guidelines

Water and Rivers Commission
Department of Environmental Protection
Department of Health

The Western Australian Horse Council (Inc)

WATER QUALITY PROTECTION GUIDELINE NO 13

ENVIRONMENTAL GUIDELINES FOR HORSE FACILITIES AND ACTIVITIES

DECEMBER 2002

ENVIRONMENTAL GUIDELINES FOR HORSE FACILITIES AND ACTIVITIES

Prepared by
Water and Rivers Commission
Department of Health
Department of Environmental Protection
Western Australian Horse Council (Inc)

WATER AND RIVERS COMMISSION
WATER QUALITY PROTECTION GUIDELINE
REPORT NO WQP 13
DECEMBER 2002

Acknowledgments

This report was prepared jointly by the Western Australian Horse Council (Inc), Water and Rivers Commission, the Department of Environmental Protection and the Health Department of Western Australia. The Department of Agriculture also contributed to its development. The Western Australian Horse Council (Inc) provided invaluable assistance in coordinating input from over 70 interest groups within the horse industry to ensure the guideline's practicality.

Note: At the time of publication of these guidelines the Department of Environmental Protection (DEP) and the Water and Rivers Commission (WRC) were amalgamating to form the Department of Water, Environment and Catchment Protection (DEWCP). In due course DEWCP will become the contact point for all references to DEP or WRC.

Recommended Reference

The recommended reference for this publication is: Water and Rivers Commission, Western Australian Horse Council (Inc), Department of Environmental Protection, Department of Health, 2002. *Environmental Management Guidelines for Horse Facilities and Activities. WQP Guideline 13.*

We welcome your feedback
A publication feedback form can be found at the back of this publication,
or online at www.wrc.wa.gov.au/public/feedback/

ISBN 1-920687-10-6
ISSN 1329-0746

Printed on recycled stock

December 2002

Foreword

These guidelines represent the end point in developing environmental guidelines for horse activities in Western Australia. Drafts of this document as a discussion paper were made available for comment to a cross section of stakeholders within the horse industry. The purpose of this document is to:

- **Promote awareness of the environmental issues related to horse activities;**
- **Provide advice for the development and assessment of new or upgraded stables and yards; and**
- **Encourage the adoption of best management practices to protect the environment.**

Good management and protection of land and water resources can sustain Western Australia's vulnerable environment. Water resources support a variety of important environmental features including wetlands, vegetation, caves, streams, springs and seeps. They are also used to supply public drinking, stock, irrigation, industry and domestic garden waters. Inappropriate land uses can harm the quality of Western Australia's limited and valuable water resources as well as its unique and diverse fauna and flora.

Horses produce nutrient-rich waste that can cause problems within the community if chemicals and microorganisms leach into the soil and groundwater or run off into water courses. Inappropriate siting and inadequate management practices of horse keepers may pose a significant threat to land and water resource quality and the environment and community amenity—particularly from animal wastes. Horses also can cause land degradation (compaction, erosion), weed spread, dust and odour problems if not managed properly. The breeding of pests such as rodents and flies can also cause concern.

Careful consideration needs to be given to design and management of holding facilities, stocking rates and the collection and disposal of wastes so that impacts to land and water resource quality are minimised. It is important to the State that the horse industry can flourish in WA, while not damaging the environment. These guidelines are not designed for use as a rigid regulatory instrument. They have been prepared to promote knowledge and understanding and inform people within the horse industry.

Consultation for these guidelines included a discussion paper that was distributed for industry comment in May 2000, and a draft which was distributed for wider public and industry comment in November 2001. Comments were sought, considered and incorporated where appropriate. This version represents the final development step for the environmental guidelines.

This guideline will be reviewed periodically (approximately every 5 years). Readers are encouraged to provide feedback to enhance their usefulness.

Please direct your comments to:

The Resource Quality Branch
Water and Rivers Commission
PO Box 6740, Hay St, EAST PERTH WA 6892
or
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0585
or
E-mail: feedback@wrc.wa.gov.au

Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

The horse industry is an important part of the Western Australian and national economy. Horses are kept in a variety of WA environments under a range of management systems. Horses used in the agricultural and pastoral areas for cattle and sheep mustering are usually kept in open paddocks with very little stabling. However in built up areas, horses are often kept intensively. For example, in the suburb of Belmont near the Capital City of Perth, there may be 12 racehorses kept in an urban backyard. These horses usually spend their time in stables and train at one of the nearby tracks.

The following statistics on the horse industry were current in 2001.

- There were about 1.5 million horses in Australia, including approximately 400 000 feral horses (brumbies).
- More horses were used for recreational purposes than for commercial gain.
- The Western Australian thoroughbred racing industry contributed approximately $140 million to the State's Gross Domestic Product and employed more than 11,000 people. It also contributed a substantial part of the $30 million in direct racing taxes to State government revenue.
- The State's trotting organisation generated an average of $11 million of stake money during the last five years.
- The horse industry was the fourth biggest employer of people in Australia.
- Horses also played a part in rehabilitation of people with disabilities via Riding for the Disabled groups.

Horse riding is a very popular recreational pursuit that provides important social values to the State. The demand for areas to ride horses, such as bush trails, creates a need for social amenities and careful management.

1.2 Scope

These Guidelines apply to all horse activities in Western Australia where there is potential to damage the quality of land or water resources.

The guidelines recommend current best environmental management practices and procedures. The site management needs will vary according to the environmental sensitivity of the location. **Alternative techniques or methods may be used provided proponents can demonstrate they are effective in addressing the risks to the surrounding environment.**

Existing horse activities in environmentally sensitive areas should progressively adopt the best practices described in these guidelines, but they are not intended to be mandatory for established facilities. Where horse activities establish, relocate or expand, best practice principles should be applied. These guidelines have been prepared to promote knowledge and understanding within the horse industry, rather than to be used as a rigid regulatory instrument.

Proposals to establish new or upgraded horse facilities should address the recommendations of these guidelines. Supplementary agricultural information can be found in Department of Agriculture (DoA) report *"Stocking Rate Guidelines for Small Rural Holdings"* (refer to Section 3.2).

2 Development approval

Most new development proposals (including for 1 or 2 horses) and extensions to existing facilities involving intensive horse developments or developments in environmentally sensitive areas will need to be submitted to local government for approval. Seeking local government advice on approval requirements before finalising development applications should hasten the passage of the proposal through the regulatory process.

2.1 Essential data

When submitting a proposal, the proponent should provide the following information:

a) A brief description of the project, including land area and the maximum number of horses on site at any time;

b) A plan of the property on which the horses are to be located, showing boundaries, the location of existing facilities and proposed improvements including treatment and disposal facilities;

c) A map showing any neighbouring dwellings within 200 metres of the proposed site, any patches of remnant vegetation, any water bores, wells, wetlands, seasonal surface water, drains or water-courses within 500 metres of the proposed site, and any areas of land to be used for waste disposal. Your local government authority (LGA) may be able to provide this information;

d) Description of land form, soil types and contours (or details of land slope) and if applicable, groundwater depth, quality and flow direction (generally available from Water and Rivers Commission or your LGA);

e) Number and types of other animals kept on the property;

f) Details of waste quantities produced, the method of treatment, recycling, disposal or ultimate use;

g) Details of planned environmental management practices for the site;

h) Details of the land area to be used for waste disposal and a description of the land form, including areas used for cropping and the cropping regime (refer to section 3.5.2 – Manure and fertiliser application);

i) Details of on-site drainage, waste and stormwater handling facilities. Details of rainfall and evaporation are available from the Bureau of Meteorology. Soil infiltration and stormwater runoff factors are also needed (refer to section 3.5.5);

j) Identification of 1 in 100-year flood level (generally available from WRC), and areas of flood-prone land (stables and washdown areas need to be above this level);

k) Identification of any Aboriginal archaeological sites or other socially significant areas (available from the WA Department of Indigenous Affairs or the LGA); and

l) Additional information as required by Local Government (consult your LGA for this information).

2.2 Sensitive environments

Proposals involving horses within environmentally sensitive areas may be restricted or denied because of the potential for environmental impact. **Borderline proposals may be accepted if the proponent addresses issues raised in Appendix A and uses specific management practices that ensure the risk to the environment meets local objectives for environmental protection.** Accordingly, proposals in environmentally sensitive areas will require additional information for assessment.

Environmentally sensitive areas include:

a) Public drinking water source areas (PDWSAs) i.e. declared Catchment Areas, Water Reserves or Underground Water Pollution Control Areas;

b) Environmental Protection Policy areas covering natural environmental features. For example, the Peel-Harvey and Swan–Canning catchments;

c) All waterways including those managed under the Waterways Conservation Act, Swan River Trust Act and the Water and Rivers Commission Act;

d) Wetlands of regional, national and international importance, including but not limited to: Conservation Category Wetlands (CCWs) and Resource Enhancement Wetlands (REW) as defined by the WRC, Environmental Protection Policy (Lakes), Ramsar, A Directory of Important Wetlands in Australia (ANCA);

e) Areas within buffer distances to sensitive environments (refer to section 3.1 and 3.3);

f) Surface waters or ground water providing private sources for irrigation or drinking water for humans or animals; and

g) Surface water bodies with publicly recognised aesthetic, commercial, cultural, or recreational values.

h) Areas prone to seasonal flooding;

i) Areas with land slopes greater than 1 in 10;

j) Areas of high ecological value and integrity i.e. critical or unique bio-diversity, supporting habitat elements such as breeding, feeding or roosting sites for significant fauna and/or the presence of rare, threatened and/ or declared flora and fauna.

