CONTENTS

FOREWORD

The Ministry of the Environment (ENV) formed a new statutory board, the National Environment Agency (NEA) on 1 July 2002.

The NEA took over the operational functions of environmental protection and public health from ENV so that ENV could focus on strategic and policy planning. For better synergy, the Meteorological Services Department which used to be part of the Ministry of Transport was integrated into NEA.

As a statutory board, NEA has greater administrative autonomy and flexibility, making it more nimble and innovative in the discharge of its responsibilities. NEA is also better placed to strengthen its partnership with the people, private and public (3P) sectors.

Within NEA, the Environmental Protection Division (EPD)'s role is to ensure that Singaporeans continue to enjoy a good quality living environment for generations to come. It will continue to implement programmes to monitor, reduce and prevent environmental pollution. In addition, it will spearhead new initiatives to enhance sustainable development. Its key goals in resource conservation will include waste minimisation, recycling and energy efficiency.

This is the second Annual Report of EPD of NEA and it outlines the programmes implemented and targets achieved in 2003.

1 HIGHLIGHTS OF 2003

During the year, the levels of major pollutants in the ambient air stayed within established international standards. There was a significant improvement in the air quality in 2003. This could be attributed to power stations and industries switching from fuel oil to the cleaner natural gas, moving towards co-regulation, stringent enforcement action and the lower incidence of smoke haze from Indonesia affecting Singapore.

The water quality of inland and coastal waters was good and supported aquatic life.

Following the launch of the Singapore Green Plan 2012 (SGP 2012) in August 2002, a SGP 2012 Coordinating Committee (CC) and six Action Programme Committees (APCs) were formed in January 2003 to develop and implement action programmes to meet the targets set out in the SGP 2012.

In March 2003, taxi companies launched a pilot project to conduct road tests on 10 CNG (compressed natural gas) taxis. They planned to use the results from the pilot project to assess the viability of operating a large fleet of CNG taxis.

From 1 July 2003, all motorcycles/scooters are required to comply with the exhaust emission standard as specified in the European Directive 97/24/EC before they can be registered for use in Singapore.

NEA continued to reduce waste by promoting waste recycling. Participation rate by households in the National Recycling Programme increased from 33% (1 in 3 households) in 2002 to 45% (1 in 2.2 households) in 2003. The percentage of condominiums with waste recycling programme increased from 4% in 2002 to 20% in 2003. Schools participating in the Recycling Corner programme increased from 2% in 2002 to 30% in 2003. The number of recycling bins in public places increased from 3,800 in 2002 to 4,500 in 2003.

The Quality of Service (QOS) standards and permit system introduced in October 2002 was enforced with effect from 1 January 2003 to ensure that collection of recyclables by appointed recycling companies meet specified service standards.

In November 2003, the Minister for the Environment launched a joint JTC Corporation (JTC)-NEA estate-wide waste recycling programme for flatted factories at the Kallang Basin Industrial Estate. The recycling programme will be introduced in phases to all JTC's flatted factory industrial estates by 2006.

In 2003, several energy efficiency and clean/renewable energy initiatives were launched under the auspices of the National Energy Efficiency Committee. These included the launch of the Fuel Economy Labeling Scheme for passenger vehicles and a Green Transport Guide. The Green Corners programme at retail stores to promote the Energy Labeling Scheme

for refrigerators and air-conditioners was launched to increase public awareness of energy efficient appliances. Two test-bedding projects were also launched to field-test a building integrated photovoltaic (BIPV) system at Biopolis in the one-north development and a proton exchange membrane (PEM) fuel cell power system at a multi-storey carpark in Pasir Ris-Punggol Town Council respectively.

2 INTRODUCTION

Singapore developed its industrial base and achieved high economic growth within a short span of three decades. In tandem with Singapore's rapid economic growth and industrialisation, programmes were also implemented, at a very early stage, to protect the environment.

The success of these environmental protection programmes is evident today and Singapore has an environment that compares favourably with the best cities in the world. Levels of major pollutants in the ambient air are within the World Health Organisation (WHO) and the United States Environmental Protection Agency (USEPA) standards. All inland waters in Singapore support aquatic life.

To ensure that rapid economic growth and industrialisation would not be at the expense of the environment, the Ministry of the Environment (ENV) was formed in 1972 to protect the environment. ENV, through its statutory boards the National Environment Agency (NEA) and the Public Utilities Board (PUB), does so by planning, developing and operating sewerage, drainage and solid waste disposal facilities, controlling air and water pollution, hazardous chemicals and toxic wastes, and providing environmental public health services and public health education.

The Environmental Protection Division (EPD) of NEA has been tasked to formulate programmes and chart NEA's course into the next decade. Since 1 October 2003, EPD has taken on new responsibilities and the departments in EPD have been restructured to carry out the new functions. These responsibilities include areas such as international, regional and bilateral cooperation and industry and manpower development.

EPD comprises the following departments:

(a) Pollution Control Department (PCD)

(b) Planning and Development Department (PDD)

(c) Resource Conservation Department (RCD)

(d) Waste Management Department (WMD)

The organisation chart of EPD is in **Appendix 1**.

PCD is tasked with the overall responsibility for air, water and noise pollution control; and hazardous substances and toxic waste control. It has the responsibility of monitoring ambient air and inland and coastal water quality. It is also responsible for the formulation and implementation of joint programmes on transboundary pollution with the neighbouring countries. The organisation chart of PCD is in **Appendix 2**.

PDD coordinates the development and implementation of action programmes to

achieve the targets in the Singapore Green Plan 2012 (SGP 2012). PDD carries out research programmes both independently and jointly with tertiary institutions and research organisations to support NEA's strategic objectives. To further streamline the environmental planning functions of NEA, the Central Building Plan Unit (CBPU) of PCD was transferred to PDD on 1 October 2003. In addition, PDD assumed the new roles of external cooperation (bilateral, regional and international environmental issues) and industry and manpower development (promoting markets and jobs in the environmental management field, research, etc.). The organisation chart of PDD is in **Appendix 3**.

RCD is responsible for promoting waste minimisation and recycling in order to reduce the waste disposed of at the incineration plants and landfill. It is also responsible for promoting energy efficiency and the use of clean energy to minimise the emissions of carbon dioxide and air pollutants. The organisation chart of RCD is in **Appendix 4**.

WMD is tasked with the responsibility for licensing general waste collectors, regulating refuse collection for the domestic and trade premises and providing refuse disposal services. It also provides technical assistance to Environmental Health Department (EHD) and Hawkers Department (HD) and vehicle maintenance services to all departments in NEA. The organisation chart of WMD is in **Appendix 5**.

3 SINGAPORE GREEN PLAN 2012 (SGP 2012)

The Singapore Green Plan 2012 (SGP 2012) was launched by the Minister of the Environment in Singapore in August 2002 and circulated at the World Summit on Sustainable Development (WSSD) in September 2002.

An SGP 2012 Coordinating Committee (CC) and six Action Programme Committees (APCs) were formed in January 2003 to develop and implement action programmes (APs) to meet the targets set out in the SGP 2012.

The CC and APCs have good representation from the 3P (People-Private-Public) sectors with about 55% of the 115 people involved coming from the people and private sectors. This underlines the emphasis given to 3P partnership and ownership of the environment.

The SGP 2012 CC, chaired by the Chief Executive Officer (CEO) of NEA, oversees the development and implementation of the APs drawn up to achieve the SGP 2012 targets.

Each of the six APCs is in charge of a functional area identified in SGP 2012 and are led by the agencies shown in the table below.

In developing action programmes for the functional areas under their charge, the APCs also address innovation and community partnership, two cross-cutting areas identified in the SGP 2012.

The development of the action programmes has been progressing well.

APC	Lead Agency
Clean Air	NEA
Clean Water	PUB
Waste Management	NEA
Conserving Nature	National Parks Board
Public Health	NEA
International Environmental Relations	ENV

4 ENVIRONMENTAL PLANNING AND BUILDING DEVELOPMENT CONTROL

Environmental Land Use Planning

Environmental problems can be prevented through proper land use planning and the imposition of appropriate controls. NEA, therefore, adopts an integrated approach in the planning control of new developments. This is to ensure that environmental considerations and factors are incorporated at the land use planning, development control and building control stages, so as to minimise pollution and to mitigate pollution impact on surrounding land use.

The Urban Redevelopment Authority (URA), which is the land use planning authority in Singapore, consults the Central Building Plan Unit (CBPU) of the Planning and Development Department (PDD) on land use planning issues. The JTC Corporation (JTC), Housing & Development Board (HDB) and private sector developers also consult CBPU on the allocation of industrial premises.

CBPU assesses and evaluates the hazard and pollution impacts of the proposed industries to ensure that they do not pose unmanageable health and safety hazards and pollution problems. A proposed industry will only be allowed to be set up if it is sited in an appropriate industrial estate and can comply with pollution control requirements.

During the year, CBPU processed 4,874 plans for residential and industrial developments. In addition, CBPU processed 3,514 applications for allocation of industries in JTC, HDB and private industrial estates. A breakdown of residential and industrial development plans and applications for allocation of industrial premises processed by CBPU is in **Tables 1**, **2** and **3**.

Major Planning Proposals

During the year, CBPU evaluated the Quantitative Risk Assessment (QRA) studies of 7 chemical plants. The proposals were supported as they could comply with the siting and technical requirements.

Consultation on Building Developments

Technical requirements on environmental matters are imposed at the Building Plan (BP) stage so that the proposals would be designed to comply with environmental requirements and guidelines.

For industries, the building plans are checked at the BP stage to ensure that the necessary pollution control equipment and facilities are incorporated.

Upon completion of a project, the Qualified Person (QP) applies to CBPU for clearance of either the Temporary Occupation Permit (TOP) or the Certificate of Statutory Completion (CSC).

When compliance with the imposed technical requirements has been confirmed through site inspections, CBPU issues TOP/CSC clearance on behalf of the technical departments (Sewerage, Drainage, Environmental Health and Pollution Control Departments).

During the year, CBPU processed 7,245 building plans and detailed plans, and issued 3,309 TOP/CSC clearances

Provision of Drainage and Sewerage Interpretation Plans

CBPU provides drainage and sewerage information for property transactions and building developments.

During the year, CBPU processed 25,691 applications for Drainage Interpretation Plans and Sewerage Interpretation Plans.

Table 1
Planning Consultations on Land Use

Classification	Total
Proposed Site for Public Housing Development	78
Proposed Site for Private Housing Development	1485
Proposed Site for Industrial Development	190
Proposed Site for Flatted Factory Development	20
Proposed Extension/Retention of Use of Existing Premises	93(1)
Proposed Use/Change of Use of Trade/Industrial Premises	135(10)
Proposals for Petrol Stations	21
Additions & Alterations	1226(2)
Miscellaneous	1626(4)
Total	**4874(17)**

Note: Figures in brackets represent the number of consultations not supported by CBPU.

Table 2

Planning Consultations for Scheduled Premises

Scheduled Premises	Total
Concrete/Cement works	8
Chemical works	5
Plants using scheduled oil-fired boilers (steam generating capacity of 2300 kg or more per hour)	3
Abrasive blasting works	2
Total	**18**

Table 3

Breakdown of Consultations on Factory Allocation

Type Of Industry	Total
Engineering works	778(1)
Shipbuilding/repairing	31
Food	285
Timber-based products	197
Paper products	14
Electrical and electronic products	241
Textile and garment	57
Plastic	31
Printing and publishing	37
Jewellery, watch and clock	15
Building and construction	61
Concrete and cement	15
Chemical	91(1)
Rubber processing & rubber products	3
Photograph & optical goods	5
Ferrous & non-ferrous metal works	80
Leather goods & footwear	6
Miscellaneous	1567
Total	**3514(2)**

Note: Figures in brackets represent the number of consultations not supported by CBPU.

5 POLLUTION CONTROL

Air Pollution Control

Overview

The ambient air quality in Singapore remained good during the year. The levels of all the air pollutants monitored were within the acceptable limits prescribed by the World Health Organisation (WHO) and the United States Environmental Protection Agency (USEPA).

The Environmental Pollution Control Act and its Regulations

Air pollution in Singapore is regulated under the Environmental Pollution Control Act and its Regulations. The Environmental Pollution Control (Air Impurities) Regulations 2000, which came into force on 1 January 2001, stipulate revised air emission standards for air pollutants. The revised standards will reduce the air emissions from industries and ensure that our ambient air quality continues to remain good. The standards are listed in **Appendix 6**.

New industries and new equipment or processes introduced by existing industries had been required to comply with the revised standards from 1 January 2001 onwards. Existing industries were given a grace period of three years to ensure that the air emissions from their equipment and processes comply with the revised standards.

Industries, which have the potential to cause serious air pollution, are classified as Scheduled Premises under the Environmental Pollution Control Act. The list of Scheduled Premises is in **Appendix 7**. The owner or occupier of Scheduled Premises is required to obtain a Licence from PCD before commencement of operation. PCD grants the Licence only after all pollution control requirements have been complied with.

Compliance Testing and Checking At Factories

PCD carries out regular inspections on industrial and non-industrial premises to ensure compliance with pollution control requirements.

During the year, 25,798 inspections were conducted on industrial premises (e.g. factories, trade premises, etc) and 3,432 inspections on non-industrial premises (e.g. farms, domestic premises, etc.).

Under PCD's source emission testing scheme, industries are required to conduct source emission tests to ensure that they monitor their emissions regularly, and take remedial measures to comply with the prescribed air emission standards. During the year, 170 companies were required to conduct source emission tests. Altogether, they conducted a total of 475 tests comprising 168 isokinetic tests and 307 tests on gaseous emission. All the companies were able to comply with the emission standards.

During the year, PCD also conducted 644 fuel analyses and smoke observations of chimneys. Of these, 42 failed to comply with the prescribed standards.

The offenders were prosecuted and required to take remedial action. A breakdown of the results is in **Table 4**.

Air Pollution Control Equipment

Industries are required to install air pollution control equipment to comply with emission standards. During the year, CBPU approved the installation of 71 pieces of air pollution control equipment. The types of control equipment approved are in **Table 5**.

Table 4
Analyses and Observations Conducted

Analysis/Observation	No. Conducted	No. Exceeded Limits
Sulphur content in fuel analysis	79	20
Lead content in petrol analysis	45	4
Smoke observation	520	18
Total	**644**	**42**

Table 5
Air Pollution Control Equipment Approved

Equipment	No. Approved	Total No. as at 2003
Bag filter dust collector	24	1,183
Inertial collector	2	189
Electrostatic precipitator	0	20
Scrubber	23	792
Smoke density meter	4	117
Miscellaneous	18	954
Total	**71**	**3,255**

Control Of Fuel-Burning Equipment

Fuel-burning equipment uses either gaseous fuel or fuel oil. The main air pollutants arising from fuel-burning are sulphur oxides and smoke. The emission of sulphur oxides is controlled by limiting the sulphur content in the fuel.

Industries located in designated industrial estates are required to use fuel oil containing not more than 1% sulphur by weight. Industries on Jurong Island and Tuas industrial estate may use natural gas, a clean fuel. Those located near housing estates or residential premises are required to use cleaner fuel, viz. diesel with 0.05% or less sulphur content, or town gas. In addition, the height of chimneys and the exit velocity of the flue gases are controlled to ensure proper dispersion of flue gases.

Operators of industrial boilers with a steam generating capacity of 2,300 kg/h or more are required to monitor their smoke emissions. Smoke density meters are installed in the chimneys to continuously monitor the smoke intensity to ensure compliance with the Ringelmann No. 1 standard. During the year, 23 new fuel-burning equipment were approved by CBPU. They included 10 boilers, 8 ovens, 3 furnaces and 2 incinerators.

Open Burning

Open burning of waste materials gives rise to serious air pollution. In Singapore, open burning of trade and industrial refuse such as construction wastes, is prohibited under the Environmental Pollution Control (Prohibition on the Use of Open Fires) Order, 1999. Most open burning incidents occur at construction sites where timber waste and construction debris are burnt. During the year, a total of 6 open burning incidents were detected and action was taken to prosecute the offenders.

Control Of Fugitive Odorous Emissions

Fugitive or residual emission of odorous substances can be a major source of smell nuisance from factories. These factories are required to install odour control equipment to minimise the nuisance.

Complaints And Incidents Of Air Pollution

During the year, PCD received 480 complaints on pollution, of which 113 were incidents of air pollution. The main causes of these incidents were poor maintenance, improper operation and/or overloading of air pollution control equipment.

PCD required the owners or occupiers to take immediate remedial action to ensure compliance with the allowable emission limits. A breakdown of air pollution complaints and incidents in 2002 and 2003 is given in **Table 6**.

Table 6
Complaints And Incidents Of Air Pollution

Type Of Air Pollution	No. Of Complaints		No. Of Incidents	
	2003	**2002**	**2003**	**2002**
Odour	225	196	36	29
Fumes/Dust	105	184	26	67
Smoke/Soot	114	67	40	22
Others	36	37	11	10
Total	**480**	**484**	**113**	**128**

Control Of Vehicular Emissions

Control Of Smoky Vehicles

PCD is responsible for enforcement operation against smoky vehicles on roads. During the year 2003, a total of 9120 motor vehicles and 15,496 motorcycles were booked and fined for emitting excessive smoke. A breakdown of the survey results of smoky vehicles in Singapore in 2002 and 2003 is given in **Table 7**.

