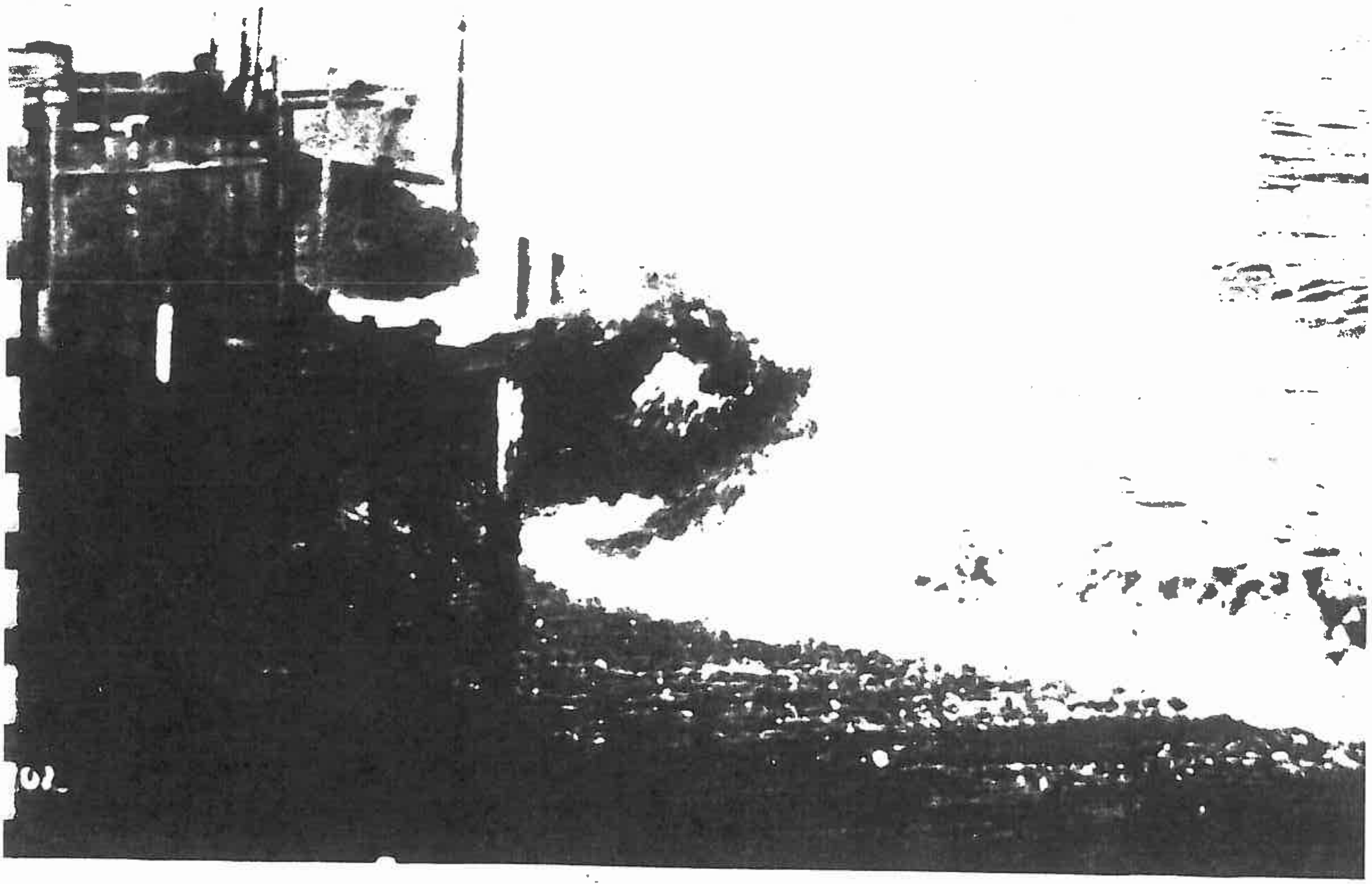
HOKITIKA BEACHFRONT
SEA EROSION

August 1984

(FINAL VERSION)



Conthok. Ltd
Hokang. Ltd.

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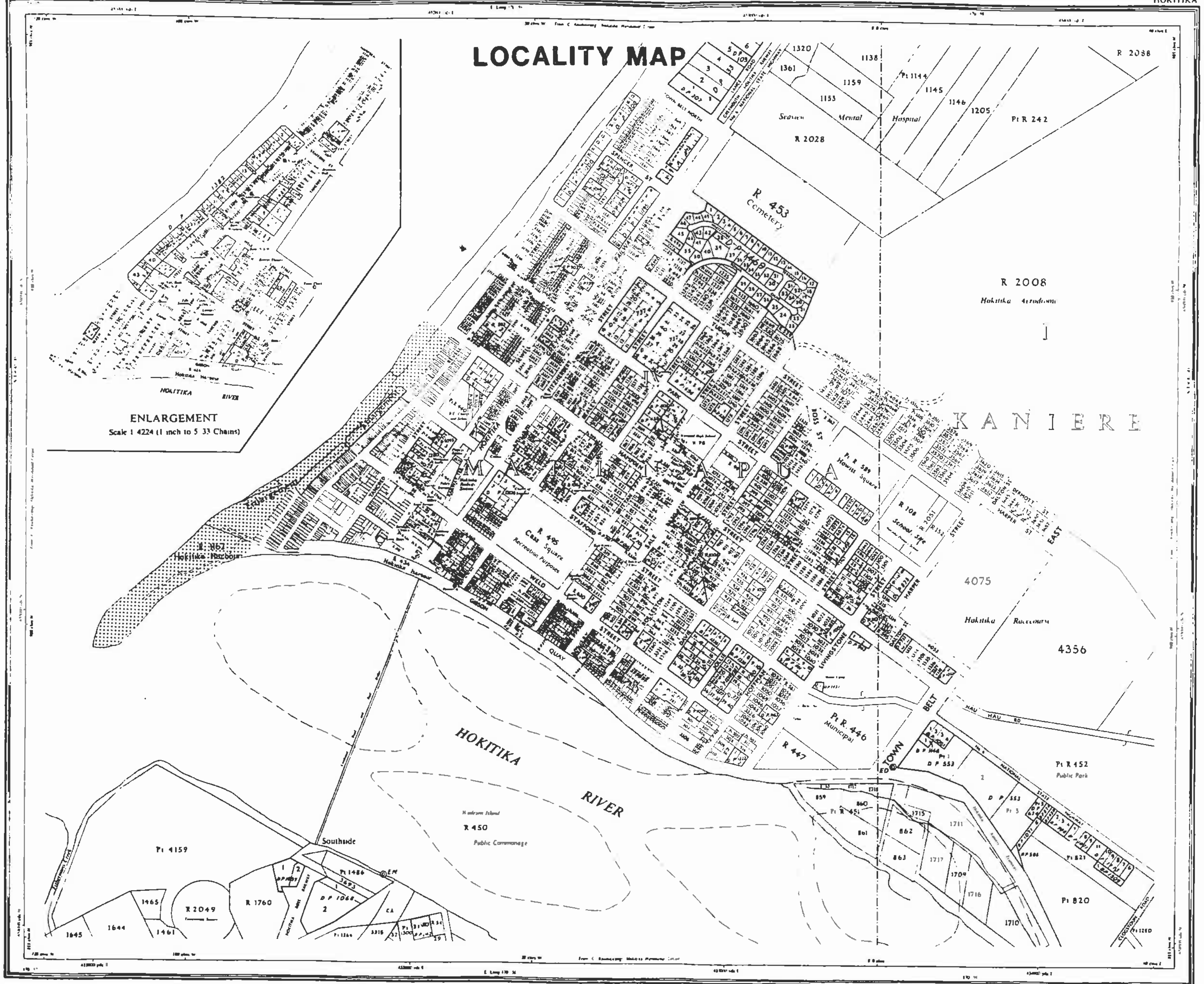
N.Z. CADASTRAL MAP - TOWN SERIES 1:6336

HOKITIKA

NZMS 189
HOKITIKA



NZMS 189
HOKITIKA

REFERENCES

Scale 1:6336 (1 inch to 8 chains)

GRID REFERENCES

GAZETTE REFERENCES

2nd August, 1984

The Chairman,
National Water and Soil Conservation Authority,
P.O. Box 12-041,
WELLINGTON.

Dear Sir,

FORESHORE PROTECTION - HOKITIKA BOROUGH

The Hokitika Borough Council are very concerned over the coastal erosion which is occurring now at a very rapid pace and threatening the township.

In June 1983 the Borough Council requested the Board to investigate a protection scheme for the township and apply for a grant from the National Authority. Over the past 12 months regular monitoring of the beach erosion has been carried out and the yearly cyclic behaviour established.

The erosion rate over the past year has been of the order of 7.5 metres.

The Borough Council at an on-site meeting on 4 July requested the Board to complete the engineering proposal and obtain a grant from the National Authority to enable works to be undertaken. I submit the following application to the National Authority for grant assistance.

1. INTRODUCTION

The Hokitika Borough Township is situated on the coastal strip immediately to the north of the Hokitika River. The Commercial portion of the town is located on the foredune with rail and highway being located on the edge of the secondary dune. The Government Building, Railway Station and yards, and Post Office are located in the low lying area between the foredune and the secondary dune.

The attached cross-sectional plan 906/202 illustrates the saucer like nature of the basin in which the Township is located.

The real problem which gives rise to the protection proposal is that the sea at the present time is rapidly eroding away the foredune - the edge of the saucer like basin. With the erosion of this edge the sea will spill across into the basin in which the township is located. The life of the town depends on sheilding the foredune from erosion.

Attached find photographs of 1914 erosion and protective works together with photographs of present erosion taken 4 July 1984.

The beach is unprotected at the present time except for some rock at the extreme end of the spit. This work was placed in January 1979. During heavy seas the waves break over the spit into the river.

2. DAMAGE TO FORESHORE

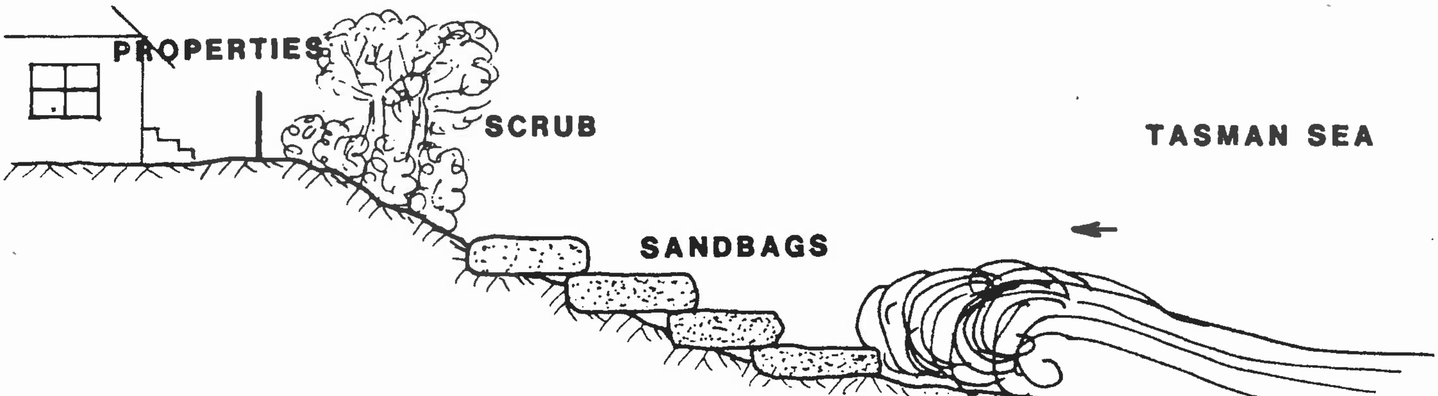
Over the past 2 years the sea has been encroaching rapidly into the foredune. Over the past 12 months the encroachment was of the order of 7.5 metres.

In January 1979 rock protection work was placed at the southern end of the spit. This rock work appeared to be very successful in that the beach built up rapidly. With the present erosion cycle, however, the seas have got around the back of the rock work and the rock is now a sea wall out from the spit.

The size of rock used varied from 4 to 8 tonne and has withstood the sea onslaughter to date. Rock placed previous to 1979, some 20 metres further seaward has slumped due to scour so that it is only visible at low tide.

The 1914 protective works consisted of rows of timber piled groynes out at right angles to the shoreline. These groynes were planted and backed with scrub. See photo 'Ben Thiem Collection' dated 10 May 1914 attached. They appear to have worked very successfully as the beach aggraded rapidly. Whether or not this aggradation was due to the groynes or not is debatable. I am of the opinion that limited aggradation can be attributed to the groynes. The bulk of the aggradation was cyclic in nature. Maybe a 80 year cycle.

In addition to the groyne protection works in 1914, a sand bag revetment wall was constructed along the beach frontage. One of the photographs shows the bag revetment wall consisting of at least 5 rows of bags on a slope of 2 to 1 or flatter, and plenty of scrub - (cut manuka) is in evidence, suggesting that the scrub formed a near vertical wall at the top of the bag layer.



TYPICAL SCHEMATIC CROSS SECTION

The erosion up until 1914 appears to have been spread over at least 8 years. When Mr Massey the then Prime Minister, advised of Government authorisation of a grant of 500 pounds on a pound for pound basis, the newspaper report of this goes on to say: "The position must be regarded as serious when it is bourne in mind that in eight years the sea has encroached between one hundred and fifty and two hundred feet."

The present erosion rate appears to be of the same order as occurred in the years 1906 to 1914, i.e. 7.5 metres per year. The storm of the 9th April 1914 caused the beach to be eroded by 15 metres. This is possible for a similarly size storm today.

The sea has 20 metres to go as at 14 June 1984 to reach residential and other buildings.

3. COASTAL PROCESSES - METEOROLOGICAL DATA

The most serious storms are from the Northwest. On 9 April 1914 when the beach eroded 15 metres overnight the newspapers record: 'A fierce nor-west gale hit the town and a tremendous sea raged on the water front.' In winter months whenever north west gales occur the erosion rate has been observed to increase. With southwest winds aggradation occurs. It is difficult to measure the effect of the erosion rate resulting from gales from different quarters as the wind usely changes from North West to South West in the cause of the event.

