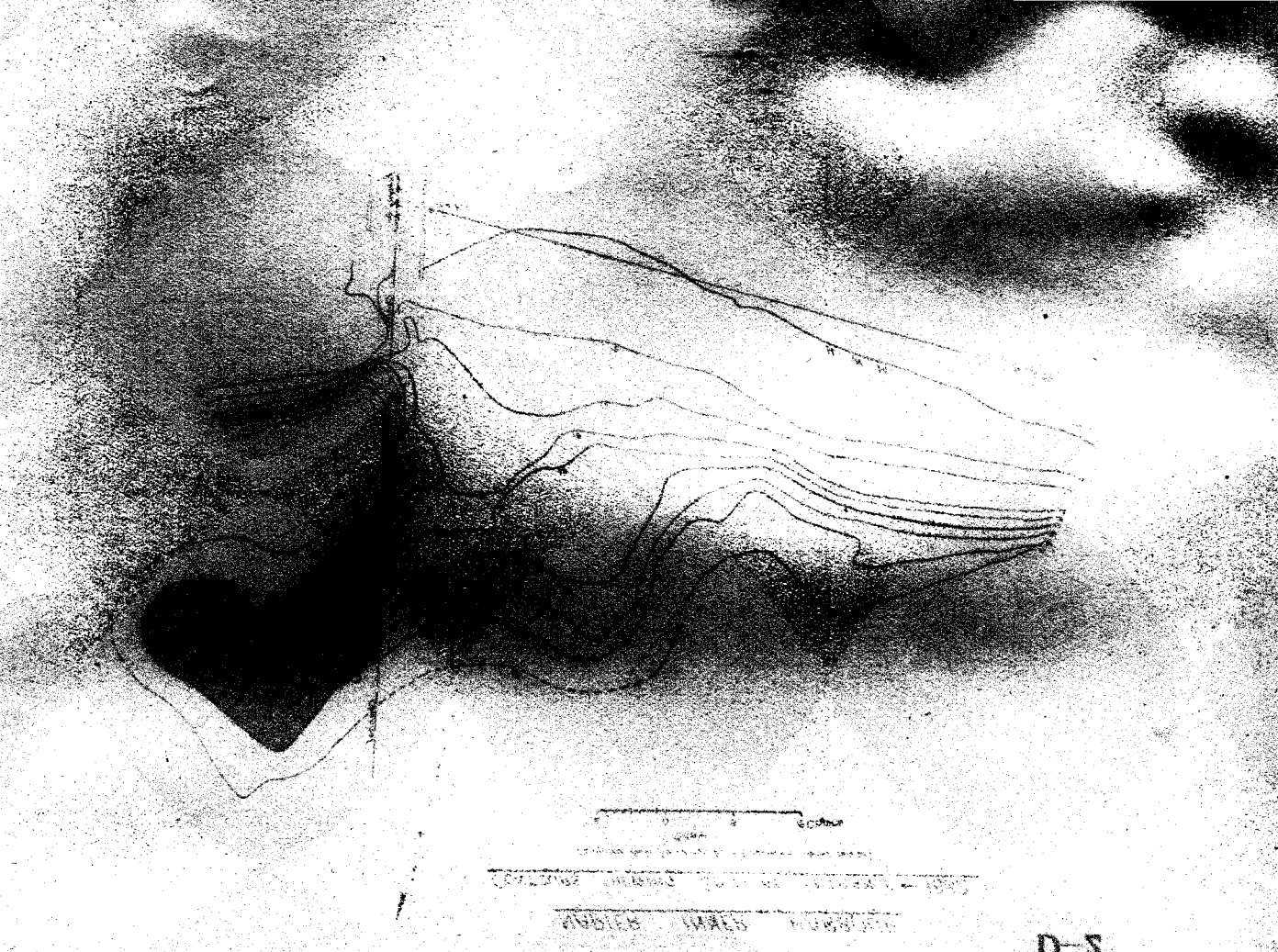
CONTOURS SHEWING SPIT AT ENTRANCE — 1882.

(Compiled from Soundings by F.E. Saunders, dated 10/9/82)

