INTRODUCTION

This conference, organised by Dr Robert Patterson of Lanfax Laboratories in Armidale, was subtitled “Advancing On-site Wastewater Systems – Design and Maintenance”. Its purpose was to build on the “On-site ’99” conference by providing “an opportunity for professionals to exchange ideas and the latest research, as well as renew networks among their peers”. The conference theme recognised “that various regulations and guidelines are in place, and the real effort of enhancing the performance of on-site systems is now the issue”.

On-Site NewZ Special Report 01/3 of October 2001 comprised Part 1 of this two-part review of conference papers. Seven papers/presentations were reported on in Part 1, and this Part 2 review covers a further eight, commencing at No. 8.

8. Iluka Wastewater Management – A Case Study
   Neville Hutton, Egis Consulting Australia

The town of Iluka on the north coast of NSW is located on coastal sands with groundwater at 1 to 4 metres depth, and is the largest unsewered township in the State. With a permanent population of 2000 on some 1000 properties, it has a significant influx of visitors during holiday periods. Some 50% of lots are less than 800 m² in size and 18% less than 600 m². Though there is a community water supply for household use, the groundwater is used extensively for on-lot garden irrigation and for public open spaces such as golf course and playing fields.

Environmental assessments of the impacts on estuarine waters showed that properties within two blocks of the river were providing the major contribution to nutrient and bacterial levels in natural water. These areas had the higher elevation of groundwater relative to ground surface level, and also the greatest concentrations of commercial and medium density residential.

A working group (comprising community and local and state government representatives) looked at three general approaches comprising do nothing, upgrade on-site systems, and provide centralised servicing. These were subdivided into 3 on-site management strategies, and 10 centralised system strategies based on a range of collection, treatment and disposal options (including potable reuse). The on-site management upgrade strategies consisted of:

- AWTS plus subsurface irrigation;
- Septic tank and modified mound;
- Reducing wastewater output via compost toilet, and using AWTS and drip irrigation for remainder of systems.

However, following a screening process related to performance criteria adopted by the working group, the on-site options were set aside in favour of three of the centralised strategies to compare with the “do nothing” approach. The paper sets out the four reasons which led to setting aside the on-site options as:

- Environmental performance criteria regarding groundwater contamination could not be met;
- Small lot sizes provided insufficient space for upgrades due to extent of on-lot development;
- Whole of life costs (over 20 years) were higher relative to other options;
- There was a preference for centralised systems amongst some stakeholders due to a perception of higher levels of service and convenience.

9. NSW On-site Sewage Management Reforms – Septic Safe – A Progress Report
   Robert Irvine and Penelope Hood, Dept Local Government, Sydney

Local government regulatory reforms to enable more effective council control of decentralised wastewater management activity were announced in 1998, and are now branded as the Septic Safe Program. The $3.8 million program consists of two stages, the first including a community education component, but with the bulk of some $2.6m going...
to local councils to provide for registration of the 300,000 or so state-wide on-site systems, and for development of local management strategies. Stage II ($1.2m) involves a systematic risk assessment for on-site wastewater pollution in selected coastal catchment areas in the State. The overall subsidy to local councils works out at around $7.40 per existing on-site system.

Information available from the SepticSafe web site (see <http://dlg.nsw.gov.au>) includes a set of on-site system guidelines and a plain language system owner’s guide. Other products also available or under development include an information management handbook, a risk assessment handbook, and some 16 technical sheets related to design, installation and operation. An “On-site Sewage Management Course”, developed in conjunction with NSW TAFE, is to be provided as a short course study program from first semester 2002. It is aimed at council staff involved in site assessment and inspection work, at septic system maintenance providers (drainlayers, pumpout contractors), and will provide a qualification for third-party certifiers of septic system performance.

A research grant component of some $500,000 is included in Stage I for some 19 projects related to monitoring and management of on-site systems in environmentally sensitive areas, and for some 5 research projects.

The concept of “on-the-spot” fines for on-site system infringements is under consideration at the moment, but such a measure cannot be viable in the current context of poorly trained supervisory personnel and inspectors. Once training gets up to speed, the fines system will be considered again.

10. Wastewater Management in National Parks

Peter Jelliffe, Jelliffe Environmental Ltd, Coffs Harbour

Inadequate management of human waste has potential to build up contaminants in park environments, and thus run counter to the conservation objectives on which the park system is founded. The most effective systems are those which have the simplest operational and maintenance requirements, and are designed to handle specific loading patterns associated with park visitation levels.

Those design principles found most useful for parks facilities are:

• Each site will be different (designers really need to spend time at the design location, and review user activity over a day or more);
• Wastewater system design and site design need to be integrated (do one or more decentralised toilet facilities best suit the site development?);
• Design for minimal wastewater production (low water use facilities best);
• Design for sustainability (being low risk of system failure and low contaminant emission to surrounding environment);
• Keep it simple (low energy, low maintenance);
• Design for growth;
• Larger facilities may benefit from economies of scale provided by centralised schemes.