4. TIDES AND CURRENTS

Mean spring tide was measured on the 13 July at 1.4 metres (Land and Survey Department datum). The top of the proposed wall is to be at 5.3 metres and base between -0.3 and 2.5 metres. Tide levels have been calculated from the nautical almanac:

- mean high water spring	+1.4
- mean high water neap	+0.9
- mean low water neap	-0.3
- mean low water spring	-0.7
- mean sea level	+0.3

Currents:

There is a northerly drift of 1 knot with a local secondary southerly current along the beach frontage from Town Belt North, south, to the river mouth.

The storm surges are such that seaweed, drift wood and other debris is thrown across the road along the sea frontage. Level 5.3.

5. HISTORIC SHORELINE MOVEMENTS

Attached find aerial photograph with historic shoreline movements shown superimposed on it.

The shoreline movements can be described as cyclic - The long term (80 year plus cycle) and the yearly cycle.

The long term cycle in 1914 caused erosion such that the top of the beach embankment was along the back of the Revell Street premises. This erosion cycle has some 60 metres to go in the northern area between Stafford and Hamilton Streets, but to the south it is now on the actual 1914 erosion line.

The yearly cycle is at present advancing some 7.5 metres per year towards the township between Stafford and Hamilton streets.

6. SAND MOVEMENT

The annual beach cycle is at the present time encroaching inshore by 7.5 metres per year. In winter months there is a degradation of 2 metres and in summer an aggradation of 2 metres making a net change in beach level of 4 metres between summer and winter.

The long term beach profile appears from old photos to have been as shown on typical cross-section at Stafford Street. See page 4 over.

7. SAND MOVEMENT - LITTORAL TRANSPORT

The longshore transport of beach sediment is of the order of 10 million cubic metres per year. Reference R.M. Kisk. A large proportion of the sediment comming from the Hokitika River. Due to the spit formation out from the Hokitika river mouth the natural feed of beach material tends to be cut off and hance a depletion cycle sets in along the township frontage.

8. SEDIMENT DATA

A summary of sieve analysie is to be forwarded when laboratory test results received.

9. DETAILS OF PROPOSAL

(a) Construction materials

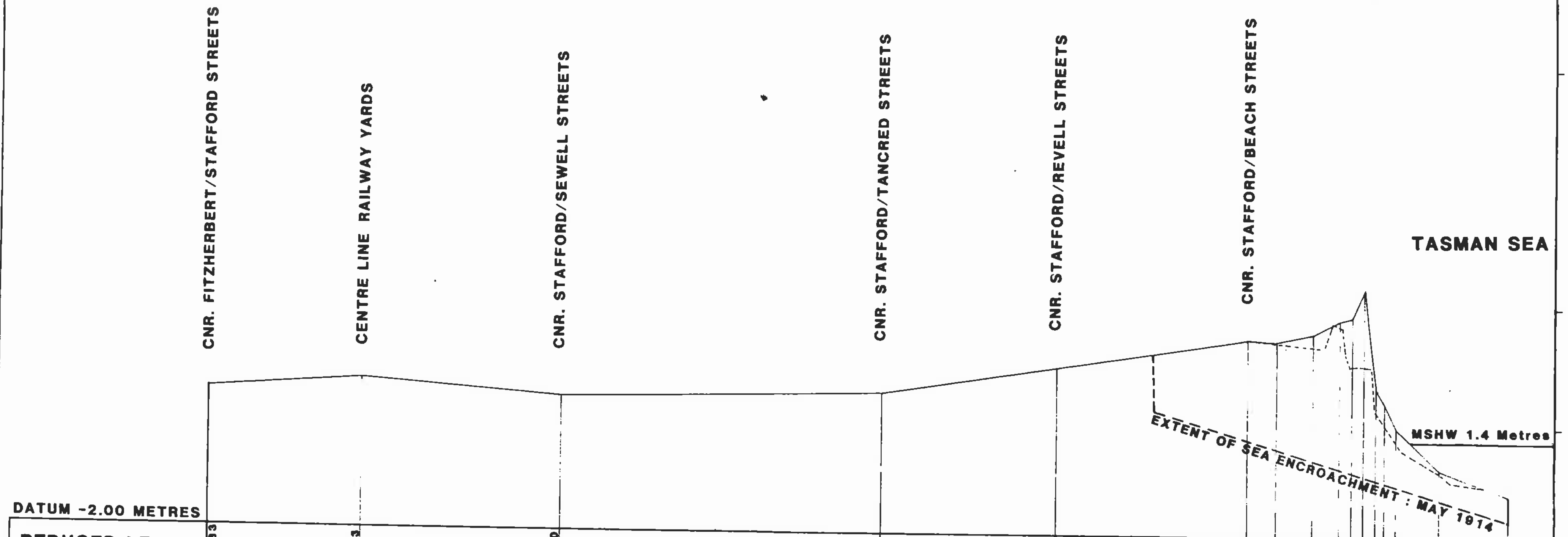
It is proposed to place a two rock thick rock revetment wall along the beach front from the existing rock work at the southern end up to Stafford Street at the north end: a distance of 1000 metres. The wall to be constructed on a 1.5 to 1 batter with the toe excavated down into the beach to provide at least one metre depth of covering over the toe. Facing rock size to be in the range 4 to 6.75 tonne. This rock to be laid two rocks deep on top of a 500mm layer of 350 to 550 kilogram quarry rock or tailings. See plan Page 4 (b) over.

The 350 to 500 kilogram rock to be laid on a bull-dozed bed covered with coarse beach gravels.

This method was used at the south end of the beach at Hokitika in 1979 and on the Cobden beach in 1969. The quantity of rock used was based on 140 cubic yards per chain (14 tonnes per metre) but on a recent inspection of the jobs there appeared to be at least 18 tonnes per metre. In both these jobs the rock walls withstand the sea forces remarkably well. At Cobden the beach material was far coarser than the Hokitika sands and a secondary layer was not used.

(b) Backfill material

It is proposed to push the beach material up with a bulldozer to form an embankment on which to lay the rockwork. Any additional backfill material required will be carted in from up river or from shingle pits to the north.



DATUM -2.00 METRES																
REDUCED LEVEL	2.833	3.233	2.660	2.661	3.861	4.907	4.792	5.122	5.622	5.682	5.712	3.219	2.722	1.797	0.437	-0.533
DISTANCE	0.00	56.5	123.5	236.5	298.5	364	374	387.5	396.5	400.5	408.0	409	412	416.5	431.5	458.5

CROSS SECTION ON STAFFORD STREET :MAIN HIGHWAY TO SEA

SCALES : HORIZONTAL : 1:1000
VERTICAL : 1:100

ORIGINAL SCALE OF INCHES 0 1 2 3 4 5 6 7 8 9 10 11 12

GRAPHIC SCALES:

SURVEYED	W MOEN	AMENDMENTS	— JULY 1983
DRAWN	W MOEN		-- JULY 1984
COMPUT'NS	WMOEN		
TRACED	W MOEN		
CHECKED	J McF H		

SCALES

DATUM
L&S MSL
LYTTELTON

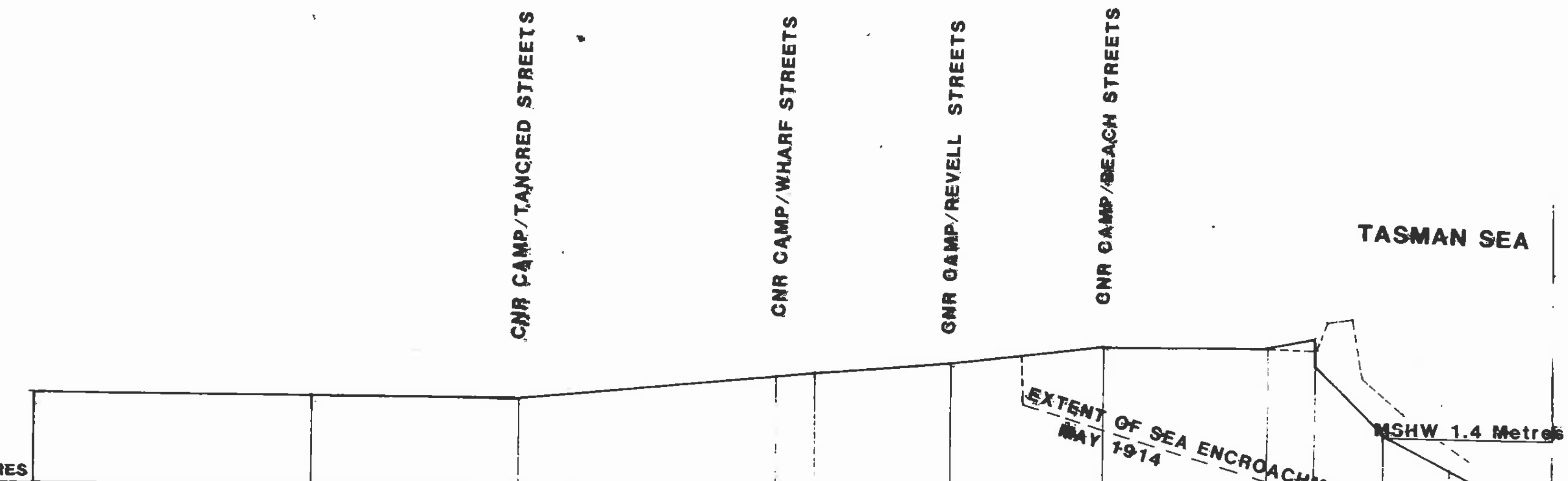
WESTLAND CATCHMENT BOARD
HOKITIKA BEACHFRONT
Typical Cross section

Engineer ________ 19 ____

REFERENCE
LB's 154,165,
172,173

SHEET 1 OF 1 SHEETS

906
No. 6202
A2



DATUM 0.00 METRES

REDUCED LEVEL	2.841	2.810	2.432	3.187		3.578	4.019	3.982	4.284 / 3.484	1.601	0.661	-0.10
DISTANCE	0	76	124.5	206.5	217.5	238.5	300	346	358	376.5	395	409

CROSS SECTION ON CAMP STREET : SEWELL STREET TO SEA

SCALES : HORIZONTAL : 1: 1000
VERTICAL : 1: 100

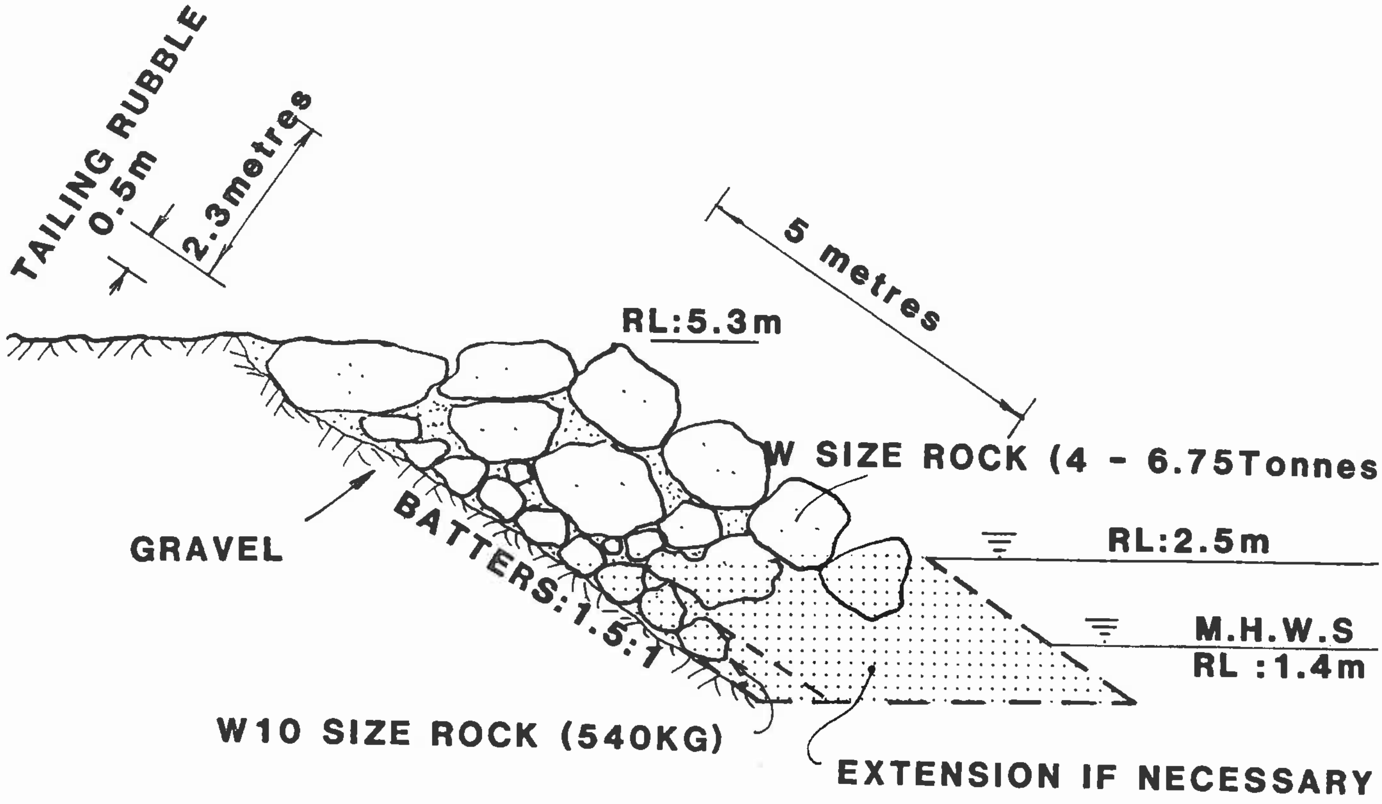
W MOEN	AMENDMENTS	—	JULY 1983	SCALES	WESTLAND CATCHMENT BOARD
W MOEN		—	AUGUST 1984		HOKITIKA BEACHFRONT
W MOEN				DATUM	Cross Section : Southern End
W MOEN				L&S MSL	
J McF H				LYTTELTON	

Engineer 19

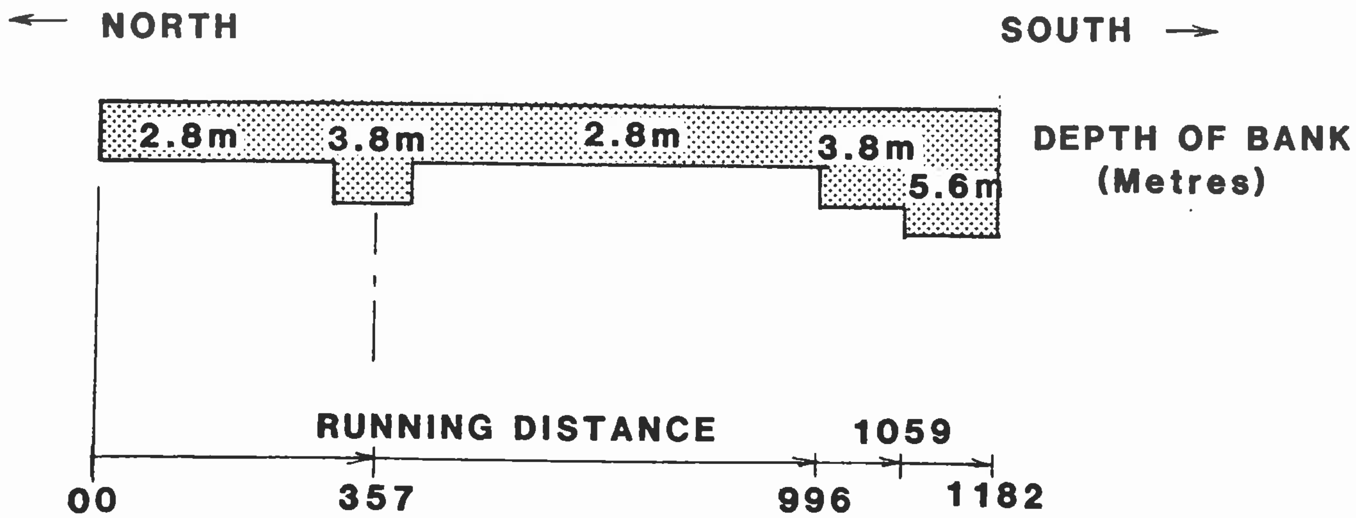
REFERENCE L.S'S 154, 165, 172, 173, 183

906/206 No

A2



TYPICAL CROSS SECTION THROUGH PROPOSED BANK



SCHEMATIC LONG SECTION

(c) Position

The attached Plan 906/202 Appendix 5 shows the position of beach profiles as at: 1867, April 1914, 1958 and June 1984.

