AN ILLUSTRATIVE EXAMPLE OF EVALUATION PROCEDURES (DRAINAGE SCHEME - NORTH CANTERBURY)

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1. Objective of the Investigation:

To provide information on an accept-reject decision on the Osborne's Drain Improvement Scheme.

2. Scope of the Project:

2.1 The scope of the project is to prevent flooding and to improve the efficiency of drainage, so that the area can be developed to its full potential as high producing land. The accompanying plan shows the boundaries of the area and the location of the work, proposed in the scheme. All properties within the scheme will have a direct outfall into an improved channel which will be maintained in the future as a public drain in a classified rating district.

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* This evaluation has been prepared in accordance with the procedures set out in the paper - "The Economic Evaluation of Investment in Large Scale Projects - An Essay to Recommend Procedures" by R.C. Jensen which is published in the Proceedings of a New Zealand Seminar on Project Evaluation in Agriculture and Related Fields, Lincoln College, Agricultural Economics Research Unit Publication No. 48, 1968. In general, this report is a modification of an economic report prepared by A.C. Norton for the North Canterbury Catchment Board in February 1963.

Wherever possible data has been brought up-to-date. Nevertheless, it should be read and understood, primarily as a type example and not as a re-evaluation of the Osborne's Drain Scheme.

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2.2 In general the proposed scheme of work will be the provision of flood pumps at the site of the present Osborne's Drain floodgates and the enlargement of the present channels to contain all flood waters except under extreme rainfall. Under average winter conditions, it is assumed that the surface level of the water in the main channels will be 3 ft. below ground level, in order to keep the ground water level (which is saline) below the root zone of all plants.

2.3 Extending in a north-westerly direction from near the mouth of the Halswell River, the major part of the Osborne's Drain catchment, prior to European settlement, would have been a shallow bay covered by the high levels of Lake Ellesmere. In 1889 the Government constructed the Halswell Canal and the spoil on the right bank from the end of the high ground just downstream of Hodgen's Bridge for some 130 chains towards the Lake formed a substantial embankment, a bank known as Osborne's Bank was constructed at approximately right angles to it in a westerly direction for about 83 chains where it merged into high ground near the present Greenpark Huts. Osborne's Bank which has a top width of 10 ft. and a height of 8 ft. above M.S.L. is stone faced on the Lake side. The westerly side of the catchment from the end of Osborne's Bank is protected from Lake Ellesmere by land which varies between 7 and 8 ft. above M.S.L. while on the N.E. and N.W. perimeter there is the boundary with the Halswell River catchment with levels in excess of 8 ft. The accumulation of water in the area is due solely to the run-off from rainfall and not from any spring action. The line of Osborne's Drain follows road and drain reserves laid off at the time of the original land surveys. The drain at present discharges via a manually controlled floodgate direct into Lake Ellesmere.

The scheme envisages that the water at present discharged into the Lake by four drains (not floodgated) located to the west of Hudson's Road between the Greenpark Huts and Jarvis Road and the small floodgated drain at OM 27.43 chains on Osborne's Bank will be brought to the pumping station located at the present Osborne's Drain floodgate. The acreage of occupied land within this proposed catchment of the pumping system is 3,944 acres.

The characteristic features of the area are:

2.3.1 The extreme flatness and low lying nature of the land. From Osborne's floodgate along the line of the drain to near the top of the catchment at Hudson's Road the ground level rises 3.71 ft. (2.81 ft to 6.52 ft.) in a distance of 4 miles 44 chains. The area of land below the 6.5 ft. contour is approximately 57% of the total catchment.

2.3.2 The area of land flooded and the duration of the flooding on some occasions. It is estimated that during periods that Lake Ellesmere is at high levels

for several weeks, 800-1,000 acres are flooded. Of the land not flooded, upwards of 2,500 acres has severely impeded drainage with the water-table virtually at ground level.

2.3.3 The salinity of the soils. It is estimated that 2,106 acres, at the lowest levels, is of medium salinity with patches of high salinity, a further 1,452 acres is weakly saline with some areas of medium salinity and 386 acres on higher ground on the margin shows nil or slight signs of salinity.

2.3.4. The low production from poor quality pastures on the areas of medium and high salinity which is also the region where flooding occurs. On average grazing is only available for about six months of the year.

