National Water Quality Management Strategy

Effluent Management Guidelines for Australian Wineries and Distilleries

1998

Agriculture and Resource Management Council of Australia and New Zealand

Australian and New Zealand Environment and Conservation Council

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ISBN 0 642 24474 X
ISSN 1038 7072

Printed on recycled paper.

Printed in Australia for the Agriculture and Resource Management Council of Australia and New Zealand, and the Australian and New Zealand Environment and Conservation Council.

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Preamble

This document is one of a suite of documents forming the National Water Quality Management Strategy. This Strategy aims to achieve the sustainable use of the nation's water resources by protecting and enhancing water quality, while maintaining economic and social development.

The series, Effluent Management Guidelines, covers guidelines for specific industries. Six separate documents deal with specific industries as set out in Figure 1. This document provides national Effluent Management Guidelines for Australian Wineries and Distilleries. It sets out principles that can form the basis for a common and national approach to effluent management for the winery/distillery industry throughout Australia.

Effluent Management Guidelines					
Dairy		Intensive Piggeries	Aqueous Wool Scouring and Carbonising	Tanning and Related Industries in Australia	Australian Wineries and Distilleries
Sheds	Processing Plants				

Figure 1. Structure of the Effluent Management Guidelines for Specific Industries.

Further information on the National Water Quality Management Strategy is given in Appendix A.

While prepared by a joint ANZECC/ARMCANZ working group these guidelines are designed primarily for the Australian situation, in recognition of the different legislative framework in New Zealand. However they could serve as a basis for discussion in New Zealand on the issues addressed in the guidelines.

Introduction

The main wine-producing areas in Australia are situated between latitudes 30_ and 40_ South in South Australia (with about 50 per cent of Australia's wine production), Victoria (about 20 per cent), and New South Wales (about 25 per cent). Western Australia accounts for some 2 per cent of Australia's wine production, and Tasmania and Queensland each about 0.5 per cent.

A small number of wineries have associated distilleries which produce spirits including brandy. There also are a very small number of stand alone distilleries.

Objectives of Guidelines

The objective in developing the *Effluent Management Guidelines for Australian Wineries and Distilleries* is to support the overall goal of the National Water Quality Management Strategy that is to 'to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development'. They do this by ensuring a nationally consistent approach to effluent management by the Australian winery and distillery industry. The guidelines aim to establish important principles for environmental management and provide guidance on acceptable waste management practices which can be applied consistently across Australia.

The Guidelines can serve as a basis for sustainable resource development extension programs and for negotiations between regulatory authorities, local government and the industry on conditions for managing, monitoring and reporting for effluent management that should apply locally. They are sufficiently flexible to allow adaptation to codes of practice, and general industry agreements, as well as the range of legislative controls around Australia. It is not practicable to produce guidelines which will be immediately applicable to licensing in all jurisdictions without adaptation and discussion of local needs and conditions.

As the Guidelines deal with effluents and associated solid components including sludge and not total site management, the document would be one of a number that may need to be used for the overall environmental management of a particular winery or distillery.

The Guidelines will be reviewed as appropriate, but it could be reasonably expected that this would be within three years.

Environmental Objectives

The Guidelines' main environmental objectives are that the operation of wineries and distilleries should:

- maintain the environmental values of surface and groundwaters, including their ecology, by minimising the discharges of effluents containing organic matter, nutrients, salts or chemical constituents

- minimise the effect of effluent addition to land, which may lead to the degradation of soil structure, salinisation, waterlogging, chemical contamination or erosion

- avoid off-site nuisance or interference with amenity, such as odours associated with inappropriate or poorly-operated waste treatment processes.

Achievement of these environmental objectives requires that winery and distillery operations throughout Australia should be managed to protect:

- surface waters

- groundwaters

- soils

- vegetation

- public amenity.

The main emphasis of these Guidelines is water quality protection. Achievement of these environmental objectives, and the specific objectives in the Guidelines section, should help ensure that winery and distillery operations are ecologically sustainable both in the short and long term.

Application of Effluent Management Guidelines

These Guidelines are intended for use by the winery and distillery industry (including consultants), regulators, planning authorities and the broader community.

The industry

The Guidelines aim to assist operators of wineries and distilleries to:

- minimise and use as far as possible the effluent they produce

- prevent the unacceptable degradation of water, land and environmental quality.

The Guidelines should be consulted where extensions or new developments are planned, or where environmental protection at existing operations is to be enhanced.

Regulators and planning authorities

Effluent Management Guidelines for Australian Wineries and Distilleries should provide the framework where State or local guidelines or codes of practice are to be developed for the regulation of wineries and distilleries. Any such guidelines should be consistent with and at least as stringent as these Guidelines. Existing codes of practice or regulations should also be consistent with and at least as stringent as these Guidelines.

In general, State, Territory, regional and local government guidelines, laws and regulations will be more detailed than these Guidelines to take account of site specific circumstances of the winery or distillery industry. Local knowledge and data specific to individual wineries or distilleries are essential to manage them responsibly.

The broader community

Integrated catchment management is increasingly becoming the "umbrella" for sustainable natural resource management. It provides the framework for the community, industry and government to work together to overcome environmental and resource management problems.

This document provides information which will help communities to participate in an informed manner in integrated catchment management, including decisions on new or existing wineries or distilleries and local resource management issues. Development of catchment-based plans and strategies is central to integrated catchment management.

Further information

Where further information is required to assist decisions relating to the management of effluent, reference should be made as appropriate to other National Water Quality Management Strategy documents (Appendix 1), or the sources listed in both Appendices 2 and 3.

The development of detailed guidelines and environmental codes of practice is the responsibility of relevant State and Territory authorities. Proponents are thus encouraged to seek advice from the relevant State and Territory authorities about current regulations and codes of practice when new developments are being contemplated, or when the effluent management system of existing operations is to be upgraded.

These Guidelines should apply immediately to any expansion and new developments, and be phased in for existing facilities to timetables agreed with State and local government authorities.

Principles of Environmental Management

The main principles of effective management of winery and distillery effluent, in order of importance, are:

- avoidance or elimination of excessive waste generation through better planning
- optimisation of waste management processes
- effective and feasible recycling and reuse of waste
- disposal of waste where its use is not practicable, in a manner that will not cause short or long term adverse environmental impact.

A fundamental consideration for sustainable management of winery and distillery effluent should be the development of an Environmental Management Plan through the implementation of an Environmental Management System. In some States an operator can be required to produce an Environmental Management Plan as a stand alone document, not as part of an Environmental Management System. The amount of detail provided in the plan will depend on the size of the enterprise, siting considerations in relation to neighbouring communities and the environmental sensitivity of the location such as proximity to surface and groundwater. The Environmental Management System provides for the management, administration and monitoring framework for the environmental aspects of an operation. It includes the principles of Total Quality Management and should incorporate the principles of risk management (see glossary).

In August 1995, the International Standards Organisation (ISO) released the draft international standard ISO 14001 on *Environmental Management Systems: Specification with guidance for use*. In late 1995 ISO 14001 was published as an interim standard within Australia and New Zealand by Standards Australia. This standard can be used to provide guidance when implementing an environmental management system.

The Environmental Management System should incorporate the principles of cleaner production to minimise the adverse environmental impacts of the production process. In the context of these Guidelines, cleaner production involves the use of:

- better housekeeping
- improved management practices
- state-of-the-art in-plant production processes

- the concept of management of all aspects of the entire production process, from the raw materials to finished product including any associated waste.

These Guidelines are not intended to present detailed performance standards as the concept of continuous improvement for performance is reflected in the Guidelines' focus on Environment Management Systems and Plans.

Effective effluent management is an important part of a winery or distillery operation, and should be allocated an appropriate share of management effort and expenditure. Good communication within the operation is important for increasing the operation's overall efficiency, including effective environmental management, and can help identify problems early to rectify them before they become significant.

Development of an Environmental Management System and/or Plan should involve consultation with regulators, planning authorities and the broader community. State and Territory environment protection authorities can provide information on the development of Environmental Management Systems and/or Plans.

General Characteristics of Winery and Distillery Waste

Sources of Winery and Distillery Wastes

Wine is produced through the crushing and fermentation of grapes, followed by the straining of skins and seeds, storage, clarification, and maturation of the young wine.

Winery effluent is mostly cleaning waste, as wineries must be kept meticulously clean to avoid contamination and spoilage. Effluent is from:

- rinsewater
- water used to wash outsides of equipment and floors
- washwater containing alkali salts (eg caustic soda) to remove tartrate and other organic acids from insides of equipment
- earth filtering
- ion exchange processes.

Wineries can produce up to five kilolitres of effluent per tonne of grapes processed depending on the extent of washwater recycling and whether stormwater is allowed to enter the effluent stream. Typical quantities of winery effluent are given in Table 1. Just under half the total effluent volume is produced within 12 to 20 weeks during vintage.

Size of winery	Weight of grape crush/per vintage (tonnes)	Effluent quantity /per annum (megalitres)
Small	up to 5000	1-9
Medium	5000 - 20 000	5-100
Large	over 20 000	40-240

Table 1. Winery Effluent Quantities

In contrast, distillation produces relatively small volumes of effluent, mainly rinsewater and spent (non-alcoholic) liquors.

Winery and distillery solid waste comprises:

- stalks, seeds and skins (marc) produced during the crushing, draining and pressing stages, almost all of which is delivered to distilleries for the recovery of ethanol

- sediments (lees) containing pulp, tartrates and yeasts from the fermentation stage

- bentonite clay and diatomaceous earth from the clarification processes much of which is delivered to third party processors for producing cream of tartar and tartaric acid.