Generally, in respect of the beach between Camp Street and Stafford Street, the sea can be said to have come in 20 metres from between 1867 and 1914, retreated 60 metres between 1914 and 1958 and came in 10 metres since 1958.

The current position being that the beach front is some 50 metres seaward of the 1914 line.

Should a wall be constructed along the present beach line the vertical height of wall needed at the present time will tapper from 5.6 metres at the southern end to 2.8 metres at the northern end 'Stafford Street'. With continued erosion the height of wall needed at Stafford Street could well be 5.6 metres too in the next few years. The 1914 beach profile plotted on the cross-section at Stafford Street indicates that a 6.5 metre wall could be needed in the ultimate.

The cost of a 6.5 or even a 5.6 vertical height wall is far beyond the means of the Borough, and this proposal proposes that the minimal height necessary at the present time only be built. Should the beach profile drop in the future then the scheme provides for extension of the base of the wall down in stages. At least one metre beach coverage should be provided over the toe of the wall at all times.

(d) Effect of Works

The effect of the works will be to halt further erosion of the shore line. The works proposed are not designed to attract aggradation of beach materials but past experience at the south end of the Hokitika beach and at Cobden has shown that aggradation has occurred following placement of the rock.

The placement of a wall along the southern portion of the Hokitika sea frontage will have little affect on the northern portion, as the beach nourishment material comes largely from river source rather than depletion of the beach. At the present time the net yearly deficit along the 1000 metre length of Hokitika foreshore is of the oder of 20,000 cubic metres, one fiftieth of the coastal movement of 1 million cubic metres per year.

From the beach profiles it is evident that the bulk of the erosion is occurring at the spit head to the south, tappering off to the north, so that at Stafford Street cross-section aggradation of the beach between high and low tides appears to be occurring. However when the erosion of the beach frontage is taken into account there is a net loss.

The explanation for this is that the spit at the Hokitika river mouth is diverting the beach nourishment material out to sea in an area around the large sand bed. The currents bring this nourishment back inshore north of Stafford Street. See photo over Page 6(a).

At the end of the proposed sea wall a return wall will be built to prevent the sea getting in behind it.

There will be a back-wash effect from the wall. Calculations indicate a reflection coeficient of up to 0.36. The effect of this will be to reduce wave forces considerably, but may cause slightly increased scour at the toe of the wall.

It is not envisaged that the construction of the wall will influence to any noticeable extent the current and drift patterns.

(e) Estimate of Cost of Construction of Sea Wall

1100 Metres in length

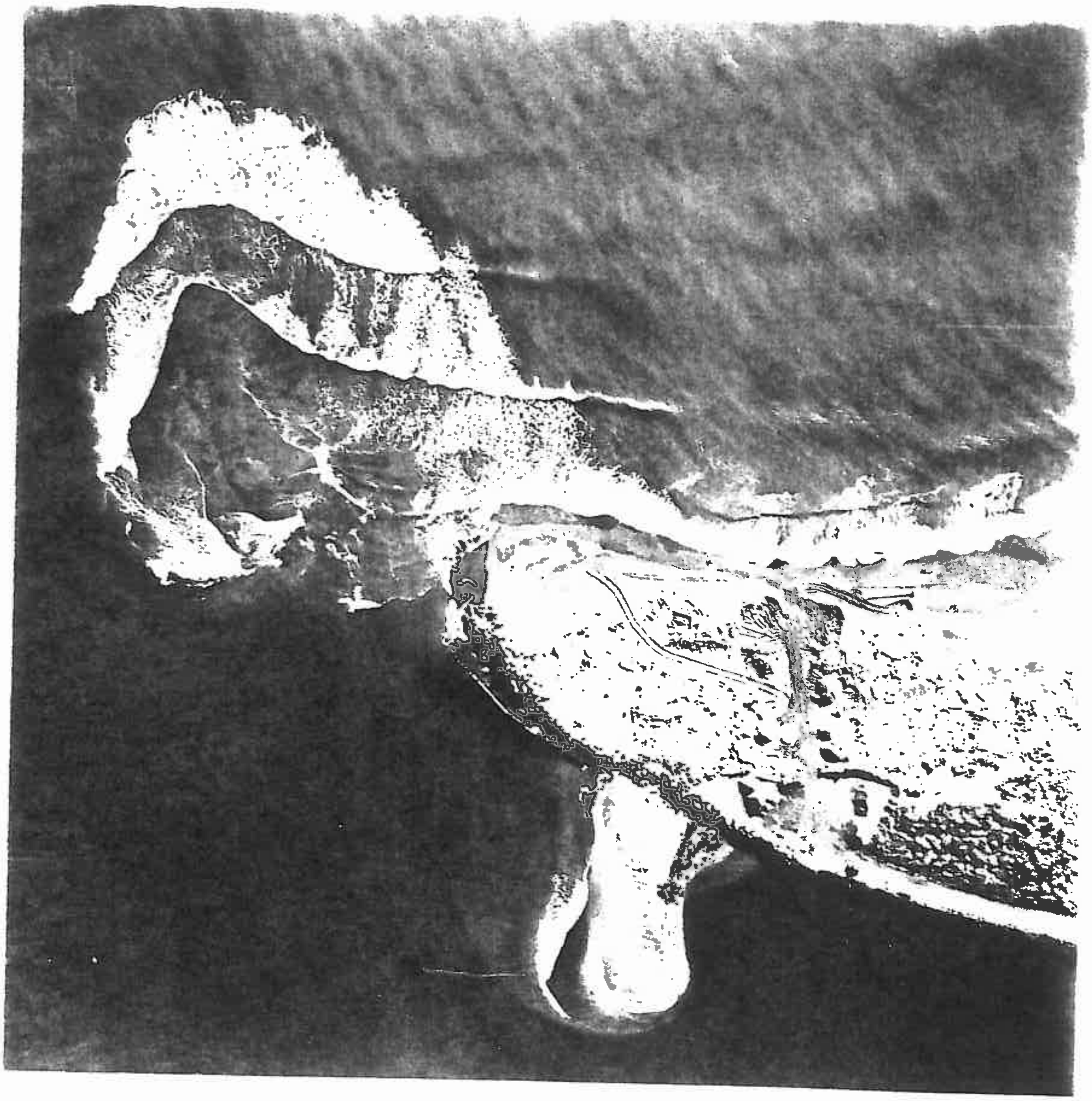
Basic dimensions:

Vertical Height	2.8 metres
Thickness	2.3 metres
Sloping Height	5 metres
Batter	1.5 to 1

Where toe of wall does not have 1 metre of beach cover wall to be extended down on 1.5 to 1 batter until the 1 metre cover obtained.

Excavation	
	$
D8 $120 per hour	
20 metres per hour	
1000 metres @ $6	6,000
Rock ex Camelback Quarry	
11.5 cubic metres/metre @ $18	
= $207/metre	
($10 per tonne rock = $18 per cubic metre loose)	
quarry charge $2.25 per tonne	
cartage $7 per tonne	
placement 0.75 per tonne	
1000 metres @ $207	207.000
Tailings ex Kaniere	
As secondary layer on which to laid large quarry rock.	
$13 per cubic metre	
2.5 cubic metres/metre	
1000 metres @ $32.50	32,500

Sand bar, north of Hokitika River mouth, photo taken 22.7.1981



Extending wall down 1 metre Cross-sections 996 and 357 200 metres @ $\frac{\$250}{2.8}$ = ($89)	17,800
Extending wall down 2.8 metres cross-sections 1059 to 1182 122 metres @ $250	30,500
Return wall at Stafford Street	4,000
	297,800
+ 5% Contingencies	14,940
	312,740
+ 20% Service Charge	62,548
	$375,288
	=======
	SAY: $375,000

10. ENVIRONMENTAL ASPECTS

In general it can be said that a sea wall is needed to protect and improve the environment of the beach.

The Internal Affairs Department have been consulted and have advised that 'they judge the environmental impact to be minimal and do not foresee any need for specific planning to protect wildlife or habitat values'.

The recreational aspects will be greatly improved, see item 11 below.

There will be no loss of historic interests by the erection of the wall. Historic buildings and sites will be protected by the erection of the wall.

The loss of vehicle access to the beach over the township frontage will not be detrimental to the environment. There are beaches to the north and south where vehicle access is available for firewood collection and other pursuits.

11. RECREATIONAL SIGNIFICANCE

The construction of the proposed sea wall will have significant recreational benefits.

(a) It will enable the beach frontage behind the sea wall to be used for construction of permanent playing fields, car parks and sporting facilities.

(b) Improvement of the visual appearance of the sea frontage. It has become a general tip head at present with various sorts of rubbish such as old sewer pipes, concrete, garden materials etc being tipped along the beach in an effort to halt the erosion.

Recreational Losses

Loss of gold prospecting on the beach face
Loss of vehicle access for collecting shingle sand and firewood.

Overall there will be a marked recreational benefit.

The present uses are:

1. Shingle and sand extraction
2. Firewood source
3. Walking, running and general beach combing.

Only limited use is made of the beach for:

- Swimming
- Surfing
- Boating
- Fishing
- Picnicing

The construction of the seawall may encourage these uses.

12. TOWN AND COUNTRY PLANNING ASPECTS

The beach foreshore is designated for public and semi public purposes.

The land behind Beach Street between Stafford and Camp Streets is zoned for light industrial purposes.

The land behind the beach frontage, south of Camp Street is zoned for residential purposes.

Until the proposed wall is erected all the land on the seaward side of the 1914 beach line should be designated 'open beach' and at least a forty metre wide strip on the landward side of the 1914 beach line reserved for public access and sea wall protection purposes.

The proposed wall is to be built on public land.

13. ECONOMIC JUSTIFICATION

At the present time approximately 1 hectare of recreational reserve is lost per year.

Unless a sea wall is erected it is highly probable that the sea will cut back to at least the 1914 beach line, and the loss of property (1981 values) will be of the order of $2,300,000.

There is no way of foretelling if the erosion will get to or halt at the 1914 line. Should the erosion get to the 1914 line then the vertical height of sea wall needed will be only 2.8 metres. But with loss of land and buildings valued at 2.3 million dollars there is no justification in letting this occur.

However, should a sea wall be erected at the rear of the properties fronting Revell Street there would be a loss of property valued at $700,000, the height of sea wall needed would be of the order of only 3 metres. Being close to the 1914 beach line there will be every probability that it will survive sea intrusions as occurred in 1914.

14. ALTERNATIVES

(a) The 'Do Nothing' Alternative

The sea came in from 1867 to 1914 and went out again until 1958. It is starting to come back in again. Whether or not it will come right in to the 1914 line or not is debatable. The chances are that it will not come back in as far as it did in 1914.

The 'do nothing' alternative would be to repair minor sea intrusions as they occur by the placement of rock and rubble and maintain a sea frontage embankment to prevent wave overtopping and flooding of business area.

(b) Erect a Sea Wall on the Present Beach Line

The erection of a sea wall on the present beach line will halt erosion at this point provided the wall is maintained, topped up where necessary and sea wall extended down if beach levels drop so as to expose the toe of the wall.

There is an indication at present that a 5.6 metre vertical height wall will be required over the full Hokitika Beach frontage.

The cost of this type of wall is beyond the finances of the Borough and would require Government input beyond the presently proposed 30% grant rate.

(c) Erect a Sea Wall (if necessary) at the back of the properties fronting Revell Street

To raise a loan to build a sea wall along the back of the properties fronting Revell Street, and build the wall at the appropriate time if necessary.

The vertical height of wall necessary is envisaged to be only 2.8 metres. The loss of land (1981 values) would amount to $700,000. Twice the value of the wall.

This wall being erected on the edge of a known beach envelope has a far greater chance of survivial than a wall erected some 50 metres seaward.

Note:

The properties fronting Revell Street refer only to the Revell Street portions of the properties located between Revell and Beach Streets.

The Hokitika Borough have opted for the sea wall on the present beach line, option (b).

15. FINANCE

The Hokitika Borough Council are not financially endowed, and require Government monies to protect the township. What monies they need to find can only be raised by way of loan. Government assistance will be required to ensure that any loan required is forthcoming.

The normal grant rate for sea erosion is 30%. Due to the serious nature of the situation, and the lack of local finance to meet any grant monies allocated a 70% grant rate is proposed.

