EPA Guidelines

Wastewater and evaporation lagoon construction

Issued March 2004

EPA 509/04—This guideline advises those proposing to construct a wastewater or evaporation lagoon on construction techniques that should assist in meeting obligations under the Environment Protection Act 1993 and the Environment Protection (Water Quality) Policy 2003. It replaces EPA Guideline 402/02, 'Wastewater lagoon construction'.

Introduction

Wastewater storage and evaporation lagoons are generally used to retain wastewater for treatment before reuse or disposal via evaporation or discharge.

Wastewater may contain a range of pollutants, and such lagoons should be lined on the bottom and sides with compacted clay and/or a synthetic membrane of sufficiently low permeability to minimise environmental harm arising from the escape of pollutants by seepage.

Legislation

The principal legislation addressing pollution in South Australia is the *Environment Protection Act 1993* (the Act). In particular, section 25 imposes the general environmental duty on all persons undertaking an activity that may pollute to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

Environment protection legislation also includes Environment Protection Policies (EPPs), which may outline both recommendations and mandatory requirements for the protection of a particular aspect of the environment. In particular, Section 18 of the *Environment Protection (Water Quality) Policy 2003* (Water Quality Policy) establishes principles and mandatory requirements for wastewater storage lagoons.

Persons intending to construct wastewater and evaporation lagoons should also have regard to the requirements and provisions of the *Development Act 1993* (and Regulations), the development plan for the area, and the Planning SA Draft Advisory Notice no. 5—*Consent Requirements for Dams* (*www.planning.sa.gov.au/pub-pdf/479p.pdf*).

Construction

All wastewater storage and evaporation lagoons must comply with the mandatory provisions of the Water Quality Policy; these guidelines outline issues to be addressed in lagoon design and construction. If the depth of wastewater exceeds 2 m, or is associated with a licensed activity, a lagoon may be subject to more stringent requirements—including seepage measurement and monitoring—as part of development approval and/or licensing processes.

Clay lining

A clay lining should be protected (by watering or other methods) from drying and cracking during construction. If groundwater is encountered during excavation, precautions should be taken to ensure that placement and compaction of the liner is not adversely affected. Where in-situ clay is proposed as the barrier system, a thorough investigation should be conducted to ensure that the materials and method of construction will provide an adequate lining system. Important factors to be considered include:

- the depth and extent of the in-situ material
- the compaction and permeability characteristics of the materials
- the nature of the pollutants to be retained in the lagoons and any possible reactions between clay and the pollutants.

A clay lining may not always be suitable for an evaporation lagoon as the liner may shrink and crack if the lagoon dries out. In such circumstances synthetic liners may be required, unless the site conditions (such as sufficient depth of naturally occurring clay) and natural isolation from groundwater indicate that surface cracking will not allow pollutants to permeate through to groundwater.

Material selection

The material used as a clay liner should be a well graded clay of medium plasticity. It should be free of topsoil, tree roots and organic matter, and compacted to achieve 90–95% maximum dry density, determined in accordance with Method 5.1.1 of Australian Standard 1289. When suitable clay materials are not readily available a synthetic liner should be used to ensure effective quality control.

Permeability

For a lagoon depth of up to 2 m, the compacted clay liner should have a minimum thickness of 300 mm and should be constructed to achieve a coefficient permeability of less than 1×10^{-9} ms^{-1}. Lagoons deeper than 2 m should be designed and constructed by appropriately qualified and experienced specialists, to ensure that adequate protection from pollution is provided.

Volume and overflow

The capacity of the pond should be such that, in addition the stored wastewater arising from an average year's nett inflow and discharge, it can deal with rainfall runoff from a 1-in-25-year, one-day duration storm event on the contributing catchment (with rainfall intensity based on the local catchment area) without overflowing. Clean stormwater runoff into the lagoon from other areas should be minimised by appropriate diversion to avoid unnecessary flows into the lagoon.

Any overflow should treated as contaminated wastewater and be captured on site or treated to minimise the escape of pollutants. Provision should be made for storm event overflow via a trickle pipe or non-erodible spillway to minimise the risk of damage to lagoon banks. This should allow for a discharge rate equal to the peak discharge for the 1-in-25-year, one-day duration storm event. 'Clean stormwater', 'contaminated stormwater' and 'wastewater' are defined in the Water Quality

Policy, and runoff should be estimated in accordance with procedures set out in *Australian Rainfall and Runoff – a guide to flood estimation*[1].

Layers

Successive layers should be of compatible materials and of similar moisture content, and the underlying layer should be scarified before placing the next layer, to improve bond and prevent interface lamination. The thickness of each layer, the compaction technique and the moisture content of the clay should be carefully controlled to achieve the required density and coefficient of permeability.

Embankments

The sides should generally have batter slopes no steeper than one vertical to three horizontal in order to assist in compaction of the liner and embankment fill. The embankments should be constructed to minimise leakage beneath the wall. This may require keying or cut-off construction. The embankments should be kept free of vegetation other than ground covers to avoid damage from roots.

Cover protection

Compacted clay linings should be protected to minimise damage from drying and cracking until the lagoon contains sufficient wastewater. If lagoons are subject to complete drying (such as in evaporation lagoons) care should be taken to ensure that drying cracks do not jeopardise the integrity of the liner.

