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A feasibility study on: irrigation in south Otago

University of Otago Leadership Programme

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Irrigation in South

Otago

2001

By: Stephen Woodhead

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INTRODUCTION

Irrigation is almost unheard of in South Otago with only a small number of farmers ever using it.

Despite being an area that is not traditionally known as being prone to drought, South Otago does occasionally suffer from extended dry periods that can cause production fluctuations, with some parts of the district being more susceptible than others due to soil type, aspect and micro climates.

The term “Drought” is relative, a drought in dry land North Canterbury is totally different to a drought in South Otago where the pastures may still be green. The result is the same though, stock and farmers under stress with lost production and increased costs.

There are several factors other than just an unreliable climate that made me look at this subject. Farmers are always looking for ways to be more efficient and produce more on the same area for similar cost. There have been large increases in per hectare production across all sectors but in the sheep industry this has come through improved genetics and new technology such as scanning. Many farmers are producing a lot more meat but carrying less capital stock to achieve this. This results in a lot more young stock that need to be grown rapidly over the spring/summer period.

There has been growth in the dairy industry, this combined with the recent improvement in sheep and beef returns has seen a huge leap in the price of land. The traditional move of purchasing more land to stay economic has become very difficult in a heated market. I believe this will result in many continuing to focus on making more efficient use of their current asset.

Consumer pressure has been developing with a quality product now not being good enough for many. Consumers wish to know that the food is safe to eat and the animal has been cared for. New technology such as ear tags that will store information to be downloaded at slaughter will be able to monitor the animal during its life and show if the animal has suffered any stress.

There has recently been an increase in the interest of cool climate crops and with information coming from Topoclimate South and Grow Otago, I see this increasing. Some of these may need irrigation of some sort. Lastly, there has been some advances in irrigation technology.

This report will focus on whether it is practical to irrigate on rolling down lands in South Otago.

It will

- outline the climate and then look at the water resource
- give an overview of the various irrigation options available and
- give an example of a system for my own property

Because every farm and owner operate an independent business with different aspirations, it is not intended for this project to provide a District wide solution.

CLIMATE

Rainfall:

The average annual rainfall for South Otago is around 700mm which is well distributed during the year, with less than 25mm a month a rare occurrence.

The average annual rainfall ranges from 450mm to 1,000mm. Mean rain days 157, ranging from 110 to 210.

High intensity rain storms are common in the North East of the district. Areas within 15km of the coast receive two to three easterly rains per year. These can last up to three days.

Rain also occurs from the west and south west with rainfall getting less at the north end of the district from these events.

Analysis of the Finegand, Milton and Lovells Flat rain fall over 35 years shows lowest monthly totals can be down to 6mm, but this is very unusual. October/November 1985 show 39 and 38mm and November/December 1989 with 21 and 28mm, these are two occasions where two low rainfall months in a row occurred. Both had serious ramifications for farmers particularly because they were so early in the season. January/February 1999 with 46 and 20mm also resulted in a severe feed shortage.

Heavy rainfall events do occur during the summer period with a maximum monthly total of 211mm being recorded at Finegand in February.

When we compare Balclutha figures with Tapanui, we see that Tapanui is at least 50% ahead of Balclutha. Tapanui's lowest annual is close to Balclutha's mean rainfall. Obviously these soils and pasture do not come under the moisture stress that the Balclutha area does.

Other climate factors for the two areas are similar with Tapanui being marginally cooler year round.

	Balclutha	Tapanui
Mean Air Temperature	10.4	9.8
Mean daily grass minimum	3.5	3
Relative humidity at 9.00am	84.7 %	80.3 %

Finegand, Balclutha

1964 to 2000

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Highest Monthly/Annual Total	158	211	166	132	115	157	126	99	131	240	112	119	944
Mean	69	58	58	48	61	61	51	42	48	66	51	68	682
Lowest Monthly/Annual Total	13	19	14	6	20	13	8	6	10	23	16	15	418

Tapanui

1897 to 2000

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Highest Monthly/Annual Total	250	245	212	185	370	277	225	185	183	221	214	204	1617
Mean	92	78	86	81	91	88	75	65	69	82	85	89	986
Lowest Monthly/Annual Total	16	12	10	10	26	10	12	4	18	8	19	16	647

Grass Growth:

Kilograms/Dry Matter/ha/Day

South Otago	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
V	6	14	28	55	56	44	36	29	28	24	12	6	10,290
W	6	12	27	54	57	43	35	24	23	21	12	6	9,720

Kilograms/Dry Matter/ha/Day

West Otago	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
M	7	10	29	61	54	53	43	34	41	21	15.5	7	11,390
H	9	15	28	61	77	70	57	54	50	39	20	10	14,920

These grass growth figures are taken from Stockpol models for two properties in South Otago and two in West Otago.

The first West Otago property is a similar contour and soil type to the South Otago properties, the second West Otago property is on very heavy, top class soils.

When analysing these graphs it is interesting to note that grass growth rates are similar at either end of the season, with the major difference occurring during the December to March period.

