

# TRAINING FOR ON-SITE WASTEWATER MANAGEMENT

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## Abstract

The current move from a prescriptive to a performance approach to designing, installing, and operating on-site systems has given focus to the need for training programmes for all participants in the implementation and use of on-site systems. The new AS/NZS 1547 on-site wastewater management standard envisages specific training for the several professional groups involved in on-site practice. Such training will only become a reality if required by regulatory authorities. In the US training has focused on the development of "training centers" complete with demonstration units displaying on-site treatment and land application hardware and fittings as teaching accessories. Australia has a well received and regular training course delivered through the Centre for Environmental Training in NSW by a group of professional specialists in on-site wastewater design and research. New Zealand's approach is currently ad hoc, with a range of seminar, workshop and inspection training exercises taking place on demand. In addition, two newsletters, "On-Site NewZ" in NZ and "NOSSIG News" in Australia, provide information flow between professionals. The variety of training models used in practice indicate that training has evolved to respond to specific national, regional and local circumstances. The future challenge for on-site training is to deliver educational programmes that ensure environmentally sustainable on-site wastewater servicing is achieved via well informed practitioners.

## Keywords

education, on-site wastewater, septic tank systems, training, wastewater management.

## 1 Introduction

On-site wastewater servicing is now accepted as a practical and sustainable option for low density rural/residential development. However, the prescriptive approach to design and approval which has dominated on-site wastewater servicing implementation for the last 50 years is no longer appropriate for the new age of environmental responsibility, with its objective of ensuring sustainable long term servicing solutions. Hence, there is considerable impetus towards a new performance-based approach to on-site wastewater practice. The key to ensuring the environmental sufficiency and technical integrity of this new approach is education of all the participants in the implementation and use of on-site wastewater servicing.

The question before the on-site wastewater industry at the present time is what type of training programmes are necessary to achieve the multiple objectives associated with investigation, design and construction, regulatory approval, and ongoing inspection and performance monitoring of on-site systems? Additional questions relate to the level and frequency of training, the composition of training groups, and the method of certification of training programmes. Delivering effective educational and training programmes is the most important challenge facing the industry today.

## 2 Historical Development - On-site Systems

Historically, design and installation procedures developed around prescriptive standards centred in the main on a simple clean water percolation test procedure first used as a soakage trench sizing technique in New York State in the US during the 1930s. Although developed for a specific set of soil

and site conditions in a local area, the prescriptive simplicity of the percolation sizing approach became universally adopted in the US, Australia and NZ, with the numerical results from the New York State procedures given direct local credence. When system failures abounded in all three countries, public authorities tended to adopt the attitude that failure represented the capacity limit for on-site servicing for the particular locality, and thus defined the time for installing sewerage.

However, in the US it was recognised that sewers were not an economic nor practical solution for many localities where rural/residential/commercial development was taking place, and a significant research effort began from the early 1960s within many universities. The first and definitive study, was the work by Winnebarger and McGauhey in California, who presented an understanding of biomat clogging of soil infiltration surfaces dosed with septic tank effluent and explained the concept of long-term-acceptance-rate (LTAR). In spite of the extensive research results coming from the university studies, prescriptive design rules still prevailed and failure rates remained high.

To counter this, regulatory agencies tended to move to more conservative design loading rates under prescriptive rules with the objective of increasing the factors of safety against failure. The aim was to provide a “cook book” approach that could be implemented and regulated by non-experienced personnel. This misunderstood the key factors in implementing successful on-site systems. Failures are the result of poor soil assessment practices, flawed design loading rate choices, inadequate supervision of construction, shortcuts in installation practices, and negligible operation and maintenance attention. The regulatory oversight of on-site systems has been centered in the myth that implementation practice is a science, when in fact it is an art. To break out of the failure cycle thus requires a new approach based on developing sound implementation processes which are then carried by responsible and well trained practitioners.

