

Good Environmental Management Guidelines:

Vineyard Fertiliser and Soil Management



GEM Guidelines: Vineyard Fertiliser and Soil Management

Acknowledgment

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The Cooperative Research Centre for Viticulture

The Cooperative Research Centre for Viticulture is a joint venture between Australia's viticulture industry and leading research and education organisations. It promotes cooperative scientific research to accelerate quality viticultural management from vine to palate. Australian grape growers and winemakers are key stakeholders in the CRCV, contributing levies matched by the Commonwealth Government and invested by the Grape and Wine Research and Development Corporation in the Centre.



GEM Guidelines: Vineyard Fertiliser and Soil Management

Table of Contents

| | | | |
|---|----|--|----|
| INTRODUCTION | 1 | Section 2: SOIL MANAGEMENT | 17 |
| Why adopt Good Environmental Management practices? | 1 | ENVIRONMENTAL OBJECTIVES | 17 |
| What is in this document? | 1 | Risk activities and Aims | |
| How should this document be used? | 2 | Cultivation of vineyards | 17 |
| VERA | 2 | Use of grape marc | 18 |
| Where do the GEM Guidelines fit with other environmental programs? | 3 | ASPECTS | 18 |
| Section 1: NUTRIENT MANAGEMENT | 4 | POTENTIAL ENVIRONMENTAL IMPACTS | 18 |
| ENVIRONMENTAL OBJECTIVES | 4 | Activity –CULTIVATION OF VINEYARDS | 19 |
| Risk activities and Aims | | Potential environmental impacts | |
| Application of fertilisers, manures and composts | 4 | 1 Degradation of soil quality (reduced sustainability), increased soil erosion and increased runoff | 19 |
| Storage of fertilisers, manures and composts | 5 | 2 Discomfort or inconvenience to local residents from dust caused by cultivation | 20 |
| Transport of fertilisers, manures and composts | 5 | Activity –USE OF GRAPE MARC | 21 |
| ASPECTS | 6 | Potential environmental impacts | |
| POTENTIAL ENVIRONMENTAL IMPACTS | 6 | 5. Contamination of land, surface water and ground water | 21 |
| Activity – USING FERTILISERS, MANURES AND COMPOSTS | 7 | 6. Soil acidification | 22 |
| Potential environmental impacts | | 7. Climate change / global warming | 23 |
| 1. Eutrophication of surface waters and algal blooms | 7 | | |
| 2. Contamination of land | 9 | | |
| 3. Soil acidification | 11 | | |
| 4. Contamination of surface water and / or ground water | 13 | | |
| 5. Adverse impact upon flora and fauna / changes to local biodiversity | 15 | | |
| Activity –USING FERTILISERS WITH GREENHOUSE GAS CONTENT | 16 | | |
| Potential environmental impacts | | | |
| 6. Long term climate change / global warming | 16 | | |

Introduction

Good Environmental Management (GEM) practices involve vineyard management activities that reduce any negative impacts on the environment, and which may sustain and even improve the natural resource base which grape growing depends upon.

Why adopt Good Environmental Management practices?

There are many reasons why a wine grape grower or vineyard manager may wish to adopt GEM practices on their vineyard. In many cases the adoption of these practices are as much for good business management as they are for environmental improvements. Some of the reasons include:

- maintaining the natural resource base of the vineyard for future grape production;
- improving the economic viability of the business through better management of resources and reducing certain inputs (e.g. fertilisers, pesticides etc);
- demonstrating to customers, neighbours and the general community good environmental performance;
- meet industry, community and government expectations about environmental management;
- maintaining or gaining access to certain markets (especially those with high environmental standards);
- meet personal goals relating to the protection of the environment and natural resources.

What is in this document?

This document presents guidelines for GEM practices for *Vineyard Fertiliser and Soil Management*. It is part of a series of guidelines developed to provide wine grape growers and vineyard managers with information about adopting GEM practices.

Other documents available in the series* include:

- *Water Use Management*;
- *Pest and Chemical Management*;
- *Equipment, Machinery and Vehicle Management*.

*It should be noted that there is some crossover of information between these documents.

The GEM Guidelines have been written from a national perspective and so they provide general information not specific to any region. They have been written to directly link with the Viticare Environmental Risk Assessment (VERA) tool (see next page).

Each document in the series describes:

- activities relevant to the document topic which can be undertaken in association with a viticultural enterprise;
- the environmental aspects of these activities and any potential impacts;
- guidance on appropriate management and viticultural practices;
- a range of possible actions to address the impact;
- recommendations for monitoring, measuring and recording to inform decision-making.

Introduction

How should this document be used?

This document should be used as a starting point by growers, managers or regional industry officers seeking to address the environmental impacts associated with everyday viticultural activities. While it may be possible to use it as a stand-alone source of information on how to address environmental risk, the guidelines are best used together with the VERA tool. It is recommended that the GEM Guidelines be used in the following way:

- **Attend a *Research to Practice® Getting Started with Environmental Management in Viticulture* workshop.** This workshop introduces participants to the VERA tool and helps them conduct an environmental risk assessment of their business.
- **Apply the VERA tool to individual businesses.** This should help to identify those environmental aspects and impacts that have the greatest potential risk, and therefore determine what needs to be addressed.
- **Having identified the areas that need addressing, refer to the relevant GEM Guidelines** for suggested management and production actions that could be taken to reduce the associated risks.

