EFFECTS OF THE LOWER MANAWATU RIVER FLOOD CONTROL SCHEME ON THE FARMING IN THE LOWER MANAWATU

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CHAPTER I

INTRODUCTION

The Lower Manawatu River Flood Control scheme came into operation in 1963. It was designed to protect 70,000 - 80,000 acres of land in the Lower Manawatu from flooding. The aim of this thesis is to examine the effects this scheme has had on the farming in the protected area. Removal of the risk of frequent and severe flooding has improved conditions for farming, and it is expected that these improved conditions should be reflected in changes in farming activities. Land which was susceptible to the most frequent inundations of floodwater should have received the most benefit from flood protection, while land on which the chance of flooding was remote, should have received the least benefit. The effects of the scheme, therefore, should be reflected to a proportionately greater or lesser extent according to the frequency with which flooding was experienced.

Selection of Criteria

In order to examine the effects of the flood control scheme, four criteria were selected to be discussed at pre- and post-scheme dates. These were: land values, changes in land use, stock numbers, and production levels. A fifth factor, that of income, would also indicate the effects, but to evaluate the influence of the scheme from income figures would entail carrying out a complete cost-benefit analysis. Taking into account the amount of detailed analysis required by such a method, and the short period of time involved since the completion of the scheme, the results gained from an analysis of this sort would probably not justify the method, since conclusions reached from a cost-benefit analysis could not be expected to differ greatly from conclusions reached by examining the four criteria selected.

Source of Information

Information concerning the selected criteria has been collected from the records of the Valuation Department, and from interviews with a number of farmers in the Lower Manawatu. The data on land values has been taken from valuation revisions made at pre- and post-scheme dates. The unimproved value, the improvements value and the capital value for each farm rated by the Manawatu Catchment Board for the flood control scheme has been used to show the effects of the scheme on land values. A stratified random sample of one-sixth of the farmers was made. From each of the four flood frequency classes 31 farmers were selected by a table of random numbers. The total comprised one-sixth of the farming population of the Lower Manawatu. Of the 124 in the sample, 104 farmers were interviewed, eight refused to co-operate and a further twelve could not be contacted. The questionnaire applied to each farmer is shown in Appendix A.

Definition of Areas

The land in the Lower Manawatu rated for the flood control scheme has been divided into seven districts and four flood frequency areas, these divisions consisting of land in the Counties of Kairanga, Manawatu and Horowhenua. (Fig. 1) The districts and flood frequency areas are those used by the Manawatu Catchment Board in classifying land for rating purposes. Flood frequency areas are defined according to the susceptibility of land to river flooding. (Table III-2) The divisions used are: 1 year, 5 year, 20 year and 100 year flooding expectancies. Farms have been classified according to districts and flood frequency areas throughout. Since it is expected that land liable to the most frequent flooding should show a proportionately greater amount of benefit from the scheme, and that land with only a remote chance of flooding should receive less benefit from protection,

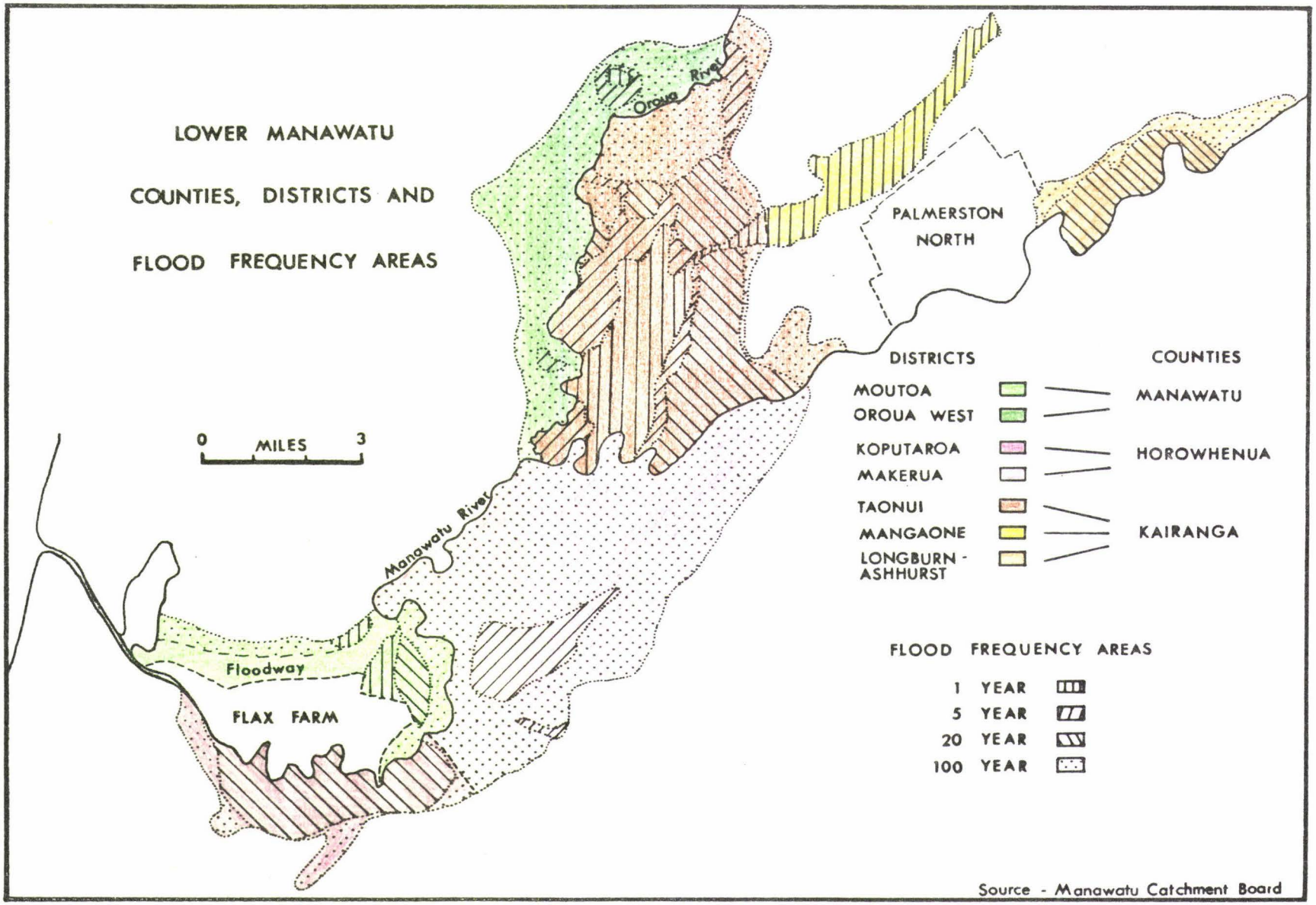
LOWER MANAWATU
COUNTIES, DISTRICTS AND
FLOOD FREQUENCY AREAS
Oroua River
PALMERSTON NORTH
0 MILES 3
Manawatu River
Floodway
FLAX FARM
DISTRICTS
COUNTIES
MOUTOA
OROUA WEST
MANAWATU
KOPUTAROA
MAKERUA
HOROWHENUA
TAONUI
MANGAONE
KAIRANGA
LONGBURN - ASHHURST
FLOOD FREQUENCY AREAS
1 YEAR
5 YEAR
20 YEAR
100 YEAR
Source - Manawatu Catchment Board

FIG. 1.

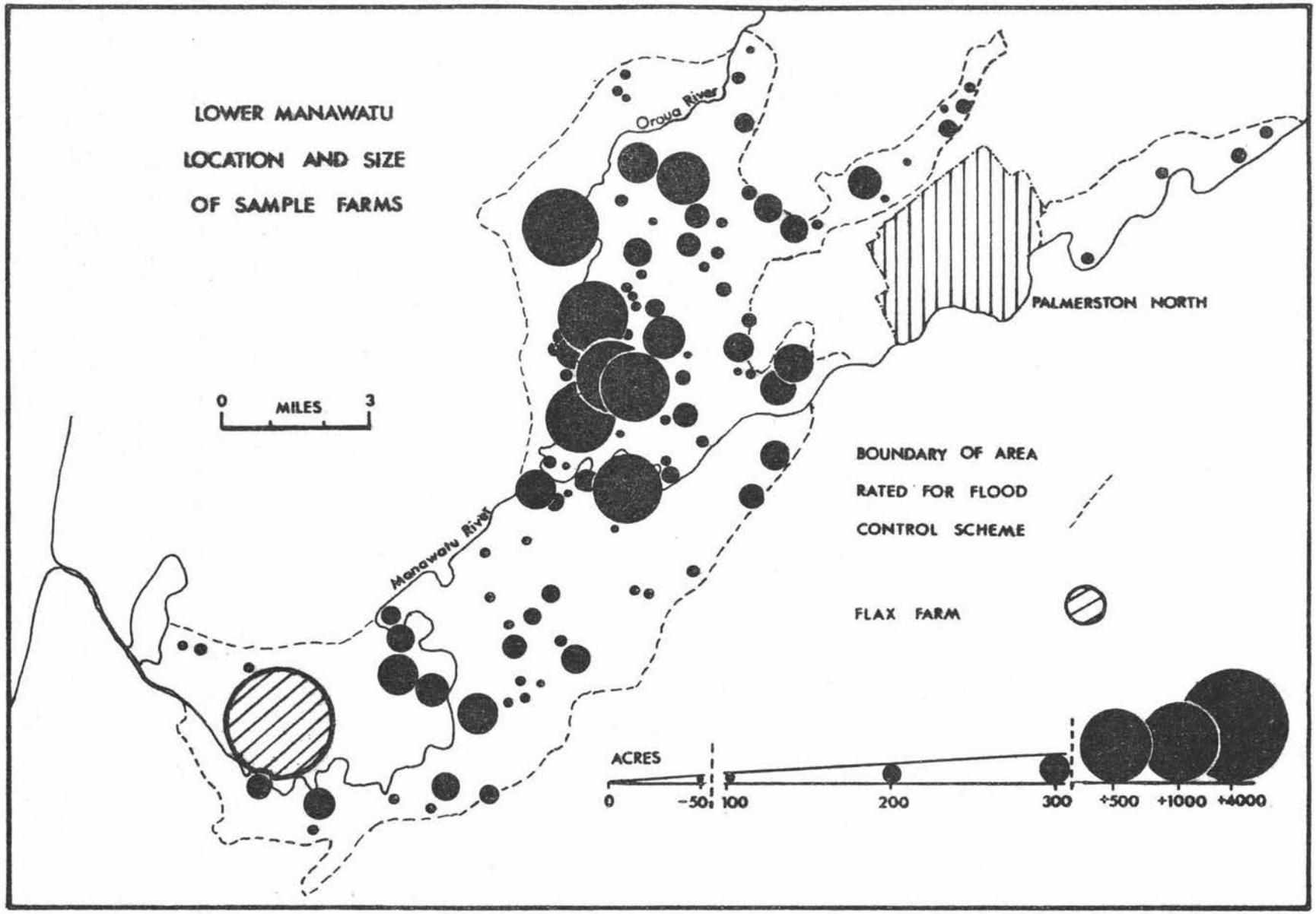
LOWER MANAWATU
LOCATION AND SIZE
OF SAMPLE FARMS
Oroua River
PALMERSTON NORTH
0 MILES 3
Manawatu River
BOUNDARY OF AREA
RATED FOR FLOOD
CONTROL SCHEME
FLAX FARM
ACRES
0
-50
100
200
300
+500
+1000
+4000

FIG. 2.

classification into flood frequency areas is necessary. The 100 year flood frequency area is regarded as a control area in order to overcome the influence of factors disconnected with the scheme, as farming activities on this land display characteristics similar to those of flood-free land.

This thesis consists of two parts. The first provides a general background to the problem of flooding in the Lower Manawatu, and the operation of the flood control scheme, and the second examines the effects of the scheme on farming activities by comparing these at pre- and post-scheme dates within districts and flood frequency areas. The effects of the scheme are discussed with reference to the four criteria: land values, changes in land use, stocking rates, and production levels.

PART I - BACKGROUND TO THE FLOOD CONTROL SCHEME

CHAPTER 2.

PHYSICAL AND ECONOMIC SETTING

The Manawatu River Catchment

The Manawatu River rises on the eastern slopes of the Ruahine Range. It flows to the west coast where it discharges water drained from an area of 2,296 square miles. (Fig. 3) The presence of the Tararua - Ruahine Ranges, through which the river flows by the Manawatu Gorge, separates this catchment into two distinct parts. The portion of the catchment east of the Ranges comprises 1,256 square miles, or 54.5% of the total. Here the Manawatu River is joined by the Mangatainoka, Tiraumea and Mangahao Rivers, these draining a total of 660 square miles. Numerous small streams rising in the Ruahine Range and the eastern Puketoi and Waewaepa Ranges also join the Manawatu River.

Fifty miles from the sea the Manawatu River flows through the Manawatu Gorge to have its volume increased by water from the western slopes of the Ruahine and Tararua Ranges. It drains an area of 1,040 square miles, being joined by the Pohangina, Mangaone and Oroua Rivers from the Ruahine Range, and the Tiritea, Kahuterawa, Tokomaru and Mangaore Streams which originate in the Tararua Range. [1]

Consideration of the extent of the catchment of the Manawatu River and its tributaries is particularly important. The existence of a large catchment area to the east of the Tararua - Ruahine Ranges as well as one to the west means the frequency of flooding and the volume of flood water is increased.

Also important is the nature of the topography within the catchment. The gradients of the rivers are a reflection of the land slopes, while the intensity of flow is a reflection of the gradients. Some consideration then of the topography is necessary. For this purpose, the catchment may be

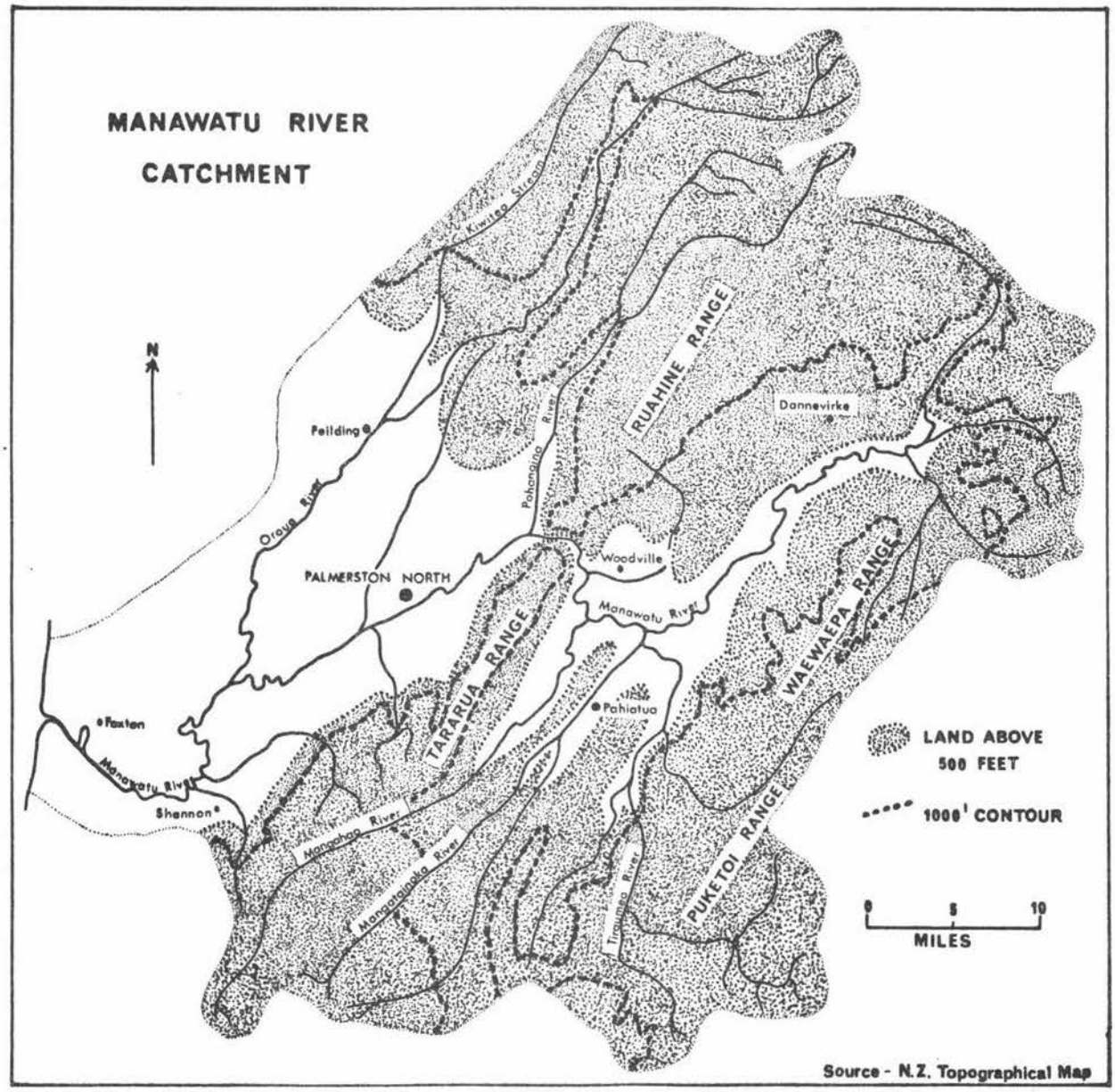
MANAWATU RIVER
CATCHMENT
N
Kiwitea Stream
Oroua River
Pohangina River
RUAHINE RANGE
Feilding
Dannevirke
PALMERSTON NORTH
Woodville
Manawatu River
TARARUA RANGE
WAEWAEPA RANGE
Foxton
Manawatu River
Pahiatua
Shannon
Mangahao River
Mangatainoka River
Tiraumea River
PUKETOI RANGE
LAND ABOVE
500 FEET
1000' CONTOUR
0
5
10
MILES
Source - N.Z. Topographical Map

FIG. 3.

divided into an upper, or 'highland' area and a lower, or 'lowland' area. The prime function of the upper catchment area is to act as an efficient collector and distributor of water for the Manawatu River, whereas the lowland area, although contributing to the water supply, serves primarily as a transporter of the large volume of water from the upper catchment to the sea.

The whole catchment is underlain by a basement of Triassic-Jurassic greywacke rocks which outcrop in the Tararua and Ruahine Ranges. Hall says of the Manawatu, 'to a large extent the present topography reflects the underlying structure. The greywacke basement has been faulted into blocks and over these the Pliocene and Pleistocene rocks have been draped in a series of anticlines and synclines. The anticlines stand out as high arched surfaces, now dissected and the synclines form the intervening lower areas, now occupied by river valleys.'[2] Material from the 'highland' area has been deposited along these river valleys by the rivers in times of flood. The lower portion of the catchment, the Manawatu River flood plain, has been formed in this manner.

Slopes and river gradients must be considered in conjunction. The Tararua - Ruahine Ranges vary in height from 1,100 feet at the lip of the Manawatu Gorge to over 5,000 feet near the headwaters of the Oroua River. In this upper catchment, river gradients are steep. The Mangatainoka River near its headwaters at the 1,000 feet contour near Putara, maintains a gradient of thirty feet per mile, this decreasing to one of fifteen feet per mile near its junction with the Manawatu River. Similar gradients are found on the upper reaches of all rivers and streams in this upper catchment. At the headwaters of the rivers, gradients become almost vertical.

This is in direct contrast to the gradients displayed by the Manawatu River in the lower portion of the catchment. The river leaves its entrenched course between high banks south of Palmerston North to follow a meandering

course across its floodplain. A fall of seven feet per mile from the gorge to Longburn, 44 river miles from the sea, decreases to a fall of three feet per mile from Longburn to the junction of the Oroua River. For the remaining thirty miles it maintains a gradient of one foot per mile.[3]

It follows also, that the concentration of flow of water will diminish with a decrease in gradients. Thus from the upper reaches of the rivers a rapid discharge of water pours into the lower Manawatu River where the gentle gradient will reduce the rate of discharge. At times when a swollen volume of water, resulting from a heavy rainfall, increases the flow of the Manawatu River, the gentle nature of the gradient on the floodplain means the river is unable to cope with transporting all the water within its normal course to the sea. This results in an overspill of water from the river course onto the floodplain.

The topography of the floodplain intensifies flooding in another way. Since it has been built up by material deposited by the river, the land slopes away from the river where there is no obstruction to the flow of alluvial material and several basins have been formed. The lowest areas in the Taonui Basin lie at 28 feet above sea level, while those in the Makerua Basin are 14 feet above the sea. These levels can be compared with the ground level by the Manawatu River south of Linton. This level is 50 feet above sea level. At the sluice gates ground levels have decreased to 20 - 24 feet, but lowlying areas of the Moutoa Basin are only six feet above sea level. (Fig.4) Water overspilling from the Manawatu River in times of increased flow will become trapped in these lowlying basins.

The extent of the catchment and the nature of the topography within this catchment give rise to the shape and slope of the course of the river. These factors have combined to produce a river course in which flooding can readily occur in periods of high runoff.

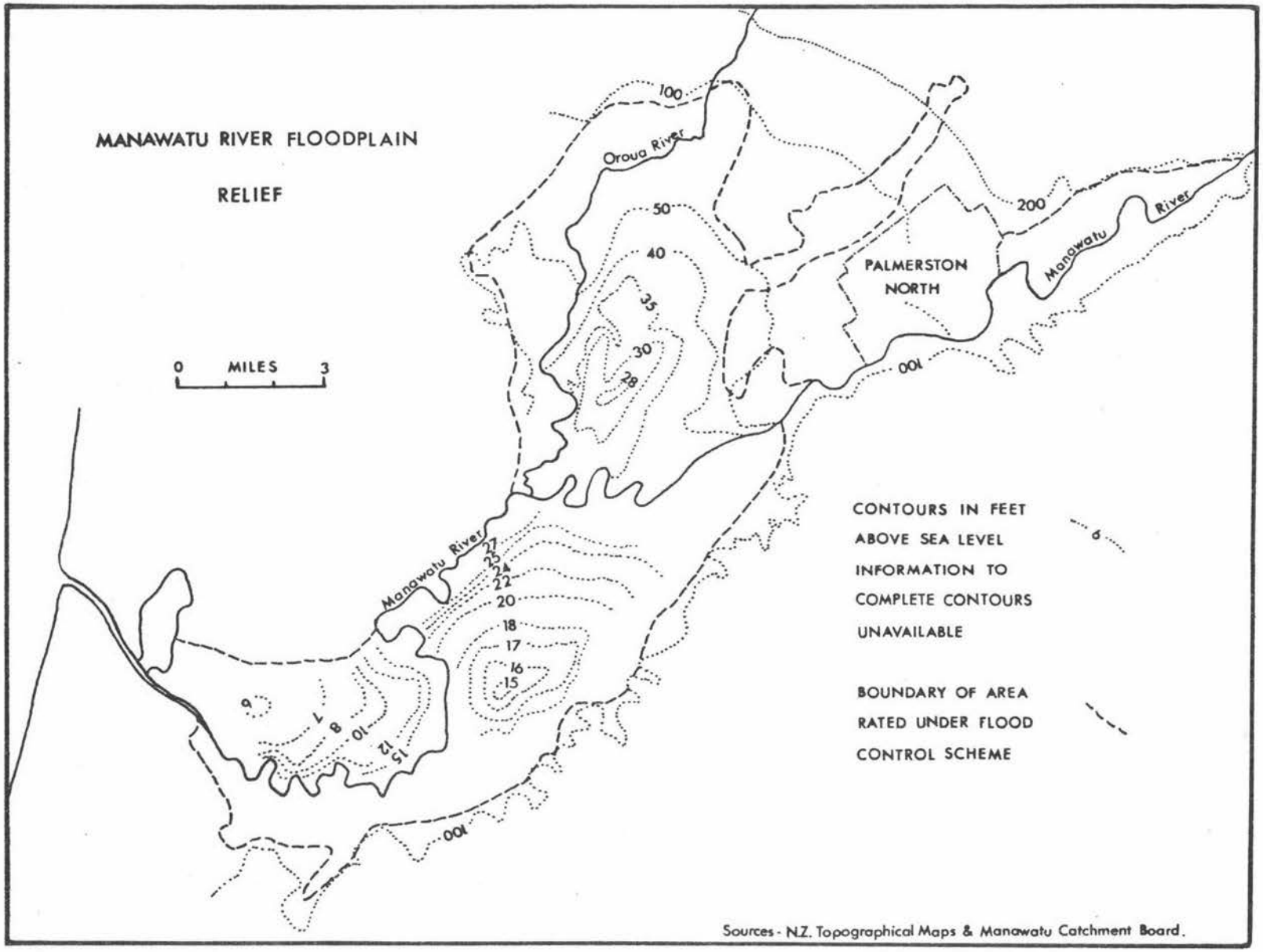
MANAWATU RIVER FLOODPLAIN
RELIEF
0 MILES 3
Oroua River
Manawatu River
PALMERSTON NORTH
Manawatu River
100
50
40
35
30
28
200
100
27
25
24
22
20
18
17
16
15
6
7
8
10
12
15
100
CONTOURS IN FEET ABOVE SEA LEVEL
INFORMATION TO COMPLETE CONTOURS UNAVAILABLE
BOUNDARY OF AREA RATED UNDER FLOOD CONTROL SCHEME
Sources - N.Z. Topographical Maps & Manawatu Catchment Board.

FIG. 4.

Climate

Fundamental to the problem of flooding is the supply of water from the catchment. This means rainfall conditions within the catchment must be considered. Other features of the climate have less direct bearing on the problem.

The distribution of rainfall throughout the catchment is shown in Fig.5. It is evident that the upper catchment area must provide the greater share of water for the Manawatu River since mean annual rainfall generally remains below 45 inches on the lowland portion, while it rises to over 200 inches in the Tararua Range. The rainfall pattern displays an even distribution throughout the year with slight maxima occurring in winter and the month of October, and a late summer - autumn minimum. (Table I-2) This pattern is common to all stations in Table I-2 , the only difference being in the amounts of rainfall. The variation can be attributed to the relief and to the position of the Manawatu with reference to the west - east passage of day to day weather conditions.

The weather in the catchment arises from the sequence of anticyclones and depressions moving in an easterly direction over New Zealand. The Manawatu Catchment Board have noted three major storm types associated with weather conditions which give rise to heavy rain and often result in flooding. 4

Storm type A. occurs when a depression from the Tasman Sea travels from west to east across the catchment, or slightly north of the catchment. This type is subdivided into A.1 and A.2. The former of these occurs when an intense low pressure system travels over the catchment with moderate to rapid movement. Rain is generously distributed over the whole catchment with the highest concentration to the east of the ranges. Fig.6 illustrates the isohyet pattern associated with such weather conditions which produced a major flood. Over a period of 72 hours, an average of 6.8 inches of rain

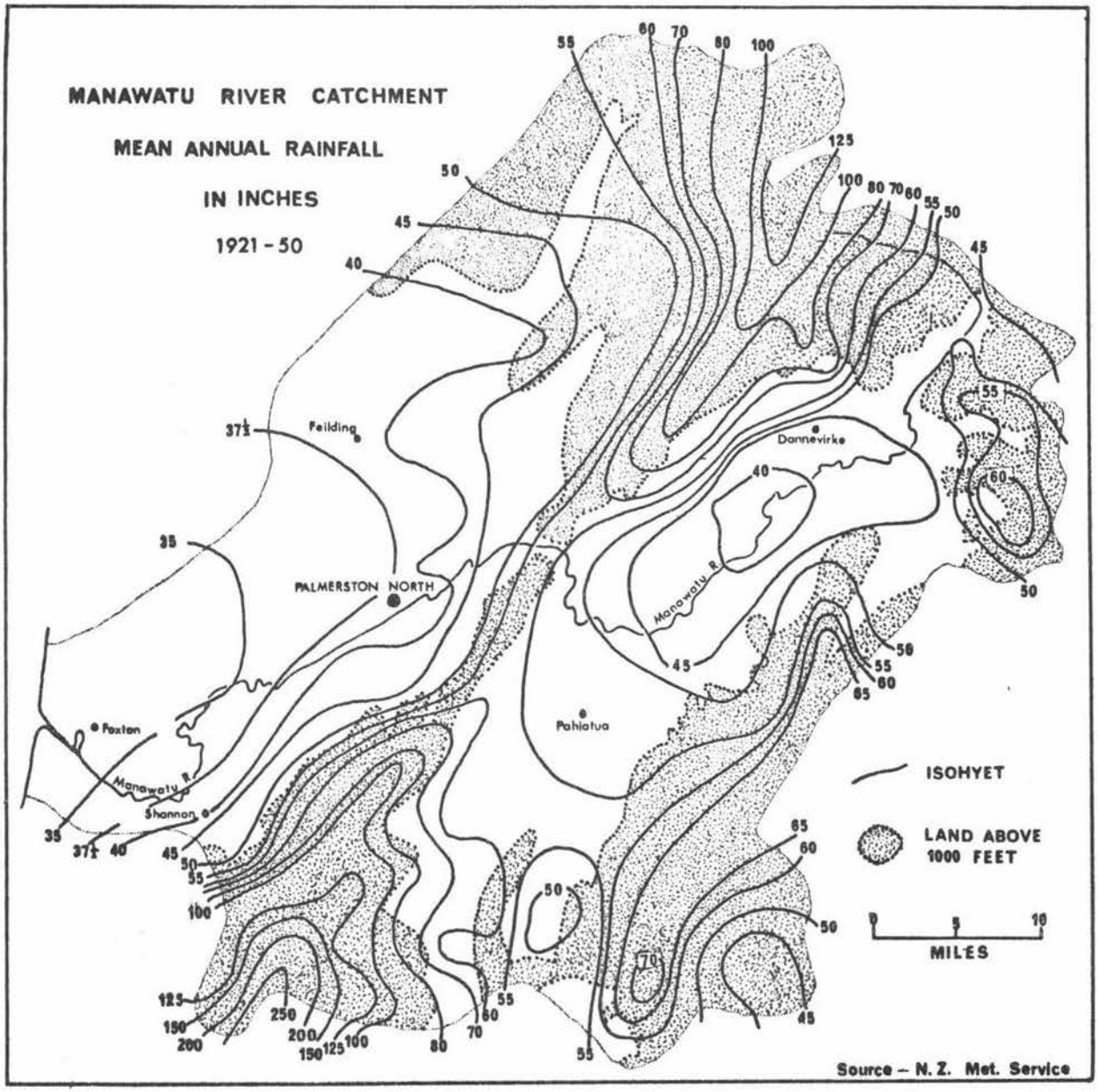
MANAWATU RIVER CATCHMENT
MEAN ANNUAL RAINFALL
IN INCHES
1921 - 50
Feilding
Dannevirke
PALMERSTON NORTH
Manawatu R.
Foxton
Shannon
Pahiatua
ISOHYET
LAND ABOVE 1000 FEET
0 5 10
MILES
Source – N. Z. Met. Service

FIG. 5.

TABLE I-2

MEAN MONTHLY AND ANNUAL RAINFALL FIGURES FOR SELECTED STATIONS IN THE MANAWATU RIVER CATCHMENT.

Station	Date	Altitude in feet.	Rainfall in Inches												TOTAL
			Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Foxton	1913-54		2.34	2.45	2.09	2.52	3.13	3.45	3.03	3.09	2.50	3.23	2.88	2.69	33.40
Ohakea	1951-66	157	3.10	2.42	2.53	2.80	2.98	3.30	3.34	2.82	2.26	3.11	3.18	3.68	35.52
D.S.I.R.	1928-66	110	3.25	2.96	2.63	3.04	2.94	3.78	3.92	3.40	3.19	2.96	3.09	3.93	39.09
Colyton	1912-63	350	3.10	2.88	2.54	3.28	3.45	3.83	3.33	3.27	3.06	3.96	3.66	3.38	39.74
Apiti	1948-66		3.47	3.46	3.54	3.72	5.13	4.90	5.48	4.65	3.47	4.21	4.17	5.19	51.39
Tiritea	1948-66	428	3.97	3.67	3.95	3.82	4.88	5.02	5.62	4.31	3.75	4.58	3.97	5.20	52.74
L.Mangahao	1948-66	2500	7.46	7.62	7.12	7.44	9.79	9.33	11.00	8.99	7.31	9.91	9.99	9.14	105.10
Wharite	1964-66	3020	3.50	8.67	18.40	5.30	4.50	5.28	9.00	7.94	3.87	4.51	7.20	13.50	91.67
Dannevirke	1948-66	680	3.02	2.41	3.35	3.22	4.13	4.17	4.56	3.71	3.10	3.19	2.90	4.85	42.61
Mangamutu	1948-66	380	3.77	3.29	3.61	3.58	4.47	4.94	5.36	4.17	4.08	4.58	4.00	4.34	50.19
Eketahuna	1948-66	1000	3.84	3.12	4.43	4.72	6.42	6.23	8.84	5.41	4.91	5.27	5.42	4.96	63.57
Putara	1960-66	1400	6.20	3.27	5.38	5.07	9.04	10.10	11.46	7.01	8.81	4.90	11.30	4.73	87.27
Tiraumea	1960-66		4.60	2.09	2.86	3.09	3.13	5.69	6.90	4.94	5.89	2.14	3.84	4.32	49.49

N.Z. Meteorological Service

fell throughout the catchment. The isohyets indicate the distribution of this rainfall, showing areas in the northeast that received up to 12 inches of rain, while coastal portions received less than one inch.

Storm type A.2 exists where a shallow depression with an associated frontal zone moves slowly over the catchment. Fig.7 shows the distribution of rainfall accompanying such a depression which resulted in flooding in the Manawatu. Heavy rain was concentrated on the Tararua - Ruahine Ranges, while land to the east and west of the ranges received less than two inches.

Storm type B. is associated with depressions of a tropical origin which move southeast on a track lying to the east or north of the catchment. Rainfall in this situation is most predominant on and east of the Tararua - Ruahine Ranges. The isohyets resulting from such a weather situation are illustrated in Fig.8 when a major flood occurred. Widespread rain fell throughout the catchment but with a marked concentration to the east of the ranges. This 1953 flood occurred in January in contrast to those of the A. type which happened either in June or October. It was associated with the heaviest rainfall recorded in this month in thirty years, Pahiatua receiving 6.9 inches in 48 hours.

Storm type C, in contrast to types A and B is mainly associated with rainfall to the west of the ranges. The rain is heavy in the Oroua catchment, through the Manawatu Gorge to Woodville and Pahiatua, but further east the falls are negligible.

For the purpose of later discussion on land use of the lower Manawatu area some mention must be made of general climatic conditions on the flood plain. Robertson classifies the climate of the lower Manawatu thus: 'west to northwest winds prevail with relatively frequent gales. Mean annual rainfall 35 - 50 inches, rainfall reliable and evenly distributed throughout the year. Warm summers, mild winters.' [5] This is substantiated by the figures in Table II-2 Mean temperatures are moderate, ranging from 46°F.

