Acid Sulfate Soils in the LMRIA

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EPA 05/18825: This factsheet summarises the acid sulfate soils issue in the LMRIA and the involvement of the EPA in its management.

Introduction

The Lower Murray Reclaimed Irrigation Area (LMRIA) is currently experiencing problems with acidic drainage water in many of the salt drains that are pumped into the River Murray. The acid drainage water has occurred as a result of the rewetting of acid sulfate soils which dried during the 2006–10 drought. The Environment Protection Authority (EPA) is working closely with other government agencies, the LMRIA Sustainable Soils Working Group and local landowners in the region to manage the issue.

What are acid sulfate soils

Acid sulfate soils are naturally occurring soils which form in waterlogged coastal and inland areas, in the presence of iron, sulfate and organic material. Acid sulfate soils are harmless when covered with water, but if exposed to air, through excavation or drainage, they react with oxygen to form sulfuric acid in the soil matrix reducing the pH of soil and groundwater. pH is a commonly used indicator of acidity and alkalinity where a pH of 7 is neutral, lower levels (pH1-6) are acidic and higher values (pH 8-14) are alkaline. This acid, and the associated metals which are released, can be toxic to plants (including pastures), livestock and native animals, contaminate water supplies and corrode concrete and steel.

Why are they a problem in the LMRIA?

The very low inflows from the Murray-Darling Basin from 2007-2009 caused the water levels in the Lower Murray River (below Lock 1) to fall from a normal pool level of +0.75 m AHD to a low of –1.05 m AHD. The low river levels and lack of irrigation during the drought led to a drop in the shallow water table of 1.5–3 m from pre-drought levels. The heavy clay soils not only salinised, dried and cracked, but also exposed and aerated large areas of acid sulfate soils under some swamp areas. This produced large quantities of sulfuric acid in the soil.

When the water levels recovered in late 2010, and the irrigation of the LMRIA recommenced, the stored acidity mixed with a rising water table to create acidic groundwater which is eventually flushed into the drainage channels. This drainage water is then discharged to the River Murray, a practice which is necessary to maintain agricultural activities in this area.

The acidic (low pH) drainage water entering the River Murray poses a risk to the water quality and environmental values.

What is being done to combat the problem

The EPA, the Murray–Darling Basin Authority (MDBA) and Department for Environment, Water and Natural Resources (DEWNR), along with support from other government agencies and SA Water, DairySA and local landowners, is undertaking a project to examine the nature and risks of acid drainage originating in the LMRIA, through monitoring and research. This work will inform development of management options to both protect the environmental values in the River Murray and farm productivity in the region.

Specifically the EPA:

- Monitors each of the 14 acidic drains on a fortnightly basis to gather data about the level of acidity and metals present in the drains (Figure 1). This gives a good indication of what is being discharged to the River Murray
- Conducts fortnightly plume monitoring in the River Murray to track the concentration, path and dilution of the acidic water being discharged in the main river channel.
- Collects riverbed sediment samples to monitor metal precipitates discharged into the River Murray
- Feeds the data from the above monitoring into a hydrodynamic and geochemical model. This model is constantly being refined and will provide an estimation of the potential risk of the discharges to the River Murray when there is a low flow situation (< 2,000 ML/day at Lock 1)
- Has conducted a series of trials to test remediation measures to combat the problem in both the drains and on the irrigation bays (see below for more details).
- Works with the CSIRO to run a series of experiments to examine how quickly the acidic water is diluting in the River channel and the potential toxicity of this water on aquatic ecosystems.

Figure 1. EPA Officers testing the quality of shallow groundwater

Remediation options undergoing trials

Option 1: Large-scale flood Irrigation

A trial site was set up on an irrigation bay at the Long Flat Irrigation Area to test whether large scale flood irrigation would be beneficial in 'flushing' the acidity out of the soil profile while river flows were very high and sufficient to dilute the acidity. Groundwater and surface drainage water was intensively monitored over a series of irrigation events.

