SWANS-SIG – Small Wastewater and Natural Systems Special Interest Group

NEWSLETTER No. 15 – OCTOBER 2011

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EDITORIAL

The three strands of the small wastewater and natural systems interest area are:

- on-site domestic wastewater systems;
- small community wastewater systems; and
- natural systems such as wetlands, ponds and land treatment in managing small wastewater flows.

The web-site pages for SWANS-SIG state the aims and objectives of the group are (see www.waternz.org.nz/swans.html):

- to provide a forum for interaction and discussion between participants in the small wastewater and natural systems industry;
- to facilitate the exchange of information between members and related organisations and agencies;
- to assist development of and provide support for training programs for participants in the small wastewater and natural systems industry; and
- to organise seminars, workshops and other meetings to support the objectives of the group; and to promote education and public understanding of small wastewater and natural systems issues.

It has been eight years since SWANS-SIG was formed at the Water NZ Conference in Auckland in 2003, with its accomplishments to date being:

- publication of a twice per year newsletter;
- participating in the Water NZ Annual Conference with a one day paper stream dedicated to SWANS topics;
- forming a close association with the NZ Land Treatment Collective with its special interest in natural systems and waste management;
- setting up the On-site Effluent Treatment (OSET) National Testing Programme (NTP) at the Rotorua City Wastewater Treatment Plant (a joint venture with Water NZ, Bay of Plenty Regional Council and Rotorua District Council); and
- establishing a SWANS discussion page on the Water NZ web forum.

With near to 400 expressions of interest in SWANS-SIG activities from Water NZ members, it is clear that SWANS has a significant following. There is, however, considerable potential for members to interact through the communication channels that have been developed, in particular the web forum pages. Please check these pages regularly, and if you have a small wastewater and natural systems topic you would like to share with others, or you want to seek information from others, use the web forum as a means of interacting with people of like interests.

Ian Gunn, Editor
[ian.gunn@xtra.co.nz]

NOTES from the CHAIR

Swan or Ugly Duckling. Is the industry heading from swan to ugly duckling? To me a swan is a natural, graceful animal that is pleasing to the eye, whereas an ugly duckling is something that craps all over your lawn and you want to hide it away. Why are we heading to the latter?

SW – Small Wastewater: We have come from a simple cost effective system that gave a fairly consistent effluent quality, although a low quality. We have seen effluent filters come into the market that have reduced the effluent quality variability further. These simple systems relied on natural bacteria within the treatment plant to partially treat the wastewater but mostly on the soil or biofilm within the soil for most of the treatment. These systems are of course septic tanks.

The good ole septic tank started getting replaced by package aerated treatment systems (ATS) and more sophisticated advanced wastewater systems (AWS) over the last 15 years. The number of these package plants that have come onto the market and now disappeared are too many to list. They give better effluent quality when they are working well. However, the ATS systems in particular, are based on the models of larger systems using a standard activated sludge process that generally has a full time operator adjusting blowers, looking at sludge age and wasting accordingly. Is it overly optimistic to have these systems work at a theoretical optimum for a single household with varying inputs and no monitoring? These are mechanical beasts in concrete or fiberglass boxes that use a lot more power than the septic tank; but that is a small concern compared to the amount of sludge that they create. However, the biggest issue is the potential over treatment of the effluent.

Over treatment; those that have shared a beer with me over the years have heard me go on about this before. ATS manufacturers used to quote effluent quality in BOD:TSS:NH_4. That's because these were the things they are good at reducing. Organic nitrogen is converted to ammonia and then nitrified to nitrate in these systems once the BOD is reduced. However, as the majority of these systems then apply the effluent to land, and many now through drip systems into the topsoil, further treatment is not optimised. The applied nitrate is an anion and is susceptible to leaching out of the root zone if not used by plants, or denitrified at warmer times of the year. This means that for long periods, what is applied is leached. This overtreatment has been somewhat exacerbated by the OSET trials where the focus was on reducing total nitrogen in the effluent. Nitrogen reduction is most simply done by nitrifying and then denitrifying, but once again this is a complex process that generally needs frequent operator input.

So what do we need: The soil is still the best medium for most of the treatment and the treatment system needs to be designed or selected around this – see the article below re Andrew Dakers' total management approach (TOWMS) – he is right on the button. Systems need to suit the location and the type of dwelling/complex, i.e. intermittent use or full time, matched to the climate (heated if necessary), hard wired in, as simple as possible, robust enough to handle fluctuating loads and chemicals, and most of all matched to the soil /plant /atmosphere /groundwater system. In most situations this should mean a system that needs very little fine tuning, can lower BOD and TSS to levels that will not cause down-pipe slime build-up or blockages, an effluent with TKN rather than TON, low reliance on mechanical input, no need for dosing chemicals, low sludge production and a very well designed dispersal system with appropriate landuse on it to match the N and P loading.

