RIVER MANAGEMENT STUDIES

THE RIVER AVON AND ITS TRIBUTARIES NEAR MALMESBURY

NRA

National Rivers Authority
South Western Region

AUGUST 1994

Shers Avon at Silk Mills, Malmesbury

(COVER PHOTO)
The Sherston Avon, with Malmesbury in the background

BACKGROUND

The NRA was formed in September 1989 to safeguard and improve the water environment. Public concern had been aroused prior to this about declining conditions in the Avon and its tributaries near Malmesbury, Wiltshire.

The NRA first looked in 1990 at the impact of groundwater abstractions on river flows. These investigations gave clear evidence of the effect of abstractions but, at a time of natural drought, were frustrated from reaching clear recommendations. Evident leakage from river beds was inconsistent with interpretations of the geology from published maps. Following this the NRA put down exploratory boreholes to re-interpret the geology and resolved to conduct a thorough review of all other data to be used in a future computer model of the water resources of the catchment.

In December 1991 consultants WS Atkins Ltd were appointed to undertake a River Management Study, 'to report on the evidence of declining conditions of the river environment with respect to the habitat and amenity value arising from water and land management practices'. The work has been recently reported and the following is a summary.

THE STUDY AREA

The upper reaches of the River Bristol Avon are fed from a network of tributaries converging near Malmesbury to form what is commonly referred to as the Malmesbury Avon. The two main tributaries, the Sherston and Tetbury Avons, meet at Malmesbury, and all flow from an area of 303 km² is recorded at Great Somerford gauging station.

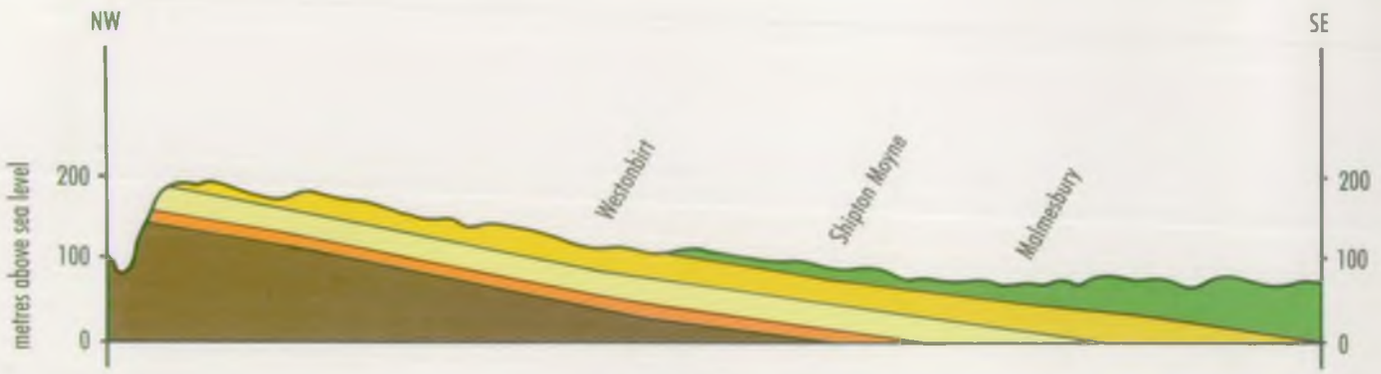
The hydrogeology of the area is complex. To the north and west there are outcrops of Great and Inferior Oolitic Limestone. These limestones readily absorb winter rainfall and when fully replenished provide a source of springs to feed the tributaries.

The Great and Inferior Oolites are not only separated by a layer of clays (Fullers Earth) but are also overlain by clayey deposits to the south and east. These clays are not total barriers to water movement. General seepage and flow through fault zones present difficulties in predicting groundwater movement.

Abstraction of groundwater for public water supplies began at Shipton Moyne and Tetbury more than 50 years ago by Bristol Water, who later (1961) added the Long Newnton source. Boreholes at Milbourne, Charlton, Rodbourne and Park Road were constructed in 1963 and are now operated by Wessex Water.

Wessex Water also operates a borehole at Cowbridge together with five independent boreholes from which water may be pumped directly into the river for 'streamflow support'. These were constructed in the late 1970s. In aggregate 56 million litres per day (Ml/d) is licensed for abstraction for public water supplies and 26 Ml/d is available for streamflow support.

