THE ROLE OF THE REGULATOR IN ADVANCING RESEARCH AND DEVELOPMENT ON ON-SITE SYSTEMS

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Abstract

On-site sewerage facilities are a necessary and appropriate component of sustainable wastewater infrastructure in Australia and New Zealand. A great deal is known about on-site sewage treatment process, design and performance, but gaps remain in the science and engineering. The regulator at State and Local Government level has a role to play in ensuring that the appropriate gaps can be filled with good science and engineering. Technology advancement proceeds from the initial bright idea through research and development, technology testing and demonstration until it evolves into broad use. This is an extremely challenging process for the on-site sewerage researchers and manufacturers but unless it is followed, then technology advancement will falter and maybe fail just as a high-rise building will fail if it is not placed on a strong foundation. The regulator is in a position to influence the direction of technology advancement but more importantly the regulator should ensure that the advancement starts off on a strong foundation. By setting explicit performance goals, the regulator is providing the direction for research and development. However, the regulator must still make decisions based on the best available data that may at times mean taking a risk on new technologies.

1 Introduction

The Macquarie Concise Dictionary (1998) defines regulator as "a person or body appointed to oversee the operation of an industry, economic sector, etc., usually with the power to enforce regulations and arbitrate disputes". I am sure that many of you in the audience today have your own shorter definition of a regulator but it is most likely not suitable for printing in these conference proceedings. Today I am speaking as a regulator, however like many other regulators of on-site sewerage facilities around the country we are usually required to wear several hats. These hats may include providing technical advise to a potential owner, design assistance and even arbitration between Council and owner, and for most of us there are times when there develops a conflict of interest between these roles. The regulator for on-site sewerage is expected to have a full and complete understanding of the regulations and administer or enforce the regulations in a fair and equitable manner. On many occasions the regulator will be asked to provide assistance in circumventing the regulation e.g., how can the separation distance between a soil absorption trench and potable water bore be reduced. Within the space of a few minutes the regulator can go from the nice person who helped with a problem septic system to that #&@^%* ignoramus who forced an applicant to spend an extra $2000 on the on-site system because an extra bedroom is being added to the house. Finally, the on-site sewerage regulator must be a "fountain of knowledge" and be able to competently discuss at length the latest advances in technology and be fully aware of the research and development that is currently in progress within Australia and overseas. This last role of the regulator leads into the theme of my presentation today.

How does the role of research and development or should we say "science" assist in making regulatory decisions now and in the future? How do regulators make decisions on the amount and quality of data needed to draft policy, regulations and technical guidelines that will meet high standards of best management practice?

2 The Regulatory Agency and The Regulator

Regulation is implicitly a function of government at a federal, state or local level. Government at all levels can be "heavy handed" or adopt a *laissez faire*, market-based approach to regulation. It can also be prescriptive in its regulations or take an outcome focus. Regulation can be centralised or distributed, involving one or more agencies. Finally, regulations can be universally applied across jurisdictions, or vary due to a range of criteria (McRae, 2002).

State Government devolves the administration of regulations governing on-site sewerage facilities in most Australian States to local government. The State Government maintains an overview of the regulations and it is the State that actually develops the regulations in consultation with local government. The State Government Department that maintains the responsibility for on-site sewerage regulations varies from state to state (Health, EPA, Natural Resources & Mines, Infrastructure Energy and Resources). Whist there is considerable variation from state to state in the regulations the overall intent of the regulations is the same, that is to protect public health and maintain and enhance the quality of the environment. Recent reform initiatives in each State are shifting the regulatory environment towards a more market based, outcome-focussed environment (e.g. performance based regulations and standards).

In New Zealand, on-site domestic wastewater discharges are "permitted activities" in all Regional Council areas. Each Regional Council have "permitted activity" rules developed through a consultative process. These rules are meant to reflect the local communities' aspirations for environmental quality management for their region. Under the Regional Plan, District and City Councils take over the administration of the "permitted activity" rules for on-site sewerage system implementation. Some Regional Councils have no design guidelines referenced into their rules, so District Councils have their own guidelines to assess compliance with both regional and district requirements (Gunn, 2003).