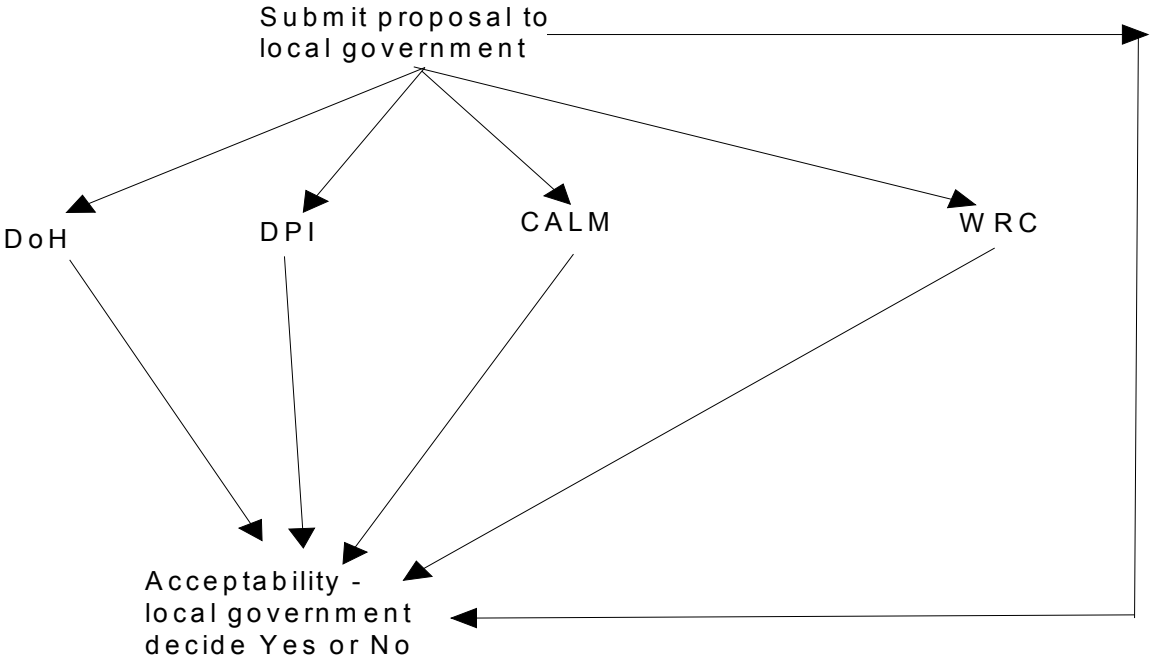
Additional information needed for proposals within these areas ensures that all aspects of nutrient and waste management are considered (refer to Appendix A). The information provided does not have to be professionally drafted, but it must be clear, unambiguous and provide an understanding of the proposed waste treatment and disposal methods.

Development proposals that have the potential to significantly affect the environment, or are located in environmentally sensitive areas, will be referred to the appropriate Government agency by the local government authority. This process is outlined in Figure 1 (overleaf) and in more detail in Appendix B.

A checklist has been developed for planners to help determine whether a proposal requires referral (refer to Appendix E).

Where a future equine development proposal is to be located within a Public Drinking Water Source Area, implementation of the management practices recommended in this guideline will meet the minimum requirements for approval and the issue of a permit (if required) by the Water and Rivers Commission.

Further advice can be obtained from the Department for Planning and Infrastructure (DPI) about "Bush Forever" sites, and from the DEP about areas covered by Environmental Protection Policies and clearing controls on remnant vegetation. Similarly, the Water and Rivers Commission can assist with information about water related issues on sites in environmentally sensitive areas. The development approvals process will be progressively streamlined as issues emerge and new technology becomes available.



WRC = Water and Rivers Commission,
DoH = Department of Health,
DPI = Department for Planning and Infrastructure,
CALM = Department of Conservation and Land Management.

3 Recommended Best Management Practices

By using suitable land/water management measures and incorporating appropriate stocking rates, horse activities can achieve minimal environmental impact. Table 1 summarises those activities that pose an environmental risk and serves as a quick reference guide to recommended Best Management Practices (BMPs).

These management practices have been prepared to promote knowledge and understanding and minimise potential environmental impact from horse activities. The authors acknowledge there may be other acceptable alternative management practices used to minimise environmental impact from horse activities, therefore the listed BMPs should be used as a guide only.

Table 1 Reference guide to common BMPs for horse keeping and related activities

Activity	Pollution risk from badly-managed activity	Sections describing BMPs
Chemical storage and use	Ground and surface water contamination	3.3.1 & 3.9
Controlling rodents	Ground and surface water contamination	3.10
Grazing	Land degradation, erosion, ground and surface water contamination	3.2, 3.3, 3.5 & 3.7
Horse mortality	Ground and surface water contamination	3.8
Management system and stock density	Land degradation, erosion, ground and surface water contamination	3.1, 3.2
Manure and fertiliser application	Ground and surface water contamination	3.5
Manure storage and collection	Ground and surface water contamination	3.6 & 3.5
Monitoring and auditing	Land degradation, erosion, ground and surface water contamination	3.11
Setting up stable bedding	Ground and surface water contamination	3.5.3 & 3.6
Sites for stables and yards	Land degradation, erosion, ground and surface water contamination	3.3
Stable construction	Land degradation, erosion, ground and surface water contamination	3.4
Stormwater management	Land degradation, erosion, ground and surface water contamination	3.5.4
Trail riding- location, design and management	Land degradation, erosion, surface water contamination	3.3.1, 3.5 & 3.12
Using woodwaste for bedding and dust control	Land degradation, ground and surface water contamination	3.5.3 & 3.6
Wastewater management	Land degradation, erosion, ground and surface water contamination	3.5.5
Weeds, excess nutrients in bush, soil compaction	Land degradation, erosion, surface water contamination	3.5 & 3.12

The following sections cover management of those horse activities that can impact the environment. Adopting best management guidelines as set out below will assist the government approval process.

3.1 Keeping horses

The keeping of horses is generally guided by zoning restrictions within local government planning schemes. These zonings account for the general planning requirements. More specific conditions may apply in environmentally sensitive areas such as those described in Section 2.

Table 2 sets out the special conditions that apply in environmentally sensitive areas. Proponents wishing to keep or use horses contrary to these conditions need to demonstrate to local government, the WRC and Department of Environmental Protection (DEP) that their proposed activities include measures that prevent adverse impacts on the environment. Similarly, this approach applies if you wish to use stocking rates greater than those recommended in Section 3.2 and Table 4.

Table 2 Special conditions for keeping horses in environmentally sensitive areas

PDWSAs-Priority 1	a. Horse keeping is incompatible with management objectives and is opposed in these areas. The only exception where approval may be given is for horses on large pastoral leases. b. For trail riding outside public road reserves, WRC written permission is required.
PDWSAs- Priority 2	Horse facilities are considered a conditional land use, i.e. special stocking rate limits apply - refer to Table 4. Normal approval processes outlined in Section 2 should be followed.
PDWSAs- Priority 3	Horses are compatible with management objectives, provided standard stocking rates are applied - refer to Table 4. Normal approval processes outlined in section 2 should be followed.
Wetlands as described in section 2.2	Horses should not be kept or allowed access to within 200 metres of wetlands (contact WRC if unsure about a wetland's category).
Waterways and surface water bodies as described in section 2.2	Horses should be kept away from wetlands and seasonally boggy areas, with a minimum distance of at least 30 metres from the banks of permanent or ephemeral streams and rivers which have bank slopes less than 1 in 4, and 50 metres for streams and rivers whose banks have slopes greater than 1 in 4.
Near water supply wells and farm dams	Horses should be kept as far away as practicable from these areas, with a minimum fenced buffer distance of at least 30 metres from water supply wells and farm dams;
Groundwater	Horses should be kept away from swampy or seasonally water-covered ground, with a minimum distance of at least 1.2 metres above the highest annual groundwater table level. A sand pad may be used to increase the distance from the groundwater table provided it is acceptable to the LGA and it is not located where stormwater runoff can erode the pad.
Environmental Protection Policy areas, "Bush Forever" sites and remnant vegetation	Horses should not be kept on "Bush Forever" sites. Information on "Bush Forever" sites can be obtained from the Department for Planning and Infrastructure (DPI). The keeping of horses among remnant vegetation is considered equivalent to clearing. Further advice can be obtained from the DEP about areas covered by Environmental Protection Policies and the clearing of remnant vegetation.

Note: Priority 1, 2 and 3 PDWSA classification is explained in Section 4.3.1

3.2 Stocking rates

Overstocking properties can cause significant environmental damage through soil erosion, vegetation damage and contaminants leaching from animal wastes. The appropriate stocking rates are determined by considering the sensitivity of the local environment, the management system to be used and impact of horses on grass growth and soil erosion in paddocks.

Recommended stocking rates are calculated using two methods, the DoA method and the WRC method. The WRC method is used in this guideline and calculates stocking rate by dividing the total property size (hectares) by the relevant stocking rate for the property's dominant soil type (refer to Table 4). Using the WRC method, stocking rates may be increased if it can be shown management practices will achieve water quality, land condition and other environmental objectives set by government agencies in this guideline. The proposal must demonstrate how management practices, other than those recommended in these guidelines, will cause less environmental impact on water quality and land condition than if the guidelines were followed.

Description of how to use the DoA method is given in *Stocking Rate Guidelines for Rural Small Holdings.*

This publication is available at the Department of Agriculture's web address:
http://www.agric.wa.gov.au/agency/pubns/miscpubs/mp2_2000/mp2_2000.pdf

Assumptions for calculations using the DoA method are described in Section 2.2 of that document. Stocking rates cannot be increased if calculated using the DoA method.

AFTER CALCULATING THE STOCKING RATE USING EACH METHOD, THE PROPONENT SHOULD ADOPT THE LOWER STOCKING RATE OF THE TWO.

The following examples compare WRC assessment criteria for proposals in P2 areas that have higher than recommended stocking rates. The results demonstrate how some different management practices may make proposals acceptable. Calculations are based on assumptions that characterise a standard horse property unless stated otherwise. For example, horses are stabled no less than 14 hours per day and their manure is collected daily. The list of contaminant loss assumptions used based on management of Nitrogen in wastes is given in Appendix D.

