

Crown Pastoral Land Tenure Review

Lease name : KILLERMONT

Lease number : PO 207

Due Diligence Report (including Status Report) Part 2

This report and attachments results from a pre tenure review assessment of the pastoral lease for the purpose of confirming land available for tenure review and any issues, rights or obligations attaching to it. The information is gathered from files and other sources available to the LINZ contractor.

Part of the information relates to research on the status of the land, resulting in a status report that is signed off by a LINZ approving officer. The remainder of the information is not analysed for relevancy or possible action until required, and LINZ does not guarantee its accuracy or completeness as presented.

The report attached is released under the Official Information Act 1982.

January 05

Memo for file

PFO Dwyer has held discussions with Mr Aubrey owner of the "Claycliff" regarding possible sale to the Crown. He has now decided not to sell to the Crown at this stage as he feels the potential to make money from the area commercially - i.e. guided tours etc, is more attractive. The matter of price was not discussed - the reason for not proceeding.

I have advised Head Office (Mr Bayley) verbally that the purchase will not proceed and there is no need to record a commitment (at 8/422)

The draft easement on folio 119 has been raised by the District Solicitor on the basis of us not acquiring the reserve but proceeding with the easement. My proposal is to enable interpretation of the "Claycliff" from across the river. P.F.O. is to discuss this possibility with Mr Thomas (lessee of Hibernant Station) who next in the area. If he is agreeable the procedure as spelt out on folio 119 will need to be complied with.

We should now write to Sena Range Omovani explaining the results of our discussions with Aubrey and our intentions with regard Thomas. Sena Range should take no action nor discuss the possible easement with Thomas until DFO forwards report.

Keep under B.I.F.
Told HO Mr. Christ Aubrey. 'Kroll' 17/3/83.

28 February 1983

Original on 8/422

CCL
OFFICE

ACCESS TO AHURIRI RIVER AND CLAY CLIFFS : KILLERMONT STATION

Re folio 112 on 8/422.

I called on Mr Thomas at his property on 16 February 1983 and discussed with him the question of access through his property from S.H. 6 to the Ahuriri River.

Mr Thomas advised that he would be prepared to grant an easement for 'public access' from the State Highway to the Ahuriri River by way of the existing track (see attached topo map). He did however stipulate that he did not want the access fenced because of ease of stock movement and he wished to retain the right to prevent public access during lambing.

I subsequently discussed this matter with Fred David who considers the access is ideal for purposes intended and agrees with Mr Thomas's conditions. Mr David and myself considered it would be appropriate to erect a new gateway on the State Highway at the Department's expense and to devise an appropriate sign for public access and prevention of access during lambing.

Recommendation

- 1) That the Department draft up an appropriate agreement for Mr Thomas's signature.
- 2) Any costs associated with obtaining the public access to be met by the Crown.

D. J. Sawyer
 D. J. Sawyer
 DFO
 18/2/83.

Records please
file~~8/28~~~~M.989~~~~P.207~~

DUNEDIN.

267

C.F.O.,
ALEXANDRA.Previous action
on 8/28

3 July 1968

ACCESS TO RIVERS AND LAKES : WAITAKI VALLEY
ACCLIMATISATION SOCIETY

The Waitaki Valley Acclimatisation Society has approached this Department with a request that assistance be given in providing for suitable access over certain Crown leases within the Society's district.

Apparently the Society has recently carried out a review of the access question on all the principal rivers and lakes of the Waitaki River system and a sub-committee was in fact set up to investigate this matter.

While access is already satisfactory in the majority of the cases investigated the Society is concerned in respect of three particular localities and has asked the Department to negotiate with the lessees to overcome the present difficulties.

The three localities are:

1. Ahuriri River

Access from the Lindis Pass Highway over Run 674 leased by Killimont Run Ltd. The track leading from the Highway to the stock bridge across the river to "Clay Cliffs" is suggested as a suitable road.

The Society have offered to erect a notice on the road entrance warning that no dogs are allowed and that access is restricted to the defined right of way.

2. Lake Benmore

In the Ahuriri Arm, access to the North shore is only possible by boat or by walking down the river through Ben Omar and Glenburn or by fording the riverbed where it enters the lake. A County road leads to the lake, but is blocked by a locked gate at Ben Omar homestead. The Society would like to see this gate unlocked and legal access restored.

3. Ahuriri River

Access from the road north of the Ahuriri Bridge to a very popular picnicking and fishing spot.

I enclose prints showing the access as suggested by the Society.

The land in (1) is held under Pastoral Lease P.207 by Killermont Run Ltd. 33 years from 1.7.1958. Annual Rent \$440

The land in (2) is held under Special Lease S.213 by I.W. Anderson 33 years from 1.7.1954. Annual Rent \$580

The land in (3) is held under Licence to Occupy M.989 by Mr J.L. O'Brien - Omarama. 5 years from 1.1.1967. Annual Rent \$6

In respect of the area in M.989 I have been informed by the M.O.W. that the problem has arisen through the actions of the licensee in locking a road fence gate on State Highway No. 8 which previously provided access to the Ahuriri River.