The data from this trial illustrated that irrigation, whilst providing positive benefits for soils and pasture, only very slowly decreases acidity present in the deeper subsoil and groundwater and results in increased acid export to the drainage channels and river.

Option 2: Surface limestone spreading followed by flood irrigation

This trial involved spreading approximately 60 tonne of superfine limestone over three hectares at the Long Flat Trial Site, followed by two irrigations.

Intensive monitoring illustrated that there was a small increase in pH and a reduction in acidity, especially in the top 1m of the soil profile. However, it is expected that it may take several months before the effect of the lime on the subsoils is noticeable, and improvement in soil acidity are seen.

Option 3: Limestone dosing of Salt Drains

This trial at Jervois Irrigation Area treated the acidic water in the drainage channels by introducing a neutralising limestone slurry prior to discharge to the River Murray (figure 2). Results showed that the acidic drainage is able to be successfully treated using this method. A neutral pH was achieved and acidity and associated soluble metals were reduced to acceptable levels before discharge to the River Murray. Although this is an effective and efficient method of neutralising acid drainage water prior to discharge, it is expensive, and does not treat the problem at the source (i.e. in the soils under the irrigation bays). This treatment method would have to be in place at each LMRIA discharge for a long time period and fails to address the potential build up of metal precipitates within the drains.

Figure 2. Limestone dosing undertaken by the EPA

Option 4: Treating acidity at the source – subsoil remediation using a modified mole plough

This trial introduced a neutralising material (lime slurry) into the subsoils by using a mole ploughing technique common to the LMRIA area (Figure 3). The mole plough was originally used in the LMRIA to form gravel lined channels to assist drainage in clay soils. In this trial, the lime slurry was used in place of the gravel in the mole drain. By using this method, the neutralising material was delivered directly to the sub soil and the zone of acidity (700mm below ground), without disturbing the pasture or topsoil. By creating pockets in the soils profile where the acidic groundwater and soil can be neutralised, it is hoped that the process of remediation can begin in these soils.

The trial has been conducted in the Mobilong Irrigation Area, a retired site owned by SA Water. Two paddocks were used in the trial, one as the mole plough trial site and one as a control. The mole ploughing was undertaken to a depth of 700mm in several parallel lines along the length of the paddock. Ploughing was followed by a series of irrigation events, which helps to spread the lime in the sub soils. This method has been undertaken over two stages. The first trial of this method was undertaken in October 2012 when 1,000 kg of lime was injected into the test paddock and a more intensive trial in December 2012 (6,000 kg of lime injected into the same paddock). Regular monitoring has been conducted to measure changes in acidity in the soil. Results are still under evaluation.

For more detail and the results of the trial to date please refer to the EPA Website.

Figure 3. Mole plough trial being undertaken at the Mobilong irrigation area

Recommendations for irrigators

- Understand what is happening on your farm – undertake visual observations and test the pH levels in your drainage water and soil.
- Ensure drainage channels, reuse drains and pumps are operating efficiently to keep the acidic ground water table below the root zone (> 0.5 m below ground level) where practical
- Try to maximise irrigation efficiency on your farm to minimise acid drainage volumes. Provided drainage is adequate, efficient irrigation should be beneficial as this will provide acid-neutralising alkalinity, leach acid down out of the root zone, and re-establish saturated conditions in the soil.
- Ensure that livestock is kept away from drains containing acid water. If animals come into contact with acid water, rinse them off. If they fall ill, call for veterinary advice.
- Where practical, keep acid water away from metal and masonry infrastructure.

For more information please visit: http://www.waterforgood.sa.gov.au/rivers-reservoirs-aquifers/river-murray/acid-drainage-water/

Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Further information

Legislation

Legislation may be viewed on the Internet at: <www.legislation.sa.gov.au>

Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet	Telephone:	13 23 24
Adelaide Service SA Centre	Facsimile:	(08) 8204 1909
108 North Terrace	Website:	<shop.service.sa.gov.au>
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