REMEMBER:

These GEM Guidelines are:

- only one source of information and should not be seen as the final answer to addressing environmental risk in a vineyard;
- a guide to current good environmental management practices for grape growers and vineyard managers;
- not production or technically based best management practice guidelines.

VERA

VERA is a CD-ROM developed by the Cooperative Research Centre for Viticulture (CRCV). It is a tool that is intended to provide a starting point for grape growers and vineyard managers to begin building formal environmental management into their overall vineyard management planning. It lists a number of management areas or categories (e.g. water use management) and the associated activities, and describes relevant environmental aspects and potential impacts (risks).

VERA helps growers to:

- think more about their viticultural practices and how these might impact on their vineyard and the wider environment;
- prioritise these issues;
- plan actions to address the issue and to reduce the risks associated with these impacts.

Should growers wish they can then build upon this base to develop a more structured approach to environmental management such as an Environmental Management System (EMS).

Growers attending a *Research to Practice® Getting Started with Environmental Management in Viticulture* workshop will receive a copy of the VERA tool as part of the training materials.

Introduction

Where do the GEM Guidelines fit with other environmental programs?

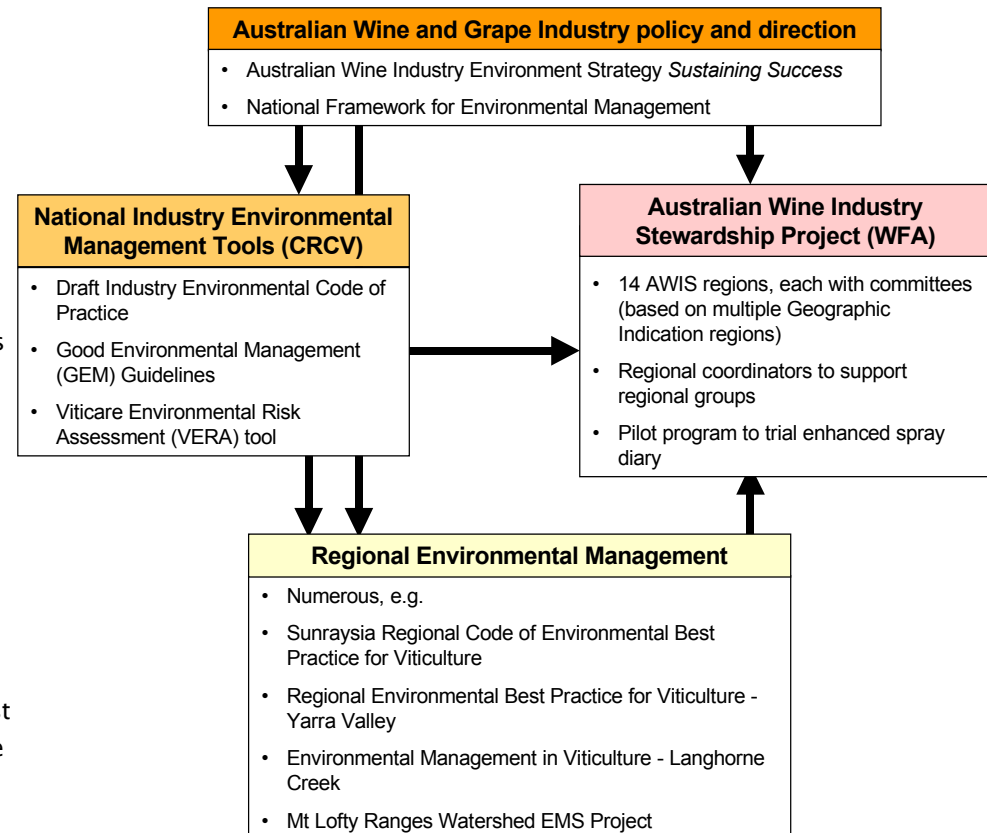
The Australian Wine Industry's Environment Strategy *Sustaining Success** was developed to provide guidance to all wine industry members about improving environmental performance and demonstrating environmental credentials. In support of this strategy the CRCV has developed a number of nationally focused documents (in addition to these GEM Guidelines and the VERA tool) including a *National Framework for Environmental Management* and a *Draft Industry Environmental Code of Practice*.

Also at a national level, the Australian Wine Industry Stewardship project, managed by the Winemakers Federation of Australia (WFA) and launched in 2005, will develop a national program to allow the industry to demonstrate its environmental credentials. Through this program regional coordinators will encourage grape growers and winemakers to participate and assist them to achieve environmental targets.

