A NEW ZEALAND FARM IRRIGATION DEVELOPMENT

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Abstract

The Francis Farm was purchased by Meridian Energy Ltd in 2003 as part of a proposed hydro-electric scheme "Project Aqua". The property was rundown, with only 155ha out of 222ha able to be farmed. The flood irrigation system was derelict but had consent to take 144L/s of surface water i.e. enough to irrigate 150% of the farm area at 0.42L/s/ha. We carried out a full development levelling old structures, installing spray irrigation, new pastures, fences, lanes, stock water and buildings.

The total cost was $2.55m for 188ha of irrigated pasture or $13,580/ha. More typical costs for a commercial farm owner would have been $11,230/ha. Possible net capital gain is $1.1m. Income from leasing the property gives a marginal return on the development capital of 4.6% to 5% depending on the value of the irrigation water made surplus by efficiency gains. This rate of return could be improved by farming the property rather than leasing.

Management of the development project required a clear focus on time, scope and budget. Fixed quotes would have resulted in a more accurate forecast cost for approval in the business case.

Significant effort and cost has gone into minimising water pollution from leaching and runoff with 27ha of wetlands retired and fenced to exclude livestock. An extensive re-vegetation plan has been drawn up. The farm is now leased to a conscientious tenant running dry dairy cows and replacement heifers.

Key words: Meridian, irrigation, development, efficiency, conservation, project.

Introduction

Meridian Energy Ltd bought the Francis Farm located near Duntroon in the Waitaki Valley of Otago in 2003. It was part of "Project Aqua" a proposed hydroelectric development to take water out of the Waitaki River, down a wide canal and through a series of low level power stations before returning it to the River. The project was eventually abandoned because resource consents were not granted. Twenty five properties owned by Meridian in the Waitaki and other parts of New Zealand, totalling over 7,000ha, were passed to our firm to supervise.

The Farm was badly rundown but had a planning consent to take irrigation water.

I put a proposal to Meridian to develop the farm to a high standard for dairy support i.e. running replacement dairy stock and wintering dry cows.

The development cost $2.55m and resulted in a highly productive irrigated farm with an enhanced market value, generating a good annual income.

Challenges included managing the project within budget, installing an irrigation system to fit the topography, resource consent issues, environmental concerns and Maori cultural issues. It was carried out under close scrutiny from the local community which had been strongly divided by Project Aqua the original hydro-electric development.

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The Opportunity

The farm is 222ha of low terrace and river flats with the Waitaki River on one boundary. It had been run in conjunction with a larger hill farm. It was in a rundown state with no buildings, poor pasture and was heavily infested with gorse. Part could be flood irrigated from streams but the water races and levies were largely derelict. Only about 155ha could be farmed effectively. The balance was either wetland or covered in gorse, broom and willows.

The farm has a proportion of good soils with flat contour. Annual rainfall is only 500mm per year but there are two consents to take water for irrigation totalling 144 litres per second from a pond and streams. At a rate of 0.42L/s/ha (25mm/week) this volume could irrigate 340ha using a modern spray irrigation system i.e. one and a half times the total farm area.
The opportunity was to take 155ha of rundown farm with a derelict irrigation system and transform it into almost 200ha of productive pastoral farmland under efficient irrigation.
Having a large corporate farm owner meant capital was available if it could be justified by a business case.

The full development involved installing a new irrigation system. With that came clearing gorse, levelling the old flood irrigation structures, taking out scattered old pine trees, capital fertiliser, pasture renewal, lane construction, fencing and stock water. We also built a new house, implement shed and cattle yards.

Pasture production could be increased from between one and five tonnes per hectare on the undeveloped unirrigated land to between ten and fifteen tonnes per hectare under spray irrigation, depending on soil type.

I presented a formal business case to Meridian. Funding was approved in November 2007 and the developed farm eventually handed over to the tenant in October 2009.

The Irrigation Development

The development involved a drastic change to the landscape and the whole layout of the farm. Designs and quotes were requested with the first choice being centre- pivot irrigators.

The design needed to achieve:

- Efficient use of the available irrigation water in terms of power consumption, distribution, application to the land and retention in the root zone. It needed to apply sufficient water to optimise pasture growth on different soil types.
- Ease of management. It needed to be simple to use by a tenant, require little labour and to fit the constraints of the farm geography.
- Acceptable Cost. The design needed to be competitive with other tenders and give an acceptable return on capital.