Possible reactions

Any possible adverse reactions between the liner material and liquids treated should be evaluated before determining the liner specification. In the case of synthetic liners, advice should be sought from the manufacturer to ensure that the material is suitable for the purpose.

Access for desludging

If significant quantities of sludges are expected to accumulate, provision should be made for appropriate access for desludging that avoids liner damage. If desludging equipment is to be used within the lagoon, care must be taken to avoid liner damage and repair any damage sustained.

Synthetic liners

Synthetic liners include PVC (polyvinyl chloride) or HDPE (high-density polyethylene). The issues of permeability, volume, embankments, and possible reactions, as listed above for natural clay linings, must also be considered for synthetic liners. Other considerations for a suitable synthetic liner include the following:

- The lagoon earthworks must be designed and constructed to meet the specifications and requirements of the synthetic liner manufacturer.
- For a lagoon depth of up to 2 m, use a membrane at least 1 mm thick and with a coefficient of permeability of less than 2×10^{-10} ms^{-1}. Lagoons deeper than 2 m should be designed and constructed by appropriately qualified and experienced specialists to ensure that adequate protection from pollution is provided.
- Membranes should be manufactured from UV stabilised material.

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[1] Pilgrim, DH (ed.) 1987, *Australian Rainfall & Runoff – A Guide to Flood Estimation,* Institution of Engineers, Australia, Barton, ACT.

- Allow for the supply and placement of one layer of synthetic liner over the floor and all sloping sides of the lagoon.
- Membranes should preferably have a smooth finish on both sides and not be embossed.
- Membranes should be uniform in thickness across the entire area of the lining.
- Membranes should be free from pinholes, blisters and contaminants.
- All welded joints and seals should be watertight.
- Lagoons should be enclosed by secure fencing to ensure that wandering livestock and other animals cannot damage the membrane liner.

Documentation should be kept by the owner of the lagoon confirming that the lining membrane used complies with the specified requirements for the purpose (including the requirements of the Water Quality Policy), and has been installed in accordance with the specifications and the manufacturer's requirements. Guarantee documentation should also be retained, and inspection and maintenance requirements associated with the guarantee should be followed. Products with a guaranteed service life of not less that 20 years are preferable.

Maintenance

Other operational and management aspects of wastewater and evaporation lagoons may be addressed through EPA licence conditions. Monitoring requirements such as bore holes, water balances, and the method and frequency of sampling will depend on the location and use of the lagoon and the type of lagoon lining.

The performance of the liner should be evaluated through regular inspections—at least annually—to ensure that it remains an effective pollution barrier. The manufacturer's product guarantees and advice on the anticipated service life should be considered so that repair or replacement action can be taken as needed.

In general, a liner membrane which is normally exposed to sunlight and weathering will have a shorter service life than one which is submerged. Accordingly, annual inspection of the exposed liner membrane can provide a guide to potential deterioration, allowing appropriate specialist advice to be sought on remedial measures. Wherever practicable, exposed liner membranes should be protected with suitable cover material to minimise weathering.

Risk management

Detailed consideration must be given to additional precautionary measures in the following situations:

- the presence of groundwater less than 2 m below the lagoon base level
- proximity of the lagoon to a watercourse or water body—an increased hazard in the event of overflow or breakout
- storage of highly polluted wastewaters, including industrial effluent, abattoir effluent, dairy and piggery effluents.

If wastewater is relatively lightly polluted (with soil sediments and the like), pond depth is shallow and pondage is of short duration, liner permeability requirements may be less stringent, provided that the requirements of the Act and the Water Quality Policy can be met.

In some circumstances, detailed investigation and design may justify variation from these guidelines. Provided that such variations ensure equal or better protection from pollution, they may be acceptable.

Further reading

NSW Environment Protection Agency 1998, Environmental Guidelines: *Assessment, Classification & Management of Liquid and Non-liquid Wastes*, NSW Environment Protection Agency, Sydney, NSW.

Qld Department of Primary Industries 2000, P00017 *Clay lining and compaction of piggery effluent ponds*, Department of Primary Industries, Brisbane, Qld.

Virginia Tech 1996, *The Effects of Stabilization Ponds on Groundwater,* Civil Engineering Department, Virginia Tech, Virginia.

Australian Pork Ltd, *Draft National Environmental Guideline for Piggeries* Australian Pork Limited, Deakin West, ACT

Pilgrim, DH (ed.) 1987, *Australian Rainfall & Runoff – A Guide to Flood Estimation,* Institution of Engineers, Australia, Barton, ACT.

Environment Protection Act 1993
Environment Protection (Water Quality) Policy 2003
Development Act 1993 (and Regulations)

Currency of these guidelines

These guidelines offer advice to assist with compliance with the general environmental duty and specific environmental policies. They are subject to amendment and persons relying on the information should check with the EPA to ensure that it is current at any given time.

FURTHER INFORMATION

Legislation

Legislation may be viewed on the Internet at: *www.parliament.sa.gov.au/dbsearch/legsearch.htm*

Copies of legislation are available for purchase from**:**

Government Information Centre
Lands Titles Office, 101 Grenfell Street
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