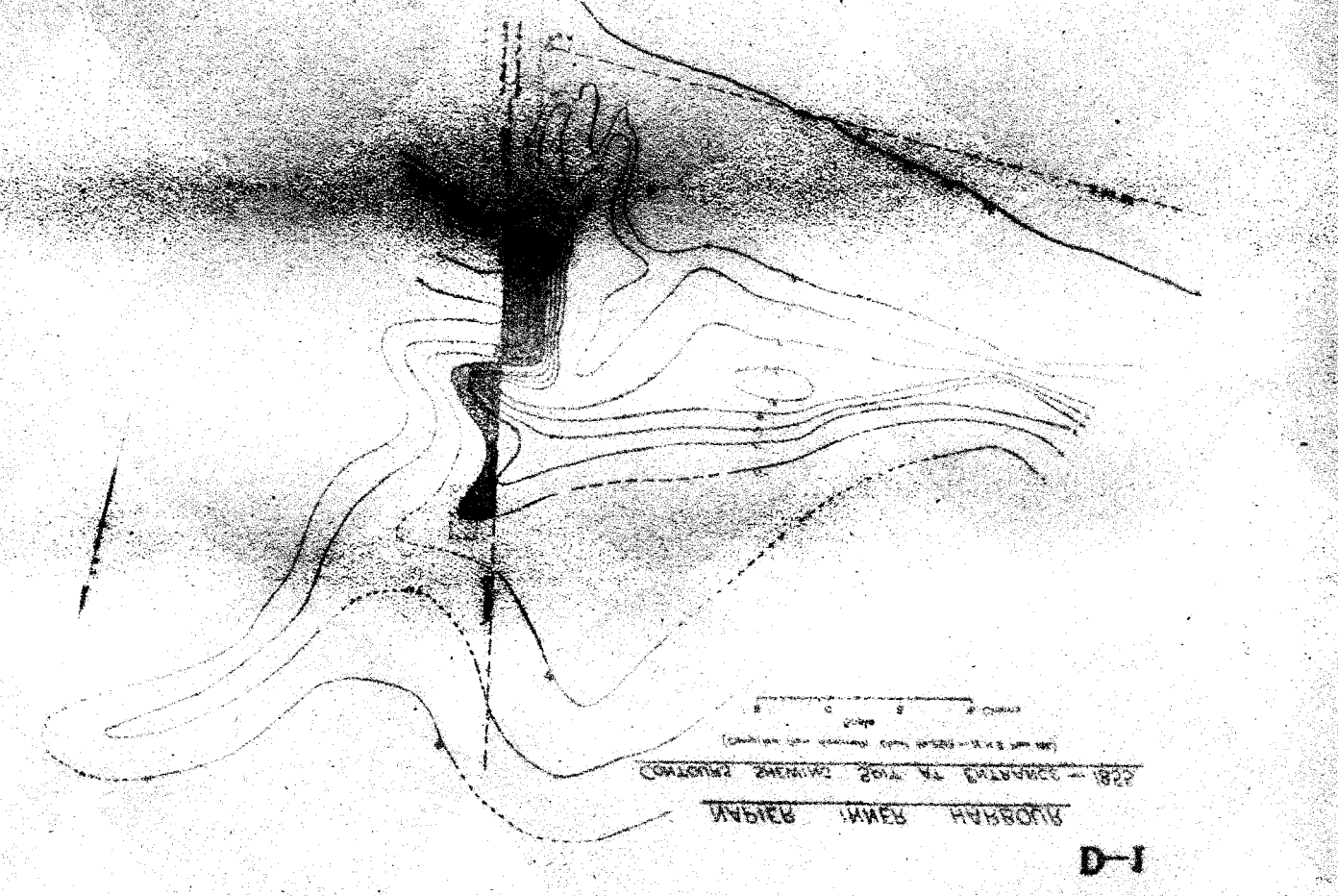
Scale

8 0 8 16 Chains



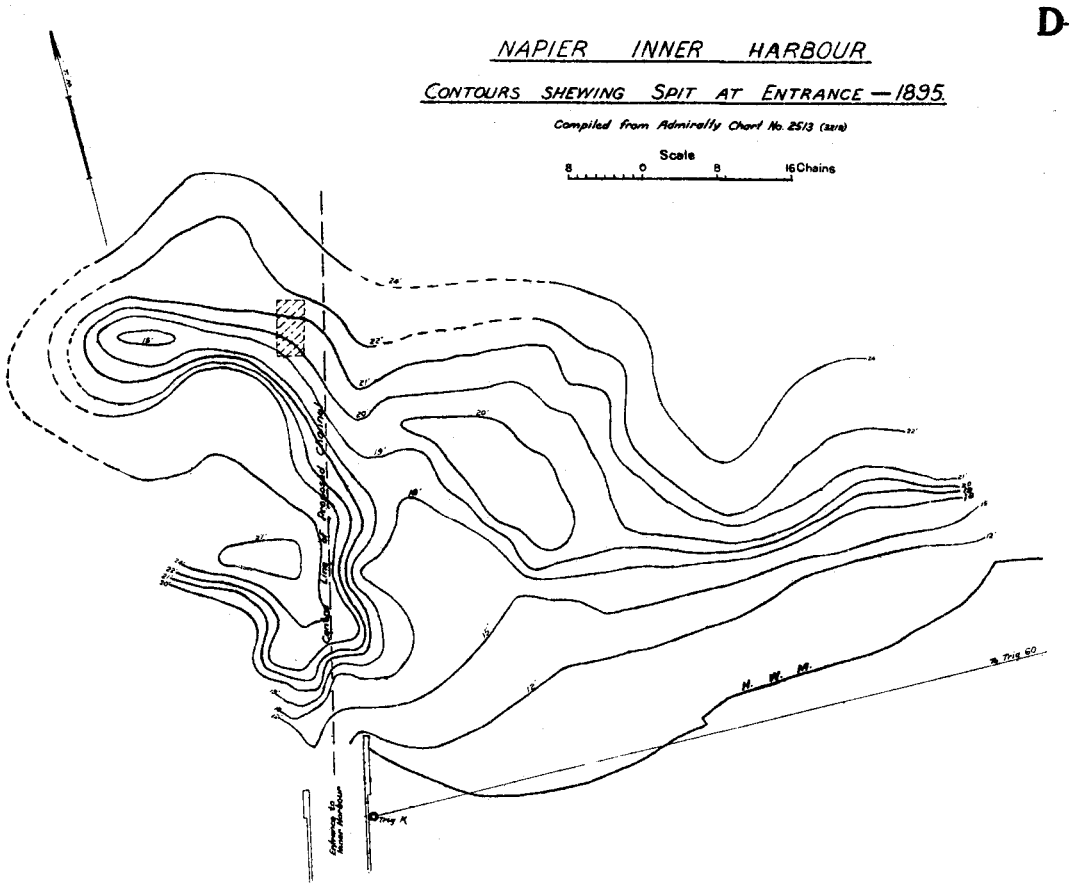


D–S

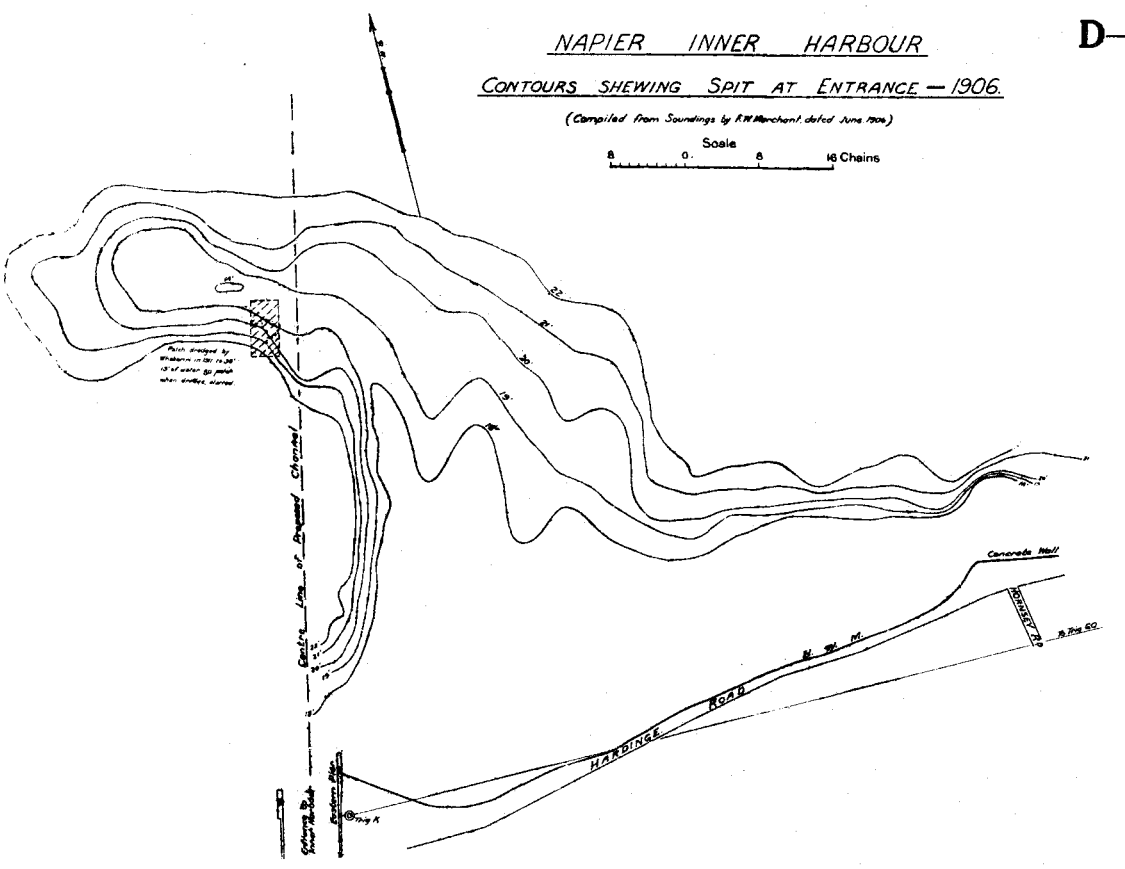


D–1

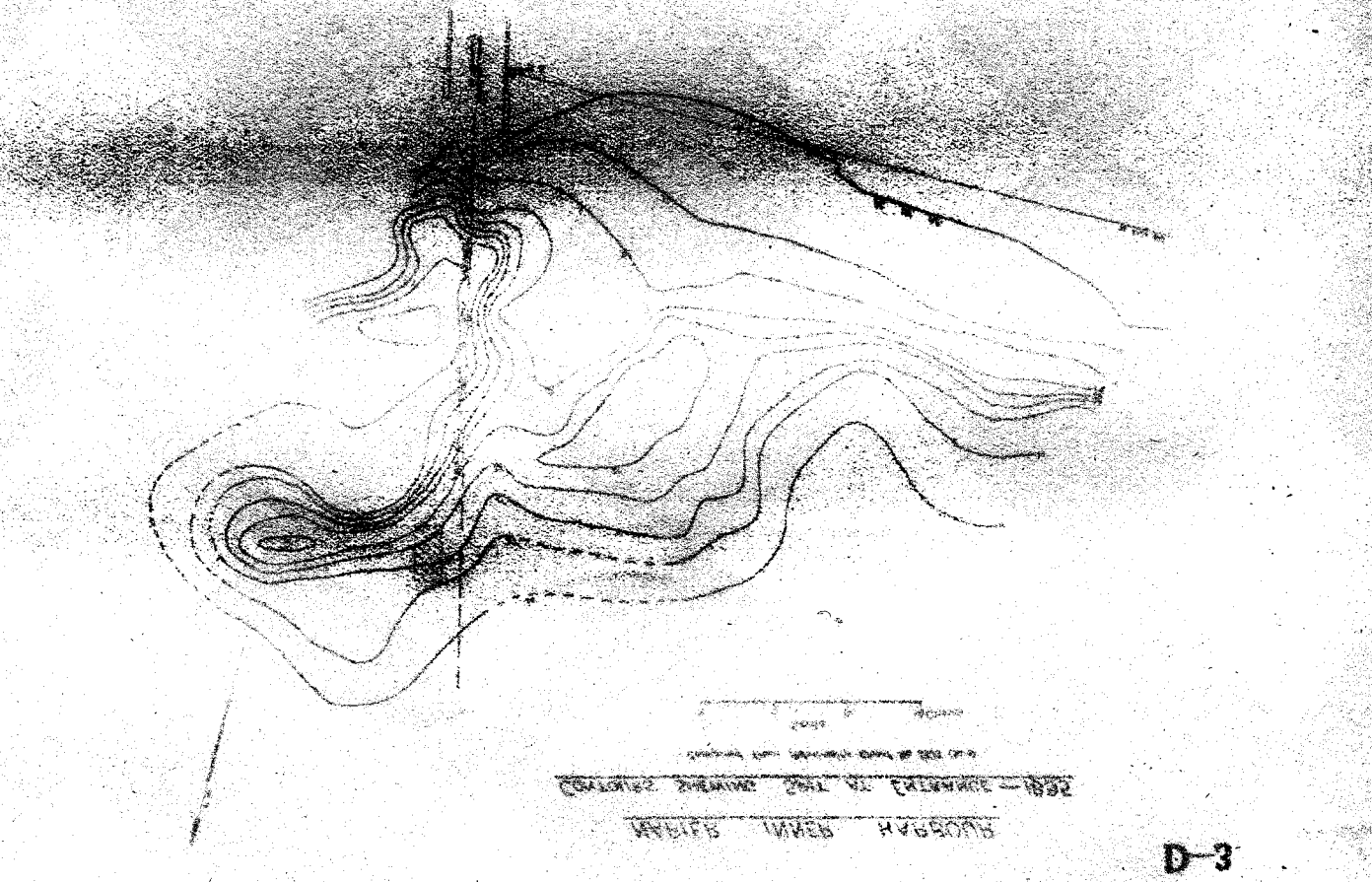
D–3


NAPIER INNER HARBOUR
CONTOURS SHEWING SPIT AT ENTRANCE — 1895.
Compiled from Admiralty Chart No. 2513 (1918)
Scale
8 0 8 16 Chains
Centre Line of Proposed Channel
Entrance to Inner Harbour
Trig A
H. W. M.
To Trig 60

