Australian Pesticides &
Veterinary Medicines Authority

The Reconsideration of Approvals of the Active Constituent Diuron, Registrations of Products containing Diuron and their Associated Labels

PRELIMINARY REVIEW FINDINGS

Volume 1
Review Summary

JULY 2005

Australian Pesticides &
Veterinary Medicines Authority

Canberra
Australia

This review report for products containing diuron is published by the Australian Pesticides and Veterinary Medicines Authority. For further information about this review or the Pesticides Review Program, contact:

Manager Pesticides Review
Australian Pesticides and Veterinary Medicines Authority
PO Box E240
KINGSTON ACT 2604
Australia

Telephone: 61 2 6272 3213
Facsimile: 61 2 6272 3218
Email: chemrev@apvma.gov.au
APVMA web site: http://www.apvma.gov.au

FOREWORD

The APVMA* is an independent statutory authority with responsibility for the regulation of agricultural and veterinary chemicals in Australia. Its statutory powers are provided in the Agvet Code scheduled to the *Agricultural and Veterinary Chemicals Code Act, 1994*.

The APVMA can reconsider the approval of an active constituent, the registration of a chemical product, or the approval of a label for a container for a chemical product, at any time. This is outlined in Part 2, Division 4 of the Agvet Code.

The basis for the reconsideration is whether the APVMA is satisfied that continued use of the active constituent diuron and products containing diuron in accordance with the instructions for their use:

- would not be likely to have an effect that is harmful to human beings; and
- would not be likely to have an unintended effect that is harmful to animals, plants or things or to the environment.

The APVMA also considered whether product labels carry adequate instructions and warning statements.

A reconsideration may be initiated when new research or evidence has raised concerns about the use or safety of a particular chemical, a product, or its label.

The process for reconsideration includes a call for information from a variety of sources, a review of that information and, following public consultation, a decision about the future use of the chemical or product.

In undertaking reviews, the APVMA works in close cooperation with advisory agencies including the Department of Health and Aging Office of Chemical Safety (OCS), the Department of Environment and Heritage (DEH), and State Departments of Agriculture as well as other expert advisors, as appropriate.

The APVMA has a policy of encouraging openness and transparency in its activities and community involvement in decision-making. The publication of review reports is a part of that process.

The APVMA also makes these reports available to the regulatory agencies of other countries as part of bilateral agreements. Under this program it is proposed that countries receiving these reports will not utilise them for registration purposes unless they are also provided with the raw data from the relevant applicant.

This document is *'The reconsideration of approvals of the active constituent diuron, registrations of products containing diuron and their associated labels, Preliminary Review Findings'* and relates to approvals of the active constituent diuron and products containing diuron and their labels that have been nominated for review by the APVMA. The review's preliminary findings and recommendations are based on information collected from a variety of sources. The information and technical data required by the APVMA to review the safety

* Prior to March 2003, the APVMA was known as the National Registration Authority for Agricultural and Veterinary Chemicals (NRA). In this report, the name APVMA is generally used even when referring to the organisation prior to March 2003.

of both new and existing chemical products must be derived according to accepted scientific principles, as must the methods of assessment undertaken.

Volume 1 summarises the APVMA's preliminary assessments and Volume 2 contains the technical reports for all registrations and approvals relating to uses of diuron. Both documents are available from the APVMA website:
http://www.apvma.gov.au/chemrev/chemrev.shtml

COMMENT FROM THE PUBLIC IS INVITED

The APVMA invites persons and organisations to submit their comments and suggestions on this draft review report directly to the APVMA. Your comments will assist the APVMA in preparing the review findings document.

The preliminary review findings outlines the APVMA review process, gives information to the public about how to respond to the review, summarises the technical assessments from the reviewing agencies and outlines the proposed regulatory action to be taken in relation to the continued registration of diuron products. Also included are the full technical assessment reports from the Office of Chemical Safety and the Department of Environment and Heritage.

PREPARING YOUR COMMENTS FOR SUBMISSION

You may agree or disagree with or comment on as many elements of the report as you wish. When making your comments:

- clearly identify the issue and clearly state your point of view;
- give reasons for your comments supporting them, if possible, with relevant information and indicate the source of the information you have used;
- suggest to the APVMA any alternative solution you may have for the issue.

Please try to structure your comments in point form referring each point to the relevant section in the Review Summary or the technical report. This will help the APVMA assemble and analyse all of the comments it receives.

Finally please tell us whether the APVMA can quote your comments in part or in full.

THE CLOSING DATE FOR SUBMISSIONS IS: 30 September 2005

Your comments should be mailed to:

Evaluator, Diuron Review
Pesticides Review
APVMA
PO Box E240
KINGSTON ACT 2604

or faxed to: (02) 6272 3218
or emailed to: chemrev@apvma.gov.au

ACRONYMS AND ABBREVIATIONS

ac	active constituent
ACPH	Advisory Committee on Pesticides and Health
ADI	Acceptable Daily Intake
ai	active ingredient
ANZECC	Australia and New Zealand Environmental and Conservation Council
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARfD	Acute Reference Dose
BA	2-bromoacrolein
CRP	Chemistry and Residues Program
ChE	Cholinesterase
CODEX	FAO/WHO Codex Alimentarius Commission
DEH	Department of Environment and Heritage (previously Environment Australia)
EHC	Environmental Health Criteria
EPA	Environmental Protection Agency
F0	parental generation
F1	filial generation, first
F2	filial generation, second
FSANZ	Food Standards Australia and New Zealand
GAP	Good Agricultural Practice
HG	Home Garden
HV	Home Veterinary
ha	hectare
IRED	Interim Re-registration Eligibility Decision
GLP	Good Laboratory Practice
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
LD_{50}	median lethal dose
LOEL	Lowest Observable Effect Limit
LOEC	Lowest Observable Effect Concentration
MoS	Margin of Safety
MRL	Maximum Residue Limit
mg/kg bw/d	milligrams/ kilogram of bodyweight/day
NEDI	National Estimated Dietary Intake
NESTI	National Estimated Short-Term Intake
NHMRC	National Health and Medical Research Council
NOEL	No Observed Effect Level
NOAEL	No Observable Adverse Effect Level
NOHSC	National Occupational Health and Safety Commission
NRS	National Residue Survey
OCS	Office of Chemical Safety
OHS	Occupational Health and Safety
PACSC	Pesticide and Agricultural Chemical Standing Committee
PHED	Pesticide Handlers Exposure Database
POEM	Predictive Operator Exposure Model
PHI	Post Harvest Interval
PPE	Personal Protective Equipment
ppm	parts per million
RAC	Raw Agricultural Commodity
RBC	Red Blood Cell
SC	Suspension Concentrate
SUSDP	Standard for Uniform Scheduling of Drugs and Poisons
TCAB	3,3',4,4'-tetrachloroazobenzene
TCAOB	3,3',4,4'-tetrachloroazoxybenzene
WHP	Withholding Period

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Introduction

Diuron is a broad-spectrum residual herbicide registered for pre- and post-emergent control of both broadleaf and grass weeds in a number of broadacre and fruit and vegetable crops. It is widely used in sugarcane production and some tropical fruit crops and is also used to control weeds in irrigation channels and drainage ditches, around buildings and right of way areas. Products containing diuron are also registered for use in aquatic weed control, cotton defoliants, as marine antifouling paints and for control of algae in home aquaria and fishponds.

There are 18 active constituent approvals (Attachment A) and 88 currently registered diuron products (Attachment B).

The active constituent diuron, products containing diuron and their label approvals were placed under review in 2002 due to potential toxicological and environmental concerns.

Toxicological Assessment

The toxicological assessment for the review of diuron was undertaken by the Office of Chemical Safety (OCS). The OCS assessed all the data and information submitted for the review of diuron and provided the APVMA with advice relating to the toxicity of the active constituent. In assessing the approved diuron active constituents, OCS considered the impurity levels. The APVMA has considered the advice received from the OCS and makes the recommendations relating to the continued approval of diuron active constituents below.

Based on the data provided it is recommended that the APVMA is satisfied that the continued use of, or any other dealing with, the active constituent diuron in accordance with instructions for its use or for such a dealing that the APVMA has approved, would not be likely to have an effect that is harmful to human beings. It is recommended that the active constituent approvals be affirmed.

Environmental Assessment

The environmental assessment for the review of diuron was undertaken by the Department of the Environment and Heritage (DEH). DEH assessed all environmental data and information submitted for the review of diuron and provided the APVMA with advice relating to the environmental findings of the assessment. In considering registered diuron products, the scope of the review for the environmental assessment assessed environmental contamination as a result of diuron run-off. The APVMA has considered the advice received from DEH and makes the recommendations relating to the continued registration and label approval of products containing diuron below.

Based on the data provided, it was found that environmental exposure from uses of diuron at current label rates in irrigation channels and drainage ditches is likely to have an unacceptable environmental impact. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied that use of diuron in irrigation channels and drainage ditches would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that these uses be deleted from labels.

Based on the data provided, it was found that environmental exposure from uses of diuron at current label rates on sugarcane, cotton, citrus and horticultural crops (apples, pears, bananas,

pawpaw, coffee, grapes and pineapples), is likely to have an unacceptable environmental impact. In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the uses may have to be deleted from labels. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied that use of diuron products on the above crops would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that product labels be varied.

Based on the data provided, it was found that environmental exposure from uses of diuron at current label rates in general purpose non crop uses are likely to have an unacceptable environmental impact. In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the uses may be deleted from labels. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied that use of diuron products in general purpose non crop uses would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that product labels be varied.

Based on the data provided, an unacceptable environmental risk due to spraydrift (from fine sprays and current label high rates) from diuron use when applied by air and ground spray to winter cereals and cotton. Because of unacceptable environmental risk the it is proposed that the APVMA cannot be satisfied that the use of diuron products applied by air to winter cereals and cotton would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that product labels be varied to include buffer zones.

Based on the data provided, it is recommended that the use of registered diuron products for algal control in aquariums and ornamental ponds would not have an unintended effect that is harmful to animals, plants or things or to the environment. However, product labels for these products are considered not to contain adequate instructions, therefore, it is recommended that labels be varied to meet the required standards.

Based on the data provided, it is recommended that the use of registered diuron products as antifouling paints would not have an unintended effect that is harmful to animals, plants or things or to the environment. Product labels for these products are considered not to contain adequate instructions, therefore, it is recommended that labels be varied to meet the required standards.

Based on the data provided, it is recommended that the use of registered diuron products in broadacre crops (wheat, barley, triticale, oats, lucerne, lupins and grass seed crops) would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that these uses be retained.

The APVMA is currently satisfied that the use of registered diuron products in asparagus, summer fallow, peas, vineyards (vines over 3 years), duboisia and ornamentals (daffodils, gladioli and tulips) would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that uses be retained.

Proposed Final Review Recommendations

The proposed final review recommendations are as follows:

a) Affirm approvals for the active constituents.

The APVMA can satisfied that continued use of, or any other dealing with, the 18 diuron active constituents in accordance with instructions for their use or for such dealing that the APVMA has approved, would not be likely to have an effect that is harmful to human beings.

b) Vary Label Approvals.

Label variations to satisfy the requirements for continued registration of products, are as follows:

- **Vary** the maximum annual application of diuron to sugarcane, cotton, citrus, horticultural crops and general purpose non crop uses to reduce the environmental load. If effective risk mitigation strategies cannot be developed these uses may have to be deleted from labels;
- **Delete uses** in irrigation channels and drainage ditches where an unacceptable environmental risk has been identified;
- **Vary** labels to contain buffer zones for application of diuron to winter cereals and cotton;
- Update labels to meet current standards and requirements.

c) Affirm product registrations.

If the proposed label variations are made then the APVMA can be satisfied that the conditions to which the label approvals of 88 products are currently subject can be varied in such a way that the requirements for continued approval will be complied with. Products would then not be likely to have an unintended effect that is harmful to animals, plants or things or to the environment.

1. INTRODUCTION

The APVMA is reconsidering the approvals of the active constituent diuron, registration of products containing diuron and all associated label approvals. The purpose of this document is to provide a summary of the data evaluated and of the proposed regulatory action to be taken, as a result of the review of diuron.

1.1 Regulatory status of diuron in Australia

As at 16 May 2005, there were 18 approvals of diuron active constituent (Appendix 1) and 88 registered products containing the active constituent diuron, with 32 registrants. Of the registered products, 5 are registered for domestic use to control algae in ornamental ponds and fish tanks (Appendix 2), 58 are agricultural products (Appendix 3) and the remaining 25 are antifouling paints (Appendix 4). There are a number of different formulation types including aqueous concentrates, dry flowables, emulsions, emulsifiable suspensions, emulsifiable concentrates, granules, paints, soluble powders, suspension concentrates, water-dispersible granules and wettable powders. A summary of the different formulation types is presented in Table 1.

Table 1: Registered formulations of diuron under consideration in review

Formulation type	Level of active constituent	Product type
Aqueous concentrate (AC)	0.5 g/L	Algae control ornamental ponds and aquariums
	5 g/L	
Dry flowables (DF) (Packaged in measured water soluble bags)	400 g/kg	Agricultural Herbicide
	468 g/kg	
	533 g/kg	
	900 g/kg	
Emulsifiable suspension (ES)	60 g/L	Agricultural Defoliant
Granules (G)	100 g/kg	Agricultural Herbicide
Paints	Various refer to Table 7	Antifouling paint for control of marine organisms on boats.
Soluble powders (SP)	160 g/kg	Domestic and agricultural herbicide
Suspension concentrates (SC)	500 g/L	Agricultural Herbicide
	800 g/L	
Water-dispersible granules (WG)	702 g/kg	Agricultural Herbicide
	900 g/kg	
Wettable powders (WP)	468 g/kg	Agricultural Herbicide
	800 g/kg	

1.2 Reasons for Diuron Review

In October 1994 the APVMA invited the public to nominate active constituents, chemical products or labels for consideration for review. Of the 600 chemical nominations, 80 were prioritised for review, one of which was diuron. Community groups, individual citizens and government agencies nominated diuron for review, on the basis of toxicological, and environmental concerns.

In December 2002, the APVMA acting on advise from the Department of the Environment and Heritage initiated the review of diuron due to concerns about environmental contamination, particularly in marine environments from diuron run-off of from agricultural areas. Concerns were also raised by the Office of Chemical Safety about the possible toxicity of some impurities in the active constituent.

1.3 Scope of the Review

The scope of the review considered the reasons for the nomination of diuron, the information already available on this chemical and the way in which it is approved for use in Australia.

The basis for a reconsideration of the registration and approvals for a chemical is whether the APVMA is satisfied that the requirements prescribed by the Agvet Codes for continued registration and approval are being met. In the case of diuron, these requirements are that the use of the product in accordance with the instructions for its use would not be likely to:

- have an effect that is harmful to human beings;
- have an unintended effect that is harmful to animals, plants or things or to the environment.

