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Environmental Awareness Training and Reference Manual

Environmental Awareness

Training & Reference Manual

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Note: All controlled copies of this document are individually numbered. Only these copies will be updated. All other copies are for reference only.

Introducing the Environmental Awareness Training and Reference Manual

What's in this manual?

As part of its environmental strategy, the RTA aims to educate all employees on the need for environmental protection and how to implement environmentally responsible planning, management and practices.

This document describes:

- the need for effective environmental controls
- environmental legislation, and how it affects the RTA, its employees and contractors
- the components of an environmental management system
- how environmental management is to be achieved within the Authority
- what techniques are available to identify, control and manage the risk of environmental pollution.

Who should use it?

This manual is for personnel responsible for planning, designing, managing or carrying out work for the RTA, which may directly or indirectly affect the environment. This includes:

- directors
- managers
- employees of the RTA
- contractors or sub-contractors carrying out work for the RTA.

How will the manual be used?

This manual has two functions:

- as notes to accompany the Environmental Awareness Training programme
- as a reference manual to provide information on environmental issues, legislation, RTA policy and RTA strategies to achieve sound environmental performance in planning, management and operations.

Environmental management in the RTA

Both government and the community recognise environmental issues as one of the key issues facing us today. The Authority is meeting this challenge by implementing a responsible approach to environmental management.

The Environmental Awareness Training Programme is an important component of the environmental programmes offered by the Environment and Community Impact Branch.

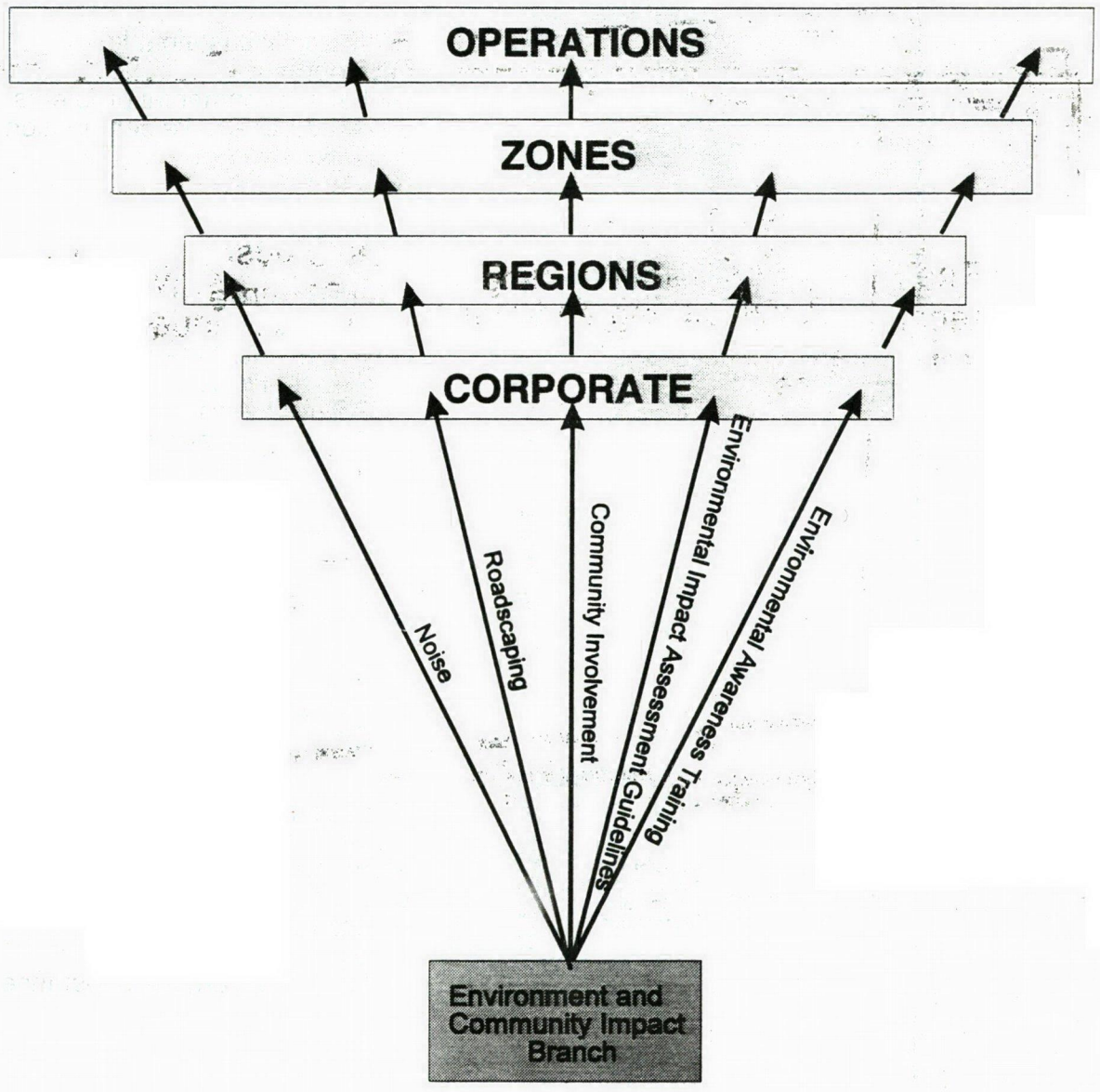
Peter Wolfe
Director, Corporate Development

RTA's Environmental Policy

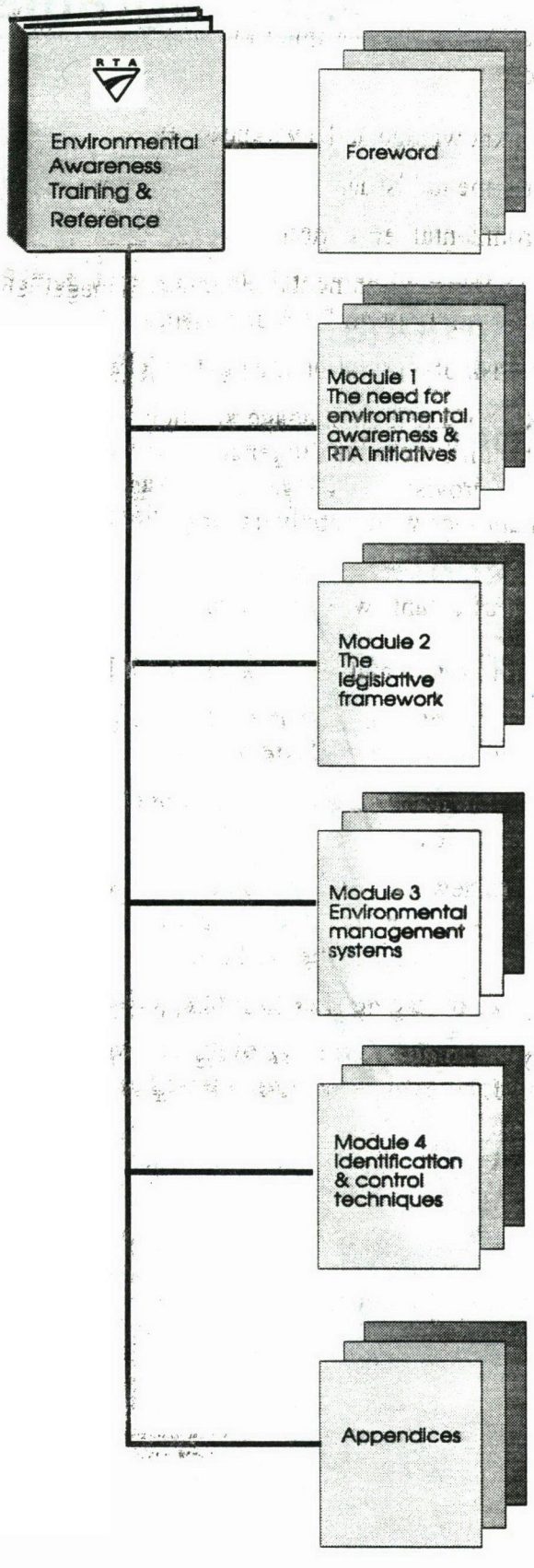
The RTA is committed to using best practical environmental technology, planning and management techniques in all its activities.

Bernard Fisk
Chief Executive

Scope of Environment and Community Impact Branch programs



How is this manual organised?



What's in this manual
RTA's environmental policy
Scope of other environmental programmes
Contents

Ecologically sustainable development
Global environmental problems
- Road transport's contribution
- RTA's strategy

Role of the EPA
Acting responsibly

Environmental rules and regulations
Laws that affect the RTA
- Planning laws
- Pollution laws
- Environmental licences

Environmental management systems (EMS)
The RTA's EMS
Major elements of an EMS
- Risk management
- Waste management
- Handling emergencies
- Chemical incidents

Conducting an environmental assessment
Identifying and implementing controls for:
- site contamination
- bunding
- storing hazardous substances

Detailed reference material
Related publications
Amendments register

Training objectives

The objectives of the Environmental Awareness Training Program are to develop the participants' skills and knowledge to:

- increase their knowledge and awareness of:
  - environmental issues
  - environmental legislation
  - responsible environmental planning, management and operation for all RTA employees
- minimise the risk of a pollution incident in RTA operations
- enable the RTA's directors, managers, employees and contractors to fulfil their due diligence obligations, thereby assisting in the provision of a legal defence against significant liabilities which apply under environmental legislation.

After attending this course, participants will be able to:

- describe the environmental issues facing the RTA
- describe the Authority's environmental policy and the Environmental Management System
- identify RTA initiatives that have been taken to deal with environmental issues
- describe the framework of legislation dealing with environmental issues and be able to apply these to themselves, contractors and the Authority
- identify ways of managing sites to control pollution
- identify ways to minimise the risk to the environment of pollution incidents using case studies based on RTA operations.

Contents

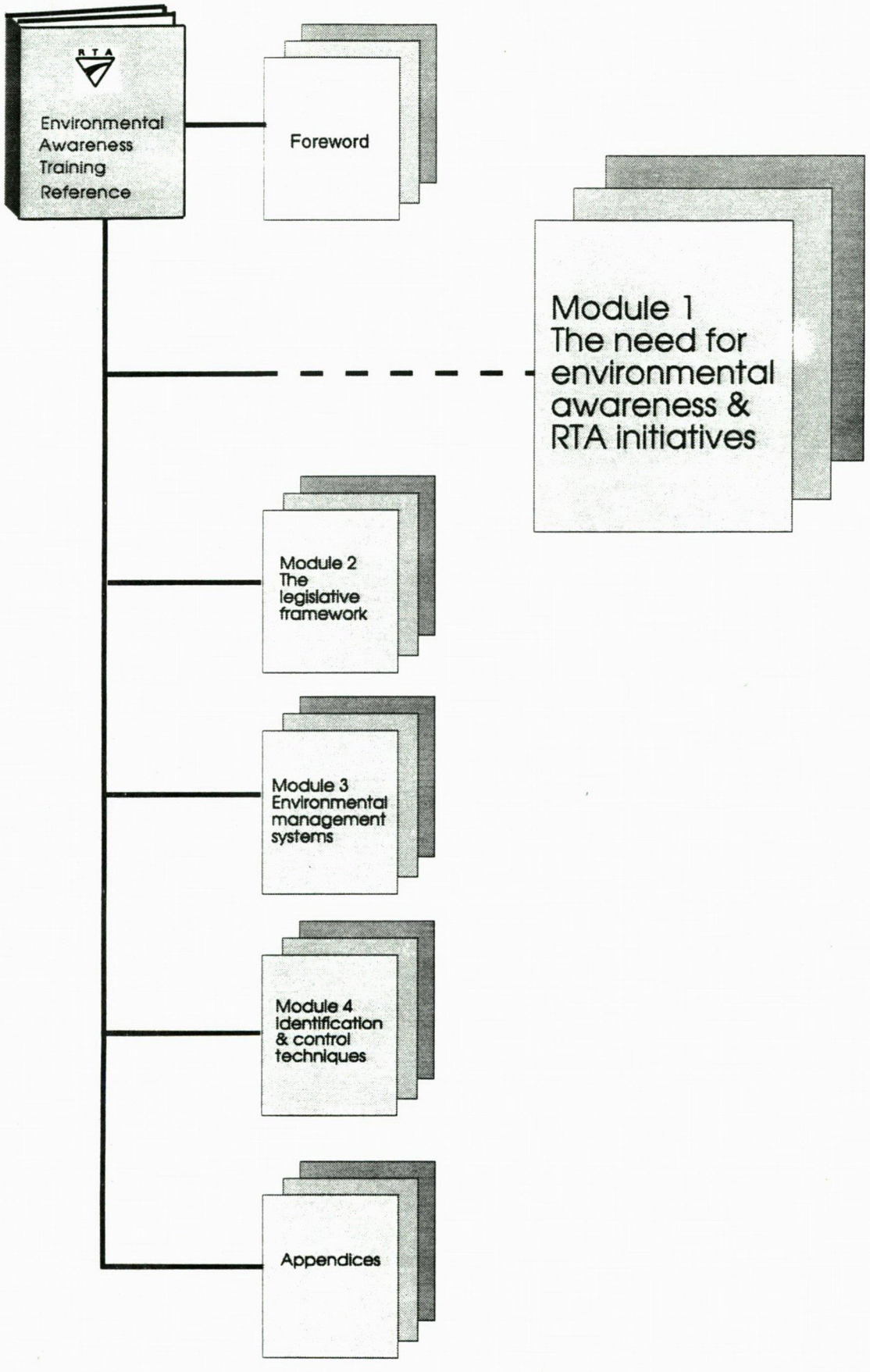
Module 1: The need for environmental awareness and RTA initiatives

Module 2: The legislative framework

Module 3: Environmental Management Systems (EMS)

Module 4 Identification and control techniques

Appendices


RTA
Environmental Awareness Training Reference
Foreword
Module 1 The need for environmental awareness & RTA initiatives
Module 2 The legislative framework
Module 3 Environmental management systems
Module 4 identification & control techniques
Appendices

Module 1: The need for environmental awareness and RTA initiatives

Introduction

In response to growing community awareness of environmental matters, the RTA developed an environmental vision - a focus for the RTA's activities.

> A roads and traffic system in harmony with the natural and social environment while meeting community access needs.

The strategies in this vision relate to all aspects of the roads and traffic system. They range from recycling materials, to how the RTA can help reduce greenhouse gases. The focus is on motor vehicles and the road system. However, the strategies extend to support for other modes of transport and contributions to the initiatives of other Government agencies.

Appendix A describes in detail the environmental vision and strategies, which form the basis of the RTA's environmental policy:

The RTA is committed to using best practical environmental technology, planning and management techniques in all its activities."

This module introduces concepts which are covered in more detail in later modules. It outlines:

- major environmental issues facing the RTA
- the Authority's strategy to avoid and control the contribution of road transport to these issues
- legislation to control environmental performance
- the basis of a responsible approach to environmental management.

Ecologically sustainable development

Ecologically sustainable development () can be defined as development which uses resources to meet the needs of the present, without compromising the ecological processes on which life depends, so that the total quality of life, now and in the future can be increased.

How ESD affects the RTA

Environmental protection, in balance with other human goals, is necessary to achieve growth that is sustainable.

ESD involves:

- controlling and limiting the use of finite natural resources
- protecting endangered species
- integrating both environmental and economic goals in policies and activities
- appropriate valuation of environmental assets.

Roads are a major land user, and as such significantly influence the use of natural resources with consequent effects on human and environmental health. Road construction uses both renewable and non-renewable resources.

What is the RTA doing?

The RTA has committed to:

- review the potential environmental effects of RTA programs
- include environmental benefit-cost analysis in the planning process
- use local native seed resources in re-vegetation programs to protect and maintain the diversity and genetic integrity of local native flora associations
- further develop recycling and re-use programs within the RTA
- investigate and preferentially purchase environmentally-friendly office stationery, equipment and furniture
- increase public awareness of the importance of road reserves as nature reserves
- expand the use of recycled materials in road works.

Major environmental concerns

Growing public awareness of the environment has raised the profile of a number of environmental issues. This section looks at some of the major concerns.

Global warming

Global warming is a gradual warming of the earth as a result of increasing levels of "greenhouse" gases in the atmosphere. "Greenhouse" gases are those that trap the energy given off by the earth's surface, so that it cannot escape into space. They include carbon dioxide, methane, nitrous oxide and CFCs. The effects of global warming are changes to our weather and climate, and a possible rise in the sea level.

What is road transport's potential contribution?

Cars, buses, trucks and motor bikes produce carbon dioxide. Motor vehicles produce relatively little of the other "greenhouse" gases through use, however CFCs are used in car air-conditioning systems and car seat and trim manufacture.

What is the RTA doing?

The RTA has committed to:

- educate the public on vehicular contributions to "greenhouse" gas emissions
- encourage the teaching of efficient driving and vehicle maintenance techniques
- promote car pooling and higher vehicle occupancy
- plan maintenance schedules to minimise delays to traffic
- investigate the potential for price incentives on fuels and registration to encourage more environmentally efficient transport
- promote the efficient use of energy within the RTA.

Ozone depletion

There is a layer of ozone in the stratosphere, the upper level of earth's atmosphere. The ozone layer shields the earth from the sun's ultra-violet radiation. Ozone is destroyed by the action of chemicals such as nitrous oxide, water, halons, HCFCs and CFCs in the atmosphere. As the ozone layer is thinning, more radiation is reaching the earth's surface. This can cause skin cancer in humans and damage to other living things.

What is road transport's potential contribution?

The most likely significant source of CFC emission from vehicles is from car air-conditioning. CFCs are also used to manufacture seats and interior trim.

What is the RTA doing?

The RTA has committed to identify ways to replace CFC and Halon use in the Authority's operations and contracts for supplies and services.

The automobile industry has made a commitment to phase out the use of CFCs both in car air-conditioners and in car manufacture.

Air pollution

Air pollution is caused by releasing chemicals and particles into the air which change the normal composition of the lower atmosphere. Polluted air can contain nitrogen oxides, lead, carbon monoxide, sulphur dioxide, hydrocarbons and particles. The sources can be human activities such as industry, vehicle exhausts, abrasion and fuel evaporation, or natural disasters such as volcanoes and forest fires. It can cause irritation, breathing difficulties and allergic responses in humans. Air pollution can also damage green plants, kill trees and damage property.

What is road transport's potential contribution?

Motor vehicles are a major source of air pollution, particularly carbon monoxide and lead. Motor vehicles might contribute to air pollution on three levels:

- local pollution, where the pollution is greater near busy roads
- regional pollution, where air quality is reduced over a wider area, such as a city
- global pollution, where emissions contribute to global warming and ozone depletion.

What is the RTA doing?

The RTA has committed to:

- investigate exhaust emission testing in conjunction with other bodies
- investigate implementing national standards and checks to reduce exhaust smoke from heavy vehicles
- evaluate converting the RTA's car fleet to LPG
- promote car pooling and higher vehicle occupancy.

Noise pollution

Noise pollution is any unwanted sound that may be offensive, or cause discomfort or harm. Machinery, vehicles, parties and loud music are some of the causes. It can cause annoyance, speech and sleep interference, decrease in concentration, reduction in efficiency, physiological disturbances and hearing loss.

What is road transport's potential contribution?

Traffic, particularly heavy trucks, may be a major source of noise pollution.

What is the RTA doing?

The RTA has committed to:

- assist in establishing and enforcing noise regulations for roads and traffic
- monitor and improve noise abatement measures
- inform people affected by traffic noise about noise reduction measures
- take steps to reduce noise levels on new roads, where warranted
- co-operate in investigating noise levels
- investigate implementing national standards and checks to reduce excessive noise levels from heavy vehicles.

Water pollution

Water pollution changes the physical, chemical or biological composition of natural waterways, dams and oceans. It can affect aquatic life, agriculture and the quality of drinking water. Some water pollutants are oils, chemicals, sewerage, heavy metals and rubbish.

What is road transport's potential contribution?

The road surface might collect bitumen, tar, petrol, oil, phenols, metal particles, rubber, dust, exhaust particles and rubbish. Run-off from roads might contain all these pollutants and can carry them to surface or ground water systems.

Accidental spills from vehicles using the roads might release highly toxic substances into water systems.

What is the RTA doing?

The RTA has committed to:

- take actions to prevent and control storm water runoff, erosion and sedimentation from State roads
- encourage use of environmentally friendly cleaning materials within the RTA.

Depletion of natural resources

The use of limited resources such as fossil fuels and minerals is depleting the earth's natural resources. Using renewable resources, like forests, faster than they can regenerate adds to the depletion. Their use can contribute to the extinction of flora and fauna species, natural resources and ecosystems, and upset the world's delicate ecobalance.

What is road transport's potential contribution?

Building roads has a significant influence on natural resources. Roads might cause the fragmentation of natural habitats, making the habitats non-viable. Manufacturing and running motor vehicles uses substantial amounts of finite natural resources, such as coal, iron and oils.

What is the RTA doing?

The RTA has committed to:

- review the potential environmental effects of RTA programs
- prepare environmental impact assessment guidelines for staff
- further develop recycling and re-use programs within the RTA
- protect ecologically valuable and sensitive areas when selecting new road locations.

Land degradation

Land degradation is damage caused by actions such as land clearing, urban development, water run-off, fire, wind and overuse of fertilisers. The result can be soil erosion, land slip and increased soil salinity, as well as vegetation decline, habitat loss and weed invasion.

What is road transport's potential contribution?

Building and operating roads might cause increased storm water run-off and velocity of flow, change surface and subsoil drainage paths, increase water pollution and transfer sediment.

Quarrying to obtain road materials can also contribute to land degradation.

What is the RTA doing?

The RTA has committed to:

- ensure that ecologically valuable and sensitive areas are adequately considered and protected, if necessary, when selecting new road locations
- avoid environmentally sensitive areas when locating gravel pits, and restore areas after use
- establish guidelines to reduce and correctly dispose of waste
- use local native seed sources for re-vegetation to protect and maintain the genetic integrity of local native flora
- design and manage roadsides to preserve and enhance native flora and fauna
- avoid or control clearing before construction to preserve soil, vegetation and animal habitats
- avoid or control the use of chemical herbicides and pesticides in maintaining roadsides
- prevent and control the quantity and velocity of water run-off, erosion and sedimentation from roads under RTA control.

Community impact

Community impact is the effect of a project on people. This can relate to their health, quality of life or the natural characteristics of their environment.

What is road transport's potential contribution?

Community impact is complex. It can include factors such as isolating communities by freeways, changing accessibility for residents and reducing the aesthetic quality of the landscape with the construction of roads and interchanges. Road construction can change property values.

Road transport might contribute to noise, odours, dust, litter, air and water pollution in an area.

What is the RTA doing?

The RTA has committed to:

- consult with the community when undertaking environmental studies, and planning and managing major road and traffic management projects
- involve community groups in the decision making and planning process for major projects
- identify social impacts early in concept development
- record and protect heritage sites likely to be affected by roads
- increase public awareness of the importance of road reserves as nature reserves
- encourage public participation in statewide clean-up days by distributing car litter bags
- extend and promote safe bicycle lanes
- encourage local traffic management schemes in local residential streets
- consider the need for reduced speeds in certain areas, such as the approach to towns and villages.

For more information, refer to the *Interim Guidelines for Community Involvement*, RTA 1993.

Environmental "best practice"

The RTA's environmental policy means following "best practice" environmental planning and management in all its activities. "Best practice" in environmental planning and management implies:

- planning and carrying out projects and operations to achieve the best possible environmental management performance while meeting the Authority's business objectives
- taking a methodical and analytical approach to all operations that affect the environment, and developing quality management procedures
- reviewing practices and systems to ensure that they:
  - ☐ are continually being improved
  - ☐ take account of new technologies
  - ☐ meet community expectations.

Environmental offences

Over the last decade, environmental awareness has increased world-wide. Changes to Commonwealth and State legislation include significant penalties for environmental offences. These penalties may have a considerable impact on the RTA's operations, as no organisation can run the risk of poor environmental performance.

Penalties

Environmental offences can attract penalties ranging up to $1,000,000 for the Authority and $250,000 and/or 7 years gaol for individuals. Individual penalties may apply to the directors and managers of the Authority right down to the individual who performed the task that caused the offence. **This applies to all RTA personnel and contractors.**

The Act which sets the penalties for environmental offences is the NSW Environmental Offences and Penalties Act, 1989. This Act establishes a three-tier system of penalties:

Tier 1 major environmental offences, involving negligent or wilful actions which are likely to harm the environment. "Due diligence" is the major defence for Tier 1 offences.

Tier 2 mid-range offences, offences defined by the Clean Air, Clean Waters, Noise Control and State Pollution Control Commission Acts.

Tier 3 minor offences, enforced by "on the spot" fines and infringement notices.

Module 2, "*The legislative framework*" discusses the environmental legislation that affects the RTA.

Liabilities and defence

Tier 1 offences

"All due diligence" is the most important defence available in a law court to Tier 1 offences, or to avoid the deemed responsibility of directors or persons concerned in management.

Due diligence requires:

- that a responsible and adequate management system is in place for ensuring compliance with regulations, policies and licences

- that the environmental management system is adequately supervised and monitored and covers all aspects of an organisation's operations
- that the environmental management system is able to identify the failure of the system and point out the likelihood of a failure
- that the environmental management system is a continuously improving, thorough and intelligent system, which is directed to avoidance of the particular offence.

Tier 2 offences

Under current legislation in NSW, if a Tier 2 offence occurs, such as the leak of a toxic substance without authority, **liability is "strict"**. This means that offenders are liable, regardless of fault, even if they can prove that they exercised "due diligence" in handling the material.

- An honest and reasonable mistake is the only acceptable defence for the individual concerned.
- "Due diligence" is a defence for directors or persons concerned in management.

Tier 3 offences

For Tier 3 offences, an honest and reasonable mistake of fact is the only acceptable defence.

Enforcement agencies

Environmental protection works at three levels: Commonwealth, State and Local government.

- The main aim of the Commonwealth Environment Protection Agency () is to provide uniform environmental guidelines and policies throughout Australia. It is expected that the stringent environmental criteria currently enforced by NSW and Victoria, will become the standard throughout Australia.
- The NSW Environment Protection Authority () administers and enforces pollution control legislation.
- Local government officers can also act under State environmental legislation.

Enforcement powers

Environmental authorities have power to:

- enforce an independently performed involuntary environmental assessment if they believe there is a threat to environmental conditions. The assessment is a public document with results available to the media and general community.
- conduct a detailed assessment themselves to assess the environmental performance of an industrial, commercial or trade enterprise
- enforce an involuntary environment improvement plan. This involves public participation in the implementation, monitoring and end-result assessment
- issue pollution abatement and noise control notices. These may be issued to corporations or individuals creating pollution, or reasonably suspected of doing so. Notices may specify a range of actions needed to control the risk. These notices usually specify a time period within which the polluting activity or potentially polluting activity must be controlled.

If the EPA deems that the threat of pollution is significant, it can order the offending operation to cease until the problem is corrected. **The EPA has the power to exercise its rights at any RTA site.**

Complying with environmental legislation

Taking a responsible approach to environmental management ensures compliance with environmental legislation. It means preparing and using an Environmental Management System (EMS).

An defines the overall approach an organisation takes to carry out its environmental responsibilities and management. The components of an EMS outlined here, are:

- planning
- managing pollution risk
- environmental improvement program
- environmental assessment process
- site environmental improvement plan.

A full description of an EMS is provided in Module 3: *Environmental Management Systems*.

Planning

Planning to avoid pollution is a major component of an environmental management system. The RTA takes the following steps to ensure that good environmental performance is achieved for new activities:

Review of Environmental Factors (REF)

A is an internal assessment which examines the likely environmental impact of a proposal. If the REF finds that the impact could be significant, it recommends the preparation of an Environmental Impact Statement (EIS).

Environmental Impact Statement (EIS)

An may be a public document. The preparation and decision making process in an EIS may be required by legislation such as the Environmental Planning and Assessment Act ().

Site Environmental Management Plan

From the REF and EIS, the RTA Project Manager should prepare a Site Environmental Management Plan to ensure that the activity complies with the RTA's environmental strategies and with legislative requirements.

Managing pollution risk

The best way to reduce pollution risk is to avoid it. To avoid pollution you must:

- establish the risk
- quantify the risk
- manage the risk.

Establish the risk

Sometimes this is referred to as a "qualitative" environmental assessment. During this process, the assessor:

- inspects the site or operation
- reviews any existing data on the site or operation
- interviews past and present on-site staff.

The RTA's self-assessment program is to identify, what, if any, environmental risks exist at a site. For more information, see "*How is environmental risk assessed in the RTA*" on page 4.13.

Quantify the risk

If the initial assessment finds a potential for contamination, the second phase is risk assessment. This is a quantitative assessment of environmental risk. The risk is assessed and quantified by:

- conducting an on-site sampling program to determine the type and extent of contamination in surface soil, sub-surface soil, air and water
- analysing the samples in a laboratory
- defining all possible areas which might have been exposed to contamination
- assessing potential risks to health and natural resources by contamination
- identifying areas on the site that may require remediation
- estimating the cost to prevent or correct damage
- assessing potential liability.

Manage the risk

Managing the risk is taking steps to ensure that "due diligence" is taken to prevent any damage to the environment. The managerial tools available to minimise environmental risk include environmental assessments and environmental improvement plans. They form part of an environmental management plan.

Environmental Improvement Program

The managers of any operation or site with the potential to pollute should take steps to manage the risk. This is called an Environmental Improvement Program. It:

- lists recommended works and practices to improve conditions and/or minimise risk
- assigns priorities
- provides a time frame for implementation
- monitors progress
- assesses and reports on end benefits.

Environmental assessment process

Pollution includes any changes in the physical appearance, chemical or biological nature of air or water. Pollution is often indicated by conditions that are offensive to human senses. Odours, dust, noise, oil slicks, black smoke, dead grass, sick or dead fish, colourations, etc, are highly noticeable signs of pollution.

In some circumstances pollutants may not be visible, may occur in minute quantities, or pose no immediate threat to a species' survival or abundance. However, there may be long term adverse effects on the environment or human health.

When the assessment is completed, the assessor produces an environmental assessment report.

Environmental assessment report

The assessment report contains:

- site history
- description of observations and interviews from site visit
- conclusions on potential risks
- recommendations for further assessment.

Internal assessments

Voluntary assessments are initiated by management to establish environmental operating risks and usually will not be confidential. Voluntary assessments are therefore an in-house tool to establish and quantify risk and enable remedial action.

The RTA is using self-assessment to identify any environmental problems that exist on RTA sites. Whilst these reports are intended for use only within the Authority, they are not confidential unless produced solely for obtaining legal service.

Site Environmental Improvement Plan

The Site Environmental Improvement Plan is based on the findings of the environmental assessment report. It contains the actions that are to be carried out to remediate the site and to improve the environmental performance.

Financial benefits

There can be indirect financial benefits in complying with environmental legislation. There can be significant cost savings from recycling and re-use programs. Most are related to cost avoidance.

The major cost of polluting is cleanup. Significant soil contamination may require a costly clean-up, particularly if pollutants are allowed to migrate through soils to ground water. There are a number of Australian examples where clean-up costs have been in excess of 20 million dollars.

Other costs come from:

- community backlash - adverse media coverage
- business interruption- closure of business during remediation, union action
- higher costs of retro-fitting, rather than ensuring compliance from the start
- waste disposal - "polluter pays" principle
- legislation - fines, gaol sentences.

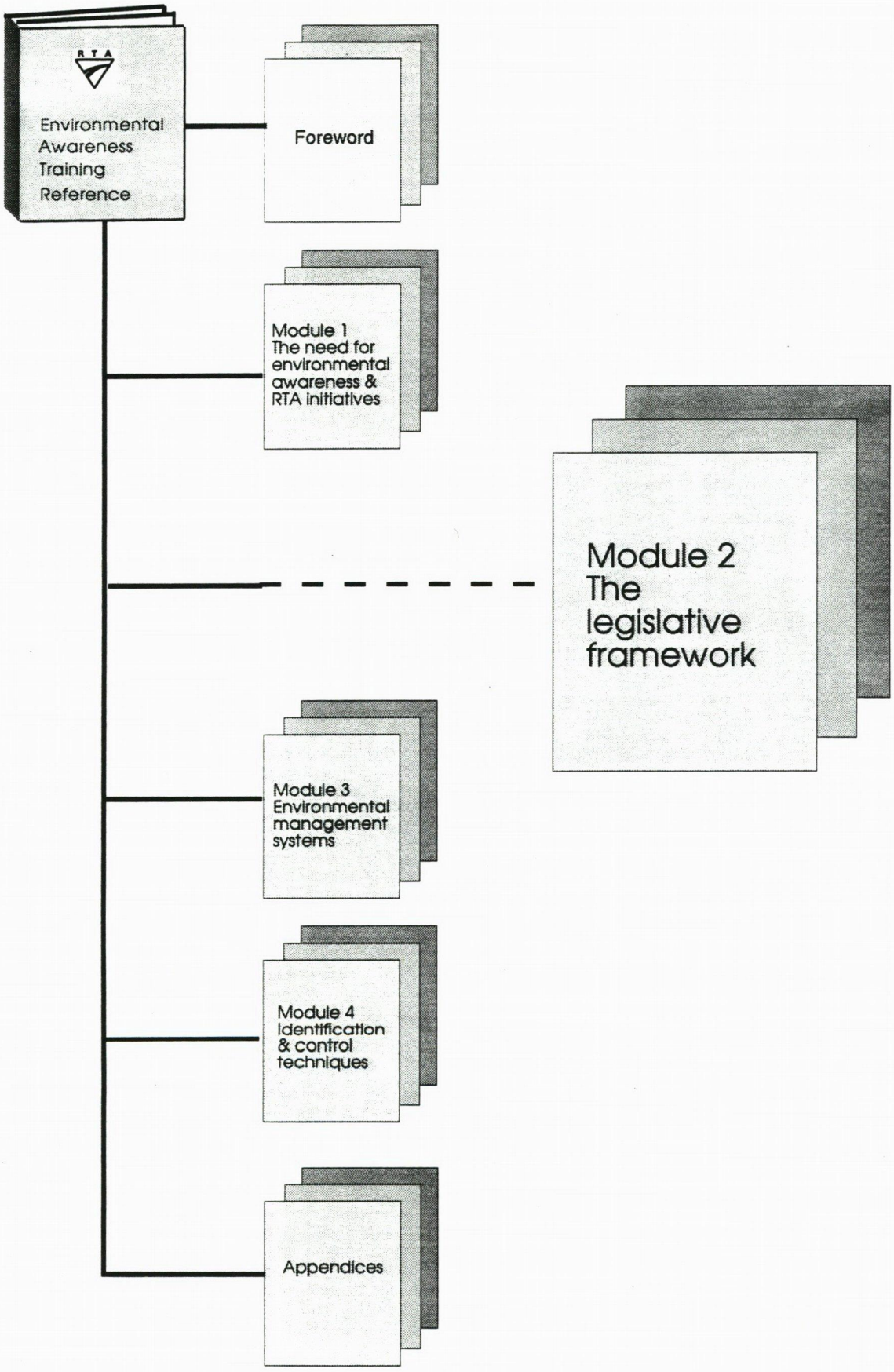
The penalty for an environmental offence can be as high as $1,000,000 for a corporation, so these costs can be considerable.

Summary

There is a recognised need for the Authority to review its operations for their effect on the environment. This review applies to existing and planned operations, management commitment and environmental awareness of all staff in day to day operations.

Because of the RTA's responsibilities for the State's major roads and traffic systems, it is important that the Authority takes a responsible approach to the environment, and complies fully with environmental legislation.

The best way to ensure compliance with environmental requirements is to actively follow an environmental management plan.


RTA
Environmental Awareness Training Reference
Foreword
Module 1 The need for environmental awareness & RTA initiatives
Module 2 The legislative framework
Module 3 Environmental management systems
Module 4 Identification & control techniques
Appendices

Module 2: The legislative framework

Introduction

This module examines environmental legislation and the impact this has on the RTA.

Society is demanding tougher environmental protection laws and better enforcement. Most environmental laws that affect the RTA are made by the NSW Parliament. Enforcement is mainly the responsibility of the Environment Protection Authority (EPA) or the local council. However, with the consent of the Land and Environment Court, private individuals may take proceedings.