D–4


NAPIER INNER HARBOUR
CONTOURS SHEWING SPIT AT ENTRANCE — 1906.
(Compiled from Soundings by R.W. Marchant, dated June 1906.)
Scale
8 0 8 16 Chains
Centre Line of Proposed Channel
Entrance to Inner Harbour
Trig A
Concrete Wall
HARDINGE ROAD
H. W. M.
To Trig 60

D–4



D–3

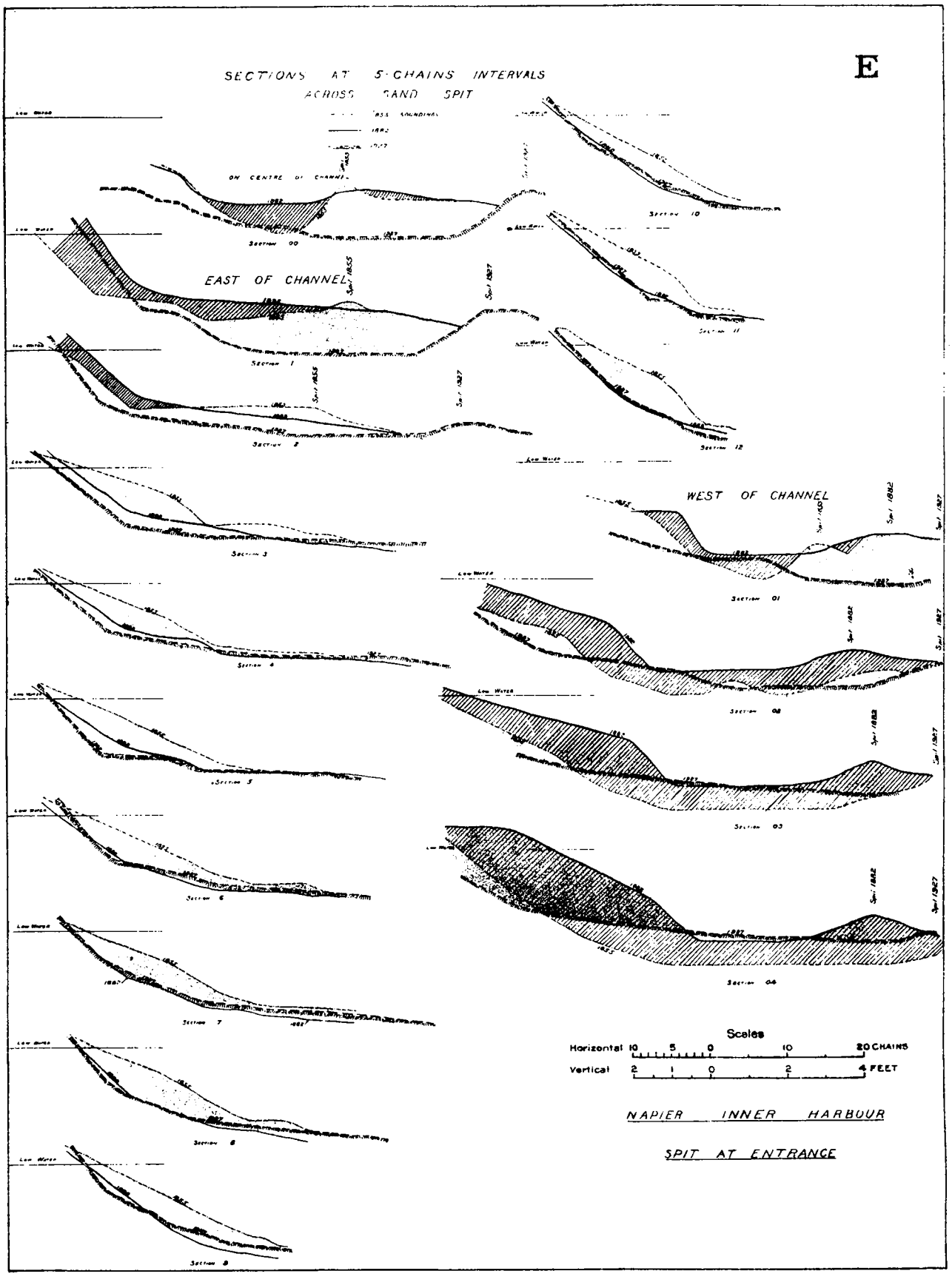
D—5

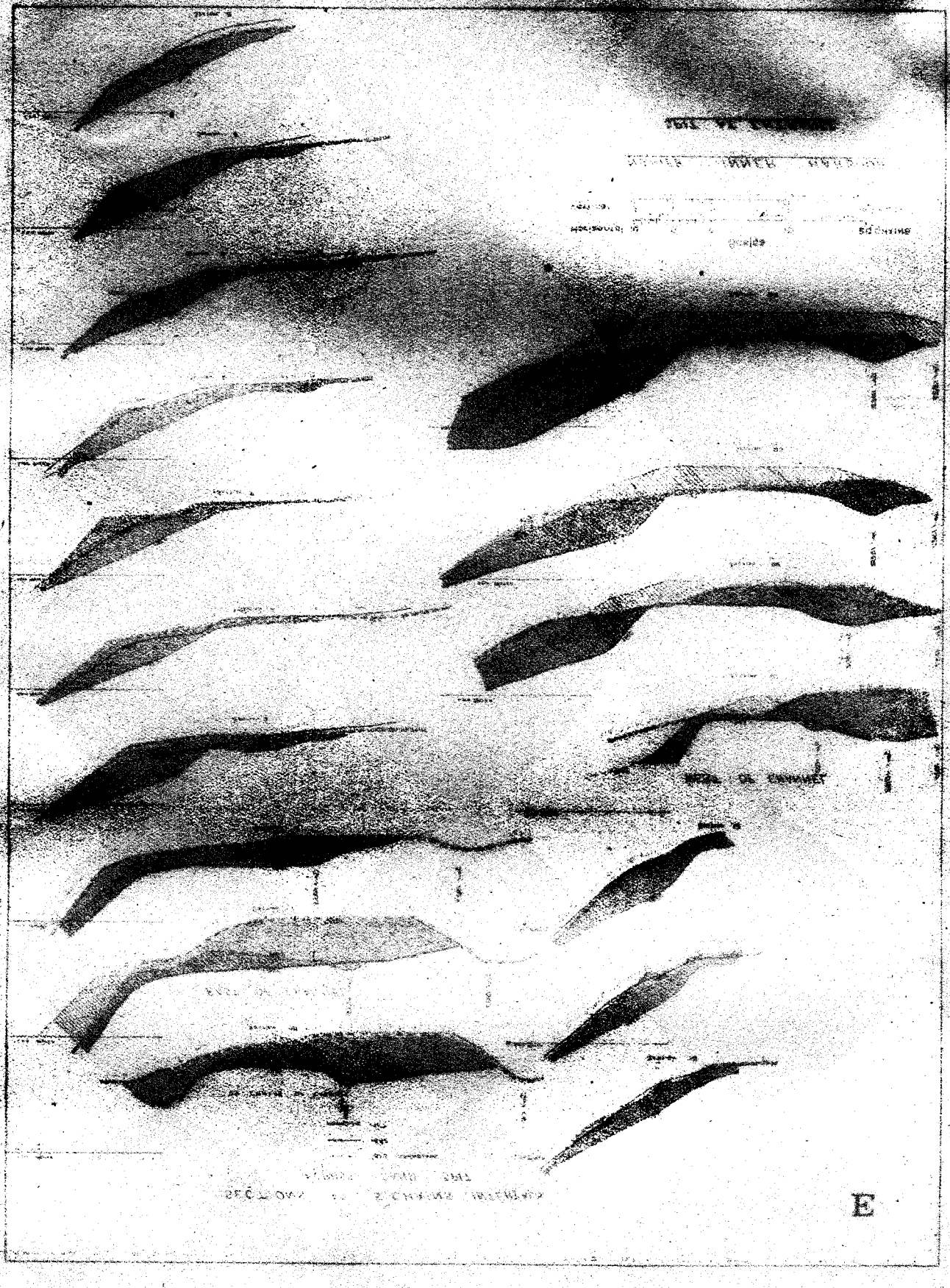
NAPIER INNER HARBOUR

CONTOURS SHEWING SPIT AT ENTRANCE — 1927.

