



Chase Mill  
Winchester Road  
Bishop's Waltham  
Hampshire  
SO32 1AH  
United Kingdom

Tel: +44 1489 893 323  
Fax: +44 1489 891 851

## ***Fish Guidance Systems Ltd***

### **Budget Cost of Hiring a SPA Fish Deflection System River Rhone, Geneva, Switzerland**

**Quotation No. 870Q0101**

The acoustic system required will comprise:

<u>Qty.</u>	<u>Description</u>
2 off	FGS Model 1-08 Signal Control Units
4 off	FGS Model 400 Amplifier/Monitors
8 off	FGS 30-600 Sound Projectors
2 off	Underwater cable harnesses
2 off	Environmental housings for control equipment
2 off	Mild steel sound projector frames

**Hire Charge for System, including carriage to Geneva** **£2,675.00**

Since two sound projector frames will be fabricated for this specific installation, these will need to be purchased in addition to the hire charge for the acoustic system.

There will also be the cost for the PrISM modelling to confirm the system configuration, and the cost of an FGS engineer and technician to assemble and run the system during herding the fish, and the technician to maintain the system during drain-down.

The additional costs will be:

1.	PrISM modelling	£1,000.00
2.	Installation, testing and maintenance of system by FGS engineers during drain-down of system (Cost to include all travel and subsistence)	£4,800.00
3.	Mild steel sound projector frames	£725.00

**Additional Costs to Hire Charge** **£6,525.00**

**Total cost of PrISM modelling, hiring acoustic system and purchasing frames, to include all time fees and expenses** **£9,200.00**

Signed..........7 April 1997

D R Lambert  
General Manager



Chase Mill  
 Winchester Road  
 Bishop's Waltham  
 Hampshire  
 SO32 1AH  
 United Kingdom

Tel: +44 1489 893 323  
 Fax: +44 1489 891 851

## **Fish Guidance Systems Ltd**

### Hire Agreement for Acoustic System

<b>Hirer's Name (in full):</b>	Federation Genevoise Des Societes De Peche (FGSP)	<b>Agreement No.</b>	870C0101
		Customer Order No.	
<b>Invoice Address:</b>	Case Postale 312 1211 Geneva 25 Switzerland	<b>Hire Period</b>	2weeks
Telephone No.	00	Date hire commences:	27 May 1997
Contact Name:	Valério Zuodar, Président F.G.S.P	Est. date of return:	9 June 1997
<b>Installation Site Address:</b>	River Rhone Geneva Switzerland	<b>Value of system on hire</b> (for insurance purposes)	<b>£37,000.00</b>
Telephone No.	00		
Site Contact Name:	Dr J-F Rubin	<b>DEPOSIT PAID</b>	<b>£0.00</b>
<b>Provisional System For Hire</b>			
<b>No.</b>	<b>Description</b>	<b>Total Hire Charge for Hire Period(£)</b>	
2	FGS Model 1-08 Signal Control Units		
4	FGS Model 400 Amplifier-Monitor Units		
8	FGS Model 30-600 Sound Projectors		
2	cable harnesses and connector sets		
2	environmental housings for acoustic control equipment	<b>2,675.00</b>	
<b>Other Costs</b>			
1.	PrISM Modelling, to determine best configuration for acoustic system	1,000.00	
2.	Provision of FGS engineer and technician to assemble and run system during herding of fish, and technician to maintain system during drain-down. Cost to include all travel and subsistence	4,800.00	
3.	Fabrication of 2 no. purpose-built mild steel sound projector suspension frames	725.00	
<b>Total Additional Costs</b>			<b>6,525.00</b>

I have read and accept the terms and conditions of this agreement

**Signed:**..... **Print Name:**..... **Date:**.....



Chase Mill  
Winchester Road  
Bishop's Waltham  
Hampshire  
SO32 1AH  
United Kingdom

Tel: +44 1489 893 323  
Fax: +44 1489 891 851

## **Fish Guidance Systems Ltd**

Monsieur Valério Zuodar  
Président  
Federation Genevoise Des Societes De Peche (F.G.S.P.)  
Case Postale 312  
1211 Geneva 25  
Switzerland

7 April 1997

Our Reference           DRL/870P0101

Dear Mr Zuodar,

### **River Rhône Verbois Dam Fish Herding Project**

Further to the site inspection carried out by Dr Andrew Turnpenny on 25-26 March 1997, we are pleased to attach a budget quotation for the hire of an acoustic system for use on the River Rhône.