It has been suggested that in view of the considerable use that is made both of the access and the area contained in the Miscellaneous Licence, both by picnickers and fishermen, that consideration should be given to the Crown resuming the total area in the licence so that it can be made available for recreational usage. The area is apparently in a very desirable situation and is frequented by large numbers of the public.

Would you please arrange to have a Field Officer inspect the three areas in question and submit a recommendation as to ways in which the Acclimatisation Society can be assisted in obtaining suitable access.

I might mention that it is somewhat unusual for the Society to have to seek Departmental help in matters of access as they are usually able to come to a satisfactory arrangement direct with the land-holder concerned and there may be some particular reason why access has been restricted in each of these cases.

G.K. Eville
Commissioner of Crown Lands

per:  3 7 63

APPENDIX 4

Our Ref: P207

2 July 1992

MB and D Thomas
Killermont Station
Box 25
OMARAMA



Dear Sirs

APPROVAL TO CONSTRUCT A WATER RACE

Thank you for your written consent to allow construction of the proposed Tara Hills/Omarama Station combined intake water race from the Ahuriri River intake to near SH8, also the new Tara Hills water race beyond SH8 to Tara Hills, across your Run 674, (Red Flat).

I am pleased to advise that Landcorp as agent for the Crown, formally consents to the proposed earth disturbance under S108 of the Land Act 1948.

DOC have been closely involved with the processes to date including participation at local and public hearings, and are in agreement that abstraction of additional Ahuriri water in essence will substitute the current abstraction by Tara Hills from Omarama Stream to allow the latter water to remain within its natural channel to enhance all wildlife and fishery values. If required, water via the new race can augment the Omarama Stream through a by-wash facility.

It is noted that Tara Hills will liaise closely with yourselves during construction work to ensure that your specific requirements will be met, viz: the placement of four bridge crossings for vehicle/stock access; the topdressing and oversowing of disturbed areas running parallel with the water race, and other unforeseen contingencies.

Also, the reserved right for Tara Hills and Omarama Station to use the two water races (from the Ahuriri intake to near SH8) until the new combined race is fully operational, is acknowledged. Landcorp will discuss the matter of registering easements in due course.

Yours faithfully

D V Pickens
Consultant
LANDCORP MANAGEMENT SERVICES LTD

INCORPORATING LANDCORP INVESTMENTS LIMITED & LANDCORP MANAGEMENT SERVICES LIMITED

Alexandra Branch Office
4 Limerick Street
P.O. Box 27
ALEXANDRA N.Z.
Tel (03) 448 6935
Fax (03) 448 9099

cc. J Land
Tara Hills Research Station
Private Bag
OMARAMA ✓

cc. R T Wardell
Omarama Station
Box 18
OMARAMA ✓


cc. Field Centre Manager
Department of Conservation
Private Bag
TWIZEL ✓

Dear Sir

Copy for your information.

Yours faithfully



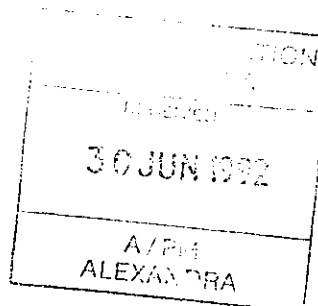
D V Pickens
Consultant 

J. L.

Killermont
Box 25
OMARAMA

16 June 1992

Landcorp
Box 27
ALEXANDRIA



Dear Sir

I hereby grant permission for Tara Hills Research Station to construct a water race across my pastoral leasehold land being Run 674 Ahuriri Survey District.

Yours faithfully

M. B. Thomas

Killermont Run Limited :

M. B. THOMAS
D. B. THOMAS
J. E. THOMAS } *PARTNERSHIP.*



29.06. 92

Mike & Dan Thomas

TO WHOM IT MAY CONCERN

Regarding the construction and operation of a transfer waterrace from the Ahuriri River (at the Omarama Station intake) across the Killermont Station flats (known as the Red Flat) to Tara Hills High Country Research Station at the point near the new meteorological site.

1) Tara Hills and Omarama Station have agreed to operate one race from the Ahuriri River to State Highway 8 at which point it will split into 2 feeder races through their own culverts under the highway. We reserve the right to use the 2 races until the new one is fully operational.

2) Tara Hills will provide Killermont Station with up to four "bridges" for vehicle and stock access across the transfer race at sites specified by Killermont Station.

3) Tara Hills will topdress and oversow the strip of disturbed soil on either side of the transfer race with appropriate dryland species that will re-establish a vegetative cover on this area.

A handwritten signature in black ink, appearing to read 'John J.T. Land'.

John J.T. Land
OIE
Tara Hills
29.06.92

PORT IN SUPPORT OF THE RESOURCE CONSENT APPLICATIONS RELATING TO THE TRANSFER CANAL FOR OMARAMA STREAM CONSERVATION FLOW

INTRODUCTION

In accordance with Clause 5 (6) of the Ahuriri River Conservation Order, Tara Hills Research Station intends to construct a race to convey 0.5 cubic metres per second of water for the purposes of augmenting the waters of the Omarama stream.