Legislation on water, air and noise pollution dates back to the 1960s. In 1989, the Environmental Offences and Penalties Act created additional pollution offences and increased the penalties for old ones. Other legislation relates to waste disposal, toxic chemicals and contaminated land. In addition, pollution can be controlled using the common law category of nuisance.

The current legislation has a three-fold approach to preventing environmental offences:

- stopping, modifying or mitigating inappropriate development from the outset through planning regulations
- setting discharge limits through environmental licences
- using fines and gaol sentences to deter and punish environmental offenders.

The RTA is committed to protecting and enhancing the environment. This means more than complying with environmental legislation. It means incorporating in its management, planning, construction, operation and daily work practices, a range of methods which represent responsible public expenditure and which protect and enhance the environment.

Environmental legislation

The Constitution gives the Commonwealth no direct power to protect the environment, however the Commonwealth Environment Protection Agency (CEPA) co-ordinates pollution control standards amongst the states.

Many NSW Government departments and agencies, including the Departments of Planning, Environment, Agriculture, Fisheries, and Conservation and Land Management have powers relating to environmental protection. NSW pollution control laws also bind residents in other states whose actions affect NSW.

Local councils have important powers to plan for and control pollution-generating development, to enforce some aspects of the pollution laws and to prevent nuisances.

What laws specifically regulate pollution?

Water pollution is very broadly defined in the Clean Waters Act, 1970, to include the introduction of anything causing a change in the condition of any underground or surface water, including the sea.

Air pollution means the emission of any air impurity and is regulated by the Clean Air Act, 1961 (NSW). Smells, smoke and invisible impurities are all air pollution.

Noise pollution is noise, from defined sources, which exceeds the levels prescribed in the Noise Control Act, 1975. If none are prescribed, "offensive noise" is prohibited. Offensive noise is noise likely to be harmful, or to interfere unreasonably with the comfort of neighbours or people in public places.

Discharging waste or allowing substances to leak, spill or escape can be in breach of the Environmental Offences and Penalties Act, 1989 (NSW). This is in addition to breaching other pollution laws.

Rubbish, including trade and domestic waste, can be controlled under the Local Government Act, 1993, the Water Board Act, 1987 and the Waste Disposal Act, 1970 (NSW). Penalty notices for littering can also be issued under the Environmental Offences and Penalties Act.

Toxic chemicals are subject to the water, air and waste discharge laws noted above. They are also regulated under the Environmentally Hazardous Chemicals Act, 1985, the Public Health Act, 1902, the Pesticides Act, 1978, the Dangerous Goods Act, 1975 and the Occupational Health and Safety Act, 1983.

Other nuisances occur when individuals' private rights have been affected, such as harm to property or personal injury. Under common law they are entitled to recover damages caused by pollution.

Planning law

Pollution control law is not the complete picture. Planning law is also important. Developers must comply with the Environmental Planning and Assessment Act (EP&A Act), 1979 before a development can proceed. This is to prevent pollution-generating developments. This can be done by:

- using the zoning provisions of the EP&A Act to stop developments in unsuitable locations
- using the project control provisions of the EP&A Act to ensure that adequate environmental impact assessments are made and suitable limits on the proposal are imposed even though development consent is not required.

Other regulations controlling pollution

Licences

If a development is permitted under the planning laws, it may be necessary to obtain a licence to pollute or permission to install and operate certain plant and equipment. Environmental licences are issued under the Pollution Control Act, 1970. This act complements the Clean Air Act, the Clean Waters Act, the Environmentally Hazardous Chemicals Act and the Noise Control Act. The licence should set specific limits on the type and quantity of discharge of certain substances. If the specific limits cannot be achieved, then an amended licence should be sought.

Fines and gaol sentences

Criminal law remains the major incentive to control pollution. Big penalties and gaol sentences are now imposed by the Environmental Offences and Penalties Act.

Civil law measures

Criminal prosecution is, in practice, used far more by regulatory authorities than civil law measures to control pollution. The EPA can issue notices to polluters to do work, to cease activity, to clean up and to provide bonds. More importantly, the EPA can revoke environmental licences, which can, in effect, close down a plant or operation.

Restraining orders and declarations can be obtained from the Land and Environment Court to fight pollution. Both regulatory bodies and citizens can take these civil law actions.

What environmental laws affect the RTA?

Following is a list of the environmental legislation which could affect the RTA. A summary of the major acts is in Appendix B.

- Roads Act, 1993 (NSW)
- Local Government Act, 1993
- Protection of the Environment Administration Act, 1991
- Endangered Fauna (Interim Protection) Act, 1991 (NSW)
- Environmental Offences and Penalties Act, 1989 (NSW)
- Ozone Protection Act 1989, (NSW)
- Ozone Protection Act, 1989
- Hazardous Waste (Regulation of Exports and Imports) Act, 1989
- Motor Vehicle Standards Act, 1989
- Transport Administration Act, 1988 (NSW)
- Water Board Act, 1987
- Environmentally Hazardous Chemicals Act, 1985 (NSW)
- Environmental Planning and Assessment Act, 1979 (NSW)
- Coastal Protection Act, 1979 (NSW)
- Land and Environment Court Act, 1979
- Heritage Act, 1977 (NSW)
- Australian Heritage Commission Act, 1975
- Noise Control Act, 1975
- Dangerous Goods Act, 1975 (NSW)
- Environment Protection (Impact of Proposals) Act, 1974
- Waste Disposal Act, 1970 (NSW)
- State Pollution Control Commission Act, 1970 (NSW)
- Clean Waters Act, 1970 (NSW)
- Clean Air Act, 1961 (NSW)
- Prevention of Oil Pollution of Navigable Waters Act, 1960
- Water Act, 1912
- Noxious Trades Act, 1902
- Public Health Act, 1902

Environmental Offences and Penalties Act 1989 (EO&P Act)

This is the main pollution control Act. The NSW Government's stated intention was to enact the toughest pollution control legislation in the world.

Operation

There are two major aspects to the Act. First, pollution of the environment without lawful authority attracts very heavy penalties. Secondly, directors and managers of corporations are personally liable if the corporation which they direct, commits an offence, unless they can prove they used all due diligence to prevent the pollution occurring.

"It is an offence under the Act to intentionally or negligently:

- dispose of waste without lawful authority
- cause a substance harmful to the environment to escape, leak or spill from a container without lawful authority.

The Act sets out the persons potentially liable if an offence is committed. Those persons include:

- the corporation or individual dealing with the waste or substance
- the directors and managers of the corporation who are automatically liable along with the corporation unless they can avail themselves of a defence under the Act
- the person in possession of the substance
- the owner of the container in which the substance was stored
- the owner and occupier of the land.

The Act will extend to banks and other lending institutions after they become a mortgagee in possession or appoint a receiver."

Extract from Mallesons Stephen Jaques
"Environmental Law and Risk Management" March 1991
Author: Graham Dent, Partner

Under the Environmental Penalties and Offences Act, there is a three-tiered system of penalties. A Tier 1 offence is a major one and is committed by negligent or wilful actions. Tier 2 offences include those that fall under the Clean Air Act, the Clean Waters Act and the Noise Control Act. Minor offences come under Tier 3.

The table on the following page shows offences, penalties and procedures under the EO&P Act.

Offences, penalties and procedures under the EO&P Act, 1989

	Tier 1 (serious new offences)	Tier 2 (older offences)	Tier 3 (minor offences)
Description of offence	1. Wilfully or negligently, and unlawfully: a) dispose of waste (b) cause any substance to leak, spill or escape (c) cause any ozone-depleting substance to escape in a manner likely to harm the environment. 2. Owner and occupier both liable. 3. Company manager and directors liable.	1. More serious offences: Clean Air Act Clean Waters Act Noise Control Act Pollution Control Act & Regulations Littering Failing to comply with orders for restoration and prevention. 2. Less serious offences under the above acts.	Schedule 2 - Environmental Offences and Penalties Act (minor infringements)
Maximum penalty	Company: $1 million Individual: $250,000 or seven years gaol or both.	Law — Company — Individual Clean air — $125,000 — $60,000 Clean waters — $60,000 — $30,000/day Noise control — $30,000 — $15,000 — $3,000/day — $3,000/day Pollution ctrl — $125,000 — $60,000 — $60,000/day — $30,000/day EOP Order — $60,000/day — $30,000/day EOP littering — $300 — $300 EOP Schedule1 — $1,500 - $30,000 — $1,500-$30,000	$150 to $600
Court where prosecutions are heard	1. Land and Environment Court (fine/gaol terms up to two years) 2. Supreme Court (fine/gaol term up to 7 years)	1. Land and Environment Court 2. Local Court (fines $10,000 limit)	1. Land and Environment Court 2. Local Court
Period to commence prosecutions	Three years from date of offence	12 months from date of offence, except three years for: Clean Air Act Clean Waters Act Noise Control Act	12 months from date of offence
Possible defences to prosecution	1. Honest and reasonable mistake 2. Individual (a) no control over cause of offence (b) Taken reasonable precautions and exercised due diligence to prevent the breach. Company directors/managers: (a) no actual, imputed or constructive knowledge of the offence (b) unable to influence the conduct of the company in relation to offence (c) acted with due diligence.	Honest and reasonable mistake of fact. Company directors/managers: (a) no actual, imputed or constructive knowledge of the offence (b) unable to influence the conduct of the company in relation to the offence (c) acted with due diligence.	Honest and reasonable mistake of fact.
Who can prosecute?	1. Authorised officer of EPA 2. Citizen with consent of Land and Environment Court	1. Authorised officer of EPA 2. Local authorities in some cases 3. Citizens with consent of Land and Environment Court	Authorised officer of local council, EPA, Maritime Services Board, Water Board, NPWS and Police Force.

extract from "Environmental Offences and Penalties Act" Fact Sheet No 14.
The Environmental Defender's Office

Powers under the EO&P Act

Authorised officers have extensive powers under the EO&P Act and other environmental legislation. Authorised officers are usually officers of the Environment Protection Authority but can also be officers of the local council. They may:

- enter premises at any time, examine equipment, operation and documents and conduct tests as considered necessary
- require the occupier to take measures to prevent or abate a discharge or emission
- shut down an operation that pollutes
- take water, air or soil samples and/or seize materials
- seize property (upon conviction)
- request and receive information as to:
  - processes and operations
  - waste being discharged
  - storage of hazardous substances
  - noise or odour emissions.

Information is to be supplied by:

- the occupier
- any person requested for information.

Environmentally Hazardous Chemicals Act, 1985 (NSW)

After the Environmental Offences and Penalties Act, the pollution law which most directly affects the RTA is the Environmentally Hazardous Chemicals Act. The RTA plays a major role in dealing with transport incidents which involve the accidental spillage of hazardous chemicals.

The Act sets the rules for controlling the effects of, and providing for the assessment of, chemicals and chemical wastes. It does this by providing a scheme for:

- assessing chemicals
- establishing an inventory of chemicals
- keeping a register of declared chemical wastes.

Under the act, the EPA may issue chemical control orders for chemicals and chemical wastes. It may also take, or require the occupier of contaminated premises, to take actions to restore those premises.

Environmental Planning and Assessment Act, 1979 (EP&A Act)

The Act regulates environmental planning and assessment for development and activities. It does this by setting the rules for environmental planning instruments, such as:

- local environmental plans
- regional environmental plans
- State environmental planning policies.

Development on land to which an environmental planning instrument applies may only be carried out in accordance with the environmental planning instrument. They may require that development consent is required from a consent authority, such as a local council, before the development starts.

The EP&A Act provides for the following:

- **Forward planning** - the making of environmental planning instruments. These instruments allow for the zoning of land.
- **Project control** - criteria for making decisions on development and activities:
  - when development consent is required. Every Development Application () must enable the local council to carry out an Environmental Impact Assessment ().
  - when consent is not required. Many road constructions do not need development consent. However, to achieve its objective to protect and enhance the environment, the EP&A Act imposes environmental impact assessment obligations.

    Under the Act, the RTA must examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of a proposed activity. This assessment is made in a Review of Environmental Factors (REF).

    Where an activity is likely to significantly affect the environment, the RTA must prepare and publicly exhibit an Environmental Impact Statement (EIS), prior to carrying out the activity or granting an approval for the activity.

- **Public access** to the decision making process. Several opportunities are provided in the legislation for public involvement and participation in environmental planning and assessment. The public can make submission concerning:

- exhibited draft regional and local environmental plans
- Environmental Impact Statements
- all development applications.

- **Rights of enforcement** to ensure compliance with the provisions of the EP&A Act. Any person may bring an action to remedy or restrain a breach of the EP&A Act.

Obtaining an environmental licence

What is an environmental licence?

Industries, activities or equipment with a recognised potential to pollute are labelled "Scheduled premises" or "Scheduled equipment" under some environmental legislation. Scheduled premises and scheduled equipment require an environmental licence. The need for licences is specified by the Clean Air Act, the Clean Waters Act and the Noise Control Act. The licence is enforced by the EPA, and is routinely monitored by them.

In addition to scheduled premises, licences are needed whenever water or other waste is discharged into a drain, open water-way or sewer. Specific bays and rivers, such as Port Jackson, are classified, under the Clean Waters Act, so that a higher standard is applied to any discharge entering these waters. This is specified in the licence to discharge.

Amongst other requirements, the licence often requires licence-holders to monitor and record all their waste and noise emissions. Licences set out acceptable practice to prevent pollution. The pollution to be monitored may be environmentally harmful or may degrade the area by introducing odours or noise or reducing aesthetics.

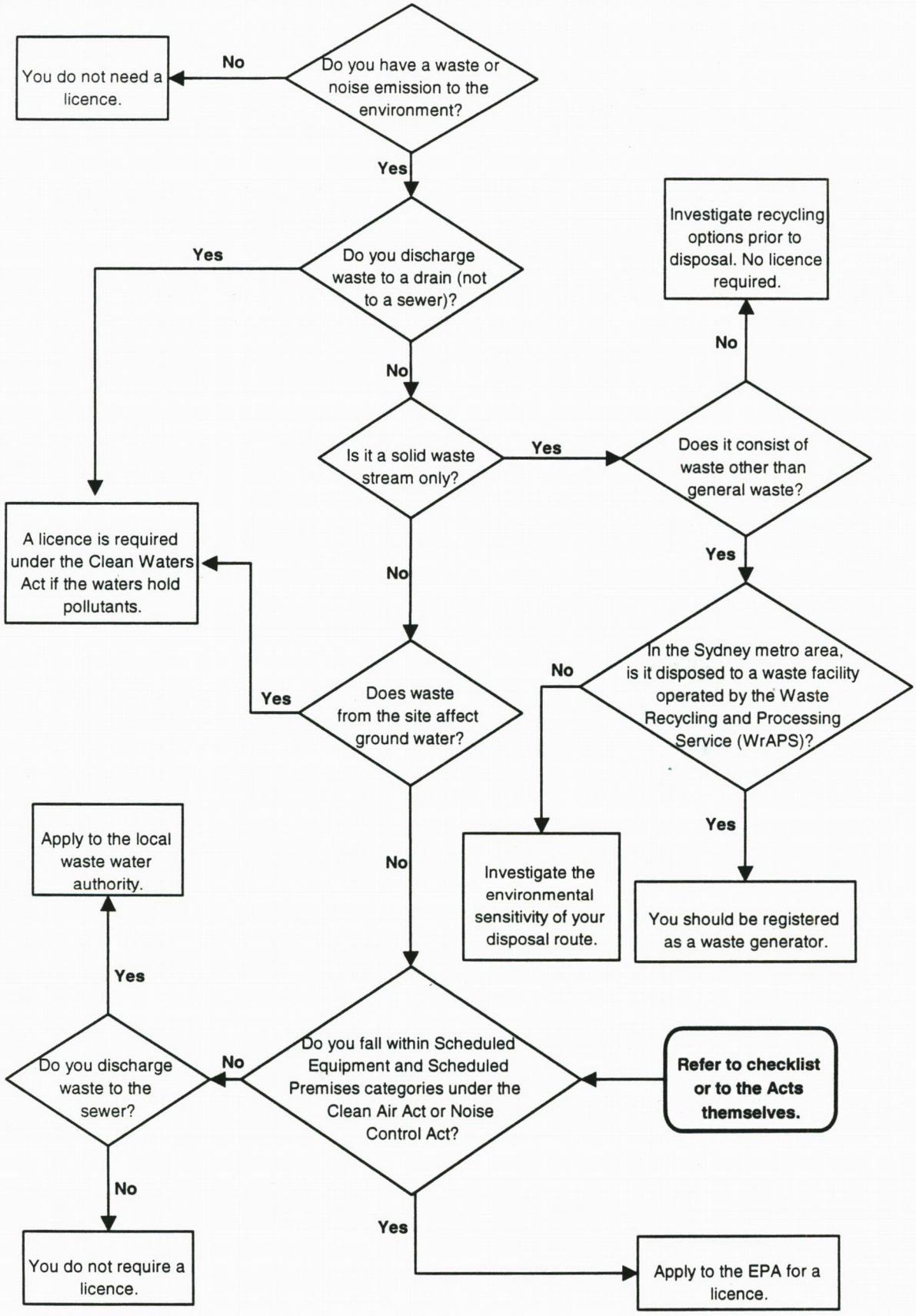
Scheduled premises may not:

- be operated without a licence
- alter their equipment, plant or waste discharges without a licence amendment.

Penalties of up to $125,000 follow non-compliance with licensing requirements.

In some legislation, non-scheduled industries do not require an environmental licence to operate. Therefore, no formal environmental monitoring program is required by law. All premises may require a licence under the Clean Waters Act.

Environmental licensing flowchart



Who needs an environmental licence?

- Assess whether your operation produces waste which is discharged to the atmosphere (air environment), or water drains, or could drain into ground water (water environment), or whether noise emissions pass beyond site boundaries.
- If the answer to any of these is "yes", compare your operations or equipment to the classification contained within the scheduled premises categories within the relevant act or regulation or defined as classified waters in the Clean Waters Act.
- If your operations fall within any specified category - your premises is scheduled and your operations require a licence to discharge waste.
- If your operations do not fit into any category, you do not require a licence. This in no way means you are free to pollute, it simply means that strict operational and monitoring provisions are not frequently inspected by the responsible authority.

Which licences apply to the RTA?

Every new program of works within the RTA needs assessment to determine if environmental licences are needed. The need for any licences should be determined during the planning phase of the project and should be dealt with as part of the Environmental Impact Assessment.

Scheduled equipment and premises

There are operations performed by the RTA, or by contractors to the RTA, which need a licence. Examples of these are:

- "Cement handling works, being works in which more than 200 tonnes per annum of cement, powdered lime or dry cement products are handled in bulk or capable of being handled in bulk, either alone or in the aggregate."

  A pugmill used in stabilising operations is an example of this.

- "Pre-mix bitumen plants, being works in which crushed or ground rock aggregates are mixed with bituminous or asphaltic materials for the purpose of producing road building mixtures."

  An example is the use of a contract mobile asphalt plant.

- "Any matter, whether solid, liquid or gaseous, in a position where it falls, descends, is washed, is blown or percolates, or is likely to fall, descend, be washed, be blown or percolate, into any waters, or onto any bed of waters, when dry, .."

  An example is bitumen or power kerosene stored at a stockpile, which might have an effect on ground water.

- "Any premises on which freeway roads, or any roads for which a toll for use is to be charged, are being constructed by the Minister of Roads."

  The construction of any tollway or freeway needs a licence.

Dangerous Goods Act, 1975

The Dangerous Goods Act is concerned with the transport and storage of dangerous goods. Certain types and quantities of materials require a special licence with WorkCover.

Some of the materials that need a licence, according to the quantity to be stored or moved are:

- DG class 1 blasting explosives
- DG class 1 detonators
- DG class 1 fuses
- DG class 2 compressed gases
- DG class 3 flammable and combustible liquids
- DG class 6 poisonous substances
- DG class 8 corrosive substances.

Even when a licence is not required, such as for small quantities, the "occupier" must comply with the general conditions for keeping dangerous goods, as specified in the Dangerous Goods Act.

Summary

In NSW, there are many laws and regulations to protect the environment. The legislation gives environmental protection in three ways:

- planning for environmentally responsible development and activities
- enforcing a licence system to set limits and monitor operations which produce waste
- imposing penalties for environmental offences.

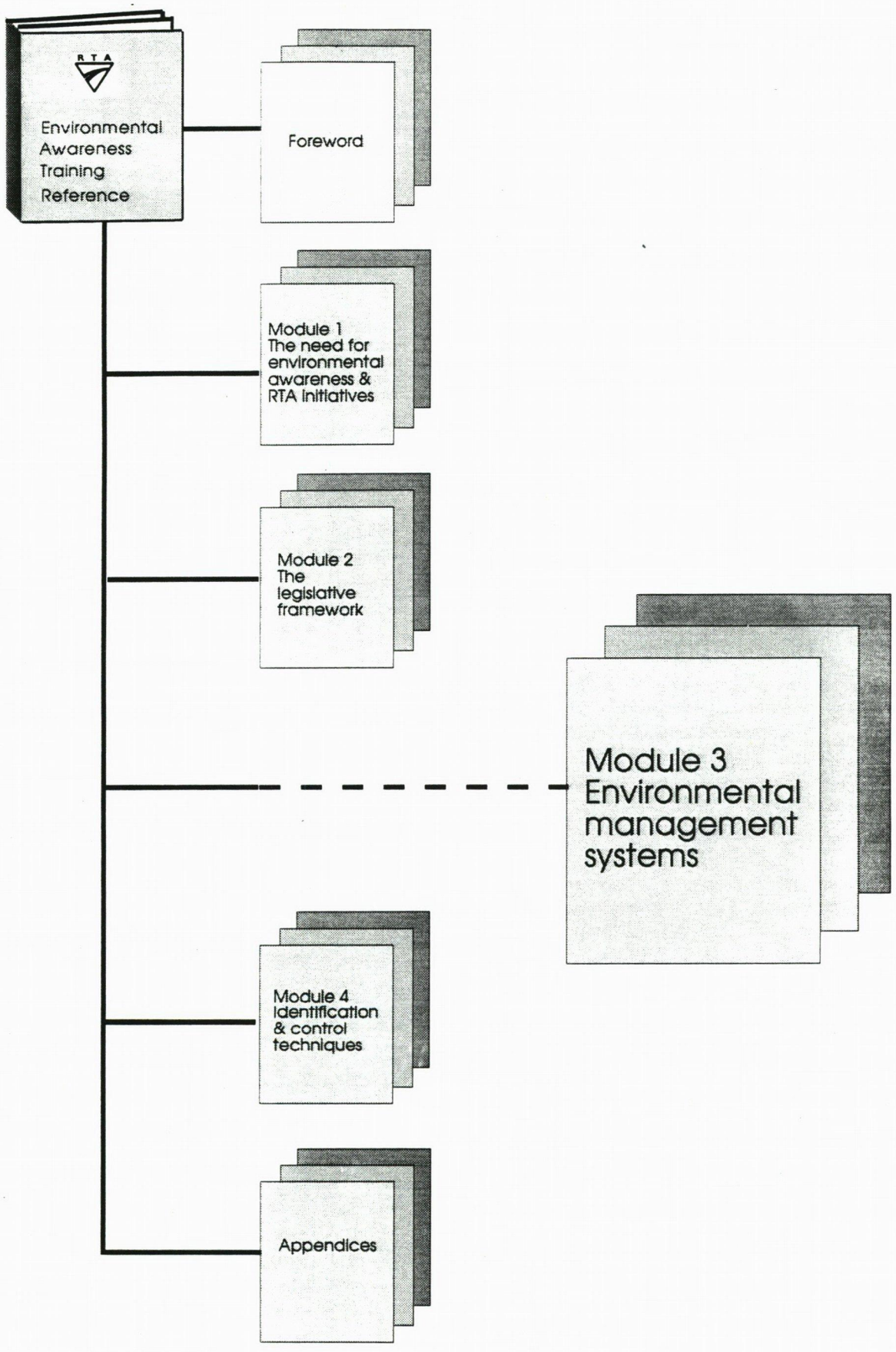
Any person who deliberately or negligently disposes of waste is guilty of an offence under the Environmental Offences and Penalties Act, 1989.

The maximum penalties for polluting are:

- $1 million for a corporation
- $250,000 and/or 7 years jail for an individual.

For the RTA, the main legislative acts which apply in this area are:

- Environmental Offences and Penalties Act, 1989
- Environmental Planning and Assessment Act, 1979
- Environmentally Hazardous Chemicals Act, 1985.


RTA
Environmental Awareness Training Reference
Foreword
Module 1 The need for environmental awareness & RTA initiatives
Module 2 The legislative framework
Module 3 Environmental management systems
Module 4 Identification & control techniques
Appendices

Module 3: Environmental Management Systems (EMS)

Introduction

This module describes the guidelines for an environmental management system and how it is implemented within the Authority. It then describes specific parts of an environmental management system, namely:

- risk management
- waste management
- emergency situation
- chemical incidents

and how to deal with them.

Due diligence

"In order to succeed in a defence of having used all reasonable care and diligence it will at least be necessary to establish the following:

- there was a proper system designed to foresee and prevent contravention of the legislation.
- the system must work. This will mean:
  - an environmental assessment
  - supervision of the system at all appropriate levels
  - periodic review of the system
  - periodic inspection of key parts of the system
  - involvement by directors and other officers, including review of relevant reports
  - instruction of relevant line management in the setting up of the system
  - reporting to management of the operation and effectiveness of the system and demonstrated ability to react immediately and personally if the system has failed
  - reporting structure for issues of non-compliance, or any concerns raised by regulatory authorities
  - training of officers in environmental compliance
  - compliance with environmental laws must be demonstrated."

Freehill, Hollingdale & Page

This definition of due diligence describes what is required in an environmental management system (EMS).

About an environmental management system

What is it?

An environmental management system is the:

- organisational structure
- responsibilities
- practices
- procedures
- processes
- resources

for implementing environmental management.

Who needs one?

An environmental management system is implemented by any organisation which wishes to:

- set and implement an environmental policy
- comply with environmental laws
- demonstrate their compliance.

The aim of the system is to prevent pollution offences from happening, either accidentally or through carelessness. Having a system protects the organisation, its directors and employees from liability **only if the system is always used.**

What does an EMS require?

This description of requirements for an environmental management system is based on the British Standard, BS 7750: 1992, "*Specification for environmental management systems*".

An organisation establishes and maintains an environmental management system to make sure that the organisation's activities meet environmental policies, objectives and targets.

An EMS includes:

- preparing
- documenting
- effectively implementing

system procedures and instructions.

The requirements for an EMS are described in this section.

Environmental policy

Management defines and documents an organisation's environmental policy. The policy should:

- be relevant to its activities, products and services, and their environmental effects
- be understood, implemented and maintained at all levels in the organisation
- be publicly available
- include a commitment to improve environmental performance
- provide for setting and publishing the environmental objectives.

Organisation and personnel

Organisation and personnel has four components:

Responsibility, authority and resources

The organisation defines and documents the responsibility, authority and reporting structure of the key personnel who manage, perform and verify work affecting the environment.

Verification resources and personnel

The organisation verifies that activities comply with environmental policies.

Management representative

The organisation appoints a management representative with the authority and responsibility to ensure that the EMS is properly set up and maintained.

Personnel, communication and training

The organisation establishes and maintains procedures to make sure that employees at all levels are aware of:

- the importance of complying with environmental policy and objectives
- how their work activities could affect the environment
- what are the benefits of improving their performance
- what they have to do to comply
- what could happen if they do not follow the agreed procedures.

It also identifies and provides training for all personnel whose work may have a significant effect on the environment.

Environmental effects

Register of legislative, regulatory and other policy matters

The organisation keeps a register containing an up-to-date copy of all the legal, regulatory and policy requirements that are about the environment. This includes:

- laws
- regulations
- policies
- licence conditions.

Communications

The organisation sets up and maintains procedures for handling communications with relevant parties about its environmental effects and management.

Environmental effects evaluation and register

The organisation sets up and maintains procedures for assessing the environmental effects of its activities, products and services. It compiles a register of those identified as significant. It should include effects such as:

- controlled and uncontrolled emissions to the atmosphere
- controlled and uncontrolled discharges to water
- solid and other wastes
- contamination of land
- use of land, fuels, energy and other natural resources
- noise, odour, dust, vibration and visual impact
- effects on specific parts of the environment and ecosystems.

The procedures include effects that could and/or do arise from:

- normal operating conditions

- abnormal operating conditions
- incidents, accidents and potential emergency situations
- past activities, current activities and planned activities.

Environmental objectives and targets

The organisation specifies and reviews its environmental objectives and targets at all relevant levels.

The primary objectives and targets ensure compliance with laws and regulations. Other objectives and targets are derived from the:

- environmental effects register
- financial, operational and business requirements of the organisation
- views of outside interested parties.

The objectives and targets are consistent with an organisation's environmental policy and quantify a practical improvement in environmental performance over a set time.

Environmental management program

The environmental management program defines how the organisation sets and achieves its targets and objectives. It includes:

- assigning responsibility for setting targets at all levels of the organisation
- how to achieve these targets.

For the environmental management of new activities, establish separate programs, defining:

- the environmental objectives
- how they will be achieved
- how changes to the activity will be handled
- how any need for correction to the program will be detected, applied and monitored.

Environmental management manual and documentation

It is necessary to create and maintain manuals which:

- record the environmental policy, objectives, targets, and programs
- document the key roles and responsibilities

- describe the interactions of system elements
- refer to related documentation and procedures within the organisation.

In addition to dealing with the normal activities of the organisation, the documentation covers:

- abnormal operating conditions
- incidents
- accidents
- potential emergency situations. Emergency plans contain essential environmental information and instructions on how to manage the emergency situation.

All the documents required by an EMS should:

- be readily identified with the appropriate organisation, division, function or activity
- be periodically reviewed, maintained and approved prior to use
- be available at all locations where needed
- be current.

Environmental management records

The organisation establishes and maintains records and inventories to show compliance with EMS requirements and to record how well its environmental objectives and targets have been met.

The records kept for an EMS should be readily accessible, legible and safely stored. Access to the records, both within the organisation and to interested parties, is set by policy and documented.

Operational control

Operational control means identifying all the functions, activities and processes which could affect the environment, and are relevant to its policy, objectives and targets. Management plan these functions and activities to ensure that they are carried out under controlled conditions. Particular attention is paid to:

- documented work instructions which define the details of individual activities. **These work instructions apply equally to staff and contractors.**
- procedures dealing with outside parties, suppliers and contractors
- monitoring and controlling processes such as waste disposal

- approval of planned processes and equipment
- written standards for performance measurement.

Verification, measurement and testing

The organisation sets up and maintains procedures to verify compliance with the target standards. The procedures:

- identify and document what is to be verified
- specify and document the verification process
- establish and document acceptable results and what to do when results are unsatisfactory
- assess and document if previous results are satisfactory if verification systems have failed.

Non-compliance and corrective action

If an activity causes non-compliance with target standards, the organisation investigates the incident and takes corrective action. The management of the individual activity concerned, together with the management representative:

- determine the cause
- draw up a plan of action
- set up preventative measures
- apply controls to ensure that the preventative actions are effective
- record any changes on procedures to prevent a recurrence.

Environmental management audits

An organisation should have a plan for conducting regular environmental audits of its activities. The audit measures:

- if the environmental management activities are effective
- if the EMS is effective in fulfilling the organisation's environmental policy.

The audit plan defines:

- which activities and areas will be audited, such as:
  - organisational structures
  - administrative and operational procedures
  - work areas, operations and processes
  - documentation, reports and records
  - environmental performance.
- how often each activity area will be audited

- who audits each activity area
- what qualities, expertise and support the auditors need to have
- how the audit will be conducted
- how to report the findings.
- how to publish the audit findings, if the organisation has such a commitment.

The audit report should include:

- conformity or nonconformity with specified requirements
- the effectiveness of the environmental management system in meeting objectives and targets
- implementation and effectiveness of any corrective actions recommended in previous audits
- conclusions and recommendations.

Environmental management reviews

An EMS should be regularly reviewed and modified if necessary. This ensures that the environmental management system remains suitable and effective.

Management reviews should include assessment of the results of environmental management audits.

Australian guidelines

The Standards Association of Australia issued a draft Australian Environmental Management System Standard (DR 92239) for discussion in December 1992. This was based on the British Standard, BS7750: 1992. Following public comment, Australian Standards is developing a guide to environmental management systems for Australian organisations.

The RTA's Environmental Management System

Why have it?

The RTA has an environmental management system in order to:

- provide a systematic way of being environmentally responsive and responsible
- carry out the RTA's *Environmental Vision*
- enable the RTA to comply with environmental laws and regulations in all its day-to-day operations
- achieve "best practice" in environmental management in accordance with quality management and environmental standards
- manage the Authority's exposure to environmental risk
- respond positively to the community's demand for operations to be managed to environmental "best practice"
- ensure that management of the environment is an important part of every project.

The RTA's implementation

The RTA's environmental management system is aimed at improving environmental management performance by:

Environmental policy and commitment

The RTA's environmental policy requires the use of "best practice" in environmental planning and management in all RTA activities. This highlights the Authority's environmental commitment.

Education and training throughout the Authority

The Environment and Community Impact Branch will develop and support Environmental Awareness Training courses, in different forms, to all responsible levels throughout the Authority. Pilot training courses have been carried out in conjunction with the Risk Manager.

Environmental self-assessment and peer review at Authority sites

An environmental self-assessment questionnaire is being developed to provide site managers throughout the Regions with a methodology to assess their environmental risks. This will be distributed to all sites.

These questionnaires are for collecting data to enable the current environmental risks and management to be assessed for each site.

The Regional Environmental Manager or Officer will co-ordinate the assessment. The results of the assessments will enable the development of environmental improvement plans wherever they are needed.

By this process, the Authority can identify and confirm the required model environmental policies and procedures which will become part of the EMS. The Authority encourages peer review of self-assessments.

Environmental objectives and business plans

Clear and defined environmental objectives are being established. These objectives will be reflected in business plans.

Organisational structure

EMS will be integrated into all RTA activities. There will be a regional focus for environment, with officers from each region responsible for environmental management and planning in their region. These officers will have the authority, background, training and support to carry out these responsibilities.

The Environment and Community Impact Branch will set policy and provide leadership, co-ordination and assistance to corporate directorates, branches and the regions.

Information dissemination

As well as formal training, information on environmental issues will be disseminated through a periodic Environmental Bulletin, distributed by the Environment and Community Impact Branch.

Performance indicators and measurement

The Authority's management performance indicators will include environmental performance as an integral part of the Authority's management performance system. This is necessary because the environmental management system is part of the strategic focus of the Authority.

Model policies and procedures

The Environment and Community Impact Branch is developing model procedures for the environmental management system, in conjunction with:

- Regions
- Group Audit Branch
- Risk Manager
- Occupational Health and Safety Branch and the Occupational Hygienist.

These policies and procedures will be a part of the Authority's Quality Management System.

Records and inventory

The RTA's existing data collection systems will keep records and inventory of all sites and their environmental assessment. The data and inventory to be recorded will be identified and stored in the appropriate database.

The records will include:

- a register of regulatory and policy requirements
- licences and notices
- record of known impacts
- incidents and accidents
- environmental monitoring data.

The Road Assets Database and MMS are two examples of ways of collecting environmental information. The environmental section of the Road Assets Database for data and reports is currently being modelled.

Audit and assessment

The environmental management system will require periodic reviews of activities and management. These will focus on internal mechanisms to improve environmental management and be integrated with existing audits.

Benefits of an EMS

Using an environmental management system will ensure that as a road authority, the RTA is planning for and protecting our environment. The system will also:

- assist in applying ecologically sustainable principles
- comply with environmental legislation and regulations and satisfy due diligence requirements

- gain recognition of the Authority's environmental management by the community and stakeholders
- save dollars by fully using and recycling resources and avoiding costly environmental penalties and litigation.

Risk management

"**Risk:** a measure of the probability and severity of an adverse effect to health, property, or the environment."