The old flood irrigation achieved none of these. In its favour the neglect of the farm was allowing regeneration of native grasses along stream margins and minimising environmental impact by default. However herds of dry dairy cows had been grazed in winter on kale crops adjoining unfenced streams resulting in water pollution with dung and mud.

The old borderdyke system dammed a stream to raise the water level. This flowed into head races, originally with dams and sills installed for automatic irrigation. Under this system a gate is installed at each dam to water groups of three paddocks. A clock drops the gate to block the water which

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backs up and flows over the sills till the next gate upstream drops. The water flows over each sill and down a strip between two levies. Each strip is typically 12 meters apart and can be hundreds of metres long. Modern borderdyke systems have laser levelled sills and strips with high volume headraces. An 8 cusec (230L/s) headrace might allow 20-30ha to be irrigated in 24 hours. Laser levelling of sills and border strips plus higher volume headraces can make this more efficient. However the system typically applies 75mm to 100mm of water in under an hour. The light soils irrigated by border-dykes are often free stony alluvial types. The result can be runoff if timing is poor and leaching nutrients into ground water.

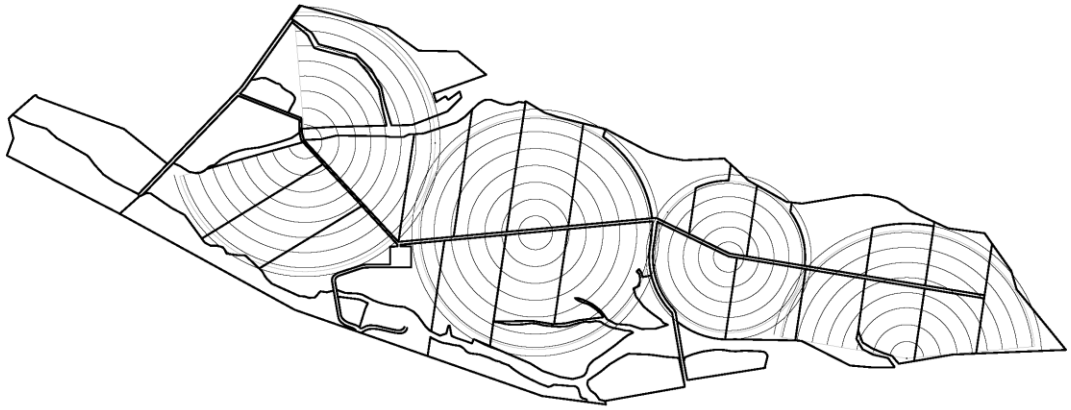
Work at Winchmore Irrigation Research Station in 2002 showed flood irrigation efficiency at between 38% and 90% depending on flow, levelling and length.

Landcare Research carried out a soil survey of the farm by showed parallel bands of recent alluvial soils deposited by the Waitaki River:

- very light stony gravels beside the river with an average profile available water (PAW) of only 25mm
- young silt soils through the middle with PAW of 40mm
- a strip of heavy silts with a high water table along the south boundary; average PAW 70mm.
- a terrace of stony silt soils over compacted gravels with PAW of 130mm.

The irrigation designs and quotes were audited by Aqaulinc. They recommended a plan prepared by KB Irrigation (now Sicon) with four centre pivots C*entre Pivot Irrigation Plan*

This plan gave 130ha of pasture under pivots. The remaining corners totalling 48ha are watered by



manually moved K-line sprinklers. The remaining 10ha of unirrigated land made a total of 188ha or 85% of the legal area of 222ha. The balance consists of riverbed, a Waitaki River margin strip to prevent erosion plus streams and wetlands retired for conservation.

The pivots were audited at 0.5L/s/ha (30mm/week) slightly less than the average summer evapotranspiration of 5-6mm/day.

We were able to use one consent for 110L/s averaging 0.58L/s/ha giving ample water to maintain soil moisture for a dairy support system. The second consent of 34L/s can be transferred to another Meridian farm.

Future modifications to the system could include variable rate irrigation equipment on the pivots to automatically adjust the depth of water applied according to soil type. This would justify computerised soil moisture monitoring equipment such as Aquaflex.

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The Cost

The eventual cost of the development was significantly higher than the original conservative budget figures drafted as early as 2005. However individual components are typical of other developments carried out by our clients.

The project has special features not normally included in a commercial farm development. For example the areas retired for conservation will contribute towards a total of 70ha of wetland required for the resource consent for a new hydro electric development on the North Bank.

