E N V I R O N M E N T P R O T E C T I O N A U T H O R I T Y

EPA Guidelines for **Wineries and Distilleries**

Government of South Australia

EPA South Australia

EPA Guidelines for Wineries and Distilleries

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This guideline replaces EPA Guideline 'Wineries and Distilleries—wastewater monitoring programs' (originally Technical Bulletin No. 11, November 1996). It provides information that will assist wineries and distilleries to develop an environmental monitoring program to comply with the Environment Protection Act and relevant Environment Protection Policies.

Introduction

Facilities that process more than **50 tonnes** of grape or grape product per annum within the Mount Lofty Ranges Watershed Protection Area—as declared under Part 8 of the *Environment Protection Act 1993* (the Act)—or more than **500 tonnes** elsewhere in the state, must have an Environment Protection Authority (EPA) licence. Licensed wineries and distilleries must develop and implement an environmental monitoring program and submit the data collected to the EPA annually.

Whilst this guideline is intended for licensed wineries and distilleries, it will also assist unlicensed facilities to meet the provisions of the Act and the relevant environment protection policies (EPPs). It should be emphasised that conditions attached to EPA authorisations take precedence over the guideline.

The terms 'winery' or 'wineries' when used in this guideline also imply 'distillery' or 'distilleries', unless the term 'distillery' or 'distilleries' is used alone within the text.

Legislation

The principal legislation that addresses pollution in South Australia is the Environment Protection Act. In particular, section 25 of the Act imposes a general environmental duty on anyone who undertakes an activity that pollutes, or has the potential to pollute, to take all reasonable and practicable measures to prevent or minimise environmental harm.

Environment protection legislation also includes EPPs, which outline both recommendations and mandatory requirements to address environment protection matters such as water quality, solid wastes, air quality and noise.

Environmental impacts of wine production

The main environmental impacts associated with wineries are:

- pollution of water, degradation of soil and damage to vegetation arising from liquid and solid waste disposal practices
- odours and air emissions resulting from the management of raw materials, and wastewater, solid and semi-solid by-products from the winemaking process
- noise from pumps, chillers, crushers and other winery equipment, as well as vehicle noise, particularly during vintage.

Some of the potential effects on the environment of the various constituents of liquid and solid waste by-products from the winemaking process are summarised in Table 1.

Table 1 Potential environmental impacts of winery and/or distillery wastes

Winery waste constituent	Indicators	Effects
Organic matter	BOD [1], TOC [2], COD [3]	depletes oxygen when discharged into water. leading to the death of fish and other aquatic organisms
		odours generated by anaerobic decomposition cause nuisance if waste is stored in open lagoons or applied to land
Alkalinity /acidity	pH	death of aquatic organisms at extreme pH ranges
		affects microbial activity in biological wastewater treatment processes
		affects the solubility of heavy metals in the soil and availability and/or toxicity in waters
		affects crop growth
Nutrients	N,P, K	eutrophication or algal bloom when discharged to water or stored in lagoons; algal blooms can cause undesirable odours in lagoons
		N as nitrate and nitrite in drinking water supply can be toxic to infants
		toxic to crops in large amounts
Salinity	EC [4], TDS [5]	imparts undesirable taste to water
		toxic to aquatic organisms
		affects water uptake by crops
Sodicity	SAR [6], ESP [7]	affects soil structure, resulting in surface crusting, low infiltration and hydraulic conductivity, hard and dense subsoil
Heavy metals	Cadmium, chromium, cobalt, copper, nickel, lead, zinc, mercury	toxic to plants and animals
Solids	TSS [8]	reduces soil porosity, leading to reduced oxygen uptake
		can reduce light transmission in water, thus compromising ecosystem health
		smothers habitats
		odour generated from anaerobic decomposition

1 Biochemical oxygen demand
2 Total organic carbon
3 Chemical oxygen demand
4 Electrical conductivity
5 Total dissolved salts
6 Sodium adsorption ratio
7 Exchangeable sodium percentage
8 Total suspended solids

Objectives of monitoring

Environmental monitoring is an effective tool that will assist the EPA and wineries to:

- determine the load and effects of winery wastes on the environment
- monitor and maintain or improve the performance of waste management systems
- analyse environmental management performance and compare it with EPA standards.