The APVMA reviewed the following aspects of active constituent approvals, product registrations and label approvals for diuron:

a) Toxicology, including:
   - Toxicology of two impurities (3,3',4,4'-tetrachloroazobenzene and 3,3',4,4'-tetrachloroazoxybenzene) specified in the MCS for diuron active constituent.

b) Environment, including:
   - impact of run-off water containing diuron on the Great Barrier Reef;
   - the impact of diuron found in sediment and water on various species of sea grass;
   - the potential role of diuron as a cause of dieback in mangroves; and
   - the possible contribution of diuron in run-off water to reported incidents of off-target damage to farmlands.

The APVMA also considered whether product labels carry adequate instructions and warning statements. Such instructions include:

- the circumstances in which the product should be used;
- how the product should be used;
- the times when the product should be used;
- the frequency of the use of the product;
- the withholding period after the use of the product;
- the disposal of the product and its container;
- the safe handling of the product.

On the basis of these concerns, it was determined that the registrations and approvals for diuron be subject to reconsideration under Part 2, Division 4, of the Agvet Codes.

1.4 Regulatory options

There can be three possible outcomes to the reconsideration of the registration of products containing diuron and their labels. Based on the information reviewed the APVMA may be:

- satisfied that the products and their labels continue to meet the prescribed requirements for registration and approval and therefore affirm the registrations and approvals.
- satisfied that the conditions to which the registration or approval is currently subject can be varied in such a way that the requirements for continued registration and approval will be complied with and therefore vary the conditions of registration or approval.
- not satisfied that the requirements for continued registration and approval continue to be met and suspends or cancels the registration and/or approval.

2 DIURON USE PATTERNS

2.1 Introduction

Diuron is a broad-spectrum residual herbicide that has a diverse range of use patterns. Diuron acts through the inhibition of photosynthesis. It is primarily absorbed through plant roots and has a soil half-life of the order of one hundred days. Diuron is registered for pre- and post-emergent control of both broadleaf and grass weeds in wheat, oats, barley, rye, triticale, lupin, sugar cane, cotton, coffee, citrus, apples and pears, pawpaw, pineapples, bananas, grapes, asparagus, peas, cut flowers and various seed crops. It is used for broad-spectrum weed control along fence lines, pipelines, powerlines, railway lines, roads, irrigation channels and ditches, footpaths, in timber yards and storage areas, around commercial, industrial and farm buildings, as well as electrical substations, bridges, tennis courts and petrol storage tanks. Products containing diuron are also registered for use in aquatic weed control, as cotton defoliants, as marine antifouling paints and for control of algae in home aquaria and fishponds.

2.2 Uses of Diuron Products in Australia

2.2.1 Algae Control

Diuron is registered for the control of algae in home aquaria and fishponds (Table 2).

Table 2: Uses of diuron for algal and green water control.

Situation	Product description	Summary of Current Label Instructions
Aquarium	AC 1.5g/L Diuron	Add 5 mL to 90 mL of water when algae first appears or after cleaning an algae infested tank. Repeat only when algae reappear.
Ornamental Ponds	AC 5g/L Diuron	Apply 5 mL to 300 mL water. Add dose to ½ bucket of water and sprinkle over pond surface. Repeat only when algae reappear.

2.2.2 Grass and Broadleaf Weed Control

Products containing diuron are registered for use on a wide variety of grass and broadleaf weeds, (Table 3). While Table 3 provides a comprehensive list of weeds controlled by diuron, it should be noted that not all products are registered for the control of all of the weeds listed. Some products are registered only for the control of specific weeds and some uses are limited to certain states. The weeds controlled also vary within formulation types. For specific information on weed species controlled, each product label should be referred to.

Table 3: Grass and broadleaf weeds controlled by diuron.

Common name	Scientific name	Common name	Scientific name
Amaranthus (dwarf, slim, Powell's, redroot, redshank, Prince of Wales Fether)	*Amaranthus spp.*	Native bluebell	*Wahlenbergia communis*
Asthma plant	*Euphorbia hirta*	Noogoora burr	*Xanthium pungens*
Barley grass	*Hordeum leporium*	Nutgrass	*Cyperus rotundus*
Barnyard grass	*Echinochloa crus-galli*	Paddy melon	*Cucumis myriocarpus*

Bathurst burr	*Xanthium spinosum*	Paspalum	*Paspalum dilataum*
Bellvine	*Ipomoea plebeia*	Paterson's curse	*Echinm plantagineum*
Billygoat weed (Bluetop)	*Ageratum conyzoides*	Phasey Bean	*Macroptillium lathyroides*
Black pigweed	*Trianthema portulacastrum*	Pigeon grass	*Setaria spp.*
Blackberry nightshade	*Solanum nigrum*	Pigweed	*Portulaca oleraceae*
Bladder ketmia	*Hibiscus trionum*	Plantain (ribwort)	*Plantago spp.*
Brome grass	*Bromus spp.*	Poppy - horned	*Glaucium flavum*
Bushy starwort	*Aster subulatus*	Poppy - rough	*Papaver hybridun*
Canadian fleabane	*Conyza canadensis*	Potato weed	*Heliotropium europaeum*
Capeweed	*Arctotheca calendula*	Prickly acacia	*Acacia nilotica*
Centro	*Centrosema pubescens*	Purple top	*Verbena bonariensis*
Charlock	*Sinapis arvensis*	Queensland bluegrass (suppression only)	*Dichanthium sericeum spp. sericeum*
Chickweed	*Stelleria media*	Rattlepod	*Crotalaria spp.*
Clovers	*Trifolium spp.*	Red natal grass	*Rhynchelytrum repens*
Coast button grass	*Dactyloctenium aegyptium*	Rhodes grass	*Chloris gayana*
Cobbler's-pegs	*Bidens pilosa*	Ryegrass	*Lolium spp*
Common sida (Paddy's lucern)	*Sida rhombifolia*	Sheepweed (white iron weed, corn gromwell)	*Buulossoides arvensis*
Convolvulus (Pink, Red,)	*Ipomoea spp.*	Skeleton weed	*Chondrilla juncea*
Crowsfoot grass	*Eleusine indica*	Sorrel	*Rumex acetosa*
Cumbungi	*Typha spp.*	Soursob	*Oxalis Pes-caprae*
Cupid's flower (Star of Bethlehem)	*Ipomoea quamoclit*	Sour grass	*Pasplaum conjugatum*
deadnettle	*Lamium amplexicaule*	Sensitive plant (Giant)	*Mimosa spp.*
Docks	*Rumex spp.*	Sesbania pea	*Sesbania spp.*
Double gee (spiny emex, three-cornered jack)	*Emex australis*	Shepherd's purse	*Capsella bursa-pastoris*
Erodium	*Erodium spp.*	Spiny burr grass	*Cenchrus incertus*
Fat-hen (White goosefoot)	*Chenopodium album*	Spurge	*Phyllanthus spp.*
Feathertop	*Pennisetum villosum*	Square weed	*Spermacoce latifolia*
Flatweed	*Hypochaeris radicata*	Storksbill	*Erodium cicutarium*
Guinea grass	*Panicum maximum*	Stinking passion flower (passionfruit vine)	*Passiflora foetida*
Hairy Indigo	*Indigo hirsuta*	Summer grass	*Digitaria ciliaris*
Horehound	*Marrubium vulgare*	Tarvine	*Boerhavia coccinea*
Itch grass	*Rottboellia cochinchinensis*	Thickhead	*Crassocephalum crepidioides*
Iceplant	*Mesembryanthemum spp.*	Thistle (saffron,sow, variegated, milk)	*various*
Johnson grass	*Sorghum halepense*	toad rush	*Juncus bufonius*
Kangaroo grass	*Themeda triandra*	turnip weed	*Papistrum rugosum*
Khaki weed	*Alternanthera pungens*	Urena Burr	*Urena lobata*
Kikuyu grass	*Pennisetum cladestinum*	Water couch	*Paspalum paspalodes*
London Rocket	*Sisymbrium irio*	Winter grass	*Poa annua*
Lupin	*Lupinus cosentinii*	Wireweed (Hogweed)	*Polygonum aviculare*
Medics	*Medicargo spp.*	Wild rose	*Rosa rubiginosa*
Melilotus	*Melilotus indicus*	Wild oats	*Avena fatua*
Mexican poppy	*Argemone mexicana*	Wild turnip	*Brassisa tournetortii*
Mimosa bush	*Acacia farnesiana*	Wild radish	*Raphanus raphanistrum*
Morning Glory	*Ipomoea spp*	Willow herb	*Epilobium billardierianum*
Mustards	*Sisymbrium spp.*	Yellow burr weed	*Amsinckia spp.*

2.3.3 Broadacre crops

Diuron is registered for use to control a number of broadleaf and grass weed in broadacre crops (Table 4).

Table 4: Uses of diuron in broadacre crops.

Situation	Product description	Maximum rate	Summary of Current Label Instructions
Barley	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	900 mL/ha 1.7 L/ha 1.1 kg/ha 980 g/ha 500 g/ha	Application varies in different states and for different weed species. In general, apply by boom spray or aircraft (in some situations) when weeds are at the 2-4 leaf stage which is normally soon after the crop has passed the 2 ½ leaf stage which is normally within 6 weeks of sowing.
Cereal rye	SC 500 g/L	500 mL/ha	Application varies in different states and for different weed species. In general, apply by boom spray or aircraft (in some situations) when weeds are at the 2-4 leaf stage which is normally and soon after the crop has passed the 2 ½ leaf stage which is normally within 6 weeks of sowing.
Cotton	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	3.5 L/ha 2.2 L/ha 2.2 kg/ha 2 kg/ha 2 kg/ha	Apply as a pre-emergence by pre-planting incorporation or spraying bare soil. Apply post emergence when cotton is at least 30 cm high or immediately after last cultivation.
Cotton Defoliant	ES 60 g/L diuron and 120 g/L thidiazuron	400 mL/ha	Apply the first spray to cotton which has been grown under good (non-stressed) conditions and is physiologically mature. Conditions for application vary depending on daytime temperature.
Lucerne (established for 1 year or more)	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	3.5 L/ha 2.2 L/ha 2.2 kg/ha 2 kg/ha 2 kg/ha	Apply by boom spray just prior to weed emergence or during the dormant period. Apply when lucerne has been grazed.
Lupins	SC 500 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	2 L/ha 1.3 kg/ha 1.2 kg/ha 1.1 kg/ha	Apply at pre-sowing to pre-emergent stage.
Oats	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg	900 mL/ha 1.7 L/ha 560 g/ha 500 g/ha	Application varies in different states and for different weed species. Broadly, apply by boom spray or aircraft (in some situations) when weeds are at the 2-4 leaf stage which is normally and soon after the crop has passed the 2 ½ leaf stage which is normally within 6 weeks of sowing.

Situation	Product description	Maximum rate	Summary of Current Label Instructions
	WG 900 g/kg	500 g/ha	
Ornamentals (Daffodils, Gladioli and Tulips)	SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	3.5L/ha 2.2 kg/ha 2 kg/ha 2 kg/ha	Apply pre-emergence of crop to moist soil before weed emerge and not less than 4 weeks prior to bulbs emergence.
Perennial grass and seed crops	SC 500 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	4.5 L/ha 3.8 kg/ha 3.3 kg/ha 3.4 kg/ha	Apply by boom spray during the dormant period before weed emergence. Apply to established plantings.
Phalaris cultivars sirolan and sirose	DF 900 g/kg WG 900 g/kg	1.7 kg/ha 1.7 kg/ha	
Sugar cane	SC 500 g/L SC 800 g/L WP 468 g/kg diuron and 132 g/kg hexazinone WP 800 g/kg DF 533 g/kg diuron and 67 g/kg hexazinone DF 468 g/kg diuron and 132 g/kg hexazinone DF 900 g/kg WG 900 g/kg WG 702 g/kg diuron and 198 g/kg hexazinone	7.2 L/ha 4.5 L/ha 4 kg/ha 4.5 kg/ha 3.5 kg/ha 4 kg/ha 4 kg/ha 4 kg/ha 2.7 kg/ha	Band or overall spray after planting or harvesting and before crop emergence. Direct spray after cultivation to emerging cane.
Summer fallows	DF 900 g/kg WG 900 g/kg	275 g/ha 275 g/ha	SA only.
Triticale	SC 500 g/L DF 900 g/kg WG 900 g/kg	500 mL/ha 280 g/ha 280 g/ha	Application varies in different states and for different weed species. Broadly, apply by boom spray or aircraft (in some situations) when weeds are at the 2-4 leaf stage which is normally and soon after the crop has passed the 2 ½ leaf stage which is normally within 6 weeks of sowing.

Situation	Product description	Maximum rate	Summary of Current Label Instructions
Wheat	SC 500 g/L	900 mL/ha	Application varies in different states and for different weed species. In general, apply by boom spray or aircraft (in some situations) when weeds are at the 2-4 leaf stage which is normally and soon after the crop has passed the 2 ½ leaf stage which is normally within 6 weeks of sowing.
	SC 800 g/L	1.7 L/ha	
	WP 800 g/kg	1.1 kg/ha	
	DF 900 g/kg	980 g/ha	
	WG 900 g/kg	500 g/ha	

Queensland Department of Primary Industries and Fisheries has indicated that Queensland producers particularly rely on products containing diuron for weed control in sugarcane, cotton and pineapples. Diuron products also form part of a general weed control program. Diuron products apparently offer a broad-spectrum, flexible method of both pre-emergent and knockdown weed control in sugarcane. Similarly, diuron products are the principal weed control herbicide for pineapple production. Diuron is claimed to be the herbicide of choice for pineapple growers as it is viewed as being long lasting and effective against weeds while at the same time relatively safe for the pineapple plants compared to some other herbicides.

2.2.4 Horticultural crops.

Diuron products are used for the control of a large number of boardleaf and grass weeds in a variety of fruit and vegetable crops (Table 5). Application of diuron on crops is dependant on a number of variables, including crop type and time of year. Types of application can be either, high volume spraying, boom spraying or spot spraying.

Table 5: Uses of diuron in fruit and vegetable crops.