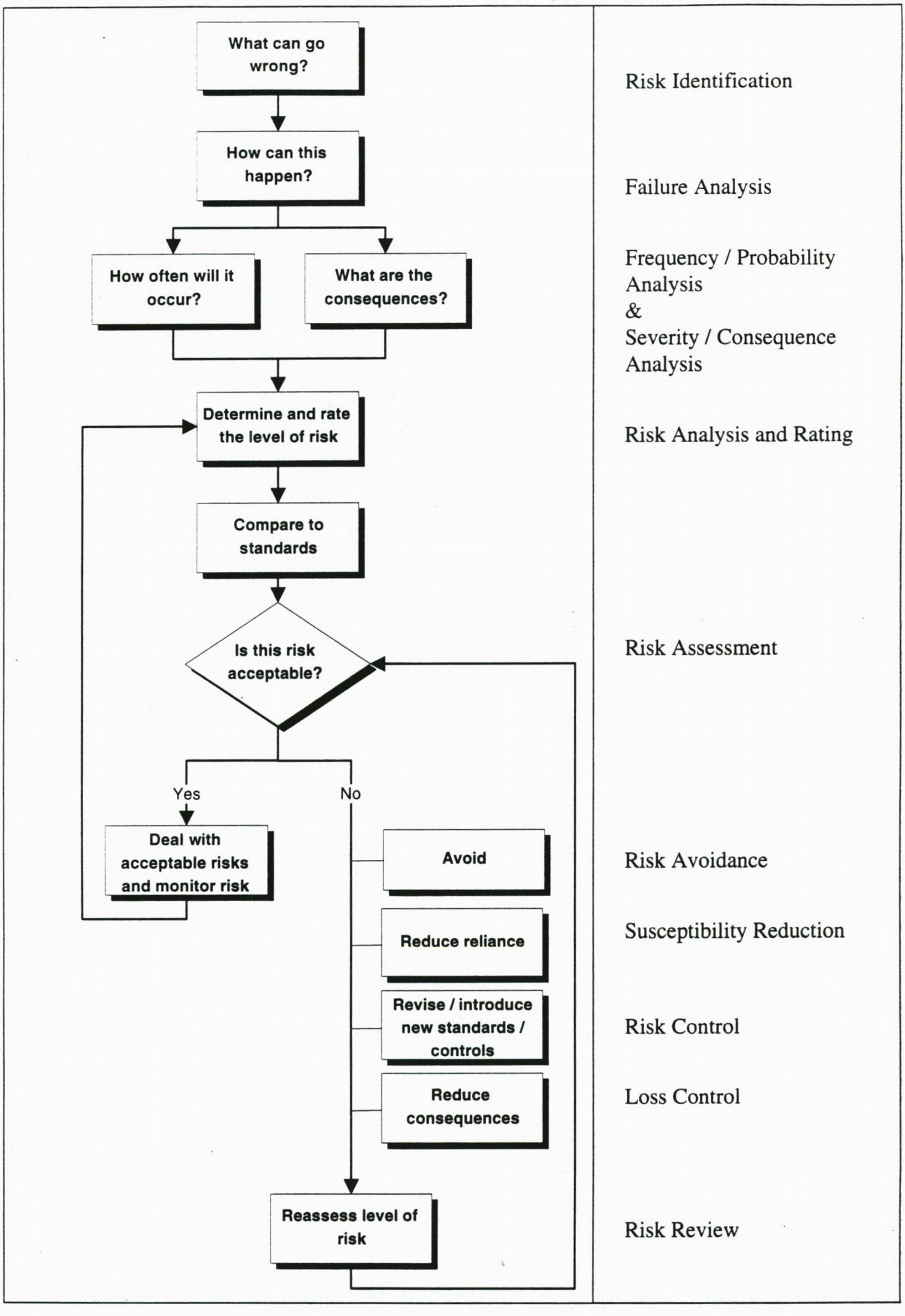
Canadian Standard,
CAN/CSA-Q634-91
Risk Analysis Requirements
and Guidelines

"**Risk management** is the complete process of risk assessment and risk control.

- Risk assessment is the process of risk analysis and risk evaluation.
  - Risk analysis is the use of available information to estimate the risk to individuals or populations, property or the environment, from hazards. Risk analyses identify any hazard and produce a measure of the level of health, property, or environmental risks being analysed.
  - Risk evaluation is the stage at which values and judgements enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risk.
- Risk control is the process of decision-making for managing risk, and the implementation, enforcement, and re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input."

Canadian Standard,
CAN/CSA-Q634-91
Risk Analysis Requirements
and Guidelines

The diagram on the next page shows the stages in the risk management process being developed for use within the RTA.


What can go wrong?
How can this happen?
How often will it occur?
What are the consequences?
Determine and rate the level of risk
Compare to standards
Is this risk acceptable?
Yes
No
Deal with acceptable risks and monitor risk
Avoid
Reduce reliance
Revise / introduce new standards / controls
Reduce consequences
Reassess level of risk
Risk Identification
Failure Analysis
Frequency / Probability Analysis
&
Severity / Consequence Analysis
Risk Analysis and Rating
Risk Assessment
Risk Avoidance
Susceptibility Reduction
Risk Control
Loss Control
Risk Review

Risk assessment and risk management

The terms 'risk assessment' and 'risk management' are often confused but each should be used separately.

Risk management is a global term, used to describe all the activities that come together to form a Risk Management Program.

Risk assessment is only part of the risk management process. It consists of two steps:

- qualitative - to identify if there is an environmental risk
- quantitative - to identify how great the risk is.

These were discussed in "Complying with environmental legislation" on page 1.12. You will find details on how to conduct an assessment in "Conducting an environmental assessment" on page 4.2.

Risk management also involves making decisions to address an exposure identified during the risk assessment process. These decisions may involve risk avoidance, hazard reduction or loss mitigation. Refer to the Canadian Standard on page 3.14.

- Risk avoidance - ceasing the activity
- Hazard reduction - assessing a risk and minimising the likelihood of an event happening
- Loss mitigation - taking steps to minimise the impact of an event which may occur.

The process involves a thorough understanding of the consequences of a given risk and the measures of protection against such an event.

Environmental risk management

Environmental risk management is the application of these techniques to environmental matters. It forms part of the overall Risk Management Program.

In an environmental risk management program, the aim is to minimise the risk of harming the environment thereby avoiding penalties, costly remediation and adverse community reaction. Environmental risk management is an essential part of an effective environmental management system.

In some businesses, loss mitigation can be effectively covered by insurance. However, in environmental matters, this is not a viable solution. The reasons for this are given in the following section.

Insuring against environmental pollution

What insurance is available?

Public Liability Insurance provides protection for death, injury or damage caused by an incident which occurs while the policy is in force. Even if the effects of that incident are not noted for some years, provided it can be traced back to an incident which occurred when the policy was in force, a claim is paid under that policy. The insurer at the time of the incident covers the claim.

Public Liability Insurance in Australia generally excludes gradual pollution claims and only allows those of a **sudden and accidental** nature, such as a hose splitting or a drum toppling over.

An innovation in the past 15 years has been the introduction of Environmental Impairment Insurance to cover **gradual** pollution claims.

Environmental Impairment Insurance:

- provides cover for incidents which are reported or claims made against the insured **during the currency of the policy**. Policies must be renewed indefinitely into the future since the nature of environmental damage means we can **never** be sure that all pollution events have been identified at any point in time.
- is expensive
- is difficult to obtain. Only three insurers in Australia and a handful world-wide provide it.
- requires a comprehensive survey of the features and controls for every location and activity. The survey is expensive. After the survey, the insurer assesses the risks and may recommend that certain controls be instigated before it will accept the risk.

Consequently, most organisations do not carry Environmental Impairment Insurance.

It should be recognised that reliance on insurance as a means of controlling risks is neither desirable nor completely effective. The existence of insurance does nothing to reduce risks - it merely transfers them to another party, the insurer. Sooner or later, someone must pay the cost of insured losses.

It is therefore more satisfactory to reduce or eliminate the risk in the first place.

Insurance against fines and penalties

No insurance protection is available for any fine or penalty under the Environmental Offences and Penalties Act.

These matters are the sole responsibility of the organisation or individual concerned.

The RTA's risks and insurance arrangements

The Authority has a number of potential sources of gradual pollution such as siltation traps, underground tanks, PCBs in transformers, or leachate from stockpiles. Not all of these pollutants are toxic. Pollution can result from non toxic substances, like sediment, as well as the more commonly accepted pollutants such as oil.

The Authority's insurance protection, provided by the Treasury Managed Fund, excludes any liability for gradual pollution as follows:

"The Fund shall not be liable for claims:-

From any pollution liability to persons, property or the environment emanating from the protected entity's operations unless wholly sudden and accidental and not preventable by reasonable precautionary maintenance....."

This means that the Authority is not protected for gradual pollution events and must develop systems to ensure that the likelihood of such events is minimal or non existent.

Contractor risk and insurance arrangements

Contractors working on RTA sites can create pollution hazards of either a sudden and accidental or gradual nature. The RTA might also be liable, and must ensure that its contractors have systems and standards to control such matters and that they comply with them.

There are two major factors to consider:

- It is not sufficient for the Authority to insert indemnity clauses in our contracts because:
  - the contractor may have inadequate insurance protection, and it is best not to rely on insurance in any case

- the contractor may not have the financial or other resources to carry out adequate clean-up operations. Clean-up costs can be extremely high since contaminated materials (including contaminated soil) must frequently be treated then trucked to an approved toxic waste disposal facility
- the RTA might be vicariously responsible for the criminal actions of the contractor or its servants.

- The Environmental Offences and Penalties Act places a joint responsibility on the RTA, as owner and/or occupier of the premises, for pollution incidents regardless of who the real culprit was and the circumstances under which the pollution event occurred. This could result in penalties against the Authority and/or individual employees and contractors.
- As part of a quality management contract, the contractor should supply evidence of their environmental management plan. This should be audited by the Authority as part of the quality management process to make sure that the contractor complies with "due diligence" requirements.

Waste management

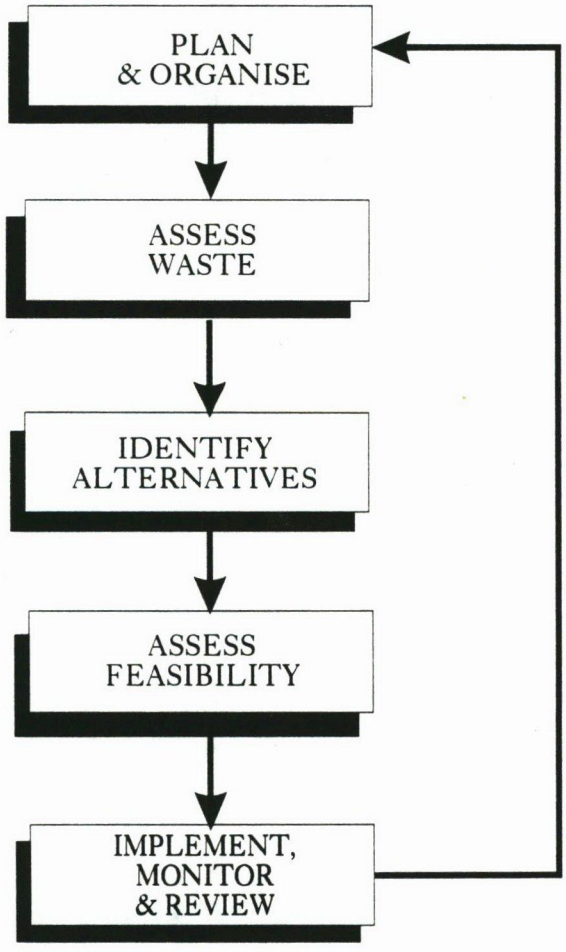
Waste management is one of the areas that should be included in an effective environmental management system.

A waste management plan is an essential step towards minimising non-productive costs. It also assists an organisation to meet its environmental and social responsibilities. It emphasises the prevention and reduction of waste, rather than treatment and disposal.

The Authority generates waste during normal operations. A waste management plan would look at minimising this waste through processes such as drums and oil recycling, concrete slab recycling and treatment of bitumen waste. It should look at waste in all areas of the Authority's operations, from construction sites to offices.

Waste management plan

The following diagram shows the five stages of a waste management plan.



Plan and organise

Management commitment is essential if the waste management plan is to be successfully integrated into the day-to-day activities of the organisation. It is just as essential to have people with assigned responsibilities, and the organisation to back them up.

Assess waste

Assessing the waste is the first task for the assessment team. The stages are:

- obtain background information from organisation records on:
  - work activities
  - waste
  - costs.
- carry out a site survey to determine types and sources of waste
- check for completeness of data by cross checking with background information
- check for regulatory compliance
- identify waste that has high toxicological impact on the environment.

Identify alternatives

In identifying alternatives, waste prevention and reduction is better than treatment and disposal. The goal is to reduce the risk to the environment and community. The options for waste disposal are listed in order of priority:

1. Minimisation
2. Recycling
3. Treatment
4. Disposal.

Assess feasibility

The assessment team evaluates the options of source reduction, recycling, treatment or disposal on the basis of technical, financial and economic feasibility. They should keep in mind the organisation's goals and constraints as part of the assessment.

Implement, monitor and review

Once the options are selected, the next step is to develop an implementation plan for each of the waste streams. The plan should cover staff education, training, waste specific accounting and co-ordination of further investigations.

The waste management plan is an ongoing one and must be continually monitored and reviewed.

Further information on waste management, is supplied in Appendix C, "Waste management - a guide for industry".

Recycling within the RTA

As the primary NSW road network has matured, the emphasis is changing from providing roads to managing the network. The need to reconstruct and repair cost-effectively is now the priority.

With increased environmental awareness and the need to consider ecologically sustainable development, the Authority is looking more to using recycling techniques for roadworks. Appendix D, "Road rehabilitation and recycling", describes recent developments in pavement rehabilitation and recycling techniques and also attempts to look at future needs and developments.

A model policy and procedures will be developed for the RTA to implement waste management.

Responding to emergencies

During emergencies, there is often risk of environmental damage. This can include :

- danger or threat of damage to people's safety or health
- damage or threat of damage to property.

Emergency procedures

Each of the Authority's Works Depots, or equivalent, has local *Emergency Callout Procedures*. These procedures outline the people and resources who are scheduled and trained to respond to emergencies.

They have these main tasks:

- secure the site safety and clean up debris and hazardous materials after an accident
- repair damaged pavement and road function and serviceability
- control the traffic until repairs are completed
- minimise any environmental damage as a result of the accident.

State Disaster Environment Protection Plan

, the EPA's State Disaster Environment Protection Plan, focuses on protecting the environment during State-level emergencies. The RTA is a participating agency in this plan.

The RTA may be requested to "clean up hazardous material spills and debris on RTA and other roadways resulting from traffic accidents".

In addition, the Authority may be requested to provide "engineering assistance, in particular road transport, heavy plant, earth moving equipment and the ability to establish and maintain access/egress routes to incident sites".

For more information, read the *New South Wales State Disaster Plan* () and the supporting plan for environmental services, the *State Disaster Environment Protection Plan* (ENVIROPLAN).

Make sure that you are familiar with the *District Emergency Management Plan* which outlines the role of all the participatory bodies for emergencies in the local district. The RTA's role is defined in this plan.

Chemical incidents

When a chemical incident occurs, there are procedures to assist the effective co-ordination of resources responsible to:

- contain
- make safe
- minimise the effect on human health and the environment.

See the State Pollution Control Commission's *Chemical Incidents Procedures Handbook* for procedures for handling chemical incidents.

Chemical Incident Co-ordinator

The Chemical Incident Co-ordinator has overriding authority for the incident scene and rendering an incident safe. The co-ordinator is the senior Fire Brigade Officer at the scene. If no Fire Brigade Officer is present, the co-ordinator is the senior Police Officer.

The co-ordinator obtains information about the chemicals involved and how to contain and treat the incident in the most effective manner. The co-ordinator's specific tasks are to:

- obtain and assess information from the incident scene and seek further information from the Fire Brigade Control Room, the EPA Chemicals Officer, specialist authorities and the chemical industry, particularly the owner of the chemicals and in transport incidents, the transport company
- identify the dangerous goods, chemicals and other materials (including foodstuffs) involved using emergency information panels (HAZCHEM signs) and other dangerous goods labels, package labels, consignment notes or shipping papers
- inform the Police, Ambulance Service and other authorities of the known hazards associated with the incident
- notify the senior Police Officer at the incident scene of any co-ordination requirements, including evacuation
- define the extent of the incident scene
- determine and arrange for relevant action at the scene by the Fire Brigade
- arrange for safety equipment to be provided by the Fire Brigade or companies

- ensure that adequate arrangements have been made for anyone trapped or injured
- arrange for neutralising chemicals to be provided by chemical companies as required
- contact, or arrange to contact, all authorities, persons and companies, including local residents and property owners, directly affected by the incident
- arrange for sand to be provided by the RTA, local councils and other sources, as required
- arrange with the owner and/or transporter of the chemicals and the EPA Chemicals Officer for collection, removal and treatment as required
- provide a written report of the incident to the EPA outlining any problems encountered and/or suggestions to improve the overall response of all authorities to such an incident.

RTA Liaison Officer

The RTA Liaison Officer, as nominated for your local area in the Local Emergency Management Plan, will work with the Co-ordinator to manage and control the Authority's resources to assist with the incident.

For a transport incident

A type of specialised safety data sheet, *Emergency Procedure Guides - Transport*, is carried in the driver's door of road vehicles transporting more than specified quantities of dangerous goods. The guides provide information on most safety aspects of a transport incident including, in most cases, appropriate render-safe, disposal and treatment methods.

Pollution

Where hazardous chemicals have escaped to the environment as the result of an incident, everyone has a responsibility to minimise or abate their effect. The EPA is primarily responsible for preventing pollution of air and waters and contamination of land. The RTA should provide all possible assistance under the direction of the Chemical Incident Co-ordinator.

Disposing of waste

Industry, that is the owner, agent, manufacturer or importer of the chemical, is responsible for the disposal of wastes as directed by the appropriate authority. In practice, disposal may be carried out by various authorities, such as the RTA, with costs recovered from industry. Recovery of the chemicals is the primary aim in all cases. Only when it is not possible to recover the chemicals should treatment or disposal be considered.

Dealing with hazardous chemicals

Hazardous chemicals can present risk to life, health and property, unless handled correctly. The Dangerous Goods Class Labels were developed to allow ready identification of dangerous goods.

Some of the labels look like this:

The Dangerous Goods Class Labels must be used when moving dangerous goods by road or rail. The code provides an easily identifiable symbol. It provides information on:

- what the chemical is
- what hazards it presents
- what to use to extinguish a fire
- whether protective clothing is needed
- if neighbours should be evacuated.

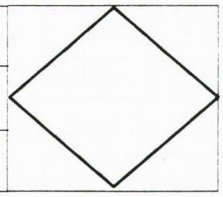
More information on hazardous chemicals, how to identify them and how to clean-up after spills is in Australian Standard 1216, Parts 1, 2, 3 and 4, Classification, Hazard Identification and Information Systems for Dangerous Goods (HAZCHEM).

Emergency procedures for dealing with spillages of hazardous chemicals is supplied in reference charts in *Australian Standard AS 1678, Emergency Procedure Guide - Transport.*

Hazchem Scale for fire and spillage

Hazchem Scale
FOR FIRE
OR SPILLAGE

Name	
UN No	
Hazchem	



1	JETS	3	FOAM
2	FOG	4	DRY AGENT

P	V	FULL	DILUTE
R			
S	V	BA	
S		BA for FIRE only	
T		BA	
T		BA for FIRE only	
W	V	FULL	CONTAIN
X			
Y	V	BA	
Y		BA for FIRE only	
Z		BA	
Z		BA for FIRE only	
E		CONSIDER EVACUATION	

Name: Chemical name, eg PETROLEUM FUEL

UN No: Dangerous Goods No, eg 1270

Hazchem: Hazchem Emergency Code, eg 3 Y E
(Use FOAM, BA for FIRE only, consider evacuation)

V Can be violently or even explosively reactive.

BA Breathing apparatus plus protective gloves.

FULL Full body protective clothing with BA.

DILUTE May be washed to drain with large quantities of water.

CONTAIN Prevent, by any means available, spillage from entering drains or watercourses.

What to do in a chemical emergency

1. Remain upwind of the incident scene
2. Identify the type of incident. Is it:
   - ☐ spillage?
   - ☐ fire?
   - ☐ explosion?
3. Determine if anybody is injured but be careful not to become a victim yourself.
4. Identify the chemical involved:
   - ☐ its name
   - ☐ its UN Number.
5. Note the time and location of the incident.
6. Notify Emergency Services:
   - ☐ Telephone 000 or 1100.

WorkCover Authority of NSW
Chemical Safety Unit

This information is provided in RTA form #1259, *Dangerous Goods, What to do in an emergency, DMR, 1988,* available under Catalogue No 45058409.

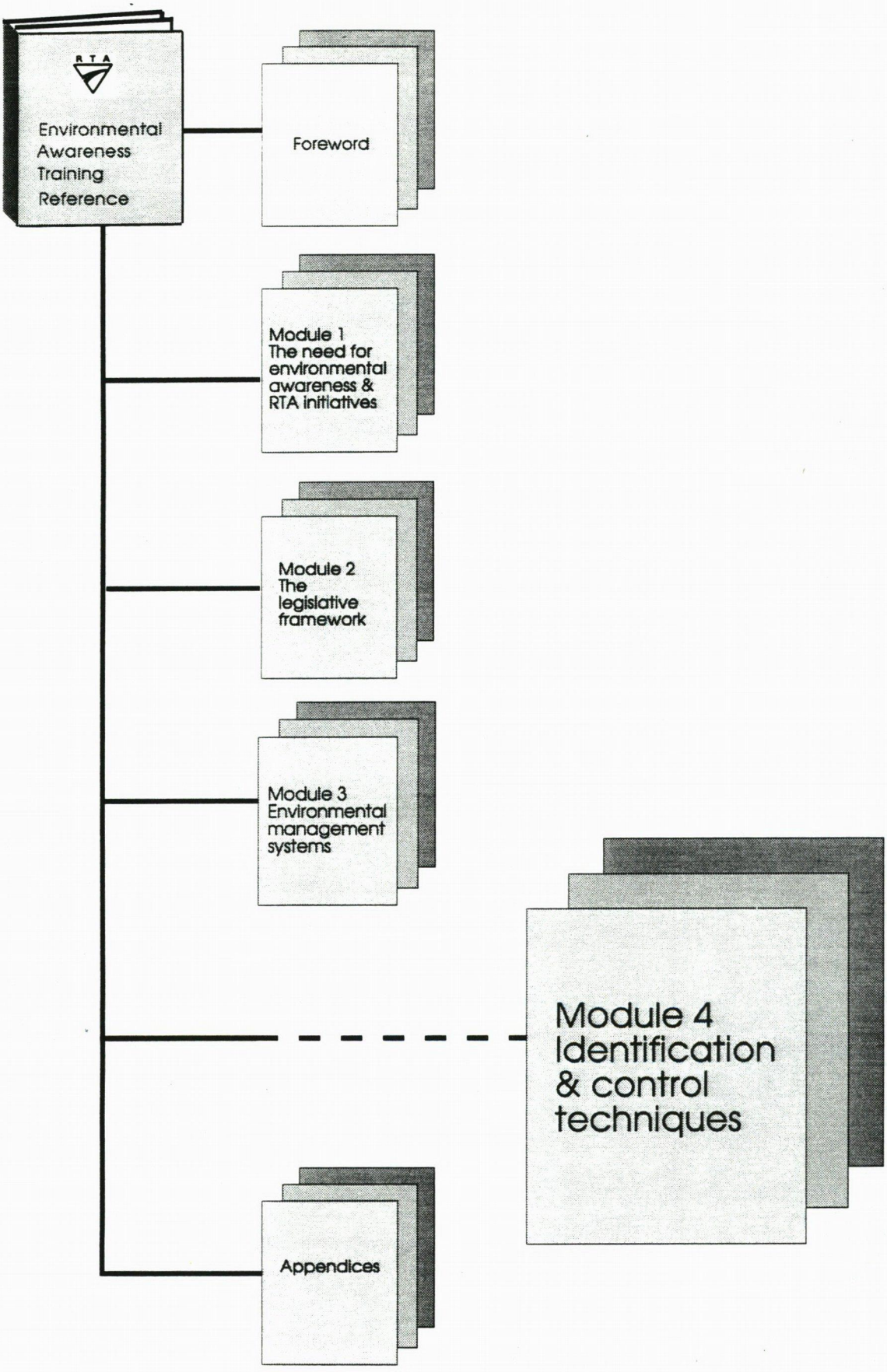
Summary

Organisations throughout the world are trying harder to achieve and prove a sound environmental record. The most effective way of achieving this is to plan and implement an environmental management system.

There is a British Standard which specifies the elements of such a system. The Australian Guideline, currently being prepared, is based on this standard.

The RTA is under pressure from Government and the community to achieve high environmental performance standards. The RTA's environmental vision and policy reflect its commitment to being environmentally responsible and responsive.

An important way in which the RTA's environmental policy can be achieved is by developing and implementing its environmental management system. This will ensure all staff understand their environmental responsibilities and know how to manage them. This applies to normal daily operations and procedures as well as in emergency situations.


RTA
Environmental Awareness Training Reference
Foreword
Module 1 The need for environmental awareness & RTA initiatives
Module 2 The legislative framework
Module 3 Environmental management systems
Module 4 Identification & control techniques
Appendices

Module 4

Identification and control techniques

Introduction

Environmental management systems are used to protect the environment and an organisation against environmental risk, in the most economic and systematic way. Risk management is a key function of any EMS.

This module describes the way risk is managed through:

- identifying the exposures through a preliminary environmental assessment
- evaluating the consequences through an environmental risk assessment
- identification and implementation of various control methods for:
  - site contamination
  - bunding
  - storing hazardous substances
  - wastes.

Conducting an environmental assessment

Environmental assessment is a tool used to form the basis of good environmental management.

The International Chamber of Commerce described environmental assessment as:

> "a management tool comprising a systematic, documented, periodic and objective evaluation of how well organisations, management and equipment are performing with the aim of helping to safeguard the environment by:
>
> 1. facilitating management control of environmental practices
>
> 2. assessing compliance with company policies, which includes meeting regulatory requirements."

Why conduct an assessment?

Environmental assessments can differ in extent and emphasis. They need to suit the site and type of operation conducted there.

To comply with environmental legislation

An assessment may be done to ensure that the site meets all the applicable environmental standards. Environmental legislation, which can apply substantial fines to organisations, is a strong motivation for managers to implement compliance assessments.

The laws also place responsibilities on the directors and officers of organisations for ensuring that their activities maintain environmental standards. This personal liability gives an even greater impetus to managers to conduct an environmental assessment, as they can demonstrate their environmental "due diligence" by doing so.

For risk management

A number of Australian corporations have carried out environmental assessments well before there was a legal requirement to do so, as a cost effective risk management tool.

Assessments identify a site's environmental exposures allowing an organisation to plan appropriate risk management strategies.

Organisations which have actively:

- approached environmental risk management
- held regular environmental assessments
- are committed to acting on the results of those assessments

usually achieve long term economic benefits as they improve their environmental performance.

For property transfer assessments

In a property transfer both parties, but particularly the purchaser, need to know the environmental exposures of the property. Assessments identify the extent of any contamination on the site. They also highlight work practices and associated costs which may need to be changed after the acquisition.

For environmental management

Environmental assessments may aim to establish management structures and reporting procedures which ensure the company maintains high environmental standards. They assess the organisation's environmental performance:

- throughout all levels of management
- for public or consumer scrutiny
- for using environmentally sound work techniques
- for avoiding materials which have adverse environmental effects and for which there are suitable substitutes
- for meeting the environmental requirements for:
  - sustainable development
  - minimal waste.

What happens after an assessment?

You need to carefully consider some issues before commissioning an environmental assessment for the following reasons:

- An output from an environmental assessment is an environment improvement plan. Carrying out this plan may be expensive. This needs to be included in budgets, competing with other budget items.
- There are ethical and legal issues about disclosure of any significant hazards identified by an environmental assessment. It may be appropriate to commission an environmental assessment through a legal officer to manage potential future legal requirements for disclosing the document if there is current litigation.
- Community organisations may get involved in the results of an environmental assessment. Some organisations will not wish to publicly release their site's environmental shortcomings. Therefore an organisation should take into consideration that the environmental assessment might be requested or reported to the environment authorities and subsequently made available under freedom of information.

Management commitment

There are certain requirements which apply to all environmental assessments.

Environmental assessments must have the backing and commitment of the executive management. The EPA require an executive officer to sign statutory enforced environmental assessments. In addition, directors should sign any environmental compliance assessments to demonstrate their good intent in maintaining environmental standards.

An environmental assessment critically examines the current operational practices of a site. Backing from the executive ensures that the site manager and other staff understand that the pro-active intent of the assessment is to raise environmental standards, and that this requires their co-operation.

What does an environmental assessment require?

Full management commitment

It is most important that management publicly supports a purposeful and systematic environmental assessment program from the outset. Commitment is demonstrated by:

- personal interest and concern during the assessment
- the allocation of all appropriate manpower and resources to actively follow up all recommendations.

A well defined and systematic procedure

To ensure comprehensive and efficient coverage of relevant matters, the assessment should follow fully documented procedures.

Written reports

The assessment process should be fully documented and a clear report submitted. The report should concentrate on factual, objective observations. If the assessment applies to one site out of a group, the importance of a group-wide, procedural approach should be emphasised for consistency.

Quality assurance

The assessors need to maintain the quality of their assessment procedures. This provides:

- a consistent assessment
- reliable results
- credibility and acceptance of the assessment.

Follow up

The full value of assessing can only be obtained if the organisation follows up the assessment and carries out the recommendations. Regular re-assessing should be adopted for sites with pollution potential.

Environment improvement plan

In the RTA, environmental assessments extend beyond ensuring legislative compliance.

While assessments are a useful, cost-effective risk management tool for identifying and prioritising exposures, the next important step is taking the proper corrective actions. This step is the environment improvement plan. It is based on the recommendations of the assessment. The schedule for environmental improvements is worked out from costing each recommendation and setting deadlines for its implementation.

The environmental improvement plan is a professionally prepared management plan for implementing environmental improvements to provide a cost-effective minimisation of environmental exposures.

Who should conduct an assessment?

To have any value for an organisation, environmental assessments should be conducted at a high professional standard. Organisations should commission qualified, objective, professional and experienced environmental assessors, so that:

- an environmental improvement plan follows the assessment in logical sequence
- the assessment is suitable for submission to the environment authority if required.

The first decision is whether internal or external resources should do the assessment. There are advantages in using both approaches:

Internal resources

Site managers have an in-depth knowledge of the sites, processes, the operational procedures and staff requirements for running the site. These persons are usually professionally qualified with experience in the industry. Therefore they are aware of many industry specific problems, including the culture of the organisation and the best internal mechanisms for achieving environmental improvements.

Using internal resources enhances an organisation's acceptance of environmental responsibilities.

External resources

External assessors are independent. This independence means that the assessor's team will not be subject to any vested interest or desire to avoid hard or controversial issues. Independent assessors should not have preconceived ideas about an operation. Therefore they will not simply accept any part of an operation that might have otherwise been accepted for historical reasons.

External assessors have broad experience in environmental matters and are able to identify all environmental exposures. Qualified environmental assessors have a structured approach and there is no lead time in determining what constitutes an appropriate assessment for the site. External assessors can also bring experience from other industries when examining available solutions to problems.

Depending on the remoteness from the actual site management, many corporate environmental officers could be considered "external" assessors.

Team resourcing

There is a place for both internal and external resources being used on environmental assessments. In large sites the team may consist of an external consultant, the site manager and a corporate environmental manager conducting the assessment.

How is environmental risk assessed?

Environmental risk management follows the general rule of risk identification, evaluation and control.

The first stage is identifying all the environmental exposures open to an operational facility such as road making or providing a service. These exposures relate to a full assessment of waste and noise changes to the environment. These include emissions to atmosphere, waters, land, sewerage system and emissions affecting the land-use of the area, i.e. nuisance impact.

It is important to review emissions to the environment, both in terms of their toxicological importance and their potential to degrade the environment beyond the site boundaries. Many environmental problems relate to inappropriate land use or insufficient attenuation distances for emissions, i.e. buffer zones for noise and odours.

The areas and activities which require a detailed assessment during a risk management review may include;

- Heritage:
  - archaeological
  - anthropological
  - historical.
- Habitat:
  - flora/fauna protection
  - conservation issues (fragile ecosystems, habitat fragmentation)
  - weeds/pests
  - erosion.
- Operational exposures:
  - Site contamination:
    - past site occupiers
    - historic practices: chemicals used, storage/handling, waste disposal
    - land filling
    - neighbouring operations

- persistent pollutants: pesticides, PCBs, heavy metals
- underground storage tanks.

- Compliance with legislation (existing and future expectations):
  - licence requirements
  - regulations, codes of practice, policy, compliance, etc.
  - monitoring results: frequency
  - impact of neighbours: noise, odour, dust
  - housekeeping
  - pollution control equipment
  - transport and disposal needs.

- Management systems:
  - responsibilities
  - reporting chains
  - documentation, procedures and standing operating practice
  - training
  - planning buffer zones and low waste technology
  - authority liaison
  - assessing
  - maintenance.

- Contingency controls:
  - storage, handling, transport
  - emergency response
  - underground piping
  - drainage lines
  - stormwater isolation
  - environmental issues: ozone depleting substances, PCBs, asbestos, OC pesticides, solvents, etc.

- Site-specific conditions:
  - surrounding land-use
  - ground water
  - surface waters
  - natural occurrence impact, i.e. flood, fire, earthquake
  - prevailing meteorological conditions
  - topography.

Scope of an environmental assessment

Assessments can vary. Some typical investigations are:

Licences to discharge and compliance with legislation

- Does the site have licences for air, water, noise or land discharge?
- Does the site need and have a development consent?
- Does the site have a Trade Waste Agreement?
- Are the emission criteria reasonable and comply with conditions?
- Does the site comply with legislation?

- Is there adequate understanding of the appropriateness of waste disposal methods?
- How regular should monitoring be?

Storage of chemicals, waste and other materials

- Are materials stored so that in the event of an accident or escape, environmental damage will be minimal?
- Are stores licensed according to legislative requirements?

Transport/loading bays

- Are loading bays designed such that in the event of an accident or spillage they will minimise environmental damage?
- What transport controls are in place?

Surrounding environment

- Is the site adjacent to an environmentally sensitive area?
- Is the site near residential dwellings?

Emergency response

- Are the site personnel in a position to act swiftly and efficiently in the event of an environmental accident?
- Do the site personnel liaise with emergency services?

Waste minimisation

- Do the site personnel know the extent and cost of all its wastes?
- Have the site personnel made sufficient efforts to minimise these wastes?

Site contamination

- Have there been any materials or chemicals stored or used in processes over the history of the site which may have caused soil or ground water contamination?
- Are there areas which are known or potentially contaminated?
- Have these areas been surveyed?

Management and environmental program performance

- Does the site have an environmental co-ordinator?
- Are regular environmental reports produced?
- Is there an environmental policy?

- Is there an environmental management plan?
- Is there an environment improvement plan?

What will an environmental assessment reveal?

Environmental assessments in Australia have detected a number of problem areas. Some of these are:

Non compliance with EPA licence or development consent

Some organisations continue to operate outside the specified limits of their licence to discharge to the environment. Others may not have monitored their discharges in recent years, and are not in a position to know whether or not they comply. Some organisations have neglected to apply for an EPA licence or development approval.

Unbunded storage

Bulk storage tanks are usually bunded, although it is quite common to find bunding which is dilapidated. Drums of chemicals are too often neglected, found in poor condition, and stored on unsealed and unbunded areas.

Chemical manifest

Some organisations do not have a properly constructed manifest. Dangerous Goods legislation requires many sites to establish a manifest. However, in other places the need for a manifest is not so widely recognised.

Disused chemicals

Disused chemicals should be removed from a site, as they represent an accident waiting to happen. Long term storage of disused chemicals is typical of environmental exposures which can be overlooked by site engineers involved in day-to-day operations. Slowly corroding drums of toxic chemical, or old equipment with asbestos insulation are often found at the rear of a site.

Insufficient control on contractors

Many managers do not realise that they are responsible for their waste and their products even after they have left their site. There is a need to ensure that all contractors and, in particular transport contractors, are reputable, trained, supervised and fully aware of their environmental responsibilities.

Contaminated areas

Within many sites are specific areas which have the potential for contamination. These include localised contamination around underground tanks or drum storage areas.