The author’s experience has found that low water use systems such as compost or Hybrid Toilet System™ (a type of wet vault) will top the options assessment list. However, compost toilets require a high maintenance commitment unless they have steady and low usage rates. Under the peak load conditions that occur with typical park visitation patterns, most compost toilet systems accumulate waste faster than their capacity to produce mature output, resulting in the need for removal of un-composted material. This is not a preferred task by park staff, and where compost toilets are the selected option, those with removable containers are more suitable for dealing with peak load maintenance than those which require shovel removal of waste. Where access for a pumpout unit is available the Hybrid Toilet System™ has significant advantages, providing effluent volumes at less than 5% of low flush septic systems, and a final product for pumpout of high quality compared to septic effluent. [Note: The author has no commercial interest or affiliation with any of the manufacturers or products mentioned in the paper.]

11. Enhancing Nutrient Removal from Existing On-site Systems

Daniel Martens, Martens & Associates Ltd, Sydney

The emphasis on sustainable on-site system performance in the context of ESD (ecologically sustainable development) has meant that nutrient control on discharges has become an important consideration. Two methods of control are first, at source reduction, and second, increasing the size of land-application areas to accommodate nutrient loads. Source control can be achieved by simple upgrade options for pre-treatment units such as sand filters, AWTS, and amended soil filter units. Intermittent sand filter units with high dosing frequencies (12 to 48 times per day) convert nitrogen to nitrate during passage through the filter. If this aerobic phase is then followed by an anoxic or near anaerobic phase prior to land application, then 50% to 70% of influent nitrogen can be removed.

Over aeration in AWTS units will inhibit the potential for anoxic conditions in the final compartment, thus limiting denitrification processes which can reduce effluent nitrogen. Simple timer control of aeration cycles can ensure that over
aeration is avoided, and the right conditions are developed for nitrogen removal.

Amended soil systems comprise a bed of media high in iron and aluminium into which septic tank effluent is applied. The P-sorption characteristics of the amended soil accumulate phosphorus, while aerobic and anoxic conditions in the bed media contribute to nitrogen removal.

These three methods should not be considered in isolation, but as “tools” which can be used separately or in combination to assist in nutrient management.

12. Peat Bed Filters for On-site Treatment of Septic Tank Effluent
Robert Patterson, Lanfax Labs, Armidale

A 600 mm depth of peat can provide significant treatment for septic tank effluent. Monitoring of five out of seven peat bed systems at the village of Tingha in northern NSW has revealed up to 99.5% FC removal, 44% TN and 83.5% TP removals. These beds were commissioned early 2001. Each of the bottomless beds sits on the existing ground, and is 3m square with the treatment peat laid 600mm deep over a course sand collection layer through which agricultural drainlines pass. Treated effluent is thus carried away from under the bed for soakage and evapo-transpiration in the natural soils surrounding the treatment unit using either mound or trench systems.

The phosphorus removal capacity of the peat bed systems was the critical performance requirement because of the low P-sorption characteristics of the local soils. These soils comprised course sands over light sandy clay, or deep coarse sands with no phosphorus retention capacity at all. The pressure distribution lines from the septic tank unit comprise a grid of 32 mm lines overlain with a further 100 mm of peat to form the upper surface of the bed. Good ammonia conversion to nitrate takes place in the peat. Effluent is brown coloured due to tannin washout, although this colour is not detrimental to subsequent soil soakage. Tannin is likely to leach downwards, although this colour is not detrimental to the receiving environment. One unit produced higher SS in the effluent than the input septic tank effluent, but this is expected to settle down.

The Biogreen™ peat used in the beds a blended product sourced from Biogreen Ltd’s resource in Victoria. For these bed systems, it is estimated that the phosphorus absorption capacity will be reached in around 7 years, although their performance in BOD and bacterial removal will continue undiminished after that time. If P-sorption is the principal treatment requirement, the peat can be readily replaced. The used peat can be utilised around the site as a soil conditioner.

13. Septic System Performance: a Case Study at Dunoon, Northern NSW
James Bruce, Southern Cross University, Lismore

Twenty septic tank and absorption trench systems were studied as to their current performance, and as to the effects of three low cost measures aimed at improving that performance. These measures included water efficiency upgrades, use of low phosphorus detergents, and pumpout maintenance. The investigation involved installing water meters so as to record all in-house uses, and placing 50 mm standpipes in all trenches to record depth of standing effluent. Six out of the 20 dwellings had greywater (laundry) diversion systems.

The ponding depth in each trench was considered a good indicator of system performance. All but one trench showed evidence of continuous surcharging (this trench being installed in fill from the excavation for the dwelling on the site). Indeed, loading rates were around 23 mm/day in soils for which AS/NZS 1457 would have set 10 mm/day as the DLR in the clay loams of the area. Four trenches showed no ponding at all throughout the study period. During rainfall, ponding depth increased temporarily, but rapidly dropped off on cessation of the event. It is possible that because the systems investigated were selected from those offered voluntarily by householders following an area wide request, that persons with surcharging systems did not come forward as potential participants. During a survey of failures at a neighbouring community (Clunes), it was found that 27% of all trench systems were surcharged.