Beyond these national initiatives many grape growers have been supported at the local level through regional environmental management projects. A number of these projects have developed *Regional Codes of Environmental Best Management Practice for Viticulture* (or Regional Environmental BMPs). Such documents highlight particular regional environmental issues and may provide more specific information to assist the adoption of environmental best practice. Local grower associations can provide information about all of these programs and what is happening in their region.

*Available online at www.wfa.org.au (follow the links to >>Issues>>Environment)

How the GEM Guidelines and other environmental programs fit together



SECTION 1: NUTRIENT MANAGEMENT

Environmental Objectives

Fertilisers, manures and composts are increasingly used in Australian vineyards. NUTRIENT MANAGEMENT should be well planned, and based on the vineyard nutrient status and soil requirements. GOOD ENVIRONMENTAL MANAGEMENT means meeting a number of AIMS for each RISK ACTIVITY involved with the USE OF FERTILISERS, MANURES AND COMPOSTS. Using these products has the potential to be of ENVIRONMENTAL CONCERN due to possible leakage, spills, leaching, run-off and drift during application, storage and transport.

Use of these products must be managed appropriately to ensure efficient uptake by the vineyard plants (vines and cover crops) and prevention of adverse off-site impacts on the environment. This includes:

- appropriate product selection and timely application;
- secure transport and storage;
- appropriate handling;
- detailed recording;
- correct application.

All activities relating to the application, storage and transport of these products must meet local, regional, state and national guidelines and regulations. Additional guidelines may also apply according to the requirements of the winery, or any cooperatives or associations to which the vineyard is a member.

Always check and follow the label directions or other information provided by the reseller or manufacturer regarding application, and access any relevant material safety data sheets (MSDS).



Risk activity – APPLICATION OF FERTILISERS, MANURES AND COMPOSTS

Aims

- Application of fertilisers, composts and manures should be a planned practice that is dependent on the vineyard's required outcomes.
- Apply fertilisers as needed based on a visual assessments, petiole testing and soil analyses.
- Apply fertilisers, manures and composts appropriate to the environmental conditions. Give consideration to:
 - soil type and chemistry;
 - irrigation system and schedule;
 - climatic conditions;
 - the surrounding environment.
- Apply fertilisers, manures and composts at the correct rate, time of the season and irrigation shift (if applicable).

SECTION1: NUTRIENT MANAGEMENT

Risk activity – *STORAGE OF FERTILISERS, MANURES AND COMPOSTS*

Aims

Storage of bagged fertiliser, manure or compost is treated separately to bulk storage. For bagged fertiliser, manure or compost, similar storage conditions to that of chemicals can be utilised, however chemicals and fertilisers should always be separated.

- Store bagged fertiliser, manure or compost in a well-ventilated and well lit shed that is lockable and has impervious flooring and shelving. Storage sheds:
 - must not be in flood areas;
 - should be separated from fuel depot areas;
 - should be bunded by a low mound or wall.
- Keep pesticides separate from animal feed, fertilisers, seeds and other chemicals.
- Ensure appropriate materials are located nearby to clean up any spills. These may include soil, water, absorbent pillows, lime or sand.
- Store bagged fertilisers, manures and composts in the original container with labels intact. If labels come off, always immediately re-label the container.
- Ensure that the shed is properly sign posted.
- Bulk fertiliser, manure and compost storage should:
 - not be in flood areas;
 - be covered if practical;
 - be away from fuel depot areas;
 - be away from highly sensitive areas (e.g. waterways and areas of high biodiversity importance).

Risk activity– *TRANSPORT OF FERTILISERS, MANURES AND COMPOSTS*

Aims

- Avoid transporting fertilisers, manures and composts with food, water, animal feed or reactive hazardous substances.
- Ensure fertilisers, manures and composts are appropriately secured and covered during transport to prevent them from moving and falling.
- Keep a record of the fertilisers, composts and manures that you are transporting.
- Carry suitable personal protective equipment, including respiratory equipment (if necessary) in case of emergency.

SECTION 1: NUTRIENT MANAGEMENT

ASPECTS

Those aspects associated with the use of fertilisers, manures and composts, which have the potential for adverse environmental impacts include:

- potential for leakage, spills, leaching, run-off and drift;
- use of fertilisers with greenhouse gas content (nitrous oxide).

POTENTIAL ENVIRONMENTAL IMPACTS

The remainder of this section provides details about potential environmental impacts for each of the risk activities associated with the use of fertilisers, manures and composts. It also outlines actions to help avoid those risks, and recommendations on data collection to aid management decisions. Impacts include:

1. Eutrophication of surface waters and algal blooms.
2. Contamination of land.
3. Soil acidification.
4. Contamination of surface water and / or ground water.
5. Adverse impact upon flora and fauna and/or changes to local biodiversity.
6. Long term climate change, eg. global warming (specific to using fertilisers with compounds which contribute to greenhouse gases, i.e. nitrous oxide).



ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

1

Eutrophication of surface waters and algal blooms

Aspect/s

- Potential for leakage, spills, leaching, run-off and drift

Explanation

Eutrophication occurs when nutrients (particularly nitrogen and phosphorus) from fertiliser, manure or compost applications move into water bodies and accumulate. Under the right conditions (slow water flow, sunny weather) algae feed on these nutrients and multiply. This rapid algal growth becomes a problem when the algae die and the subsequent breakdown of their remains by bacteria reduces the level of oxygen available in the water, thus impacting on other flora and fauna. Blue-green algae blooms are of most concern as certain of these species also release toxins into the water that can kill other organisms. The risk of leakage, spills, leaching, runoff and drift of these nutrients is increased if fertiliser, manure and compost products are incorrectly stored and transported (particularly if in bulk rather than bagged or in containers).

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|---------------|--|---|
| 200 | Application | <p>Reduce run-off following application by, e.g. maximising ground cover to limit exposure of bare ground, and timing applications to minimise nutrient movement relevant to rainfall etc.</p> <p>Maintain good soil structure and minimise erosion by, e.g. reducing cultivation and length of time soil is bare, and stabilising banks of water courses.</p> <p>Limit storm water movement and vineyard organic waste into natural waterways as these can often contain large amounts of nutrients. Consider the development of artificial wetlands to achieve this aim.</p> | <p>Regularly assess:</p> <ul style="list-style-type: none"> • levels of nitrogen and phosphorus in water ways; • stream flow rates; • water movement through the vineyard. |

(Continued on next page...)

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential
impact

1

Eutrophication of surface waters and algal blooms

(...continued from previous page)

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|------------------|------------------|--|--|
| 206 | Storage | <p>Store bagged fertiliser, manure and compost products in secure lockable sheds with flooring and shelving made of impermeable materials e.g. cement/steel.</p> <p>Site shedding away from natural water courses, boundaries with neighbours and areas of high biodiversity importance in or adjacent to the vineyard.</p> <p>Construct a low wall or mound around the shed to contain any spills (bundling) and consider the soil type at the shed location with regards to risk of infiltration of any spilled materials into the soil profile and the local water table.</p> | <p>Regularly assess:</p> <ul style="list-style-type: none"> • levels of nitrogen and phosphorus in water ways and soils around storage areas; • stream flow rates. |
| 211 | Transport | <p>Minimise transport of fertilisers, manures and composts (particularly bulk loads) as much as possible.</p> <p>Ensure all transport equipment is properly maintained.</p> <p>Cover loads while they are being transported.</p> <p>Investigate and use transport pathways through less environmentally sensitive areas wherever possible.</p> <p>Develop containment and clean up strategies for each type of product transported.</p> | <p>Maintain detailed records of:</p> <ul style="list-style-type: none"> • products transported; • equipment use and maintenance for all classes of transport vehicles. |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

2

Contamination of land

Aspect/s

- **Potential for leakage, spills, leaching, run-off and drift**

Explanation

Contamination of land due to the use of fertilisers, manures and composts can occur if products are incorrectly applied, stored and transported. Over application can lead to an accumulation of nutrients and other compounds, and products may contain impurities. Contamination can impact on soil health and the viability of local ecosystems, and may make a vineyard (or other enterprise/locale, if the impact is off-site) temporarily or permanently non-viable, eg. if an applied product contains a heavy metal such as lead or cadmium. Land contamination due to leaks, spills, leaching, run off and drift is more likely to occur from stored bulk fertilisers, while storage of bagged products in properly equipped sheds should minimise the risks.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------|---|---|
| 201 | Application | <p>Choose appropriate fertiliser, manure and compost products that minimise potential contamination from impurities (e.g. heavy metals, fluoride and salt).</p> <p>Prepare fertiliser products for application in an area where leaks or spills can be contained.</p> <p>Minimise drift when applying foliar sprays to reduce off target impacts by:</p> <ul style="list-style-type: none"> • maintaining and calibrating delivery equipment/machinery; • avoiding spraying in adverse weather conditions; • planting windbreaks¹/buffers between sprayed areas and sensitive areas where possible. | <ul style="list-style-type: none"> • Analyse soil to determine base line data. • Read and understand analyses of chemical constituents of fertilisers, manures and composts used. • Record calibration of application equipment/machinery. |

(Continued on next page...)

¹ Current specifications for windbreaks are not viticulture-specific. Some issues to consider include:

- Site windbreaks in strategic positions such as facing prevailing winds or near neighbours. This reduces wind blown soil, fertiliser, manure and compost particles.
- Ideally plant multiple rows of trees and shrubs (especially species like hakeas, casuarinas and grevilleas which have rough long thin foliage).
- Do not use plants which form a solid 'wall', like dense plantings of pine trees, as spray will drift over the top.
- Aim for vegetative buffers which will grow or can be maintained to a height 50% taller than the vines.