Great Somerford Gauging Station



Indicative NW–SE Section

CATCHMENT GEOLOGY

ENVIRONMENT AGENCY

Further copies can be obtained from Public Relations Section, NRA South western Region, Exeter.

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 line

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The NRA is committed to the principles of stewardship and sustainability. In addition to pursuing its statutory responsibilities as Guardians of the Water Environment, the NRA will aim to establish and demonstrate wise environmental practice throughout all its functions.

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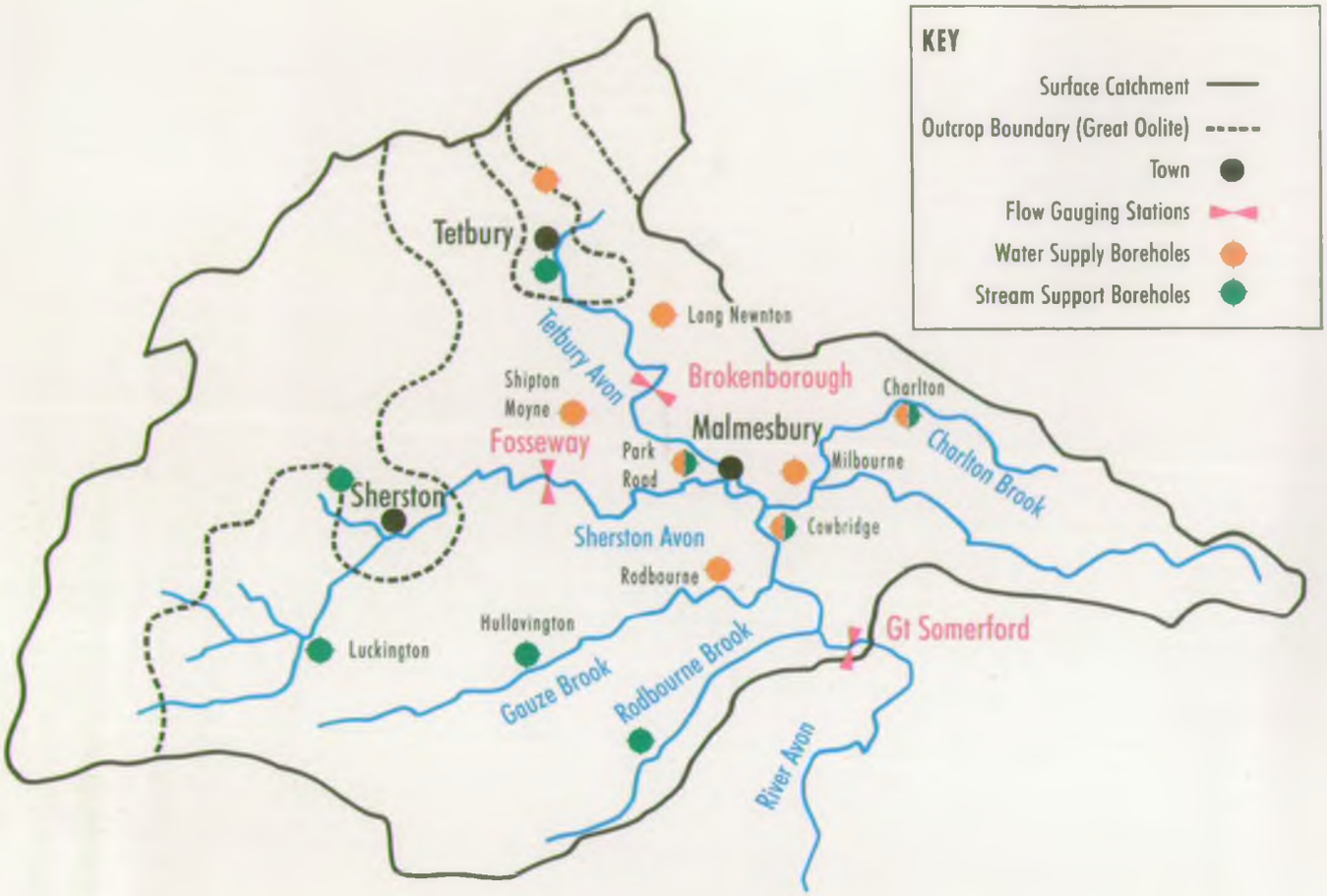

CATCHMENT DIAGRAM—MALMESBURY AVON

OBJECTIVES OF STUDY

The brief to WS Atkins Ltd was wide ranging. Several of the concerns publicly expressed focussed on aspects of river management not entirely influenced by groundwater abstractions.