### **3 Training Requirements Envisaged by AS/NZS 1547**

The committee set up to review the current AS 1547:1994 and to incorporate New Zealand on-site practice with Australian quickly came to the conclusion that, given widely varying loading rate requirements in design rules already used in State, regional and local government practice in both countries, then it was unlikely to come up with sizing methods for land application systems that it could claim were superior to all others currently in use. Rather, it was perceived by the committee that success in terms of achieving sustainable use of on-site systems did not lie with the technical content of the new Standard, but with the diligence by which all persons regulating, designing, installing, servicing and using on-site systems undertake their responsibilities. The key to ensuring responsible oversight of on-site systems is education, training and information sharing. The current level of unsatisfactory environmental performance of on-site systems is a reflection on the lack of co-ordinated information transfer. The new Standard advocates specific training groups for the range of players involved in on-site wastewater servicing. These include planners, surveyors and land developers, site evaluators/soil assessors, designers, installers and contractors, equipment manufacturers and suppliers, pumpout/de-sludging contractors, regulatory authorities, homeowners and occupiers, estate agents and property transfer lawyers. Regulatory authorities are seen as having a most significant role in monitoring and co-ordinating training and information sharing activities.

It must, however, be pointed out that all reference to training in the new Standard is “informative”, and not “normative”. It thus has no status other than advisory, and for training programmes to be implemented as envisaged by the committee will require a shift in approach to on-site implementation which can only be led by regulatory agencies. Indeed, this shift in approach has begun in both countries, driven not by the imminence of the new Standard, but by the environmental imperative inherent in a community wide concern for the environment. To deliver better on-site servicing means providing better information to practitioners, and to some authorities training programmes are an important first step in delivering such information.

### **4 US Training Developments**

#### 4.1 Background

The EPA-funded National Small Flows Clearinghouse (NSFC) at West Virginia University, Morgantown, West Virginia has played a key role in initiating training programmes in the US. NSFC Special Assistant Mike Aiton has responsibility for co-ordinating training developments, and has considerable experience in assisting State agencies in the setting up of training and demonstration facilities for on-site and small community wastewater servicing. In the early 1990s the NSFC saw a shift in interest in its principal service to the small flows industry of just providing information, to a substantial increase in demand for its phone-in service providing advice on the use, operation, maintenance and repair of on-site systems. Given the level of inquiries, there was clearly a need for training programmes at the local level. This began with the formation of the NETCSC (National Environmental Training Center for Small Communities) set up to train the trainers. Professor Mike Hoover of North Carolina State University (NCSU) was contracted to write a training manual, and the concept of training and demonstration centers at the State level grew from this beginning as universities and State health and environmental agencies worked together.

An extension of the training center concept at State level has been the National On-site Demonstration Project. The first phase of the Project involved seven community demonstration projects in five States where alternative wastewater treatment and disposal technologies are installed and operated for public general educational and familiarisation purposes. The earliest of these was the Chestnut Ridge Park facility located outside Morgantown where eight technologies were set up. These are recirculating sand filter, constructed wetlands, drip irrigation, contour disposal trenches, home aeration package treatment plant, waterless toilets, low pressure pump system, and gravelless absorption trench.

The whole aim of the project is to enhance the capacity of States to provide on-site training, the construction of demonstration facilities, and technical support to local agencies. The next phase is to develop and encourage field system inspection programmes, and to implement trouble-shooting capability at the environmental health officer level so that instead of adopting the regulatory approach of shutting down malfunctioning systems, technical support and advice is directed to correcting/repairing systems. This approach is being piloted in West Virginia, with Mike Hoover of NCSU providing technical support. Failure analysis work being developed by Mike will be a most important element of this phase. Six Counties are to be surveyed to assess failure modes, failure causes, and potential remedies. Training programmes will then be set up to implement the technical support programmes. The final phase of the National On-site Demonstration Project will be investigation and support for the development and implementation of Management Districts.

#### 4.2 National Training Center for Land-Based Technology and Watershed Protection

This Center is based at the College of Agriculture and Life Sciences, North Carolina State University (NCSU), Raleigh, North Carolina. The current training facility at NCSU's Lake Wheeler Field Research Laboratories is situated within a farmland location some 7 minutes from campus. The original facility began seven years ago in Chatham County, where its earlier work in on-site systems training and development has led to the adoption of advanced septic systems throughout the State.