### **Background**

The River Rhône exits from Lake Geneva and passes a number of hydro-electric dams before crossing the French border. One of these, located about 16 km below the city of Geneva, is the Verbois Dam.

Since the construction of the Verbois Dam there has been a progressive accretion of sediment in the reaches upstream of it, and it has proved necessary every three to four years to open the dam and flush out the silt. During this process, the majority of fish that are present in the drained reach are also flushed out and lost downstream to France.

The repeating of the process at three to four year intervals means that much of the fish stock is lost just as soon as it becomes established.

### **Aims of the Proposed Project**

A solution to the fish loss problem is being sought by Geneva's angling federation, Federation Genevoise Des Societes De Peche (FGSP).

Fish Guidance Systems Ltd was approached by the Federation and their consulting fishery biologist, Dr J-F Rubin, to consider the feasibility of using recently-developed underwater sound generating systems to herd fish from the drain-down reach to areas of safety upstream before the flushing process.

Once driven upstream, the fish would be retained by the sound field in the safe area, until the flushing process was complete. After this, the sound field would be removed, and the fish allowed to spread back downstream.

### **Site Visit of 25-26 March 1997**

FGSP invited FGS fishery biologist Dr Andrew Turnpenny to visit the area on the above dates in order to consider the feasibility of the proposed scheme. Dr Turnpenny visited the Verbois Dam and some key points on the river, by road, on the afternoon of 25 March and, the following morning, was taken by boat to see the river in more detail. Here are a number of points of information:

1. The river has a mixed fishery of trout and cyprinid fish, with trout to about 40 cm.
2. The affected reach of the river is about 16 km in length but FGSP intends, at this experimental stage, to attempt to rescue only the fish in the upper 8 km, where the river is narrower. To attempt to cover the whole 16 km is considered too ambitious at the first try.
3. Velocity in the upper 8 km of river is generally high, which may limit effective rescue to the larger (but more valuable) fish. During the drain-down period high flows are used to dislodge silt; combined with the reduced depth, velocities can be much higher, e.g. 2 m/s. Detailed flow-velocity data were provided to FGS.
4. The river has a relatively uniform cross-section along the 8 km reach. Width of the river varies from 120 to 195 m; depth is up to 19 m, shallower towards the margins. A series of cross-sections was provided to FGS.
5. The margins of the river are well provided with cover, including areas of reed bed and submerged tree branches and roots.
6. Fish are found chiefly near to the sides of the river, rather than in the faster-flowing centre region.

### **Biological Aspects of Fish Diversion**

The premise of the FGS guidance concept is that a sound signal can be generated that will be repellent to all swim-bladder species, making it possible to deflect the fish away from areas they are not wanted.

Fundamental behavioural studies by FGS have indicated substantial inter-specific variations in the responses of fish to sound stimuli. The main fish species of concern are a mixed population of cyprinids and salmonids, which are sensitive to sound in the 10 - 1000 Hz range.

The sound signal to be used would be selected from a number of proprietary, broad spectrum deterrence signals that cover the most sensitive hearing band of cyprinids and salmonids and will be within the audible range of humans.

### **Acoustic Systems**

FGS fish deflection systems comprise of the following components:

**1. The Signal Generator**

FGS signal generators are based on solid-state digital recording technology and can accommodate up to eight separate switchable fish guidance signals.

**2. Power Amplifiers**

The signal generator feeds into a bank of audio frequency power amplifiers that boost signal levels to the required output levels for the transducers.

**3. Sound Transducers**

Underwater sound projectors are used to create the underwater sound field. Generally, a linear array of sound projectors is used to create a field of repulsion. We refer to this array as the 'Sound Projector Array' or **SPA**.

### **Proposed Method of Approach**

The herding process will involve towing sound generating systems upstream from the lower end of the 8 km reach (Profile P12) to the upper containment point at the Bridge with Profile P3A-4A-4B.

The speed will be kept low (1 km/h or ~27 cm/s) in order to avoid exhausting or panicking the fish. The distribution of fish, chiefly at the sides of the river, suggests that the most effective way will be to use two boats, each towing a sound source, one on each side of the river. The scheme is fully illustrated in Figures 1-5 (attached).

It will be seen from the sketches provided that each of the sound sources may be comprised of a number of sound projector units to create the necessary power level, these being suspended from a raft towed behind the boat. The exact number, deployment depth and operating power of the sound sources will need to be determined by acoustic modelling (Subacoustech PrISM Model) before the final arrangement can be confirmed.