(Compiled from Plan by R.W. Holmes & Son, dated 17/2/27)

Scale 8 0 8 16 Chains


E
SECTIONS AT 5 CHAINS INTERVALS
ACROSS SAND SPIT
EAST OF CHANNEL
WEST OF CHANNEL
Scales
Horizontal 10 5 0 10 20 CHAINS
Vertical 2 1 0 2 4 FEET
NAPIER INNER HARBOUR
SPIT AT ENTRANCE



E

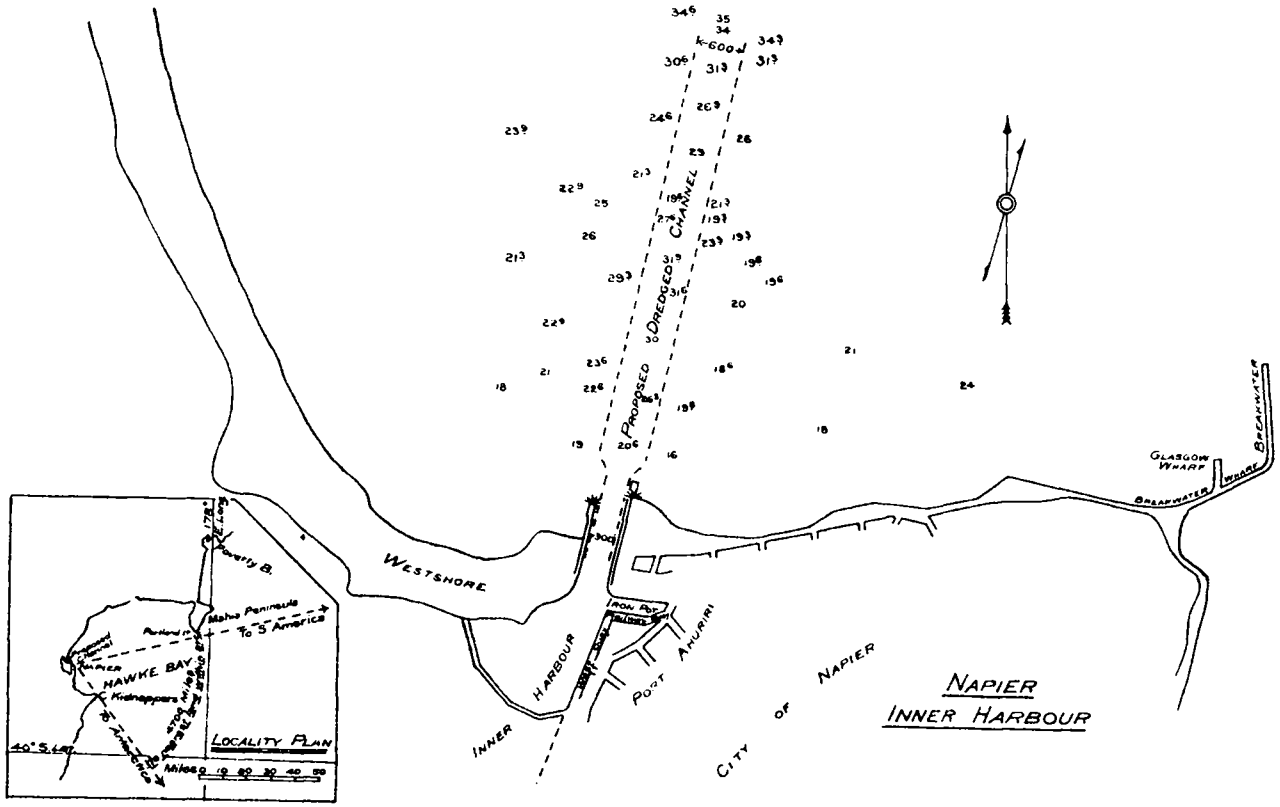
F

NAPIER INNER HARBOUR

Comparative Sections from West Quay to Outer Bar

Scales { Horizontal 1:2500 (1 inch = 250 feet)
Vertical 1:250 (1 inch = 25 feet)