Vehicle Emission Standards

With the continuing growth of vehicle population in Singapore, total emissions from vehicles have to be kept in check through the implementation of stringent emission standards for new vehicles. Over the years, NEA has tightened the emission standards in tandem with advances in vehicle technology. With effect from 1 January 2001, all new vehicles registered for use in Singapore must comply with the Euro II emission standards. With effect from 1 July 2003, all motorcycles/scooters must comply with the exhaust emission standard as specified in the European Directive 97/24/EC before they can be registered for use in Singapore. The emission standards are summarised in **Table 8**.

In addition, in-use vehicles are required to undergo mandatory periodic inspections. These vehicles are tested for exhaust emission for compliance with the emission standards. This is to ensure the proper maintenance of engines and efficacy of catalytic converters.

To provide vehicle owners with a better standard of maintenance, PCD had initiated the formation of an industry-led Motor Industry Certification Board (MICB) (Singapore) for the administration of the Certification Scheme for Motor Workshop on 1 September 2000. Under this scheme, certificates are awarded only to motor workshops with trained mechanics, proper equipment and procedures, and quality assurance checks for the maintenance of diesel-driven vehicles to prevent black smoke emission. To date, 23 workshops have been certified under the scheme.

PCD has also from 1 September 2000, introduced the Chassis Dynamometer Smoke Test (CDST) to replace the free acceleration test for diesel-driven vehicles caught emitting black smoke. The CDST simulates the actual driving conditions that a loaded vehicle is subjected to while it is on the road. Hence, the CDST measures the actual smoke emission from a vehicle under load during testing. To date, 23,666 vehicles were sent for CDST test and an average of about 77% of the vehicles were able to pass the CDST on the first attempt.

Control Of Automotive Fuel Quality

The quality of fuel used by vehicles in Singapore is controlled because of its impact on vehicular emissions. Unleaded petrol was introduced in January 1991 and leaded petrol was phased out on 1 July 1998. To reduce smoke emission from diesel vehicles, the permissible sulphur content in diesel was reduced from 0.3% to 0.05% by weight on 1 March 1999. Smoke emission from diesel-driven vehicles is harmful as the fine particulate matter present in smoke has a significant health impact on people. The reduction of the sulphur content in diesel had paved the way for the introduction of the more stringent Euro II emission standards on 1 January 2001.

CNG Bus and CNG Taxi Pilot Projects

Natural gas is a cleaner source of energy than petrol or diesel. Vehicles powered by natural gas emit little or no pollutants such as fine particulates, sulphur dioxide, carbon monoxide and hydrocarbons. Natural gas vehicles also emit less carbon dioxide than petrol-driven or diesel-driven vehicles. The use of natural gas vehicles will therefore reduce the emission of air pollutants as well as carbon dioxide.

In April 2002, NEA and its project partners, SembGas and SBS Transit, launched the first CNG refilling station on Jurong Island and the pilot project to introduce CNG buses in Jurong.

In March 2003, taxi companies launched a pilot project to conduct road tests on 10 CNG taxis. They planned to use the results from the pilot project to assess the viability of operating a large fleet of CNG taxis in future.

In December 2003, NEA and Land Transport Authority (LTA) extended the green vehicle rebates to natural gas vehicles for another two years. Owners of natural gas vehicles will continue to enjoy the following rebates:

(a) Rebate equivalent to 5% and 20% of the vehicle's Open Market Value (OMV) for buses and other vehicles respectively that can be used to offset the fees and taxes payable at registration; and

(b) Road tax rebate of 20% for all natural gas vehicles.

Table 7

Survey Results of Smoky Vehicles on Singapore Roads

Origin & Type Of Smoky Vehicle	% of Smoky Vehicles in 2002	% of Smoky Vehicles in 2003
Singaporean		
(i) Motor vehicles	0.8%	0.5%
(ii) Motorcycles	1.6%	1.1%
Malaysian		
(i) Motor vehicles	2.6%	2.3%
(ii) Motorcycles	3.1%	3.3%

Table 8

Summary Of Emission Standards For Motor-Vehicles

Type of Vehicle	Emission Standard	Implementation
Petrol-driven vehicles	All new petrol-driven vehicles are required to comply with the EC Directive 96/69/EEC.	1 January 2001
Diesel-driven vehicles	All new diesel-driven passenger cars are required to comply with the EC Directive 96/69/EEC.	1 January 2001
	All new light commercial vehicles 3.5 tonnes or below are required to comply with the EC Directive 96/69/EC.	1 January 2001
	All new heavy duty vehicles exceeding 3.5 tonnes are required to comply with the EC Directive 91/542/EEC Stage II.	1 January 2001
Motorcycles & scooters	All new motorcycles and scooters are required to comply with the EC Directive 97/24/EC.	1 July 2003

Water Pollution Control

Overview

Water quality of the inland and coastal waters remained good. All inland waters supported aquatic life.

Acts And Regulations

The Environmental Pollution Control Act (EPCA) and the Sewerage and Drainage Act (SDA) and their regulations are used to control the discharge of wastewater from domestic, industrial, agricultural and other premises into public sewers and watercourses. The Environmental Pollution Control (Trade Effluent) Regulations and the Sewerage and Drainage (Trade Effluent) Regulations stipulate the standards, which trade effluent must comply with before discharge into watercourses and public sewers respectively. The discharge standards stipulated in both the regulations are in **Appendix 8**.

Industries may apply for permission to discharge trade effluent, which contain biodegradable pollutants, as measured by biochemical oxygen demand (BOD) and total suspended solids (TSS), into the public sewers on payment of a tariff when the BOD and TSS exceed the stipulated limits in the TER. The current schedule of trade effluent tariffs is in **Appendix 9**. Apart from the above two parameters (BOD and TSS), industries must comply with the discharge standards of the TER for all other parameters. Where necessary, they shall install on-site treatment plants to treat their effluent to the stipulated standards.

Industries generating large quantities of acidic effluent are required to install a pH monitoring and shut-off control system to prevent the discharge of acidic effluent into the public sewer. This helps to protect the sewerage system against corrosion and damage.

In general, industries which have potential to cause pollution are located in designated industrial estates such as Jurong/Tuas Industrial Estates, which are outside water catchments and served by public sewers. Only clean or light industries are allowed within water catchments and in proper industrial estates served by public sewers.

Sampling Of Trade Effluent

During the year, PCD collected 1,689 trade effluent samples for analysis. Of these, 118 samples or about 7% failed to comply with the stipulated standards. PCD required the offenders to take measures to prevent recurrence and initiated enforcement action against those found exceeding the standards.

Trade Effluent Treatment Facilities

Industries are required to install pretreatment facilities to treat their trade effluent that exceeds the limits of discharge stipulated in the TER. The pretreatment plants would have to be installed prior to the commissioning of the factories.

During the year, CBPU approved 49 trade effluent treatment facilities. A breakdown of the treatment facilities approved is in **Table 9**.

Table 9
Trade Effluent Treatment Facilities Approved

Treatment Facility/Method	No. Approved in 2003	Total No. as at 2003
Oil interceptor	10	1002
Balancing tank	10	393
Sedimentation	0	205
Neutralisation	15	274
Chemical	13	590
Activated sludge oxidation	0	19
Biological filtration	0	23
Ion exchanger/RO	0	1
Activated carbon adsorption	1	15
Total	**49**	**2,522**

Emergency Response Plan For Oil/ Chemical Spills On Land

During the year, there was 1 incident of chemical spill on land. The NEA, PUB and the Singapore Civil Defence Force (SCDF) dealt with the spill quickly to limit and contain environmental pollution.

Backyard Industries

There are still some backyard industries in undeveloped areas not served by public sewers. These backyard industries will be phased out when these areas are developed. PCD continues to monitor these backyard industries to ensure that adequate measures are adopted by these industries to minimise pollution.

Complaints And Incidents Of Water Pollution

PCD received 91 complaints of water pollution during the year, of which 20 were substantiated. Most of the incidents were due to illegal discharge or spillage of industrial wastewater or chemical/oil into drains. PCD required the offenders to clean up the pollution and legal action was taken against them for causing pollution.

A breakdown of the water pollution complaints and incidents in 2002 and 2003 is in **Table 10**.

Table 10
Complaints and Incidents of Water Pollution

Type Of Water Pollution	No. of Complaints		No. of Incidents	
	2003	2002	2003	2002
Chemical/Oil	33	50	4	19
Industrial wastewater	12	3	3	1
Farm wastes	0	2	0	1
Domestic wastewater	16	22	2	7
Others	30	34	11	7
Total	**91**	**111**	**20**	**35**

Hazardous Substances and Toxic Wastes Control

Overview

PCD controls the import, transport, sale, storage and use of hazardous substances. PCD also controls the disposal of toxic industrial wastes. These controls ensure the safe and proper management of hazardous substances and toxic industrial wastes in Singapore.

Besides regulatory controls, PCD also works with international organisations, relevant government agencies and industry groups to organise seminars and briefings to assist companies and traders to manage hazardous substances and toxic industrial wastes safely.

Hazardous installations, which store hazardous substances in bulk quantities, are also required to carry out safety audits to systematically identify and rectify weaknesses in the management systems and practices of handling hazardous substances.

Hazardous Substances Control

The import, transport, sale, storage and use of hazardous substances are controlled under the Environmental Pollution Control Act and the Environmental Pollution Control (Hazardous Substances) Regulations.

Any person or company planning to engage in such activities needs to obtain a Hazardous Substances Licence or Permit from PCD. The chemicals controlled under the Environmental Pollution Control Act are in **Appendix 10**.

During the year, PCD issued 625 Hazardous Substances Licences and 832 Hazardous Substances Permits. PCD also processed electronically 29880 inward declarations for the import of chemicals and chemical products through the TradeNet computerised network system.

Also, under the Environmental Pollution Control (Hazardous Substances) Regulations, PCD's approval is required for the transportation of hazardous substances in quantities exceeding the limits stipulated in the Regulations. The specified limits for each hazardous substance are in **Appendix 11**.

During the year, PCD issued 208 transport approvals. Requirements on packaging, maximum allowable load, route, timing and emergency plans are imposed to ensure the safe transportation of hazardous substances.

Surprise road checks were also conducted jointly with the Land Transport Authority and the Singapore Civil Defence Force (SCDF) to ensure that companies transporting hazardous substances complied with the imposed safety requirements.

During the year, PCD conducted 999 surprise inspections to audit the records of hazardous substances kept by the holders of Hazardous Substances Licences and Permits. Of these,

63 were not in order. PCD took legal action against 6 offenders, issued written warnings to 49 offenders and gave verbal warnings to the remaining 8 offenders.

Application of Hazardous Substances Licence/Permit via the Internet

Applicants can submit an electronic application via the Internet, and check the status of their electronic applications at their own convenience. The website address is: http://web9.internet.gov.sg/nea/login.html.

All the necessary guidance and information for filling up the electronic application are available on-line to applicants. Applicants are able to save their trips to PCD to collect application forms, seek clarification or submit application forms.

Training For Tanker Drivers

Drivers of road tankers and tank containers carrying hazardous substances and dangerous petroleum products are required to undergo a special one-day training course jointly organised by Singapore Civil Defence Force (SCDF) and PSA Institute. Those who have successfully completed the course will be granted a HAZMAT Transportation Driver Permit (HTDP). All drivers conveying controlled hazardous substances listed in the Environmental Pollution Control (Hazardous Substances) Regulations are required to posses a HTDP that is valid for only 2 years. They are required to undergo the one-day course once every 2 years as a form of refresher training for the renewal of their HTDP.

Toxic Industrial Wastes Control

The Environmental Public Health (Toxic Industrial Waste) Regulations require all toxic industrial waste collectors to be licensed. Approval is also required to transport toxic industrial wastes which exceed the quantities stipulated in the Regulations.

The types of toxic industrial wastes controlled under the Regulations are listed in **Appendix 12**.

During the year, PCD granted and renewed licences to 122 toxic industrial waste collectors to carry out treatment, reprocessing and disposal of toxic wastes. PCD also required licensed toxic waste collectors to obtain approval to transport toxic industrial wastes that exceeded specified quantities.

Control of Tanker Cleaning Activities and the Disposal of Sludge and Slop Oil

Since 4 April 1993, Singapore has implemented a scheme to tighten control on tanker cleaning activities and the disposal of sludge and slop oil generated from tanker cleaning activities. Under the scheme, the Maritime and Port Authority (MPA) will only issue permits to contractors registered with PCD to carry out tanker cleaning activities in designated areas.

Sludge and slop oil generated from tanker cleaning activities are required to be sent to approved reception facilities for treatment and disposal.

Also under the scheme, any ship or vessel entering Singapore in a “clean condition” for repairs would be allowed entry only if it could show proof that the sludge and slop oil from its tanker cleaning activities had been disposed of at approved facilities.

During the year, 40 companies were registered to carry out tanker cleaning activities. 14,399 tonnes of oily sludge were sent to the reception facilities for treatment and disposal.

Collection Of Industrial Waste Chemicals

The main types of industrial waste chemicals include waste solvents, spent etchants, acid, alkali and other obsolete chemicals. PCD encourages the reuse and recovery of waste chemicals as it would reduce the amount of wastes that require treatment and disposal.

During the year, licensed collectors collected 217,039 tons of waste chemicals from local industries.

Control of Biohazardous Wastes

Biohazardous wastes from hospitals and polyclinics are segregated at source and stored in colour-coded plastic bags. The wastes are then put in secured containers and collected by 3 licensed companies for disposal in high temperature incinerators.

During the year, 14,860 cubic metres of biohazardous wastes were collected and disposed of.

Environmental Noise Management

Industrial Noise Control

PCD controls noise from factories by siting them in designated industrial estates and where appropriate, requiring them to implement noise abatement measures to comply with allowable boundary noise limits. PCD conducts regular checks on factories to ensure noise control equipment is operated and maintained properly. The boundary noise limits for factory premises are at **Appendix 13**.

During the year, PCD received 153 complaints of noise pollution from factories, of which 34 were substantiated incidents. The main causes of these incidents were improper siting of mechanical equipment and/or poor maintenance of mechanical equipment. The owners or occupiers were required to take remedial action to reduce noise to comply with the allowable noise limits.

Traffic Noise from Expressways

NEA strategy is to reduce traffic noise from expressways through the use of cost-effective measures.

In land-scarce and highly urbanised Singapore, some degree of traffic noise pollution is inevitable. NEA, together with the Ministry of Transport (MOT) and the Ministry of National Development (MND), use the following cost-effective measures to alleviate the problem:

- tightening noise emission standards for vehicles;
- using noise-absorptive porous asphalt material for road surfacing;
- siting multi-storey carparks, electrical substations or other non-residential structures to screen traffic noise from new residential buildings;
- setting back new residential buildings from expressways; and
- designing new flat layouts such that living rooms and bedrooms are located away from traffic noise

Construction Noise Control

PCD enforces The Environmental Pollution Control (Control of Noise at Construction Sites) Regulations to control noise pollution from construction sites. On 1 October 2001, the Regulations were amended by introducing more stringent permissible noise limits for noise generated at night. The new noise limits are applicable to construction sites that commenced on or after 1 October 2001 and are within 150 m of residential premises. The permissible noise limits for construction sites are at **Appendix 14**.

The regulations require contractors to schedule their construction activities and to take noise abatement measures to comply with the permissible noise limits. However, the Regulations do not restrict the working days or hours of construction sites.

During the year, PCD received 5,733 complaints of noise pollution against construction sites. Of these, 314 complaints against 75 construction sites were found to be substantiated, i.e. the noise levels had exceeded the permissible noise limits. The main causes of these substantiated cases were from concreting work carried out at late night. The contractors were prosecuted and required to reschedule their activities to ensure compliance with the permissible noise limits.

6 ENVIRONMENTAL MONITORING

Overview

Singapore has, over the years, managed to maintain an impressive environmental record despite the increase in industrialisation and urbanisation.

Our success in keeping the environment clean and safe is partly due to regular monitoring and assessment of the quality of ambient air and water. The results have helped in the development and review of pollution control measures.

Ambient Air Monitoring

The ambient air quality in Singapore is routinely monitored through the Telemetric Air Quality Monitoring and Management System (TAQMMS).

The system, which comprises 16 remote air monitoring stations linked to a Central Control System (CCS) via dial-up telephone lines, provides an efficient means of obtaining air quality data. The locations of the monitoring stations are shown in **Chart 1**.

Fourteen of the air monitoring stations monitor ambient air quality and two stations measure roadside air quality. Automatic analysers and equipment are deployed at the stations to measure the concentrations of major air pollutants, such as sulphur dioxide, oxides of nitrogen, carbon monoxide, ozone and respirable suspended particles (PM10).

In 2003, the overall average levels of sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone and PM10 were within international standards. The ambient air quality standards established by the World Health Organisation (WHO) and the United States Environmental Protection Agency (USEPA) are summarised in **Appendix 15**.

The Pollutant Standards Index (PSI), an indicator of air quality developed by the USEPA, was 'Good' for 93% and 'Moderate' for 7% of the days measured during 2003, as shown in **Table 11**.

