

# **Shallow Groundwater Quality and Transport of Contaminants from a Domestic Wastewater System**

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# DECLARATION

*This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to this copy of my thesis, when deposited in the University Library\*\*, being made available for loan and photocopying subject to the provisions of the Copyright Act 1968.*

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# LIST OF ABBREVIATIONS

<b>AWTS</b>	Aerated Wastewater Treatment Systems
<b>APHA</b>	American Public Health Association
<b>ANZECC</b>	Australian and New Zealand Environment Conservation Council
<b>BOD</b>	Biochemical Oxygen Demand
<b>DO</b>	Dissolved Oxygen
<b>EC</b>	Electrical Conductivity
<b><i>E.Coli</i></b>	<i>Escherichia Coli</i>
<b>FWS</b>	Free Water Surface
<b>HRT</b>	Hydraulic Retention Time
<b>NHMRC</b>	National Health and Medical Research Council
<b>NRMMC</b>	Natural Resource Management Ministerial Council
<b>OWTS</b>	Onsite Wastewater Treatment System
<b>SAS</b>	Soil Absorption System
<b>SSF</b>	Subsurface Flow
<b>TDS</b>	Total Dissolved Solids
<b>TKN</b>	Total Kjeldhal Nitrogen
<b>TN</b>	Total Nitrogen
<b>TON</b>	Total Oxidized Nitrogen
<b>TP</b>	Total Phosphorus
<b>TSS</b>	Total Suspended Solids
<b>USEPA</b>	United States Environmental Protection Agency
<b>WSAA</b>	Water Services Association of Australia
<b>WHO</b>	World Health Organization

# ABSTRACT

The performance of septic tanks and soil absorption systems (SAS) has been the focus of research for decades. The treatment efficiency of on-site systems can be highly variable, and depends on the specific hydraulic dynamics of the site. An evaluation of these transport dynamics can provide an insight into the efficiency of treatment in soil-absorption-systems and the potential for off-site export.

This thesis involves an examination of the performance of an individual domestic wastewater treatment system and the processes associated with the subsurface transport of effluent in shallow groundwater at Taylor's Beach, near Port Stephens, NSW. The area is adjacent to Tilligerry Creek and has a shallow groundwater table ( $< 1.5$  m) and fast-draining sandy soil (infiltration rate  $> 1000$  mm/day). At the property monitored, the septic tank received blackwater and kitchen water from the household, while the majority of the laundry water was discharged to a separate trench. Nine monitoring bores were installed at different distances from the land application area to assist in delineating the plume of effluent in the groundwater. Groundwater samples were taken each month and analysed for pH, electrical conductivity (EC), nutrients (nitrogen and phosphorus) and bacteria (total coliform and *E.Coli*). The monitoring data and performance of the SAS and land application area have been examined along with the effluent transport dynamics in the shallow groundwater.

It was found that the anaerobic processes in the septic tank successfully reduced the concentrations of a number of pollutants in the domestic wastewater. The concentrations of the pollutants in effluent sampled adjacent to the SAS were diluted to background levels within metres beyond the boundary of the property. Even though concentrations were substantially reduced, it is inappropriate to construct SAS at sites where there is groundwater close to the surface. The results from the study are important given that further unsewered urban development is planned for the area and that there is uncertainty due to rising sea level associated with climate change.

# **PUBLICATIONS AND CONFERENCE PRESENTATIONS**

## **1. Journal Papers**

Su, D. X., Geary, P. M., & Lucas, S. A. (2013). *The Influence of Coastal Site Conditions on Subsurface Effluent Transport in Groundwater*. International Journal of Civil Engineering and Building Materials, 3(1), 10-18.

## **2. Conference Presentations**

International Conference on Integrated Water Management 2011, Perth, West Australia.

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