The amount produced depends on the extent of juice extraction, the number of fermentation and clarification stages used in the manufacture of each wine type and the type of equipment used.

A typical winery produces about one tonne of marc per 9-13 tonnes of fresh grapes crushed, of which about 65 per cent is water.

Distillation produces spent fruit and other dried forms of waste. Large amounts of solids are also generated from the desludging of lagoons. Processes involved in winery and distillery operations, including stages where effluent is generated, are described in Figures 2 and 3.

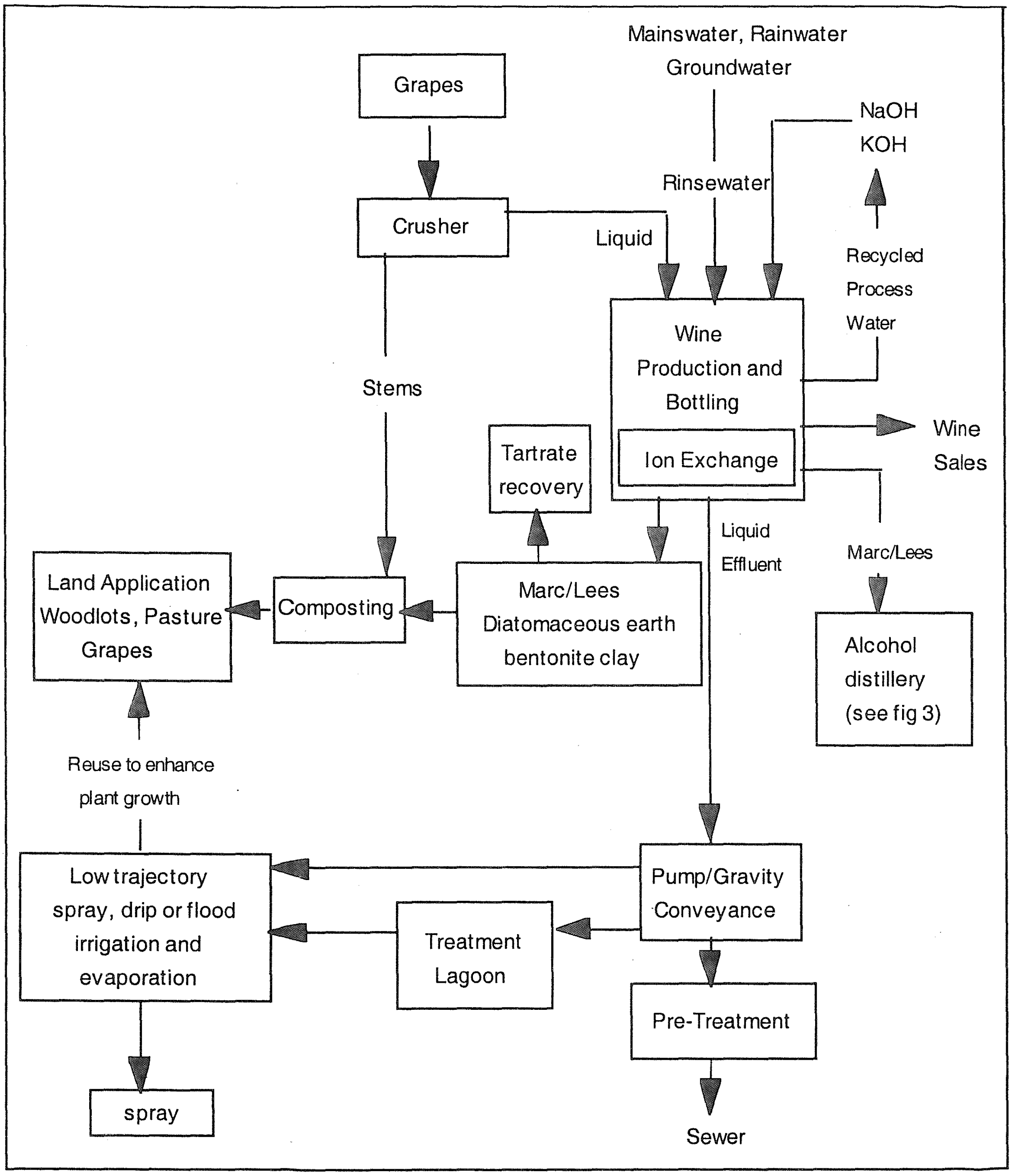

Figure 2. Components of a Winery Effluent Management System

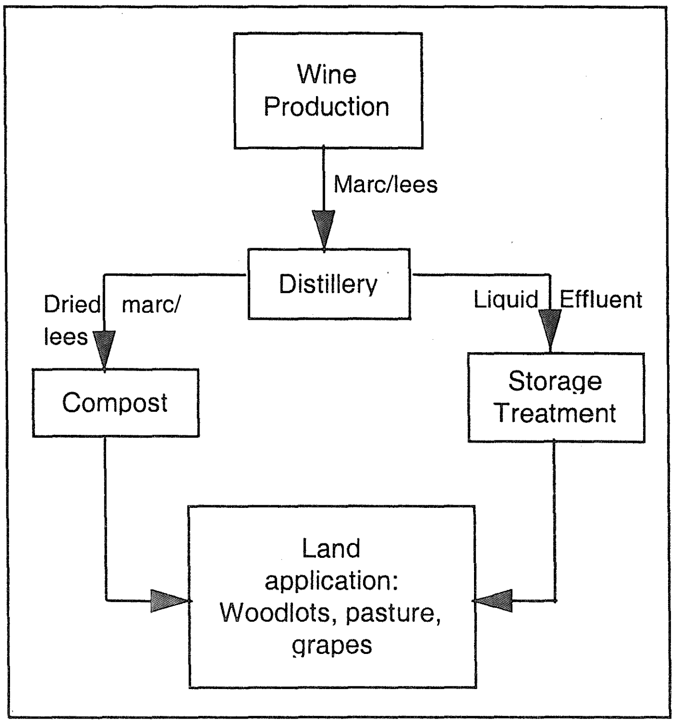

Figure 3. Components of a Distillery Effluent Management System

Composition of Effluent

Both winery and distillery effluents contain:

- simple organic acids, sugars and alcohols from grapes and wine. As a result, the effluents have a high requirement for oxygen for biological decay (BOD) (see Table 2). The BOD of distillery effluent can be as high as 35 000 mg/L
- a pH in the range of 3 to 10 - the pH of the fresh winery and distillery effluents varies with the relative concentrations of organic acids and caustic cleaning wastes (which can change very quickly)
- moderate salinity
- a proportionally high concentration of sodium relative to that of calcium plus magnesium
- low amounts of nitrogen and phosphorus relative to total carbon
- inorganic components from the water supply, alkali washwaters and processing operations.

Best practice for wineries is to screen their products (juice and wine) for agrochemicals to ensure they comply with local and overseas Agrochemical Maximum Residue Limits (MRL's). Refer to Appendix B, Australian Wine Research Institute for further information. The juice component of the effluent is negligible which means that chemical fertilisers, pesticides and herbicides used in growing grapes are insignificant components of the effluent.

Winery effluent contains a small amount of suspended and settleable solids, with the latter normally forming part of the solid waste.

Distillery effluent originating from spent liquor can have more than 30 000 mg/L particulate material.

The carbon content of the organic solid wastes is dominated by complex materials including polysaccharides which are readily degradable by soil micro-organisms, and lignins and tannins which are less degradable and can be incorporated as soil carbon in the form of humus.

Due to their fine particulate nature, bentonite clay and diatomaceous earth have poor physical properties including a tendency to set hard and an inability to transmit water.

Analysis	Distillery	Winery vintage	Winery non-vintage
Suspended solids (mg/L)	5000-30 000	100-1300	100-1000
pH	3-5	4-8	6-10
Total dissolved solids (mg/L)	1100-4500	<550-2200	<550-850
Biochemical oxygen demand (mg/L)	13000-35000	1000-8000	<1000-3000
Total organic carbon (mg/L)	1000-15000	1000-5000	<1000
Total Kjeldahl Nitrogen (mg/L)	500-1700	5-70	1-25
Sodium (mg/L)	260-540	110-310	250-460
Total Phosphorus (mg/L)	100-400	1-20	1-10
Carbon:Nitrogen:Phosphorus	10-50:4:1	30-100:4:1	15-30:5:1
Calcium (mg/L)	90-140	13-40	20-45
Magnesium (mg/L)	70-100	6-50	10-20
Sodium Absorption Ratio (SAR)	8	4-8	7-9
Potassium (mg/L)	1300-2100	80-180	40-340

Table 2. General characteristics of liquid winery and distillery effluent

Table 2 is indicative only. Site specific information on the particular effluent stream should be obtained for modelling purposes when developing effluent processes.

Guidelines

The Guidelines are designed to provide general principles for the nationally consistent environmental management of wineries and distilleries to protect water quality. The principles of these guidelines can be adapted by jurisdictions to take account of their own legislative and environmental requirements for the approval of new projects, setting licensing conditions and the general environmental management of wineries and distilleries. They are not intended to provide detailed prescriptive standards.

The important factors in planning, developing and managing wineries and distilleries to ensure economic and ecological sustainability are:

- site suitability assessment
- effluent management system design
- effluent treatment
- effluent use
- solids/sludge management
- effluent disposal in circumstances where reuse is not practicable
- monitoring and reporting
- contingency measures.

Site Suitability Assessment

Siting has a significant impact on the intensity and cost of effluent treatment, and the management required to protect water quality. Carefully planned siting of facilities, particularly the effluent utilisation areas, facilitates the environmental management of the operation. Where possible the site selected should be one which avoids the need for costly environmental protection measures and which ensures preservation of community amenity.