The variance between the districts range between 25% in December, moving to a 50% advantage for West Otago in March. There are many factors that effect grass growth, such as soil type and fertility. It is interesting that the man rainfalls show a similar variation through the summer, for example the mean rainfall in Tapanui for March is 50% higher than the mean rainfall in Balclutha.

There is a clear correlation between the summer rainfall and grass growth in South and West Otago.

Soils:

Most of the Topography is flat to easy rolling with intensive pastoral farming being the predominant use. There are also large areas suitable for cropping and horticulture. Most soils in the District are identified as Yellow Brown, Yellow Grey and Yellow Brown/Yellow Grey intergrade. These soils have a subsoil drainage restriction with tile and mole drainage systems being common.

This is an extremely broad description. Assessments on individual properties needs to involve detailed field inspections. Information from Topoclimate and Grow Otago projects will provide accurate and detailed soil classifications in the near future.

Temperature:

The district average temperatures are neither very high or very low. They range from a mean high of 15°C to a mean low of 5.4°C at Finegand. Maximum temperature is 33°C.

Wind:

The predominant wind is from the south west/westerly direction. Mean daily run (kilometres) is reasonably constant at 250km. Maximum of 1,165km has been recorded in October.

Due to the almost complete lack of drying northerly winds, evapotranspiration levels are low in coastal areas but increase to the north. The periods when soils are at wilting point are therefore short but may occur two or three times in any year.

Potential Evapotranspiration and Water Balance:

Soil water is released to the atmosphere by evaporation from the surface and by plant transpiration. This combined loss is termed evapotranspiration, so long as it is not limited by the available water supply, it occurs at a maximum rate known as potential evapotranspiration. When soil moisture is short, plants conserve moisture by reducing transpiration.

The rainfall and soil moisture graphs show that from October till the end of March the historical average potential evapotranspiration is greater than the historical average rainfall. The graph shows these figures in 10 day intervals, but when you break them down to daily figures it is quite surprising how much moisture can be potentially lost. During January and February there is approximately 4mm evapotranspiration per day, this drops to around 2.5mm in March.

Obviously soil moisture levels drop rapidly when there is only around 15mm of rain for the month, this corresponds with the readily available soil moisture shown by the red line in graph two that indicates that pasture was at wilting point for most of the month. This is shown as accumulated days of deficit on the right axis. Balclutha had just over 100 days of soil moisture deficit in 00/01 as against 50 during the 99/00 year.

Most of the information on these graphs is historical, the important part for me was to realise that on average there was going to be a soil moisture deficit during the summer, the length of the deficit varies from year to year.

Climate Summary:

South Otago has good soils, a cool temperate climate and a relatively evenly spread rainfall through out the year. However it is clear from this information that grass growth is inhibited by lack of moisture at some stage of the summer most years. The effect of this for individual properties varies depending on location, soil type, management decisions and the timing of the deficit.

Water Balance:

Soil Moisture Reservoir Graphs

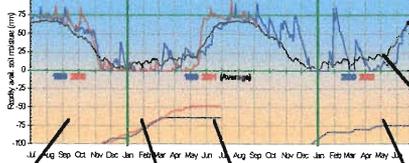
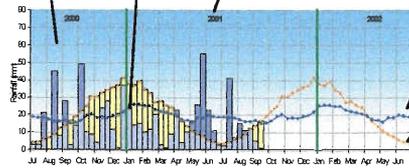
Total rainfall for the first 10 days of the month.
The darker shade of blue indicates the amount of rainfall in excess of evapotranspiration.

Potential evapotranspiration in excess of rainfall over the 10 day period.

