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Tackling the problem off the farm

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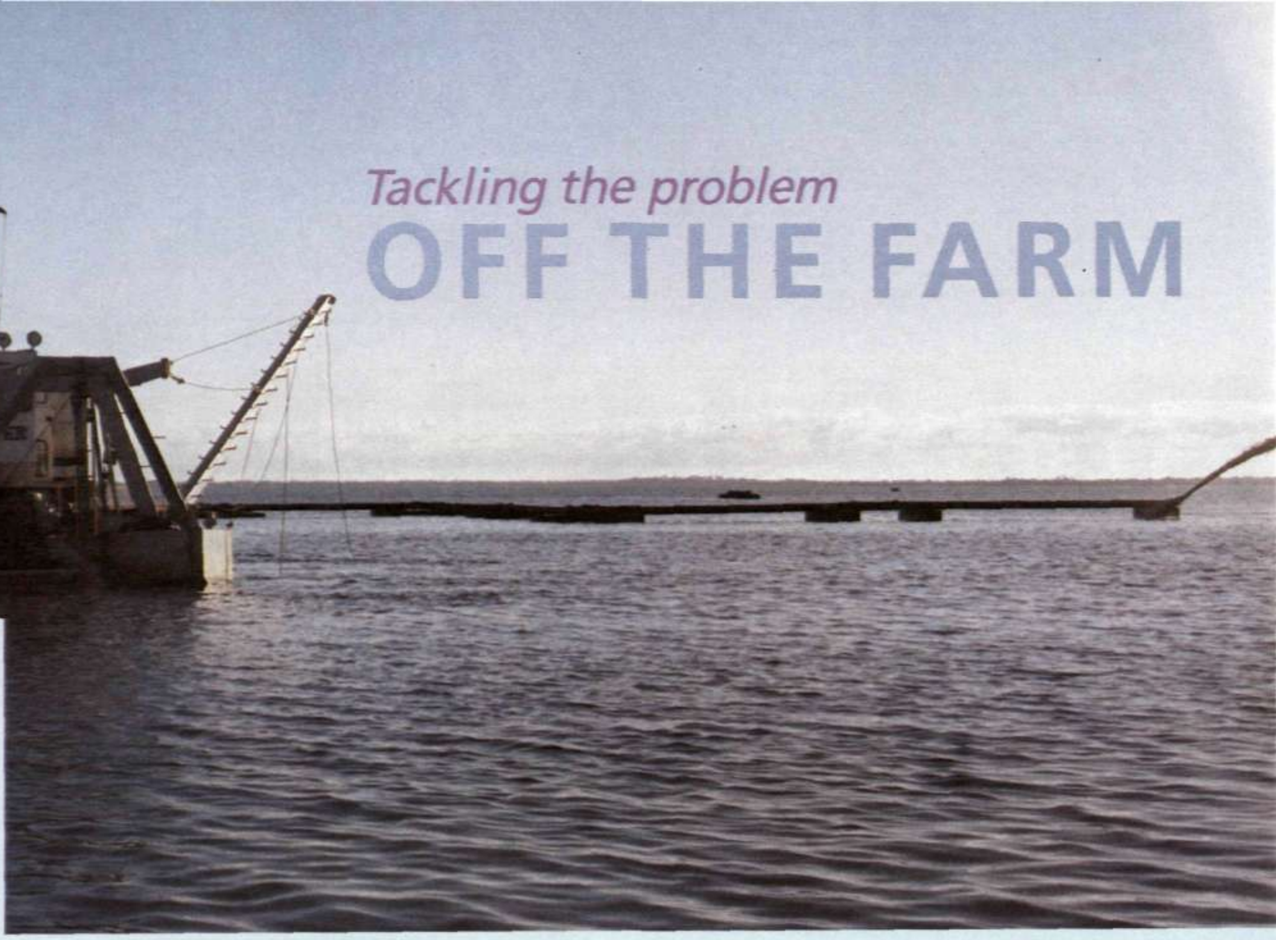
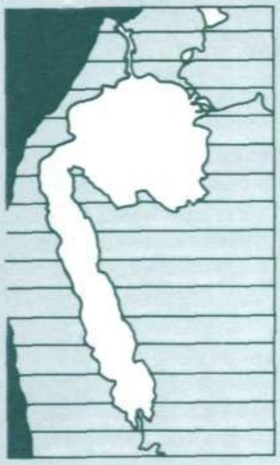


Tackling the problem
OFF THE FARM



PEEL-HARVEY
Estuarine System

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■ A dredge working at the mouth of the Serpentine River near where it joins the Murray River.

Methods of reducing phosphorus losses from the catchment soils of the Peel-Harvey estuarine system have been discussed in other articles in this Journal.

This article briefly discusses a range of 'off the farm' techniques to improve phosphorus flushing from Peel Inlet or Harvey Estuary to the sea and to treat the phosphorus and the algae. These techniques were among more than 100 management options evaluated by the Peel-Harvey Study Group.

Drainage network

Phosphorus could be removed from the drainage water or the water could be diverted to prevent it from entering the estuary. This could be done by:

- using vegetation to remove phosphorus from drainage water,
- treating drainage water with chemicals,
- diverting inflowing water away from algal growth areas.

The use of vegetation to remove phosphorus from drainage water is controlled by the rate of phosphorus uptake by plants. This rate is low when compared with the amount of phosphorus flowing into the estuary. Natural beds of plants in the drainage canals or in and around swamp outlets only remove small quantities of phosphorus. Artificial wetlands would have to be larger than the area of catchment being treated and they are unlikely to significantly decrease algal growth.