2.3.5 The complete absence of stock shelter on all but the highest ground in the catchment. The region is very exposed to both the north east wind which whips down out of Gebbie's Pass, after being funnelled there by the configuration of the Lyttelton Harbour and the winds from the southerly quarter.

2.4 There are 19 holdings completely or partly within the Catchment. However, as 5 of the whole or part properties (65 acres in area) are located on the higher ground and will receive no benefit from the proposed work, they have been neglected in the subsequent analysis and estimates. The area of the 14 properties is 3,879 acres within the catchment and 1,196 acres outside the catchment, to give a total of 5,075 acres. Of the 3,879 acres, 669 acres on 6 properties are held under L.I.P. tenure and the balance is freehold

3. Viewpoint of Investigation:

The investigation of the scheme is from the national viewpoint. Externalities to the New Zealand economy are not likely to be significant and therefore have not been included in the calculations.

4. Present Production:

The present production is as follows:-

The stock carried is for the total area of the properties (within and outside of catchment) while the crop acreages are for land completely within the catchment. Several of the properties have various combinations of the various types of production.

Town supply dairy cows - 8 properties, 344 milking cows and 130 replacements.

Butterfat Supply dairy cows	- 3 properties, 72 milking cows and 43 replacements together with pigs.
Beef Cattle	- 3 properties, 77 head of various descriptions.
Grazing cattle	- 2 properties, 85 head of dairy heifers and cows.
Fat land production	- 6 properties, 4,455 ewes with 951 replacements.
Barley	- 3 properties, 69 acres.
Perennial rye-grass seed	- 1 property, 30 acres.

5. Expected Future Production

The construction of the proposed work will allow each farmer to carry out developmental work within his own property with a resultant increase in production. The areas of the differing benefits within the 3,879 acres are estimated as follows:

Major benefit	- 2,106 acres -	low lying land below the 6.5 ft. contour which on average is of moderate salinity.
Minor benefit	- 1,452 acres -	land about and immediately above the 6.5 ft. contour which on average is weakly saline.
No benefit	- 321 acres -	land at the highest elevation in the catchment.

The 1961 Government Capital Value of the 2,106 acres (no homestead sites) is $63,000 or $29.80 per acre and the 1,452 acres (4 homestead sites included) is $125,640 or $86.60 per acre.

In assessing the increase in carrying capacity and crops it has been assumed that the present types of farming continue in the future under the present efficiency of management. After 10 years of development work the following is the estimate of the increase in stock numbers and crops for the benefiting area of 3,558 acres.

Town supply dairy cows	-	86
Butterfat supply dairy cows	-	29
Dairy Replacements	-	36
Beef cattle - breeding cows	-	50
Ewes on fat lamb production	-	4,225
Other sheep - hoggets & rams	-	509
Barley - acres	-	146
Rye-grass seed - acres	-	30

6. The Period of Analysis and Discount Rate:

The analysis has been taken to infinity and the discount rate at $5\frac{1}{2}$ per cent.

7. Costs and Returns:

The costs and returns are set out in Table I. The following provides some details on the preparation of the figures.

7.1 The Scheme costs (Row A) of $42,000, obtained from the engineering report includes the estimated expenditure on, pumps; electric motors; pumping well and foundations; building at pump site; improvements to just over 8 miles of drains; culverts, and engineering fees for supervision once the work commences.

7.2 The maintenance (Row B) is the estimated annual charges to clean the 8 miles of drains; labour for regular checking of pumping station, screens and electrical equipment; insurance of building and plant; plant maintenance and the power charges to pump out drainage water, plus water used in de-salting and or irrigation of the land.

7.3 The sinking fund (Row C) is the amount of money which has to be set aside annually and invested at $5\frac{1}{2}$ per cent compound interest in order to have $8,000 available to pay for the replacement of the pumps and motors at the end of twenty years. $8,000 represents the anticipated purchase price of pumping equipment.

7.4 Row D - (the summation of rows A, B, & C) - is the total of the direct costs.

7.5 The annual land development costs (Row E) also includes the increase in capital outlay of new buildings, plant and additional livestock required as a consequence of the land development. It is assumed that these costs will be incurred as equal increments over a five year period. The details of the total costs are in Appendix I.

