## Screening Proposal for HDI

As part of its resource consent application Hunter Downs Irrigation (HDI) proposes to implement fish screening [or barriers] to exclude fish from the intake system and provide a bypass to return excluded fish to the Lower Waitaki River.

The final design details will be developed with experts in this field and to the approval of Environment Canterbury (ECan). In order to ensure that a fish screen is constructed, operated and maintained appropriately, the following consent condition is proposed in the application (AEE):

a. *Prior to the taking of water pursuant to the Hunter Downs take allocation, the consent holder shall:*

   i. *install and maintain for the duration of this consent a fish deflection barrier or fish screen, with a bypass system, to prevent fish entering the Hunter Downs pump intake and carry out associated works and flow modifications within the intake pond (headpond); and*

   ii. *advise the Canterbury Regional Council of the date of commencement of the Hunter Downs Irrigation Scheme take.*

b. *The rate of discharge in the bypass system to the intake pond (headpond) bypass channel in condition (a) shall be no less than 250 litres per second.*

c. *The consent holder shall commission an audit by an independent research organisation approved by the Canterbury Regional Council for one migration season to determine the effectiveness of fish screening or deflection barriers installed. The methodology to be adopted shall be approved by the Canterbury Regional Council. The consent holder shall provide the results of the audit to the Canterbury Regional Council within 18 months of the commencement of the Hunter Downs Irrigation Scheme take.*

d. *The consent holder shall monitor the effectiveness of the fish screening or fish deflection barrier and the bypass system and shall provide a report to the Canterbury Regional Council annually by 31 August after the provision of the audit report*

e. *The consent holder may apply to change condition (a) of this consent pursuant to section 127 of the Resource Management Act 1991 if it can show that fish screening or fish deflection is no longer necessary or appropriate at the location specified in that condition.*

A return channel will lead fish to a significant flowing braid of the Lower Waitaki River. Consultation would be undertaken with organizations that have a particular interest in fish screen operation, for example: Fish and Game and tangata whenua.

A mechanical device to remove debris and algae would clean the fish screen. Water level sensors would probably activate this. Mechanical components would be serviced regularly and items replaced as required, according to the operation and maintenance plan.

It is not envisaged that there will be any need for fish protection for upstream migrants or any emergency overflow channel from the future pump station fore bay. This is because the intended channel would be dry for most of the time and fish will not be attracted into it.

## Fish Barrier Design Considerations

It is considered most effective to design fish screen / barriers on a case-by-case basis to suit the particular intake and river condition. For the Hunter Downs Irrigation Scheme the screen will be designed once the resource consents are approved. The two main options for fish screening are:

1. *Behavioral barriers* e.g. a physical barrier such as a screen
2. *Positive barriers screens* e.g. light and sound barriers.

Behavioral barriers have been successfully used to screen fish from takes of this volume. Behavioral barriers are most commonly used in south island rivers – particularly rotary or drum screens.

Positive barrier screens activate fish to move away from the screen. Many are experimental at this stage (USBR, 2006) and although they can offer an alternative at intakes that are difficult to screen their effectiveness is not yet well documented. The capability of sound barriers is being investigated for the Rangitata Diversion Race in South Canterbury. Hunter Downs Irrigation intends to investigate all options.

Fish barrier design is based on the fish species present, their life stage, size, and fish swimming strength. The ability for the fish to move away from the intake is a particularly important design aspect. If fish enter the intake when the velocity is too high they risk being impinged upon the screen, thus increasing mortality rates.

Best practice guidance for fish barrier design is being developed by a Canterbury Regional Council Working Group as part of a Sustainable Farming Fund project (Annexure A). To date the group indicates the following preferred features:

- *Screens should be either rotary or flat screens that will be designed to be cleaned automatically of both debris and algae (for HDI intake it would be preferred to use flat screens);*

- *Screens should be installed at a maximum of 45 degree angle to the flow so as to encourage fish to sweep past the screens towards bypass channels and to facilitate passage of debris;*
- *Screens should be installed in a series of V-formations to reduce the geographical extent of a screen site;*
- *Approach velocity to the screens will be a maximum of 0.12m/s to enable salmonid fry to move away from the screens towards the bypasses;*
- *Bypasses with a total flow rate of up to 2m$^3$/s would be designed to ensure fish are taken from the race and screen area with minimal damage.*

The Canterbury Regional Council Working Group is concentrating primarily on providing best practice guidance for fish barriers on relatively small diversion flows (i.e. less than about 10 m$^3$/s), these being by far the most common size requiring barriers in Canterbury. The HDI take of 20.5 m$^3$/s is large by New Zealand standards and will undoubtedly require case-specific design consideration, taking into account the general principles highlighted by the Working Group.