Chart 1

Location of Air Quality Monitoring Stations

Table 11

Summary of Pollutant Standards Index (PSI)

Year	Days	No. of Days in which the PSI was Classified as			Percentage		
		Good (0-50)	Moderate (51-100)	Unhealthy (101-200)	Good (0-50)	Moderate (51-100)	Unhealthy (101-200)
2003	365	340	25	0	93%	7%	0
2002	365	299	66	0	82%	18%	0

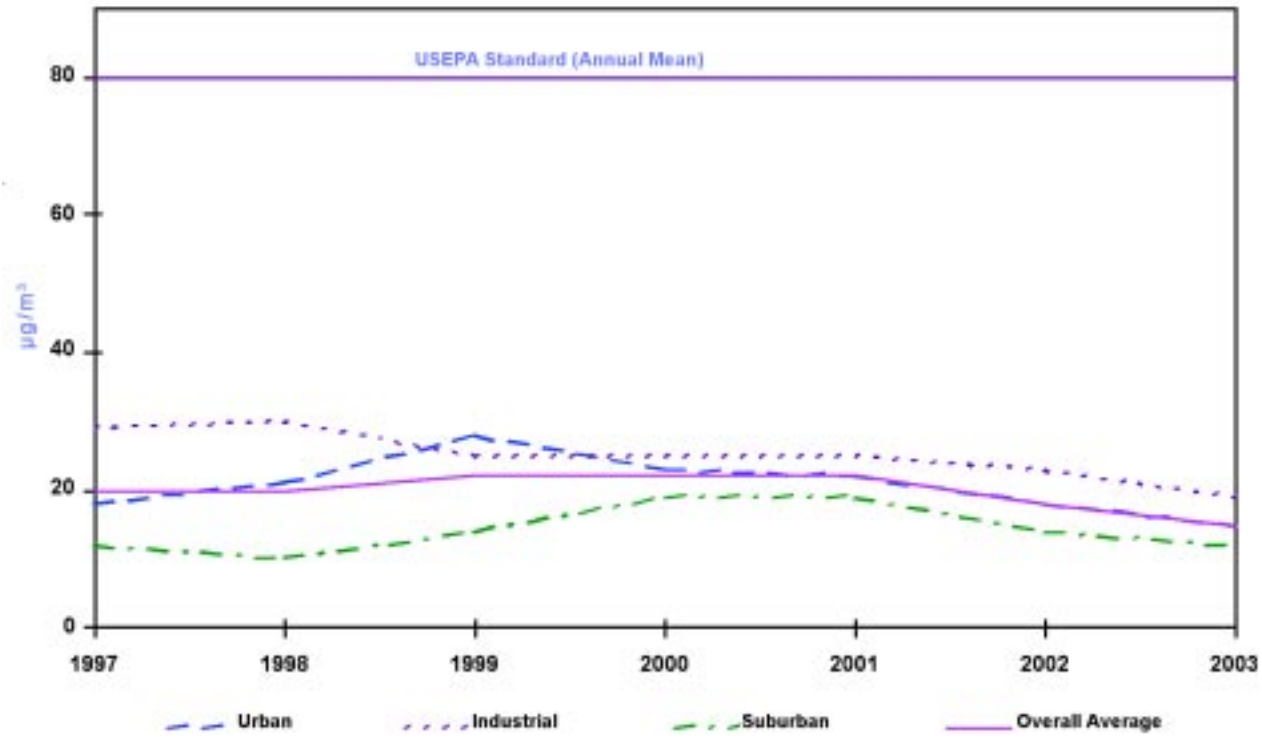
Sulphur Dioxide

Sulphur dioxide is an undesirable by-product from the combustion of sulphur-containing fuels and to a lesser extent, from petroleum refining processes.

Prolonged exposure to high concentrations of sulphur dioxide increases the risk of contracting respiratory diseases.

The annual average levels of sulphur dioxide are shown in **Chart 2**. In 2003, the annual average level was 15 µg/m^3, which was within the USEPA standard of 80 µg/m^3.

Chart 2
Annual Average Levels Of Sulphur Dioxide



Nitrogen Dioxide

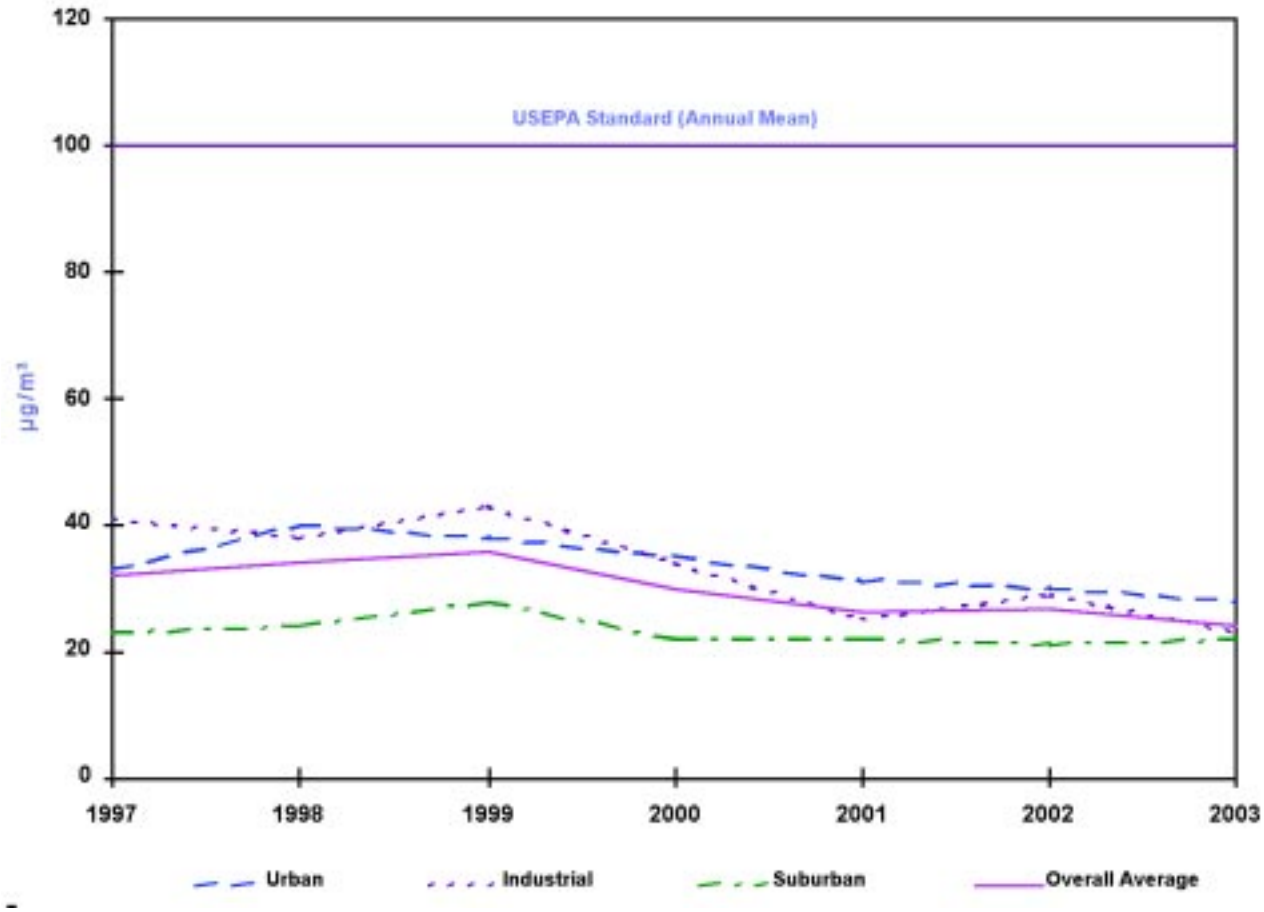
Nitric oxide accounts for most of the nitrogen oxides emitted by man-made sources. Nitric oxide is oxidised in the atmosphere to form nitrogen dioxide.

High levels of nitrogen dioxide increase the risk of respiratory infection and impair lung functions in asthmatics.

The annual average levels of nitrogen dioxide in the ambient air are shown in **Chart 3**.

In 2003, the annual average level of nitrogen dioxide was 24 µg/m^3, which was within the USEPA standard of 100 µg/m^3.

Chart 3
Annual Average Levels of Nitrogen Dioxide



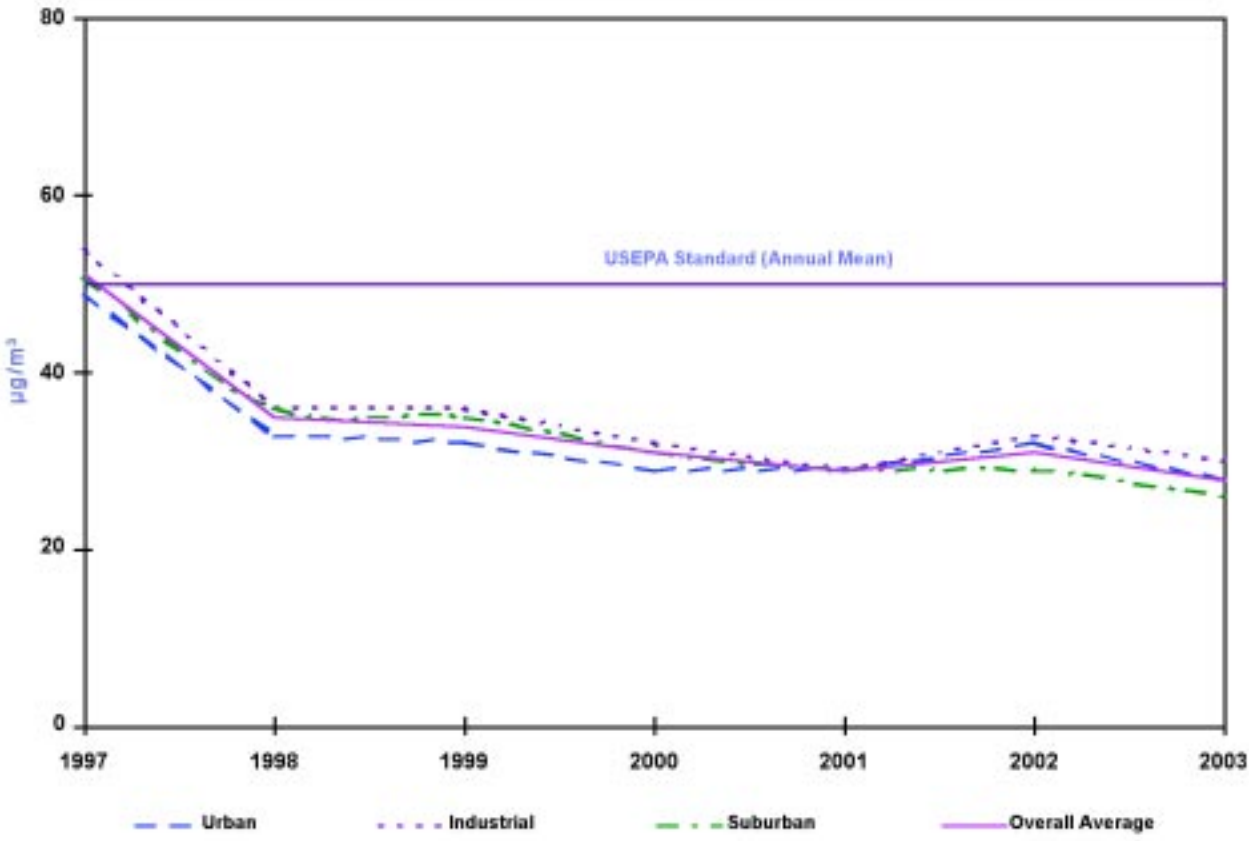
Respirable Suspended Particles (PM10)

Respirable suspended particles (or PM10) refer to particulate matter of size 10 (m and below. These particles have health implications as they are able to penetrate into the deeper regions of the respiratory tract. When present in very high amounts, the particles cause breathing and respiratory problems, and aggravate existing respiratory and cardiovascular diseases.

The 2003 PM10 level of 28 µg/m^3 was within the USEPA standard of 50 µg/m^3. **Chart 4** shows the annual average levels of PM10 in the ambient air

Chart 4

Annual Average Levels of Respirable Suspended Particles (PM10)



Note: 1997 PM10 levels were affected by transboundary smoke haze from plantation and forest fires in Indonesia

Low-Level Ozone

Ozone in the stratosphere is desirable as it protects life on earth by absorbing much of the harmful ultraviolet radiation from the sun.

However, ozone occurring in the lower atmosphere is a health hazard. Ozone can severely irritate eyes, mucous membranes and the respiratory system in humans as well as cause damage to plants.

Low-level ozone may be produced by the complex reactions of nitrogen oxides and volatile organic compounds catalysed by actinic radiation, or may result from the intrusion of stratospheric ozone into the troposphere.

The USEPA standard stipulates that the hourly average ozone concentration should not exceed 235 µg/m^3 on more than one occasion per year. The 1-hour ozone level did not exceed this limit in 2003. The results of the ozone measurements carried out in 2003 are shown in **Table 12**.

Table 12

Annual Low-Level Ozone Monitoring Results in 2002 and 2003

Station	2002	
	No of Days When 1 Hr Concentration ≥ 235 μg/m³	Maximum 1 Hr Concentration (μg/m³)
Environment Building	0	161
Woodbridge Hospital	0	138
Singapore Science Centre	0	183
Nanyang Technological University	0	104
Yishun ITE	0	130
Changi Airport	0	181
Station	**2003**	
	No of Days When 1 Hr Concentration ≥ 235 μg/m³	**Maximum 1 Hr Concentration (μg/m³)**
Environment Building	0	150
Singapore Science Centre	0	152
Nanyang Technological University	0	214
Yishun ITE	0	145
Bishan ITE	0	131
Changi Airport	0	122

Carbon Monoxide

Carbon monoxide is a colourless and odourless gas with a higher affinity than oxygen for the haemoglobin in the blood. Hence, when it is inhaled, it can deprive body tissues of oxygen.

Exposure to moderate levels of carbon monoxide may cause nausea and impair vigilance. In excessive doses, it can cause death through asphyxiation.

The sources of carbon monoxide range from vehicular emissions, cigarette smoke to incomplete combustion of fuels. Vehicular emission usually accounts for most of the carbon monoxide in the air.

Carbon monoxide is measured at both ambient and roadside air monitoring stations. The ambient 8-hourly average level of carbon monoxide measured in 2003 was 0.6 mg/m^3. This level was well within the USEPA standard of 10 mg/m^3. The roadside levels of carbon monoxide are shown in **Table 13**.

Table 13

Roadside Average Carbon Monoxide Levels (mg/m^3) in 2003

Monitoring Station	Time Interval (Hours)					
	0000 – 0800		0800 – 1600		1600 – 2400	
	2002	2003	2002	2003	2002	2003
Central Regional Office	1.2	1.0	1.3	1.1	1.4	1.1
Ngee Ann Polytechnic	1.5	1.4	1.4	1.2	1.5	1.4

Pollution From Vehicles

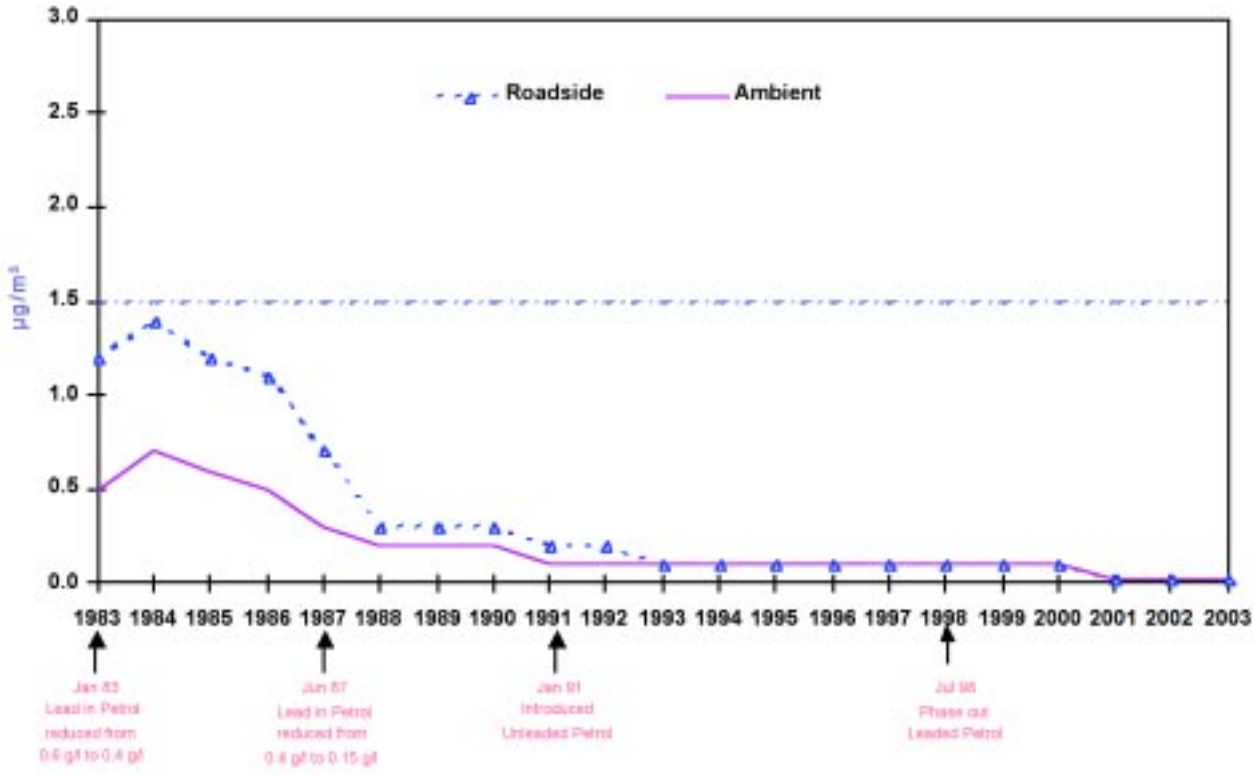
Lead compounds, such as tetra-ethyl lead and tetra-methyl lead, have for many years been added to petrol as anti-knock agents. The combustion of leaded petrol, therefore, results in the emission of lead particulates into the air. If imbibed in large quantities, lead can cause irreversible damage to the brain and other organs.