The intentions and requirements of the conservation orders on the Ahuriri and Omarama Stream will be maintained. Clause 5 (6) describes this water as for being for management purposes so that fisheries and wildlife values can be maintained. To this end supplying this water into the Tara Hills Irrigation System in replacement of their current abstraction from the Omarama stream conforms with this requirement.

The conservation order requirements for the Omarama stream effecting Tara Hills Research Station i.e. as outlined in 6 (2) still bind Tara Hills Research Station regardless of the augmentation. In effect during the irrigation season the low flow of 250 litres per second must be maintained, this could mean in times of extreme low flows that this 250 litres per second would come almost entirely from the augmentation from the Ahuriri. These minimum flows are 500 litres per second at the Wardell's gauging site. These flows refer to the November to April inclusive, during the May to October period the minimum flow levels are raised to 750 litres per second for the middle reach and 1200 litres per second at Wardell's Bridge. While there is often no abstraction during this period these minimum flows will still be maintained.

The general effect of the augmentation for the fisheries and wildlife is that effectively the current Tara Hills Research Station abstraction right will be reduced by the amount of water arriving from the Ahuriri and this flow which is not being abstracted will increase the mean low flows in the Omarama stream from this point downwards. It would also mean that the minimum low flow of 250 litres per second is guaranteed.

From Tara Hills Research Station point of view it means that they will have effectively an additional 0.5 added to the Omarama stream giving them a more reliable of supply. From the limited flow records available it appears that Tara Hills with the Transfer would seldom face restrictions. However the amount abstracted would be reduced to ensure compliance. For practical purposes the border-dyking system would still operate down to 200 litres per second on a reduced area. The spray system will operate on 100 litres per second and the spray alone is the smallest abstraction likely.

It is accepted that due to the minimum flow conditions of the Conservation order in the middle and lower reaches, that all of the 500 litres per second of flow being transferred, may be required to be discharged, at times of extreme low flow into Omarama Stream, for management purposes so that fisheries and wildlife values can be maintained.

While in practical terms it is intended to transfer the Ahuriri water through to the Tara Hills Research Station in-take system this in no way conflicts with the intent or wording of the conservation order. A by-wash will be installed at the Omarama stream crossing to ensure by-washing in compliance with the Omarama stream rates of flow as is required.

With the transfer of this water the Omarama water users will of course be keen to ensure that no additional abstractions occur below this point thus jeopardising any increased fishery and wildlife values that were envisaged being compromised.

The physical aspects of this race are that a combined in-take point with Dick Wardell's existing race would be built. This would have fish screens on and a total capacity of 1.125 cumecs.

This flow being made up of the 525 litres per second right of Dick Wardell, the 100 litres per second right applied for by Killermont Station and the 500 litres per second right for the augmentation of the Omarama stream.

The Wardell race would continue on its current location.

The new race with a total capacity of 600 litres per second will carry on at a flatter grade across towards Tara Hills Research Station crossing the State Highway about 100 metres above the existing crossing and continuing out across the flat.

Killermont Station intends to purchase a large spray irrigation machine which would be operated out of this race using their own water right separately applied for to water an area between the race and Omarama Station.

From Killermont Station the race crosses the existing road and goes down through below the houses to the Omarama stream. The race would be piped under the Omarama stream and join into the existing Tara Hills Research Station irrigation system immediately above the pump house. The by-wash for 250 litres per second could be provided at the Omarama stream crossing.

The intended operation is that the flow that Tara Hills Research Station is currently taking from the Omarama stream during the irrigation season would be reduced by the amount arriving from the Ahuriri. Tara Hills Research Station doesn't have the ability to take more than this volume, simply because its irrigation system is not able to cope with an increased supply over its current water rights.

What they are looking for is an increased reliability of supply which in turn will give all wildlife and fishery values an increased reliability of supply during the low flows.

An associated agreement has been reached with Killermont Station to allow access in construction and maintenance of the race.

At present 75 litres per second of this water right can be taken out of the Ahuriri within the Ahuriri Conservation Orders while the gorge flow exceeds 10 cumecs. The remaining 25 litres per second would only be available at flows above 15 cumecs in

the Ahuriri. In recognition of that problem Tara Hills Research Station will assign during those periods and while it is able to without contravening either of the conservation orders 25 litres per second of its water right to ensure that the Killermont spray system could keep functioning. However it is recognised that when the low flow regime in the Omarama stream comes into effect that this water right assignment or agreement would cease.

CONSENT TO TAKE SURFACE WATER

The source of the water is the Ahuriri River and it is proposed that the water landed via the transfer race will replace water which at present is being abstracted from the Omarama Creek.

The maximum water right that Tara Hills holds from the Omarama Stream is 570 litres per second.