Grant	$262,500
Local Share	$112,500
	$375,000

The interest payment alone on a loan of $112.500 will be $10,125 per year. This represents a rate of $1 on every $200 of capital value for the properties affected by the sea erosion. (Between Revell Street and the sea.)

Examples of rate increases for average valued properties are:

Domestic property value $10,000 rate increase $50
Commercial property value $100,000 rate increase $500

If interest and repayment are considered, these figures will be doubled.

16. DESIGN

Design of Revetment Type Sea Wall

Based on U.S. Army Coastal Engineering Research Centre, Shore protection manual.

(a) Design Wall Height

Note: Datum referred to is mean sea level Lyttelton. Mean high water spring at Hokitika is 1.4 metres.

The existing embankment has had to be lifted in places to a level of 5.3 metres to prevent excessive sea overflows into the township. After severe storms, Council staff remove drift wood and debris thrown up by the high seas. To keep costs to a minimum an embankment height to a level of 5.3 metres is proposed. The embankment can be topped up in the future should the Council require freeboard.

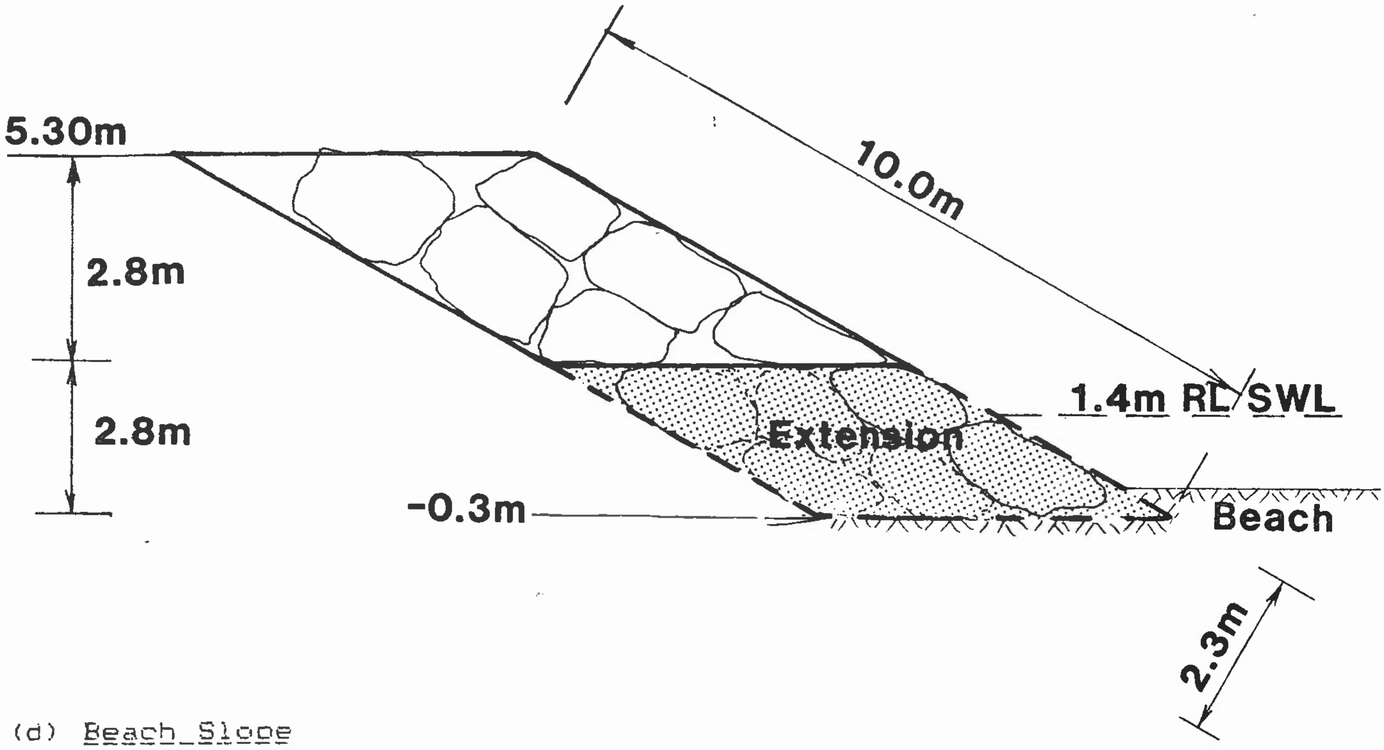
(b) Depth of Base of Wall

Over the past year cross-sections have been taken of the beach profile to establish the seasonal beach envelope. The survey has shown that there is a general build up of the beach in the summer months and a degradation in the winter months. The rise and fall ranging from plus 1.5 metres to minus 1.5 metres.

For design purposes the toe of the wall should be buried at least 1 metre into the beach. With the top of the sea wall at a level of 5.3 metres and the base at 2.5 metres the toe of the wall has 1 metre of cover over only about half its length. At the southern end the wall will need to be extended down to -0.3, and at cross-sections 357 and 1182 the extension down to 1.5 metres.

The maximum vertical height of the sea wall will be 5.6 metres. Slope height 10 metres.

(c) Wall Profile



(d) Beach Slope

Cross-sections indicate the beach slope is 1 in 18 S = 0.056

(e) Design Wave Height

The Science Centre, Christchurch, have been measuring wave characteristics offshore of Ngakawau, Westport and Carters Beach. The Ngakawau data is the most appropriate to use for Hokitika with its open coast line.

Wave Height:	10 year return period	7.8 metres
	20 year return period	8.4 metres
	50 year return period	9.3 metres
	100 year return period	10 metres

Design is based on 50 year return period, that is 9.3 metre wave.

Average wave period 7.5 seconds (35% frequency)
Variation: 5.5 seconds (5% frequency)
10.5 seconds (5% frequency)

Wave length

$$L_o = \frac{gT^2}{2} = 1.56\ T^2$$

Average Wave Length = 87.8 metres (288 ft.)
Minimum Wave Length = 47.2 metres
Maximum Wave Length = 172 metres

(f) Wave Breaking Height and Depth

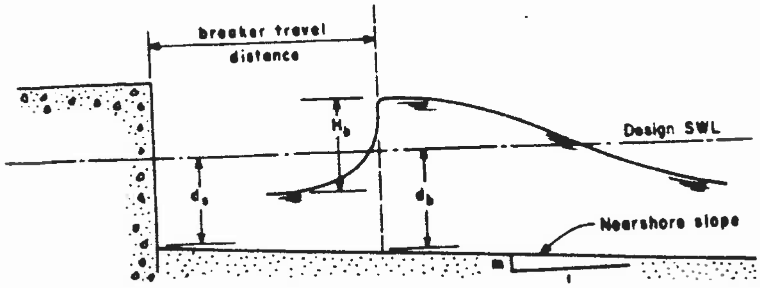
Reference Figure 7 Page 7 - 9

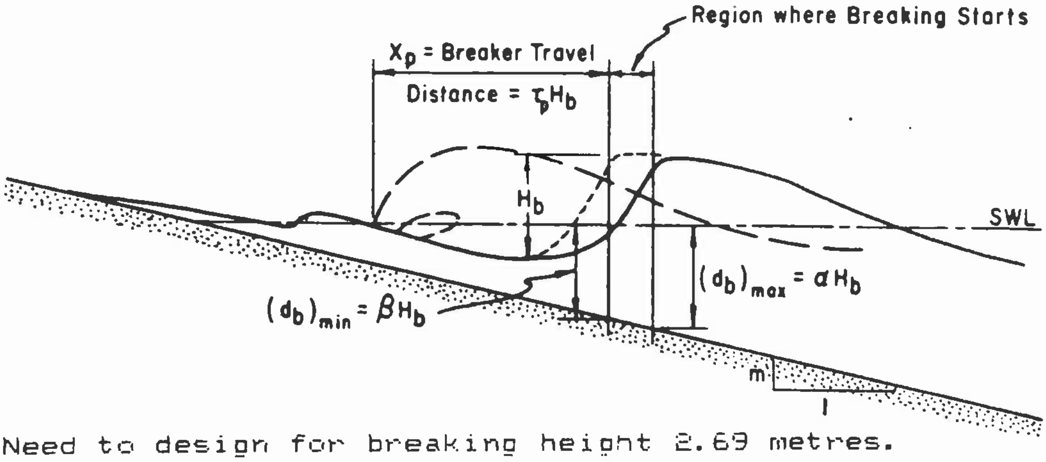
S = 0.056
ds = 1.7 metres (5.58 feet)
T = 7.5 seconds

$$\frac{ds}{gT^2} = \frac{6.57}{32.2 \times 7.5 \times 7.5} = 0.00308$$

$$\frac{Hb}{ds} = 1.58$$

Hb = 2.69 metres (8.82 feet)



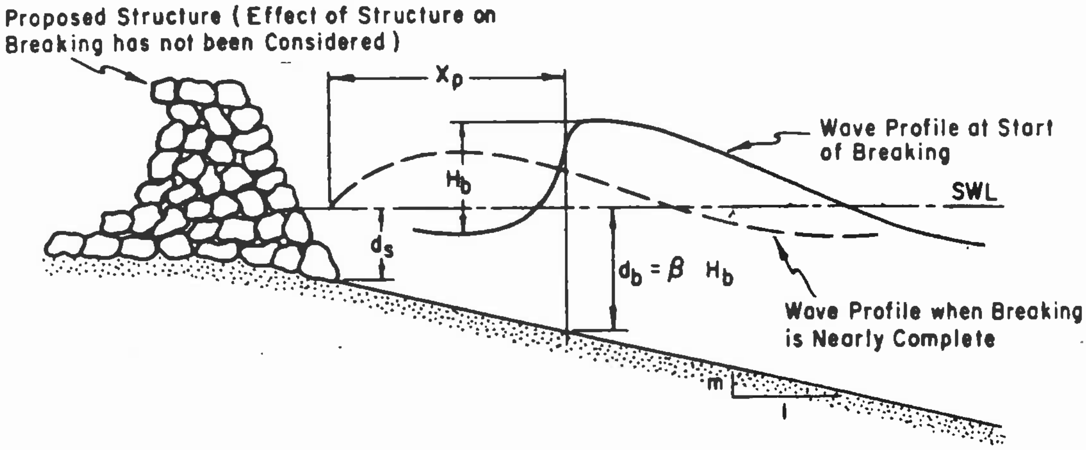


Need to design for breaking height 2.69 metres.

Breaking Depth

db = 1.28 Hb = 3.4 metres

(g) <u>Distance of Breaking Wave Offshore</u>



$$\frac{m}{1} = \frac{db - ds}{Xp} \qquad \frac{0.056}{1} = \frac{3.4 - 1.7}{Xp}$$

$$Xp = \frac{1.7}{0.056}$$

= 30.36 metres

(h) Design of Wall

Reference Page 7.169   Wave Height 2.69 metres (8.8 feet)

W = WrH 3 / KD(Sr-1) 3. Cot Ø

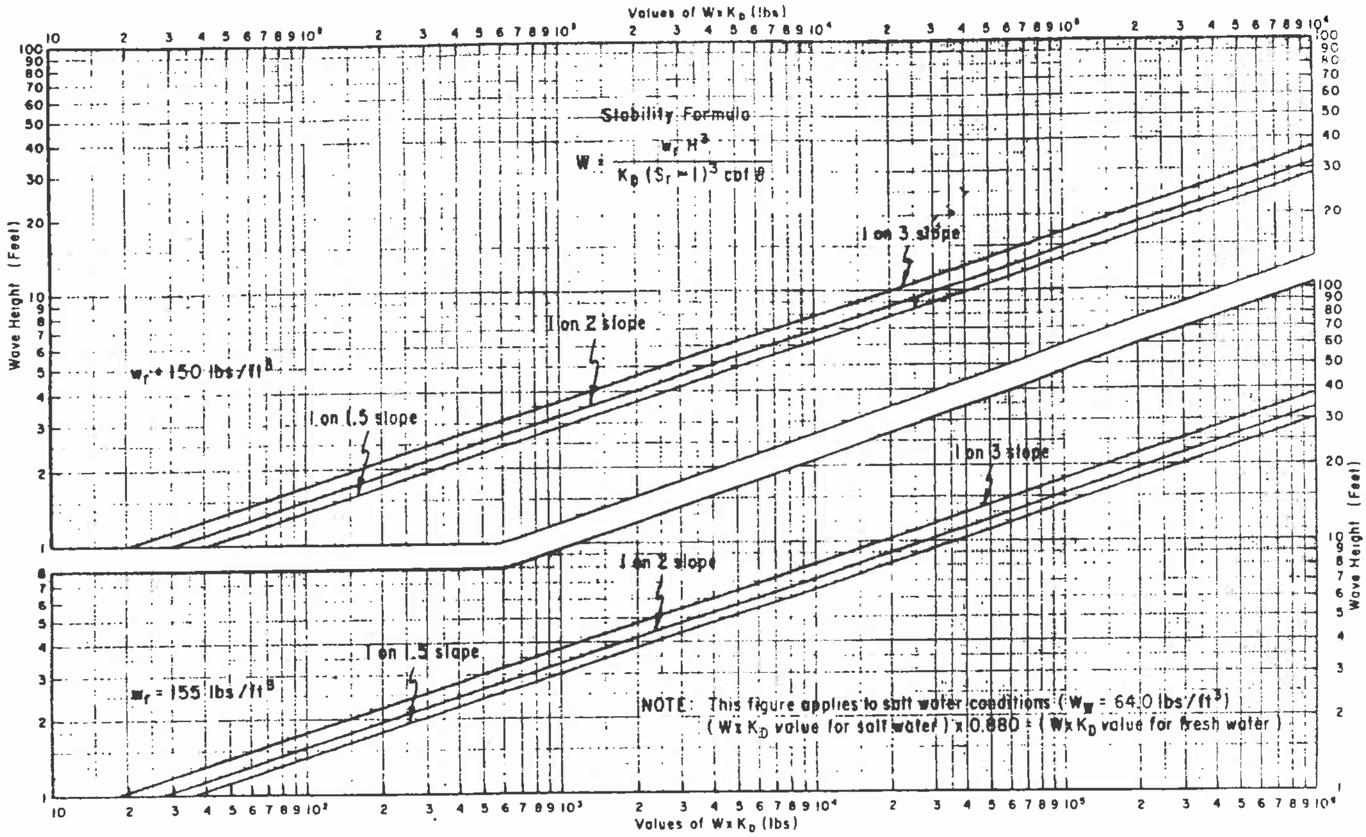


Figure 7-84. Weight of Armor Units x K_D Versus Wave Height for Various Slope Values (w_r = 150 lbs/ft³ and 155 lbs/ft³)

WKD = 30000 lls   KD = 2.5 rough quarry stone

W(mean rock size) = 12000 lls   Slope 1:1.5

= 5.4 tonnes

Maximum rock size = 1.25 W = 6.75 tonnes

Minimum rock size = 0.75 W = 4 tonnes

The above rock sizes calculated on using 2.69 metre wave height at wall match reasonable well with rock sizes used and remaining intact at the south end of the wall.