Monitoring and reporting requirements

Wineries **must** develop procedures to sample and monitor influent water (water coming into the winery), wastewater, soil, groundwater and other receiving environments (e.g. vegetation and watercourses) as required by the EPA licence. The following points should be considered:

- Influent water and wastewater sampling and monitoring procedures **should** be developed and undertaken to comply with both the Australian/New Zealand Standards (AS/NZS 5667:1998) and relevant EPA guidelines.
- Soil sampling and monitoring **should** be developed and take into account relevant schedules of the *National Environment Protection* (*Assessment of Site Contamination*) *Measure 1999* (Site Contamination NEPM) to suit specific situations (e.g. Schedule B(2) Guideline on Data Collection, Sample Design and Reporting, and Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils).
- Groundwater sampling and monitoring procedures **should** be developed, and take into account both the AS/NZS 5667.11:1998 and the relevant schedules of the Site Contamination NEPM (e.g. Schedule B(2) Guideline on Data Collection, Sample Design and Reporting).
- Analysis of samples must be undertaken by a National Association of Testing Authorities (NATA) accredited laboratory and use NATA accredited procedures to ensure the integrity of the data. The NATA web site—www.nata.asn.au—contains a list of suitable accredited laboratories.
- Other laboratories can be used to undertake the analysis on occasions not prescribed by the EPA licence (e.g. to provide information to help review and improve waste management systems, monitor the performance of a newly installed wastewater treatment plant, or determine a chemical dose for pH adjustment). Submission of this data to the EPA is optional.
- The monitoring program **must** be approved by the EPA before it is implemented. The EPA must be consulted before changes to the approved monitoring program are made.
- Data obtained from the monitoring requirements of the licence **must** be forwarded to the EPA, where it will be used to establish industry benchmarks and inform the public.

In reporting the data, the EPA recommends that wineries:

- use the EPA reporting format for ease in data management and consolidation
- present the concentrations of substances in water and wastewater to two significant figures, where possible using the preferred units indicated in Tables 2 and 5 of this guideline.

As part of the EPA's quality management system, the EPA also requires that the monitoring activity and resulting data are verified by an independent qualified professional, at intervals prescribed by the licence.

In undertaking the verification audit, the verifier must be able to:

- make an independent professional examination of records, procedures and processes in the winery
- give an opinion on the accuracy and integrity of the winery's monitoring results
- confirm whether the approved monitoring program has been followed
- confirm whether sampling and monitoring was undertaken in accordance with the guidelines specified above
- undertake other requirements that may be specified by the winery's licence.

When selecting someone to conduct the verification audit, the winery should take into account that they:

- are independent of the winery
- are a member of appropriate professional bodies
- have experience in the development and implementation of monitoring programs
- have a degree in or knowledge of a relevant field of environmental science.

Note: Before undertaking verification audits, the winery **must** contact the EPA to confirm that the independent verifier selected meets the above criteria.

Production process description

The quantity and types of wastes produced by a winery vary due to waste management practices and the activities undertaken. Wineries must review and amend their monitoring programs regularly to allow for changes in production methods and scale, and to incorporate recommendations from independent verification audits.

The environmental monitoring program submitted to the EPA **must** include the following information:

- a schematic diagram to show the inputs (e.g. grapes, grape juice, chemicals, water) and outputs (e.g. various wastewater streams, grape marc, lees, filtered solids, stalks, wastewater sludge)
- a clear and concise description of the processes being undertaken in the winery (e.g. crushing, fermentation, storage, maturation, bottling, sparkling wine production, distillation)
- details of annual processing inputs and outputs (e.g. crush size, volume of grape juice produced, ratio of red to white grapes processed, volume of processed grape product taken in from other sites, volume of grape product sent for off-site processing, and percentage of wine, sparkling wine and spirits).

This information will assist the EPA to consolidate and analyse the monitoring data and to understand the waste characteristics and generation patterns of each site. The information can also be used as the basis for undertaking environmental improvement initiatives on site, such as cleaner production.

Monitoring the pollutant load in wastewater

Water supply

The source of water used in the winery will influence the quality of the effluent stream. For instance, if water is taken from the River Murray, its relatively high salt content will make the effluent more saline than would be the case if the water was sourced from stormwater collected from roofs and clean paved areas. Table 2 lists the parameters that must be analysed in influent water at least annually.

Table 2 Parameters to be analysed in influent water

	Parameter	Standard units
Required	EC	dS/m
	pH	pH units
	Sodicity	SAR
	Sodium [1]	mg/L
	Magnesium [1]	mg/L
	Calcium [1]	mg/L
Optional	BOD [2] (or TOC, if BOD/TOC ratio can be determined accurately)	mg/L
	Total nitrogen (Total N) [2]	mg/L
	Total potassium (Total K) [2]	mg/L
	Chloride [3]	mg/L

1 To be used in determining SAR.

2 Optional, but will be useful when applying the WASTLOAD model (contained in the Manual for Spreading Nutrient-Rich Wastes to Agricultural Land) if the influent water is also used for dilution of effluent irrigated to land.

3 Optional, but as the major problem with sodium is from the damage done by excess salt (as NaCl), it would be in the winery's best interest to determine chloride concentration if the influent water was being used for irrigation purposes.

For facilities supplied by SA Water, analytical results provided by SA Water will be acceptable to the EPA for water used directly from the supply. However, water supplied by SA Water but stored in open dams **must** be tested at least annually.