Situation	Product Description	Maximum Rate	Summary of Current Label Instructions
Apples and Pears (established at least 1 year)	SC 500 g/L	7.2 L/ha	Apply to bare moist soil under trees as a broad cast spray or band spray. Area should be cleared of weeds prior to spraying using a knockdown herbicide.
	SC 800 g/L	4.5 L/ha	
	WP 800 g/kg	4.5 kg/ha	
	DF 900 g/kg	4 kg/ha	
	WG 900 g/kg	4 kg/ha	
Asparagus	SC 500 g/L	3.6 L/ha	Apply in established beds after they have been "hilled up" and before emergence of spikes. Post-emergence applications can be made but spray should be directed so as only to contact the base of the stems.
	WP 800 g/kg	2.2 kg/ha	
	DF 900 g/kg	2 kg/ha	
	WG 900 g/kg	2 kg/ha	
Bananas	SC 500 g/L	7.2 L/ha	Direct spray to new plantings immediately after planting. Direct spray to established plantings before weed emergence.
	SC 800 g/L	4.5 L/ha	
	WP 800 g/kg	4.5 kg/ha	
	DF 900 g/kg	4 kg/ha	
	WG 900 g/kg	4 kg/ha	

Citrus	SC 500 g/L SC 500 g/L SC 800 g/L DF 400 g/kg diuron and 400 g/kg bromacil WP 800 g/kg DF 900 g/kg WG 900 g/kg	1.3L/200 L 7.2 L/ha 4.5 L/ha 4.5 kg/ha 4.5 kg/ha 4 kg/ha 4 kg/ha	For spot spraying, spray to point of run-off Apply to bare moist ground prior to emergence of weeds in autumn and spring. Avoid contact with crop foliage or fruit. Use on trees over 1 yr old.
Coffee	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	7.2 L/ha 4.5 L/ha 4.5 kg/ha 4 kg/ha 4 kg/ha	Apply as an initial spray. Area should be cleared of weeds prior to spraying using a knockdown herbicide. For some weeds spot spray, spray to point of run-off
Duboisia	SC 500 g/L	4 L/ha	Apply as a pre-emergent baud spray to mature plants (over 12 months) following harvest.
Pawpaws (not for use on tress under 9 months old)	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	7.2 L/ha 4.5 L/ha 4.5 kg/ha 4 kg/ha 4 kg/ha	Avoid contact with plants.
Peas	WP 800 g/kg WG 900 g/kg	1.2 kg/ha 1.2 kg/ha	WA only. Apply to soil after sowing.
Pineapple	DF 400 g/kg diuron and 400 g/kg bromacil SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	4.5 kg/ha 7.2 L/ha 4.5 L/ha 4.5 kg/ha 4 kg/ha 4 kg/ha	Apply as an overall blanket spray. Spray inter-row prior to flower differentiation. Repeat if necessary but not more then 2 monthly intervals.
Vineyards (vines must be older than 3 years)	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	7.2 L/ha 4.5 L/ha 4.5 kg/ha 4 kg/ha 4 kg/ha	Band treatment to crops, apply to established vines at least 3 years old. Apply to moist soil prior to emergence of weeds. Avoid spray drift or contact with fruit or foliage.

2.2.5 General purpose non-crop uses.

Products containing diuron are used in a number of non-crop situations (Table 6). These uses include controlling weeds around outbuildings, sheds and in right of way areas, irrigation channels and drainage ditches and bore drains. Application in these areas is dependant on the weed and is mostly applied as a spray from an agricultural spray unit or handheld spray pack.

Table 6: General purpose non crop uses of diuron.

Situation	Product Description	Maximum Rate	Summary of Current Label Instructions
Bore drains	SC 500 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	64 L/ha 40 kg/ha 35.5 kg/ha 35.5 kg/ha	QLD only. Block off bore drain 24 hr prior to spraying and allow drain to empty. Spray 1m wide strip onto mud. Wait 48-72 hr before opening drain.
Driveways, paths, lanes, drains, ditches, fence lines, car parks, factory sites, tennis courts	SP 160 g/kg, 110 g/kg amitrole and 504 g/kg 2,2 - DPA DF 400 g/kg diuron and 400 g/kg bromacil	10 g/L treats 2 sq. mtrs. 22 kg/ha	Apply to areas requiring weed control.
Irrigation channels, drainage ditches	SC 500 g/L SC 800 g/L WP 800 g/kg DF 900 g/kg WG 900 g/kg	Rates vary Maximum 144 L/ha or 1.4 L per 100 square meters or 90 kg/ha 22 kg/ha or 220g per 100 sq meters	Apply during non-crop season and when channel is not in use it is necessary to "fix" it into the soil by applying prior to expected rainfall. Soil should be moist and preferably bare i.e after regrading and clearing channels. Do not use channels or ditches for horticultural irrigation for 8 weeks after treatment.
Right-of-way, commercial and industrial areas,	500g/L diuron SC 800 g/L WP 800 g/kg DF 900 g/kg DF 400 g/kg diuron and 400 g/kg bromacil GF 50 g/kg diuron, 50 g/kg bromacil and 100g/kg hexaxinone WG 900 g/kg	Rates vary Maximum 72 L/ha 45 L/ha 90 kg/ha 40 kg/ha 22 kg/ha 50 kg/ha 40 kg/ha	If moderate weed growth is present at the time of spraying add knockdown herbicide to the mixture. Apply to short growth. Apply just before or during the active growing season.

2.2.6 Antifouling Paints

Antifouling paints containing diuron are registered to control marine growth on boats below the water line (Table 7).

Table 7: Use of antifouling paints containing diuron.

Situation	Product description	Summary of Current Application instructions
Pleasure craft, fibreglass, steel, timber hulls. Racing yachts, high speed power craft	5 g/L diuron and 635 g/L cuprous oxide and 50 g/L chorotholonil and 377.4 g/L xylene 20 g/L diuron and 600 g/L xylene 35-45 g/L diuron and 200-240 g/L cuprous thiocyanate 35-45 g/L diuron and 440-480 g/L cuprous oxide 35-45 g/L diuron and 505-555 g/L cuprous oxide 40-50 g/L diuron and 590-610 g/L cuprous oxide 42-52 g/L diuron and 612-665 g/L cuprous oxide 45 – 50 g/L diuron and 240-290 g/L cuprous thiocyanate 45 – 50 g/L diuron and 540-565g/L cuprous oxide 50 – 60 g/L diuron and 198-225 g/L cuprous thiocyanate and 100-141 g/L zinc oxide 59-62 g/L diuron and 644-670 g/L cuprous oxide 60 g/L diuron and 680-690 g/L cuprous oxide 60 g/L diuron and 700 g/L cuprous oxide 62 g/L diuron and 543-559 g/L copper present as cuprous oxide 65-67 g/L diuron and 505-518 g/L cuprous oxide 67-70 g/L diuron and 255-276 g/L cuprous thiocyanate 70 g/L diuron and 622 g/L copper present as cuprous oxide 70-75 g/L diuron and 820-830 g/Lcuprous oxide 80 g/L diuron and 635 g/L cuprous oxide and 40 g/L xylene	Apply 2 coats per season on the hull and 3 on the leading and trailing edges, waterline, rudder, keel and skeg.

3. ACTIVE CONTITUENT CONSIDERATION

3.1 Chemistry

Approved common name: Diuron

Alternative names: Karmex, Krovar

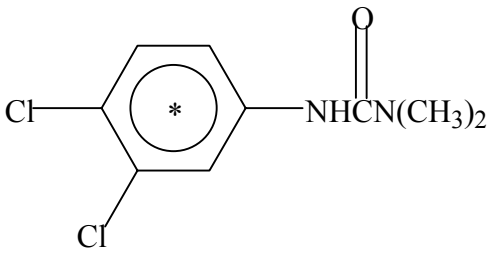
Chemical name: 3-(3,4-dichlorophenyl)-1,1-dimethylurea (IUPAC)
N'-(3,4-dichlorophenyl)-N,N-dimethylurea (CAS)

CAS Registry number: 330-54-1

Empirical formula: $C_9H_{10}Cl_2N_2O$

Molecular weight: 233.1

Chemical structure:



Isotope label: The position of the radiolabel (^{14}C) is indicated by an asterisk*

Chemical class: Phenylurea herbicides

Structural analogues: linuron, monuron, propanil

Vapour Pressure: 1.1×10^{-3} mPa at 25˚C. Very slightly volatile (Mensink *et al* 1995).

Water Solubility: 36.4 mg/L at 25°C. Rated as moderately soluble (Mensink *et al* 1995).

Henry's Law Constant: 7.0×10^{-6} Pa m^3/mole (calculated by the Department of the Environment and Heritage). Very slightly volatile (Mensink *et al* 1995).

Dissociation Constant: There are no dissociable hydrogens within the normal environmental pH range (pH 4 to 9).

3.2 Chemical and physical properties

Colour:	White
Odour:	None
Physical state:	Crystal
Melting point:	158^{o}C
Partition coefficient:	2.68 (log K_{ow})
Vapour pressure:	2 x 10^{-7} mm Hg at 30^{o}C
Water solubility:	42 ppm @ 25 ^{o}C
Stability:	Stable for 2 yrs. In double polyethylene bag inside a fiber drum under warehouse conditions. Metals and metal ion data not given.

3.3 Impurities of Toxicological Concern

The APVMA standard for active constituent diuron is given in the table below:

Chemical	Standard
Diuron	Minimum 950 g/kg
3,3'4,4'-tetrachloroazobenzene (TCAB)	Maximum 20 mg/kg
3,3',4,4'-tetrachloroazoxybenzene (TCAOB)	Maximum 2 mg/kg

The maximum impurity levels for diuron were set by Pesticides and Agricultural Chemical Committee in 1986. The Office of Chemical Safety (OCS) raised concerns regarding two impurities of diuron TCAB and TCAOB. The concerns relate to potential carcinogenicity.

There is no strong evidence to rule out the possibility that higher levels of TCAB and TCAOB (out of the limit) in the active constituent diuron might increase the risk of genotoxicity/carcinogenicity. Hence, establishing a limit for the impurities is considered to be appropriate since all sources of the active diuron comply with existing levels, and this standard should be retained.

The Food and Agriculture Organisation (FAO) of the United Nations does not specify maximum levels for TCAB and TCAOB in the active constituent diuron. It is possible under current manufacturing methods to produce diuron active constituents with no recorded traces of TCAB and TCAOB. In accordance with meeting current standards of Good Manufacturing Practice (GMP) consideration should be given to retaining the current APVMA standard or amending it to recognise best practice.

4. SUMMARY OF DATA ASSESSMENT

4.1 Toxicology

The toxicology report consolidates data on metabolism, subchronic and chronic toxicity, reproductive and developmental toxicity and genotoxicity. The toxicities of two impurities in the active, namely TCAB and TCAOB have been assessed. After the completion of data assessment no specific toxicological concerns with the continued approval of the active constituent diuron was found. A summary of the toxicological profile of diuron is included in Appendix 5.

The existing Acceptable Daily Intake (ADI) for diuron is 0.006 mg/kg bw/day. After reviewing all submitted data, an amended ADI of 0.007 mg/kg bw/day has been established. The ADI is based on a No Observed Effect Level (NOEL) of 0.7 mg/kg bw/day for haemolytic anaemia and a 100-fold safety factor. As part of considering the data OCS has also established an Acute Reference Dose (ARfD) of 0.007 mg/kg bw/day. The current limit of maximum impurity levels in the active constituent diuron is 20 mg/kg TCAB and 2 mg/kg TCAOB. No changes to the approval status of diuron and the existing impurity limit for diuron have been proposed in this review. The current scheduling state of diuron has been reviewed. Its inclusion in Appendix B of the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) is considered to be adequate.

4.2 Environment

The environmental report consolidates data on environmental chemistry, fate and ecotoxicity. Additional material was obtained from other registrants, international reviews, Internet searches and other available literature sources.

This review focuses on several key environmental impacts surrounding the use of diuron, as detailed in the Diuron Review Scope Document (APVMA, 2002). The scope of the review is limited to runoff from sugarcane; its effects on the Great Barrier Reef Lagoon, seagrasses and mangroves; and the impact of runoff from other uses. Spraydrift was also briefly considered as it can be a significant route of environmental exposure, contribute to the overall loading in natural water systems and therefore contribute to the apparent level of runoff. The risk to avian and terrestrial non-target organisms was also examined.

4.2.1 Runoff

Modelling

Runoff of diuron is a key route of environmental exposure and is the most important aspect of this review. It is highly dependant on several factors, some of which are location specific while others are event specific. The most important are rainfall volume and intensity, infiltration of soil (in turn related to moisture content of soil), slope, type of soil, type of drainage, type of crop, amount of trash on soil and the extent of cultivation.

A simple model was used initially as a first tier assessment. This showed that there is unlikely to be a risk to fish and only a slight risk to aquatic invertebrates at rates of <3.6 kg ac/ha but a high risk to algae. For the very high rates (>10 kg ac/ha), particularly from use in rights-of way, commercial areas and irrigation/drainage channels, the model estimated a high risk to fish and invertebrates and a high risk to algae. These results were comparable with those from the US EPA GENEEC model.

The model was refined and an allowance was made for one cycle of adsorption with two K_d values, one worst case and the other an average value. The results of this modelling indicated an unacceptable risk to fish and invertebrates at rates higher than 16 kg ac/ha. For algae, the risk was high and unacceptable for all application rates when the low soil adsorption value was used. However, when the average soil adsorption value was used the risk was estimated to be slight at lower rates (<0.9 kg ac/ha) and high at rates of 1.8 kg ac/ha and above. Risk to duckweed was estimated to also be high and unacceptable at application rates of 3.6 kg ac/ha and above. The results from the model at 3.6 kg ac/ha (the maximum rate for sugarcane) were comparable with peak measured concentrations from the Pioneer River. They were therefore considered as reasonable.

Field Studies

Runoff from sugarcane fields

The level of diuron in the Pioneer River, draining a major sugarcane area, was measured during a two-day rainfall event. This event represents a '1 year in 2' occurrence. Therefore, it was not considered the worst case but one that could be expected to occur relatively frequently. Samples taken at the bottom of the catchment gave measured concentrations of between 0.9 to 8.5 μg/L. The higher values occurred at the start of the runoff event and then tapered off. In the centre of the catchment, the levels of diuron were less. Calculations showed that the peak levels of diuron during this one runoff event were toxic to algae for most of the flow, but declined to acceptable levels after 24 hours. This describes one intense rainfall event that occurred approximately half way during the wet and some time after the likely last applications of diuron. Had earlier runoff events been monitored, the measured concentrations of diuron could have been higher. In addition, diuron slowly adsorbs to the sediments, thus remaining available for uptake by plants. The degradation rate in the sediment from the Pioneer River and its estuary is unknown; however, laboratory studies estimated that the maximum half-life was 232 days.

Diuron has been found in the sediments of irrigation drains from sugarcane farms. As these drains were not considered part of the natural environment, a dilution factor (1:4) was used to allow for mixing of the contaminated sediment with uncontaminated sediment. Calculations showed that the level of diuron in sediment draining from sugarcane fields is potentially toxic to plants, including aquatic plants. There is also likely to be chronic exposure given that the longest sediment half-life was 232 days and the shortest 48 days. It was concluded that the measured levels of diuron in sediment from sugarcane areas are high and likely to affect non-target plants including aquatic plants and mangroves growing in sediments near to sugarcane fields. Note that there are two sources of diuron involved, direct application to the drains (very high rate) and application to sugarcane (high amounts of diuron used). Both would have to be reduced or eliminated to mitigate these risks. The environmental impact from application to drains will be considered below.

