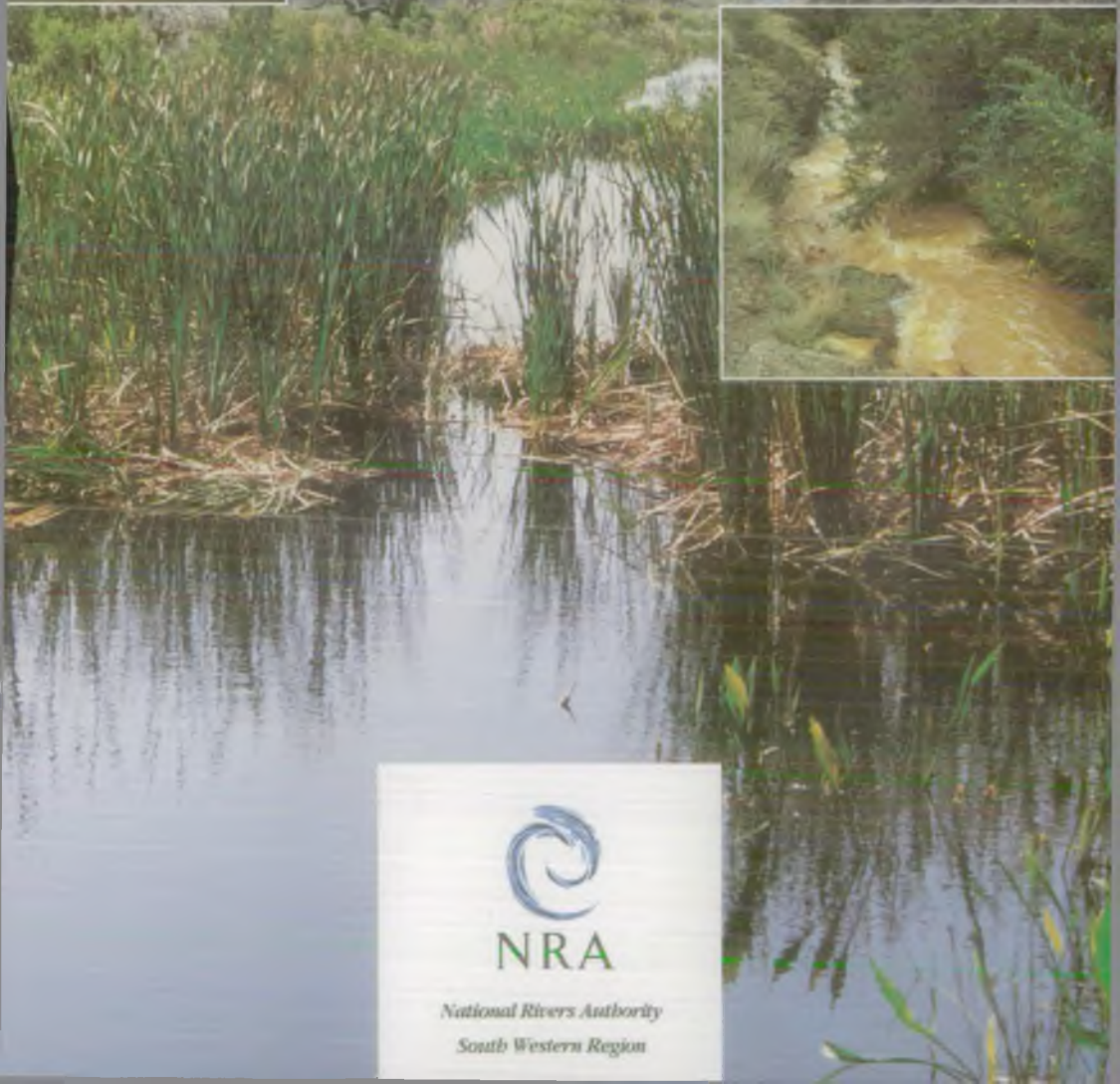




# WHEAL JANE

## A Clear Way Forward

National Rivers Authority  
Information Centre  
Head Office  
Class No .....  
Accession No ATA0/2



**NRA**

National Rivers Authority  
South Western Region

# PIONEERING MINEWATER TREATMENT IN CORNWALL



It was a unique event – and one that caught the breath of everyone concerned with the quality of our rivers. Over 10 million gallons of heavily contaminated water burst from the disused Cornish tin mine workings of Wheal Jane, causing serious pollution.