Monsieur Valério Zuodar  
Federation Genevoise Des Societes De Peche

The signal generators and amplifiers will also be located on the rafts, with power being provided from portable 1.5 kVA 240 v ac petrol generators (plus backup generators in case of failure).

Once the final position has been reached at the upper bridge, the two rafts will be moored from the bridge piers, as shown in Figure 5. The portable generators will be replaced by mains power via land-line from the bridge. The two acoustic systems are expected to remain in this position for about 3-4 days, while the dam is open.

There are a number of factors which may effect the efficiency of the herding process:

The velocities within the channel are high, and the fish must have the swimming capacity to swim against the flow of the river to reach the holding point. Once the dam is opened the velocities will be increased even further.

Since reed beds and other potential cover are present along the banks of the river, the fish may seek refuge in this cover while the acoustic system passes by, returning to the river once the system has moved upstream. Alternatively, the fish may pass between the two boats where the sound field may be reduced, due to interference between the separate acoustic signals.

It is therefore expected that a proportion of fish, especially smaller individuals, will not be saved by the herding process. It is understood that FGSP will be arranging to monitor the distribution of fish throughout the process using sonar technology.

### **PrISM Modelling Requirements**

The PrISM acoustic model will be run for three selected, representative transects to determine the optimum system configuration and operating positions. It is expected that operating two separate sound projector clusters will inevitably lead to some interference of the sound field in the centre of the river, but this is not considered to be of overriding importance, given the marginal distribution of the fish.

The PrISM Model is the property of Subacoustech Ltd, a company specialising in underwater acoustics, and will be run by Subacoustech under subcontract.

### **Equipment Requirements**

The following requirements are expected, but may be altered subject to the outcome of the PrISM modelling:

To be supplied by Fish Guidance Systems Ltd:

- 2 off FGS Model 1-08 Signal Control Units
- 4 off FGS Model 400 Amplifier-Monitor Units
- 8 off FGS Model 30-600 Sound Projectors
- 2 off cable harnesses and connector sets.
- 2 off purpose-built mild steel sound projector suspension frames (see Fig. 1)
- 2 off environmental housings for acoustic control equipment.

To be supplied by FGSP:

- 2 off rafts for sound projector suspension, with lifting frame, winch and cable for sound projector frames
- 2 off tow lines
- 4 off portable 1.5 kVA 240 v ac petrol generators plus fuel for 1 day
- 2 off towing vessels
- 2 off power cables at the bridge at profile location P3A-4A-4B, each with a single phase 1.5 kVA, 230 V ac power supply
- 2 off chains and mounting points to attach the rafts to at the holding bridge

### **Staffing Requirements**

We consider that two FGS members of staff should be present for the initial setting up period and for the 2-boat tow. Once the rafts are in fixed position, a single FGS technician will be sufficient, provided that FGSP can provide other personnel to meet safety requirements for working on the river.

### **Timetable**

- 27<sup>th</sup> May: Equipment dispatched from UK
- 28<sup>th</sup> May: FGS staff fly out from UK
- 29-30<sup>th</sup> May: Equipment assembled, tested and made ready
- 31<sup>st</sup> May: Tow sound systems up-river and herd fish
- 1<sup>st</sup> -3<sup>rd</sup> June: Rafts remain in position during drain-down
- 4<sup>th</sup> June: System dismantled and dispatched back to UK.

### **Assumptions**

In the preparation of this budget quotation we have assumed:

Eight FGS 30-600 sound projectors and associated control equipment will be sufficient to herd the fish. The final system specification will be dependant on the PrISM modelling.

Monsieur Valério Zuodar  
Federation Genevoise Des Societes De Peche

The electricity supplies from the generators and power cables will be uninterrupted, and not subject to excessive voltage fluctuation.

Since the deployment frames will be specific to this project, they will be purchased by FGSP, while the remaining components of the acoustic system will be hired.

### **Delivery**

The acoustic system quoted is in stock, however the system specification must be first confirmed by PrISM modelling. Once the system specification has been confirmed the deployment frames will have to be fabricated. We will therefore require an order to proceed with the PrISM modelling by 14 April 1997.

Once the results of the PrISM modelling are known, we will confirm the system specification and hire cost. In order that the system is available for shipment on 27<sup>th</sup> May, we will require an order to proceed with the fabrication of the frames by 6 May 1997.