Training Center Director, Professor Mike Hoover of the Department of Soil Science at NCSU, first became involved in the on-site and small community training area by producing the training manual for the NETCSC (National Environmental Training Center for Small Communities) under contract to the National Small Flows Clearing House. In North Carolina he was able to utilise this experience in implementing training for local health authorities, commencing with training of health supervisors and then moving on to courses for sanitarians involved in on-site approvals. The development of the Chatham County demonstration facility provided means for introducing practical hands-on experience of system construction and operation. A partnership relationship with private industry has been invaluable in setting up a comprehensive range of technologies through donated equipment, and the move to the Lake Wheeler farm has seen considerable expansion of the range of on-site treatment units and effluent land application systems. The next step is to complete full classroom facilities at the demonstration centre. At the moment course instruction is given on campus, and the classes move out

to the site to participate in field exercises. Being on site will enable integrated instruction and demonstration as groups can deal with both theoretical elements in the classroom, and practical implementation in the field, all within a single session as they move between indoor blackboard and outdoor equipment.

On-site wastewater systems at Lake Wheeler include in-ground conventional gravel trench systems (which have been deliberately constructed with out-of-permit sections to aid in a fault finding exercise), a range of concrete and polyethylene septic tanks, household wastewater treatment units (including aeration plants, biofilter systems including RBC and random packed media, peat bed treatment, and sand filters), gravity distribution boxes and pumped manifolds, LPED (or shielded LPP) shallow trench distribution, and dripper irrigation networks.

All treatment units are only partly set in the ground, and are fed with clean water. By this means, training course participants are able to clearly view the structural and compartmental components of treatment configurations, and get a feel for baffling arrangements and hydraulic flow patterns. In addition, apart from the trench in-ground demonstration, all trench and land application lines are constructed above ground and fed with clean water to enable demonstration of gravity and pumped distribution effectiveness. Designers, installers and regulators find these clean water demonstration methods invaluable in understanding the capabilities and limitations of the range of systems used in common practice.

Mike Hoover has a team of around a dozen project leaders and support staff who co-ordinate input from up to 40 other university, State, and local governmental personnel as well as professionals and representatives of industry. The educational programmes are very well received by their target groups, including environmental health specialists, professional engineers, soil scientists, system operators, installers, public officials, and college students.

#### **4.3 Missouri Small Wastewater Flows Education and Research Center**

Based within the College of Agriculture, Food, and Natural Resources, University of Missouri, Columbia, Missouri, the Center has been in operation since mid-1996. Its origins were in training programmes developed for the State Health Department back in 1987/88. Professor Dennis Sievers of Agricultural Engineering and Associate Professor Randy Miles of Soil Science were asked to run 2 day courses for sanitarians, with Randy providing the soils assessment component and Dennis the on-site wastewater design and implementation material. In 1992 a task force was set up to review State legislation related to on-site systems, with new laws introduced in 1995 placing responsibility for management of on-site systems of up to 3000 gal/day or up to 14 lots in a subdivision under local health agency controls. Larger systems came under the Department of Natural Resources for permitting. The legislation required provision to be made for education of installers/contractors, so the earlier courses for health professionals were adapted for this group, with around 2,500 installers taking advantage of the training in the first year or so. Dennis and Randy, through their contacts with private industry, began gathering donated equipment and other resources to set up the "Missouri Small Wastewater Flows Education/Research Center Field Training Site" at one of the University research farms. Classroom facilities were already in place at the Center (associated with agricultural and soil science courses), and with the demonstration units outdoors alongside the classrooms, this provides an ideal teaching arrangement.

Currently a contractor's course of two days is still available as a "road show" to different centres in the State, but the demonstration units at the Center showing alternative technologies have proven very important in assisting contractors to understand the requirements for installation relative to design and operational objectives. The new Center also provides a basic on-site course of 2 days for all practitioners, a 2 day soil evaluators course, a 3 day alternative systems course for engineers, and the original Health Department courses. Because State legislation for on-site wastewater implementation requires a particular method of percolation test to be undertaken, then practitioners who have not qualified as soil morphologists (who with college qualifications automatically can practice as soil evaluators) have to complete the soil evaluator course. This is particularly relevant to engineers.

Technologies installed at the Center include conventional, gravelless, and infiltrator trenches, home aeration package plants, septic tanks and distribution boxes, buried sand filters, drip irrigation, and LPP distribution.