Table 3 Examples of proposals in PDWSA P2 areas that have higher stocking rates than recommended, with outcomes decided using the WRC assessment model (maximum nitrate loss to the environment of 2.8 mg/L)

Scenario	Nitrogen in recharge water (mg/L)	Status using DoA method	Status using WRC method	Final Outcome
1 hectare (ha) property – SR1 soils, horses stabled for 22 hours a day, remainder on 1 ha of irrigated pasture	2.8	Acceptable 2 horse/ha	Acceptable 1 horse/ha	Acceptable 1 horse/ha
2 ha property –SR5 soils, no garden, however 0.2 hectare area of irrigated pasture	2.7	Not acceptable	Acceptable 1 horse/ha	Not acceptable
2 ha property– SR7 soils, horses on 1 ha of irrigated pasture– pasture as feed (no supplementary feed), manure not collected	2.3	Acceptable 2 horse/ha	Acceptable 1 horse/ha	Acceptable 1 horse/ha
2 ha property – SR3 soils, 10 horses/ha – no pasture, stabled 22 hrs/day, racetrack for 2hr/day, waste fully contained.	0	Acceptable 10 horses/ha	Acceptable 10 horses/ha	Acceptable 10 horses/ha

The standard stocking rates in Table 4 have been derived from DoA *guideline Stocking Rate Guidelines for Small Rural Holdings*. This document provides guidance on stocking rates for most farmed animals and information on local soil types in the Peel-Harvey North, Mandurah-Murray, Gingin and Darling Range. DoA publications provide land resources mapping information sufficient for landholders to describe soils in development applications. The DoA *guideline Stocking Rate Guidelines for Small Rural Holdings* provides soil information and is used for calculating acceptable soil protection stocking rate. It does not cover other aspects of horse keeping, including BMPs.

Table 4 Acceptable stocking rates - adapted from Department of Agriculture Stocking Rate Guidelines for Small Rural Holdings

Stocking rate unit	Soil type	Standard stocking rates (minimum hectares required per horse)		P2 PDWSAs (Hectares/horse)
		dry pasture	irrigated pasture	dry and irrigated pastures
SR1	Well drained yellow to brown sands	1.7	0.5	1.7
SR2	Rapidly drained calcareous sands	5	NR	NR
SR3	Rapidly drained pale sands	5	1	5
SR4	Pale sand flats	1.7	0.5	2
SR5 SR5.1 SR5.2	Semi-wet soils (swamps and drains) (salty areas)	1.7 5 5	0.5 NR NR	5 NR NR
SR6	Clay flats	1.7	0.5	1.7
SR7	Loamy flats and terraces	1	0.4	1
SR8 SR8.1	Gravel slopes (shallow gravels and ironstone outcrop)	1.0 5	0.4 NR	1 NR
SR9 SR9.1	Steep slopes (shallow rocky soils and crests)	1.7 5	1 NR	1.7 NR
SR10	Loamy slopes	1	0.4	1

Notes:

1 *NR = Not Recommended.*

2 *Soil information can be found in DoA document, Stocking Rate Guidelines for Small Rural Holdings.*

3 *In some areas that have historically been used for keeping horses, higher level stocking rates may be acceptable on irrigated land (does not apply for dry pasture) where suitable waste management measures are demonstrated (refer to Appendix A).*

4 *For WRC to accept a higher stocking rate than described in Table 4, effective pollution control measures — additional to those outlined in these guidelines — would be needed to limit environmental risks to levels equal to or less than provided in these guidelines.*

3.2.1 Environmentally sensitive areas

In environmentally sensitive areas, other conditions may apply. Proposals located within environmentally sensitive areas (as defined in Section 2) that do not comply with Tables 2 and 4, should be referred to the WRC and DEP for detailed assessment and response.

Information on the location of Public Drinking Water Source Areas and wetlands can be obtained by contacting WRC's Resource Quality Branch and the Catchment Management Branch respectively.

3.2.2 Public Drinking Water Source Areas

In Public Drinking Water Source Areas, horse stocking rates should be limited as described in Tables 2 and 4.

3.3 Siting of stables and yards

Stables, compounds and facilities excluding paddocks associated with keeping horses (e.g. exercise areas, feed stockpiles, manure, compost, wood waste and horse carcass burial pits) should be sited in accordance with local government planning and building laws. Stables should be sited as far away as practicable from sensitive environments, with a buffer distance of at least:

a) 200 metres from the boundary of wetlands, lakes and estuarine dependant vegetation, determined by soil type, wetland category and management practices used to minimise pollution risk;

b) 30 metres from private water supply wells and farm dams;

c) 30 metres from the banks of permanent and ephemeral streams and rivers which have a slope less than 1 in 4, and 50 metres for streams and rivers whose banks have slopes greater than 1 in 4.

d) 1.2 metres above the highest annual groundwater table level. A sand pad may be used to increase the distance from the groundwater table provided it is acceptable to the local government authority, and it is not located where stormwater runoff can erode the pad; and

e) The minimum distance from residences, as required by local authorities (usually 30 metres).

The above measures should minimise the potential impact on the environment from land degradation, weed spread, manure accumulation and stormwater runoff.

Stables should be sited on gently sloping ground where gradients are between 1 in 10 and 1 and 200. Land slopes with more than 1 in 10 gradients produce excessive runoff with potential erosion, depending on soil type. Ponding and boggy areas often occur on sites with a slope less than 1 in 200. Runoff and boggy areas can become paths for the movement of contaminants to water bodies.

Horses, stables and associated compounds are not compatible with the water quality objectives of Priority1 PDWSA. In P2 and P3 areas, stables, compounds and facilities associated with keeping horses should be sited:

f) At least 300 metres away from any public water supply well;

g) Outside any reservoir protection zone; and

h) At least 100 metres from any water-course upstream of a public water supply reservoir.

Recommendations on buffer distances to wetlands and waterways will be updated to reflect current scientific knowledge. Useful information on protection of buffer zones and riparian vegetation can be found in the WRC's Water Notes *Wetland buffers and Protecting riparian vegetation* respectively.

3.4 Stable construction

Stables sited on sandy soils or in an environmentally sensitive area, need floors and washdown areas constructed with a water resistant hard-stand such as concrete or compacted limestone. These should comply with building regulations and the local government by-laws. Most local governments require an impervious hard-stand for stables on all soil types.

The use of impervious hard-stands or rolled, compacted limestone is encouraged as it will reduce the amount of nutrients in the leachate from manure, urine and woodwaste reaching the groundwater. If compacted limestone is used, it should have a minimum depth of 300 millimetres. Straw, clean white sand, river sand or wood waste may be used as a soft absorbent overlay to improve the comfort and well-being of horses.

The use of creosote and oil treated wood in the construction of stables exposed to the weather should be avoided where practical. Toxic elements may leach from the treated wood into the groundwater.

3.5 Waste management

The amount of contaminants from horse waste reaching groundwater and surface water will depend on a number of factors. These include rainfall/ irrigation patterns, manure management, land slope and soil type.

A standard light horse (450 kg) produces approximately the following waste:

Contaminant load	Per day	Per year
Solid (wet) manure	15 kilograms	5.5 tonnes
Urine	15 litres	5.5 kilolitres
Nitrogen (N)	170 grams	62 kilograms
Phosphorus (P)	15 grams	5.5 kilograms

Leachate and runoff from horse waste will infiltrate and contaminate groundwater and surface water resources if the waste is poorly managed. Horse manure can also create odour and fly problems.

3.5.1 Manure management

Where practical, manure should be collected daily then contained and covered, especially if rain is anticipated. Manure stored prior to removal off-site or for composting as fertiliser, should be covered with a waterproof cover on a low permeability surface to prevent fly breeding, liquid waste runoff and discharge to ground. Manure storage areas should be designed to hold all manure collected prior to disposal or use.

Worm drenches given to horses can kill non-target organisms such as dung beetles and earthworms when it leaches out of manure and urine. The active ingredient in some of the wormers can also pose a serious contamination risk to water resources. Avoid drenching horses with wormers during dung beetle season (November to February in the SW of WA). Horses should also be kept away from watercourses for at least two days after the drenching. If it is necessary to worm during that time of the year, use a wormer containing *Ivermectin* as the active ingredient, which research has shown to have a less detrimental effect on the environment compared to other commercial wormers.

Contained storage of woodchips and manure on an impermeable surface

3.5.2 Manure and fertiliser application

Animal manure is a valuable source of plant nutrients and organic matter and can be used as an alternative to artificial fertiliser. Maximum benefit is derived from fertiliser and manure when it is spread on the land in the summer pasture-growing season (under controlled irrigation). At this time leaching and runoff risks are low and crop growth and nutrient uptake is at its peak. The risk of contaminating groundwater and surface water from excessive nutrient leaching can be reduced by not spreading manure:

a) During wet months and periods of heavy rainfall;

b) In areas prone to stormwater runoff;

c) In low lying areas prone to flooding; and

d) Before periods of crop dormancy.

The manure should be stabilised e.g. by composting, before it is applied. Where practical, distribute manure uniformly. This will help reduce foul odours, fly problems and adverse impacts to water resources.

To reduce land degradation, if practical, rotate feeding paddocks where horses are grazing on pasture.

To reduce odour and limit leaching to water resources, it is best to avoid spreading horse manure:

a) On steep slopes where erosion and/or surface runoff is likely to occur;

b) In paddock depressions where water accumulates, especially during times of the year when there is a high risk of direct surface runoff to a watercourse;

c) Late in the day when air is settling, cooling and concentrating odours. It is better to spread manure early in the day (late morning) when air is warming and rising to dilute odours; and

d) On hot days when odour production is high.

Soil testing should be used to help determine fertiliser requirements for pastured areas. Manure and fertiliser application should be determined by the nutrient status of the soil before application, the soil's ability to retain applied phosphorus (measured by Phosphorus Retention Index [PRI] refer to Section 6), the pasture nutrient requirements and the depth to the root zone.

In environmentally sensitive areas, the application of manure should be undertaken sparingly to ensure leaching of excess nutrients is avoided. In PDWSA P2, manure should be applied in accordance with the nutrient application / stocking rates given in Table 4. In all other areas, except those designated for intensive horticulture, the maximum nutrient loads should not exceed rates listed in Table 5.