Wastewater

Wastewater quantity

Wastewater flow volumes **must** be measured by using acceptable and properly calibrated flow meters. This will make it easier to accurately determine hydraulic and chemical loads.

Magnetic flow meters are the best devices for measuring winery wastewater volumes. These flow meters are recommended because they are accurate and low maintenance, as well as being able to measure wastewater containing solid materials that would normally block traditional mechanical meters. Other acceptable wastewater volume monitoring methods include calibrated 'pump hours run' meters; ultrasonic (doppler), orifice plate, or mechanical flow meters; and open-channel weirs or flumes. As these methods are subject to error due to fouling, poor maintenance, equipment faults, etc, they **must** be calibrated according to the manufacturer's specifications.

Winery wastewater flow volumes **must** be measured at a single location after wastewater has been collected and treated and before it is disposed of or re-used. Flow measurements must be synchronised with wastewater quality monitoring to enable accurate pollutant load calculations.

A record of winery wastewater volume **must** be provided annually to the EPA. Calibration records of the flow-measuring device **should** be kept at the winery in electronic or hard copy form; this record **should** be available for inspection at any time by an officer authorised under the Act.

Licensed facilities that discharge wastewater to the sewer or septic tank effluent disposal schemes (STEDS) **must** comply with the trade waste requirements of the SA Water facility or STEDS management. However, in these cases,

monthly wastewater generation data must be reported to the EPA annually. As a good management practice, the EPA also encourages unlicensed facilities to keep a record of their monthly wastewater production.

Wastewater quality

Winery wastewater comes from a number of sources that include:

- cleaning of tanks
- ion exchange columns
- hosing down of floors and equipment
- rinsing of transfer lines
- barrel washing
- spent wine and product losses
- bottling facilities
- filtration units
- laboratory wastewater
- stormwater diverted into, or captured in, the wastewater management system.

Wine production is seasonal, and the characteristics of wastewater vary with the production period. Up to six production periods can be defined; these are summarised in Table 3.

Table 3 Description of winery wastewater production periods at wineries[1]

Period [2]	Typical months of the year	Description
Pre-vintage	January–February	Bottling, caustic washing of tanks, non-caustic washing of equipment in readiness for vintage
Early vintage	February–March	Wastewater production is rapidly rising to peak vintage flows and has reached 40% of the maximum weekly flow; vintage operations dominated by white wine production.
Peak vintage	March–May	Wastewater generation is at its peak; vintage-only operations are at a maximum.
Late vintage	April–June	Wastewater production has decreased to 40% of the maximum weekly flow; vintage operations dominated by production of red wines; distillation of ethanol spirit may coincide with this period.
Post-vintage	May–September	Pre-fermentation operations have ceased; effect of caustic cleaning, ion exchange etc. is at its greatest, and wastewater quality may be poor.
Non-vintage	June–December	Wastewater generation is at its lowest—generally less than 30% of maximum weekly flows during vintage; wastewater quality is highly dependent on day-by-day activities.

1 Chapman et. al., *Winery Wastewater Handbook* 2001

2 The demarcation between one period and another, and the timing or existence of each period, will vary between wineries and regions.

To accurately determine the pollutant load that is discharged to the environment, sampling **must** reflect wastewater quality during the production period. It must be performed at a suitable location before it is disposed of to land or re-used for irrigation. Monitoring programs submitted to the EPA to comply with licence requirements **must** be accompanied by a schematic diagram. This must indicate the sequence of wastewater treatment processes employed and where the wastewater sampling is to be performed, to enable the EPA to advise on the suitability of the monitoring point.

Table 4 shows the EPA monitoring frequency requirements for differing volumes of wastewater generated by wineries. For facilities that do not have distinct production periods, a suitable frequency **must** be discussed with the EPA.

Table 4 Prescribed wastewater monitoring frequencies

Wastewater produced per year, ML	Frequency
<10	once per production period
10–20	twice per production period
>20	three times per production period

For a winery that generates more than 10 ML of wastewater per year the EPA may permit a reduction in wastewater monitoring frequency if:

- an adequate treatment system, approved by the EPA to treat wastewater before application to land, has been installed
- the facility fully implements an irrigation management plan (IMP) approved by the EPA
- the wastewater management system is equipped with in-line monitoring devices for dissolved oxygen (DO), and pH or EC to indicate irregularities that may indicate a need for further testing.

The parameters to be monitored in wastewater are listed in Table 5. The winery may need to consult its EPA licence coordinator to confirm whether the optional parameters listed in the table need to be monitored.

If a winery generates less than 1 ML of wastewater per year, the EPA may permit the omission of some minor wastewater parameters from the monitoring regime if it can be demonstrated that the risk to the environment is low, and the wastewater management system has been working effectively for the past two years.

The EPA recommends that winery effluent not be combined with wastewater generated from cellar door and food preparation activities. This is due to health concerns. If separation is not possible, the winery **must** seek advice from the Department of Human Services.