Objectives

For existing operations to:

- identify site constraints which can result in adverse environmental impacts

- manage the winery or distillery operations through effective use of appropriate practices, techniques and technologies to allow for these constraints

- enhance or maintain the water quality of relevant water resources based on their agreed environmental values.

For new winery or distillery developments to:

- avoid unacceptable environmental impacts on water resources, soils and amenity

- enhance or maintain the water quality of relevant water resources based on the agreed environmental values for the resources.

Guidelines

The following factors should be taken into account when choosing a site.

Existing operations
Existing operations with site constraints (eg high watertable, nature of the soils, topography, presence of incompatible land uses, size of site, availability of services) should implement the following:

- innovative and effective technologies to minimise effluent and allow for its reuse

  - effective design of the plant

  - effective housekeeping and best management practices

  - an effective monitoring system to enable potential problems to be detected early

  - replacement of obsolete technology

  - liaison with regional planning/zoning authorities.

If the operation cannot overcome the constraints, its scale should be reduced to a manageable level, be re-established in a suitable location, or closed.

New developments
Siting of new operations should consider:

- the amount of land required for establishing the enterprise, in particular for the treatment, storage and application of effluent and solid wastes/sludges on or off site

- characterisation of the soil to determine its suitability for the storage, treatment and application of effluent and other solid wastes/sludges

- estimation of quality and quantity of effluent and solid wastes/sludges produced at all stages of the process (ie, pre treatment, post treatment, etc)

- land suitability (including topography, slope, surface soil type and previous landuse practices)

- climate (including rainfall, prevailing winds, katabatic wind/ drainage, evaporation)

- type of effluent storage and treatment system to be used

- neighbouring landuse, including residential, commercial, industrial and agricultural

- proximity to sensitive sites, including surface and groundwaters, areas of scientific value, areas of Aboriginal significance and areas containing unique, uncommon or endangered fauna and flora

- the proximity of services and amenities including water supply

- the need for appropriate buffer zones between the enterprise and sensitive areas including waters and residences

- hydrogeological considerations including depth to groundwater and potential beneficial uses of groundwater

- other factors outlined in, Use of Winery and Distillery Effluent section, eg surface runoff/soil erosion.

Once the site has been chosen, it should be benchmarked to:

- develop siting, operational and management systems that ensure the facility is managed to minimise environmental impact

- compare benchmark information with subsequent monitoring information to assess environmental performance.

Odour control
Odours from winery or distillery operations can be detected up to several kilometres from the site, resulting in loss of public amenity. These odours arise from poor design and management of winery and/or distillery effluent treatment systems, and the stockpiling of used bentonite clay/diatomaceous earth at wineries.

The effectiveness of buffer zones in protecting the community from odours depends on several factors, including:

- whether methods are used to minimise odours generated from effluent treatment, storage and disposal

- whether effective buffer zones have been considered at all stages of the planning process for the operation, including
  - the distance between sites on the property where operations are undertaken and the surrounding amenities
  - physical barriers, including topography and vegetation
  - climatic conditions, including wind direction, speed and turbulence
- community consultation and involvement.

By themselves, buffer zones do not protect the community from odour unless they are effectively managed. Most odour problems will be alleviated if the effluent management practices recommended elsewhere in these guidelines (ie direct land application of effluent and only short term storage of bentonite clay/diatomaceous earth) are adopted for new and existing wineries and/or distilleries. Proponents, as well as operators of existing wineries and distilleries, are encouraged to discuss separation distances for buffer zones, and other related requirements, with the relevant State or Territory agencies or authorities and the local community.

Performance assessment options

Performance Indicators for site suitability could include whether:

Existing sites
- appropriate practices, techniques and technologies have been developed and used on site
- an acceptable Environmental Management System and/or Plan is in place
- public amenity has been maintained by odour control
- a monitoring program is in place for water and odour (for monitoring of water resources, see the NWQMS documents: *Australian Water Quality Guidelines for Fresh and Marine Waters*, and *Guidelines for Water Quality Monitoring and Reporting*).

New sites
- Best Available Technology has been implemented, where possible at reasonable cost, to ensure environmental protection measures specific to the site have been undertaken
- an acceptable Environmental Management System/Plan has been developed.

New and existing sites
- risk management assessment of the site has been undertaken

- assessment has been made of the suitability of the soil and hydrology at the site for a winery and distillery
- protection measures specific to the site have been established
- adverse impacts on water resources, land and amenity have been minimised
- adequate safeguards for possible system failure are in place.

The proponent's past environmental performance should be considered where approval is to be given for the development of new wineries or distilleries or for extensions to existing operations.

Design of the Effluent Management System

The design of wineries and distilleries should incorporate modern technologies and processes for producing wines and spirits. This involves adopting technology which has consistently achieved the desired effluent quality levels in economically viable operations. It should also consider state-of-the-art engineering and scientific developments in effluent treatment, as well as opportunities for waste minimisation. It is recognised that good effluent management is not necessarily dependent on high technology and may often involve simple, innovative solutions.

Objective

To effectively design winery and distillery operations to minimise the volume of effluent, and control effluent quality and treatment, prior to its application to land or discharge to sewer.

Guidelines

Separating stormwater from winery and distillery effluent
Stormwater not contaminated from the winery and distillery operation should be separated from the effluent system, and either collected for use within the plant or directed to watercourses to maintain environmental flows and recharge aquifers. Separating stormwater from the effluent will reduce the effluent volume and will improve treatment performance due to more even hydraulic loading. Stormwater separation may be required by some sewage authorities before disposal to sewer will be permitted.

Contaminated stormwater should be directed to effluent collection ponds, provided the ponds have the capacity to handle the extra volumes that may be involved. If the effluent system cannot handle the volume, then the plant should be designed to allow for the separate collection of contaminated stormwater.

In urban areas where wineries or distilleries discharge to the sewer, some authorities may require the operation to have the capacity to store all polluted stormwater for discharge after heavy rain. Where the first downpour of rain will flush an open area clean, the relevant authority may accept this polluted water with the discharger being required to divert the following rainfall to stormwater, on the grounds that it is no longer polluted.

Best management practice will minimise, where practicable, the opportunity for stormwater to be contaminated. This should be considered in the Environmental Management System/Plan for both new and existing wineries and distilleries.

Optimising effluent and enhancing recycling
Efficient water use throughout the plant, including recycling, will minimise the volumes of effluent generated as well as the consumption of clean water. The use of waste by-products will reduce total effluent load and may improve the effluent quality.

The key consideration is to ensure the plant is designed to optimise the overall operation. This can be achieved by ensuring that the plant's various components, including the effluent management systems, are mutually compatible and well-integrated.

Separating the various waste streams
Attention should be given to separating the waste stream components related to their characteristics and specific treatment needs to improve the resultant effluent quality. This would obviate the need for costly treatment and enhance opportunities for reuse. The main components to be considered for separation are:

- solids and liquids
- high and low salinity effluent
- effluent from ion exchange processes.

Effective effluent containment and storage
Storage and treatment lagoons should be designed to contain their maximum operational load safely, including provision of sufficient freeboard. This should take into account the maximum volumes of effluent to be stored when land application may not be possible because of climatic conditions, as well as increased volumes resulting from unusually heavy rainfall events (relevant authorities should be consulted on conditions required to satisfy local requirements). A generally accepted standard is to design any system to cope with the wettest year in ten.

Storage systems may also need to incorporate a spillway to prevent damage during any overtopping under extreme conditions (relevant authorities should be consulted on conditions required to satisfy local requirements). The base should be constructed with low permeability materials or lined with such materials to prevent leakage from the storage facilities. Leakage of effluent to groundwater resources also needs to be minimised. In addition, lagoons should be designed and constructed to prevent potential pollution of surface water through runoff.

Controlling spillages
Areas where accidental spillage of effluent or products could occur should be adequately bunded or sloped to waste drains and directed to storage or effluent treatment areas. Effective alarm systems should be installed particularly in areas where equipment malfunction or a spillage would cause pollution, to enable immediate detection of accidents and remedial action to be instituted without delay.

Preventing contamination of public water supplies
When water supply is from a reticulated source, surface water impoundment or direct from groundwater bores, backflow prevention devices which meet the relevant Australian standards should be installed. Water authorities should be contacted to ascertain any controls on establishing and operating wineries or distilleries within declared drinking water source areas.

Performance assessment options

Monitor:

- the volume and characteristics of treated and untreated effluent so that they are kept within sustainable and manageable limits
- quantities of recycled and reused process liquors and effluent
- spillages; ensure they are contained and deal with sources of spillages
- any odours.

Assess the winery and distillery's overall performance in consultation with the community and relevant government authorities.

Treatment of Winery and Distillery Effluent

Suitable treatment in a properly constructed and maintained treatment system will normally be required prior to utilisation of the effluent.

Objective

To treat winery and distillery effluent to enable its use or disposal in an environmentally acceptable manner for a particular site.

Guidelines

The treatment systems should permit safe, effective and sustainable land application of liquids and separated solids. For disposal to sewer, the treatment should achieve the quality required by the treatment plant owner/operator for trade waste acceptance to sewer. Selection of an effluent treatment system could be based on the factors outlined in Use of Winery and Distillery Effluent section. Any treatment system will need to be able to either reduce or deal with:

- total suspended solids
- BOD
- nutrients
- odour
- pH

Options for effective treatment and management of winery and distillery effluent are summarised in Figures 4, 5 and 6.