It is accepted that this right should be tagged with a condition that reads, "that the maximum take from the Omarama Stream is 570 litres per second and shall be reduced by whatever flow arrives via the Ahuriri transfer race, such that the maximum combined flow does not exceed 570 litres per second. The holder of this right shall use the Ahuriri transferred water in preference to the Omarama Stream water."

The existing Tara Hills irrigation system is the only development proposed to be irrigated by this transferred water.

The existing development is a combination of spray using a Briggs irrigator and border-dyke irrigation. The spray is used predominately on lucerne and the border-dyking is a mixture of lucerne and grass. The soils which are to be irrigated are Mackenzie 2 soils which are a medium irrigability class soil.

Extension work on irrigation by Philip Greenwood in this area and work at Tara Hills have indicated a peak application rate in the summer requiring 10 day intervals, this is because of the intense growing season that occur in this region.

Environmentally the effects of the race are reasonably complex, it is however important to realise that this allocation is in terms of the conservation order. The allocation was made by the Judge after weeks of hearings and volumes of evidence. It is not logical to now attempt to review all that extensive investigation work and subsequent analysis without reviewing the conservation order in total. This probably could only be done by an Appeal Court.

The only net effect of the take consent is the reduction of the mean flow. As can be seen from the attached graph this is not substantial and as I said was undoubtedly considered by the Judge.

RESOURCE CONSENT TO DISCHARGE WATER

This discharge right relates to the by-washing of the Ahuriri water into the Omarama Stream in accordance with the conservation order. This would be by way of a side spill weir from the augmentation race and is necessary in the time periods where the

flow drops such that this race would become the basis for maintaining the low flow regime in the river.

With Tara Hills using the augmentation or transfer water in preference to its Omarama Stream rights the number of times that this would be used would be small.

It is however recognised that the conservation order low flows take total precedence for any water and the by-wash is therefore envisaged.

The main environmental concern relating to this by-wash relates to the discharge of silt laden water from the Ahuriri into the Omarama Stream. This can be overcome a condition thus " Tara Hills shall not by-wash silt laden or discoloured water from the transfer race into the Omarama Stream but shall either discharge that water onto their on-farm development which returns the water to the Omarama Stream after travelling over the border-dyking and through ponds or shall shut the water off from the Ahuriri."

"In the rare occasions that the Ahuriri River is carrying flood or discoloured water at the same time as the Omarama Stream is required augmentation the Manager of Tara Hills Research Station shall seek direction from the Canterbury Regional Council as to whether they want that water by-washed or not."

RESOURCE CONSENT TO USE BED OF RIVER

This relates to the construction or the cleaning out of the existing intake channel used by Omarama Station to cope with the additional flows from the transfer channel and Killermont Station water rights.

It requires basically the excavation of river gravels after floods or the reinstatement of the lead-in channels as necessary, immediately at the river. The applicants seek to clean out this channel whenever it becomes clogged with gravel, possibly only once a year and if in the event of a major flood they loose the intake or satisfactory braided patterns necessary for getting water into the intake, then they would wish to undertake such works as necessary, within the river, to reinstate that flow. Those works being only that required to reinstate the flow.

The cleaning out of the gravel in the lead-in channel represents a very small length of probably only 50 to 100 metres and has no environmental impact or create no problems at all.

Work within the actual river bed should they loose the flow onto the intake channel would have to be carried out with a minimum disturbance option and could be conditional upon the Canterbury Regional Council being informed each time this is undertaken.

OTHER PARTIES AFFECTED

These water rights have been discussed with a group known as the Omarama Water Users which has representatives of the adjoining landowners and the Department of Conservation and the Fish & Game Council the Arowhenua Runanga. The responses from these groups is that they accepts that the transfer is in accordance with the conservation order offered no objections at this stage. The Fish & Game Council have been represented and have expressed no opposition but will of course require suitable fish screens and approval of detail.

The Arowhenua Runanga have expressed the view that it is not a problem to them as it is basically what they would consider an in-catchment transfer of water from one source to another, it is still the same waters.

The two affected landowners have agreed with minor conditions to ensure their support, they are with Omarama Station that the fish screens be built with a combined head and with Killermont Station that the race have sufficient capacity to allow them to install a spray system. This water for their spray system is subject to a separate water right application.

CONCLUSION

This proposal is a proposal which will enable the low and mean flows of the Omarama Stream through the summer to be substantially increased to enhance the fishing and wildlife values to be enhanced.

It would also allow Tara Hills a better reliability during the low flows.

The concerns of discoloured or silty water can be met by conditions on the applicant as can any requirements for winter releases.

ENCLOSURES

Attached are graphs;

- firstly the graph showing the Omarama Stream records from 1984 to 1991 this data has been synthetically corrected. This is because there were two gauging sites one above the Tara Hills intake and the other below the Tara Hills intake and it has been necessary to correct for the Tara Hills abstraction which is a major abstraction which unfortunately has not been continuously measured thus we have a synthetic correction.

- The graph of the Ahuriri means from 1963 to 1991 as shown the bottom line is the effect with the half cumec diversion.