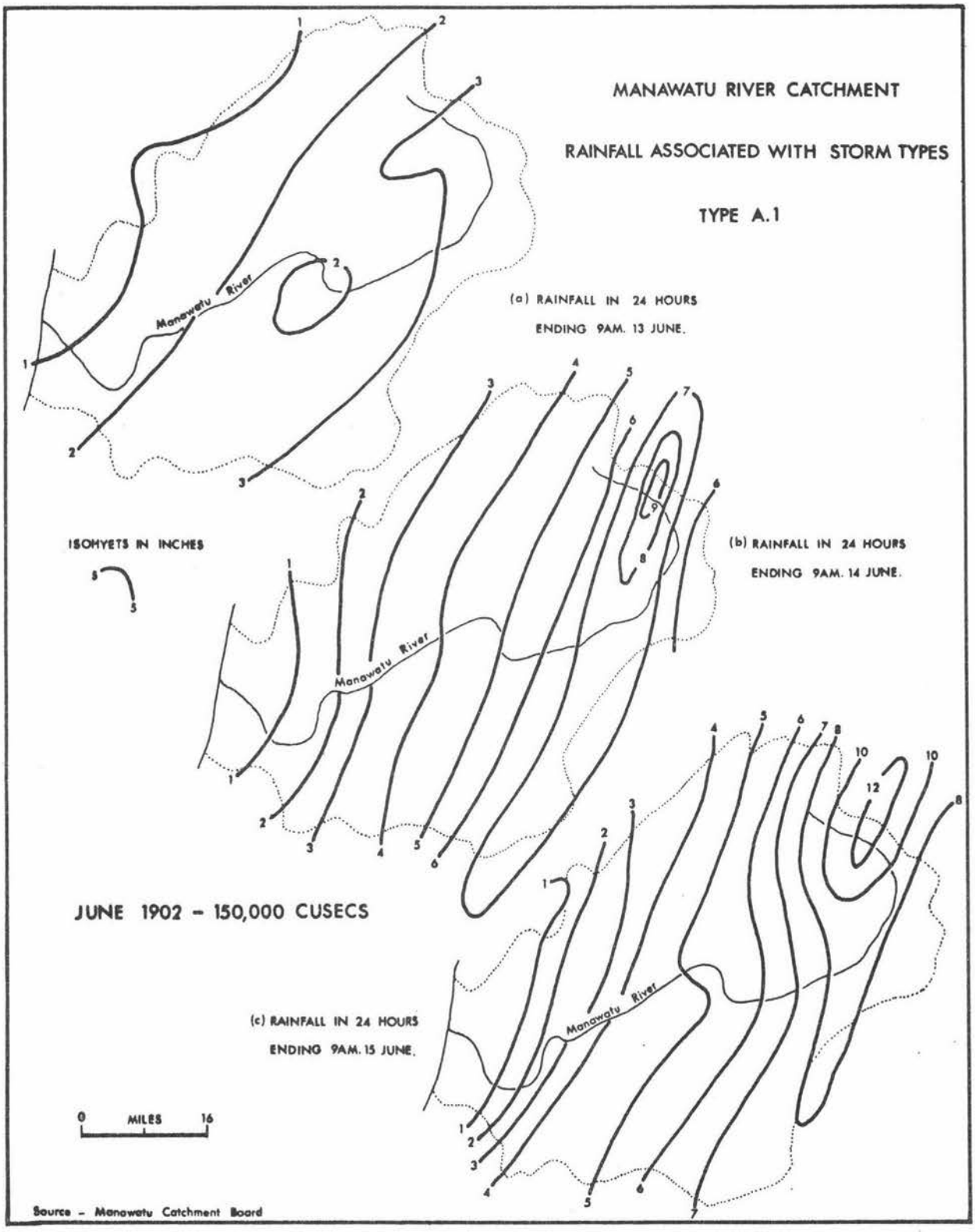
MANAWATU RIVER CATCHMENT
RAINFALL ASSOCIATED WITH STORM TYPES
TYPE A.1
(a) RAINFALL IN 24 HOURS ENDING 9AM. 13 JUNE.
(b) RAINFALL IN 24 HOURS ENDING 9AM. 14 JUNE.
(c) RAINFALL IN 24 HOURS ENDING 9AM. 15 JUNE.
Manawatu River
ISOHYETS IN INCHES
JUNE 1902 - 150,000 CUSECS
0 MILES 16
Source - Manawatu Catchment Board

FIG. 6.

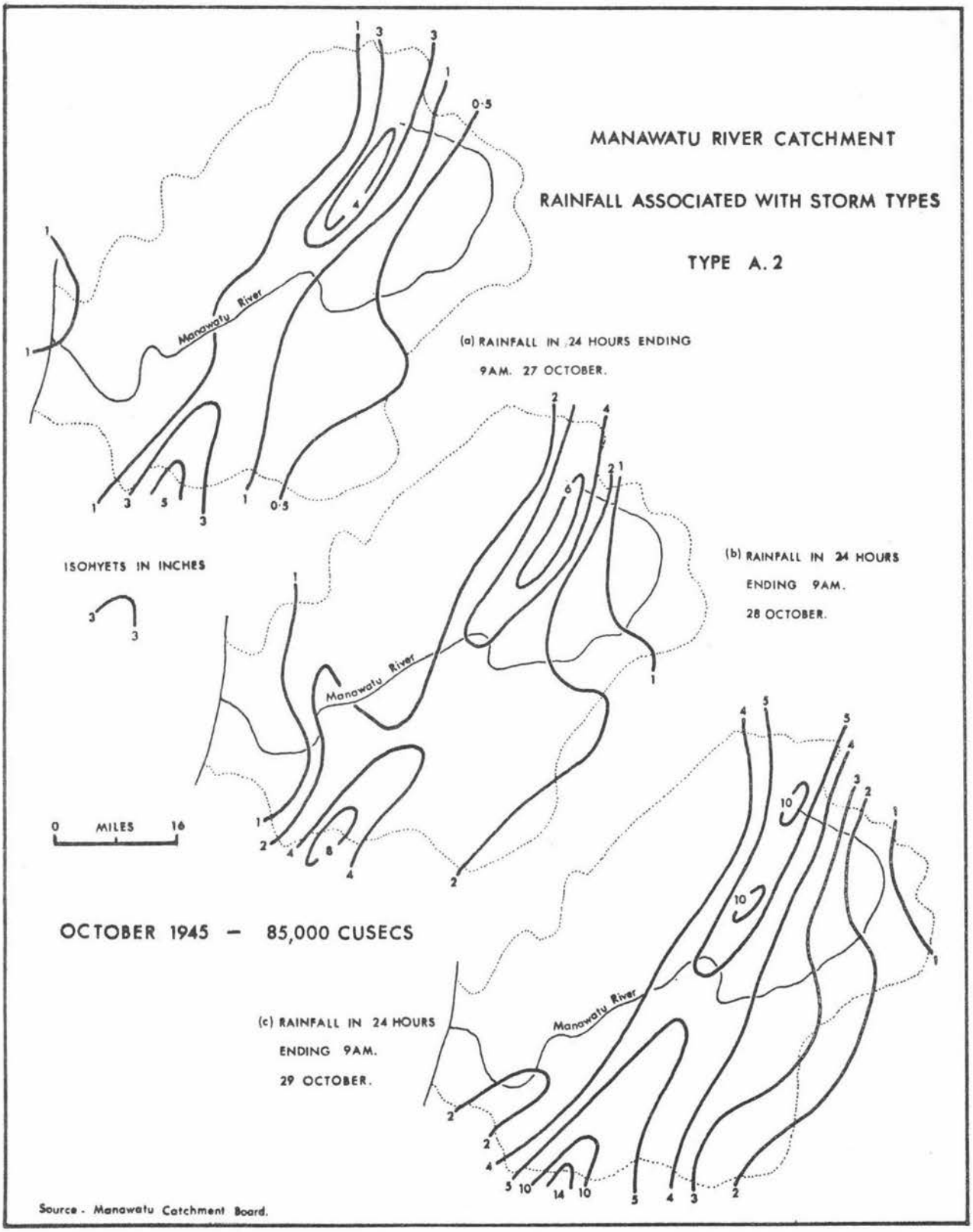
MANAWATU RIVER CATCHMENT
RAINFALL ASSOCIATED WITH STORM TYPES
TYPE A. 2
(a) RAINFALL IN 24 HOURS ENDING 9AM. 27 OCTOBER.
(b) RAINFALL IN 24 HOURS ENDING 9AM. 28 OCTOBER.
(c) RAINFALL IN 24 HOURS ENDING 9AM. 29 OCTOBER.
Manawatu River
ISOHYETS IN INCHES
0 MILES 16
OCTOBER 1945 – 85,000 CUSECS
Source. Manawatu Catchment Board.

FIG. 7.

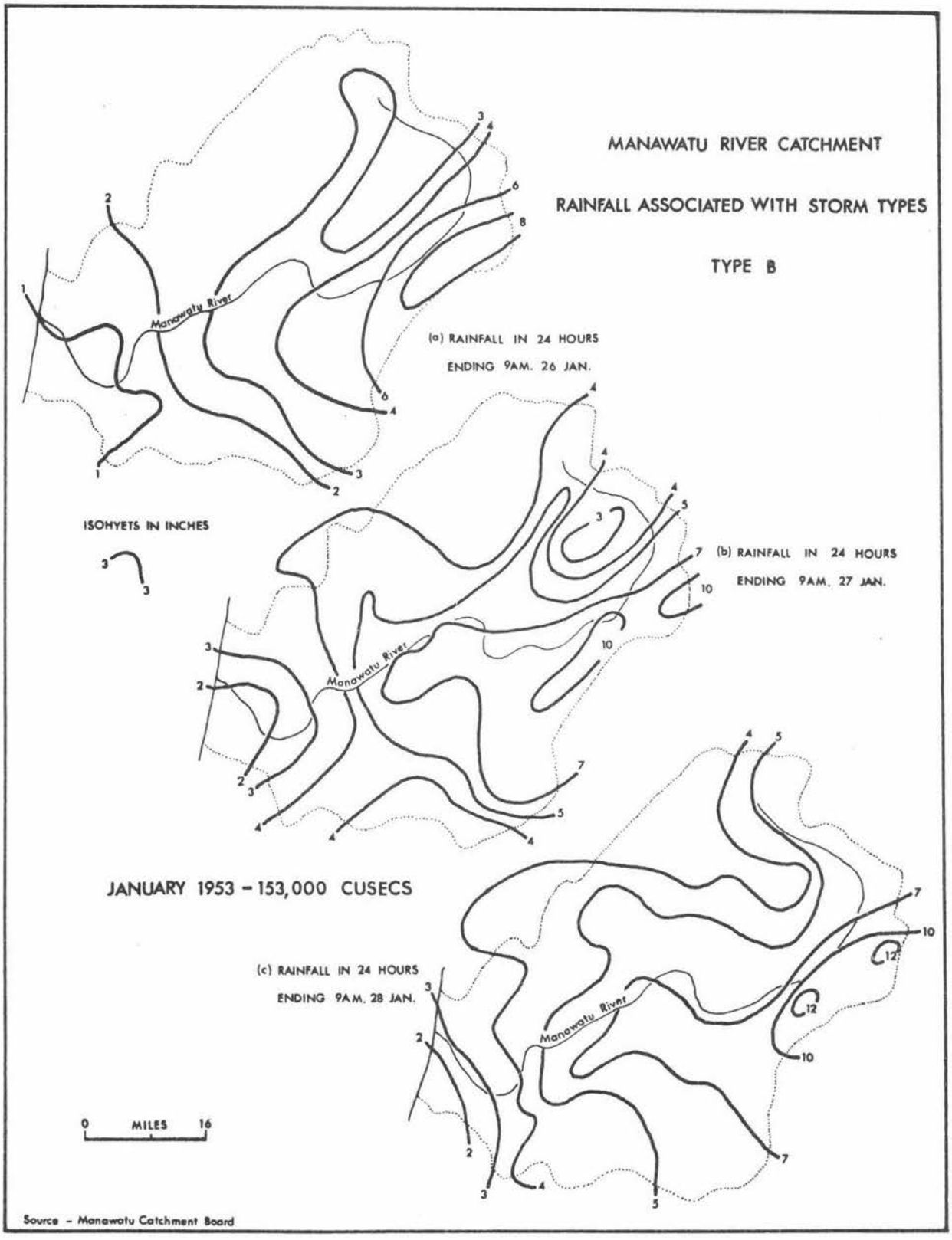
MANAWATU RIVER CATCHMENT
RAINFALL ASSOCIATED WITH STORM TYPES
TYPE B
(a) RAINFALL IN 24 HOURS ENDING 9AM. 26 JAN.
(b) RAINFALL IN 24 HOURS ENDING 9AM. 27 JAN.
(c) RAINFALL IN 24 HOURS ENDING 9AM. 28 JAN.
ISOHYETS IN INCHES
JANUARY 1953 – 153,000 CUSECS
Manawatu River
0 MILES 16
Source – Manawatu Catchment Board

FIG. 8.

TABLE II - 2

CLIMATIC STATISTICS FOR THE LOWER MANAWATU

Station	Recording period.	Temperature Deg. F.					Rainfall		Sunshine
		Jan. Mean Max.	July Mean Min.	Year	Range	No. of ground frosts	Total (ins)	No. rain days	No. hours
Palm. Nth. (D.S.I.R.)	1928-60	62.7	46.1	54.9	15.4	61.3	39.0	173	1814
Ohakea	1940-60	63.3	47.1	55.6	15.2	19.2	35.6	152	2030
Levin	1949-60	62.2	46.6	55.2	14.7	48.7	43.1	157	1874

Wind (based on three-hourly observations from Dines' recording anemometers)

Station	Recording period.	Per cent frequencies.					
		N and NE	E and SE	S and SW	W	NW	Calm
Palm. Nth. (Milson)	1940-49	8.4	20.5	4.1	17.9	17.6	31.4
Ohakea	1939-51	26.8	19.5	7.7	12.4	24.4	9.2
Shannon	1938-45	4.7	13.0	6.0	19.3	9.7	47.7

Saunders, 1964, 47.

to 64°F. for the coldest and warmest months. Palmerston North experiences about sixty days of ground frost annually, while places such as Ohakea nearer the coast, receive about nineteen days per year. Sunshine hours are high at the coast, Foxton receiving over 2,000 hours a year. This amount decreases inland where Palmerston North records approximately 1,800 hours annually.

The number of days during which rain falls varies between 150 and 173 a year. Rainfall is evenly distributed, with no season experiencing drought conditions. A noticeable feature of this lowland is the prevalence of wind, especially those from a west or northwest direction, but winds decrease in frequency and force from the coast inland, Ohakea having an average of only nine calm days a year, while Shannon has a mean of 47 calm days.

The climatic conditions on the lowland show a gradual variation from the coast inland, but the differences are not sufficient to become a dominant influence in land use variations.

The Incidence of Flooding

Flooding depends fundamentally on the availability of water and the topography of the land. In the Lower Manawatu the amount of water available is directly related to the climatic situations producing periods of prolonged and heavy rainfall, the course of the Manawatu River and its tributaries, the extent of the catchment and the nature of the topography within this. Flooding is a result of the interaction between these factors. It is the process which has been responsible for the formation of the floodplain.

The extent of the catchment and the slopes of the land within it provide the potential physical setting for the Manawatu River to flood. The frequency and intensity of the flooding, however, depends on the amount and intensity of the rainfall. For a probable maximum flood with a runoff of 165,000 cusecs in the Manawatu River at the Fitzherbert gauge at Palmerston North the Catchment Board has estimated it would require a period of 24 hours of rainfall concentration, producing an average of five inches throughout the catchment

with a runoff factor of at least 80%. The average frequency of a flood of these proportions is once in 200 years.

From a record of water levels at the Fitzherbert bridge since 1926 a flood frequency table has been calculated.

TABLE III -2

Frequency of Probable Floods in the Manawatu River Measured at Fitzherbert Bridge.

1 year	50,000	cusecs.	13'0"	Height	at	Fitzherbert	Bridge
5 "	85,000	"	16'6"	"	"	"	"
10 "	100,000	"	18'0"	"	"	"	"
25 "	120,000	"	19'0"	"	"	"	"
50 "	135,000	"	20'0"	"	"	"	"
100 "	150,000	"	21'0"	"	"	"	"
250 "	170,000	"	22'0"	"	"	"	"
500 "	185,000	"	23'0"	"	"	"	"

Source: Manawatu Catchment Board Report on Scheme of Control for the Lower Manawatu River, 1950, 1.

Fig. 9 shows the number of floods and the discharge rates which have risen to 50,000 cusecs or more since 1880. Of these floods, 65% have occurred in the winter months from May to August and a further 11% in October. (Fig. 9) This follows the seasons of rainfall maxima when runoff remains higher than during the rest of the year. The average discharge rate of the Manawatu River in winter ranges from 2,000 to 5,000 cusecs depending on the amount of ground water available. It remains at a higher level than that of summer when the discharge rate averages about 1,000 cusecs. A flood occurring in summer usually results from a storm of type B which is of tropical origin and heavy rainfall takesplace over a relatively short period.

The size of the flood, however shows no correlation with the season of greatest frequency of flooding. The January 1953 flood reached a record level of 152,000 cusecs. This can be compared with the previous record flood of 152,000 cusecs which occurred in June 1902. [6]

FLOOD LEVELS OF MANAWATU RIVER ABOVE 50,000 CUSECS AT FITZHERBERT BRIDGE, PALMERSTON NORTH.

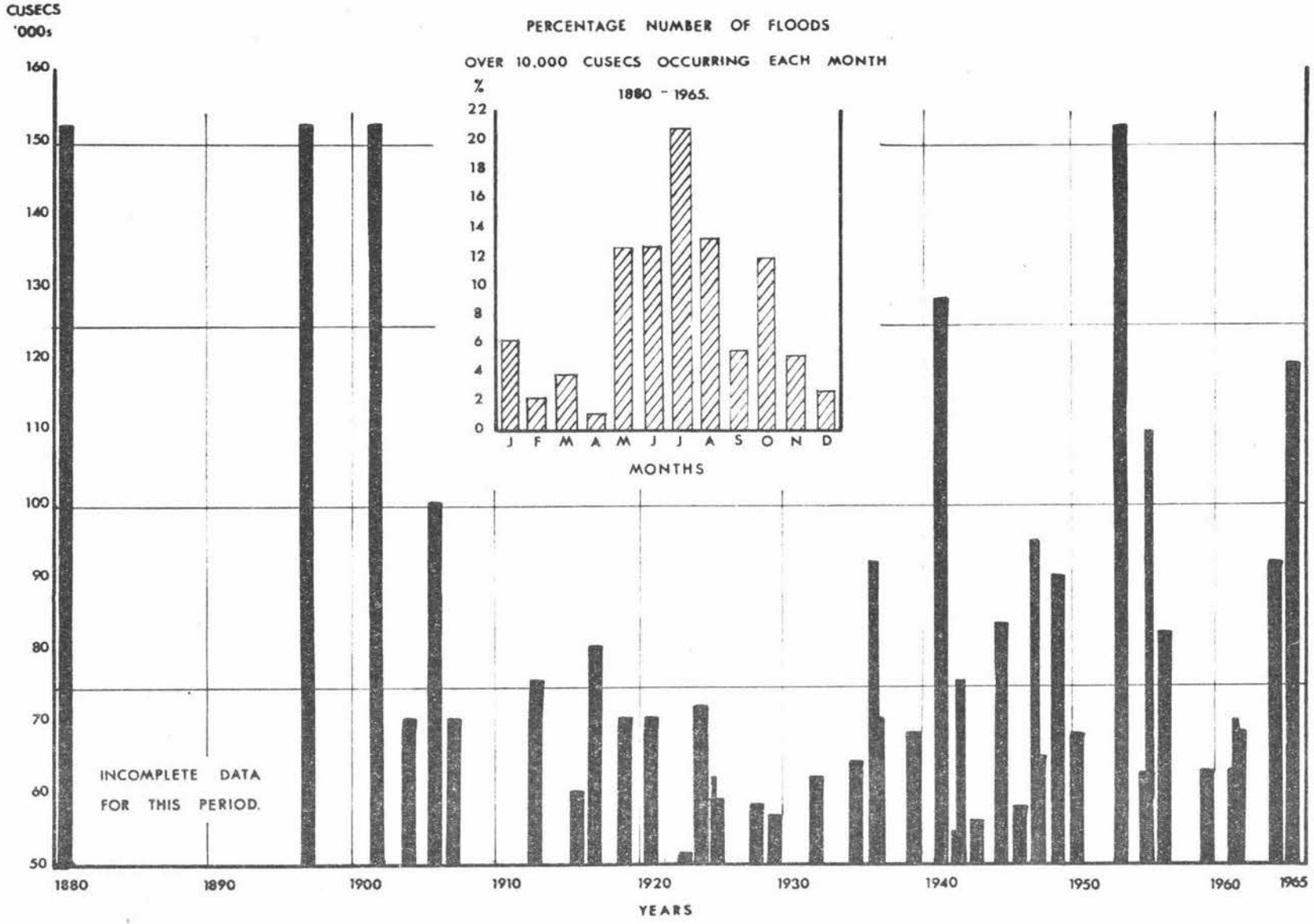

FIG. 9.

The fact that the Manawatu River does flood does not constitute a problem in itself. It is only when it is considered within the context of human occupance that any problem arises.

The Effect of Flooding on Human Occupance

The natural flooding process of the Manawatu River has built up the floodplain with deposits of alluvium and provided a fertile, silty soil. Man has been attracted to such soil because of its agricultural potential. However, periodic inundations by the river have caused severe disruption at times to the economic activity on the floodplain. Man occupying a floodplain is normally aware of the inherent risk of flooding and the knowledge of this constant threat is reflected in his attitudes and in his organization of social and economic life. The need to be prepared to meet flood emergencies is, for those in the lower lying areas, a constant strain on mental and physical resources. The unpredictability of the river means farmers will either try to develop some form of flood protection, whether the result of individual effort or that of a collective body, or restrict the scope of farming activities.

Farmers in low lying areas are unwilling to undertake the same risks in farming methods and practices as those who occupy flood free land. This is a long term effect which prevents the land from realizing its full agricultural production potential. Farming remains less intensive since the risk of capital loss from a flood is present. This means pastoral farming rather than arable, the running of dry stock rather than breeding stock and lower stocking rates. Credit for capital development will not be as readily available to farmers whose land is liable to frequent inundations by the river as to those whose properties are not faced with the risk of flooding.

It may be necessary for farmers to own a runoff area for wintering off stock when the risk is greatest, or as a reserve for shifting stock to in a flood emergency. It may also mean a farmer cannot farm his property as a

unified project since particular higher paddocks may have to be shut up to provide feed in the event of a flood.

Inundation for short periods which may cause more inconvenience than real damage will usually mean some loss of production due to reduced grazing. A major flood, however, means severe loss of production and capital through losses of stock, pasture, crops, fencing, drainage, machinery and buildings. This means a direct loss to individual farmers as well as an indirect loss to the New Zealand economy. Transport and communications become disrupted due to blocked roads and railways and broken lines. It takes many months for the effects of the flood to be overcome completely.

The 1953 flood in the Manawatu provides an example of the amount of damage incurred by a major inundation. It is proposed to give details of this flood and its results because it is the largest to have occurred in the district since farming has become well established. The full impact of the volume of water was not felt in all areas susceptible to flooding as protective measures prevented the Makerua, Buckley and Kopuroa districts from being flooded. In all, an area of 70-80,000 acres in the lower Manawatu is liable to flooding, and in the 1953 flood 36,805 acres were affected.[7] (Fig.10)

The flood which occurred on January 28th, 1953, was the result of continuous heavy rain caused by the convergence of a moist, tropical air mass with a cool, polar air mass, the centre being over the eastern side of the ranges. (Fig. 8) Five inches of rain fell at Ohakea, while the heaviest falls recorded were at Motuotaraia with 9.19 inches from 6 a.m. to 6 p.m. on January 27th and Nikau Hill with 10.31 inches in the 24 hours ending 9 a.m. January 28th. From 4 p.m. on the 28th of January the flood maintained its peak of 21'5" at the Fitzherbert gauge for five hours. The river remained at a level of at least 20 feet for 15½ hours. Owing to the northward movement of the storm, the peak flows of the Tiraumea and Upper Manawatu Rivers coincided, although the peak flows of the 1902 and 1953 floods were almost

Photo - 'Floods in New Zealand. 1920-53.'

PLATE 1.

Extent of 1953 flood in Lower Manawatu.
Makerua district protected by stopbanks.

Photo - 'Floods in New Zealand. 1920-53.'

PLATE 2.

Floodwater of 1953 flood in Lower Taonui district.

TABLE IV-2

ESTIMATION OF FLOOD DAMAGE IN LOWER MANAWATU AFTER 1953 FLOOD

Flood Damage	Woodville	Ashhurst	Te Matai	Aokautere	Tokomaru	Shannon	Foxton	Moutoa	Longburn	Tiakitahuna	Kairanga	Mangawhata	Rangiotu
						DISTRICTS							
Acreage under water	1270	544	2000	572	369	1107	1292	2760	718	721	6057	1939	2549
Buildings	–	1 house	9 houses	1 house	1 house	5 houses	–	1 house	–	2 & 6 houses	14 houses		14 houses
Farm Stock													
Sheep	4200	–	422	36	–	7	–	6	122	18	128		253
Cattle	(heavy)	–	13 dairy	7 dairy	1 dairy	–	6 dairy		1 calf	7 dairy			54 dairy
Pigs	7	6	–	–	9	83	4		1	1	102	14	46
Poultry	–	12	458	–	–	42	–		6	8	257		47
Horses	–	–	–	–	–	2	–						
Fencing	6½ miles	9 miles	16 miles	47½ miles				5¾ miles		¼ mile	4½ miles	¼ mile	
Drains	½ml.silted	1½ml.silted	1½ml.silted		¼ml.silted	1½ml.silted				¼ml.silted	9½ml.silted	4½ml.silted	4ml.silted
Pasture (ac)	1135	120	171	263		47		11000		155	800	120	
Crops													
Hay	25 tons		52ac.stand. 152 tons.	23ac.stand. 76 tons.	20 tons.	91ac.mown. 37 tons.	10ac.stand. 46 tons.	147ac.stand. 31 tons.	18ac.stand. 4 tons.	84 tons.	40ac.stand. 294 tons.	3ac.stand. 30 tons.	75ac.stand 113 tons
Silage	–	–	792 tons.	–	–	–							
Feed crops	–	15 ac.	55 ac.	–	24 ac.	6 ac.	6 ac.	86 acres	21 acres	12 acres	240 acres	14 acres	144 acres
Other	–	4½ac.potato	3ac.potato	¼ac.potato	¼ac.potato	4ac.potato	4ac.potato	6ac.potatoes 50ac.barley	12ac.potatoes	21ac.potatoes 24ac.cash cr.		¼ac.potatoes	22ac.potatoes (30 beehives)

Evening Standard, 1953

the same, the volume of water involved in 1953 was greater than that of 1902.[8] (Fig.9)

Table IV -2 gives an estimate of the amount of damage resulting from this flood. Altogether 199 farms were affected, serious damage being done to 53 houses and 65 other farm buildings and over 5,000 acres of pasture requiring to be resown. The acreage was particularly large because the flood occurred in summer and grass lying under water quickly rotted with the heat of the ground and the air. The total cost to repair the damage was estimated at £160,000. Further expense was incurred by the repair work necessary to stopbanks and river protection works through erosion. This cost was calculated to be £20,900.

Although a flood of these dimensions is likely to occur only once in a hundred years, the estimated flood frequencies, (Table III -2) indicates a flood of over 50,000 cusecs can be expected to occur annually. Any flood covering fertile agricultural land will have detrimental short term and long term effects on the level of production of the land affected. To overcome this problem various measures have been taken by individual farmers and by local bodies.

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1. Evans, 1964, 411.
2. Hall, 1964, 18.
3. Evans, 1964, 411.
4. Unpublished map, Man.Catch.Board
5. Robertson, 1960, 21.
6. Floods in N.Z. 1920-1953, 99, 109.
7. Dominion, 1953
8. Evening Standard, 1953.

CHAPTER 3

DEVELOPMENT OF FLOOD CONTROL MEASURES

In his report of 1945, D.J. Halley, the first engineer of the Manawatu Catchment Board stated:

> 'the last sixty years have seen the very rapid development of the lower Manawatu valley where, from a wet flax and bush covered swamp, the land has been brought to a state of very high productivity. From earliest times, settlers in the valley have seen their farms periodically flooded, their stock drowned and communications severed. In an effort to obtain some relief from flooding, stopbanks have been built along the river banks from Linton down to the lower Moutoa. These banks are sufficiently high to keep out medium floods, but could not cope with a flood such as was experienced in 1902. With further intensive development of the Makerua and Moutoa areas, each successive flood will cause more damage and dislocation, and with improved drainage in the upper catchment areas and faster runoff, flooding must be expected to be both more frequent and more severe. It would appear that the stage has now been reached where further intensive development of the Manawatu valley cannot proceed on account of the ever-increasing risk of flooding and the time has come when some scheme of complete flood control must be decided upon and put into effect.'

However, although a comprehensive scheme was outlined, (Appendix B) control was not achieved during his years with the Catchment Board, and the disastrous 1953 flood occurred. The present Catchment Board engineer, P.G. Evans, subsequently designed a scheme which embodied many features from previous proposals (Appendix B). The new plan came into effect in 1963 and has provided a co-ordinated scheme of flood control for the lower Manawatu River (Fig. 10). It differs from the previous ones in that the floodwaters are controlled in magnitude by a spillway and in direction by stopbanks.

The aims were:-

(a) to prevent flooding of as much land as possible.

(b) to stabilize the river in a permanent channel.

(c) to reduce maintenance to a minimum.

The provision of drainage was not included in the scheme but it was

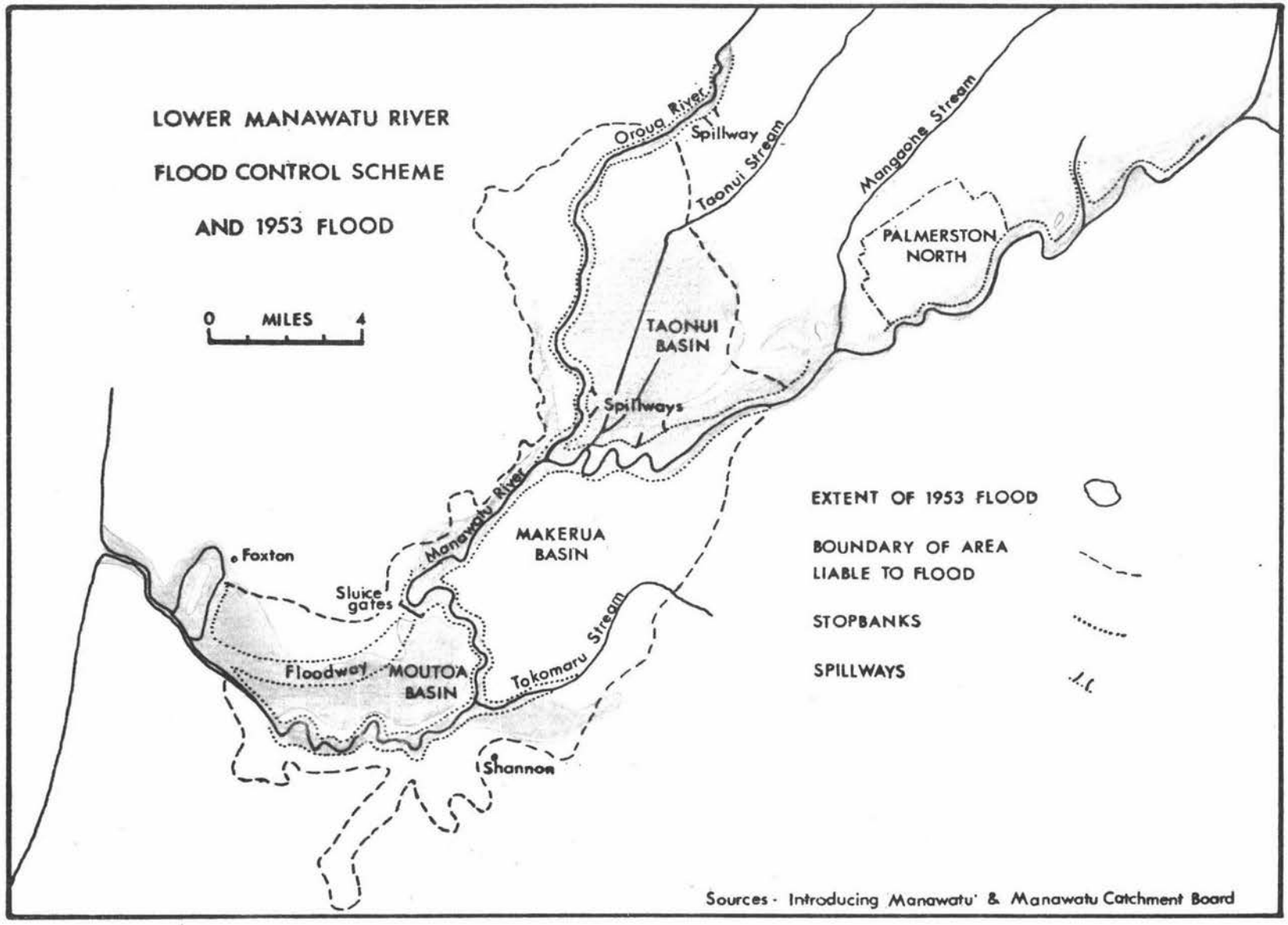
LOWER MANAWATU RIVER
FLOOD CONTROL SCHEME
AND 1953 FLOOD
0 MILES 4
Oroua River
Spillway
Taonui Stream
Mangaone Stream
PALMERSTON NORTH
TAONUI BASIN
Spillways
Manawatu River
MAKERUA BASIN
Foxton
Sluice gates
Floodway
MOUTOA BASIN
Tokomaru Stream
Shannon
EXTENT OF 1953 FLOOD
BOUNDARY OF AREA LIABLE TO FLOOD
STOPBANKS
SPILLWAYS
Sources - Introducing Manawatu' & Manawatu Catchment Board

FIG. 10.

Photo -'Introducing Manawatu.'

PLATE 3.

Lower Manawatu River Flood Control Scheme

Moutoa floodgates and spillway.

PLATE 4.

Small floodgate outlets situated inside the stopbanks on the main drains.

designed to enable good drainage to be achieved as cheaply as possible. The following additional factors also had to be considered:-

(a) the 'regime' condition of the river should be maintained as far as possible.

(b) stopbank levels should be kept as low as possible.

(c) disturbance of existing settlement and farming should be avoided as far as possible.

(d) cost must be kept in mind throughout.'[2]

Fig.10 shows the completed scheme and the area of land it protects. It is designed to cope with 'century' floods of up to 150,000 cusecs.

The scheme consists of stopbanking from the Manawatu Gorge to the sea except in a few places where the area liable to flood is not sufficient to warrant banking. Sluice gates allow up to 105,000 cusecs of water to be diverted from the river course through a floodway in times of flood. Evans states 'the use of sluice gates rather than a weir at the head of the floodway was based on the following considerations. It gives complete control of water levels in the river enabling the velocities to be kept at the best values for regime conditions.'[3] Emergency spillways into the Taonui Basin near the junction of the Oroua River and another on the Oroua River three miles above the junction (Fig. 10) have been provided to operate if the total flow of the Manawatu and Oroua Rivers should exceed 150,000 cusecs. The completion of this scheme has meant that land which was liable to flooding in the lower Manawatu has now become floodfree except in times of the exceptional flood.