Australia and similarly New Zealand and the United States of America have no federal regulatory control over on-site sewerage facilities. The National Water Quality Guidelines for Effluent Management (1997) and Use of Reclaimed Water (2000) are very clear in their scope that they do not deal with the effluent from individual household systems. However the House of Representatives Standing Committee on Agriculture, Fisheries and Forestry is currently conducting an inquiry into the provision of future water supplies for Australia's rural industries and communities. An integral part of this inquiry is what role can the beneficial use of greywater have in ensuring an adequate and sustainable supply of water in rural and regional Australia. It is noted there are several papers at this conference that address the issue of the beneficial use of greywater.

It is the State Government in Australia and the Regional Council in New Zealand that has the responsibility of formulating the policies, legislation and regulations that govern on-site sewerage facilities. It is interesting to consider how regulation of on-site sewerage facilities in Queensland is spread over several different pieces of legislation each administered its respective department.

At present there is the *Sewerage And Water Supply Act, 1949*, which provides the power to make regulations covering sewerage, sanitary conveniences, water supply and stormwater drainage. The *Standard Sewerage Law 1998* contains the regulations governing sewerage, sanitary conveniences, water supply and stormwater drainage. In addition, the *Health Act* contains provisions pertaining to situations considered to be a nuisance or injurious or prejudicial to health or a breeding ground for mosquitoes, in particular, the ponding of greywater. The *Environmental Protection Act 1994* through the *Environmental Protection (Water) Policy 1997* requires local government to consider the cumulative impacts of on-site land application of effluent on the environment when assessing and approving development applications under the *Integrated Planning Act 1997*. Under this policy it is also an offence to deposit or release solid or liquid waste from an on-site sewage treatment plant outside the boundary of a property. To complete the picture, the *Water Act 2000* requires a person to discharge all human and liquid waste from fixtures or appliances on the person's premises into the sewerage system. Obviously, the question that is often raised is; "which Department has the responsibility for formulating policy and maintaining an oversight of the legislation and regulations?" At the present time the Department of Natural Resources and Mines has this responsibility.

3 Current State of Research and Development

Local government regulators are required to review numerous applications for a permit to install an on-site sewerage facility and State government regulators are receiving a growing number of manufacturer's requests for technology approvals. Technical support documentation from the designers of the on-site sewerage facility and manufacturers of sewage treatment plants is often very spartan with claims of "our system is the best" or "our system is going to solve all problems". In some cases it can be extremely difficult to ascertain from the support documentation how the proposed system operates or achieves the desired outcomes. Manufacturers supply little, if any, third-party research data to support the application for approval, relying on the performance evaluation testing to demonstrate the capability of the technology.

At the same time policy, regulations and standards are becoming more performance-based. The growing environment focus in on-site sewerage is also causing a shift in emphasis from the traditional disposal aspect to more of a treatment aspect. On-site sewerage facilities can now be designed from a rapidly increasing array of options. These include the conventional septic tank, activated sludge processes, packed-bed reactors, as well as natural system treatment operations that can be tailored for a given application to yield high treatment efficiencies over a long service life while protecting public health and environmental quality (Crites and Tchobanoglous, 1998).

There is a considerable knowledge base regarding on-site sewerage facility design, implementation and performance that enables experienced practitioners to effectively implement most commonly used systems. While much is known through research and field experiences, the current state-of-knowledge does not fully support rational system design to predictably and reliably achieve specific performance goals (Siegrist, 2001).