- The next graph shows the Omarama Stream flow at Tara Hills it shows on the bottom the existing minimum flows against that of the water right minimum and the minimum flow with the augmentation in.

The two average flows are with the augmentation and without the augmentation showing the effects of that augmentation.

It is once again a synthetic record because it is based on the broken records from the two Tara Hills sites.

- The next graph once again shows Omarama Stream flows at Tara Hills and it is

to show the affect on the maximum flows should the augmentation flows still continue ring a high flow period.

The lower maximum is the maximum without augmentation and the higher maximum is with augmentation and as can be seen maximum flows are not substantially affected by that augmentation.

- The next graph shows the Omarama Stream flow restrictions and this indicates the number of days of restricted in that 1985 to 1991 period on a month to month basis and the average days that would be restricted in any year on average.

- The graphs are also included for the Omarama Stream at the Wardell site which will become the key or the trigger site.

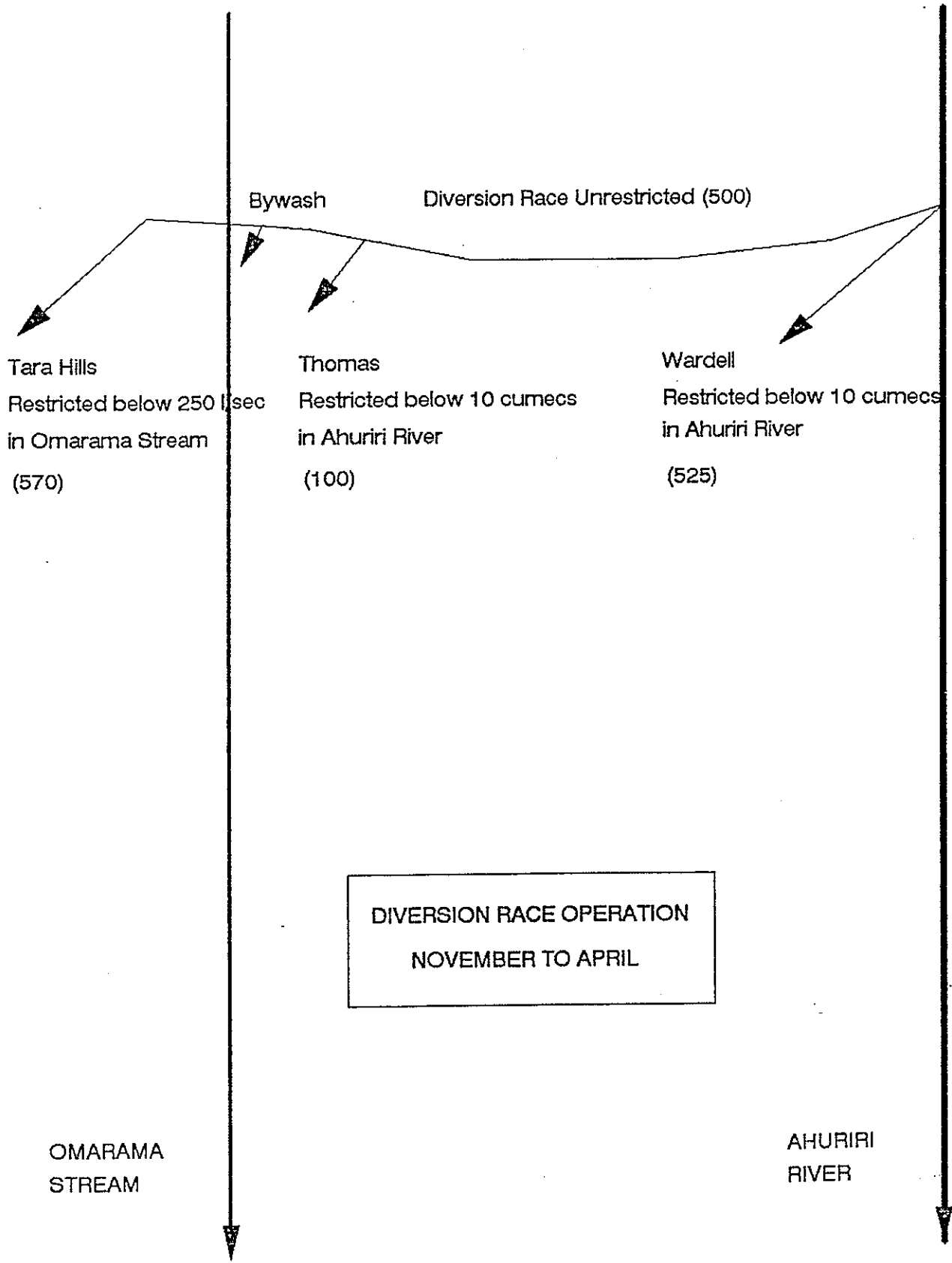
Unfortunately the records for the Omarama Stream are extremely short but do indicate that the augmentation will be of substantial benefit. Two graphs are included one which shows the stream record and the other one which shows the affect on the minimum and average flows.