Table 5 Parameters to be analysed in wastewater

	Parameters	Standard units
Required	BOD	mg/L
	Total N	mg/L
	Total P	mg/L
	Total K	mg/L
	EC	dS/m
	pH	pH units
	Sodium [1]	mg/L
	Magnesium [1]	mg/L
	Calcium [1]	mg/L
	Sodicity	SAR
	Chloride	mg/L
	Total suspended solids [2]	mg/L
Optional	TOC [3]	mg/L
	COD [3]	mg/L
	Sulphate [4]	mg/L
	Carbonate [5]	mg/L
	Bicarbonate [5]	mg/L

1 To be used in determining SAR.

2 Solids may generate odours upon anaerobic decomposition and may result in the clogging of drippers.

3 Although BOD is the accepted environmental pollution indicator, TOC or COD can provide a quicker indication of irregularities in the wastewater system

4 Sulphate reduction under anaerobic conditions may generate odours; measurement may only be necessary where wastewater is stored in open tanks and lagoons; precipitation with calcium can lead to white scale formation and clogging of drippers.

5 Precipitation with calcium can lead to white scale formation and clogging of drippers; measurements of these parameters will also allow for determination of alkalinity and Adjusted SAR.

Monitoring the effects of wastewater disposal

To ensure the sustainability of the State's soil and water resources and to meet the water quality objectives set by the *Environment Protection (Water Quality) Policy 2015* (Water Quality Policy), the EPA requires that the rate of wastewater application to land **must** be regulated according to:

- the dominant soil types in irrigated sites (including texture, structure, chemistry, moisture holding ability, depth of topsoil, effective rooting depth, depth to impeding clay layers or to layers highly permeable to water)
- the concentration of organic carbon, nutrients and salts in the wastewater
- an organic carbon, nutrient and salt balance analysis to determine the potential effects on crop growth and long-term soil loadings

- the sensitivity of the area (including depth to groundwater, proximity to watercourses, public roads, residences and other facilities, slope of the site, areas prone to waterlogging, salinisation, flooding and/or erosion).

For irrigated sites that contain more than one soil type, hydraulic and chemical loading rates **must** be determined in accordance with the requirement of each Irrigation Management Unit (IMU).

Soil

Wineries that irrigate with wastewater (treated or untreated) at a rate greater than 100 mm (1 ML/ha) per year **must** include annual soil chemistry monitoring in their monitoring program to detect any changes in soil properties. An exemption from this requirement may be provided if the winery is able to demonstrate that:

- the hydraulic load applied to land is based on proper water budget calculations
- nutrient uptake by crops far exceeds the rate at which the nutrients are applied
- the soil microorganisms can easily sustain the organic carbon loading
- any other constituents in the wastewater (e.g. sodicity, acidity/alkalinity, chloride concentration) can be easily tolerated by the crops or sustained by the soil
- no significant changes in soil chemistry have been observed in the past three years.

Facilities that undertake intensive wastewater irrigation, or are located in sensitive areas, may also be required to develop and implement an irrigation management plan (IMP).

A map of the wastewater-irrigated site that shows the areas of the IMUs and the locations of soil moisture monitoring devices, and the sampling location for soil chemistry analysis for each IMU, **must** be attached to the monitoring program or IMP submitted to the EPA. The locations of monitoring sites must be consistent with previous monitoring locations to make it possible to analyse the data.

Soil moisture

Only a portion of soil-stored water, called readily available water (RAW), can be extracted by plants before water stress becomes evident. RAW is governed, among other factors, by the ability of different soil textures to store water against gravity, and by root depth and distribution.

To minimise percolation to groundwater, wastewater **must** be applied at a rate equal to that at which it is removed by plants. Daily water requirements can be estimated from a water balance (otherwise referred to as water budget) that takes into consideration the following:

- irrigation and rainfall contributions
- canopy interception of rainfall
- depth of active root zone
- crop water requirements (crop factor x evaporation and as measured with calibrated soil water monitoring devices)
- salt leaching requirements to ensure that soil salinity levels do not exceed crop tolerance
- efficiency of irrigation systems.

Rainfall and evaporation data can be obtained from the SA Bureau of Meteorology or by installing a weather station on site.

Soil moisture monitoring before and after wastewater application is an important tool for irrigation management. Submission of the soil moisture data to the EPA is not mandatory, unless specified in the EPA licence. However, records of the soil moisture and water budget calculations **should** be kept and made available to the EPA for inspection when required.

The installation, maintenance and operation of soil moisture monitoring equipment require a high level of technical expertise. Many facilities have linked their irrigation systems to soil moisture monitoring devices for automated control. The EPA recommends that wineries seek the assistance of irrigation specialists to determine the system that best suits the needs of the site.

Soil chemistry

The accuracy of soil monitoring data relies highly on the sampling methods and techniques employed and hence **must** be undertaken only by qualified professionals or suitably trained and/or experienced persons. Winery employees must only be allowed to undertake this activity if they have satisfactorily completed suitable soil sampling and monitoring training.