7.6 Row F is the increased annual farm running costs incurred in obtaining the increase in gross farm returns as outlined in 7.9 below. Included in these costs is the running expenses, repairs and maintenance and depreciation of the items under land development and capital outlay in 7.5 above. The increased annual costs at the end of 5 years are given in detail in Appendix II.

7.7 Row G - (the summation of rows E & F) - is the total of the indirect costs.

7.8 Row H - (the summation of rows D. & G.) - is the total of the annual costs.

7.9 The increase in annual gross farm returns (Row I) is the monetary value of the expected increase in future production given in paragraph 5. Details of the increased returns, at the end of the 5 year development period, are in Appendix II.

7.10 The net annual returns or the direct benefits (Row J) obtained by subtracting Row I from Row H.

7.11 The cost of investigations for the scheme, estimated at $1,615 have not been included in any of the costs as set out in Table I.

8. Technical Change:

8.1 In the "without" situation there is no possibility of increased technical efficiency giving any increase in returns from the area. The drainage and local flood problems of the region place an absolute limitation on how the area is used without a scheme.

8.2 In the "with" situation it is anticipated that technical change in this area as well as the country as a whole will increase gross returns. This has been allowed for in the increased annual gross farm returns (Row I) at the compounded rate of $1\frac{1}{2}$ per cent.

9. Input Prices:

Throughout the country input prices are increasing. Therefore, cash flow streams of Rows E, and F have been increased by the compounded rate of $2\frac{1}{2}$ per cent. Annual maintenance costs (Row B) are not expected to increase in the long term. Technological improvements in drain maintenance methods, will possibly lead to lower maintenance costs, and these are assumed to compensate for increasing pumping costs.

10. Discounting Analysis:

The discounting procedures applied to the costs and returns are detailed in Table II and Table III.

11. Results:

The results can be summarised as follows:-

From Table III - Present Worth of Returns = 1,801,536 --------(V)
" " II - " " " Costs = 1,641,199 --------(C)

The present worth of the net returns
or the direct benefits of the project
= (V - C)
= $160,337 (which is positive)

The returns/costs ratio = $\frac{V}{C}$

= 1.098

12. Policy Conclusions:

12.1 The economic benefits - that is the net present worth of the project are estimated at $160,337. This amount does not include any allowance for indirect benefits which we feel are insignificant and need not be considered in the decision to accept or reject the project.

12.2 The authors consider that from the national viewpoint there is economic justification for proceeding with the project.

12.3 The report does not include any information on the financing of the project which could be the subject of a separate report.

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APPENDIX I

Estimate of development costs and increase in capital outlay.

Development costs - per acre			
Internal farm drainage	$9.00		
Farm Shelter	7.50		
Sub-division fencing	19.00		
Fertiliser	27.00		
Seeds	11.00		
Cultivation	11.50		
Stock Water	2.00		
Lucerne establishment	1.00		
De-salting	22.00		
On 2,106 acres at	$110.00	=	$231,660
New Buildings			
Two houses and layouts at $9,000	$18,000		
Hay barns	3,000		$21,000
New Plant			
One tractor and hydraulic fittings			$3,000
Additional Livestock			
115 cows at $100	$11,500		
4,225 ewes at $4.30	18,168		
84 rams at $18	1,522		
50 beef breeding cows at $100	5,000		
1 bull (beef breed)	150		$36,340
TOTAL development and capital outlay			$292,000

APPENDIX II

(a) Increase in annual gross returns at the end of 5 years.

Town Supply Dairying	$18,920
Butterfat Dairying (including pigs)	2,726
Beef Calves	1,260
Cull cows	262
Fat lambs	15,100
Wool	17,768
Cull ewes	2,680
Barley	6,204
Perennial rye-grass seed	1,080
	$66,000

(b) Increase in annual farm running costs at the end of 5 years.