### **Purchase Options**

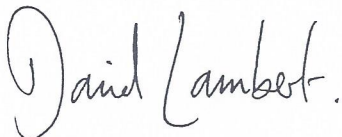
FGS systems are available to be either purchased, leased or hired. We have attached a quotation for the hire of the system, which we understand is your preferred option.

### **Terms and Conditions**

FGS terms and conditions relating to the hire of FGS acoustic equipment are attached to this budget price.

I trust we have provided all the information you require at this stage, however if you have any queries, or require any further information, please do not hesitate to contact us.

Yours sincerely



Dr D R Lambert  
General Manager

cc. Dr J.- F. Rubin





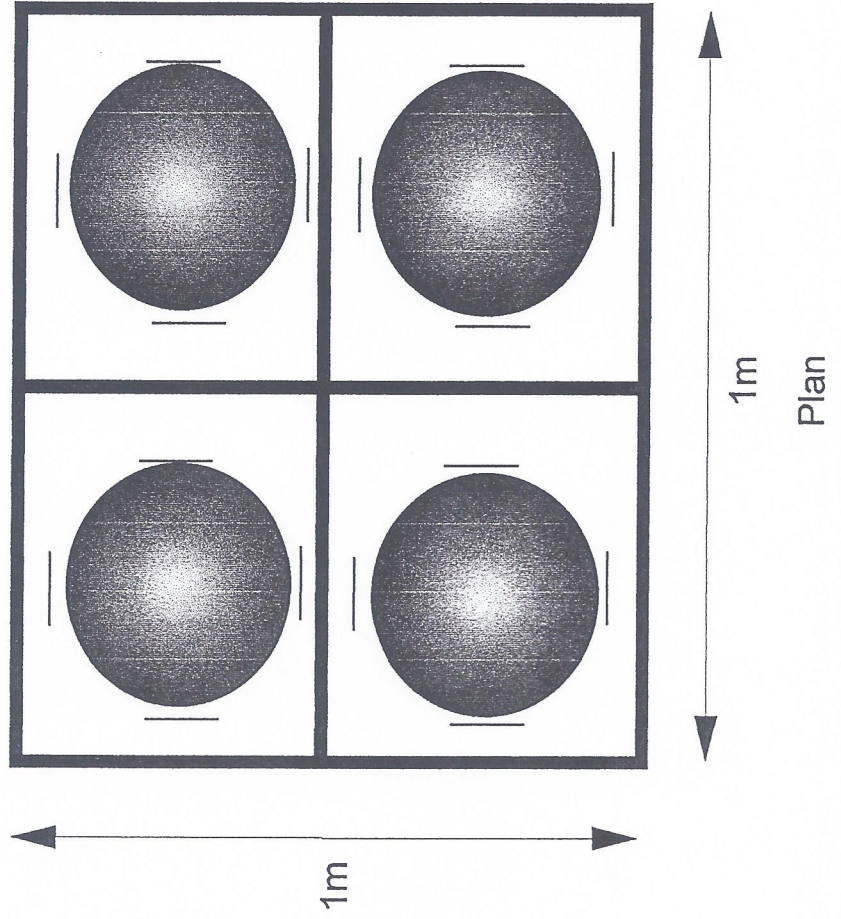
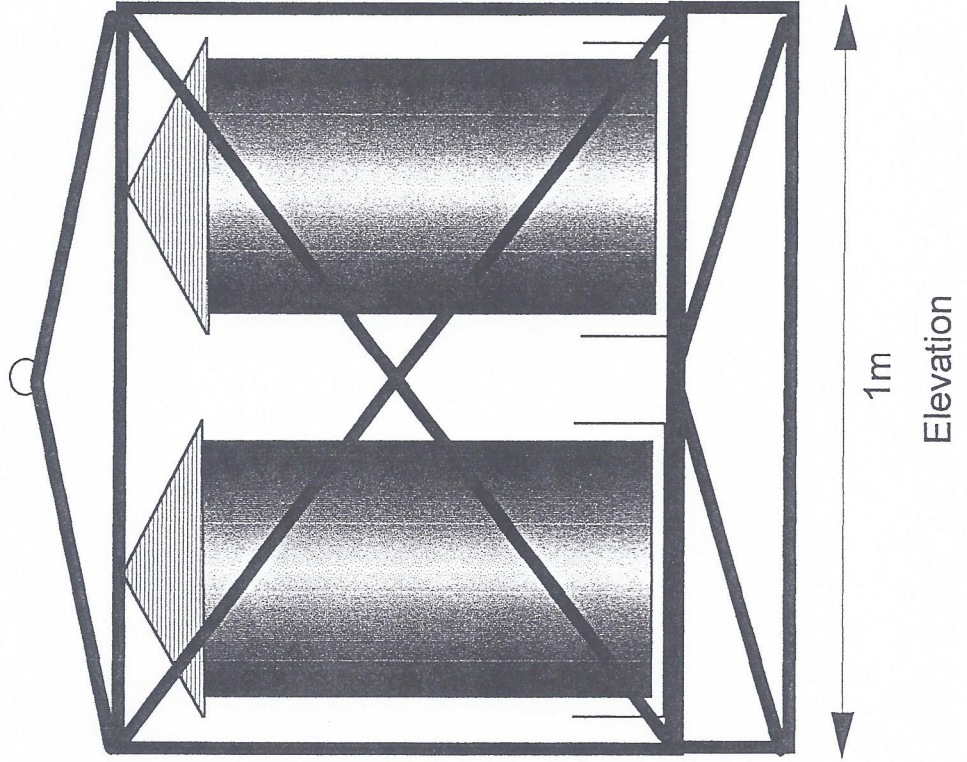
Chase Mill  
Winchester Road  
Bishops Waltham  
SO32 1AH  
Tel:01489-893323  
Fax:01489-891851