The highly toxic water, loaded with cadmium, zinc, arsenic and iron, swept into the Carnon River and spectacularly spread its metal-rich contents throughout the Restronguet Creek and into Carrick Roads and Falmouth Bay.

The National Rivers Authority's response to this event was swift and effective in first controlling and then treating the worst elements of the contaminated minewater.

As 'Guardians of the water environment', the NRA was faced with a complex engineering and scientific project. Its objectives are extremely challenging:

- Minimise the polluting effect of the contaminated minewater discharge from Wheal Jane;
- Monitor changes in water quality and the effects on the aquatic environment;
- Determine the most cost-effective long-term treatment strategy.

In recognition of the unprecedented scale of the problem, the Government pledged over £8 million for this pioneering work.

This leaflet details the NRA's response and action in meeting this undoubted challenge.



## THE PROBLEM

Cornwall is famous for its tin mines, but the demise of this once flourishing industry has left a legacy of pollution as old mine workings have become flooded.

In the case of Wheal Jane, regular pumping during its productive life depressed the water table by about 400 metres. The mine was closed in 1991 and pumping operations ceased.

As the water level in the mine began to rise, and in anticipation of a heavily contaminated discharge of minewater polluting the Carnon River, the NRA instigated a temporary treatment system.

Minewater reached the surface in November 1991, but events then took a turn for the worse.

The dramatic burst at Wheal Jane arose when a plug in the underground Nangiles Adit unexpectedly failed in January 1992. The highly acidic water contained significant quantities of dissolved heavy metals, more than 5000 parts per million at its peak.

In parallel with carrying out temporary treatment operations, a comprehensive river and mine flows and water quality monitoring system was installed at key locations throughout the area.



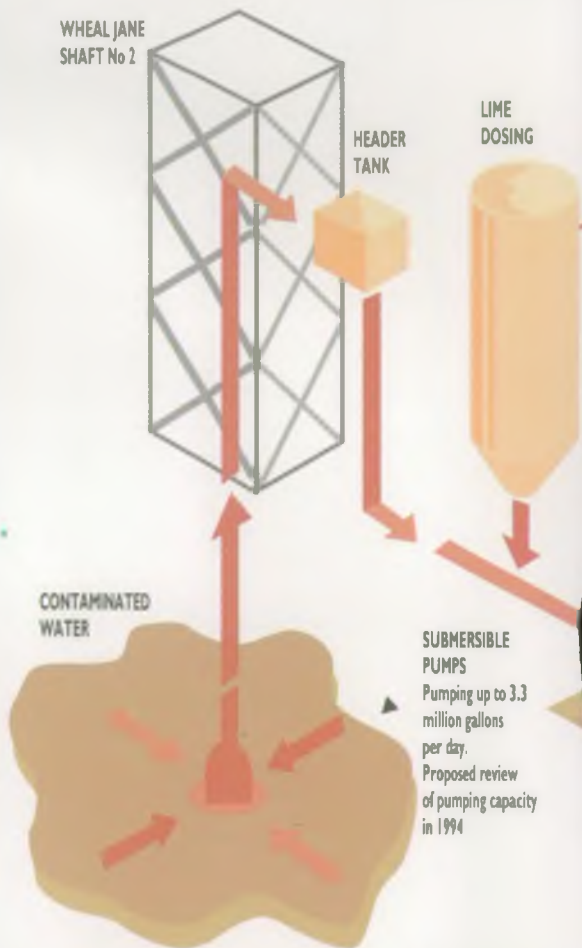
*Carrick Roads, January 1992. The plume of contaminated minewater advances downstream towards Falmouth Bay*