Table 5 Maximum phosphorus and nitrogen application rate criteria to protect water quality

Site / Soil description	Max phosphorus (as P) loading (kg/ha/yr)	Max nitrogen (as N) loading (kg/ha/yr)	Maximum equivalent horse manure application rate (wet tonnes/ha/yr)
Coarse sandy soil/gravel (PRI<10) draining to water with moderate/high eutrophication risk.	10	140	12
Coarse sandy soil/gravel (PRI<10) draining to water with a low risk of eutrophication.	20	180	25
Loam/clayey soil (PRI>10) draining to water with moderate/high eutrophication risk.	50	300	60
Loam/clayey soil (PRI>10) draining to water with a low risk of eutrophication.	120	480	150

Notes:

1 *The above criteria provide the upper limits for nitrogen and phosphorus application.*

2 *Department of Agriculture recommended rates are commonly less than those shown above.*

3 *Maximum manure application assumes no additional nutrient sources.*

4 *There are no soil type descriptions for the two soil types described in Table 5 because their self-explanatory description is adequate for classifying any soil type and is sufficient for determining appropriate fertiliser application rates.*

An alternative to direct land application of horse manure is to compost the manure for on or off-farm use. To avoid creating problems with fly breeding, odours and water contamination from any compost-related activity, ensure:

a) Windrows are turned over regularly to maintain aerobic stabilisation processes;

b) All surface water is diverted away from the composting site;

c) Any contaminated surface runoff from the composting area is contained on an impermeable surface such as a concrete hard-stand with perimeter bund and speed-bump access, to prevent flow from the site;

d) The composting area is protected by a weather-proof cover in high rainfall areas; and

e) The composting area is sited away from residences to minimise odour problems.

3.5.3 Stable bedding

Careful consideration should be given to the type of bedding used in stables and associated compounds. Manure containing a large amount of wood shavings or sawdust is often not suitable to be spread as a soil improver. Repeated applications of this material onto land could result in a temporary reduction of available nitrogen, which may reduce crop productivity. Composting of spent bedding will reduce this effect.

Soiled straw, grain and wood waste bedding should be periodically removed to a composting facility. Every effort should be made to reduce the amount of clean woodwaste removed from the stall when mucking out.

3.5.4 Stormwater management

Uncontaminated stormwater should be kept separate from wastewater and should not be allowed to enter any wastewater storage pond. Contaminated stormwater is likely to carry waste contaminants to both surface and groundwater resources. To minimise groundwater and surface water contamination, stormwater management should include:

a) Using gutters and downpipes on roofs to divert rainfall away from stable areas;

b) Using drains to divert uncontaminated surface runoff away from stables, riding arenas, manure composting areas, exercise areas and wastewater storage ponds; and

c) Fencing to prevent horses from congregating in boggy areas.

3.5.5 Wastewater management

Contaminated wastewater such as wash-down wastewater, should be contained and managed. Wash-down wastewater typically contains hair, urine, sweat, manure, dirt, cleansers, woodwaste or straw.

Roofed wash-down bay with drainage

Wash-down and runoff from stables with less than 10 horses should be directed to adequately designed septic tank systems or reticulated sewerage if available. Where 10 or more horses are stabled, wash-down and runoff can be connected to sewer or should be drained to an impermeable, lined waste stabilisation pond system. For sewer connection, the waste management system must be accepted by the service provider and an industrial waste permit is normally required.

Areas connected to a waste stabilisation pond system or sewer should be roofed, where practical, to prevent uncontaminated stormwater runoff from mixing with wastewater. Pond system effluent may be disposed of by:

a) Solar evaporation;

b) Controlled on-site irrigation;

c) Removal offsite for disposal to a site acceptable to the DEP; or

d) To sewer (if available) in accordance with the sewerage service provider's Waste Acceptance Policy.

The wastewater ponds should be designed to collect and contain all wastewater expected from operations and normal seasonal rainfall events. The ponds should be sized to stabilise the anticipated organic waste loading without creating odours. Information on construction and operation of the ponds is available in the Water and Rivers Commission's Water Quality Protection Note – *Ponds for stabilising organic waste.* Major accidental overflows from ponds, such as embankment failure, should be reported to the Water and Rivers Commission or the Department of Environmental Protection.

3.6 Wood-waste (for bedding/dust control)

Wood-waste is often used in riding arenas, as a bedding material, a soil conditioner, and for on-farm access ways. Wood-waste leachate may be acidic and contains contaminants that can pollute water. The application of woodwaste to soil can temporarily reduce nitrogen availability for plant growth. The following management practices should help reduce contamination of water resources:

a) Limit wood-waste depth to 250 millimetres (mm) in areas used for footing e.g. on riding trails and riding arenas. Avoid using on steep terrain or in areas where the waste may be washed away;

b) Cover stockpiled wood-waste in high rainfall areas (more than 600 mm per year) or control and contain runoff from the stockpile; and

c) Chemically treated wood-waste should not be used as bedding because of the potential water contamination risk.

3.7 Grazing and irrigation in horse paddocks

To reduce paddock erosion from grazing horses, it is best to use permanent pasture sites. Pasture should be allowed to become well established before allowing horses to graze. This encourages good root growth and avoids boggy areas being formed. Contour tillage and drainage systems can be used to control water flow in areas prone to erosion.

The following practices should be adopted when grazing horses on pasture:

a) Where use of waterways for stock watering purposes cannot be avoided, use fencing to control access and bank protection. Two possible methods to prevent erosion of river banks are the application of gabions (rock cages) or rip-rap. Revegetate between the fence and the waterway because it will help reduce erosion and increase the natural filtration of contaminants. For advice on river crossings, refer to the WRC's Water Note # 6 *Livestock Management: construction of livestock crossings*;

b) Use fencing to ensure horses use watering troughs in preference to natural waterways and wetlands. For advice on fencing, refer to the WRC's Water Note # 18 *Livestock Management: Fence Location and grazing control*;

c) Clean water troughs regularly, check the float valve is functioning correctly and check for system leaks. This will minimise the development of boggy areas, wastage and the generation of runoff. For advice on watering points and pumps, refer to the WRC's Water Note # 7 *Livestock Management: Watering points and pumps*;

d) Prevent contaminated runoff from confined exercise areas entering watercourses using effective engineered drainage management systems;

e) Collect and store manure daily, where practical or harrow pastures frequently enough to break up accumulated manure piles. This will kill parasitic insect larvae, reduce the availability of moist manure that attracts adult flies and provides ideal breeding conditions and reduce leaching of nutrients to water sources;

f) Avoid tillage or excessive grazing activities that would leave soil bare, or lead to poor crop growth or poor crop residue and cover late in the season on sloping land. Consider perennial pasture where possible as this will help in the recycling of nutrients from manure and urine;

g) Cover bare areas with straw, re-seed or use contour banks to divert rainfall runoff;

Paddock with sparse pasture cover resulting from poor management

h) Rotate stock from pasture to stable at night to rest paddocks; and

i) When irrigating pastures, water should not be applied excessively because it may cause significant leaching and may exacerbate stable fly problems. Water should be applied at a rate suitable for the soil and seasonal evaporation rates.

You may require a water abstraction licence from the Water and Rivers Commission if using groundwater or diverting water from a stream to irrigate pasture. Further information is available from the WRC's regional offices.

3.8 Horse mortalities

The preferred method of dealing with horse mortalities is to deliver the dead animal to a rendering (by-products) plant. If a rendering service is unavailable, it may be disposed of according to local health regulations.

Horses should not be buried within a wetland or waterway (as described in section 2.2) or its associated buffer. In Public Drinking Water Source Areas, a horse should only be buried on site if it died on the property, and a rendering service is not available. In addition the carcass should be:

a) Buried with more than 30 centimetres of soil cover;

b) Located more than 100 metres from wells, domestic water bores, streams and surface water bodies; and

c) Located in the pit with a base more than 1.5 metres above seasonal high water table.

If more than one horse needs to be buried, bury one per pit and distribute pits evenly over the property. If a mass death occurs, then advice should be sought from Department of Agriculture on disposal options.

3.9 Chemical storage and use

Leakage of chemicals such as fuel, oils, solvents, paints and pesticides, can pose a serious contamination risk to streams and groundwater. If considerable quantities of chemicals are used, stored or handled then this should meet the requirements of the Department of Mineral and Petroleum Resources and the Department of Health.

General information about handling and storage of chemicals such as fuel and pesticides is provided in Appendix C.

3.10 Control of rodents

Rodents i.e. rats and mice can only be eradicated or controlled by a vigorous campaign consisting of good sanitation, feed spillage and storage management. This includes:

a) Keeping feed storage buildings in good repair and free of surrounding weeds;

b) Removing food (including spilt feed) that is not going to be eaten immediately by the horses;

c) Eliminating potential rodent nesting sites and openings to buildings; and

d) Using covered containers for feed and stable waste.

In extreme cases, poisoning or trapping may be necessary to kill the rodents. Rodenticides that do not result in secondary poisoning of non–target species such as birds of prey e.g. owls should be specified for the control of rodents. Rodenticides can be dangerous to humans, animals and the environment. For this reason, a licensed pest control operator should be used to conduct a thorough program that is suitable for the situation.

3.11 Monitoring and auditing

Monitoring of water resource quality may be necessary in the management of horse activities. Monitoring and reporting requirements may be placed as conditions on approvals to establish a horse facility. Details of monitoring requirements and contingency measures (in the event of an emergency e.g. treatment pond overflow) will be included in approval documents provided by the local government. This may include conditions calling for audit of compliance.

3.12 Bridle trails, overnight camping and vegetation management

Bridle trails and overnight camping can have a significant impact on vegetation communities by increasing the levels of soil compaction, causing soil break-up, erosion, weed distribution, loss of native plant species through trampling and cropping of plants, spread of dieback as well as other fungi, fouling problems and litter release. It is unlikely that proposals to develop new bridle trails within most environmentally sensitive areas will be approved because of the potential for unacceptable environmental impact.

3.12.1 Development of bridle trails

Properties that have existing bridle trails should comply with best management practices described below. Plans for future bridle trails should be submitted to the local government authority.

Large equestrian facilities, significant bushland clearing proposals or disturbance of environmentally significant areas may require approval from the EPA and/ or the Department of Conservation and Land Management. Local Government will in the majority of cases, determine the need for referral. Approval for clearing of native vegetation for the development of bridle trails will need to be sought from the relevant decision-making authorities including the Environmental Protection Authority. It is illegal to clear any bush without permission.

Local government should be the first contact point when seeking approval for clearing. If State Government agencies need to be contacted, the local government authority will inform development proponents.