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential
impact

2

Contamination of land

(...continued from previous page)

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|------------------|------------------|--|--|
| 207 | Storage | <p>Store bulk products on a cement pad with the facility to retain and treat run off.</p> <p>Cover storage mounds to reduce drift.</p> <p>Locate bulk stores away from areas of high biodiversity significance.</p> <p>Store bulk supplies of composts and manures at least 100m from waterways and not on sloping ground (ie. slope less than 5°), on a compounded clay base or concrete pad. If these are not available, then care should be taken to site storage areas where the water table is at least 2m from the soil surface.</p> <p>Remediate bulk storage sites when no longer in use.</p> <p>Storage of bagged products in properly equipped sheds should minimise the risk of land contamination.</p> | <p>Regularly assess:</p> <ul style="list-style-type: none"> • soil chemistry around storage sites. |
| 212 | Transport | <p>Minimise transport of fertilisers, manures and composts (particularly bulk loads) as much as possible.</p> <p>Ensure all transport equipment is properly maintained.</p> <p>Cover loads while they are being transported.</p> <p>Investigate and use transport pathways through less environmentally sensitive areas wherever possible.</p> <p>Develop containment and clean up strategies for each type of product transported.</p> | <p>Maintain detailed records of:</p> <ul style="list-style-type: none"> • products transported; • equipment use and maintenance for all classes of transport vehicles. |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

3

Soil acidification

Aspect/s

- **Potential for leakage, spills, leaching, run-off and drift**

Explanation

Acidic soils can occur naturally, but human-induced soil acidification results from the use of ammonium-based fertilisers. As biochemical processes in the soil convert ammonium to nitrate, acid is produced which slowly lowers soil pH making it more acidic. Plants and soil organisms have preferences for soil within certain pH ranges, usually moderately acid or alkaline, or neutral. Acidification of soils affects soil biology by reducing earthworm numbers, and changes the population dynamics of useful bacteria and fungi. Low soil pH also alters the mobility and availability to plants of a range of minerals, including toxic elements such as aluminium. The rate of soil acidification depends on the texture of the soil.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------|---|---|
| 202 | Application | Identify soil pH before using any fertilisers and select products which will minimise acidification (e.g. use a nitrate-based fertiliser instead of ammonium-based). Investigate soil management options to improve soil health generally, and for specific treatment of soils which are already acidic (e.g. application of lime and organic matter). | <ul style="list-style-type: none"> • Measure and record soil pH annually if acidic (pH less than 5.5). |
| 208 | Storage | Store bulk fertilisers on cement pads and contain and treat any run-off. Store bagged fertilisers in properly designed and equipped sheds. | <ul style="list-style-type: none"> • Measure and record soil pH annually around storage sites. |

(Continued on next page...)

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential
impact

3

Soil acidification

(...continued from previous page)

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|------------------|------------------|---|--|
| 213 | Transport | <p>Minimise transport of fertilisers, manures and composts (particularly bulk loads) as much as possible.</p> <p>Ensure all transport equipment is properly maintained.</p> <p>Cover loads while they are being transported.</p> <p>Investigate and use transport pathways through less environmentally sensitive areas wherever possible.</p> <p>Develop containment and clean up strategies for each type of product transported.</p> | <p>Maintain detailed records of:</p> <ul style="list-style-type: none"> • products transported; • equipment use and maintenance for all classes of transport vehicles. |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

4

Contamination of surface water and / or ground water

Aspect/s

- **Potential for leakage, spills, leaching, run-off and drift**

Explanation

Contamination of surface and ground waters with compounds contained in fertilisers, manures and composts can occur if these products drift, blow or are washed into a water body by rain or irrigation water or dissolved compounds leach into the water table. Environmental concerns vary but can include eutrophication of surface waters, or accumulation of toxic elements in ground water used for domestic purposes. The risk of leakage, spills, leaching, runoff and drift is increased if fertiliser, manure and compost products are incorrectly stored and transported (particularly if in bulk rather than bagged or in containers). Sites for sheds and bulk storage should be carefully considered and constructed to minimise potential risks of leaching or movement of compounds into the soil and nearby waterways.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|---------------|--|---|
| 203 | Application | <p>Minimise drift when applying foliar sprays to reduce off target impacts by:</p> <ul style="list-style-type: none"> • maintaining and calibrating delivery equipment/machinery; • avoiding spraying in adverse weather conditions; • planting windbreaks/buffers between sprayed areas and sensitive areas where possible. <p>Minimise movement by water and leaching of compounds in fertilisers by:</p> <ul style="list-style-type: none"> • maximising ground cover to minimise bare ground and reduce the potential for run-off and erosion; • applying a relevant product only where a need has been identified by visual assessment of deficiency and soil and petiole analysis; • applying fertiliser efficiently with respect to application amount and timing; • installing drainage meters to extract drainage water and to allow determination of nutrients moving through the soil profile. <p>To minimise mobility of toxic compounds in very acid or very alkaline soil conditions (and therefore potential for them to leach down the soil profile into the water table), aim to keep soil and applied water pH in the neutral range (best between 5.5 – 8.0).</p> | <ul style="list-style-type: none"> • Read and understand analyses of chemical constituents of fertilisers, manures and composts used. • Record calibration of application equipment/machinery. • Regularly measure water quality in nearby surface and ground waters, especially for nitrogen, phosphorus, salt and heavy metals. • Monitor and measure drainage water amount and quality. <p style="text-align: right;"><i>(Continued on next page...)</i></p> |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential
impact