Calendar year

Historical average rainfall for each 10 day period

Historical average potential evapotranspiration for each 10 day period



Average readily available soil moisture

Readily available soil moisture from 1 July, 1998 to 30 June, 2000

Vertical gridlines indicate the first day of each calendar month

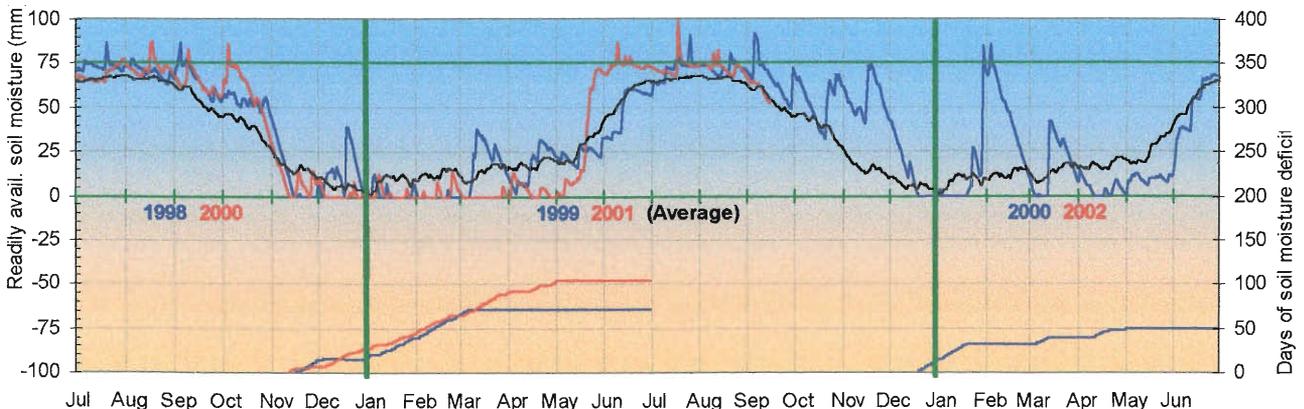
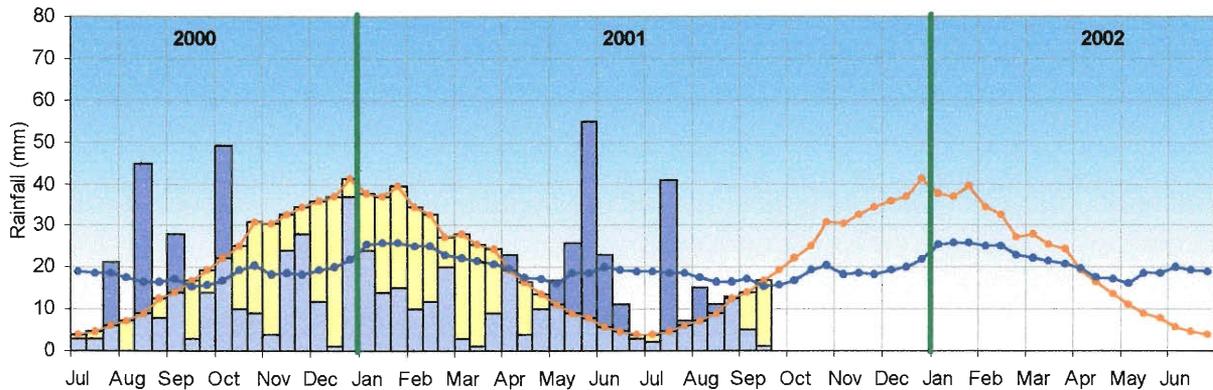
Accumulated days of deficit, 1998-99 season

Accumulated days of deficit, 1999-2000 season

Accumulated days of deficit, 2000-01 season

UPPER GRAPH: Inputs and outputs that determine the level of readily available soil moisture. The bars show totals for a third of each month (periods beginning 1st, 11th and 21st) of rainfall and potential evapotranspiration as indicated. The vertical gridlines indicate the first day of each calendar month. Note that the final bar may not be a full 10 day period.

LOWER GRAPH: The daily soil moisture balance for an average soil type where the readily available water capacity is taken to be 75mm (this may be approximately half the available water capacity). When field capacity (75mm line) is exceeded, the surplus rainfall is considered to be lost as runoff. When the readily available water is fully depleted (zero line on left axis), pasture begins to wilt and days of soil moisture deficit are accumulated (totals shown on right axis).



HOW MUCH WATER CAN THE SOIL HOLD FOR PLANT GROWTH?

There are two aspects to this:

- The soil water holding capacity
- The maximum available soil water

The water holding capacity is principally a physical characteristic of the soil. It varies between horizons in a soil profile.

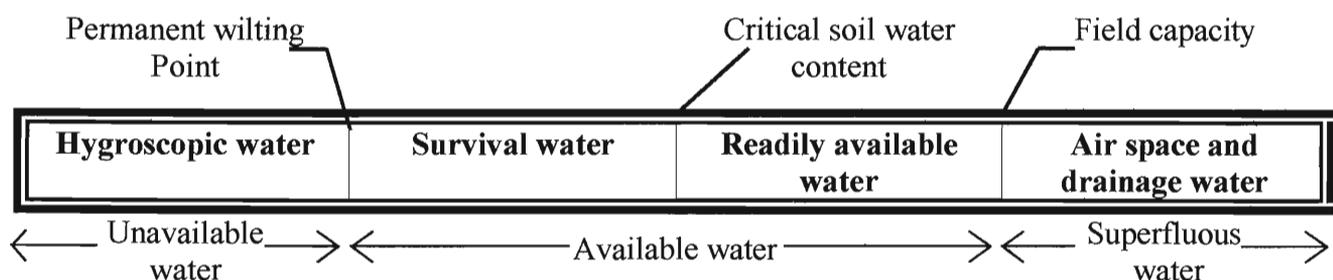
The maximum available soil water in a soil profile depends on the depth of the root zone and the thickness and water holding capacity of each soil horizon within the root zone.

Water Holding Capacity (WHC):

The WHC of a soil horizon is the maximum amount of water that can be held in the soil that is available for plant growth. The soil texture (type of soil) and the crop type determine the WHC. It is the water bank for plant growth. Withdrawing water without a deposit (rainfall or irrigation) will lead to overdraft or conditions where water limits potential plant growth. Ultimately if there are no deposits then bankruptcy or plant death occurs.