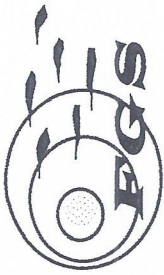
**Fish Guidance Systems Ltd**

**River Rhone Verbois Dam:  
Fish Herding Project  
Project No. 870**

Figure 1: Sketch of Sound Projector Frame with 4 Model 30-600 Sound Projectors

Note frames made from 50 mm mild steel angle, painted.





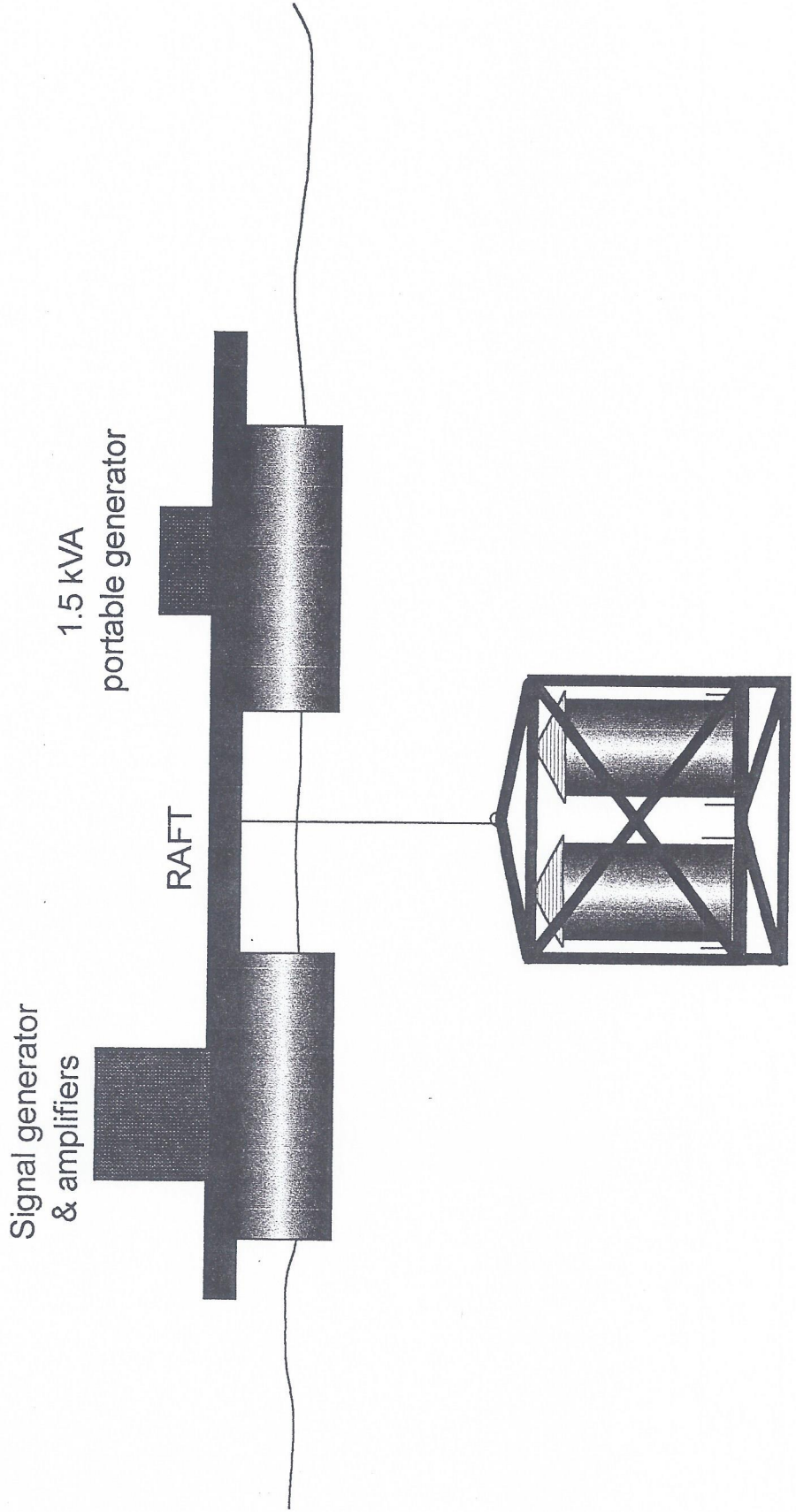
Chase Mill  
Winchester Road  
Bishops Waltham  
SO32 1AH

