RESEARCH BULLETIN

Investigating Lake/Groundwater Interactions at Lake Tutchewop

Summary

Salinity is an on-going environmental concern that causes damage to agricultural land, downstream water users, aquatic ecosystems and biodiversity, as well as to regional and urban infrastructure. One strategy to manage increasing salinity in the Murray Darling Basin is the construction of 13 major salt interception schemes that divert 550,000 tonnes of salt away from the Murray River each year (Figure 1). The Barr Creek Drainage Disposal Scheme is one of these schemes diverting saline water into Tutchewop Lake. Ross Stottelaar was awarded a NPSI undergraduate scholarship to study the geology under Lake Tutchewop to determine the potential for salt to leak from the lake into groundwater and assess the ongoing sustainability of salt disposal at the site. This work was part of a larger review commissioned by Goulburn-Murray Water to better understand the hydrogeological interactions at the Lake Tutchewop disposal site before funding a salt harvesting scheme. Ross's work suggests that there is potential for salt leakage from Lake Tutchewop into groundwater but more specific research is required in order to confirm this hypothesis. To develop a reasonable conceptual hydrogeological model more information is needed on soil properties specific to the site. A conceptual hydrogeological model would then be used to determine how salt may be leaking from the lake.

Ross Stottelaar (foreground) setting up the drill rig on the north western side of Lake Tutchewop.

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Figure 1: Sites of the 13 Salinity Interception Schemes located in the Murray-Darling system.

Salinity in the Murray-Darling

Within the Murray-Darling Basin land-use change due to European settlement, changing farming techniques and the introduction of irrigation areas has contributed to significant increases in groundwater recharge. All these changes have led to increasing 'dryland' and 'irrigation' salinity, with Victoria alone, dealing with some 460,000 hectares of irrigated area currently at risk of salinity, as shown in Figure 2.

The Murray-Darling Basin Ministerial Council and the Murray-Darling Basin Commission are responsible for managing the freshwater resource and salinity mitigation initiatives throughout the shared rivers of the Murray-Darling Basin. An important part of this salinity management is improving salinity control and protecting the fresh water resource. To achieve this, the Commission has set out a series of works and measures in the Basin Salinity Management Strategy (BSMS) 2001 to 2015. This strategy includes the ongoing investment in salinity mitigation infrastructure (MDBC, 2003). The 13 salt interception schemes form the major part of this infrastructure.

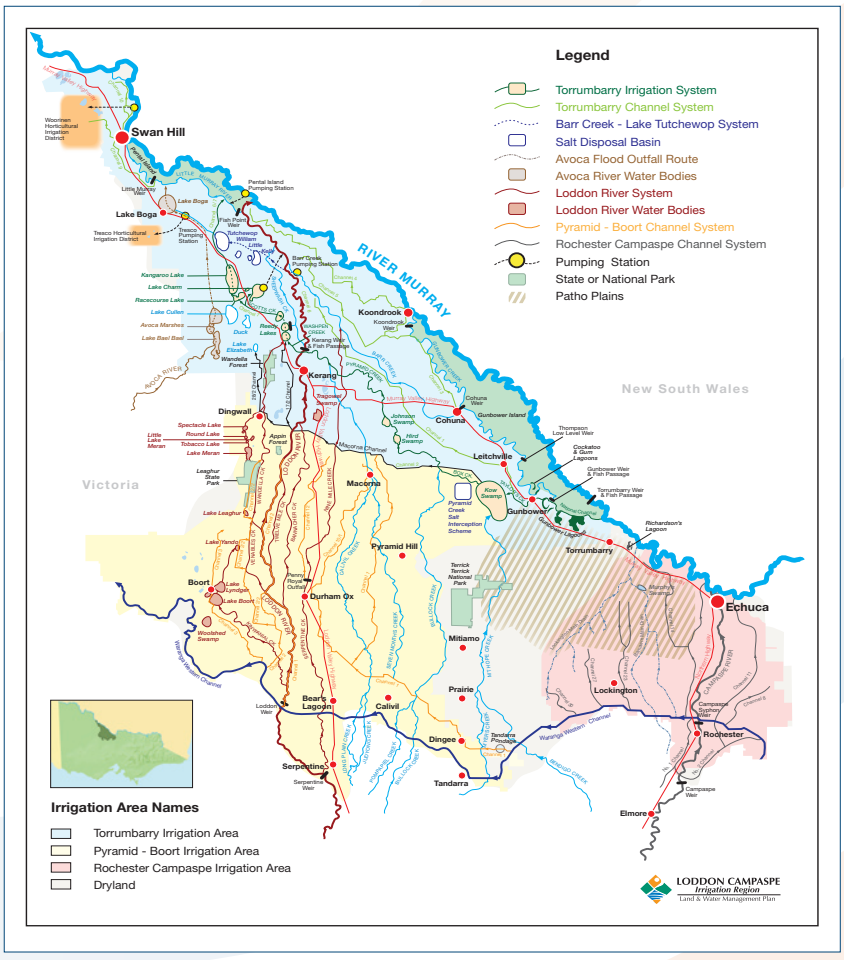


Figure 2: Schematic Representation of the Loddon Campaspe Irrigation Region

Managing the salt interception schemes

The interception schemes and their associated disposal basins are key elements in reducing the damaging affect of salinity. In optimising the management of each salt disposal lake, the interception schemes efficiently divert 550,000 tonnes of salt away from the River Murray each year, therefore, continuing the protection of the freshwater resource. The Barr Creek Drainage Disposal Scheme (BCDDS) is one such initiative that was constructed in 1968 to divert saline water flowing from Barr Creek away from the River Murray for disposal into the Tutchewop Lakes. Prior to construction, Barr Creek was recognised as the single largest source of salt entering the Murray River from any single point.