## International Examples

Because constructing fish barriers for relatively large flows is new in New Zealand, it is useful to look to international examples for feasible design options.

The following report provides a comprehensive overview of available fish screening technology and demonstrates the technical feasibility of engineering screens for water takes of various sizes including a number over 20.5m$^3$/s:

USBR: (U.S. Department of the Interior Bureau of Reclamation Denver) (2006) *Fish Protection and Water Diversions: A Guide for Planning and Designing Fish Exclusion Facilities* [available at: www.usbr.gov/pmts/hydraulics_lab/pubs/manuals/fishprotection/index.html ]

The report summarises the advantages and disadvantages of each type of screen and provides real-life example of their use. USBR (2006) indicate that for a take of 20.5m$^3$/s the range of screens including:

- *Flat plate screen* - Flat plate screens have been effectively installed at in-canal, in-river, and in diversion settling pond sites. When flat plate screens are applied at in-canal sites, a fish bypass or bypasses are typically included.
- *Drum screens* - Because of the specific submergence requirements, drum screens are typically not used for in-river sites. Drum screens are most often used with in-canal installations and have been used in the pool of some in-diversion sites
- *Traveling screens* - Traveling screens are mechanical screens installed vertically or on an incline that include screen panels, baskets, trays, or members connected to form a continuous belt. The most common application

for traveling screens at irrigation facilities is for fish exclusion in the secondary dewatering structures used to reduce the bypass flow rates

Further detail on each of these screens and design considerations can be found in the report.

# Annexure A: Sustainable Farming Fund Project Summary

**Project Title:** Fish Screen Guidelines
**Grant No.:** 05/052

## Contact Details


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|---|---|
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## Project Details

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|---|---|
| **Status:** | In progress |
| **SFF Funding:** | $84,750 |
| **Total Project Funding:** | $167,750 |
| **Proposed Start Date:** | 2005-07 |
| **Proposed Finish Date:** | 2005-12 |
| **Region:** | Canterbury |
| **Sector:** | Cross sector |
| **Sub-sector:** | |
| **Topic:** | Irrigation |

## Project description:

The project aims to develop guidelines for fish screens and installations that represent an agreed position between Fish and Game, Irrigation New Zealand and Environment Canterbury that will be applicable for most consent applications. The project intends to use the extensive knowledge and local experience of all organisations involved (Irrigation NZ, Fish and Game, ECAN, DoC and NIWA) to produce a fish screen design guidelines document. This will cater for three groups of users:

1. those who wish to "just find some designs and get building"
2. those who wish to gain insight into why particular design characteristics have been recommended
3. those who wish to undertake further in-depth investigation independently

## The issue / opportunity:

Fish screens are a requirement on most irrigation and stock water intakes from New Zealand Rivers. Currently, each intake is contested on a consent-by-consent basis at great time and expense to involved parties. In addition, existing installations face large ongoing costs including:

- Maintenance and re-consenting costs
- Losses due to blocked screens
- Potential enforcement costs

Currently, there is a lot of North American work relating to fish screens that needs careful interpretation to New Zealand conditions. Similarly, the US ASCE manual has a good back-ground but its solutions are too big for New Zealand.

## Methods:

1) Undertake extensive literature review and preparation of technical material by Fish and Game. Undertake independent review of North American and European Fisheries information by NIWA. Assemble information on practical screening techniques.

2) Determine initial design parameters based on fish behaviour. Consult with structure designers

3) Evaluate initial design against series of parameters including:

- Biological efficiency
- Ease of construction
- Ease of maintenance

4) Refine and agree on preferred design options.