Foetuses and children are particularly sensitive to the deleterious effects of lead as their nervous systems are still developing.

Lead levels in petrol had progressively been reduced since the 1980s and, in January 1991, unleaded petrol was introduced in Singapore. On 1 July 1998, leaded petrol was phased out.

The efficacy of these measures in reducing lead concentrations in the air is evident from **Chart 5**. From roadside levels of as high as 1.4 µg/m^3 in 1984, the lead levels have stabilised at around 0.1 µg/m^3 since 1992. The lead levels remained at < 0.1 µg/m^3 in 2003. The USEPA standard for three-monthly average lead level is 1.5 µg/m^3.

Chart 5
Lead Levels (1983 to 2003)



Water Monitoring

Overview

PCD regularly monitors the water quality of various inland water bodies and coastal areas. The monitoring points are shown in **Charts 6** and **7**.

Water Quality in Water Catchment Areas

35 streams and 12 ponds in the water catchment areas are monitored each quarter.

Water quality of the 14 reservoirs within the water catchment areas is jointly monitored by PCD and PUB.

The water quality, based on the measured levels of dissolved oxygen (DO), biochemical oxygen demand (BOD) and total suspended solids (TSS) remained good in 2003. The monitoring data is shown in **Table 14**.

Water Quality in Non-Water Catchment Areas

Water quality of the 18 rivers and streams in non-water catchment areas is monitored quarterly. Physical, chemical and microbiological parameters are analysed to assess the water quality. Results of the monitoring, as given in **Table 14**, revealed that the rivers and streams were low in pollution and were able to sustain aquatic life.

Table 14
Monitoring Results of Inland Waters

Parameter Monitored		Water Catchment Streams (Percentage Of Time)	Non-Water Catchment Rivers/Streams (Percentage Of Time)
Dissolved Oxygen (> 2 mg/l)	2003	100 %	95 %
	2002	100 %	91 %
Biochemical Oxygen Demand (< 10 mg/l)	2003	91 %	90 %
	2002	91 %	91 %
Total Suspended Solids (< 200 mg/l)	2003	97 %	96 %
	2002	95 %	100 %

Chart 6

Locations of Non-Catchment and Seawater Sampling Points

Chart 7

Locations of Catchment Sampling Points

Monitoring Of Coastal Waters

Water samples are collected monthly from 9 sampling points along the Straits of Johor and 12 sampling points along the Straits of Singapore. These samples are subjected to physical, chemical and microbiological examinations.

Table 15 gives the monitoring results for the coastal waters.

Table 15
Monitoring Results of Coastal Waters

Parameter		Straits of Johor East (Percentage of Time)	Straits of Johor West (Percentage of Time)	Straits of Singapore (Percentage of Time)
Faecal Coliform Count (<1,000 per 100 ml)	2003	85 %	83 %	100 %
	2002	95 %	75 %	98 %

7 RESOURCE CONSERVATION

Strategies

From 1970 to 2000, the amount of waste disposed increased six times. At that rate, we would need to build a new incineration plant every 5 – 7 years and a new landfill the size of Semakau Landfill (current offshore landfill) every 25 – 30 years. This is not sustainable.

The sustainable solution is to close the solid waste loop by minimising waste and maximising recycling. This will help to bring us nearer our goal of "Towards Zero Landfill" and prolong the lifespan of Semakau Landfill and reduce the demand for more incineration plants. The strategies to meet the goal of "Towards Zero Landfill" are as follows:

i) Reduce waste disposed of at incineration plants;

ii) Reuse incineration ash to divert it from landfill; and

iii) Recycle waste that is disposed of directly at landfill

Energy fuels our industries, drives our economy and allows us our quality of life. Practically all our energy is derived from fossil fuels, viz oil and natural gas. Singapore is totally dependant on imported fossil fuels and does not have any indigenous sources of energy. The production of energy from fossil fuels results in the emission of air pollutants and carbon dioxide, a greenhouse gas.

The strategies to deal with energy use are as follows:

i) To be energy efficient – i.e. to get the maximum output from the consumption of energy

ii) To be carbon efficient – i.e. to get the maximum energy output from every unit of fossil fuel burned

iii) To be eco efficient – i.e. to minimise effect on the environment from the emissions of particulates and other pollutants when fossil fuels are burned.

Overview on Waste Minimisation and Recycling Programmes

Since the early 1990s, Singapore has been actively promoting waste minimisation and recycling to reduce the waste disposed of at the incineration plants and landfill. In 2003, the overall rate of recycling increased to 47% as compared to 45% in 2002. **Table 18** provides the details on the waste disposal and recycling rates for 2003.

Table 18

Waste Statistics and Recycling Rates for 2003

Waste Types	Total Waste Disposed of (tonnes)	Total Waste Recycled (tonnes)	Total Waste Output (tonnes)	Recycling Rate (%)
Food	515,100	32,900	548,000	6
Paper/Cardboard	618,500	466,200	1,084,700	43
Plastics	540,800	39,100	579,900	7
Construction Debris	24,600	398,300	422,900	94
Wood/Timber	172,600	40,800	213,400	19
Horticultural Waste	185,300	119,300	304,600	39
Ferrous Metal	57,700	799,000	856,700	93
Non-ferrous Metal	18,100	75,800	93,900	81
Used Slag	21,800	238,500	260,300	92
Sludge	88,500	0	88,500	0
Glass	59,300	6,200	65,500	9
Textile/Leather	90,700	900	91,600	1
Scrap Tyres	8,200	6,200	14,400	43
Others	103,800	0	103,800	0
Total	**2,505,000**	**2,223,200**	**4,728,200**	**47**

Waste Management and Recycling Industry

There are some 400 companies in the waste management and recycling industry in Singapore. They range from small operators to big international companies. Most of the companies are in the waste collection business and the rest carry out sorting and recycling of waste.

The Waste Management and Recycling Association of Singapore (WMRAS), established on 8 August 2001, has more than 80 members today. It aims to raise the level of professionalism and develop the waste management and recycling industry in Singapore as a leading industry in the region.

WMRAS held an Industry Forum in February 2003 to discuss the findings of a study on the waste management and recycling industry in Singapore. The study included an analysis of the current situation of the waste management and recycling industry in Singapore and the development of an action plan comprising 150 initiatives to help propel the industry forward both locally and regionally. The forum provided a timely opportunity to exchange views among key players in the industry and explore areas for collaboration and building partnerships.

WMRAS also co-organised with NEA on the inaugural exhibition cum conference "EnviroAsia 2003". The event was held from 30 October to 1 November 2003. The exhibition included companies that showcased their technologies and products in solid waste, recycling, public cleansing and water management.

In 2003, several new facilities were set up to recycle wastes such as wood and horticultural wastes, construction and demolition wastes.

National Recycling Programme

To provide residents with a convenient way to recycle, NEA introduced a National Recycling Programme (NRP) in April 2001 for households in HDB estates and landed properties. In this programme, the public waste collectors licensed by NEA provide door-to-door collection of recyclable waste. Households are given recycling bags, crates or bins for their recyclables such as waste paper, drink cans, glass bottles, old clothing and plastic bottles, and collection of recyclables is carried out once every fortnight. Residents are informed of the collection dates in advance and can place their recycling bags, crates or bins outside their doors for collection on the pre-determined dates.

To ensure that a reliable and consistent recyclable collection service is provided to households under the NRP, NEA introduced the Quality of Service (QOS) standards and a permit system in October 2002 and enforcement took effect from January 2003. Under the permit system, Singapore is divided into 22 precincts and only one permit is issued to the permit holders to operate in each of the precincts to ensure orderliness of collection.

The permit holders have to meet a set of QOS standards. NEA officers conduct audit checks on the performance of the permit holders. Demerit points are issued for any lapses in service standards.

Participation rate by households increased from 33% (1 in 3 households) in 2002 to 45% (1 in 2.2 households) in 2003. NEA has set a target of increasing the household participation rate to 55% by 2004.

Recycling Programme at Condominiums

RCD has also been working with the Managing Agents, Management Councils of condominiums and recycling companies to introduce recycling programmes in condominiums. The percentage of condominiums with recycling programmes has increased from 4% in 2002 to 20% in 2003.

Recycling Programme at Schools

A structured waste recycling programme at schools was launched by NEA together with recycling companies and the Singapore Environment Council (SEC) on 12 September 2002. The recycling programme involves the setting up of a Recycling Corner in schools where recycling bins for paper, cans, and plastic are placed at a designated area called a Recycling Corner. Educational materials are also made available at the Recycling Corners to raise awareness on waste minimisation and recycling among students. Regular talks, activities, and surveys organised by NEA and SEC are also conducted to sustain the recycling programme. The percentage of schools with the recycling programme has increased from 2% in 2002 to 30% in 2003.

Recycling Bins at Public Places

Recyclable waste such as flyers, newspapers, drink cans and plastic bottles are also generated at public places. To supplement the National Recycling Programme, NEA has been working with various partner organisations to provide recycling bins at public places with high human traffic such as Orchard Road, Chinatown, Raffles Place, Holland Village, hawker centres, food courts, coffee shops, industrial estates, bus interchanges, institutions and outside key MRT (mass rapid transit) stations. The recycling bins serve also as a channel to educate the public on waste recycling. The number of recycling bins increased from 3,800 in 2002 to 4,500 in 2003.

Recycling at Industrial Estates

An estate-wide waste recycling programme for flatted factories in JTC's industrial estates was launched by Minister for the Environment at the Kallang Basin Industrial Estate on 28 November 2003. The recycling programme provides a convenient way for tenants in the Kallang Basin Industrial Estate to recycle waste. Recycling bins have been placed at convenient locations such as in the lift lobbies of each block at the estate, as well as inside the premises of 25 companies.

Tenants can put recyclable waste such as paper, plastic, metal and glass items into the recycling bins. In addition, designated corners have been set up at bin centres in the estate to recover used wooden pallets for reuse or recycling.

JTC and NEA target to extend similar waste recycling programme to all JTC's flatted factory industrial estates by 2006.

Guidebook on Waste Minimisation for Industries

NEA, JTC, WMRAS, Singapore Manufacturers' Federation (SMa), and representatives of private companies have formed a joint working group to produce a "Guidebook on Waste Minimisation for Industries". The objective of the guidebook is to help companies reduce waste through more efficient and effective use of resources, reuse and recycling. It aims to provide companies with practical tips on planning and implementing a waste minimisation and recycling programme. The guidebook also contains case studies to showcase the best practices of several companies. The online version of the draft guidebook can be found in the NEA website at http://www.nea.gov.sg.

Waste Recycling Projects

NEA funded several waste recycling projects under the Innovation for Environmental Sustainability (IES) Fund in 2003. Among the approved projects are the following:

(a) Use of ladle furnace slag, a by-product of steel making, for road asphalt production. A trial road of 40m long along Jurong East Central, had been constructed using ladle furnace slag-modified road asphalt. Preliminary findings from the study showed that ladle furnace slag is suitable for use in asphalt production.

(b) Use of recycled aggregates from construction and demolition waste to produce structural precast concrete products. The project is expected to be completed by Apr 2005.

Awareness Building and Education

The first national environmental camp in Singapore was organized by Nan Hua Secondary School with the support of NEA, SEC and South West CDC in July 2003. The one-day camp sought to teach primary school students the need to sustain a clean and green environment through fun-filled activities. More than 40 primary schools, each represented by five students, participated in the camp.

NEA and the Rotary Club of Singapore also introduced an annual 'Waste Recycling Competition' for primary schools. The competition was supported by the SEC and Nan Hua Secondary School, and was held from July to October 2003. The competition comprised a Green Quiz and a Recycling Project. The Recycling Project

requires participating schools to design and implement a comprehensive and sustainable waste recycling programme. The competition also encourages students to be ambassadors for the environment and bring the 3R – Reduce, Reuse, Recycle, message home to their family and friends.

Solid Waste Management

With limited resources available for waste disposal, NEA's policy for solid waste management necessitates the incineration of all incinerable waste that are not recovered, reused or recycled. Non-incinerable waste, such sludge, silt, shipyard waste, construction and demolition waste and incineration ashes, are disposed of at the offshore Semakau Landfill.

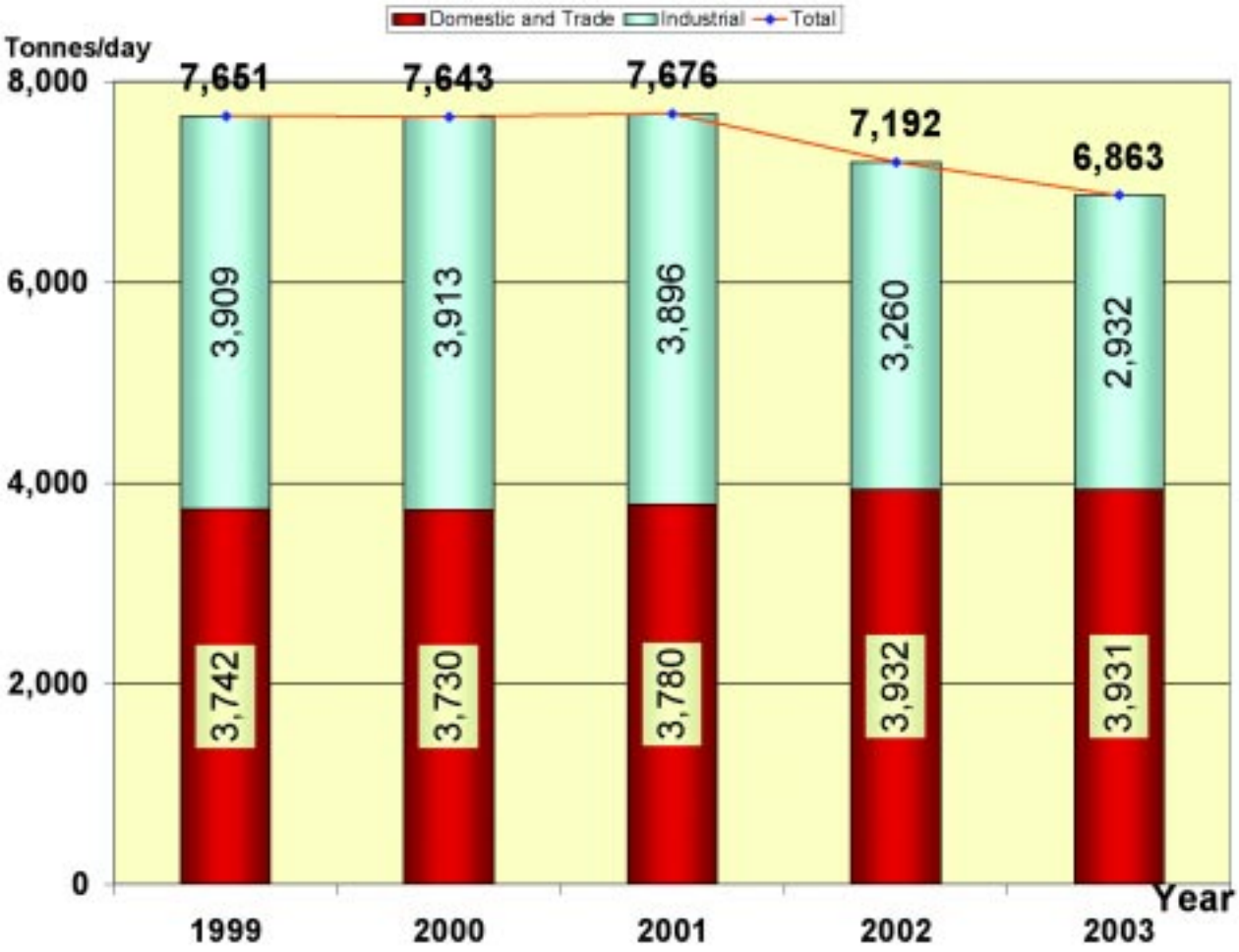
As the quantity of refuse disposed of at the incineration plants and the landfill at Semakau has been increasing over the years, a parallel policy of waste minimisation is gradually proving to be effective in solid waste management. Waste minimisation was actively promoted in all sectors of the community in an effort to accommodate land constraints and offset the rising costs of waste disposal.

Nevertheless, with refuse disposed of in 2001 tipping the scales at 2.80 million tonnes, the availability of land to cope with the increasing rates of refuse disposal can become a pressing problem. Daily average for 2003 was 6,863 tonnes per day, a decrease of 4.9% as compared to the amount of refuse disposed of in 2002.

The amount of refuse collected from 1999 to 2003 is shown in **Chart 8**.

Chart 8

Refuse Collected



Solid Waste Collection System

The huge amount of municipal refuse generated daily, demands a highly efficient system to manage its collection and disposal. Our operations over the years have resulted in Singapore having one of the most efficiently operated refuse collection services in the region.

Public Waste Collection Scheme

The collection service is built on a collective platform where pre-qualified waste collection companies competed to provide refuse collection services for the island's nine geographical sectors. A map of the nine sectors is shown in **Chart 9**. Successful bidders were awarded tenders to serve the respective sectors for a period of 5 years. They are also required to provide door-to-door collection services for recyclable materials in their sectors under the National Recycling Programme. The commencement date and the waste collection companies for the various sectors are listed in **Table 21**.