For practical purposes, the water holding capacity is defined as:

- WHC equals the amount of water in the soil between Field Capacity and Permanent Wilting Point.
- WHC is usually expressed as mm of water / m depth of soil, or as volumetric water content, V%.



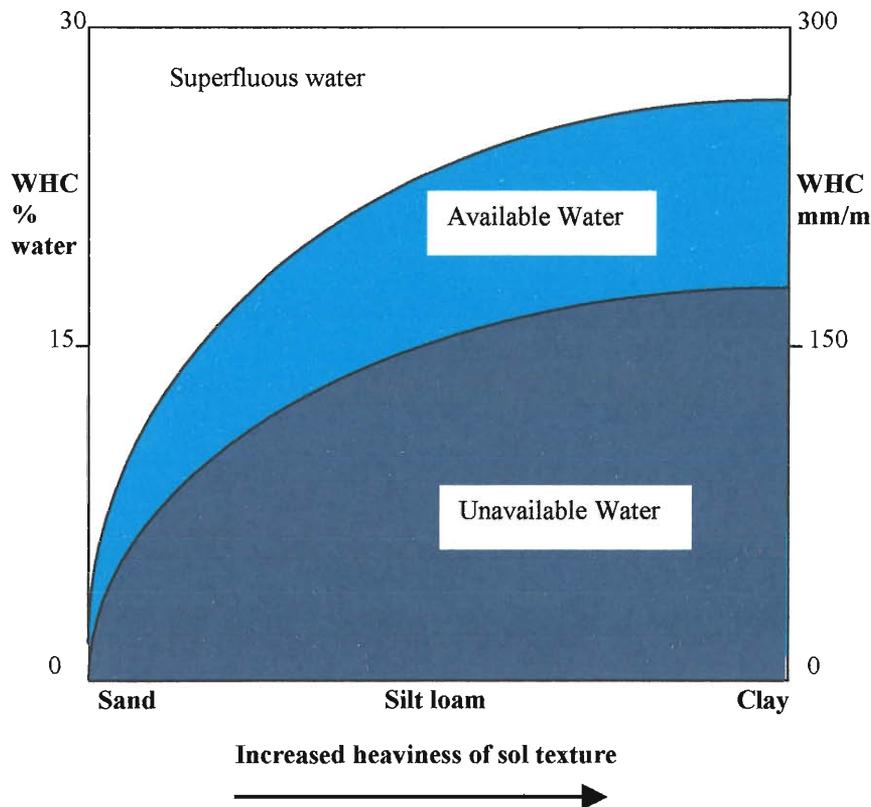
Field Capacity – may also be referred to as Full Point

- The soil water content of well-drained soils becomes a relatively “definite” value after drainage from an initially saturated profile has become negligible.
- It is normally reached 1-3 days after a very large rainfall or irrigation events.
- At Field Capacity the macro pores of the soil are filled with air and water fills the micro pores as a film on the soil particles.
- While drainage will continue after Field Capacity is reached, the rate is very low and is due to capillary forces and not gravitational forces associated with initial drainage.
- Field Capacity is expressed as volumetric soil water V% or mm depth of water per mm of soil depth.
- Exceeding Field Capacity begins to saturate the soil and reduces the proportion of air in the soil. For some crops growth will be impaired.

Permanent Wilting Point

- The soil water content when the crop will die is referred to as the Permanent Wilting Point.
- As the soil dries out the supply of water to plants is insufficient to maintain turgor and wilting occurs.
- At first, daytime wilting will be followed by renewed turgor at night when the supply of water exceeds the reduced transpiration requirement of the plant.
- Eventually the supply of water cannot maintain even night time demand and the plant will become permanently wilted.
- If water is not added the plant will die.
- For practical purposes, Permanent Wilting Point is defined to be the soil water content equivalent to a soil tension of 15 bar (1500cba).
- Permanent Wilting Point is expressed as V% or mm depth of water per mm of soil depth.

The relationship between soil type (texture) and the components of soil water is further illustrated in the following diagram:



The table below is a guide to the WHC of different soil textures:

Soil Texture	WHC (mm/m)
Clay loam	175-190
Silt Loam, no stones or gravel	155-165
Silt Loam, approx. 30% gravel by volume	110-120
Sandy Loam	65-110
Sand	45-55