There are many factors at work which contribute to changes in river flow, water quality, river biology and fisheries, and these are common to many river catchments where land development pressures have been high. They range from changes to field drainage efficiency, urban cover, increased use of agrochemicals, lack of channel maintenance by riparian owners and river channel engineering for flood protection. It was not expected that a perfect and whole answer could be provided 'at a stroke' but that problems and their causes should be identified and potential remedies classified within a practical timescale and with reference to a scale of costs.

Fundamental to the study was the need for a thorough analysis of the effects of groundwater abstraction and for a reliable computer model for use in examining the options for changes.

NATURE OF THE STUDY

To achieve a clear understanding of the concerns a local liaison group was formed, comprised of representatives of civic, countryside, nature conservation, riparian and fisheries interests. Through this group an open day was organised in the summer of 1992 to which the general public was invited to share with us their experiences, past and present, of the river system. From these sources the various concerns were distilled into 15 river management issues.

Through the open day event a number of volunteers were recruited to keep a 'River Diary'. These people were regular visitors to, or users of, the river and they were asked to record at weekly intervals their personal views of the adequacy of river conditions. Records supplied were checked by the NRA against measured flows obtained at the time to assess the diarists' perception of what flows were acceptable.

At the core of the study lay the need to provide, test and use a computer model of the catchment drainage processes in order to evaluate what changes had occurred and why. The MIKE-SHE system was chosen as the computer model on the basis of its scope and completeness. The catchment area was represented in the model by some 3,000 land elements; each allocated elevation, geology, abstraction, river channel and rainfall data. The model as set-up was then tested against a 12 year period of observed streamflows. Simulated streamflows could then be produced from the computer model for various theoretical changes: no abstraction; some abstraction; different stream support arrangements.

GENERAL FINDINGS

From the public open day the 15 river management issues not entirely attributable to water abstractions have been grouped within a set of environmental considerations as follows.

In the main these aspects are to be addressed within the Upper Bristol Avon Catchment Management Plan. Copies of the initial consultation report are available free of charge from the NRA South Western Region. Several aspects have the potential for early resolution; others will take longer.

River Water Quality

Although in general river quality is good, there are localised problems caused by poorly diluted discharges from Tetbury sewage treatment works and by the offensive product of unscreened storm overflows at Malmesbury. Dissolved oxygen levels, particularly in the upper reaches, might be improved despite the natural low level in spring outflows.

Channel Engineering

At Malmesbury a number of weirs encourage the build-up of silt and debris and some crest levels and hence water levels may not be ideal. Downstream of Malmesbury there has been an element of re-sectioning for flood defence that is unsympathetic to wildlife.

Flora and Fauna

The encroachment on river channels by aquatic or semi-aquatic plants is widely evident and requires action where beneficial, not only by the NRA but also by riparian owners who should be advised by the NRA.

Particular concern is warranted for increasingly common algal blooms. Nutrient concentrations and their entrapment in sediments are a probable major influence. River corridor habitat is diminished downstream of Malmesbury where arable land has replaced meadows.

Aesthetics

There has been an increase in the appearance of rubbish and debris in river channels. Although the NRA has a responsibility to consider the impact on flood risk the district council also has powers to deal with such nuisance. Otherwise voluntary organisations can be effective in dealing with this problem with support from the NRA and council staff.

Flow Distribution

At two particular locations in Malmesbury on the Sherston Avon, at the Back Stream and at Daniels Well, local opinion has been tested and now needs to be canvassed in detail over a revision to existing arrangements for division of flows between two channels. At the Back Stream too little of the dry weather flow enters the channel. At the leat below Daniels Well Spring a generous flow results in major losses of water from the channel bed.