3.12.2 Use of bridle trails

The following management practices should be followed to minimise environmental damage when horse riding on bush trails:

a) Stay within party-size restrictions or seek any approval needed for larger parties;

b) Observe access restrictions to lands managed by the Department of Conservation and Land Management;

c) Stay on designated bridle trails, roads or tracks. Do not take shortcuts across switchbacks on trails as they create new treads which can cause erosion and gullies;

d) Avoid crossing streams and watercourses except at designated bridges and fords. If it is necessary to cross water-bodies, do not have all the horses cross them at the same place as this can create erosion and damage the riparian zone;

e) Use tree-saver sheathing to prevent damage to trees;

f) Hobble most or all horses when they are grazing;

g) Clean horses hooves out before a ride to reduce the chance of carrying any soil containing dieback disease or weed seeds into bush areas;

h) Use designated picnic areas (where horses are permitted) and keep the area clean and tidy;

i) Take care when lighting fires. Be aware of restrictions and fire bans;

j) Act in accordance with signposting by regulatory authorities;

k) Use toilet facilities when available. Where there are no toilets, bury human waste. Rubbish should be taken home with you for disposal; and

l) Do not feed horses unprocessed hay or feed on the ground, because it may spread noxious weeds.

(Adapted from Equestrian Landcare Association recommendations, 1998)

In future, resource management agencies intend to work together to prepare comprehensive guidelines on bridle trails.

3.12.3 Areas where there are restrictions on horse riding

Horse riding is permitted in multiple use areas such as State Forests (except in Public Water Supply Catchment Areas - see below), timber reserves and some miscellaneous reserves subject to forest operations and forest disease requirements. Horse riding is not permitted in areas of special scientific or cultural value such as nature reserves, wilderness/ remote areas or other areas requiring special access permission.

a) Land managed by the Department of Conservation and Land Management: Horse riding in national parks, nature reserves and conservation parks is not generally permitted except as provided in the park's management plan. Evaluation of proposals to ride horses within national parks, nature reserves and conservation parks is undertaken through the management planning process and will take into account any previous history of horse riding and claims of "prior right of access" to cross Department land.

   The primary consideration is that a horse riding proposal will only be allowed on conservation lands where the impacts are considered to be manageable. Such proposals are subject to public comment. Horse riding is currently permitted in some areas of national parks including John Forrest and Yalgorup National Parks.

   Individuals or groups wishing to conduct horse riding and equestrian events on Department-managed land should contact their local Department of Conservation and Land Management office for more information.

b) Within public drinking water source catchments: The riding in a Public Water Supply Catchment Area is restricted to the public road system. If you wish to ride outside public road reserves on Crown land then you need to obtain written permission from the Water Corporation, where it is the Commission's delegated catchment manager. Public Drinking Water Supply Catchment Areas cover most of the Darling Range so it is best to check your planned riding area with the Water Corporation.

c) Camping with horses: This is prohibited in most public water source catchments. If the proposed camping area is in a State Forest, the Department may place special conditions on camping. Contact the Department of Conservation and Land Management for more information.

Approval may be subject to conditions and be enforced through By-laws. Conditions can include directions on the handling of rubbish, human and horse waste and separation distances to water resources.

4 Regulation of horse activities

There are several Statutes that relate to environmental protection, health and community welfare in Western Australia. This section discusses how these Acts relate to the approval and operation of horse activities.

4.1 Town Planning and Development Act

The State Planning Strategy 1997 (SPS) and the State Planning Framework (SPF) have been prepared under the *Western Australian Planning Commission Act 1985* (WAPC Act) and *the Town Planning and Development Act 1928* (TP & D Act). The SPS and the SPF guide the preparation and implementation of statutory or strategic plans, such as WAPC endorsed regional plans, local government town planning schemes, and the operational policies of the WAPC Act e.g. subdivision and development control polices. Under this framework, statutory or strategic plans are prepared incorporating environmental issues.

The *TP & D Act* also gives local government responsibility for preparing Town Planning Schemes (TPS). TPS set out the long-term planning directions for the local government and are guided by statutory or strategic plans prepared by the WAPC. The conditions for keeping horses is likely to vary according to the local planning requirements reflected in the local TPS, and proponents should inquire about what applies in their local government area.

It is necessary to refer Town planning schemes to the EPA under the Environmental Protection Act, 1986. This provides for environmental assessment and, where appropriate, the requirement of environmental conditions to be incorporated into the scheme by the Minister for Environment and Heritage.

Statement of Planning Policies (SPP) can be prepared under the *TP & D Act* to guide development in environmentally sensitive areas. For example, SPP No. 6 The *Jandakot Groundwater Protection Policy* incorporates requirements to reduce the risk to groundwater. This SPP places controls on establishing equestrian activities within the Rural Water Protection Zone. SPP provide guidance to local government on planning approvals within the policy area.

Local governments will often refer development proposals to other regulatory agencies for advice. This advice may be included in the conditions of approval. Proponents should contact their local government as the first step in gaining development approval.

4.2 Environmental Protection Act

The *Environmental Protection Act 1986* is the primary legislation for protecting the environment and controlling pollution.

Part III of the Act enables Environmental Protection Policies (EPP) to be established for the "prevention, control or abatement of pollution". An example that impacts on horse activities is *the EPP for the Peel – Harvey Estuary 1992* which guides development likely to contribute nutrients to the system.

Development proposals that are considered likely to have a significant effect on the environment, such as racetracks and equestrian centres, may be referred to the Environmental Protection Authority (EPA) and be subject to Environmental Impact Assessment under Part IV of the Act.

Pollution is controlled under Part V of the Act. It is an offence to cause pollution or discharge waste in a manner which may cause pollution. For example, it would be an offence to pollute a creek by discharging manure.

4.3 Water and Rivers Commission Act

The *Water and Rivers Commission Act 1995* has a number of subsidiary Acts and by-laws described below to protect and manage water resources. These acts are administered by the Water and Rivers Commission.

4.3.1 Within Public Drinking Water Source Areas

Proclaiming protected areas collectively known as Public Drinking Water Source Areas (PDWSA) protects the quality of public drinking water sources. PDWSA include Catchment Areas, Water Reserves and Underground Water Pollution Control Areas. They are proclaimed under *the Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*. By-laws under these Acts enable the WRC to control potentially polluting activities, regulate land use, inspect premises and take steps to prevent or clean up pollution.

The WRC uses a three-tiered priority classification system to manage water sources in PDWSA as follows:

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of **risk avoidance** and therefore land development is generally not permitted.

Establishment and or development of horse keeping facilities are incompatible with water protection objectives in P1 source protection areas. These new or upgraded facilities will be opposed, however existing horse facilities may remain but will be expected to progressively implement best environmental management practices

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of **risk minimisation** and therefore some development is allowed under specific conditions.

In P2 areas, horse keeping facilities are considered a conditional land use for the purposes of protecting water sources. Restrictions on animal stocking densities and application of nutrient rich material to land apply in these areas. Suitability of proposals will be assessed by WRC as part of the local government approvals process.

Priority 3 (P3) source protection areas are defined to manage the risk of pollution to the water source. P3 areas are declared over land where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through management guidelines (such as these) rather than restrictions on land use.

In P3 areas, horse keeping facilities are a compatible land use, subject to the recommendations set out in these guidelines or use of alternate approved measures achieving equivalent or lower levels of environmental risk.

Sewerage connection may be available to stables in some areas. If not, an apparatus for the treatment of wastewater may be approved by the local government under the Health Act regulations. Under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* an industrial waste permit is required to connect to sewer. The Water Corporation implements this part of the Act. Sewerage reticulation is mainly limited to urban areas.

Riding horses on Crown land in PDWSA is permitted along public roads. Proposals for riding outside public road reserves on Crown land should be referred to the WRC or delegated authority for consideration. Approval is only likely to be obtained for use of recognised bush trails. Camping with horses within PDWSA is only permitted in designated areas for horses. Otherwise, prior written approval is required from the WRC or its delegated agent.

Well-head and reservoir protection zones are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Special conditions may apply within these zones. For example, no fuel or animal manure storage is permitted within a 100 metres of a production well.

4.3.2 Wetlands

Under the provisions of the *Water and Rivers Commission Act 1995*, the Commission is vested with the conservation, protection and management of wetlands. Development proposals with the potential to affect wetlands (as described in section 2.2) should be referred to WRC by local government authorities as part of the development approvals process.

4.3.3 Waterways Conservation Act

Under the provisions of the *Waterways Conservation Act 1976*, the WRC has a conservation function and associated planning and pollution control powers in declared management areas.

The Avon River, Albany Waterways, Leschenault Inlet, and Wilson Inlet (and their respective catchment areas), and the Peel Inlet's environs are declared Waterways Management Areas. Location details are available by contacting regional offices of WRC.

Development proposals in declared management areas are assessed on the basis of risk posed to the waterways and should be referred to the WRC by local government as part of the approval process.

4.3.4 Rights in Water and Irrigation Act

Under the *Rights in Water and Irrigation Act 1914*, proponents need to obtain a water licence from the WRC if they intend to take groundwater or surface water from a proclaimed area or from artesian sources. Licensing is used by WRC to manage the allocation of water taken from the environment.

You should contact the WRC if you wish to use groundwater or divert water from streams or waterways as part of your development.

4.4 Swan River Trust Act

The Swan and Canning River systems are protected under the *Swan River Trust Act 1988*. Management measures are defined to protect the Swan/Canning catchment system.

Development proposals in or adjacent to management areas, or that will affect the Swan/ Canning catchment system, should be submitted to the Swan River Trust as part of the local government approval process.

4.5 Soil and Land Conservation Act

The *Soil and Land Conservation Act 1982* is administered by the Department of Agriculture and provides for the conservation of soil and land from the effects of erosion, salinity and eutrophication.

Land degradation causes a significant loss of rural production capacity. It includes the removal or deterioration of vegetation and soil erosion. These impacts may be detrimental to the present or future use of the land, and can foster algal problems in water bodies.

The *Soil and Land Conservation Act* requires the use of appropriate land management practices to maintain the stability of that land in perpetuity. Where a landholder causes land degradation and this is brought to the attention of the Commissioner for Soil Conservation, the Commissioner may, after consultation with the land holder, issue a Notice directing the land holder to rectify the situation.