There was no laboratory information that shows the effects of diuron on mangroves, the major plant growing in estuarine sediments. Field observations in the Pioneer River showed that the common mangrove, *Avicennia marina,* has been affected by nearby sugarcane fields with the hypothesis that diuron in the sediments is the primary toxicant responsible. There was a positive correlation between concentration of diuron and the level of damage to *A. marina* together with a dose response in several areas. These limited field observations showed that the mangroves were affected when diuron was >2 μg/kg in sediment. Therefore, the LOEC was considered to be 2 μg/kg.

The measured levels of diuron in sediment were higher than the LOEC for mangroves with a

maximum of 8.2 μg/kg. The experimentally derived EC25 for terrestrial seedling emergence was also compared to the measured levels in sediment, indicating a potential hazard. Again, there are possibly two sources of diuron involved, direct application to the drains and application to sugarcane.

Diuron has been detected in offshore sediments in shallow water (<5 m deep) near the coast ranging from 0.2 to 10.1 μg/kg dw. These detections were mainly near rivers draining sugar cane growing areas. Using the most sensitive terrestrial plant species (tomato seedlings, leaf exposure), effects on non-target plants in these sediments were considered likely. The laboratory data on seagrasses showed that at concentrations of 0.1 μg/L diuron affected chlorophyll fluorescence in two species of seagrasses. This was used as the LOEC for seagrasses. Calculations using a partitioning model showed that diuron concentrations were above the LOEC and therefore some impacts on seagrasses are considered likely. While the level of inhibition of photosynthesis is not expected to cause extensive mortality to seagrasses, the key ecological importance of seagrasses to the endangered dugong and to juvenile marine organisms means that this risk is considered unacceptable.

Diuron contaminated runoff from the rivers draining sugarcane crops that flows into the Great Barrier Reef lagoon (GBRL) could directly impact reef coral, especially those on inshore reefs. An indirect effect could occur when diuron affects crustose coralline algae - effects on the species distribution of crustose coralline algae will indirectly affect the species distribution of corals.

Assuming a 1:10 dilution for water entering seawater, the measured levels of diuron in the Pioneer River during the flood event were above the LOEC for corals on inshore reefs. The concentrations in the Pioneer River are high enough that based on a laboratory study, some mortality could be expected to crustose coralline algae inhabiting inshore areas. The diuron adsorbed to the suspended sediments and carried by rivers to the inshore reefs was considered to impact on the inshore reefs. Calculations using a partitioning model showed that diuron concentrations were above the LOEC for both corals and crustose coralline algae. It is assumed that further dilution will reduce the concentrations of diuron to below the LOECs on the offshore reefs.

It is concluded that the measured levels of diuron in the Pioneer River due to runoff, as well as in sediments in the drains and river/estuary systems that drain sugarcane growing regions, are higher than those acceptable to protect algae and aquatic plants, including mangroves and seagrasses. There is a growing body of evidence to show that diuron in sediments in the Pioneer River estuaries has affected mangroves, the common mangrove in particular. In offshore areas where these river discharges occur, there is a risk to seagrasses due to diuron in sediment, which was considered unacceptable due to the key ecological role of seagrasses. There is also a risk to crustose coralline algae and corals offshore from the currently measured levels of diuron in the Pioneer River. The current use of diuron is unacceptable. Note there are two sources of diuron involved, application to the crop and application to the drains. The environmental impact from application to drains will be considered below.

Due to the high conservation values within the GBRMP, the level of diuron in inshore regions is unacceptable and measures should be taken to reduce the overall amount and peak concentrations reaching the GBRL. The measured levels in sediment are approximately 4 times the observed effect level for mangroves (~2 μg/kg) while the peak levels in the Pioneer River are approximately 4 times the EC50 for algae (the most sensitive organisms). There has been a strong uptake of using a trash blanket by growers to control weeds, reducing the need for longer-term weed control and herbicide use in the sugarcane production system. It is noted that use of a trash blanket is not common practice in the Burdekin cane area.

In order to reduce the environmental risk from application to sugarcane, risk mitigation strategies need to be found to reduce the environmental load. This may include rate reductions and changes in industry practices. If no changes to industry practices can be found it is recommended that the maximum application rate for diuron be reduced to 0.9 kg ac/ha and the number of applications per season/annum be limited to one. In addition, diuron should not be used to treat channels or drains in the sugarcane areas or other areas that drain into the GBRMP. These actions would also reduce the offshore concentration of diuron to approximately be below or occasionally equal to the LOEC for seagrasses, crustose coralline algae and corals, making the risk more acceptable. Efficacy of such rate reductions will also need to be considered. If risk mitigation strategies cannot be found this use may have to be removed from labels. Application to drains will be considered below.

Runoff from cotton fields

The use of diuron in cotton relates to use before sowing to treat weeds and it is used for irrigation channels and drains within the cotton irrigation areas. The concentration of diuron in each season from 1991-2 to 1998 has been measured by the NSW Department of Land and Water Conservation program in Northern NSW. The maximum measured levels of diuron from weekly/fortnightly grab samples in the rivers from Northern NSW ranged from 0.4 to 23 μg/L, generally above acceptable levels for the protection of algae. Monitoring the Gwydir River during a heavy rainfall event over 3 days gave maximum levels of diuron of 24 μg/L, which then declined to 6 μg/L. Calculations of the risk to the river ecosystem indicated that sensitive algae species in the river could have been affected but any effected algae would recover from one such challenge. However, if there were several such runoff events, all resulting in concentrations of diuron >1.2 μg/L (Q = 0.5), which is considered to be likely given the levels of diuron in the grab samples, then algal populations could be affected.

The level of diuron in sediments from drains draining cotton fields in Queensland is relatively high and approaches that obtained from sugarcane fields. While there were no data on levels of diuron in sediment in NSW, there was no reason not to suppose that the drains in NSW have similar levels of diuron.

It is concluded that use of diuron in cotton fields and to treat channels and drains in the cotton growing areas of Australia results in levels of diuron in rivers that are likely to cause environmental impacts, although the extent of any impacts is not known at this stage. Algae are at risk as well as aquatic plants and terrestrial non-target plants growing in the contaminated sediments from cotton applications or use of diuron to treat drain and channels. This is a significant use in cotton areas and therefore, the high rates used for channels and drains need to be significantly reduced.

In order to reduce the environmental risk from application to cotton fields (assuming that approximately half of the observed diuron in the rivers is due to applications to cotton fields), risk mitigation strategies need to be found to reduce the environmental load. This may include rate reductions and changes in industry practices. If no changes to industry practices can be found it is recommended that the maximum application rate for diuron be reduced to 0.9 kg ac/ha. If two applications are to be made, these should be as a split rate with total annual application not exceeding 0.9 kg ac/ha. Efficacy of such rate reductions will also need to be considered. If risk mitigation strategies cannot be found this use may have to be removed from labels. Application to drains will be considered below.

Runoff from citrus orchards

Diuron is used for weed control in citrus at rate of between 1.8-3.6 kg a/ha and in irrigation channels during winter. Sampling of the main drains over a 2 year period in the Murrumbidgee Irrigation Area (MIA) showed that in 41% of all samples taken diuron was detected (>0.05 μg/L) with a maximum of 9.5 μg/L. Monthly samples of surface water gave a maximum concentration of 5.4 μg/L. These peak levels are above the EC50 for algae and indicate that there is an environmental risk to the water ecology during these periods. Samples taken of tile (sub-surface) drains at horticultural, mainly citrus, farms in the MIA in January, May and August gave a maximum concentration of 28 μg/L from the August sample. As these samples were taken from the tile drain pump-outs, there should be further dilution in the receiving waters. Nevertheless, these results were considered to indicate that diuron is likely to pose a potential unacceptable environmental risk in this area.

The surface runoff from a citrus farm (normally grown on sandy soils or other soils with good drainage) following the first irrigation event (although runoff from a storm event had already occurred following herbicide application) after application of diuron at 4.5 kg ac/ha (above the current label rate of 3.6 kg ac/ha) had concentrations between 1.2 to 20 μg/L, with an average concentration of 10.9 μg/L, which was considered to be unacceptable. Grab samples for Mirrool Creek, just above Barren Box Swamp, showed diuron was present most of the time but at low levels and below levels were there was an acute risk to algae. Daily automatic monitoring of Mirrool Creek gave low levels of diuron but similar monitoring of Little Mirrool Creek gave mean levels of 1.19 μg/L with range 0.1 and 7.5 μg/L. Calculations showed that the mean levels in Little Mirrool Creek are unacceptable. As all samples from both creeks had diuron present above the detection limit (0.05 μg/L), there was a chronic risk from diuron.

It is concluded that the peak measured levels of diuron in the MIA are above acceptable levels. Given that daily sampling of two major creeks in the area showed high levels of diuron, together with chronic exposures, the use of diuron should be reduced. Again, there are two sources of diuron involved: direct application to the drains and application to citrus (the risk from use in drains will be addressed below).

In order to reduce the environmental risk from application in citrus, to reduce the maximum risk quotient in Little Mirrool Creek to <1.0 for algae, noting the crop is grown on sandy or other well draining soils, risk mitigation strategies need to be found to reduce the environmental load. This may include rate reductions and changes in industry practices. If no changes to industry practices can be found it is recommended that the maximum application rate for diuron be reduced to 0.9 kg ac/ha. If two applications are to be made, these should be as a split rate with total annual application not exceeding 0.9 kg ac/ha. Efficacy of such rate reductions will also need to be considered. If risk mitigation strategies cannot be found this use may have to be removed from labels.

Runoff from horticultural crops

From the runoff modelling there is likely to be unacceptable environmental impact from all applications equal to or greater than 1.8 kg ac/ha, with the crops not already mentioned mainly being horticultural crops (apples, pears, bananas, pawpaw, coffee, grapes and pineapples). Many of these crops are grown and treated with diuron in a similar way to citrus. As the current use in citrus is considered to pose an unacceptable environmental risk, the use of diuron according to the current labels in these crops is also likely to result in an unacceptable environmental risk. Several of these crops (bananas, pawpaw, coffee, and pineapples) are grown in the tropics. Thus, they could affect the Great Barrier Reef Lagoon.

In order to reduce the environmental risk from application to horticultural crops (based on the runoff model and considering the measured levels in rivers from citrus applications), risk mitigation strategies need to be found to reduce the environmental load. This may include rate reductions and changes in industry practices. If no changes to industry practices can be found it is recommended that the maximum application rate for diuron be reduced to that recommended for sugarcane, *i.e*. maximum application of 0.9 kg ac/ha. If two applications are to be made, these should be as a split rate with total annual application not exceeding 0.9 kg ac/ha. Efficacy of such rate reductions will also need to be considered. If risk mitigation strategies cannot be found thes uses may have to be removed from labels.

Runoff from right-of-ways commercial and industrial areas

While there is little or no information on concentration of diuron in runoff waters in Australia resulting from application to rights-of-way, commercial and industrial areas, there is limited information from overseas. In California, diuron was applied at 3.6 kg ac/ha to the edge of a highway. Runoff was measured during both simulated and natural rainfall. At two sites, the concentration of diuron ranged from 144-1175 and 348-1770 μg/L with mass of diuron leaving the plots accounting for up to 5.4% of the applied diuron. In the UK the routine monitoring of pesticides show that concentrations of diuron reached 51 μg/L in freshwater, with the higher levels occurring in urban areas where it was used to control weeds in rights-of-way situations (diuron is not registered for use in agricultural crops in the UK).

It is concluded that these two overseas studies noted here clearly indicate that runoff from rights-of-way, commercial and industrial areas where diuron has been used is contaminated with diuron and at concentrations of concern. In order to reduce the environmental risk from application to right-of-way commercial and industrial areas, risk mitigation strategies need to be found to reduce the environmental load. Using the runoff model and assuming average Kd, the maximum application rate recommended is 1.8 kg ac/ha per annum for rights-of-way, commercial and industrial areas noting that algae are expected to recover from single exposures. As there needs to be a recovery period for algae, it is recommended that there is at least 6 months between multiple applications at split rates (0.9 kg ac/ha). Efficacy of such rate reductions will also need to be considered. If risk mitigation strategies cannot be found this use may have to be removed from labels.

Irrigation channels and drainage ditches

While there is little or no information on concentrations of diuron in runoff waters in Australia for from use of diuron in irrigation channels and drainage ditches, there is information from overseas. In the USA, a field study was conducted on the dissipation and transport of diuron following application to tops and sides of drainage ditches at 13.4 kg/ha. The rainfall over the study period was considered typical of high rainfall areas on the tropical and sub-tropical coast fringe in Australia. There were significant levels of diuron in the ditch water due to runoff from the treated areas. Using this USA data and allowing for dilution in receiving water (1:2), calculation show that there was a high risk to algae at concentrations of 3.6 kg ac/ha and above that last for at least 34 days. At higher rates (10 kg ac/ha), the risk lasts for approximately 7 weeks, constituting unacceptable chronic exposure.

In the same US study, an automatic sampler was used to take samples during flow events over a 24-hour period. The peak concentration was 130 μg/L, which occurred 5 days after treatment and remained between 110-130 μg/L for 20 hours. The last positive sample (>10 μg/L) occurred 93 days after treatment. Using a dilution factor of 1:2 for receiving waters,

this corresponds to peak concentrations of 37-43 μg/L and levels of up to 3.3 μg/L over approximately 90 days, above the relevant EC50 for algae. These results showed that diuron will runoff from treated area during rainfall events at concentrations in the runoff water at levels of concern. Considering the actual concentration of diuron could be higher at other locations due to weaker adsorption (Kd varied from 2.9 to 28) and larger areas sprayed (data is from just 0.048 ha treated), this was considered an unacceptable risk to algae, the primary tropic level in all aquatic ecosystems. As the treatment area in this study was small and limited to the slopes and tops of the ditch compared to typical Australian situations where kilometres of irrigation ditches are treated, including the bottom of the channels, the risk under Australian conditions is expected to be higher.

To assess the risk under Australian conditions, a simple irrigation ditch model was used for the treatment of a channel. If the channel is filled, held (72 hours) and then drained (flushing the channel), as given by the label directions, the EEC was calculated as 0.25 mg/L of diuron for the lowest label rate (10 kg ac/ha) and 1.8 mg/L at the highest rate (72 kg ac/ha). Allowing a 1:2 dilution in receiving water, there is a risk to invertebrates and an extreme risk to algae even at the lowest rates.

The model shows that changing the management practices and just treating the side of the channel and reducing the application rate, reduced the risk to reach a more acceptable environmental level. In order reduce the environmental risk the to the maximum rate would need to be reduced to 0.45 kg ac/ha or less per annum. As this rate of application of diuron is likely to be not efficacious it is recommended that application to channels and drains be removed from all approved labels.