There are fixed film multiple pass package systems on the market that meet some or most of the above requirements. But they are being set up to over treat; usually to meet consent conditions that are tending to be based on end of pipe rather than a holistic approach. They can be set up as roughing filters and create mainly TKN but at a higher TN concentration than if they were set up to nitrify and denitrify. Therefore, either larger land area is needed to meet many Regional Councils guidelines, or education that higher TN in an ammoniacal form is better than less in a nitrified form.

aNS – and Natural Systems: These are generally difficult for individual on-site systems, however, there are a small number of passionate homeowners that have small wetlands/reed beds in their back yards.

On the small community scale, Natural Systems are the most cost effective system available as they use natural sunlight, wind, algae and plants to do the treatment rather than electricity and mechanics. Like the discussion on on-site systems above, ponds and wetlands produce very little sludge (desludge every 30 years), produce an effluent low in TON and use no or little power. So why are oxidation/facultative ponds out of favour? Land area, lack of control, at whim of Mother Nature, odour issues and Engineers wanting to build bigger and better things? I don't think any of the above are real issues that cannot be designed around. What we need are Scientists, Engineers and Planners willing to fight the NIMBY and Regional Council perceptions that these systems are old and poor technology.

Land treatment is a natural system but it is very hard to get a scheme off the ground, for similar reasons to ponds – land area and NIMBY. NZ is not considered a water short area compared to elsewhere in the world, however, our water is not always in the right place at the right time. Generally the East Coast of New Zealand is in water deficit for most of summer. Take Canterbury for instance. Christchurch puts about 200,000 m^3/d of effluent out to sea, which is enough to directly irrigate 4,000 ha. In the shoulder seasons and winter, aquifer recharge would allow a further 8,000 ha to be irrigated the following season and this is in an area that basically has a moratorium on further groundwater takes - water consents are being traded for thousands of dollars – the water has a value!!! Add to this earthquakes and our philosophy to build bigger pipes to take the wastewater to a centralised treatment plant looks shaky. Not only is the cost of this conveyance exorbitant, having all your eggs in one basket is high risk. Decentralised plants on the western side of Christchurch (where all the growth is occurring) with land application further to the west needs more than serious consideration.

What now?: Its obvious when you get old and cynical and have more questions than answers that it is time to move on and let people with passion and drive step up and have a go. So those out there with a passion for natural systems and perhaps a bit more time than some of us on the SWANS-SIG Management Committee, please make yourself known to the current committee. We need good science and then Regional and District frameworks to support natural systems that have a much lower cost to the community. We need people to dig their toes in and fight for these systems.

Let's push the Ugly Duckling aside and get the SWAN out where it can be admired.

Regards and Enjoy the Rotorua Conference

Rob Potts
CPG

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WITHER SWANS? It's the MEMBERS' CHOICE

I have the privilege of being on this year's Water New Zealand's Technical Committee. In July the Committee members met in Wellington to review the abstracts for the 2011 Conference in Rotorua. Reviewing the SWANS stream papers for the conference, I was surprised by the few papers with the SWANS theme and filling the allocated slots was a bit of a challenge.

I am aware that over the years significant, exciting and ground-breaking research and project work has been carried out by SWANS Special Interest Group (SIG) members and this continues to be the case. Using this work to produce good quality conference and technical papers is an important way of demonstrating the value such work has for the environment, clients and in some cases the project life cycle benefits. It also provides a way for knowledge sharing to enhance the SIG's standing by raising the bar through skills dissemination and attracting an increasing number of talented young scientists and engineers into the profession.

I therefore take this opportunity to encourage members to actively participate in the SIG by attending meetings, participating in forum discussions, writing and presenting papers at conferences (such as the Water New Zealand and Land Treatment Collective conferences). In the workplace, for the more senior members, mentoring up and coming junior staff is an important part of the process.

Contributed By:
Victor Mthamo
Senior Associate
CPG New Zealand Limited (CPG)

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BACTERIA, VIRUSES and SEPARATION DISTANCES

The following items are extracted from "On-Site NewZ", Issue 11/3, July 2011.

Keeping Waters Apart – New Separation Distance Guidelines for On-site Wastewater Systems and Wells

A paper on the above topic was presented at the 2010 Water NZ Conference. It was authored by a five person team from ESR (Institute of Environmental Science and Research Ltd) of Christchurch together with co-authors from a consultant in Christchurch and a staff officer from the Northland Regional Council.