This study concerns salt management issues in Lake Tutchewop and associated lakes of Kelly, Little and William which are located to the south of the Murray River and approximately 30km north-west of Kerang in Victoria. The Tutchewop Lakes, are RAMSAR listed (no.265) sites as Salinity Disposal Reserves. Most of the area surrounding the lake has been developed for flood irrigation of pasture supplied by a series of channels. The Tutchewop Lakes are estimated to have received some 1.4 million tonnes of salt since the construction of the BCDDS in 1968. Continual disposal of salt loads into the Tutchewop Lakes is fundamentally not sustainable over the long term without substantial salt removal from the region. Goulburn-Murray Water manages 70% of the stored water in Victoria used for farming and is concerned with the long term sustainability of using the Tutchewop Lakes as salinity-disposal reserves. To protect against the gradual filling of the lake with salt, Goulburn-Murray Water proposed serial flushing of the lakes coupled with a salt-harvesting scheme to manage the salt load.

Preparing for a salt-harvesting scheme

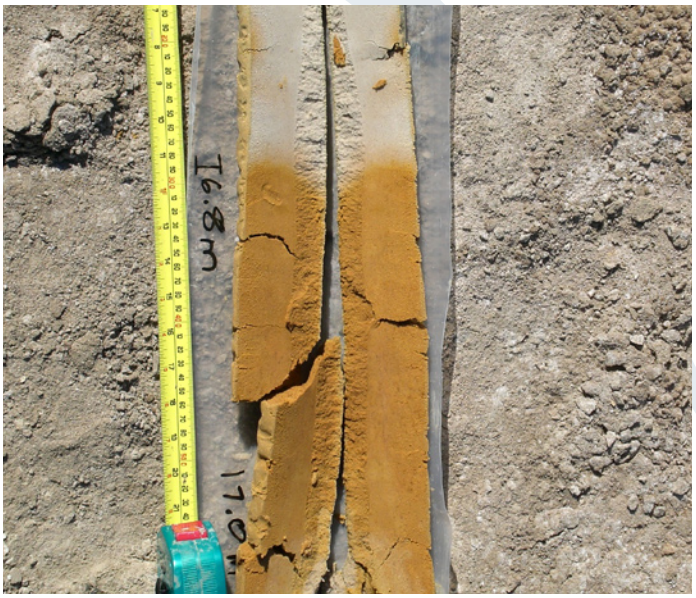
A salt-harvesting scheme would involve contracting a commercial salt harvester to remove some 55,000 tonnes of salt per year. To prepare for advertising a salt-harvesting scheme, Goulburn-Murray Water proposed to obtain an independent technical review of the salt, water balance assessments, salt concentration and storage calculations. This review was considered a necessary part of the Expression of Interest process for advertising the harvesting contract so that there was confidence in the economic evaluation of the salt-harvesting concept. The review was later expanded to include a technical review of the hydrogeology of the Tutchewop Lakes region, placing particular emphasis on current understanding of the surface water and groundwater interaction and salt concentration and storage process within and surrounding the Tutchewop Lakes. Contracting a commercial salt harvester was suspended and further work ceased until an independent examination of the hydrogeology of the lakes was completed and Goulburn-Murray Water was satisfied that salt was not leaking into groundwater.

The hydrogeological study of the lakes

The study used 38 stratigraphic bores to collect data on the geological layering under the lakes. The soil samples collected from the bores revealed interbedded sands, silts and clays of varying types, e.g. clayey sands and silty clays. This geology was formed over time from various sand types and muds being deposited due to changes in stream direction and flood waters.

The stratigraphic sequence, or layering, of the geology of Lake Tutchewop demonstrates that there is potential for salt leakage out of the lake. This salt leakage would be due to hydraulic gradients, found at certain locations, running away from the lake. The exact location and extent of the potential leakage is uncertain as previous studies of the soil properties and stratigraphy are not comprehensive enough. The permeability of the underlying stratigraphy is also uncertain as previous studies conducted were not specific to Lake Tutchewop.

These studies indicate that Lake Tutchewop is not hydrogeologically 'sealed' and salt is most likely being lost to the groundwater system. However, further studies need to be done to confirm this, including looking at the soil properties of the lake. With this additional information, a conceptual hydrogeological model could be developed and then modelling of potential salt leakage from the lake. Other factors which need to be considered are the response to importing salt load from the BCDDS, evaporation and salt accumulation.



Sand core from the ancestral stream



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Thanks

The student would like to thank:

- Goulburn-Murray Water for the opportunity to study salinity issues affecting Northern Victoria and to observe a field investigation drilling program.
- Associate Professor John Brumley for supervising the project.
- Glenn Passfield of Aquaterra for the supervision and technical support provided during this project.

About the student

Ross Stottelaar completed this project as a final-year undergraduate student in the RMIT University Environmental Engineering Program. The Tutchewop Lake study was a final-year work-integrated learning project forming part of Ross's undergraduate degree. As a result of the contacts Ross made during this project, Ross has relocated to Perth to take up a position of Resource Engineer with environmental consultant, Aquaterra. NPSI is proud to have sponsored Ross and wishes him good luck in his new job.

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GOULBURN-MURRAY WATER

About the Scholarship

The NPSI Undergraduate Student Scholarships enable university students in their final year of study to conduct short research, extension or industry projects under the direct supervision of a researcher or extension officer from either the public or private sector. The Scholarship is a great opportunity for students to gain practical experience in managing real issues and work in the irrigation industry.

About the Program

The National Program for Sustainable Irrigation defines and invests in research on the development and adoption of sustainable irrigation practices in Australian agriculture. The aim is to address critical emerging environmental management issues, while generating long-term economic and social benefits that ensure irrigation has a viable future.

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