

EXECUTIVE SUMMARY

INTRODUCTION

An expanding South African population growth creates a growing demand for recycled water in agriculture. Urban communities in particular perceive treated wastewater effluent as an accessible water and fertiliser source for food production. Optimal use as well as control of recycling of treated wastewater became critical in order to protect public health. When effluents are to be recycled for health-related agricultural and other purposes (excluding recycling for potable purposes and recharge of aquifers), it becomes a function of the Department of Health (DOH), who applies the South African Guide for the Permissible Utilisation and Disposal of Treated Sewage Effluent (1978). This Guide was not reviewed or updated significantly since its inception in 1978. Recent international studies on epidemiological advances, as well as other reviews of international guidelines for the use of wastewater in agriculture and aquaculture, offered the ideal opportunity to assess the current value of the South African Guide and to suggest changes if necessary. This document contains a review of the applicability of the South African Guide to assess whether it still suits its purpose under current and rapidly changing South African circumstances.

PROJECT AIM AND OBJECTIVES

The aim of this project was to evaluate whether the South African Guide for the Permissible Utilisation and Disposal of Treated Sewage Effluent (1978) is still applicable in the current South African situation. Did it still fulfil its original brief of protecting public health during the process of recycling or is it impeding access to an essential renewable resource?

Objectives towards achieving the project aim were:

- To assess the applicability of the Guide to encourage the safe use of treated wastewater in agriculture and aquaculture rather than prohibit.
- To assess whether the Guide criteria are adequate to protect both the consumer public and the health of workers involved with the use of treated wastewater in agriculture.

To achieve the above, the following steps were implemented:

- Current and recent international trends on wastewater recycling and reuse were investigated.
- The South African Guide was compared with selected international guides to identify shortcomings and recommend important changes.
- The proposed changes were tabled and evaluated at a workshop held with specialists in this field.

Recommendations from the workshop proceedings were formulated and presented in this report for future research and development.

INTERNATIONAL TRENDS IN GUIDELINES FOR RECYCLING WASTEWATER

With the emphases on public health risk more than on environmental risk, international guidelines for the recycling of wastewater focus more on the risk posed by health-related microbiological quality of the water. It is evident that in developed countries, guidelines tend to follow a conservative high technology/high cost/low risk (NR) approach, especially towards health sensitive crops. On the other hand, the Health Guidelines for the use of Wastewater in Agriculture and Aquaculture of the World Health Organisation (1989) encourage the low technology / low cost / controlled risk approach.

These guidelines are currently under review by Blumenthal and co-workers (1999) and are discussed in this document as a basis for the review of the South African Guide (1978). The Specialist Group of the International Water Association on Water Reuse, is developing guidelines in a concept international framework based on matching recycled water quality with applications, thereby balancing risk with affordability. Further discussions on both the abovementioned concept guidelines were still in progress at the time of drafting this WRC report, but are included in this review since these activities are at the cutting edge of wastewater recycling discussions taking place internationally, as well as in South Africa.

THE APPLICABILITY OF THE SOUTH AFRICAN GUIDE

The South African Guide for the Permissible Utilisation and Disposal of Treated Sewage Effluent (1978) was reviewed against the recent trends in international water recycling discussions and concept guideline developments. International guides and concepts, in which more than 140 relevant national and international guidelines, literature references and research topics were referenced, were used for this review.

The following were the outcomes:

- The South African Guide places excessive emphases on wastewater treatment options.
- The South African Guide does not, like the international guidelines, use non-treatment options such as crop-type regulation and irrigation restriction supported by microbiological threshold criteria to control risks associated with applications of recycled water.
- International microbiological threshold criteria are based on faecal coliform (FC) guideline ≤ 1000 FC / 100 mL recycled water for food crops eaten raw and an intestinal nematode egg guideline <1 per litre recycled water to protect against helminth infections.
- SA criteria of zero (0) detectable FC / 100 mL allowed for irrigation of crops likely to be eaten uncooked are stricter than those of the WHO Health Guidelines (1989) and even, in some respects, those of the US-EPA (1992) Guide.
- Nematode egg or protozoa criteria are not included in the South African Guide, an aspect that needs to be urgently reviewed.
- The South African, as well as international guides, do not contain virus threshold criteria. Recent risk assessments and epidemiological studies have indicated that the faecal coliform guideline of 1000 FC / 100 mL is adequate and no extra viral guideline is necessary.

POLLUTED URBAN DISCHARGES AND AGRICULTURE

South African, as well as international guidelines for the microbiological quality of irrigation water used on a particular crop, do not exist. The quality of water discharged from diffuse sources in urban areas is often comparable to untreated wastewater, yet no regulation or guideline exists for the safe use of these waters in agriculture and aquaculture. A future review of the South African Guide should be extended to investigate and include criteria for the safe unrestricted irrigation of microbiologically polluted water such as untreated urban discharges.

SLUDGE

The South African Guide does not provide for permissible utilisation and disposal of sewage sludge. This should be addressed in the guide to Permissible Utilisation and Disposal of Sewage Sludge (Water Research Commission, 1997).

EFFLUENT USE IN AQUACULTURE

The South African Guide does not provide criteria for recycled water quality intended for use in aquaculture. It seems that no such guidelines exist in South Africa. Aquaculture in South Africa is growing rapidly, adding to the demand for recycled water. Proposed *tentative* effluent guidelines (WHO, 1989) for aquaculture are:

- $\leq 10^3$ faecal coliforms per 100 mL (geometric mean) for fishpond water.
- The absence of viable nematode eggs.