Removing the threat of river flooding has been perhaps the greatest single factor in releasing the full agricultural potential of the land in the Lower Manawatu although supplementary drainage measures are still necessary. This was recognized from the beginning of European settlement in the district.

The low-lying nature of the land below the level of the river meant that not only was the land subject to frequent inundations by the river, but that drainage outlets for this and local surface water were lacking.

The problem of drainage was tackled by the pioneers as individuals and gradually Drainage Boards were formed to provide some measure of co-ordination between local farmers. Today every farm has access to a Drainage Board drain for removal of excess surface water. 'An extensive drainage system collects both the surface drainage from the flat lands and the water flowing down from higher lying land behind and drains through the stopbanks into the river. The culverts through the banks have floodgates to prevent the river entering and causing flooding when it rises. The drainage for the greater part of the year is by gravity, but floods and freshes cause the river to rise for periods which would cause considerable flooding if gravity were the only method of disposing of the water behind the banks.'[4] In the Moutoa, Makerua and Buckley areas, pumps of adequate capacity have been installed to overcome this problem.

In Taonui the problem of disposing of excess local water remains and some flooding still occurs from overspill from the main drains. Proposals to widen the Main Drain and to increase the height of its stopbanks aim at solving this problem, but as improved drainage throughout both the low-lying areas and the higher farms continues, it may become necessary to install pumps. At present, many local farmers are considering installing pumps on their own farms to pump water into the Drainage Board drains, but the great expense involved in providing a pump of suitable capacity to pump water from the Main Drain into the Manawatu River means this is not economically feasible yet.

For many years then, it has been the belief that flood control is essential in the Lower Manawatu for successful farming to be carried out.

A co-ordinated scheme has been provided to enable maximum benefit to be gained from protection measures in all parts of the Lower Manawatu. This flood control scheme, however, has to be supplemented by extensive drainage programmes in the area, by local bodies and by individual farmers before full production can be achieved from the land.

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1. The Times, 1945.
2. Evans, 1964, 412.
3. Evans, 1964, 413.
4. Fancourt, 1965, 13.

PART II THE EFFECTS OF THE FLOOD CONTROL SCHEME

CHAPTER 4.

LAND VALUES

There are two aspects to be considered in discussion of the effects on land values of the Lower Manawatu River flood control scheme. The first, and more significant aspect is that concerned with the ability of the flood protection scheme to release the full agricultural potential of the protected land, and the second involves the rates levied to pay for this flood protection.[1]

Farms rated for the scheme have been grouped into seven districts and four flood frequency areas. It has been necessary to retain both these methods of classification throughout for two reasons. Firstly, the valuation data spans a period of five years for land in districts within the Kairanga County, whereas in those of the Manawatu and Horowhenua Counties, it covers periods of ten years and this means values in the flood frequency areas are not at comparable levels over the whole area. Secondly, the nature of the flooding problem accentuates these differences. Flooding did not affect all parts of the Lower Manawatu in the same way. This problem has been largely overcome by classifying land into flood frequency areas, but even within each of these, some differences still remain because the severity of flooding varied from district to district.

The valuation revisions of 1958 and 1963 for areas in the Kairanga County, the revisions of 1955 and 1965 for land within the Horowhenua County, and the 1956 and 1966 revisions for land in the Manawatu County have been used.[2] These dates were selected as being the last County revision made prior to the construction of the scheme, and the only one made since the scheme has been in operation. It is unfortunate that the only revision for the Kairanga County since the scheme has been completed, took place in 1963.

As the scheme came into operation in 1962, the 1963 values cannot indicate more than trends. The next County revision, which is to be made in 1968, should confirm trends indicated, or reveal new trends as yet invisible.

Valuation revisions are made according to the terms set by the 1951 Valuation of Land Act. This is in order to ensure conformity of standards among valuers and to allow for an objective approach throughout New Zealand. The definitions do not provide an infallible guide and guarantee absolute conformity, especially in the case of the unimproved value of land, but they reduce the incidence of subjective estimates.

The three land values on which this chapter is based, the capital value, the improvements value, and the unimproved value are defined as follows by the 1951 Act: the 'capital value' of the land means 'the sum which the owner's estate or interests therein, if unencumbered by any mortgage or other charge thereon, might be expected to realize at the time of valuation if offered for sale on such reasonable terms and conditions as a bona fide seller might be expected to require.' 'Improvements' means 'all work done or material used at any time on or for the benefit of the land by the expenditure of capital or labour by any owner or occupier thereof in so far as the effect of the work done or material used is to increase the value of the land.' The 'unimproved value' is defined as the 'sum which the owner's estate or interest therein, if unencumbered by any mortgage or other charge thereon, might be expected to realize at the time of valuation if offered for sale on such reasonable terms and combinations as a bona fide seller might be expected to impose, and if no improvements had been made on the said land'.

The aim of this chapter is to compare levels of land values and rates of increase between flood frequency areas (operating at all times within district areas) in order to examine the effects of the flood control scheme. Increases will finally be measured against County increases. It is expected that land which was liable to the most frequent flooding should have received the most

benefit from the flood protection scheme and this, therefore, should be reflected in the rates of increase in land values between the two revision dates. The land in the 100 year flood frequency area can be regarded as a control area, or a standard of measurement for the rates of increase because the chance of a flood on this land was so remote that farmers have been able to operate their farms on the same basis as those farmers occupying flood-free land. Rates of increase on these farms where a flood is expected only once a century are comparable with those of farms on flood-free land.

The approach adopted to evaluate the effects of the flood control scheme from land valuation data has been to present tables and graphs which show rates of increase on a percentage basis within districts and flood frequency areas. The percentage increases have been converted to annual terms to allow for some degree of comparison between districts. It is debatable whether percentage increases should be used in preference to absolute increases. However, the method which is selected as preferable must be able to extract from the data the information that is required.

Percentage increases have been used rather than absolute increases because the factor of most importance concerning the value of the land used for farming is the ability of the land to produce, or its potential usefulness for agriculture. Since flooding has been the prime factor responsible for inhibiting varying amounts of this potential in the Lower Manawatu, the major effect of the flood control scheme lies in its ability to release this latent agricultural potential. If very low-valued land should increase its value at a rate proportionately greater than that of higher-valued land during the same period, it can be assumed that the potential of the former land for farm production purposes has risen proportionately more than that of the latter land. If absolute values are used exclusively, this 'release of potential' factor may be overlooked when rates of increase in absolute terms happen to be identical for low and high valued land.[3] This argument

is of direct importance in consideration of the unimproved value, and indirectly affects both the capital and improvements values.

Also, a danger in using absolute values arises through the process of inflation in New Zealand. With County valuations separated by as much as three years, comparisons based on absolute values alone, become distorted. The use of percentage increases overcomes this problem to some extent.

There is another aspect to be considered also. The ability of the flood control scheme to release latent agricultural potential of land which was formerly frequently flooded is the most significant effect of the scheme on land values, but the rates which farmers on such land are charged to pay for flood protection cannot be ignored. The differential levels of rates do influence the sales value of the land to some extent, and this aspect will be considered in a later section of this chapter.

The Unimproved Value

The assessment of the unimproved value is an attempt to measure the inherent worth or potential of the land prior to improvements being made by man. It is the basic value, therefore, in measuring the suitability of the physical properties of the land for direction by man into agricultural production.

In Chapter 2 it was noted that climatic conditions provide no severe contrasts in the Lower Manawatu, but that a gradual lessening of rainfall and number of frosts occurring, together with an intensification in the frequency and force of winds plus an increase in sunshine hours takes place from Palmerston North to the west coast. This process is insufficient to influence land values in this lowland area.

Soil types may exert some influence on the assessment of unimproved values since there is a range from silt and clay loams to peat soils. However, these soils are all recent alluvials with a naturally high fertility.[4]

The influence of the city of Palmerston North affects the level of the

unimproved value of land in close proximity to its boundaries. This affects properties in the Mangaone district in particular, and has a lesser influence on some land in the Taonui and Longburn-Ashhurst districts.

It is the remaining factors, those of topography and drainage which overall are of the greatest significance in influencing the level of the unimproved value in the Lower Manawatu. The location of individual properties in relation to the Manawatu River and the height of each above or below the river level provides the context within which drainage and river flooding operate to influence the levels of unimproved value.

Physical factors, then, have a dominant influence on unimproved values. Since the flood control scheme removes a problem caused essentially by physical elements, its effects can largely be measured through examination of pre-scheme and post-scheme levels of unimproved values.

Before discussion of the rates of increase between the two revision dates, which have taken place in districts and flood frequency areas, it is necessary to mention briefly, three points:[5]

1. The unimproved value of all districts and FFA's has increased between the two revision dates.

TABLE I-4

AVERAGE UNIMPROVED VALUE PER ACRE FOR

DISTRICTS AT BOTH REVISION DATES

Districts	Dates	1st date	2nd date
Koputaroa	(1955-65)	(£) 20.82 (per acre)	(£) 33.97 per acre)
Moutoa	(1956-66)	24.84 "	46.24 "
Oroua West	(1956-66)	34.66 "	46.95 "
Taonui	(1958-63)	41.66 "	48.14 "
Makerua	(1955-65)	44.17 "	69.34 "
Mangaone	(1958-63)	60.17 "	70.24 "
Longburn-Ashhurst	(1958-63)	65.00 "	96.88 "

Pre-scheme values ranged from a level of £20.83 per acre in the Koputaroa district to £65 per acre in the Longburn-Ashhurst district. A

difficulty arises in comparing data from different dates separated by as much as three years. However, it is obvious that a range in the level of unimproved values existed between districts at the pre-scheme dates, and that a range continued to exist at the post-scheme dates, although all values were considerably higher. Increase in unimproved values between revision dates is to be expected in the Lower Manawatu since this is a feature of valuation revisions throughout New Zealand.

2. Unimproved values in the Kairanga County are generally higher than values in the Manawatu and Horowhenua Counties. (Table II-4) This is partly due to the pre-scheme revision date of 1958, compared with 1955 and 1956 in the other counties, and to inflation. It is also partly due to the better quality land in parts of this County, especially soils of land devoted to market gardening in the Longburn-Ashhurst district, while the urban influence of Palmerston North raises the unimproved value of some properties in all districts of the Kairanga County.

TABLE II-4

MEAN UNIMPROVED VALUE OF FFA'S AT PRE-SCHEME DATES

Counties	No. FFA'S - MEAN U.V. PER ACRE 0-£30	£30-40	£40-50	+£50
Kairanga	1	1	1	6
Manawatu	3	3	-	-
Horowhenua	3	1	-	-

Those FFA'S in the Kairanga County with mean unimproved values below £50 per acre at the pre-scheme date consisted of the 1, 5 and 20 year FFA'S of the Taonui district, areas which were subject to the most frequent and severe flooding. The one FFA in the Horowhenua County to have a mean unimproved value greater than £30 per acre was the 100 year FFA in Makerua which has been protected from flooding since 1926.

3. There is some correlation at the pre-scheme dates between the levels of unimproved values and the frequency of flooding.

TABLE III-4

MEAN UNIMPROVED VALUE OF FFA'S AT PRE-SCHEME DATES

FFA'S	NO. FFA'S - MEAN U.V. PER ACRE 0-£30	£30-40	£40-50	+£50
100 year	3	1	-	3
20 year	1	1	1	2
5 year	1	2	-	-
1 year	2	1	-	1

In the 100 year FFA a greater amount of land had a pre-scheme mean unimproved value of over £50 per acre than was present in any other FFA. Also, the proportion of land having a mean unimproved value of less than £50 per acre increases in those areas with a higher flood frequency. An exceptional area in the 1 year category is that of Mangaone, adjacent to the city, which had an average unimproved value greater than £50 per acre.

By the post-scheme dates, mean unimproved values of all districts and FFA'S had increased at differential rates. Discussion of these rates of increase reveals the effects of the flood control scheme on the unimproved value of the land.

Mean annual increases in the unimproved value between the two revision dates ranges from as low as 1.7 percent, in the Mangaone district, to 9.5 in the Moutoa district. (Table III-4).

TABLE IV-4

MEAN ANNUAL PERCENTAGE INCREASES IN UNIMPROVED VALUES

Districts	Dates	1 Year	5 Year	20 Year	100 Year
Moutoa	1956-66	9.5	-	7.9	8.7
Koputaroa	1955-65	-	-	7.1	4.7
Makerua	1955-65	-	5.3	-	4.6
Taonui	1958-63	6.3	3.5	2.6	2.3
Oroua West	1956-66	2.3	3.5	-	4.9
Longburn-Ashhurst	1958-63	-	-	6.7	6.2
Mangaone	1958-63	3.5	-	1.8	1.7

A greater number of the 100 year FFA'S show an annual increase of less than 5%, while in the 1, 5 and 20 year FFA'S more areas support increases above 5% annually. (Table IV-4). In five out of the seven districts, land which formerly flooded the most frequently, has shown the greatest rate of increase between pre- and post-scheme dates, while in only two cases, a reverse trend is indicated.

The Koputaroa district consists of two FFA'S the 20 year area, which shows a mean annual increase of 7.1 percent, and the 100 year area with an increase of 4.7, both these increases taking place between 1955 and 1965. (Table IV-4). This means the unimproved value of that land in the 20 year FFA has shown an increase exceeding that of the 100 year area by 2.4 per cent. (Fig.12). The most significant increase has been in those farms classified as grazing.[6] Increase between the two revision dates in the 20 year area was 9.4 percent as compared with that of 7.1 in the 100 year FFA (Appendix C). It is this land which has been improved in value by the Aratangata Drainage Scheme. A large portion of it, before the flood control scheme and this drainage scheme were constructed, was in a state of semi-permanent swamp and unable to be used for intensive farming activities.

The farms classified as fattening and dairying in the Koputaroa district also display proportionately greater increases in the unimproved

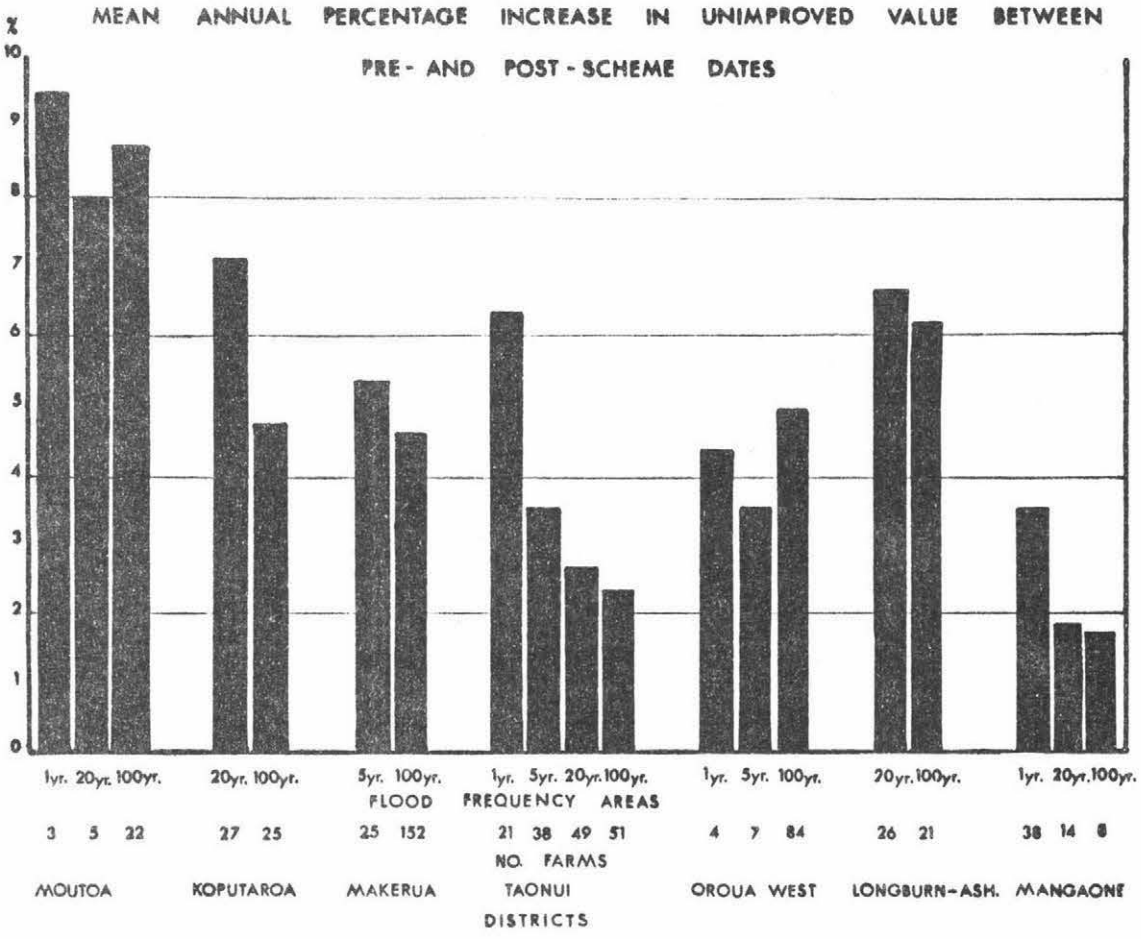

MEAN ANNUAL PERCENTAGE INCREASE IN UNIMPROVED VALUE BETWEEN PRE- AND POST-SCHEME DATES
%
10
9
8
7
6
5
4
3
2
1
0
1yr. 20yr. 100yr.
20yr. 100yr.
5yr. 100yr.
1yr. 5yr. 20yr. 100yr.
1yr. 5yr. 100yr.
20yr. 100yr.
1yr. 20yr. 100yr.
FLOOD FREQUENCY AREAS
3 5 22
27 25
25 152
21 38 49 51
4 7 84
26 21
38 14 8
NO. FARMS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASH.
MANGAONE
DISTRICTS

FIG. 11.

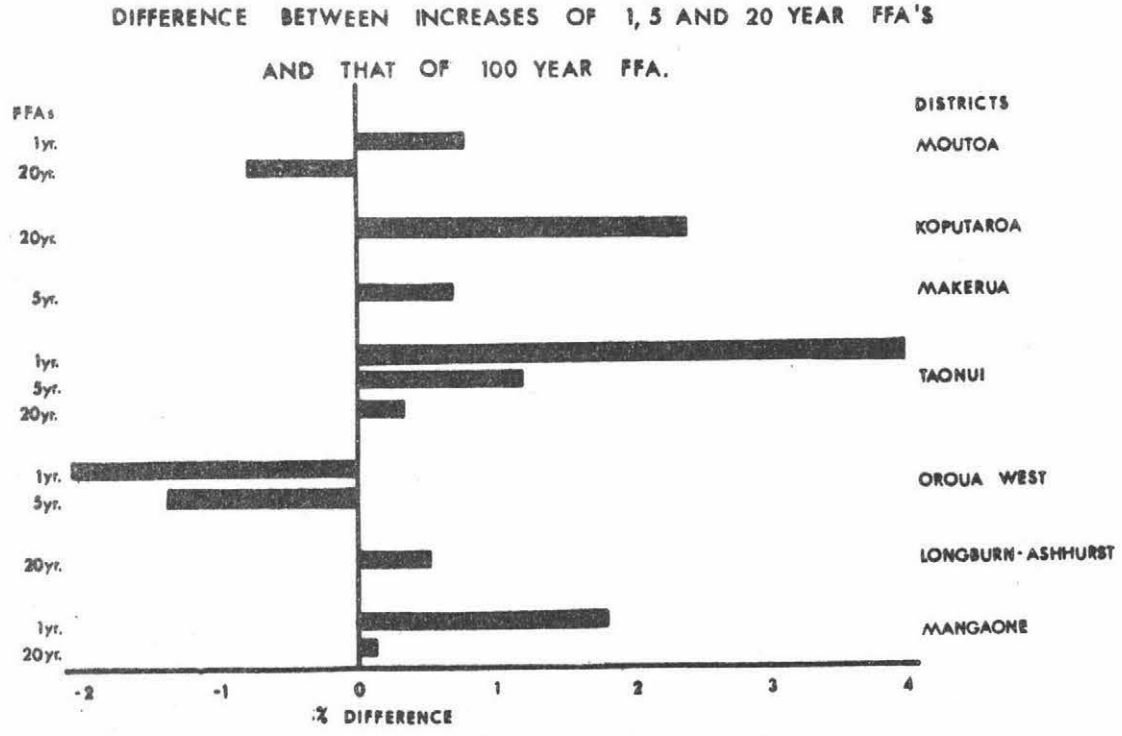

DIFFERENCE BETWEEN INCREASES OF 1, 5 AND 20 YEAR FFA'S AND THAT OF 100 YEAR FFA.
FFAs
1yr.
20yr.
20yr.
5yr.
1yr.
5yr.
20yr.
1yr.
5yr.
20yr.
1yr.
20yr.
DISTRICTS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASHHURST
MANGAONE
-2
-1
0
1
2
3
4
% DIFFERENCE

FIG. 12.

value in the 20 year FFA than in the 100 year area, although the increase is not as pronounced as that of the grazing land.[7] Fattening and dairying farms in this district often consist of a combination of terrace land an river flats. Terrace land has had consistently high values as it has never been flooded (since the establishment of agriculture) whereas the river flats were often subjected to either river or local water flooding. Since the completion of the scheme and the subsequent installation of pumps to serve this and the Buckley district, this low-lying land has been freed from the problem of flooding. It is these factors of flood protection and the associated drainage improvements which have been mainly responsible for the large annual percentage increases shown in the unimproved values within the Koputaroa district.

The amount by which the increase in the unimproved value of land in the 5 year FFA exceeds that of the 100 year area in the Makerua district, only 0.7 per cent, is not as great as that recorded in the Koputaroa district. Makerua has been protected from Manawatu River flooding by stopbanks since 1926, but the land in the 5 year FFA has been subject to severe local water flooding from Manawatu River tributary streams and large drains. Lowest levels in the Makerua Basin lie only 14 feet above sea level and are below the Manawatu River level, so that water which spills over from streams and drains during periods of heavy rainfall has been unable to escape into the Manawatu River. To overcome this problem, pumps have been installed which are normally able to remove this water. This factor has been responsible, to a large degree, for the greater increase in the unimproved value of the 5 year FF land as compared with that of the 100 year FFA (Table IV-4 and Fig.12).

It is the Taonui district which provides the clearest guide to evaluating the effects of the flood control scheme, in that it has land within each of the four flood frequency categories. The amount of increase

in the unimproved value in the 100 year FFA is proportionately less than that which has taken place in all other FFA'S. (Table IV-4 and Fig.11). The increase in value of the 20 year FFA exceeds that of the 100 year area by 0.3, per cent while the increase of the 5 year FFA exceeds it by 1.2, and the 1 year area by 4.0 (Fig. 12).

The large difference between the rates of increase in the 1 year and 100 year FFA'S between 1958 and 1963 can be attributed to the removal of the flood risk from land in the 1 year FFA since this land, lacking any effective protection till the completion of the flood control scheme, has been subject to the most frequent and severe inundations. During winter months in particular, drainage conditions were very poor, low-lying portions remaining in a waterlogged state for long periods. Although the flood control scheme has removed the risk of river flooding, and this is reflected in increase in the unimproved value of this land, there is still a lesser problem of local water flooding. After heavy rainfall, the Rangiotu floodgates, which release water from the main drains into the Manawatu River, are unable to cope when the level of the river is also high. This means water overspills from the drains and causes some flooding. When this local water problem has been removed it is probable that the unimproved value of this land will rise further.

In the Longburn-Ashhurst district, percentage annual increases in the mean unimproved value have remained high in both the 20 year and the 100 year FFA'S with the increase of the 20 year area exceeding that of the 100 year area by only 0.5. (Tables IV-4 and Figs. 11 & 12) Flooding has not been a great problem to contend with in this district. However, the flood control scheme has removed the risk of any flooding and therefore must have had a degree of influence on increasing the unimproved value of the land, but much of the increase must be attributed to the urban influence of Palmerston North and to the quality of the land used for

market gardening.

Values of the Mangaone district are also subject to the influence of Palmerston North, and consequently are high both at pre- and post-scheme dates. Annual percentage increases in the unimproved value between 1958 and 1963 have not been high in any FFA of this district, although the increase in value of the land in the 1 year FFA exceeds that of the 100 year area by 1.8 percent as compared with a difference of only 0.1 between the 20 and 100 year FFA'S. (Table IV-4 and Fig. 12). This means that the 1 year FFA has increased in unimproved value more rapidly than both the 20 year and 100 year FFA'S and part of this increase must be attributed to the flood protection works carried out along the Mangaone Stream.

The two districts which show exception to the general trend under discussion are those of Moutoa and Oroua West. In the Moutoa district, values of fattening farms conform, but those of dairy farms reverse the pattern slightly (Appendix C). The annual increase in unimproved value for dairy farms in the 1 year FFA lies at 9.0 percent, while for those in the 100 year area, a greater increase of 9.8 can be seen. (Table IV-4 and Fig. 12). The flood control scheme has had an important influence on the values but external factors, in part due to soil types and in part to the influence of Foxton on dairy farms in close proximity to its boundaries in the 100 year FFA, operate to distort the pattern.

The Oroua West district also shows a reverse trend. (Table IV-4 and Figs. 11 & 12). In this case it must be taken into account that the number of farms involved in the 1 year and 5 year FFA'S is insufficient to provide accurate results. Not only is the number of farms low, but the area of land concerned is only 172 acres in the 1 year area and 615 acres in the 5 year area. When the amount of land involved is so small, individual farm characteristics (soil types and drainage slopes) become highly significant factors and obscure any effects of the flood control scheme.[8]

The percentage rates of annual increase in the unimproved value of the FFA'S show that the flood control scheme has been of benefit to the Lower Manawatu. The amount of benefit received varies with the former frequency of flooding, in that land which flooded the most frequently in the past, has received proportionately more benefit than land which rarely flooded. (Table IV-4 and Fig. 11). When increases in the 1 year, 5 year and 20 year FFA'S are measured against that of the 100 year FFA some indication of the amount of benefit received by each area can be gauged. (Fig.12). The most significant effect of the flood control scheme, then, has been its ability to release the potential of the land which was previously restricted in its capacity to support a high level of agricultural production. This has been directly reflected in the increases of the unimproved value.

The Value of Improvements

The improvements value measures the amount of capital development which has taken place on a farm between valuation revision dates. It cannot be said that this value has risen as a direct consequence of the provision of a flood control scheme in the Lower Manawatu. Only the unimproved value can reflect increase directly resulting from the scheme. It is feasible to say, however, that the flood control scheme will have an indirect effect on the improvements value, since it is likely that when the risk of flooding has been removed from farmland, farmers will be willing and able to invest more money in the development of their land.

Additional information from the random sample taken supplements the figures provided by the Valuation Department.[9] It has been necessary to obtain such data because of the complexity of factors involved in decisions to carry out capital development on individual farms. Influencing a farmer's decision to improve his property are a combination of physical, psychological and socio-economic factors, and it is almost impossible to single out any particular one as being dominant. However, some factors can

be regarded as providing highly favourable conditions for increased improvements to take place.

Two of the more significant of these are the availability of capital, and the personality and ability of the individual farmer. The availability of capital is an essential prerequisite to making improvements on a farm. It is related to such factors as external market and price conditions, the political climate influencing interest rates and credit facilities, the scale of farming operations and the length of occupancy of a particular farmer. When conditions for the availability of capital are favourable, it then rests with the individual farmer as to the investment decisions made. The age of the farmer, whether he is of a conservative or progressive nature and his management ability all influence his decisions.

Such factors are psychological and socio-economic and serve to influence final investment decisions. Capital development, however, cannot be fully effective and will not usually be carried out if the physical properties of the farm inhibit the attainment of profitable financial returns. Factors such as the inherent fertility of the soil, its ability to drain freely, the provision of adequate moisture all play a significant role in influencing the level of improvements carried out.

In the Lower Manawatu, especially in the low lying basins, the inability of the land to drain freely, together with its propensity for flooding, have meant lower overall financial returns for capital investment, while the full production potential of this land has been restricted. The flood control scheme and the associated drainage improvements have removed this restriction, thus providing more favourable conditions for development. It is in this way that the flood control scheme has affected the improvements value of the farms now protected from flooding.

It must be kept in mind that while the effect of the flood control scheme on the improvements value is indirect, it is not insignificant.

It will follow that in those areas where the frequency of flooding was greatest, the amount of restriction placed on capital development by flooding was also greatest. This means that with the removal of the flood factor as an inhibiting force, these areas should show an increased level of capital development. This is the case in four of the seven districts, those of Moutoa, Koputaroa, Makerua and Taonui. (Table V-4). The lowest-lying portions of these districts comprise the areas which have experienced the most severe and frequent flooding in the Lower Manawatu.

TABLE V-4

MEAN ANNUAL PERCENTAGE INCREASES IN IMPROVEMENTS VALUE

Districts	Dates	1 Year	5 Year	20 Year	100 Year
Moutoa	1956-66	9.5	-	8.5	7.1
Koputaroa	1955-65	-	-	10.4	5.7
Makerua	1955-65	-	6.0	-	5.1
Taonui	1958-63	8.6	4.1	3.5	2.5
Oroua West	1958-63	5.9	7.7	-	6.4
Longburn-Ashhurst	1958-63	-	-	2.3	3.0
Mangaone	1958-63	1.1	-	2.4	2.4

In the Moutoa district, the land in the 1 year FFA shows an increase in the improvements value exceeding that of the 100 year area by 2.4, and in the 20 year FFA an increase of 1.4 percent over that of the 100 year area. (Table V-4 and Fig. 14). It may be possible to attribute much of this recent development in the Moutoa district in the 1 and 20 year FFA'S to the presence of the flood control scheme since the majority of this land was devoted to an extensive form of land use before the scheme's construction, and has subsequently shown considerable intensification.[10]

This is also the case in the Koputaroa district, especially on those farms classified as grazing properties where a very high level (16.4% annual increase) of capital development has taken place between the pre-and post-scheme dates. (Appendix C). It is only since the early 1960's that a large amount of this land has been broken in from a state of semi-permanent

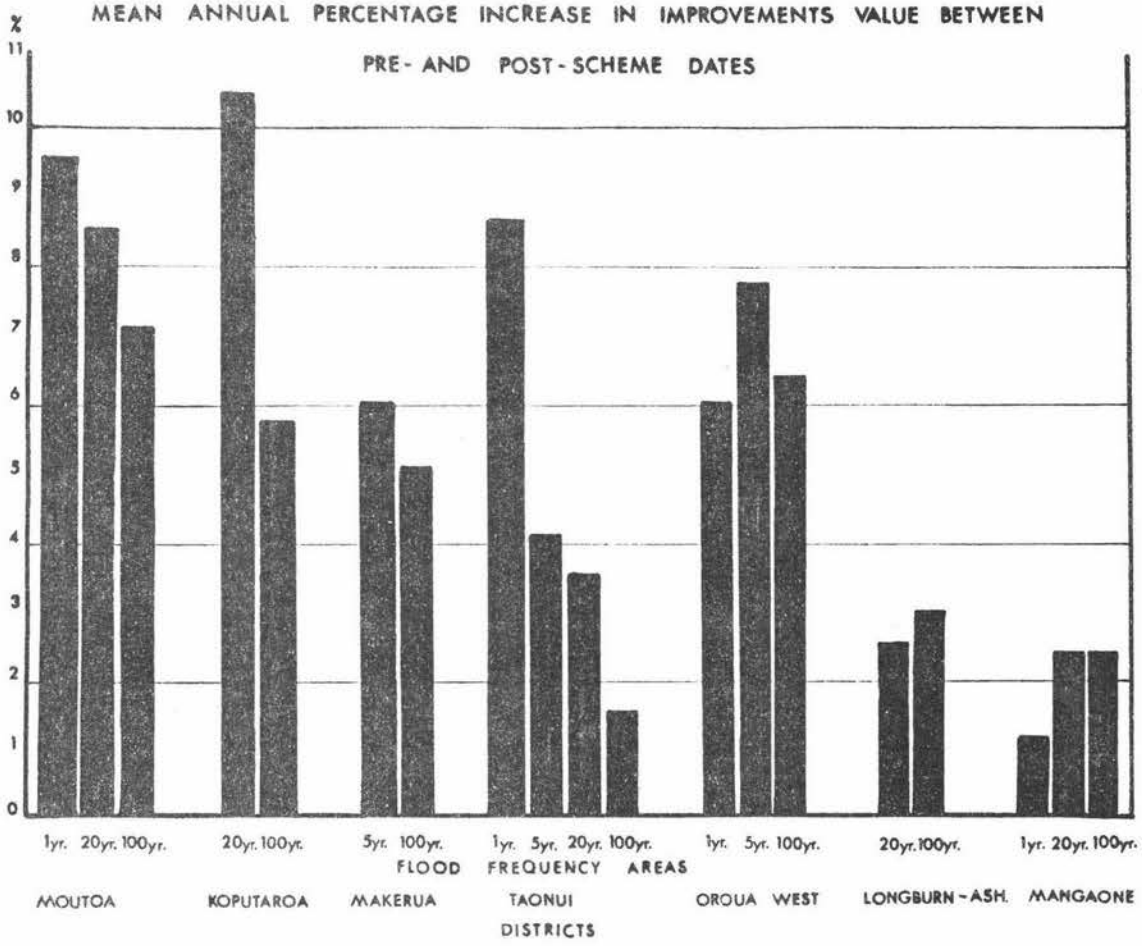

MEAN ANNUAL PERCENTAGE INCREASE IN IMPROVEMENTS VALUE BETWEEN
PRE- AND POST-SCHEME DATES
%
11
10
9
8
7
6
5
4
3
2
1
0
1yr. 20yr. 100yr.
20yr. 100yr.
5yr. 100yr.
1yr. 5yr. 20yr. 100yr.
1yr. 5yr. 100yr.
20yr. 100yr.
1yr. 20yr. 100yr.
FLOOD FREQUENCY AREAS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASH.
MANGAONE
DISTRICTS

FIG. 13.