While treatment methods will vary between wineries and distilleries, methods should be the best available considering:

- the required level of treatment
- cost
- technical capabilities and backup
- ability to handle extreme events, eg shock loadings, maintenance periods, storm events.

After treatment, the effluent can be applied to the land at a managed rate which ensures long term sustainable application. Any treatment system needs to be carefully managed and regularly maintained. It is important to ensure that the management expertise for efficient effluent treatment is available at all times.

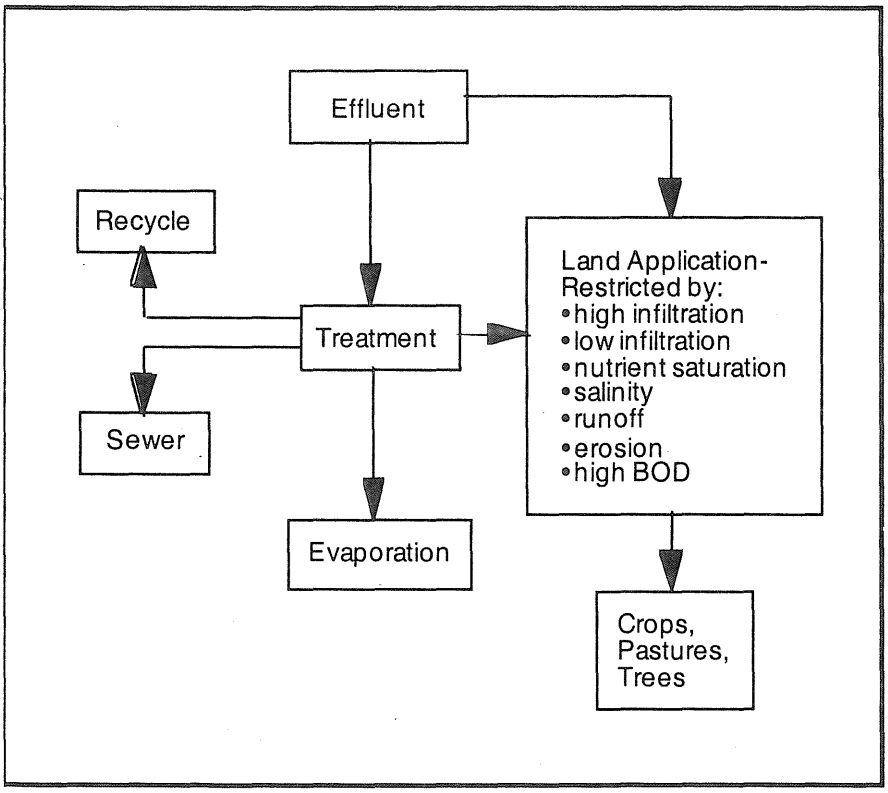

Figure 4. Winery and Distillery Effluent Management Options

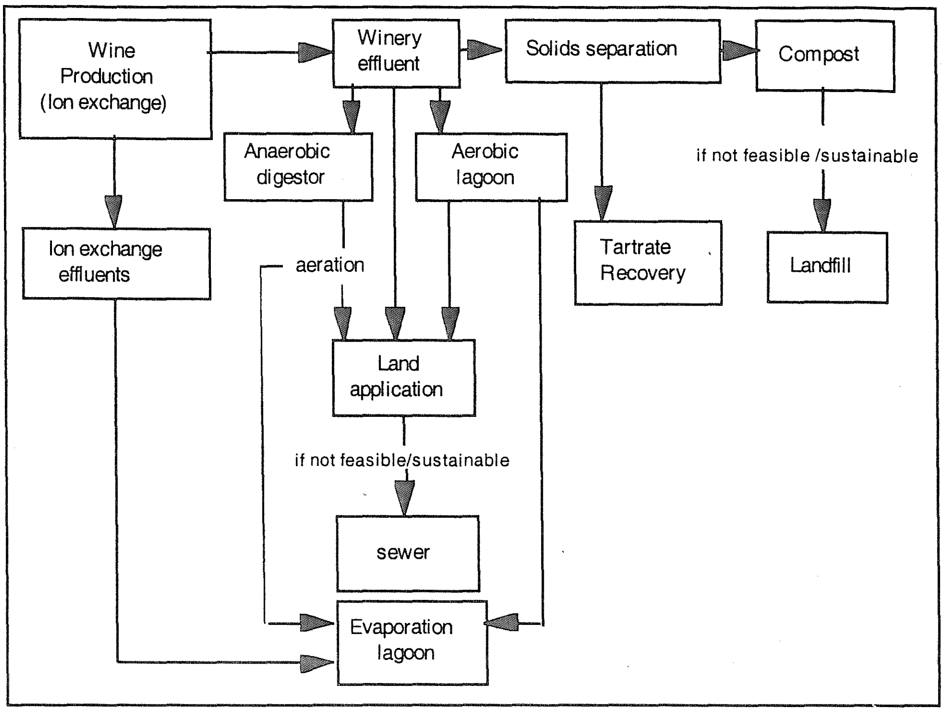

Figure 5. Winery Effluent Treatment Options

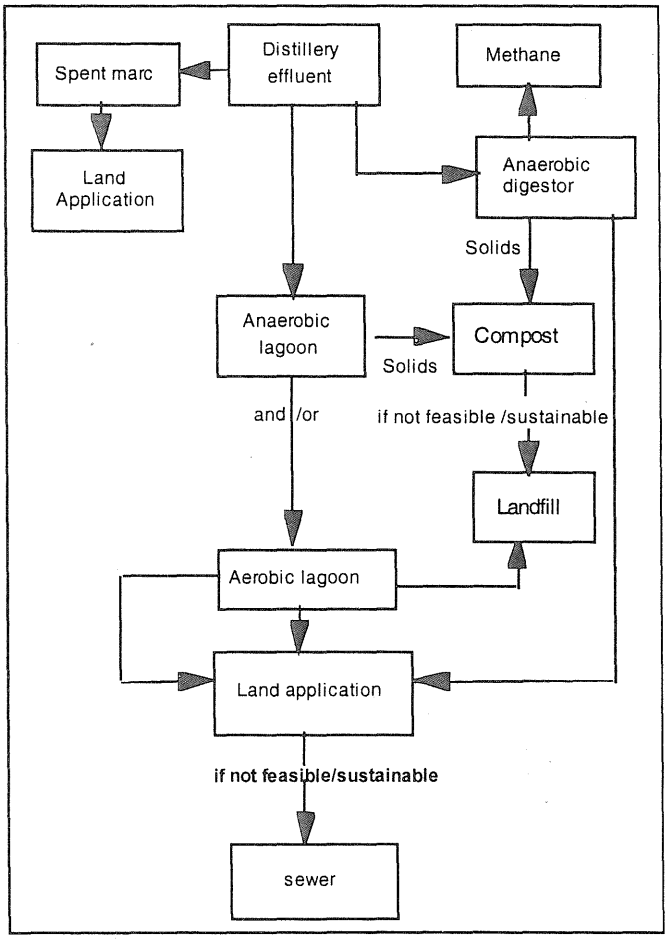

Figure 6. Distillery Effluent Treatment Options

Treatment options

There are a range of methods which if used in an appropriate combination can achieve effluent treatment objectives.

Physical and Chemical treatment
Solids and suspended matter can be separated from the effluent stream by using equipment such as coarse screening, sedimentation tanks, centrifugation and micro-filtration.

This type of treatment not only reduces the rate of sludge build up in lagoons and wear on pumps, but also is a rapid way of reducing the BOD concentration in effluent before disposal or reuse.

Chemicals can be used to enhance treatment characteristics, (eg settling of solids maybe enhanced by pH correction) and to improve treatment performance or suitability for land application.

Biological treatment
The most common form of biological treatment is anaerobic and/or aerobic lagoons. Small package proprietary treatment systems are also available. Lagoon systems should be designed to take account of quantity, quality and intermittent generation of effluents, the likelihood of odours affecting nearby landowners, and the ultimate reuse/disposal method to be adopted.

Siting and design of treatment lagoons

Lagoon systems are suitable for effluent treatment where odour buffers, climate, topography, soil and groundwater conditions favour their installation. Some State regulatory authorities may have information on the siting and design of treatment lagoons to prevent surface and groundwater contamination.

Lagoon siting and soils
Lagoons may be installed where the slope of the land is not too steep to cause problems with their construction and where soils are sufficiently impermeable to retain effluents in the lagoon. Low permeability clay and/or liners should be used in lagoon construction to minimise effluent leaching to groundwater. Great attention must be paid to their installation. Lagoons should not be constructed where overflows can enter surface waters or natural wetlands. They should not be installed across watercourses. Adjacent surface water runoff should be prevented from entering the lagoon.

Design and sizing
Lagoons should be designed to cater for maximum hydraulic and waste load and future expansion of a winery or distillery. In areas where soils may be saturated for a period, such as those with ample winter dominant rainfall, lagoon systems should be large enough to retain the total volume of effluent during these periods.

Allowance needs to be made for primary lagoons to be taken out of service, solar dried and desludged after about 5-10 years of service.

The sludge should be stored so as to prevent leaching to susceptible groundwaters, with any discharge from the stored sludge being directed to the effluent system. Provision for desludging and the effect of application to land should be considered in the Environmental Management Plan in all situations.

If sludge is unable to be utilised productively, for example as a soil conditioner, it should be disposed of in an authorised land fill.

Capacity of the effluent management system

Planning for any increase in winery or distillery production needs to consider the capacity of the effluent treatment system to accommodate the possible production increase. An augmentation of treatment capacity can be accomplished in several different ways, including:

- load reduction due to improved housekeeping and/or effluent stream segregation
- physical pre-treatment processes
- enhanced aeration of lagoons
- expansion of the lagoon capacity
- new effluent treatment facilities
- chemical or microbiological supplements
- anaerobic pre-treatment processes with appropriate controls on gases generated.