Emergency  
scheme to  
treat river  
pollution  
EMERGENCY action  
to treat millions  
of gallons of river water  
polluted by a  
to stem  
the rivers  
of poison  
By IAN MALCOLM  
A BATTLE to stop  
lions of gallons  
deadly poisons  
the sea w  
NRA launches full invest  
Mine water  
discharged  
into river  
By DEBRA LEAN  
Environment Editor  
linked to mining  
in Cornwall  
NRA

## TEMPORARY TREATMENT

Minewater from Wheal Jane is processed by short term treatment arrangements instigated by the NRA in conjunction with Carnon Consolidated Ltd – who own the site and use it for processing ore from the mine at South Crofty – and consultants Knight Piésold and Partners.

*Between February '92 and February '94 these temporary measures prevented over 9000 tonnes of heavy metals from being deposited in the estuary.*



The metalliferous sediment settles into the Clemow's Valley Tailings Dam which is designed to store mine tailings arising from milling operations carried out on the site.

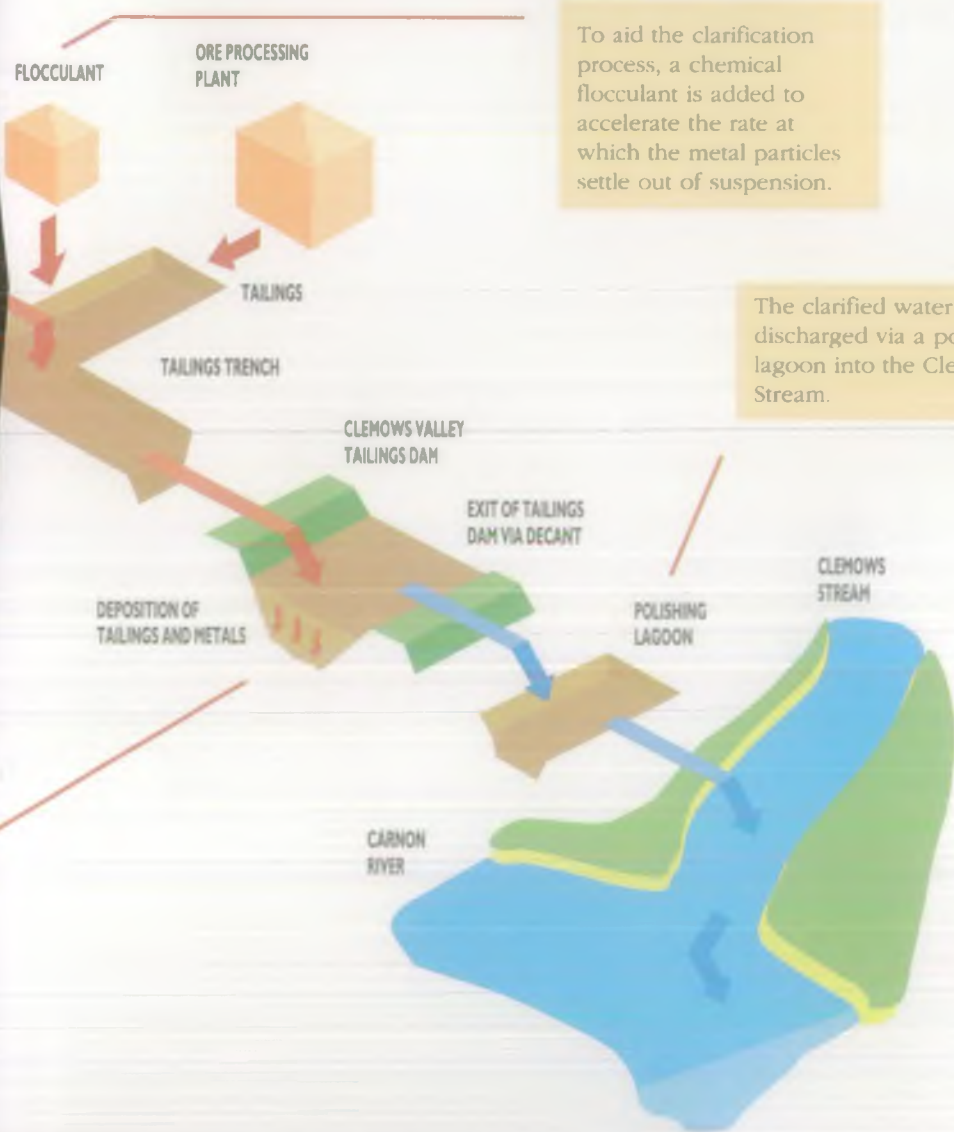
Lime is added to the pumped minewater to neutralise acidity and render the metals insoluble.