To the new and uninformed but intelligent practitioner moving into the field of on-site sewerage facility design, the absence of more fundamental understanding embodied in mathematical models and employed as part of a rational design practice would almost certainly suggest that the current state-of-knowledge is not well understood. How does an informed and knowledgeable regulator explain the wide variability in design loading rates for soil absorption trenches? What is the basis for 1.2 m of unsaturated soil to the seasonal

groundwater table or why does one jurisdiction require 250 m separation distance to a surface water and another may only require 50 m?

Some are explained by various practices evolving over a period of time and were found to be appropriate for most cases even though failures did occur, but very few can be satisfactorily explained by acceptable scientific principles.

We are in the midst of a dilemma of sorts. There is a clear and recognised need for continued use of on-site sewerage facilities as a component of a sustainable sewerage infrastructure but there are continued concerns on both health and environmental protection that require better scientific understanding and rational engineering practice. No longer can the attitude "it's worked O.K. for the past 40 years so why change" be an excuse for not advancing our scientific knowledge of on-site sewerage facilities. Practitioners must be prepared to contribute towards the acceptance of a stronger scientific foundation as the basis for improving the quality and credibility of our decisions in the on-site sewerage industry.

4 Advancing Research and Development

Lets briefly review the components of scientific method for conducting a research study. These go to the heart of science and are the pieces that make science work:

- Problem definition;
- Literature review;
- Hypothesis;
- Research methodology;
- Data collection, analysis, results and discussion;
- Conclusions and recommendations; and
- Publication of results.

Peer-reviewed research that is published in scientific journals carries more weight than that published without review. Raw, unpublished data collected by a manufacturer who can benefit from the results would not generally be considered to be scientifically valid. Unfortunately, much of the scientific understanding of on-site sewage treatment process, design and performance has not been fully and clearly documented.

The classic approach for technology advancement proceeding from the initial bright idea through research and development, technology testing and demonstration until it evolves into broad use is depicted in Figure 1.

I would be the first to admit that applying the process illustrated in Figure 1 to on-site sewerage research and development can be extremely challenging for a variety of reasons such as:

(1) performance can be affected by numerous design and environmental conditions;

(2) certain aspects of performance can be difficult to rigorously monitor and measure;

(3) the system service life and timeframe for evaluation can be exceedingly long; and

(4) management is a variable to be considered in performance.