Chart 9

Privatised Refuse Collection Services – 9 Geographical Sectors

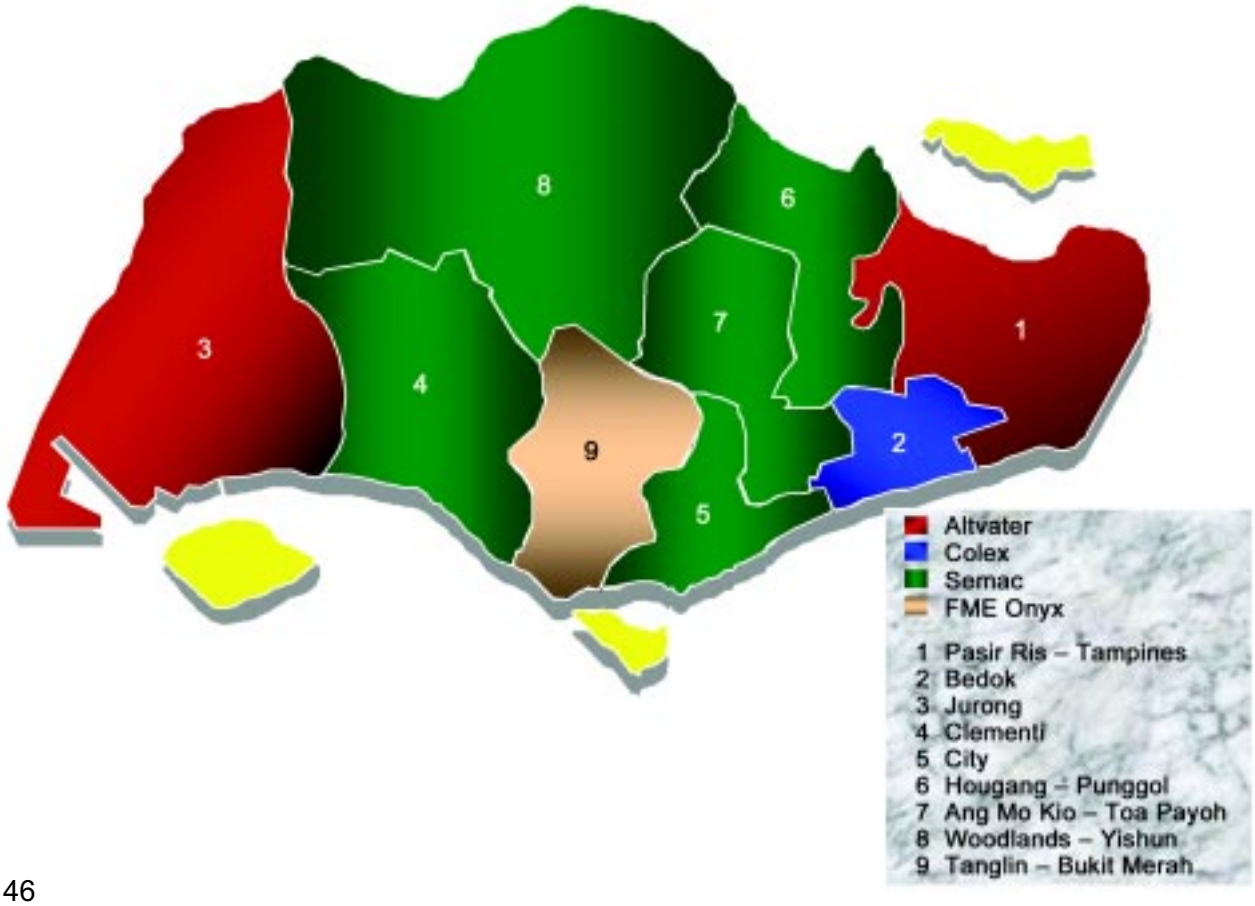


Table 21

Commencement Date for the 9 Geographical Sectors under the Privatisation Scheme

No	Sector	PWC	Commencement Date
1	Pasir Ris – Tampines	Altvater Jakob	1 July 99
2	Bedok	Colex	1 November 99
3	Jurong	Alvater Jakob	1 April 01
4	Clementi	Sembwaste	1 May 01
5	City	Sembwaste	1 June 01
6	Ang Mo Kio - Toa Payoh	Sembwaste	1 July 01
7	Hougang-Punngol	Sembwaste	1 July 01
8	Woodlands-Yishun	Sembwaste	1 August 01
9	Tanglin-Bukit Merah	FME Onyx	1 September 01

Licensed General Waste Collectors

WMD licenses and monitors the collection of refuse by licensed general waste collectors, who mainly serve commercial and industrial premises. It is an offence for any person or company to collect or transport waste as a business without a valid General Waste Collector Licence. Licensed general waste collectors can refer to 'The Code of Practice for Licensed Waste Collectors' for work protocols and guidelines on good practices in the waste collection business. The Code of Practice is available in the website at http://app10.internet.gov.sg/scripts/nea/cms/htdocs/category_sub.asp?cid=101

Application of General Waste Collector Licence

Applicants can download the application forms from the website at http://www.nea.gov.sg/cms/esd/gwcapplication.pdf.

Refuse disposal

NEA's solid waste disposal infrastructure comprises four incineration plants – Ulu Pandan, Tuas, Senoko and Tuas South as well as an offshore landfill at Pulau Semakau. Collectively, they disposed of a total of 2.51 million tonnes of waste in 2003, or about 6,863 tonnes per day. Approximately 2.31 million tonnes or 92.0% of the refuse was

incinerated while the remaining refuse was landfilled. **Table 22** shows the amount of refuse disposed of in the landfill and the incineration plants over the last 10 years.

From the refuse incinerated, about 981 million kWh of electricity were produced from the waste heat. The power generated represents about 2 to 3% of the total electricity generated in Singapore. The quantity of scrap metal recovered in 2003 amounted to 22,800 tonnes. These were sold to a local steel mill for reprocessing into steel products mainly for the construction industry. The incineration plants are equipped with advanced air pollution control equipment such as dry lime reactors, electrostatic precipitators and catalytic bag filters to ensure compliance with the emission standards stipulated in the Environmental Pollution Control (Air Impurities) Regulations 2000.

The total effective incineration capacity of the four incineration plants is 8,200 tonnes per day. Their capacity is sufficient to dispose of all incinerable wastes generated in Singapore.

Table 22
Refuse Disposed of at Authorised Sites (1994 – 2003)

Year	Landfill ('000 tonnes)	Incineration Plants ('000 tonnes)	Total Refuse Disposed Of ('000 tonnes)
1994	666.3	1,758.6	2,424.9
1995	848.5	1,826.7	2,675.2
1996	883.1	1,873.5	2,756.6
1997	1,051.3	1,745.0	2,796.3
1998	958.1	1,884.1	2,842.2
1999	756.2	2,036.3	2,792.5
2000	357.2	2,440.1	2,797.3
2001	251.3	2,550.9	2,802.2
2002	204.3	2,421.3	2,625.6
2003	193.8	2,311.2	2,505.0

Energy Conservation

The National Energy Efficiency Committee (NEEC) is an inter-agency committee with 3P (People, Private and Public sector) representation. It seeks to integrate the promotion of energy efficiency and the use of clean energy sources with the reduction of emissions of air pollutants and carbon dioxide from the production of energy.

The key thrusts of the NEEC are as follows:

i) Promotion of energy conservation through the efficient use of energy in the industrial, building, transportation and consumer sectors.

ii) Promotion of the use of cleaner energy sources such as natural gas and renewable energy sources.

iii) Promotion of Singapore as a location for the pilot test-bedding of pioneering energy technologies and as the hub for development and commercialisation of clean energy technologies.

RCD coordinates and facilitates the NEEC's programmes and provides secretariat support to the NEEC and its Sub-committees and Workgroups.

National Energy Efficiency Committee

In 2003, the Industry Sub-committee formed two workgroups representing two manufacturing sub-sectors that are large energy consumers, namely electronics and pharmaceuticals.

With the formation of these workgroups, another 19 organisations joined the NEEC in 2003, bringing the total number of organisations involved in the NEEC to 64 by 2003. The organisations participating in the Electronics workgroup and the Pharmaceuticals workgroup are listed in **Table 21**.

Table 21[1]

Electronics Workgroup (Industry Sub-Committee)	**Pharmaceuticals Workgroup (Industry Sub-Committee)**
National Semiconductor Manufacturing Singapore Pte Ltd	Schering Plough Ltd
ST Microelectronics Pte Ltd	Glaxo Wellcome Manufacturing Pte Ltd
Chartered Semiconductor Mfg Pte Ltd	Pfizer Asia Pacific Pte Ltd
Seagate Technology Int'l	Kaneka Singapore Co. Pte Ltd
HP Singapore Pte Ltd	Wyeth Pharmaceuticals (Singapore) Pte Ltd
3M Singapore Pte Ltd	Merck Sharp & Dohme (Singapore) Ltd
CNA Engineers Pte Ltd	Aventis Pharma Mfg Pte Ltd
Precicon Automation (S) Pte Ltd	Johnson Controls (Singapore) Pte Ltd
Supersolutions Pte Ltd	Elyo South East Asia Pte Ltd
Trane Singapore	Energy Market Authority (existing NEEC member)
Energy Market Authority (existing NEEC member)	Economic Development Board (existing NEEC member)
ASHRAE (existing NEEC member)	
JTC Corporation (existing NEEC member)	
NTU (Observer) (existing NEEC member)	

[1] The full list of representations in the NEEC can be viewed in the NEEC website http://www.neec.gov.sg/

Energy Efficiency Initiatives

In 2003, the following energy efficiency initiatives were launched under the umbrella of the NEEC:

(a) Energy Labelling Scheme

The Green Corners programme was launched on 28 March 2003 by the then Chairman NEEC, Dr Balaji Sadasivan, the Minister of State for Health and the Environment. This joint SEC-NEA programme showcases air-conditioners and refrigerators that have been awarded Energy Labels in electrical appliance retail stores. Altogether, six Green Corner retail stores were launched in 2003. There is now better visibility for labelled appliances in retailers' showrooms.

To address the lack of international standards for inverter-type air-conditioners, a study group consisting of representatives from major air-conditioner brands was set up in February 2003 to draft labelling and testing standards for such air-conditioners.

Green Corners at Various Retail Outlets

As at 2003, there were 64 refrigerator and 70 air-conditioner models registered with the Energy Label.

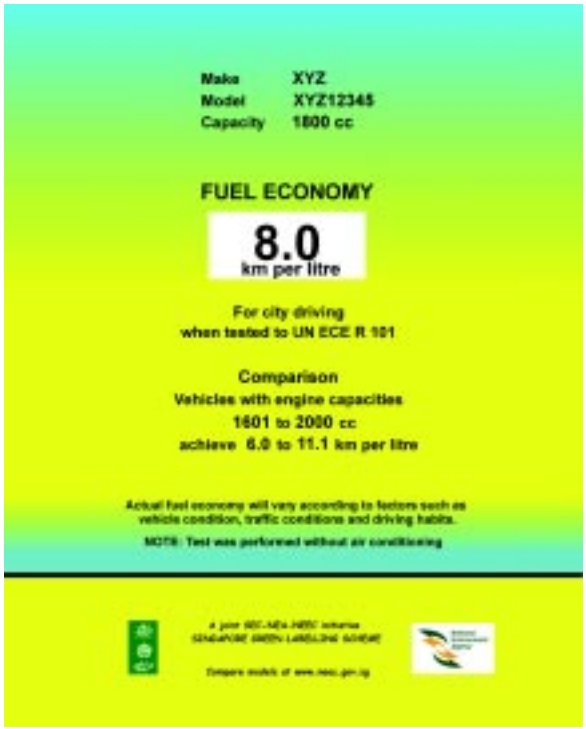
(b) Fuel Economy Labelling Scheme

Chairman NEEC, Mr Mohamad Maidin, Senior Parliamentary Secretary for the Environment and Home Affairs, launched the Fuel Economy Labelling Scheme on 5 June 2003. A mini-exhibition to promote green vehicles and public transportation was also held at the event.

The aim of the Scheme is to promote greater awareness among motorists of fuel economy and to provide car buyers an objective means of comparing the fuel economy of different car models.

NEA and SEC also produced a Green Transport Guide to educate motorists about greener forms of transportation. The Guide is now available at car showrooms and vehicle inspection centres, and downloadable free of charge from the SEC and NEEC websites.

As at end 2003, 83 car models were issued with the Fuel Economy Label, representing 18% of the car models in the market.



Picture of the Fuel Economy Label

(c) Energy Efficiency Projects under the Economy Drive (ED)

In July 2003, NEA and EDB presented a proposal to the Economy Drive Committee (EDC) set up by the Singapore Government, to implement energy saving projects at public sector facilities as a means to reduce energy costs. The proposal was adopted by EDC as one of its service-wide initiatives, and NEA, together with EDB, was asked to assist interested public sector agencies in implementing pilot energy saving projects.

A technical committee, comprising of representatives from NEA, EDB, BCA, DSTA, EMA and NUS, as well as a private sector representative, was formed to provide guidance and advice for the projects and develop contractual documents for the procurement of energy performance contracting services.

Seven public sector agencies are involved in the pilot phase of the project and they would be inviting tenders for the provision of energy performance contracting services in 2004.

Clean/Renewable Energy Initiatives

In 2003, the following clean/renewable energy initiatives were launched under the auspices of the NEEC:

- EDB, HDB, NTU and NEA established an MOU for collaboration on fuel cell testbedding projects in August 2003. The first project under this MOU is a fuel cell power system that would be installed at a multi-storey carpark in Pasir Ris-Punggol Town Council. This project would provide up to 5kW of electricity for lighting to the carpark. The installation and commissioning of the fuel cell power system is targeted for April 2004. Subsequently, the system will be field-tested for a year.

- NEA is collaborating with JTC and a private company to demonstrate the innovative use of building integrated photovoltaic systems (or BIPV) in the form of architectural special glass modules at the facade through a test-bedding project at the Biopolis, a JTC development in one-north.

  The concept of an energy-neutral building will be illustrated by the project, where the PV system would produce sufficient electricity to meet the electrical needs of the Biopolis Visitor Centre during the day. The 20 kWp system is expected to be installed by May 2004 and will be field-tested for a period of one year.

Awareness Building and Education

To enhance existing educational programmes on energy conservation for schools, NEA has produced posters that explain the effects of electricity use on the environment and provide tips on conserving energy in schools and at home. The posters are targeted at the primary and secondary school levels.

Posters for Schools

8 INTERNATIONAL COOPERATION

Overview

Since the formation of NEA in July 2002, PDD has been spearheading NEA's efforts to promote Singapore's environmental interests. In 2003, NEA's active participation in environmental fora has helped to strengthen Singapore's environmental cooperation with regional countries and international organisations. This has also enhanced Singapore's standing on matters relating to environmental policies, management and technology in the international arena.

Bilateral Cooperation

Malaysia

At the 18th Malaysia-Singapore Joint Committee on the Environment (MSJCE) Meeting held in Putrajaya, Malaysia in September 2002, the MSJCE decided to form the MSJCE Working Group (MSJCE WG) to support the MSJCE. The MSJCE WG is co-chaired by CEO of NEA and Director-General of Department of Environment, Malaysia.

The 1st meeting of the MSJCE WG was held in Singapore on 6 – 7 February 2003. The meeting discussed environmental issues of mutual concern. These included the control of vehicular emissions, water quality in the Straits of Johor and the Skudai River catchment and the emergency response plan to deal with chemical spill on the Second Crossing.

Indonesia

In November 2002, a new Indonesia-Singapore Environment Partnership (ISEP) initiative was launched to enhance the existing environmental collaborations between Indonesia and Singapore. At the same time, the Indonesia-Singapore Working Group (ISWG) on the Environment was formed to drive the ISEP and to develop joint programmes and activities under this bilateral partnership initiative.

The 1st Meeting of the ISWG was held on 19 – 20 February 2003 in Singapore. The Meeting was co-chaired by CEO, NEA and Assistant to Minister for Global Environment Affairs, Ministry of Environment (MOE), Indonesia. The meeting discussed various areas of collaboration and projects such as capacity building under the ISWG.

NEA conducted a training programme on "Interpretation of Satellite Imageries" for 13 Indonesian officials on 25 – 29 August 2003 as one of the projects under the ISWG to train Indonesian officers to become more effective in using satellite imageries to track forest/plantation fires.

Regional Cooperation

ASEAN Working Group on Multilateral Environment Agreements (AWGMEA)

Singapore has been chairing the AWGMEA since 2002. The 7th meeting of the AWGMEA was held in Kuala Lumpur, Malaysia on 27 – 28 March 2003 and was attended by representatives from all ASEAN member countries and the ASEAN Secretariat.

The meeting agreed on a list of common understanding on various issues under the MEAs, namely the United Nations Framework on Climate Change Convention, Montreal Protocol on Substances that Deplete the Ozone Layer, Rotterdam Convention on Prior Informed Consent Procedure and Stockholm Convention on Persistent Organic Pollutants.

The 7th meeting of the AWGMEA enabled ASEAN member countries to better understand the current concerns of other ASEAN member countries on the various MEAs. It has also enabled ASEAN member countries to exchange information and experience on dealing with MEA-related issues.

ASEAN Working Group on Environmentally Sustainable Cities (AWGESC)

Singapore is spearheading a regional initiative on environmentally sustainable cities in ASEAN. The ASEAN Working Group on Environmentally Sustainable Cities (AWGESC) held its 1st meeting in Singapore on 25 – 26 June 2003. The meeting developed the "Outline of Framework for Environmentally Sustainable Cities in ASEAN".