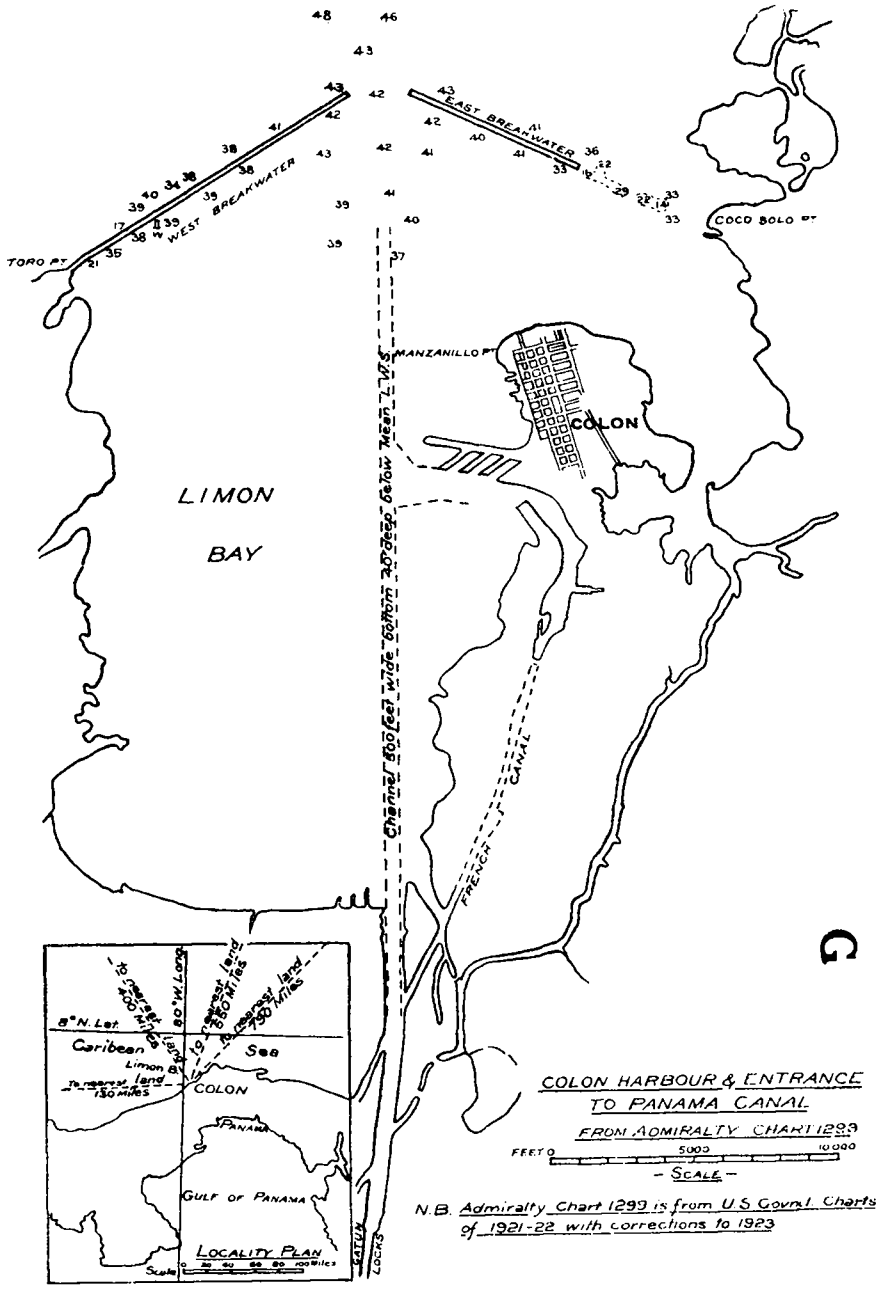
L



H

NAPIER INNER HARBOUR

0 500 1000 2000 3000 FEET



G

COLON HARBOUR & ENTRANCE TO PANAMA CANAL

FROM ADMIRALTY CHART 1299

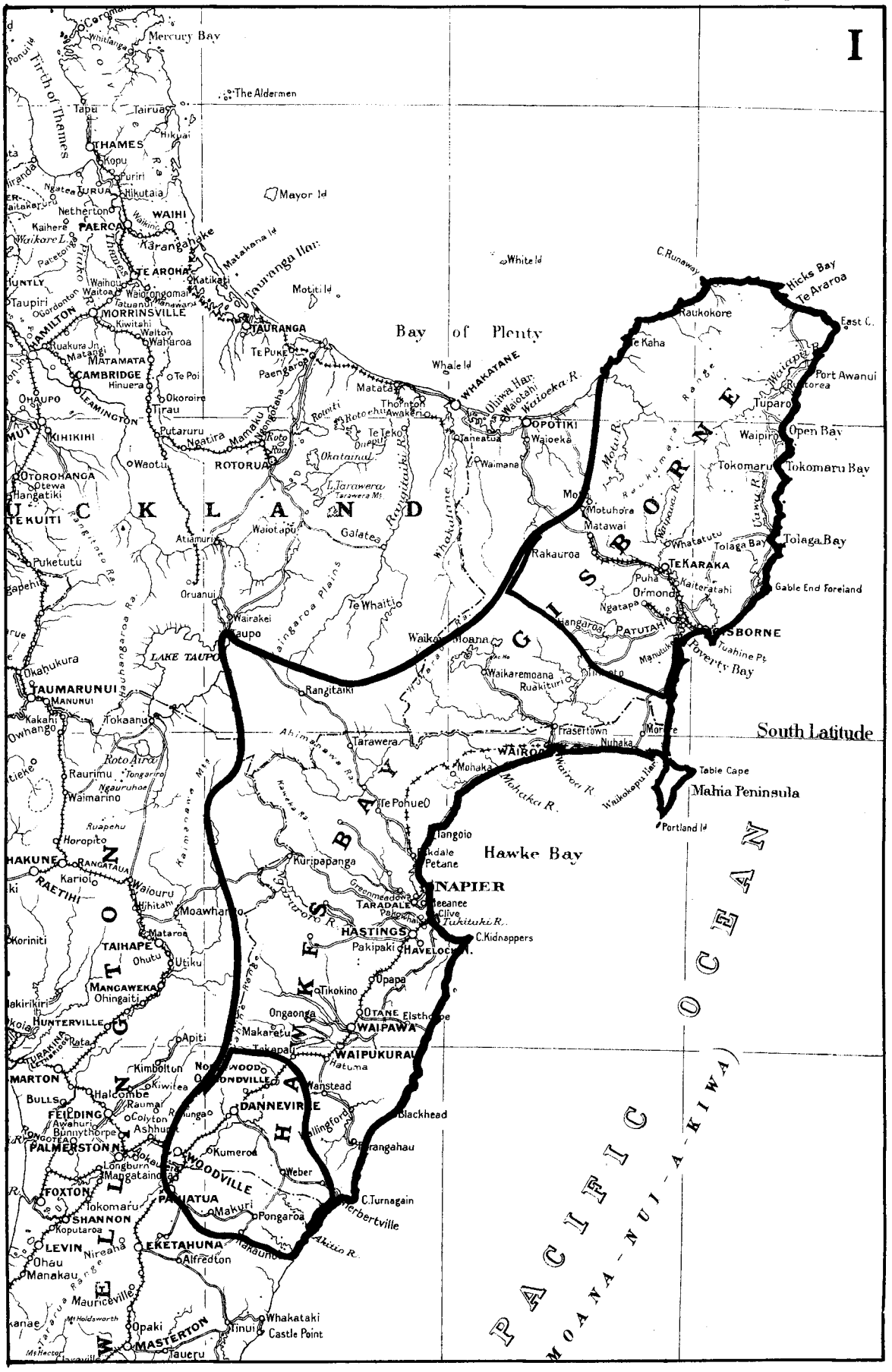
FEET 0 5000 10000

– SCALE –

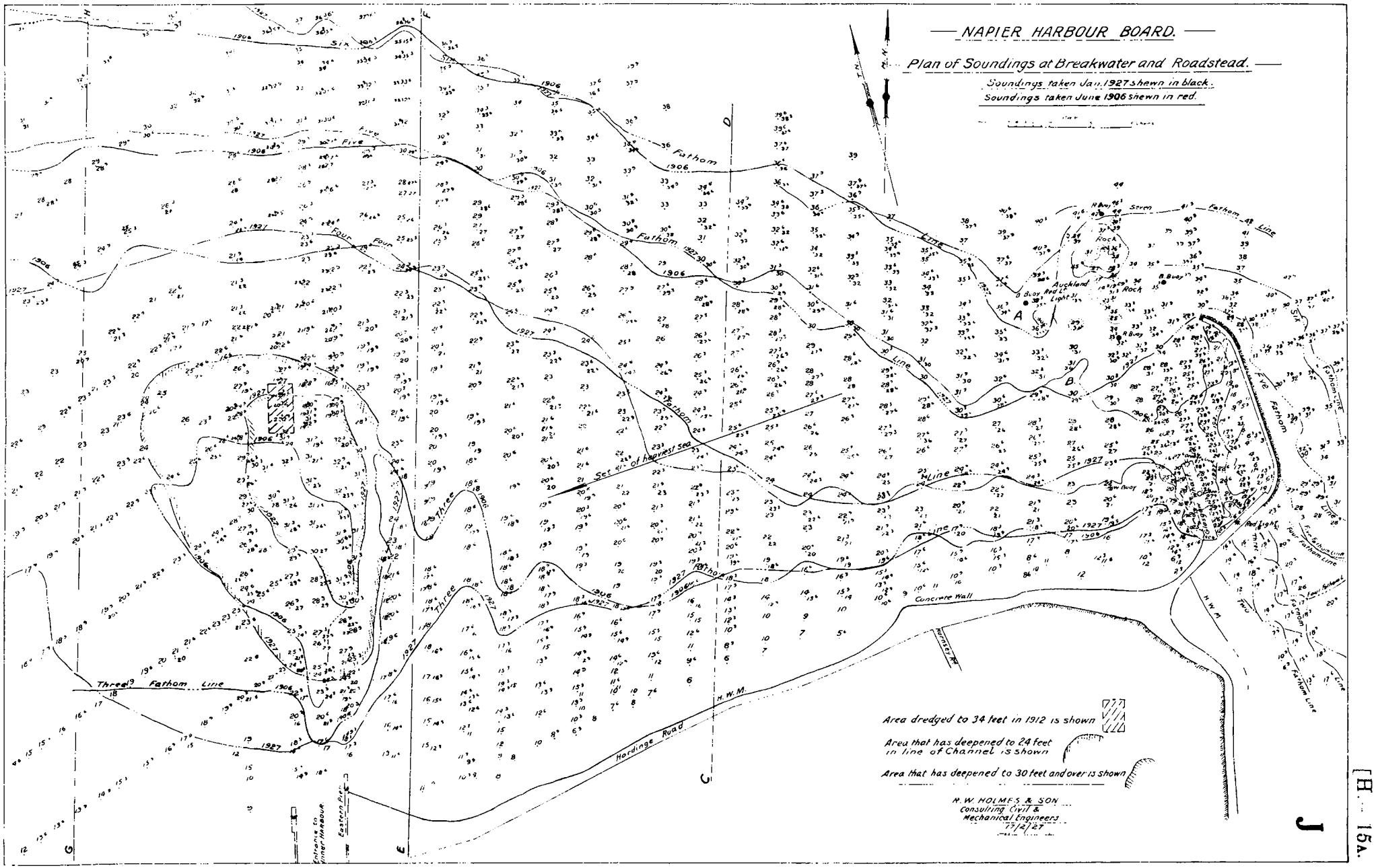
N.B. Admiralty Chart 1299 is from U.S. Govnt. Charts of 1921-22 with corrections to 1923