Management structure and systems

While the previous examples describe engineering works which fail acceptable standards, there are other environmental exposures which relate to the training and management structure.

Often site managers are not aware of their environmental responsibilities or to whom within the corporate structure they should report any environmental concerns. Regular environmental reports are not wide-spread. This is often complemented by the lack of a corporate environmental manager, corporate environmental policy and adequate documentation evidencing high environmental standards.

Assessments can help develop environmental awareness. Site managers may be well aware of all environmental exposures and are progressing along the correct paths, as well as day to day activities will permit. In these cases, the systematic approach of an environmental assessment often prompts the corporate head office to fund a planned program of reform, instead of depending on the initiatives of the site manager.

Training

General training of staff to maintain high environmental standards is often lacking. When operators receive instructions on good house keeping, aspects such as how to clean up spillages without washing them into storm water drains, are often overlooked.

Environmental assessments cover the full range of responsible environmental management. Some organisations have used assessments to change the lack of environmental culture in their organisation. In these cases an environmental assessor begins to identify changes to many of the rudimentary engineering works and practices on the site.

Minimising the cost of wastes

Many operations have accepted wastes as an integral part of an industrial operation. The cost of waste disposal has escalated and will continue to become more expensive.

Environmental assessments often uncover potential for large cost savings associated with minimising wastes.

How is environmental risk assessed in the RTA?

The Authority will be conducting an environmental review of its operations throughout NSW. The review is to identify the environmental problems which may exist on RTA sites. Once identified, these problems can be addressed and systems put in place to ensure that the RTA's operations achieve good environmental performance. Details of this program are described in Appendix E, "RTA's Environmental self-assessment procedures".

Pilot environmental assessment

The first stage, now completed, was a pilot environmental assessment of selected sites. The pilot assessments identified the key environmental issues and exposures and prepared a framework for the subsequent self-assessment program.

Self-assessment

The second stage in the program is the assessment of each individual site by the site managers. Each site's manager will complete a self-assessment questionnaire. The completed questionnaires will be assessed at each regional office and each site rated for compliance and environmental risk.

Detailed assessment

The third stage of the program is the detailed assessment of individual or high-risk operations. This will be followed by the implementation of licensing, operational or management recommendations where warranted.

Management involvement

Carrying out the self-assessments will increase the level of environmental awareness and performance within the RTA. Site managers will play a key role in carrying out the assessments.

Benefits of RTA's program

When the recommendations from the environmental assessments are implemented, a number of benefits are expected. Among them are:

- improved environmental practices
- waste minimisation and recycling opportunities
- reduction of energy use
- reduced exposure to penalties
- enhanced public image.

Contaminated sites

Some chemicals which are environmentally harmful, persist in the environment. Over a period of time, quantities of hazardous chemicals can accumulate on the ground. Such chemicals may contaminate soils on their own property and adjacent sites, making them unsuitable for certain land uses.

Contaminated sites are a major environmental exposure. The Australian and New Zealand Environment and Conservation Council (ANZECC) has defined acceptable levels for contaminated sites. For more information see "*Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*" January 1992.

Legislation now requires an assessment for contamination when land is rezoned from industrial-use to residential or public use.

Soil contamination legislation follows the "polluter pays" principle. If a site survey identifies contamination, the organisation or individual responsible for the pollution must pay for the cost of the clean-up. There are examples in Australia of clean-up costs in excess of $50 million.

Sources of contamination

There are many sources of soil and ground water contamination. Some of the more common sources are:

- leakage from underground tanks used for storing liquid chemicals such as solvents or petroleum products
- leakage from drums stored on unsealed and unbunded areas
- contaminated soils brought to the site in the initial construction phases for land fill
- past practices of burying waste on the site
- inappropriate waste water disposal, such as discharging process waters directly to open drains, or pumping them to the ground water aquifer
- substances discharged into the air can settle down wind, and cause large-scale pollution on other properties
- businesses, such as metal plating works, which by their very nature are polluters of soil
- migrating pollution from a neighbouring site.

Migration of contamination

Commonly, contaminants are concentrated in specific areas on a site. For example particulate heavy metals tend to settle close to the discharge point. Other chemicals may bind to the soil. In cases where the contaminant is immobile, the site can be readily surveyed by mapping the contamination. This mapping should include a depth profile as well as surface spread.

Some contaminants migrate off the site. Migration of contaminants can occur when air emissions precipitate some distance down wind or ground waters leach from the site.

Business considerations

When property is purchased, both parties should know if any environmental exposures exist. This identifies:

- the occurrence and extent of any past contamination
- if any work practices or cost estimates need to be changed after the acquisition.

Because the current owner/occupier is responsible for cleaning up contaminated sites, the Property Management Group, valuers and project managers involved in an acquisition should take these safeguards to avoid disputes:

- Purchasers of any industrial site should have the site surveyed for contamination before purchase.
- If no known contamination exists, the seller should ensure that the purchaser acknowledges that the site is clean and accepts responsibility for any future contamination found on the site.
- If the site is contaminated, the seller should ensure that the purchaser acknowledges the current level of contamination and takes responsibility for any future costs involved in cleaning up the site.
- Contact a legal officer with an understanding of contaminated site issues. You will need to have legal interpretation, procedures and clauses that define:
  - to what extent
  - when

  a purchaser accepts responsibility for contamination found on an industrial site.
- Additionally the purchaser should obtain from the seller, a statement that they have cleaned up the site and properly managed it to meet environmental legal requirements, prior to the sale.

Management considerations

Managers should consider taking these steps:

- If a site is contaminated, depreciate its land assets in proportion to its potential clean-up costs.
- Survey all industrial sites to assess their current contamination level.
- Consider all industrial sites to have future rezoning potential, and implement practices to prevent future site contamination.

Lending authorities using industrial land as a mortgage, will require surveys and other guarantees before they lend.

Conducting a contaminated site survey

Environmental site surveys assess the potential for contamination of soil and ground water on a premises. They may range from a cursory assessment to a full contaminated site survey.

- The first step in assessing the extent of site contamination is a detailed review to identify any potential contaminants, the physical characteristics of the area and the likelihood of any contaminants migrating.
- The next step is to survey the expected area of contamination.

Identifying contaminated sites

Assessors can't always identify soil and ground water contamination from the surface. If a former industrial site or land fill has been cleared or rehabilitated, there may be little surface evidence to warn a prospective purchaser or a current owner that the site is contaminated. To identify contamination, assessors take the following steps:

Site inspection

Initial examination may show evidence of old structures and filling or dumping of materials. Signs of soil discolouration or surface depressions might indicate former lagoons or land fill settlement. Adjacent industry or land-usage that may lead to migration onto the site should be noted.

Data Search

It is essential to know the former use of the property prior to setting up a program for any monitoring. You can find this through state and local government planning records. Other authorities may have ground water records for the area.

Interviews with local residents and former site employees are a valuable source of information. They may reveal previous site use, waste disposal practices and other relevant information.

Remote Sensing Techniques

Such techniques as seismic refraction, resistivity, ground penetrating radar and several other techniques can be used in an initial site assessment.

Drilling and Sampling

If the assessors require positive confirmation of soil or ground water contamination, they will obtain and analyse samples. They may obtain samples by:

- core sampling
- test pits
- installation of ground water monitoring bores
- installation of gas probes.

Core samples should retain the vertical structure of the soil so that the analysis can be mapped against depth.

Designing an investigation program

Assessors should make sure that they take representative samples of the chemical's conditions in the ground. They consider such factors as:

Statistical sampling approach

Using grid patterns, particularly when validating the effectiveness of the remediation.

Contaminant mapping

Mapping all contamination until it peters out.

Off-site contamination

Fully investigating the potential for off-site contamination.

Topography

The topography of the land and site lay-out will affect the sampling grid. For example, there is no point in doing expensive sampling under a concrete pad or factory which has been installed since the site was a green field. However, grid sampling may be intensified around suspected areas.

Intended use of site

The intended use of land may influence how thorough the survey is.

Sampling methodology

Maintain sample quality by using rigorous cleaning and decontamination standards. These standards apply to all of the drilling, sampling, handling and storing stages. For example, consider the potential volatility of the contaminant when sampling soil contaminated with solvents or fuel.

Risk assessment

After mapping soil and ground water contamination the surveyor assesses the size of the hazard to human health and the environment. Any contaminant may present a hazard through various pathways to one or more receptors. Receptors are humans, plants, and animals. The hazard also depends on the intended use of the land.

Acceptance standards for contaminated soils and ground water are often related to their effect on human health. These criteria consider all the direct and indirect pathways by which a contaminant may affect public health:

- ingestion
- inhalation of vapours
- contact with skin
- absorption by food plants
- contamination of drinking water.

Risk assessment also includes the health and safety of the people who will carry out any site decontamination.

ANZECC has guidelines on acceptance criteria for contaminated sites. Usually the assessor determines whether the site meets these acceptance criteria. However sometimes the assessor requests:

- professional interpretation to avoid unsuitable clean up procedures
- computer modelling of contaminant mobility to justify acceptance criteria.

Cleaning up contaminated sites

A well-documented contaminated site survey gives a summary of the appropriate remediation treatments. The treatments depend on the type of contamination and the urgency of the clean up.

For instance, an oil terminal with soil heavily contaminated with petroleum hydrocarbons, may opt to excavate the contaminated soil and remove it to a secure land fill. The organisation may take this costly option for commercial reasons, such as pending re-development or sale. Alternatively, the oil company may choose a less expensive remediation technology, such as land farming. Petroleum hydrocarbons under the right conditions will bio-degrade.

Identifying contamination, as part of an environmental management program, allows cheaper long-term plans for remediation. For example, an organisation could plan to introduce land farming, before any transfer, and avoid a number of costly measures such as:

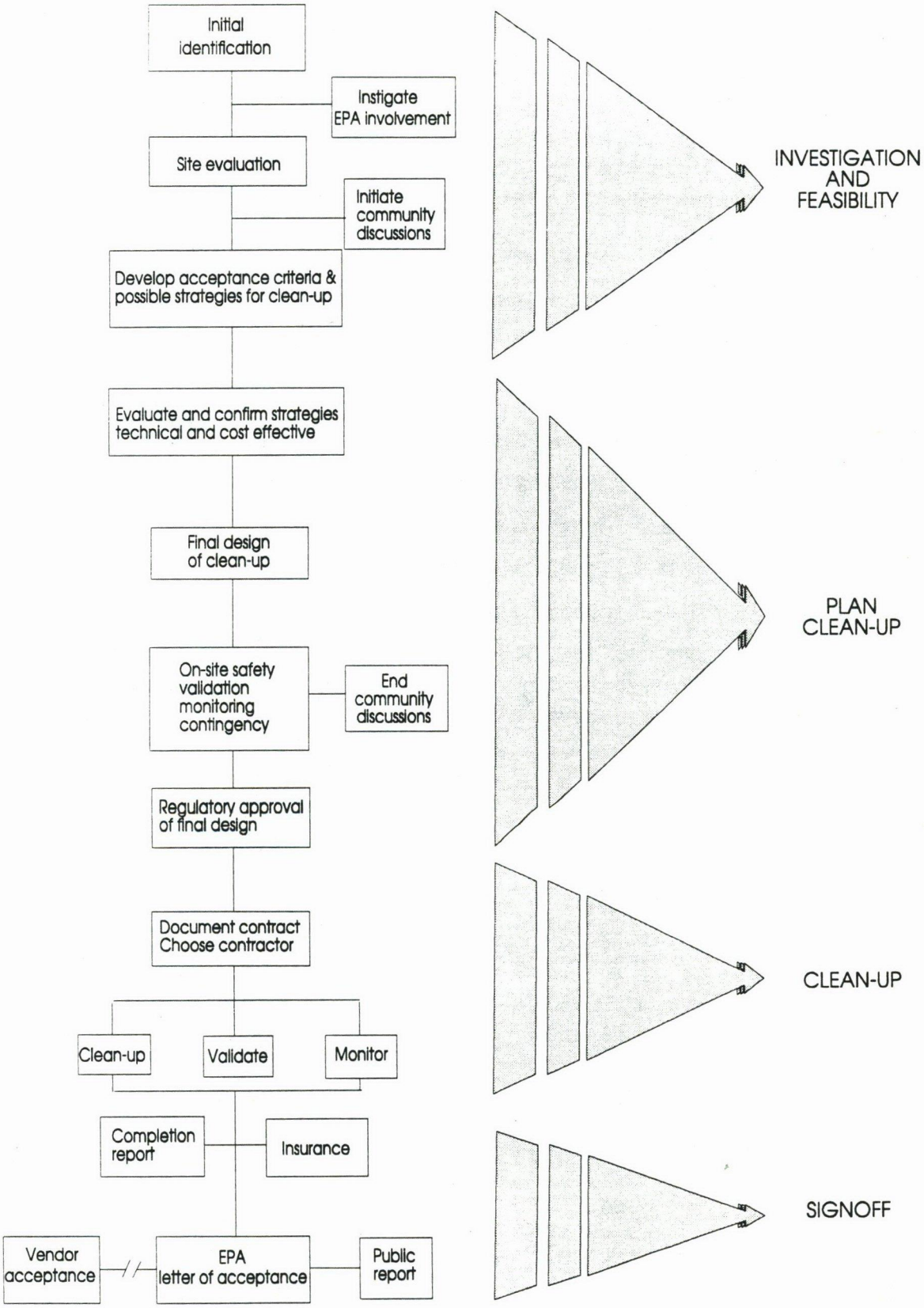
- discovering the contamination at the time of sale
- costly remediation
- extensive business interruption.

The remediation program depends on various factors, such as the:

- nature of the site
- location and severity of the contamination
- type and toxicity of the contaminant
- size and location of the site
- public or media reaction.

The flowchart on the next page shows procedures for dealing with a contaminated site. You can see the role assessment plays in the initial identification and site evaluation.

Identification and remediation of heavily contaminated sites



Storage and bunding guidelines

These guidelines were developed by environmental authorities for general use.

What is a bund?

A bund is a physical embankment which is used to contain substances. It usually surrounds chemical storage areas and acts as a containment area for spillage.

How to construct a bund

For storage of environmentally hazardous substances, the minimum bund construction standards are to ensure the bund is "liquid tight":

- all bunded storage areas must have a base and walls which are impervious to, and compatible with, the substances stored in the bunded area, e.g. concrete is suitable for most substances
- concrete bunds are to be poured integrally with the base; or with all joints sealed with a suitable sealant material
- masonry bunds must have all joints sealed with a suitable material
- pipes can be installed through the bund wall provided the junctions are sealed in accordance with good engineering practice
- roll-over bunds should be used at door openings to maintain effective bund height where vehicular access is required
- if concrete is used, it should be of a standard that ensures that it is impervious. The Cement and Concrete Association can provide advice on this matter.

Storing substances

Where two or more substances are stored on site, they should be stored such that:

- separate bunded areas are provided where possible for each different substance to maximise collection and re-use of uncontaminated spillages
- tanks and drums should be separated from the bund wall by a distance of half the height of the tanks or drums. If multiple layers of drums are stored, then the height shall be calculated as the combined height of the layers

- the above half-height rule may be varied depending on the site drainage and bund height relative to the tank
- the above half-height rule may be waived where drums are stored in a bunded area, with adequate restraint provided to protect drums falling outside the bund area, e.g., cyclone wire fence.

Bund height

Where an automatic fire sprinkler system is installed in or over any bunded tank or drum storage compound, the net capacity of the compound should be increased by a volume equal to the output of the sprinkler system over a period of a least twenty minutes.

For all storage areas, the bunded areas should be designed so that all spills drain to a collection point e.g. sump. Spills should not drain to a stormwater drain or the sewer. All spills should be cleaned up promptly.

Tank storage

- In a roofed area, bunding should be of a height sufficient to hold 100% of the capacity of the largest tank plus 10% of the capacity of the second largest tank, if there is more than one tank in the same bunded area.
- In an unroofed area, bunding should be of a height sufficient to hold 100% of the largest tank plus 10% of the capacity of the second largest tank, if there is more than one tank in the same bunded area, plus a freeboard of 150mm.

Drum storage

- In a roofed area, bunding should be of a height sufficient to hold 25% of the total stored volume within the bund up to 10,000 litres, plus 10% of any volume in excess thereof.
- In an unroofed area, bunding should be of a height sufficient to hold 25% of the total stored volume within the bund up to 10,000 litres, plus 10% of any volume in excess thereof, plus a freeboard of 150mm.

Empty used drum storage

- In a roofed area designated solely for the storage of used empty drums, the minimum requirement is that all drums should be located on an impervious pad. In an unroofed area designated solely for the storage of used empty drums, a minimum bunding height of 150mm is also required.

- When a combination of full and empty drums may be stored in an area, the bunding height should be designed as specified above, for a bund-stored volume on the assumption that all drums are full.

Controlling stormwater

Bunds should be provided with facilities to transfer accumulated stormwater to:

- the sewer, subject to approval of the local sewerage authority
- storage, prior to disposal to a site licensed by the EPA to accept this waste
- the stormwater drainage system, subject to written approval of the responsible environmental authority, typically including discharge licence requirements for on-site primary treatment.

Controlling erosion and sedimentation

Erosion and sedimentation control is a very important issue in the work carried out by the Authority. This is discussed in Appendix F, "*Sediment pollution control on construction sites*".

For information on planning roadworks to avoid erosion and sedimentation, refer to the *Road Design Guide*, Section 8: Erosion and Sedimentation, RTA, April 1993.

For information on erosion and sedimentation in road construction, see *Interim Guidelines for Erosion and Sedimentation Control*, DMR 1984.

Underground fuel tanks

Underground tanks have been found to be a potential source of soil pollution and contamination throughout the world. Depending on a number of factors, such as soil acidity, tanks have been known to leak after as little as two years.

Leakage from underground tanks can migrate a considerable distance from the tank and can contaminate ground water.

To safely manage the risk of pollution from underground tanks, a management system would include:

- creation of a tank register containing information on the location, age, volume and conditions of tanks and details of their contents
- inspection, soil testing and decommissioning of redundant tanks

- ongoing management of existing tanks
- management of new tanks.

Oil separators

It is important to collect used oils which can be recycled. Oils can be separated and collected from:

- washdown bays
- service ramps.

By carefully regulating the type and concentration of solvents used in the wash bay, so that only those with quick break times are used, oil can be separated readily from the solvents and extracted for recycling.

Other solvents

Other solvents should be collected in a suitable container and returned to the depots for collection. These include:

- power kerosene used for cleaning bitumen sprayers
- cleaning solvents used in emulsion sprayers
- solvents used to clean road-making equipment.

Keeping a register of hazardous substances

This register should include all of the chemicals and raw materials used on-site, including chemicals brought on-site by contractors. Before coming on-site, contractors should be asked to provide Material Safety Data Sheets () for all their products.

The hazardous substances register contains a list of all chemicals on the premises and for each:

- chemical name
- UN number
- Dangerous Goods classes
- storage area
- quantity on hand
- primary supplier
- alternative suppliers.

The register also contains:

- a block plan of the site with storage areas shown which lists the names of individuals responsible for each area

- Material Safety Data Sheets (MSDSs) for each chemical listed
- operating procedures including:
  - handling precautions
  - storage precautions
  - safety equipment needed
  - training required.

This format allows responsible chemicals management and supplements the documentation required under the applicable "dangerous goods" requirements.

Waste categories

Waste management is discussed on page 3.20. More detail is given in Appendix C.

General wastes

General waste is non-putrescible, inert material which is capable of causing damage to the environment. The materials are not toxic. Most can be recycled in some way, avoiding waste generation.

This list gives examples of wastes classified as general. It is not a complete listing.

- glass and bottles
- paper and cardboard
- plastics
- ferric materials i.e. iron
- building rubble
- concrete
- garden wastes, vegetable matter
- aluminium cans
- food scraps (not processing)
- soil.

Environmentally hazardous wastes

Environmentally hazardous wastes are materials that have a toxological impact on the environment. Some environmentally hazardous wastes are:

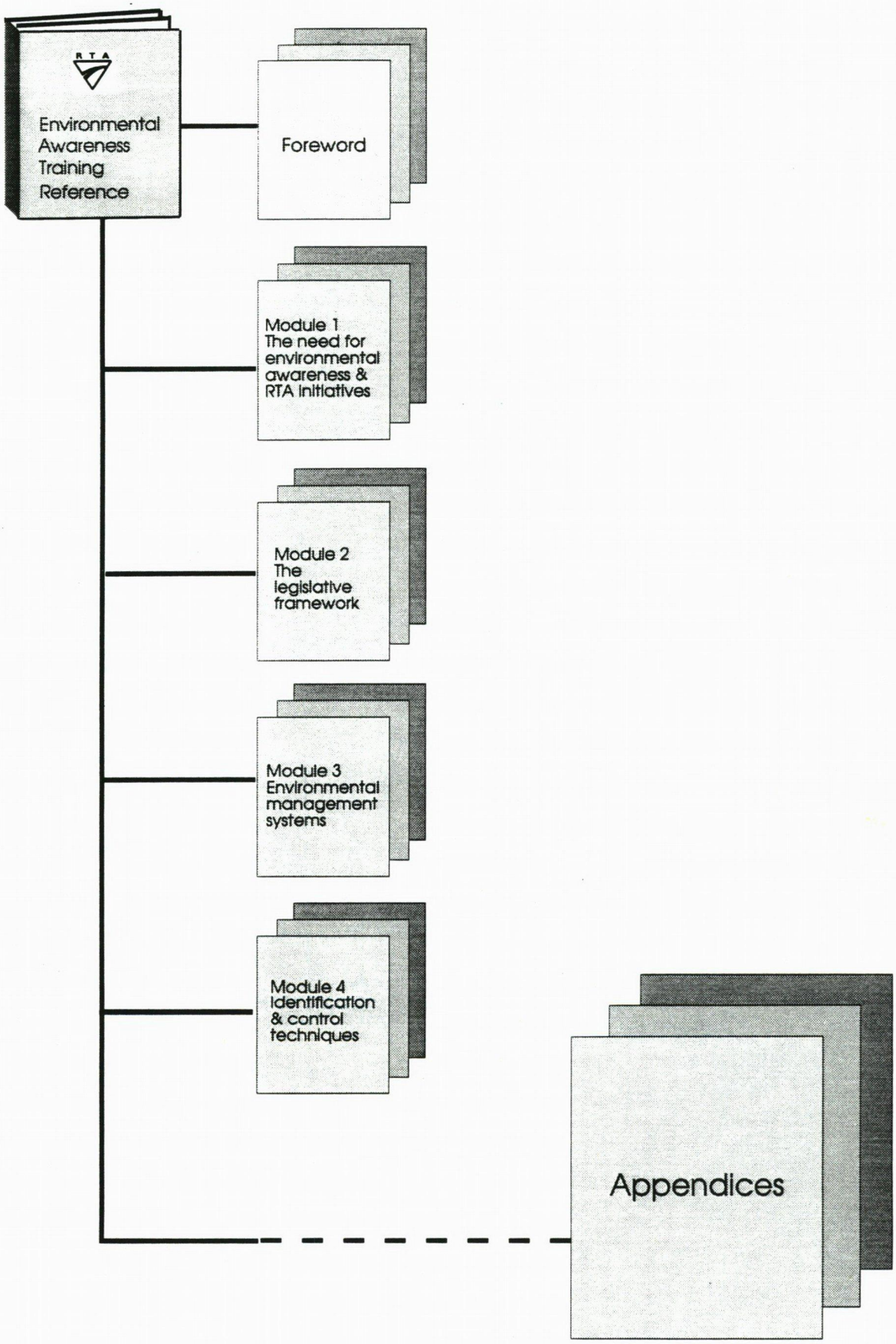
- acids and acidic solutions
- adhesives (excluding solid inert polymeric materials)
- alkalis and alkaline solutions
- arsenic and arsenic compounds
- asbestos (all chemical forms)
- beryllium and beryllium compounds
- biocides
- bituminous compounds
- boiler blowdown sludge
- cadmium and cadmium compounds
- caustic solutions
- chlorates
- chromium compounds
- concrete sludge and leachate
- containers and bags containing hazardous compounds
- copper compounds

- ☐ detergents
- ☐ electroplating effluent and residues
- ☐ filter backwash waters
- ☐ filter cake sludges and residues
- ☐ grease interceptor trap effluent and residues
- ☐ herbicides
- ☐ hydrocarbons and their oxygen, nitrogen or sulphur compounds
- ☐ immobilised waste
- ☐ industrial plant washdown waters
- ☐ inks
- ☐ insecticides
- ☐ laboratory chemicals
- ☐ lead compounds
- ☐ lime neutralised sludges
- ☐ lime sludges
- ☐ mercury and its compounds and equipment containing mercury
- ☐ metal finishing effluent and residues
- ☐ nickel compounds
- ☐ oils
- ☐ oil interceptor sludges
- ☐ oil water emulsions
- ☐ oil water mixtures
- ☐ organic solvents
- ☐ oxidising agents
- ☐ paint sludges and residues
- ☐ perchlorates
- ☐ peroxides
- ☐ pesticides
- ☐ phosphorus and its compounds
- ☐ pickling liquors
- ☐ polychlorinated biphenyls and related materials and equipment containing polychlorinated biphenyls and related materials
- ☐ reactive chemicals
- ☐ reducing agents
- ☐ resins (excluding solid inert polymeric materials)
- ☐ solvent recovery residues
- ☐ surfactants
- ☐ treatment plant sludges and residues (excluding sewage and septic tank sludges and residues)
- ☐ triple interceptor trap effluent and residues
- ☐ waste-carrying vehicle washdown waters
- ☐ zinc compounds.

Priority wastes

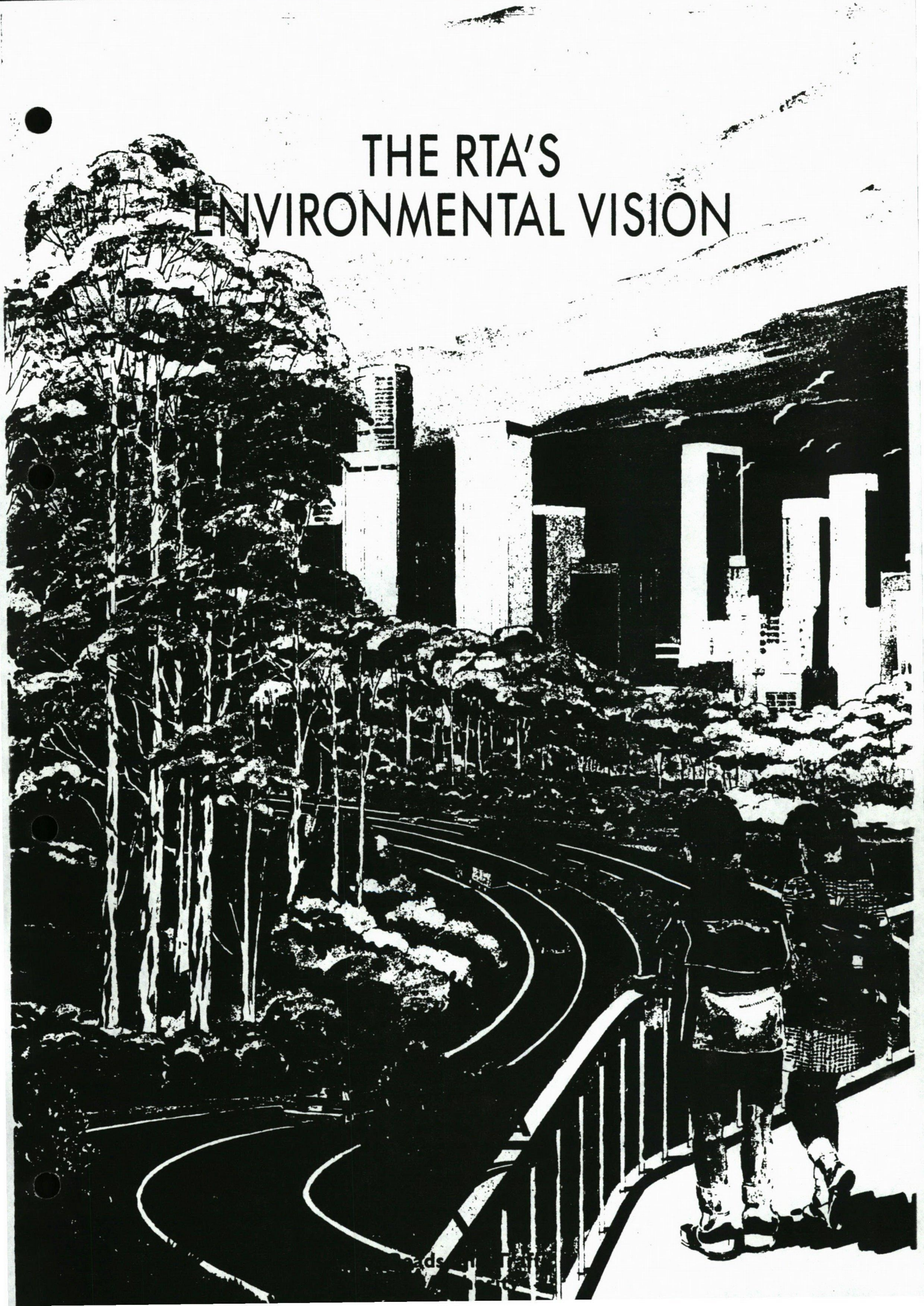
Priority wastes are waste materials that have a high toxological impact on the environment and are capable of causing significant environmental damage. They include:

- ☐ arsenic and its compounds
- ☐ acrylonitrile
- ☐ benzene
- ☐ cadmium and its compounds
- ☐ chlorinated hydrocarbons
- ☐ chromium and its compounds
- ☐ copper and its compounds
- ☐ lead and its compounds
- ☐ mercury and its compounds
- ☐ nickel and its compounds
- ☐ organo tin and its compounds
- ☐ ozone depleting substances
- ☐ photochemically active organic substances
- ☐ polychlorinated or polybrominated biphenyls or related substances or equipment containing polychlorinated or polybrominated biphenyls or related substances
- ☐ polycyclic aromatic hydrocarbons
- ☐ vinyl chloride monomer.


RTA
Environmental Awareness Training Reference
Foreword
Module 1 The need for environmental awareness & RTA initiatives
Module 2 The legislative framework
Module 3 Environmental management systems
Module 4 Identification & control techniques
Appendices

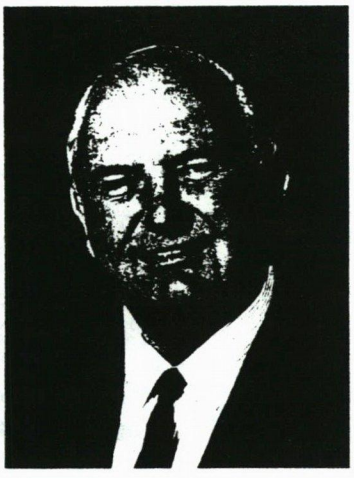
Appendix A: RTA's Environmental Vision

THE RTA'S ENVIRONMENTAL VISION



CONTENTS

A roads and traffic system in harmony with the natural and social environment while meeting community mobility needs.



DEPUTY PREMIER'S MESSAGE

It gives me great pleasure to release the RTA's Environmental Vision.

The Environmental Vision is a landmark in defining the RTA's approach to the environment. It carries the full endorsement of the Government of New South Wales, which has a commitment to the environment.

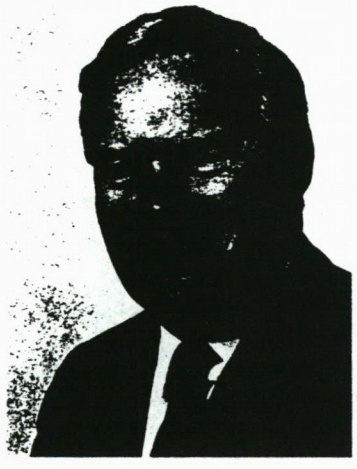
The Vision is supported by strategies which relate to all aspects of the roads and traffic system. These strategies cover a broad range of issues, from recycling to addressing major global questions such as greenhouse gases.

The strategies focus on both motor vehicles and the road system. They also extend to support for other transport modes and contributions to other governmental agencies.

The physical extent of our State's road system emphasises the importance of the Environmental Vision. With over 42,000 kilometres of roads and 3,250,000 registered motor vehicles under its jurisdiction, the RTA has a significant role to play in preserving the environment of New South Wales.

But while the RTA continues to address environmental issues, it cannot carry the full workload alone. All of us must therefore ask ourselves what we can do as individuals. As such, many of the strategies in this booklet can act as guidelines not just for the RTA, but for each of us.

Wal Murray, MP
Deputy Premier and Minister for Roads



CHIEF EXECUTIVE'S MESSAGE

The RTA, like other Government agencies, is in a transitional phase between yesterday's focus on providing basic infrastructure to meet society's needs, and today's focus on both managing existing resources and providing more environmentally responsive planning for the future.

The RTA's responsibility for the State's major roads and traffic system places us in an important position to ensure that the environmental issues associated with roads and traffic are addressed in a timely and effective manner.

Environmental issues pose major challenges and must be addressed through innovative actions. These actions will take time and resources to develop in detail. They will also need to be integrated with other RTA initiatives, particularly in the areas of road safety and network policy.

The RTA's Environmental Vision is therefore a major first step setting out our commitment to continue to be environmentally sensitive.

The Environmental Vision provides a sound basis for us to be more responsive and to continue incorporating environmental considerations into everything we do.

Bernard Fisk
Chief Executive, Roads and Traffic Authority

ABOUT THIS BOOKLET

The road system is a fundamental part of the overall communications network and plays an important role in the State's development and prosperity.

Roads enable the timely movement of raw materials and products to markets, industrial centres, ports and transport interchanges. They are also used by people to travel to work, school, shops and recreation areas.

However, recently there has been growing concern about the effects of the roads and traffic system on the environment. This has been part of an increasing community awareness about local, national and global environmental issues.

The result has been a growing commitment by all levels of government to address these issues.

The RTA is already incorporating environmental considerations into its activities. This booklet formalises its environmental position as well as its proposed environmental strategies.

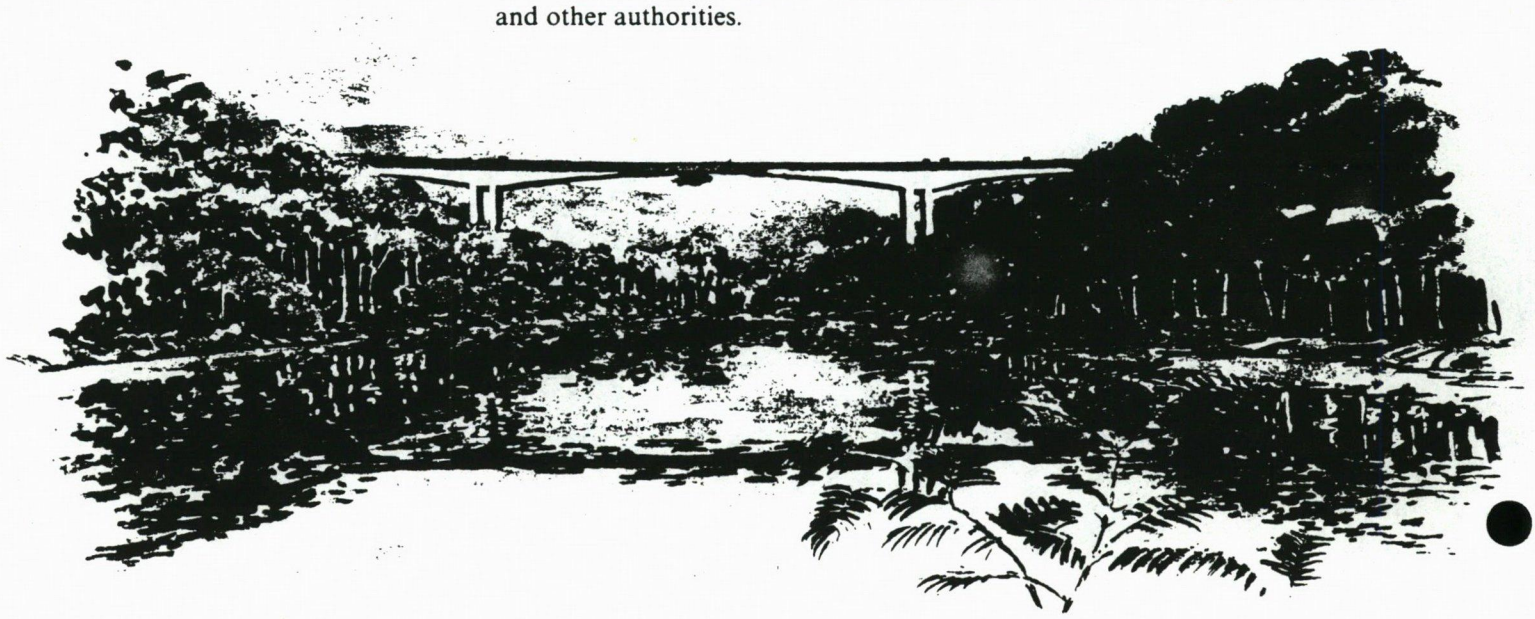
The Environmental Vision is the culmination of two years' work by the RTA. During this time a number of initiatives have been undertaken to help develop an environmental position. These have included:

- An environmental workshop in February 1990 to identify important macro issues.
- An environmental conference in August 1990 to identify further issues and promote discussion between the RTA, leading academics, conservationists and members of the public.
- Establishment of the RTA's Environmental Strategy Branch in 1990 to develop policy and strategic direction on environmental issues.
- A public survey in December 1990 to obtain comment on the key issues for the RTA to address.