Stock purchases	$5,415
Dairy shed expenses	480
Veterinary expenses and animal health	810
Herd testing	105
Crop harvesting	1,405
Machine dressing and certification	200
Freight and cartage	1,900
Feed charges	1,350
Fertilizers	4,680
Seeds	1,040
Weeds and pest control	885
Wool expenses	1,425
Vehicle and motor expenses	2,105
Repairs and maintenance	5,860
General and unforeseen	660
Wages	7,750
Rates	1,220
Insurances	220
Depreciation	2,490
	$40,000

TABLE I - PROFILE OF COSTS AND RETURNS

ROW	YEAR	1	2	3	4	5	6
DIRECT COSTS:							
A	Scheme	$42,000					
B	Annual Maintenance of Scheme	2,400	2,400	2,400	2,400	2,400	2,400
C	Sinking Fund	230	230	230	230	230	230
D	TOTAL DIRECT COSTS: (A & B & C)	$44,630	$2,630	$2,630	$2,630	$2,630	$2,630
INDIRECT COSTS:							
E	Annual land development costs	$58,400	59,860	61,356	64,462	66,074	-
F	Increase in annual farm running costs	8,000	16,400	25,215	34,460	44,152	45,256
G	TOTAL INDIRECT COSTS: (E & F)	$66,400	76,260	86,571	98,922	110,226	45,256
H	TOTAL ANNUAL COSTS (D & G)	$111,030	78,890	89,201	101,552	112,856	47,886
I	Increase in Annual Gross Farm returns	$ 13,200	26,796	40,797	55,212	70,050	85,321
J	NET ANNUAL RETURNS or DIRECT BENEFITS (H - I)	-$ 97,830	-52,094	-48,404	-46,340	-42,806	+37,435

TABLE II - PRESENT WORTH OF COSTS

Discount Rate $5\frac{1}{2}\%$

(a) Years 1 to 5

Year:-	1	2	3	4	5
From Table I Row H	111,030	78,890	89,201	101,552	112,856
Present Worth Factor	.94787	.89845	.85161	.80722	.76513
Present Worth	105,242	70,879	75,964	81,975	86,350

TOTAL PRESENT WORTH YEARS 1 to 5 = $420,410

(b) Years 6 to infinity

Present Worth of years 6 to infinity, at the end of year 5 is capitalisation of uniform cost stream

= $47,886 x 33.3333

= $1,595,531

(The capitalisation rate should be the discount rate less the rate of increase in unit costs in this case $5\frac{1}{2}\%$ less $2\frac{1}{2}\%$ = 3%. This provides an approximate true discount rate.)

Present Worth at beginning of year 1 of $1,595,531 is that sum discounted for 5 years

= $1,595,531 x .76513

= $1,220,789

(c) Total Present Worth of Cost Stream - Years 1 to infinity:

Total Present Worth = (a) + (b)

= 420,410 + 1,220,789

= 1,641,199

TABLE III - PRESENT WORTH OF INCREASED RETURNS

Discount Rate $5\frac{1}{2}\%$

(a) Years 1 to 5

Year:	1	2	3	4	5
From Table I - Row I	13,200	26,796	40,797	55,212	70,050
Present Worth Factor	.94787	.89845	.85161	.80722	.76513
Present Worth	12,512	24,075	34,743	44,568	53,597

TOTAL PRESENT WORTH YEARS 1 to 5 = 169,495

(b) Years 6 to infinity

Present Worth of years 6 to infinity at the end of year 5 is capitalisation of uniform return stream

= 85,321 x 25.00 Capitalisation Rate = $(5\frac{1}{2} - 1\frac{1}{2})\% = 4\%$

= 2,133,025

Present Worth at beginning of year 1 of 2,133,025 is that sum discounted for 5 years