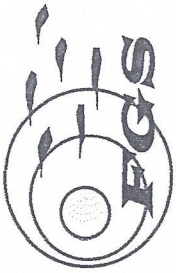
Tel:01489-893323  
Fax:01489-891851

**Fish Guidance Systems Ltd**

**River Rhone Verbois Dam:  
Fish Herding Project  
Project No. 870**

Figure 2: Sketch showing suspension of the sound projector frame from the raft





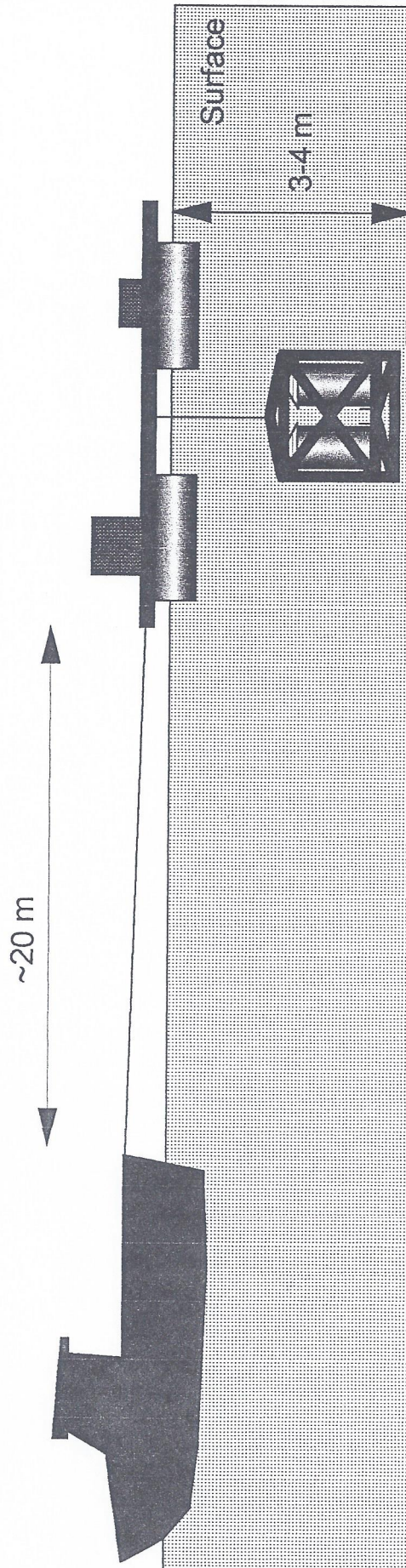
**Fish Guidance Systems Ltd**

Chase Mill  
Winchester Road  
Bishops Waltham  
SO32 1AH

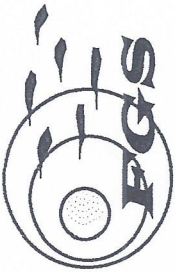
Tel: 01489-893323  
Fax: 01489-891851

River Rhone Verbois Dam:  
Fish Herding Project  
Project No. 870

Figure 3: Towing Arrangement (section)