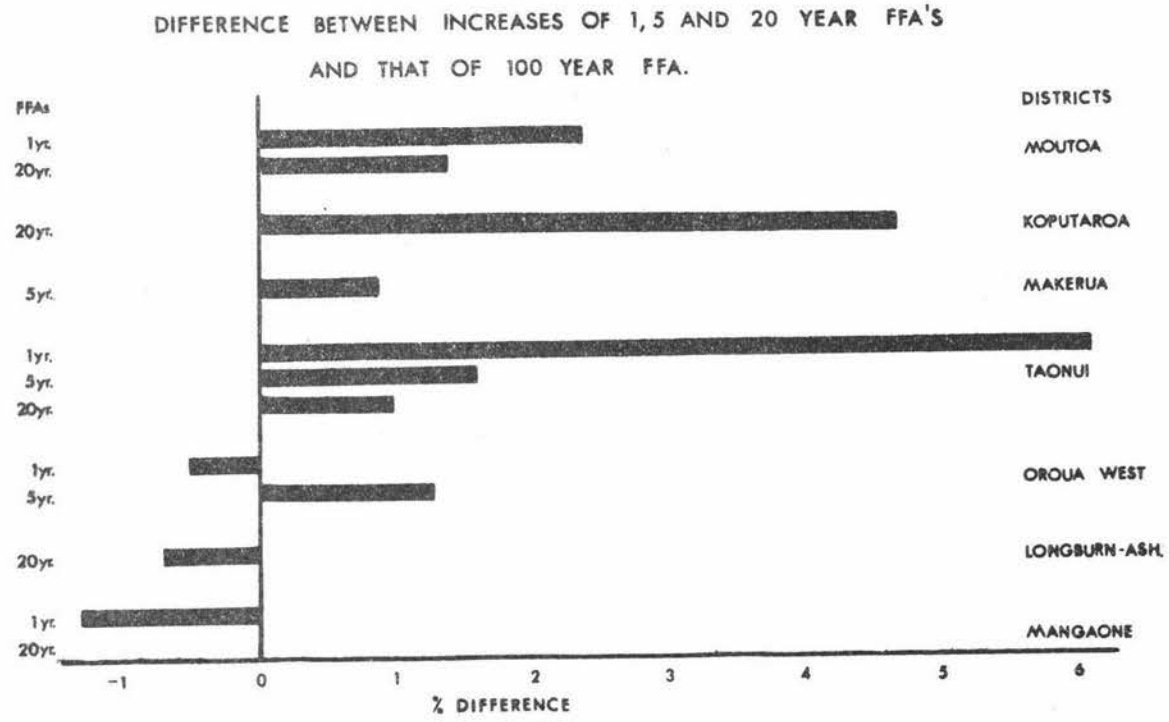

DIFFERENCE BETWEEN INCREASES OF 1, 5 AND 20 YEAR FFA'S
AND THAT OF 100 YEAR FFA.
FFAs
1yr.
20yr.
20yr.
5yr.
1yr.
5yr.
20yr.
1yr.
5yr.
20yr.
1yr.
20yr.
DISTRICTS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASH.
MANGAONE
-1
0
1
2
3
4
5
6
% DIFFERENCE

FIG. 14.

swamp for productive fattening farms. The initiation of this development coincides with the completion of the flood control scheme and the installation of pumps associated with the Aratangata Drainage Scheme. The improvements value of the land in the 20 year FFA has increased at a rate of 4.7 percent over that of the 100 year FFA (Table V-4 and Fig.14), this being one of the greatest differences in increases in the FFA'S of the Lower Manawatu. This is a consequence of the extremely low level of improvements existing in the 20 year FFA at the pre-scheme date; an average value of £27 per acre. (Appendix D).

The amount by which the increase in the 5 year FFA exceeds that of the 100 year area in the Makerua district is 0.9 percent (Fig.14). This difference can be attributed mainly to the installation of pumps to remove water from the low-lying parts of the Basin. Formerly, after heavy rain, especially in winter, many of the farms in the 5 year FFA would become waterlogged for months. This factor has in the past prohibited intensification of farming activities, on many of these farms, to a level comparable with farms in the 100 year FFA of Makerua.

Farms in the 1 year FFA of the Taonui district show a proportionately greater increase in the amount of capital development between the pre- and post-scheme dates than those of the other FFA'S. (Table V-4 and Fig. 13). There has been considerable intensification in farming activities in this FFA in particular, and in the 5 year FFA, between 1958 and 1963.[11] The difference between mean increases for the 1 year and 100 year FFA'S stands at 6.1 percent this being greater than the difference of 1.6 between the 5 year and 100 year areas, and that of 1.0 percent between the 20 year and 100 year FFA's. (Fig. 14).

Several of the farms in the 1 year FFA in the Taonui district contained no farm buildings as they were used as grazing runoffs before the scheme came into operation. Since the removal of the flood risk, buildings have

been erected on only some of these runoff properties, but the slow rate of development is a reflection of the conservative nature of many farmers, or a lack of available capital at present. The trend, however, is for improvements to be made on these farms which were formerly runoffs.

The remaining three districts display trends the reverse of that under discussion. The low number of farms and the small area of land involved in the 1 year and 5 year FFA'S prevent significant comparisons being made between levels of values in the Oroua West district. Decisions of individual farmers, who may be extremely progressive or conservative, will add undue emphasis to results in this case.

The Longburn-Ashhurst district shows a slightly greater mean annual increase of 3.0 percent in the 100 year FFA than that of 2.3 in the 20 year area. (Table V-4 and Figs. 13 & 14). The rate of increase in the 100 year area is raised considerably by intensive market gardening farms since improvements values have been among the highest in the Lower Manawatu at both revision dates for this area. (Appendix C). The decisions to carry out improvements on these farms bear little relation to the removal of a remote flood risk.

Farms in the 20 year and 100 year FFA'S in the Mangaone district both had a rate of increase of 2.4 percent between 1958 and 1963, this being greater than that of the 1 year area by 1.3 percent (Table V-4 and Figs. 13 & 14). Values in this district are influenced by extraneous factors such as the urban influence of Palmerston North so that the pattern becomes distorted and any influence of the flood control scheme on the improvements value disguised.

Although in some districts, the number of farms in each FFA is too low to base many conclusions on, it is evident from this valuation data that in those FFA'S where flooding was the most frequent, recent increases in development are recorded, while in those areas where the chance of flooding

was remote, farms are well-established and the amount of recent development is less.

This trend, revealed by the valuation data, is substantiated in a more detailed account of the reasons for the main periods of development taking place on the sample farms. In the Moutoa district, development has taken place at all periods with two of the seven farmers interviewed stating that the main period of development has been since 1960. In the districts of Oroua West and Longburn-Ashhurst (with the exception of one farmer in the 20 year FFA in the latter district) all farmers stated that the main development had been completed by 1960. In neither of these districts has the problem of flooding been as severe as it has in the low-lying basins of Moutoa, Makerua and Taonui. The flooding by the Mangaone Stream in the Mangaone district has not influenced values and development to the same extent as Manawatu River flooding in those basins liable to frequent inundations from it, and over half the farmers in the Mangaone district stated that development was carried out mainly before 1950.

Although the number of farmers in the sample is small in the Koputaroa district, a clear pattern emerges in which the main development has been carried out since 1960 on those farms in the 20 year FFA. This supports the valuation information for this area with its very high rate of increase between 1955 and 1965 and this corresponds with the removal of the flood risk.

Half the farms in the 5 year FFA in the Makerua district have shown greatest development since 1960, while the other half were developed between 1950 and 1960. Farms in this latter group were all Rehabilitation farms for returned servicemen and formed from the subdivision of several large estates which, in 1950, were still largely swampland with only rough grazing pasture. An important factor contributing to the recent development on farms in this five year area, has been the provision of improved drainage facilities. This pattern contrasts with that shown by the development of

farms in the 100 year FFA, where the problem of flooding has not been great since 1926. There, over half the farmers stated that the main period of development took place on their farms before 1950, and approximately one quarter stated the main period of development has been since 1960. (Table VI-4).

The Taonui district shows most effectively the effects of the flood control scheme in influencing the development of farms. With one exception, all farms in the 100 year FFA were well developed by 1950. A similar pattern is shown by farms in the 20 year FFA. In the 5 year FFA however, it is apparent almost half the farms have undergone their main period of development since 1960, and only just over a quarter were well developed by 1950. Of the eleven farms in the 1 year FFA, only two were well developed by 1950, and since 1960, five have undergone extensive development. In these two areas, the main stimulus for this development has come from the improved drainage conditions and the removal of the flood risk since the early 1960's. The conservative lag is evident again, in that three farms have had very few improvements carried out at any time, these farms still being used as grazing runoffs. (Table VI-4).

A feature of the 20 year and 100 year FFA'S in the Taonui district, and the 100 year area in the Makerua district, is that drainage refinements in the form of tile drainage have been carried out extensively since 1960 on a number of thosefarms which were well developed by 1950. (Table VI-4). This development has been a consequence of the improved drainage outlets into the Manawatu River with the removal of the flood risk from the low-lying land and the trend towards intensification in farming activities.

TABLE VI-4

MAIN PERIOD OF DEVELOPMENT ON SAMPLE FARMS

Districts	Periods of development	FFA's - NO. OF FARMS 1 year	5 year	20 year	100 year
Moutoa	Before 1950	1	-	1	1
	1950-1960	-	-	-	1
	Since 1960	1	-	-	1
	Very little	-	-	-	-
Koputaroa	Before 1950	-	-	1	-
	1950 - 1960	-	-	-	-
	Since 1960	-	-	5	1
	Very little	-	-	-	-
Makerua	Before 1950	-	-	-	9 (2)
	1950 - 1960	-	4	-	3
	Since 1960	-	4	-	4
	Very little	-	-	-	1
Taonui	Before 1950	2	5	8 (6)	5 (2)
	1950 - 1960	1	5	1	-
	Since 1960	5	9	1	1
	Very little	3	-	-	-
Oroua West	Before 1950	1	-	-	1
	1950 - 1960	1	-	-	1
	Since 1960	-	-	-	-
	Very little	-	-	-	-
Longburn - Ashhurst	Before 1950	1	-	-	2
	1950 - 1960	-	-	-	-
	Since 1960	-	-	1	-
	Very little	-	-	-	-
Mangaone	Before 1950	5	-	-	-
	1950 - 1960	-	-	-	-
	Since 1960	3	-	-	-
	Very little	-	-	-	-

Farm numbers in brackets indicate those farms which have been carrying out tile drainage programmes since 1960.

It is evident, then, with the exception of a few areas, that the improvements value follows a similar trend to that of the unimproved value in the Lower Manawatu. While much of the increase in unimproved value between pre- and post-scheme dates in areas where flooding occurred the most frequently, can be directly attributed to the flood control scheme, it cannot be said with the same confidence that increases in the improvements value are directly due to the influence of the scheme. It can only be said that it is highly probable that the scheme has influenced the improvements value in an indirect manner by providing more favourable conditions for capital investment and by stimulating the complex of socio-economic and psychological factors which are responsible for ensuring improvements being made on a farm. A factor which cannot be overlooked in connection with development, is the time lag involved while conservative farmers adjust to this more favourable climate for investment. This suggests that the full effect of the flood control scheme on capital development of farms in the Lower Manawatu is not yet apparent.

The Capital Value

The capital value, as defined by the 1951 Valuation Act, is that price which a property should realize under normal sale conditions. It includes both the unimproved value and the value of the improvements which have been made on the farm. Since this value is a synthesis of the values discussed in the preceding sections of this chapter, it is unnecessary to discuss it in detail. It serves as a link between the unimproved and the improvements values.

The rising sequence of capital values for the districts conforms largely to that shown by the unimproved values. (Tables I-4).

TABLE VII-4

AVERAGE CAPITAL VALUE PER ACRE FOR DISTRICTS AT BOTH REVISION DATES

Districts	Dates	1st date	2nd date
Koputaroa	(1955-65)	(£) 52.43	(£) 89.98
Moutoa	(1956-66)	66.60	122.04
Oroua West	(1956-66)	88.11	140.93
Makerua	(1955-65)	100.23	145.43
Longburn-Ashhurst	(1958-63)	139.09	173.22
Taonui	(1958-63)	146.11	174.41
Mangaone	(1958-63)	162.22	185.41

The values for districts within Kairanga County are, as may be expected, still higher than those in either the Horowhenua or Manawatu Counties.

It is evident that in six of the seven districts in the Lower Manawatu, the capital value of farms susceptible to the most frequent flooding, has shown an annual percentage increase which is proportionately greater than that of areas where the chance of flooding was remote. (Table ~~IV-8~~ VIII-4 and Fig. ~~IV-7~~ 15). The exceptional district is Oroua West where, however, the amount of land involved is too small to enable valid conclusions to be made.

TABLE VIII-4

MEAN ANNUAL PERCENTAGE INCREASES IN CAPITAL VALUES

Districts	Dates	1 Year	5 Year	20 Year	100 Year
Moutoa	1956-66	9.5	-	8.2	7.7
Koputaroa	1955-65	-	-	9.1	5.3
Makerua	1955-65	-	6.0	-	4.9
Taonui	1958-63	7.8	3.8	3.2	2.4
Oroua West	1956-66	4.5	6.2	-	5.9
Longburn-Ashhurst	1958-63	-	-	4.2	2.4
Mangaone	1958-63	2.1	-	2.4	2.1

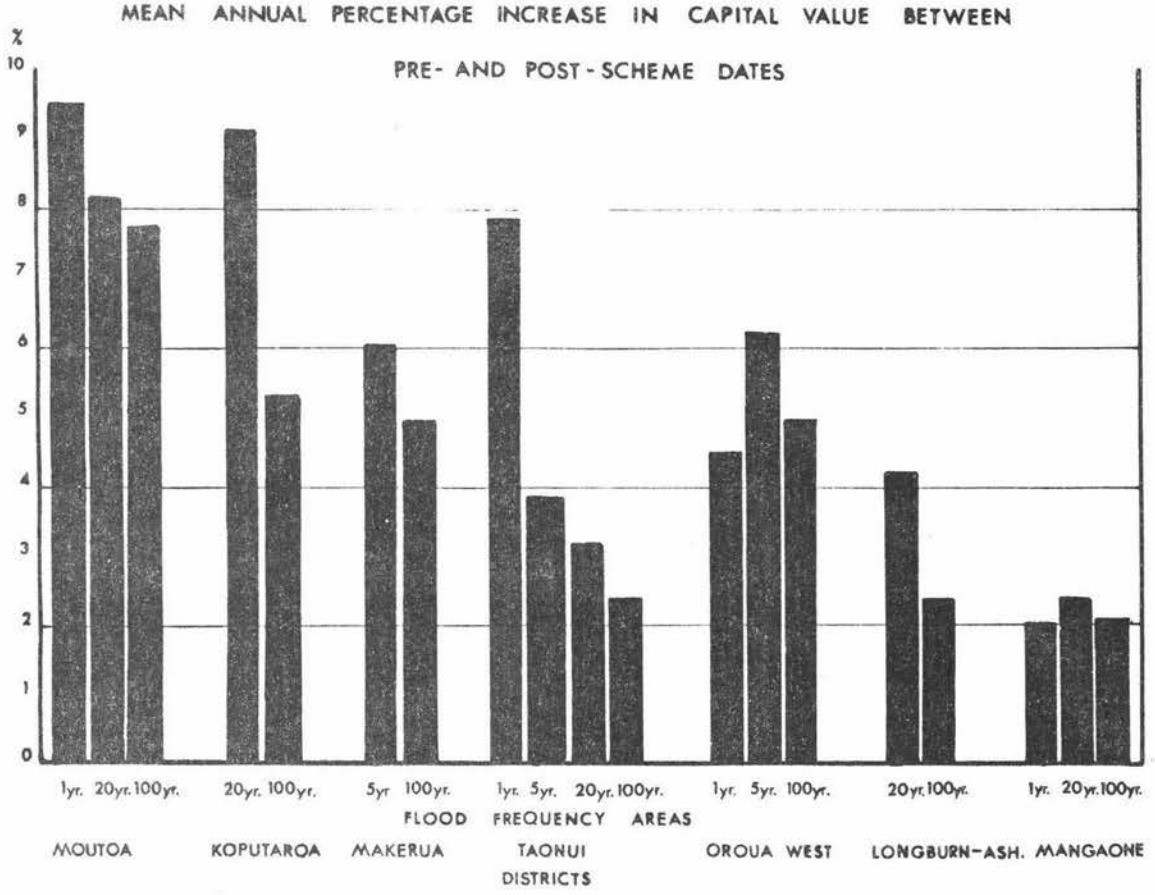

MEAN ANNUAL PERCENTAGE INCREASE IN CAPITAL VALUE BETWEEN
PRE- AND POST-SCHEME DATES
%
10
9
8
7
6
5
4
3
2
1
0
1yr. 20yr. 100yr.
20yr. 100yr.
5yr 100yr.
1yr. 5yr. 20yr. 100yr.
1yr. 5yr. 100yr.
20yr. 100yr.
1yr. 20yr. 100yr.
FLOOD FREQUENCY AREAS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASH.
MANGAONE
DISTRICTS

FIG. 15.

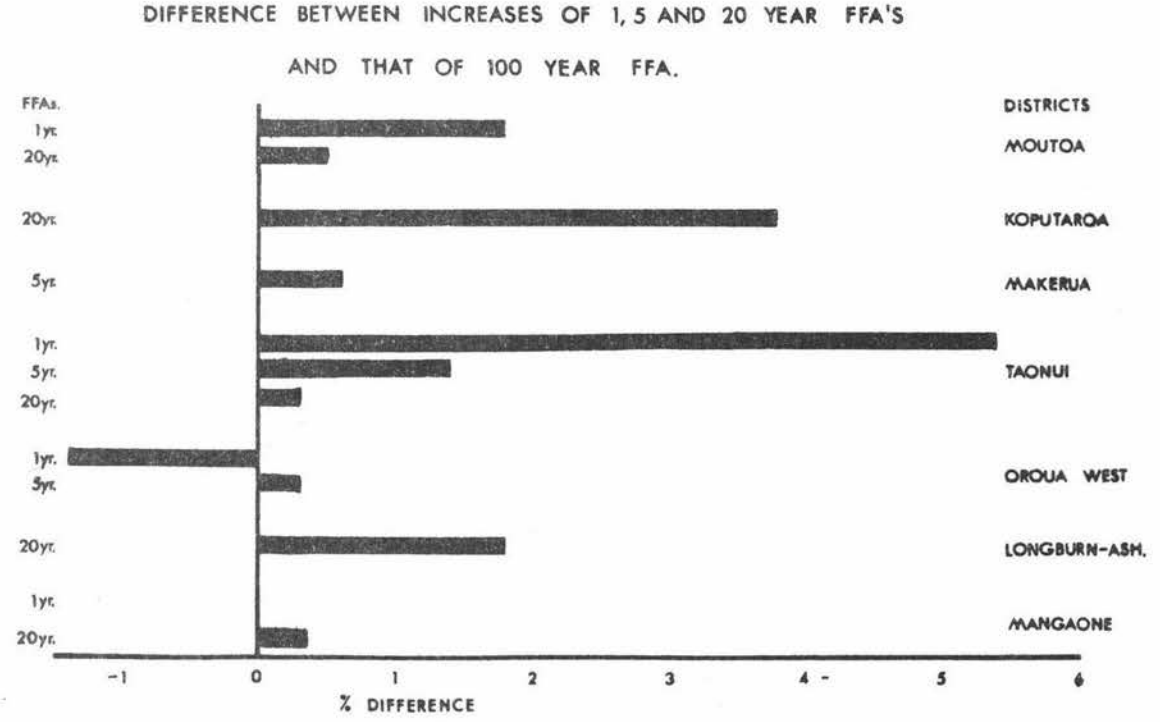

DIFFERENCE BETWEEN INCREASES OF 1, 5 AND 20 YEAR FFA'S
AND THAT OF 100 YEAR FFA.
FFAs.
1yr.
20yr.
20yr.
5yr.
1yr.
5yr.
20yr.
1yr.
5yr.
20yr.
1yr.
20yr.
DISTRICTS
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN-ASH.
MANGAONE
-1
0
1
2
3
4
5
6
% DIFFERENCE

FIG. 16.

In all districts except those of Oroua West and Mangaone, the increases in the value of the land of the 1, 5 and 20 year FFA'S, have exceeded increases shown in the 100 year areas over the same period. (Table VIII-4 and Fig.15). It can be seen that in the districts of Moutoa and Taonui, the greatest difference in increase has been between the values of the 1 year and the 100 year FFA'S. (Fig.16).

The fact that, in the majority of the districts, the value of the land in the 100 year FFA'S has not increased as fast as that of land in the other FFA'S indicates that the value of that land which was formerly the most frequently flooded, has increased proportionately more than the value of land where flooding was unlikely to occur. The greatest gap at pre-scheme dates between land value levels was between the 1 year and the 100 year FFA'S, but because of the proportionately greater increase shown in the capital value of land in the 1 year area between pre- and post-scheme dates, this gap has been narrowed considerably. This means, that with the removal of the flood risk, and the associated improvements in drainage, the trend is for the value of the land in the 1 year FFA'S to rise, gradually to attain a value more comparable with that of the land in the 100 year areas.

Comparisons with County Increases

Table IX-4 and Fig. 17 show the percentage rates of annual increase in the land values which have taken place in districts and FFA'S of land rated for the flood control scheme, and compares them with increases in the Horowhenua, Manawatu and Kairanga Counties over the same period of time. Incorporated in the overall County figures are the increases in values of land rated for the scheme. It was not possible to extract values of this land accurately, since the rated land does not fall into complete Ridings. This means the County increases do not consist exclusively of flood-free land and so do not provide a comparison as precise as that desired, but a general trend is evident.

Those areas which were formerly liable to the most frequent flooding show increases which are proportionately greater than those of the Counties. Likewise, the areas with only a remote chance of flooding show increases similar to, or less than County increases. It is particularly noticeable that the 20 year FFA of Koputaroa and the 1 year area of Taonui show rates of increase in land values which exceed those of the Counties. These are the two areas, together with the Moutoa district, in which rates of increase in all FFA'S are above the County increase, and where land values have been inhibited to the greatest extent by the problem of frequent flooding. It is also notable that land values in the 100 year area of Makerua, the 20 and 100 year FFA'S of Taonui, and all areas of the Mangaone district, have increased proportionately less than the whole Counties.

TABLE IX-4

ANNUAL PERCENTAGE INCREASE IN VALUES

Horowhenua County - 1955-65

Districts	FFA'S	U.V.	Impts.	C.V.
COUNTY		6.9	5.1	5.6
Koputaroa	20 year	7.1	10.4	9.1
	100 year	4.7	5.7	5.3
Makerua	5 year	5.3	6.0	6.0
	100 year	4.6	5.1	4.9

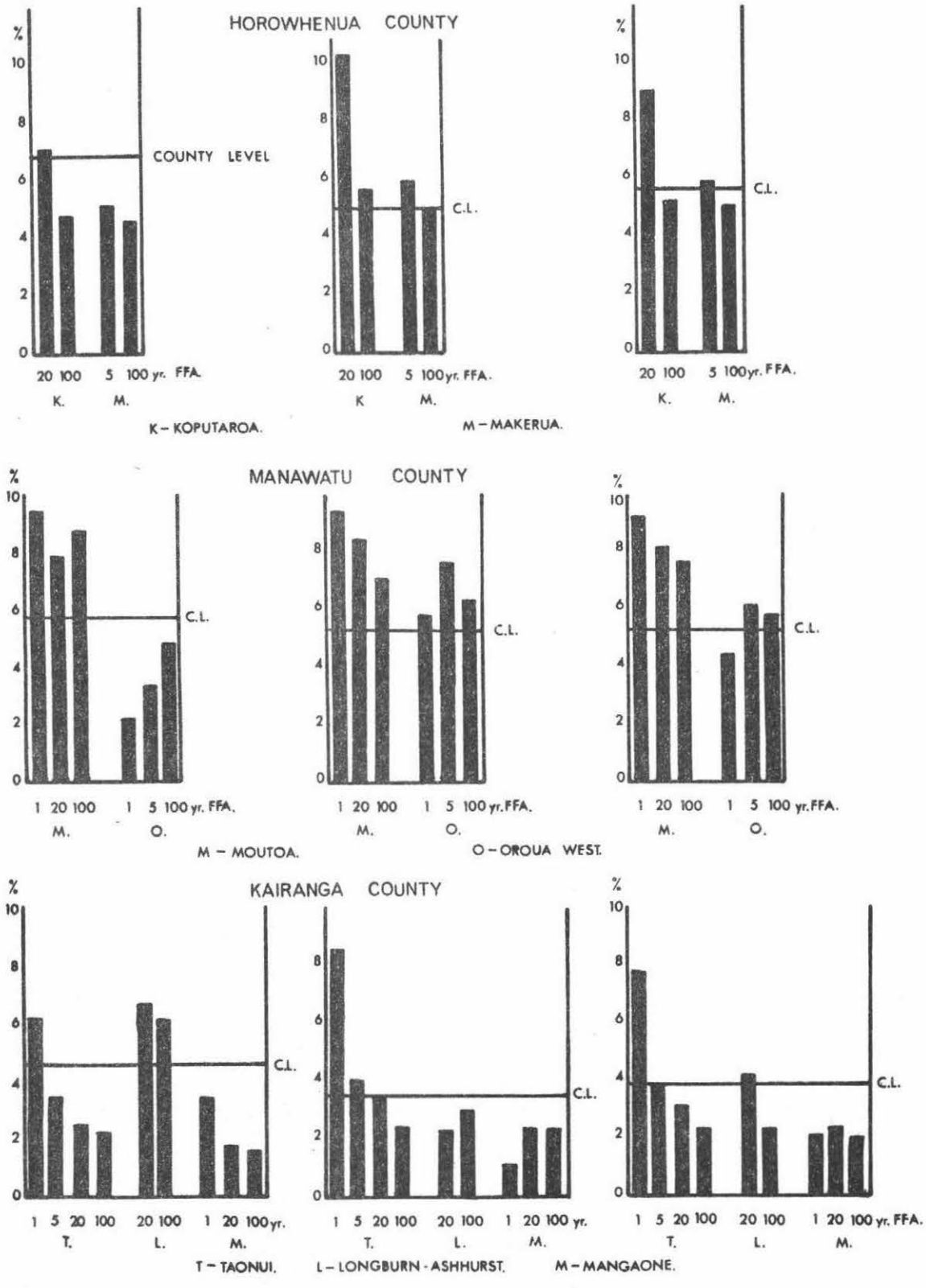
Manawatu County - 1956-66

Districts	FFA'S	U.V.	Impts.	C.V.
COUNTY		5.8	5.4	5.2
Moutoa	1 year	9.5	9.5	9.5
	20 year	7.9	8.5	8.2
	100 year	8.7	7.1	7.7
Oroua West	1 year	2.3	5.9	4.5
	5 year	3.5	7.7	6.2
	100 year	4.9	6.4	5.9

Kairanga County - 1958-63

Districts	FFA'S	U.V.	Impts.	C.V.
COUNTY		4.6	3.5	3.9
Taonui	1 year	6.3	8.6	7.8
	5 year	3.5	4.1	3.8
	20 year	2.6	3.5	3.2
	100 year	2.3	2.5	2.4
Longburn-Ashhurst	20 year	6.7	2.3	4.2
	100 year	6.2	3.0	2.4
Mangaone	1 year	3.5	1.1	2.1
	20 year	1.8	2.4	2.4
	100 year	1.7	2.4	2.1

MEAN ANNUAL PERCENTAGE INCREASES IN LAND VALUES OF DISTRICTS AND FFA'S COMPARED WITH THOSE OF COUNTIES



UNIMPROVED VALUE IMPROVEMENTS VALUE CAPITAL VALUE

FIG. 17.

The Incidence of Rating

The second aspect in considering the effects of the flood control scheme on land values is that concerned with rates levied to pay for flood protection. The first, and most important aspect, is the effect of the flood control scheme in raising the value of the protected land as productive farmland.

In order that this land, which was subject to frequent inundations from the Manawatu River, should become flood-free, the flood control scheme was constructed with finance from a Government subsidy and from a loan of £350,000. This loan was to be paid back on an annuity basis over 25 years.[13] Rates, comprising a portion for loan repayment and one for works carried out, have had to be levied on all farmers occupying land protected from flooding by this scheme. The amount of rates to be paid depends on the amount of benefit an area is estimated to receive from the flood protection. Thus, the land which formerly flooded the most frequently, pays a proportionately greater share of the rates than land where the chance of receiving a flood was remote.

These rating charges influence the sale price of this land to some extent and also the values of the Valuation Department, since these values, according to the definitions stated, are a reflection of the sale value of the land. The amount the market value is depressed by heavy rates depends partly on the time period over which the loan has to be paid back. Rate payment for the flood control scheme loan reached a maximum in 1965-6 and has now begun to diminish. It has been calculated that, assuming similar interest rates and an annuity basis, 'rating for loan repayment should stabilize from 1970-1 until the end of the 25 year period at approximately £14,000 per annum for all loans at present current.'[14] This means rates will continue to diminish till eventually a maintenance charge will become the basic rate levied for the flood control scheme. This factor means farmers planning on a long term basis will not be so concerned about short term heavy rate payments, since these payments will be diminishing annually, and consequently the market value will not be

greatly affected.

To accommodate any influence of special rates, (those above County rates) depressing the market value of the land, an amount of money proportionate to the rate charge is deducted from the total value of the land.[15] (Adjusted values shown in Table X-4). In Table X-4 instead of this amount being deducted, it has been added to the capital value in order to show the total value of the land. It is evident that this modified value of the land is considerably higher than the capital value, or the market value, particularly in those areas which receive the greatest benefit from flood protection.

The areas with the highest flood frequencies, the 1 and 5 year areas, have the greatest proportion of land in the A. and B. (heaviest) rating classes and consequently the altered value shows a proportionately greater increase over the capital value than the areas of C. and D. rating classes which generally belong to the 20 and 100 year FFA'S (Table X-4). In the Kairanga County, the Mangaone district supports D. class rates although the majority of the land lies within the 1 year FFA. This can be attributed to the type of flooding received from the Mangaone Stream, which was less severe and less damaging than that of the Manawatu River. Land in the 20 and 100 year FFA'S of the Makerua and Koputaroa districts bears Class A. and B. rates, while low-lying land in Taonui in the 1 year FFA pays Class B. rates. This disparity is a reflection of the degree of flood protection received by these areas. Excess peak flows of water from the Manawatu River in a flood exceeding the capacity flood of the scheme, 150,000 cusecs, will be discharged through emergency spillways (Fig.10) to flow into the low-lying portions of the Taonui Basin in order that the districts of Makerua, Koputaroa and Moutoa may remain flood-free. Consequently, these latter districts pay a greater proportion of the rates per acre than does Taonui.

As well as carrying flood protection rates, the majority of the land in the Lower Manawatu is also subject to special rating by Drainage Boards for

TABLE X-4

CAPITAL VALUE AND ADJUSTED CAPITAL VALUE WITH RATES

County	District	Dates	Rate Class	Pre-scheme dates C.V.(/acre)	Pre-scheme dates C.V.-Rates	Post-scheme dates C.V.(/acre)	Post-scheme dates C.V.-Rates
1 year FFA'S							
Manawatu	Moutoa	1956-66	A.	(£) 71.3	(£) 79	(£) 134.7	(£) 144
	Oroua West		A.	98.7	107	142.6	151
Kairanga	Taonui	1958-63	B.	66.2	72	99.3	106
	Mangaone		D.	143.6	145	163.6	165
5 year FFA'S							
Horowhenua	Makerua	1955-65	A.	92.9	105	147.7	157
Manawatu	Oroua West	1956-66	B.	86.5	93	152.8	158
Kairanga	Taonui	1958-63	B.C.	95.3	104	113.4	124
20 year FFA'S							
Horowhenua	Koputaroa	1955-65	A.	46.1	58	91.0	100
Manawatu	Moutoa	1956-66	B.	75.0	82	136.6	142
Kairanga	Taonui	1958-63	C.	130.7	134	148.9	152
	Longburn-Ash.		A.B.	126.5	141	157.7	175
	Mangaone		D.	125.4	127	141.2	143
100 year FFA'S							
Horowhenua	Koputaroa	1955-65	B.C.D.	58.6	67	88.9	96
	Makerua		A.B.C.	101.6	120	143.2	158
Manawatu	Moutoa	1956-66	C.	53.6	57	94.8	98
	Oroua West		B.C.D.	79.1	87	127.4	136
Kairanga	Taonui	1958-63	C.	146.2	149	161.5	165
	Longburn-Ash.		C.	151.7	155	188.7	192
	Mangaone		D.	122.3	124	138.0	140

local drainage schemes. The work of these bodies is essential and supplementary to that of the Catchment Board and similarly entails increased costs and returns. The effect of these rates is to depress the market value of the land to some degree also. It is not necessary to detail this effect here. However, the combination of Drainage and Catchment Board rates operates to reduce the market value of the land to a degree proportionate to the total amount of rates levied. This particularly affects the value of land in the Makerua - Opiki districts, and the Moutoa district where heavy rates are charged to repay loans for pumping schemes operating in these areas. With the lighter rates charged in the Kairanga, the market value of the land is not affected to the same degree.

Conclusion

The significant difference in land value increases is that shown between the 1 year, 5 year and 20 year FFA'S, and the control area, the 100 year FFA (Tables IV, V & VIII-4 and Figs. 12, 14 and 16). It is probable, then, that the additional increases in land values of the 1 year, 5 year and 20 year FFA'S over those increases of the 100 year FFA'S are attributable to the flood control scheme and the associated drainage improvements.

The protection offered the land by the flood control scheme has had a direct effect in increasing the unimproved value, since flooding has been the factor primarily responsible for influencing the levels of unimproved value on the floodplain. Improvement in the unimproved value has stimulated development of this land and thus, the improvements and capital values have been indirectly increased by the presence of the flood control scheme.

The provision of flood protection enabling increased benefit to be gained from this land has meant, however, increased rates. These rates alter the market value of the land to some degree, and to allow for this effect, the capital value of the Valuation Department is one which has been reduced slightly. Thus, although flood protection enables the full agricultural

potential of the land to be utilized, farmers encounter increased costs to pay for this protection. However, as rating for the flood control scheme will gradually be dininished, till the completion of loan payments in 1988, this rate factor will become of decreasing significance over this period of time.

The major effect, then, of the flood control scheme has been to release the full agricultural potential of the low-lying land in the Manawatu subject to flooding and thus inhibited in its capacity to support intensive farming activities. This has been reflected in land values. Those areas which were frequently flooded had the lowest values prior to the existence of the scheme, while land with a remote chance of flooding was valued highly. Since the completion of the scheme, the low valued land, now protected from flooding, has shown a proportionately greater increase in value than that of the high valued land. This means that, in all probability, now the restrictive flood factor has been removed, land values in the Lower Manawatu will gradually move towards a common level.

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1. This Chapter is based on information from the Valuation Department for all farms in the Lower Manawatu which are rated by the Manawatu Catchment Board for the scheme. The Lower Manawatu flood control scheme will be referred to as either"the flood control scheme"or"the scheme"in the following pages.
2. Valuation 'revisions' are the periodic reassessment of land values carried out by the Valuation Department, usually every five years.
3. This example may explain the argument put forward more clearly: Area A. may show an increase in valuation from £20 to £25 in a five year period while Area B. may show an increase from £60 to £65 over the same period. Both areas, in absolute terms show an annual increase in value of £1, but when the differences are converted to a percentage basis, Area A. has increased 25% as compared with the increase of 8.3% shown by Area B. In other words, Area A. has increased its agricultural potential by 25%, while that of Area B. has increased by only 8.3%.
4. See Chapter V.
5. Flood frequency areas will be referred to as FFA'S in the following pages.
6. See Chapter V.
7. See Chapter V. 'Fattening' refers to 'fat lamb' farms.
8. While the 1 year and 20 FFA'S of Moutoa consist of only three and five farms, the area of land involved is considerably larger (Appendix C) and more weight can be given to results.
9. See Chapter 1 and Appendix A.
10. See Chapters V and VI.

11. See Chapters V and VI.

12. By development, it is meant the process of stumping, draining, fencing and establishing good quality pastures. The main period of development, therefore, is the time when capital and labour resources have been directed to these activities.