- A schematic flow chart of the augmentation and the various flows is included. This shows the combined intake with Wardell's 525 litres, Thomas' 100 litres and the diversion race 500 litres.

The Thomas and Wardell water rights relating to the Ahuriri conservation order, Tara Hills water rights with the diversion race still relating to the Omarama Stream conservation order.

- The sketch of the intake details are included, it is proposed to move the actual control gates from the existing site downstream to the first bend this is because the old site has suffered from inundation at times. The same system would apply that is a diversion with a by-wash return channel. Fish screens will be placed on the upstream sides of the gates.

- The next sketch shows the transfer race crossing the Omarama Stream and details of the by-wash. Because the proposal is to direct Tara Hills to use Ahuriri water in preference to Omarama Stream water rights this by-wash would not receive any major use except in times of extreme low flow.



"RELEASED UNDER THE OFFICIAL INFORMATION ACT"
Gravel rapids

Excavated Intake Channel

Old gate

New Gates and
Fish Screens

Old bywash and channel

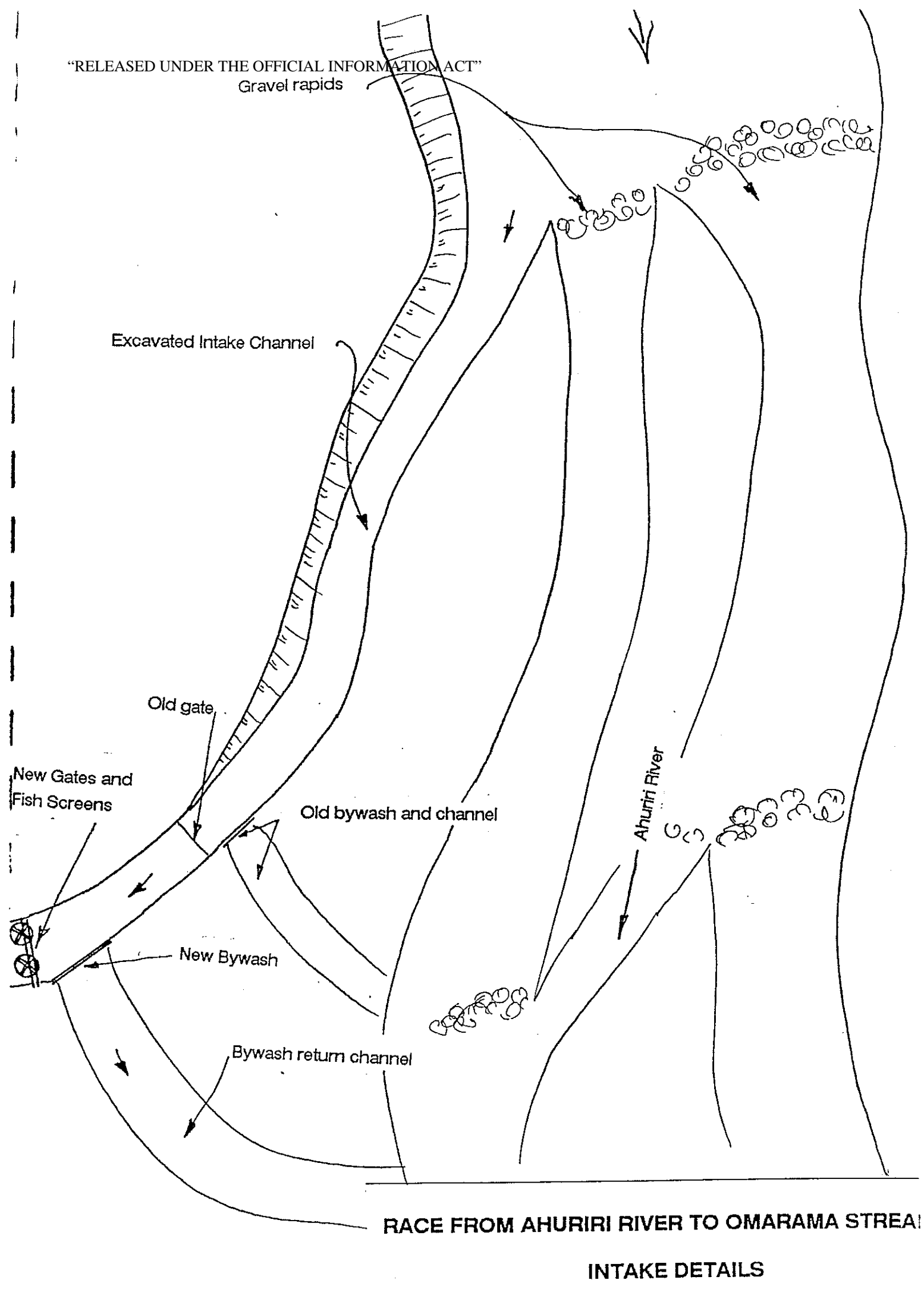
New Bywash

Bywash return channel

Ahuriri River

RACE FROM AHURIRI RIVER TO OMARAMA STREET

INTAKE DETAILS



ATTWELL IRRIGATION CONSULTANTS
RACE DESIGN MODEL

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TTTTTT
  TT
  TT
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  TT  ARA

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HH  HH
HHHHH
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Run on 04-Dec-91

123R3 Multiple Sheet Format

Sheet A Index
Sheet B Variable Inputs & Prisms Hydraulics
Sheet C Pipe Losses

All sheets are linked and altering variables will change all following sheets.