The AWGESC organised a workshop on Environmentally Sustainable Cities in ASEAN in Singapore in December 2003 for ASEAN city managers and officials to develop a Framework on Environmentally Sustainable Cities for ASEAN. The workshop was well received by representatives from all ASEAN member countries, the ASEAN Secretariat, as well as representatives from various international organisations.

The ASEAN Environment Ministers endorsed the proposed Framework at the ASEAN Ministerial Meeting on the Environment (AMME) held on 17 – 18 December 2003 in Yangon, Myanmar. The ASEAN member countries will nominate cities in their respective countries to participate in the initiative and implement the Framework.

Sub-Regional Fire-Fighting Arrangements (SRFA) for Sumatra and Borneo

The 12th and 13th Joint Meeting on the Sub-regional Fire-fighting arrangements (SRFA) for Sumatra and Borneo were held on 13 – 14 January 2003 in Brunei Darussalam and 31 July – 2 August 2003 in Jambi, Indonesia respectively.

These regular meetings, attended by officials from Brunei Darussalam, Indonesia, Malaysia and Singapore, provided opportunities for the officials to be updated on the latest weather and haze situation, as well as review the progress made in implementing the ASEAN Regional Haze Action Plan.

To help countries better prepare for future smoke haze episodes and to ensure that there is a coordinated collective regional response to deal with smoke haze episodes, a SRFA fire and haze table-top exercise was conducted on 29 – 30 July 2003 in Jakarta, Indonesia. The exercise, participated by environmental agencies from Brunei Darussalam, Indonesia, Malaysia, Singapore, and representatives from the ASEAN Secretariat and UN Office for the Coordination of Humanitarian Affairs, provided a means for the officials to familiarize themselves with provisions for joint emergency response under the mechanisms outlined in the draft SRFA standard operating procedures.

International Cooperation

RCA National Representatives Meeting and General Conference

The Regional Cooperative Agreement (RCA) is an intergovernmental agreement for East Asia & Pacific region, under the auspices of the International Atomic Energy Agency (IAEA), in which member countries undertake to promote and co-ordinate projects in nuclear science and technology. NEA has taken over the role of National RCA Coordinator from ENV.

The 25th RCA National Representatives Meeting (NRM) was held in Colombo, Sri Lanka from 26 – 28 May 2003. NEA represented Singapore at the NRM. The meeting reviewed Technical Cooperation (TC) projects under the RCA. The meeting also agreed that technical co-operation should focus on quality projects that would form the foundation for strong regional programmes.

The 32nd RCA General Conference (GC) was held in Vienna, Austria on 17 September 2003. The GC discussed and endorsed 35 projects in the main areas of environment, health care, industry, energy, radiation protection and agriculture as well as various activities planned for 2004.

At the GC, Singapore also had a bilateral meeting with the Technical Cooperation Department (TCD) of IAEA. During the meeting, Singapore reaffirmed its support for IAEA and its commitment to continue hosting fellowships/study visits in Singapore.

Second Session of the Expert Group (EG) on Best Available Techniques (BAT) and Best Environmental Practices (BEP)

The 2nd session of the Expert Group (EG) on Best Available Techniques (BAT) and Best Environmental Practices (BEP) of the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) was held in Villarrica, Chile from 8 – 12 December 2003. The EG is tasked to develop BAT/BEP guidelines to help Parties to the SC to reduce/ eliminate unintentional releases of POPs. NEA represents Singapore and ASEAN in the EG.

At the 2nd session, BAT/BEP guidelines for non-thermal processes using chlorine and diffuse activities such as open burning were developed. Singapore shared with the EG the ASEAN Guidelines on Zero Burning Technique for the Development of Plantations. BAT/BEP guidelines for cement kilns firing hazardous wastes had been drafted at the first session.

The EG is expected to complete its work by its next meeting and submit the final BAT/ BEP guidelines to the 1st Conference of Parties in 2005.

International Conventions

Protection of the Ozone Layer

Singapore has been a party to the Montreal Protocol since 5 January 1989. On 2 March 1993, Singapore acceded to the London Amendment to the Montreal Protocol and more recently, the Copenhagen Amendment and the Montreal Amendment on 22 September 2000.

The Montreal Protocol deals with control measures and phase-out schedules for various Ozone Depleting Substances (ODS) such as chlorofluorocarbons (CFCs), Halons and methyl bromide. Some of these ODS, namely CFCs, Halons, carbon tetrachloride and methyl chloroform, have been phased out in Singapore. In addition, industries that are currently using hydrochlorofluorocarbons (HCFCs) or methyl bromide are encouraged to replace them with non-ozone depleting substitutes wherever practicable.

The control measures implemented by Singapore are summarised in **Table 22**.

Table 22

Summary of Measures to Phase Out Ozone-Depleting Substances

Date	Measure
5 Oct 1989	Quota Allocation System implemented for Chlorofluorocarbons (CFCs).
5 February 1991	Prohibit the import and manufacture of non-pharmaceutical aerosol products and polystyrene sheets/products containing controlled CFCs.
1 January 1992	(a) Prohibit the use of Halon 1301 for new fire-protection systems. (b) Prohibit the import of Halon 2402.
1 January 1993	Prohibit the import of new air-conditioning and refrigeration equipment using CFC 11 and CFC 12.
1 January 1994	Prohibit the import of Halon 1211 and Halon 1301.
15 April 1994	Prohibit the import of fire-extinguishers filled with Halon 1211.
1 January 1995	All new cars must be equipped with non-CFC air-conditioning systems.
1 April 1995	Prohibit the import of HBFCs.
1 January 1996	Prohibit the import of CFCs, carbon tetrachloride and 1,1,1-trichloroethane (methyl chloroform).
1 January 2002	Freeze the consumption of Methyl Bromide (MeBr) for non-quarantine and pre-shipment (non-QPS) applications*.

***Note:** Quarantine applications – Include treatments to prevent the introduction, establishment, and/or spread of quarantine pests, or to ensure their official control.

Pre-shipment applications – These include non-quarantine methyl bromide applications within 21 days prior to export that are required to meet the official requirements of the importing or exporting countries.

The import and export of ODS are regulated under the Environmental Pollution Control Act (EPCA) and the Environmental Pollution Control (ODS) Regulations 2000. Under the Act and its Regulations, a licence is required for the import and/ or export of ODS listed in the Schedules of the Act and its Regulations **(Appendix 16)**.

During the year, PCD issued 40 Hazardous Substances Licences for the import and export of ODS, and processed electronically 2479 inward and outward declarations for the import and/or export of ODS through the TradeNet computerised network system. PCD carried out 40 inspections on consignments of hazardous waste imported into Singapore or bound for export overseas. All were found to be in accordance with the conditions in the Basel permit.

Control on Export, Import and Transit of Hazardous Wastes (Basel Convention)

Singapore acceded to the Basel Convention on 2 January 1996. The Hazardous Waste (Control of Export, Import and Transit) Act and its Regulations were enacted and came into operation on 16 March 1998. The Act and its Regulations enable Singapore to fulfil the obligations of the Basel Convention. Under the Act and its Regulations, any person who wishes to export, import or transit any hazardous waste scheduled under the Basel Convention will have to apply for a permit from PCD.

During the year, PCD processed and issued 14 export, 4 import and 34 transit permits under the Basel Convention.

Control of Persistent Organic Pollutants

The Stockholm Convention seeks to control and ultimately eliminate the release of persistent organic pollutants (POPs). It sets out control measures on the production, import, export, disposal, and use of 10 commercially produced POPs, namely 8 pesticides and 2 industrial chemicals, and 2 unintentional by-products (furans and dioxins) from waste incineration and chemical plants.

Singapore has already banned the use of the 10 commercially produced POP chemicals in Singapore. We have already taken measures to limit furans and dioxins from our incineration plants. In keeping with internationally accepted practices to control such emissions, we have recently introduced air emission standards under the EPCA (Air Impurities) Regulations 2000 to limit dioxins and furans releases.

Control on International Trade in Hazardous Chemicals and Pesticides (The Rotterdam Prior Informed Consent Convention)

The Rotterdam Convention on Prior Informed Consent for Hazardous Chemicals and Pesticides in International Trade seeks to regulate the international trade of 31 highly dangerous pesticides and chemicals using the Prior Informed Consent (PIC) procedure.

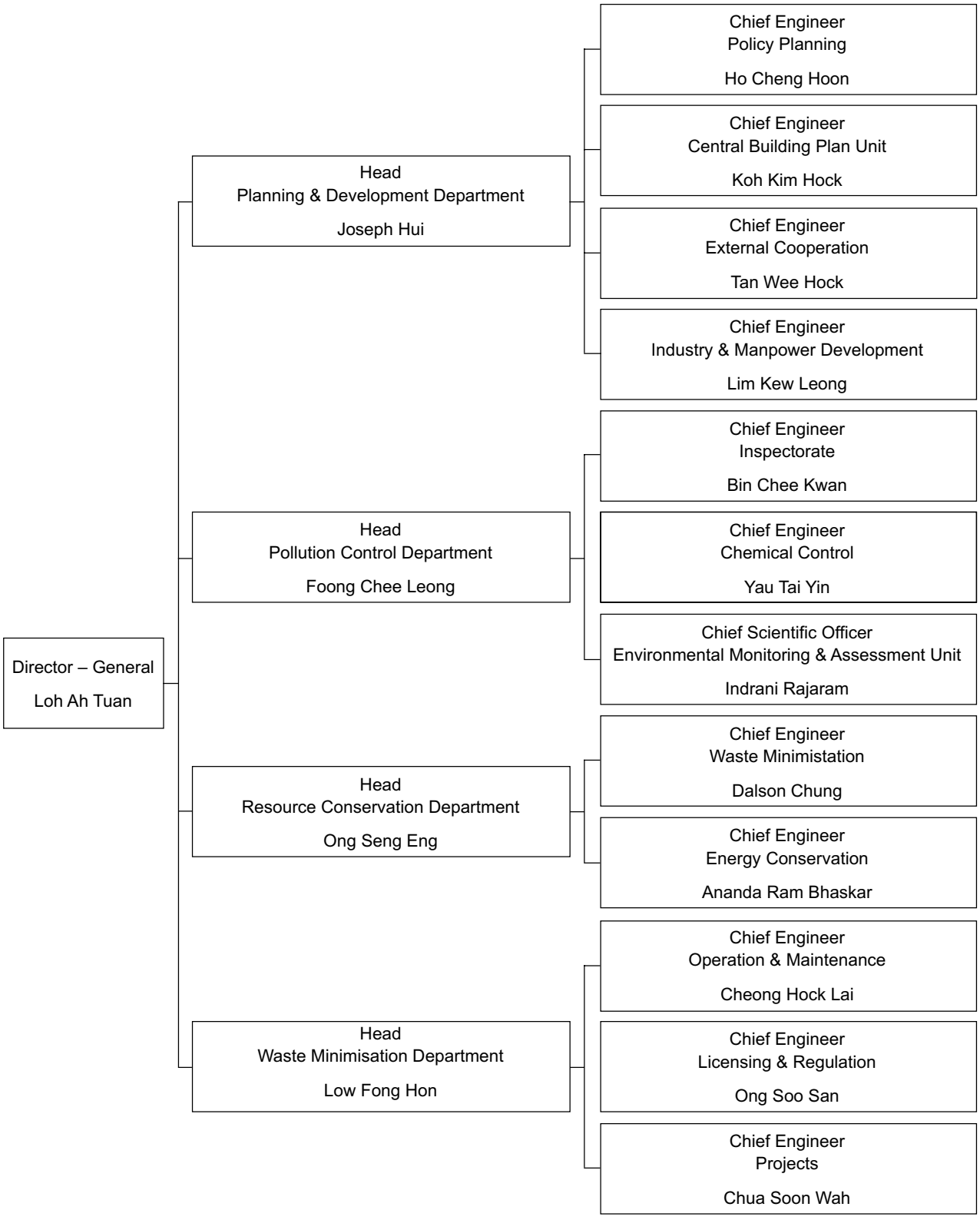
None of the chemicals, except Ethylene Oxide (ETO), is produced in Singapore. There is, however, no export of ETO for use as pesticide, fungicide, insecticide, herbicide, etc. ETO that is exported is for medical and clinical sterilisation use.

Singapore has implemented the Interim PIC Procedure (IPP) from 1 June 2001. PCD is the Designated National Authority for the control of the import and re-export of these 31 highly dangerous pesticides and chemicals. PCD will grant a licence to a company to import and re-export any of the 31 controlled chemicals using the PIC procedure.

During the year, PCD approved 16 applications of export of chemicals controlled under the Rotterdam Convention. The exports were granted in accordance with the PIC procedure under the Rotterdam Convention.

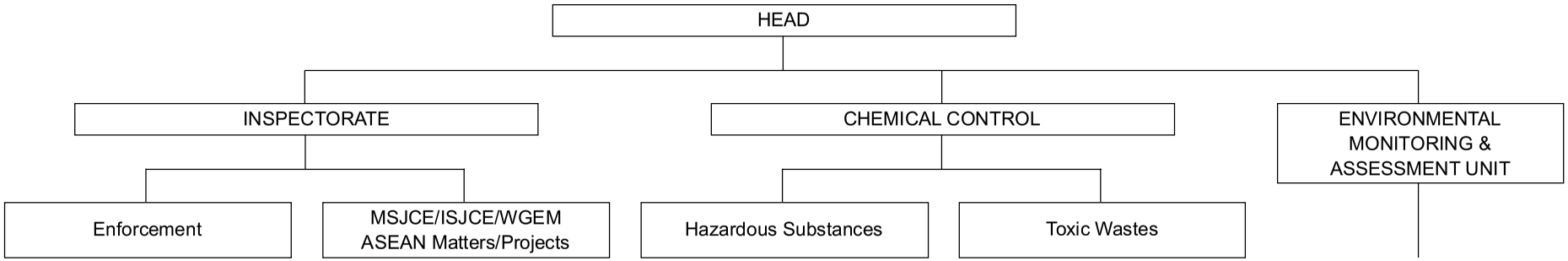
APPENDIX 1

ORGANISATION CHART
ENVIRONMENTAL PROTECTION DIVISION



APPENDIX 2

ORGANISATION CHART OF POLLUTION CONTROL DEPARTMENT



- Enforce pollution control legislation.
- Implement air and water pollution control programmes eg. inspections, water samplings & emission testing, surveillances of rural areas, backyard industries and industries.
- Investigate complaints of air and water pollution.

- Formulate and implement programmes/projects on environmental management for the ASEAN Working Group on Environmental Management.
- Formulate and implement programmes/projects on environmental co-operation for the Malaysia-Singapore Joint Committee on the Environment and the Indonesia-Singapore Joint Committee on the Environment.
- Control vehicular emissions and fuel quality.

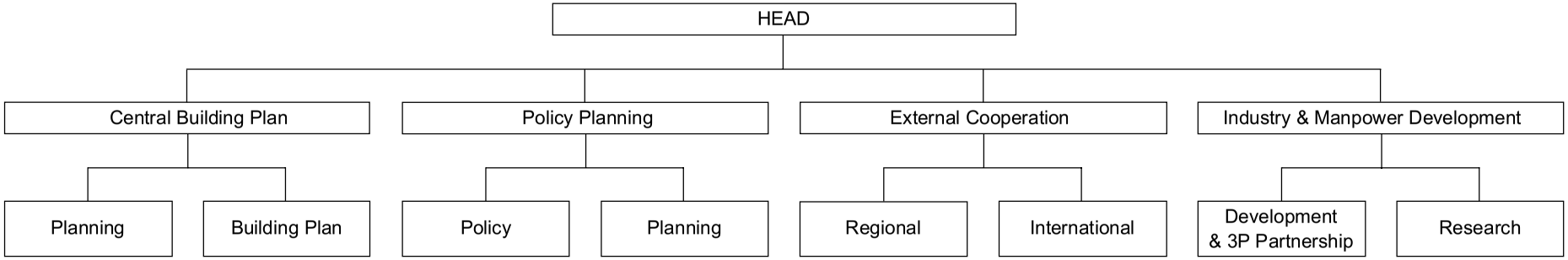
- Plan and implements programmes such as hazard analysis, safety review, wastes audit, emergency & spill response, to control hazardous substances.
- Approve and checks on the transportation of hazardous substances.

- Plan and implements programmes such as hazard analysis, safety review, wastes audit, emergency & spill response, to control toxic wastes.
- Approve and checks on the transportation and disposal of toxic wastes.
- Implement programmes to phase-out ozone depleting substances.

- Undertake monitoring programmes to assess air quality and the quality of the inland and coastal waters.
- Monitor toxic trace contaminants in the environment.
- Track air and water quality trends to identify emerging environmental problems
- Provide laboratory services for investigations and enforcement action.
- Undertake studies and projects related to environmental quality.
- Develop and upgrade monitoring methods for air and water quality assessment.

APPENDIX 3

ORGANISATION CHART OF PLANNING AND DEVELOPMENT DEPARTMENT



- Assess environmental impact of new developments at land use and development control stages.
- Impose environmental control requirements on new developments.
- Process sewerage and drainage interpretation plan applications.

- Provide walk-in pre-consultation sessions to architects and professional engineers on building plan submission.
- Register building plans/detailed plans on sewerage, drainage and environmental health.
- Check building plans on pollution control.
- Process applications for Temporary Occupation Permit/Certificate of Statutory Completion.