4.2.2 Spraydrift (aquatic risk)

Ground-rig application

Two models were used to evaluate the spraydrift from ground-rig application of diuron: Ganzelmeier and Agdrift. Calculations using Ganzelmeier showed that there is unlikely to be a hazard to fish and invertebrates but that there is a high risk to algae, which could be mitigated with buffers for broadacre, orchards and sugarcane but not for high application uses to rights-of-way, commercial area and irrigation/drainage channels. The result for duckweed broadly followed the algae results with high risks from use to rights-of way, commercial area and irrigation/drainage channels. The AgDrift models showed there is a higher risk to algae (and duckweed) than the Ganzelmeier model. The difference between the two models can be explained by noting that AgDrift is based on typical US usage patterns, while Ganzelmeier is based on European usage under ideal conditions that sought to minimise spraydrift (best agricultural practice).

In order to protect algae species (Q ~0.5), a spraydrift buffer of 100 metres would be required for orchard, broadacre and sugarcane crops (50 metres for late application to sugarcane, just before canopy closure, when the dense cane itself will limit any spraydrift). No buffer would be protective for rights-of way, commercial area and irrigation/drainage channels at the maximum rates allowed on currently approved labels.

Aerial application

Currently approved labels carry instructions for aerial application to wheat and other winter grains at rates up to 280 g ac/ha, which calculations showed present a high risk to algae. To mitigate this risk, a medium spray together with a spraydrift buffer of 750 metres or with a coarse spray with a spraydrift buffer of 500 metres would be required.

Aerial application of diuron is also approved for cotton defoliation together with other herbicides. Calculations clearly indicated that when used as instructed this product presents a risk to alga. To mitigate this risk, a spraydrift buffer of 600 metres would be required with fine sprays.

4.2.3 Leaching

Use of the laboratory data for persistence and sorption indicated that diuron is a transitional to probable leacher in a range of soils. Field lysimeter data showed only limited leaching, which was confirmed by field studies. Field studies that were conducted in Europe and USA showed very limited leaching of diuron with no detections below 30 cm except at one sandy site in California where diuron showed leaching down to 60 cm.

Australian field studies conducted in sugarcane at Bundaberg detected diuron in ground water at maximum concentrations of ~6 μg/L. Diuron was also found in the Murrumbidgee Irrigation Area (MIA) in tile drains at levels up to 28 μg/L. As these tile drains are at approximately 2 metres deep, diuron appears to be leaching in these well draining sandy soils in the MIA (diuron is mainly used in citrus grown on well draining soils). As the previous recommendations to reduce the application rates of diuron to a quarter of current rates will also reduce the concentration of diuron that leaches to groundwater by a quarter, a separate recommendation to control leaching is not considered necessary.

4.2.4 Multiple Applications

While the model analysis of the risk to the environment is based on single applications, the use of field data has eliminated the need to recalculate the models to allow for an extra application. Considering the relative long degradation rates in some soils (half-lives up to 372 days) and water/sediment systems (half-lives up to 232 days), additional applications of diuron will significantly increase the environmental risk. It is recommended that unless otherwise stated, only one application of diuron should be allowed per season/year on the label. However, if two applications are to be made, these should be as a split rate with total annual application not exceeding the maximum label rate.

4.2.5 Antifouling Paints

The use of diuron on vessels < 25 metres in length has been revoked in the UK, Demark and the east coast of Sweden. The use of diuron in antifouling paint was modelled using a large marina situated on the coast near the GBR. The predicted steady state concentration in the marina was calculated as 3.46 μg/L. This would present a risk to green algae, seagrass, crustal algae and corals within the marina. As a marina generally does not have high conservation values, this is of minor concern. However, allowing for a 1:10 dilution outside the marina, the concentration outside of the marina is still above the LOEC for seagrasses, crustal coralline algae and corals. In addition, there is a potential hazard from localised environmental exposure during paint application and during washdown or preparation of existing surfaces for repainting. Release of diuron during application and maintenance operations is likely to be localised to areas such as slipways and drain outlets in facilities lacking good control measures. The paint flakes may accumulate in sediment near the release points and any remaining diuron would be released slowly and potentially affect algae, seagrasses etc in the immediate vicinity.

The Australian data for levels of diuron in marine sediments and seagrasses showed positive detections in areas not closely associated with sugarcane: the subtidal sediments outside of the Fitzory River and in intertidal seagrass at Pallarenda. Both the Fitzory River and Pallarenda

sites are near large metropolitan centres where diuron could be used on rights-of-way, industrial and commercial areas, as well as antifouling uses in marina and ports *etc*. In addition, the Fitzory River has a substantial area of the catchment used for horticultural crops where diuron can also be used.

It is concluded that antifouling use of diuron makes a contribution of the overall load of diuron in the Great Barrier Reef Lagoon, although the field evidence to support this is confounded by other non-agricultural uses of diuron. However, the level of contribution is expected to be relatively small compared to that coming from agriculture. Therefore, retention of the use of diuron in antifouling paints is considered acceptable at this time.

4.2.6 Risk to Terrestrial Organisms

Assessment of the currently approved labels concluded that there was a low risk to birds from contamination of avian food items by the use of diuron when used at 3.6 kg ac/ha. The risk rises to be unacceptable at rates of 16.5 kg ac/ha or higher. This corresponds to uses in non-agricultural situations (rights-of-way, commercial and industrial areas; irrigation and drainage channels). No acute or chronic hazard is expected for earthworms, honeybees, most arthropods and soil micro-organisms.

4.2.7 Risk to Terrestrial Plants

When used according to label directions, the exposure to non-target vegetation should be limited to spraydrift or runoff and runoff has already been examined. The US EPA has recently set its level of concern for terrestrial plants using EC25 data. In tests using dicotyledon and monocotyledon seedlings, the most sensitive was tomato seedlings with EC25 of 2.2 g/ha but another five species (wheat, pea, soybean, cucumber and sugar beet) were also very sensitive.

For aerial application to wheat at maximum rates (280 g ac/ha), calculations using AgDrift show that there is a risk to terrestrial plants to 620 metres away from spraydrift. For ground rig applications to broadacre crops (maximum rate 1.8 kg ac/ha), both the Ganzelmeier and AgDrift models show a high risk at 20 and 150 metres away respectively. As the endpoint is not mortality but reduced shoot weight, these results are conservative.

The quotients for effects on non-target plants from spraydrift underline the need for care when using diuron. There are few, if any, reports concerning damage to non-target plants from using diuron, which would appear to show that users are well aware to the toxicity of diuron to non-target plants and take appropriate precautions or that plants affected by spraydrift recover and there is no long tem damage. However, considering the very low application rate, this drift is unlikely to significantly add to the extent of runoff, the main focus of this assessment.

4.3 International Regulatory Status

Diuron products are registered in many countries, including New Zealand, United States, Canada, Europe and the United Kingdom.

4.3.1 Netherlands

There is a review of the fate and ecological effects of diuron conducted by the Dutch RIVM The report found that diuron was hydrolytically stable, degraded with UV light and was moderately stable in aerobic soil with a half-life of 79-108 days. In field studies, half-lives

ranged from 60 to 365 days. Leaching studies gave mixed results with some studies reviewed showing leaching (0-56% recovered in leachate, 90 cm soil columns) while others showed no leaching below 5 cm of soil. Adsorption studies gave a K_{om} of 190-340 (Koc of 330-595). Bioaccumulation was limited in laboratory studies with BCFs of 15-85, although one field test gave a BCF of 190-300.

The review found diuron was practically non-toxic or slightly toxic to birds, moderately toxic to most aquatic animals (fish and aquatic invertebrates) but highly toxic to one species of scud. Algae were very sensitive to diuron with an EC50 of 7.9 µg/L for one species.

4.3.2 European Union

Diuron was to be reviewed in the second stage of the European Union (EU) review program that was considering all chemicals registered in the EU before 26 July 1993. The data submission for the second stage of the EU review closed on 30 April 2002. The review is to be conducted by the Danish agricultural chemical regulator. A final report is not yet available. Diuron is currently approved in the UK, but it has been prohibited in Sweden since 1993 for health and environment reasons.

In recent years, Denmark has prohibited the use of diuron in anti-fouling paints for boats in order to protect the aquatic environment. The Statutory Order issued by the Ministry of Environment and Energy stated that it is not permitted to import, sell or use anti-fouling bottom paint containing the biocide diuron on ships shorter than 25 metres (Fact Sheet No 24: Anti-fouling bottom paint, 07/01/2003).

Following an incident where it was claimed that irrigation water contaminated by pesticides from railway tracks had caused crop damage, the German Railways (DB) stopped using diuron for weed control on railway lines in 1996. DB switched to glyphosate and trialled alternate means of control such as superheated steam. The German federal parliament subsequently imposed a legal ban on the use of diuron on railways, due to high levels of diuron in groundwater. Use of diuron has been restricted in Sweden with use on railway embankments banned after 1994 (Torstensson *et al* 2002).

4.3.3 United States Environmental Protection Agency (USEPA) activity

The US EPA conducted a review of diuron under its Reregistration Eligibility Decision [RED] program and published a draft RED environmental report for comment in March 2003 (US EPA, 2003). The uses for diuron in the US are similar to those in Australia. Application in the US can be aerial and by ground boom spraying, applied mainly at pre-emergence. The highest application rates of 7.2-13.5 kg ac/ha (6.4-12 lb ac/A) is for weed control in orchards and non-agricultural sites as spot or row treatments.

The US EPA review concluded that diuron is stable to hydrolysis and photolysis, is very persistent on soil and did not readily degrade. It is moderately mobile and has been found in both surface and ground waters. The major metabolites are sequentially demethylated compounds, which have no herbicidal effects. The review found diuron was practically non-toxic or slightly toxic to birds and mammals; moderately toxic to most aquatic animals (fish and aquatic invertebrates) but highly toxic to one species of fish (cutthroat trout) and scud. Terrestrial and aquatic plants are very sensitive to diuron. Based on screening level risk assessments, diuron poses a potential risk to terrestrial and aquatic animals and a higher risk to terrestrial and aquatic plants. The RED requested several additional environmental fate and toxicity studies, several for diuron but the majority for the metabolite 3,4-DCA (3,4-dichloroaniline).

There were no recommendations at this stage due to the risk analysis having only been conducted to a screening level.

4.3.4 **UK Department of Environment, Food and Rural Affairs** (formerly, Ministry for Agriculture, Fisheries and Forestry)

As part of a review of all chemical used in marine anti-foulants, the UK Advisory Committee on Pesticides took the decision to cancel the use of diuron in antifouling treatments at its September 2000 meeting, due to environmental and human health concerns. Concerns regarding human health were raised because the available exposure data showed an insufficient margin of safety when compared with the NOAEL. There are no ADI or ARfD to be set by the Joint FAO/WHO Meetings on Pesticide Residues (JMPR).

The UK Advisory Committee on Pesticides reviewed antifouling use of diuron and took the decision to revoke the use of diuron on all vessels due to environmental and human health concerns (ACP, 2002 and ACP 2000). Significant levels of diuron were detected in water and sediment throughout UK estuary and coastal sites as well as freshwater sites.

4.4 Public submissions to the review

- Stewart Sutherland, Chairman of the Temperate Grass Seed Producers group.
  Letter (via email) outlining the case to retain diuron for use by these users.

  Action: Concerns noted.

- Robert Packett (via email), Department of Natural Resources and Mines, Queensland Government. Letter outlining additional reports on diuron used in sugar production.

  Action: All of the reports mentioned by Robert Packett have been evaluated in the environmental assessment.

- Ralph Dowling, EPA, Queensland Government. Copy of the report entitled 'Investigation of Mangrove Dieback, Pioneer River Estuary, Mackay'.

  Action: Report evaluated in the review.

- Bruce Simpson, Department of Natural Resources and Mines, Queensland Government. Copy of the report entitled 'Offsite Movement of Agrochemicals in Tropical Sugarcane Production'.

  Action: Report evaluated in the review.

- Bruce Simpson, Department of Natural Resources and Mines, Queensland Government. Copy of the reports entitled 'Pesticide Transport in Sugar Production Systems' and 'Extension Workshop, Bundaberg, Australia 8-9 May 2001.

  Action: Report evaluated in the review.

- Bureau of Sugar Experiment Stations (BSES). The letter outlines the case for the importance of diuron to Canegrowers (efficacy and economic arguments); voluntary changes to management practices (green trash blankets etc); arguments that diuron is not

affecting mangroves or other non-target vegetation and concern over the ANZECC/ARMCANZ trigger values for diuron.

Action: These concerns are noted and have been addressed throughout the review.

- Eoin S Wallis, CEO, Canegrowers. Repeat of the BSES letter above.

- Alicia Bell, Centre for Marine Studies, University of Queensland. Letter (via email) enclosing executive summary of most recent report regarding the dieback of mangroves at MacKay.

  Action: Report evaluated in the review.

- Mitchell Carl, Department of Natural Resources and Mines, Queensland Government. Member of the MacKay Health Waterways Program. A Copy of report entitled 'Pioneer River Catchment Event Based Water Quality Sampling' together with laboratory reports and hydrological data on the flow event sampled.

  Action: Report and data evaluated in the review under report entitled 'River Water Quality in the Pioneer Catchment on February 14-15, 2002'. See below.

- Clive Rogers, Chair, Mackay Whitsunday Regional Strategy Group Inc, Department of Natural Resources and Mines, Queensland Government. Copy of report entitled 'River Water Quality in the Pioneer Catchment on February 14-15, 2002'.

  Action: Report evaluated in the review.

- Ross Jones, Bermuda Biological Research Station . Copy of the papers entitled 'Testing the 'Photoinhibition' model of coral bleaching using chemical inhibitors' and 'Phytotoxicity evaluation of Photosystem-II (PSII) herbicides (from antifouling paint and agricultural sources) on scleractinian coral' and 'The effects of the herbicides diuron and atrazine on corals of the Great Barrier Reef (Australia)'.

  Action: Report considered during the assessment.

- Phil Hales, Fisheries and Aquaculture Development Unit, Queensland Department of Primary Industries. Copy of final report entitled 'Mackay Mangrove Dieback – Investigations in 2002 with Recommendations for Future Research, Monitoring and Management" by Duke *et al* (2003).

  Action: Report evaluated in the review.

5. REVIEW RECOMMENDATIONS

On the basis of the evaluation of the submitted data and information, the following recommendations are made with regard to the continued approval of the active constituent diuron, registration of diuron products and label approvals in Australia.

5.1 Affirm approvals of the active constituent

The APVMA is satisfied that provided the conditions to which an approval is currently subject are complied with, the continued use of, or any other dealings with the active constituent diuron would not be likely to have an effect that is harmful to human beings. The APVMA recommends that active constituent approvals listed in Table 8 be affirmed.

Table 8: Active constituent approvals to be affirmed.