The monitoring location must be properly marked to enable samples to be collected at locations adjacent to previous sampling points for valid comparison of results. Two samples for each dominant soil type **must** be collected once a year (preferably in September or October) from depths which correspond to horizontal stratigraphy to take into account the soil profile physical variation. For each sample, the EPA prefers composite portions taken from at least two sampling points for a more representative result.

For wastewater-irrigated sites with more than two dominant soil types, a practical soil sampling intensity must be discussed with the EPA.

The following depths can be taken as a guide for sampling:

- topsoil—separate samples from the following soil layers:
    - 0–20 cm
    - 20–60 cm
- subsoil—typically from 60 cm to bottom of the rootzone or depth of first impeding layer.

The samples collected **must** be analysed for the parameters listed in Table 6.

Table 6 Parameters to be analysed in soil

Parameters[1]	**Standard units**
TOC	%
Total N	mg/kg
Total P	mg/kg
Total K	mg/kg
pH (1:5 soil:water)	pH units
ECe [2]	dS/m
Sodium	mg/kg
Magnesium	mg/kg
Calcium	mg/kg
Sodicity (1:5 soil:water)	SAR

1 The WASTLOAD model requires the use of specific methods of analysis for data to be entered into the model. The recommended methods are listed under the WASTLOAD Model Operating Instructions section of the manual.

2 Saturated electrical conductivity

Facilities that apply sludge produced from wastewater treatment systems **must** also monitor the soil in the receiving area for the heavy metals listed in Table 9. The information so gained will make it possible to calculate the maximum rate at which sludge can be applied to land, following the principles outlined in the EPA Guideline *Use of Water Treatment Solids (WTS)*, *August 2002*.

For comparative purposes, the winery must also monitor the soil chemistry of a reference site at the same time and frequency. Each IMU may require a separate reference site.

Groundwater

Wastewater-irrigated sites

Wineries that irrigate with wastewater at a rate greater than 100 mm per year **must monitor** groundwater in the irrigation site if there is a confined or unconfined groundwater aquifer less than 15 metres below the surface. Again, the rule may be varied depending on the sensitivity of the irrigated site (e.g. presence of fractured rock, limestone aquifer or permeable soil layers, or proximity to a watercourse or groundwater extraction bore).

If the depth of the aquifer is unknown, the EPA recommends that an exploratory bore be drilled to 15 metres, or the uppermost impeding layer, to confirm the depth to groundwater. For areas where the depth to groundwater is known to be more than 15 metres, drilling an exploratory bore will detect a developing perched water table. Contact the Department of Water, Land and Biodiversity Conservation (DWLBC) or the Primary Industries and Resources SA (PIRSA) for information on the presence and/or location of existing bores in your area.

Due to the complexity of groundwater systems, the layout and installation of groundwater monitoring bores must be undertaken by qualified groundwater professionals. For small irrigation areas (<20 ha), the EPA requires a minimum of three observation bores arranged in a triangular configuration, with one bore hydrologically uphill of the irrigation area to provide reference data for comparison with wastewater-irrigated sites. Large irrigation sites and areas lying above complex groundwater systems require advice from groundwater specialists to determine the required number of monitoring bores.

The use of existing wells or bores is not recommended unless it can be demonstrated that they are suitable for the winery's sampling and monitoring objectives and procedures.

Groundwater sampling and monitoring **must** only be undertaken by qualified groundwater professionals or suitably experienced and/or trained operators. The depth to groundwater in monitoring bores **must** be measured in AHD (Australian Height Datum) at least quarterly, and the quality of groundwater **must** be analysed once every six months for the parameters listed in Table 7.

Table 7 Parameters to be analysed in groundwater

Parameters	Standard units
TOC	mg/L
pH	pH units
EC	dS/m
Oxidised nitrogen (nitrite and nitrate)	mg/L
Ammonia nitrogen[1]	mg/L

1 Optional but can be used as an indicator for the development of anaerobic conditions in the aquifer system.

Wastewater storage lagoons

To ensure the integrity of wastewater storage lagoons, groundwater in the vicinity of lagoons **must** be monitored. Again, wineries must seek advice from qualified groundwater professionals to locate a suitable place for monitoring to be conducted. If a lagoon is equipped with a leakage detection device, monitoring may not be necessary.

The mandatory provisions for wastewater lagoon construction and reconstruction are outlined in Clause 18 of the Water Quality Policy. Information can also be found in the EPA Guideline *Wastewater Lagoon Construction, September 2003*.

Watercourses

Where wastewater management system components (sumps, settling tanks, lagoons, wetlands, irrigated sites, etc.) are located within 50 metres of a watercourse, the quality of the water in the watercourse during periods of flow **should** be monitored at frequencies agreed to with the EPA. The parameters to be measured are listed in Table 8. A suitably experienced and/or trained winery staff member can undertake the measurements using properly calibrated instruments.