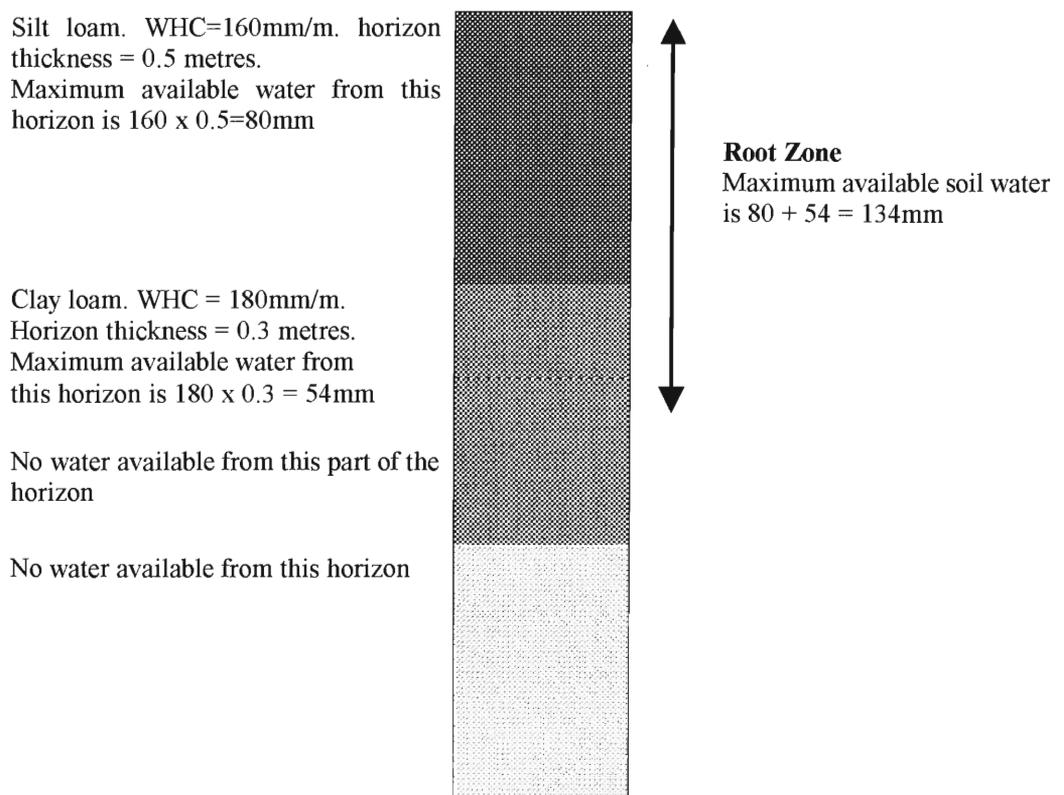
Maximum Available Soil Water:

The maximum available soil water is the volume or depth of water available to a crop when all soil horizons within the crop's root zone are at their full point, or field capacity. It is a measure of the root zone's capacity to store water for crop growth, and is therefore a key factor in irrigation management.

To determine the maximum available soil water in the root zone you must know the:

- Soil type
- Depth of the crop root zone, for that specific soil type
- Thickness and WHC of each soil horizon within the root zone.

The following diagram illustrates how to determine the Maximum Available Soil Water in the crop root zone.



South Otago Soil Example:

Our clay loams have a fragipan horizon that limits root growth at 400-600mm. Top soils are better at holding water than sub soils, so we use a high WHC for topsoils.

Landcare Research have measured the WHC for the Te Houka soil near Balclutha. The silt loam topsoil is 210mm thick and has a WHC of .224 (ie 224/mm/m), so $224 * .210 = 47\text{mm}$.

The fragipan is at depth 460mm, so the silty clay loam subsoil that is available for roots is $460 - 210 = 250\text{mm}$. It has a WHC of .134 (134mm/m), so $134 * .250 = 33.5\text{mm}$.

Maximum available soil water for Te Houka soil = $47 + 33.5 = 80.5\text{mm}$.

WATER RESOURCE

Ground Water Resource:

There are several ground water studies on the South Otago area, these include the Lower Clutha Ground Water Survey 1998 and the Tokomairiro Ground Water Investigation 1998 by Irricon Consulting.

The South Otago Ground Water Supply 1996 by Stone Environmental INC for the Clutha Agricultural Development Board which looked at the possibility of using ground water in the Pomahaka, Clydevale and Richardson rural water supply schemes.

The Kuriwao basin Ground Water Report by Kingston Morrison Ltd, reviewed by Darryl Lew and Tom Heller from the Otago Regional Council, August 1999.

There are three primary aquifers in the South Otago area, the Kuriwo, Tokomairiro and the lower Clutha, with other known resources in the Wairuna and Clydevale areas.

Thus far these ground water reports have concentrated on identifying existing bores and wells, outlining estimates of current use and recharge from surface infiltration. Water quality checks have also been done as part of these studies.

These reports all state there is significant ground water resources that are under utilised at the moment and capable of sustaining a significant lift in extractions. Water quality is variable with many having excessive levels of iron. Infiltration of sea water is a risk in the lower Clutha.

The factors that will limit further development are poor hydraulic conductivity that translates into wells of limited specific capacity. Many of the current bores yield around 1 litre per second, with very few yielding more than two 2lt/sec. Longevity also appears to be a problem with some bores silting up after 5 to 7 years in some areas.

On the Tokomairiro plain there are approximately 142 wells, many very shallow (4-7m) that have been dug by hand.

Very little knowledge exists of the hydraulic capacity of the aquifers, although there is currently some work underway to model the aquifers in the Wairuna and Clydevale areas as part of the Clutha Water Study.