The launch of the Environmental Vision is not the end of this process.

The Vision will be regularly updated to reflect changing environmental concerns and to ensure continual improvement in the RTA's environmental performance. Further, the RTA will continue to integrate environmental considerations into all its activities.

To facilitate this, the RTA will continue to work with the public, industry and other authorities.



THE RTA'S ROLE

The RTA's mission is to *manage the use, maintenance and enhancement of the State's roads and traffic system with emphasis on road safety and transport efficiency as part of an integrated and balanced transport system.*

In fulfilling this mission, the RTA recognises its obligation to respond to environmental concerns, and to identify and respond to reasonable community expectations.

It is in pursuit of the mission and these obligations that the RTA has planned and prepared this Environmental Vision.

The RTA was created in 1989 by the amalgamation of the Department of Main Roads, the Department of Motor Transport and the Traffic Authority.

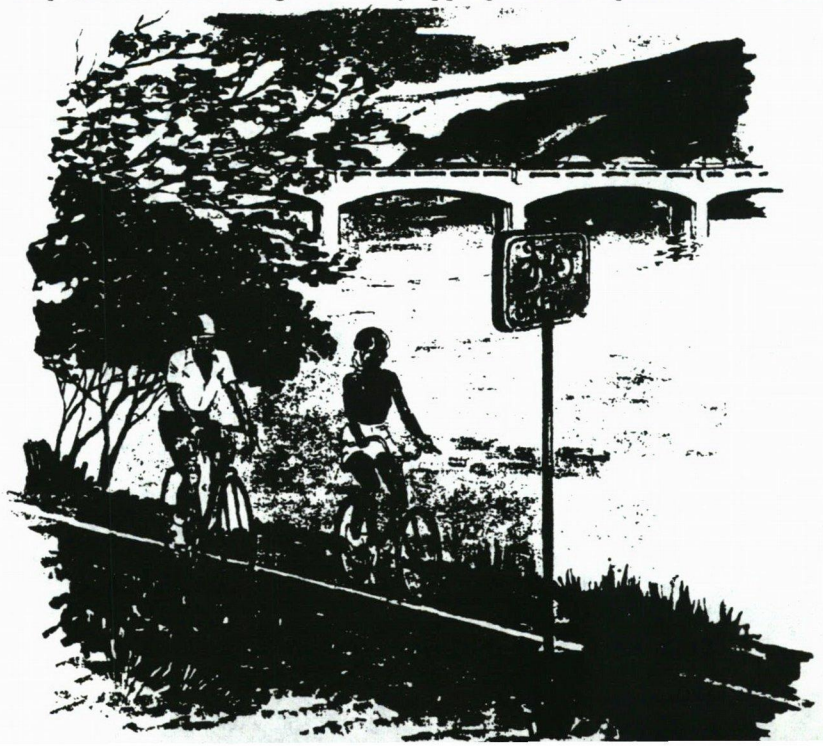
It manages the State's major roads and traffic system, comprising a 42,000 km network of major roads, and has an annual budget of about $1.7 billion. This is spent on construction, traffic management, road maintenance, research and development, road safety, the environment, registration, licensing and customer services.

The RTA therefore has a significant influence over the development of the State's principal road system and the impact it has on the environment.

Other authorities, including local councils, manage other parts of the State's road network.

The RTA also works closely with councils, government departments and agencies such as:

- State Rail Authority to promote the use of rail-based mass transport.
- State Transit Authority to coordinate government buses and ferries.
- Department of Planning to establish a framework for efficient transport links based on current and planned land use patterns.
- Department of Transport to improve the efficiency and safety of private buses and taxis.
- State Pollution Control Commission and its successor, the new NSW Environment Protection Authority, to effectively meet pollution control standards.
- Department of Housing to identify appropriate transport links to residential areas.



THE ENVIRONMENTAL CHALLENGE

The last 20 years have seen a tremendous increase in worldwide concern for the environment by communities, business and government. This has been reflected in expanding media coverage of environmental issues.

As a result, there is now common awareness of terms such as *global warming* and *ozone depletion.* And concerns, such as air, noise and water pollution, the depletion of natural resources and land degradation have become a focus for regular public debate.

These and other issues present a challenge to the RTA in both urban and rural areas.

Overseas, increasing concern about environmental degradation has prompted several important initiatives.

Possibly the most important is the Brundtland Commission report *Our Common Future.* This introduced the concept of *sustainable development*, defined as development which meets the needs of the present without compromising the abilities of future generations to meet their own needs.

This concept has been taken forward in Australia with the establishment of working groups focusing on ecologically sustainable development.

The aspect of ecologically sustainable development which relates to transport has been termed *sustainable transport.*

This refers to the implementation of measures to manage demand for road-based trips by altering the intensity, timing and distribution of travel demand. It focuses on mass transit systems in urban areas.

The key measures to achieve more sustainable transport are:

- Changing the urban form and land use.
- Providing facilities for more environmentally sensitive transport modes and encouraging their use.
- Promoting behavioural changes to reduce the demand for travel.
- Travel pricing.

THE ENVIRONMENTAL VISION

The stated Vision is:

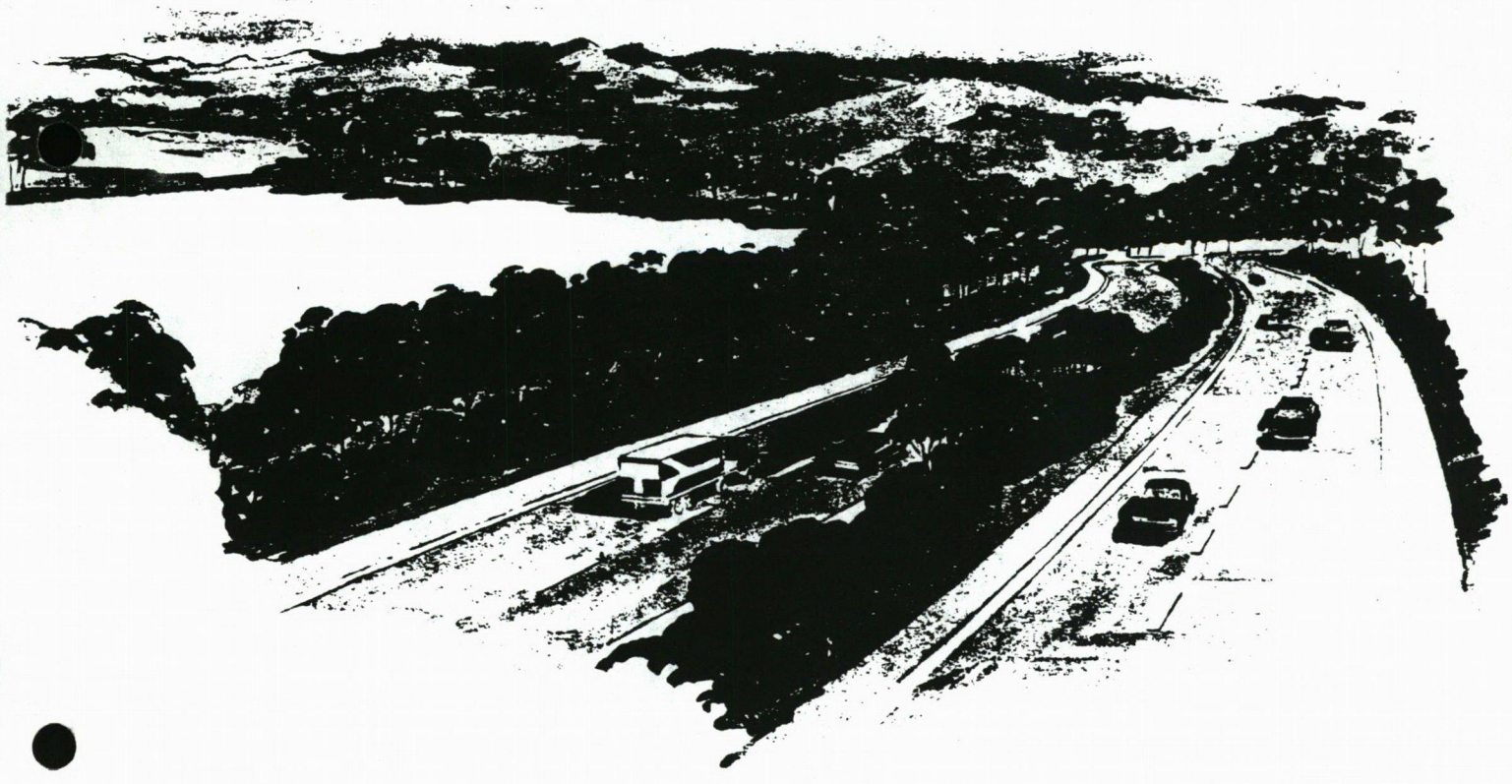
A roads and traffic system in harmony with the natural and social environment, while meeting community mobility needs.

Ultimately, collective actions by the public, industry, government and government authorities are needed to address the key environmental problems and implement the solutions. The RTA's vision of the role it can play is set out in this booklet.

The RTA recognises its important role in addressing key environmental concerns and will work both independently and with the public, industry and other authorities to implement solutions.

It is committed to protecting and enhancing the environment by seeking out a comprehensive range of traditional and innovative methods which represent responsible public expenditure. These methods are being incorporated into the RTA's management, planning, construction, operation and daily work practices.

The Environmental Vision describes the relationship between the RTA's activities and its environmental responsibilities.



ENVIRONMENTAL STRATEGIES

To achieve its Environmental Vision, the RTA will pursue the five environmental strategies outlined below.

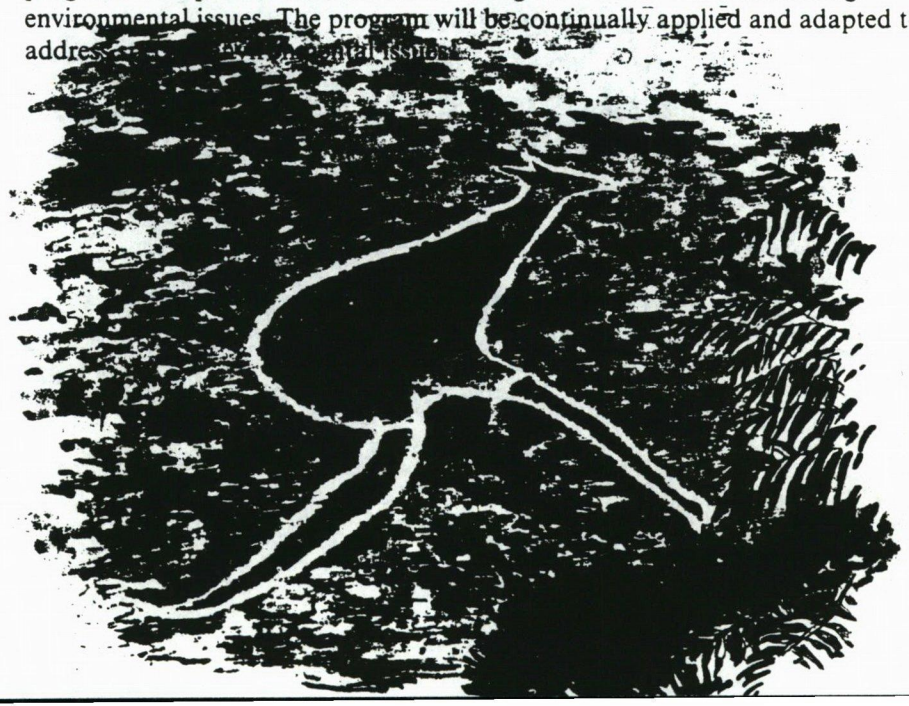
1 Reduce the environmental impacts of the roads and traffic system.
The RTA, as the authority responsible for the State's major roads and traffic system, is faced with the challenge of reducing the environmental impacts of this system. This can be achieved by seeking out and implementing a range of innovative and carefully planned initiatives.

2 Incorporate environmental considerations into all RTA activities.
The environmental impacts of all RTA activities — from the planning, design and construction of road systems to daily management, structures, maintenance activities and licensing procedures — will be evaluated and environmental considerations built into all RTA activities. This is integral to ensuring that environmental issues are explicitly addressed.

3 Communicate and coordinate with the public, industry, and other authorities on environmental impacts and issues.
The RTA, industry and the public have a role to play in reducing the environmental impacts of the road system. The RTA, therefore, is committed to community consultation as part of its key decision-making processes. The RTA will also continue to develop closer ties with other government authorities to enhance the integration of land use, transport and environmental planning and to achieve the most appropriate balance of transport modes.

4 Increase environmental expertise and awareness within the RTA.
A sound understanding by RTA staff of the environmental challenges and ways of meeting these challenges is critical to addressing environmental issues. The environmental awareness of all RTA staff and contractors will be promoted through the dissemination of information about problems and solutions.

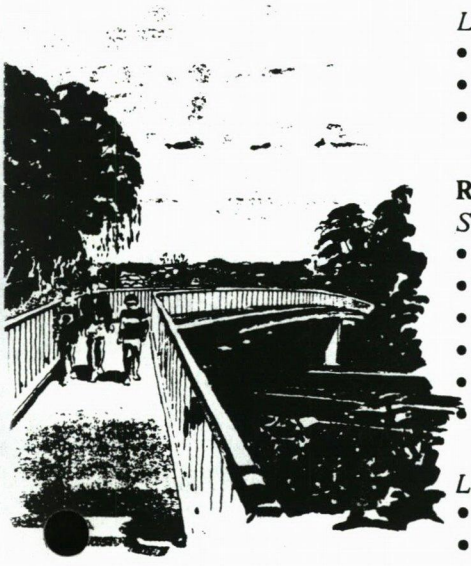
5 Conduct and support environmental research.
The RTA has a well established environmental research and development program. This provides a basis for fostering innovation when addressing environmental issues. The program will be continually applied and adapted to address [illegible] environmental issues.



ACTION PLANS

The RTA has identified a series of short- and long-term actions for each of its five environmental strategies. These are listed below.

Reduce the environmental impacts of the roads and traffic system



Vehicles

Short term

- Co-operate with appropriate authorities in the investigation of exhaust emission testing and noise level checks.
- Investigate implementing national standards and checks for excessive exhaust smoke and noise levels from heavy vehicles.
- Encourage recycling of chlorofluorocarbons (CFCs) used in car air-conditioners.
- Investigate the potential for price incentives on fuels and registration to encourage more environmentally efficient transport.

Long term

- Identify and support measures to assist public transport.
- Investigate the application of a road user-pays philosophy.
- Investigate the implementation of a more stringent registration system that penalises inefficient, high energy consuming vehicles.

Roads

Short term

- Incorporate measures to reduce noise levels on new roads where warranted.
- Take opportunities to introduce and extend transit lanes and bus lanes.
- Extend and promote safe bicycle lanes.
- Expand the use of recycled materials in road works.
- Design and manage roadsides to preserve and enhance flora and fauna.
- Use local seed sources in revegetation programs to protect and maintain the genetic integrity of local flora associations and diversity.

Long term

- Establish guidelines for managing road corridors for native plants and animals.
- Encourage lower speed limits throughout residential areas, supported by engineering devices such as humps or platforms.
- Examine the feasibility of introducing demand management techniques.
- Study the potential for including an environmental levy in road user charges.
- Consider developing urban infrastructure pricing to contain urban sprawl.

Incorporate environmental considerations into all RTA activities

Design and planning

Short term

- Review the potential environmental effects of all RTA programs.
- Assess the social impacts of road initiatives.
- Prepare environmental impact assessment guidelines for staff.
- Include environmental benefit-cost analysis in the planning process.
- Record and protect heritage sites likely to be affected by roads.
- Ensure that ecologically valuable and sensitive areas are protected when selecting new road locations.
- Consider the need to reduce speeds at the entry to rural towns and villages through changes to visual design and the road's horizontal alignment.

Long term

- Identify social and environmental impacts early in concept development.
- Consider heritage values as part of the road planning process.

- For projects involving road construction, maintenance or changes to traffic flow, identify resultant changes in travel patterns, assess impacts on communities and identify and minimise changes to neighbourhood or community cohesion.
- Investigate the incorporation of permanent sedimentation basins on new roads.
- Where appropriate, introduce speed control devices and allocate more space to bicycles, pedestrians and trees on arterial and sub-arterial roads in retail and residential areas.

Construction

Short term

- Minimise clearing before construction to preserve soil and vegetation.
- Implement initiatives to minimise water runoff, erosion and sedimentation.
- Avoid environmentally sensitive areas when locating gravel pits, and restore areas after use.
- Further develop recycling and re-use programs.

Long term

- Adhere to the highest appropriate environmental standards in all construction.
- Develop audit procedures to monitor activities against environmental impact assessment standards and to give feedback into methods for predicting environmental impacts.

Maintenance

Short term

- Plan maintenance schedules to minimise delays to traffic.
- Minimise the use of chemical herbicides and pesticides in maintaining roadsides.

Long term

- Produce management plans to protect remnant vegetation along road corridors.

Other considerations

Short term

- Promote energy efficiency in the RTA's own structures, equipment and activities.
- Evaluate the likely benefits and costs of converting the RTA's car fleet to LPG.
- Establish guidelines for reducing and correctly disposing of waste.
- Investigate and preferentially purchase environmentally friendly office stationery, equipment and furniture.
- Encourage the use of environmentally friendly cleaning materials.
- Investigate the extent of CFC and halon use by the RTA, and identify possible substitutes.

Long term

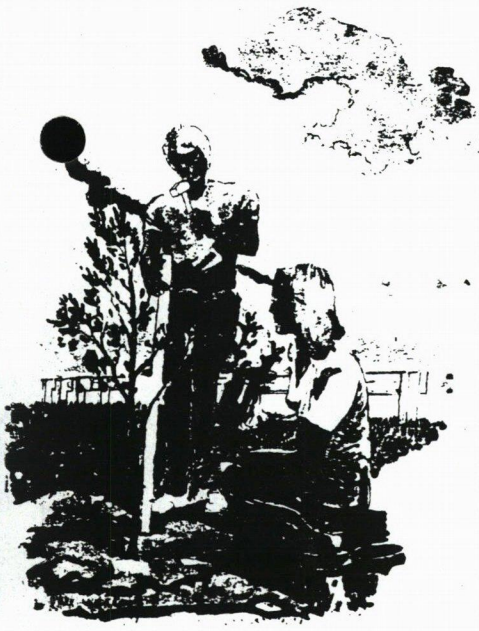
- Eliminate the use of CFCs and halons by the RTA.
- Investigate internal opportunities for car pooling schemes.

Communicate and coordinate with the public, industry and other authorities on environmental impacts and issues

Public liaison

Short term

- Provide information about noise reduction measures to those affected by traffic noise.
- Encourage public participation in Statewide clean-up days and distribute car litter bags.
- Consult with the community when undertaking environmental studies for significant road and traffic management projects.
- Involve community groups in the decision-making and planning process for significant projects.
- Educate the public about vehicular contributions to greenhouse gas emissions.



- Encourage the teaching of efficient driving techniques.
- Promote car pooling and encourage higher vehicle occupancy.
- Increase public awareness of the importance of road reserves as nature reserves.

Long term

- Monitor the development of alternative vehicles and transportation systems.
- Encourage changes in behaviour which minimise adverse environmental impacts.
- Improve facilities to make public transport more attractive.

Industry liaison

Short term

- Encourage the use of alternative materials to CFCs and HCFCs (partially chlorinated hydrocarbons) in vehicle component manufacture.
- Encourage the development of more fuel efficient vehicles whilst maintaining safety standards.
- Encourage industries to support car pooling.

Long term

- Encourage the setting of a lower national average fuel consumption target for new cars whilst maintaining safety standards.
- Encourage the development of less noisy vehicles.

Governmental liaison

Short term

- Assist in promoting public transport.
- Participate in projects aiming to integrate planning for roads, public transport, freight and land use.
- Assist in establishing and enforcing noise regulations associated with roads and traffic.
- Encourage local area traffic management schemes in local residential streets.
- Encourage the development of bus/rail interchanges.
- Consider opportunities to develop alternative transport schemes using existing roads.

Long term

- Work with other agencies to reduce air pollution from roads and traffic.
- Jointly with councils, introduce speed control schemes on sub-arterial and local roads, and vehicle weight limits where appropriate.
- Encourage integrated transport planning.

Increase environmental expertise and awareness within the RTA

Short term

- Monitor and disseminate the results of environmental research and encourage innovative application of research findings.
- Hold sessions aimed at raising environmental expertise and awareness in seminars and training courses.
- Develop an in-house environmental auditing and monitoring capability.

Long term

- Establish environmental performance indicators for use by all levels of staff, and commence monitoring these.

Conduct and support environmental research

Short term

- Continue to offer scholarships for environmental research.
- Enhance research by encouraging joint research projects with other authorities, research groups, environmental organisations and industry.
- Monitor, evaluate and further develop noise abatement measures.

Long term

- Sponsor an ongoing environmental research and development program which is responsive to changing environmental issues.

WHAT IS THE RTA ALREADY DOING?

The RTA is already implementing a large number of environmental practices in its activities and programs, from project development through to construction, corridor management, vehicle standards, and road demand management. These practices are listed below.

Project development

- Potential impacts are identified early in the design stage.
- If there are potential impacts, a review of environmental factors is prepared to identify the extent of the impacts.
- If significant impacts are likely, an environmental impact statement is prepared.
- The community is consulted to identify the full range of impacts and possible solutions.
- Places and buildings of Aboriginal and historical significance are identified and assessed.

Construction practices

- Construction hours are limited to minimise noise disturbance.
- Dust suppression techniques are used on construction sites.
- Vibrations near buildings are minimised.
- Where possible, road pavements are rehabilitated or recycled.
- Waste by-products, such as blast furnace slag and fly ash, are recycled for use in pavements, in concrete, and for backfilling around pipes.
- Sediment traps, siltation basins and silt-stop fencing are used to keep silt on work sites.
- Procedures are implemented to minimise vegetation disturbance.
- Roads are re-routed to avoid rare and endangered plant species.
- Areas are revegetated using local native seeds.

Corridor management

- Low-noise road pavements are used in residential areas.
- Topsoil is conserved.
- More trees are being planted than removed.
- Trees felled for roadworks are chipped for mulch to assist native plant regeneration along the corridor once work is completed.
- Direct seeding regeneration methods developed and used by the RTA have received Greening Australia awards.
- The RTA is actively involved with community groups to improve roadsides by re-establishing vegetation. These groups have included high school students at Parkes, the Armidale Tree Group and Greening Australia at Armidale, and the Beautifying Bega Committee. Work with a number of groups in Wollongong, has led to the RTA receiving the *Rise and Shine Gold Environmental Award* for contributions to the Wollongong environment.

Vehicle standards

- The RTA supports other government authorities in relation to Australian Design Rules for vehicle noise levels and emission controls for newly registered vehicles.
- The RTA supports the police and State Pollution Control Commission in checking vehicle noise and emissions at roadside stops.

Road demand management

- Van pooling is being trialled at the RTA's Granville office.
- Public transport and high occupancy vehicles are supported by providing clearways, transit lanes and bus priority measures.
- Restricted routes are defined for B-doubles to prevent intrusion into residential areas.
- Support is provided for special facilities such as the tourist coach terminus at Central Station.
- The community is being involved in innovative planning for road, rail and bus facilities, such as in the Botany West Transport Study.
- Trial speed control works are sponsored on sub-arterial roads to enhance safety and the environment.
- Local government proposals are supported, such as local area traffic management schemes and vehicle weight limits on local roads which warrant environmental protection.

THE RTA AND THE FUTURE

The RTA recognises its responsibility to limit environmental degradation and to help improve the natural and social environment. But it cannot achieve these aims by working alone.

The public, industry and other governmental authorities also have their environmental responsibilities. By working together, we can reduce the impact of the motor vehicle on the environment, reduce the need to build more roads and ensure that new road works are carried out in an environmentally sensitive way.

Produced by Coopers & Lybrand Consultants for the Roads and Traffic Authority's Environmental Vision Steering Committee
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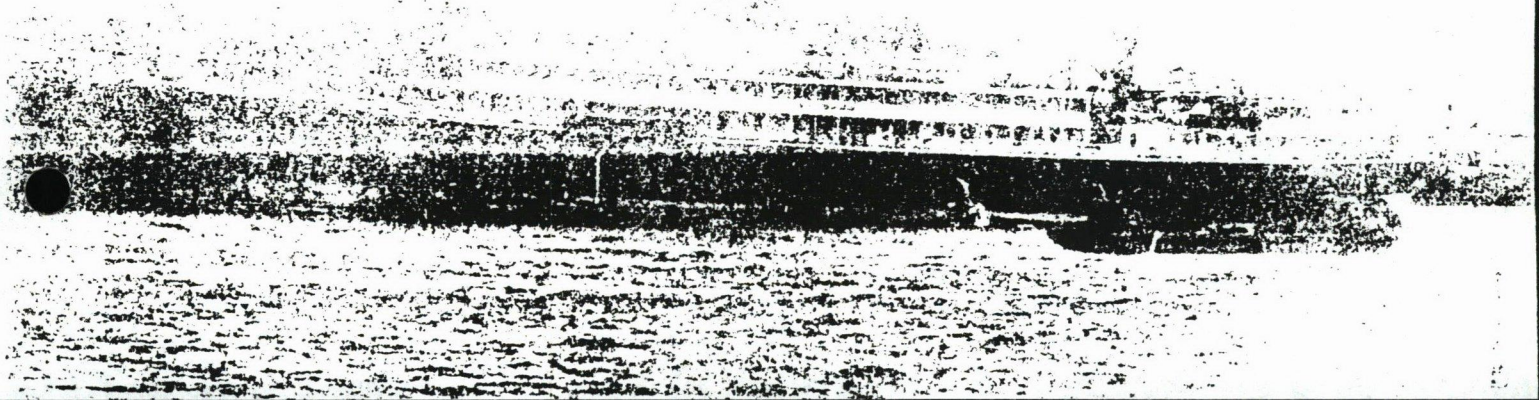


Appendix B: Summary of major environmental legislation

Protection of the Environment Administration Act, 1991 (NSW)

This Act establishes the Environment Protection Authority (EPA) in NSW. It:

- deals with the objectives and administration of the EPA
- outlines how the EPA administers the environment protection legislation previously administered by the SPCC
- makes provision for additional functions for the EPA:
  - regulatory aspects of waste management
  - licensing regulations for radioactive substances
  - control of the transport of dangerous goods.
- makes the EPA subject to the control and direction of the Minister for the Environment
- envisages:
  - the establishment of an environmental data base
  - bi-annual "state of the environment" reports to parliament
  - environmental auditing requirements for industry and public authorities.

Endangered Fauna (Interim Protection) Act, 1991 (NSW)

This Act amends the National Parks and Wildlife Act, 1974 (NSW) to require an assessment of the impact of a proposal on endangered wildlife and their environment (fauna impact statement).

A fauna impact statement is required:

- where a development is likely to significantly affect the environment of endangered fauna. This can be prepared as a separate document or as part of an Environmental Impact Statement.

- where there are proposals by government bodies or private sector to carry out activities which fall within Part V of the Environmental Planning and Assessment Act where they are likely to significantly affect the environment of endangered fauna
- where a general licence to take or kill endangered fauna is applied for.

A fauna impact statement should include:

- a full description of the fauna to be affected by the actions and habitat used by the fauna
- an assessment of the regional and statewide distribution of the species
- a description of the proposed activities and how they will modify the environment and affect the essential behavioural patterns of the fauna in the long and the short term
- details of measures to be taken to ameliorate the impacts
- details of the qualifications of the person preparing the statement.

Environmental Offences and Penalties Act, 1989 (NSW)

The Act provides additional environmental offences and establishes common procedures for the prosecution of environmental offences under this and other acts.

The Act establishes a three-tier system of offences:

- The first tier, or major offences, are for negligent or wilful actions which are likely to harm the environment.
- The second tier, or mid-range offences, contain those offences previously found in the Clean Air Act, Clean Waters Act, Noise Control Act and State Pollution Control Commission Act.
- The third tier, or minor offences, provides for "on the spot" fines and infringement notices.

The EPA Act is discussed in more detail in Module 2, "*The legislative framework*".

Ozone Protection Act 1989, (NSW)

This Act sets up the rules to regulate and prohibit the manufacture, sale, distribution, use, emission, recycling, storage and disposal of ozone-depleting substances and articles.

The regulations prohibit the use and purchase of ozone-depleting substances (including CFCs and halons) without authorisation of the State Pollution Control Commission and imposes obligations on persons using ozone-depleting substances.

It also regulates the servicing of existing or new refrigeration equipment, car air-conditioning equipment and dry cleaning equipment.

Ozone Protection Act, 1989

This is a Commonwealth Act to control the import and export of CFCs and halons.

Licences and quotas are required to import, manufacture or export CFCs and halons. Quotas are to be progressively reduced each year.

The Act also allows the regulation or prohibition of the manufacture or import of particular kinds of products containing scheduled substances.

Hazardous Waste (Regulation of Exports and Imports) Act, 1989

This Act regulates the export and import of hazardous waste both within and outside Australia. It prohibits importing or exporting hazardous wastes without a permit.

A permit must be granted if the Environment Minister is satisfied that the hazardous waste would be disposed of safely. The minister may order a person contravening the law to deal with the waste in a specified way or to remedy or mitigate any damage caused.

Motor Vehicle Standards Act, 1989

This Act establishes national standards for motor vehicle use in Australia.

The regulations under the Act establish a system of "compliance plates" indicating the vehicles comply with national standards as approved by the Australian Motor Vehicle Certification Board.

The Act prohibits the manufacture, importation, modification and sometimes use of vehicles which do not comply with standards prescribed under the Act.

Transport Administration Act, 1988 (NSW)

The Act establishes the Roads and Traffic Authority, the State Rail Authority, the State Transit Authority and a number of other associated bodies and gives them various powers and duties.

The Act confers on the RTA the functions conferred or imposed on it by or under the State Roads Act, 1986, the Traffic Act, 1909 and the Motor Vehicles Taxation Act, 1988 and any other act which imposes functions on it.

Roads Act, 1993 (NSW)

The object of the Act is to provide for the construction and maintenance of major roads in NSW.

The Act:

- provides for the declaration of classes of roads
- gives the RTA power in relation to the construction and maintenance of classified roads
- allows for the acquisition and resumption of land
- governs the declaration and operation of freeways and toll roads.

Environmentally Hazardous Chemicals Act, 1985 (NSW)

After the Environmental Offences and Penalties Act, the pollution law which most directly affects the RTA is the Environmentally Hazardous Chemicals Act. The RTA plays a major role in dealing with transport incidents which involve the accidental spillage of hazardous chemicals.

The Act sets the rules for controlling the effects of, and providing for the assessment of, chemicals and chemical wastes. It does this by providing a scheme for:

- assessing chemicals
- establishing an inventory of chemicals
- keeping a register of declared chemical wastes.

Under the Act, the EPA may issue chemical control orders for chemicals and chemical wastes. It may also take, or require the occupier of contaminated premises to take, actions to restore those premises.

Environmental Planning and Assessment Act, 1979 (NSW)

The Act regulates environmental planning and assessment for development and activities. It does this by setting the rules for environmental planning instruments, such as:

- local environmental plans
- regional environmental plans

- State environmental planning policies.

Development on land to which an environmental planning instrument applies may only be carried out in accordance with the environmental planning instrument. They may require that development consent is required from a consent authority, such as a local council, before the development starts.

Coastal Protection Act, 1979 (NSW)

The Act makes provisions for the use and occupation of the coastal region and works to facilitate coastal protection works.

The Act establishes the Coastal Council of NSW and gives it various powers and duties. It permits orders to prohibit public authorities from carrying out or granting approval for development in the coastal zone without the approval of the Minister for Public Works.

Land and Environment Court Act, 1979 (NSW)

The Land and Environment Court was established by this Act. It has power for jurisdiction in five classes:

- development appeals
- building applications
- valuation and compensation
- civil enforcement or a civil challenge to the legality or procedural compliance of authorities in exercising their powers
- enforcement of criminal offences for pollution.

Heritage Act, 1977 (NSW)

This Act is to protect the cultural heritage of NSW. It establishes the Heritage Council of NSW which may make recommendations to the Minister in matters of environmental heritage.

The Heritage Council:

- must keep a register of buildings, works, relics and places which are subject to conservation instruments under the Act
- makes recommendations for the imposition of permanent or interim conservation orders
- holds enquiries into heritage property
- revokes conservation orders.

Australian Heritage Commission Act, 1975

This Act requires Commonwealth ministers, departments and authorities to refrain from taking action adversely affecting the national estate.

The Act establishes the Australian Heritage Commission.

The Commission:

- must keep a register of the national estate
- advises the Minister administering the Environment Protection Act of any matter relating to the national estate.

Decisions affected by the Australian Heritage Commission Act must take into account any requirements under the Environment Protection (Impact of Proposals) Act.

Noise Control Act, 1975 (NSW)

This Act sets the rules to prevent, minimise and abate noise.

It requires occupiers of scheduled premises to be licensed and imposes obligations on them. It also covers the issue of:

- noise control notices
- noise abatement orders
- noise abatement directions

to occupiers of any premises.

Dangerous Goods Act, 1975 (NSW)

This Act regulates explosives and other dangerous substances. It:

- regulates how dangerous goods must be handled or stored
- requires licences for storing dangerous goods in prescribed circumstances
- regulates the import, manufacture and sale of explosive substances.

Environment Protection (Impact of Proposals) Act, 1974

This Act is to ensure that the Commonwealth takes into consideration all matters affecting the environment when making decisions.

The Environment Minister may decide whether environmental assessment is required and to what extent. The Minister may then advise that conditions are to be attached to protect the environment.

Waste Disposal Act, 1970 (NSW)

The Act regulates the transportation, storage and disposal of waste.

The Act:

- establishes the Waste Management Authority of NSW
- regulates the transportation , storage and disposal of waste within the Metropolitan Waste Disposal Region.

Persons producing, transporting or otherwise dealing with waste must hold a certificate of registration, licence or approval from the Waste Management Authority in specified circumstances.

This has been superseded by the creation of the Waste, Recycling and Processing Service, NSW (WrAPS), which is an arm of the EPA.

State Pollution Control Commission Act, 1970 (NSW)

The Act established the State Pollution Control Commission and gave it various powers and duties. It also regulates the administration of licences under other pollution control regulations.

The Act provides for the administration of licences under the Clean Air Act, Clean Waters Act, Noise Control Act and Ozone Protection Act. The SPCC is also given extensive powers to enter properties and obtain information.

Clean Waters Act, 1970 (NSW)

The Clean Waters Act is to prevent and reduce water pollution.

The Act prohibits the pollution of waters by any person unless done in accordance with a licence issued under the Act.

A pollution control approval is required prior to starting certain works. Obligations are imposed on occupiers of premises with respect to pollution control equipment.

Clean Air Act, 1961 (NSW)

The Act is to prevent and reduce air pollution.

It operates by requiring licences and approvals to be obtained in certain circumstances and by establishing a series of offences.

Licences are required by the occupiers of all scheduled premises. A pollution control approval is required before starting certain works.