4

Contamination of surface water and / or ground water

(...continued from previous page)

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|------------------|------------------|--|--|
| 209 | Storage | <p>Store bagged fertiliser, manure and compost products in secure lockable sheds with flooring and shelving made of impermeable materials e.g. cement/steel.</p> <p>Store bulk products on a cement pad with the facility to retain and treat run off.</p> <p>Store bulk supplies of composts and manures at least 100m from waterways and not on sloping ground (ie. slope less than 5°), on a compounded clay base or concrete pad. If these are not available, then care should be taken to site storage areas where the water table is at least 2m from the soil surface.</p> <p>Site shedding and bulk storage areas away from natural water courses.</p> <p>Cover storage mounds to reduce drift.</p> <p>Construct a low wall or mound around the shed or bulk storage site to contain any spills (bunding) and consider the soil type at the shed location with regards to risk of infiltration of any spilled materials into the soil profile and the local water table.</p> | <ul style="list-style-type: none"> • Regularly measure water quality in nearby surface and ground waters, especially for nitrogen, phosphorus, salt and heavy metals. |
| 214 | Transport | <p>Minimise transport of fertilisers, manures and composts (particularly bulk loads) as much as possible.</p> <p>Ensure all transport equipment is properly maintained.</p> <p>Cover loads while they are being transported.</p> <p>Investigate and use transport pathways through less environmentally sensitive areas wherever possible.</p> <p>Develop containment and clean up strategies for each type of product transported.</p> | <p>Maintain detailed records of:</p> <ul style="list-style-type: none"> • products transported; • equipment use and maintenance for all classes of transport vehicles. |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

5

Adverse impact upon flora and fauna / changes to local biodiversity

Aspect/s

➤ **Potential for leakage, spills, leaching, run-off and drift**

Explanation

Changes to local flora and fauna populations can occur as a result of leakage, spills, leaching run off, or drift during the application and storage of fertilisers, manures and composts. For example, compounds in these products can change soil pH, thereby affecting population dynamics and numbers of soil fauna and organisms, or eutrophication of water bodies or accumulation of toxic elements may impair or kill fish and other aquatic organisms or water birds. Loss of individual organisms from a population, and alteration to populations in ecosystems, changes local biodiversity.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------------------|---|---|
| 204 | Application and Storage | Minimise fertiliser, manure and compost application close to highly sensitive areas (e.g. biologically diverse areas of high importance, waterways etc.) Implement biodiversity monitoring plans to provide baseline information on biodiversity status. Get information on local issues and important species by making contact with local environmental/wildlife groups, catchment management authorities and/or land protection authorities involved in biodiversity management. | Record: <ul style="list-style-type: none"> • vegetation types and amounts; • types and numbers of regionally important fauna species. |
| 215 | Transport | Minimise transport of fertilisers, manures and composts (particularly bulk loads) as much as possible. Ensure all transport equipment is properly maintained. Cover loads while they are being transported. Investigate and use transport pathways through less environmentally sensitive areas wherever possible. Develop containment and clean up strategies for each type of product transported. | Maintain detailed records of: <ul style="list-style-type: none"> • products transported; • equipment use and maintenance for all classes of transport vehicles. |

ACTIVITY: USING FERTILISERS, MANURES AND COMPOSTS

Potential impact

6

Long term climate change / global warming

Aspect/s

- Use of fertilisers with greenhouse gas content (nitrous oxide)

Explanation

There are still many uncertainties in the understanding of long term climate change and global warming, and the role of greenhouse gasses in these processes. It is known however that nitrous oxide is a greenhouse gas and that many factors affect its emission from soil (e.g. temperature, moisture, pasture growth/ground cover and soil type), and that variation occurs in time and space in the amount of nitrous oxide released from a given site. Efforts are being made both internationally and in Australia to improve on current knowledge and methodologies of analysis.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|---------------|---|--------------------------|
| 205 | Application | Keep up-to-date with developments regarding this issue by actively reviewing industry media for future information. | |

Remember the NUTRIENT MANAGEMENT Environmental Objectives from the start of this section

USE OF FERTILISERS, MANURES AND COMPOSTS should be well planned, and based on the vineyard nutrient status and soil requirements. Good Environmental Management means MINIMISING THE POTENTIAL FOR RISK from leakage, spills, leaching, run-off and drift during application, storage and transport of these products. These Guidelines provide one way to consider the risks associated with the use of fertilisers, manures and composts and outline Aims and Actions to LIMIT ENVIRONMENTAL IMPACT.

SECTION 2: SOIL MANAGEMENT

Environmental Objectives

Australian soils are a fragile resource that contribute significantly to grape and wine quality. Monitoring and measuring of soil properties is critical to MAINTAINING THE SOIL RESOURCE. Application of soil management techniques such as CULTIVATION and use of additives such as GRAPE MARC should involve consideration of RISKS associated with these activities and products. Any soil management practices should identify and aim to minimise ENVIRONMENTAL IMPACTS.