Performance assessment options

These include:

- effluent characteristics are monitored before and after treatment to gauge the effectiveness of any treatment
- whether winery and distillery effluent is used for land application, eg irrigating crops, pastures and trees and if so,
- land application does not lead to:
    - polluted runoff

- accession of harmful components to surface or groundwaters, (surface and groundwater is monitored for ambient levels of salt, BOD, nitrogen, phosphorus, potassium, pH, and carbon, and C:N:P (Carbon:Nitrogen:Phosphorus) does not exceed recommended levels for sustainable downstream environmental values as indicated in *Australian Water Quality Guidelines for Fresh and Marine Waters*);

- degradation of soils, including physical, chemical and biological characteristics (soils are monitored and do not show, for eg, surface crusting and sealing due to poor salinity management, toxic chemical build-up or the development of anaerobic conditions)

- loss of public amenity - observe buffer zones and keep note of any public complaints

- crops, trees and pasture are monitored for yield and foliar symptoms, growth rates and health

- records are maintained from which the history of loading of water, nutrients, salts and contaminants can be calculated for all areas where effluent is applied.

Use of Winery and Distillery Effluent

Objective

To encourage the use of:

- nutrients
- organic matter
- water values.

Of the effluent and solid waste/sludge, where this use is not precluded by other components of the effluents, such as salts, in a manner which protects water quality consistent with the environmental objectives.

Guidelines

Generally, land application provides the most efficient means of recycling valuable water, along with the effluent's nutrient and organic components. Suitable treatment in a properly constructed and maintained treatment system will normally be required.

Further information on the use of treated effluent by irrigation is available from relevant State and Territory Environment authorities, including, the Victorian and NSW Environment Protection Authorities (EPA (Victoria) (1992) and EPA - NSW (1995)).

Land requirement
The amount of land required depends on a number of factors including:

- susceptibility to surface runoff and soil erosion
- potential effect on groundwater and surface water
- climatic conditions (amounts of rainfall, evapotranspiration)
- the nature of pasture or crop grown
- pastoral, agricultural and horticultural practices
- the properties of soils (structure, infiltration rate including phosphorus sorption capacity, moisture storage capacity in the root zone and chemical and physical characteristics)
- the quality and quantity of the effluent
- maximum operational life of the application site determined by phosphorus sorption capacity of the site and predicted salt accumulation.

The nature of the soils
Long term application of winery and distillery effluent at excessive levels could damage soils. To select land for irrigation with winery and distillery effluent, it is important to ensure that the soils have the following characteristics:

- a structure that permits air movement and water penetration
- sufficient depth to permit optimum root development by the crop
- adequate natural drainage, or suitable artificial drainage
- sufficient capacity to hold water for plant use between successive irrigations
- nutrients in sufficient but not excessive quantities for adequate plant growth
- moderate pH, ie it should be neither too acid nor too alkaline
    - neutral to slightly acid soils are best for most irrigated crops
- ease of cultivation
- no salinity problems
- sodium content of subsoil
- depth to bedrock.

It is not always possible to have all of these qualities, and the relative importance of each will depend to some extent on the type of crop to be grown, as well as the characteristics of the effluent.

The most satisfactory soils for efficient irrigation are deep, well structured and well drained, ranging in texture from loam to clay loam. They are generally preferred to sandy soils, which are very permeable, and heavy clay soils, although the range of soils that are satisfactory for crop production under irrigation is quite wide.. These types of soils may also be suitable for effluent irrigation. For solid waste/sludge application soils should be suitable for improved pasture or dryland cropping, able to withstand cultivation without incurring significant erosion or major structural declines and not prone to waterlogging.

Soils generally considered unsuitable for irrigation include:

- poorly structured clays
- shallow soils with rock, gravel or impeding clay close to the surface
- swamps that cannot be drained
- soils with poor drainage
- soils with a high salt content and low permeability
- coarse silica sand soils (without iron or aluminium-rich fines).

A soil survey is the most satisfactory way of determining the suitability of different soils for the different types of irrigated agriculture.

Land application rates

Before and during land application, scheduling and application rates based on the properties of the effluent including its salinity and nutrient content, pH and BOD need to be considered. This should be assessed seasonally.

While maximum application rates for land treatment of effluent will depend on site-specific conditions, in general the maximum application rate will be limited by one or more of the following:

- hydraulic loading
- nutrient loading/balance (N, P, K)
- salt loading
- BOD of effluent.

Guidelines which aim to maintain effluent loading at a rate which, after accounting for rainfall, is balanced by evapotranspiration are inadequate to protect groundwater. This is especially so in areas where rainfall can exceed evapotranspiration over periods which are sufficiently long that excess water (and solutes) can leach beneath the root zone.

As rainfall cannot be controlled, the only effective way of preventing excessive contamination of groundwater is to ensure that concentrations of nutrients and salt below the root zone remain at an acceptable level. This may require land application of effluent to be suspended during wet periods or seasons.

A nutrient balance can be developed, where the losses from the system are:

- the uptake of nutrient by plants which are removed
- gaseous losses of nitrogen and
- net accumulation of nutrients in the soil.

Such balances should be calculated to account for seasonal variations in components of the nutrient budget (particularly plant uptake, net mineralisation and leaching). Long term nutrient monitoring of the soil and/or soil solution could substitute this approach.

Water budgets
Water budget studies are an important tool for quantifying land requirements and the volume of effluent which may be applied.

Surface runoff/soil erosion
To minimise surface runoff and soil erosion, effluent should not be used on land which is:

- immediately adjacent to streams and water courses
- subject to flooding (flood risk analysis should be undertaken)
- waterlogged or saline
- sloping with inadequate ground cover
- rocky, slaking and highly erodible
- of highly impermeable soil type.

Bunding and cut off drains, etc can be used to control accidental irrigation runoff. The use of expert advice is recommended.

Groundwater
Important factors to consider are the depth to groundwater including perched and seasonal watertables and soil type, which can influence infiltration rates, and the location, characteristics and potential use of groundwater. A small increase in infiltration from the surface to groundwater can cause a significant rise in groundwater pressures and watertable levels. As the watertable rises, it carries the salts in the soil towards the surface, increasing salt levels in the root zone and possibly causing waterlogging. It is unlikely to occur where winery or distillery effluent is applied to dryland crops and pastures (in permeable soils with a substantial separation between the surface and watertable).

The NWQMS document *Guidelines for Groundwater Protection* should be consulted when considering groundwater issues. Factors to consider are:

- the watertable level
- groundwater quality
- current and potential usage of groundwaters.

Hydrogeological expertise will be required to evaluate the characteristics of the groundwater beneath the land application area. This will include evaluation of mixing and dilution, travel times, direction of groundwater flow, and the possibility of contamination occurring.

Surface waters
The following should be taken into account:

- general features - distances of various waterbodies and water uses from proposed winery and distillery and /or land application site
- hydrological features - catchment area and drainage patterns.

Climatic conditions
Factors include the following, all of which affect evapotranspiration rates and any tendency to flooding or waterlogging:

- regional climate - rainfall, temperatures, humidity, winds and evaporation
- local microclimate - diurnal pressure and associated air movement patterns.

Effluent should only be applied during conditions which will minimise polluted run-off or groundwater contamination. However if managed correctly polluted runoff and groundwater contamination should not occur.

Agricultural and horticultural practices
The decision to use either crops, trees or pasture, and the selection of species should be based on the characteristics of the effluent and on other factors discussed in this section.

Characteristics of the effluent

The characterisation of the effluent for a particular enterprise is fundamental to the operation and management of that enterprise and for the adequate assessment for any land application program. Collection of data by operators is encouraged and should include the following where required for initial characterisation and ongoing monitoring:

- total solids
- suspended solids
- BOD
- COD
- organic carbon
- electrical conductivity (EC)
- exchangeable cations (sodium, magnesium, calcium)
- sodium adsorption ratio
- pH
- total Kjeldahl nitrogen
- nitrate-nitrogen
- phosphorus.

Concentrations of nutrients, total dissolved solids or salinity, organic matter, BOD, sodium adsorption ratio (SAR) and suspended solids (non-filterable residue) should be tested for regularly in effluent and solid wastes/sludges. This is particularly important just prior to land application to calculate and determine appropriate application rates.

Biochemical Oxygen Demand (BOD)
Application of untreated winery and/or distillery effluent can deplete the soil and soil micro-organisms of oxygen as the BOD is moderately high, and that of distillery effluent very high. Prolonged oxygen depletion reduces the soil micro-organisms' capability to break down the organic matter in the effluent and may ultimately lead

to odours and surface and/or groundwater pollution. It is therefore essential to apply effluent at rates that will not cause the development of anaerobic conditions. Resting periods between applications may also be required to permit re-aeration of the soil. However, the quantity of oxygen which can be held in different types of soil varies according to soil texture and structure. State authorities may be able to advise on loading rates which do not cause environmental effects under various climatic conditions.

pH

Distillery effluent is often very acidic and winery effluent can also have a low pH. Adding lime to the soil can be used to correct low pH. Low pH effluent could also be blended with near neutral effluent or effluent pH automatically adjusted using pH probes and the addition of lime. This will also reduce the effluent's Sodium Adsorption Ratio (SAR). Over a long period, however this may impact on soil structure, erodibility and infiltration. A better option may be to pre-treat the effluent before irrigation.