= 2,133,025 x .76513

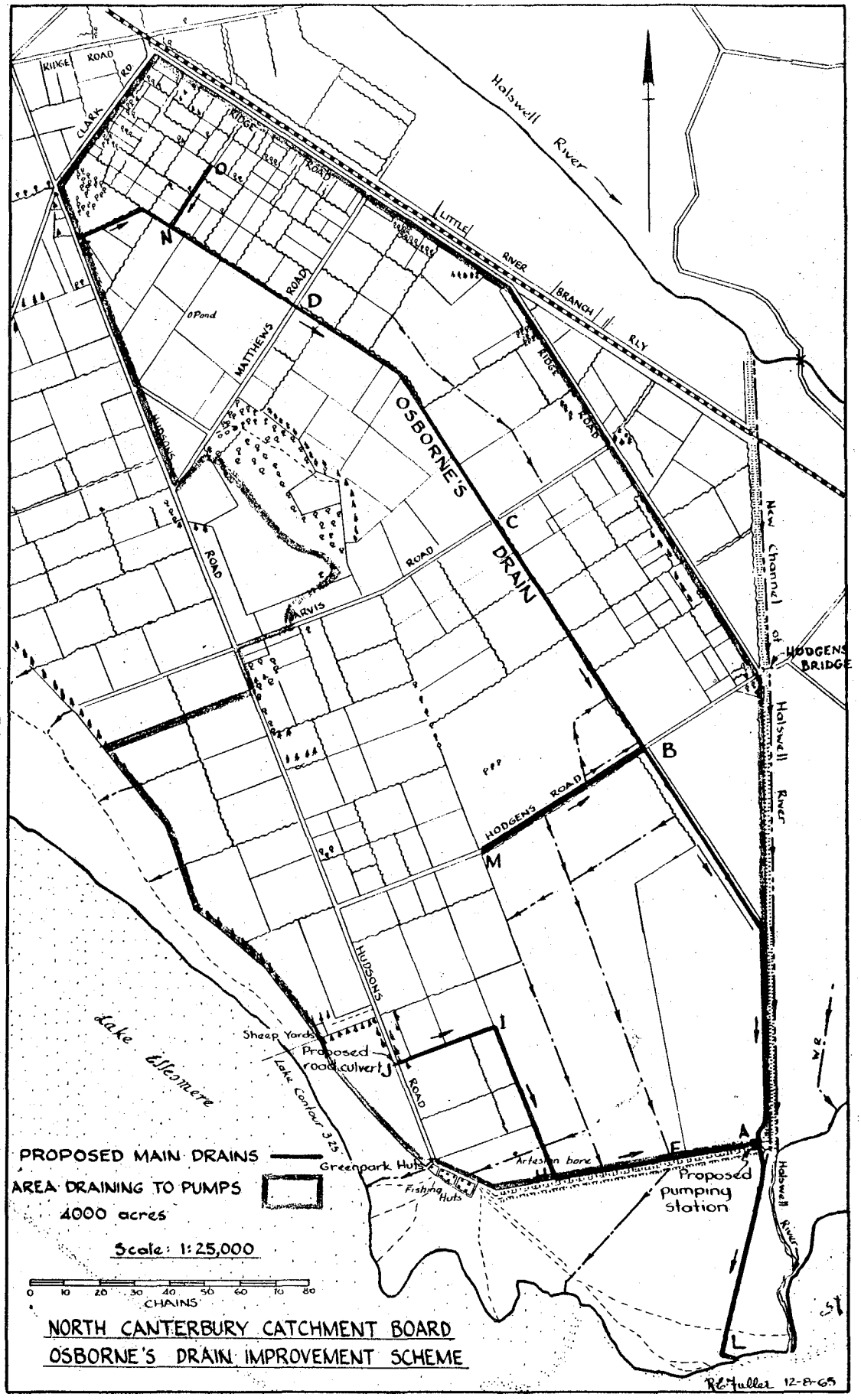
= 1,632,041

(c) Total Present Worth of Increased Return Stream - Years 1 to infinity

Total Present Worth = (a) + (b)

= 169,495 + 1,632,041

= $1,801,536


Halswell River
RIDGE ROAD
CLARK
ROAD
LITTLE RIVER BRANCH RLY
MATTHEWS ROAD
OSBORNE'S DRAIN
HUDSONS ROAD
RIDGE ROAD
ARVIS ROAD
New Channel of Halswell River
HODGENS BRIDGE
HODGENS ROAD
Halswell River
HUDSONS ROAD
Lake Ellesmere
Lake Contour 325
Sheep Yards
Proposed road culvert
Greenpark Huts
Fishing Huts
Artesian bore
Proposed pumping station
Halswell River
N
Q
D
C
B
M
J
I
E
A
L
PROPOSED MAIN DRAINS
AREA DRAINING TO PUMPS
4000 acres
Scale: 1:25,000
0 10 20 30 40 50 60 70 80
CHAINS
NORTH CANTERBURY CATCHMENT BOARD
OSBORNE'S DRAIN IMPROVEMENT SCHEME
R.E. Fuller 12-8-65