Approval number	Approval holder
44120	Lanxess Pty Ltd
44277	Nufarm Australia Ltd
44278	Lanxess Pty Ltd
44476	Du Pont (Australia) Ltd
44477	Du Pont (Australia) Ltd
44484	Makhteshim-Agan (Australia) Pty Ltd
44507	Ancom Australia Pty Ltd
44588	United Phosphorus Ltd
45535	Griffin Corporation Australia Pty Ltd
47275	Mastra Corporation Pty Ltd
52458	Nufarm Australia Ltd
52556	Farmoz Pty Limited
52901	Rotam Australasia Pty Ltd
54623	Becot Pty Ltd T/AS Imtrade Commodities
55233	4Farmers Pty Ltd
56686*	Agrogill Chemicals Pty Ltd
56728*	Echem (Aust) Pty Limited
56858*	Du Pont (Australia) Ltd

* Active constituents approved after the commencement of the review that are subject to the outcomes of the review.

5.2 Label Variations

5.2.1 Agricultural Products

5.2.1.1 Sugarcane

Studies submitted to the review have shown measured levels of diuron in the Pioneer River due to runoff, as well as in sediments in the drains and river/estuary systems that drain sugarcane growing regions, are higher than that acceptable to protect algae and aquatic plants, including mangroves and seagrasses situated where these sediments deposit. There is a growing body of evidence to show that diuron in sediments in Pioneer River estuaries has adversely affected mangroves.

Based on the measured sediment concentrations offshore, the predicted chronic concentrations near the mouths of wet tropics rivers that drain sugarcane areas are also likely to unacceptably impact upon the inshore reef system of the Great Barrier Reef Marine Park (GBRMP), including crustose coralline algae and corals.

In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the uses may have to be deleted from labels. A 75% reduction in the maximum annual application of diuron in sugarcane crops is needed to reduce the environmental load to an acceptable level.

The required 75% reduction in total application can be achieved by considering a number of options. One mechanism would be to maintain the current industry practices and reducing the maximum application rate to 0.9 kg ac/ha per annum. In this case if two applications are to be made, these should be as a split rate with total annual application not exceeding 0.9 kg ac/ha. This would be dependant on whether the lower rate is efficacious.

Alternatively, a combination of changes in industry practices (such as, band spraying and removing non crop use) in combination with a reduction in the maximum application could similarly result in the required 75% reduction.

The APVMA will be consulting with stakeholders before determining the final recommendations for diuron uses in sugarcane.

5.2.1.2 Cotton

It has been determined that levels of diuron found in the drains and rivers of cotton growing areas in NSW and Queensland are likely to cause unacceptable environmental impacts. Algae, aquatic plants and terrestrial non-target plants growing in sediments contaminated by applications to cotton fields or treatment of irrigation drains and channels (a significant use in cotton areas) are potentially at risk.

In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the use may have to be deleted from labels.

One mechanism would be to maintain the current industry practices and reduce the maximum application rate to 0.9 kg ac/ha per annum. In this case if two applications are to be made, these should be as a split rate with total annual application not exceeding 0.9 kg ac/ha. This would be dependant on whether the lower rate is efficacious.

Alternatively, a combination of changes in industry practices in combination with a reduction in the maximum application could similarly result in the required reduction.

The APVMA will be consulting with stakeholders before determining the final recommendations for diuron use in cotton.

5.2.1.3 Citrus

The main production use of diuron in the Murrumbidgee Irrigation Area (MIA) is in citrus. Measured levels of diuron in the MIA are above acceptable levels and thus likely to impact on algae and aquatic plants. Evidence has also shown that diuron is leaching into subsurface tile drains.

In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the use may have to be deleted from labels.

One mechanism would be to maintain the current industry practices and reduce the maximum

application rate to 0.9 kg ac/ha per annum. This would be dependant on whether the lower rate is efficacious. Alternatively, a combination of changes in industry practices in combination with a reduction in the maximum application could similarly result in the required reduction.

The APVMA will be consulting with stakeholders before determining the final recommendations for diuron use in citrus.

5.2.1.4 Horticultural crops

Runoff modelling has determined that there is likely to be unacceptable environmental impact from horticultural crops (apples, pears, bananas, pawpaw, coffee, grapes and pineapples) at current label application rates

In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the uses may have to be deleted from labels.

One mechanism would be to maintain the current industry practices and reduce the maximum application rate to 0.9 kg ac/ha per annum. This would be dependant on whether the lower rate is efficacious.

Alternatively, a combination of changes in industry practices in combination with a reduction in the maximum application could similarly result in the required reduction.

The APVMA will be consulting with stakeholders before determining the final recommendations for diuron use in these crops.

5.2.1.5 Broadacre crops

The use of diuron in broadacre crops (wheat, barley, triticale, oats, lucerne, lupins and grass seed crops) does not present an unacceptable risk to the environment. No changes to this use are required.

5.2.1.6 Irrigation channels and ditches

Based on a simple model, it was found that there was a high risk from run-off to algae and aquatic plants when diuron is used to control weeds in irrigation and drainage ditches at current label rates. This finding is supported by an overseas study that examined the use of diuron in drainage ditches. This shows that the measured level of diuron in run-off waters would be toxic to algae over a considerable period of time.

As a result of these findings it is recommended that use of diuron in irrigation channels and drainage ditches be deleted from labels.

5.2.1.7 General purpose non-crop uses

In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load from non-crop uses (eg, roadways, around sheds). To reduce the environment risk the maximum annual application rate, is recommended to be reduced to 1.8 kg ac/ha. As there needs to be a recovery period for algae, it is recommended that there is at least 6 months between multiple applications at split rates (0.9 kg ac/ha). This would be dependant on whether the lower rate is efficacious. If such

strategies cannot be found the use may have to be deleted from labels.

5.2.1.8 Summary Table

A summary of the above label proposed label variations by crop is listed in Table 9.

Table 9: Summary of proposed label variation by situation.

Situation	Recommendations
BROADACRE CROPS	
Barley	No concerns associated with use – **Retain use**
Cereal rye	No concerns associated with use – **Retain use**
Cotton	Unacceptable risk to the environment, recommended reduction in the maximum application rate **– Retain and Vary use**
Cotton Defoliant	Unacceptable risk to the environment, recommended reduction in the maximum application rate **– Retain and Vary use**
Lucerne (established for 1 year or more)	No concerns associated with use – **Retain use**
Lupins	No concerns associated with use – **Retain use**
Oats	No concerns associated with use – **Retain use**
Perennial grass and seed crops	No concerns associated with use – **Retain use**
Phalaris cultivars sirolan and sirose	No concerns associated with use – **Retain use**
Sugar cane	Unacceptable risk to the environment, recommended reduction in the maximum application rate **– Retain and Vary use**
Triticale	No concerns associated with use – **Retain use**
Wheat	No concerns associated with use – **Retain use**
HORTICULTRAL CROPS	
Apples and Pears (established at least 1 year)	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
Bananas	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
Citrus	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
Coffee	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
Pawpaws (not for use on trees under 9 months old)	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
Pineapple	Unacceptable risk to the environment recommended reduction in the maximum application rate **– Retain and Vary use**
GENERAL NON CROP USES	
Bore drains	Unacceptable risk to the environment – **Delete uses from labels**
Driveways, paths, lanes, drains, ditches, fence lines, car parks, factory sites, tennis courts	Unacceptable risk to the environment, recommended reduction in the maximum application rate **– Retain and Vary use**
Irrigation channels, Drainage ditches	Unacceptable risk to the environment – **Delete uses from labels**
Right-of-way, commercial and industrial areas,	Unacceptable risk to the environment, recommended reduction in the maximum application rate **– Retain and Vary use**

5.2.1.9 Other Label Uses.

Six crops included on approved labels (asparagus, summer fallow, peas, vineyards (vines over 3 years), duboisia and ornamentals (daffodils, gladioli and tulips)) are considered to be minor uses of diuron with small production areas. There have been no reported incidents of run-off or off-target damage from the use of diuron on these crops. Taking into consideration currently available information these uses are considered not to pose an unacceptable environmental risk and uses are recommended to be retained.

5.2.1.10 Proposed Buffer Zones.

There is an unacceptable risk due to spraydrift (from fine sprays and current high label rates) when applied by air to winter cereals and cotton. Current labels do not include any instructions for spraydrift buffers or directions on how to minimise the risk from spraydrift (*i.e.*, spray qualities).

In the absence of information indicating an acceptable risk to aquatic ecosystems from aerial and ground application of diuron, it is recommended that labels carrying instructions for aerial and ground rig application as outlined below.

Ground rig All crops: 100 m buffer.
Sugarcane: 50 m buffer only when applied immediately before canopy closure.

Aerial All crops: 750 m buffer with medium spray.
All crops: 500 m buffer with coarse spray.
Cotton (defoliant use only): 600 m with fine spray.

The APVMA will be seeking advice from aerial and ground spray groups in determining the final recommendations to reduce the risk of spraydrift.

5.2.1.11 Proposed Label Variations

As a result of the information examined in the assessment, the APVMA is not satisfied that the labels of the products in Table 10 contain adequate instructions and correct information. The APVMA is satisfied that the conditions of label approval for the products in Table 10 can be varied in such a way so that they contain adequate instructions in accordance with s.14(3)(g) of the Agvet Codes (as proposed in sections 5.2.1.1 – 5.2.1.10).

Table 10: The following registered products and label approval numbers are affected by the proposed label changes describe in 5.4.

Product Number	Product name	Registrant	Label Approval Numbers
31253	Dupont Krovar DF Herbicide	Dupont (Australia) Ltd	31253/4732
31275	Agspray Kill-All Total Herbicide	Agspray Chemical Co. Pty Ltd	Ψ
31682	Agspray Die-It 800 Wettable Powder Diuron Herbicide	Agspray Chemical Co. Pty Ltd	Ψ
31685	Bayer Diuron 500 SC Liquid Herbicide	Lanxess Pty Ltd	31685/1103^
31702	Nufarm Flowable Diuron Liquid Herbicide	Nufarm Australia Ltd	31702/0200
39201	Nufarm Diuron 900 DF Herbicide	Nufarm Australia Ltd	39201/0802
45177	Bayer Diuron 900 WG Herbicide	Lanxess Pty Ltd	45177/0204^
45441	Macspred Dymac G Granular Herbicide	Macspred Pty Ltd	45441/02
45772	Diurex WG Herbicide	Crop Care Australasia Pty Ltd	45772/0101

45909	Dupont Velpar K4 DF Herbicide	Dupont (Australia) Ltd	45909/02
46812	Farmoz Diuron 900 WDG Herbicide	Farmoz Pty Ltd	46812/02
47242	Dropp Ultra Cotton Defoliant	Bayer Cropscience Pty Ltd	47242/1102
47485	Dupont Karmex DF Herbicide	Dupont (Australia) Ltd	47485/0598
47661	Striker 500 SC Selective Herbicide by Sanonda	Sanonda (Australia) Pty Ltd	47661/02
47764	Macspred Kromac Industrial Herbicide	Macspred Pty Ltd	47764/02
48052	Farmoz Diuron 800 Flowable Herbicide	Farmoz Pty Ltd	48052/01
48974	Zee-Uron 800 WP Herbicide	United Phosphorus Ltd	48974/01
49104	Summit Diuron Herbicide	Sumitomo Australia Ltd	49104/01
49540	Zee-Uron 500 SC Herbicide	United Phosphorus Ltd	49540/01
49541	Zee-Uron 900 WG Herbicide	United Phosphorus Ltd	49541/01
50020	Generex Diuron 500SC Herbicide	Generex Australia Pty Ltd	50020/1197
50258	Dupont Diuron DF Herbicide	Dupont (Australia) Ltd	50258/1197
50481	Agcare Biotech Flowable Diuron 500 SC Herbicide	Agcare Biotech Pty Ltd	50481/0398
51253	Country Diuron 500 Flowable Herbicide	A&C Rural Pty Ltd	51253/0399
51613	Dupont Comanche Herbicide	Dupont (Australia) Ltd	51613/0999
51852	Griffin Diuron WG Herbicide	Griffin Corporation Australia Pty Ltd	51852/0499
52176	Farmoz Diuron 500 Flowable Herbicide	Farmoz Pty Ltd	52176/0100
52342	Chemag Diuron Liquid Herbicide	Chemag Pty Ltd	52176/0100
52532	Crop Care Diuron Flowable Herbicide	Crop Care Australasia Pty Ltd	52532/0200
52672	Sipcam Diuron 500 SC Herbicide	Sipcam Pacific Australia Pty Ltd	52672/0800
53042	Agcare Biotech Diuron 900DF Herbicide	Agcare Biotech Pty Ltd	53042/0600
53046	Smart Diuron 500 Flowable Liquid Herbicide	Agcare Biotech Pty Ltd	53046/0600
53812	Chemag Diuron 900WG Herbicide	Chemag Pty Ltd	53812/0901
54182	Agricultural Product Services Diuron/Hexazinone DF Herbicide	Agricultural Product Services Pty Ltd	54182/0501
54183	Agricultural Product Services Diuron/Hexazinone WP Herbicide	Agricultural Product Services Pty Ltd	54183/0501
54352	Rotam Diuron 500SC Herbicide	Rotam Australasia Pty Ltd	54352/0801
54358	Nufarm Stamina DF Herbicide	Nufarm Australia Ltd	54358/1003^
54408	Farmoz Bobcat Combi Herbicide	Farmoz Pty Ltd	54408/0801
54662	APS Diuron/Hexazinone WG Herbicide	Agricultural Product Services Pty Ltd	546620702
55094	Country Diuron 900 WG Herbicide	A&C Rural Pty Ltd	55094/0102
55561	Conquest Diuron 900 WG Herbicide	Conquest Agrochemicals Pty Ltd	55561/0302
55612	Kenso Agcare Diuron 500 Herbicide	Kenso Corporation (M) SDN BHD	55612/0102
56349	4 Farmers Diuron 500 SC Liquid Herbicide	4 Farmers Pty Ltd	56349/0204^
56602*	Halley Diuron 500sc Herbicide	Halley International Enterprise (Australia) Pty Ltd	56602/0603^
57291*	Agan Diuron 900 Wg Herbicide	Makhteshim-Agan (Australia) Pty Limited	57291/0403^
57299*	Agan Diuron 800 Wg Herbicide	Makhteshim-Agan (Australia) Pty Limited	57299/0303^
57728*	Agan Diuron 500 Sc Herbicide	Makhteshim-Agan (Australia) Pty Limited	57728/0503^
57823*	Echem Diuron 500 Sc Herbicide	Echem (Aust) Pty Limited	57823/0204^
57886*	Summit Diuron 900wg Herbicide	Summit Agro Australia Pty Ltd	57886/1003^
57934*	Runge Agrichems Diuron 900 Wg Herbicide	Runge Agrichems Pty Ltd	57934/0104^
58128*	4Farmers Diuron/Hexazinone Wg Herbicide	4Farmers Pty Ltd	58128/1103^
58440*	Tradewyns Diuron 500 Flowable Herbicide	Ospray Pty Ltd	58440/0304^
58451*	Tradewyns Diuron 900 Wg Herbicide	Ospray Pty Ltd	58451/0304^
58455*	United Farmers Diuron 900 Wg Herbicide	United Farmers Cooperative Company Ltd	58455/0204^

59108*	Agronica Diuron Sc Herbicide	Farmoz Pty Limited	59108/0804^
59109*	Agronica Diuron Wg Herbicide	Farmoz Pty Limited	59109/0804^
59134*	Echem Thi-Ultra Cotton Defoliant	Echem (Aust) Pty Limited	59134/1004^
59557*	Barrage Herbicide	Crop Care Australia Pty Ltd	59557/0105^

Ψ Labels transitioned from the states and not having an approval number
* Products registered after the commencement of the review, that are subject to the outcomes of the review.
^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

5.2.2 Algal Control Products

Algal control products registered for use in aquariums and ornamental ponds are considered not to pose an unacceptable risk to the environment and it is recommended that these uses be retained. A summary of the uses and the proposed recommendations can be found in Table 11.