The Act:

- imposes obligations on occupiers of scheduled premises, persons operating scheduled equipment and persons occupying non-scheduled premises
- sets emission standards for certain types of processes
- sets prescribed standards concerning motor vehicles and unleaded petrol.

Appendix C: Guide to waste planning for industry

Waste Planning for Industry a Guide

Waste Management Authority
of New South Wales

April 1990

Contents

Summary

TODAYS' challenge for industry is to provide creative managerial solutions to ensure the long-term protection of the environment.

The Waste Management Plan (WMP) is an essential step towards the minimisation of non-productive costs. It will also assist an organisation in meeting its environmental and social responsibilities.

Management commitment is essential for successful integration of the Plan into the day-to-day activities of a business. The establishment of a workplace committee with achievable goals will assist in its successful implementation. The committee should provide feedback to production and management staff and encourage their involvement during the various phases of the WMP.

The ***Waste Audit***, which is divided into five stages, is the first task undertaken by the committee. Firstly, background information from company records detailing the production process, the waste streams, costs and other relevant data are summarised. A plant survey is then carried out to determine sources of wastes and their composition. This information is then cross-checked against the background information and a detailed material balance is completed. Quantitative information allows a business to identify priority waste streams.

The WMP is based on the following hierarchy:

» *waste minimisation*

» *recycling or re-use*

» *waste treatment*

» *waste disposal by landfill.*

The prevention and reduction of waste is emphasised rather than treatment and disposal.

Waste minimisation can involve changes to the raw material input, the production process and/or the final product. It can often be achieved through simple procedural changes or may involve, and often justify, significant capital expenditure.

Recycling or re-use of materials can be carried out either on-site or off-site. The potential is greatest if materials are segregated early within the process as there are less contaminants to remove before re-use.

Waste treatment should only occur when source reduction, recycling and re-use options have been fully considered and evaluated on a cost-benefit basis. Where treatment achieves a reduction of toxicity or pollutant mobility, a greater range of disposal options may be available.

Disposal is the last option in the waste management hierarchy. Approval must be gained for the disposal of hazardous waste and conditions apply to the storage and transport of these wastes. ***Generators have absolute responsibility for ensuring that all wastes are disposed of in an approved manner.***

All waste management options must be evaluated on the basis of both their ***technical and economic feasibility*** given program goals and constraints. The technical criteria used should first consider the waste reduction effectiveness. There are a number of economic benefits (eg., reduced risks-reduction in workers compensation claims and insurance costs) which, although difficult to equate in dollar terms, must be included in the economic analysis.

Once the proposed options are selected an ***Implementation Plan*** is developed for each of the waste streams. Considerations include staff education, training, waste specific accounting and coordination of further investigations.

It is important to recognise that the WMP is a ***continual review process.*** Options that are not feasible at a given point in time may become feasible at some future stage. The dynamic nature of the Plan will allow firms to be pro-active in meeting their environmental responsibilities.

Introduction

Background and Objectives

One of the major issues of the 1990s will be protection of the environment, an important aspect of which is waste management.

Waste quantities handled by the Authority arising from the general community, industry and government have grown significantly over the past decade (Figures 1 & 2).

Figure 1 : **Solid Waste Quantities, Sydney Region**
Million Tonnes

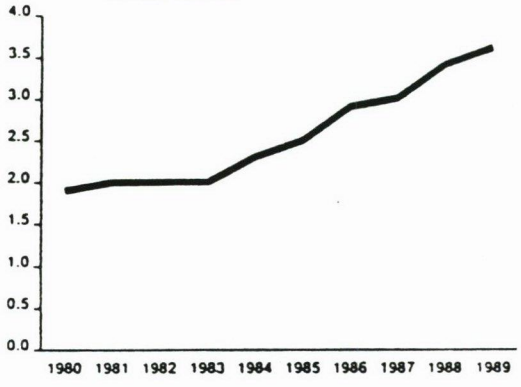
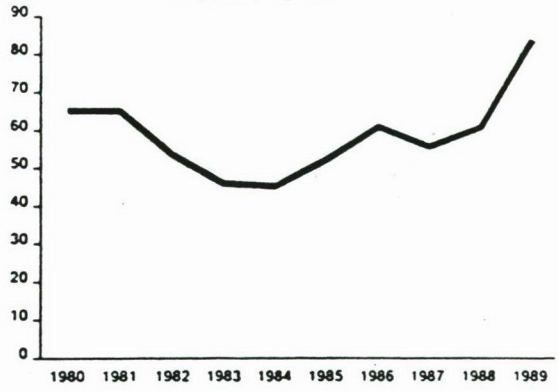


Figure 2 : **Bulk Liquids, Sydney Region**
Thousand Tonnes



Waste management policies are now increasingly being viewed in terms of environmental objectives with the following hierarchy:

- » *waste minimisation*
- » *recycling, or re-use*
- » *waste treatment*
- » *land disposal.*

In keeping with the above objectives, these guidelines for waste management have been developed to assist companies in the total management of their wastes. Figure 3 outlines the steps involved.

The aim is to encourage the development and provision of alternatives to waste treatment and disposal through reduction of pollution at the source of generation. This will require creative managerial solutions to address a range of complex and often interrelated problems.

Application to industry

The Waste Management Plan is applicable to any organisation, regardless of size, generating pollutants discharged to either the air, water or land environment. It is an essential step towards the minimisation of non-productive costs, and the avoidance of possible future liabilities.

The first step is to ensure compliance with all current Acts and Regulations governing waste management. As well as meeting current obligations, this minimises possible future liabilities associated with site clean-up costs. In a situation of non-compliance, the Waste Management Plan provides the structure for the costing of available options to achieve regulatory compliance and the priority of required actions.

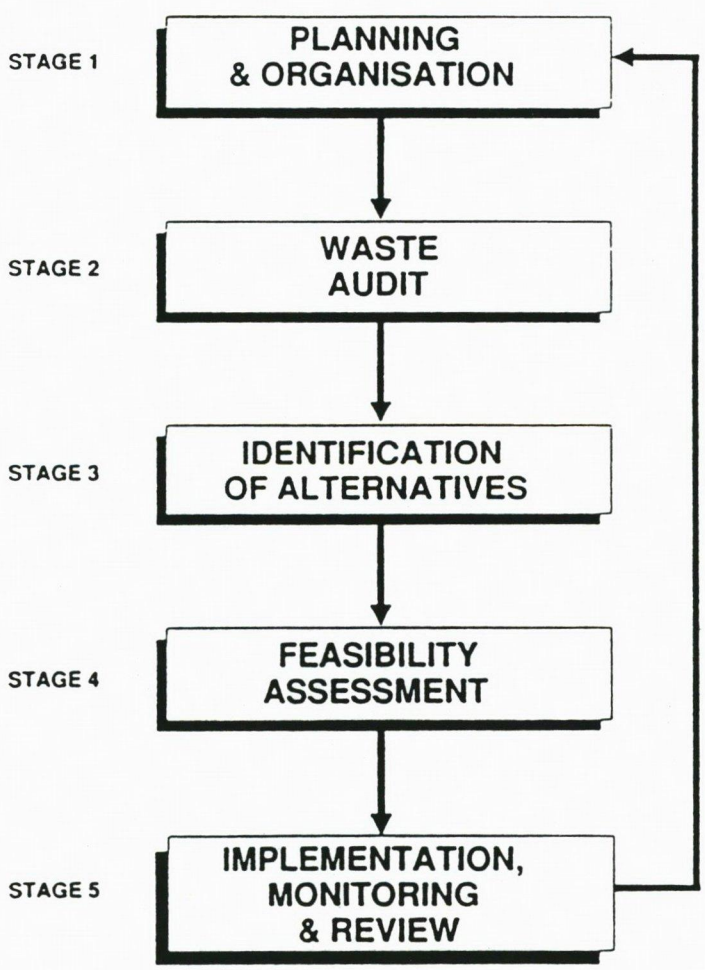
Other benefits include reducing the cost of waste management and improv-

ing occupational health and safety standards by reducing the toxicity and quantity of waste streams. This can be achieved by source reduction of waste, recycling or re-use in production processes or by waste treatment. Relatively minor changes to the production process can often yield large cost savings in waste handling, treatment and disposal.

A conscientious approach to waste minimisation may also improve a company's image and relations with other local land users and the public. Widespread environmental concerns are often expressed over proposed developments and the production of a Waste Management Plan can be a critical step in the acceptance of a development application. An integrated strategy for waste management from generation through to disposal, will help to answer or minimise public concerns at an early stage.

The concept stage for a new facility is the most favourable time to consider alternative technologies, production processes and capital equipment available. Such considerations are an important aspect of the Waste Management Plan which encourages a company to achieve the preferred management option of prevention and source reduction of wastes.

Figure 3 : The Waste Management Plan



Planning and Organisation

Management Commitment

Waste generation is a management problem. ***In many cases managerial decisions are of greater importance than narrow technical solutions.***

Management commitment is essential if employees are to be motivated to conduct and implement a successful Waste Management Plan. Corporate policies and objectives with a demonstrated commitment to environmental protection, and in particular the waste management hierarchy, are essential. Such commitment will provide both encouragement and direction to staff in the day-to-day and long-term management of waste.

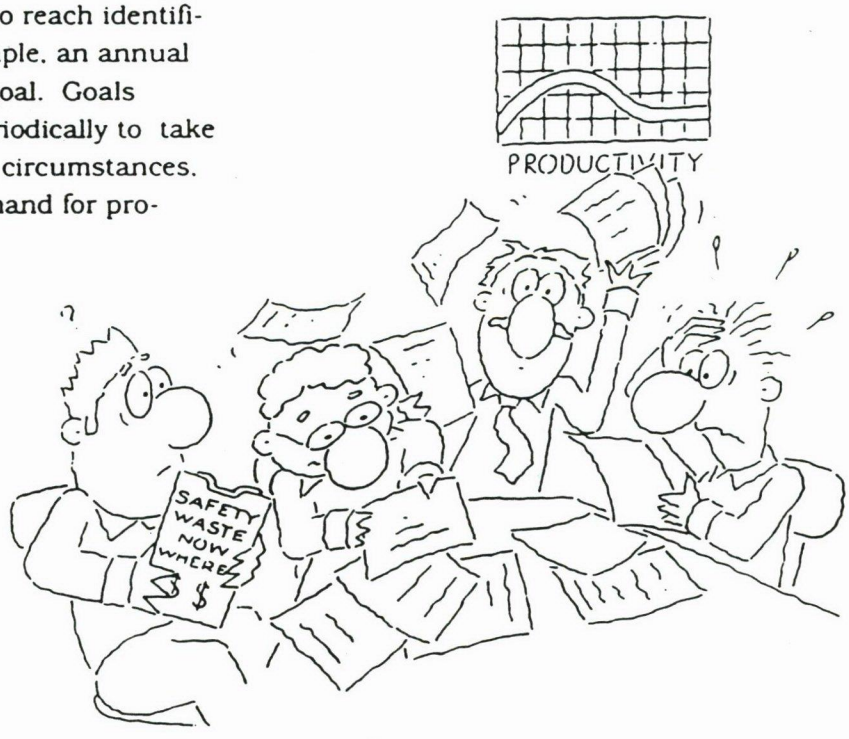
Goals

Achievable goals need to be set which can be either qualitative or quantitative. The latter is preferable as it gives staff the opportunity to reach identifiable targets. For example, an annual 10% waste reduction goal. Goals should be reviewed periodically to take into account changing circumstances, such as consumer demand for products, government regulation, technology, work practices or management techniques.

Workplace Committee

Depending on the operational complexity at a site, either one or a number of personnel may form a workplace committee. They should be selected from major waste generating areas and be familiar with the various operations of the business. The committee will liaise with the various sectors affected by the Plan's implementation and draw upon the expertise found within these areas. Management backing, including time, authority and monetary support, if necessary, is essential.

The committee provides feedback to production and management staff and encourages their involvement during the various phases of developing the Waste Management Plan.



Waste Audit

THE waste audit is divided into five stages, which are discussed below.

Pre-Audit Phase

The aim of this phase is to compile all the background information available on the business. Much of the data can be obtained from company records, responsible personnel, and through discussions with staff to highlight perceived environmental problems. Preparation should include a review of the literature on the activities performed at the site and other relevant documents which relate to waste discharge. In general, the four main aspects are discussed below.

Production Process Information

The inputs to and outputs from the various processing areas need to be quantified to allow the origins and quantities of waste to be determined. Information can be broadly obtained from the measurement of raw materials, units of product and water usage.

Other information required to assist this analysis can include:

- *design process flow diagrams*
- *heat and material balances*
- *equipment lists*
- *piping and instrument diagrams*
- *production schedules*
- *sewer layout*
- *number of process lines*
- *operational manuals, process descriptions*
- *operator data logs, batch sheets*
- *accounting reports.*

Waste Stream Information

Information should be collated on the types, quantities, composition and sources of gas, solid and liquid streams. A standard recording form for all wastes will enable data to be analysed more easily. The location of all waste collection and storage points need to be identified, as well as operating data and diagrams of any on-site treatment plant, for example, wastewater or incineration units.

Other relevant information, depending on the type of business, may include:

- *waste flow characteristics (quantity and rate)*
- *environmental monitoring reports*
- *physical properties of wastes, e.g. solid, liquid*
- *waste dockets*
- *waste analyses*
- *sewer discharge records*
- *transportation records*
- *current methods of disposal, control systems for dust, odours or first-flush systems*
- *hazard assessment (i.e., toxicity, flammability, etc.)*
- *spill incidences - quantities and composition.*

It is particularly important to note whether the flow rates are continuous, batch or incidental (spills), as this will have an impact on storage requirements and treatment process design.

The waste generation rate, if possible, should be related back to the process

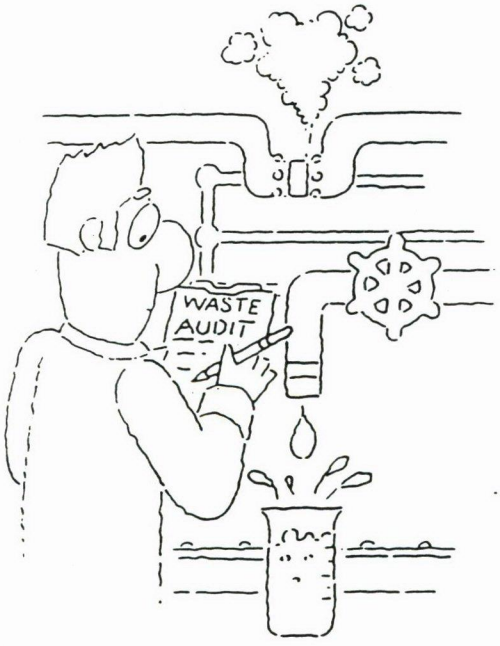
or business, e.g. kg/unit of product, kg/value added, kg/sales, etc.

Cost Information

To enable correct management decisions, waste treatment and disposal costs must be separately accounted for. Information required includes:

- *disposal costs (solid, liquid, packaged wastes, etc.)*
- *transportation costs*
- *water and sewer discharge costs*
- *packaging costs*
- *treatment costs (on-site/off-site)*
- *storage costs*
- *raw material costs.*

These costs can be obtained from company accounts, the transporter, Water Board notices, or other sources including the Waste Management Authority and need to be reviewed regularly.



General Information

Current source reduction and recycling practices need to be documented, as well as any previous correspondence with government departments or authorities.

When the background information is obtained a general flow diagram or material balance can be developed. This is simply a diagram relating inputs to outputs. If possible, the diagram should clearly identify the source, type, quantity and concentration of each identified waste stream.

This information can be used to develop and organise the plant survey and help identify gaps in data, problem areas and information conflicts.

Plant Survey

The plant survey provides the opportunity to compare the actual conditions at the site with the background data collected in the pre-audit assessment. Information gaps and additional waste streams which may not have been evident initially can be identified.

Sources of Waste

All steps in the operation of a business, from the reception area to the product storage areas are examined. The main elements are:

- *prepare an agenda in advance*
- *schedule inspections to coincide with the operation of the areas of interest*
- *monitor operation at different times*
- *interview staff in the areas of concern*
- *note housekeeping practices and general appearance of the site*
- *photograph observations for later reference.*

In most cases the survey should follow the process flow from start to finish. Notes on housekeeping practices such as rinsing operations, sources of odour, sumps, smoke plumes, waste segregation and product use should be made. Simple things should not be overlooked, for example, rinse hoses not turned off after use; equipment clean-up frequency; spent containers; dust and sweepings. Product storage areas can also be useful indicators of potential problems such as evidence of expired raw materials or materials no longer in use.

It is particularly important to examine waste storage areas, sewer discharge points and emission points. Floor drains can show if anything was discharged incorrectly, for example, odours or visual signs of grease and oil. Areas which can generate hazardous materials such as solvents, oil and paints should also be looked at, for example, maintenance or workshop areas.

The plant survey could also commence at the waste storage or treatment areas and work back to the point of generation. However, in doing so less obvious wastes could be accidentally overlooked and could increase on-site hazards.

Waste Sampling

Information on both the quantity and composition of waste is required. If this cannot be calculated then it will be necessary to undertake a sampling program with points identified prior to the commencement of the survey. Identification can be as simple as observing physical characteristics. Additional points may be added as new sources of wastes are discovered during the audit.

Things to take into account are:

- *production scheduling*
- *fluctuations in production, e.g. seasonal variations.*

Composite samples can be taken for constant wastewater flows whereas batch tanks should be spot sampled.

Data Completion Check

Once the data has been gathered it is important to correct and adjust the waste flow diagram. For each waste stream the following details should be documented:

- *point of origin*
- *physical/chemical characteristics*
- *quantity*
- *waste handling/treatment/disposal*
- *rate of generation (e.g. kg/unit of product)*
- *variations in generation rate*
- *costs to manage and dispose of waste*
- *potential for contamination or upset.*

Regulatory Compliance

With all of the quantitative information summarised, reference must be made to the regulatory requirements relevant to the identified waste streams. For instance, air emission standards, sewer discharge standards, waste disposal requirements, etc. In addition, the various costs associated with meeting those regulations under current practices must be identified. This should be cross-checked with the expense ledger.

Priority Waste Streams

To assist in resource allocation, waste stream priorities can be made according to criteria such as:

- *regulatory compliance*
- *toxicity and other hazard risks*
- *quantity*
- *costs – treatment, storage, disposal*
- *perceived problem areas*

Identification of Alternatives

Waste Management Hierarchy

The preferred path in the management of wastes lies within an integrated waste management hierarchy. The hierarchy acknowledges that no single approach will solve all the problems presented by the range of wastes.

The waste management plan considers waste from its point of generation through a variety of reduction, treatment and recovery options to its ultimate disposal. This can be viewed appropriately as a hierarchy of alternatives as shown in Figure 4

There are basically three general options:

- *In-plant options should be used to prevent or reduce the generation of wastes.*
- *Wastes that are generated should be converted to less hazardous forms or useable products.*
- *The remaining residues and wastes should be stored, treated and disposed of in a manner that minimises risks to both the environment and the community.*

The prevention and reduction of waste is emphasised rather than treatment and storage. The goal is the reduction of risk to the environment and community. The hierarchy must be viewed as an order of priorities with prevention given the greatest emphasis – it is not a bottom-up approach.

It is within this framework that the guide has been prepared.

Figure 4 : **The Waste Management Hierarchy**

Minimisation
- Good housekeeping
- Product formulation
- Product substitution
- Equipment redesign
- Process modification
- Alternative manufacturing process
- Non–production of material

Recycling
- Re-use of drums, glass, paper
- Solvents and oil recovery
- Sawdust / shavings
- Waste Exchange
- Water re-use

Treatment
- Incineration / other thermal
- Physical / chemical
- Biological

Disposal
- Landfill

Waste Minimisation

The minimisation of waste at the source of generation is well recognised as the most desirable waste management option. To maximise efficiencies and avoid future environmental degradation, ***a fundamental change is necessary from pollution treatment and control, to anticipation and prevention.***

While the treatment of a waste stream can reduce the disposal charges involved, reduction of the waste at source will eliminate the raw material losses and all other costs associated

with the waste. Raw material and labour costs will generally far exceed the more obvious cost of waste disposal.

Source reduction of waste can involve changes to the raw material input, the production process and/or the final product. It can often be achieved through simple procedural changes or may involve, and often justify, significant capital expenditure.

Raw Material Changes

The use of less hazardous raw materials can result in a less hazardous waste stream, or facilitate greater recycling or treatment of waste.

Raw material substitution has been widely adopted in recent years in the coatings and printing industries. The widespread change from solvent based products to water based, has reduced the generation of hazardous waste and made in-house treatment of waste easier. Reduced emissions of volatile organic compounds have also improved health and safety standards. Similarly, the use of lead-based pigments in paint has been phased out with the use of less hazardous alternatives.

With waste disposal charges being increasingly related to priority pollutants which present difficulty in treatment or disposal, substitution of raw materials will become increasingly desirable. Chlorinated degreasing solvents and phenolic paint strippers, for example, will increasingly be substituted by less hazardous alternatives as disposal charges and acceptance standards become prohibitive.

Companies generating hazardous waste will need to critically examine all inputs to the production process and, through research and development activities, appraise all possible alternatives.

It is through raw material substitution that changes to the waste stream are most readily effected and therefore production efficiencies most readily achieved.

Production Changes

Changes to production may involve either simple changes to operational procedures and work practices, or the employment of alternative or additional equipment.

Procedural Changes Significant waste reduction can often be achieved by changes to work practices or procedures. A detailed examination of these aspects should be made to determine where improvements are possible.

Large volumes of washwater are commonly generated, for example, from the cleaning of small spills with high pressure hoses, where a small brush or absorbent cloth would be adequate. As inefficient work practices are identified, staff will require re-training. Some form of recognition or reward for improved process operations will give greater success. Similarly, improved plant maintenance can increase process efficiency by reducing leaks or spills from hoses, valves, pumps, etc. and reducing material loss upon plant start-up or shutdown.

Equipment Upgrading With the increasing cost of waste generation and disposal, upgrading to new, more efficient production equipment can often be justified by a short pay-back period. If a particular equipment change is not justified at a given point in time, it is important to recognise that the Waste Management Plan is a continual review process. ***At some future time the upgrading, or an aspect of it, may be feasible.***

Many good industry examples exist of changed process operations resulting directly in decreased waste generation and financial benefit. Often changes are implemented primarily to improve production. The computerisation of production equipment may be introduced for raw material and labour efficiencies, but can result in significant waste reduction. The reverse may also be true. The development of powder coating and electrostatic painting technologies greatly reduced the generation of hazardous waste. It also provided technical and economic benefits for the wide range of applications in which it is used.

Product Changes Major product changes most frequently occur as a result of major changes in community concern, government regulation or consumer demand. With the banning or phasing out of products such as DDT, leaded petrol and more recently CFCs, alternatives have been readily developed and accepted without significant evidence of the severe economic dislocation predicted by some groups. For some products, current disposal options may not be available in the future.

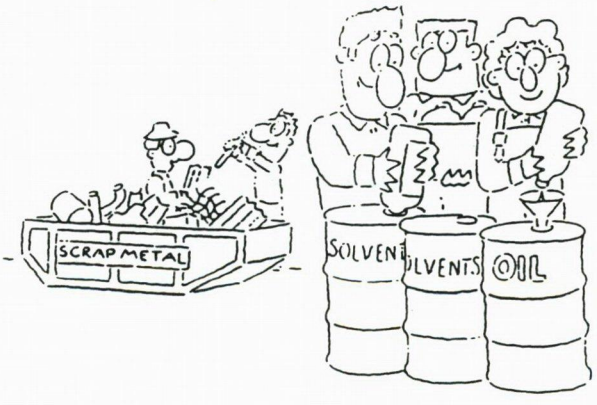
The manufacturer of a raw material may change the product formulation in response to a customer's changing requirements. For example, during the manufacture of contact moulded products such as bath tubs and boat hulls from polyester resins, toxic styrene monomer is released into the air. A styrene suppressed resin has been developed and is now used by many manufacturers. The development of the product was in response to the end users' pollution problem and proved a significant advantage over competitors (Campbell, 1982). Innovative research and development into alternative production technologies and products, will undoubtedly continue to see some companies gaining a competitive advantage over others and in the long term see improved technologies widely introduced.

Recycling or Re-use

Recycling may be done either on-site or off-site, with advantages and disadvantages for both. Factors affecting the decision will include the costs, quality of the waste and recycled material, and the final use for the material.

On-Site Recycling

On-site, recycling may be direct or indirect. *Direct* recycling involves the return of the material to the process that generated it: for instance, scrap metal may be put back into the furnace and re-melted. *Indirect* recycling is returning the product to another process within the same site, where input quality is



of lesser consideration, such as using coloured plastic scrap to produce a dark coloured product.

By recycling on-site the generator is able to have a greater control over the characteristics of the material. The potential is greatest if the materials are segregated early within the process as there are less contaminants to remove before re-use.

The use of washwaters in countercurrent flow or re-use of the water has also

resulted in major reductions in wastewater for many industries and should be investigated wherever technically feasible. In some cases it may involve treatment of the washwater prior to re-use.

Off-Site Recycling

A recovered waste stream may be sent off–site for recycling and either returned to the generator or sold to someone else for re-use. For example, used oil may be sent to an oil refiner where it may be refined for use as a boiler fuel.

Off-site recycling has several advantages. It avoids the installation of equipment to treat the material, thus minimising capital expenditure and operating costs. There may also be savings on disposal costs. A disadvantage is the additional costs and risks of handling, transport and re-processing.

Often there are limitations on the characteristics of the waste, for example, water content. The user of the recycled material will have certain specifications that need to be met. The recycler must be reliable and able to supply material that meets these specifications.

Industrial Waste Exchange

Industrial waste exchanges are a means of putting companies in contact with each other, where the waste produced by one may be useful to another. They generally include a description of the material, the quantity requested or available and how frequently it is generated.

Waste exchanges are aimed at keeping potentially useful industrial by-products out of the waste stream. In doing so they can help industry find raw materials at significantly reduced costs. At the same time disposal costs are minimised.

The Waste Management Authority operates an **Industrial Waste Exchange** in Sydney (Phone (02) 412 1388). Information on waste exchanges in other States may be obtained from the relevant environmental agencies.

Waste Treatment

Consideration for waste treatment should only occur when source reduction, recycling and re-use options have been fully considered and evaluated on a cost-benefit basis. However, a commitment to waste prevention does not assume that all waste streams will be eliminated and treatment options may need to be investigated.

The principal aims of waste treatment include a reduction of toxicity, mobility in the environment and/or volume. Where technically feasible, treatment can involve the recovery of material able to be re-used or recycled. For example, conventional waste treatment in the plating industry involves the production of large volumes of metal hydroxide sludge with no recovery of raw material. Metal recovery technology, now firmly established in some companies, can recover up to 99% of metal and reduce sludge generation to zero. The recovered metal is of sufficient purity to be re-used as raw material and substantial economic and environmental benefits are achieved (Campbell, 1982).

Off-site versus On-site

On-site or in-house treatment of waste minimises the potential hazards and associated liabilities of off-site handling and transport. In the assessment of alternative treatment opions,such potential liabilities must be carefully considered.

Segregation of Waste Streams

It has often been considered cost effective to combine all waste streams to one point for collection or disposal. While this may be beneficial in some instances, to adjust pH levels for example, it may also result in a hazardous waste stream mixing with non-hazardous wastes and rendering the total hazardous. For example at regional landfill depots in the Sydney region, fine dusty wastes such as sawdust or activated carbon require additional care in handling during disposal. They are, therefore, charged at a higher rate. The mixing of such waste with non-hazardous trade or domestic wastes requires the combined load to be treated as hazardous and therefore charged at the higher rate.

Simple segregation of waste streams not only has the potential to reduce hazardous waste volume, but may often facilitate treatment, either in-house or off-site. It may also allow the recovery of an uncontaminated raw material where technically feasible.

Hazard and Volume Reduction

Where treatment achieves a reduction of toxicity or pollutant mobility, a greater range of disposal options may be available. The relative costs of these alternatives may provide an incentive for companies to render waste non-hazardous.

Many inorganic sludges are currently being disposed of in a secure landfill at a higher cost as they do not meet the required leaching criteria. Further treatment of these wastes to immobilise the pollutant load would allow disposal to a non-hazardous facility at a considerably lower price. Similarly, many organic sludges are currently disposed of in secure landfill because of their high liquid content and odour.

Dewatering and minimal chemical treatment would allow disposal of these wastes into ordinary landfills.

Where technically feasible solutions exist, industry will be increasingly required to treat waste prior to disposal to reduce the demand on hazardous waste disposal facilities.

Incineration achieves a reduction of volume, toxicity and pollutant mobility and for a number of wastes is currently recognised as the best available treatment technology. With an incinerator having recently commenced operation in Sydney for the destruction of hospital wastes, landfill disposal of such waste is now being phased out.

While all technically feasible treatment options should be considered during the evaluation of alternatives, it should again be stressed that the real, long-term benefit to industry and society is in the reduction of waste at source.

Disposal

Disposal is the last alternative in the waste management hierarchy. As legal requirements for proper waste disposal become tighter it is becoming increasingly difficult to dispose of many wastes without treatment. Tradeable licences and quotas have been proposed as possible future options.

Approvals

For disposal of liquid and sludge wastes approval must be obtained from the relevant authorities. In Sydney the Waste Management Authority issues all hazardous wastes with approval numbers to enable tracking from the gener-

ator to final disposal by using a four-docket system.

Applications for approval must be accompanied by a chemical analysis of the material. The approval numbers are specific to the waste and where it is generated, i.e. each waste generated on a site will need a unique approval number.

Storage

Storage is not a desirable long-term option for waste materials. If waste is to be stored then it must be managed in a manner that minimises the hazards created for the workforce, the environment and the general public. Dangerous goods should be stored in accordance with the Dangerous Goods Act in bunded areas and in well maintained and labelled containers.

At present long-term storage is used for intractable wastes, for example, PCBs and HCB, for which there is no acceptable method of disposal within Australia. Intractable wastes must be stored in an approved storage facility, which is isolated, bunded, out of the weather and regularly monitored.Records must be kept of what is in the store as well as what enters or leaves the store. The Waste Management Authority and State Pollution Control Commission must be notified if any intractable wastes are to be transported.

Acceptance Standards / Conditions

Acceptance of waste for disposal is dependent upon the characteristics of the waste. These standards are determined partly by the chemical and physical nature of the substance and by the disposal method to be used. For example, metal hydroxide sludges must meet the leach test criteria set down in the SPCC document "Guidelines for Landfill Disposal of Industrial Wastes in NSW, Environmental Guide WD-3". Other acceptance standards will be based on odour, amount of liquid and the reactivity of the material. All waste discharged to sewer must meet the Water Board standards under its trade waste policy.

Transport

All wastes transported into, out of or within the Sydney Region must be transported by contractors licensed by the Waste Management Authority. Vehicles carrying bulk liquids must also comply with the NSW Dangerous Goods Regulations, 1978. ***It is the generator's responsibility that the bona fides of a transporter are correct for the type of waste generated.*** Vehicles are likely to be refused use of an Authority facility if they do not comply with the licensing conditions.

Final Disposal

There will always be a need for landfill as most treatment methods generate a residue of some kind. Within the Sydney Region, wastes can be landfilled at regional depots and at a secure landfill, depending on the type of waste. Outside this region advice may be obtained from the State Pollution Control Commission. ***Generators have absolute responsibility for ensuring that all wastes are disposed of in an approved manner.***

Feasibility Assessment

THE options of source reduction, recycling, treatment or disposal identified in the preceding sections must be evaluated on the basis of both their technical and economic feasibility given program goals and constraints.

Technical Evaluation

The technical criteria used should firstly consider the waste reduction effectiveness, i.e. does it reduce toxicity and quantity? In addition, reliability, effect on product quality and plant operations, should be factored into the evaluation process.

The techniques or technology under review must at least meet current regulatory requirements. Environmental standards are likely to become increasingly stringent with time and therefore, when selecting new processes, consideration should be given to likely new standards.

Other evaluation criteria include:

- *reduction in occupational health and safety hazards*
- *reduction in inputs such as energy, water and raw materials*
- *waste minimisation rates achieved, i.e. kg/unit of product or total waste reduction*
- *wastes recovered for recycling*
- *other environmental problems that may arise from the proposed options*
- *reduction in liability – source reduction highest, disposal the lowest.*

Other benefits can also accrue. Innovative technology developed to solve a particular problem may lead to a diversification in the product line of a business and, as a result, increased profit.

Economic Evaluation

Standard discounted cash flow techniques can be used, such as Net Present Value or Internal Rate of Return, to determine the cost-effectiveness of a proposal. The pay-back period for each of the options will need to be stated.

The overall costs and benefits should include:

- *liability and insurance costs*
- *capital costs*
- *operating costs*
- *savings in inputs*
- *savings in treatment/disposal costs.*

There are also a number of economic benefits which, although difficult to equate in dollar terms, must be included in the economic analysis. Too frequently, however, companies assess only short-term accounting costs without consideration for these benefits which include:

- *reduced risks, e.g. reduction in workers compensation claims, insurance costs*
- *compliance with environmental regulations avoids plant shut down or criminal penalties for a company if violations occur*
- *waste reduction reduces the need for staff to be deployed on environmental problems*
- *resources can be re-directed into production*

» *improved community relations*

» *delays in the siting of new facilities can be avoided*

» *waste prevention avoids the need for costly development applications and procedures which are required for on-site treatment or significant plant modifications.*

Other Considerations

Once the costs and savings for each of the options have been identified, a comparison can be undertaken either in-house or externally. This can be based on either costs alone, or cost per unit of waste or waste constituent(s) reduced. This is shown in Figure 5 - where the on-site options are compared to the costs of treatment or disposal off-site. In the situation illustrated, options A,B,C,F would be selected over options D,E,G,H. Note that some options are actually profitable (Overcash, 1988).

The options selected can then be broken into three broad groups, according to their likely time frame for implementation, namely:

» *Low cost options - waste segregation, stock control procedures, raw material control, housekeeping methods, simple equipment or process changes.*

» *Intermediate cost options - raw material substitution requiring either product or market testing or both.*

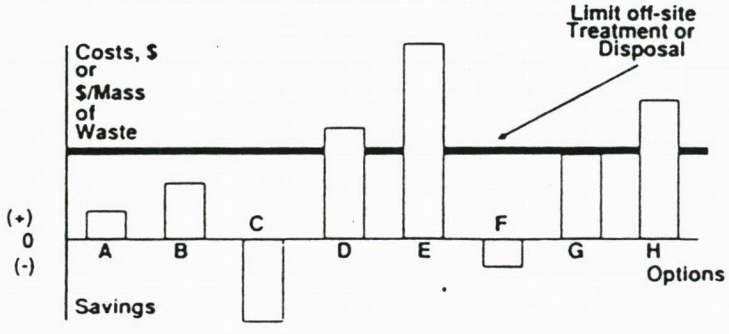
» *High cost options - those requiring capital outlays for new equipment or replacement of plant.*

Low cost options can be implemented as soon as cost savings have been identified. However, higher cost options such as the need for new equipment or the replacement of old plant will entail a longer time frame. Feasibility will depend on the availability of capital within the overall business plan, pay-back periods and the age and economic life of current plant.

Depending on the size and complexity of a site, there may only be one or two technically and economically feasible alternatives. In other situations, a number of options may be used together to effectively reduce the waste stream.

Once options are selected, the waste management team must consult with staff in the affected areas regarding the proposed changes. Without their support and commitment, successful implementation of the program is unlikely to proceed smoothly or even reach the implementation stage.

Figure 5 : **Economic Assessment Of Alternatives**



Implementation, Monitoring and Review

Waste Specific Plans

Once the proposed options are selected an implementation plan can be developed for each of the waste streams. Information should include:

- *management requirements - organisational structure and lines of responsibility*
- *implementation schedule*
- *equipment needs - add on or future replacement of plant*
- *capital and operating cost estimates*
- *staff training*
- *frequency of review*
- *monitoring of performance.*

Education and Training

All staff need to be aware of good housekeeping practices such as waste segregation or rinsing practices. Methods selected must be easy to follow, such as proper labelling of drums or storage bins for recyclable materials.

Clear guidelines need to be circulated on the procedures to be followed for incident reporting (spills), storage, handling and disposal for each waste stream. The need for off-site treatment or disposal documentation to be completed accurately must be stressed.