Irrigation Quantities:

To get suitable quantities for irrigation alluvial aquifers would need to be mapped and tested, with modelling required to assess the long term effects of ground water use.

The CADB report states high yield bedrock wells may be achievable, but locating a successful well would require an organised and systematic exploration programme.

It appears that ground water will be a very limited resource for irrigation through out the district and cannot be relied on for large scale irrigation development.

There may be potential for small systems to utilise this resource.

The construction or alteration of a bore requires resource consent.

Ground water takes of more than 1.5 lt/s require a resource consent.

Rivers and Streams:

There are a number of potential water sources in the South Otago area. These include the Kaihiku stream, Waiwera river, Pomahaka river, Waitahuna river, Tokomairiro river, Waitepeka river and the Clutha river.

The taking of water from the Clutha river is permitted providing the take does not exceed 100 l/s, nor 1,000,000 lt per day.

Takes greater than 1 l/s require resource consent from other sources.

Refer to chapter 12 of the ORC Water Plan.

On Farm Storage:

Parts of the District with rolling hills and associated gullies have potential to store water through the construction of dams or ponds. These would have to be very large structures because of the quantities of water required eg 40 hectares receiving 40mm over 10 days with K Line would require 17 million litres of water. A dam 68 x 25 x 10 metres deep would be needed to hold this amount of water which is only enough for one rotation.

The damming or diversion of water is a permitted activity provided the size of the catchment is no greater than 50ha's and the dam is no deeper than 3m and the volume of the dam is no more than 20,000 cubic metres.

Dams outside these specifications need a resource consent. Refer to ORC Water Plan for more detail.

Summary:

The ground water resource appears to have a very limited use for irrigation.

There is a huge potential for the utilisation of water from the many rivers and streams in the district, either extracted to be used immediately, for example the Clutha river, or to be extracted in times of excess flow and stored for irrigation later.

Dams/ponds could be filled during the wetter months utilising off peak power or simply harvesting water that would normally run down the gully.

Some properties have the ability to harvest large quantities of water with a series of dams.

IRRIGATION

Options:

There are numerous options available when considering irrigation. These include: Border Strip, Rotary Boom, Fixed Boom, Hard Nose Gun, Drag Hose Gun, Fixed Centre Pivot, Towable Centre Pivot, Long Laterals, Siderolls and K Line.

Many of these are extremely capital intensive, only suitable for flat ground, put on large amounts of water and are not flexible. This rules out the bigger boom and pivot type irrigators which typically apply 20-50 mm/h.

Gun irrigators may be suitable in some areas, but require high water pressure and are expensive to operate.

Long laterals are flexible, apply lower rates of water but are very labour intensive to shift. South Otago conditions mean that anybody contemplating irrigation for pasture would be thinking of it more as a safety valve or back up and not necessarily be relying on it every season.

With this in mind the system must be flexible, not have a high capital cost and be suitable on rolling ground.

K Line:

Our soils also dictate that the application rate per hour be low. I believe K Line is the most suitable system available at the moment for pasture irrigation, advantages are:

- Minimal capital outlay
- K Line applies 3-8mm/h to a depth of 50-80mm unless moved twice a day
- A low pressure system
- Can be installed on a small scale initially and expanded as required
- Farmers can install themselves
- Livestock remain unaffected
- Easily stored
- Easily moved while system is operating
- Wind has a minimal effect
- Very flexible

I believe there are several changes that could be made that are not commonly accepted to allow K Line to suit the many different situations in South Otago. These include keeping the main lines above ground.

There is no reason why mainlines can not be above ground, this would allow you to utilise several water sources on the one property with the one system. This would involve a mobile diesel pump or the use of a tractor to operate the pump.

Currently lines are designed to suit individual paddocks, there is no reason why lines can not be added to or shortened to suit a number of paddocks.

With sufficient fall, K Line can be gravity operated.

Hydraulic Design:

K Line irrigation systems need to be hydraulically calculated to provide even distribution and the required average daily density for water over the complete area to be irrigated (approx 3mm/day). This figure may vary due to the soil type, ground conditions and the available water supply volume. The following items are taken into consideration to achieve this average density:

- The return period for each paddock irrigated
- The average density of water provided by each sprinkler line over a 24 hour period

The return period is the number of days taken to completely irrigate a paddock and return to the first shift. The return period for each paddock will vary due to the size and shape of the paddock which influences the number of shifts required to cover the whole paddock. To achieve acceptable return periods in large paddocks more than one sprinkler line may be required per paddock.

As only one part of the total irrigated area is irrigated in any 24 hour period, the density provided in a 24 hour period is determined by multiplying the average required daily density, by the return rate for a particular paddock.