Installation of water efficiency devices in several dwellings showed a net reduction of around 45 l/person/day (or 26%) over previous use. Where water saving devices were introduced, and where pumpouts were carried out, TSS trended downwards, although overall TSS outputs were highly variable over time.

14. Towards a Better Understanding of Sustainable Lot Density – Evidence from Five Australian Case Studies
Joe Whitehead, School of Geosciences, The University of Newcastle, Callaghan, NSW

A number of surveys of the performance of on-site wastewater systems in Australia have demonstrated a high proportion of failing or poorly performing systems. One study in Victoria into nitrate impacts on groundwater noted that high contamination levels (where nitrate nitrogen was raised above drinking water standards) resulted from a septic tank density of 15 systems per km². However, there is little published literature which shows direct linkage between specific incidences of receiving water contamination and the performance of on-site systems.
Four coastal settlements in NSW and one in Tasmania have been studied since 1998 for links between surface water and groundwater quality and impacts due to on-site systems. Specific catchments containing some 10’s of domestic properties were mapped in detail and appropriate sampling points identified for both surface and groundwater. The sampling programme included for both dry weather and wet weather conditions.

The water quality data for the five community areas indicated the following:
- Allworth, Karuah Valley, NSW - seasonally water logged clay soils; dwelling densities 338 to 426 per km²; surface water NO₃ slightly elevated in parallel with indicator bacteria.
- Coomba Park, Wallis Lake, NSW – thin soils sandier than Allworth; dwelling densities 209 to 548 per km²; surface water NO₃ lower than Allworth, bacterial indicators high.
- North Arm Cove, Port Stephens, NSW – permeable light sandy clay loam soils at depth; dwelling densities 0 to 619 per km²; surface water NO₃ and bacterial indicators generally low.
- Pindimar, Port Stephens, NSW – flat poorly drained sands, high water table; dwelling densities 6 to 58 per km²; surface water NO₃ and bacterial indicators low; groundwater NO₃ low and bacterial indicators below detection limits.
- Dodges Ferry, Hobart, TAS – sands and sandy clay layers creating perched water tables in places; dwelling densities 435 to 923 per km²; surface water NO₃ generally low, indicator bacteria at modest levels; groundwater NO₃ variable (some localised high spots), but bacterial indicators not detected.

In all five areas a mix of on-site system types and variable performance exists, and in each area problem systems have been historically linked to contamination of surface and ground waters. However, there is no consistent association between nitrate and bacterial contamination of both surface and ground waters, nor is there a clear correlation between contamination levels and on-site system density. In some areas with high density and failing systems, impacts on receiving waters are either negligible or not evident.

It would therefore appear that high on-site system density need not adversely impact on natural water quality (even in areas with poorly performing systems). However, there is still a risk of contamination, and more detailed studies of contamination pathways are needed to differentiate between contamination impacts from poorly performing on-site systems and other potential contaminant sources.

In discussion, the lack of correlation between nitrate levels and bacterial indicators was explained by the variable treatment capacity of the soil. Sand, in fact, provides good treatment. In respect of new development, Joe stated that we need not be afraid of high densities. With the higher levels of treatment available with modern on-site systems coupled with better management and ongoing monitoring of systems, then sound environmental performance can be readily achieved. The use of management entities would be a good approach whereby the uninterested homeowner is taken out of the picture.

15. Sand Filter Systems

Chris Palmer, Envirotech Treatment Systems, Brisbane, QLD

[Note: This presentation was a substitute keynote at short notice, with no published paper in the proceedings, and deals with Chris’s experience in Queensland as a supplier and installer of sand filter systems. Chris is also Chairman of the Joint Australia/NZ Standards Committee for on-site systems.]

Some 18 years ago AWTS took off in NSW in providing improved on-site systems to conventional septic tank and soakage trenches. ISF (intermittent sand filters) were very much a curiosity at that time, and as they were more expensive to install than AWTS (initially some $2000 more) their use did not take off in the same way. However, ISF units produce a very good quality effluent with little maintenance (compared to the variable effluent quality of AWTS), and are an attractive option for homeowners seeking to use high quality effluent for on-lot landscape watering.

The benefits compared to AWTS are consistently superior effluent, minimal O&M, simple to operate, less mechanical equipment, lower power consumption, and good natural disinfection. In the long run ISF units are a least cost system; however, customers and drainlayers are only often interested in the initial cost. A typical household system will provide surface area of 20 m² with 600 mm depth of medium sand (0.3 to 0.5 mm and U < 4). Septic tank effluent (after outlet filtering) is dose loaded at 50 l/m²/day, with the resulting final effluent pressure dosed through a final physical filter to a drip line land-application system. ISF units can be installed above ground, although most owners prefer them in ground (in which case protection against surface water run-on must be provided).

Some 300 systems are currently in operation around Brisbane and the Gold Coast with effluent qualities ranging from 4 to 6 g/m³ for BOD, 2 to 5 g/m³ for SS, and FC (faecal coliform) median at 100/100 ml. About half the lower side values to the median are < 10 FC/100 ml. In some cases ISF units have gone 7 years without service, but service contracts are the norm.

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