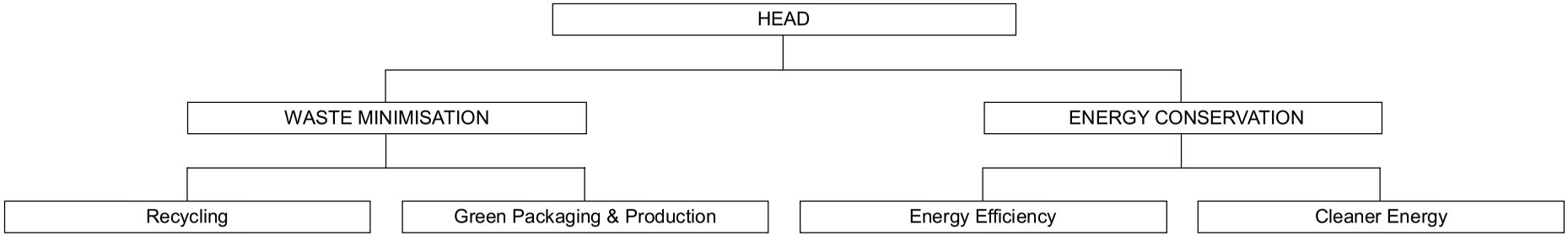
- Develop & review environmental policies, standards & strategies
- Develop vehicular emission control programmes.
- Develop green vehicle programmes
- Coordinate review and implementation of the Singapore Green Plan 2012 and the action programmes.
- Attend to technical matters pertaining to Montreal Protocol and United Nations Framework Convention on Climate Change.

- IAEA RCA National Coordinator.
- Coordinate implementation of MEAs.
- Represent NEA/provide support at multilateral, regional and bilateral meetings.
- Coordinate & oversee bilateral/regional environmental cooperation & other regional activities.
- Track & formulate responses to regional and bilateral issues.

- Lead and coordinate development of 5 key environmental industry sectors: Waste Management & Recycling, Energy Service, Pollution Control and Public Health.
- Identify and promote creation of new jobs in the environmental sectors for Singaporeans and PRs.
- Develop the local environmental technology sector through Innovation for Environmental Sustainability Fund, test-bedding projects and joint research projects with tertiary institutions and research institutes.

APPENDIX 4

ORGANISATION CHART OF RESOURCE CONSERVATION DEPARTMENT



- Formulate & implement waste recycling initiatives & programmes.
- Manage & develop Sarimbun Recycling Park.
- Collect and analyse waste & recycling statistics.
- Promote waste recycling in Households, Commercial, Industrial and Public sectors.
- Plan, promote and coordinate the deployment of recycling bins in public places.

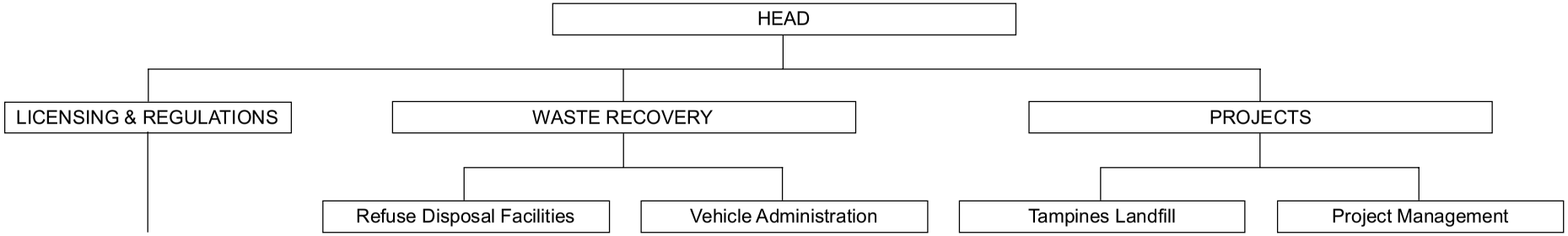
- Facilitate and initiate the development of innovative technologies.
- Green labeling scheme.
- Product repackaging.
- Product life cycle assessment.

- Develop strategies and programmes for energy efficiency.
- Promote energy efficient technologies.
- Promote energy efficiency in the Buildings, Consumer, Industrial, Transportation, and Public sectors.
- Secretariat support for the NEEC.

- Develop strategies and programmes for cleaner energy.
- Promote cleaner energy in the Buildings, Consumer, Industrial, Transportation, and Public sectors.
- Promote development and test-bedding of promising energy technologies.

APPENDIX 5

ORGANISATION CHART OF WASTE MANAGEMENT DEPARTMENT



- Licence general waste collectors.
- Regulate refuse collection for the domestic and trade premises.
- Enforce illegal dumping.

- Provide refuse disposal services.
- Operation of 4 incineration plants, Tuas Marine Transfer Station and Semakau Landfill.
- Collect revenue.
- Review of refuse disposal fee.

- Maintain and repair NEA's fleet of vehicles.

- Operation and maintenance of leachate collection and treatment facilities.
- Operation and maintenance of gas management system.
- Post-closure maintenance.

- Development of Solid Waste Disposal Facilities
- Management of new projects for the Environmental Public Health Division such as HUP, development of cemeteries, columbaria and crematoria facilities.

APPENDIX 6

STANDARDS OF CONCENTRATION OF AIR IMPURITIES

SUBSTANCE	TRADE, INDUSTRY, PROCESS, FUEL BURNING EQUIPMENT OR INDUSTRIAL PLANT	EMISSION LIMITS
(a) Ammonia and ammonium compounds	Any trade, industry or process	76 mg/Nm^3 expressed as ammonia
(b) Antimony and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as antimony
(c) Arsenic and its compounds	Any trade, industry or process	1 mg/Nm^3 expressed as arsenic
(d) Benzene	Any trade, industry or process	5 mg/Nm^3
(e) Cadmium and its compounds	Any trade, industry or process	3 mg/Nm^3 expressed as cadmium
(f) Carbon monoxide	Any trade, industry, process or fuel burning equipment	625 mg/Nm^3
(g) Chlorine	Any trade, industry or process	32 mg/Nm^3
(h) Copper and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as copper
(i) Dioxins and furans	Any waste incinerator	(i) 1.0 ng TEQ/Nm^3 for waste incinerators commissioned before 1st Jan 2001 (ii) 0.1 ng TEQ/Nm^3 for waste incinerators commissioned on or after 1st Jan 2001
(j) Ethylene oxide	Any trade, industry or process	5 mg/Nm^3
(k) Fluorine, hydrofluoric acid or inorganic fluorine compounds	Any trade, industry or process	50 mg/Nm^3 expressed as hydrofluoric acid
(l) Formaldehyde	Any trade, industry or process	20 mg/Nm^3
(m) Hydrogen chloride	Any trade, industry or process	200 mg/Nm^3
(n) Hydrogen sulphide	Any trade, industry or process	7.6 mg/Nm^3
(o) Lead and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as lead
(p) Mercury and its compounds	Any trade, industry or process	3 mg/Nm^3 expressed as mercury
(q) Oxides of nitrogen	Any trade, industry, process or fuel burning equipment	700 mg/Nm^3 expressed as nitrogen dioxide

(r) Particulate substances including smoke, soot, dust, ash, fly-ash, cinders, cement, lime, alumina, grit other solid particles of any kind	Any trade, industry, process, fuel burning equipment or industrial plant (except for any cold blast foundry and cupolas)	(i) 100 mg/Nm^3; or (ii) where there is more than one flue, duct or chimney in any scheduled premises, the total mass of the particulate emissions from all of such flue, duct or chimney divided by the total volume of such emissions shall not exceed 100mg/Nm^3 and the particulate emissions from each of such flue, duct or chimney shall not exceed 200 mg/Nm^3 at any point in time
(s) Smoke	All stationary fuel-burning sources	Ringelmann No. 1 or equivalent opacity (Not to exceed more than 5 minutes in any period of one hour)
(t) Styrene monomer	Any trade, industry or process	100 mg/Nm^3
(u) Sulphur dioxide (non-combustion sources)	Any trade, industry or process	500 mg/Nm^3
(v) Sulphur trioxide and other acid gases	The manufacture of sulphuric acid	500 mg/Nm^3 expressed as sulphur trioxide. Effluent gases shall be free from persistent mist
(w) Sulphur trioxide or sulphuric acid mist	Any trade, industry or process, other than any combustion process and any plant involving the manufacture of sulphuric acid	100 mg/Nm^3 expressed as sulphur trioxide
(x) Vinyl chloride monomer	Any trade, industry or process	20 mg/Nm^3

Note: The concentration of any specified substance (1st column) emitted from any specified operation in any trade, industry, process, fuel burning equipment or industrial plant (2nd column) shall not at any point before mixture with air, smoke or other gases, exceed the specified limits (3rd column).

"dioxins and furans'' means polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), being tricyclic and aromatic compounds formed by 2 benzene rings which are connected by 2 oxygen atoms in PCDD and by one oxygen atom in PCDF and the hydrogen atoms of which may be replaced by up to 8 chlorine atoms;

"mg'' means milligram;

"ng'' means nanogram;

"Nm^3'' means normal cubic metre, being that amount of gas which when dry, occupies a cubic metre at a temperature of 0 degree Centigrade and at an absolute pressure of 760 millimetres of mercury;

"TEF'' means Toxic Equivalency Factor

APPENDIX 7

LIST OF PREMISES CLASSIFIED AS SCHEDULED PREMISES UNDER THE ENVIRONMENTAL POLLUTION CONTROL ACT

Scheduled Premises are any premises:

(a) being used for:

(i) cement works, being works for the manufacture or packing of portland cement, similar cement or pozzolanic materials;

(ii) concrete works, being works for the manufacture of concrete and of each batch capacity greater than 0.5 cubic metre;

(iii) asphalt works, being works for the manufacture of asphalt or tarmacadam;

(iv) ceramic works, being works in which any products such as bricks, tiles, pipes, pottery goods, refractories or glass are manufactured in furnaces or kilns fired by any fuel;

(v) chemical works, being works in which acids, alkali, chemical fertilizer, soap, detergent, sodium silicates, lime or other calcium compounds, chlorine, chemicals or chemical products are manufactured;

(vi) coke or charcoal works, being works in which coke and charcoal is produced and quenched, cut, crushed or graded;

(vii) ferrous and non-ferrous metal works, being works in which metal melting process for casting and/or metal coating are carried out;

(viii) gas works, being works in which coal, coke, oil or other mixtures or derivatives are handled or prepared for carbonisation or gasification and in which such materials are subsequently carbonised or gasified;

(ix) crushing, grinding and milling works, being works in which rock, ores, minerals, chemicals or natural grain products are processed by crushing, grinding, milling or separating into different sizes by sieving, air elutriation or in any other manner;

(x) petroleum works, being works in which crude or shale oil or crude petroleum or other mineral oil is refined or reconditioned;

(xi) scrap metal recovery works, being works in which scrap metals are treated in any type of furnace for recovery of metal irrespective of whether this is the primary object of any specific premises or not;

(xii) primary metallurgical works, being works in which ores are smelted or converted to metal of any kind;

(xiii) pulping works, being works in which wood or cellulose material is made into pulp;

(xiv) abrasive blasting works, being works in which equipment or structures are cleaned by abrasive blasting;

(b) on which there is erected any boiler of steam generating capacity of 2300 kilogrammes or more per hour, incinerator or furnace burning 500 kilogrammes or more of solid combustible material per hour or 220 kilogrammes or more of liquid material per hour;

(c) being used or intended to be used for storing:

(i) more than 100 tonnes of one or more of the following substances:

chemicals, chemical products, hydrocarbons or hydrocarbon products which are toxic or which produce toxic gases on burning or on contact with water or air; or

(ii) more than 1000 tonnes of one or more of the following substances:

chemicals, chemical products, hydrocarbons or hydrocarbon products with a flash point lower than 55º C.

APPENDIX 8

ALLOWABLE LIMITS FOR TRADE EFFLUENT DISCHARGED INTO A PUBLIC SEWER/WATERCOURSE/CONTROLLED WATERCOURSE

Items Of Analysis	Public Sewer	Watercourse	Controlled Watercourse
	Units in milligram per litre or otherwise stated		
1 Temperature of discharge	45ºC	45ºC	45ºC
2 Colour	-	7 Lovibond Units	7 Lovibond Units
3 pH Value	6 - 9	6 - 9	6 - 9
4 BOD (5 days at 20ºC)	400	50	20
5 COD	600	100	60
6 Total Suspended Solids	400	50	30
7 Total Dissolved Solids	3000	2000	1000
8 Chloride (as chloride ion)	1000	600	400
9 Sulphate (as SO4)	1000	500	200
10 Sulphide (as sulphur)	1	0.2	0.2
11 Cyanide (as CN)	2	0.1	0.1
12 Detergents (linear alkylate sulphonate as methylene blue active substances)	30	15	5
13 Grease and Oil	-	10	5
Grease and Oil (Hydrocarbon)	60	-	-
Grease and Oil (Non-hydrocarbon)	100	-	-
14 Arsenic	5	1	0.05
15 Barium	10	5	5
16 Tin	10	10	5
17 Iron (as Fe)	50	20	1
18 Beryllium	5	0.5	0.5
19 Boron	5	5	0.5
20 Manganese	10	5	0.5
21 Phenolic Compounds (expressed as phenol)	0.5	0.2	Nil
22 *Cadmium	1	0.1	0.01
23 *Chromium (trivalent and hexavalent)	5	1	0.05
24 *Copper	5	0.1	0.1

25	*Lead	5	0.1	0.1
26	*Mercury	0.5	0.05	0.001
27	*Nickel	10	1	0.1
28	*Selenium	10	0.5	0.01
29	*Silver	5	0.1	0.1
30	*Zinc	10	1	0.5
31	*Metals in Total	10	1	0.5
32	Chlorine (Free)	-	1	1
33	Phosphate (as PO4)	-	5	2
34	Calcium (as Ca)	-	200	150
35	Magnesium (as Mg)	-	200	150
36	Nitrate (NO3)	-	-	20

Note: * The concentration of Toxic Metal shall not exceed the limits as shown, individually or in total.

'Controlled Watercourse' means a watercourse from which potable water supplied by PUB under the Public Utilities Act is obtained but does not include a watercourse from which water is pumped into a main of the PUB.

The trade effluent discharged must not include:-

(1) Calcium carbide.
(2) Petroleum spirit or other inflammable solvents.
(3) Materials that may give rise to fire or explosion hazards.
(4) Materials that may be a hazard to human life, a public nuisance, injurious to health or otherwise objectionable.
(5) Refuse, garbage, sawdust, timber, or any solid matter.
(6) Pesticides, fungicides, insecticides, herbicide, rodenticide or fumigants.
(7) Radioactive material.

The trade effluent discharged into a public sewer must not include rainwater, storm water, ground water or other form of street drainage, subsurface drainage, roof drainage or yard drainage.

The trade effluent shall be analysed in accordance with the latest edition of 'Standard Methods for the Examination of Water and Wastewater' published jointly by the American Water Works Association and the Water Pollution Control Federation of the United States.

APPENDIX 9

TRADE EFFLUENT TARIFF SCHEME

The fees to be levied for discharge of biodegradable trade effluent into the public sewers are as follows:

Concentration (mg/l)	Fee at $ per cubic metre or part thereof	
	BOD	TSS
400 – 600	0.21	0.15
601 – 800	0.42	0.30
801 – 1000	0.63	0.45
1001 – 1200	0.84	0.60
1201 – 1400	1.05	0.75
1401 – 1600	1.26	0.90
1601 – 1800	1.47	1.05
1801 – 2000	1.68	1.20
2001 – 2200	1.89	1.35
2201 – 2400	2.10	1.50
2401 – 2600	2.31	1.65
2601 – 2800	2.52	1.80
2801 – 3000	2.73	1.95
3001 – 3200	2.94	2.10
3201 – 3400	3.15	2.25
3401 – 3600	3.36	2.40
3601 – 3800	3.57	2.55
3801 – 4000	3.78	2.70

NB: BOD = Biochemical Oxygen Demand (5 days at 20°C)
TSS = Total Suspended Solids

Trade effluent with BOD and TSS each in excess of 4000 mg/l shall be treated to below this standard at the factory prior to discharge into the public sewers.

Prior approval is required to dispose of organic sludge at designated Water Reclamation Plants/Sludge Treatment Works on the payment of a fee at a rate of $7.00 per cubic meter or part thereof.

Organic sludge means the organic matter in trade effluent which has a minimum solid content of 3 per cent by weight or a maximum moisture content of 97 per cent by weight.