4.6 Health Act

Under the *Health Act 1911* local government can make local laws in respect to prescribing and regulating the design, construction, and position of stables. Also they may regulate the keeping of animals so as not to be a nuisance, injurious or dangerous to health, and may define areas that prohibit the keeping of animals. Prevention of fly breeding is supported through fly eradication regulations made under the *Health Act*. Application must be made to the Department of Health for the installation of on-site wastewater treatment systems, wastewater ponds or irrigation of wastewater. Environmental health officers from local government can provide further information on health related matters.

Appendix A - Additional information required for horse proposals in sensitive environments

This appendix outlines the additional information required for proposals to establish a horse operation within the following sensitive environments:

a) Public drinking water source areas (PDWSAs) i.e. declared Catchment Areas, Water Reserves or Underground Water Pollution Control Areas;

b) Environmental Protection Policy areas covering natural environmental features. For example, the Peel-Harvey and Swan–Canning catchments;

c) All waterways including those managed under the Waterways Conservation Act, Swan River Trust Act and the Water and Rivers Commission Act;

d) Wetlands of regional, national and international importance, including but not limited to: Conservation Category Wetlands (CCWs) as defined by the WRC, Environmental Protection Policy (Lakes), Ramsar, A Directory of Important Wetlands in Australia (ANCA);

e) Areas within buffer distances to sensitive environments (refer to section 3.1and 3.3);

f) Surface waters or ground water providing private sources for irrigation or drinking water for humans or animals; and

g) Surface water bodies with publicly recognised aesthetic, commercial, cultural, or recreational values.

h) Areas prone to seasonal flooding;

i) Areas with land slopes greater than 1 in 10;

j) Areas of high ecological value and integrity i.e. critical or unique bio-diversity, supporting habitat elements such as breeding, feeding or roosting sites for significant fauna and/or the presence of rare, threatened and/ or declared flora and fauna.

Development proposals that have the potential to significantly affect the environment or are located in sensitive environments, should be referred to the appropriate Government agency by the local government authority. This process is described in Appendix B.

A1 Water resources description

a) Provide a brief description of any confined and unconfined groundwater aquifers beneath the site (define direction and magnitude of groundwater flow, seasonal variation, minimum depth to groundwater).

b) Provide details of any licensed use of water resources at the site.

c) Provide data covering on-site or local water resources quality e.g. pH, salinity, nutrients and metal concentrations and any seasonal variability.

A2 Nutrient management (nutrient use by pasture)

Sufficient nutrients should be applied to meet the pasture needs only. They should also be applied in a manner that is timely and minimises runoff or leaching losses.

a) Identify pasture species to be grown. Select pasture species appropriate to the seasonal nutrient loads anticipated from the proposed activity.

b) Determine fertiliser requirements during the establishment and operational phases of the project and assess technical advice on crop needs (e.g. soil testing, plant tissue testing). Define nutrient needs for planned short-term crops at various points in their growth cycle including any planned long-term vegetation e.g. trees based on seasonal needs.

d) Outline the types and constituents of supplementary fertiliser proposed for application. Consider the use of any slow-release fertilisers or fertigation to match pasture nutrient needs. Take into account the input of nutrients already present in irrigation water.

e) Identify those areas of the site to be fertilised. Include information on quantity, frequency and method of application.

f) Provide details of any off-season water retention or runoff collection basins designed to hold water for recycling. Details of leaching, odour and algal controls should be included.

A3 Irrigation

Efficient methods of irrigation not only lower water, power and maintenance costs, but also minimise fertiliser leaching. Use of modern technology can permit well-controlled and efficient irrigation systems.

a) Outline quantity, quality and availability of the water sources to be used.

b) Determine a water balance i.e. seasonally how much water enters and leaves the site (include rainfall and evaporation estimates).

c) Describe the irrigation methods and how application will be managed to ensure water and nutrients will not be applied to excess.

d) Define how irrigation will be scheduled to avoid runoff, excessive groundwater mounding and leaching. The schedule should incorporate regular monitoring of pasture water usage and soil moisture status to match irrigation with crop requirements. The aim should be to minimise irrigation water passing beyond the plant root zone. Soil type, root depth and plant species uptake rate should be considered. The schedule should include the frequency, rates and timing (time of year and days/week) of applications.

e) Outline how soil structure will be maintained. Intensive cultivation or use of salty irrigation water may harm pasture and lead to dispersive or poorly drained soils, increasing the risk of runoff soil erosion and crop failure.

f) Consider potential to recapture runoff from irrigated areas and recycle the water. The concentration of salts and toxins by evaporative processes may place limits on recycle systems.

A4 Stormwater management

A stormwater management system should be designed with the objective to treat any potential contaminants on-site, before excess runoff enters the offsite drainage system.

a) Outline the design and function of any artificial water bodies, which are proposed (e.g. multiple use and purpose built wetlands, or compensating basins).

b) Incorporate bunding, contouring and/ or filtration systems into design where potential exists for export of water off-site via water bodies.

c) Outline projected storm and surface water runoff rates and the volume and destination of surface runoff. Describe how site drainage will be affected by the development proposal. Will any storm water be diverted to storage? How are the effects of extreme storm events managed?

d) Drainage design should incorporate the principles of water sensitive urban / rural design (Department for Planning and Urban Development, 1994).

A5 Water resource protection

Solid and liquid waste disposal can degrade surface and groundwater quality. Management options to prevent water resource contamination should be considered. Some options are:

a) Amend soils with fine iron or aluminium rich material to increase moisture retention and minimise leaching of nutrients. Describe any soil amendment program (e.g. nature of amendment, application rate, incorporation method and depth). Provide design details of expected performance and effective life of the soil amendment program.

b) Avoid areas where the seasonal depth to the water table is less than 2 metres.

c) Construct leachate barriers that drain to collection basins.

A6 Pasture management

Careful management of pasture can minimise nutrient loss.

a) Provide a brief description of how pasture will be maintained.

b) What is planned to protect soil and water resources when any crop is harvested?

c) Describe any remnant or other vegetation buffers along property boundaries and on unused land.

d) Specify windbreaks to reduce the amount of water used, stabilise sands and reduce erosion, particularly in horticultural activities.

e) Explain management of the site to avoid soil compaction and salinity problems.

A7 Pesticide use and storage

Provide details of pesticides used by including:

a) Outline form and type of pesticides, frequency, and rate of application.

b) Discuss potential for site export and impact on non-target species.

c) Details of secure chemical storage facilities.

d) For more details refer to Appendix B.

A8 Monitoring and reporting

Describe the monitoring system to be implemented. The monitoring program should:

a) Determine the soil PRI in areas where horses are active.

b) Determine phosphorus and nitrogen concentrations in the soil and nearby water resources.

c) Describe frequency of any sampling.

d) Describe planned monitoring of water bodies that may be affected by irrigation seepage or runoff.

e) Outline procedures for recording the use and rates of application of various artificial fertilisers.

f) Determine whether application rates need altering on the basis of results from monitoring bores.

Records of data gained in managing an irrigation area should be retained for a minimum of five years, for review or reporting where requested by government agencies.

A9 Contingency plans

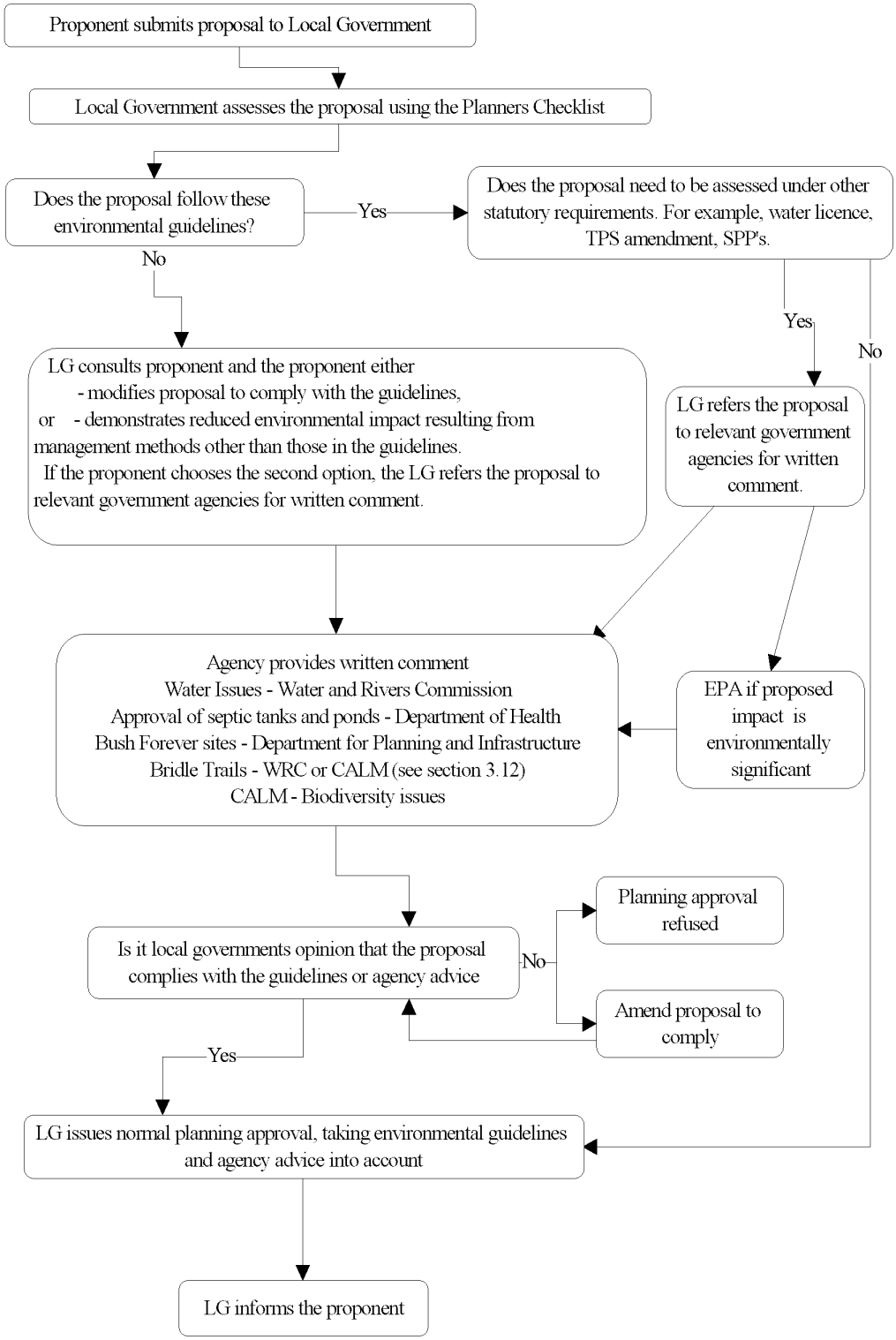
Indicate steps that will be taken to minimise loss of chemicals to water resources in the event of :

a) Fire or storm damage;

b) Accidental spillage and leakages of chemicals; and

c) Overflow or seepage from ponds used to store/treat contaminated water.