Total dissolved solids or salinity

The salinity or total dissolved solids (TDS) concentration of irrigation water, measured as electrical conductivity (EC) is an extremely important water quality consideration. An increase in salinity or EC levels causes an increase in the osmotic pressure of the soil solution, and results in reduced availability of water for plant consumption and possible retardation of plant growth. Recommended guidelines for irrigation water quality are given in the NWQMS document *Australian Water Quality Guidelines for Fresh and Marine Waters* and cover a number of parameters including salts (TDS) and sodium adsorption ratio (SAR). Soil loadings for particular contaminants are influenced by soil characteristics, crop tolerance, climate and irrigation practices.

With adequate drainage, salt accumulation in the soil can be controlled to an extent by the application rate of water. If the sum of applied irrigation water and rainfall is lower than evaporation and plant consumption, accumulation of salts in the main root zone will result. However long-term application of low salinity effluent may result in a build-up of sodium. Proper irrigation management will allow application of sufficient excess water (leaching fraction) to move a portion of the salts out of the root zone, without causing excessive increases in the groundwater table. (NWQMS - *Australian Water Quality Guidelines for Fresh and Marine Waters, p 5-7*).

Where the winery/distillery effluent is moderately saline, potential irrigation areas should have free draining soils (sandy loam to loam texture with macropores penetrating to at least one metre below the root zone). They may need to be planted with salt tolerant species and managed to drain excess salt to surface and/or groundwater at a rate which is not detrimental to existing and potential future water users. Sites should not be irrigated with effluent if sub-surface drainage is likely to cause rising groundwater tables and the threat of land salinisation in the direction of groundwater flow.

Other points to consider:

- grapevines are moderately sensitive to salinity based on yield and foliar symptoms with documented yield loss varying between 600-2000 mg/L total dissolved solids
- salinity due to sodium chloride should be distinguished from that due to other dissolved solids, some of which may be beneficial to soil
- use effluent with moderate salt content only when it is in accordance with conditions outlined in Australian Water Quality Guidelines for Fresh and Marine Waters.

Salt management plan
A salt management plan that takes into account the issues discussed in the previous section, and which will consequently adequately manage salt in a land application program, should be developed. The decision to apply saline effluent will need to be dealt with on a case by case basis. Unless a detailed salt management plan can be developed to adequately manage the salt in a land application program, alternative methods of reuse/disposal of effluents should be considered.

Sodium Adsorption Ratio (SAR)
Excessive sodium in irrigation water relative to calcium and magnesium can adversely affect soil structure and reduce the rate at which water moves into and through the soil. Problems of soil permeability increase when SAR approaches 10 (NWQMS - *Australian Water Quality Guidelines for Fresh and Marine Waters, p 5-5*).

Where possible, application to land of winery and distillery effluent with a SAR greater than 10 should be avoided to minimise the risk of soil waterlogging and destabilising soil structure. The SAR can be expressed as:

$$S.A.R = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

Na = sodium concentration (meq/L)
= (mg/L in effluent) / (22.99)
Ca = calcium concentration (meq/L)
= (mg/L in effluent) / (40.08)
Mg = magnesium concentration (meq/L)
= (mg/L in effluent) / (24.32)

Where effluent with a high SAR poses a problem, consideration could be given to blending it with better quality water. Dilution of effluent streams with high quality water is not recommended practice in areas where water resources are scarce. Evaporative disposal may be an alternative worth considering. Alternating irrigation with high quality water is not recommended unless soil amelioration is also made. Alternating low salinity water after using high salinity water must be monitored to avoid crusting and sealing which can lead to an appreciably reduced infiltration rate. As with all other parameters in design of a land irrigation system the actual suitable SAR of the effluent will depend on the soil characteristics of the site. Sodium is required in limited amounts for most plant growth. However, some plants are sodium-sensitive and can be affected by low concentrations of exchangeable sodium. It has been reported that sodium toxicity can occur in sensitive fruit crops when SAR is as low as 5.5 (Bernstien (1962) p 5-6 NWQMS - *Australian Water Quality Guidelines for Fresh and Marine Waters).*

Nutrients
The nutrients in effluent most likely to be utilised by plants are nitrogen, phosphorus and potassium.

Irrigation Management

An irrigation management plan should be developed detailing the following:

- irrigation methods
- crop, water and nutrient requirements
- application rates
- scheduling
- design for the collection of effluent
- storage
- utilisation and management of stormwater and tailwater
- a salt management plan.

Irrigation of vines after harvest will help reduce problems associated with peak effluent production during vintage as well as allow the winter rainfall to flush out salts. Depending on local climatic conditions one or two irrigations during or immediately after winter may reduce the need for extra storage lagoons to cover for times when it is too wet to irrigate.

The intensity and depth of irrigation should be adapted to the soil and vegetation to prevent excessive leaching of effluent beneath the root zone. This can be determined by appropriate monitoring of soil moisture and salinity profiles.

Applications should be scheduled, based on a water deficit. When the soil is saturated in periods where rainfall exceeds evaporation, irrigation waters will need to be stored until the soil is suitable for irrigation. Hydrological expertise should be engaged to design this capacity and to provide guidance on local constraints on effluent irrigation.

Other nutrient-intensive activities incompatible with environmental objectives (such as animal holding) should be excluded from irrigated areas.

Irrigation equipment
The quantity of effluent is an important variable to consider when considering irrigation systems. Equipment which sprays effluent more than 1.5 m into the air and/or produces fine droplets which can be readily carried off-site should not be used when irrigating with winery and/or distillery effluent. Low trajectory, large droplet irrigation equipment or drip irrigation equipment is preferred.

Drip irrigation is the best option where winery effluent is low in suspended solids. Drip lines should be monitored to avoid blockages. Concentrations of salts under the dripper can be avoided by sprinklers dispersing water over a slightly wider area. Frequent short irrigations may be preferred to minimise the risk of concentrating salts and decreasing permeability through the destruction of soil structure.

Control of stormwater and irrigation tailwater
Upslope stormwater should be diverted to prevent it from entering the solid and effluent utilisation areas. The use of earth bunds and contour drains to direct runoff from irrigated areas to storage and recovery dams for re-use should be considered, particularly in areas with long dry summers. Runoff from the sludge and effluent utilisation areas should be managed to minimise discharge to waters by the use of buffers zones, terminal ponds etc. If irrigation runoff occurs, it should be contained.

Wastewater irrigation may yield a tailwater discharge which will ultimately need to be disposed of in an environmentally sensitive way. Management of tailwater must be a key consideration of every wastewater irrigation project, as it is often this issue which provides a major impediment to the sustainability of wastewater irrigation.

Where flood or furrow irrigation is used, terminal ponds should be constructed for the management of tailwaters.

Performance assessment options

The following is a means to assess whether the objective is being achieved:

- winery and distillery effluent is used for land application, eg irrigating crops, pastures and trees

- land application does not lead to:

    - any polluted runoff

    - accession of harmful components to surface or groundwaters (surface and groundwater is monitored for ambient levels of salt, BOD, nitrogen, phosphorus, potassium, pH, and carbon (see recommended levels for sustainable downstream environmental values as indicated in the Australian Water Quality Guidelines for Fresh and Marine Waters)

  - degradation of soils, including physical, chemical and biological characteristics (soils do not show surface crusting and sealing due to poor salinity management or the development of anaerobic conditions)
  - loss of public amenity - observe buffer zones and keep note of any public complaints

- crops, trees and pasture are monitored for yield and foliar symptoms, growth rates and health
- records are maintained from which the history of loading of water nutrients, salts and contaminants can be calculated for all areas where effluent is applied
- soils are monitored.

Solids Management

Solids arising from winery and distillery operations such as marc can be valuable by-products. Other solids such as lees or diatomaceous earth are waste products which can be utilised following some treatment.

Objective

To make effective and environmentally sound use of solid winery and distillery by-products and wastes.

Guidelines

By-products:

- Spent marc from distilleries can be used as a soil conditioner.
- Fresh marc from wineries not used for distillation should be composted.

Waste products:

- Solid potassium bitartrate and lees or diatomaceous earth containing high concentrations of potassium bitartrate can be sent in a solid or paste form for tartaric acid recovery.
- Solids not feasible for the recovery of tartrate can be disposed of as landfill in an environmentally sound manner.

Performance assessment options

The following is a means to assess whether the objective is being achieved:

- measure the output of solid waste from the winery or distillery and record amounts being utilised to gauge the program's effectiveness

- monitor the levels of solid potassium bitartrate and lees or diatomaceous earth for its concentrations of potassium bitartrate
- record composting duration of fresh marc.

Use of Sludges

Objective

To make effective and environmentally beneficial use of winery or distillery sludge.

Guidelines

Lagoon sludges
Lagoon sludges can be used as a stable, high strength fertiliser. Lagoons should be desludged once the sludge takes up one third of total volume (or half depth) of the lagoon. This typically represents 5 to 7 years and 10 to 12 years use for primary lagoons receiving unscreened and screened effluent respectively. Secondary lagoons rarely need desludging. When sludges are dewatered, the supernatant waters should be drained back to the lagoon system.

Sufficient sludge should be retained in the lagoon to enable its activity to be regained quickly upon recommissioning. Professional advice should be sought on removal from the lagoons and application rates (based on tests of that particular sludge).

Sludge should be stored with bunding and adequate drainage to prevent leaching to susceptible groundwaters, with any discharge from the stored sludge being directed to the effluent system. Stored sludges, if not adequately treated, can be a significant source of odour and attract flies and rodents. They should not be allowed to become anaerobic.

Provision for desludging and the effect of application to land should be considered in the Environment Management System/ Plan.