G

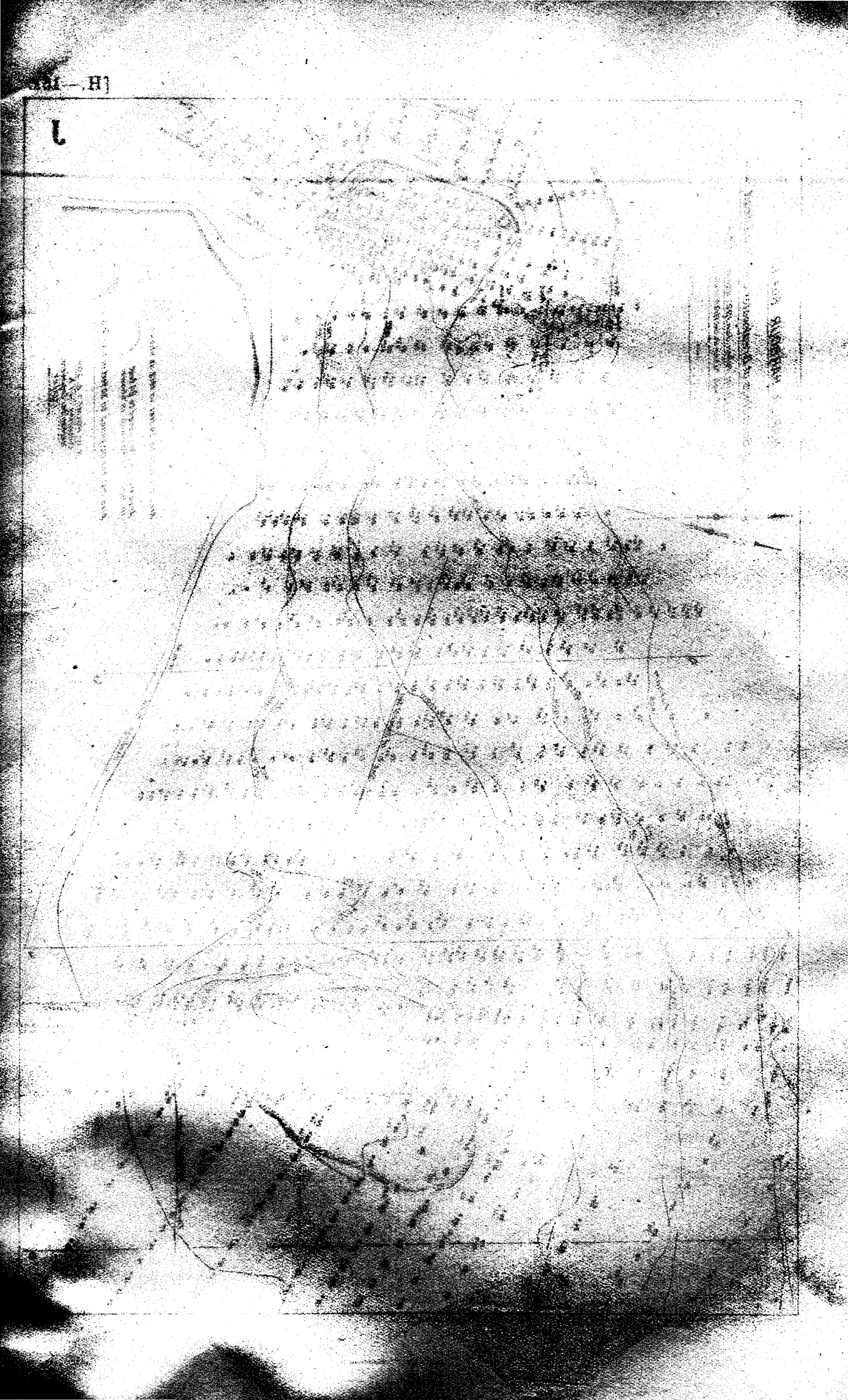
H


I
Mercury Bay
Firth of Thames
Colville Ra.
The Aldermen
Tapu
Tairua
Hikuai
THAMES
Kopu
Puriri
Ngatea
TURUA
Hikutaia
Mayor Id
Netherton
WAIHI
Kaihere
PAEROA
Waikare L.
Karangahake
Matakana Id
Tauranga Har.
TE AROHA
Katikati
Waihou
Waitoa
Waiorongomai
Tatuanui
Manawaru
MORRINSVILLE
HUNTLY
Taupiri
Gordonton
HAMILTON
Kiwitahi
Walton
Waharoa
Ruakura Jn.
Matangi
MATAMATA
CAMBRIDGE
Hinuera
Te Poi
Okoroire
Tirau
LEAMINGTON
OHAUPO
KIHIKIHI
Putaruru
Ngatira
Mamaku
Ngongotaha
Roto Rua
ROTORUA
Waotu
OTOROHANGA
Otewa
Hangatiki
TE KUITI
TAURANGA
TE PUKE
Paengaroa
Motiti Id
White Id
Bay of Plenty
Whale Id
WHAKATANE
Matata
Thornton
Awakeri
Rotoiti
Rotoehu
Te Teko
Onepu
Okataina L.
L. Tarawera
Tarawera Mt
Ohiwa Har.
Waiotahi
Waioeka R.
OPOTIKI
Waioeka
Taneatua
Waimana
Rangitaiki R.
Whakatane R.
AUCKLAND
Atiamuri
Waiotapu
Galatea
Puketutu
Rangitoto Ra.
Oruanui
Wairakei
Taupo
Kaingaroa Plains
Te Whaiti
LAKE TAUPO
Okahukura
TAUMARUNUI
MANUNUI
Kakahi
Owhango
Tokaanu
Roto Aira
Tongariro
Ngauruhoe
Raurimu
Waimarino
Ruapehu
Horopito
Hauhangaroa Ra.
Kaimanawa Mts
OHAKUNE
RANGATAUA
RAETIHI
Karioi
Waiouru
Hihitahi
Moawhango
Mataroa
TAIHAPE
Ohutu
Utiku
MANGAWEKA
Ohingaiti
HUNTERVILLE
Rata
Apiti
TURAKINA
MARTON
Kimbolton
Kiwitea
Halcombe
BULLS
FEILDING
Raumai
Colyton
Awahuri
Bunnythorpe
Ashhurst
RONGOTEA
PALMERSTON N.
Longburn
Mangatainoka
FOXTON
Tokomaru
SHANNON
Koputaroa
LEVIN
Ohau
Manakau
Nireaha
Tararua Range
Mauriceville
Mt Holdsworth
Mt Hector
Opaki
MASTERTON
Taueru
EKETAHUNA
Alfredton
Tinui
Whakataki
Castle Point
WELLINGTON
C. Runaway
Hicks Bay
Te Araroa
Raukokore
East C.
Te Kaha
Waiapu R.
Port Awanui
Ruatorea
Tuparoa
Waipiro
Open Bay
Tokomaru
Tokomaru Bay
Uawa R.
Raukumara Range
Motu R.
Motu
Motuhora
Matawai
Waipaoa R.
Whatatutu
Tolaga Bay
Rakauroa
TE KARAKA
Puha
Kaiteratahi
Ormond
Gable End Foreland
Ngatapa
Hangaroa
PATUTAHI
GISBORNE
Manutuke
Tuahine Pt
Poverty Bay
Muriwai
Waikare Moana
Waikaremoana
Ruakituri
Frasertown
Morere
Nuhaka
South Latitude
WAIROA
Wairoa R.
Waikokopu Har.
Table Cape
Mahia Peninsula
Portland Id
Mohaka
Mohaka R.
Rangitaiki
Ahimanawa Ra.
Tarawera
Kaweka Ra.
Te Pohue
Tangoio
Eskdale
Petane
Hawke Bay
Kuripapanga
Greenmeadows
NAPIER
Meeanee
TARADALE
Clive
Pakowhai
Tutaekuri R.
Tukituki R.
Ngaruroro R.
HASTINGS
Pakipaki
HAVELOCK N.
C. Kidnappers
Ruahine Range
Tikokino
Opapa
Ongaonga
OTANE
Elsthorpe
Makaretu
WAIPAWA
Takapau
WAIPUKURAU
Hatuma
NORSEWOOD
ORMONDVILLE
Wanstead
Rakaunui
Tamaki
DANNEVIRKE
Blackhead
Wallingford
Porangahau
Kumeroa
WOODVILLE
Weber
C. Turnagain
PAHIATUA
Makuri
Pongaroa
Herbertville
Akitio R.
Mangaone
HAWKE'S BAY
PACIFIC OCEAN
(MOANA-NUI-A-KIWA)

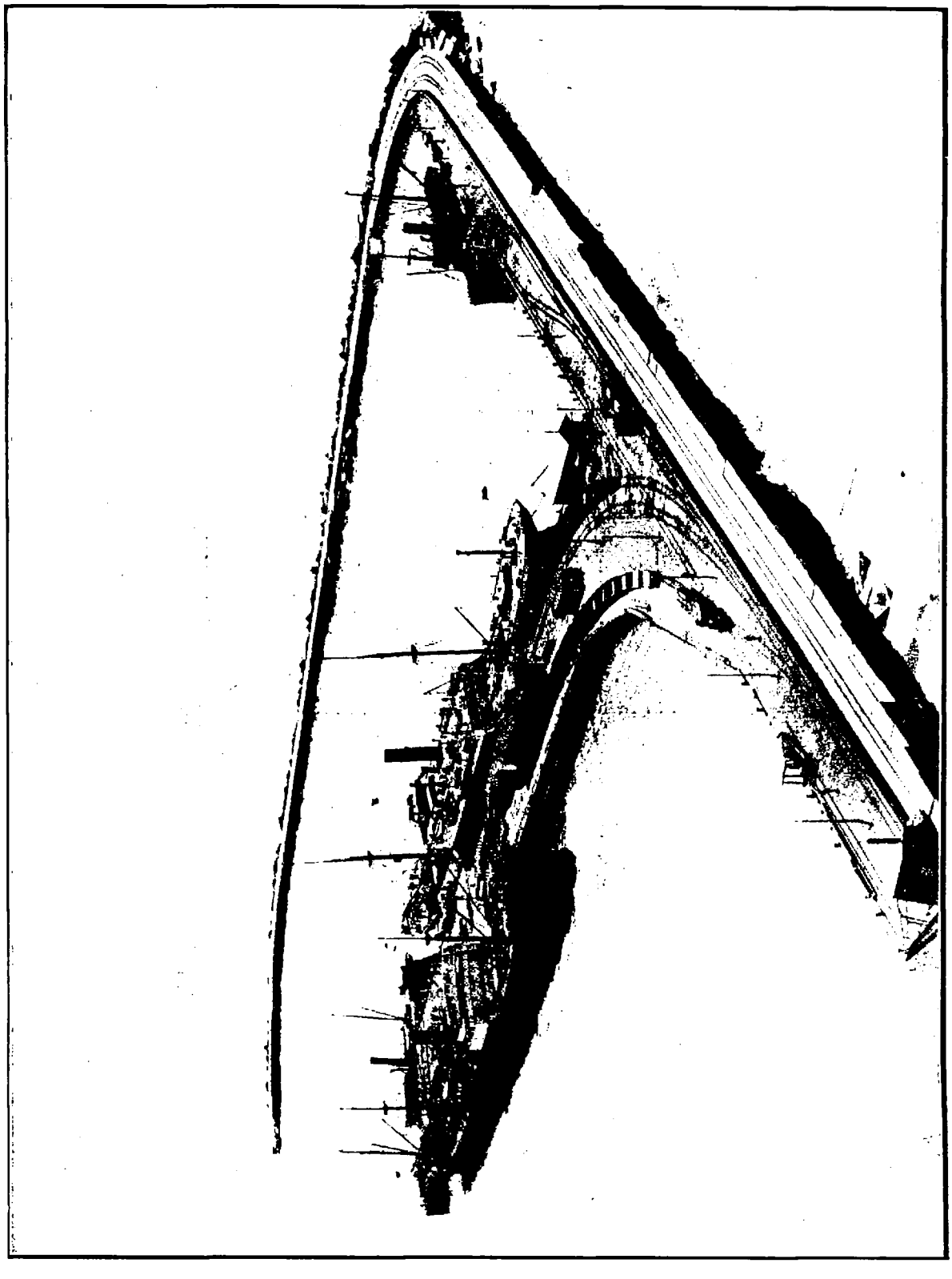
I


NAPIER HARBOUR BOARD.
Plan of Soundings at Breakwater and Roadstead.
Soundings taken Jan. 1927 shewn in black.
Soundings taken June 1906 shewn in red.
Area dredged to 34 feet in 1912 is shown
Area that has deepened to 24 feet in line of Channel is shown
Area that has deepened to 30 feet and over is shown
H. W. HOLMES & SON
Consulting Civil & Mechanical Engineers
15/2/27
Hardinge Road
Concrete Wall
H.W.M.
Three Fathom Line
Four Fathom Line
Five Fathom Line
Six Fathom Line
Auckland Rock
Red Light
Set of harvest sea
Entrance to Inner Harbour
Eastern Pier
A
B
C
D
E
F
G
H
J

[H. — 15A.