As the legislation put responsibility for seeing that education happened into the hands of the Health Department, that agency is principal organiser of the courses at the facility. It has recently introduced 4-day courses for private agency inspectors who will be engaged in on-site monitoring in Counties throughout the State. Participants in the contractors and soil evaluators courses have to sit an exam at the end of each course, and passing provides them with a license to operate State wide. This is a once-only requirement, and no provision for license renewal is currently in place. However, some Counties are requiring attendance at refresher courses, with a total ongoing training requirement of 10 hours over three years.

## 5 Australian On-site Training

The Centre for Environmental Training (**cet**) in NSW is the only agency offering regular training courses and workshops in the area of on-site wastewater servicing in Australia. Based on courses originally developed by staff of the University of Newcastle as continuing education programmes, the **cet** now operates as an independent training entity. Its initial "Domestic Wastewater Disposal Training Course" has been presented to over 550 participants during the past few years, delivered by a group of specialists with wide research, design, and implementation experience. **cet** has now embarked on a new programme to anticipate the training needs of both the NSW Environment & Health Protection Guidelines, and the proposed new AS/NZS 1547 Standard.

The new **cet** programme is developed around two individual two day courses which are intended to be taken as a package. First is an introductory course, then followed by an advanced course, with a several week gap between courses being used by participants to undertake assignments and field exercises related to site assessment. The keeping of a log book relating to field exercises provides the basis for participant presentations during the advanced course, thus enabling case study sharing of information between all attendees.

The **cet** courses are well placed to provide the basis for certified training programmes to meet the intent of the new AS/NZS Standard for on-site domestic wastewater management, and the training concept has potential for transport across the Tasman to NZ. Details and experience with the **cet** programmes is covered elsewhere in these conference proceedings.

## 6 New Zealand Training and Educational Experience

### 6.1 Background

No formal on-site training programmes are at present offered in New Zealand. The original Ministry of Works and Development training school for water and wastewater treatment operators has now become Opus International Consultants Environmental Training Centre (**ETC**). The **ETC** is registered with the NZ Qualifications Authority, and its water and wastewater training courses are recognised as the industry standard. Recently **ETC** began investigation of the potential for on-site training in anticipation of the new on-site Standard, but this is currently on hold until the AS/NZS document is published.

The main effort in on-site education has been with an on-demand university based travelling seminar serving the needs of Regional and District Councils, and separate workshop events and training sessions organised by local authorities to deal with local issues. These are not training programmes as such, but rather education and awareness raising exercises.

### 6.2 Seminar events

In 1989 the Department of Civil and Resource Engineering at The University of Auckland was commissioned by the Auckland Regional Council (ARC), in its capacity as the environmental management agency for the Auckland Region, to produce an on-site design manual which would set the basis for design standards and regulatory agency approvals. The manual has become known by its ARC technical publication series number as TP 58.

TP 58 subsequently became adopted by several Regional Councils throughout NZ, and thereby the District Councils in those regions. To facilitate its interpretation and application in their area, several councils have in the last five years run one day seminars with TP 58 as the basis for presentations, and including a session on the requirements of Regional Rules for environmental management of on-site wastewater servicing, plus a session on local design problems and case studies. In some cases the seminars are held at a central location and members of all branches of the industry invited; in other cases a "roadshow" approach is adopted, and/or specific target groups such as inspectors or designers invited. In 1996 a newsletter, "On-Site NewZ" was introduced to provide updates on TP 58. With four issues a year, "On-Site NewZ" is a companion to "NOSSIG News" in Australia.

### **6.3 Inspection exercises**

During 1998 the Napier City Council (east coast North Island) was evaluating the need for replacing septic tank and soakage systems with sewers and local or regional treatment for a coastal community outside the urban boundary. In order to get a better appreciation of the operational performance of existing on-site systems, it was decided to run a two day training programme for local inspectors and regional environmental staff. This involved a first day seminar reviewing the TP 58 methods and procedures against the Council's inherited procedures when, during local government restructuring, the City took over a substantial rural area from the old County Council. The second day was given over to a field inspection exercise in which septic tanks were uncovered and sludge and scum levels determined, disposal areas were identified and excavated to assess their condition, and overall environmental effects from individual systems were evaluated. A comprehensive checklist document was provided for use in the field. Technician support was provided to assist with uncovering septic tanks, and drilling auger holes for soil and ground condition investigation. Full health and safety gear was provided to cover the occupational hazard of dealing with a raw wastewater environment. A selection of failed (water logged) and normal systems (no direct evidence of operating problems) were inspected, and useful experience gained on the inspection process.