13. Appendix E.

14. Smith, 1963, 3.

15. Appendix E.

CHAPTER 5

LAND USE

Both physical and human factors influence the use of the land for agricultural activities. Physical factors provide the environment within which the human factors operate. Human factors, in turn, modify this physical environment with the objective of carrying out the most 'profitable' type of agriculture. Because of the similar climatic conditions experienced throughout the Lower Manawatu, climate can be disregarded as a factor causing variation in the land use pattern.[1]

It is the complex of physical factors including soils, topography and drainage which has been largely responsible for the land use pattern shown in Fig. 20. The soils of the Lower Manawatu are recent and 'where recent soils from alluvium are on broad flats, and measures have been taken to protect them from flooding, they rank amongst the most highly productive soils for either crops or pasture.'[2] The soils in themselves are of natural high fertility. Paradoxically, the soils in the most frequently flooded areas, and consequently of the lesser value for agriculture, are generally the most fertile due to quantities of silt deposited during floods.

These recent soils of the river flats have been classified into six series by the Soil Bureau of the D.S.I.R. on the basis of drainage and the rate of accumulation of alluvium. The relationship between these can be seen from Fig. 18 and the distribution of the types from Table I-5. In addition to this series, there are the organic soils, the Opiki and Makerua peaty loams which have formed in low-lying areas where the water table remains close to the surface and where poor aeration and partially decomposed organic matter accumulates as peat. There are also the saline soils of the Meanee-Farndon complex which have formed at the mouth of the Manawatu River where the river flats are periodically inundated with brackish water.

A general description of these soils is provided by the D.S.I.R. Bulletin 29.

> 'Soils of the river flats are derived from material brought down by the rivers and deposited during flooding. Periodic additions of alluvium have interrupted the soil-forming processes such as breakdown of the mineral grains, removal of plant nutrients in solution, and the incorporation of organic matter into the topsoil. Consequently there is not the development of distinct horizons that is found in non-accumulating soils. Fertility is generally high and except where the texture of the alluvium is coarse and has a low moisture retention in summer or where drainage is poor, these soils are very suitable for intensive production through market gardening, cropping, dairying, or stock fattening.'[3].

Again stressed is the natural high fertility, particularly of the Manawatu soils, and the importance of drainage. All these soils are capable, when well-drained, of supporting high producing agriculture with little necessity for the application of artificial fertilizer. The Rangitikei soils are mostly contained on the berm land inside stopbanks so that they still receive frequent flooding and are only used for supporting grazing. The gley recent soils, with imperfect to poor drainage, comprise the Parewanui and Kairanga soils. (Fig.18) Intensive production and cultivation has been restricted on these soils because of the poor drainage conditions. In winter, water lying on the surface has damaged crops, and severe poaching of heavily stocked pasture has occurred. In the past this problem has been accentuated by frequent inundations of floodwater. With the flood risk removed, artificial drainage measures can operate efficiently and thus allow these soils to support annual cash crops in rotation with pasture.

The recent soils, (Table I-5) are particularly suited to intensive production in the form of dairying and fattening lambs, but the intensity with which these activities could formerly be carried out was restricted by the frequent flooding from the Manawatu River. This was especially the case with the Manawatu soils, which, unlike the Parewanui and Kairanga soils, are freely and well-drained and therefore, the removal of the flood risk has been the factor of greatest significance in releasing the full agricultural

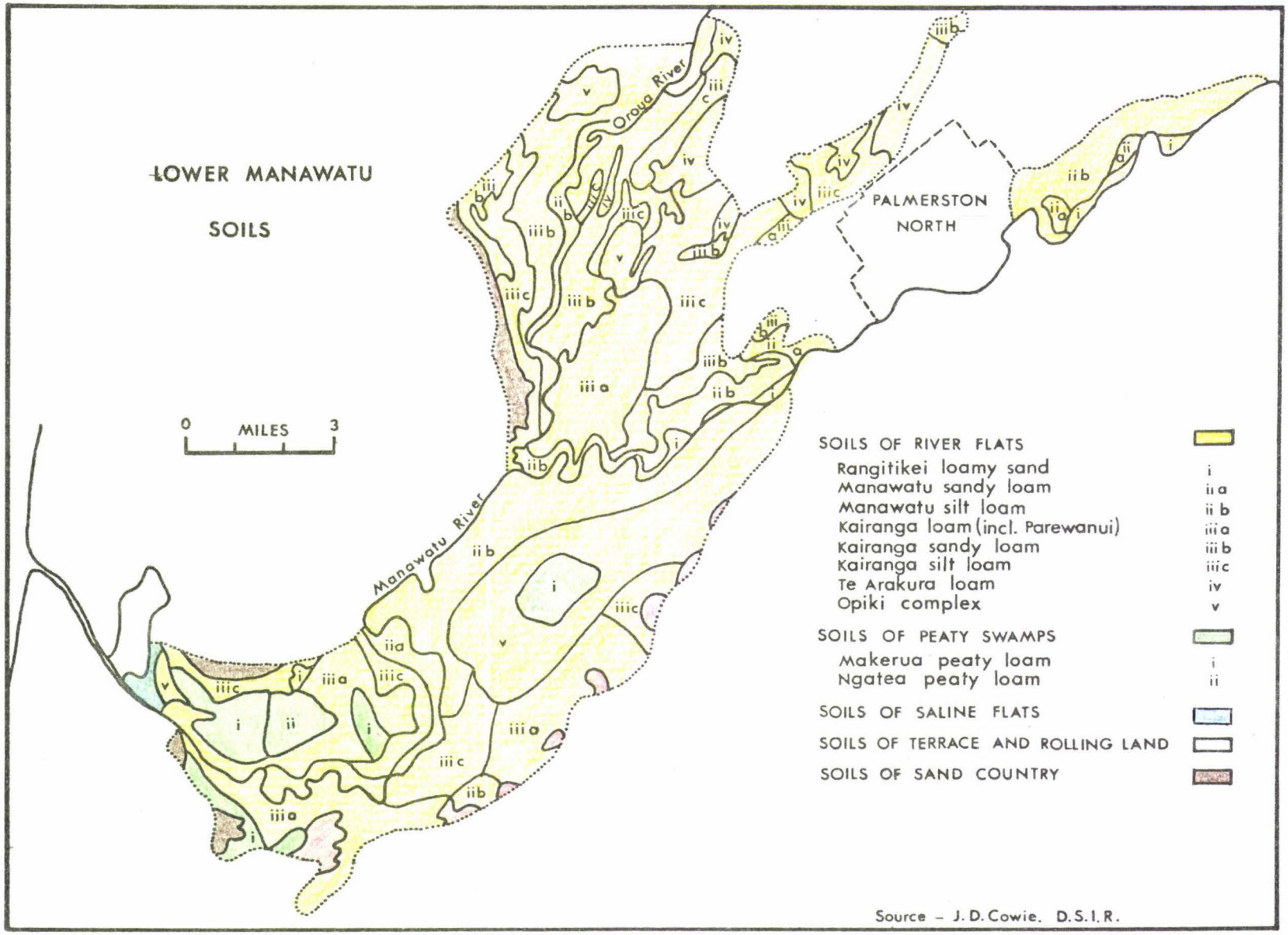
LOWER MANAWATU
SOILS
0 MILES 3
Oroua River
Manawatu River
PALMERSTON NORTH
SOILS OF RIVER FLATS
Rangitikei loamy sand i
Manawatu sandy loam ii a
Manawatu silt loam ii b
Kairanga loam (incl. Parewanui) iii a
Kairanga sandy loam iii b
Kairanga silt loam iii c
Te Arakura loam iv
Opiki complex v
SOILS OF PEATY SWAMPS
Makerua peaty loam i
Ngatea peaty loam ii
SOILS OF SALINE FLATS
SOILS OF TERRACE AND ROLLING LAND
SOILS OF SAND COUNTRY
Source – J. D. Cowie, D.S.I.R.

FIG. 18.

TABLE I-5

CLASSIFICATION OF SOILS ACCORDING TO RATE OF ALLUVIUM ACCUMULATION AND DRAINAGE

Drainage	Rates of Alluvium Accumulation: Rapid	Slow	Negligible
Good. (Recent Soils)	Rangitikei	Manawatu	Karapoti
Poor. (Gley recent soils)	Parewanui h.sa.l. s.l. h.s.l.	Kairanga f.sa.l. s.l. h.s.l.	Te Arakura (Gley soil) sa.l. f.s.l. s.l.

Key:

h.sa.l. - heavy sandy loam
s.l. - silt loam
h.s.l. - heavy silt loam
f.sa.l. - fine sandy loam
sa.l - sandy loam

Derived from personal communication with J.D. Cowie

potential of this land.[4]

Thus, while the Manawatu River has been responsible for developing fertile soils on the floodplain, it has also restricted the use of these soils for intensive agriculture by frequently flooding. Additional to this problem of river flooding is the tendency for local surface runoff to lie in the low-lying basins where there is a lack of natural drainage outlets to the river. (Fig. 4) In order that the lower-lying areas should be able to support high producing agricultural activities, artificial flood protection and drainage measures have been introduced.

It is, then, a combination of potentially suitable physical factors operating in the context of human factors such as market prices, technology, management policies and personal preference, and being modified by these factors, which produces the land use pattern of the Lower Manawatu. (Fig. 19a)

The Pre-scheme Land Use Pattern

At the pre-scheme dates, dairying and fat lamb farming were the predominant activities in all districts of the Lower Manawatu. (Table II-5) The districts of Makerua, Longburn - Ashhurst, Oroua West and Mangaone showed a marked dominance of dairying over fat lamb farming, while in Moutoa and Taonui, a greater proportion of the land was devoted to fattening, and in Koputaroa, there was an equal proportion of dairy and fat lamb farms. Mixed dairy and sheep farms comprised 25 percent of the land use in Moutoa, but elsewhere the proportion of land devoted to this activity ranged between six and eleven percent. The amount of land classified as grazing remained small in all districts. This category includes land which was used as runoffs, and a portion, mainly in the Mangaone district, on which several farmers grazed stock for Palmerston North butchers. These farms carried a large number of stock for short periods of time throughout the year.

TABLE II - 5

PROPORTION OF LAND USE IN CATEGORIES FOR DISTRICTS - 1955 and 1965

DISTRICTS	DAIRYING	FATTENING	MIXED	GRAZING	FAT LAMB/CROP	MARKET GARDEN	TOTAL %
Moutoa	26.7 (29.0)	47.4 (51.3)	25.9 (13.0)	- -	- (6.7)	- -	100
Koputaroa	48.8 (46.0)	42.2 (50.7)	- -	9.0(3.3)	- -	- -	100
Makerua	57.7 (52.5)	24.6 (27.4)	7.5 (4.4)	3.1(2.2)	7.1 (13.5)	- -	100
Taonui	26.3 (21.9)	47.7 (35.3)	11.0 (11.1)	9.0(2.2)	7.0 (29.5)	- -	100
Oroua West	47.8 (45.4)	27.9 (25.0)	6.3 (4.9)	5.9(7.9)	12.1 (16.8)	- -	100
Longburn-Ashhurst	73.5 (61.9)	17.6 (33.3)	- -	- -	- -	8.9 14.8	100
Mangaone	49.7 (53.4)	36.6 (26.9)	7.8 (6.3)	5.9(7.1)	- (6.3)	- -	100

'Fattening' stands for fat lamb farming.

'Mixed' stands for mixed sheep and dairy farming.

'Fat lamb/crop' stands for mixed fat lamb farming and cash cropping.

1st revision date proportions unbracketed, 2nd revision date figures in brackets.

At pre-scheme dates there was only a small proportion of land devoted to mixed sheep and cash cropping, below 12.5 percent, in the districts of Taonui, Makerua, Longburn-Ashhurst and Mangaone, while the remaining districts supported none. (Table II-5) The Opiki district of Makerua maintained a large acreage of potatoes and onions, usually on fattening farms. The only district with market gardening was that of Longburn - Ashhurst, where 4.6 percent of the land was devoted to this activity.[5]

Farm sizes varied considerably. (Appendix F) The average size of dairy farms ranged from 70 to 115 acres. In the Moutoa and Koputaroa districts the average was 111 to 115 acres, while the size of dairy farms in other districts remained below 100 acres. Fat lamb farms were larger, the average size in districts, ranging from 96 to 381 acres, but this class had a median value of 173 acres as compared with that of 84 acres for dairy farms. The size of mixed sheep and dairy farms, mixed sheep and cash cropping farms, and grazing farms fluctuated greatly so that no generalizations can be made, but market gardening farms of the Longburn-Ashhurst district had an average size of only 25.5 acres. Farm sizes did not change significantly from pre- to post-scheme dates, although, in many cases, changes have occurred in the types of farming carried out.

Changes in the Land Use Pattern since the Scheme.

Changes which have taken place in the types of land use since the pre-scheme dates, fall into two types. Firstly, there are complete changes in the type of farming carried out, and secondly, there are changes resulting from an intensification of farming activities. Both these types of change have taken place in the Lower Manawatu since completion of the flood control scheme.(Fig. 19b and Appendix G).

There has been a slight overall decline in the amount of dairying, in that five of the seven districts record declines in dairying acreages. The

two exceptions are the districts of Moutoa and Mangaone, both of which support a large number of town milk supply farms. There has been no great change in the proportions of dairying carried out between pre- and post-scheme dates, however, as this remains between one third and one half of the total land use in the majority of districts. Four of the districts showed slight increases in the amount of land devoted to fat lamb farming. This change represents a trend towards intensification when it reflects changes from grazing to fat lambs, but also becomes a complete change when a change from dairying is recorded. In the Longburn-Ashhurst district, an increase from 8.9 percent to 14.8, in the proportion of land in market gardening has taken place. (Table II-5) These complete changes in the type of farming carried out are not confined to any particular FFA's.

The trend towards intensification, however, although it is similarly common to all districts, is of more significance in particular FFA's. In the 20 year FFA's of Moutoa and Koputaroa, and the 1 year area of Taonui, there has been an increase in the number of fat lamb farms, while the number which were formerly grazing properties, has declined. From 1958 to 1963, in the Taonui 1 year FFA a decline in the proportion of grazing land from 37 to 2 percent, has been accompanied by a 13 percent increase in the amount of land devoted to fat lamb farming, plus a substantial increase in the acreage of mixed sheep and cash cropping.

This recent upsurge in the amount of mixed sheep and cash cropping between pre- and post-scheme dates has been particularly notable in the districts of Makerua and Taonui, especially in those areas which formerly received frequent flooding. The 5 year FFA of Makerua records an increase from no cash cropping to 12.9 percent between 1955 and 1965, while the 1, 5 and 20 year FFA's of Taonui have shown even more spectacular increases from the pre-scheme dates. The 1 year FFA has shown an increase from 298 to 1,255

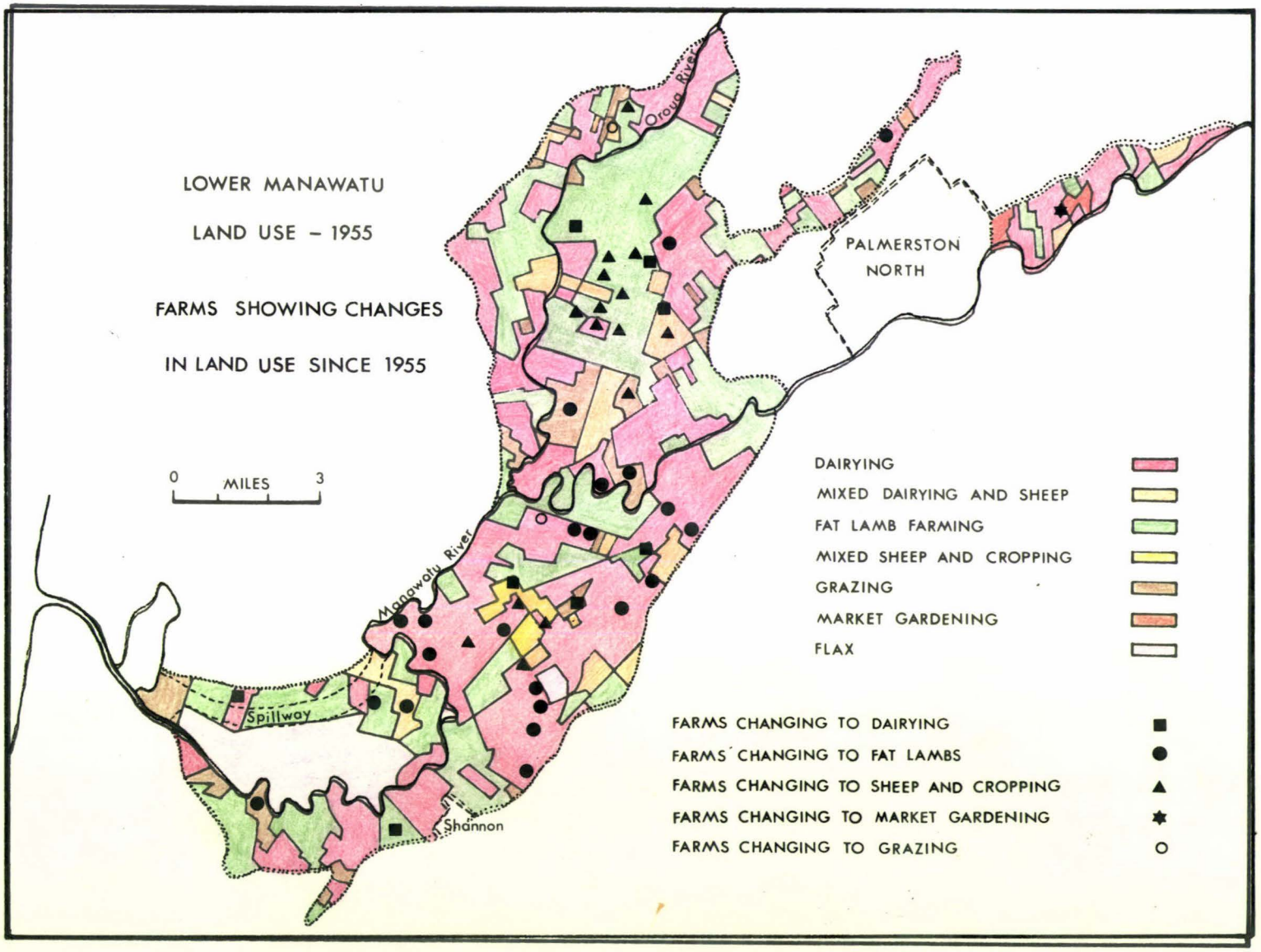
LOWER MANAWATU
LAND USE – 1955
FARMS SHOWING CHANGES
IN LAND USE SINCE 1955
0 MILES 3
Oroua River
PALMERSTON NORTH
Manawatu River
Spillway
Shannon
DAIRYING
MIXED DAIRYING AND SHEEP
FAT LAMB FARMING
MIXED SHEEP AND CROPPING
GRAZING
MARKET GARDENING
FLAX
FARMS CHANGING TO DAIRYING
FARMS CHANGING TO FAT LAMBS
FARMS CHANGING TO SHEEP AND CROPPING
FARMS CHANGING TO MARKET GARDENING
FARMS CHANGING TO GRAZING

FIG. 19b.

acres, the 5 year area, from none to 1,116 acres, and the 20 year area, from 494 to 1,579 acres. (Appendix G) In 1963, almost a third of the land use acreage in all FFA's of Taonui was devoted to mixed sheep and cash cropping. Though the 100 year areas of Makerua and Taonui have also shown large increases, (Makerua, from 6.6 to 12.7% and Taonui, from 10 to 29.9% - Appendix G) each were cropping a considerable amount of land at the pre-scheme dates. This indicates that a proportionately greater increase in cash cropping has taken place in those FFA's which formerly received the most frequent flooding.

These changes in the land use between pre- and post-scheme dates (Table II-5 and Fig. 19b) are in themselves significant, but it is the reasons behind these changes which are of greatest importance. It is not possible to give reasons for changes made by all farmers in farming types in the Lower Manawatu over this period since the information used here is from valuation records alone. However, from the random sample of farms, it is possible to state why some of these changes have been made. It is highly probable that the pattern of all changes made would follow that shown by the sample.

Of the 104 farms in the sample, 33 or 31.7 percent have undergone some change in type of farming over this period. (Table III-5) This figure is higher than that shown for land use changes over the whole area rated for the scheme (Fig. 19b and Table II-5) because it has been possible to allocate the sample farms to eight land use categories instead of the six used in the preceding section.

The percentages of farms in FFA's showing some change in land use from pre- to post-scheme dates are: 1 year area, 43.4, 5 year area, 33.3, 20 year area, 18.1, and the 100 year area, 31.2 percent. It is noticeable that the proportion of farms to change land use types is particularly great in the 1 year FFA's as compared with that of the 100 year areas. The reasons for

TABLE III-5

NUMBER OF SAMPLE FARMS IN EACH CATEGORY OF LAND USE - 1955 AND 1965

DISTRICTS	DAIRYING		FATTENING		MIXED		GRAZING		MIXED SHEEP/CASH CROPPING				DAIRY/ CROPPING		OTHER		TOTAL
									DRY SHEEP		FAT LAMBS						
	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	
Moutoa																	
1 yr.	-	-	-	1	1	-	1	1	-	-	-	-	-	-	-	-	2
20 yr.	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	1	2
100 yr.	2	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-	3
Koputaroa																	
20 yr.	2	2	2	4	-	-	2	-	-	-	-	-	-	-	-	-	6
100 yr.	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1
Makerua																	
5 yr.	6	5	1	-	-	-	-	-	-	-	1	2	-	-	-	1	8
100 yr.	8	7	1	2	2	1	-	1	-	-	3	4	1	-	2	2	17
Taonui																	
1 yr.	3	3	1	3	2	1	3	-	-	4	2	-	-	-	1	-	11
5 yr.	10	9	4	2	-	1	3	1	-	3	-	2	1	-	1	1	19
20 yr.	4	2	2	1	1	1	-	-	1	2	2	4	-	-	2	2	12
100 yr.	1	1	1	1	-	-	-	-	-	1	3	2	-	-	1	-	6
Oroua West																	
1 yr.	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
100 yr.	1	1	-	-	-	-	1	-	-	1	1	1	-	-	-	-	3
Longburn Ashhurst																	
20 yr.	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
100 yr.	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2
Mangaone																	
1 yr.	5	4	1	1	2	1	-	-	-	-	-	1	-	-	-	1	8
TOTAL:	48	41	13	17	9	5	12	4	1	11	12	17	2	-	7	9	104

'Other' includes 11 Stud sheep farms, 4 in Makerua 100 year area, the rest in Taonui, plus 3 farms which supply dry stock for city butchers and 2 farms with a mixture of dairying, fattening, pigs and cash cropping activities being carried out.

these changes are listed in Table IV-5. These reasons include all those stated by farmers who were interviewed and who had altered their type of farming since 1955 in some manner. In some cases, farmers gave more than one reason as influencing their decisions to change farming types.

The first six reasons have no connection with flooding or drainage problems, while the last two are solely related to these problems. (Tables IV - V-5) The first six of these reasons cannot be attributed to any particular local conditions, but are related to personal, economic, technological, and perhaps political factors. The last two, however, are localized; the removal of the flood risk, improvements to drainage resulting from the flood control scheme, and to the work of Drainage Boards in the district. These now allow farmers to develop the full potential of the farmland in order to support intensive farming activities comparable to those on flood-free land.

Farmers giving these latter two reasons imply that protection from flooding and drainage improvements are beneficial, but there is one aspect of this which has proved detrimental to a few farmers. The location of the stopbanks has meant that a portion of a few farms is included in the berm land and is therefore, still liable to frequent flooding. With the confined water travelling at an increased velocity, this has had a more severe effect on this land than previous inundations by the river. This was the reason given by two farmers for changes in their farming activities to a less intensive form of agriculture.

Of the 23 farms in the 1 year FFA's ten have shown changes in farming activities since 1955 (Table IV-5) and in half of these cases, the reason given for making the changes, was the removal of the flood risk by the flood control scheme. The farmers giving this reason were all located in either the Taonui or Moutoa districts. There was only one exception in Taonui,

TABLE IV - 5

REASONS STATED FOR CHANGES IN FARMING ON SAMPLE FARMS

Reasons	Districts and FFA's											
	Moutoa		Koputaroa Makerua			Taonui				Longburn	Mangaone	
	1 yr.	100 yr.	20 yr.	5 yr.	100yr.	1 yr.	5 yr.	20 yr.	100 yr.	100 yr.	1 yr.	
New manager or owner	1				3	2	2				1	
Personal preference					5		1	2	1	1	2	
Owner's health or age.					1	1	1	1				
Financial							2	1	1		4	
Temporary cropping to improve pasture							2					
Labour problems							1				2	
Flood scheme (a) risk gone	1	1	1	1		3	4	1	1			
(b) risk increased because berm land					1	1						
Improved drainage	1	1	1	1			2	1				

All reasons stated by each farmer interviewed are included here.

TABLE V - 5

REASONS AS STATED BY SAMPLE FARMERS FOR CHANGING FARMING TYPES

Changes in farming.	No. Farms	Reasons for changes 1	2	3	4	5	6	7	8
(1) Change in type of farming.									
(a) Dairying to fat lamb	9	2	3	3	1		2	1a.1b.	1
(b) Fat lamb to dairying	2	1	1						
(2) Change in type plus cash cropping added.									
(a) Dairy to fat lamb & crop	5		3	1	2	1		2a.	1
(b) Dairy to dry sheep & "	2	1	1		1			1a.	1
(3) Change from dry to breeding sheep	2							1a.	2
(4) Change from dry to breeding sheep plus cash cropping.	2	1				1		2a.	
(5) Change from breeding to dry sheep	1	1			1				
(6) Change from breeding to dry sheep plus cash cropping.	2		1		1			1b.	
(7) Adding cash cropping to farming programme.									
(a) fat lamb plus cash cropping	3				1	1		2a.	2
(b) dry sheep plus cash cropping	2							2a.	
(8) Other	3	3	2					1a.	
TOTAL:	33	9	11	4	7	3	2	12a.2b.	7

Key to Reasons.

(1) New manager or owner.
(2) Personal preference.
(3) Owner's health or age.
(4) Financial considerations.
(5) Temporary cropping for pasture renewal.
(6) Labour problems.
(7) Flood control scheme - a. risk gone.b.berm.
(8) Improved drainage since scheme.

that of a farmer who changed his type of farming because of age, but in the Mangaone district, all reasons stated were either personal preference, labour problems or a new owner. This would imply, that in the Taonui and Moutoa districts, in contrast to that of Mangaone, flood protection has been the decisive force influencing farmers to alter farming types. In the former two districts, flooding from the Manawatu River has always been a much greater problem, and has proved an inhibiting factor in the development of much of this land in the 1 year areas of these two districts. Floods from the Mangaone Stream have not restricted the development of intensive farming in the Mangaone district.

Of the ten changes made in the 1 year FFA's five were of the first type, complete changes from dairy to fat lamb farming, (or the reverse) and reasons stated for these changes concerned personal preference, the age of the farmer, or a new owner. Two farmers changed from dry stock to fat lamb farming, and the remaining three added cash cropping to the farming programme. Without exception, the reason stated for this change to a more intensive type of farming was the removal of the flood risk.

Of the 27 farms in the sample in the 5 year FFA's, nine showed some change in the type of farming between 1955 and 1965. In six of these, the reason given for making the change, was the removal of the flood risk, while in the remaining cases, the reason was either labour problems, age of farmer or a new owner. (Table IV - 5) The one farmer in the Makerua district who changed his farming activity, stated that the change was due to the removal of the flood risk and its associated drainage improvements. In the Taonui district, half of those farmers who had made changes, gave the reason as being the removal of the flood risk, while the rest stated that reasons of age, labour, or new ownership were dominant.

Three of the changes in the 5 year FFA's were from dairy to fat lamb

farming, (or the reverse) one made a change from dry stock to fat lamb farming and the remaining five changes involved adding cash cropping to the farming programme. As in the 1 year areas, reasons for complete changes from dairy to sheep farming involved personal preference, or the age of the farmer, while the dominant reason for intensifying the farming activity was the removal of the flood risk and improved drainage. (Table IV - 5) It is evident, therefore, in the 5 year FFA's that flooding has been the factor largely responsible for preventing farmers from developing their farms to the same degree as farms on flood-free land. The flood control scheme has thus been the decisive factor in influencing those farmers who have made changes in their farming activities in these areas of the Makerua and Taonui districts.

In the 20 year FFA's, only four farmers have made changes in the type of farming carried out since 1955. Two farmers stated age of owner or preference as reasons for changing, and both these changes incorporated dairying and fat lamb farming. The other two farmers stated improved drainage or removal of the flood risk as reasons. These were the reasons given for the change made in one case from grazing to fat lamb farming, and in the other, cash cropping has been added to the farming programme.

The change from grazing to fat lamb farming took place in the Koputaroa district where the Aratangata Drainage Scheme has allowed for the intensification of farming. The other three changes occurred in the Taonui district. Here flooding has not constituted the problem in the 20 year FFA as it has in the 1 and 5 year FFA's, nor has it restricted farming activities to the same extent. Flood protection, however, has removed the risk of flooding from the land and this, together with drainage improvements, has had the greatest influence on farmers' decisions to intensify farming.

In the 100 year FFA's of the ten farmers reporting change, eight stated

the reasons influencing their decisions were either labour problems, new ownership, or personal preference. These changes took place in either the Makerua or Taonui districts and involved a movement from dairy to fat lamb farming in four cases, and additions of cash cropping to the farming programme in four other cases.

Only two farmers, one in the Moutoa district, and the other in the Longburn-Ashhurst district gave removal of the flood risk and improved drainage as reasons for making changes. The Longburn-Ashhurst farmer added cash cropping, while the one in Moutoa changed from dry to breeding stock. Once again, the move to intensification is associated with flood protection and improved drainage, but in the 100 year FFA's factors other than these are more commonly responsible for changes being made in the type of farming. (Table IV - 5).

It is evident that the principal reasons influencing changes made in farming in the 1 year and 5 year areas, as stated by the farmers interviewed, have been flood protection and the associated drainage improvements in all districts, whereas in the 100 year flood frequency areas there has not been the same preoccupation with these problems. In this area drainage improvements are still a significant factor, but more general considerations, connected with economic conditions, technology, and farmers' personal concerns are more significant. This is particularly so of the Makerua and Taonui districts. In the 20 year FFA's, both the general reasons and those connected with the flood control scheme are equally used.

Conclusion

It must not be forgotten that many factors influence a farmer's decision to change his type of farming or to intensify his activities, and no one factor can be regarded as the sole cause. The reasons mentioned in Tables IV & V - 5 are those given by farmers interviewed, and it must be

understood that behind whatever reasons stated as being dominant, financial considerations based on costs and market prices must be the fundamental reason for undertaking these changes. Also important are technological advances in methods and materials, as well as personal preference and management ability.

It is evident, that of the two types of changes recorded, those of a complete change in activities, or those due to intensification, the first type are generally made because of factors concerning ownership, personal preference, financial and market considerations, and labour problems, while in contrast, those related to intensification of farming activities have been carried out because of flood protection measures and improved drainage conditions. (Table V - 5)

This intensification is part of a general trend throughout the Lower Manawatu, but it is of more significance in the 1 year and 5 year FFA's, where prior to the flood control scheme, frequent flooding prevented the attainment of high producing agriculture. In these areas, especially, the removal of the flood risk and associated drainage improvements can be regarded as the fundamental factor in providing conditions favourable for changes in farming activities, in particular, for moves towards intensification of farming activities.

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(1) Farms have been assigned to one of six categories on the basis of the dominant activity which was assessed from consideration of stock types and numbers, production from these, and farmers' opinions wherever these were available.

(2) D.S.I.R. Bulletin 29, 1967, 32.

(3) D.S.I.R. Bulletin 29, 1967, 39.

(4) Cowie, 1964, 28; Kear, 1965, 38.

(5) See Appendix G for more detail on land use in FFA's as well as districts.

CHAPTER 6.

PRODUCTION

The flood control scheme has been followed by increases in land values and by changes in farming types. It has also resulted in increases in carrying capacities and production levels.[1]

The land which is protected from flooding can now support more stock. Removal of the problem of flooding has eliminated the risk associated with heavy stocking, and the associated drainage improvements have reduced the danger of soils poaching during the winter months. This, then, allows more intensive farming to be carried out on land which formerly flooded frequently. There are now no inhibiting physical factors to prevent high producing farming in the Lower Manawatu.

High production levels should follow intensive farming. The actual production gained from a farm, however, is dependent on a great number of factors. Theoretically the optimum combination of land, labour and capital inputs will yield the maximum output, or production. In this case, the physical factors associated with the land, after efficient drainage has been established, provide a favourable foundation upon which the human factors related to labour and capital inputs can act. Among those human factors, of the most importance are ones concerned with a farmer's management ability together with decisions on the application of sufficient fertilizer and the provision of adequate mechanization, the maintenance of high quality pastures, and the selection of stock breeds and crop varieties. Seasonal variations in weather conditions, and market prices associated with the economic and political climate prevailing, may also affect production levels. Production levels, then, while providing some indication as to the influence of the flood control scheme, are primarily the result of a combination of physical and human factors. With such a great number of variables involved in farm production, it becomes difficult to single out any direct influence from the scheme.

Increases in production levels will, therefore, be regarded as of secondary importance in showing the effects of the scheme. However, it can be stated that the scheme has provided more favourable conditions for investment since the land is now able to support more intensive farming, and it is likely, therefore, that higher production will result.

The main concern here, then, is with increases in stock numbers and cropping acreages. These will be compared between FFA'S within districts and finally with County increases between 1955 and 1965. Increases in carrying capacities and cropping acreages are to be discussed under the headings of dairying and sheep farming, since the diverse nature of these activities renders comparisons between these types of farming difficult.

Dairying

The relationship between the area of land devoted to dairying, the number of cows carried, and the number of cows to the acre in the years 1955 and 1965 is an important indicator of the influence of the scheme.

Appendix G shows that the area of land involved in dairying increased in Makerua and Mangaone, while it remained stationary in Moutoa, Oroua West, Koputaroa, and the 100 year FFA'S of Longburn-Ashhurst and Taonui. The remaining FFA'S of Longburn-Ashhurst and Taonui showed a slight decline in dairying.