Table 11: Proposed recommendations for aquarium and ornamental pond products

Situation	Recommendations
Aquarium	No concerns associated with use – **Retain use**
Ornamental Ponds	No concerns associated with use – **Retain use**

However, the APVMA is not satisfied that the labels of the aquarium and ornamental pond products in Table 12 contain adequate instructions. The APVMA is satisfied that the conditions of label approval for the products in Table 12 can be varied in such a way so that they contain adequate instructions in accordance with s. 14(3)(g) of the Agvet Codes.

Table 12: Algal control products and label approvals.

Product No	Product name	Registrant	Label Approval Numbers
52183	Pets Pond Algae Killer	Australian Pet Supplies Pty Ltd	52183/1199
54571	Pond Science Crystal Pond (Algaecide for Ornamental Ponds)	Universal Manufacturing & Laboratories Pty Ltd	54571/0102
54572	Aquarium Science Algae Clear (For Aquarium Use)	Universal Manufacturing & Laboratories Pty Ltd	54572/0302
56886*	Biotec Algae Control	Biotec Restoration Pty Ltd	56886/0503^
58674*	Aquapro Algaway (For Ornamental Ponds)	Chemkay Pty T/A Aquatec Equipment	58674/0504^

* Products registered after the commencement of the review, that are subject to the outcomes of the review.
^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

5.2.3 Antifouling Paint Products

It is concluded that while antifouling use of diuron makes a contribution of the overall load of diuron in the environment, the level of contribution is expected to be relatively small compared to agricultural uses. Therefore, continued use of diuron in antifouling paints is considered acceptable and it is recommended that this use be retained.

A summary of the use and the proposed recommendations can be found in Table 13.

Table 13: Proposed recommendations for antifouling paint products

Situation	Recommendations
Antifouling Paints	No concerns associated with use – **Retain use**

However, the APVMA is not satisfied that the labels of the antifouling paint products in Table 14 contain adequate instructions. The APVMA is satisfied that the conditions of label

approval for the products in Table 14 can be varied in such a way so that they contain adequate instructions in accordance with s. 14(3)(g) of the Agvet Codes.

Table 14: Antifouling paint registrations and label approvals.

Product Number	Product name	Registrant	Label Approval Numbers
40186	Wattyl Marine Coatings Sigmaplane Ecol Antifouling	Wattyl Australia Pty Ltd	40186/0400
45412	Interspeed Super BWA900 Bright Red	Akzo Nobel Pty Ltd	Ψ
46918	Hempels Antifouling Mille Dynamic Aluminium	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
46919	Hempels Antifouling Mille Dynamic	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
46920	Hempels Antifouling Nautical	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
47587	International Interviron Super Antifouling Topcoat	Akzo Nobel Pty Ltd	47587/01
47588	International Interviron Super Antifouling Basecoat	Akzo Nobel Pty Ltd	47588/01
48843	Top Quality 40 South Marine Paint Atlantic Controlled Solubility Copolymer Antifouling	Tasmanian Paints Pty Ltd	48843/0603^
48969	Transocean Marine Paint Cleanship Antifouling 2.95	Asian Paints (Qld) Pty Ltd	48969/01
48970	Transocean Marine Paint Longlife Antifouling 2.77	Asian Paints (Qld) Pty Ltd	48970/01
49606	International Epiglass Longlife High Strength Hard Antifouling	Akzo Nobel Pty Ltd	49606/01
49607	International Epiglass Interspeed 2000 Hard Antifouling for Aluminium	Akzo Nobel Pty Ltd	49607/01
49608	International Epiglass Cruiser Superior Ablative Antifouling for Aluminium	Akzo Nobel Pty Ltd	49608/01
49609	International Epiglass VC Offshore Extra Polymer Reinforced Racing Antifouling	Akzo Nobel Pty Ltd	49609/01
49611	International Epiglass Micron CSC High Strength Self Polishing Antifouling	Akzo Nobel Pty Ltd	49611/01
49612	International Epiglass Coppercoat Ablative Antifouling	Akzo Nobel Pty Ltd	49612/01
49687	Hempels Seatech Antifouling	Hempel's Marine Paints (Australia) Pty Ltd	49687/01
49992	International Epiglass Coppercoat Extra Trade Antifouling	Akzo Nobel Pty Ltd	49992/01
52241	Newport 88 Hard Racing Antifouling	Wattyl Australia Pty Ltd	52241/0802
52242	Wattyl Marine Coatings Sigmaplane Ecol HA 120 Antifouling	Wattyl Australia Pty Ltd	52242/0700
52243	Newport 77 Self-Polishing Copper Antifouling	Wattyl Australia Pty Ltd	52243/0802
53398	International Biolux New Technology Micron Extra High Strength Self Polishing Antifouling	Akzo Nobel Pty Ltd	53398/0801
54009	Wattyl Marine Coatings Trawler Antifouling	Wattyl Australia Pty Ltd	54009/0301
56524*	Wattyl Marine Coatings Seapro Plus Antifouling	Wattyl Australia Pty Ltd	56524/1102^
58268*	Awlcraft Marine Paint Awlcraft Antifouling	Akzo Nobel Pty Limited	58268/0504^

Ψ Labels transitioned from the states and not having an approval number
* Products registered after the commencement of the review, that are subject to the outcomes of the review.
^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

5.3 Affirm Product Registrations

Section 5.2 above has identified various changes to labels as an outcome of the review. These variations to label instructions would satisfy the requirements for continued registration of products identified in Section 5.2 and it is recommended that product registrations be affirmed.

5.4. Withdrawn Diuron Products

A number of diuron products have been voluntarily withdrawn since the commencement of the review.

Table 15: Diuron products included in the review that have been withdrawn prior to the completion of the review.

Product Number	Product Name	Registrant	Label Approval Number/s
31704	Nufarm Diuron 800 Herbicide	Nufarm Australia Ltd	Ψ
42075	Di-On 800W Herbicide	Makhteshim-Agan Pty Ltd	Ψ
45417	Macspred Kromac G Granular Herbicide	Macspred Pty Ltd	Ψ
46853	Farmco Flowable Diuron Liquid Herbicide	Nufarm Australia Ltd	46853/01 46853/0699
47142	Diurex 500 SC Herbicide	Makhteshim-Agan (Australia) Pty Ltd	47142/01 47142/02 47142/0599
48712	Nomix G-D Ready-to-use, Non-selective Herbicide	Nuturf Pty Ltd	48712/01
49205	Flowable Herbicide Diurmax	Artfern Pty Ltd	49205/0500 49205/0202
50658	Diurmax Granules 900 WDG Herbicide	Artfern Pty Ltd	50658/0101 50658/0202 50658/0300 50658/0698
51631	Dow Agrosciences Diuron 500 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51631/0799
51632	Dow Agrosciences Diuron 800 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51632/0799
51853	Griffin Diuron Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51853/0599
52930	Griffin Diuron 800 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	52930/0800
52931	Griffin Diuron 500 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	52931/0700
53684	Crop Care Diurgranz WG Herbicide	Crop Care Australasia Pty Ltd	53684/1200
55703	Diurex 800 WG Herbicide	Makhteshim-Agan (Australia) Pty Ltd	55703/1002

Ψ Labels transitioned from the states and not having and approval number.

5.5 Old Previously Approved Labels

Old approved labels for currently registered products are deemed not to contain adequate instructions and are to be cancelled.

Table 16: The following label approvals are deemed not to contain adequate instructions and thus are to be cancelled.

Product Number	Label approval numbers
31253	31253/01
31685	31685/0399
39201	39201/1298 and 39201/0499
45177	45177/03
45772	45772/1098
47242	47242/0598 and 47242/0799
47485	47485/02
48843	48843/01
52241	52241/0400
52242	52242/0400
52243	52243/0400
52672	52672/0200
54358	54358/0801
56349	56349/1002

6. AMENDMENTS TO STANDARDS

6.1 Public Health Standards

6.1.1 Acceptable Daily Intake

The current Australian ADI for diuron is 0.006 mg/kg bw/day, based on a NOEL of 0.6 mg/kg bw/day in a 2-year dog dietary study for the abnormal blood pigments and using a 100-fold safety factor. An amended ADI of 0.007 is recommended in this review, based on a NOEL of 0.7 mg/kg bw/day in a 6-month rat dietary study for the reduced haemoglobin and increased reticulocytes and using a 100-fold safety factor.

6.1.2 Acute Reference Dose

An ARfD of 0.007 mg/kg bw/day is established based on a NOEL of 0.7 mg/kg bw/day in the 6-month rat dietary study for the reduced haemoglobin and increased reticulocytes and using a 100-fold safety factor.

6.1.3 Water Quality Guidelines

The Australian Drinking Water Guidelines (ADWG, 1996) are a joint publication of the National Health and Medical Research Commission (NH&MRC) and Agricultural and Resource Management Council of Australia and New Zealand (see *http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm*). The ADGW are not legally enforceable but rather provide a standard for water authorities and State health authorities to ensure the quality and safety of Australia's drinking water.

The Guideline Value (mg/L) is analogous to an MRL in food and is generally based on the analytical limit of determination. It is set at a level consistent with good water management practice and that would not result in any significant risk to the consumer over a lifetime of consumption. If a pesticide is detected at or above this value then the source should be identified and action taken to prevent further contamination. A guideline value is not established for diuron since it is one of the pesticides that have either only been detected occasionally in Australian drinking water or its likely use would indicate that they may only occasionally be detected.

The Health Value (also expressed as mg/L) is intended for use by health authorities in managing the health risks associated with inadvertent exposure such as a spill or misuse of a pesticide. The health values are derived so as to limit intake from water alone to approximately 10% of the ADI, on the assumption that (based on current knowledge) there will be no significant risk to health for an adult weighing 70 kg having a daily water consumption of 2 L over a lifetime. The current Health Value for diuron is 0.03 mg/L.

6.1.4 Poisons Scheduling

Diuron is currently in Appendix B (Substances considered not to required control by scheduling) of the SUSDP (Confirmed by the NDPSC in November 1987).

7. CONCLUSION

Based on the data provided it is recommended that the APVMA be satisfied that the continued use of or any other dealing with the active constituent diuron in accordance with instructions for its use or for such a dealing that the APVMA has approved, would not be likely to have an effect that is harmful to human beings. It is recommended that the active constituent approvals be affirmed.

Based on the data provided, it was found that environmental exposure from uses of diuron at current label rates in irrigation channels and drainage ditches is likely to have an unacceptable environmental impact. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied that use of diuron in irrigation channels and drainage ditches would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that this use be deleted from labels.

Based on the data provided, it was found that environmental exposure from uses of diuron at current label rates on sugarcane, cotton, citrus, horticultural crops (apples, pears, bananas, pawpaw, coffee, grapes and pineapples) and general purpose non crop uses is likely to have an unacceptable environmental impact. In order to reduce the environmental risk, risk mitigation strategies need to be found in order to substantially reduce the environmental load. If such strategies cannot be found the uses may have to be deleted from labels. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied these uses of diuron products would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that product labels be varied.

Based on the data provided, there is an unacceptable environmental risk due to spraydrift (from fine sprays and current label high rates) from diuron use when applied by air and ground spray to winter cereals and cotton. Because of unacceptable environmental risk it is proposed that the APVMA cannot be satisfied that the use of diuron products applied by air to winter cereals and cotton would not have an unintended effect that is harmful to animals, plants or things or to the environment. It is recommended that product labels be varied to include buffer zones.

Based on the data provided, it was found that the use of registered diuron products for algal control in aquariums and ornamental ponds and antifouling paints would not have an unintended effect that is harmful to animals, plants or things or to the environment. However, labels for these products are considered not to contain adequate instructions. Therefore, it is recommended that labels be varied to meet the required standards.

Based on the data provided, it was found that the use of registered diuron products in broadacre crops (wheat, barley, triticale, oats, lucerne, lupins and grass seed crops) would not have an unintended effect that is harmful to animals, plants or things or to the environment. Therefore, it is recommended that these uses be retained.

The APVMA is currently satisfied that the use of registered diuron products in asparagus, summer fallow, peas, vineyards (vines over 3 years), duboisia and ornamentals (daffodils, gladioli and tulips) would not have an unintended effect that is harmful to animals, plants or things or to the environment. Therefore, it is recommended that uses be retained.

APPENDICES

Appendix 1

List of active constituent approvals, considered as part of the reconsideration of diuron.

Approval number	Approval holder
44120	Lanxess Pty Ltd
44277	Nufarm Australia Ltd
44278	Lanxess Pty Ltd
44476	Du Pont (Australia) Ltd
44477	Du Pont (Australia) Ltd
44484	Makhteshim-Agan (Australia) Pty Ltd
44507	Ancom Australia Pty Ltd
44588	United Phosphorus Ltd
45535	Griffin Corporation Australia Pty Ltd
47275	Mastra Corporation Pty Ltd
52458	Nufarm Australia Ltd
52556	Farmoz Pty Limited
52901	Rotam Australasia Pty Ltd
54623	Becot Pty Ltd T/AS Imtrade Commodities
55233	4Farmers Pty Ltd
56686*	Agrogill Chemicals Pty Ltd
56728*	Echem (Aust) Pty Limited
56858*	Du Pont (Australia) Ltd

* Active constituents approved after the commencement of the review that are subject to the outcomes of the review.

Appendix 2

List of registered algal control products and associated label approvals, considered as part of the reconsideration of diuron.

Product No	Product name	Registrant	Label Approval Numbers
52183	Pets Pond Algae Killer	Australian Pet Supplies Pty Ltd	52183/1199
54571	Pond Science Crystal Pond (Algaecide for Ornamental Ponds)	Universal Manufacturing & Laboratories Pty Ltd	54571/0102
54572	Aquarium Science Algae Clear (For Aquarium Use)	Universal Manufacturing & Laboratories Pty Ltd	54572/0302
56886*	Biotec Algae Control	Biotec Restoration Pty Ltd	56886/0503^
58674*	Aquapro Algaway (For Ornamental Ponds)	Chemkay Pty T/A Aquatec Equipment	58674/0504^

Ψ Labels transitioned from the states and not having an approval number
* Products registered after the commencement of the review, that are subject to the outcomes of the review.
^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

Appendix 3

List of agricultural products and associated label approvals, considered as part of the reconsideration of diuron.