The addition of lime transforms the water from a clear fluid to a dark blue-green liquid containing finely dispersed metal hydroxide particles.

To aid the clarification process, a chemical flocculant is added to accelerate the rate at which the metal particles settle out of suspension.

The clarified water is then discharged via a polishing lagoon into the Clemows Stream.



## LONG-TERM TREATMENT

The temporary treatment scheme may not necessarily offer a satisfactory long-term solution due to the operating costs and the limited storage capacity in the Clemovs Valley Tailings Dam. The NRA has therefore instigated a research project to establish the most effective method of long-term remediation of the problem. This study is intended to examine the performance and cost-effectiveness of both active and passive methods of treatment to establish potential for future use on the site.

Active methods involve the use of treatment systems which physically or chemically remove the metals from the minewater. Trials of these techniques will be undertaken at the mine site using small lorry mounted pilot plants.

## TEMPORARY TREATMENT OPERATION



Passive treatment allows for the removal of metals and the neutralisation of acidity using a combination of physical, chemical and biological mechanisms similar to those found in many natural wetlands.

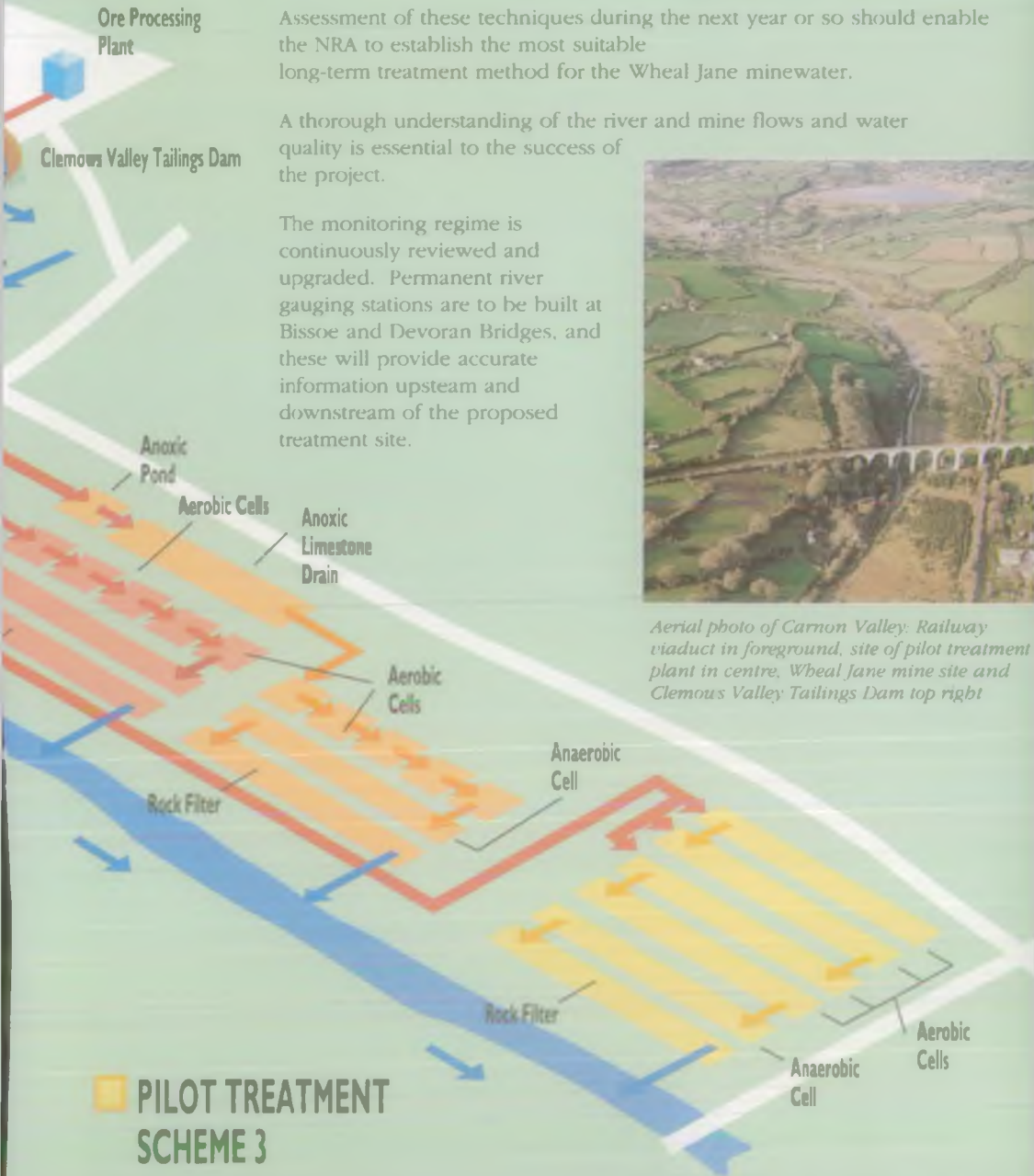
Assessment of these techniques during the next year or so should enable the NRA to establish the most suitable long-term treatment method for the Wheal Jane minewater.

A thorough understanding of the river and mine flows and water quality is essential to the success of the project.

The monitoring regime is continuously reviewed and upgraded. Permanent river gauging stations are to be built at Bissoe and Devoran Bridges, and these will provide accurate information upstream and downstream of the proposed treatment site.



*Aerial photo of Carnon Valley. Railway viaduct in foreground, site of pilot treatment plant in centre, Wheal Jane mine site and Clemous Valley Tailings Dam top right*