Accompanying these changes in the acreages of dairying, the numbers of cows also fluctuated. In general, in those areas where the acreage of land in dairying increased, cow numbers showed corresponding increases, and similarly where the area of dairying land decreased, reduced numbers of dairy cows were reported in 1965. (Appendix G) However, a notable exception to this pattern is shown in the Taonui 5 year FFA in which the acreage decreased from 1157½ to 1111½ acres, but cow numbers showed an increase from 863 to 1253 over the same period. Also, it is notable that numbers of cows carried increased in those areas where the acreage of dairying land remained stationary

TABLE I-6

NUMBERS OF CATTLE JANUARY 31. 1955 AND 1965

Districts and Flood Frequency Areas	Dairy Cows		Dairy Stock		Beef Stock		Proportion of dairy cows in milk/100 cattle	
	1955	1965	1955	1965	1955	1965	1955	1965
1 year areas								
Moutoa	90	-	110	-	300	1040	21.9	-
Taonui	568	528	690	666	1105	1820	31.6	21.2
Oroua West	115	137	138	161	-	-	83.3	85.0
Mangaone	475	649	567	839	45	50	77.6	72.2
5 year areas								
Makerua	244	411	369	631	146	90	47.4	57.0
Taonui	863	1253	1030	1647	770	768	48.0	51.8
20 year areas								
Moutoa	160	130	185	130	100	160	56.1	81.2
Koputaroa	130	280	166	360	353	830	25.0	23.5
Taonui	395	295	503	398	400	605	43.7	29.4
Longburn-Ashhurst	155	196	202	261	-	-	76.7	85.0
100 year areas								
Moutoa	117	101	148	130	100	100	48.8	43.9
Koputaroa	-	-	100	-	-	-	-	-
Makerua	788	874	961	1156	415	819	57.2	44.2
Taonui	28	34	36	43	450	700	5.7	4.5
Oroua West	65	70	74	90	800	800	7.4	7.8
Longburn-Ashhurst	150	80	191	145	-	-	78.5	55.1

between 1955 and 1965. The only exception was the Moutoa 100 year FFA. This was mainly due to a decline in the management ability of one farmer in this area because of his health and age, and while his farm carried 55 cows in 1955, the number carried in 1965 had been reduced to 30. His farm was on the market at the time of this survey.

A ratio index (see Appendix G) for correlating cow numbers with land acreages of the sample dairy farms shows the relative increases or decreases which have taken place between 1955 and 1965.

TABLE II-6

RATIO INDEX FOR CORRELATING STOCK NUMBERS WITH LAND ACREAGES OF DAIRY FARMS BETWEEN 1955 AND 1965.

District and Area	1955	1965
1 year areas		
Taonui	77	94
Oroua West	82	98
Mangaone	80	99
5 year areas		
Makerua	53	74
Taonui	75	113
20 year areas		
Koputaroa	35	70
Taonui	86	82
Longburn-Ashhurst	61	77
100 year areas		
Moutoa	68	60
Makerua	72	73
Taonui	93	113
Oroua West	83	89
Longburn-Ashhurst	54	70

Two areas stand out as having increased at a rate considerably greater than the rest, the 5 year area of Taonui and the 20 year FFA of Koputaroa. In Koputaroa however, the amount of dairying land remained constant while that of Taonui declined slightly. This would indicate great intensification

in dairying has taken place in these two areas since 1955.

It is also evident that all areas of the 1 year and 5 year FFA groups have intensified at a rate greater than those of the 100 year group during this time. Thus, while some areas may have recorded decreases in dairying acreages, and in cow numbers, in all but two areas, the 20 year FFA of Taonui and the 100 year area of Moutoa, overall increases in the intensity of farming are indicated by the index.

While the index (Table II-6) expresses the simplest relationship of cows per acre, the relationship of most significance concerning the land involved in dairying and the numbers of stock carried, is that shown in Table III-6 where the carrying capacity figures have been calculated according to numbers of dairy stock per acre per month and incorporate the presence of young stock, the growing of fodder crops and the use of runoffs for wintering off stock.[2] These figures indicate the real intensity with which the dairy farming is carried out. The method of converting land acreages and stock numbers to carrying capacities is shown in Appendix H.

It is apparent, that while both the amount of land devoted to dairying and the number of cows supported has changed between 1955 and 1965, in no FFA has the carrying capacity declined over this period, (Table III-6) although in the Oroua West 100 year FFA, the number of cows carried per acre has remained the same.

A significance test (standard error of the difference, Appendix I) revealed a highly significant difference between the overall carrying capacity of the sample farms in 1965 as compared with 1955. However, an analysis of variance (Appendix I) on the increases shown by each group of FFA'S was not significant. These results would indicate, that while there has been a considerable increase in the carrying capacity of dairy farms in the Lower Manawatu between 1955 and 1965, this increase has not been confined to any particular FFA'S. A general intensification in dairying is indicated.

This lack of significance in increases shown by the four FFA'S may be attributed mainly to a combination of the following factors:

1. The size of the sample taken may not have been sufficient to reveal clear differences.

2. Exceptional characteristics exist in various FFA'S in some districts.

3. The data may have been collected too soon after the introduction of the scheme.

The size of the sample of dairy farms represents fifteen per cent of the total population. Since only forty of the sample farms were carrying out dairying both in 1955 and 1965, this means an average of only 5.7 farms for each of the seven districts, or an average of ten farms within each of the FFA groups. This factor, however, must be considered in conjunction with the two other reasons.

The presence of exceptional characteristics in various FFA'S helps obscure any differences between flood frequencies. In 1955, the dairy farms in the Mangaone 1 year FFA supported carrying capacities similar to those in the Oroua West and Taonui 100 year areas. (Fig. 20). These farms have carried out intensive high producing dairying throughout this time period, because the flood problem in the Mangaone district has never been as great as that in the Taonui district. (Chapter 4) Without the restraining influence of serious flooding, farmers in the Mangaone district recorded high carrying capacities in 1955, and increases between 1955 and 1965 were less than those shown by other 1 year FFA'S. This serves to distort the differences between each group of FFA'S.

The dairy farms in the Koputaroa 20 year FFA also further obscure the differences. Carrying capacities were extremely low im 1955 (Table III-6 and Fig. 20) because of the problems of flooding and very poor drainage, and increases recorded between 1955 and 1965 have been large, comparable with those in most of the 1 year areas.

The third aspect, that of the lack of time since the completion of the scheme, is of importance because of the conservative nature of many farmers. This means a large number of dairy farms are not yet producing at capacity level. Thus, while the flood control scheme has provided conditions favourable for increased stocking rates, many farmers have not yet taken advantage of this situation. Together these three factors could explain the lack of significant differences between carrying capacity increases of the FFA'S.

Production levels attained by farmers, (Table III-6) and increases between 1955 and 1965, follow those of carrying capacities. There was a significant increase (standard error of the difference, Appendix I), between production per acre for the sample farms in 1965 as compared with 1955, and again, no significant difference between increases recorded for the four FFA groups over this period. The same reasons for the lack of significance in carrying capacity increases would apply to production, although total yield achieved by a particular farmer is dependent on a great number of variables.

It is evident from Fig.21 that, in general, those areas which showed the greatest increases in carrying capacity, have also shown the greatest increases in production between 1955 and 1965. This is particularly so in the Koputaroa 20 year area, the Taonui 1 and 5 year areas, and the Oroua West 1 year FFA. It is possible to attribute some of this increase to the greatly reduced flood risk and the drainage improvements resulting from the scheme, but the large increases shown in production in the Makerua 100 year area, and in the Mangaone district, are attributable to improved management and technology.

The effects of improved management and technology are evident both within those areas which formerly flooded frequently and in those areas where the risk of flooding was remote. Whereas previously the risk of flooding made it almost obligatory to own a wintering runoff, the removal of this risk has opened the way for feeding pads and wintering sheds. However, in view of the peaty nature of some of the soils, it may be a desirable management policy to

TABLE III-6

PRODUCTION LEVELS, CARRYING CAPACITIES AND NUMBER OF RUNOFFS

1955 AND 1965

Districts and Flood Frequency Areas	Carrying Capacity		Production (lbs.butterfat)		Runoffs		Wintering Off	
	1955	1965	1955 (/acre)	1965	1955	1965	1955	1965
1 year areas								
Taonui	0.7	0.9	204	251	2	1	2	1
Oroua West	0.9	1.1	166	241	1	1	(young stock)	
Mangaone	1.0	1.1	190	228	-	-	-	1 ($\frac{1}{2}$ herd)
5 year areas								
Makerua	0.8	0.9	173	210	-	1	-	1 (young)
Taonui	0.8	1.1	188	268	3	1	3	1
20 year areas								
Koputaroa	0.6	0.8	165	208	1	1	1	1
Taonui	0.9	1.0	220	239	-	-	-	-
Longburn-Ashhurst	0.7	0.9	118	161	-	-	-	-
100 year areas								
Moutoa	0.7	0.8	212	212	-	-	-	-
Makerua	0.8	1.0	163	232	2	3	3	3
Taonui	1.1	1.3	280	280	-	-	-	1
Oroua West	1.0	1.0	203	230	-	-	-	1 (young)
Longburn-Ashhurst	0.6	0.8	113	136	-	-	-	-

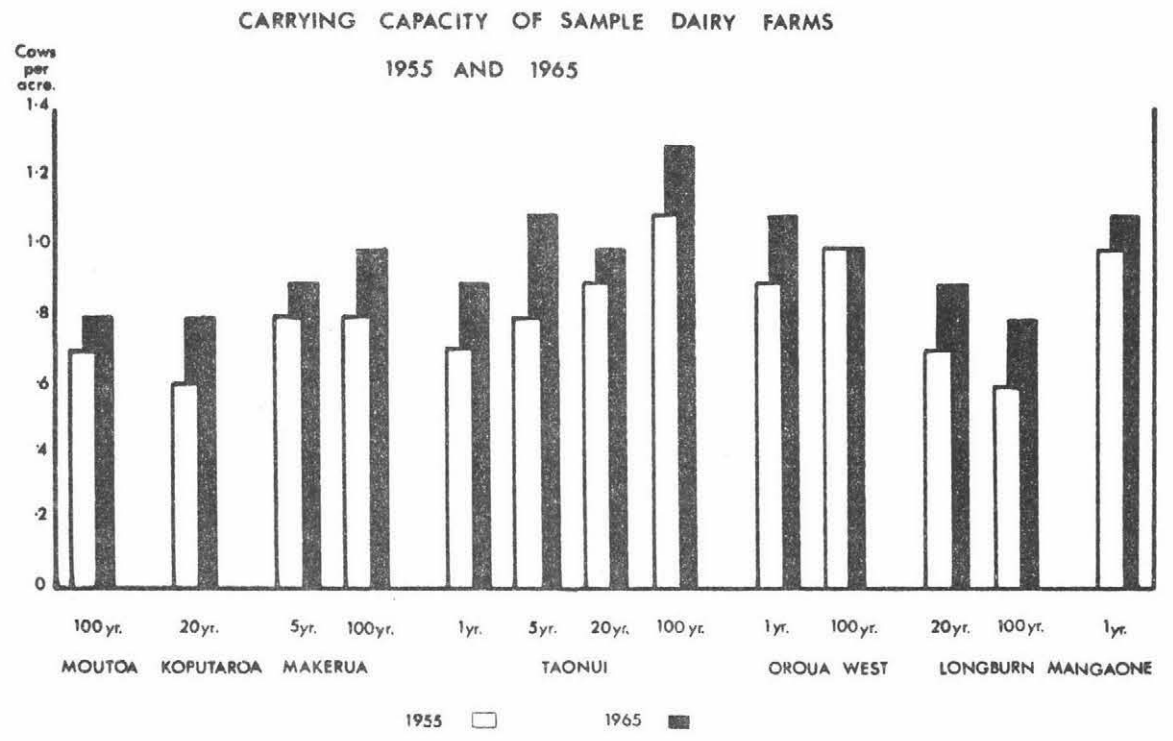
CARRYING CAPACITY OF SAMPLE DAIRY FARMS
1955 AND 1965
Cows per acre.
1·4
1·2
1·0
·8
·6
·4
·2
0
100 yr.
20yr.
5yr.
100yr.
1yr.
5yr.
20yr.
100 yr.
1yr.
100yr.
20yr.
100yr.
1yr.
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN
MANGAONE
1955
1965

FIG. 20.

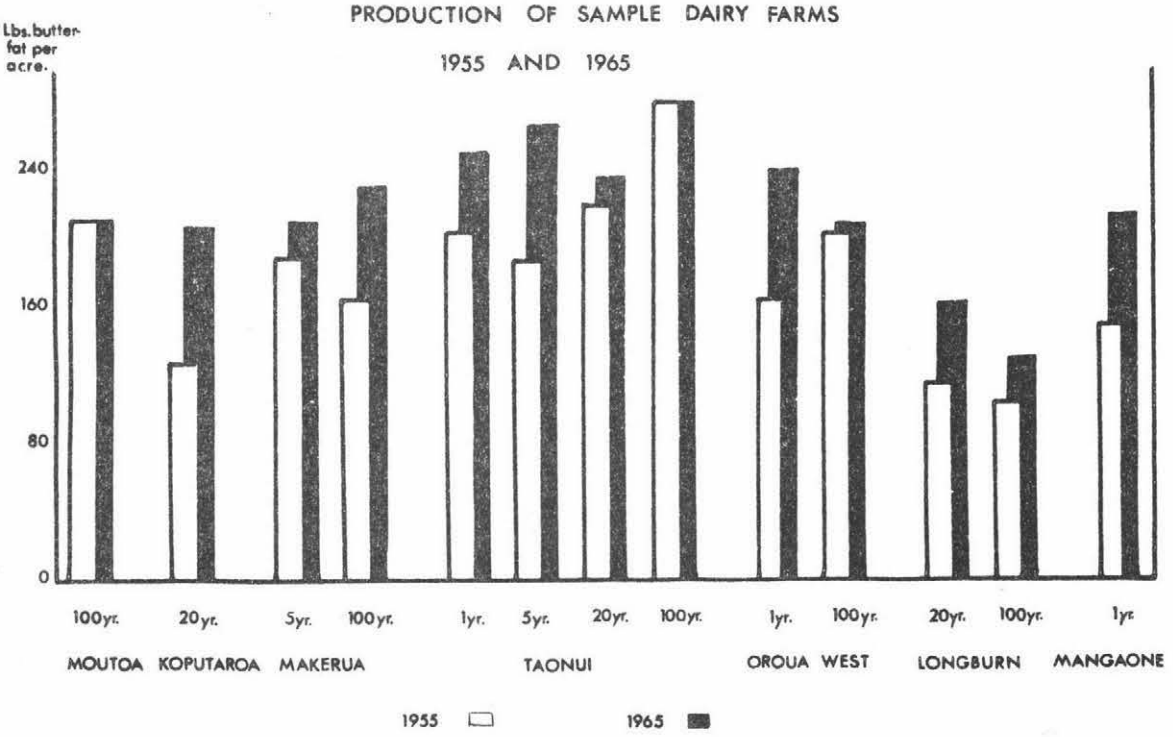
PRODUCTION OF SAMPLE DAIRY FARMS
1955 AND 1965
Lbs. butter-fat per acre.
240
160
80
0
100yr.
20yr.
5yr.
100yr.
1yr.
5yr.
20yr.
100yr.
1yr.
100yr.
20yr.
100yr.
1yr.
MOUTOA
KOPUTAROA
MAKERUA
TAONUI
OROUA WEST
LONGBURN
MANGAONE
1955
1965

FIG. 21.

CASE STUDY NO.1. - TABLE IV$_a$-6

TAONUI DISTRICT - 5YEAR FFA

	1955	1965
Area (acres)	200	200
Cows in milk	140	260
Carrying Capacity	0.68	1.31
Production (lbs.butterfat)	40,000	75,000
Production butterfat per acre	177	317
Runoff	70 off 3½ mths. & young stock	Only young stock
Supplementary feed (acres)	Chou moellier 13 Turnips 13	Turnips 3½ Mangels 3½
	Hay 4000 bales	2500 bales & 4500 bales bought
Fertilizer used	2-3 tons on all	25 tons on all
Development - since 1962-3	1½ miles new fencing ½ farm tile drained 2 haysheds 1 herringbone cowshed 1 mile concrete path 1 mile metal race	
Flooding History 1953 flood	17 feet deep water over whole farm for 13 days. Had to resow whole farm. Farm out of production for whole season.	
1956 flood	Two-thirds of farm covered.	
1961 flood	Three floods in one year - 40 acres covered for 8-10 days each time.	

Farmer's Statement

Reluctant to stock heavily before the scheme, but land can now be worked to capacity.

Was really bullock country before scheme as such animals could be shifted quickly.

Pugging occurred before the scheme, and could not tile drain.

Present Problems

Some minor local water flooding over 20 acres in wet winter conditions, only of nuisance value.

CASE STUDY NO.2. - TABLE IVb-6

TAONUI DISTRICT - 5 YEAR FFA

	1955	1965
Area (acres)	160	116
Cows in milk	60	145
Carrying Capacity	0.45	1.7
Production (lbs. butterfat)	18,000	41,000
Production butterfat per acre	94	402
Runoff	-	-
Supplementary feed	Hay 1200 bales	500 bales Turnips 12 ac. Barley 40 ac. Mangels 5 ac.
Fertilizer used	-	2 cwt. ammophos.
Diseases	75% herd mastitis - mineral deficiency & wetness.	-
Development - since 1956	Open drain to serve 80 acres Tile drained 90 acres since 1963 1 hayshed	
Flooding History 1956 flood	2 floods with water 14-15 feet deep	
1961 flood	Three floods in one year. 60 acres under water over one month. Had to resow 20 acres. Lost 11 acres of crop.	
	30-40 acres of farm formerly wet 8-9 months of the year.	

Farmer's Statement

Flood protection has removed the risk of flooding, so can now stock to capacity.

Present Problems

Local water flooding from Burkes Drain affects about 20 acres after very heavy rainfall.

CASE STUDY NO.3. - TABLE IVc-6

KOPUTAROA DISTRICT - 20 YEAR FFA.

	1955	1965
Area (acres)	108	108
Cows in milk	65 & 20 sows	100 & 20 sows
Carrying Capacity	0.56	0.94
Production (lbs.butterfat)	16,700	33,000
Production butterfat per acre	138	278
Runoff	Herd wintered off ...	
Supplementary feed	Hay 1200 bales	750 bales Barley 12 ac.
Fertilizer used	-	3 cwt/acre on all last 3-4 years. 1965-nitrolime
Development - since 1961	85% of farm resown Surface v-drained 150 chains of fencing	
Flooding History 1961 flood	Three in 5 weeks - 40 acres covered by water. 4 feet deep over five weeks. Lost new pastures.	

Farmer's Statement

Formerly was unable to carry as many cows.

Great benefit from pumps on the drain - lowered the water table - pastures recover better after winter.

own a runoff to avoid poaching and to allow for optimum feed conditions in order that high production may be maintained. Thus the overall number of farmers using a runoff has only decreased by one from 1955 to 1965, and the number of farmers wintering off all, or a portion of the herd, has remained the same. (Table III-6). It is in the 1 year FFA'S and the Taonui 5 year FFA that the number of farmers using runoffs has declined from six to three, a consequence of the removal of the flood risk. In the Makerua district, however, the number increased from two to four from 1955 to 1965, a consequence of heavy stocking rates on peaty soils. (Table III-6).

Three case studies of individual farms in low-lying areas of the Manawatu have been included. (Table IV-6). These farms have been selected subjectively as farms which are maintaining high production levels. The effect of the flood control scheme in removing the flood problem is evident from the greatly increased stocking rates and the production which has been achieved by these farmers since 1963. This provides evidence that there has been a very real benefit received from the scheme in the Lower Manawatu. The overall increases in stocking rates and production levels, however, show that as yet, the less progressive farmers are hesitant in taking advantage of the improved conditions, to develop dairy farms to produce at capacity levels.

Sheep Farming

The diverse range of activities carried out in the Lower Manawatu under the heading 'sheep farming' makes it virtually impossible to find an accurate, common basis of comparison, such as the cows per acre basis adopted for dairy farms. To find an accurate method of assessing the carrying capacity of these farms would involve a programme of computing a great number of variables which would be impracticable with the amount of data available for this section. In dealing with those farms which are solely concerned with fat lamb farming and associated beef cattle fattening, it is possible to convert stock numbers to a carrying capacity expressing the number of ewe equivalents per acre. For

those farms, however, where cash cropping has become an important feature, a simple conversion of stock numbers to ewe equivalents per acre distorts the true carrying capacity of the farm, and the question of assessing cash cropping raises many problems. An important example is: how can crops be assessed in terms of ewe equivalents to show the number of stock a farm is capable of supporting? It is, then, proposed to outline the various systems of sheep farming and to treat each separately and in a different manner from the others.

Basically the three systems outlined, and the variations within these, show a gradation from pure fat lamb farming to cash cropping where sheep are a useful, but subsidiary part of the farming programme.

1. Fat lamb farming, where the number of ewes carried can be wintered without a great amount of supplementary feed is still the most common system. The rapid spring growth of feed means that, on such farms, ewes and lambs alone cannot control this grass and a surplus results. Farmers may solve this problem in one of two ways, or by a combination of both, depending on market prices and personal preference:

(i) A farmer may buy beef cattle to fatten over the spring months. He therefore supplements his fat lamb income with sales of fattened beef, and solves the problem of surplus feed satisfactorily.

(ii) A farmer may crop a portion of his farm in order to avoid surplus grass. A cash crop such as wheat, barley or peas, will yield additional income and this may be followed by a cash crop of grass seed the following season, or a cash crop of hay.

Whether a farmer fattens beef cattle, or cash crops a portion of his farm, a supplementary relationship develops between the major activity of fat lamb farming and these additional activities.

2. Mixed fat lamb and cropping becomes the type of farming carried out when the cropping activity competes with fattening. This means there is

generally a reduction in the number of ewes for the spring months. However, with fewer ewes, there will be spare carrying capacity in the winter, so that hoggets may be brought in over this time.

3. A further stage, that of cropping, is reached when a farmer decides to cash crop his whole farm. To utilize the young grass, wethers will probably be carried for a few months of the year. On such a farm, sheep become a complementary, but minor feature.[3]

All three systems and modifications of each, are present in the Lower Manawatu. It is, therefore, almost impossible to develop a simple basis of comparison between such farms labelled 'sheep farms'.

Between the years 1955 and 1965, there has been an overall increase of 63 percent in sheep numbers expressed as ewe equivalents. (Appendix H) This has been accompanied by increases in acreages devoted to fat lamb farming, and mixed farming and cash cropping in all districts. Particularly large increases in fat lamb farming acreages have taken place in the Taonui 1 year area, and the Koputaroa 20 year FFA, while considerable increases in mixed sheep and cash cropping acreages have been recorded in all areas of the Taonui district, together with the 5 year FFA of Makerua.

Carrying capacities have increased between 1955 and 1965 in all districts and FFA'S. (Table V-6).

Table V-6 is based on information from 27 fat lamb farms, these primarily concerned with the fattening of sheep and beef cattle. In the 1 year, 5 year, and 20 year areas of Taonui, in 1955, the carrying capacity was lower than in the 100 year FFA'S. By 1965, however, although all carrying capacities showed increases, those of the 1 year areas in Moutoa and Taonui, contrary to the trend which might be expected, have not increased as much as those in the 100 year areas of the same districts. This may suggest that fat lamb farmers in low-lying areas who have received the greatest benefit from flood protection, have not yet taken advantage of the improved conditions, although

with the small number of farms involved here, it may be that the influence of one or two very conservative farmers significantly alters the overall picture.

The most notable improvement in carrying capacity between 1955 and 1965, from 3.2 to 7.4 ewes per acre, is shown in the 20 year FFA of Koputaroa. This great increase can be attributed largely to flood control and the improved drainage conditions in that area since 1962-3.

One of the significant trends to become evident since completion of the flood control scheme has been the increase in the proportion of breeding to dry sheep. (Table VII-6 and Fig.22) which represents an increase in the intensity of farming carried out in the Lower Manawatu. This is particularly the case on fattening farms in the areas which used to flood the most frequently. Previously, many of these farms could carry only wethers and bullocks because the flood risk meant stock had to be suitable for moving rapidly.

The proportion of farms carrying only dry stock (and not cash cropping) in 1955 and 1965 is shown in Table VI-6.

TABLE V-6

CARRYING CAPACITIES OF FAT LAMB FARMS 1955 AND 1965

Districts & FFA'S	Carrying Capacities as Ewe Equivalents		
	1955	1965	Increase
1 year FFA'S			
Moutoa	4.4	9.0	4.6
Taonui	4.2	5.5	1.3
Mangaone	4.6	6.8	2.2
5 year FFA'S			
Taonui	4.9	6.1	1.2
20 year FFA'S			
Koputaroa	3.2	7.4	4.2
Taonui	5.1	6.1	1.0
100 year FFA'S			
Moutoa	4.8	10.0	5.2
Makerua	5.5	6.4	0.9
Taonui	5.2	7.0	1.8

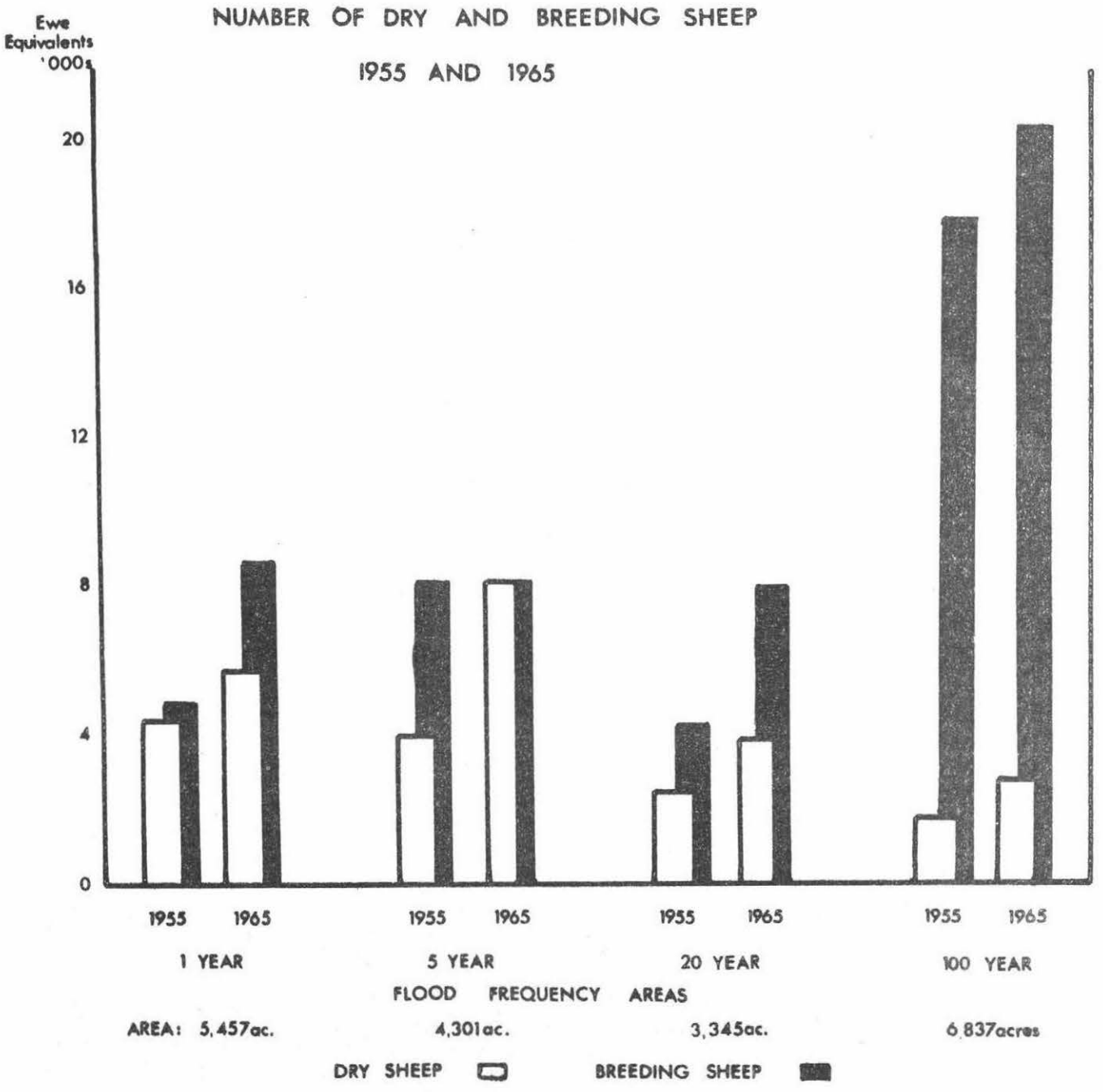

FIG. 22.

TABLE VI-6

PROPORTION OF SHEEP FARMS CARRYING ONLY DRY STOCK 1955 AND 1965

FFA'S	No. sheep farms	Percentage carrying only dry stock 1955	1965
1 year area	14	29	7
5 year area	13	15	-
20 year area	14	29	14
100 year area	19	11	-

In all FFA'S a decline has taken place, till in 1965 there were only three farms running dry stock alone. These farms are all situated in close proximity to Palmerston North and they have a high turnover of stock for supplying city butchers. This is a type of farming with heavy stocking rates and which has no connection with the flood control scheme.

Because of the great flood risk, the 1 year FFA'S, in 1955 included a high proportion of farms running dry stock (Table VI-6) and in addition, a further 740 acres was used solely as runoff land. However, the proportion devoted to running dry stock in the 20 year FFA equals that of the 1 year area shown in Table VI-6. The farms of the Koputaroa area boost the former figure, since the extremely poor drainage and the risk of flooding made it infeasible to carry breeding stock in 1955.

The proportion of dry to breeding sheep numbers has altered significantly over the period 1955 to 1965. (Table VII-6 and Fig.22).

TABLE VII-6

PROPORTION OF DRY TO BREEDING SHEEP 1955 AND 1965

FFA'S	Breeding	Dry	Breeding	Dry
	(as ewe equivalents)			
	1955		1965	
1 year area	4890	4475	8732	5928
5 year area	8148	3998	8175	8201
20 year area	4300	2450	9020	3962
100 year area	18040	1941	20574	2940

It is not possible to express these numbers accurately on a per acre basis because of the complicating factors of beef cattle and cash cropping. As a result of this, the sheep numbers of the 100 year areas in Fig. 22 appear disproportionately large. In spite of this difficulty, some important facts emerge. In the 1 year area in 1955 the proportions of dry and breeding sheep are almost equal, but by 1965, although numbers of both types have increased, a proportionately greater increase has occurred in the numbers of breeding stock. This increase is greater than that shown in the 100 year areas (78.6% in breeding stock in 1 year areas as compared with 14.0% in the 100 year areas.)

The 20 year FFA'S follow a similar trend to that of the 1 year areas. However, the 5 year areas provide a notable exception, in that the proportion of dry stock has increased by 105% between 1955 and 1965, while the number of breeding stock has remained virtually identical. This feature is important in connection with the recent upsurge of cash cropping in the 5 year FFA'S of Makerua and more especially, Taonui.

The most outstanding trend in the Lower Manawatu since 1955 has been the great increase in cash cropping which reflects the general move towards intensification. The increase taking place between 1955 and 1965 for individual cash crops can be seen from Table II-J. The crops showing greatest increases are wheat, barley and grass seed, but all cash crops have shown large increases. Increases have occurred in both the acreage of land under cropping and in the number of farmers carrying out cash cropping in all districts and flood frequency areas. (Tables VIII, IX, X and XI-6 and Figs. 23 & 24).

Expansion in the amount of land used for cash cropping between 1955 and 1965 in districts has been greatest in Taonui. (Table VIII-6) Increases recorded in Oroua West, Longburn-Ashhurst and Mangaone concern only one farmer in each case, while those in Moutoa and Koputaroa involve three and four farmers. It is, then, the districts of Makerua and Taonui which are of most importance in connection with cash cropping. In both these districts

a substantial acreage was devoted to cropping in 1955, but, by 1965, the acreage in Makerua had only slightly increased while that of Taonui had increased by 580 percent. (Table VIII-6) Much of this great increase has taken place in the 1 year and 5 year FFA'S. (Table IX-6 and Fig.24). It is evident that the 5 year area now has the largest acreage of cash cropping.

TABLE VIII-6

INCREASE IN CASH CROPPING ACREAGES IN DISTRICTS 1955 TO 1965

Districts	1955 (acres)	1965
Moutoa	-	141
Koputaroa	8	90
Makerua	385	387
Taonui	411	2387
Oroua West	200	200
Longburn-Ashhurst	-	45
Mangaone	-	32

TABLE IX-6

INCREASE IN CASH CROPPING ACREAGES
IN FLOOD FREQUENCY AREAS 1955 TO 1965

Flood Frequency Areas	1955 (acres)	1965	Increases as %
1 year area	50	544	988
5 year area	145	1236	752
20 year area	122	511	318
100 year area	687	991	44.2

On these cash cropping farms sheep fattening becomes a supplementary activity. In those areas where the largest cropping acreages were recorded in 1955, mainly breeding sheep are associated with the cropping, but in those areas where cropping has become significant since the scheme's completion, it is more often associated with dry sheep. This accounts for the recent increase in dry sheep in the Taonui 5 year FFA. (Table VII-6).

The pattern of most significance in considering cash cropping is that shown in Tables X and XI-6 and Fig.23 in which the number of farmers carrying

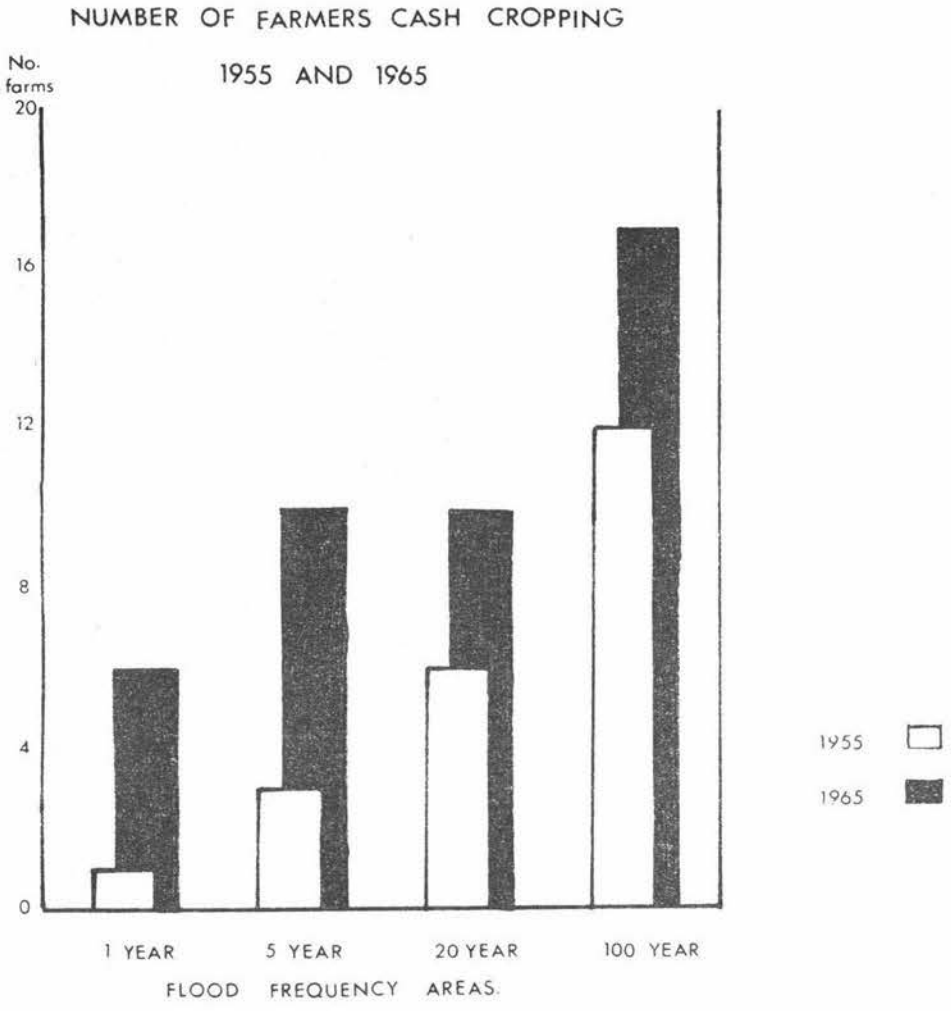
NUMBER OF FARMERS CASH CROPPING
1955 AND 1965
No. farms
20
16
12
8
4
0
1955
1965
1 YEAR
5 YEAR
20 YEAR
100 YEAR
FLOOD FREQUENCY AREAS.