River bed



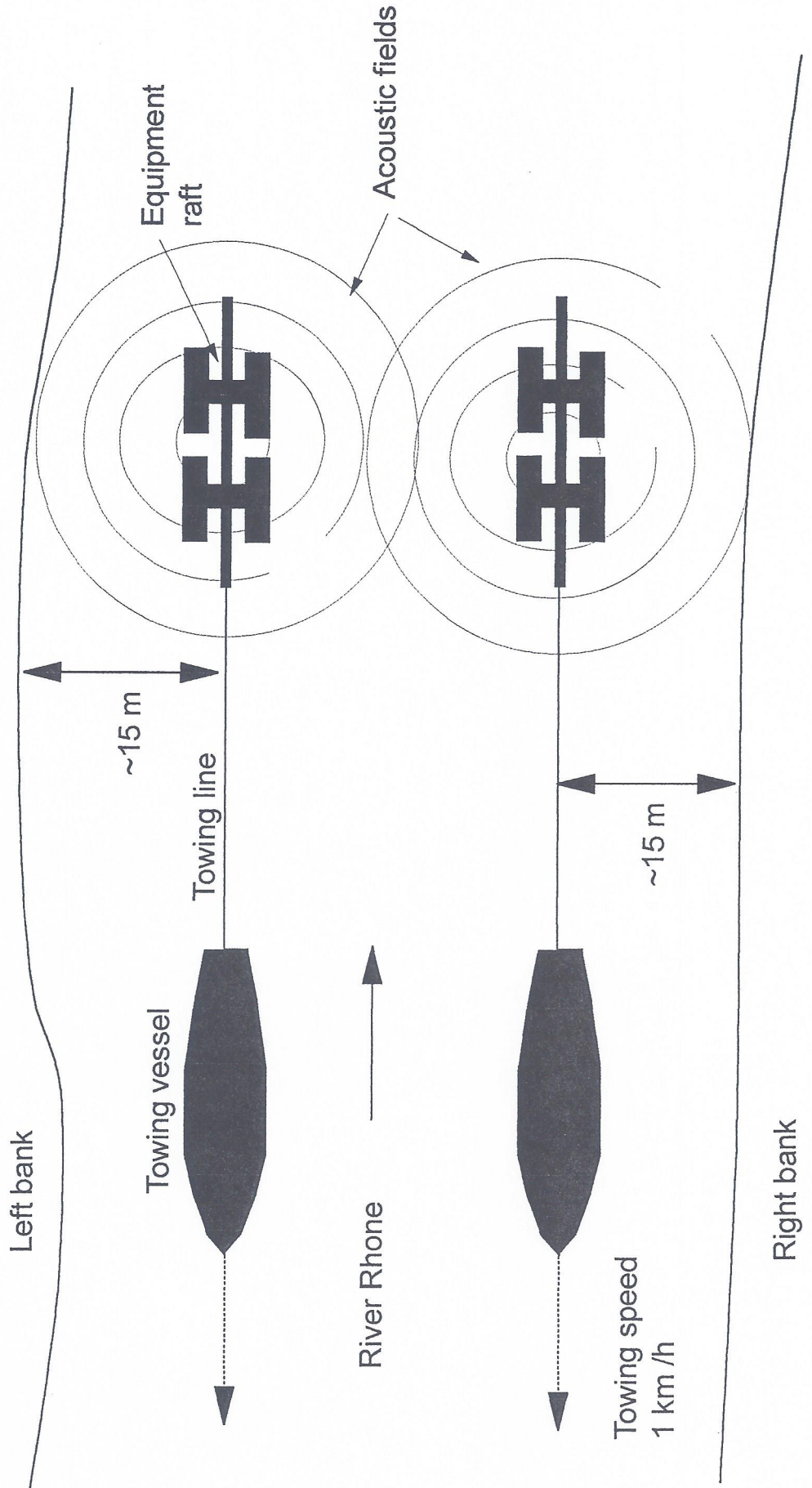
**Fish Guidance Systems Ltd**

Chase Mill  
Winchester Road  
Bishops Waltham  
SO32 1AH

Tel: 01489-893323  
Fax: 01489-891851

River Rhone Verbois Dam:  
Fish Herding Project  
Project No. 870

Figure 4: Towing arrangement (plan view)