	MEL Francis Farm Duntroon 2008/10		188	ha effective pasture area.		
	ITEM	Total	Total/ha	Notes:	Typical	Typical/ha
1	Consents	$30,596	$163	Environment Canterbury - transfer point of take etc	$10,000	$53
2	Clearing & earthworks	$327,654	$1,743	Demolish borderdykes, remove gorse & trees, clear and level	$120,000	$638
3	Spray irrigation	$803,983	$4,277	4 pivots plus K-line. Pumped from a pond 200m from Waitaki river.	$800,000	$4,255
4	Electricity reticulation	$233,015	$1,239	500m 3-phase, house supply, shared supply to pivot. Pivot cables & installation.	$200,000	$1,064
5	Stock water	$118,822	$632	2 pumps, ring main & troughs. Dairy standard.	$100,000	$532
6	Fencing	$161,448	$859	24km 3 & 4-wire stayed & sprung electric fence to suit pivots, 20ha of streams & wetlands fenced	$120,000	$638
7	Lanes & feed pad	$99,973	$532	2.6km x 9m x 300mm+ lanes excavated & compacted. Gravel from property. Dairy standard without capping.	$75,000	$399
8	Buildings – house	$345,790	$1,839	Benchmark homes, 230m2, 4brm, Oamaru stone, lawns, septic tank etc	$345,000	$1,835
9	Buildings – cattle yards	$50,794	$270	Te Pari Cattlemaster SY120, concreted race.	$50,000	$266
10	Buildings – implement shed	$36,558	$194	Four bay, one enclosed with concrete floor 20m x 9m	$36,000	$191
11	Re-vegetation & shelter	$25,383	$135	House garden, whole farm landscape plan.	$5,000	$27
12	Pasture improvement	$152,835	$813	Full spray, cultivation & sowdown.	$152,000	$809
13	Lime & fertiliser	$75,885	$404	Capital lime & fertiliser. Part at peak fertiliser prices.	$75,000	$399
14	Project Management	$61,376	$326	Engineers, surveyors, auditing, supervision & control	$25,000	$133
15	Other:	$28,883	$154		$0	$0
	TOTAL:	$2,552,995	$13,580		$2,113,000	$11,239

Retiring land at least 4m back from the water's edge required another 6-7km of fence costing $40,000.

The cost of consents includes fees to Ecan (the regional authority) and consultants' fees. For conservation and cultural reasons we decided to move the point of take of the irrigation water from the stream below the rock art up to an existing pond excavated in the river gravels many years ago. This was granted last month after nearly two year's debate.

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Earthworks seemed endless with particular delays in removing willows to allow the passage of the pivot towers.

Electricity reticulation required three connection points. I moved one connection point away from the rock art site and shared the cost of a neighbour's line.
Lanes and the stock water reticulation system were built to a high standard and would allow eventual conversion to a dairy farm if appropriate. The lane is 9m wide, fenced to 8m, with at least 300mm of gravel base.

The house is an attractive three bedroom home of an appropriate standard for the present scale and land use.

Economics

The economic return from the development is in two parts: the gain in the market value of the property and the increase in annual cash income.

Conservatively the value of the developed farm is $5.87m or $31,000/ha for the 188ha effective grazing area. In its rundown condition before development the value at the same date would have been in the order of $2.2m or $12,000/ha.

With the current shortage of finance available from banks and the economic downturn few farms have been selling and there are few comparable sales. In my opinion the irrigation water consents are undervalued in the Waitaki Valley. For example: piped water from the Ashburton Lyndhurst scheme is worth up to $12,000 per litre per second. This farm now has a surplus consent to take 34L/s of surface water at no cost and with no annual volume restriction. In Mid Canterbury this could be worth over $400,000 to partially offset the development cost to a more efficient irrigation system. Local farm sales reflect the higher cost and annual charges of the North Otago Irrigation Company piped water but don't add a significant premium for consents like this.

The estimated increase in market value from the development is $3.67m compared to an actual cost of $2.55m. The capital gain from the development is $1.1m. In New Zealand this is a tax free gain.

There has been a significant gain in annual income.

Before development the farm was managed in association with a Meridian owned dairy farm harvesting surplus pasture for silage in summer and grazing dry dairy cows on pasture and kale crops in winter. 700 cows and 160heifers were grazed for six weeks in winter on 50ha of kale. 60ha of poor pasture was harvested for silage. The annual EBIT was estimated at $32,000 or a return on capital of 1.5%.

We designed a dairy support farming system to be run by an employed manager. At the time of the business case in late 2007 the farm would have returned an EBIT of $174,000 or 4% of values at that time.