Table 8 Parameters to be analysed in watercourse

Parameters	Standard units
Dissolved oxygen	mg/L
pH	pH units
EC	dS/m

The watercourse **should** be monitored at locations upstream and downstream of, and adjacent to, the facility. If there is any indication that the watercourse may be contaminated, it is in the winery's best interests to extend the range of tests made on the water and to notify the EPA as soon as possible.

Stormwater

The EPA recommends that clean stormwater run-off from roofs and hard-paved surfaces in the winery be put to some productive use (e.g. for re-use within the winery, or to increase the flow of adjacent rivers and creeks). Some facilities have installed devices to detect whether captured stormwater has become polluted before it is diverted to watercourses. The EPA recommends that potentially polluted stormwater be stored temporarily so that it can be checked for quality prior to discharge to a watercourse.

Before the discharge to any watercourse of stormwater that may be polluted with winery or other wastes, the water **must** be analysed to ensure that it meets the water quality criteria outlined in the *Environment Protection (Water Quality) Policy 2015* (Water Quality Policy). If the water quality does not meet the criteria of the Water Quality Policy, the polluted stormwater must be diverted to the wastewater management system if capacity allows, transported to an off-site wastewater treatment facility licensed by the EPA, or treated to meet the levels of the Water Quality Policy before disposal to the watercourse.

However, under very special circumstances, the EPA may grant an exemption to allow the discharge of this stormwater to the watercourse upon meeting certain water quality criteria and conditions agreed to by both parties.

Vegetation health

The EPA recommends that the health of vegetation in treelots, pastures or vineyards irrigated with winery wastewater is monitored. Visual observation and recording of the condition of marked patches of vegetation will allow early detection of extremely poor wastewater quality or accidental discharges to the wastewater stream.

Monitoring the management of solid wastes

Wineries must maintain and submit to the EPA a record of solid wastes (e.g. grape marc, filtered solids, wastewater sludge, stalks, lees) produced each year. The record should include:

- the quantity of each waste produced
- what is done with it (on-site management or composting, or off-site disposal)
- if managed on-site, the date, area covered and location of the application (e.g. name of vineyard, woodlot)
- the waste management company used (if applicable).

Some waste depots are licensed by the EPA to receive wastewater treatment sludge. These facilities may require information on the leachability characteristics of the sludge before accepting such waste. The EPA recommends that wineries contact waste depots for disposal requirements before using their services.

If sludge is applied to land owned by the winery, the EPA recommends that it be applied uniformly to the largest possible area. Wineries that undertake this practice **must** monitor, at least annually, the heavy metal content (as listed in Table 9) of the sludge and the soil to which it is applied.

Table 9 Parameters to be analysed in wastewater treatment sludge

Parameters	Standard units
Arsenic	mg/kg
Cadmium	mg/kg
Copper	mg/kg
Lead	mg/kg
Mercury	mg/kg
Nickel	mg/kg
Zinc	mg/kg
Chromium	mg/kg
Aluminum	mg/kg

Wastewater treatment sludge is composed mainly of microbial cells and grape residues that may increase the organic carbon and nutrient levels in the soil. If sludge and other solid wastes are applied to land at frequent intervals, or in large quantities, their contribution **must** be incorporated into soil organic carbon and nutrient balance analyses.

If flocculating or coagulating agents are used to treat wastewater, then the health and ecotoxicological effects of these substances **must** be examined before applying the sludge to land.

Wastewater sludge from combined winery and domestic wastewater disposal systems may contain other substances that have significant health concerns associated with them. The application of this sludge must comply with the *South Australian Biosolids Guidelines.*

For facilities that compost on site, a suitable monitoring program **must** be developed to assess any effect composting may have on the environment.

Monitoring the impacts of noise and odour

The EPA encourages all industries, licensed or unlicensed, to keep a complaint register and have a telephone number for receiving complaints. Odour and noise are the most common complaints against wineries.

If there is a complaint, the EPA recommends that the winery and the other party(s) discuss the matter openly. For noise complaints, the EPA may request that the noise be measured by qualified acoustic engineers in accordance with the *Environment Protection (Industrial Noise Policy) 1994*. This will determine whether noise reduction measures need to be implemented.

Some wineries that have received occasional odour complaints have incorporated crude odour rating systems into their monitoring programs. If the problem becomes persistent and difficult to overcome, expert advice must be sought from consultants who specialise in waste or wastewater management. In these cases, the EPA may also require that the odour be assessed using the methodology and the criteria outlined in the EPA Guideline *Odour Assessment Using Odour Source Modelling, March 2003*.

National Pollutant Inventory

Monitoring of air emissions is not required under current winery licences. However, estimations of emissions may be required for the National Pollutant Inventory (NPI).

