ON-SITE SEWAGE MANAGEMENT, AS/NZS 1547 AND THE SYDNEY CATCHMENTS

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Abstract

Past operation and management of on-site sewage treatment and disposal systems has often resulted in the failure of these systems to comply with NSW guidelines. As such, they may represent a significant risk to the environment through nutrient pollution and to human health by the release of pathogens. This is of particular concern in drinking water catchments such as the Sydney catchments.

The new Australian/New Zealand Standard for on-site sewage management, AS/NZS 1547:2000, has the potential to reduce these failure rates in new systems through improved design. It also has the potential to improve the performance of existing systems through the implementation of better management activities, in particular the education of stakeholders, better operation and maintenance, and regular inspections.

The new standard appears to inadequately address the risks posed by nutrients and pathogens. The Centre for Water and Waste Technology UNSW, in conjunction with the Sydney Catchment Authority is undertaking research to address these issues. The project involves monitoring pathogen and nutrient attenuation in a range of on-site sewage management systems (OSMS), including absorption trenches, aerated systems and amended soil mounds. The monitoring will be used to validate and calibrate models of pollutant transport and attenuation in the subsurface, which will aid in the assessment of the environmental impacts of effluent release at local and catchment scales.

The Sydney Catchment Authority will use this information to assist in their risk management, planning and development control. The information will also be available to other decision-makers, and will be integrated with the results of other on-going research to improve the management of OSMS in general.

Keywords

Australian Standards, buffer, model, nutrient, pathogen, Sydney Catchment Authority

1 Introduction

Poorly designed and managed on-site sewage management systems (OSMS) are a threat to water quality. The pathogenic and nutrient pollution from these systems is of particular concern in water supply areas due to potential impacts on human health and the environment.

The current Australasian standard for on-site domestic wastewater management, AS/NZS 1547:2000, should increase the sustainability of new OSMS though improved design, reducing the risk to the environment and public health. The management section has the potential to improve the performance of existing systems. However, this standard does not appear to adequately address pathogen and nutrient issues.

The authors aim to address these and other perceived inadequacies in catchment scale management of OSMS. Their research focuses on developing appropriate buffer distances to minimise the risks to water quality from surface and subsurface land application areas, and aims to improve the understanding and management of pathogen and nutrient issues.

2 Background

The Sydney Catchment Authority (SCA) was formed to protect water quality in the Sydney drinking water supply catchments. The catchments cover an area of 1.6 million hectares, supply water to over 4 million customers and contain in excess of 18 000 OSMS. Pathogens and nutrients from OSMS have been identified as a significant risk to water quality in the SCA area of operations (Williams, 1999).

To minimise this risk, improved management is required for existing systems to reduce the incidence of performance failure, and ensure that new systems are designed sustainably. AS/NZS 1547:2000 includes valuable management information that has the potential to improve the performance of existing systems through stakeholder education, operation and maintenance guidelines, better tracking of system information and regular monitoring. It also includes more sustainable system design through consideration of a broader range of site factors.

The implementation of the management section, particularly stakeholder education, is vital for the success of the standard, including adequate consideration of site factors and qualitative performance criteria, but may be limited by the informative status of the management section and by a lack of available resources.

For example, performance criteria require that systems not adversely impact on public health or the environment. Yet the standard provides little guidance in these areas, particularly with respect to pathogens and nutrients, relying on the knowledge of the designer and regulator to ensure these issues are properly considered on a local and on a catchment scale.

Additionally, pathogens and nutrients are not adequately addressed by the quantitative performance criteria. Thermotolerant (faecal) coliforms are the only microbial organism required to be monitored, yet the standard acknowledges that these bacteria are an inadequate measure of public health risk. Phosphorous and nitrogen are not covered by quantitative performance criteria in AS/NZS 1547:2000, although it does recognise their potential impact on surface water, groundwater and native vegetation. These nutrients can have adverse impacts at a local and catchment scale, and hence require appropriate management.

Buffer distances are not covered by AS/NZS 1547:2000. The transport of effluent through the soil and groundwater in the buffer, or on the surface, should provide additional treatment such that the effluent discharged from groundwater or surface runoff into surface water does not adversely impact on water quality. This is a complex definition that requires consideration of surrounding land uses, background water quality and water quality objectives.

The SCA has adopted a buffer zone of 100m between on-site sewage land application areas and permanent or intermittent waterways. This buffer zone is under review to include slope, soil type and other site conditions in the consideration of pathogen and nutrient transport.

3 Literature Review

The New York City Department for Environmental Protection undertook research in the New York City watershed (Curry, 2000) to assess the risk to water quality from septic systems (with subsurface disposal). This study initially sought to explore the concept of developing a variable (site-specific) buffer distance. This proved too complicated, and the study simplified to assess the effectiveness of the present 30.5 m (100 ft) buffer (Olson, *pers comm.*).