Vineyard soils may be cultivated for a number of reasons (e.g. for weed control), however continual cultivation breaks down soil structure resulting in a number of problems, including:

- reduction in soil organic matter content;
- wheel track compaction;
- plough pans, hard setting and crusting of the soil surface.

These soil problems contribute to poor water infiltration, increased water run-off, erosion and the creation of dust. Over cultivation creates the potential for a general degradation in soil quality leading to reduced sustainability.

Maintaining and improving soil quality in vineyards may involve the use of ameliorants such as grape marc. This is a by-product of the wine making process which can be used as mulch under vines, and its use helps to

minimise waste by-products of the viticulture industry. However there can be some issues with acidity and potassium levels in the marc, and the output of methane (a greenhouse gas) to the atmosphere as the product decomposes.

Applying grape marc sourced directly from the winery poses a higher environmental risk than marc that has been through a distillation process (additional fermentation followed by steam distillation to remove any remaining alcohol). The risks are further lessened if either of these types of marc are composted.

All activities relating to cultivation of vineyards and application and storage of grape marc must meet local, regional, state and national guidelines and regulations. Additional guidelines may also apply according to the requirements of the winery, or any cooperatives or associations to which the vineyard is a member.

Risk activity – CULTIVATION OF VINEYARDS

Aims

- Maintain and improve soil quality by minimising cultivation.
- Reduce impacts of cultivation on the greater environment.
- Contact local soil management catchment management authorities and/or land protection authorities for information and to contribute to soil management activities.



SECTION 2: SOIL MANAGEMENT

Risk activity – USE OF GRAPE MARC

Aim

- If applying grape marc consider the quality of product available with regards to any potential impacts.



ASPECTS

Those aspects associated with soil cultivation and the use of grape marc, which have the potential for adverse environmental impacts include:

- potential for over cultivation;
- potential for dust from over cultivation
- incorrect storage/disposal of grape marc
- application of grape marc on ground.

POTENTIAL ENVIRONMENTAL IMPACTS

The remainder of this section provides details about potential environmental impacts for each of the risk activities associated with the soil cultivation and the use of grape marc. It also outlines actions to help avoid those risks, and recommendations on data collection to aid management decisions. Impacts include:

1. Degradation of soil quality, increased soil erosion and increased runoff due to over cultivation.
2. Discomfort or inconvenience to local residents from dust caused by cultivation.
3. Contamination of land, surface water and ground water from incorrect storage/disposal of grape marc.
4. Soil acidification from application of uncomposted grape marc.
5. Climate change / global warming from greenhouse gases released from grape marc.

ACTIVITY: CULTIVATION OF VINEYARDS

Potential impact

1

Degradation of soil quality (reduced sustainability), increased soil erosion and increased runoff

Aspect/s

➤ **Potential for over cultivation**

Explanation

Over cultivation may lead to a number of problems relating to soil structure which can reduce the overall sustainability of the vineyard. Such problem may include increased soil erosion and run-off. Soil erosion can contribute to reduced soil fertility as nutrients are removed with the eroded soil. With increased water run-off, less water enters the subsoil for plant use, while soil particles and nutrients can also be lost from the vineyard in run-off water.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|-------------------|--------------------|---|---|
| 216 217 218 | Cultivation | <p>Improve soil sustainability by investigating alternative management practices (e.g. zero-till, mulch, volunteer plant growth and cover cropping).</p> <p>Minimise any cultivation activities and time them to reduce erosion and run-off.</p> <p>Increase and improve ground coverage to minimise erosion and run-off.</p> <p>Maximise water infiltration by:</p> <ul style="list-style-type: none"> • chemical amelioration (e.g. gypsum); • increased organic matter (mulch, volunteer plants and cover crops). <p>Identify and implement any local, state and national soil management plans.</p> | <ul style="list-style-type: none"> • Monitor soil properties such as infiltration rate, organic matter content and biological activity (e.g. earthworm numbers) as indicators of sustainability. • Record erosion events and use information to manage timing of any cultivation. |

ACTIVITY: CULTIVATION OF VINEYARDS

Potential impact

2

Discomfort or inconvenience to local residents from dust caused by cultivation

Aspect/s

➤ Potential for dust from over cultivation

Explanation

Cultivation of vineyard soils, particularly when soil is dry or conditions are windy, has the potential to result in significant amounts of dust that may cause inconvenience to local residents. This may be a particular problem where dust may exacerbate health problems (e.g. asthma).