(i) Wave Reflection

P 2.117 - 2.120

X = x1 x2

$$\text{Contangent } B = \frac{1}{\tan B} = \frac{1}{0.056} = 17.9$$

$$\frac{Ho}{Lo} = \frac{9.3}{87.8} = 0.106$$

from 2-63 x2 = 0.05

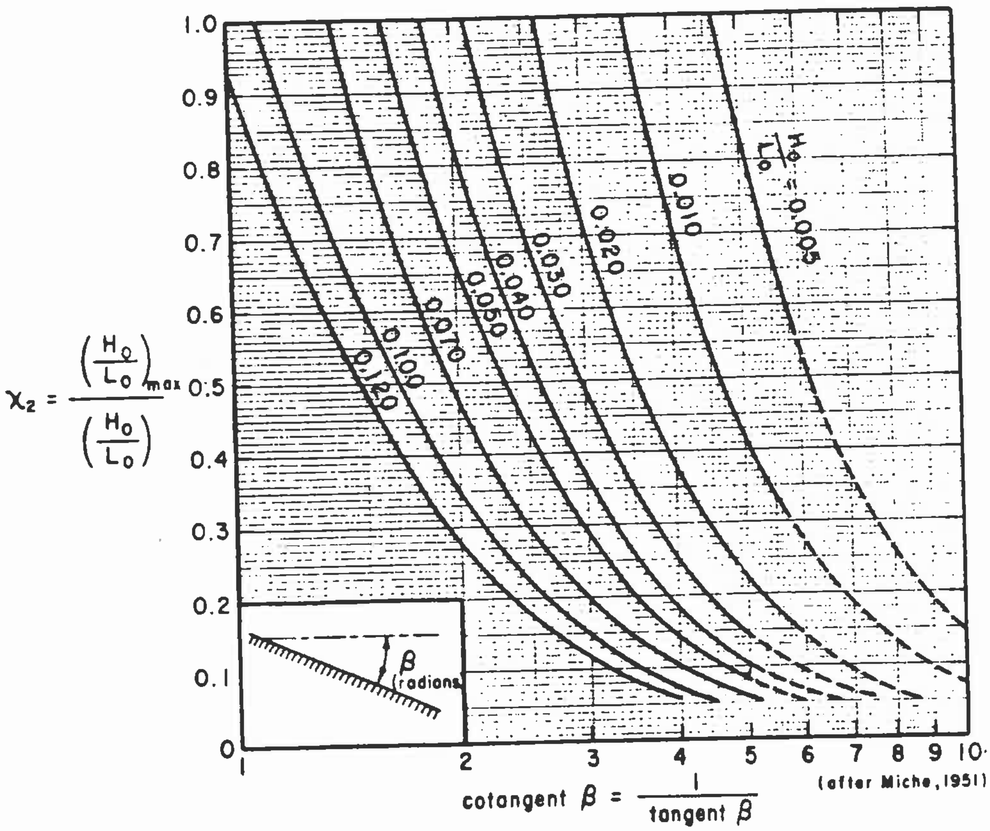


Figure 2-63. X_2 Versus Beach Slope for Various Values of H_o/L_o

x1 = 0.5

X = 0.025

Reflective Energy Factor 0.025

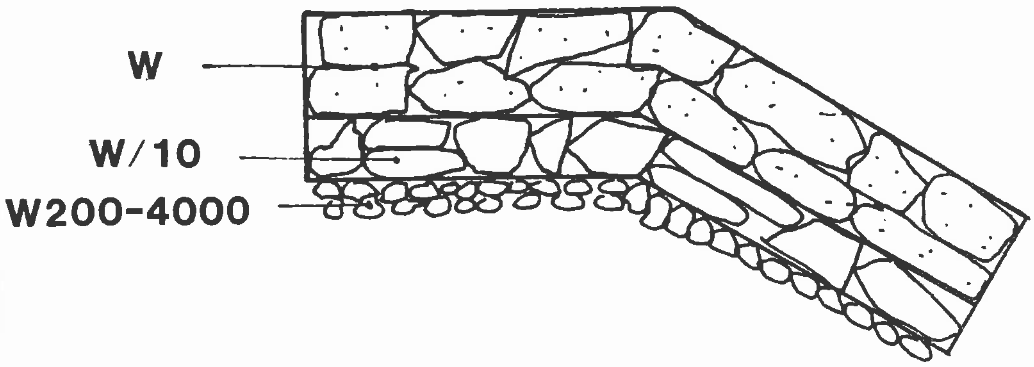
Crest Width

Recommended crest width 3 armour units wide
= 3.6 metres

actual width SQR 3.25 2.3 = 4 metres

Design of 3 layer wall

Reference P 7-193



W = 5.4 tonnes	thickness 2.3 metres
W/10 = 540 kilograms	thickness 0.5 metres
W/200 = 27 kilograms	thickness 0.1 metres

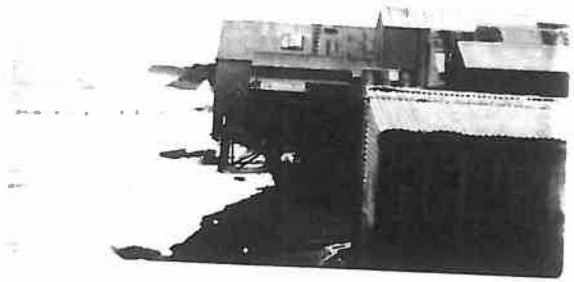
HOKAUG.LTR

HOKITIKA FORESHORE EROSION

10 May 1914

Ben Thiem Collection






HOKITIKA FORESHORE EROSION

10 May 1914

Ben Thiem Collection




LOW TIDE 4 JULY 1984

LOW TIDE 4 JULY 1984

SEA EROSION BETWEEN WELD AND CAMP STREETS

LOW TIDE 4 JULY 1984

HIGH TIDE 30 JULY 1984

HIGH TIDE:30 JULY 1984

LOW TIDE 4 JULY 1984

EROSION : SOUTH END

LOW TIDE 4 JULY 1984

Business Places Seriously Damaged By Sea Encroachment

9 APRIL, 1914.

Tuesday night will long be remembered by the people of Hokitika as the wildest night on record. A fierce nor-west gale accompanied by heavy rain descended upon the town about five o'clock. The gale gradually increased in fury until midnight and a tremendous sea raged on the waterfront.

Between nine and ten o'clock the tide was at is highest and the mountainous breakers pounded upon the beach. Rising higher and higher as the gale increased the big seas were soon pounding against the back fences and rears of the premises facing Revell Street. Tremendous damage was wrought. It is estimated that over fifty feet of the properties was eaten out by the sea.

Fences, outhouses and the back portions of the business premises were soon carried along the beach by the raging torrent. At the rear of the Exchange Hotel most damage was done, five fully furnished bedrooms being washed away. Many other premises suffered much damage and the amateur protection works that have been constructed by the residents were demolished.

Among the Revell Street residents who suffered considerably was Mr J. Brocklehurst, who lost his greenhouse and large woodshed, with their contents, together with a fine variety of choice gladioli bulbs, the sea dashing into one of the bedrooms and wash-house, attached to the main building.

As the sea gradually receded an indescribable scene of confusion and chaos met the eye yesterday morning. Fences were wrenched into all shapes, buildings were wrecked and parts were overhanging the bank the sea had cut and numerous outhouses were washed away entirely.

At the southern end of the beach a scene of confusion was to be seen. There were heaps and heaps of timber, dozens of boxes, large pieces of walls, pieces of furniture, long strips of linoleum, and thousands of pieces of smashed timber.

Lying here and there among the debris could be seen outhouses quite intact while a complete roof or a whole side of a shed helped to make the scene of complete desolation.

The gale went down in the early hours of yesterday morning, but the sea increased. At eight o'clock last night a tremendous sea was running but, fortunately, there was no wind. As it was considerable damage was done. A large store room belonging to Messrs McKay and Sons had been undermined by Tuesday night's storm and when last night's big breakers pounded upon its foundations the shed was soon badly kinked and a few minutes after eight o'clock a big wave reduced the shed to matchwood as it dropped with a heavy thud into the angry sea below. The sea continued to make and along the beach additional damage was done and at ten o'clock the huge curly breakers were breaking high up on the shore and so great was the force that just after ten o'clock the end of McKay's showroom was so undermined that it was carried down into the waves by its own weight and the breakers quickly cleared the room of its stock.

The residents, especially of Revell Street, are overawed and are quite helpless. Hundreds of pounds worth of protective works have been demolished and all the labour rendered useless by the encroachment of the sea.

The damage done by the sea is quite the worst disaster that has ever visited Hokitika. The owners of property on the sea side of Revell Street have spent hundreds of pounds upon protection works, but, in the main, these works were unable to withstand the sea. Very heavy timber was used and 8 x 8 inch posts were sunk into the sand and an equally heavy superstructure erected. Tuesday's storm dashed the whole structure to pieces.

Historical Newspaper Clippings

Government Grants £500

11 APRIL, 1914

On Thursday afternoon an emergency meeting of the Borough Council was held and the Revell Street property owners were invited. The position was regarded as extremely dangerous and it was agreed that immediate action was necessary.

The Mayor was instructed to telegraph the Prime Minister and place the position before the Government, and urge assistance.

On Thursday evening the following reply was received from Mr Massey:

"On behalf of the Government I will authorise a grant of £500 as a pound for pound subsidy on expenditure by residents or local authorities for protection of property from encroachment of sea. It is to be understood that the expenditure will be subject to Government supervision and approval."

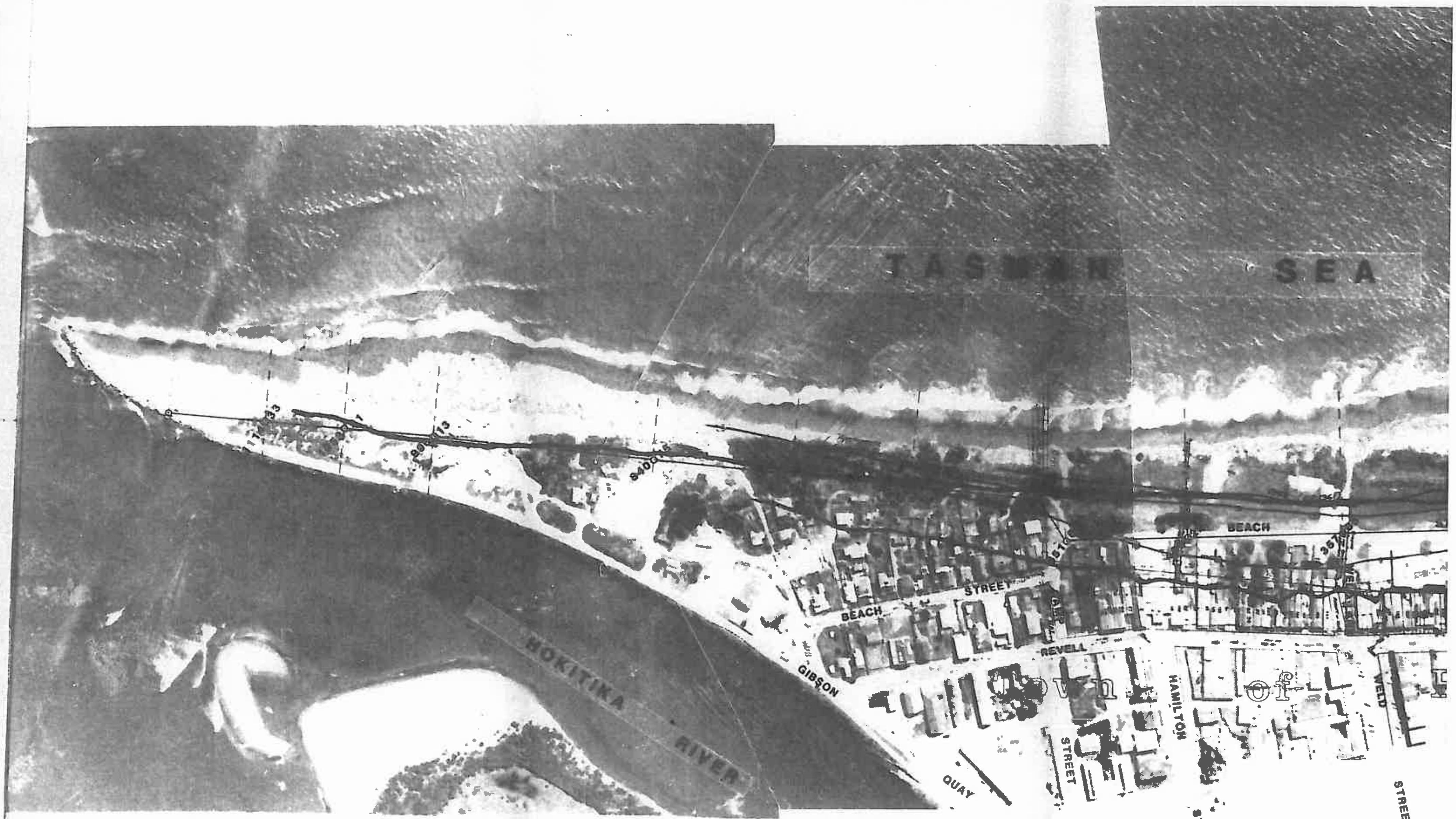
The position must be regarded as serious when it is borne in mind that in eight years the sea his encroached between one hundred and fifty to two hundred feet, while the capital value on the side of the street that is threatened is something like £16,000.

The residents are naturally alarmed as it is realised that unless very substantial protective works are constructed the main street in the town will be eaten away by the sea encroachment.