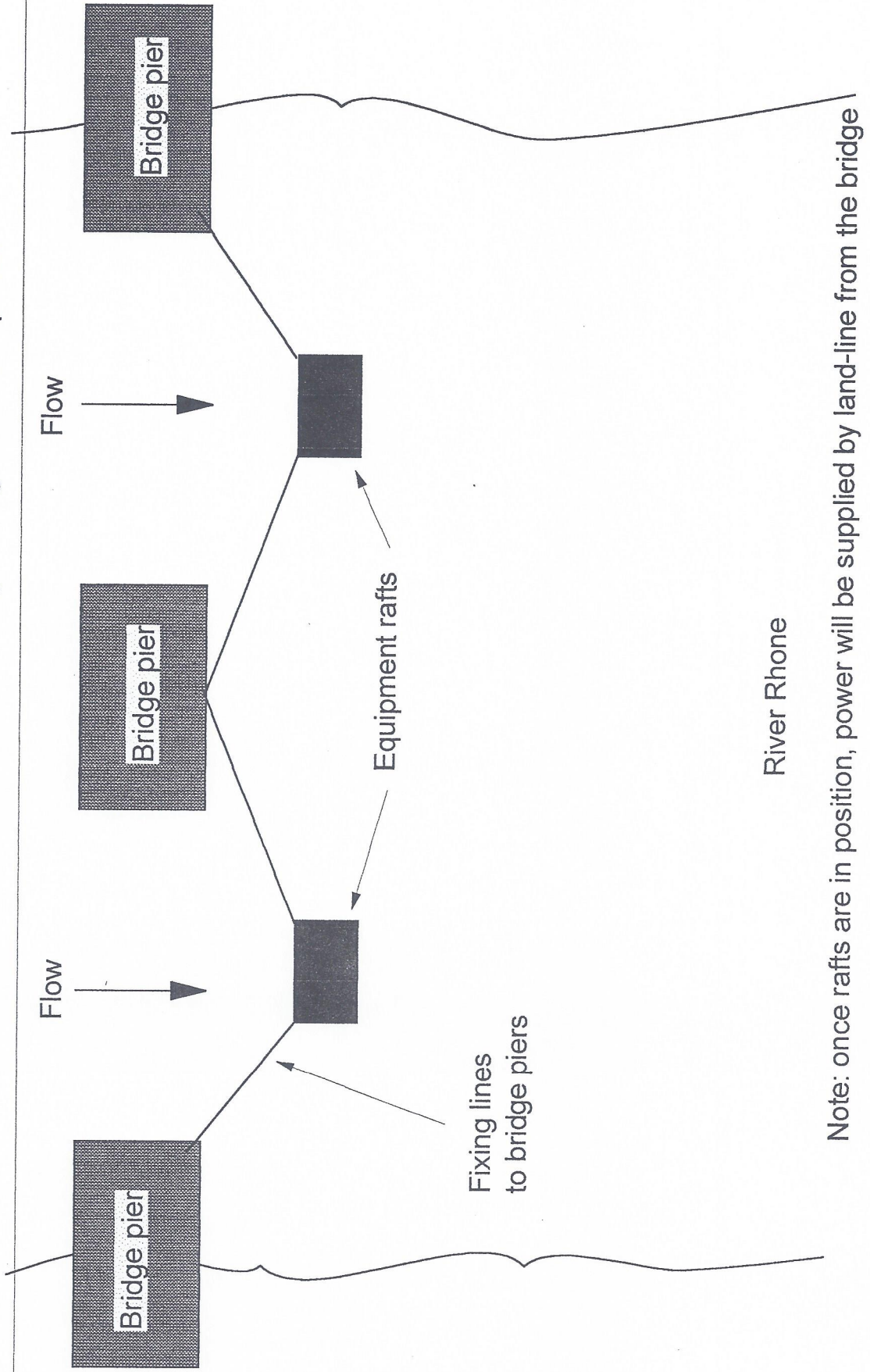
Chase Mill  
Winchester Road  
Bishops Waltham  
SO32 1AH

Tel:01489-893323  
Fax:01489-891851

**Fish Guidance Systems Ltd**

**River Rhone Verbois Dam:  
Fish Herding Project  
Project No. 870**

Figure 5: Fixed position of equipment rafts at bridge during drain-down period



Note: once rafts are in position, power will be supplied by land-line from the bridge