Performance assessment options

These include whether:

- sludges are being handled and utilised in an effective and environmentally acceptable manner
- the output of sludge from the winery or distillery is measured and amounts being used are recorded
- minimal onsite and off-site impacts on water, land, air or vegetation, with a regular assessment of the condition of the soil, including salt and entrained nutrient content, and surface and groundwater.

Disposal of Winery and Distillery Effluent

Objective

To dispose of winery and distillery effluent in an environmentally acceptable manner, only when effective use of the effluent is not feasible.

Guidelines

No effluent should be discharged to surface or groundwaters unless it can be demonstrated that it is consistent with the integrated catchment management strategy of the area, or the relevant guidelines of the licensing agency. Ambient water quality immediately downstream of the plant should remain within the limits for parameters set for the most sensitive environmental value to be protected in the receiving water body. This may require tertiary treatment (viz. nutrient removal, filtration and disinfection) of the effluent prior to discharge. Environmental values of water and the related ambient water quality parameters are described in the NWQMS document *Australian Water Quality Guidelines for Fresh and Marine Waters.*

Where salinity is a problem, highly saline effluents should be separated and directed to evaporating basins for collection of the salts. In some jurisdictions, particularly in inland areas, disposal of salt to landfills may be rejected. Alternative, secure landfills will need to be found. Treated effluents may be discharged to sewer (where applicable), provided the effluents meet the local treatment authority's criteria. Additional information on the management of industrial effluent is contained in the NWQMS document *Sewerage Systems - Acceptance of Trade Waste.*

Performance assessment options

These include whether:

- the effluent quality of any discharge is monitored
- the environmental values of relevant water bodies are monitored
- if discharge to sewer is permitted, the requirements of the relevant authority are monitored to ensure they are being achieved
- compliance with both a regional catchment plan and the relevant guidelines of the licensing agency or agriculture department regarding effluent disposal, including by sewer
- regular assessment of soil condition, surface water, groundwater and odour
- minimisation of unacceptable off-site impacts on water, land, air or vegetation
- the winery/distillery operator considers environmental guidelines and complies with legislation regarding effluent disposal.

Monitoring and Reporting

Monitoring is an essential part of any Environmental Management System and/or Plan. The extent of monitoring required should be determined on the basis of the winery or distillery and property size, and the location's environmental sensitivity. Monitoring of effluent quality and volumes discharged at land treatment areas is needed to effectively manage an effluent land treatment system. Monitoring of groundwater levels and quality, and soil water concentrations below rooting depths is essential.

Objectives

To ensure that winery or distillery effluent discharge does not adversely affect the environment and that it meets statutory discharge licence conditions if applicable. To ensure the operation is meeting its Environmental Management System/Plan objectives.

Guidelines

- Include monitoring and reporting on the plant's performance as an integral part of the operation's Environmental Management System.
- Maintain records of monitoring data, which should be made available for review by relevant authorities on request.
- Review procedures and data periodically with regulatory authorities to ascertain its usefulness and to effectively monitor performance.
- Develop a Quality Assurance system and use accredited procedures and laboratories to analyse samples to ensure the integrity of monitoring data (eg NATA accredited).
- Conduct regular inspections of facilities, in particular pumps and waste storage reservoirs.
- Undertake regular monitoring of land to which effluent has been applied. The soil should be monitored for nutrient levels, particularly phosphorus adsorption as well as for salt levels. Visual assessment should be made for waterlogging, sealing, erosion etc. Harvested crops should also be sampled and analysed to monitor nutrient removal from the site.
- Regularly monitor surface and groundwater bodies liable to be affected by the winery and distillery's operations.
- Monitor soil water concentrations to ensure the irrigation system is attuned to the needs of the vegetation, and to avoid excessive leaching of contaminants.

- Maintain records of each effluent irrigation area as separate management units including effluent volumes, dates of application, and any pasture/crop management information (eg bales of hay cut and removed).

- Supplement regular reporting with "exception" reporting produced for plant management to alert supervisors to unusual variations in plant performance and to alert regulatory authorities to any significant deviations from licence requirements.

- Provide plant managers with up-to-date information on their plant's environmental performance to enable problems to be detected early and remedial action implemented.

- Provide operators with adequate education and training, particularly in total quality management procedures, and risk management techniques, to assist in ensuring compliance with environmental regulations and requirements.

Relevant State/Territory and/or local authorities should require wineries or distilleries and other related establishments to submit reports on their environmental performance, at least annually. Establishments with a history of consistently poor environmental performance may be required to submit reports on their environmental performance more frequently.

Performance assessment options

These include:

- adequate operational planning, consultation, recording, monitoring, reporting, and education and training of staff in place

- consistent adherence to licence conditions

- number of environment related complaints

- regular reporting to management and staff, including feedback on performance, changes to the system, and an internal audit system with relevant documentation and reporting.

Contingency Measures

Objective

To ensure the plant management includes plans and procedures to respond effectively to emergencies and contingencies.

Guidelines

Contingency plans should address:

- disruption of power supplies which may affect the plant's effluent management system
- disruption to winery/distillery operation or effluent treatment by storms, flooding, fire
- plant breakdowns
- overloading of aerobic or anaerobic treatment plants or lagoons, or unusually low effluent inputs which can affect the biological treatment activity of the system
- accidental discharge of hazardous materials into the effluent stream
- changes in the physico-chemical environment which can disrupt the effectiveness of the treatment system's biological activity
- temporary or permanent loss of access to effluent application and disposal facilities
- temporary or permanent loss of trained operators. All managers and staff should be aware of the plan and their individual responsibilities during emergencies. The plan should be regularly rehearsed and updated
- potential leakage from lagoons.

Performance assessment options

- An up to date contingency plan is disseminated to staff and regularly inspected and trialed.
- Record and regularly analyse the operations response to specific contingencies which have arisen.

Appendices

Appendix 1: The National Water Quality Management Strategy (NWQMS)

The Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) are working together to develop a National Water Quality Management Strategy (NWQMS). The guiding principles for the National Water Quality Management Strategy are set out in *Policies and Principles - A Reference Document*, which emphasises the importance of:

- ecologically sustainable development
- integrated (or total) catchment management
- best management practices, including the use of acceptable modern technology, and waste minimisation and utilisation
- the role of economic measures, including user pays and polluter pays.

The process of implementing the Strategy involves the community working with government to set and achieve local environmental values, which are designed to maintain good water quality and to progressively improve poor water quality. It involves developing a plan for each catchment and aquifer, taking account of all existing and proposed activities and developments, and containing the agreed environmental values and feasible management options.