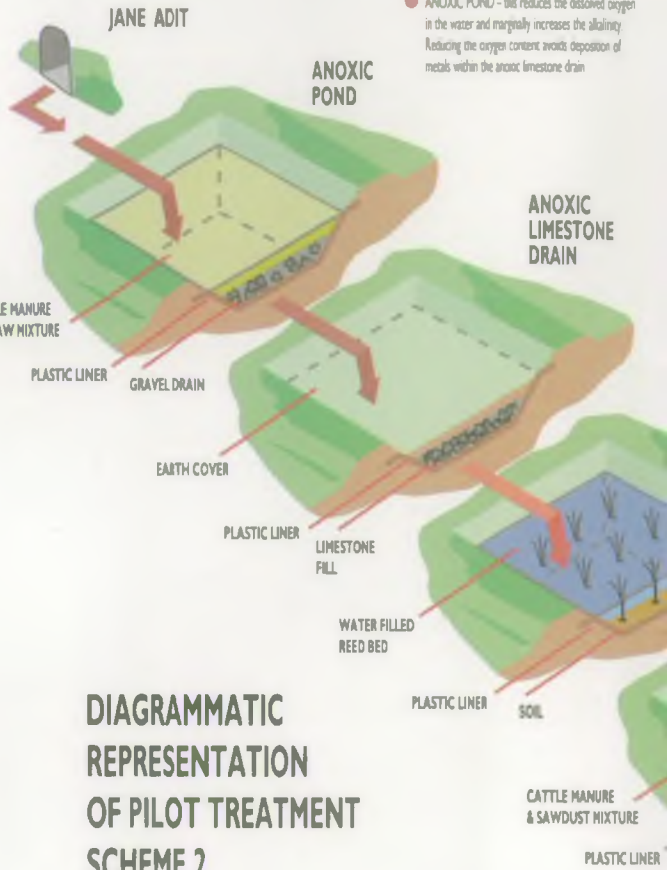


**PILOT TREATMENT SCHEME 3**

# THE PILOT TREATMENT SCHEMES

It is proposed to undertake this pioneering work by the construction of three pilot treatment schemes within the Carnon Valley. The schemes will involve the construction of a series of shallow lined lagoons (or cells) within which a combination of aerobic (containing air) and anaerobic (excluding air) environments can be created.

The three schemes are the same in the final or 'polishing' stages, the difference between them being in the pre-treatment methods adopted for each scheme.



## DIAGRAMMATIC REPRESENTATION OF PILOT TREATMENT SCHEME 2





- **ANOXIC LIMESTONE DRAIN (ALD)** - this consists of an encased limestone layer which adds alkalinity and thereby allows a reduction in the size of the aerobic cells.

- **AEROBIC CELLS** - these remove iron as iron hydroxide. Arsenic will be removed by absorption onto the iron hydroxide surface. Plants will aerate the substrate and produce alkalinity by passing carbon dioxide through the root system. This will help maintain a suitable pH to promote bacterial activity in the anaerobic cell

- **ANAEROBIC CELLS** - these remove cadmium, zinc, copper, some iron and sulphate. This occurs by bacteria reducing the sulphate which combines with the metals to form insoluble metal sulphides. Alkalinity will increase in the discharge

- **ROCK FILTER** - these rocks provide a large surface area on which algae grow. These generate a high pH which allows manganese to be removed

### AEROBIC CELL

### ANAEROBIC CELL

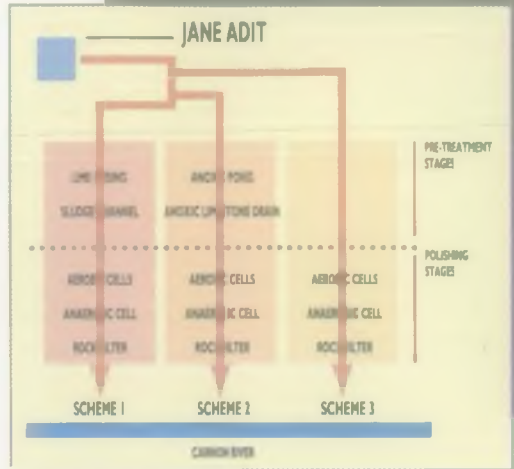
### ROCK FILTER

GRAVEL DRAIN

ROCKFILL

PLASTIC LINER

CARBON RIVER



*Artists impression of pilot treatment Scheme 3 looking downstream towards railway viaduct*