Appendix B - Flowchart for processing a development proposal



Appendix C - Handling and storage of chemicals

C1 Pesticide use

Pesticides may contaminate water resources including drinking water if poorly managed. Most pesticides are extremely soluble, easily transported and can be toxic in the short and long term. The use of biological and other biodegradable pesticides should be investigated as alternatives to long-life synthetic chemicals.

Pesticide application near rivers and wetlands should be carried out in accordance with directions provided by the manufacturers, the Water and Rivers Commission Water Note No. 22 *Herbicide Use in Wetlands,* Department of Health and Department of Agriculture guidelines and, where possible, be target specific. Application of pesticides within a PDWSA should be in accordance with the Water and Rivers Commission Statewide Policy No. 2, *Pesticide Use in Public Drinking Water Source Areas*. Taking account of weather and environmental conditions and using appropriate buffer zones near water bodies will minimise the risk of contamination.

a) A contingency plan should be developed to manage accidental spills in PDWSA. The plan should include notification of Fire and Rescue WA if the spill is serious.

b) Pesticide containers should be stored in a weather proof and fire resistant building that is maintained in good condition. Pesticide containers should be stored on an impermeable base, such as sealed concrete. The storage and handling areas should have either a perimeter bund, or slope inwards to a central grated sump to fully contain spills and facilitate clean-up. Ideally, the handling area should be roofed to exclude rainfall.

c) When preparing sprays, empty pesticide containers should be triple rinsed to remove pesticide concentrate. Add rinse water to the sprayer mixing tank.

d) Management of agricultural chemicals should comply with the Department of Agriculture's *Code of Practice for the Use of Agricultural and Veterinary Chemicals In Western Australia* which can be found at the following internet address - http://www.agric.wa.gov.au/agency/pubns/bulletin/bull4560/index.htm

e) Unused pesticide and contaminated disposable equipment should be disposed of outside PDWSA in accordance with the Health (Pesticides) Regulations 1956. If they are left lying around with chemical residues, contamination or even poisoning of people, stock or crops may occur.

C2 Pesticide container disposal

Do not burn or bury pesticide containers on the farm.

Operators should contact their local council for details of the DrumMuster program. These programs are collection schemes for non-returnable rigid metal and plastic containers used in the packaging of crop production products and animal health products.

For further information on the use of pesticides and the disposal of empty pesticide containers, contact your local Department of Agriculture office.

C3 Fuel storage

Fuel should be stored in accordance with the appropriate Water and Rivers Commission Water Quality Protection Note:

1. *Tanks - Above ground chemical storage in Public Drinking Water Source Areas.;*
2. *Tanks - Above ground chemical storage in sensitive environments;*
3. *Tanks - Underground chemical storage;*
4. *Tanks - Underground chemical storage closure.*

The Water and Rivers Commission also provides guidance on reducing environmental impacts from other types of activities involving fuel and oils. These Water Quality Protection Notes include but not are not limited to:

1. *Toxic and Hazardous Substance Storage;*
2. *Mechanical Servicing and Workshop Facilities;*
3. *Washdown of Mechanical Equipment.*

Appendix D – List of assumptions used to calculate nitrogen concentration in recharge water

The assumptions used to calculate nitrate concentrations in recharge water and phosphorus loads from horse properties located on Bassendean sands are listed below:

D1 Assumptions

The following assumptions were used in the scenarios outlined in Table 3 in Section 3.2.

a) Horse waste – the standard light horse weighs 450 kg and produces 15 kg of manure and 15 kg of urine per day. This waste contains 170 g of nitrogen (N) and 15 g of phosphorus (P).

b) Manure removal – Manure in paddocks and stables was removed and stored so that no leachate reaches the groundwater. When the manure was taken offsite, 20% of paddock manure, plus all paddock urine remained in the soil (Dr Nick Costa, personal communication, 1997).

c) Household septics – the average nitrogen load from a household septic system providing for wastes from four people was estimated at 18 kg of N/ household/ year (Whelan & Parker, 1987).

d) Recharge estimates – average rainfall in Perth area is 865 mm per year. It was assumed that 22% of rainfall reached groundwater (figure includes evaporation factor) in the sandy soils of the Perth Basin (Davidson, 1995).

e) Water application rates – average volume applied to pasture is 7,500 kilo litres per hectare per annum (kL/ ha/ yr) and to gardens is 5,000 kL/ ha/ yr.

f) The nitrogen leaching factor – is the estimated percentage of nitrogen in rainwater and irrigation residue that is able to percolate down to the water table. The best leaching estimates for soils of the Swan Coastal Plain can be found in the nitrogen load modelling in Kinhill, 1995. It was assumed a horse property was located on Bassendean sands for these calculations. This resulted in an estimated 30% leaching factor applied to the nitrogen loads of the household septics, 10% leaching factor applied to the nitrogen load of stock and the leachate from fertilised grazed pasture and 50% leaching factor applied to the nitrogen loads of domestic lawns and garden. Plant uptake, volatilisation and denitrification have all been accounted for in the leaching factors.

g) National Health and Medical Research Council (NH&MRC) Australian Drinking Water Guidelines – these guidelines recommend that the concentration of N as nitrate in drinking water should not exceed 11.3 milligrams per litre (mg/L). The WRC's water quality protection policy states that in Priority 2 PDWSA, the concentration of N as nitrate in recharge water should not exceed 25% of the NH&MRC guideline value (i.e. 2.8 mg/L). In P3 areas, the policy limits N as nitrate in recharge to 50% of the NH&MRC guideline value (ie 5.6 mg/L).

h) Manure produced on-site was used preferentially to meet pasture nutrient needs, rather than importing artificial fertilisers.

i) Horses were fed supplements in addition to grazing on pasture.

j) Pastures and garden were irrigated and nutrients applied to match pasture growth needs.

k) Manure was collected from the stables and pasture.

l) 60% of property was pastured for the horses.

m) Bedding and manure removal from stables captures 100% of the N in manure and 95% of the N in urine. Thus 76% (95% of 80%) of waste was recovered, with 4% going to ground.

n) When horse manure is picked up, approximately 20% of the solid material remains on the ground.

o) Horses are stabled for 14 hours (58%) a day unless otherwise stated.

p) Nitrogen input from fertilised gardens/ lawns – the garden was assumed to cover 500 square metres. Fertiliser application rate was 70 kg of N and 10 kg of P per hectare per year.

q) Nitrogen input from fertilised pasture – the application rate was 70 kg of N and 10 kg of P applied per hectare per year. No additional fertiliser is applied to irrigated pastures.

r) Nitrogen input from stock (horses and sheep) – estimates of nitrogen loads from the excreta of grazing animals were obtained from Costa (1998). The amounts of N and P found in urine and wet manure are summarised in the following table.

Table D1 Nitrogen and Phosphorus content in horse manure and urine including percentage remaining in the soil after manure is collected

	Description	N calculation	N kg /yr	P calculation	P kg/yr	Rationale
a.	Wet Manure	15 kg of wet manure/horse/day x 365days x 0.23%N	12.6	15 kg of wet manure/horse/day x 365days x 0.08%P	4.4	% and load of nutrients in wet manure
b.	Urine	15 L x 365 days x 0.9%N	49.3	15 L x 365days x 0.02%P	1.1	% and load of nutrients in horse urine
c.	Total nutrients	12.6 + 49.3	61.9	4.4 + 1.1	5.5	a+ b = c
d.	% nutrients in urine	49.3 / 61.9	80%	1.1/5.5	20%	b / c = d
e.	% nutrients in leachate from solids	0.2 x 12.6 / 61.9	4.1%	0.2 x 4.4 / 5.5	16%	20% of a / c = e
f.	% N and P remaining in the soil	80 + 4.1	84.1%	20 + 16	36%	d + e = f

Appendix E – Planners checklist : does a proposal need to be referred?

E1 If the answer is YES to any of the following questions refer the proposal to the Water and Rivers Commission.