FIG. 23.

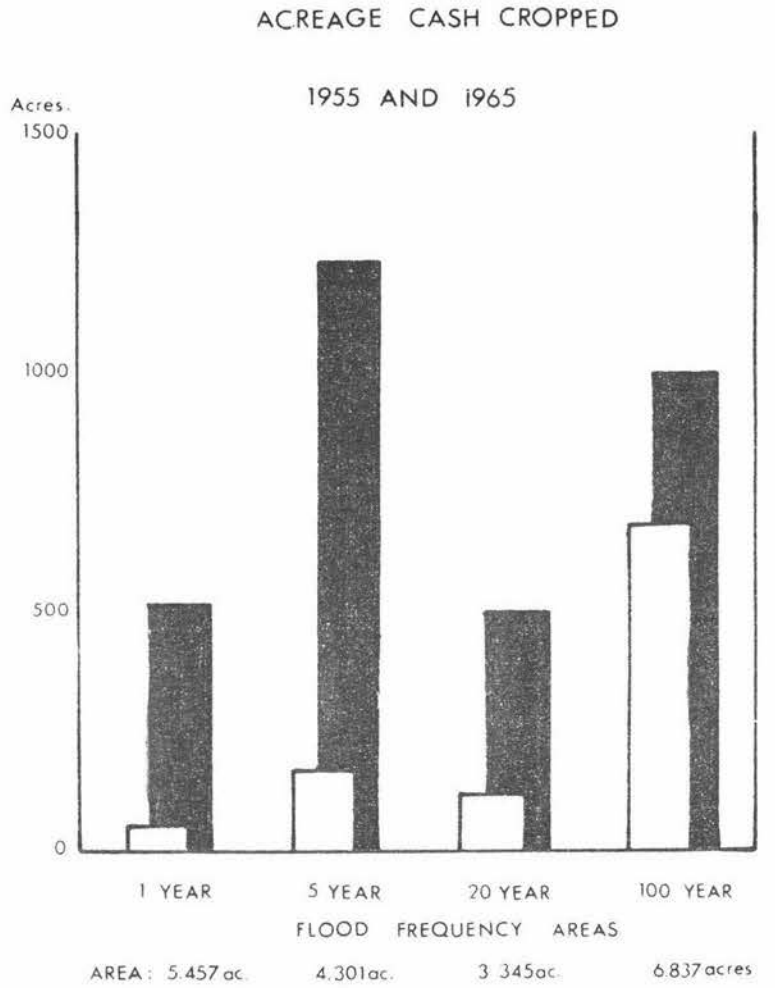
ACREAGE CASH CROPPED
1955 AND 1965
Acres.
1500
1000
500
0
1 YEAR
5 YEAR
20 YEAR
100 YEAR
FLOOD FREQUENCY AREAS
AREA: 5.457 ac.
4.301 ac.
3.345 ac.
6.837 acres

FIG. 24.

out cash cropping is considered. The greatest increases are recorded in the 1 year and 5 year FFA'S while the least is found in the 100 year areas.

TABLE X-6

NUMBER OF FARMERS CASH CROPPING IN DISTRICTS 1955 AND 1965

Districts	1955	1965
Moutoa	-	3
Koputaroa	1	4
Makerua	8	10
Taonui	12	23
Oroua West	1	1
Longburn-Ashhurst	-	1
Mangaone	-	1

TABLE XI-6

NUMBER OF FARMERS CASH CROPPING
IN FLOOD FREQUENCY AREAS 1955 AND 1965

Flood Frequency Areas	1955	1965	Increases as %
1 year area	1	6	500
5 year area	3	13	333
20 year area	6	10	67
100 year area	12	17	42

This pattern shows very clearly in Fig.23 where it can be seen that the number of farmers involved in cash cropping ranges from the least to most according to decreasing frequencies of flooding at both dates, but that the increases in numbers shown in the 1 year and 5 year FFA'S greatly surpasses those of the 20 and 100 year areas.

A chi square test on the number of farmers cash cropping in the Taonui district assumed the null hypothesis that, in 1965, there was no significant difference between the number of farmers cropping in the 1 year, 5 year, 20 year FFA'S and the 100 year area. The result showed this to be the case. (Appendix I). In 1955, farmers in the 100 year FFA could carry out cash

cropping if they wished to, whereas, cropping in the 1 year and 5 year FFA'S in particular, and in the 20 year area, was always a risk which very few farmers were prepared to take. Consequently, the number of farmers cropping in these FFA'S remained low till after the completion of the flood control scheme.

There is now no physical factor inhibiting the amount of cash cropping, although a local water drainage problem still causes some overspill from drains after heavy rainfall in the very low-lying parts. Plans for improving this drainage, however, should ensure removal of this problem in the near future. Providing market conditions are favourable and farmers have the desire, and capital available, cash cropping can now be carried out successfully in almost all parts of the Lower Manawatu.

Once again, three farm case studies have been presented (Table XII a,b, c-6) in order to show the profound influence the flood control scheme has had on some farmers. These farmers have taken advantage of the favourable conditions provided by the scheme by greatly increasing stocking rates and cash cropping acreages to attain greater production levels. Each of the selected properties is from a different district and a different FFA. Those in the Moutoa and Koputaroa are now fat lamb farms, while that in Taonui is predominantly a cash cropping property. These studies show that great development has taken place on all three farms since 1955 when all were largely grazing properties carrying dry stock.

Comparisons with County Increases

Trends discussed with regard to the increases and decreases in stock numbers and cropping acreages shown by the sample farms, closely parallel those shown by the Counties. (Table XIII-6) In all Counties the proportion of dairy cows in milk, per 100 total cattle, has slightly declined, while sheep numbers and cash cropping acreages have increased. The trend toward cash cropping has been general throughout the Manawatu because of more

CASE STUDY NO.4. - TABLE XIIa-6

FAT LAMB FARM - MOUTOA DISTRICT - 1 YEAR FFA

	1955	1965
Area (acres)	400	400
Stock	90 dairy cows 1506 wethers	300 cattle 3000 ewes
Carrying Capacity (ewes per acre)	3.7	9.0
Production (lbs butterfat)	70,000	
	16,415 lbs wool	32,250 lbs wool
	1,506 sheep sold	3,000 sheep sold
		300 cattle sold
Supplementary feed	some hay	2,000 bales Barley 35 ac.
Fertilizer used	-	2½ cwt per ac.
Development - since 1964	65% new fences 1 haybarn cattleyards pasture improvements	
Flooding History 1961	Last flood covered whole farm	

Farmer's Statement

Great benefit from the scheme - can carry more stock and can crop.

Formerly needed extra land for stock in emergencies.

Present Problems

Minor local water flooding - 20 acres for one week.

Main drain being deepened by Drainage Board - should eliminate this trouble.

CASE STUDY NO.5. - TABLE XIIb-6

FAT LAMB FARM - KOPUTAROA DISTRICT - 20 YEAR FFA

	1955	1965
Area (acres)	240	240
Stock	700 wethers	500 hoggets & wethers 700 ewes 150 bullocks 80 breeding cows 40 weaners
Production	700 sheep sold	1050 sheep sold 190 cattle sold
	7525 lbs wool	12900 lbs wool
Supplementary feed	-	Oats 28ac. Swedes 8ac. Hay 2000 bales
Development - all since 1963	Just broken in from swamp and willows to pasture. Stumping Fencing subdivision Open drainage Haybarn	
Flooding History	Formerly a permanent swamp	

Farmer's Statement

Development possible only since the scheme and the Aratangata Drainage scheme have been in operation.

PLATE 5.

Clearing willows and stumping.

PLATE 6.

Providing large open drains.

PLATE 7.

Fencing and new pasture established.
Stopbank protection from flooding.

Plates 5,6 and 7 show stages of development being carried out on farmland in the Koputaroa district since the early 1960's. (Table XIIb - 6)

CASE STUDY NO. 6 - TABLE XIIc-6

PREDOMINANTLY CASH CROPPING FARM - TAONUI DISTRICT - 5 YEAR FFA.

	1955	1965
Area (acres)	294 run with 600 ac. hill country.	294
Stock	2400 wethers 120 cattle	3750 wethers
Cash Crops	-	Wheat 30ac. @ 85 bush/ac. Grass seed 40ac. @ 70 bush/ac. Seed peas 40ac @ 70 bush/ac. Partridge peas 60ac @ 40-70 bush/ac. Barley 120 ac. @ 90 bush/ac. Grass seed hay - 90-120 bales per acre. Pea straw - 40- 50 bales per acre.
Fertilizer used	-	Lime every four years 2 cwt. phosphate per acre

Development - since 1955

Open drains
5000 tiles
Implement and hayshed
2 diesel tractors, 2 mowers, 1 harvester and bagging unit.

Flooding History

1956 last flood - covered whole farm for 5-6 days and up to 10 days in lowest parts. Cut down carrying capacity.

Farmer's Statement

Would be a swamp without drainage.

Formerly needed extra land in hills for flooding emergencies.

Since the scheme can farm safely - means can crop.

Present Problems

Very minor local water drainage problem in wet winter conditions.

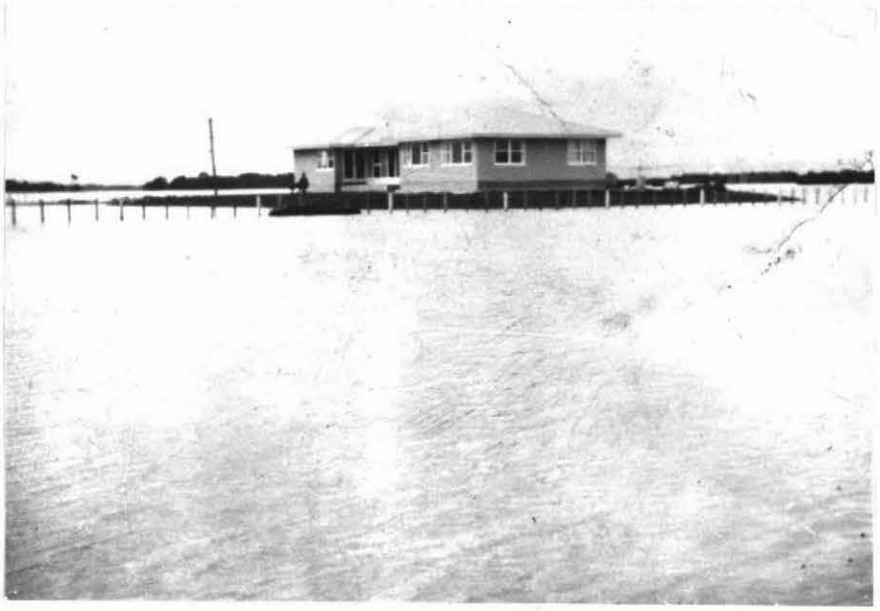

Photo - R.Coulson.

PLATE 8.

A farm in the Taonui Basin under water during a flood in 1956. (see Table XIIc - 6)

Photo - R.Coulson.

PLATE 9.

The extent of flooding on this farm since the flood control scheme. This water is due to heavy winter rainfall.

Photo - R.Coulson.

PLATE 10.

Cash crops now able to be grown on this farm.
Plate 10 - grass seed harvesting.
Plate 11 - a wheat crop.

Photo - R.Coulson.

PLATE 11.

TABLE XIII-6

COUNTY INCREASES IN STOCK NUMBERS AND CASH CROPPING ACREAGES

BETWEEN 1955 AND 1965

Counties	DAIRY AND BEEF CATTLE								SHEEP					
	Dairy Cows in Milk		Dairy Stock		Beef Stock		Proportion cows in milk per 100 total cattle		Ewes		Wethers		Hoggets	
	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965
Kairanga	53,027	21,620	78,274	34,358	24,187	15,044	51.75	43.76	120,110	150,779	19,946	14,869	41,992	59,704
Manawatu		30,306		43,047		26,311		40.76	157,616	220,540	15,349	26,146	29,117	59,256
Horowhenua	37,216	37,196	57,540	67,186	14,368	21,256	51.76	47.42	131,091	168,544	14,965	21,728	40,995	59,052

Counties	CASH CROP ACREAGES						FODDER CROP ACREAGES													
	Grass seed		Wheat		Oats		Barley		Peas		Potatoes		Onions		Green Fod.		Root Fod.		Other		Hay		Silage	
	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965
Kairanga	868	1477	188	787	-	22	489	1546	99	331	169	376	-	7	2386	2264	821	974	3	347	5606	6672	1355	897
Manawatu	605	747	277	376	23	21	996	2194	261	171	148	235	14	15	3334	3287	2242	2258	56	559	7111	10357	954	894
Horowhenua	211	445	-	2	-	79	131	614	4	16	778	1701	151	93	3005	3079	1412	2020	98	487	9161	10107	2620	4209

Farm Production Statistics 1955-6, 1965-6.

favourable market conditions, and improvements in technology, which reduce the danger of adverse weather conditions e.g. grain drying plants. The expansion of tile drainage, following the improved drainage outlets associated with the flood control scheme, is also an important factor contributing to the recent increase in cash cropping acreages in the Manawatu.

Conclusion

It has become evident from examining the numbers of stock carried, and the acreages of cash cropping, that in both there has been an upsurge between 1955 and 1965. Such an increase, however, is in line with similar increases in County figures. The increases become significant when those of the 1 year, 5 year and 20 year FFA'S appear greater than those of the 100 year area. This is the case in the change from carrying dry to breeding stock and the increase in the number of farmers involved in cash cropping. This represents a greater increase in the intensity of farming activities in these areas.

As yet, no similarly significant increases are evident in the overall pattern of dairy farms. It would appear, though, that the flood control scheme has released the full agricultural potential of the land which formerly flooded frequently, but that only some farmers have taken advantage of the improved conditions to produce at capacity levels. This is very evident from the case study farms included which represent some of the more progressive farmers who have utilized the advantages provided by the scheme. It is probable that the more conservative farmers will gradually realize this also.

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1. Information for this chapter is from the sample farms for the dates of 1955 and 1965 (Chapter 1 and Appendix A) farms are grouped into seven districts and four FFA'S (Chapter 1 and Fig.1)
2. Runoffs are areas of land run in association with farms, used for providing supplementary grazing. The term 'wintering off' applies to the practice of grazing stock during winter months away from the farm.
3. Information on systems of sheep farms supplied by J.N. Hodgson.

CHAPTER 7.

CONCLUSION

The Lower Manawatu River flood control scheme, acting in association with a number of local drainage schemes, has largely eliminated the greatest single problem of a physical nature confronting farmers on the floodplain. It is now possible for farmers in low-lying portions to carry out farming of equal intensity to that on similar land of a higher elevation. Before the completion of the scheme, the threat of serious loss from flooding restricted the development of such farming on the lower levels.

The scheme, then, has improved conditions for farming through releasing the full agricultural potential of land which used to flood frequently. This became evident from a comparison of land values, land use patterns, stock numbers and production levels at pre-and post-scheme dates.

Of the land values, the unimproved value is the only one which directly reflects the inherent agricultural worth of the land. Unimproved values of land liable to frequent flooding, in particular to annual flooding, have risen proportionately more than those of land susceptible only to 'century' floods. This is especially noticeable in the Taonui district where a large amount of low-lying land, which was lacking adequate protection, experienced particularly frequent and severe flooding. Unimproved values of such land showed an annual increase of as much as 6.4 percent between 1958 and 1963, compared with one of 2.1 percent in the 100 year FFA. A similar trend, though less pronounced, is apparent in unimproved values of other districts in the Lower Manawatu.

Arising mainly as a consequence of the improved physical conditions, has been a move towards intensification of farming activities in low-lying portions of the floodplain. This was discernible from an examination of the improvements value of farms. Farmers on low-lying land have carried out proportionately more improvements since the completion of the scheme, than those on higher

land which rarely flooded. This is exemplified especially well by the annual increases of the Koputaroa 20 year FFA and the Taonui 1 year FFA. Increases in these areas exceed those of each 100 year FFA by 4.7 and 7.1 percent respectively. While other districts generally conform to this pattern, the differences between 1, 5 and 20 year FFA's and the 100 year FFA's are not as great.

Accompanying recent improvements has been an increase in stocking rates and a general intensification in farming activities. While much of this trend is in line with New Zealand-wide moves, certain features of it in the Lower Manawatu are a consequence of the flood control scheme. As previously mentioned, this is most evident in the sheep and cash cropping farms where the proportion of dry to breeding sheep has altered significantly. In low-lying areas farmers can now carry ewes and greater numbers of stock where formerly only wethers and bullocks could be supported.

It is notable though, that instead of this change from dry to breeding sheep with the introduction of flood control, a number of the farmers in low-lying areas have continued to run wethers, but these have become a supplementary activity to cash cropping. Before the completion of the scheme, cash cropping was a risk too great for most of these farmers to accept, but now the way has opened for successful cash cropping on low-lying portions of the Manawatu floodplain. This is manifest in a spectacular increase in both the acreage of land devoted to cash cropping, and in the number of farmers carrying out this activity. This is especially evident in the Taonui district since the early 1960's.

Although most dairy farms in the Lower Manawatu have shown great increases in the number of stock carried and in production levels, this has not been confined to any particular FFA's as was the case with sheep and cash cropping farms. Several farmers in 1966 were carrying between 1.0 and 1.5 cows to the acre while in 1955 they were carrying between 0.5

and 1.0 cows per acre. This recent intensification is part of a national trend, but it is clear that the improved physical conditions for farming have influenced the intensity and flexibility with which dairy farming can be carried out on low-lying areas.

It would seem apparent that, although definite trends are evident in the farming of the Lower Manawatu since the completion of the flood control scheme, it is still too soon to see the full effects of this scheme on the farming. The more progressive farmers have taken advantage of the improved conditions provided by the flood control scheme. These farmers have carried out improvements, increased stocking rates and are carrying out activities formerly restricted by the threat of frequent inundations. However, many farmers, more conservative, have as yet been slow to advance their farming methods to the same degree. While the scheme itself allows more intensive farming to be carried out successfully, full exploitation of the improved conditions eventually rests with the farmers themselves. A further study of the farming activities in the Lower Manawatu in several years should confirm trends indicated at present and reveal new trends, also a consequence of flood control, which are not yet apparent.

APPENDIX A

QUESTIONNAIRE APPLIED TO FARMERS IN RANDOM SAMPLE

NAME:

ADDRESS:

(1) Area of Farm

	1955		1965	
	Farm	Runoff	Farm	Runoff
Waste				
Total				

(2) Basis of Ownership — Owned — Leased

(3) How long have you operated this farm?

(4) Since 1950 has the farm:
   (a) undergone subdivision?
   If so, how much?
   (b) been increased in size?
   If so, how much?

(5) Labour, 1955

Family	No. workers	Full-time	Part-time
Owner			
Others			
Non-family			

Labour 1965

Family			
Owner			
Others			
Non-family			

(6) Do you employ contract labour?
   If so, for what activities?
   How many weeks per year are these employed?

(7) What type of farm do you operate?
   How long has it been operated as such?
   If it has changed its form of tenure,
   What was the previous form?
   When was the change made?
   Why was the change made?

DAIRY FARMS:

(1) Do you employ a sharemilker?
   If so, on what basis?

(2) Stock Numbers:

1st January	1955	1965
Cows in milk		
Replacements		
Bobby calves		
Bulls		
Other stock		

(3) Type of supply:

	1955	1965
Town milk		
Factory supply		
Milk or cream		

(4) Production:

	1955	1965
Town milk quota		
Total butterfat at factory		

(5) What proportion of the herd is wintered off?

	1955	1965
For how long?		

(6) Cattle or sheep sold

(7) Do you anticipate any changes in stock numbers and farming practices in the near future?

If so, what sort?

SHEEP FARMS:

(1) Stock Numbers:

For season	1955	1965
Ewes		
Rams		
Wethers		
Hoggets		
Lambs		
Type		
Beef cattle		
Steers		
Bullocks		
Dry cattle		
Summer fattened		
Winter grazed		
Other		

(2) Number of lambs sold annually
Other sheep sold

(3) Number of cattle sold annually
When sold

(4) Wool clip

	1955	1965

(5) Do you anticipate any changes in stock numbers or farming practices in the near future?

If so, what sort?

CROPPING:

(1)	1955			1965		
	Types	Acreages	Yields	Types	Acreages	Yields

(2) Have there been any changes in the proportion of crops grown over the last ten years?

(3) Are there any changes anticipated for the near future?

(4) Stock numbers

Pasture:

(1) Composition	1955	1965

(2) How often is it resown?

(3) Rotation grazing practices -
How long have they been carried out this way?

(4) Is hay made? How much?	1955	1965

(5) Are supplementary crops grown? What sort and how much?	1955	1965

Fertilizer:

	1955	1965
Types		
Amount		
Frequency of application		

Diseases:

	1955	1965
Types		
Losses		
Frequency		

Capital Development:

Since 1955 -

		Amount
(a)	Land	
	Fencing	
	Stumping	
	Drainage	
	Other	
(b)	Buildings	
(c)	Plant	

Are any improvements anticipated in the near future?
If so, what sort?

Flooding:

(1) When was the farm last flooded?
Acreage flooded?
Time under water?
Losses - stock
buildings
fencing
pasture
other

Frequency of floods in past years

(2) Was the flooding due to local water problems or directly to the Manawatu River?

(3) What is the nature of flood protection on your farm?

Type	Amount	Who installed
Stopbanks		
Pumps		
Drains		
Other		

(4) What rates for flood protection schemes were paid?

	1955	1965

(5) What benefits (if any) have you obtained from flood protection and drainage schemes in the past?

(6) Do you anticipate further benefits as a result of present measures?

(7) Do you consider further measures are necessary?
If so, what sort?

APPENDIX B.

As early as the 1890's schemes for the control of flooding by the Manawatu River have been put forward. J.E. Fulton, resident engineer for the Palmerston North-Waikanae section of the railway proposed a comprehensive scheme similar in many aspects to the completed scheme. His conclusions were that the Manawatu River could and would carry through the Gorge a flood of 160,000 cusecs, that the configuration of the country was such that improvement to the channel and construction of stopbanks would enable this flood to be contained to a point he called Poplar Bend (approximately where the spillway gates have been erected) but below that point it would not be practicable to carry more than 35,000 cusecs through the channel with its flat gradients and long meanders to the sea. He recommended a channel to be cut from Poplar Bend to Whirokino and the river be turned into it through the 'waste land of the Moutoa swamp to rejoin again at Whirokino.'[1]

Commissions in 1908 and 1926 investigated the problem realizing the importance of the control of flooding. In 1926 it was recommended that control works should proceed and be subsidized by the State. F.C. Hay, engineer to the Manawatu-Oroua River Board produced a scheme in 1925 similar to that suggested by Fulton. At this time the Makerua stopbank was erected, but the full scheme did not eventuate.

A.P. Grant of the Public Works Department put forward several schemes of river control. In his 1937 report he considered the flood flow could be carried between stopbanks with a width of thirty chains. This is the width generally adopted by the present scheme. He also advocated a ponding area in the Moutoa Basin, of 4,400 acres. Of this land, 2,200 acres was below spring tide levels, but the remaining 2,200 acres contained fertile land.[2]

In 1944, D.J. Halley prepared two reports for a flood control scheme. His proposals contained much which is embodied in the present scheme. He suggested a channel from Walls spillway to Whirokino and a ponding area below the one foot spring tide mark at Moutoa. The river's course was to be confined between stopbanks.[3]

One other significant proposal, the Himatangi scheme, should be mentioned. It advocated a cut through sand country to divert the river's course. This was rejected because of the difficulty and expense involved in stabilizing the cut.

A combination of ideas from these earlier proposals and from new suggestions resulted in the present flood control scheme. Lack of finance and co-operation prevented any earlier scheme from being constructed when suggested, although it was realized that one was necessary. The results of the 1953 flood together with a Government subsidy, helped this scheme become established, while the determination of the Catchment Board ensured that it was completed.

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(1) Taylor, cyclostyled notes
(2) Evans, 1950.
(3) The Times, 1945.

APPENDIX C

MEAN ANNUAL PERCENTAGE INCREASES IN UNIMPROVED VALUE
AT PRE- AND POST-SCHEME DATES

DISTRICT	TYPE OF FARMING	1 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	5 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	308	(£) 8.5	16.3	9.0	-	(£) -	-	-
	Fat lamb	545	12.1	24.0	9.8	-	-	-	-
KOPUTAROA	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Grazing	-	-	-	-	-	-	-	-
MAKERUA	Dairying	-	-	-	-	1337	37.7	59.6	5.8
	Fat lamb	-	-	-	-	1047	31.1	45.5	4.6
	Grazing	-	-	-	-	-	-	-	-
	Sheep/Cash Crop	-	-	-	-	183	5.2	8.2	5.7
TAONUI	Dairying	1408	38.5	50.8	6.4	1807	69.4	80.1	3.1
	Fat lamb	2647	66.7	87.3	6.2	2452	98.1	114.6	3.4
	Grazing	-	-	-	-	231	4.8	7.5	11.5
OROUA WEST	Dairying	80	3.2	4.1	2.8	418	16.3	21.8	3.4
	Fat lamb	-	-	-	-	127	4.7	6.6	4.0
	Grazing	93	3.3	3.9	1.8	70	2.3	3.1	3.9
LONGBURN-ASHHURST	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Sheep/Cash Crop	-	-	-	-	-	-	-	-
MANGAONE	Dairying	1821	108.1	125.1	3.2	-	-	-	-
	Fat lamb	1008	61.9	68.1	2.0	-	-	-	-
	Grazing	364	28.8	40.2	7.9	-	-	-	-

DISTRICT	TYPE OF FARMING	20 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	100 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	-	(£) -	-	-	1459	(£) 28.4	56.3	9.8
	Fat lamb	1220	37.3	66.6	7.9	1489	27.6	48.9	7.7
KOPUTAROA	Dairying	2143	48.6	79.0	6.3	746	21.1	32.0	5.2
	Fat lamb	1782	40.6	72.7	7.9	1036	23.3	32.6	3.9
	Grazing	363	4.2	8.2	9.4	206	3.5	5.9	7.1
MAKERUA	Dairying	-	-	-	-	9122	299.4	421.2	4.1
	Fat lamb	-	-	-	-	4900	122.5	189.7	5.5
	Grazing	-	-	-	-	311	10.4	15.5	4.8
	Sheep/Cash Crop	-	-	-	-	1118	28.6	48.8	4.9
TAONUI	Dairying	2445	111.6	127.8	2.9	1402	92.3	101.3	1.9
	Fat lamb	2737	131.1	147.1	2.5	5031	266.9	298.4	2.4
	Grazing	191	10.6	11.5	1.8	36	2.0	2.3	2.6
OROUA WEST	Dairying	-	-	-	-	8361	159.9	236.3	4.8
	Fat lamb	-	-	-	-	2854	137.0	208.9	5.2
	Grazing	-	-	-	-	653	22.6	33.0	4.6
LONGBURN-ASHHURST	Dairying	1138	54.0	68.9	5.5	995	55.6	67.7	5.8
	Fat lamb	451	17.8	24.4	6.3	286	11.9	17.4	9.1
	Sheep/Cash Crop	375	31.2	44.9	8.8	139	17.4	22.2	5.6
MANGAONE	Dairying	880	46.6	50.7	1.8	171	10.6	10.8	0.4
	Fat lamb	47	2.7	2.9	1.9	504	29.6	32.8	2.1
	Grazing	-	-	-	-	50	3.4	3.7	2.4

MEAN ANNUAL PERCENTAGE INCREASES IN IMPROVEMENTS VALUE AT PRE- AND POST-SCHEME DATES

DISTRICT	TYPE OF FARMING	1 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	5 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	308	(£) 18.7	30.7	6.4	-	(£) -	-	-
	Fat lamb	545	17.4	39.7	12.8	-	-	-	-
KOPUTAROA	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Grazing	-	-	-	-	-	-	-	-
MAKERUA	Dairying	-	-	-	-	1337	102.7	160.9	5.7
	Fat lamb	-	-	-	-	1047	68.5	114.3	6.7
	Grazing	-	-	-	-	-	-	-	-
	Sheep/Cash Crop	-	-	-	-	184	12.5	19.2	5.4
TAONUI	Dairying	1408	82.3	111.9	7.9	1807	153.3	193.6	5.2
	Fat lamb	2647	104.1	152.2	9.2	2452	153.8	169.2	2.0
	Grazing	-	-	-	-	231	9.1	9.4	6.5
OROUA WEST	Dairying	80	6.5	9.6	4.7	418	29.9	51.4	7.2
	Fat lamb	-	-	-	-	127	8.2	13.5	6.5
	Grazing	93	3.7	6.7	7.9	70	1.7	5.6	21.8
LONGBURN-ASHHURST	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Market Gardening	-	-	-	-	-	-	-	-
MANGAONE	Dairying	1821	164.3	167.9	0.2	-	-	-	-
	Fat lamb	1008	83.4	94.2	2.6	-	-	-	-
	Grazing	364	24.8	25.4	4.8	-	-	-	-

DISTRICT	TYPE OF FARMING	20 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	100 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	-	(£) -	-	-	1459	(£) 59.3	98.1	6.5
	Fat lamb	1220	52.3	100.1	8.5	1489	42.3	75.8	7.9
KOPUTAROA	Dairying	2143	80.8	153.3	8.9	746	50.6	70.0	3.8
	Fat lamb	1782	54.9	121.4	12.1	1036	26.8	50.9	9.1
	Grazing	363	4.6	12.0	16.1	206	2.9	4.1	3.9
MAKERUA	Dairying	-	-	-	-	9122	664.6	993.3	4.9
	Fat lamb	-	-	-	-	4900	220.4	384.2	7.4
	Grazing	-	-	-	-	311	25.7	36.1	4.1
	Sheep/Cash Crop	-	-	-	-	1118	92.3	103.1	0.8
TAONUI	Dairying	2445	217.9	270.7	4.8	1402	153.2	170.7	2.3
	Fat lamb	2737	191.9	214.3	2.3	5031	399.0	451.5	2.6
	Grazing	191	15.9	17.4	1.8	36	2.6	2.8	0.8
OROUA WEST	Dairying	-	-	-	-	8361	331.1	546.6	6.5
	Fat lamb	-	-	-	-	3854	215.4	346.2	6.1
	Grazing	-	-	-	-	653	34.2	61.3	7.9
LONGBURN-ASHHURST	Dairying	1138	80.3	85.4	1.3	995	86.9	99.6	2.9
	Fat lamb	451	20.6	24.7	4.0	286	20.6	22.7	2.0
	Market Gardening	375	34.9	41.7	3.9	139	10.5	13.5	5.8
MANGAONE	Dairying	880	81.4	92.8	2.8	171	9.9	11.2	2.6
	Fat lamb	47	2.2	2.6	3.5	504	39.3	43.4	2.1
	Grazing	-	-	-	-	50	2.2	2.9	0.7

MEAN ANNUAL PERCENTAGE INCREASES IN CAPITAL VALUE
AT PRE- AND POST SCHEME DATES

DISTRICT	TYPE OF FARMING	1 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	5 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	308	(£) 27.2	46.9	7.3	-	(£) -	-	-
	Fat lamb	545	29.5	63.7	11.6	-	-	-	-
KOPUTAROA	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Grazing	-	-	-	-	-	-	-	-
MAKERUA	Dairying	-	-	-	-	1337	140.4	220.5	5.7
	Fat lamb	-	-	-	-	1047	80.8	134.6	6.6
	Grazing	-	-	-	-	-	-	-	-
	Sheep/Cash Crop	-	-	-	-	183	17.7	27.4	5.5
TAONUI	Dairying	1408	118.7	162.8	7.4	1807	222.7	273.6	4.6
	Fat lamb	2647	170.7	239.4	8.1	2452	251.9	283.9	2.5
	Grazing	-	-	-	-	231	13.9	16.9	4.4
OROUA WEST	Dairying	80	9.7	13.7	4.1	418	46.2	73.1	5.8
	Fat lamb	-	-	-	-	127	12.9	20.1	5.6
	Grazing	93	7.1	10.6	4.9	70	4.0	8.8	11.7
LONGBURN-ASHHURST	Dairying	-	-	-	-	-	-	-	-
	Fat lamb	-	-	-	-	-	-	-	-
	Market Gardening	-	-	-	-	-	-	-	-
MANGAONE	Dairying	1821	254.3	272.9	1.5	-	-	-	-
	Fat lamb	1008	145.3	162.3	2.3	-	-	-	-
	Grazing	365	53.5	65.6	4.5	-	-	-	-

DISTRICT	TYPE OF FARMING	20 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.	100 YEAR F.F.A. Area	1st date	2nd	Annual % Incr.
		acres	000's	000's	%	acres	000's	000's	%
MOUTOA	Dairying	-	(£) -	-	-	1459	(£) 87.8	154.4	7.6
	Fat lamb	1220	91.5	166.7	8.2	1489	69.9	124.8	7.8
KOPUTAROA	Dairying	2143	129.4	232.3	7.9	746	71.7	102.1	4.2
	Fat lamb	1782	95.5	194.0	10.3	1036	50.1	83.6	6.7
	Grazing	363	8.8	20.2	12.9	206	6.5	10.1	5.6
MAKERUA	Dairying	-	-	-	-	9122	963.9	1414.5	4.7
	Fat lamb	-	-	-	-	4900	361.7	599.1	6.7
	Grazing	-	-	-	-	311	36.1	51.6	4.3
	Sheep/Cash Crop	-	-	-	-	1118	123.9	145.9	1.8
TAONUI	Dairying	2445	329.5	398.5	4.2	1402	245.5	271.9	2.2
	Fat lamb	2737	322.9	361.4	2.4	5031	665.9	749.9	2.5
	Grazing	191	26.6	28.9	1.8	36	4.7	5.1	1.6
OROUA WEST	Dairying	-	-	-	-	8361	491.1	782.8	5.9
	Fat lamb	-	-	-	-	3854	352.4	555.1	5.8
	Grazing	-	-	-	-	653	56.9	94.3	6.6
LONGBURN-ASHHURST	Dairying	1138	134.3	154.4	2.9	995	86.9	99.6	2.9
	Fat lamb	451	38.4	48.1	5.1	286	20.6	22.7	2.0
	Market Gardening	375	66.1	86.6	6.2	139	10.5	13.5	5.8
MANGAONE	Dairying	880	127.9	143.5	2.4	171	20.5	21.9	1.4
	Fat lamb	47	4.9	5.6	2.6	504	68.9	76.2	2.1
	Grazing	-	-	-	-	50	5.5	6.7	4.3