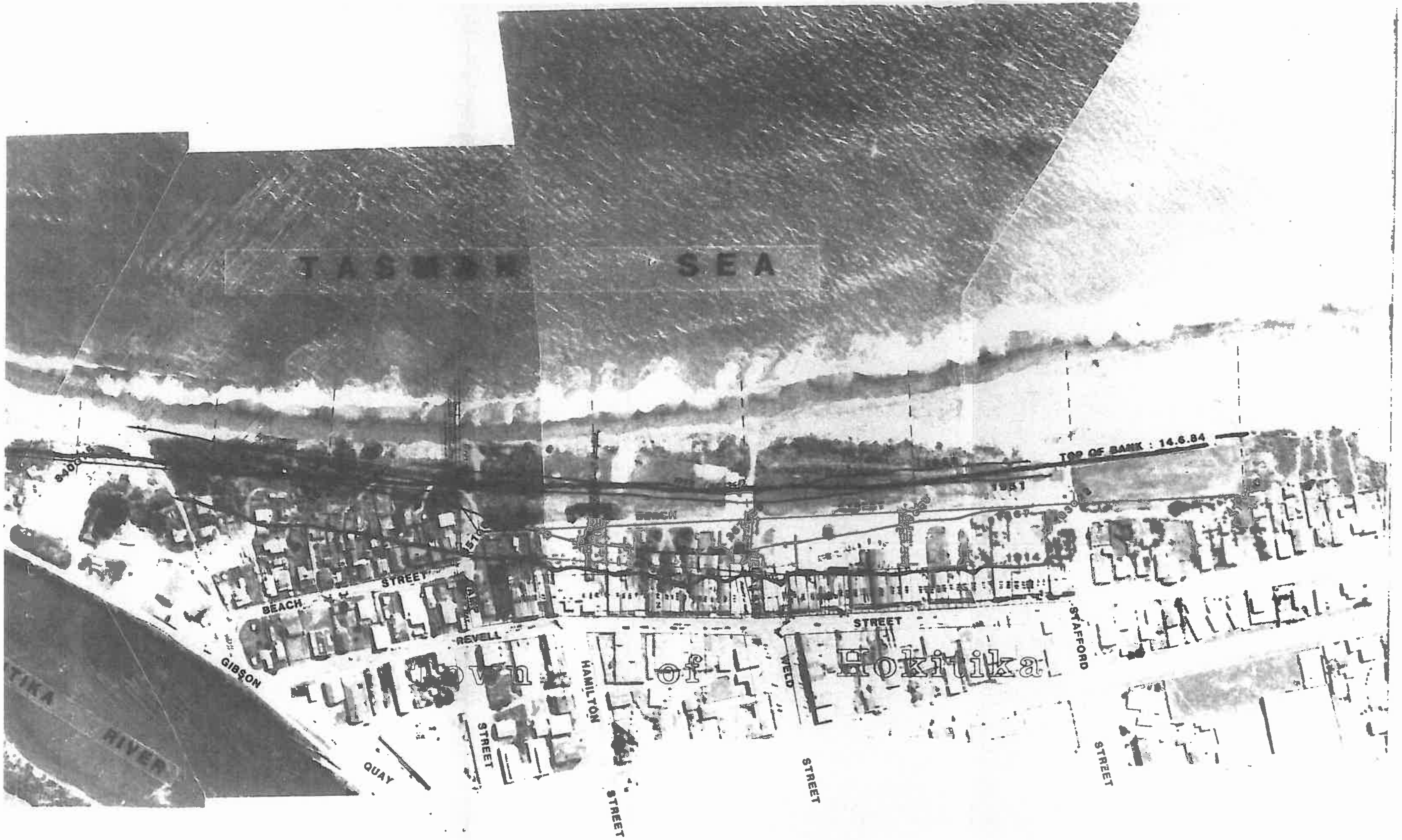
Should this happen, other portions of the town would be flooded as the bank in the vicinity of Revell Street acts as a sort of natural protection and prevents the sea flowing into the low-lying portions of the town.

THE SEA ENCROACHMENTS.

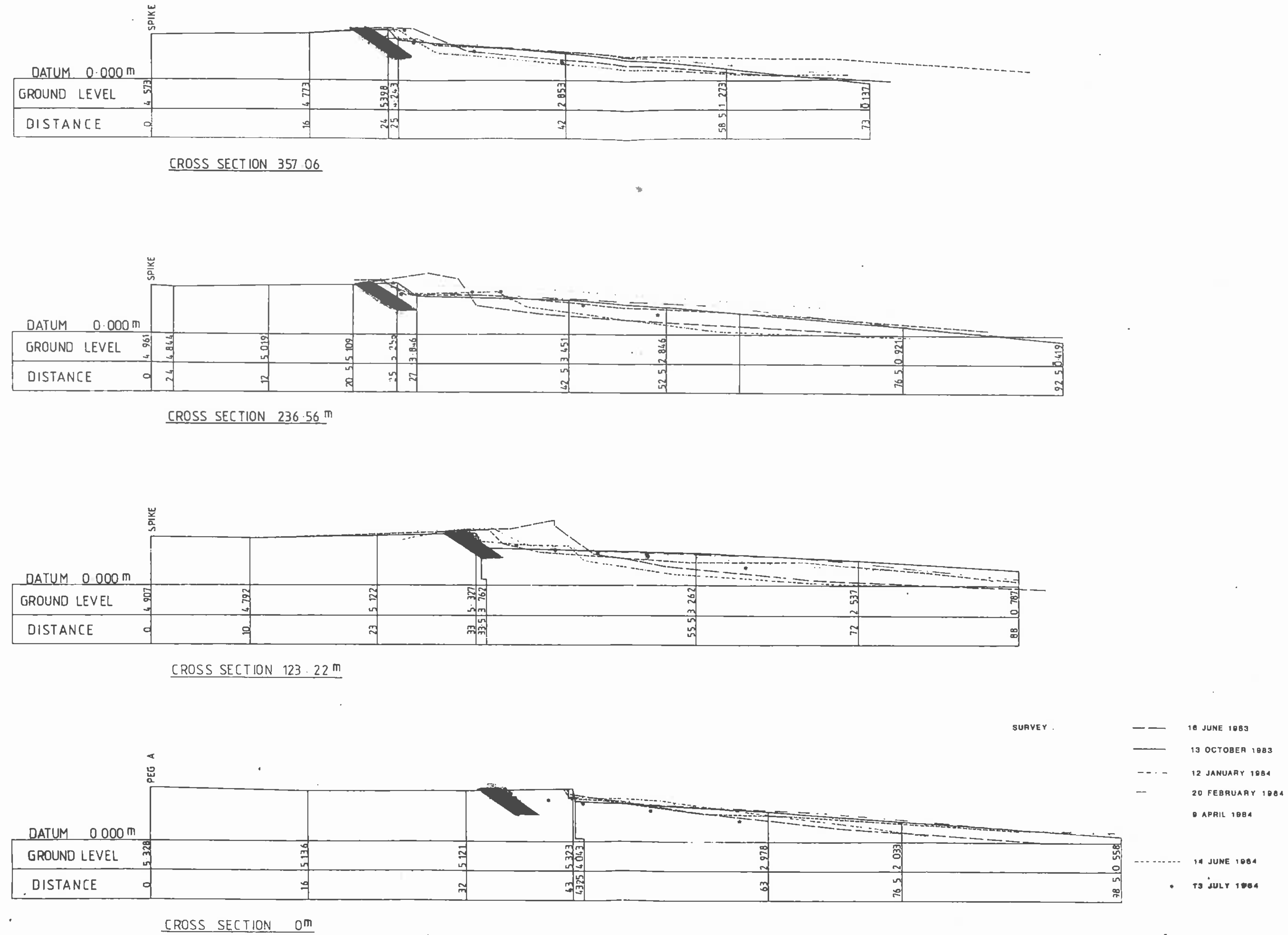
Yesterday, a rapidly-falling barometer gave warning that the splendid weather which was ushered-in by the new moon on Monday, was about to come to an end. During the night the barometer continued to fall with alarming rapidity, and the wind began to rise with that heavy wailing sound which is usually the precursor of a strong gale. These warnings were not without their due issue, as, towards midnight, a whole gale was blowing from the northward, accompanied with terrific downpours of rain and hail. The sea also rose rapidly, and at the time of high-water last night, the rollers were thrown up in dangerous proximity to the buildings on the west side of Revell-street; whilst on the terraces the wind howled around the frail wooden tenements, threatening momentarily their overthrow—many of them rocking to-and-fro like a ship in a sea-way. Fortunately no serious damage was caused by either element, further than an occasional overthrow of a chimney, or the removal of a few shingles from the roofs. The gale, however, commenced to abate about four o'clock in the morning, but though moderated to a breeze, it made rather violent attempts to sustain its worn-out fury. The sea which it had risen was something terrific, and as the flood tide made during the forenoon, the waves, as far as the eye could see, were mountainous in their size. The Alhambra and Isabella riding in the roadstead, were frequently obscured from observation from the beach, by the height of the waves. As the flood made, it became evident that the houses in north Revell-street were in imminent peril, but the inhabitants, although frequently warned of the danger approaching, made no appearance of anxiety for the safety of their effects, and it was not until a heavy roller or two broke in their midst, that any movement to save property was made. Then commenced a scene of indescribable confusion. Women running to and fro, wet up to the waist, and raising cries the most frantic in their alarm. Fortunately a number of the inhabitants had been drawn to this end of the town, in anticipation of such a mishap as the present, and by their efforts, things were soon reduced to some kind of order. A strong body of them immediately set to work in removing the furniture and other household effects to a place of safety, doing their work manfully, and being oftentimes submerged to the very waist in the heavy seas, which rapidly succeeding each other, kept the dwellings continually submerged. By their efforts the furniture from about a dozen houses was rescued from complete destruction. Meanwhile all along the north end of the beach, as far as Park-street, the waves were carrying on their work of devastation. Every portable article in the rear of the houses being washed away, icluding fences, water-butts, and closets, the latter certainly no great loss to the community at large. Several out-houses between Park-street and the end of the town were also entirely demolished, the waves lifting them completely off their piles, and washing them to and fro like a plaything, until they were utterly smashed to pieces. Providentially the dwelling houses suffered no greater harm than a complete inundation, and the destruction of a few window sashes and doors. Between Tudor-street and the Montezuma the waves made clean breaks over the street and tramway far into the marshy ground which borders the timber in the rear of the cattle pound, leaving high billows of froth, which covered the ground in the vicinity as though a heavy fall of snow had taken place. The tramway carriages on the Arahura line were compelled to cease running during the middle of the day, as the sea was sweeping portions of the line, between town and the Ho Ho creek; in fact, during one of the trips, a huge roller completely smothered the carriage and almost washed it off the line. A carrier, named Fletcher, who had left town early in the morning, was compelled to come to a stand-still with his waggon in the vicinity of the Three Mile creek, having previously had the waves washing round his vehicle as high as the axeltree. Just before coming to a halt, the waggon was surrounded by a larger wave than usual, and he had the misfortune to loose a valuable horse, which was thrown off its legs and drowned before it could be extricated. At the south-end of the town, we are happy to report no damage occurred from the seas, although at times their near proximity to the dwellings were a sufficient source of alarm to the residents. The river, although containing no great fresh, yet the send-home backed up its waters to such an extent, that fears were entertained of the flood overspreading the wharf, which would have inevitably taken place, but for the protection efforded by the South Spit in the shape of a breakwater. Much damage was also done to this natural barrier to the waves, as the sea so completely levelled the crown of the spit, that at high water it was completely awash. The appearance of the river from Gibson's Quay, at the top of high-water was picturesque in the extreme, presenting the appearance of almost an inland lake, with its dark fringe of trees on the South shore, and the tall masts of the shipping on the oppcsite side.