Waste Specific Accounting

It is important that waste management costs are separately accounted for and are costed back to each production area. ***Regular reporting back to the production area will create an awareness of the quantity and cost of waste treatment and disposal.***

This will involve some type of tracking and recording system for each waste stream. Information should include a description of the waste type, quantity and generation source. Storage, transport, treatment and disposal information should also be maintained.

Co-ordination of Further Investigations

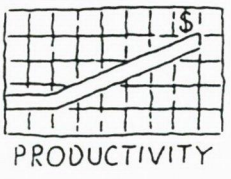
Given changes in production, development of new techniques or technologies and rising disposal costs, ***a regular review of the Waste Management Plan is required.*** Monitoring the performance of introduced waste management methods will also identify any weaknesses in the Plan and provide guidance for any future improvement. The dynamic nature of the Plan will allow firms to be pro-active in meeting their environmental responsibilities.

Conclusion

THE Waste Management Plan provides a structural outline for improved waste management at the corporate level. Beyond the obvious economic and environmental benefits identified in this guide, other important factors include improved community relations and a reduction in liability and risk. To provide maximum benefits to business and the community, prevention and source reduction must be given the highest consideration.

If all that is achieved in the coming years is a shift in focus from disposal, to treatment and disposal, the public perception will be that industry has failed in its environmental and social responsibilities.

It is therefore critical that industry demonstrates its ability to effectively manage its waste by undertaking and implementing a Waste Management Plan that minimises waste generation and ensures long-term protection of the environment.



Appendix

Legislative Framework

Any management plan must take into account the legislative framework within which industry operates including laws or regulations of an environmental nature. Legislative and administrative measures have been introduced to deal with many environmental problems encountered by the community.

Legislation exists to control emissions to the air, discharges to the sewer and waterways, the levels of noise generated, and their impact on the health of the public and the workforce. Other legislation covers hazardous chemicals, radioactive substances and waste disposal. Offences against these Acts will result in penalties being imposed.

The relevant Acts are administered by several different government departments. These include the State Pollution Control Commission, the Department of Health, the Department of Planning, the Water Board, the Waste Management Authority and the Workers Compensation and Rehabilitation Authority.

The **State Pollution Control Commission** is involved in administering those Acts which are directed at pollution control, waste disposal, and protection of the environment. The Acts which come under the State Pollution Control Commission jurisdiction are the:

- *Clean Air Act 1961*
- *Clean Waters Act 1970*
- *Environmentally Hazardous Chemicals Act 1985*
- *Noise Control Act 1975*
- *State Pollution Control Commission Act 1970*
- *The Environmental Offences and Penalties Act 1989.*

The *Environmental Offences and Penalties* Act, introduced in 1989 supplements other laws intended to protect the environment from pollution. It introduces new fines and jail sentences for offences against it and other Acts.

The **Workcover Authority** is responsible for the welfare of the workforce and the public. This is achieved by administration of various Acts including the :

- *Dangerous Goods Act 1975*
- *Occupational Health and Safety Act 1983.*

The **Waste Management Authority of NSW** is responsible for the collection and disposal of effluent, garbage and trade wastes within the Sydney Metropolitan Region. It does this under the regulations of the *Waste Disposal Act*, 1970. Under recent amendments to the Act the Authority also has the powers to establish and operate a high temperature incinerator at a site yet to be determined in NSW.

The **Water Board** is responsible for water supply, the sewerage system and elements of the stormwater and drainage systems in the Sydney, Illawarra and Blue Mountains areas. These functions are administered under the *Water Board Act*, 1987. Beyond these regions these functions are the responsibility of the Department of Public Works, the State Pollution Control Commission, local Councils and the Hunter Water Board.

The **Department of Planning** administers the *Environmental Planning and Assessment Act, 1979.* This gives statutory force to a system of environmental assessment for both public and private sector development. Under the legislation certain development applications must be accompanied by an Environmental Impact Statement. The Act outlines the role and responsibilities of local government, government committees, Department of Planning, the community and the courts.

Information on or copies of all of the Acts and any other Acts which may be relevant to industry may be obtained from the authorities mentioned, the Department of Business and Consumer Affairs and the Government Information Service on (02) 228 8900.

References & Further Reading

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Community Services & Information

Advisory Services

The Authority provides advice to the public on all aspects of waste management, phone (02) 412 1388. The following specific services are also offered:

- **Industrial Waste Exchange:** is a contact point for putting generators of waste in touch with potential users. In addition to the telephone service - (02) 412 1388, the Exchange produces a free directory listing waste users, and waste available
- **Recycling Hot-Line:** is a telephone service listing the location and operating details of all known waste recycling facilities in metropolitan Sydney. Phone (02) 412 1388
- **Waste Management Library:** a specialist library available to the public, by appointment: borrowing by inter-library loan only.

Publications

The following technical publications are available from the Waste Management Authority:

- Waste : Site Storage and Handling Guidlines (1981).
- High Temperature Waste Incineration Review (1985) examines the issues of intractable waste destruction in Australia.
- Composting and Sydney's Waste (1987). A Working Party report on the potential of composting waste in the Sydney region.
- Recycling Directory - annual directory of the Industrial Waste Exchange.
- Community Recycling (1987). A review of the Glenquarie Buy-Back Centre experience.
- NSW Recycling Status & Opportunities (1988). NSW Recycling Committee report on the State's recycling performance and future direction.
- Annual Reports

A number of leaflets explaining various aspects of the Authority's activities are available upon request, free of charge:

- Recycling in NSW
- Home Composting
- This Affects You - explanation of registration and licensing regulations
- Hot-Line Recycling - information on the service
- Waste Watch - newsletter
- Industrial Liquid Waste Disposal at Castlereagh
- Aqueous Waste Treatment Plant
- Solid Waste Disposal & Recycling - Depot opening hours, locations and charges
- Treatment & Disposal of Liquid & Special Wastes - Charges

Video and Films

Available for free loan on U-Matic, VHS and Beta video cassette, and 16 mm film, from the Authority's Library:

- **Managing Sydney's Waste** - illustrates how solid waste is collected, transported and disposed of in Sydney (23 min).
- **The Safe Solution** - depicts the management of Sydney's industrial liquid waste (15 min).
- **Gone but not forgotten** - looks at Sydney's recycling and waste disposal system and what the community can do help (15 min).

Appendix D: Road rehabilitation and recycling

FACING THE CHALLENGES

ROAD REHABILITATION AND RECYCLING

G.P. YOUDALE

General Manager, Technology Development

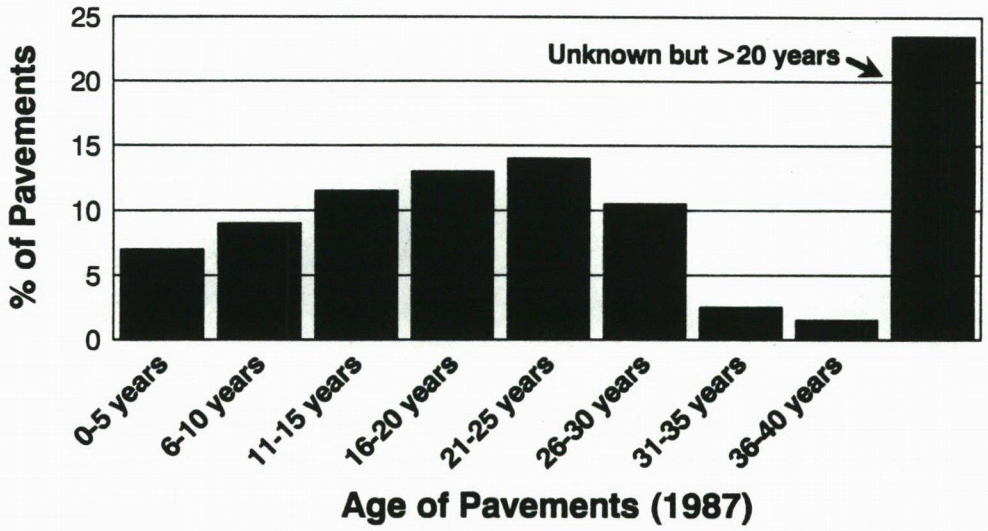
Roads and Traffic Authority NSW

As the primary Australian road network has matured, there has been a change of emphasis occurring from provision of roads to the management of the network. The need to carry out rehabilitation work in a cost effective manner is now paramount. Also, with the increased environmental awareness and the need to consider sustainable development, the use of recycling techniques is playing an increased role in decision making for roadworks. This paper describes recent developments in pavement rehabilitation and recycling techniques and also attempts to look at future needs and developments.

Paper presented at the Australian Road Research Board Ltd
16th ARRB Conference, Perth, Western Australia, November 1992.

THE CURRENT POSITION

1. It is difficult to obtain an accurate picture of the state of the nations pavements. Figure 1 shows the distribution of pavement ages for major roads (NAASRA 1987). This should be viewed in the light that the usual design life for pavements is 20 to 25 years and also the growth in traffic loading on pavements, both in terms of Gross Vehicle Mass, axle loads and tyre pressures, has increased substantially in the last 15 years.



The estimated replacement value of the Australian road system is about $100 billion dollars. Of this about $15 to $20 billion is the value of the pavements. Currently about $5 billion is spent annually on roads in Australia.

Figure 1. Age distribution of National Highways and Arterial Roads

THE FACTORS

2. There have been a number of factors that have influenced the increased emphasis now being given to maintenance and rehabilitation of road pavements in Australia. These include:-

- *A change in emphasis within Road Authorities from construction to management of roads and traffic systems.*

Most of the Road Authorities have evolved from essentially road construction authorities to a broader base concerned with the provision of the network, its maintenance, controlling access to it, and ensuring it is efficiently utilised.

- *The development of broadly based asset management systems such as Pavement Management Systems (PMS) and Maintenance Management Systems (MMS).*

PMS have lead to a greater appreciation, at the global level, of network condition and maintenance needs and costs. The use of PMS systems to gain an appreciation of the value of the pavement asset has lead to a new perspective of the roles of Road Authorities in terms of maintaining the value of these assets, including a trend to put maintenance needs first when developing budgets. PMS is also leading to the planning of maintenance and rehabilitation over a longer time frame than has been the case in the past (RTA 1992a).

MMS is allowing the systematic gathering of data on maintenance costs and treatment effectiveness that will lead to efficiency increases.

- *A more systematic and technically based approach to maintenance and rehabilitation work.*

The need for efficiency and productivity gains in traditional maintenance and rehabilitation works are now more pressing than ever before. Improved guidelines and design procedures for maintenance and rehabilitation works, that enable the most appropriate treatment on the basis of minimum life cycle costs to be readily determined, are in demand. Also the new materials and processes that are becoming available offer new opportunities for improved performance. There needs to be improved processes for the evaluation and introduction of this new technology, co-ordinated at a national level. The Accelerated Loading Facility (ALF) has made a substantial contribution in this area (Sharp 1991).

- *The need for greater innovation.*

The need to look for treatments and technology that is "outside the box" and provides cost effective solutions should be encouraged. The development and use of performance based specifications, perhaps with the incorporation of warranty provisions for unproven technology, needs to be pursued, subject of adequate provision for risk sharing.

Increased co-operation between industry and Government is needed to develop technically sound, innovative solutions. The co-operative asphalt research work carried out between AUSTROADS and the Australian Asphalt Pavement Association since 1988 is a good example of what can be achieved (Bethune 1991). This work has enabled the introduction of new technology for the evaluation of the performance of asphalt that allows considerable scope for future innovation in terms of the use of new materials and innovative mixes.

WHAT IS REHABILITATION?

3. Ramanujam and Bell (1992) gave the following definition of Pavement Rehabilitation:-

"The term 'Pavement Rehabilitation' refers to any treatment which will overcome the deficiencies in an existing pavement in order to reinstate structural and functional adequacy for a specified period of time. The strategy of pavement rehabilitation is to take maximum advantage of the remaining usable structure in an existing pavement to build a reconditioned pavement."

4. The need for rehabilitation usually arises from one or both of the following broad causes:-

- Structural inadequacy.
- Inadequate serviceability.

5. Typical problems that exist across the network relating to these categories are:-

- Structural inadequacy
  - Fatigue and block cracking

  - Failure due to moisture ingress leading to loss of strength
  - Heaving due to materials and/or subgrade failure
  - Cracking and loss of shape due to volume changes
  - Cracking and moisture ingress leading to erosion and pumping
  - Cracking and stepping of rigid pavements
- Inadequate serviceability
  - Loss of skid resistance of wearing surface
  - Oxidation of bituminous wearing surfaces
  - Shrinkage cracking of stabilised materials
  - Potholing
  - Bleeding and stripping of sprayed bituminous seals
  - Rutting and shoving of asphalt
  - Deterioration of riding quality

REHABILITATION TREATMENTS

6. Rehabilitation treatments can also be categorised on the basis of addressing either structural adequacy or serviceability.

Treatment Selection and Design.

7. With the current levels of axle loads and tyre pressures being experienced, the performance of many of the traditional rehabilitation treatments, particularly surface treatments, is coming under question.

With the introduction of radial ply tyres for trucks over the last decade or so truck tyre pressures have increased significantly. Truck tyre pressures in excess of 700 KPa are now the norm. This has put considerable strain on the performance of surfacings. For asphalt, particularly in high stress situations such as adjacent to intersections and on climbing lanes, there has been an increased tendency to rut and shove. 'Double rut' deformation, caused by dual wheel assemblies, which was relatively unheard of 10 years ago, is now commonplace.

8. However, most of this deformation occurs only in about the top 70 mm of the asphalt and so can be minimised by the correct design of the wearing course mix. Tools for this design are now becoming available in the form of a dynamic creep test (Bethune 1991) and the use of such equipment as the RTA/AAPA plate compactor/rut tester (Youdale 1991).

9. For sprayed bituminous surfacings, high tyre pressures have caused problems with aggregate being pushed through the seal into the base and cracking and rocking of individual pieces of aggregate. All these phenomena can lead to a loss of the waterproofing characteristics of seals as well as stripping and bleeding. The tendency of stones to be pushed into the base can be alleviated by allowing for it in the design (RTA 1992d) and the cracking and movement of stone minimised by the use of smaller sized aggregate and or double/double seals. Aggregate retention and reduction in the reflection of pavement cracks is improved by the use of polymer modified or scrap rubber binders.

10. The selection of appropriate treatments and the design of these treatments to meet the traffic loading and environmental conditions is of considerable importance. This selection and design process has been made more complex by the availability of a wide range of materials that enhance rehabilitation performance, if used correctly. These materials include Polymer Modified Binders (PMBs) and scrap rubber bitumen for bituminous works, a wide variety of cementitious binders and reinforcing materials such as geotextiles and geogrids.

11. The development of guidelines for the selection and design of rehabilitation treatments has received considerable attention in recent times and there are some excellent guides now available.

12. For structural overlay design, AUSTROADS (1992a), provides detailed procedures for the design of granular and asphalt overlays. These procedures are empirically based and are currently being revised to provide a mechanistic basis for design (Potter 1989) and also to include design procedures for cemented and rigid overlays.

13. For the selection and design of bituminous sprayed sealing treatments, RTA (1991 and 1992b) provides comprehensive guidelines for the selection and design that includes:-

- conventional hot bitumen seals,
- PMB and scrap rubber seals,
- emulsion seals, including polymer and tar emulsions
- geotextile reinforced seals
- enrichments
- epoxy seals

AUSTROADS (1992b) also provides guidelines for the use of PMBs in sprayed sealing, asphalt and crack sealing work. AUSTROADS also has completed work to facilitate the use of bituminous emulsions (AUSTROADS 1992c) and slurry seals (AUSTROADS 1992d). A further AUSTROADS project is aimed at improving sprayed seal design procedures. The use of automated pothole patching equipment has also gaining in acceptance and guidelines for selection and use have been produced (RTA 1992c).

The introduction and development of improved slurry surfacings (sometimes called cold overlay or micro-asphalt when applied in thicker layers) has provided a cost-effective surfacing treatment capable of rejuvenating and waterproofing wearing surfaces and providing improvements to ride quality. AUSTROADS have developed a draft specification for slurry sealing (AUSTROADS 1992d).

14. For rigid pavements rehabilitation usually consists of joint sealing, attention to spalling, cracking and stepping. Guidance for these types of treatments can be found in RTA's Concrete Pavement Maintenance Manual (RTA 1992e).

15. The Queensland Department of Transport's Pavement Rehabilitation Manual (DoTQ 1992) provides comprehensive guidelines for the collection and analysis of pavement condition data, materials evaluation, the design of specific rehabilitation treatments and economic analysis based on life cycle costing.

16. RTA's Guide to the Rehabilitation of Urban Flexible Pavements (RTA 1991b) contains simple procedures for selection and design and economic analysis of treatments for flexible urban pavements.

17. These is also an increasing trend towards evaluation of rehabilitation alternatives on the basis of minimum life cycle costs. Methodology for this type of economic analysis is now readily available (DoTQ 1992a, AUSTROADS 1992a). The computerisation of these tasks (RTA 1992f) is allowing them to be carried out rapidly and accurately.

Waterproofing

18. The major cause of pavement deterioration has always been the interaction of water and heavy traffic. As tyre pressures and axle loads increase, there is a tendency to use more stabilised layers within pavements. This inevitably means that more cracking will occur, both as shrinkage cracking and structural (fatigue) cracking. If left unattended this may lead to erosion and pumping in the presence of moisture and heavy traffic. (Kadar et al 1989).

Waterproofing of existing pavements is therefore of primary importance. DoTQ (1992b) has been carrying out systematic trials of sealing techniques that are clearly showing which are cost effective, as illustrated in figure 2.

The use of geotextile reinforced seals is also being successfully used to provide an effective initial seal over newly constructed cemented bases.

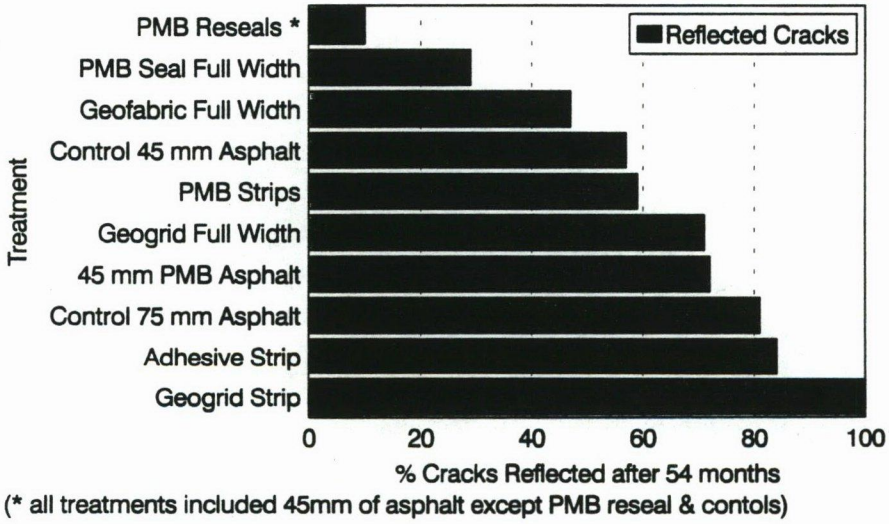


Figure 2. Results of Beerburrum cracking trials.

RECYCLING - WHAT IS ITS ROLE?

TYPES OF RECYCLING

20. Recycling may be defined as the reuse, usually after some processing, of a material that has already served its first-intended purpose. The recycling of pavements can be divided into two broad categories; those that utilise materials taken from an existing pavement and those using recycled materials from some other source.

MATERIALS FROM EXISTING PAVEMENTS

21. The major types of pavement recycling are:-

- Asphalt
  - Use of milled Reclaimed Asphalt Pavement (RAP) in new hot mix asphalt
  - Hot in-place recycling of asphalt
  - Cold in-place or off-site recycling of asphalt
- Granular materials
  - Recycling using cementitious binders
  - Recycling using bituminous binders

ASPHALT RECYCLING

22. Bowering (1991) estimated that there some 75 million tonnes of asphalt in road pavements in Australia less than 15 years old, plus an unknown amount of older asphalt. There are probably about 50,000 kms of road with recyclable depths of asphalt surfacing in place. About 5 million tonnes of asphalt being added to this stock each year.

Bowering estimated that the amount of asphalt that is profiled each year is of the order of 190,000 to 290,000 tonnes of Reclaimed Asphalt Pavement (RAP). About 75% of this material is downgraded to use as fill, subbase or shoulder material or just stockpiled. Less than 36% of RAP is used to its full potential and only 5% of hot mix asphalt produced in plants contains RAP.

Incorporation of RAP into Plant Mix

23. Incorporation of RAP in the amounts have between 10 and 30% into plant mix to meet current asphalt specifications has been occurring since the early 1980s in Australia. Performance is recorded as equivalent to that of asphalt made with 100% new materials (Bowering 1991).

24. Overseas experience with the incorporation of RAP into plant mixes has also been positive. Stock (1987) reports a regular use of 50% RAP mixes at cost savings of between 10 and 29%. Use of RAP of between 70 and 100% has been used in plants with heat shields in drier drum plants.

Van der Zwan and Hopman (1988) report the regular use of 50% RAP in asphalt in the Netherlands and the use of RAP preheaters to eliminate the need to superheat the virgin aggregate.

Ferreira et al (1987) reported the results of a thorough investigation into the performance of asphalt mixes that include up to 70% RAP. The investigation included laboratory testing, accelerated loading trials and evaluation of field trials. The conclusion reached that

'the initial engineering properties of recycled asphaltic concrete can be expected to compare well with those of conventional asphaltic concrete'

'the results of the accelerated loading trials have not provided any evidence to contradict the findings of previous work'

and

'the proportion of reclaimed material does not appear to have an adverse effect on the durability of the resultant mix'.

Cornelius and Edwards (1991) in a British study reported that

'bituminous roadbase and basecourse material containing up to 60% reclaimed material can be produced to comply with British Standard specifications in modified off-site mixers'

'a 30% saving in cost and some saving in energy can be achieved using this process.'

'in laboratory tests to measure elastic modulus, fatigue resistance and resistance to deformation, recycled dense grade bitumen macadam performed similarly to virgin material.'

'after 4 years in service, test sections of recycled hot rolled asphalt roadbase and basecourse containing up to 60% reclaimed material have performed to the same standard as those containing new material'.

From the above there is little doubt that the incorporation of significant amounts of RAP into plant mixes is technically feasible and cost effective. However, it does not appear to be happening to any great extent in Australia. Perhaps this is a result of the combination of the current batching equipment, some inertia amongst specifiers and poor organisation with regard to handling RAP and getting it returned to the asphalt plant.

When RAP is part of a asphalt mix some changes in normal plant procedures are necessary. The objective is to heat and dry the RAP without exposing it directly to the high temperature flame and combustion gases in the drier that will harden the bitumen in the RAP. Without these changes, recycled mixes cannot be produced economically (Asphalt Institute 1986, AAPA 1991). There are a number of ways these changes in plant can be achieved.

The use of RAP in recycled asphalt has some disadvantages including:-

- The variability of the source of the RAP may lead to the introduction of petrologically unsuitable aggregates into wearing courses with subsequent adverse affects on skid resistance.
- The control of binder properties will depend on the variability of the RAP input sources (such things as the extent of patching, presence of surface dressings, age of RAP).

Hot In-place Asphalt Recycling

25. Hot in-place asphalt recycling was introduced to Australia in 1990 (Dobisz 1990). There are 4 modes of operation for hot in-place recycling:-

- **Reshape**, where the existing asphalt is heated, loosened, respread and compacted to restore the surface profile without altering the properties of the asphalt mix.

- **Repave**, as well as reshaping the existing asphalt as above, a thin layer of new asphalt is spread and compacted over the reshaped mix.
- **Remix**, where the existing asphalt is modified with a rejuvenating agent and maybe fresh mix before being relayed.
- **Remix plus**, where the existing asphalt is modified with rejuvenating agent but the fresh mix is placed over the remixed layer instead of being incorporated into the layer.

Remix and remix plus are the options most likely to be used in Australia.

26. The hot remixing process has the ability to convert brittle, aged asphalt into a satisfactory paving material with properties similar to fresh asphalt. The successful use of this technique, which can only be used to a maximum depth of about 60 mm, requires careful consideration to a number of factors:-

- Evaluation of the existing pavement. The treatment will only renew the wearing surface of the pavement and will not correct structural problems or increase the structural capacity of the pavement (DoTQ 1992c). However, significant decreases in roughness can be obtained (40 - 60%), as well as improvements to transverse profile and waterproofing.
- Materials testing and mix design are critical to the success of the process. The addition of too much rejuvenating agent may decrease the voids content of the mix to the extent that it will become unstable in service and deform. Design methods using local materials are becoming available (RTA 1992g, Cunningham 1992 , DoTQ 1990).

27. The advantages of hot in-place asphalt recycling include:-

- Savings of 20 - 40% over conventional methods
- Savings in traffic delays due to one pass operation
- Aggregate degradation is minimised as the materials are heated and tyned.
- Hot bonds are obtained between layers and at joints.
- Conserves energy and resources.
- The remix process can be used to change the asphalt mix properties (ie change open grade to dense graded asphalt)

28. The disadvantages of hot in-place asphalt recycling include:-

- It can not treat structural defects in the pavement
- Mix uniformity is dependent on the uniformity of the material being recycled
- Mixes with modified binders or reinforced mixes cannot be recycled
- The work needs to be organised into reasonable sized jobs (usually about 5000m2 minimum) to gain maximum advantage of transportation and establishment costs.

29. For large scale usage of hot in-place asphalt recycling there is a need to balance the savings made against the risks of a poor quality job. For current mill and resheet work, there is a well defined testing and specification regime for supplying and laying of the asphalt with suitable penalties on the contractor for poor quality work. For the current usage of the in-place asphalt recycling equipment, mix design and evaluation is usually done by the road agency and the recycler hired as a plant item. Thought needs to be given to future specification of this type of work so that risks are distributed equitably between the road agency and the contractor and are balanced by the savings.

Cold Asphalt Recycling

30. Cold asphalt recycling is relatively new to Australia and involves the addition of new binder and/or rejuvenating additives to RAP, either in-place or offsite, to produce cold mix asphalt. However, there is considerable experience with the process overseas, particularly in the USA, where some 29 states have used the process (NCHRP 1990).

31. Typical depths of cold recycling are 50 to 100 mm, slightly more than hot in-place recycling as the material is milled out prior to treatment, rather than heated and scarified. This enables a layer of thickness that may improve the structural capacity of the pavement to be treated but has the disadvantage that the aggregate size is reduced due to the milling process.

32. Mix design, like that for hot in-place recycling, requires careful evaluation of the existing pavement. Guidance for design is readily available (NCHRP 1990, Asphalt Institute 1983, WITCO undated, DoTQ 1992a).

33. Cold asphalt recycling trials have reported in Victoria (Readymix 1991) and South Australia (DRTSA 1992a).

The South Australian trial was carried out in-place to a maximum depth of 95 mm at an estimated cost saving of 37% compared to the conventional mill and resheet option. There were construction problems with gaining bonding between the old and recycled layers and a poor ride quality was obtained, requiring the application of a cold overlay to correct. There was also a problem with deformation of part of the trial site during hot weather 8 days after it was laid, probably caused by a high application of binder.

The Victorian trial was carried out by removing part of an existing pavement and replacing it with off-site plant mixed cold asphalt to a depth of 170 mm. The material was crushed and screened, allowing a uniform application of rejuvenating agent and assisting in compaction. Cost savings of 20%, compared to milling and resheeting were estimated. The pavement was sealed with a SAM seal.

34. The advantages of cold asphalt recycling include:-

- Use of existing materials, reducing the need for their disposal
- Cost and energy savings
- It can provide increased pavement structural capacity
- With proper construction techniques, significant improvements to roughness can be obtained.

35. Disadvantages of using cold asphalt recycling include:-

- Possible greater variation in mix as a result of variation in RAP.
- Curing needed for strength gain (Care needed to avoid ravelling during curing period).
- Curing and strength gain susceptible to climatic conditions
- A wearing surface must be provided over the recycled material. NCHRP recommends a sprayed surfacing up to 1500 vehicles per day, hot mixed asphalt between 1500 and 3000 vehicles per day and not to use cold recycling over 3000 vehicles per day. The Asphalt Institute do not limit its application provided a suitable wearing surface of asphaltic concrete is placed over the recycled mix.

RECYCLING OF GRANULAR MATERIALS

Recycling of Granular Materials Using Cementitious Binders

36. Recycling of granular pavements by stabilisation with either cementitious binders is not new. Local Government have been amongst the leaders, primarily with the use of cementitious binders (Ritchie 1992, Hodgkinson 1991). However, the depths of stabilisation achieved have generally not been adequate for the high speed heavy traffic experienced on rural arterial roads where stabilised depths in excess of 300 mm are required.

However, recent trials have indicated that equipment and techniques are now available to effectively stabilise to depths exceeding 300 mm, either in 1 or 2 layers (C&CA 1991). Trials in NSW (Porter 1992) have shown that compaction of stabilised pavements has been achieved up to depths of 330 mm in one layer. At a recent workshop in Sydney (RTA 1992h) it was shown that the pavement and materials evaluation and design procedures for deep lift recycling exist, new milling, spreading and compaction equipment is becoming available and it should be feasible to develop a realistic, performance based specification for this type of work in a short period of time.

Recycling in one layer has the significant advantages in terms of improving the structural integrity of the pavement by eliminating the chances of delamination of layers that could lead to erosion and pumping of fines in the presence of moisture and fast moving, heavy traffic.

Savings for this type of work, when compared to reconstruction or substantial overlays are estimated to be in the range of 30 to 50%.

37. The practicality of this type of work has been enhanced in recent time by the availability of a wide range of cementitious binders with various setting times which allow adequate time to achieve compaction and shape of the pavement without sacrificing long term strength. However, the use of cementitious binders does bring with it a number of risks. If insufficient binder is used, the recycled materials may be susceptible to erosion and pumping in the presence of moisture. If too much binder is used, or the material stabilised is unsuitable or poorly cured, substantial shrinkage or block cracking may occur.

A development that is occurring in Europe, by the use of cementitious binder in conjunction with non-ionic bitumen emulsion, may lead to minimisation of these tendencies and would be worthy of further research and trials.

Recycling of Granular Pavements Using Bituminous Binders

38. There has also been an increased incidence in the recycling of granular pavements using bitumen emulsion with the introduction of one pass recycling equipment (Hall 1991, DRTSA 1992b). This process does not add structural capacity to a pavement but can substantially improve pavement serviceability.

When is a Recycling Technique Worth Using?

39. The economic justification for the use of recycling techniques is a balance between accepting the possible disadvantages of increased variability of the product and subsequent reduction in life and balancing them against savings in initial costs. Many of the new recycling techniques are reporting initial cost savings of between 10 and 40%. To balance this against any reduction in life due to increased variability or other factors, life cycle costs need to be considered.

Figure 3 presents a crude analysis of the equivalency of life cycle costs as a function of initial cost savings at a discount rate of 7% using discounted cash flow theory. Figure 3 indicates, for example, that if a recycling process can provide a product that will last 10 years, it will have lower life cycle costs than an equivalent 'conventional' process that lasts 14 years provided the initial cost saving is greater than 20%.

While the life of particular recycling techniques is not known at present, the use of this type of analysis may give an insight into whether it is worthwhile to pursue the development of a particular recycling technology. It also points to the need to gain, as quickly as possible, reliable estimates of the life cycle costs of these treatments. The use of such tools as the Accelerated Loading Facility (ALF) would be a cost effective way of pursuing this.

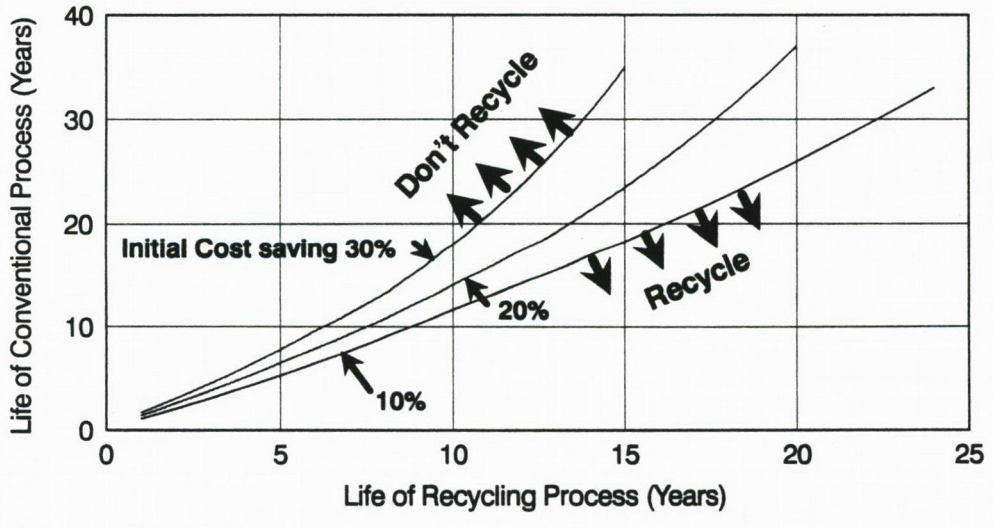


Figure 3. Life Cycle Cost Comparison

RECYCLED MATERIALS FROM OTHER SOURCES

40. There is an increasing use in roads of recycled materials from sources other than pavements. These materials include:-

- Slag

- Blast furnace slag
- Steel slag

- Ash
  - Flyash
  - Bottom ash
  - Risk husk ash
- Rubber

Slag

41. Blast furnace slag has been used as a pavement material for many years. Current production rates for slag Australia wide are about 2,160,000 tonnes per annum. This use has been historically to areas close to the steelworks as a result of the cost of haulage of the slag. However, with the recent availability of granulated slag and ground slag for use as stabilising and binding agents (Kadar and Walter 1989), the area of utilisation of blast furnace slag in pavements has increased greatly. The formation of the Australasian Slag Association has significantly accelerated the development and use of slag based products.

42. Steel making slag is beginning to be utilised as an aggregate source for both asphalt and sprayed bituminous surfacings. It has been used successfully overseas, particularly in the UK, in these applications for some time.

Ash

43. The use of ash in pavements has primarily been the use of flyash as a supplementary cementitious material in concrete pavements to improve 'slipformability' although some quantity has also been use in blended binders for stabilisation work (eg lime/flyash blends).

44. There are currently 5 million tonnes of power station ash (flyash and bottom ash) produced annually in Australia. About 93% of this is dumped as landfill. About 85% of the flyash that is utilised is used in cement and concrete. Bottom ash has been successfully used as a pavement material in the past (Chapman and Youdale 1982).

The Ash Development Association of Australia has recently been formed to develop and promote the utilisation of flyash and bottom ash. No doubt one of their major efforts will be to encourage developments within the roads industry.

45. Other sources of ash that have potential to provide a source of stabilisation material for road pavements. One of these is rice husk ash. Currently there is about 170,000 tonnes of rice husks produced annually in NSW and Queensland. Only about 20,000 tonnes of these husks are burnt in controlled combustion furnaces annually to produce about 4,000 tonnes of rice husk ash. (Montgomery and Chmeisse 1991) have shown the cementitious properties of this material is adequate for use in road pavements.

Rubber

46. There are about 10.5 million tyres discarded in Australia every year. The incorporation of rubber into road surfacings has been carried out in Australia since the 1970s. The enhanced performance that the incorporation of rubber brings is well known, particularly the ability of these materials to inhibit cracking.

However, in recent times the use of rubber has apparently decreased in favour of specially manufactured polymers, primarily as a result of the ease of incorporating the polymers into the bitumen binders and delays experienced in the laying of rubber asphalt where additional cooling time is required before allowing traffic onto the compacted mat.

47. In the USA legislation was passed in 1991 compelling a certain amount of tyre rubber to be incorporated in public road construction. It seems only a matter of time before similar legislation is passed in Australia. The technology (equipment, specifications and knowledge) is available to do it now.

CONCLUSIONS

48. During the second half of the 1980s there has been considerable focus on pavement rehabilitation and recycling in Australia. The change of emphasis in many road authorities towards a 'maintenance first' philosophy and the development of asset management tools has led to a longer term focus on planning rehabilitation treatments and also a more systematic, technologically based approach to maintenance and rehabilitation than may have occurred in the past.