Current separation distances between domestic wastewater dispersion fields and groundwater sources used for drinking purposes as applied by regional councils do not protect against viral pathogens. A two year study has developed guidelines for determining scientifically defensible separation distances based on virus transport through various combinations of hydrogeological settings. The paper describes the guidelines (which comprise a 296 page document set out in three parts, and is available for download from ESR) and provides an example of their use.

The guidelines were developed from information based on either the scientific literature or field measurements made by regional councils. Removal rates via attenuation mechanisms are assessed for the wastewater treatment unit, the soil through which flow passes within the dispersal field, the unsaturated soil zone above the water table and passage through the groundwater prior to withdrawal via well or bore. Virus reduction requirements were then evaluated from viral quantities in wastewater and the standards for drinking water. The resulting separation distances were developed for protection of groundwater wells against discharges from a single household on-site wastewater system. The resulting guidelines are designed to provide adequate protection for at least 95% of cases and in many situations will over-protect groundwater. They also are for unconfined, not confined aquifers.

They guidelines have not been verified by empirical testing via aquifer sampling. This would require replicating discharge of viral content from an infected household and tracking the resulting virus load.

Separation distances less than 40m are not covered by the guidelines except for pumice sand where virus reduction levels are so high a 20m separation is considered satisfactory.

A worked example is given for separation distance determination in locating a well away from a neighbour's property where a secondary treated and disinfected effluent is dispersed via drip irrigation, and a infectious waterborne viral disease breaks out in the neighbours' household. The result is determined via a six step process, each step having a series of decision stages, and results in a 155 m separation requirement for the soils involved.

The paper's conclusions note that although the best available scientific information and modelling methods have been used, in some hydrogeological situations the virus removal rates have been best estimates. The guidelines are however a step forward in establishing separation distances, but are not the final answer. "Refinement of the values it contains will be needed when sufficient new information becomes available."

On-Site NewZ Reviews of Clearance Distances

Over the years On-Site NewZ has published a range of reviews of literature on the topic of bacteria, viruses and clearances (separation distances) between on-site effluent discharges and ground and surface waters. Overall the results of the reported research and field studies indicate that the ESR guidelines above are likely to be extremely conservative. Admittedly the ESR and co-author team do qualify their outcomes, given that estimates have had to be made re some of the attenuation rates used in the guidelines. They have also been developed for protection of wells on neighbouring properties from a household infected with an outbreak of viral disease, have not been verified by field testing, and are judged to be conservative.

The On-Site NewZ review in July 2002 produced as Special Report 02/2 evaluated the content and findings of 13 referenced documents and presented a set of findings on both vertical and horizontal clearance distances which in summary stated:

Separation distances to groundwater and surface waters have in the past been set to provide arbitrary factors of safety based upon use of septic tank and soakage trenches. There is no consistency in the values adopted. They probably reflect an expectation that such on-site systems are not a fully reliable means of wastewater servicing, and that poor performance can be compensated for by an appropriate buffer between the system and water sources used for community and/or individual household supply. Research and practice experience is now available to confirm that properly designed on-site systems can totally retain microbiological contaminants within the land application system and thus protect natural waters both on-site and off-site for subsequent use. Design methods enable variable vertical separation distances to be utilised. Arbitrary horizontal distances are still set by some Regional Councils as factors of safety for use in District Council approvals. However, Regional Councils are able to consider reduced clearances on a case by case basis through their consents procedures.

Essentially the literature review gave some assurance that good design and operational practices could boost the attenuation of bacterial and viral discharges within a land application system and within the unsaturated soil layers immediately below the infiltrative surface so that off-site effects were neutralised. Clearly there is a need for a comparative study of the ESR guidelines versus past and current field research results to reconcile the findings and establish a better context for protection of groundwater sources from potential on-site wastewater effluent contamination.

AS/NZS 1547 Revision and Separation Distances

Although the revision of AS/NZS 1547:2000 has not been published yet, the Public Comment version in November 2007 included a new appendix dealing with separation distances. The 2000 version sidestepped on this issue by leaving it to regulatory authorities to set their own guidelines.

The proposed appendix indicates it "provides a summary of information on setback distances compiled from a literature review. Local conditions and sensitive receiving environments may require different setback distances. The tables in the Appendix provide a guide on the setback distances that may be applied to land application areas, based on site constraints identified during the site-and-soil evaluation".

The two tables are:

Table 1: Guidelines for Horizontal and Vertical Setback Distances (to be used in conjunction with Table 2).