### **6.4 Monitoring training**

Environment Bay of Plenty (BOP) is a Regional Council with environmental management responsibilities for significant lengths of North Island ocean and estuarine coastline between Tauranga and Whakatane, plus extensive river and lake shorelines towards and including the Rotorua area. There are many rural/residential and holiday area settlements throughout the region, some 14 of which are considered environmental "hot-spots" because of the impact of septic tank effluent systems on water quality. Unacceptable levels of bacterial organisms and nutrient salts attributable to inadequate effluent disposal have been found. Under its Regional Rules, Environment BOP has authority to require all property owners in these communities to obtain a certificate of compliance for continued operation of their on-site system.

To implement the certification process, home owners will have to engage a "certified septic tank inspector" who will inspect the tank and disposal system, arrange pumpout of the scum/solids, and determine to what extent the system complies with construction and environmental requirements in the Regional Rules. Systems found in compliance will be provided with a certificate. Those not in compliance will need to apply for a resource consent, which may lead to upgrade conditions being set for continued operation. Environment BOP has instituted a training programme for certifying inspectors, who then compete with each other picking up inspection work from individual homeowners.

The September 1998 training programme involved a half day workshop which discussed the context of the Regional Plan, outlined the work specification for inspection processes, and led participants

through the inspection exercise and the administrative work involved in providing a certificate of compliance. The workshop and inspection process is supported by a "Septic Tank Certification Manual" which deals with the management of the inspection programme, and provides "how to" guidance on inspection activities. A take home exercise is provided, and returned to demonstrate that trainees understand what was being asked of them. All homeowners in the 14 communities were advised by letter of the requirement to have inspections completed by December 1999, the reasons for the inspection, what it will entail, and the list of certifiers who have completed the training programme and are approved by Environment BOP. Potential applicants for training came from the on-site wastewater industry, including installers and inspectors. The work specification document was sent out to those registering interest, and applications for training accepted on the basis of past experience with on-site system installation and maintenance. Twenty three people qualified as certifiers following the first training workshop, and a further workshop is to be arranged mid-1999 because of the interest generated. Follow up contact with the first group of trainees is being maintained via a newsletter, and a fact sheet with the answers to commonly asked questions from householders was prepared and distributed to all certifiers.

## 7 Training Futures

It is clear that on-site wastewater training programmes have evolved as a response to the recognition that past implementation practices have not been delivering good environmental outcomes. The inadequacy of prescriptive approaches to investigation, design, installation and operation and maintenance of domestic wastewater systems has resulted in unacceptable levels of performance failure. In moving from a prescriptive to a performance basis for developing a new technical Standard, the joint Australia/New Zealand committee decided that a new approach was needed. This approach had to centre around the "performance" of the implementation processes that achieve on-site wastewater servicing, and the "performance" of those persons who have responsibility for carrying out those implementation processes. The key to ensuring the responsible implementation of on-site wastewater servicing is education, training, and information sharing.

There is no one ideal model for training on-site practitioners. Existing models have evolved to respond to local, regional, and national circumstances. They include, but are not limited to, formal training courses based on classroom and field exercises for a mixed group of practitioners, specific discipline courses for particular professional or industry groups, training centre courses complete with demonstration hardware and fittings, road show courses which travel to meet trainees in their local environment, seminar courses covering basic on-site practice supplemented by local case studies, and workshop courses designed for specific training, such as on-site inspections and monitoring procedures.

The new Standard advocates specific training groups for the range of players involved in on-site wastewater servicing. Each group would participate in three potential levels of training which include the study of the basic principles of on-site systems and their management, application training specific to the group members role and the implementation process, and regular refresher training on new technology practices and procedures. As to who delivers training, there is clearly a role for both private agency training such as **cet** in Australia and **ETC** in New Zealand, and public agency sponsored and run courses aimed at meeting particular environmental objectives.

The future challenge for on-site training is to deliver educational programmes which lift the performance of on-site systems to ensure environmental sustainability of this form of rural/residential wastewater servicing.

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