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------|---|--|
| 219 | Cultivation | <p>Time cultivation to ensure minimal impact on neighbouring residences (e.g. only cultivate when soil is moist or when wind is blowing away from neighbours).</p> <p>Reduce the amount of cultivation and investigate alternative methods (e.g. minimal till or zero-till).</p> <p>Maintain vegetative ground cover of the inter-row soil for as much of the year as possible and consider mulching under vine rows.</p> <p>Investigate windbreaks to minimise movement of dust off-site.</p> <p>Identify and implement any local, state and national soil management plans.</p> | <ul style="list-style-type: none"> • Monitor weather conditions to ensure suitability for cultivation. • Record weather events and time of cultivation activities. • Estimate volumes of dust produced from cultivation activities. |

ACTIVITY: USE OF GRAPE MARC

Potential impact

3

Contamination of land, surface water and ground water

Aspect/s

➤ **Incorrect storage/disposal of grape marc**

Explanation

Incorrect application and storage of grape marc can have potential environmental impacts, particularly as a result of the input of quantities of potassium into soil and water supplies. Marc can contain quite high levels of potassium, especially when fresh and uncomposted. High potassium input to irrigation water and soil can have a negative impact on soil structure. Vines may take up excess potassium and they subsequently have a higher pH in the grape juice – this has negative implication for wine making, particularly for red varieties.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------------------|--|--|
| 220 | Application and Storage | <p>Where possible, compost grape marc to minimise any negative impacts to soil, water supplies and vines, particularly if grape marc is applied regularly.</p> <p>Allow 9–12 months before using grape marc composted on site.</p> <p>Locations for composting grape marc on site should:</p> <ul style="list-style-type: none"> • be at least 100m from waterways; • avoid sloping ground (ie. slope should be less than 5°); • be on a compacted clay base or concrete pad, or if this is not possible, then the water table should be at least 2m from the soil surface. <p>If uncomposted grape marc is applied in a vineyard as a mulch, to minimise potential adverse impacts to the soil:</p> <ul style="list-style-type: none"> • spread at a rate of 5–10m³/ha; • rotate application throughout the vineyard to avoid continual re-application of this material to the same sites. <p>When storing uncomposted grape marc:</p> <ul style="list-style-type: none"> • store under cover where possible, and on a cement pad where any run-off or leachate can be contained; • Locate storage sites so as to minimise contamination of surface and ground water. | <ul style="list-style-type: none"> • Regularly measure and record potassium levels in soil and water in the vineyard and adjacent to storage sites. |

ACTIVITY: USE OF GRAPE MARC

Potential impact

4

Soil acidification

Aspect/s

➤ **Application of grape marc on ground**

Explanation

Grape marc can have an acidifying effect on soils when fresh and uncomposted. Acidification of soil has direct chemical impacts on the soil itself and affects soil biota and the availability of nutrients to vines. Toxic minerals such as heavy metals can be more easily taken up by plants from acidic soil.

| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record |
|---------------|--------------------|---|--|
| 222 | Application | <p>Where possible, compost grape marc to minimise any negative impacts to soil, particularly if grape marc is applied regularly.</p> <p>Allow 9–12 months before using grape marc composted on site.</p> <p>Locations for composting grape marc on site should:</p> <ul style="list-style-type: none"> • be at least 100m from waterways; • avoid sloping ground (ie. slope should be less than 5°); • be on a compacted clay base or concrete pad, or if this is not possible, then the water table should be at least 2m from the soil surface. <p>If uncomposted grape marc is applied in a vineyard as a mulch, to minimise potential adverse impacts to the soil:</p> <ul style="list-style-type: none"> • spread at a rate of 5–10m³/ha; • rotate application throughout the vineyard to avoid continual re-application of this material to the same sites. <p>If acidification of soil is indicated, implement a liming program to maintain soil between pH 5.5 – 8.0.</p> | <ul style="list-style-type: none"> • Regularly measure and record pH of soil. • Measure pH of grape marc to give an indication of its acidification potential. |

ACTIVITY: USE OF GRAPE MARC

| | | | | |
|-------------------------|--|--|--|--|
| Potential impact | 5 | Climate change / global warming | | |
| Aspect/s | <ul style="list-style-type: none"> ➤ Application of grape marc on ground | | | |
| Explanation | <p>If grape marc mulch is spread thinly so that it decomposes aerobically (by bacteria and other organisms that require oxygen), it makes no contribution to greenhouse gas outputs. However, application of deep layers of this product as a mulch causes anaerobic decomposition (without oxygen) by bacteria in the deeper levels of the mulch layer. The result is the release of methane, a greenhouse gas.</p> | | | |
| Vera Ref. No. | Risk activity | Action to avoid impact | Monitor, Measure, Record | |
| 221 | Application | Apply grape marc mulch thinly – at a rate of 5–10m ³ /ha. | <ul style="list-style-type: none"> • Monitor the rate of mulch application, | |

Remember the SOIL MANAGEMENT Environmental Objectives from the start of this section

Application of soil management techniques such as CULTIVATION and use of additives such as GRAPE MARC should involve consideration of RISKS and practices which MINIMISE THE POTENTIAL FOR RISK. Monitoring and measuring soil properties is critical to MAINTAINING VALUABLE SOIL RESOURCES. These Guidelines provide one way to consider the risks associated with soil cultivation and the use of grape marc and outline Aims and Actions to LIMIT ENVIRONMENTAL IMPACT.