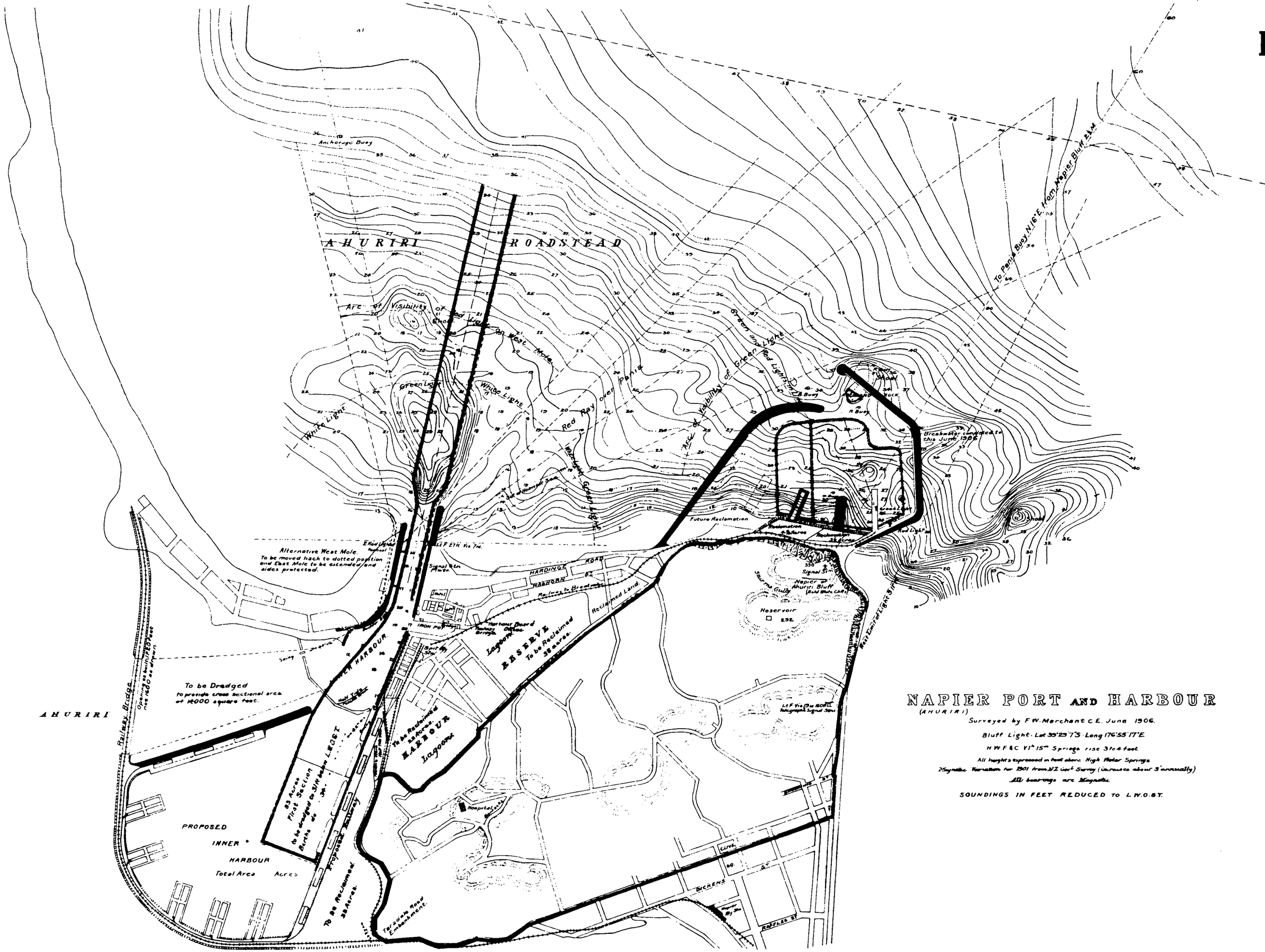


K.



NAPIER BREAKWATER, 1927.

L



NAPIER PORT AND HARBOUR
(AHURIRI)

Surveyed by F.W. Merchant C.E. June 1906.

Bluff Light - Lat 39°29'7"S Long 176°55'17"E

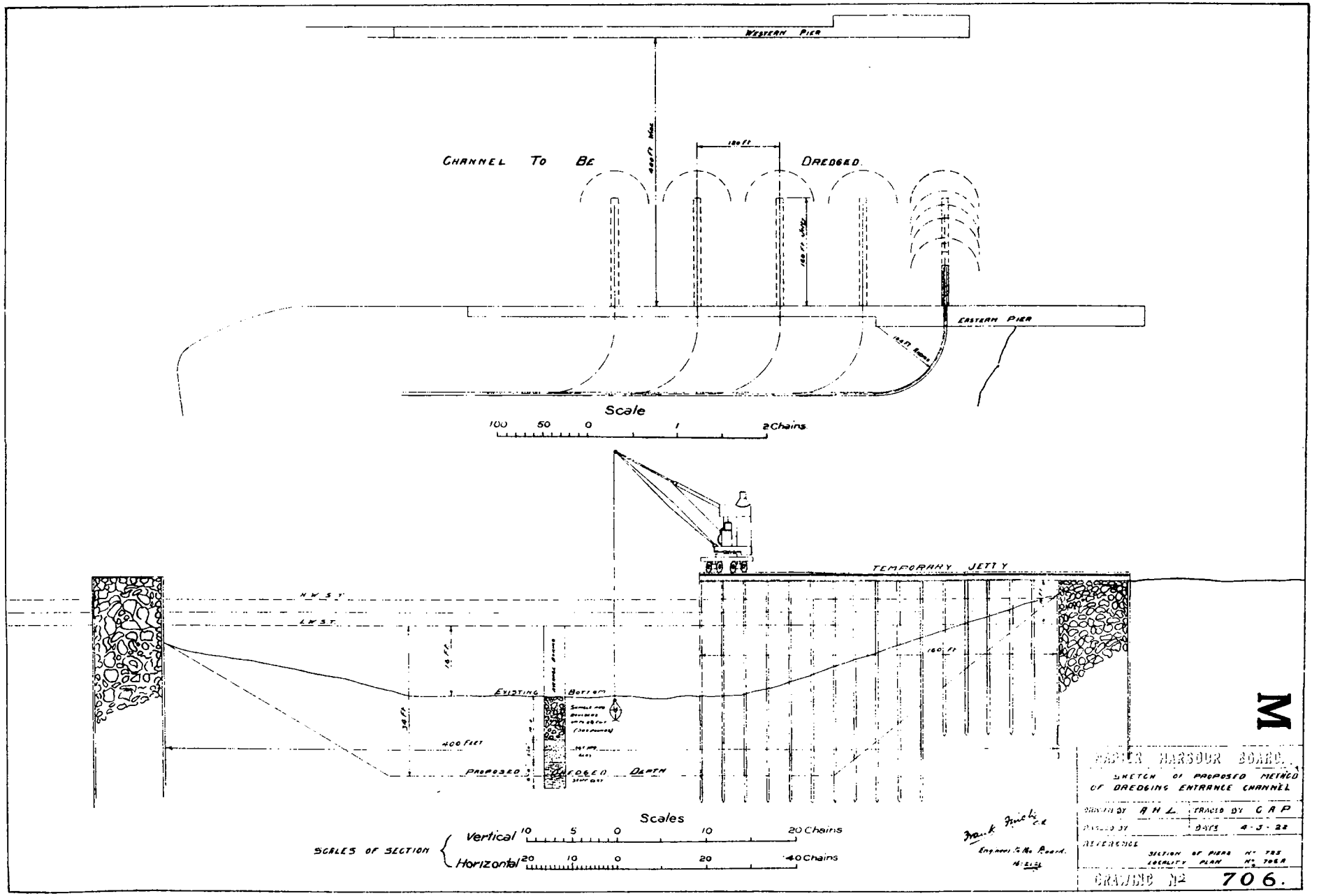
H.W.F.&C. VI^h 15^m Springs rise 3 to 4 feet

All heights expressed in feet above High Water Springs

Magnetic Variation for 1901 from N.Z. Govt Survey (increases about 3' annually)

All bearings are Magnetic.

SOUNDINGS IN FEET REDUCED TO L.W.O.S.T.



By Authority: W. A. G. Skinner, Government Printer, Wellington.

NAPIER HARBOUR BOARD

Soundings on 10acre patch previous to dredging Oct 24th to Nov 4th 1911

Depths as at mean low water

N

Line from Beacons 98° 04' 103° 53'

Line from Beacons

Line from Beacons

Dredged to 34 feet

30' Line of Wallace Pier

30' Line of Eastern Pier

Iron Pot

Railway Buoy

INNER HARBOUR

Soundings shown in black figures taken on 4th November 1911
" " red " " 12th January 1912
" " green " " 10th February "
" " purple " " 29th April "
" " brown " " 15th August "
" " blue " " 12th June 1913.