Example 1

Average required daily density	=	3mm	} Moving lines 12 hourly cuts these rates in half
Return Period	=	21 days	
Line density over a 24 hour period	=	3 x 21 = <u>63 mm/day</u>	

Example 2

Average required daily density	=	3.5mm
Return Period	=	15 days
Line density over a 24 hour period	=	3.5 x 15 = <u>52.5 mm/day</u>

As can be seen from the examples above, as the return period for each paddock varies the required density for any 24 hour period varies. Full hydraulic analysis allows the correct 24 hour density to be achieved from each line by altering pipe sizes and sprinkler nozzle sizes, until the desired result is achieved. This insures that each paddock is receiving the correct amount of water, avoiding dry spots, excessive run off or leaching.

A South Otago Example:

On our own property there are no suitable creeks that would support water take during a dry spell. There are a number of sites suitable for constructing dams, factors that would need to be taken into account with the siting of these would include:

- Distance to paddock(s) to be irrigated
- Ability to hold the required amount of water
- Water source, eg: several gullies, springs or solely run off
- Ability to handle high rainfall events
- Recourse consent issues, eg: effect on other users and aquatic life
- Access for pumps

Careful planning is necessary so as to get the appropriate amount of water required somewhere close to the paddocks suitable to be irrigated.

K Line uses approximately two litres per second per line, this means that a system running twenty four hours being shifted every 12 hours would use 1.8 million litres over a ten day period to irrigate 5 hectares.

To irrigate a total of 20ha's ie: 10ha's either side of a gully with a dam as the supply using two K Lines applying 35mm would require a dam capacity of at least 7.2 million litres.

This would require a dam to be 65m by 25m with an average depth of 4.5m.

These calculations allow nothing for potential inflow and evaporation.

Establishment costs

Construction of dam, using a Bulldozer and a Digger

Three days, a total of 60 hours at \$80 per hour = \$4,800

Pump Options

There are three options to drive a K Line irrigation system, electricity, diesel and gravity. Our property does not have the fall for gravity.

Electricity is clean, easy to maintain and automate but is expensive to set up depending on the site of the water source in relation to existing power lines. Electricity also has the ongoing cost of line charges regardless of whether the system is being used or not.

Diesel driven systems offer flexibility in that it can be portable. Many farmers will also have existing plant such as an old tractor that could be used to drive the pump.

For systems running for a small number of hours a year, the overall cost of diesel driven pumps will probably be lower than equivalent electrical systems when the costs of installing power lines and poles are taken into account.

Indication of costs for pump and two K Lines (supplied by Southland Equipment)

Electric Power

For a suitable pump for a 50 metre lift

18.5 kw electronic motor

65 x 40 – 250 Grundfos pump

Coupling, Frame

\$ 5,345.00 + GST

For a suitable pump for 100 metre lift

30.0 kw electric motor

65 x 40 – 315 Grundfos pump

Coupling, Frame

\$ 8,758.00 + GST

Diesel Power

For a suitable pump with 50 metre lift

20 kw Yanmar diesel

65 x 40 – 250 pump

Coupling, Frame, Tank etc.

\$15,000.00 + GST

For a 100 metre lift
37 kw Yanmar diesel
65 x 40 – 315 pump
Coupling, Frame, Tank etc. \$20,000.00 + GST

K-Lines etc for 50 metre lift
300 metres x 63 MDOD PN 12 Feeder Line
300 metres x 40 mm MDOD PN 6 laterals
22 pods \$ 4,517.00 + GST

So then for 2 x identical lines \$ 7,134.00 + GST

K-Lines for 100 metre lift ADD \$ 500.00 + GST/line

This allows to change the first part (150m) to a higher grade alkathene to take the extra pressure required.

These are not Quotes but indications of approximate costs.

Total cost for Dam construction, pump for 50m lift with two lines \$24,300 (approximately).

Practical Tips : K Lines:

Paddock layout

When planning paddock layout, arranging the property into square or rectangular paddocks is ideal. Length of the paddock determines line length. For general management and convenience, K Line length should ideally be 125-150 metres. This allows for both a reasonable paddock size and a feasible weight for line movement. If possible, length of the paddocks should be designed to fit a set number of pods. For paddocks of uneven length, the K Lines are sized to accommodate the longest run, which then causes over-watering when used on shorter runs.

Width of the paddocks determines length of the irrigation cycle. Fourteen days is usually the maximum realistic length for a pasture irrigation cycle; any longer may be detrimental to the irrigation's effectiveness.

Hydrants

Hydrants, being only 600mm deep in the ground, are susceptible to being knocked or pulled out of the ground. When not in use, hydrants are prone to damage from cattle and vehicles. Placing fencing posts near the hydrant can identify hydrant location for vehicles, though this can also attract cattle to rub against the post and hydrant. Bulls are a particular problem and are frequently to blame for hydrant damage.

Pod placement

When setting up and installing K Lines, pod placement can have a great effect on the ease of line management. Allow half the inter-pod spacing on the lowing end of the line before the first pod. When moving the lines, the first pod should therefore remain on the ground at all times, reducing the likelihood of flipping and damaging the pods and sprinklers. This also reduces the need for

judging distance when moving the lines. If measurements are done correctly, driving the motorbike up to the fence line should ensure the correct position of the first pod.