## THE FUTURE

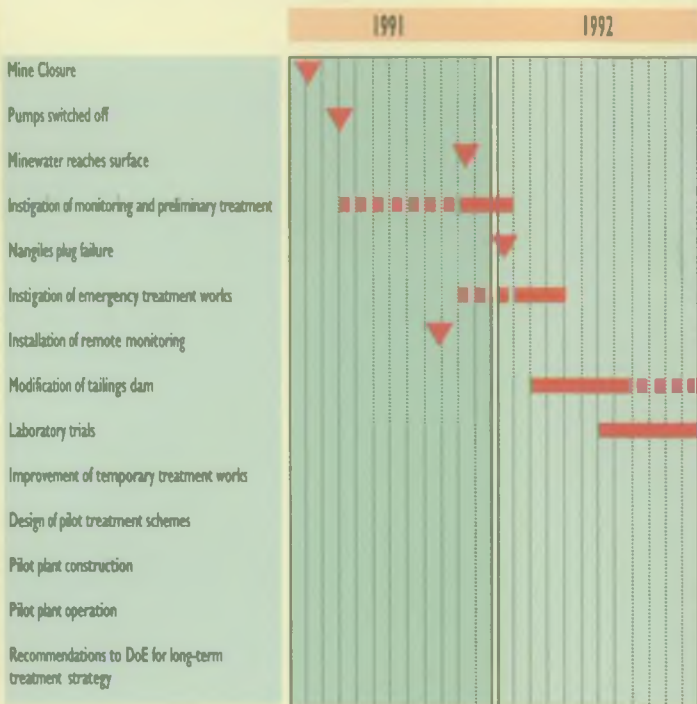
The NRA has tapped expertise from around the world - in particular, the USA - in developing the pilot plant systems.

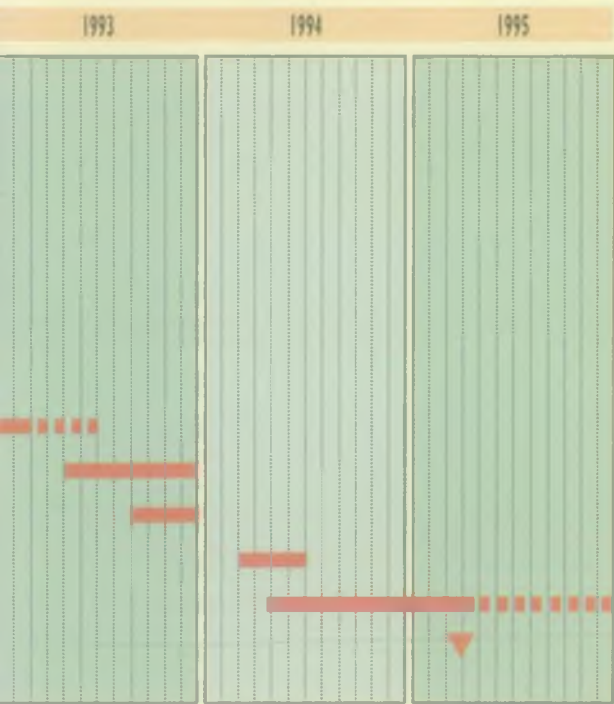
In the long-term, the pilot plant schemes, together with other studies currently being undertaken, will lead to the best design to deal with the unprecedented problem at Wheal Jane. Results will also provide invaluable data for the treatment of other minewater discharges, such as the County Adit and mine sites nationwide.

The NRA's commitment to a viable long-term solution is underlined by its purchase of over 100 acres of land in the Carnon Valley between Bissoe and Devoran Bridges as a potential site on which to provide further treatment and a clear way forward for the future.

*Site of local wetland environment. Reeds (*Typha latifolia*) to be tested for suitability in aerobic cells of treatment works*

## MINEWATER TREATMENT PROGRAMME





*NRA Field staff carrying out monitoring work*

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The National Rivers Authority is an independent public body established in 1989 as 'Guardian of the Water Environment'. The main functions of the NRA are water quality regulation, pollution control, environmental monitoring, flood defence, water resources planning and control, fisheries, recreation and conservation.

Telephone the emergency hotline to report all environmental incidents, such as pollution, poaching and flooding, or any signs of damage or danger to our rivers, lakes and coastal waters. Your prompt action will help the NRA to protect water, wildlife, people and property.

**NRA emergency hotline**

**0800 80 70 60**

**24-hour free emergency telephone**



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Ashford, Kent.

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ENVIRONMENT AGENCY



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South Western Region*