The study included a literature review of previous studies of nutrient and pathogen contamination of groundwater from septic systems. Nitrogen pollution of groundwater from OSMS was reported at 97% of sites, bacterial indicators at 88%, viruses at 80% and phosphorous at 72%. Additionally, nitrate was reported to travel greater than 600 m in groundwater, ammonia greater than 180 m, and coliphage greater than 150 m.

Whilst the experiments undertaken showed transport of indicators of pathogens beyond the buffer zone, no recommendations were made regarding a more appropriate buffer due to insufficient information. Areas identified for further research include the significance of pathogen transport in groundwater to drinking water quality and better understanding of the impacts of soil chemistry on pathogen transport.

Neither the literature review undertaken for the New York study or the experiments of pathogen transport and attenuation in the field support the findings of laboratory scale studies which have reported 100% pathogen attenuation within 0.6 m (2 ft) of unsaturated soil.

A study undertaken in the Netherlands (Schijven, 2001) looked at pathogen survival and transport in groundwater drinking water supplies. This included several field and laboratory experiments and modelling. The results of the field experiments included an 8 $\log_{10}$ reduction in the concentration of virus surrogate MS2 bacteriophage within 30 m (25 days) in dune passage, and within 38 m (40 days) in deep well injection. Use of a worst-case scenario in the calculation of the protection zone for groundwater wells resulted in estimates of 3 to 7 times greater than the present Dutch guideline of 60 days aquifer travel time depending on site and aquifer characteristics.

Pollutant transport and attenuation depends on a number of factors including site and soil characteristics, climate and system design. Hence, the authors do not conclude that the results reported above are representative of the Sydney catchments, merely that this is possible.

4 Current Research

Similarly to the New York study, the research being undertaken by the Centre for Water and Waste Technology (CWWT) and the SCA aims to assess the risks to water quality from OSMS, and provide useful management tools for managing these risks. The project focuses on the risks from pathogen and nutrient pollution due to the concerns they represent in drinking water catchments and the lack of information provided by the standard and similar documents to adequately manage these issues.

The primary management tool under investigation is a model to predict the buffer distance required to protect water quality based on pathogen and nutrient transport and attenuation in the environment. This would provide buffer distances that vary with climate, soil type and depth, slope and other site-specific conditions. It will incorporate subsurface and surface transport (runoff) to permanent and intermittent waterways and the level of effluent treatment, effluent treatment reliability and type of land application system.

The definition of a buffer distance includes consideration of surrounding land uses, water quality and water quality objectives. Therefore, a model of the impacts of catchment pollutant loads on water quality is required to assess the acceptable effluent quality and buffer distances. This will also allow better understanding of the current cumulative impacts of OSMS on water quality throughout the catchment.

As part of this research, indicators of human faecal pollution, including a broader range of biological indicators (including phages, *E. coli* and *Clostridium perfringens*) and tracers such as MBAS will also be assessed.

5 Experiments

A series of experiments have been developed to provide information to develop and calibrate the model to site and soil conditions experienced within the Sydney catchments.

The primary experiment will monitor groundwater quality, to assess the transport and attenuation of contaminants in the subsurface, and examine surface (spray irrigation) and subsurface (absorption trenches) land application systems. These will be located in a range of soils and climates throughout the catchments to provide information on the influence of site and soil conditions on contaminant transport and attenuation. This experiment will also assess the performance of residential amended soil treatment systems.

Surface runoff quality will not be measured directly due to the presence of confounding variables such as pets and fertilisers. If deemed necessary, quantitative experiments may be undertaken to aid in modelling surface runoff quality.

A pilot study of the primary experiment was being undertaken at the time of writing. This study aims to assess the methods to be used in the full-scale study and provide preliminary results for use in model development.

To assess treatment system performance, samples of effluent from septic tanks and aerated wastewater treatment systems (pre- and post- chlorination) will be collected. These will be analysed for a range of indicators, nutrients and pathogens to produce data for use in risk assessment and modelling. If possible, effluent from systems with ultraviolet (UV) disinfection will be sampled to assess performance and for comparison with chlorine disinfection.

As part of this project, an amended soil treatment system installed on SCA land was designed to allow for sampling of influent, effluent and during treatment. This system will be used to assess treatment processes, performance under shock loads from public toilets and long-term performance. Treatment processes within the system will be modelled similarly to subsurface land application systems.

6 Conclusion

AS/NZS 1547:2000 has the potential to improve the performance of existing OSMS, reducing the risks to water quality in the catchments, as well as improving the design of new systems. However, more information and direction is required regarding pathogen and nutrient issues to ensure sustainable design and management. While there is information available internationally on pathogen and nutrient pollution from land application of domestic and municipal sewage, further research is required to apply it to Sydney catchments. In particular, information on catchment characteristics and experiments for calibration of models should provide the required information to assess the buffer zones required to protect water quality.

References

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