Augmentation Flows

Water pumped from a borehole at Hullavington as streamflow support may be lost to a sink hole a few metres from the source. The sink hole could be isolated from the channel. In general stream support from the eight operational boreholes used for this purpose is not provided instantaneously when measured river flows decline to critical levels. There is a delay of seven days for assessment before support is provided.

EFFECTS OF ABSTRACTIONS

Sherston Avon

At the Fosseway Gauging Station average flows are reduced by abstraction, but during periods of genuine drought they are now artificially enhanced by water from stream support boreholes.

Tetbury Avon

Similarly, at the Brokenborough Gauging Station there is a reduction in average flows from the natural condition but an increase in minimum flows.

Avon at Malmesbury

Both the Sherston and Tetbury tributaries suffer major losses of flow due to river bed leakage caused by depressed groundwater levels around the abstraction boreholes near Malmesbury. At the confluence of these tributaries it is estimated that flows are now reduced to around 40% of the natural flow.

Avon at Great Somerford

At this key measurement location it is assessed that the average flow is reduced by 40 Ml/d, which equates to the nett abstraction from the catchment. In the period of summer low flows the flow now represents around 60% of the natural flow.

General

The results of computer simulations indicate that groundwater abstractions from the catchment to Great Somerford represent 34% of the average annual recharge from rainfall. This is a high proportion by South West England standards of aquifer development and places the catchment at as high a risk of river flow degradation as any other in the North and South Wessex areas. The impact of abstractions made either by Wessex Water or Bristol Water is similar in scale but has different emphasis at different locations.

Invasive weed growth

Stream support pumping, Luckington

OPTIONS FOR IMPROVEMENTS

While many of the general findings offer the prospect for early improvements, the impact of groundwater abstractions cannot be substantially mitigated in the short term. Major changes involve major costs and possible extensive reorganisation of water supply systems over a very wide distribution area.

There are four approaches that can be made to the problem, all of which would involve a measure of change to the licences held by water supply companies.

Adjust stream support flows

Different operating rules could be devised for existing stream support arrangements. These might include changes to the in-stream control flows which determine when and where the boreholes should be pumped. They would also involve a review of which of the eight stream support boreholes should be operated for greatest benefit at given times. The immediate use of stream support without the present delays would be an aim.

Change locations of stream support

Some stream support is made downstream of Malmesbury for which no benefit is seen within the town. Consideration can be given to the relocation of discharge points to upstream of Malmesbury, although this is likely to be expensive and to require the laying of pipes.

Additional stream support sources

New boreholes might be provided to increase the augmentation of streamflows. Computer modelling suggests that flows may be increased further by 50% of any new borehole yield and this may meet the required flows in Malmesbury. This may however prejudice the reliability of public water supply sources.

Reduction in public water supply yields

This cannot be considered in isolation of the standards we expect from our public water supply system. If these standards of reliability are to be maintained then a loss of resources from groundwater in this catchment will need to be balanced by a commensurate increase of resources from elsewhere. In the longer term it may be possible that river intakes in the lower Bristol Avon could be used in lieu of some groundwater sources. This would allow greater flexibility in the use of existing groundwater sources for increasing stream support and simultaneously maintaining flows for abstraction downstream.

THE NEXT STAGES

- Where feasible, early action will be taken on the general findings on river conditions, within the Upper Bristol Avon Catchment Management Plan.
- A report will be prepared on the causes of change to aquatic flora and recommendations made for the management of this change.
- The water supply companies will be consulted on the findings of the River Management Studies with a view to seeking some agreement on the need for remedies to river low flows and on the form which an Action Plan should take.
- Discussions will be held with Wessex Water on the potential for early changes to stream support arrangements.
- There will be a review of the control flow at Great Somerford to redefine what is ecologically acceptable.
- The benefits to the environment in financial terms will be assessed in order to attempt to demonstrate the worth of expensive changes to the public water supply arrangements.
- The NRA's priorities for river low flow problems will be reviewed in the light of the present findings on the Malmesbury Avon.

ACKNOWLEDGEMENTS

The NRA is indebted to the people of the Malmesbury area, and in particular to those on its liaison group, as well as to Bristol Water and Wessex Water for their help with information for the River Management Studies.