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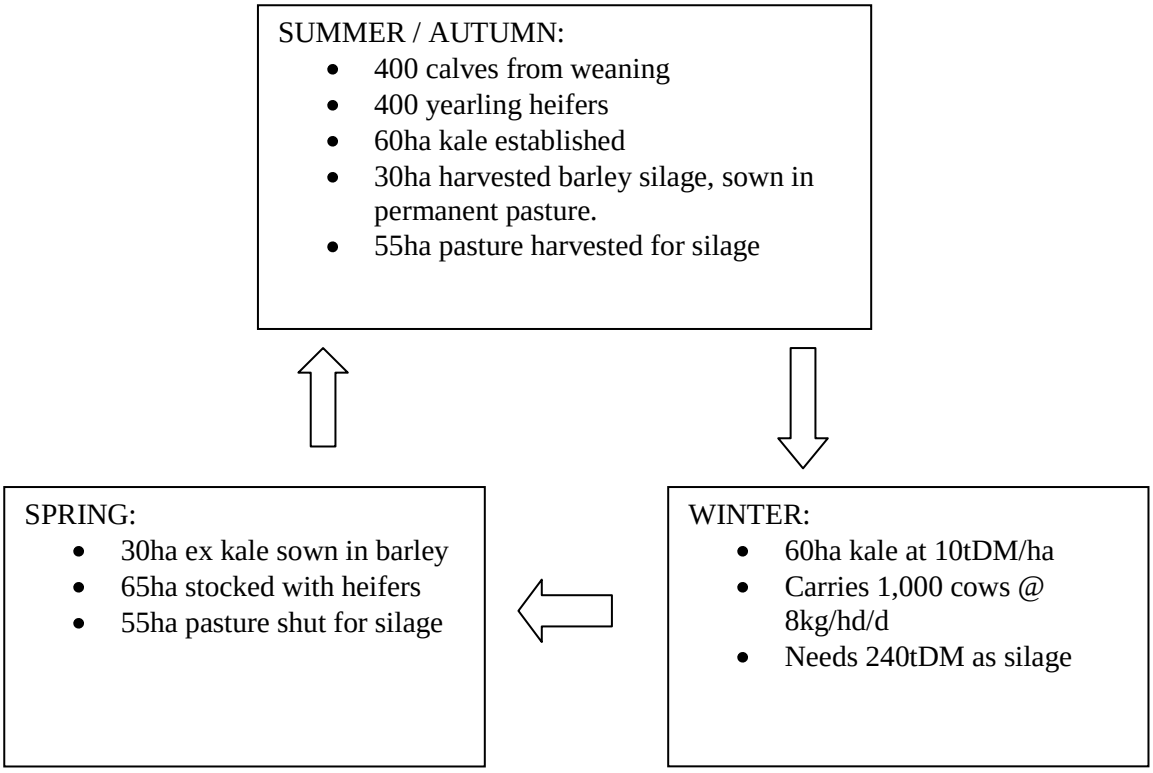

Under the current ownership we prefer to lease properties rather than employ staff and buy livestock, so the farm is leased. The total rent is $149,800 including the best land under pivot irrigation at $900/ha/year.

The terms of the lease require the tenant to pay all rates, insurance, fees and working expenses. The intention is that the property is returned at the end of the term of the lease in the same condition as at commencement.

The return on capital has risen by 1% to 2.5%. Historic farm rents have been in the order of 3.5% to 4% of market value but have declined in recent years because of static farm profitability and rising farm values.

The gain in EBIT attributed to the development is approximately $118,000 or 4.6%. If the surplus irrigation consent could be sold for even half the Mid Canterbury value, then the marginal return on the capital invested in the development rises to 5%.

A typical average cost of farm capital at present is around 6.5%. The cash return is therefore less than the cost of capital. This will be improved by the next rent review and could be improved further by farming rather than leasing the property.

The cost of irrigation in the South Island has pushed land use away from sheep and cattle towards more profitable farm systems such as intensive cropping and dairying. Leasing this farm for dairy support is a conscious decision by the owners fitting their wider business plans.
There is an on-going debate in New Zealand about high land values, poor farming returns and the resulting low return on capital. Farmers typically rely on long term capital gain to provide a competitive return on the capital invested in their farming assets.

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Project Management

I was told at a recent project management seminar that about 35% of projects in New Zealand are completed on time, to specification and to budget. It made me marginally happier about the cost overruns on this project.

I quickly learnt that my job was principally to annoy people and bully them into doing what I wanted.