Table 2: Site Constraint Scale for Development of Setback Distances (used as a guide in determining appropriate setback distances from ranges given in Table 1).

Table 1 cites vertical clearances for groundwater of 0.6 to 1.5m, and horizontal clearances to bores and wells of 15 to 50m. The ranges given are then to be related to some 10 site constraints of specific concern set out in Table 2, which gives guidance on adjustment of the separation distances to deal with the constraints and the sensitivity of the receiving environment.

Overall, the Standard concludes that:
An adequate depth of unsaturated soil below the base of the land-application system is necessary in order to remove bacteria and virus particles within the soil system. Human intestinal bacteria and viruses are removed and inactivated in the soil by adsorption, straining desiccation, and other soil microorganisms, thus enabling the retention and die-off of both harmless gut organisms and pathogens over time. This is facilitated by maintaining aerobic (unsaturated) conditions in the soil.

Clearly the Standard accepts that the attenuation capacity of the soil system has a major role in controlling bacterial and viral contamination from on-site wastewater effluent discharges, and the separation distances set out in the appendix provide the means of confirming that protection.

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TOTAL ON-SITE WASTEWATER MANAGEMENT (TOWMS)

This topic has recently been addressed by Andrew Dakers in a posting on the SWANS pages of the Water NZ Web Forum (go to http://forum.waternz.org.nz and follow the link to SWANS). Andrew states:

"I would like to encourage some discussion in this forum on the concept of total on-site wastewater management (TOWMS). My reason for raising this issue is that, as a consequence of many years of working as an independent designer and educator of on-site wastewater systems, engaging with purchasers of these system, technology suppliers, regulators, installers, servicing agents, academics and research scientists, I am becoming increasing aware of the importance of, and benefits for, stakeholders adopting a more holistic systems approach to on-site wastewater management and services. I am not yet convinced that this has been the case and that our industry is hobbled by an overriding mechanistic approach. In terms of the key outcome we should be aiming for, I think this is best described by AS/NZS 1547 i.e. to provide a *sustainable and effective* on-site wastewater service that provides the purchaser of the system with a convenient amenity service at the same time as it protects the health of the public, individuals and the ecosystem within which it is embedded. (My words but in accordance with the essence of what the Standard says).

The TOWMS comprises the following key technological components.
1. Source technologies
2. Treatment unit
3. Dosing system
4. Land application systems and it distribution system.

All the above components (apart from being affordable) are required to be effective, efficient, durable, reliable and resilient.

In addition to the above technological components the TOWMS also comprises:
5. Competent site assessors and total system designers;
6. Competent installers and system commissioning;
7. Competent servicing agents that will provide regular maintenance and servicing.
8. All in the context of a well-informed, real-risk related regulatory framework.

All the 1 to 8 items above have to be locally available and failure or incompetence in any one of the above will put at risk the effectiveness and sustainability of the on-site wastewater management service."

Andrew is interested "to hear the views of others with real-world experience in this field on this matter". To comment and/or present a view, go to the forum page and follow the instructions re registering and posting comments.

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REINVENTING the TOILET – HIGH-TECH or NATURAL SYSTEMS?

On-Site NewZ recently reported on the Bill & Melinda Gates Foundation "Reinvent the Toilet Challenge" and questioned whether the money intended to "reinvent the toilet" would be better used in solving the sanitation challenge by developing services to collect human faecal solids and liquids from the range of non-flush toilets already available and utilising these "wastes" as a potential resource."

Essentially the "challenge" was to "invent a waterless, hygienic toilet that is safe and affordable for people in the developing world and doesn't have to be connected to a sewer". Projects funded to date appear to be mainly high-tech, and include toilet systems which produce biological charcoal, produce electricity for local use, divert and recover urine, mechanically dehydrate faecal matter, use solar power to generate hydrogen, and recover energy and nutrients via advanced adsorption desalination. Eight projects have received funds from a total grant package of $3m (US).

On-Site NewZ made the point that there exists a decade's long experience record from many development agencies' and research groups' work in alternative sanitation servicing using non-flush toilets and human waste resource recovery systems, but their implementation is often constrained by deficiencies in the organisational, institutional and political processes necessary to provide effective sanitation servicing. Hence, the problem that needs addressing is not technical, but organisational.