HOKITIKA BEACHFRONT : ERO



HOKITIKA BEACHFRONT : EROSION



ORIGINAL SCALE OF INCHES 0

SURVEYED	
DRAWN	
COMPUTNS	
TRACED	
CHECKED	

AMENDMENTS

SCALES 1:200 NATURAL

DATUM LWS

WESTLAND CATCHMENT BOARD

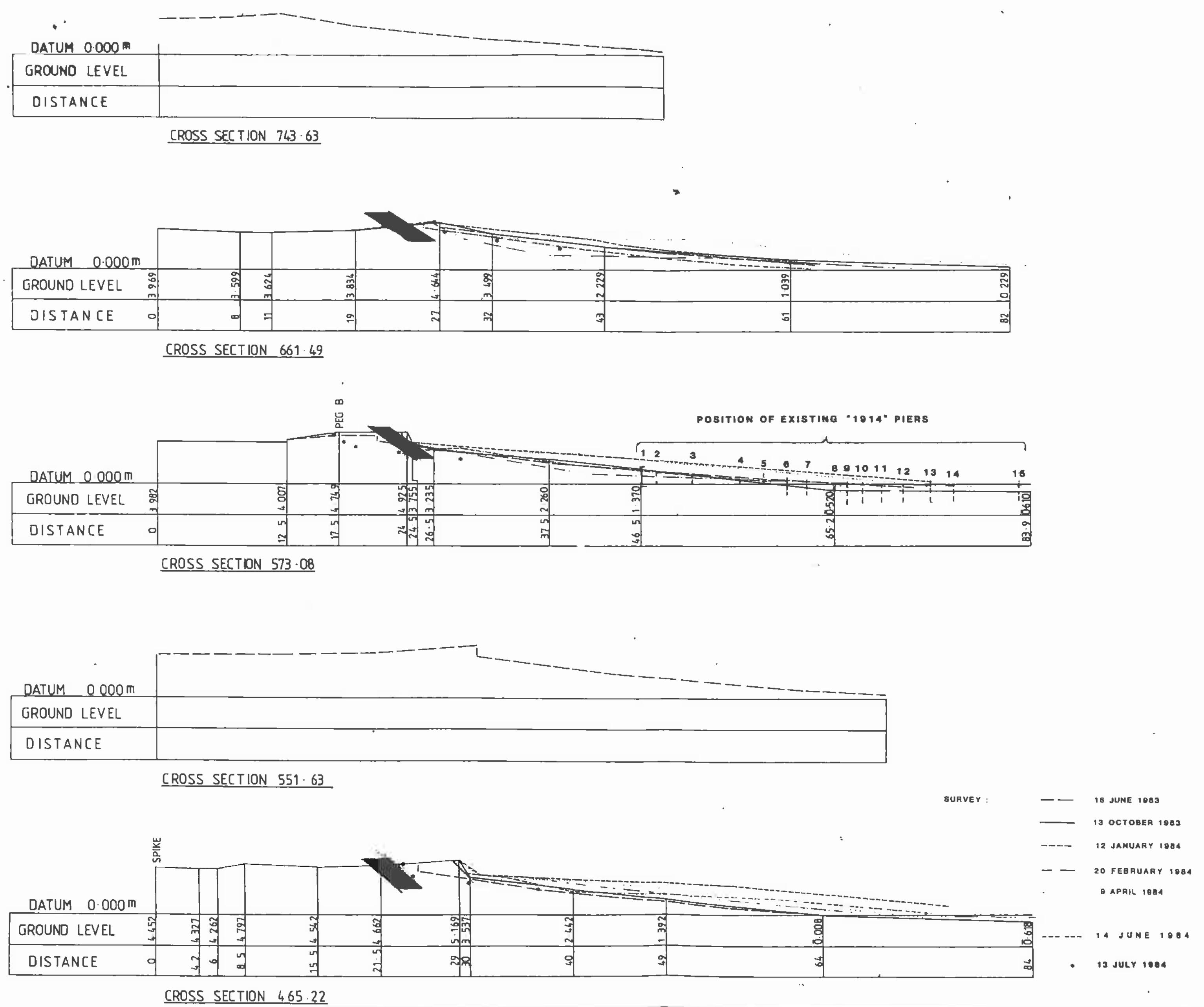
906000 HOKITIKA BEACH FRONTAGE
LOCATION OF PROPOSED BANK

Engineer ______ 19__

REFERENCE L.B'S 164,166, 172,173

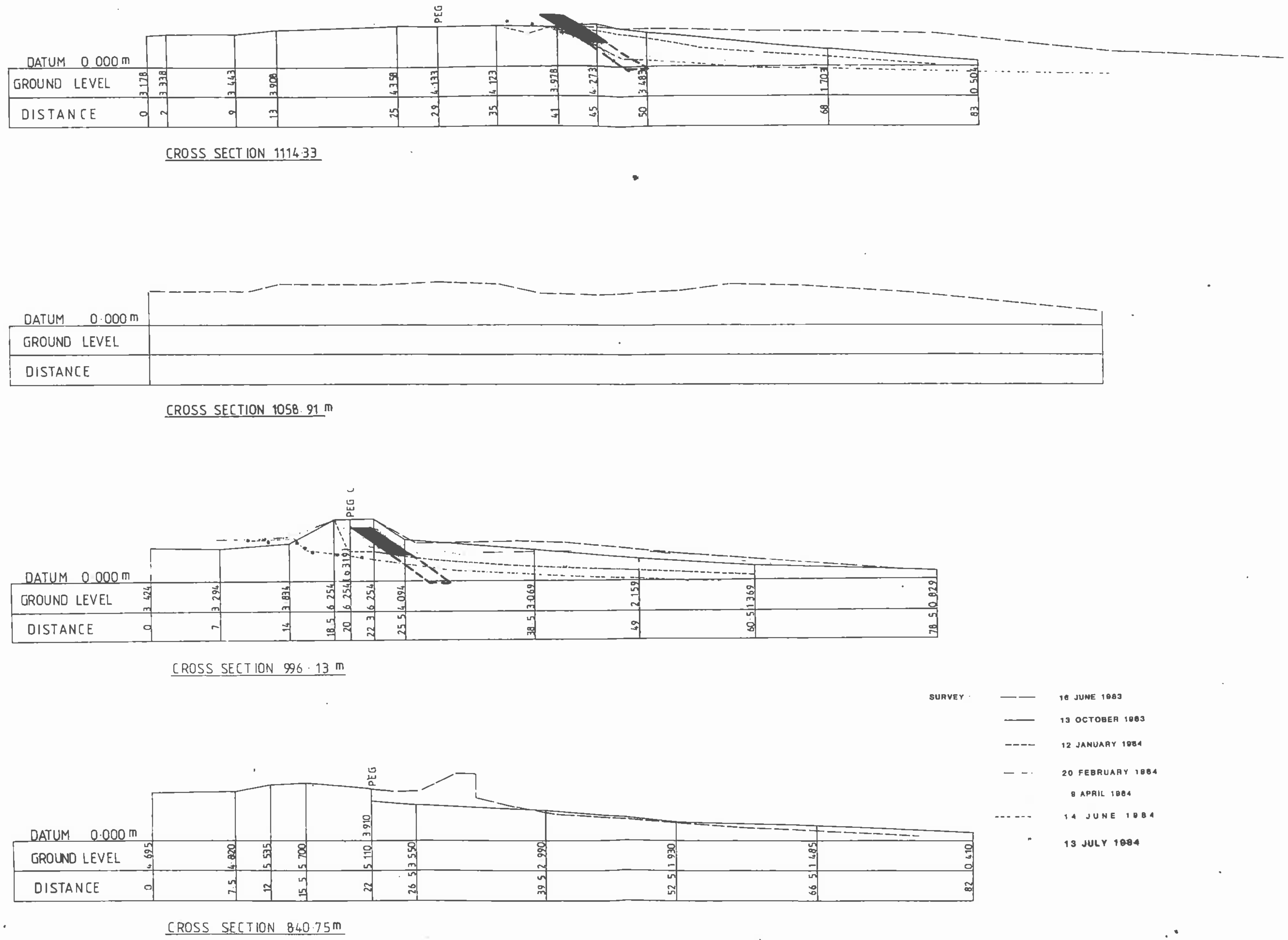
SHEET 1 of 3 SHEETS

906/ No 204 A3



ORIGINAL SCALE OF INCHES

SURVEYED			AMENDMENTS		SCALES 1:200 NATURAL	WESTLAND CATCHMENT BOARD	Engineer	SHEET 2 of 8 OF SHEETS
DRAWN						906000 HOKITIKA BEACH FRONTAGE		
COMPUTNS					DATUM LSS	**LOCATION OF PROPOSED BANK**	REFERENCE L.S.'s 164, 166, 172, 178	906/ No. 204 A3
TRACED								
CHECKED								



CROSS SECTION 1114.33

DISTANCE	0	2	9	13	25	29	35	41	45	50	68	83
GROUND LEVEL	3.178	3.338	3.443	3.908	4.358	4.133	4.123	3.978	4.273	3.483	1.703	0.504

CROSS SECTION 996.13 m

DISTANCE	0	7	14	18.5	20	22.3	25.5	38.5	49	60.5	78.5
GROUND LEVEL	3.424	3.294	3.834	6.254	6.254 (6.319)	6.254	4.094	3.069	2.159	1.369	0.829

CROSS SECTION 840.75 m

DISTANCE	0	7.5	12	15.5	22	26.5	39.5	52.5	66.5	82
GROUND LEVEL	4.695	4.820	5.535	5.700	5.110 (3.910)	3.550	2.990	1.930	1.485	0.410

ORIGINAL SCALE OF INCHES 0

SURVEYED			AMENDMENTS	SCALES 1:200 NATURAL
DRAWN				
COMPUTNS				DATUM
TRACED				
CHECKED				

WESTLAND CATCHMENT BOARD

906000 HOKITIKA BEACH FRONTAGE

LOCATION OF PROPOSED BANK

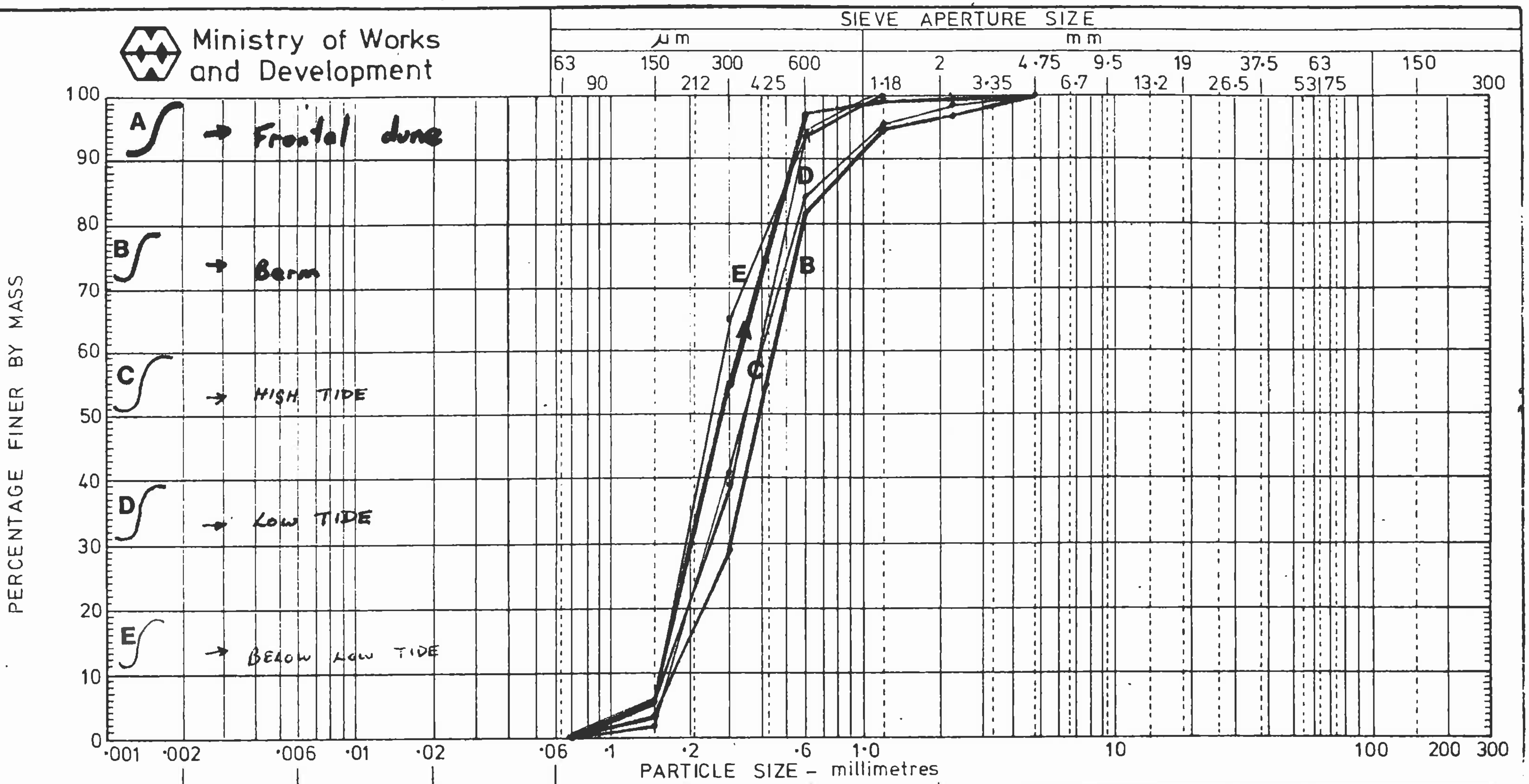
Engineer ______ 19__

REFERENCE L.B'S 194, 196, 172, 173

SHEET 3 of 3

No 906/204 A3

Ministry of Works and Development



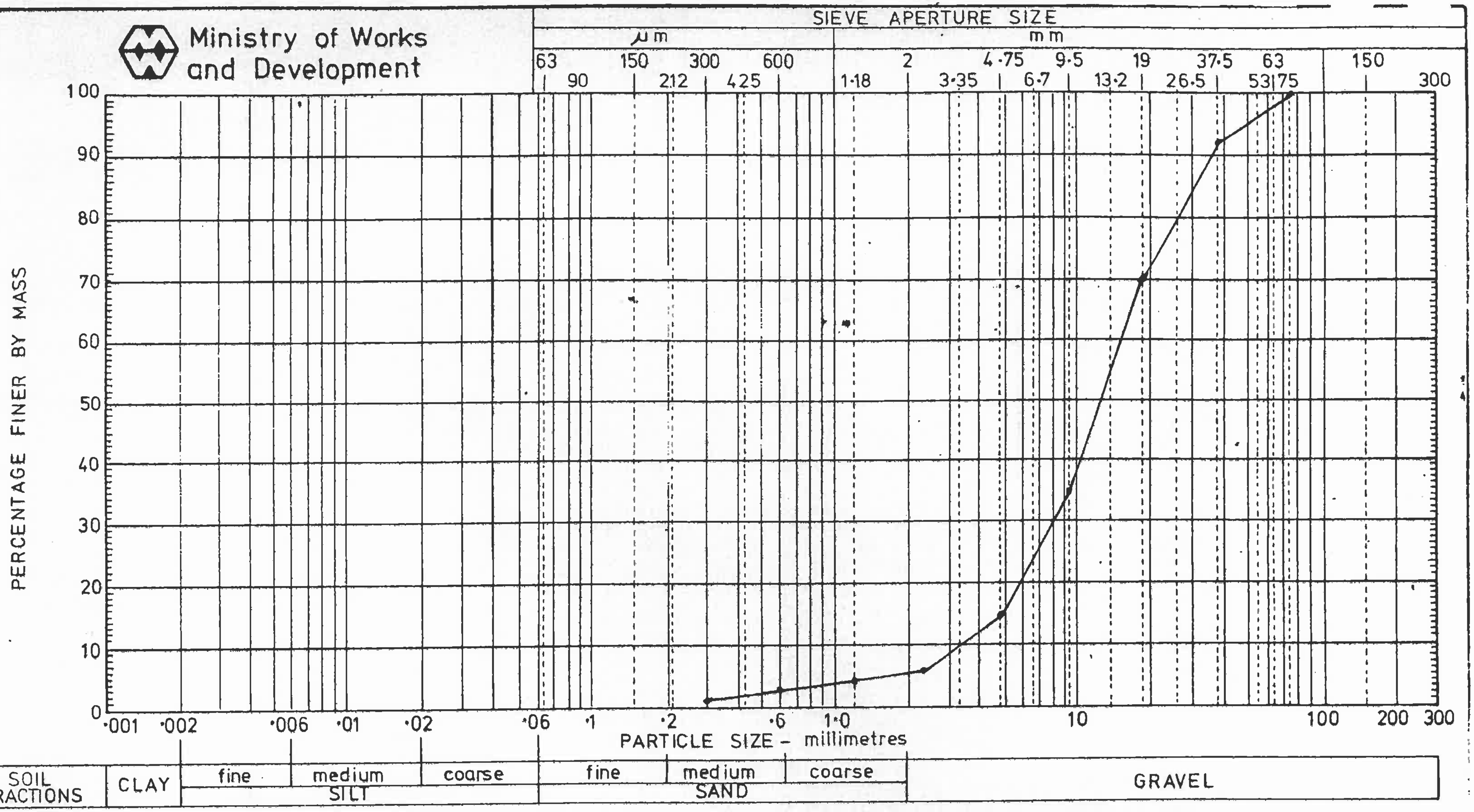
SOIL FRACTIONS	CLAY	SILT fine	SILT medium	SILT coarse	SAND fine	SAND medium	SAND coarse	GRAVEL