This computer run is based on 600 litres per second

Sheet A

DESIGN VARIABLES

=====
Change any variables here to alter all subsequent sheets

RUN NAME: BENMORE 4 Cumec

| | | |
|-------------------|-------|-----------------------|
| Flow Q= | 0.6 | cubic metres per hour |
| Bottom Width W= | 1.5 | metres |
| Grade = 1 in | 3500 | |
| Berm Sides = 1 in | 2 | |
| Depth D = | 0.71 | metres change below |
| Manning N = | 0.035 | |
| Pipe Diam = | 0.75 | metres |
| Pipe 2 Diam= | 0.75 | metres |
| Freeboard = | 0.2 | metres |

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OPEN CHANNEL HYDRAULICS

=====

Prisim Hydraulics - must be reworked if any of the variables are changed

Flow Q= 0.6 cubic metres per hour
Bottom Width W= 1.5 metres
Grade = 1 in 3500
Berm Sides = 1 in 2
Depth D = 0.71 metres
Manning N = 0.035

$$Q = AV$$

$$V = 1/n (A/p)^{2/3} S^{1/2}$$

to find D

$$A = Q/V$$

$$A = 2.0732$$

$$P = 4.675217$$

$$V = 0.280839 \text{ m/sec} \quad \text{manning}$$

$$V = 0.289408 \text{ m/sec} \quad \text{area check most balance with above}$$

LEVELS
=====

RACE GRADES 1 in 3500
 FLOW 0.6 cumecs
 Pipe Diameter 0.75 metres

PIPE LOSSES AT SH8

| | | | | | | | |
|-----------|-------|------|--------|--------|-------|-------|----------|
| Friction | dia | flow | | dist | loss | area | vel |
| E&E,Bends | 0.750 | 0.60 | 135.00 | 0.00 | 20.00 | 0.04 | 0.441786 |
| TOTAL | | | 2.50 | | | 0.24 | 1.358122 |
| | | | | total= | | 0.27 | |
| | | | | | | ===== | |

PIPE LOSS BERWEN ROAD

| | | | | | | | |
|-----------|-------|------|--------|--------|-------|-------|----------|
| Friction | dia | flow | | dist | loss | area | vel |
| E&E,Bends | 0.600 | 0.50 | 135.00 | 0.00 | 15.00 | 0.06 | 0.282743 |
| TOTAL | | | 1.00 | | | 0.16 | 1.768388 |
| | | | | total= | | 0.22 | |
| | | | | | | ===== | |

OMARAMA STREAM CROSSING

| | | | | | | |
|-----------|-------|------|--------|--------|-------|-------|
| Friction | dia | flow | | dist | loss | area |
| E&E,Bends | 0.600 | 0.50 | 135.00 | 0.00 | 20.00 | 0.08 |
| TOTAL | | | 1.00 | | | 0.16 |
| | | | | total= | | 0.24 |
| | | | | | | ===== |

ACCESS CROSSINGS

| | | | | | | |
|-----------|-------|------|--------|--------|------|-------|
| Friction | dia | flow | | dist | loss | area |
| E&E,Bends | 0.600 | 0.60 | 135.00 | 0.01 | 6.00 | 0.03 |
| TOTAL | | | 1.00 | | | 0.23 |
| | | | | total= | | 0.26 |
| | | | | | | ===== |

| | | | | | | |
|-----------|-------|------|--------|--------|------|-------|
| Friction | dia | flow | | dist | loss | area |
| E&E,Bends | 0.600 | 0.50 | 135.00 | 0.00 | 6.00 | 0.02 |
| TOTAL | | | 1.00 | | | 0.16 |
| | | | | total= | | 0.18 |
| | | | | | | ===== |