49. The use of recycling technology is developing rapidly and promises substantial economic and environmental benefits. However, the use of in-place recycling techniques must lead to greater construction variability than would occur using fixed-plant based processes. However, this should not deter the use of these processes as the initial cost savings are sufficiently large to indicate reduced life cycle costs, even given higher variability in the process. Systematic trials are required, monitored at a National level, to gain experience and quantitative data on these processes.

There is also a need to develop, in co-operation with industry, performance based specifications for recycling work that incorporate appropriate levels of risk for both the client and contractor and take into account the variability and the likely life cycle benefits of the processes. Specifiers need to take an innovative approach to these new processes to accelerate their acceptance and regular use. The use of a trade off between detailed specification of a process and the warranting of performance may be a method of achieving this.

50. There is a need to monitor closely the performance of recycled pavements and materials to gain objective whole-of-life cost and performance data at the earliest opportunity. The potentially large economic gains from these processes should justify the use of accelerated pavement loading to validate many of these processes.

51. The use of by-products from other industries in roads is already significant and will increase. The formation of industry based groups such as the Australasian Slag Association and the Ash Development Association provides a mechanism to develop technologically and economically sound uses for these products, to the benefit of all concerned.

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RTA (1992d) - Test Method T271 - The ball penetration test. Roads and Traffic Authority NSW.

RTA (1992e) - Draft Concrete Pavement Maintenance Manual. Roads and Traffic Authority NSW. Materials Services Branch.

RTA (1992f) - Life Cycle Costing (LCC) software. Roads and Traffic Authority NSW. Asset Control Technology Section.

RTA (1992g) - Draft Guide to hot-in-place asphalt recycling. Roads and Traffic Authority NSW. Engineering Services Section.

RTA (1992h) - Workshop on recycling of granular pavements using cementitious binders. Proc (In print). Roads and Traffic Authority NSW. Technology Development Branch.

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Appendix E: RTA's Environmental self-assessment procedures

The RTA's environmental self-assessment questionnaire is divided into three main sections. These are:

- general site information
- site assessment questionnaire
- assessment parameter documentation.

Compiling site information

Site information covers:

- corporate information - identifies the policies and structures that govern many of the site activities and decision making process
- site organisation - documents organisational structure, lines of communication and individual responsibilities for environmental management
- site operations
- waste management.

The site operational and waste management information provides the review team with full details of site operations. This enables them to readily identify actual and potential waste and emission sources, review operational practices and procedures and assess compliance with relevant statutory requirements.

Detailed data collection

Detailed data will be collected to assess the degree of compliance of each site with environmental legislation.

The assessment areas will cover:

- air emissions
- waste water discharges
- noise
- solid wastes
- hazardous wastes (liquid and solid)
- toxic and hazardous materials
- liquid fuels

- other parameters.

Self-assessment questionnaires

There are separate detailed self-assessment questionnaires for the following areas of the Authority's operation:

- General (applies to all sites)
- Works depots and maintenance depots
- Maintenance sites
- Stores, depots and sites
- Inspection Stations/Motor Registries
- Construction sites
- Laboratories
- Traffic Signal Control Centre

This is followed by detailed documentation to cover areas such as:

- classification of wastes
- waste management.

For full details of the program and the questionnaires see the *RTA Environmental Self-Assessment Procedures Handbook, 1993.*

Appendix F: Sediment pollution control on construction sites

Aquatic ecosystems are easily damaged by eroded soil and associated contaminants from construction sites, land subdivisions and other areas where soil is exposed. Water is a scarce resource and it is important to prevent it being polluted by muddy sediment wherever possible.

Benefits of control

With careful planning, erosion and sediment control usually result in many on-site advantages in addition to protecting the environment.

Environmental benefits include:

- reduced risk of damage to aquatic ecosystems
- improved appearance of the site and downstream waters
- reduced water treatment costs
- reduced blockage of drains and waterways
- less mud dropped or washed onto roads.

On-site benefits typically include:

- less risk of works being undermined by erosion or buried by sediment
- improved drainage and reduced site wetness as a result
- less dust problems
- improved working conditions
- reduced downtime after rain
- less stockpile losses
- reduced clean-up costs
- earlier works completion
- earlier land sales
- less chance of complaints by neighbours.

Water pollution

Water which flows or is pumped from land disturbance sites can be contaminated by suspended, dissolved, floatable and settleable soil materials, oils, detergents, litter, fertilisers, alkaline cement materials and other chemicals.

Soil nutrients and chemical pollutants become attached to and are transported by sediment particles as a result of soil erosion, dewatering of trenches, washing of vehicles, cleaning of concrete supply equipment, careless waste disposal and other similar incidents. Heavy metals and disease organisms also become attached to, protected by and transported on sediment particles. These pollutants reduce the usefulness and enjoyment of the water environment to people downstream and damage aquatic life in streams, lakes and estuaries.

Muddy sediment can smother stream beds where aquatic animals live, reproduce and obtain nourishment. Material suspended in water can choke and abrade aquatic organisms and their eggs. Suspended material can also reduce visibility and the ability of fish and other organisms to capture prey. Suspended and coloured materials can block sunlight and prevent the growth of aquatic plants.

Sediment can fill dams and block waterways and drains, thereby increasing removal or dredging costs. Siltation of streams can reduce their capacities to carry flood waters and increase the risk of flooding as a consequence. Muddy material in water can also degrade its aesthetic appearance.

General principles

The following principles are a summary of the erosion and sediment controls needed on construction sites. They are most easily achieved if planned during initial investigation and land purchase stages. *They may need to be submitted to the EPA for approval or used to prove that due diligence has been used.*

1. Avoid critical locations

Avoid excavation or earthworks on steeply sloping land, along streams or in other environmentally sensitive areas.

2. Plan controls

Complete detailed erosion and sediment control plans, specification and schedules prior to commencing works.

Calculate water discharge rates and design drainage systems to cope with increased water flows.

Prepare a maintenance plan to schedule responsibilities for cleaning basins, etc.

3. Protect drainage lines

Establish or maintain wide buffer zones of dense vegetation along streams and other drainage lines.

Prevent erosion by reducing channel gradients and by providing erosion resistant surfaces.

Provide hay bales and filter fencing where needed.

4. Minimise soil exposure

Minimise the area of soil disturbed and work in staged sections. Retain existing vegetation wherever possible.

5. Install sediment traps, dams and basins

Install sediment traps, dams or basins to good engineering standards prior to commencing earthworks. *These should comply with the erosion and sedimentation control plan.*

6. Install drainage early

Install stormwater drainage pipes, if any, as soon as possible to control rill and gully erosion. Sediment traps and litter screens near inlets can prevent the blockage of pipes.

7. Stabilise early

Completely vegetate, pave, cover or stabilise all areas of exposed soil as early as possible. Use mulch where needed to assist plant establishment.

8. Divert water

Divert water along stable diversion drains, banks or bunds around or away from exposed areas of soil or loose material. *"Clean" and "dirty" water should be kept separate.*

9. Control waste

Ensure that no visible oil, scum, foam, grease, litter, floating material, toxic substance or other polluting material flows from the site.

10. Maintain and re-assess controls

Maintain pollution control works on a frequent basis. Improve their effectiveness wherever possible.

EPA Technical Guideline, TG 208/90

Appendix G: Discussion papers on environmental issues

Global warming - how much do we know about it?

by Willem Bouma, CSIRO Division of Atmospheric Research
Aspendale, Victoria

Predicted changes

By using mathematical models which describe the world's climate (general circulation models, GCMs). Scientists can compare computations of the climate for recent carbon dioxide levels (300 ppm) with the climate expected for when carbon dioxide levels have doubled (600 ppm). We now know that because of the contribution of other greenhouse gases (methane, CFCs, nitrous oxide, etc.) an effect **equivalent** to a **doubling of carbon dioxide** is expected **by 2030 AD**.

At this stage the predictions are mainly for global changes: the current levels of greenhouse gases and their projected increases over the next 40 years are thought to lead to a rise in the **global mean temperature** of between **2 and 4 °C**. With the atmospheric warming the surface layers of the ocean will warm, and the thermal expansion of these surface layers together with some melting of temperate glaciers will lead to a **global sea-level rise** of between **20 and 140 cm**.

While it is known that the warming will be greater at higher latitudes and in winter, at this stage the GCM results are not consistent or detailed enough to provide estimates of changes on a regional basis.

Both the temperature increase and the sea-level rise will vary from place to place. Over the next 5 to 10 years, research programs in Australia and overseas will try to determine what the regional changes are likely to be.

Observed changes

The greenhouse effect theory and predictions are based on observed changes in the composition of the atmosphere, and on our physical understanding of how the climate system will respond. So, while the theory is not based on evidence of changes already happening, we can point to some changes in temperature and sea-level which are consistent with what we would expect.

Global mean sea level

Although the number of locations around the world with accurate sea-level measurements over the last 100 years is relatively small, scientists agree that the **sea level has risen** by about **10 cm** over that period.

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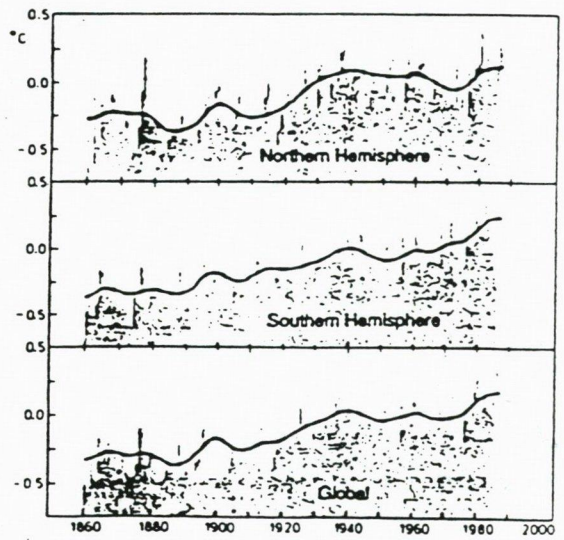
Global mean surface temperature

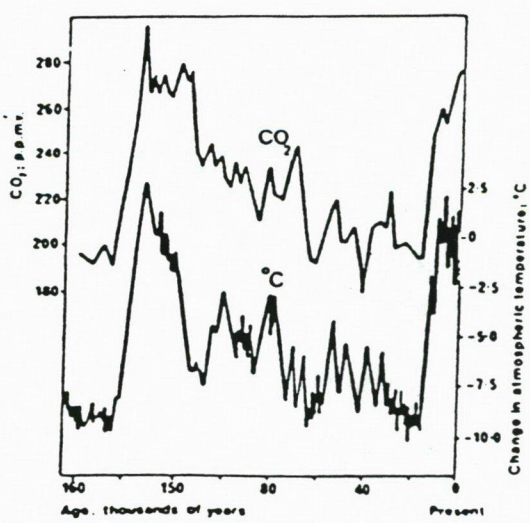
The global mean temperature **varies significantly** from year to year, with differ-ences of up to 0.3°C between years. This reflects the natural variability of weather and climate. Likewise, over periods of 10 years or more, the climate from decade to decade is **equally variable**. Nevertheless, over the timespan of the last 125 years, a warming trend is clearly evident, with an overall **temperature rise** of about **0.5°C**.



The temperature trend in the northern and southern hemispheres, and the global average (from New Scientist)

Carbon dioxide and temperature

Recent evidence from air bubbles trapped in Antarctic ice has shown that there is a **clear link** between the **carbon dioxide concentration in the atmosphere** and the **global temperature**. A difference betwen the past and today is that we are now rapidly increasing the carbon dioxide concentration, to levels higher than anytime in the last 160 000 years.



The Vostok record of temperature and concentrations of carbon dioxide in the atmosphere over the past 160 000 years (from New Scientist)

31 August 1988

The greenhouse effect and sea-level rise

by Willem Bouma, CSIRO Division of Atmospheric Research
Aspendale, Victoria

The greenhouse effect

The **greenhouse effect** is the expression used to describe the increased retention of heat by the Earth's atmosphere as a result of **increasing levels of greenhouse gases** in the atmosphere. It is estimated that by 2030 AD the global warming will increase the global mean surface temperature by 2-4°C, and raise the global mean sea level by 20-140 cm.

Why will the sea-level go up?

When the Earth's atmosphere warms, it will pass on this heat to the upper layers of the oceans. The upper layer is well-mixed, and up to a few hundred metres deep. When it **warms**, it will **expand**, and this **thermal expansion** of the water will make the sea level go up.

A second factor will be that **land-based ice** in the temperate regions of the world (South and North America, Greenland, etc.) will start to melt more rapidly, and **glaciers may retreat**. Thus, in addition to the thermal expansion, the melt water from the retreat of land-based ice will also contribute to the sea-level rise. However, **a rapid melting or slipping of the Antarctic Ice sheet is out of the question**, and floating sea-ice, when it melts, does not change the sea level.

What will the local effects be?

For any given coastal region a number of questions stand out:

1. How vulnerable is the region to sea-level change?
   This will vary enormously depending on the coastal geography.

2. What is the current situation?
   Depending on whether the land in your region is subsiding or being uplifted, regional sea level may be rising or falling; the coastline may be eroding or accreting for other reasons too.

3. How much of the global mean change would be felt locally?
   Just as the atmospheric temperature increase will not be uniform, sea-level rise will not be uniform around the globe. In addition, changes in weather and climate (coastal currents, storminess) may aggrevate or ameliorate the direct effects of a sea-level rise.

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Can we plan for the changes?

At this stage the most important message to planners and coastal engineers is: **don't assume that the present is a good guide for the future**, given that there is a **high probability** that sea level will go **up**. In addition, changes in weather and climate are also likely to affect the coastal environment. For some long-term developments these considerations will already be factors that can affect decisions. In the meantime we will have to look forward to further research on the global prognosis and the regional effects providing us with more detailed answers over the next five to ten years.

31 August 1988

The greenhouse effect and a warmer world

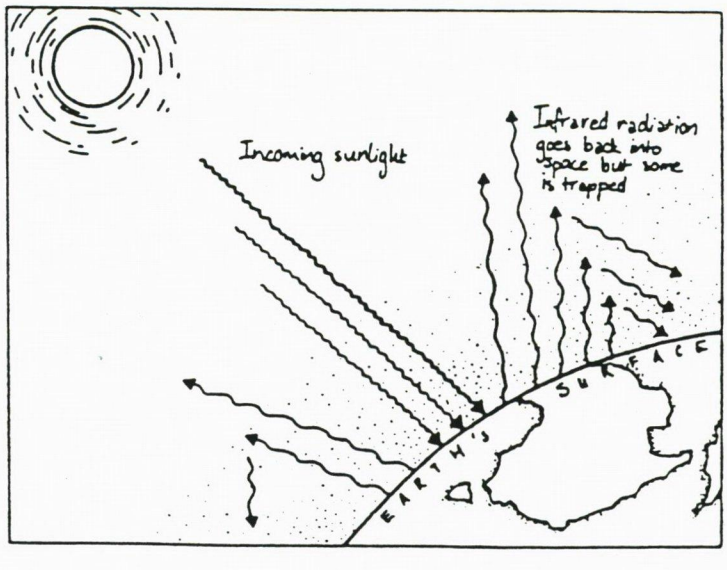
by Willem Bouma, CSIRO Division of Atmospheric Research
Aspendale, Victoria

The earth's atmosphere

Planet earth is surrounded by an **atmosphere** which is almost completely made up of **two gases: oxygen** and **nitrogen**. But there are also **small amounts** of other gases in the air - water, for example. The best known of these other gases is **carbon dioxide**. Plants **use** carbon dioxide to grow; people and animals **produce** carbon dioxide when they digest food (each time that we breathe out, we put some carbon dioxide in the air).

The atmosphere is like a greenhouse

When **sunlight** travels to the earth it passes through the atmosphere without any trouble: the atmosphere is **transparent** to **visible solar radiation**. The sunlight warms the ground, and the warm ground sends **infrared radiation** out in return (this infrared radiation is like the heat which you get from a heater: you can't see it). The carbon dioxide in the air **stops** some of this infrared radiation from being **lost to space**, and this keeps the earth warm. Without the carbon dioxide the earth would be much colder, and we often compare this effect with that of a **greenhouse** (it would be even better to compare it with a **blanket**).



Sunlight travels through the atmosphere, and warms the Earth.
The heat from the warm earth would travel back out to space, but gets trapped by greenhouse gases, keeping the earth's surface warm.
If the amount of greenhouse gases increases, more heat will be trapped and the earth will get warmer.

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Greenhouse gases

We now know that carbon dioxide is not the only gas which can keep the earth warm. There are several **other gases**, all in **very small amounts**, which have the same warming effect. We often call all these gases **"greenhouse gases"**. Some of these other gases are **methane** and the **chlorofluorocarbons** (yes, the same chemicals which we are afraid may damage the ozone layer).

The greenhouse effect

Scientist are now certain that these **greenhouse gases** are actually **increasing**. There is now more carbon dioxide and more methane than a hundred years ago. Chlorofluorocarbons (CFCs) were only invented 60 years ago. We have found out that **the extra carbon dioxide** comes from the burning of **coal, oil** and **gas**, and we have used more and more of these **fossil fuels** since the beginning of the **industrial revolution**, some 130 years ago. We also know that methane comes from **rice paddies** (which are like marshes) and from **cows** (when they digest grass), and both the number of rice paddies and the number of cows are increasing with the number of people on earth.

If there are more greenhouse gases in the earth's atmosphere, the atmosphere will become better at trapping infrared radiation, and so the atmosphere will get warmer. This is what we mean when we talk about the greenhouse effect.

A warmer world

We now think that the greenhouse effect will warm the atmosphere by between 2 and 4 degrees over the next 50 years. And that will not only mean that it will get warmer, but also that **our weather and climate may change**. Some places may get more rain, other places less; some places may get more storms, other places less. And in a warmer world, **the sea level may be higher** (not much, only 20 to 140 cm, but it would be an important change).

What can we do?

If we use **less energy**, we will use **less fossil fuels**. So we may be able to **slow** the greenhouse warming. But unless we discover other ways of making energy, and different ways to produce food, **we will have to learn how to live in a warmer world.**

Scientists will have to study what the changes will be, and, we will have to plan on how we will cope when we know more about the changes.

31 May 1988

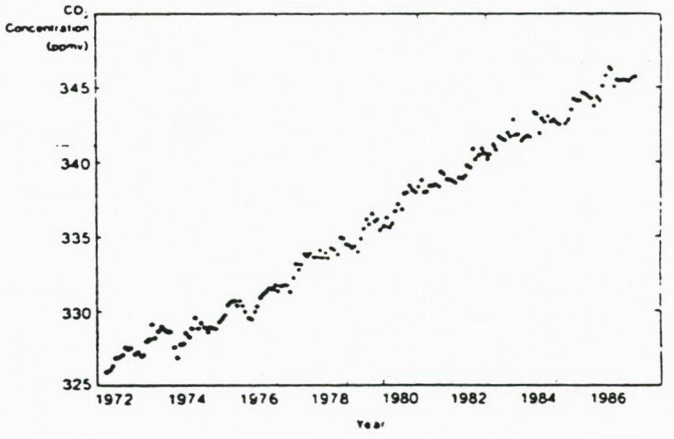
Greenhouse gases - what do we know about them?

by Willem Bouma, CSIRO Division of Atmospheric Research
Aspendale, Victoria

Carbon dioxide (CO_2)

The concentration of CO_2 in the atmosphere has increased from about **275 parts per million** before the industrial revolution (1800 AD) to **348 parts per million** today. Currently it is increasing by 0.4% per year. Almost all the current increase is due to the **burning of fossil fuels**; the biosphere appears to be compensating for deforestation in the tropics by increased growth elsewhere.

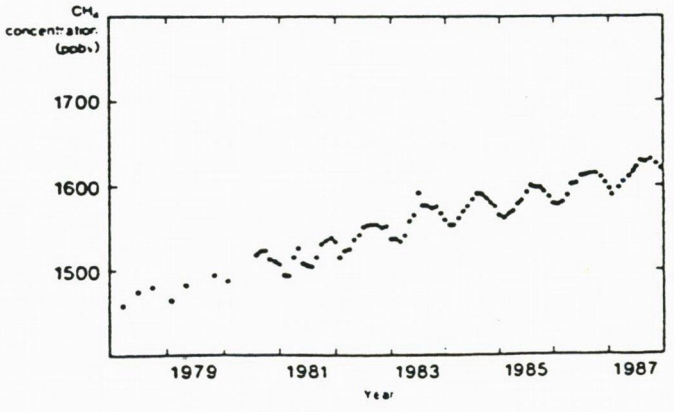
- Of the estimated output of 5 Gigatonnes **(5 000 million tonnes)** of Carbon from fossil fuels, about **half is taken up by the oceans**, the rest stays in the atmosphere.



Atmospheric CO_2 measured in the mid-troposphere over southeastern Australia (from Greenhouse: Planning for climate change)

Methane (CH_4)

Methane has increased from about **750 parts per billion** 200 years ago to **1650 parts per billion** today. Currently it is increasing by 1% per year. The increase in methane is closely linked to **the worlds growing population**, and its **growing need for food**: large numbers of ruminant animals (cows and sheep) and vast increases in the acreage of rice paddies are the main source. Another source of extra methane is through losses from coal mines and natural gas fields.



The observed increase of atmospheric methane at the Cape Grim Observatory, Tasmania (from Greenhouse: Planning for climate change)

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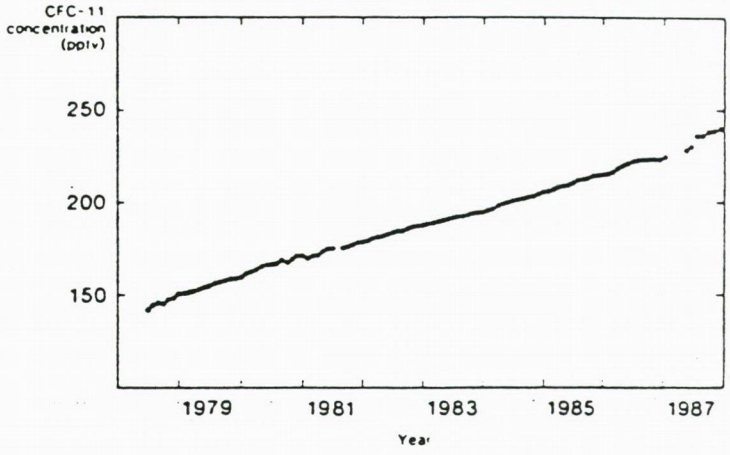
Chlorofluorocarbons (CFCs)

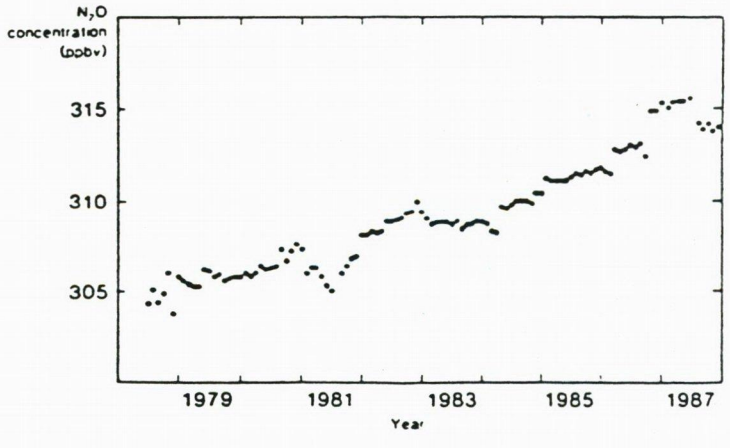
This family of **man-made gases** has only become significant in recent decades. The CFCs are best known because of their potential to **destroy ozone in the upper atmosphere**. But in the lower atmosphere they contribute to the greenhouse warming. Currently they are **increasing by 5-10% per year**. Future increases in these gases will depend on how the world fares in cutting back the use of these chemicals (to stop damage to the ozone layer, a 50% cutback has been agreed to: **the Montreal Protocol).**



Trichlorofluoromethane (CFC-11) concentrations as observed at the Cape Grim Observatory, Tasmania (from Greenhouse Planning for climate change)

Nitrous oxide (N_2O)

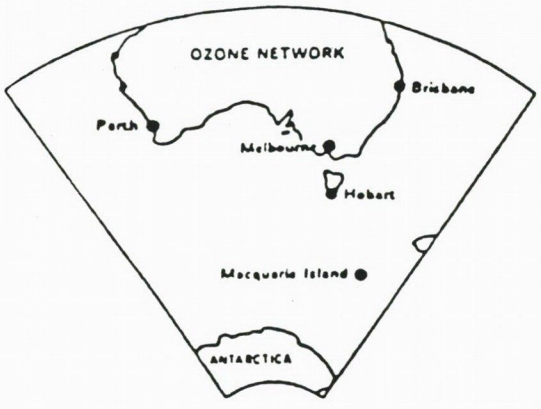
This greenhouse gas appears to be increasing too (0.3% per year), being raised above its natural levels by fossil fuel combustion, biomass burning and fertilizer use.



Atmospheric N_2O measured in the air at the Cape Grim Observatory, Tasmania (from Greenhouse: Planning for climate change)

All these gases contribute to the greenhouse effect, their rising concentrations will be the cause of the future warming.

31 August 1988



BUREAU OF METEOROLOGY

The Bureau of Meteorology's national ozone network of Dobson spectrophotometers

OZONE

What is ozone?

Ozone is a naturally occurring gas that makes up approximately one part in three million of the atmosphere. It is mostly concentrated between 15 and 30 km above the earth. The ozone layer spans most of the stratosphere and has the ability to absorb harmful solar ultraviolet (UV) radiation and strongly absorb and emit infrared radiation. Sun-loving Australians, with their fair, caucasian skins, have the highest incidence of skin cancer in the world. It is considered that a reduction in the amount of ozone in the earth's atmosphere, and a consequent increase in the amount of radiation reaching the earth's surface, could result in hundreds of new cases of skin cancer in Australia each year. In addition, UV radiation has been linked to the formation of cataracts and a weakening of the immune system. Ozone also has a significant effect on the atmosphere's thermal structure. A change in the amount of ozone could therefore have implications for some aspects of global climate, similar to the well-documented 'greenhouse' (warming) effect.

The ozone 'hole'

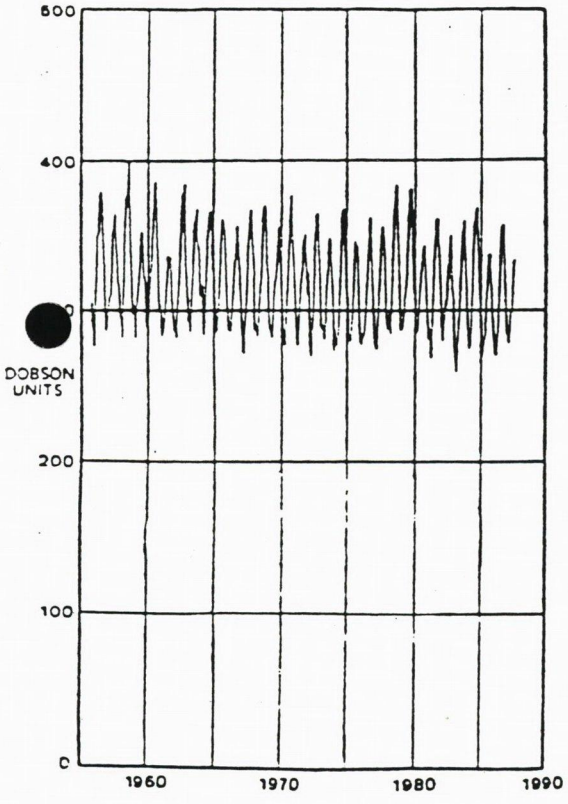
The Antarctic ozone 'hole' is a springtime thinning of the ozone layer over Antarctica. First detected in 1985, the phenomenon has been observed each year for the past decade. Although its interannual variation is complex, the phenomenon has generally increased in severity from year to year. Minimum ozone concentrations in October 1987, the lowest ever recorded on earth, were about half those of October 1979. Formation of the ozone hole occurs each September and recovery to 'normal' conditions coincides with the change of seasons in November/December. For seasons other than spring no similar depletion has been observed. Current understanding is that there are two major causes of the ozone hole - the observed increasing worldwide emission of chlorofluorocarbons (CFCs), which are used as refrigerants, solvents, aerosol propellants, etc, and the unique wintertime meteorological environment over Antarctica with its very cold temperatures which allow the chlorine in CFCs to react chemically with ozone to break it down. Scientists believe the ozone hole cannot directly spread beyond Antarctica, but its severity in future years and possible indirect effects on other regions of the hemisphere cannot yet be reliably predicted.

Worldwide ozone depletion

As well as the occurrence of the ozone hole, recent analyses indicate that during the last decade a small but significant overall depletion of the ozone layer, about half of which is not attributable to natural geophysical variability, has occurred on a global scale.

Keeping a check on ozone

Ozone concentrations in the atmosphere can be measured with an instrument called the Dobson spectrophotometer (named after G M B Dobson who designed the instrument and established the first routine ozone observing program at Oxford England in 1924). A network of Dobson spectrophotometers was set up in Australia during the 1950s and 60s by CSIRO in cooperation with the Bureau of Meteorology. In 1982 total responsibility for the program was passed to the Bureau. Today the network comprises stations at Melbourne, Perth, Brisbane, Hobart and Macquarie Island. At each station the total amount of ozone in the atmosphere overhead is measured each day. Also, at Melbourne, a balloon-borne instrument for measuring ozone is launched fortnightly to determine ozone's vertical distribution. The Bureau is currently developing the capacity to use US satellites to routinely monitor ozone.



The total ozone over Melbourne on a monthly basis since 1956 measured in 'Dobson units' Note that, although there is a slight long term downward trend, is much smaller than the normal variation through the year

All data from the Australian network are regularly transmitted to the World Ozone Data Centre (WODC) in Toronto Canada, from where they are available to the international scientific community.

World action

In 1975, following concern that man's activities may threaten the ozone layer, the World Meteorological Organization (WMO), at the request of the United Nations Environment Programme (UNEP), initiated the Global Ozone Research and Monitoring Programme (GORMP).

In 1977 a UNEP meeting of experts adopted the World Plan of Action on the Ozone Layer. This led, in 1985, to the adoption by UNEP of the Vienna Convention for the protection of the Ozone Layer. In September 1987, UNEP adopted a protocol to the convention - the Montreal Protocol on Substances that Deplete the Ozone Layer.

What is Australia doing?

Australia's expertise in the calibration and maintenance of Dobson spectrophotometers is recognised worldwide. Bureau experts assist with the calibration of instruments used in SE Asian and SW Pacific regions, and also help to train operators from neighbouring countries.

Australia makes a significant contribution to GORMP by provision of data to the WODC and is also the focus of expertise on SW Pacific ozone matters for WMO. In September 1987 Australia became a party, by accession, to the Vienna Convention and became a signatory to the Montreal Protocol on 8 June 1988. The Protocol calls on developed signatory nations to progressively reduce production and consumption of CFCs by 50% in the year 1999. Australia's participation in UNEP matters is administered by the Department of the Arts, Sport, the Environment, Tourism and Territories with frequent consultation with other departments through an interdepartmental working group, on which the Bureau has representation.

The ozone layer and the Antarctic ozone hole

by Willem Bouma, CSIRO Division of Atmospheric Research
Aspendale, Victoria

The ozone layer

The air we breathe is made up of different **gases**, mostly **oxygen** and **nitrogen**. High up in the **atmosphere**, between 20 and 40 kilometres above the ground, the sunlight is so intense that it can start **chemical reactions** which change oxygen into a different gas, called **ozone**. The ozone is spread out through the atmosphere around the world - so we often call it the **ozone layer**. Although there is only very little ozone, it protects the earth below from a harmful part of sunlight (ultraviolet light) - the ozone layer acts like a **sunscreen**!

There are also chemical reactions which change ozone back to oxygen, but the sunlight makes enough ozone to keep the sunscreen intact.

Chlorofluorocarbons

Chlorofluorocarbons (CFCs) are **chemicals** which are used in many applications around us. They are used in some **spray cans** to push out the product (insect repellant, for example), they are used in **refrigerators and air conditioners**, to keep our food and ourselves cool, they are used to put the bubbles in certain **foam plastics**, and they are also used in **dry-cleaning** our clothes and to clean **electronics components** (used in computers, for example).

The CFCs are made up by man, not by nature, and we now know that nature cannot break them down quickly. So once they escape in the air, they hang around for a long time. Long enough to be carried into the upper atmosphere, where the ozone layer is. There the intense sunlight can change the CFCs into chemicals which destroy ozone.

If we continue to use CFCs, we might destroy ozone faster than sunlight can make it. The result would be less ozone, and a **thinner ultraviolet sunscreen**.

Protecting the ozone layer

Now that we know that there is a threat to the ozone layer, we should do something to protect it. **Governments** are planning to make **us use less** by telling **industry** to use less. **Industry** is now looking into using other chemicals which do not destroy

(turn over)

ozone, but it may take some years to find the right ones. Using the same CFCs more than once (**recycling**) is also a way of using less. We can help in a small way by trying to avoid products that use CFCs - but this is often impossible.

The Antarctic ozone hole

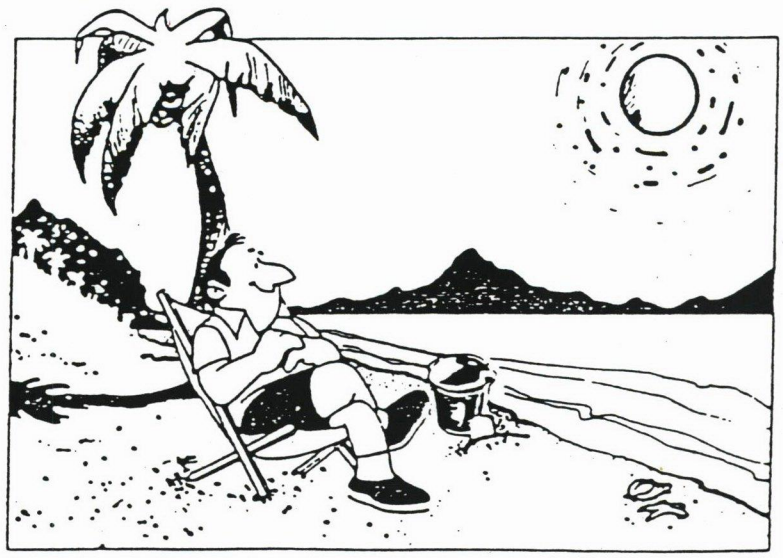
Satellites have been used to look down at the atmosphere, and measure how much ozone there is. They have found that the ozone layer has not yet been seriously damaged by CFCs - but there are signs that there is somewhat less ozone than there should be.

But satellites have also shown that each year in spring the ozone layer over the South Pole (Antarctica) becomes **very thin** - it is as if there was **a hole in the ozone layer.** We have recently learned that this hole is there because in the very cold air over Antarctica the chemical reactions involving CFCs and sunlight produce more of the ozone destroying chemicals than normal. The Antarctic ozone hole shows that we are right to be worried about what CFCs can do to the ozone layer.

Less ozone - more harmful sunlight

Why are we so concerned about damage to the ozone layer? What does it mean? The ozone layer sunscreen stops **ultravoilet radiation** - sunlight which you can't see, but which can damage your skin. It can cause **skin cancer.** This sunlight can also damage other living things, and could affect life in the oceans and food production on land.

Protecting the ozone layer means protecting life on earth as we know it, it means protecting our future.



Too much sun is not good for us (remember the 'slip, slop, slap' campaign). If there is damage to the ozone layer, we will have to be more careful still.

Appendix H: Related reading

Environment Manual Volume 1, RTA, 1991.

Interim Traffic Noise Policy, RTA, 1992.

Interim Guidelines for Erosion and Sedimentation Control, DMR, 1984.

Interim Guidelines for Community Involvement, RTA, 1993. This document will be distributed widely during the implementation program for community involvement.

Road Design Guide, Section 8: Erosion and Sedimentation, RTA, April, 1993.

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Index

E

F

G

H

I

L

M

N

O

P

Q

R

S

T

U

V

W

Amendment register

Amendments to this manual will be made periodically to reflect revised and updated information. When you receive amended pages, replace or insert them where required, then enter details in the following table.

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