Product Number	Product name	Registrant	Label Approval Numbers
31253	Dupont Krovar DF Herbicide	Du Pont (Australia) Ltd	31253/01 31253/4732
31275	Agspray Kill-All Total Herbicide	Agspray Chemical Co. Pty Ltd	Ψ
31682	Agspray Die-It 800 Wettable Powder Diuron Herbicide	Agspray Chemical Co. Pty Ltd	Ψ
31685	Bayer Diuron 500 SC Liquid Herbicide	Lanxess Pty Ltd	31685/0399 31685/1103^
31702	Nufarm Flowable Diuron Liquid Herbicide	Nufarm Australia Ltd	31702/0200
31704	Nufarm Diuron 800 Herbicide	Nufarm Australia Ltd	Ψ
39201	Nufarm Diuron 900 DF Herbicide	Nufarm Australia Ltd	39201/1298 39201/0499 39201/0802
42075	Di-On 800W Herbicide	Makhteshim-Agan Pty Ltd	Ψ
45177	Bayer Diuron 900 WG Herbicide	Lanxess Pty Ltd	45177/03 45177/0204^
45417	Macspred Kromac G Granular Herbicide	Macspred Pty Ltd	Ψ
45441	Macspred Dymac G Granular Herbicide	Macspred Pty Ltd	45441/02
45772	Diurex WG Herbicide	Crop Care Australasia Pty Ltd	45772/1098 45772/0101
45909	Dupont Velpar K4 DF Herbicide	Du Pont (Australia) Ltd	45909/02
46812	Farmoz Diuron 900 WDG Herbicide	Farmoz Pty Ltd	46812/02
46853	Farmoz Flowable Diuron Liquid Herbicide	Nufarm Australia Ltd	46853/01 46853/0699
47142	Diurex 500 SC Herbicide	Makhteshim-Agan (Australia) Pty Ltd	47142/01 47142/02 47142/0599
47242	Dropp Ultra Cotton Defoliant	Bayer Cropscience Pty Ltd	47242/0598 47242/0799 47242/1102
47485	Dupont Karmex DF Herbicide	Du Pont (Australia) Ltd	47485/02 47485/0598
47661	Striker 500 SC Selective Herbicide by Sanonda	Sanonda (Australia) Pty Ltd	47661/02
47764	Macspred Kromac Industrial Herbicide	Macspred Pty Ltd	47764/02
48052	Farmoz Diuron 800 Flowable Herbicide	Farmoz Pty Ltd	48052/01
48712	Nomix G-D Ready-to-use, Non-selective Herbicide	Nuturf Pty Ltd	48712/01
48974	Zee-Uron 800 WP Herbicide	United Phosphorus Ltd	48974/01
49104	Summit Diuron Herbicide	Summit Agro Australia Pty Ltd	49104/01
49205	Flowable Herbicide Diurmax	Artfern Pty Ltd	49205/0500 49205/0202
49540	Zee-Uron 500 SC Herbicide	United Phosphorus Ltd	49540/01
49541	Zee-Uron 900 WG Herbicide	United Phosphorus Ltd	49541/01
50020	Generex Diuron 500SC Herbicide	Generex Australia Pty Ltd	50020/1197
50258	Dupont Diuron DF Herbicide	Du Pont (Australia) Ltd	50258/1197
50481	Agcare Biotech Flowable Diuron 500 SC Herbicide	Agcare Biotech Pty Ltd	50481/0398
50658	Diurmax Granules 900 WDG Herbicide	Artfern Pty Ltd	50658/0101 50658/0202 50658/0300 50658/0698
51253	Country Diuron 500 Flowable Herbicide	A&C Rural Pty Ltd	51253/0399

51613	Dupont Comanche Herbicide	Du Pont (Australia) Ltd	51613/0999
51631	Dow Agrosciences Diuron 500 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51631/0799
51632	Dow Agrosciences Diuron 800 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51632/0799
51852	Griffin Diuron WG Herbicide	Griffin Corporation Australia Pty Ltd	51852/0499
51853	Griffin Diuron Flowable Herbicide	Griffin Corporation Australia Pty Ltd	51853/0599
52176	Farmoz Diuron 500 Flowable Herbicide	Farmoz Pty Ltd	52176/0100
52342	Chemag Diuron Liquid Herbicide	Chemag Pty Ltd	52176/0100
52532	Crop Care Diuron Flowable Herbicide	Crop Care Australasia Pty Ltd	52532/0200
52672	Sipcam Diuron 500 SC Herbicide	Sipcam Pacific Australia Pty Ltd	52672/0200 52672/0800
52930	Griffin Diuron 800 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	52930/0800
52931	Griffin Diuron 500 Flowable Herbicide	Griffin Corporation Australia Pty Ltd	52931/0700
53042	Agcare Biotech Diuron 900DF Herbicide	Agcare Biotech Pty Ltd	53042/0600
53046	Smart Diuron 500 Flowable Liquid Herbicide	Agcare Biotech Pty Ltd	53046/0600
53684	Crop Care Diurgranz WG Herbicide	Crop Care Australasia Pty Ltd	53684/1200
53812	Chemag Diuron 900WG Herbicide	Chemag Pty Ltd	53812/0901
54182	Agricultural Product Services Diuron/Hexazinone DF Herbicide	Agricultural Product Services Pty Ltd	54182/0501
54183	Agricultural Product Services Diuron/Hexazinone WP Herbicide	Agricultural Product Services Pty Ltd	54183/0501
54352	Rotam Diuron 500SC Herbicide	Rotam Australasia Pty Ltd	54352/0801
54358	Nufarm Stamina DF Herbicide	Nufarm Australia Ltd	54358/0801 54358/1003^
54408	Farmoz Bobcat Combi Herbicide	Farmoz Pty Ltd	54408/0801
54662	APS Diuron/Hexazinone WG Herbicide	Agricultural Product Services Pty Ltd	546620702
55094	Country Diuron 900 WG Herbicide	A&C Rural Pty Ltd	55094/0102
55561	Conquest Diuron 900 WG Herbicide	Conquest Agrochemicals Pty Ltd	55561/0302
55612	Kenso Agcare Diuron 500 Herbicide	Kenso Corporation (M) SDN BHD	55612/0102
55703	Diurex 800 WG Herbicide	Makhteshim-Agan (Australia) Pty Ltd	55703/1002
56349	4 Farmers Diuron 500 SC Liquid Herbicide	4 Farmers Pty Ltd	56349/1002 56349/0204^
56602*	Halley Diuron 500sc Herbicide	Halley International Enterprise (Australia) Pty Ltd	56602/0603^
57291*	Agan Diuron 900 Wg Herbicide	Makhteshim-Agan (Australia) Pty Limited	57291/0403^
57299*	Agan Diuron 800 Wg Herbicide	Makhteshim-Agan (Australia) Pty Limited	57299/0303^
57728*	Agan Diuron 500 Sc Herbicide	Makhteshim-Agan (Australia) Pty Limited	57728/0503^
57823*	Echem Diuron 500 Sc Herbicide	Echem (Aust) Pty Limited	57823/0204^
57886*	Summit Diuron 900wg Herbicide	Summit Agro Australia Pty Ltd	57886/1003^
57934*	Runge Agrichems Diuron 900 Wg Herbicide	Runge Agrichems Pty Ltd	57934/0104^
58128*	4Farmers Diuron/Hexazinone Wg Herbicide	4Farmers Pty Ltd	58128/1103^
58440*	Tradewyns Diuron 500 Flowable Herbicide	Ospray Pty Ltd	58440/0304^
58451*	Tradewyns Diuron 900 Wg Herbicide	Ospray Pty Ltd	58451/0304^
58455*	United Farmers Diuron 900 Wg Herbicide	United Farmers Cooperative Company Ltd	58455/0204^
59108*	Agronica Diuron Sc Herbicide	Farmoz Pty Limited	59108/0804^
59109*	Agronica Diuron Wg Herbicide	Farmoz Pty Limited	59109/0804^
59134*	Echem Thi-Ultra Cotton Defoliant	Echem (Aust) Pty Limited	59134/1004^
59557*	Barrage Herbicide	Crop Care Australia Pty Ltd	59557/0105^

Ψ Labels transitioned from the states and not having an approval number

* Products registered after the commencement of the review, that are subject to the outcomes of the review.

^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

Appendix 4:

List of registered antifouling paint products and associated label approvals, considered as part of the reconsideration of diuron.

Product Number	Product name	Registrant	Label Approval Numbers
40186	Wattyl Marine Coatings Sigmaplane Ecol Antifouling	Wattyl Australia Pty Ltd	40186/0400
45412	Interspeed Super BWA900 Bright Red	Akzo Nobel Pty Ltd	Ψ
46918	Hempels Antifouling Mille Dynamic Aluminium	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
46919	Hempels Antifouling Mille Dynamic	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
46920	Hempels Antifouling Nautical	Hempel's Marine Paints (Australia) Pty Ltd	Ψ
47587	International Interviron Super Antifouling Topcoat	Akzo Nobel Pty Ltd	47587/01
47588	International Interviron Super Antifouling Basecoat	Akzo Nobel Pty Ltd	47588/01
48843	Top Quality 40 South Marine Paint Atlantic Controlled Solubility Copolymer Antifouling	Tasmanian Paints Pty Ltd	48843/01 48843/0603^
48969	Transocean Marine Paint Cleanship Antifouling 2.95	Asian Paints (Qld) Pty Ltd	48969/01
48970	Transocean Marine Paint Longlife Antifouling 2.77	Asian Paints (Qld) Pty Ltd	48970/01
49606	International Epiglass Longlife High Strength Hard Antifouling	Akzo Nobel Pty Ltd	49606/01
49607	International Epiglass Interspeed 2000 Hard Antifouling for Aluminium	Akzo Nobel Pty Ltd	49607/01
49608	International Epiglass Cruiser Superior Ablative Antifouling for Aluminium	Akzo Nobel Pty Ltd	49608/01
49609	International Epiglass VC Offshore Extra Polymer Reinforced Racing Antifouling	Akzo Nobel Pty Ltd	49609/01
49611	International Epiglass Micron CSC High Strength Self Polishing Antifouling	Akzo Nobel Pty Ltd	49611/01
49612	International Epiglass Coppercoat Ablative Antifouling	Akzo Nobel Pty Ltd	49612/01
49687	Hempels Seatech Antifouling	Hempel's Marine Paints (Australia) Pty Ltd	49687/01
49992	International Epiglass Coppercoat Extra Trade Antifouling	Akzo Nobel Pty Ltd	49992/01
52241	Newport 88 Hard Racing Antifouling	Wattyl Australia Pty Ltd	52241/0400 52241/0802
52242	Wattyl Marine Coatings Sigmaplane Ecol HA 120 Antifouling	Wattyl Australia Pty Ltd	52242/0400 52242/0700
52243	Newport 77 Self-Polishing Copper Antifouling	Wattyl Australia Pty Ltd	52243/0400 52243/0802
53398	International Biolux New Technology Micron Extra High Strength Self Polishing Antifouling	Akzo Nobel Pty Ltd	53398/0801
54009	Wattyl Marine Coatings Trawler Antifouling	Wattyl Australia Pty Ltd	54009/0301
56524*	Wattyl Marine Coatings Seapro Plus Antifouling	Wattyl Australia Pty Ltd	56524/1102^
58268*	Awlcraft Marine Paint Awlcraft Antifouling	Akzo Nobel Pty Limited	58268/0504^

Ψ Labels transitioned from the states and not having an approval number

* Products registered after the commencement of the review, that are subject to the outcomes of the review.

^ Labels approved after the commencement of the review, that are subject to the outcomes of the review.

Appendix 5

Toxicology Hazard Profile

Absorption, distribution, metabolism and excretion in mammals

Rate and extent of oral absorption	T_{max}=1.7 – 6.8 h; and almost complete (~ 90% in bile and urine and only ~ 4% in faeces in rats with biliary fistulae).
Distribution	Extensive.
Potential for accumulation	No evidence for accumulation.
Rate and extent of excretion	Rapidly excreted in urine and feaces (≥ 94% eliminated after 96 h).
Metabolism	Extensive; numerous metabolites in urine and faeces, and only < 2% unchanged parent compound in the faeces.
Toxicologically significant compounds (animals, plants and environment)	Diuron

Acute toxicity

Rat oral LD_{50} (mg/kg bw)	1017-5000 (in an oil vehicle); 3000-9087 (in an aqueous vehicle).
Worst oral LD_{50} in other species	8244 in mice
Rat dermal LD_{50} (mg/kg bw)	> 5000 (no deaths)
Worst dermal LD_{50} in other species	-
Rat inhalation LC_{50} (mg/m^3)	> 7100 (dust; MMAD > 10 μM, whole body; no deaths)
Worst inhalation LC_{50} in other species	-
Skin irritation	Non-irritant
Eye irritation	Slight irritant
Skin sensitization	Non-sensitiser (Magnussen & Kligman method)

Short-term toxicity

Target/critical effect	Haemotoxicity (haemolytic anaemia)
Lowest relevant oral NOEL (mg/kg bw/d)	0.7 (rats, 6 months)
Lowest relevant dermal NOEL (mg/kg bw/d)	No NOEL; LOEL = 250 (rat, 3 months)
Lowest relevant inhalation NOEC (mg/m^3)	6.6 (rat, nose-only, 3-weeks)

Genotoxicity	Non-genotoxic

Long-term toxicity and carcinogenicity

Target/critical effect	Haemotoxicity (haemolytic anaemia) and pathological changes in the urinary bladder epithelium.
Lowest relevant NOEL (mg/kg bw/d)	25 ppm (0.6 mg/kg bw/day) in a 2-y dog dietary study.
Carcinogenicity	Non-genotoxic neoplasia in rat bladder epithelium due to diet-induced changes in urinary pH.

Reproductive toxicity

Reproduction target/critical effect	Reduced pup weight at maternotoxic doses.
Lowest relevant reproductive NOEL (mg/kg bw/d)	16 (250 ppm)

Developmental target/critical effect	Lower pup body weight and delayed ossification at maternotoxic doses.
Lowest relevant developmental NOEL (mg/kg bw/d)	80

Delayed neurotoxicity	Not an organophosphate compound, and not expected to cause delayed neurotoxicity.
Immunotoxicity	No evidence.
Dermal absorption	No data.

Toxic Impurities

3,3',4,4'-tetrachloroazobenzene (TCAB)

3,3',4,4'-tetrachloroazoxybenzene (TCAOB)

Summary

	NOEL (mg/kg bw/d)	Study	Safety factor
ADI (0.007 mg/kg bw/d) [Haemolytic anaemia and haemosiderin deposition]	0.7	Schmidt & Karbe (1986)	100
ARfD (0.007 mg/kg/bw) [Haemolytic anaemia and haemosiderin deposition]	0.7	Schmidt & Karbe (1986)	100

Health Value in drinking water	0.03 mg/L