Towing vehicle

Prior to commencing irrigation and the moving of K Lines, it is important to ensure that the operator's towing vehicle has the capabilities and a sufficient power rating for movement of the K Line weight. Depending on the length of the lines being removed, the minimum a motorbike should be is a 4WD 300cc; ideally the motorbike should have a 400cc motor. A motorbike that is too small can burn out. It is also advisable to check with insurance companies that a bike is covered for pulling K Lines.

Weather effects

The effect of weather conditions such as wind and evaporation on the K Line irrigation system is generally not significant enough to warrant any changes in the irrigation movement pattern, unless there is a constant predominant wind. In most areas, wind patterns are unlikely to remain constant throughout a 24-hour period, so all areas are eventually irrigated.

First Use

When first using the K Line, it is important to flush the lines of all debris, particularly the plastic drill off-cuts resulting from assembly of the K Lines. Ensuring that the fittings are all tightly screwed is also important, as these are known to come loose relatively easily.

Moving the lines

K Lines are simple and easy to move as long as certain rules are followed. Always take tight turns with the lines, as wide arcs will lead to the pods flipping over. Drive slowly, especially when driving over bumpy terrain such as border dykes. Knocking the line about can cause parts in the system to become loose and eventually completely unscrew. When moving the lines, be aware that the tapping saddle and clamp in the pods can move along the pipe inside the pods and misalign the sprinkler system with the drilled water-supply hole. This occurs more frequently when moving the lines in longer pastures. Decreasing speed will minimise this happening.

RESOURCE MANAGEMENT ACT

Otago Regional Council:

To complete an application for a consent from the Otago Regional Council to take water for irrigation, you will need to provide the following specific information in addition to the general requirements.

Applicant and site details

- Location sketch/plan:
 - Septic tanks, springs, waste disposal areas and other bores within 150m of the proposed take point

Details of the irrigation activity

- Pump make, type, model and maximum capacity (l/s)

For groundwater takes

- Is the bore existing or new? If existing, provide the bore permit number
- Is pump test data available? If yes, provide the water permit number
- Does the proposed activity involve discharge? If yes, a discharge consent may be required.

For surface water takes

- Does the taking of water also involve:
 - Dam/weir?
 - Diversion?
 - Intake structure?
 - Other structure?
 - Discharge?

If so, you may need to complete an additional schedule to the consent application (eg the schedule to divert water).

Assessment of environmental effects

Effects on the environment

For groundwater takes

- Within 150m, are there any:
 - Septic tanks?
 - Springs?
 - Waste disposal areas?
 - Other bores?

For surface water takes

- Within a reasonable distance up or downstream of the abstraction point, describe any:
 - obvious signs of fish, eels, insect life, aquatic plants etc.
 - wetlands
 - waste discharges

- recreational activities
- areas of particular aesthetic or scientific value
- areas of aspects of significance to iwi

If any, describe what adverse effects your take may have and the steps you proposed to mitigate these.

- Is the watercourse subject to seasonal flows?
- Attach any stream flow data or observations (if available) that show that there is sufficient water available in the water course.
- Describe any other possible effects that are not referred to elsewhere in the schedule, and describe the means by which those effects will be avoided or mitigated.

Effects on other users

- Effects on groundwater users
- Will the taking of water have an effect on water availability to neighbouring properties?

Standard consent conditions

- As per general requirements.

(As at June 2001)

SUMMARY

South Otago has good soils, a cool temperate climate and a reasonably evenly spread rainfall. There are however exceptions with the occasional dry spell resulting in a large drop in grass growth. The evapotranspiration rate on average is above the rainfall over the summer months, so there is always a soil moisture deficit at some stage during the summer.

There can be as many as 100 days of soil moisture deficit per annum.

A comparison with West Otago shows a clear relationship between summer rainfall and total grass production.

Ground water resources appear to have very little potential for irrigation, although further modelling would need to be done before completely ruling out ground water.

There are a number of rivers and streams suitable for extracting water, the most obvious is the Clutha river. There is also potential for on farm storage, although the quantities needed for reasonable scale irrigation mean these structures would need to be large.

There are many irrigation methods available, but K Line appears to be the only one suitable at the moment due to its low cost, low application rate and flexibility.

The capital cost of \$24,300 for a system that may only be used for a short time each season to irrigate 10ha is interesting. If we spread the capital cost over 10 years and the system is able to grow an extra 4,000 kg DM/ha per annum, the cost would be 6c kg /DM. An extra 2,000 kg DM/ha would cost 12c kg/DM. This does not account for any extra labour or fertiliser required.

There may also be potential for return times to be lengthened allowing for 20ha to be irrigated using the same two lines, this would depend on soil moisture and evapotranspiration rates.

Currently there is one large K Line system in South Otago irrigating 80ha of light soil next to the Clutha river. This system operates on a 10 day rotation using small nozzles applying 40mm per rotation.

I believe it is practical to irrigate in South Otago and there is potential for K Line as farmers strive to be more efficient.

The financial viability will depend on the cost of the water and the utilisation of grass grown. The primary restriction will be the availability of water.

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