JOB. Hokitika Beach Recession	SAMPLE No. 84/25	~~DRY SIEVE~~		NAME	DATE	DRAWING No.
MATERIAL. Beach Material	HOLE No.	WET SIEVE	Test by	G. Kimber	11-8-84	
			Plotted by	G. Kimber	12-8-84	
REMARKS. South of Hokitika River	DEPTH		Check by			

PARTICLE SIZE DISTRIBUTION

94106F–4,000/4/77CTM

Ministry of Works and Development

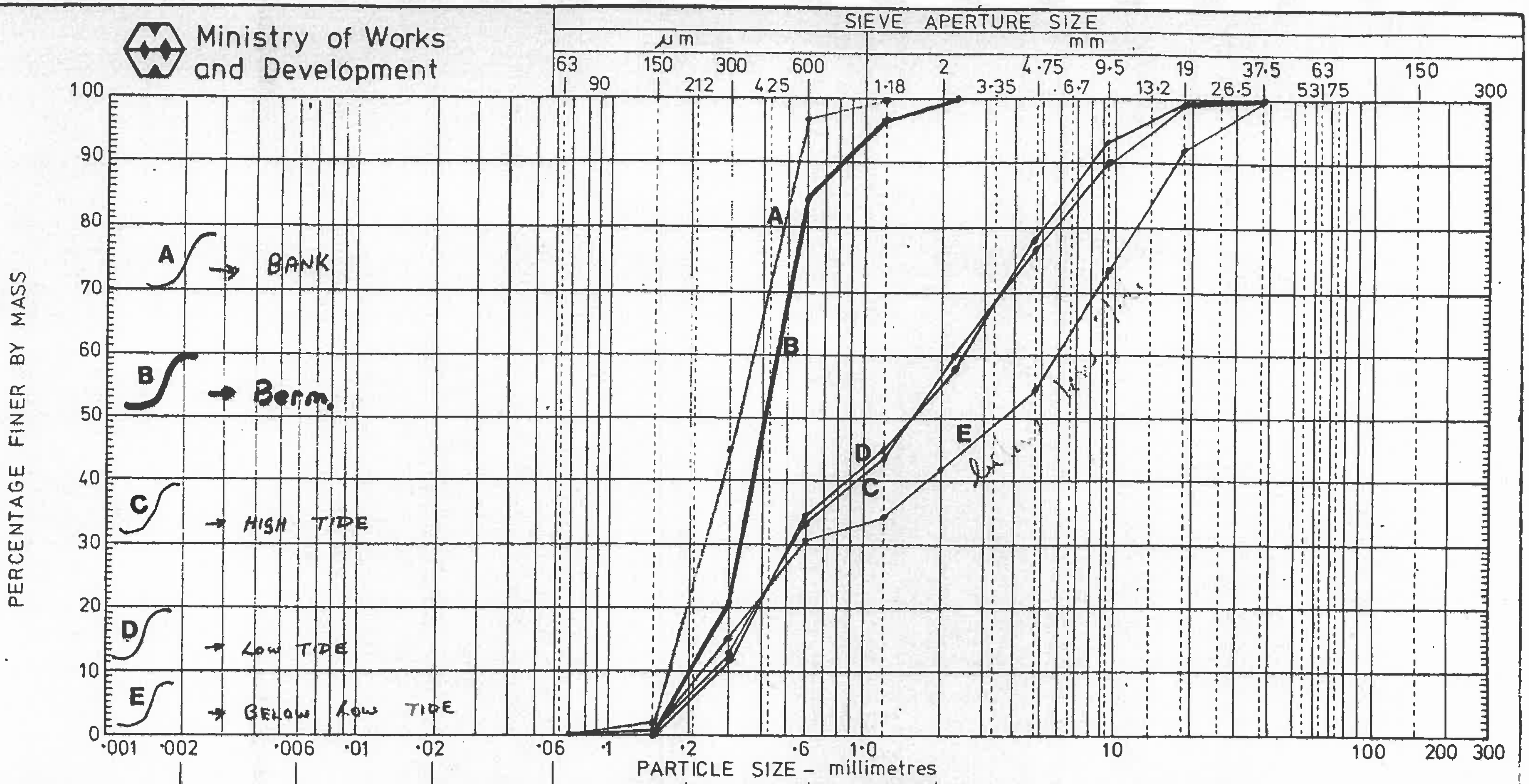


JOB. Hokitika Beach Recession	SAMPLE No. 84/25	~~DRY SIEVE~~		NAME	DATE	DRAWING No.
MATERIAL. ex Right Bank of Hokitika River	HOLE No.	WET SIEVE	Test by	G. Kimbone	11-8-84	
REMARKS.	DEPTH		Plotted by	G. Kimbone	12-8-84	
			Check by			

PARTICLE SIZE DISTRIBUTION

94106F—4,000/4/77CTM

Ministry of Works and Development



SOIL FRACTIONS	CLAY	SILT fine	SILT medium	SILT coarse	SAND fine	SAND medium	SAND coarse	GRAVEL

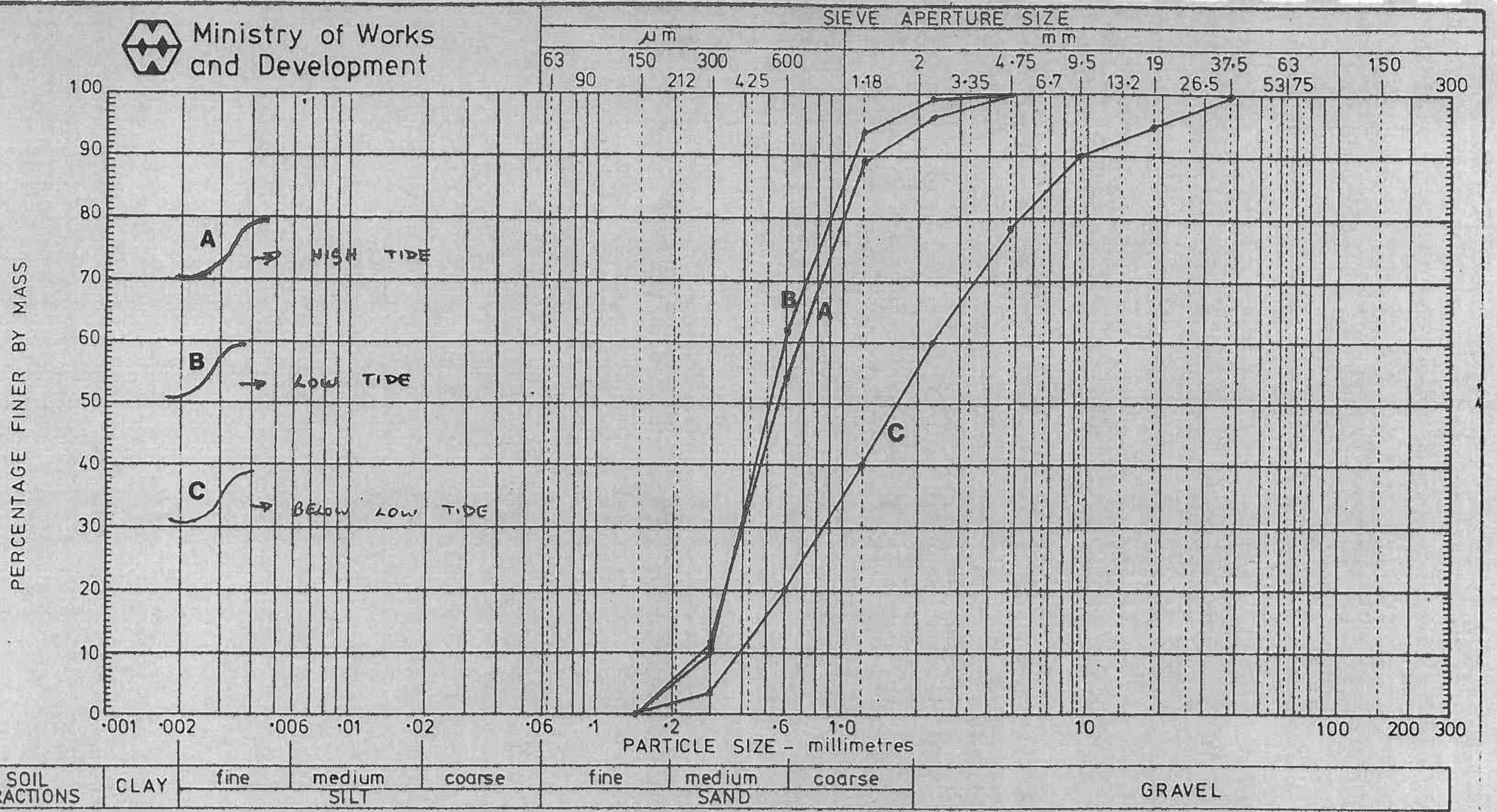
JOB. Hokitika Beach Recession	SAMPLE No. 84/25	~~DRY SIEVE~~		NAME	DATE	DRAWING No.
MATERIAL. Beach Material	HOLE No.	WET SIEVE	Test by	G. Kimber	11-8-84	
REMARKS. Camp St	DEPTH		Plotted by	G. Kimber	12-8-84	
			Check by			

PARTICLE SIZE DISTRIBUTION

94106F–4,000/4/77CTM

3

Ministry of Works and Development

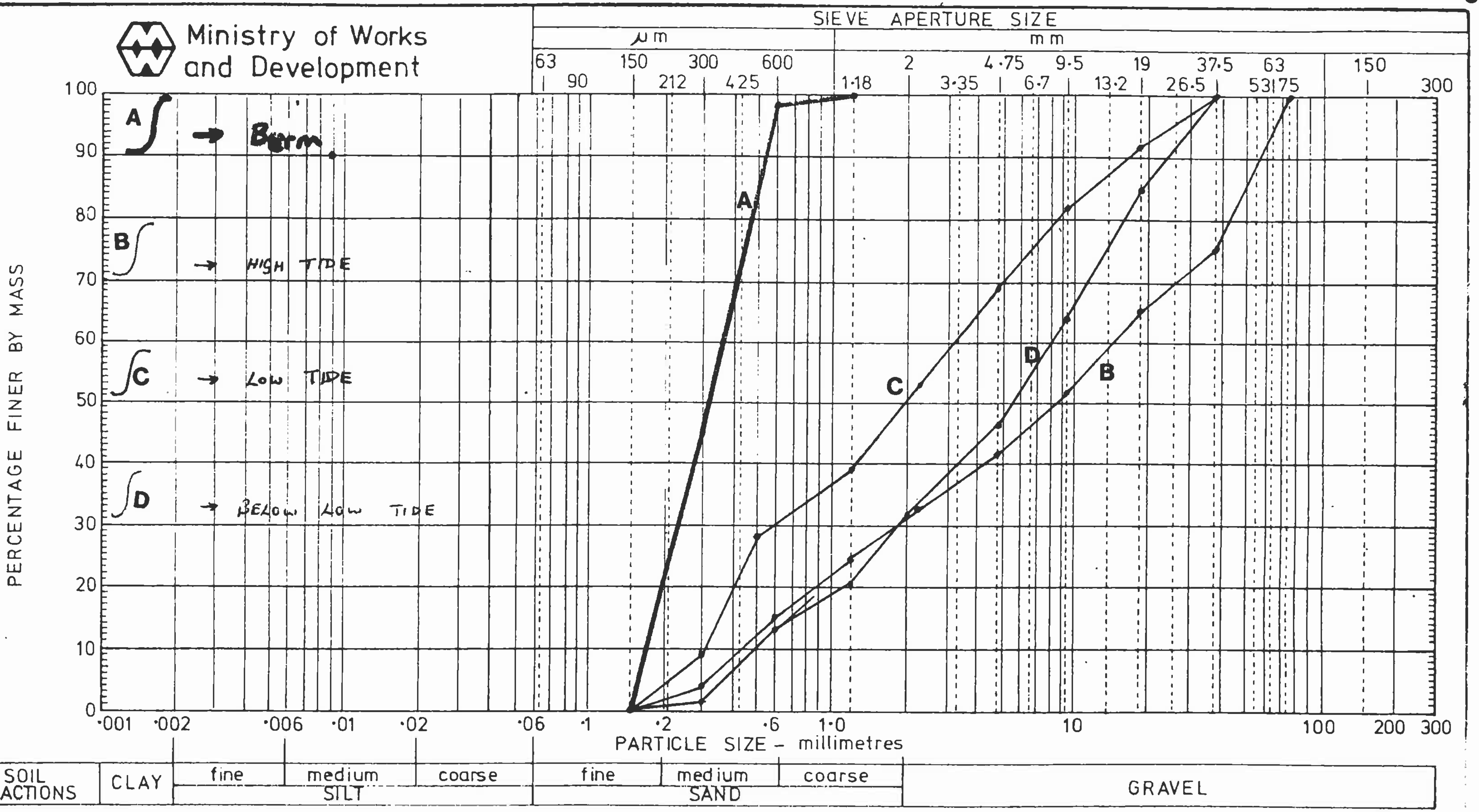


JOB. Hokitika Beach Recession	SAMPLE No. 84/25	~~DRY SIEVE~~		NAME	DATE	DRAWING No.
MATERIAL. Beach Material	HOLE No.	WET SIEVE	Test by	G. Kumbone	11-8-84	
REMARKS. North Belt.	DEPTH		Plotted by	G. Kumbone	12-8-84	
			Check by			

PARTICLE SIZE DISTRIBUTION

94106F–4,000/4/77CTM

Ministry of Works and Development



JOB. Hokitika Beach Recession

SAMPLE No. 84/25

~~DRY SIEVE~~

MATERIAL. Beach Material

HOLE No.

WET SIEVE

REMARKS. Stafford St

DEPTH

	NAME	DATE	DRAWING No.
Test by	G. Kimbore	11-8-84	
Plotted by	G. Kimbore	12-8-84	
Check by			

PARTICLE SIZE DISTRIBUTION

94106F–4,000/4/77CTM