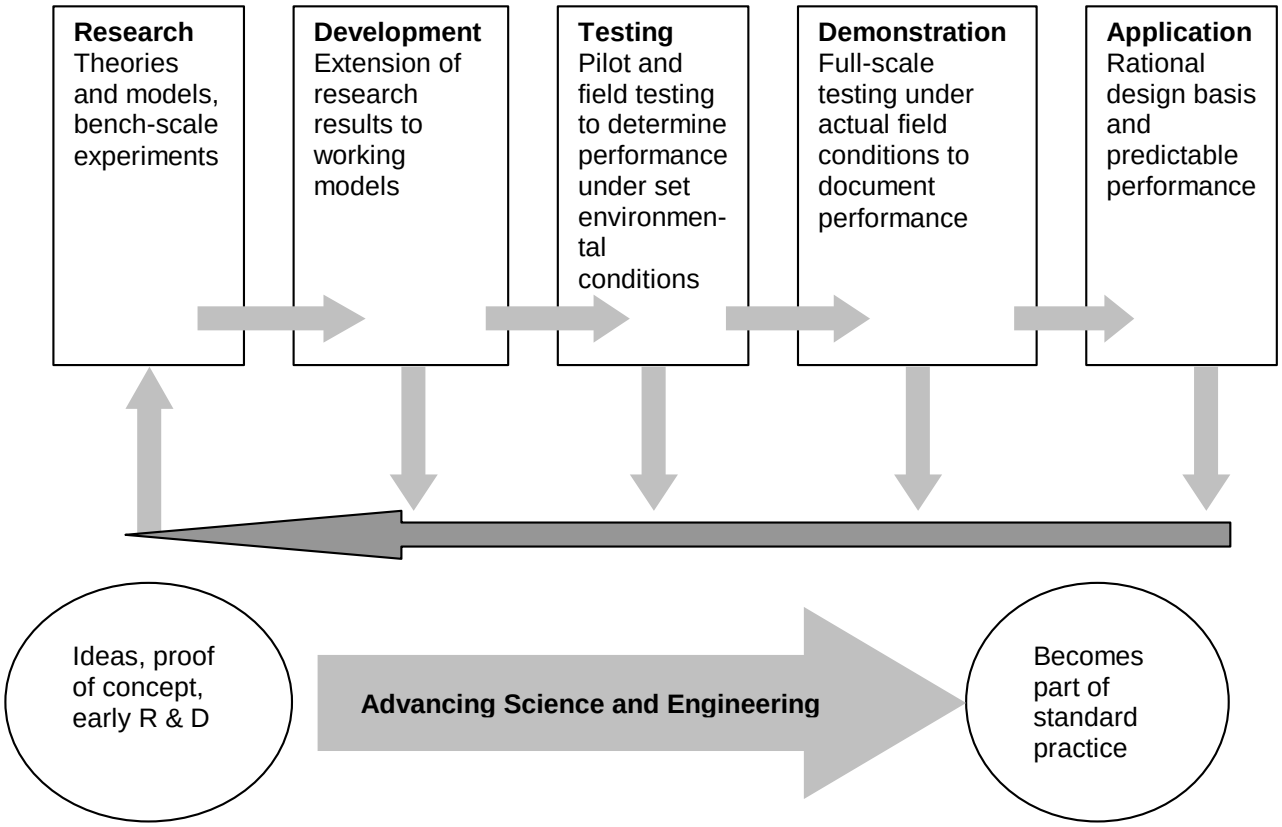

Figure 1 – Stages in Technology Development and Application (Adapted from Siegrist, 2001)

Unfortunately, the general approach to technology development is to go from the bright idea to the full scale testing without any of the intermediate steps. This may be compared with placing a five-storey building on a poorly prepared foundation. The end result being that the building could ultimately fail sometimes with disastrous consequences. Sound technological based decisions are somewhat like building the five-storey building. First you start with the investigations for the foundations, then place the building blocks of the foundation and continue floor by floor.

In Figure 1, the theories, models, bench scale experiments all provide the building blocks for the foundation of the technology development. If this part fails then the following steps will experience failure at some stage. No doubt there are regulators here today who can cite an experience where a technology has been presented for performance evaluation testing only to find the technology fails to complete the testing regime. The manufacturer has wasted valuable funds that could have been used to a better advantage in the intermediate steps.

Apart from defensible scientific foundations and the engineering ability derived therefrom, there are factors that could and often do impact and constrain realisation of advancements on on-site sewerage technology. Siegrist (2001) identified a range of factors, which include but are not limited to:

- absence of explicit performance goals for which generic or site-specific technologies or designs can be developed and tested against;
- current difficulty to cost-effectively monitor on-site sewerage facilities for process control and performance assessment;
- absence of effective and reliable management to ensure system function occurs as specified;
- inability or unwillingness to recognise the value of the effluent from the on-site sewage treatment plant and the beneficial use that can be realised;
- lack of education of current and future system users, scientists/engineers and regulator/policy makers; and
- perception that the on-site sewerage facility should be simple, require no maintenance, last forever, and be cheap.

5 Research and Development and the Regulator

In the previous section we saw how it is necessary to build a strong foundation as a basis for improving the quality and credibility of our decisions in the on-site field. However, "pure" scientific method and studies are not enough in the world of practical regulatory decision-making. There are many competing factors that have an impact on the decision making process, of which "political willingness to implement" can be the ultimate factor.

We are currently moving toward a more performance and treatment-based approach to regulation of on-site sewerage facilities, therefore it is necessary to consider the same objectives as are needed in all other aspects of environmental protection: "how clean is clean" groundwater and surface water. The Australian Water Quality Guidelines for Fresh and Marine Waters (1992) have provided guidance on the quality of water that is suitable for fishing and swimming. Good research and development is required to determine whether products, technologies, management practices or other pollution mitigation mechanisms are practical and sufficient to achieve the standards.