NPI reporting is mandatory under the *Environment Protection Act (1993)*, and estimates of emissions of NPI-listed substances to air, water and land must be reported for each substance emitted at above threshold levels. (The full list of 90 reportable substances can be seen on the NPI web site - www.npi.gov.au/about/list_of_subst.html). The full list must be considered when determining if thresholds are being exceeded. NPI reporting of pollutant emissions is required annually by 30 September for financial year reporters (calendar year reporting can be negotiated). Greenhouse gases and ozone depleting substances are currently not reported to the NPI.

A Wine and Spirit Handbook has been developed to advise on what a winery is required to provide or retain for NPI reporting purposes, including emission estimation techniques. *The Wine and Spirit Handbook* and associated *Emission Estimation Technique Manuals* are available from the NPI website at www.npi.gov.au.

Individual review of monitoring data

Monitoring is an expensive and resource-intensive process, so wineries **must** effectively use the data obtained for improvement of their processes and environmental management practices.

Each winery **must** develop a database to consolidate its monitoring data, and a trained employee of the winery **must** regularly review the monitoring data. The results and trends **must** be examined to determine:

- if waste generation patterns in the winery have changed
- if there are any characteristics of the wastewater that make it unsuitable for irrigation or management on site
- the organic carbon, nutrient and salt loads to the environment
- whether there are changes to the soil, including increased sodicity, alkalinity, acidity, etc.
- how wastewater management and irrigation affect soil and water (surface and groundwater) in comparison with control or reference sites
- if there are potential breaches of the water quality criteria for the protected environmental values as outlined in Schedules 1 and 2 of the Water Quality Policy
- whether there is an accumulation of heavy metals within or in the vicinity of the application area.

Wastewater management systems **must** be modified in accordance with the monitoring results obtained. Specialist advice **must** be sought to develop an Environment Improvement Program to address suspected declines in environmental performance or if environmental impacts are evident.

References and related reading

Agriculture and Resource Management Council of Australia and New Zealand 1998, *Effluent Management Guidelines for Wineries and Distilleries*.

Chapman J, Baker P and Wills, S 2001, *Winery Wastewater Handbook: Production, Impacts and Management*, Winetitles Publishers, Adelaide, South Australia.

National Environment Protection Council Service Corporation 1999, *National Environment Protection (Assessment of Site Contamination) Measure 1999*.

Primary Industries and Resources SA 2003, *Manual for Spreading Nutrient-Rich Wastes on Agricultural Land*.

[1]South Australian EPA 1996, *South Australian Biosolids Guideline for the Safe Handling, Reuse or Disposal of Biosolids*.

South Australian EPA 2002, *Use of Water Treatment Solids*, August 2002.

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South Australian Wine and Brandy Industry Association 1996, *Cleaner Production for the Wine Industry*.

Standards Australia 1998, Australian/New Zealand Standard AS/NZS 5667:1998 Water Quality Sampling.

[1] All SA EPA publications are available from the EPA web site - www.epa.sa.gov.au - or by contacting the EPA (telephone: (08) 8204 2004)

Definitions and abbreviations

AHD	Australian Height Datum (in metres); mean sea level for 1966–1968 was assigned the value of zero on the Australian Height Datum at thirty tide gauges around the coast of the Australian continent
anaerobic	in the absence of air (oxygen)
biochemical oxygen demand	a measure which provides an indication of the amount of oxygen required for microbiological oxidation of organic materials to carbon dioxide
chemical oxygen demand	a measure of the oxygen equivalent of the organic matter content of the sample that is susceptible to oxidation by a strong chemical oxidant
distillery	a plant where winery by-products are distilled
electrical conductivity (EC)	a measure of electrical conductance due to dissolved salts. EC can be converted to an approximate salt content.
saturated electrical conductivity, ECe	a measure of electrical conductivity of water extracted from saturated soil
exchangeable sodium percentage	the proportion of sodium ions to other exchangeable cations in soil, expressed as a percentage
groundwater	water below the ground surface in a zone of saturation
heavy metals	group of metallic elements with, generally, a specific gravity greater than 5
irrigation management unit (IMU)	a delineated area of land of one dominant soil type, that receives the same quantity of wastewater per irrigation
lees	the material which accumulates in the bottom of grape juice or wine fermentation tanks
marc	the grape material (mainly skin, pulp and seeds) which is left over after grape crushing and pressing
production period	cycles in winery operations that influence the volume and characteristics of waste streams
readily available water (RAW)	water that can be extracted by the crop between field capacity and the irrigation point.
septic tank effluent disposal scheme (STEDS)	a system for the common collection and disposal of wastes from septic systems
sewer	the pipe network used for the common collection of untreated wastewater generated on individual properties in centres with large human populations
sludge	material that has settled to the bottom of a wastewater collection, treatment or storage device