Rob Verkerk talks about the "Project Management Triangle" of Scope, Time and Budget. A change in any one will affect the others eg "Scope creep" will affect the cost and the delivery time.

Reporting to the Land Manager at Meridian made the chain of command simple. I had my project, other people wanting a say had to go to Meridian. Ngai Tahu and the local community had an interest. The tenant wanted a number of improvements. Contractors continually had bright ideas about ways to spend more money and why they couldn't finish the job on time.

If the cost of preparing a business case is covered then the manager can go into detail with formal quotes for each stage. A company like Meridian has the resources to take on any appropriate project that can be justified, but it does not like surprises. Any departures from the plan should have written authority in advance.

The house, pivots, cultivation and stock water all had firm quotes. Slippage came in earthworks, electricity reticulation and fencing. These were partly due to changes in the scope but also simple underestimates that would have been corrected by a firm quote from the contractor.

The farm is 200km from my base so I could be there weekly but not daily. The lessee Richard Metcalf was a great help day by day and had a vested interest in seeing the job done properly.

On this experience I would:

- Define the task and identify the client.
- Quantify the cost and get firm quotes, covering exchange rate risks.
- Get approval from the client for the business case and all variations.
- Focus on delivering the project on time, to specification and within budget.
- Be on site during key phases, daily if necessary.

Environmental Issues

The farm development had to allow for the environmental sensitivity of the site and the sensitivities of the owners. The company has a strong interest in environmental issues but even its renewable energy projects involving hydro and wind power can attract criticism.

The Francis farm has a boundary with the Waitaki River which is a large braided river with flows ranging from below 100 cumecs up to floods of over 1500 cumecs. The farm has free-draining alluvial soils and is cut by spring-fed streams and wetlands. The environmental issues are:

- Runoff carrying soil, dung and urine into streams and the river.
- Leaching of nutrients into groundwater.
- Depletion of the streams by pumping irrigation water.
- Destruction of native vegetation regenerating in wetland areas.

We commissioned an environmental survey and a detailed re-vegetation plan from Boffa Miskell.

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The estimated cost of full re-vegetation and maintenance of the wetlands is $977,000. This is unreasonable for a farmer and unlikely to be approved by Meridian but we have adopted the principles.

All wetlands have been fenced at least four metres back from the water's edge to provide a filter for runoff and exclude grazing stock. Low native shrubs will be planted to protect the heads of the streams. Fence lines will be planted to provide shelter for livestock, biodiversity and linking vegetation corridors.

Parts of the Waitaki River bank have been fenced over 100m back from the bank to provide a marginal buffer zone. Ecan has planted poplar poles in this zone for erosion control.
The farm was developed to be run as a dairy support farm not a milking dairy farm. Nutrient loading should be less and there is no dairy shed effluent. However we will need to be aware of possible nutrient losses and soil damage from grazing large mobs of dairy cattle on kale crops in winter.

The irrigation system was designed and audited to apply only the required rate and volume of water that the soil can absorb without runoff or leaching.

The irrigation consent for 110 litres per second could be taken from either of two streams, one flowing within a hundred metres of the site. The previous owner and a neighbour had shared the take, week about for flood irrigation. By pumping the full consent continuously there was a risk of depleting the stream, competing with the neighbours and reducing its viability. We now have approval from Ecan to move this consent to a landlocked pond. The trade-off is that we may need to develop an adjoining gallery to get the flow we need.

Cultural Issues

Immediately across the road is a limestone cliff with an overhang at the base used for hundreds of years by Waitaha and Ngai Tahu people for shelter. The overhang has a series of drawings and is linked to rock art sites throughout South Canterbury and North Otago. The local Maori people still have a strong interest in maintaining water quality to preserve sources of traditional food such as eels and white bait.

This Maori cultural link has been a real incentive to preserve the streams and to restore as much native vegetation as possible along waterways.

My plans to dig a trench to bury a power cable would have needed consultation with Ngai Tahu and the Historic Places Trust and an archaeologist present at all times. Instead I arranged to share an existing line with a neighbour well away from the site.

Conclusions

The commercial components of the development were typical of South Island irrigation costs. Other considerations took the total cost from $11,230 to $13,580.

The development was a success financially in terms of a possible capital gain of $1.1m. It is generating a return on the marginal capital of 4.6% to 5% depending on the value of the water released by efficiency gains. The return could be improved by farming rather than leasing the property.

Other gains have been in using less water to irrigate more land and minimising loss of nutrients by leaching. The streams and wetlands have been retired and will be gradually restored with native grasses and shrubs.

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