Syphon under Omarama Stream

Farm Dam

Omarama Stream

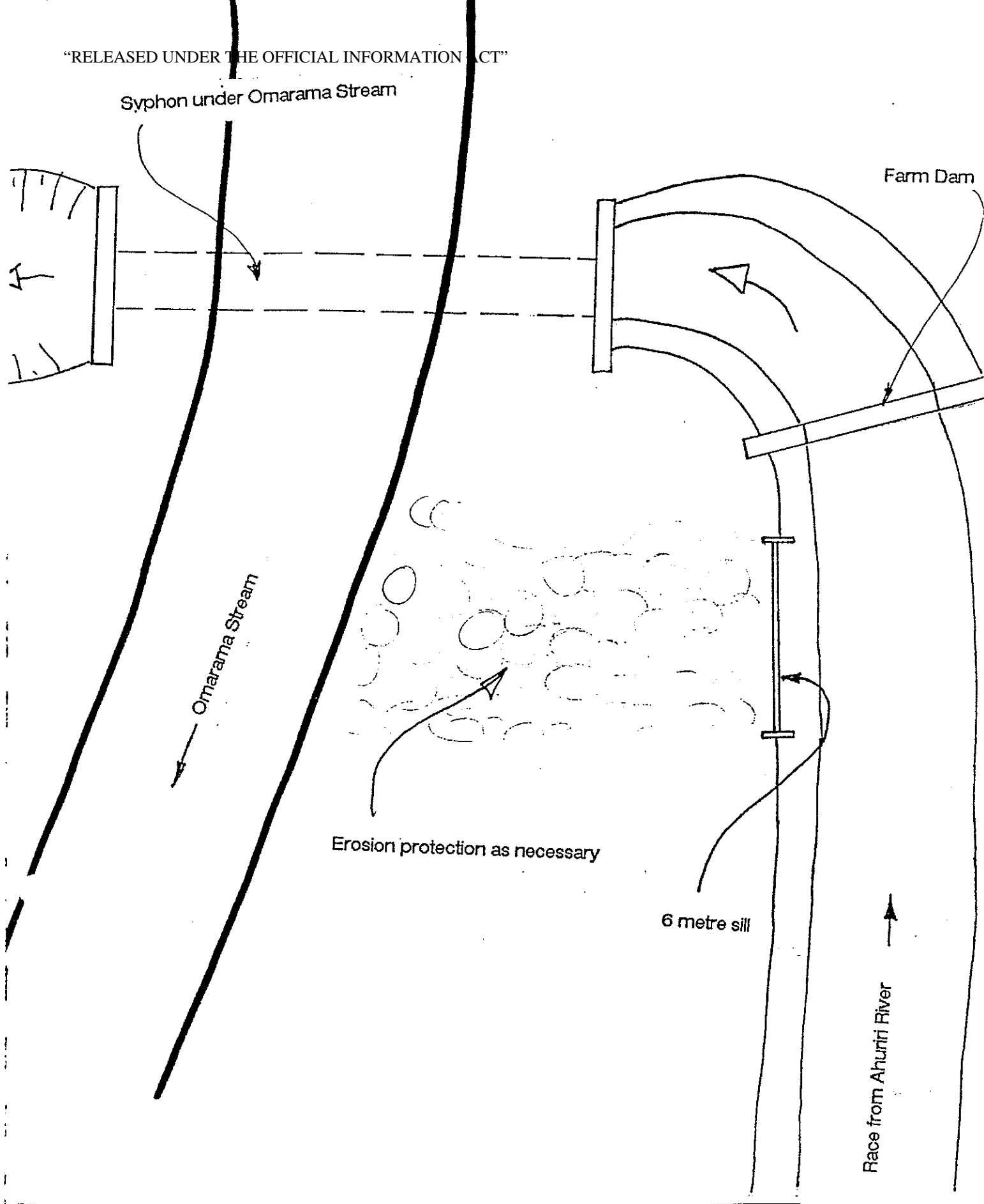
Erosion protection as necessary

6 metre sill

Race from Ahuriri River

RACE FROM AHURIRI RIVER TO OMARAMA STREAM

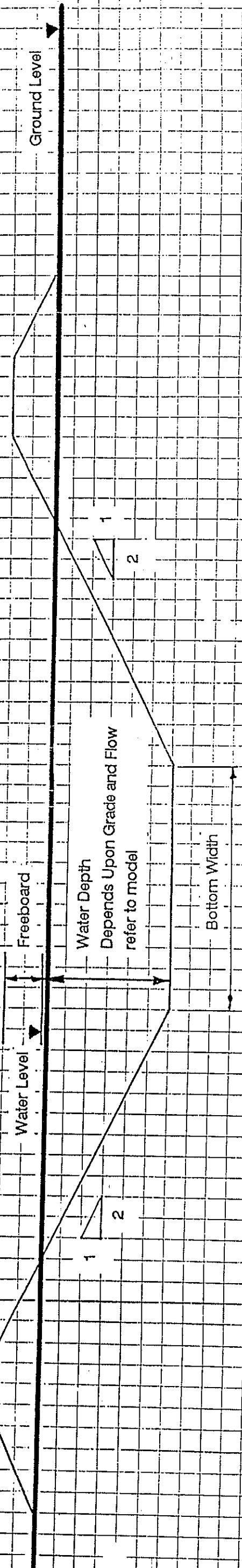
OMARAMA STREAM DISCHARGE DETAILS



TYPICAL CROSS SECTION

DETAILS OF GRADER CUT SUPPLY RACES

Race Capacities Up to 1000 litres per second
Depending Upon Location and Materials



ATHEWELL IRRIGATION CONSULTANTS LTD

40 Glenross Street, Dunedin

Phones

(03) 767 585 Home

(03) 767 585 Fax

(025) 322 591 Mobile

CADASTRAL PLAN
SHOWING PROPOSED RACE