However, although the On-Site NewZ view may be valid, it has overlooked the full spread of initiatives being undertaken by the "Water, Sanitation & Hygiene" programme of the Foundation which has invested some $265m (US) into this area over the last five years. These include looking beyond just giving people a latrine or toilet, and extend to evaluating the context in which people, communities, commercial companies and local and central government contribute to effective sanitation services and policies. The Foundation's grant programme is currently contributing in four key areas:

- Sanitation science and technology [of which the reinvent the toilet challenge is $3m (US) out of $18m (US) in project grants].
- Sanitation delivery models at appropriate scale [some $28m (US)].
- Policy and advocacy [some $14.5m (US)].
- Monitoring, learning and evaluation [some $12.6m (US)].

Admittedly, several of "grand challenge explorations" in the science and technology area include high-tech approaches, some of which have been tried before, but others focus on low-tech natural systems such as compost treatment or algal treatment and recovery, of which some also have been tried before. In algal recovery and utilisation NASA had a 1970s study into spaceship waste recycling growing algae on nutrients from human waste, and recovering dried algal flour for astronaut consumption. However, the "astronauts" running the study were not too keen on the resulting green cookies. Another US research project looked at growing algae on chicken farm manure and feeding the algal product back to the hens. However, hens preferred standard chicken feed to the algal substitute and about the only benefit to the research team was the regular output of eggs from the subjects being researched.

So, in spite of On-Site NewZ's concerns re the reinvent the toilet project, it looks like the mix of high-tech and natural systems being investigated under the Gates Foundation grants has promise in leading to delivery of improved sanitation services in its target areas. No mention has been made re worm based faecal containment and stabilisation systems yet – maybe NZ has something to offer in this area.

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BIOLYTIX UPDATE

Newsletter 14 reported the January 2011 liquidation of the Biolytix companies in Australia, and noted that the New Zealand company was continuing in business. Subsequently (February 2011) the intellectual property of Biolytix Australia was purchased by a new company, Biolytix Ltd, with the now wholly NZ owned operation commencing manufacture of the Biolytix BioPod in Auckland.

The web-site for the NZ company (www.biolytix.com) has full details of the setting up of the company this year, along with information on the technical team working with General Manager, Karl Geiseler. Karl states "the other owners of Biolytix Ltd are a team of engineers including Chemical, Civil, Mechanical and Electrical engineers all with backgrounds in many aspects of environmental engineering including on-site, decentralised and municipal wastewater treatment, sewer reticulation, land irrigation and land disposal projects and all with local and international experience". The companies register shows the new owners include principals from Ecogent Environmental Engineering Solutions in Auckland. Ecogent is a highly experienced consultancy and well placed to underpin the Biolytix product with technical support and development.

As readers will be aware the Biolytix treatment system is based on full flow treatment of domestic wastewater via a treatment tank containing layered pods of "humus" media through which household black and greywater filters, with worms and other organisms used to degrade and consume the waste matter. For a worms eye view of activity on the surface of the pod system, go to the PooCam on the home page of the website [the video is rated "PG (Pretty Gruesome)"].

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WATER NZ ANNUAL CONFERENCE, 2011

This year's Annual Conference and Expo in Rotorua 9-11 November is being held at the Rotorua Events Centre. There is a 3-paper SWANS session on Thursday morning 10 November as well as other small community wastewater papers elsewhere in the conference programme. Details of the preliminary programme and registration information can be found can be found on the Water NZ web-site.

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NZ LAND TREATMENT COLLECTIVE CONFERENCE, 2012

From 28 to 30 March 2012 the New Zealand Land Treatment Collective will hold its annual conference at the Sebel Trinity Wharf in Tauranga bringing together staff from research institutes, district and regional councils, universities and private consultancies. The theme of the conference is

> ***Emerging contaminants - unlocking the secrets of everyday chemicals and their fate in our environment***

The conference aims to encompass the latest developments in emerging contaminant research in wastes products and their fate in the receiving environment. Topics for presentations or posters for which submissions have been invited relate to the disciplines of:

- Small wastewater and natural systems
- Land application of agricultural wastes: e.g., dairy, piggeries

- Land application of horticultural wastes
- Land application of municipal wastes
- Small community wastewater management
- Cultural, social, economic and environmental impacts of land
- application of wastes
- Biosolids management

The submission of abstracts has been extended to 21 October 2011. Successful authors will be notified in early November and a preliminary programme will be available on the Scion website by mid November [go to www.scionresearch.com and "Working with Scion" and click on the link to "New Zealand Land Treatment Collective"].

Preference will be given to papers relating to the theme but all presentations relating to the application of wastes to land will be welcome. If you are uncertain whether your paper will fit the programme please don't hesitate to contact Marie Heaphy, Technical Manager NZLTC at Marie.Heaphy@scionresearch.com.

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