Source - Valuation Department Records

APPENDIX D

MEAN LAND VALUES AT PRE- AND POST-SCHEME DATES FOR DISTRICTS AND F.F.A'S OF LOWER MANAWATU

1 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	TYPE OF FARMING	UNIMPROVED VALUE £ PER ACRE		CAPITAL VALUE £ PER ACRE		IMPROVEMENTS VALUE £ PER ACRE	
		1st Date	2nd Date	1st Date	2nd Date	1st Date	2nd Date
MOUTOA	Dairying	27.7	52.8	88.4	152.6	60.8	99.8
	Fat lamb	22.2	44.1	54.2	116.8	31.9	72.8
	Average	24.9	48.4	71.3	134.7	46.4	86.2
TAONUI	Dairying	27.3	36.1	84.3	115.7	57.0	79.5
	Fat lamb	25.2	32.9	64.5	90.5	39.3	57.5
	Grazing	23.2	23.2	49.8	91.9	26.5	68.7
	Average	25.2	30.4	66.2	99.3	40.9	68.6
OROUA WEST	Dairying	40.1	51.5	121.3	171.0	81.1	119.5
	Grazing	36.1	42.3	76.2	114.3	40.2	72.0
	Average	38.1	46.9	98.7	142.6	60.6	95.8
MANGAONE	Dairying	59.3	68.7	139.7	149.9	80.3	81.2
	Fat lamb	61.4	67.6	144.1	161.0	82.8	93.4
	Grazing	79,0	110.4	147.0	180.0	67.9	69.5
	Average	63.9	83.2	143.6	163.6	77.0	81.4

MEAN LAND VALUES AT PRE- AND POST-SCHEME DATES FOR DISTRICTS AND F.F.A'S OF LOWER MANAWATU

5 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	TYPE OF FARMING	UNIMPROVED VALUE £ PER ACRE		CAPITAL VALUE £ PER ACRE		IMPROVEMENTS VALUE £ PER ACRE	
		1st Date	2nd Date	1st Date	2nd Date	1st Date	2nd Date
MAKERUA	Dairying	28.2	44.6	105.0	164.9	76.8	120.4
	Fat lamb	29.7	44.3	72.2	128.6	65.4	109.2
	Mixed sheep and cash cropping	28.4	44.6	96.5	149.5	68.3	104.9
	Average	28.8	44.1	92.9	147.7	83.5	111.5
TAONUI	Dairying	38.4	44.3	123.3	151.4	84.9	107.1
	Fat lamb	40.0	46.8	102.7	115.8	62.7	69.0
	Grazing	20.5	32.3	60.0	73.1	39.5	40.8
	Average	32.9	41.1	95.3	113.4	62.4	72.3
OROUA WEST	Dairying	38.9	52.1	110.5	174.8	71.5	122.8
	Fat lamb	37.1	51.9	101.4	158.3	64.3	106.3
	Grazing	32.4	44.9	57.6	125.3	25.3	80.4
	Average	36.1	49.6	86.5	152.8	53.7	103.2

MEAN LAND VALUES AT PRE- AND POST-SCHEME DATES FOR DISTRICTS AND F.F.A'S OF LOWER MANAWATU

20 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	TYPE OF FARMING	UNIMPROVED VALUE £ PER ACRE		CAPITAL VALUE £ PER ACRE		IMPROVEMENTS VALUE £ PER ACRE	
		1st Date	2nd Date	1st Date	2nd Date	1st Date	2nd Date
MOUTOA	Fat lamb	30.5	54.6	75.0	136.6	44.5	82.1
KOPUTAROA	Dairying	22.7	36.9	60.4	108.4	37.7	71.5
	Fat lamb	22.8	40.8	53.6	108.9	30.8	68.2
	Grazing	11.7	22.7	24.4	55.8	12.7	33.1
	Average	19.1	33.4	46.1	91.1	27.1	57.6
TAONUI	Dairying	45.6	52.3	134.8	162.9	89.2	110.7
	Fat lamb	47.9	53.7	117.9	132.0	70.1	78.3
	Grazing	55.6	60.5	139.4	151.8	83.8	91.3
	Average	49.7	55.5	130.7	148.9	81.0	93.4
LONGBURN-ASHHURST	Dairying	47.5	60.6	118.1	135.6	70.6	75.0
	Fat lamb	39.6	51.9	85.3	106.9	45.7	54.9
	Market gardening	83.2	119.7	176.2	230.7	93.0	111.0
	Average	56.7	77.4	126.5	157.7	69.8	80.3
MANGAONE	Dairying	52.9	57.6	145.4	163.1	92.5	105.5
	Fat lamb	58.2	63.7	105.5	119.4	47.3	55.6
	Average	55.6	60.7	125.4	141.2	69.9	80.5

MEAN LAND VALUES AT PRE- AND POST-SCHEME DATES FOR DISTRICTS AND F.F.A'S OF LOWER MANAWATU

100 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	TYPE OF FARMING	UNIMPROVED VALUE £ PER ACRE		CAPITAL VALUE £ PER ACRE		IMPROVEMENTS VALUE £ PER ACRE	
		1st Date	2nd Date	1st Date	2nd Date	1st Date	2nd Date
MOUTOA	Dairying	19.5	38.6	60.2	105.8	40.6	67.2
	Fat lamb	18.5	32.9	46.9	83.8	28.4	50.9
	Average	19.0	35.7	53.6	94.8	34.5	59.1
KOPUTAROA	Dairying	28.3	42.9	96.1	136.9	67.8	93.9
	Fat lamb	22.5	31.4	48.3	80.7	25.8	49.2
	Grazing	17.0	29.1	31.5	49.2	14.4	20.1
	Average	22.6	34.5	58.6	88.9	36.0	54.4
MAKERUA	Dairying	32.8	46.2	105.7	155.1	72.9	108.9
	Fat lamb	28.8	43.9	73.8	122.3	44.9	78.4
	Grazing	33.6	49.8	116.2	165.9	82.5	116.2
	Mixed sheep and crop	25.6	38.3	110.8	130.5	85.2	92.2
	Average	30.2	44.5	101.6	143.2	71.4	98.9
TAONUI	Dairying	65.8	72.2	175.1	193.9	109.3	121.7
	Fat lamb	53.1	59.3	132.4	149.1	79.2	89.7
	Grazing	57.5	65.0	131.1	141.7	73.6	76.7
	Average	58.8	65.5	146.2	161.5	84.0	96.0
OROUA WEST	Dairying	19.1	28.3	58.7	93.6	39.6	65.4
	Fat lamb	35.6	54.2	91.5	144.0	55.9	89.8
	Grazing	34.7	50.6	87.2	144.5	52.5	93.9
	Average	29.8	44.4	79.1	127.4	49.3	83.0
LONGBURN-ASHHURST	Dairying	52.8	68.0	140.1	168.1	87.3	100.1
	Fat lamb	41.9	60.9	114.3	140.6	72.3	79.6
	Market gardening	125.0	159.9	200.7	257.4	75.6	97.4
	Average	73.3	96.3	151.7	188.7	78.4	92.4
MANGAONE	Dairying	62.3	63.4	120.2	128.9	57.9	65.4
	Fat lamb	58.8	65.1	136.8	151.3	77.9	86.3
	Grazing	67.0	75.0	110.0	138.8	43.0	58.8
	Average	62.7	67.8	122.3	138.0	59.6	70.2

Source - Valuation Dept. Records

APPENDIX E

LOAN REPAYMENT FOR THE LOWER MANAWATU FLOOD CONTROL SCHEME

The Lower Manawatu flood control scheme was financed in part by a Government subsidy, and in part by a loan of £350,000 which is to be paid back over a period of 25 years on an annuity basis. This loan was raised in separate portions as required thus enabling interest charges to be kept to a minimum. Borrowing began in 1958. In addition to this, a supplementary loan of £35,000 was raised in 1963. The total loan was raised in the following portions:

1st Issue	1958	£29,000
2nd Issue	1959	£88,000
3rd Issue	1960	£100,000
4th Issue	1961	£100,000
5th Issue	1963	£33,000
6th Issue	-	Supplementary loan 1963 £35,000
7th Issue	1963	£35,000

Of the total loan, 48.4% has a 6 to 10 year maturity, while the remaining 51.6% has a 20 to 25 year maturity.

The actual rate charges are calculated according to the following considerations: 'the incidence of rating is contingent upon the amount of loan money borrowed and not repaid at any particular time. The early years of the total loan term prior to the maturity of any portions of the loan will require the highest rating revenue for repayment purposes. The amount required between 1962 and 1970 is shown below:

Year	Rating Revenue Required for Repayment
1962-3	£34,482
1963-4	£41,730
1964-5	£44,490
1965-6	£46,532
1966-7	£43,110
1967-8	£38,133
1968-9	£33,236
1969-70	£30,711

'Repayment of short term portions of loans will commence in 1966-7 and continue until renewal loans are raised for £40,800 in 1969-70 and £29,600 in 1970-71. Assuming that renewal loans could be raised at present day interest rates and on an annuity basis, rating for loan repayment should stabilize from 1970-71 until the end of the 25 year period at approximately £14,000 per annum, for all loans at present current.'

Formula for making Reductions.

Deductions must be made from the total Valuation land value for all special rates to ensure that all properties maintain the same outgoings. (Table X-4 and I-E).

Assuming an interest rate of 5% and County rates of 1½d. in the £1, allowance for the incidence of special rating is calculated as follows:

	%
Interest on capital	5.000
County rates @ 1½d in £1	.625
Outgoings for interest rates	5.625
Special rate of 1d in £1	.416
Outgoings for interest rates and special rates	6.041

$$\text{Reduction} \quad \frac{1000 \times 5625}{6041} = 931$$

Therefore, a property valued at £1000 with a special rate of 1d in the £1 would have its value reduced to £930.

The reductions in Table I-E are calculated by the Valuation Department according to this formula. It is a theoretical concept designed to accommodate any depressing influence the incidence of special rating may have on the market value of land.

This table shows the actual rates levied per £1 for rating classes of land in each county, together with the amount calculated by the Valuation Department which is deducted from the total value in land valuation calculation to produce the capital value. In this Table this amount has been re-added to

the capital value to show the total value of the rating classes of land in the Lower Manawatu.

1. Smith, 1963, M.C.B.L.M.S. Loan.

TABLE I-E

CAPITAL VALUE AND ADJUSTED VALUE TO ACCOMMODATE RATING

County	Rate Class	Actual Rate per £1		Deducted Rate per £1000		Capital Value		Total Value C.V. plus rates	
		1958	1963	1958	1963	1958	1963	1958	1963
Kairanga	A	1.95	1.623	90	100	74,044	98,115	80,708	107,926
	B	1.30	1.082	55	70	874,680	1,032,855	922,787	1,105,121
	C	.65	.541	30	35	1,216,635	1,396,370	1,253,134	1,446,525
	D	.325	.271	15	15	654,755	757,010	664,576	768,366
	E	.13	.108	-	-	3,228,548	3,663,657	same	same
	F	.05	.041	-	-	208,053	258,720	same	same
		1955	1965	1955	1965	1955	1965	1955	1965
Horowhenua	A	1/8d	1.53	118	90	1,023,225	1,635,910	1,143,965	1,783,142
	B	1/2d	1.20	82	70	801,613	1,102,830	867,345	1,180,038
	C	.6d	.51	43	30	154,145	239,475	160,773	246,695
	D	.3d	.25	22	15	42,320	66,220	43,251	67,213
	E	-	.102	-	-	797,489	1,186,030	same	same
		1956	1966	1956	1966	1956	1966	1956	1966
Manawatu	A	1.8	1.42	80	88	102,445	175,300	110,641	190,726
	B	1.2	.94	65	55	518,015	834,390	551,686	880,291
	C	.6	.47	30	30	553,635	932,060	570,244	960,022
	D	.3	.24	15	15	105,750	179,195	107,336	181,883
	E	-	.095	-	5	630,804	971,495	same	976,352

APPENDIX F

AVERAGE SIZE OF HOLDINGS. (1 YEAR FLOOD FREQUENCY AREAS)

DISTRICTS	DAIRYING		FATTENING		MIXED		GRAZING		FAT LAMB/CROP		MARKET GARDENING	
(Dates)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	acres		acres		acres		acres		acres		acres	
MOUTOA	-	-	277½	277½	307¾	307¾	-	-	-	-	-	-
OROUA W.	72½	80	-	-	-	-	91½	78¼	-	-	-	-
TAONUI	74	71¾	173¾	284	463	463	395¾	90¼	149	251	-	-
MANGAONE	80½	89½	193¼	159¼	126	102	41	49½	-	153¼	-	-

	NUMBER OF HOLDINGS												TOTAL	
													1st	2nd
MOUTOA	-	-	2	2	1	1	-	-	-	-	-	-	3	3
OROUA W.	2	1	-	-	-	-	1	2	-	-	-	-	3	3
TAONUI	7	7	5	5	2	2	4	1	2	5	-	-	20	20
MANGAONE	18	18	6	5	3	2	7	7	-	2	-	-	34	34

Median of Dairy Farms 1955 = 84
1965 = 85

Median of Fat Lamb Farms 1955 = 173
1965 = 172

AVERAGE SIZE OF HOLDINGS (5 YEAR FLOOD FREQUENCY AREAS)

DISTRICTS	DAIRYING		FATTENING		MIXED		GRAZING		FAT LAMB/CROP		MARKET GARDENING	
(Dates)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	acres		acres		acres		acres		acres		acres	
MAKERUA	74¾	76¾	175¼	145	196	196	-	-	221½	141½	-	-
OROUA W.	85½	85½	127	127	-	-	35	35	-	-	-	-
TAONUI	83¼	82¾	173¼	255	67	67	29½	77	-	124	-	-

NUMBER OF HOLDINGS

MAKERUA	17	14	5	5	1	1	-	-	1	4	-	-
OROUA W.	3	3	1	1	-	-	2	2	-	-	-	-
TAONUI	19	16	12	4	3	3	1	3	-	9	-	-

AVERAGE SIZE OF HOLDINGS (20 YEAR FLOOD FREQUENCY AREAS)

DISTRICTS	DAIRYING		FATTENING		MIXED		GRAZING		FAT LAMB/CROP		MARKET GARDENING	
(Dates)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	acres		acres		acres		acres		acres		acres	
MOUTOA	-	-	161	274	331¾	334	63	63	-	334	-	-
KOPUTAROA	114½	134½	381	306	148½	-	362	-	-	-	-	-
TAONUI	80¾	79¾	142¼	131	98¼	94	75	75¼	164½	143¾	-	-
LONGBURN	83¾	94¾	128	128	-	-	-	-	-	-	28½	37½
MANGAONE	78	78	145½	46¾	-	98¾	-	-	-	-	-	-

NUMBER OF HOLDINGS

MOUTOA	-	-	1	3	3	1	1	1	-	1	-	-
KOPUTAROA	15	16	5	7	2	-	1	-	-	-	-	-
TAONUI	18	15	16	12	10	10	2	1	3	11	-	-
LONGBURN	16	12	2	4	-	-	-	-	-	-	6	10
MANGAONE	10	10	1	1	-	1	-	-	-	-	-	-

AVERAGE SIZE OF HOLDINGS (100 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	DAIRYING		FATTENING		MIXED		GRAZING		FAT LAMB/CROP		MARKET GARDENING	
(Dates)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	acres		acres		acres		acres		acres		acres	
MOUTOA	111¼	111¼	178¾	186	-	-	-	-	-	-	-	-
KOPUTAROA	115	93	185	207	-	-	68	68	-	-	-	-
MAKERUA	92¼	90½	220½	194¾	135	206	112¾	77¾	104¾	113¾	-	-
OROUA	86	83	184¾	192½	148¾	240	57	60½	609½	406½	-	-
TAONUI	83¾	78¾	164½	152½	52¾	41¾	36	36	206½	205½	-	-
LONGBURN	98½	90½	96½	142½	-	-	-	-	-	-	22¾	22¾
MANGAONE	85	85	151	151	-	-	-	-	-	-	-	-

NUMBER OF HOLDINGS

MOUTOA	12	13	9	8	-	-	-	-	-	-	-	-
KOPUTAROA	9	8	4	5	-	-	3	3	-	-	-	-
MAKERUA	114	106	19	25	11	4	6	6	11	20	-	-
OROUA	49	49	14	12	4	2	7	9	2	4	-	-
TAONUI	20	16	23	19	1	3	1	1	3	9	-	-
LONGBURN	12	11	1	2	-	-	-	-	-	-	6	6
MANGAONE	2	2	3	3	-	-	-	-	-	-	-	-

Source - Valuation Department Records

APPENDIX G

LAND USE OF THE LOWER MANAWATU FOR DISTRICTS AND F.F.A'S AT PRE- AND POST-SCHEME DATES

4 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	DAIRYING		FATTENING		MIXED SHEEP & DAIRYING		GRAZING		MIXED SHEEP & CASH CROPPING		MARKET GARDENING		TOTAL	
	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd
	acres		acres		acres		acres		acres		acres		acres	
MOUTOA	-	-	305	305	400	400	305	305	-	-	-	-	1010	1010
TAONUI	519	502	868	1420	926	926	1583	91	298	1255	-	-	4194	4194
OROUA W.	145	80	-	-	-	-	92	157	-	-	-	-	237	237
MANGAONE	1442	1611	1160	797	376	204	287	346	-	307	-	-	3265	3265
	per cent		per cent		per cent		per cent		per cent		per cent		per cent	
MOUTOA	-	-	30.2	30.2	39.6	39.6	30.2	30.2	-	-	-	-	100	100
TAONUI	12.5	11.9	20.7	33.9	22.0	22.0	37.7	2.2	7.1	30.0	-	-	100	100
OROUA W.	61.3	33.8	-	-	-	-	38.7	66.2	-	-	-	-	100	100
MANGAONE	44.2	49.4	35.5	24.4	11.5	6.2	8.8	10.6	-	9.4	-	-	100	100
5 YEAR FLOOD FREQUENCY AREAS														
	acres		acres		acres		acres		acres		acres		acres	
MAKERUA	1391	1197	964	725	75	75	75	-	333	566	-	-	2563	2563
TAONUI	1582	1323	2081	1021	202	202	29	231	-	1117	-	-	3894	3894
OROUA W.	257	257	127	127	-	-	70	70	-	-	-	-	453	453
	per cent		per cent		per cent		per cent		per cent		per cent		per cent	
MAKERUA	54.3	46.7	29.8	28.3	3.0	3.0	-	-	12.9	22.0	-	-	100	100
TAONUI	40.6	33.9	53.4	26.3	5.2	5.2	0.8	5.9	-	28.8	-	-	100	100
OROUA W.	56.5	56.5	28.0	28.0	-	-	15.5	15.5	-	-	-	-	100	100

LAND USE OF THE LOWER MANAWATU FOR DISTRICTS AND F.F.A'S AT PRE- AND POST-SCHEME DATES

20 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	DAIRYING		FATTENING		MIXED SHEEP & DAIRYING		GRAZING		MIXED SHEEP & CASH CROPPING		MARKET GARDENING		TOTAL	
	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd	1st date	2nd
	acres		acres		acres		acres		acres		acres		acres	
MOUTOA	-	-	161	823	996	334	63	63		-	-	-	1220	1220
KOPUTAROA	2017	2141	1905	2143	-	-	362	-	-	-	-	-	4284	4284
TAONUI	1457	1197	2278	1572	984	940	150	75	494	1579	-	-	5364	5364
LONGBURN-ASHHURST	1341	1137	513	513	-	-	-	-	-	-	171	375	2025	2025
MANGAONE	780	780	146	47	-	99	-	-	-	-	-	-	926	926
	per cent		per cent		per cent		per cent		per cent		per cent		per cent	
MOUTOA	-	-	13.2	67.4	81.6	27.4	5.2	5.2	-	-	-	-	100	100
KOPUTAROA	40.1	49.9	44.4	50.1	7.0	-	8.5	-	-	-	-	-	100	100
TAONUI	27.2	22.4	42.4	29.3	18.4	17.5	2.8	1.4	9.2	29.4	-	-	100	100
LONGBURN-ASHHURST	66.2	56.1	25.3	25.3	-	-	-	-	-	-	8.4	18.5	100	100
MANGAONE	84.3	84.3	15.7	5.1	-	10.6	-	-	-	-	-	-	100	100

LAND USE OF THE LOWER MANAWATU FOR DISTRICTS AND E.F.A'S AT PRE- AND POST-SCHEME DATES

100 YEAR FLOOD FREQUENCY AREAS

DISTRICTS	DAIRYING		FATTENING		MIXED SHEEP & DAIRYING		GRAZING		MIXED SHEEP & CASH CROPPING		MARKET GARDENING		TOTAL	
	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date
	acres		acres		acres		acres		acres		acres		acres	
MOUTOA	1336	1457	1609	1488	-	-	-	-	-	-	-	-	2945	2945
KOPUTAROA	1037	744	741	1034	-	-	204	204	-	-	-	-	1982	1982
MAKERUA	10511	9572	4188	4873	1485	824	676	466	1153	2278	-	-	18013	18013
TAONUI	1677	1263	3779	2893	53	125	36	36	619	1847	-	-	6164	6164
OROUA W.	4222	4061	2585	2305	595	480	394	544	1219	1625	-	-	9015	9015
LONGBURN-ASHHURST	1183	994	96	285	-	-	-	-	-	-	138	138	1417	1417
MANGAONE	170	170	453	453	-	-	-	-	-	-	-	-	623	623
	per cent		per cent		per cent		per cent		per cent		per cent		per cent	
MOUTOA	45.4	49.4	54.6	50.6	-	-	-	-	-	-	-	-	100	100
KOPUTAROA	52.3	37.6	37.4	52.1	-	-	10.3	10.3	-	-	-	-	100	100
MAKERUA	58.3	53.2	23.2	27.0	8.2	4.5	3.7	2.6	6.6	12.7	-	-	100	100
TAONUI	27.3	21.5	61.3	46.9	0.8	2.0	0.6	0.6	10.0	29.9	-	-	100	100
OROUA W.	46.8	45.0	28.6	25.6	6.6	5.4	4.4	6.0	13.6	18.0	-	-	100	100
LONGBURN-ASHHURST	83.5	70.2	6.8	20.1	-	-	-	-	-	-	9.7	9.7	100	100
MANGAONE	27.3	27.3	72.7	72.7	-	-	-	-	-	-	-	-	100	100

APPENDIX H.

Table for conversion of stock to carrying capacities.

Stock	Ewe equivalents
Ewes	1
Weathers	0.7
Hoggets	0.7
Lambs	0.6
Stud ewes	1.1
Stud hoggets	0.7
Stud rams	0.9
Dairy cows	7.0
2yr. old heifers	5.0
Yearlings	3.5
Calves	2.5
Breeding cows	6.0
Steers	5.0
Weaners	4.0
Calves	2.5

Department of Agriculture.

APPENDIX I

Standard Error of the Difference -

$$\text{Variance } (\bar{a} - \bar{b}) = \frac{\sigma^2 a}{na} \quad \frac{\sigma^2 b}{nb}$$

$$\text{SE } (\bar{a} - \bar{b}) = \sqrt{\frac{\sigma^2 a}{na} \quad \frac{\sigma^2 b}{nb}}$$

Dairy Carrying Capacity 1955 and 1965 -

Difference $(\bar{a} - \bar{b})$ = 54

S.E. of Difference = 4.96

Dairying Production 1955 and 1965

Difference $(\bar{a} - \bar{b})$ = .15

S.E. of Difference = .04

Analysis of Variance or Dairying Carrying Capacities between FFA'S. -

$\xi X = 7.31$

$\xi X^2 = 3.1173$

n = 40

Source of Variation	Degrees of freedom	Sum of Squares	Mean Square
Total	39	1.7813	
Areas	3	0.0517	.0172
Values in Area	36	1.7296	.0480

S = 0.219

F = .358 not significant

Chi Square -

Null hypothesis - there was no difference in 1966 between the number of farmers cash cropping in each of the 1 year, 5 year, 20 year and 100 year FFA'S in the Taonui District.

$$X^2 = \xi \frac{(O-E)^2}{E}$$

Observed -

	1 Year	5 Year	20 Year	100 Year	
Cropping 1966 only	6	13	5	8	32
Rest	17	14	17	24	72
	23	27	22	32	104

Expected -

	1 Year	5 Year	20 Year	100 Year	
Cropping 1966 only	7.08	8.30	6.77	9.85	32
Rest	15.92	18.70	15.23	22.15	72
	23	27	22	32	104

$X_3^2 = 5.261$

$P\ (X^2 : X^2 > 5.261) = .30$ or 30%

Would not destroy hypothesis - can be accepted

APPENDIX J

TABLE I-J

SHEEP AT JUNE 30 - 1955 AND 1965 (SAMPLE FARMS)

Districts & FFA'S	Breeding Ewes	Wethers 1955	Hoggets	Breeding Ewes	Wethers 1965	Hoggets
1 Year FFA'S						
Moutoa	-	3506	-	3060	700	-
Taonui	4200	200	2487	4972	2717	4351
Mangaone	690	-	200	700	550	150
5 Year FFA'S						
Taonui	4468	5430	282	6175	9730	1986
Makerua	3680	-	-	2000	-	-
20 Year FFA'S						
Moutoa	1100	-	300	1100	-	300
Koputaroa	1000	900	1200	3500	250	1950
Taonui	2200	-	1100	4420	-	3160
100 Year FFA'S						
Moutoa	-	-	-	-	-	1000
Koputaroa	-	-	-	1200	-	-
Makerua	7140	1330	300	7974	1600	3200
Taonui	7300	-	-	7300	1000	-
Oroua West	3600	1000	-	3600	1000	-
Longburn-Ashhurst	-	-	-	500	-	-

TABLE II-J

ACREAGE IN ARABLE CROPS 1955 AND 1965 (SAMPLE FARMS)

Districts FFA'S	Wheat		Oats		Barley		Peas		Potatoes		Onions		Green Fodder		Root Fodder		Other		Grass Seed		* Hay		Silage	
1 year FFA'S	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965	1955	1965
Poutoa	–	–	–	–	–	–	–	–	–	20	–	–	25	25	–	10	–	–	–	–	120	120	–	–
Waonui	–	58	–	–	75	210	–	28	9	28	–	–	30	102	9	19	–	–	29	180	48	71	–	–
Moroua	–	–	–	–	–	–	–	–	–	–	–	–	8	8	6	6	–	–	–	–	20	26	4	–
Mangaone	–	–	–	–	–	28	–	–	–	–	–	–	40	47	–	8	–	–	–	20	113	172	11	11
5 year FFA'S																								
Makerua	–	–	4	–	–	48	–	–	114	86	4	20	34	29	10	1	–	10	–	42	69	127	13	30
Waonui	–	214	–	–	20	486	–	125	7	18	–	–	42	91	38	63	–	–	12	210	230	246	–	–
20 year FFA'S																								
Poutoa	–	–	–	–	–	53	–	–	–	17	–	–	20	20	–	3	–	–	–	13	25	25	–	–
Poputaroa	–	–	–	32	–	43	–	10	7	7	–	–	–	15	5	8	–	–	–	–	45	90	–	–
Waonui	–	18	–	–	35	95	15	51	50	72	–	–	13	34	16	5	–	–	10	122	71	95	–	10
Rongburn	–	–	–	–	–	–	–	–	–	–	–	–	15	15	–	–	–	–	–	–	70	85	9	–
100 year FFA'S																								
Poutoa	–	–	–	–	–	32	–	–	–	–	–	–	–	10	5	2	–	20	–	–	28	25	–	–
Poputaroa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	–	–	–	–	30	30	–	–
Makerua	–	–	–	–	–	10	–	4	227	180	50	–	90	130	36	40	–	–	10	25	215	309	34	10
Waonui	15	70	–	–	50	235	55	–	–	15	–	–	105	35	–	–	–	–	75	190	64	49	–	–
Moroua	–	–	–	–	100	100	–	–	–	–	–	–	37	30	36	35	–	–	100	100	19	25	–	7
Rongburn	–	–	–	10	8	–	–	–	–	45	–	–	12	–	10	10	–	–	–	–	44	44	–	–
1 year FFA	–	58	–	–	75	238	–	28	9	48	–	–	103	162	15	43	–	–	29	200	301	389	15	11
5 year FFA	–	214	4	–	20	534	–	125	121	104	4	20	76	120	48	64	–	10	12	252	299	373	13	30
20 year FFA	–	18	–	32	35	191	15	61	57	96	–	–	48	84	21	16	–	–	10	135	211	295	9	10
100 year FFA	15	70	–	10	158	377	55	4	227	240	50	–	244	205	87	102	–	20	185	315	400	482	34	17

* Grass seed hay excluded

APPENDIX K

The trend of annual land sales from 1955 to 1965 for the Horowhenua, Manawatu and Kairanga Counties can be seen from Fig. 25. The outstanding feature is the great increase in the volume of sales after 1963. This coincides with the date of the completion of the flood control scheme, and some of this increase in sales is undoubtedly attributable to this factor, but of more importance, is the generally buoyant conditions throughout New Zealand at this time. There was confidence in the market, and supporting this, was the money released by the State Advances Loans onto the market. This is shown by Table I-K of land transfers and mortgages for New Zealand. This obscures the influence of the flood control scheme on sales.

TABLE I-K

LAND TRANSFERS AND MORTGAGES

Year ending 31 March	No.	Area (000) acres	Consideration $ (000)	Weighted Average Price/acre
1956	7112	1237	74732	59.84
1957	6677	1205	72178	60.50
1958	7703	1440	92226	65.78
1959	6796	1072	79238	70.12
1960	7204	1263	89152	69.74
1961	8403	1710	124352	81.70
1962	7787	1408	117156	85.12
1963	6782	1135	92464	81.54
1964	7269	1297	110980	84.20
1965	8642	1589	156156	97.02
1966	9281	1560	185253	109.70
1967	8914	1592	184007	112.23

Monthly Abstract of Statistics July, 1967

TOTAL ANNUAL SALES FOR COUNTIES OF MANAWATU AREA

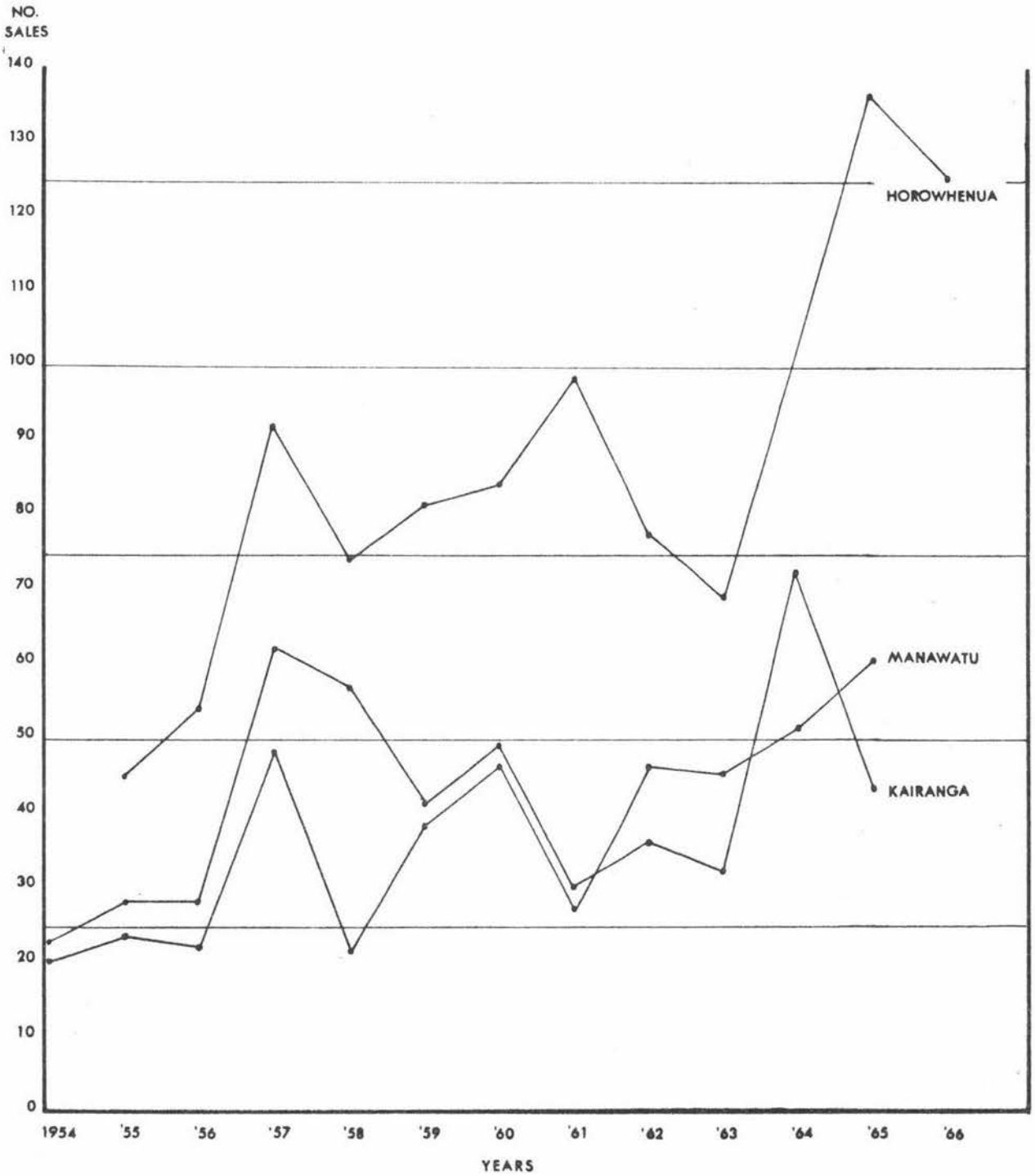

FIG. 25.

APPENDIX L

The Moutoa Flax Estate of 4952½ acres has been omitted from the main text partly because it is a Government enterprise and partly because the land is devoted to an extensive type of land use which has not undergone much change since the completion of the flood control scheme.

The unimproved value increased by 75% between 1956 and 1966. This represents an increase of from £15.4 per acre to £27 per acre. While the increase between pre-and post-scheme dates has been great, the unimproved value of this land is still below values of other land in the Moutoa district.

Prior to the operation of the scheme, this low-lying area (6-9 feet above sea level) flooded up to four times a year, meaning it was in a continual state of swamp which provided suitable conditions for flax growing. However, the scheme has rendered flooding negligible, with the consequent transformation of the area from a natural swamp to a comparatively dry area. These drier conditions have caused the swamp flax to die out, but flax cultivation has been maintained by the growing of a new variety more able to withstand dry conditions.

In conjunction with flax growing, wethers and cattle are grazed. In 1955, 2400 ewe equivalents were supported together with 240 head of cattle, but by 1966, 11334 ewe equivalents and 300 bullocks were grazed. Removal of constant flooding has allowed for great increases in the number of stock carried on this land.

The flood control scheme has removed flooding from this land thus increasing the potential of the area for supporting intensive agriculture. The utilization of this land, however, has remained extensive, although the fertile peat soils are capable of maintaining intensive agriculture, particularly that associated with large scale vegetable growing or market gardening on a smaller scale. This is, therefore, a large area of land which is now being very much under-utilized.

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