ID	Questions	Guideline reference
a)	If located over *rapidly drained soils*, is irrigation planned for any of the paddocks?	Section 3.2
b)	Does the proposed stocking rate exceed the *Acceptable Stocking Rates* in the guidelines? (Refer to WRC only if the proposal is to use management practices not covered in the guidelines. If the proposal does not comply with the guidelines, either refuse the application or request the proponent modify proposal to comply.	Section 3.2
c)	If located within a *Sensitive Environment*, are there any special conditions in Table 2 that it does not comply with?	Section 2.2 & 3.1
d)	Will stables be located within the buffer distances described in *Siting of stables and yards*?	Section 3.3
e)	Will the stable floors be permeable?	Section 3.4
f)	Is manure collected less often than daily, or held in a permeable storage?	Section 3.5.1
g)	Will the gross nutrient application rate to paddocks exceed 70 kg of Nitrogen and /or 10 kg of Phosphorus / hectare / year?	Section 3.5.2 & Appendix D
h)	If keeping more than 10 horses, will wastewater runoff be directed to septic systems or discharged direct to ground?	Section 3.5.5
i)	Will the horses be in paddocks on pasture for more than 10 hours a day?	Appendix D
j)	Will more than 5000 litres of fuel or 5000 kg of fertiliser be stored on-site?	Covered by current CAWS and MWSS & D Acts.
k)	Will more than 20 litres of any pesticide be stored on-site?	Section 3.9 & Appendix C
l)	Will any land be cleared of native vegetation?	Section 2.0, 3.1 & 3.12.1
m)	Are any bridle trails, horse riding, equestrian events or camping with horses proposed within any PDWSA?	Section 3.12

E2 If the answer is YES to any of the following questions, refer the proposal to the Department of Conservation and Land Management.

a)	Will horse riding or equestrian events occur within an environmentally sensitive area or any Department-managed land?	Section 3.12
b)	Will there be bridle trails on Department-managed land or riding outside public road reserves in any PDWSA on Department land?	Section 3.12
c)	Will camping with horses occur in a PDWSA that is managed by the Department of Conservation and Land Management?	Section 3.12

Legend:
CAWS = Country Areas Water Supply
MWSS & D = Metropolitan Water Supply, Sewerage and Drainage
PDWSA = Public Drinking Water Source Areas

Glossary

Artesian well	A groundwater well¸ from which water naturally flows to the surface
Compost	A mixture of organic and inorganic substances subjected to a fermentation process to produce a stable product with a nutrient quality unique from that of its constituents. Compost production is a means of converting plant wastes into a useable soil amendment or fertiliser.
Compounds	For the purposes of these guidelines, compounds refer to exercise areas, watering troughs, feed stockpiles, manure, compost, wood-waste, and horse carcass burial pits riding arenas, washdown areas, racetracks and carparks for horse associated facilities.
Contaminant	Any physical, chemical, biological or radiological substance that renders soil, air or water impure by contact.
Yard	Pen for horses or other domesticated animals.
Dry Sheep Equivalents (DSE)	Basic animal unit of carrying capacity. Based on the feed required by a non-lactating ewe. Conversions can be made to other animals, such as horses.
Erosion	The removal of soil by wind or water action.
Eutrophication	Excessive growth of aquatic plants in a watercourse, caused by elevated nutrient levels and ultimately resulting in low oxygen content of the water. When eutrophication occurs as a natural process, the types of aquatic organisms present change slowly with the water quality, however, excessively high nutrient levels bring on too rapid a change, often resulting in the destruction of aquatic habitat, odours and aesthetically displeasing mats of algae.
Fertigation	Irrigation using a precise blend of water and soluble nutrients designed to match a plants needs related to its growth cycle and seasonal weather conditions.
Fine-textured soil	Soil with a high percentage of silt and clay particles, resulting in low permeability but a high potential for erosion.
Gabion	Woven metal or metal screening filled with rock to form a fortification or earth bank protection.
Hobble	Tie horses front legs together for a short time to stop straying e.g. when camping in an unfenced area.
Impermeable	The inability of a material to permit liquid to pass through it.

Infiltration	The action of water moving through small voids between soil particles as it seeps downward into the groundwater.
Inundated	Land that is covered or saturated by water.
Leaching	The process by which nutrient-rich chemicals or other contaminants are dissolved and carried away by water or are moved into a lower layer of soil.
Nitrate (NO3)	An important nutrient source of nitrogen to plants with known adverse human health effects when found in elevated concentrations in drinking water. Major sources of nitrates are septic systems, animal feed lots, agricultural fertilisers, manure, industrial waste-waters and landfills.
Permeability	The ability of a material to permit liquid to pass through it.
pH	A measure of the acidity or alkalinity of a material. The pH level is represented on a scale of 0 to 14 with 7 being neutral, 0 most acidic, and 14 most alkaline.
PRI	Phosphorus Retention Index (PRI) a number representing a soils ability to retain phosphorus. High numbers indicate soil can adsorb large amounts of Phosphorus. A PRI index of 0 to 10 indicates a low ability to retain phosphorus while a PRI index > 20 indicates a high ability to retain phosphorus.
Pollution	The presence of substances or contaminants that substantially alter or impair the usefulness of the environment.
Remnant vegetation	Stands of vegetation consisting substantially of original plant communities from the area.
Riparian zone	The narrow strip of land containing moist soils and plants that borders creeks, rivers, or other bodies of water.
Riprap	Tightly placed rock or stone used for waterway bank stabilisation.
Runoff	Water from rain or irrigation that flows over the ground surface and returns to streams. It can collect pollutants from air or land and carry them to receiving waters.
Soil conditioner	An organic material such as manure, humus or compost that helps soil absorb water, build a bacterial community, and distribute nutrients and minerals.
Swale	A gentle natural or artificial depression in the ground for draining surface water.
Watercourse	A waterway perennially or intermittently containing flowing water, including an estuary, river, creek, brook, spring, ravine, ditch or drainage works leading into any of the foregoing.

Water table The upper surface of unconfined water contained within soil, fractured rock or cavernous formations beneath the ground surface.

Wood-waste Includes wood chips, bark and sawdust but does not include demolition waste, construction waste, tree stumps, branches, logs or log ends.

Wood-waste leachate Most often a dark-coloured liquid containing tannins emerging from accumulations of wood-waste when rain or irrigation water is allowed contact the waste. Wood-waste leachate can be very harmful to aquatic life.

Wetlands Areas of marsh, fen, peat-land or surface water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (Government of WA, 1997).

References and Recommended Reading

Agricultural Department of Western Australia, 1997, *Pasture Management for Small Land Owners*.

Agricultural Department of Western Australia, 1998, *Draft Stocking Rate Guidelines for Rural Small Holdings, Swan Coastal Plain and Darling Scarp, Western Australia.*

Ministry of Agriculture, British Columbia, 1996, *Environmental Guidelines for Horse Owners Resource Management Branch, Canada.*

Charleson, M.A., (ed) 2001, *Racebreed Australia* magazine. August/September.

Costa N., 1997, Head of Biochemistry and Nutrition (Associate Professor) in the Division of Veterinary and Biomedical Sciences - Murdoch University, personal communication.

6. Davidson, W.A., 1995, *Hydrogeology and Groundwater Resources of the Perth Region, Western Australia.* Bulletin 142. Perth; Geological Survey of WA.

Department of Agriculture, 2001, *Code of practice for the use of agricultural and veterinary chemicals in Western Australia.* Bulletin 4527.

Department of Planning and Urban Development, Water Authority of Western Australia and the Environmental Protection Authority, 1994 *Planning and Management Guidelines for Water Sensitive Urban (Residential)* Whelans.

Equestrian Landcare Association (Inc), 1998, *Code of Practice - Bush Trail Horse Riding.* Save the Bush Program and Equestrian Landcare Association (Inc).

Foyel, J., 1994, *Hoofprints - a manual for horse property management.* Primary Industries, South Australia.

Gerritse, R.G., Barber, C. and Adenay, J.A., 1988, *The Effect of Urbanisation on the Quality of Groundwater in Bassendean Sands.* CSIRO Division of Water Resources.

The Government of Western Australia, 1997, *Wetlands Conservation Policy for Western Australia*.

Kinhill, 1995. *Nitrogen Application Limits for Various Land Uses*. Prepared for the Water Authority of Western Australia. Kinhill Engineers Pty Ltd, January 1995.

The Ministry of Sport and Recreation – South West Office, 1998, *Peel Equine Industry Study* Peel Development Commission.

National Health and Medical Research Council and Agricultural and Resource Management Council of Australia and New Zealand (NH&MRC and ARMCANZ), 1996, *Australian Drinking Water Guidelines*. Canberra: National Health and Medical Research Council.

Office of Racing, Gaming and Liquor, 1999, *Western Australian Racing Industry Status Report 1997/98* – January 1999.

Overcash, M.R., Humenik F.J. and Miner, 1983, *Livestock Waste Management*. Boca Raton, Florida: CRC Press.

Peel Equine Taskforce and the Peel Development Commission, 1999, *Peel Equine needs analysis study – Planning the future of the Peel Horse Industry*. Prepared on behalf of Peel Equine Taskforce and the Peel Development Commission by Australian Equine Services, Strategic Leisure Planning, SRM Pty Ltd and Everall Consulting.

Water Authority of Western Australia, 1990, *General Principles and Policy for Groundwater Licensing in Western Australia*. Water Authority of Western Australia Water Resources Directorate, Groundwater Branch. Report # WG 90.

Water and Rivers Commission, 2000, *Pesticide Use in Public Drinking Water Source Areas* Water and Rivers Commission, Statewide Policy No.2.

Water and Rivers Commission, 2000, *Water Note -Livestock Management: Fence location and grazing control.* Advisory notes for land managers on river and wetland restoration. WN18 July 2000.

Water and Rivers Commission, 2000, *Water Note -Livestock Management: Watering points and pumps.* Advisory notes for land managers on river and wetland restoration. WN7 January 2000.

Water and Rivers Commission, 2000, *Water Note -Livestock Management: Construction of livestock crossings.* Advisory notes for land managers on river and wetland restoration. WN6 January 2000.

Water and Rivers Commission, 2000, *Water Note –Herbicide Use in Wetlands.* Advisory notes for land managers on river and wetland restoration. WN22 January 2001.

Water and Rivers Commission, 2001, *A review of Stream and River Logging Buffers in Western Australia, to ensure their adequacy in protecting waterways from salinity, degradation and turbidity"* Report to the Conservation Commission of WA.

Publication feedback form

The Water and Rivers Commission welcomes feedback to help us to improve the quality and effectiveness of our publications. Your assistance in completing this form would be greatly appreciated.

Please consider each question carefully and rate them on a 1 to 5 scale, where 1 is poor and 5 is excellent (please circle the appropriate number).

How did you rate the quality of information?

1 2 3 4 5

How did you rate the design and presentation of this publication?

1 2 3 4 5

How can it be improved?

1 2 3 4 5

.....

How effective did you find the tables and figures in communicating the data?

1 2 3 4 5

How can they be improved?

.....

.....

.....

How did you rate this publication overall?

1 2 3 4 5

If you would like to see this publication in other formats, please specify. (Eg. CD)

.....

Please cut along the dotted line on the left and return your completed response to:

Publications Coordinator
Water and Rivers Commission
Level 2, Hyatt Centre
3 Plain Street
East Perth WA 6004
Fax: (08) 9278 0639