The same principle can be applied to the use of effluent for toilet flushing where guidance on water quality is provided in the National Water Quality Guideline for Reclaimed Water (2000).

However, this guideline deals with effluent from municipal (i.e., community) wastewater plants treating mainly domestic and some industrial wastes. It could be argued that this guideline is not applicable to effluent from a domestic on-site sewage treatment plant. In the absence of an applicable guideline for on-site sewerage systems, the regulator will usually accept an alternative that has a defensible scientific foundation. It then becomes the responsibility of the researcher/manufacturer to develop a system that will meet the requirements stipulated by the regulatory authority.

It would be fair to say that almost all of us in this forum agree that we need:

(a) treatment and performance standards that are applicable to the industry but also consistent with other industry standards;

(b) to get better at using scientific data in making decisions; and

(c) better enforceable procedures for management and maintenance of on-site facilities.

Implementing what we agree on will almost inevitably lead to an increase in cost of the on-site sewerage facility and therein lies our dilemma. How, exactly, do I as a regulator convince John Citizen that he needs to spend money on a better system in order to protect the environment and more money on maintenance to ensure his system does not fail?

The community and industry has an inherent dislike or disrespect for the regulator regardless of the quality of scientific information available to support the policy or regulation. The regulator is seen as a body who endeavours to delay the approval of the proposed installation and in some instances impose additional expenditure by the applicant. So I suggest that the regulator makes use of non-government environment and community groups to engage the community on the benefits of a well designed and maintained on-site sewerage system.

There is never enough "pure" science to make the perfect decision. The regulator cannot sit and wait for the perfect scientific answer to every problem that he/she is confronted with. Little would be achieved by taking this approach. The regulator must be prepared to accept the weight of scientific evidence or rely on the best available information at the time as in the case of the water quality guideline for toilet flushing.

Regulators should place data into a hierarchy, rather, like the high rise building used as an example. For example, one weight to data supplied by a self-interested manufacturer, another weight to informal surveys by other regulators, still other emphasis to studies performed by non-academic third parties; weight to tests performed in other countries or climates, weight to laboratory studies versus field studies versus epidemiological studies, and so forth (Hoover and Beardsley, 2000).

Regulators should be consulted on research and development needs for improved policy and regulation. However, by setting explicit performance goals, the regulator is providing the direction for research and development. Care must be taken when setting that direction that we start at the foundation and work carefully through the process. Starting on floor 1 and then jumping to floor 3 without any foundation is a recipe for disaster for the researcher/manufacturer.

6 Conclusions

On-site sewerage facilities have been and will remain a necessary and appropriate component of sustainable wastewater infrastructure in Australia and New Zealand. While a great deal is known about on-site sewage treatment processes, principles, design and performance; gaps still remain in the science and engineering. It will be essential to fill these gaps so that the potential for on-site sewerage can be fully exploited.

Science linked to research and development will be a necessary component of future decision making by regulators and industry. The regulator when placing data in the hierarchy is well placed to identify the gaps in the data that are needed to prepare the regulations and sound policy. However, the regulator must communicate those gaps to the appropriate researchers.

As for John Citizen, the community is often very sceptical of any information that is provided by the regulator. Regardless of how good the science is, the community often has an inherent distrust of the regulator. To get the message across, the assistance of non-governmental environmental groups with their amazing historical ability to create public interest and support for addressing environmental problems will greatly assist to achieve improved on-site wastewater management.

And about the strength of the building, well you will have to make a judgement. I believe the following by Hoover and Beardsley (2000) is a very appropriate concluding statement:

> *"As with practicing medicine there will never be perfect certainty, but that should not keep you from making decisions or taking risks on new technologies. Just as in medicine, old remedies are often not the best remedies."*

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