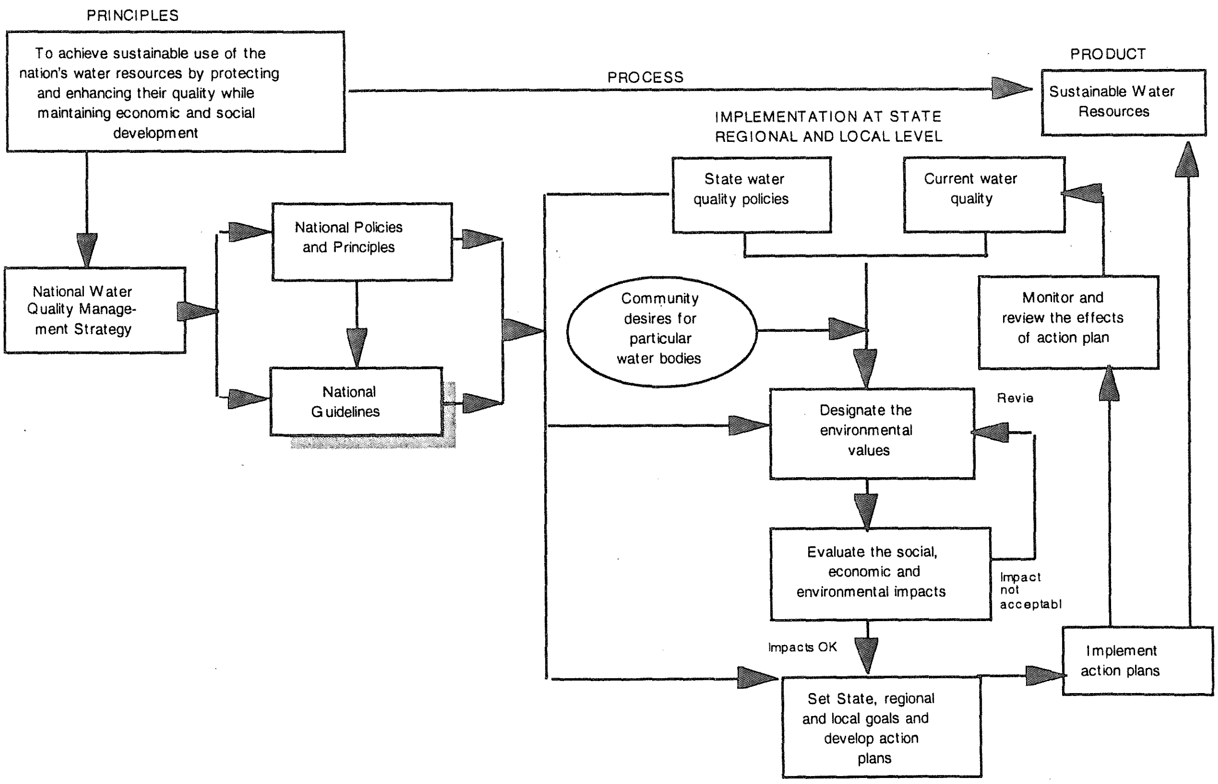

Figure A1: National Water Quality Management Strategy

National Water Quality Management Strategy

Guidelines and Documents

Paper No.	Title
Policies and Process for Water Quality Management	
1	Water Quality Management - An Outline of the Policies
2	Policies and Principles - A Reference Document
3	Implementation Guidelines
Water Quality Benchmarks	
4	Australian Water Quality Guidelines for Fresh and Marine Waters
5	Australian Drinking Water Guidelines - Summary
6	Australian Drinking Water Guidelines
7	Guidelines for Water Quality Monitoring and Reporting
Groundwater Management	
8	Guidelines for Groundwater Protection in Australia
Guidelines for Diffuse and Point Sources	
9	Rural Land Uses and Water Quality - A Community Resource Document
10	Guidelines for Urban Stormwater Management
11	Guidelines for Sewerage Systems - Effluent Management
12	Guidelines for Sewerage Systems - Acceptance of Trade Waste (Industrial Waste)
13	Guidelines for Sewerage Systems - Sludge (Biosolids) Management
14	Guidelines for Sewerage Systems - Reclaimed Water
15	Guidelines for Sewerage Systems - Sewerage System Overflows
16a	Effluent Management Guidelines for Dairy Sheds
16b	Effluent Management Guidelines for Dairy Processing Plants
17	Effluent Management Guidelines for Intensive Piggeries
18	Effluent Management Guidelines for Aqueous Wool Scouring and Carbonising
19	Effluent Management Guidelines for Tanning and Related Industries
20	Effluent Management Guidelines for Australian Wineries and Distilleries

The guidelines for diffuse and point sources are national guidelines which aim to ensure high levels of environmental protection that are broadly consistent across Australia.

Appendix 2 : Further Information

Further reading

Australian Water Resources Council, *Review of Effluent Disposal Practices,* Water Management Series No. 20. 1991

Australian Wine Research Institute, *Agrochemicals registered for use in Australian viticulture* compiled by Alex Sas and Catherine Daniel 24 July 1996.

Bowmer K.H. & P. Laut (1992) *CSIRO Waste Management in Intensive Rural Industries* in Division of Water resources: Research areas pertinent to intensive rural industry waste management. *Divisional Report 92/4 CSIRO.*

Dillon, P & G. Schrale 1993, Wastewater irrigation and groundwater quality protection, *AGSO* J. *Aust.Geol & Geophys. 14 (2/3):*259-262

Dillon P et al., 1993 Groundwater quality protection at wastewater land-treatment operations-workshop summary, *AGSO J.Aust.Geol & Geophys. 14 (2/3):*263-267

Environment Protection Authority NSW 1995, *The Utilisation of Treated Effluent by Irrigation.* Draft Environmental Guidelines for Industry. EPA 95/20.

Environment Protection Authority (Victoria) 1992, *Guidelines for Wastewater Irrigation,* EPA Publication no 168.

Gilpin A 1990, *An Australian Dictionary of Environment and Planning* Oxford University Press Australia.

Hunter Catchment Management Trust 1994, *Management of Winery Wastewater - Interim Code of Practice 1994 Hunter Valley, NSW*

Murray-Darling Basin Ministerial Council 1989, *Salinity and Drainage Strategy,* April 1989 AGPS, Canberra

Standards Australia 1995, *Environmental management systems - Specification with guidance for use.* Interim Australian/New Zealand Standard AS/NZ ISO 14001 (Int):1995

Standards Australia 1995, *Environmental management systems - General guidelines on principles, systems and supporting techniques.* Interim Australian/New Zealand Standard AS/NZ ISO 14004 (Int):1995

Appendix 3: Sources of Further Advice

State and Territory Environment Protection Authorities

State and Territory Environment Departments of Agriculture and Primary Industries

State and Territory Environment Departments of Conservation and Land Management

State and Territory Water Authorities

Local Government Authorities

The CSIRO Division of Water Resources (DWR)

Regional Colleges

Industry Consultants

Appendix 4: Glossary

aerobic	a process where dissolved or free oxygen is present.
anaerobic	a process or condition where there is no dissolved or free oxygen.
aquifer	an underground layer of rock or sediment which holds water and allows water to percolate through.
bentonite clay	used as a clarifier in the winery process
Biochemical Oxygen Demand (BOD)	the amount of oxygen required by aerobic rganisms to carry out oxidative metabolism in water containing organic matter. It is determined by measuring the amount of oxygen gas absorbed during a particular laboratory analytical test (BOD test), in which components of a water sample are broken down by aerobic micro-organisms under specified conditions during a stated number of days. BOD5 denotes a 5-day BOD.
catchment area	a natural drainage area, especially of a reservoir or river.
Chemical Oxygen Demand (COD)	a measure of the quantity of oxidisable (combinable with oxygen) components present in water. It is determined by measuring the amount of oxygen gas absorbed during a particular laboratory analytical test (COD test), in which components of a water sample are broken down by an inorganic chemical (an oxidising agent) under specified conditions during a certain number of hours.
diatomaceous earth	used as a clarifier in the winery process
distillery	refers in this document to grape not grain distillery
drainage rate	rate of movement of water through the soil
denitrification	removal of nitrogen.

effluent

is used here to refer to the liquid and associated solids (sludge) at all stages from production to utilisation or disposal. It does not include runoff from pastures or crops which have been irrigated with effluent, which is addressed in the NWQMS document *Rural Land Uses and Water Quality - A Community Resource Document.*

electrical conductivity

measure of salinity in water.

Environmental Management System

provides the management, administrative and monitoring framework which ensures that an organisation's environmental risk is minimised and that its environmental policy together with associated objectives and targets are achieved. Stages in an EMS, based on the ISO 14000 series comprise commitment to a policy, planning which includes evaluation of relevant regulatory framework, setting objectives and targets, establishing a management program (EMP), definition of personnel and responsibilities, identifying training needs, establishing and maintaining EMS documentation, emergency and preparedness and response procedures and establishing operational controls, and carrying out audits and reviews including monitoring and review.

environmental values

particular values or uses of the environment that are conducive to public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits. They are often called beneficial uses in the water quality literature. Five environmental values are:

. ecosystem protection

. recreation and aesthetics

. drinking water

. agricultural water

	. industrial water Refer to the NWQMS documents *Policies and Principles - A Reference Document,* and *Australian Water Quality Guidelines for Fresh and Marine Waters*
evapotranspiration	Water lost from soil by evaporation and/or plant transpiration.
Exchangeable Sodium Percentage (ESP)	the amount of exchangeable sodium as a percentage of the cation exchange capacity. It is a measure of the sodicity of the soil. Sodicity relates to the likely dispersion on wetting and shrink/swell properties.
facultative	a condition where both the aerobic and anaerobic conditions occur. The surface of a pond may be aerobic and the bottom anaerobic. The term also refers to micro-organisms that can survive and reproduce under both aerobic and anaerobic conditions.
freeboard	the difference between the maximum liquid level of a pond or lagoon and the lowest point of the top of the wall.
groundwater recharge	the rate at which infiltrating water reaches the watertable.
guideline	provides guidance on possible means of meeting desired environmental outcomes. Guidelines are not mandatory.
hydraulic loading	volume of water applied to an area of land.
infiltration rate	rate of entry of water into the soil
ion exchange	purification of water by removal of ions.
katabatic drainage/wind	a wind caused by cold air flowing downhill. When a sloping land surface cools by night time radiation, the cold air in contact with the ground flows downhill and along the valley bottom.
leaching	the downward movement of a material in solution through soil.

leaching fraction	the leaching fraction of soils refers to the ratio of deep drainage to the depth of rainfall plus irrigation over the same time period. The smaller the leaching fraction, the larger the water salt concentration within the root zone, or the higher the salt concentration experienced by plant roots.
lees	winery fermentation sediment, mainly yeasts, pulp and tartrates
marc	wine stalks, pips and skins produced during the crushing and pressing stages
Maximum Residue Limits	maximum concentration of a residue resulting from the officially authorised safe use of an agricultural chemical, that is recommended to be legally permitted in or on a food, agricultural commodity, or animal feed. The concentration is expressed in milligrams per kilogram of the commodity.
osmotic	force associated with the tendency of solvent separated from a solution by a membrane, to pass through the membrane and dilute the solution.
perched watertable	upper surface of a zone of saturation where an impermeable stratum causes groundwater to accumulate above it over a limited lateral extent. It is situated above the main watertable.
Phosphate Sorption Capacity	a measure of the inherent ability of soil particles to adsorb phosphorus from the soil solution.
risk management	is a decision-making process that entails considerations of political, social, economic, and engineering information together with risk-related information to develop, analyse and compare regulatory options and to select the appropriate regulatory response to a potential health or environmental hazard. The entire risk management process consists of eight steps. These are hazard identification, exposure assessment, effects assessment, risk

	characterisation, risk classification, risk benefit analysis, risk reduction, monitoring.
standard	a standard is a quantifiable characteristic of the environment against which environmental quality is assessed. Standards are mandatory.
tailwater	runoff from irrigation areas which contains nutrients and salts. Also first flush rainfall runoff from land used for wastewater disposal
Total Dissolved Solids (TDS)	the total concentration of dissolved anions and cations in a water sample, expressed in mg/L
Total Kjeldahl Nitrogen (TKN)	is a determination of organic nitrogen and ammonia
Total Solids (TS)	the sum of dissolved and undissolved solids in water or waste water, usually expressed in milligrams per litre.
Total Suspended Solids (TSS)	the amount of volatile and fixed suspended solids in waste water.
watertable	the level below which the pore space between sediments and fractures in rock are saturated with water. In an unconfined aquifer, the watertable is the level of the water standing in a well.