DISCUSSION OF THE ASSESSMENT OUTCOMES

The project steering committee suggested that the report outcomes should be discussed at a technical level in a workshop with knowledgeable persons engaged in the field of wastewater reuse. A workshop was held in Pretoria on January 26; 2000. The theme of the workshop was: *A Revised South African Guide for the reuse of treated wastewater*. The recommendations are presented as follows:

Guideline Philosophy

A new Guide should be developed that at all times reflect its true purpose, which is the protection of public health, while enabling the optimal use of treated effluents.

A new Guide based on needs: A reviewed or new South African Guide should clearly reflect the needs of the components of our society the Guide aims to serve.

A new Guide based on risk: The guidelines would be based on "no excessive risk" (the epidemiological perspective). In the face of lacking epidemiological data in South Africa, a new Guide should be designed in such a way that other technological and scientific information could ensure optimum use of treated effluents as a resource, without compromising public health.

Extent of the new Guide: The Guide should be aimed at recycling wastewater from predominantly domestic environments.

- *Faecally polluted surface waters used for agriculture:* This was referred for intersectoral discussion for possible inclusion in future revisions of the volumes dealing with water quality in Agriculture, which are part of the South African Water Quality Guidelines.
- *Sludges:* Health-related microbiological quality of sludges, generated in wastewater treatment facilities, is to be dealt with in the guide for Permissible Utilisation and Disposal of Sewage Sludge (WRC, 1997).
- *Pollution sources:* The use of water from point and diffuse pollution sources, other than domestic treatment facility discharges, should become a function of catchment management programmes.

Water Quality

The new Guide should focus on the health-related microbiological quality of treated effluents. The use of microbiological indicator organisms is supported.

- *E coli* should be used, as this indicates definite faecal contamination of the effluents.
- Faecal coliforms should also be added to provide a more sensitive indication of faecal contamination. Use of the 1000 FC per 100 mL for unrestricted irrigation should be further investigated and discussed during the development of the new Guide.
- Nematode criteria should be included as recommended by Blumenthal et al. (1999).
- Criteria for other parasites such as *Giardia* spp. can be included in future.
- Virus criteria: inclusion should be intensively investigated and discussed during the development of a new South African Guide. The recommendations of Blumenthal et al. (1999) that a 1000 FC per 100 mL are sufficient public health protection against the possible presence of viruses are provisionally accepted.

Monitoring and compliance

Frequency of monitoring, as well as the level of exceedence (standard deviations etc.) of guideline criteria, appears to be a definite and urgent research need that should be addressed during the development of the new guide.

Physico-chemical criteria

The new Guide should make provision for future inclusion of, but preferably cross-referencing to, physico-chemical criteria.

Treatment Criteria

Treatment systems should remain a main focus of the new Guide. It must be ensured by authorities that systems, including waste stabilisation pond systems, must be properly designed and maintained.

Effluent Classification

Effluents need to be clearly classified as this forms the basis for decision making on water quality criteria, treatment criteria, crop restriction, as well as irrigation type requirements.

Irrigation Types

The new Guide should make provision for modern agricultural practices such as hydroponic crop cultivation. Sub-surface drip irrigation is recommended as the safest form of crop irrigation and should be applied wherever possible. Irrigation should be so managed to minimise human exposure to the water.

Crop Restriction

Crop restriction should be dictated by the quality of the effluent, the treatment system design as well as the irrigation type. Although the current Guide makes provision for this combination of factors, it is too restrictive in this regard and should be reviewed to allow for more optimal use of treated effluent.

Site Management

It is foreseen that urban agriculture would often be practiced in or near densely populated areas. The new Guide should include site management criteria that would ensure protection of public health.

Future Research Needs Identified

- Effluent monitoring frequency, as well as the acceptable level of exceedence of guideline criteria.
- Measuring of acceptable risk in South African communities, posed by irrigation of food crops with recycled wastewater.
- The need to include protozoa and especially nematode criteria in a reviewed Guide.
- Exposure and protection of workers in wastewater irrigation areas.
- Effluents classification to facilitate decision making on water quality criteria, treatment criteria, and crop restriction, as well as irrigation type requirements.
- The impact of recycled wastewater on modern agricultural practices such as hydroponic crop cultivation.
- Microbiological criteria for polluted urban surface run-off used in agriculture and aquaculture.
- Microbiological quality of sewage sludges.

Recommendations

It was beyond the scope of this project to write a new guide. The project steering committee as well as the technical working group expressed the urgency for a new South African Guide. This should be undertaken as an immediate follow-up project.

Conclusion

The aim of this project was achieved. It is evident from the report above that the current South African Guide for the Permissible Utilisation and Disposal of Treated Sewage Effluent (1978) is too prohibitive to encourage the optimum use of a valuable resource such as treated wastewater effluent for agricultural purposes. It is therefore not optimally applicable for the South African circumstances and should be reviewed as a matter of urgency.

Workshop

A revised South African Guide for the reuse of treated waste water, Roodevalley, Pretoria, January 26; 2000.

Paper

Jagals P and Steyn M. *Guidelines for the re-use of treated wastewater: public health protection or denial of essential resources?* International Association for Water Quality, April 1999. Specialist Conference on Waste Stabilisation Ponds, Marrakech Morocco

Poster

Steyn M and Jagals P. *Guidelines for the re-use of treated wastewater: public health protection or prohibiting access to essential resources?* Water Institute of Southern Africa. May, 2000. 6th Biennial Conference, Sun City

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During the execution of the project, the steering committee requested that the outcomes of the investigation be discussed at a technical level in a workshop with knowledgeable persons engaged in the field of wastewater reuse. This was presented to a technical working group for discussion at a workshop held at Roodevallei, near Pretoria on January 26; 2000.

The constructive contributions of the following persons, who participated in the specialist workshop, are specially noted with appreciation:

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