sodium adsorption ratio (SAR)	amount of sodium relative to calcium and magnesium in wastewater
stormwater	rain or melted precipitation that runs off land or structures on land
wastewater storage lagoon	any dam, pond or lagoon constructed and used for the purpose of holding wastewater; does not include a sediment retention basin
wastewater management system	a system designed and operated for the purpose of collecting and managing wastewater to minimise adverse impacts of wastewater on the environment
watercourse	means any of the following (whether or not temporarily dry): a river, creek or other natural watercourse (whether modified or not) a dam or reservoir that collects water flowing in a watercourse a lake, wetland or other water body through which water flows the Coorong an artificial channel a public stormwater disposal system part of a watercourse
winery	works for the processing of grapes, grape juice, must or wine into liquids used by other wineries or into finished wine ready for bottling; excludes works for bottling only
wastewater	means waste principally consisting of water. Includes wash down water, cooling water, effluent, irrigation runoff and contaminated stormwater

Appendix Environmental monitoring checklist

The following checklist will assist all wineries and distilleries (licensed or unlicensed) in the development of best practice environmental monitoring programs. It is recommended that the checklist be used only after the guideline has been read and understood.

Follow the sequence unless directed otherwise.

1. Does the winery dispose of wastewater on site?

- ❑ No → Measure monthly wastewater generation. Go to 5.
- ❑ Yes → Monitor the following:
  - o influent water supply quality
  - o wastewater volumes
  - o wastewater quality
  - o volume of wastewater applied to land per year.

2. Is the wastewater irrigated at a rate greater than 100 mm (1 ML/ha) per year, or is the wastewater-irrigated site located in a sensitive area? (Note: *Wineries irrigating at a rate less than 100 mm within the Mount Lofty Ranges Watershed Protection Area may also be required to undertake soil monitoring*.)

- ❑ No → Go to 4.
- ❑ Yes → Monitor the following in the irrigation site:
  - o soil moisture
  - o soil chemistry.

3. Is there a confined or unconfined groundwater aquifer less than 15 m below ground, or is the wastewater-irrigated site located in a sensitive environment?

- ❑ No → Go to the next question.
- ❑ Yes → Monitor the following in the irrigated site:
  - o depth to groundwater
  - o groundwater quality.

4. Do the wastewater-irrigated sites show signs of poor health?

- ❑ No → Go to the next question.
- ❑ Yes → Undertake regular vegetation monitoring.

5. Is any component of the wastewater management system located within 50 metres of a watercourse?

- ❑ No → Go to the next question.
- ❑ Yes → Monitor the quality of water in the watercourse.

6. **Is there a wastewater storage lagoon on the property?**

   - ❑ No → Go to the next question.
   - ❑ Yes → Monitor the following in the vicinity of the lagoon:
     - o depth to groundwater
     - o groundwater quality.

7. **Does the EPA licence require noise and/or odour monitoring?**

   - ❑ No → Go to the next question.
   - ❑ Yes → Monitor noise and/or odour in accordance with EPA requirements.

8. **Does the winery receive occasional noise and/or odour complaints?**

   - ❑ No → Go to the next question.
   - ❑ Yes → Maintain a complaints register.

9. **Does the winery keep a record of its solid wastes generation and management?**

   - ❑ No → Develop a solid wastes management record in accordance with the guideline.
   - ❑ Yes → Go to the next question.

10. **Does the winery apply wastewater treatment sludge to land?**

    - ❑ No → Go to the next question.
    - ❑ Yes → Monitor the heavy metal content in sludge and soil.

11. **Does the winery discharge potentially polluted stormwater to any watercourse?**

    - ❑ No → Go to the next question.
    - ❑ Yes → Monitor the quality of the captured stormwater and ensure that, before each discharge, it meets the criteria outlined in the *Water Quality Policy 2015*.

12. **Does the winery or the wastewater management system produce any NPI-listed substances at levels that could exceed the allowable threshold?**

    - ❑ No → Go to the next question.
    - ❑ Yes → Report emissions to the NPI.

13. **Is there evidence of any of the following?**

    a) extreme or strange results that were not observed in previous years

    b) increasing pollutant load generation rates

    c) excessive hydraulic, organic carbon, nutrient or salt loading

    d) significant changes in soil chemistry

e) breaches of the water quality criteria for the protected environmental values as outlined in the Water Quality Policy

f) accumulation of heavy metals in soils where sludge is applied

g) significant differences in soil chemistry, and groundwater depth and quality, between irrigated and reference sites

h) significant differences in groundwater depth and quality between wastewater lagoon areas and reference sites

i) significant differences in water quality upstream and downstream of an adjacent watercourse

j) continuous vegetation health decline

k) increasing noise and odour complaints

l) other evidence of environmental degradation

- ❑ No → Maintain the monitoring program.
- ❑ Yes → You may need to
    - o look for ways to improve production or housekeeping
    - o undertake changes or improvements to waste or irrigation management systems
    - o seek specialist advice.