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

Dongxin Su
BSc

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DECLARATION

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LIST OF ABBREVIATIONS

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

International Conference on Civil Engineering and Building Materials 2011, Kunming, China.