

science summary



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SCHO0307BMEG-E-P

Fate and transport of particles in estuaries

Summary SC000002/SS

A team of Environment Agency-sponsored researchers has developed an accurate mathematical model of bacterial pollution in the Severn estuary and Bristol Channel, based on studies of bacterial discharges, transport and decay. The model will help to improve understanding of how bacterial pollution from different sources affects the water quality of nearby beaches.

To generate the model, the researchers had to calculate likely estimates for discharges of enterococci bacteria into the Severn estuary and Bristol Channel – from rivers and wastewater treatment works (WwTWs) – and for the rate of removal of bacteria from the water by processes such as natural decay and accumulation of sediment.

They obtained data on bacterial discharges from previous studies and from the Environment Agency. This data showed that during dry periods most of the major discharges of enterococci bacteria come from WwTWs, particularly Cardiff and Avonmouth, but that rivers become the most important sources, particularly the River Seven, during periods of heavy rainfall.

The researchers then conducted a number of studies into the effect of sunlight on bacterial decay in samples of water collected from various locations along the Bristol Channel, and also investigated the attachment of bacteria to sediment. They discovered that bacteria survive for longer in highly turbid (cloudy) water than in less turbid water, because the sediment protects the bacteria from the irradiating effects of sunlight. However, they also found that sediment removes attached bacteria from the water when it settles, although increased water flow can re-suspend the sediment, causing bacterial concentrations to increase.

Using this information, the researchers developed mathematical functions relating bacterial decay and turbidity. This allowed them to generate, for the first time, a model for bacterial pollution incorporating a value for bacterial decay that varies in line with sediment concentrations and the pattern of solar radiation.

Finally, the researchers calibrated the model using data on a variety of parameters collected during four site survey days in the Bristol Channel. The data collected included current velocity and direction, sunlight radiation levels, enterococci concentrations, turbidity, and sediment particle size and concentration.

Predictions subsequently generated by the model confirmed that concentrations of enterococci bacteria in the Severn estuary and Bristol Channel are closely linked to bacterial decay and the transport of sediment. They also highlighted the fact that major discharges of bacteria from WwTWs and rivers are able to affect the water quality of beaches quite some distance away.

Using these predictions, the researchers were able to categorise 29 bathing waters along the Bristol Channel according to the primary sources of bacterial pollution (discharges from rivers and WwTWs, and sediment transport).

- Seven were affected by both discharge sources and sediment transport.
- Eleven were affected by either discharge sources or sediment transport.
- Eleven were not affected by either discharge sources or sediment transport.

Categorising the beaches in this way should help the Environment Agency to devise appropriate pollution control strategies to ensure that the bathing waters are able to meet increasingly stringent regulatory guidelines.

This summary relates to information from Science Project **SC000002** volumes 1-4, reported in detail in the following output(s):-

Title: Fate and Transport of Particles in Estuaries, volumes 1-4.

Volume 1: Summary and conclusions
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