NATIONAL PROGRAM FOR Sustainable Irrigation

factsheet

NUTRIENT REMOVAL FROM RURAL DRAINAGE SYSTEMS USING WETLANDS

Investigating improvement to irrigation drainage systems

BACKGROUND

The Goulburn Broken Catchment Management Authority identified irrigation drainage as contributing 47% (1999) of the total catchment phosphorus loads to the Murray River each year. Environment Protection Authority guidelines for managing environmental impacts of construction projects, in this case the mobilisation and transport of sediments in both new and old drainage systems, also highlighted the need for appropriate drain construction and maintenance techniques.

In response, this project was commissioned to investigate the potential of reducing nutrients in irrigation drainage systems using in-line wetland technology and batter stabilisation. Two aspects of reducing nutrients were investigated:

- use of aquatic plants to remove nutrients
- stabilising the drain cross-section to minimise the drain contribution to nutrient run-off.

KEY FINDINGS

The results showed that planting aquatic plants in the drain, on average, reduced total phosphorus concentrations by 23% and average turbidity by 31% over the trial period. Minor reductions in other nutrient levels were recorded but these were not statistically significant.

Investigation of the components of the nitrogen and phosphorus revealed that most of this reduction was due to the insoluble portions of the nutrients and that the processes were physical processes such as sedimentation and filtration. A second important contributor to nitrogen concentration was the process of nitrification.

The trial section of the drain did achieve the first project objective as nutrient and sediment generation from the drain infrastructure was prevented. Only minor erosion was detected during inspections, and the levels of turbidity and suspended solids were reduced across the trial even immediately after construction.

IMPLICATIONS

The results indicated that if constructed off-line to the drains, wetland systems could offer significant benefits for nutrient reduction. A review of nutrient removal performance of the trial section for low flows (less than 2.5 ML/d) showed that nutrients were removed from the trial section relative to the control with a catchment nutrient reduction of between 10 and 29% achieved.

These results show that strategically placed off-line wetlands protected by suitably scaled inlet flow controls (in this case diverting flows with a greater velocity greater than 0.035 m/s) would be valuable as part of an integrated nutrient removal strategy. The balance of nutrient removal loads could be reduced through re-use, diversion and batter stabilisation.

The results indicate in-line wetland had the potential to reduce the level of service to irrigators in regard to drainage capacity during runoff events. However, this hypothesis was untested because of the lack of high flows during the trial period.

However in-line wetlands in irrigation drains have limitations in reducing nutrients in irrigation drainage water and that they will be of greater value in reducing turbidity and suspended solids.

ABOUT THE PROJECT

Research aims

The objectives of the project were:

1. To investigate the potential of reducing nutrients in irrigation drainage systems using wetland technology and batter stabilisation.
2. To determine the effectiveness of wetland technology within drainage systems with respect to:
   - nutrient removal
   - construction and maintenance costs
   - impacts of measures on drainage operation
   - other practical problems associated with construction and maintenance.
3. To recommend further design and implementation of nutrient mitigation measures within the Shepparton Irrigation Region, with the potential to retrofit existing drains and modify design of new drains.

Two particular aspects of nutrient removal were to be explored:

- stabilisation of drainage cross section to prevent drainage infrastructure from contributing to drainage sediment and nutrient loads
- using in-line aquatic plants to remove nutrients from the drainage water (biological and physical processes)

METHODOLOGY

A 1600 m continuous length of drain with a capacity of 100 ML/day was prepared. The upstream half of the drain was maintained as a control using existing drain management practices. The downstream half was sown with aquatic plants in the bed of the drain and vegetation was established on the batters of the trial section.

Flow monitoring stations were established upstream and downstream of each section to record flow and collect water quality data.

The drain was monitored over three irrigation seasons from December 1999 to March 2002. Manual sampling involved regular sampling once per fortnight and intensive sampling once per month. The intensive sampling consisted of daily sampling for five days. The manual samples at each of the three sampling stations were tested for the following water quality parameters:

- total phosphorus
- filterable reactive phosphorus
- total nitrogen
- total Kjeldahl nitrogen
- nitrates and nitrites
- ammonia
- suspended solids.

The turbidity, salinity, temperature, pH and stage were measured by an automatic probe with a data logger and manual measurements of these parameters were taken approximately every two weeks.

The results of the monitoring were analysed at the conclusion of the trial to assess the effectiveness of the trial in reducing nutrient in drainage water. The results were also subjected to economic analysis to determine the cost per Kg of removing the particular nutrients from drainage water.

RESEARCHERS

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The project started in November 1999 and investigations were carried out over the next three irrigation season until March 2002. A final report was prepared and completed in December 2002.

For a full report, go to Land & Water Australia's National Program for Sustainable Irrigation CD, *Irrigation Research 1993-2003* CD (item number EC030601), <*www.lwa.gov.au/catalogue*> or call 1800 776616 and quote the item number.

NATIONAL PROGRAM FOR SUSTAINABLE IRRIGATION

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