" " enclosed red circles taken by P.W. Dept 14.12.17

Taken by Mr C.D. Kennedy

Scale
100 50 0 100 200 Feet

и

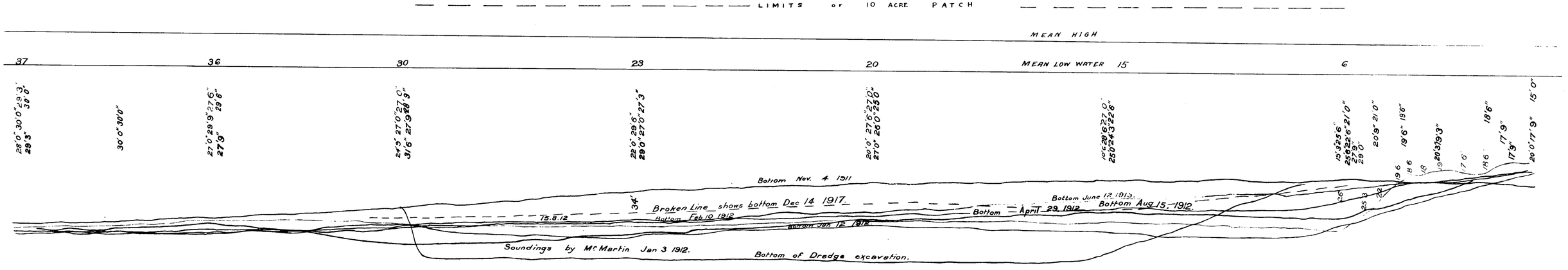
NAPIER HARBOUR BOARD

O

SOUTH

Longitudinal Section through 10ac. patch (in continuation of line of Western Pier) N. + S

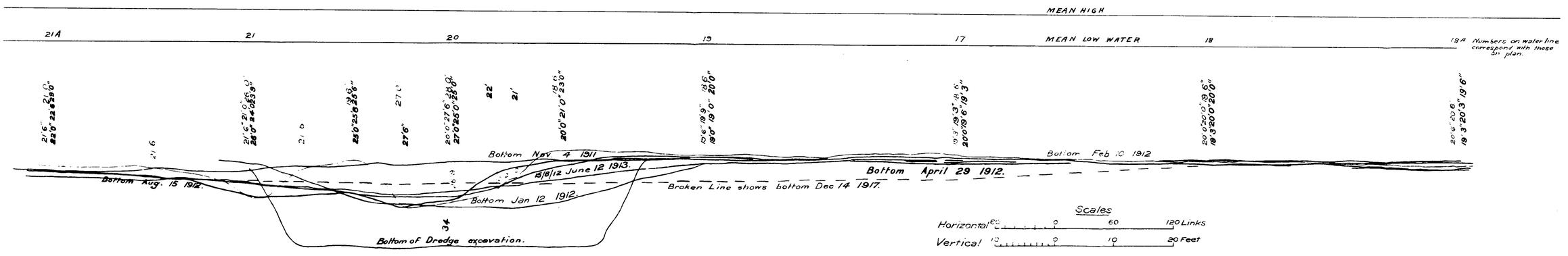
NORTH



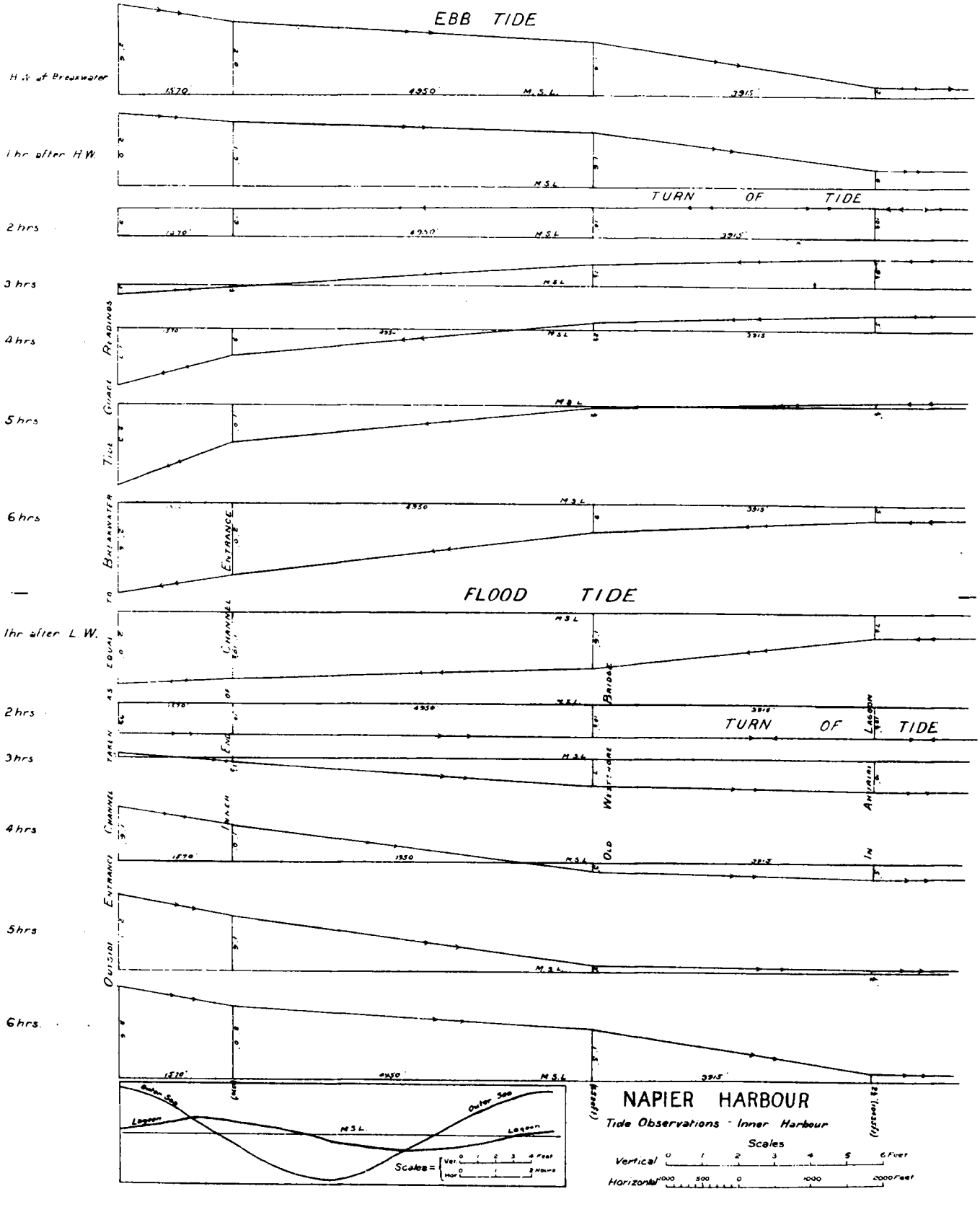
WEST

Section across centre of patch E & W

EAST



P


EBB TIDE
H.W. at Breakwater
1 hr after H.W.
2 hrs
3 hrs
4 hrs
5 hrs
6 hrs
TURN OF TIDE
FLOOD TIDE
1 hr after L.W.
2 hrs
3 hrs
4 hrs
5 hrs
6 hrs
M.S.L.
1570'
4950'
3915'
Breakwater
Entrance
Channel
Bridge
Lagoon
Inner Harbour
Outer Sea
Lagoon
Scales
Vertical 0 1 2 3 4 5 6 Feet
Horizontal 1000 500 0 1000 2000 Feet
NAPIER HARBOUR
Tide Observations - Inner Harbour

Q

WEST SHORE NAPIER

EROSION OF FORESHORE

Scale 200 100 0 200 400 Feet

PREPARED FROM NAPIER HARBOUR BOARD PLANS.

REFERENCE.

Shore Line	H.W. in	Shows	Full	Blue.
	1851			Yellow.
	1878			Red.
	1883			Green.
	1887			Purple.
	1890			Brown.
	1894		Broken	Red.
	1907		Full	Black.
	1920		Broken	Black.
	1924			

9

PLAN OF
NAPIER HARBOUR BOARD
RESERVES

Scale
20 10 0 20 30 40 Chains

Outer Harbour

Ahuriri Lagoon

(14)

Balance Area
7319 - 0 - 31·24.

STATUTES 1874 PAGE 169
1887 185 (2nd Schedule)

C.T 34/56 5·2·0
Rd & Rly. 0·3·10
4·2·28

1·2·20
Beacon Site
Gaz 1910. 2186.

Esk River

Te Karo-o-kuri

Te [illegible] Pa

Whareongi Native Reserve

Parks Island

Pt. 169

Mc.Donald's Block
(32)
543·0·00
Port Ahuriri Lagoon
4th Schedule
Statutes 1887 - 186

Meeanee Suburban
(42)

Inner Harbour
Road & Rly.
37-2-36·42
Gaz. 1918 - 3526
1919 - 3512.3513
1920 - 431
1922 414

Borough of Napier
See Litho plan

Breakwater

Statutes 1887-186
4th Schedule
14 1·24

Napier Rly. Stn.

Napier South
See Litho

Napier South Syndicate

Balance Area east of Tamatea Road
200 - 0 - 31·1

D.P. 4206

Richmond Block

Part Maraenui

Awatoto Block

Te Pureora

Tutaekuri River

Reference

Reserves coloured thus

Lands reclaimed "

R