Chemical treatment to remove phosphorus from drainage water may be possible.

Limestone can adsorb phosphorus. If this material were placed in an adsorbent bed across a drainage canal and the water forced to flow through it, the phosphorus could be removed. Adsorbent beds of a realistic size could not remove enough phosphorus to significantly reduce the amount entering the estuary. Huge areas of land would be needed although smaller treatment areas may be viable for individual 'hot spots' in the catchment where phosphorus concentration is high.

Most of the water flowing into the Harvey Estuary or part of the inflow into Peel Inlet could be diverted elsewhere. A number of schemes to divert inflows into Harvey Estuary would involve preventing the water flowing through the estuarine system to the sea by installing a low dam or barrage and re-routing the flow through pipelines or tunnels to the sea. Apart from the cost of land acquisition and construction, algal blooms would still build up in the retained water.

A scheme was proposed to divert the Murray and Serpentine River inflows directly through the Mandurah Channel away from Peel Inlet. The access difficulties created in the Murray and Serpentine Rivers would outweigh the small benefits possible.

Phosphorus recycling

Phosphorus enters the estuary during winter and the microscopic alga, *Nodularia*, blooms in late spring and early summer.

The recycling of phosphorus as part of algal growth could be prevented by using chemicals to fix phosphorus, dredging to remove phosphorus-rich sediments or by preventing blooms of microscopic diatoms in winter.

Two chemicals, alum and nitrate salts, which can bind phosphorus were investigated. Mixing these chemicals into the water would not be efficient as much would be flushed out to the sea over a relatively short time. It may be more efficient to inject these salts directly into the sediments, using compressed air and a harrow. However, chemical would still be lost to the water over time.

Dredging the upper most layers of sediment should remove a large amount of the available phosphorus because most of it is in the top 10 centimetres of the sediment. Large quantities of spoil would have to removed and the long term effect of dredging without a reduction in phosphorus input is dubious.

Phosphorus is trapped during winter by diatom blooms. Recycling of phosphorus would be reduced if these blooms were stopped. Diatoms are an important part of the estuarine food cycle and any large scale attack on them could adversely affect the fishery.

Techniques for interrupting phosphorus recycling mechanisms are important in many highly eutrophic lakes. However, these techniques are not essential to the solution of the problem of the Peel-Harvey estuarine system in its current state. Of the methods discussed, chemical treatment of the sediments appears to be the most favourable.

Flushing

Once the phosphorus has entered the estuary, a large amount is lost by flushing to the sea, either dissolved in water or trapped in floating plant tissue. Water exchange between the estuary and the ocean may be improved by either pumping or increasing water level differences between them. The cost of pumping sufficient water to significantly improve exchange would be prohibitive.

At present water and phosphorus flows from Peel Inlet to the sea through the restricted Mandurah Channel. Studies have shown that dredging this channel could increase the flushing rate of Peel Inlet by 22 to 34 per cent. It could cost $3 million and take 1 to 2.5 years to complete. The effect on Harvey Estuary would be slight as nutrient exchange between Peel Inlet and Harvey Estuary is also restricted. This option would reduce the amount of macroalgae in Peel Inlet, but would not significantly affect *Nodularia* blooms in the Harvey Estuary.

Another suggested option would be to build a new channel near Mandurah. The high cost of this channel ($10 million) and of land acquisition, and the slight improvement in flushing, would suggest that this is not a practical solution.

By using tidal differences between the estuary and the sea and a pipeline at the southern end of Harvey Estuary, water exchange could be improved. This scheme would be extremely costly. Insufficient water would be exchanged because of the small tidal ranges between the sea and the estuary and the large volume of water in the estuary.

One other suggestion would be to increase the flow of water through the rivers feeding the system by either redirecting flows from the Harvey River diversion drain or opening irrigation dams. The amount of water available is small when compared with the amount of water required to significantly increase flushing.

The most favourable method of increasing flushing in Harvey Estuary would be to construct a new channel from Harvey Estuary to the sea. This channel would flush both Peel Inlet and Harvey Estuary. The costs are high ($20 to $25 million), but the benefits are far greater than all other options of this type.

The construction of a new channel (the Dawesville Cut) is being evaluated. This channel and dredging the Mandurah Channel would be the most practical methods of increasing nutrient losses through flushing.

The algae

A number of methods have been suggested to control the algae without affecting phosphorus input or retention. These options at present offer only short term improvements. The use of algicides in particular may provide a longer term solution if their regular application is environmentally acceptable and not too costly.

Biological control techniques are not practical for the Peel and Harvey system. Suitable pathogens, although identified, could not control the massive *Nodularia* blooms seen in Harvey Estuary. *Nodularia* in Harvey Estuary is unpalatable and cannot be controlled by grazing by fish. There is insufficient grazing of palatable algae by native species of fish within the system and the introduction of exotic species is not favoured.

Changes to the environment such as deepening the estuary have been suggested to control the algae. In general, these changes would be extremely expensive and would have an adverse effect on the current ecosystem.

Macroalgae are being mechanically removed from the estuary and the beaches. These techniques have minimised the nuisance caused by the algae but they do not remove sufficient nutrients to alter the productivity of the system. However, algae must be harvested each year until a permanent solution is found and sufficient time has elapsed for it to become effective.

Algicides may also be used to reduce the nuisance of the algae without affecting the phosphorus in the system. The method must first be tested and evaluated to ensure that there are no adverse environmental effects.