APPENDIX 10

HAZARDOUS SUBSTANCES LISTED IN THE 2ND SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL ACT

Hazardous Substances	
Substance	**Exclusion**
Acetic acid	Substances containing not more than 80%, weight in weight, of acetic acid; Preparations and solutions for photographic use.
Acrolein	
Alkali metal bifluorides; Ammonium bifluoride; Potassium fluoride; Sodium fluoride; Potassium silicofluoride; Sodium silicofluoride; Silicofluoric acid	Preparations containing not more than 0.3%, weight in weight, of potassium fluoride in radiator protectors; Preparations containing not more than 0.96%, weight in weight, of potassium fluoride in photographic chemicals; Substances containing not more than 3%, weight in weight, of sodium fluoride or sodium silicofluoride as a preservative; Substances containing sodium fluoride intended for the treatment of human ailments.
Ammonia	Preparations and solutions of ammonia containing not more than 10%, weight in weight, of ammonia; Refrigeration equipment; Photographic and plan developers; Hair colour dyes; Perm lotions; Smelling bottles.
Ammonium chlorate	
Ammonium perchlorate	

Hazardous Substances	
Substance	**Exclusion**
Anionic surface active agents	Preparations containing less than 5% by weight of anionic surface active agents; Preparations containing anionic surface active agents which are not less than 90% biodegradable under a test carried out in accordance with that part of the OECD method which is referred to as “Confirmatory Test Procedure” in European Communities Council Directive No. 73/405/EEC (C) or other equivalent test methods acceptable to the Director.
Antimony pentachloride	Polishes
Arsenical substances, the following: Arsenic acid Arsenic sulphide Arsenic trichloride Arsine Calcium arsenite Copper arsenate Copper arsenite Lead arsenate Organic compounds of arsenic Oxides of arsenic Potassium arsenite Sodium arsenate Sodium arsenite Sodium thioarsenate	Pyrites ores or sulphuric acid containing arsenical poisons as natural impurities; Animal feeding stuffs containing not more than 0.005%, weight in weight, of 4-hydroxy-3-nitrophenyl-arsonic acid and not containing any other arsenical poison; Animal feeding stuffs containing not more than 0.01%, weight in weight, of arsanilic acid and not containing any other arsenical poison; Animal feeding stuffs containing not more than 0.0375%, weight in weight, of carbarsone and not containing any other arsenical poison.

Hazardous Substances	
Substance	**Exclusion**
Asbestos in the form of crocidolite, amosite, chrysotile and amphiboles and products containing these forms of asbestos	Asbestos products containing chrysotile other than roofing sheets, refuse chutes, ceiling boards, partition boards, fire barriers, doors, paints, cement, floor tiles and putty; Asbestos in the form of chrysotile in any vehicle brake or clutch lining not installed in any vehicle if the packaging of the vehicle brake or clutch lining is affixed with the appropriate label or in any vehicle brake or clutch lining installed in any vehicle registered before 1st April 1995. The label to be affixed on the packaging of the vehicle brake and clutch lining is in accordance with Part III of the Second Schedule of the EPCA.
Benzene	Substances containing less than 1%, weight in weight, of benzene.
Boric acid; Sodium borate	Boric acid or sodium borate in medicinal preparations, cosmetics, toilet preparations and substances being preparations intended for human consumption; Preparations containing boric acid or sodium borate or a combination of both where water or solvent is not the only other part of the composition.
Boron trichloride	
Boron trifluoride	
Bromine; Bromine solutions	
Cadmium-containing silver brazing alloy	
Captafol	

Hazardous Substances	
Substance	**Exclusion**
Carbamates	Benomyl; Carbendazim; Chlorpropham; Propham; Thiophanate-methyl; Preparations containing not more than 1%, weight in weight, of propoxur and not containing any other carbamate; Preparations containing not more than 1%, weight in weight, of methomyl and not containing any other carbamate.
Carbon disulphide	
Carbon tetrafluoride	
Chlorinated hydrocarbons, the following: Aldrin Benzene hexachloride (BHC) Bromocyclen Camphechlor Chlorbenside Chlorbicyclen Chlordane Chlordecone Chlorfenethol Chlorfenson Chlorfensulphide Chlorobenzilate Chloropropylate Dicophane (DDT) pp'-DDT Dicofol	Paper impregnated with not more than 0.3%, weight in weight, of benzene hexachloride or gamma – BHC provided it is labelled with directions that no food, wrapped or unwrapped, or food utensils are to be placed on the treated paper, and that it is not to be used where food is prepared or served.

Hazardous Substances	
Substance	**Exclusion**
Dieldrin Endosulfan Endrin Fenazaflor Fenson Fluorbenzide Gamma benzene hexachloride (Gamma – BHC) HEOD [1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a- octahydro-1, 4 (exo): 5,8 (endo)-dimethano naphthalene] HHDN [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4 (exo): 5,8 (endo)-dimethano naphthalene] Heptachlor Isobenzan Isodrin Kelevan Methoxychlor [1,1,1-trichloro-2,2-di-(p-methoxyphenyl) ethane] Tetrachlordiphenylethane [TDE; 1,1-dichloro-2,2-bis (p-chlorophenyl) ethane] Tetradifon Tetrasul Toxaphene Allied chlorinated hydrocarbon compounds used as pesticides (insecticides, acaricides, etc.)	
Chlorine	Chlorine used for chlorination of water in swimming pools.

Hazardous Substances	
Substance	**Exclusion**
Chlorine trifluoride	
Chlorobenzenes, the following: Monochlorobenzene Meta-dichlorobenzene Ortho-dichlorobenzene Trichlorobenzene Tetrachlorobenzene Pentachlorobenzene Hexachlorobenzene	
Chlorophenols, the following: Monochlorophenol Dichlorophenol Trichlorophenol Tetrachlorophenol Pentachlorophenol and their salts	Substances containing not more than 1%, weight in weight, of chlorophenols.
Chlorophenoxyacids; their salts, esters, amines	
Chloropicrin	
Chlorosilanes	
Chlorosulphonic acid	
Chromic acid	Substances containing not more than 9%, weight in weight, of chromic acid; Photographic solutions containing chromic acid in individual containers containing not more than 15 kilograms each of such solutions and of aggregate weight of not more than 500 kilograms of such solutions.
Cyanides	Ferrocyanides; Ferricyanides.

Hazardous Substances	
Substance	**Exclusion**
Diborane	
Dibromochloropropane	
Diethyl sulphate	
Dinitrocresols (DNOC); their compounds with a metal or a base	
Dinosam; its compounds with a metal or a base	
Dinoseb; its compounds with a metal or a base	
Diquat; its salts	
Disilane	
Drazoxolon; its salts	Dressings on seeds.
Endothal; its salts	
Epichlorohydrin	
Ethyl mercaptan	Substances containing less than 1%, weight in weight, of ethyl mercaptan.
Ethylene dibromide	
Ethylene dichloride	
Ethylene imine	
Ethylene oxide	Mixtures of inert gases and ethylene oxide comprising not more than 12%, weight in weight, of ethylene oxide contained in cylinders of water capacity less than 47 litres and for aggregate of not more than 3 numbers of such cylinders.
Ferric chloride	
Fluorine	
Fluoroacetamide	
Formaldehyde	Substances containing not more than 5%, weight in weight, of formaldehyde; Photographic glazing or hardening solutions.

Hazardous Substances	
Substance	**Exclusion**
Formic acid	Substances containing not more than 5%, weight in weight, of formic acid.
Germane	
Hydrazine anhydrous; Hydrazine aqueous solutions	
Hydrochloric acid	Substances containing not more than 9%, weight in weight, of hydrochloric acid.
Hydrofluoric acid	Preparations or solutions containing not more than 2%, weight in weight, of hydrofluoric acid.
Hydrogen chloride	
Hydrogen cyanide; Hydrocyanic acid	Preparations of wild cherry; In reagent kits supplied for medical or veterinary purposes, substances containing less than the equivalent of 0.1%, weight in weight, of hydrocyanic acid.
Hydrogen fluoride	
Hydrogen peroxide	Preparations and solutions containing not more than 20%, weight in weight, of hydrogen peroxide.
Hydrogen selenide	
Isocyanates	Polyisocyanates containing less than 0.7%, weight in weight, of free monomeric diisocyanates; Pre-polymerised isocyanates in polyurethane paints and lacquers; Hardeners and bonding agents for immediate use in adhesives.

Hazardous Substances	
Substance	**Exclusion**
Lead compounds in paint	Lead compounds in paint in which the lead content is not more than 0.06% by weight of the paint; Lead compounds in paint in which the container is affixed with an appropriate label. The labels to be used for paints containing lead compounds are in accordance with Part IV of the Second Schedule of the EPCA.
Lead tetra-ethyl and similar lead containing compounds	
Lead tetra-ethyl and similar lead containing compounds in petrol intended for use in Singapore as fuel for motor vehicles	
Mercuric chloride; Mercuric iodide; Organic compounds of mercury	Dressings on seeds or bulbs; Toilet, cosmetic and therapeutic preparations containing not more than 0.01%, weight in weight, of phenyl mercuric salts as a preservative; Antiseptic dressings on toothbrushes; Textiles containing not more than 0.01%, weight in weight, of phenyl mercuric salts as a bacteriostat and fungicide.
Mercury and its compounds in batteries	Batteries other than mercury oxide batteries, zinc carbon batteries containing more than 0.001% by weight of mercury per cell and alkaline batteries, except those in button form, containing more than 0.025% by weight of mercury per cell.
Metanil yellow (sodium salt of metanilylazo-diphenylamine)	Dye-indicators used in laboratories.

Hazardous Substances	
Substance	**Exclusion**
Methyl chloride	
Methyl mercaptan	Substances containing less than 1%, weight in weight, of methyl mercaptan.
Monomethyltetrachloro diphenyl methane	
Monomethyl-dichloro-diphenyl methane	
Monomethyl-dibromodiphenyl methane	
Niclofolan	
Nicotine sulphate	
Nitric acid	Substances containing not more than 9%, weight in weight, of nitric acid.
Nitric oxide	
Nitrobenzene	Substances containing less than 0.1%, weight in weight, of nitrobenzene; Soaps containing less than 1%, weight in weight, of nitrobenzene; Polishes and cleansing agents.
Nitrogen trifluoride	

Hazardous Substances	
Substance	**Exclusion**
Ozone depleting substances, namely: (a) Chlorofluorocarbons, the following: Chloroheptafluoropropane Chloropentafluoroethane Chlorotrifluoromethane Dichlorodifluoromethane Dichlorohexafluoropropane Dichlorotetrafluoroethane Heptachlorofluoropropane Hexachlorodifluoropropane Pentachlorofluoroethane Pentachlorotrifluoropropane Tetrachlorodifluoroethane Tetrachlorotetrafluoropropane Trichlorofluoromethane Trichloropentafluoropropane Trichlorotrifluoroethane (b) Halons, the following: Bromochlorodifluoromethane Bromochloromethane Bromotrifluoromethane Dibromotetrafluoroethane	Products containing any ozone depleting substance other than the following products: (a) in the case of chlorofluorocarbons – (i) air-conditioners in vehicles registered on or after 1st January 1995 or intended for such vehicles; (ii) equipment for domestic or commercial refrigeration or air-conditioning installed on or after 1st January 1993, or heat pump equipment, which contains any chlorofluorocarbon substance as a refrigerant or in any insulating material of such equipment; (iii) refrigerators that have a compressor rating which exceeds one horsepower; (iv) non-pharmaceutical aerosol products; (v) insulation boards, panels or pipe covers; (vi) polystyrene sheets or finished products; (b) in the case of Halons, portable fire extinguishers; and (c) in the case of bromotrifluoromethane, fire protection systems with building plans approved after 17th June 1991 and installed after 31st December 1991.

Hazardous Substances	
Substance	**Exclusion**
(c) Hydrochlorofluorocarbons, the following: 1,1-dichloro-1-fluoro-ethane 1,1-dichloro-2,2,3,3, 3-pentafluoropropane 1,3-dichloro-1,2,2,3, 3-pentafluoropropane 1-chloro-1,1-difluoro-ethane Chlorodifluoroethane Chlorodifluoromethane Chlorodifluoropropane Chlorofluoroethane Chlorofluoromethane Chlorofluoropropane Chlorohexafluoropropane Chloropentafluoropropane Chlorotetrafluoroethane Chlorotetrafluoropropane Chlorotrifluoroethane Chlorotrifluoropropane Dichlorodifluoroethane Dichlorodifluoropropane Dichlorofluoroethane Dichlorofluoromethane Dichlorofluoropropane Dichloropentafluoropropane Dichlorotetrafluoropropane Dichlorotrifluoroethane Dichlorotrifluoropropane Hexachlorofluoropropane	

Hazardous Substances	
Substance	**Exclusion**
Pentachlorodifluoropropane	
Pentachlorofluoropropane	
Tetrachlorodifluoropropane	
Tetrachlorofluoroethane	
Tetrachlorofluoropropane	
Tetrachlorotrifluoropropane	
Trichlorodifluoroethane	
Trichlorodifluoropropane	
Trichlorofluoroethane	
Trichlorofluoropropane	
Trichlorotetrafluoropropane	
Trichlorotrifluoropropane	
(d) Hydrobromofluorocarbons, the following:	
Bromodifluoroethane	
Bromodifluoromethane	
Bromodifluoropropane	
Bromofluoroethane	
Bromofluoromethane	
Bromofluoropropane	
Bromohexafluoropropane	
Bromopentafluoropropane	
Bromotetrafluoroethane	
Bromotetrafluoropropane	
Bromotrifluoroethane	
Bromotrifluoropropane	
Dibromodifluoroethane	
Dibromodifluoropropane	
Dibromofluoroethane	

Hazardous Substances	
Substance	**Exclusion**
Dibromofluoromethane Dibromofluoropropane Dibromopentafluoropropane Dibromotetrafluoropropane Dibromotrifluoroethane Dibromotrifluoropropane Hexabromofluoropropane Pentabromodifluoropropane Pentabromofluoropropane Tetrabromodifluoropropane Tetrabromofluoroethane Tetrabromofluoropropane Tetrabromotrifluoropropane Tribromodifluoroethane Tribromodifluoropropane Tribromofluoroethane Tribromofluoropropane Tribromotetrafluoropropane Tribromotrifluoropropane (e) Carbon tetrachloride (f) 1,1,1-trichloroethane (methyl chloroform) (g) Methyl bromide	
Oleum	
Orange II [sodium salt of p-(2-hydroxy-1-naphthylazo) benzenesulphonic acid]	Dye-indicators used in laboratories.

Hazardous Substances	
Substance	**Exclusion**
Organic peroxides	Car puttys; Substances and preparations containing not more than 3%, weight in weight, of organic peroxides; Solutions of not more than 60%, weight in weight, of methyl ethyl ketone peroxides and total aggregate weight of less than 50 kilograms of such solutions.
Organo-tin compounds, the following: Compounds of fentin Cyhexatin	
Paraquat; its salts	Preparation in pellet form containing not more than 5%, weight in weight, of salts of paraquation.
Perchloromethyl mercaptan	Substances containing less than 1%, weight in weight, of perchloromethyl mercaptan.
Phenols, the following: Catechol Cresol Hydroquinone Octyl phenol Phenol Resorcinol	Preparations containing less than 1%, weight in weight, of phenols; Phenols which are intended for the treatment of human ailments and other medical purposes; Soaps for washing; Tar (coal or wood), crude or refined; Photographic solutions containing hydroquinone in individual containers containing not more than 15 kilograms each of such solutions and of aggregate weight of not more than 500 kilograms of such solutions.
Phosgene	
Phosphides	
Phosphine	
Phosphoric acid	Substances containing not more than 50%, weight in weight, of phosphoric acid.

Hazardous Substances	
Substance	**Exclusion**
Phosphorus compounds used as pesticides (insecticides, acaricides, etc.)	Acephate; Bromophos; Iodofenphos; Malathion; Pirimiphos-methyl; Temephos; Tetrachlorvinphos; Trichlorfon; Preparations containing not more than 0.5%, weight in weight, of chlorpyrifos and not containing any other phosphorus compound; Preparations containing not more than 0.5%, weight in weight, of dichlorvos and not containing any other phosphorus compound; Materials impregnated with dichlorvos and not containing any other phosphorus compound for slow release; Preparations containing not more than 1%, weight in weight, of azamethiphos and not containing any other phosphorus compound.
Phosphorus oxychloride	
Phosphorus pentachloride	
Phosphorus pentafluoride	
Phosphorus trichloride	
Polybrominated biphenyls	
Polychlorinated biphenyls	
Polychlorinated terphenyls	
Potassium chlorate	
Potassium hydroxide	Substances containing not more than 17%, weight in weight, of potassium hydroxide; Accumulators; Batteries.

Hazardous Substances	
Substance	**Exclusion**
Potassium perchlorate	
Prochloraz	
Propylene imine	
Propylene oxide	
Silane	
Sodium chlorate	
Sodium hydroxide	Substances containing not more than 17%, weight in weight, of sodium hydroxide; Made-up formulated preparations either liquid or solid for biochemical tests.
Sodium perchlorate	
Styrene monomer	
Sulphur in diesel intended for use in Singapore as fuel for motor vehicles or industrial plants	Sulphur in diesel in which the sulphur content is 0.05% or less by weight.
Sulphur tetrafluoride	
Sulphur trioxide	
Sulphuric acid	Substances containing not more than 9%, weight in weight, of sulphuric acid; Accumulators; Batteries; Fire extinguishers; Photographic developers containing not more than 20%, weight in weight, of sulphuric acid.
Thallium; its salts	
Titanium tetrachloride	
Tris (2, 3-dibromo-l-propyl) phosphate	
Vinyl bromide	
Vinyl chloride monomer	

APPENDIX 11

HAZARDOUS SUBSTANCES
QUANTITIES EXCEEDING WHICH TRANSPORT APPROVAL IS REQUIRED

Substance	Qty (kg)
Acetic acid	1000
Acrolein	50
Ammonia	500
Antimony pentachloride	50
Arsenical Substances	50
Boric Acid; sodium borate	5000
Boron trichloride	50
Boron trifluoride	50
Bromine, bromine solutions	50
Captafol	0
Carbamates except bendiocard, BPMC (fenobucarb), mercaptodimethur (methiocarb)	0
Carbon disulphide	50
Carbon tetrafluoride	500
Chlorine	500
Chlorine trifluoride	0
Chlorinated hydrocarbon compounds used as pesticides	0
Chlorobenzenes	0
Chlorophenols	0
Chlorophenoxyacids	0
Chlorosilanes	50
Chlorosulphonic acid	50
Chromic acid	50
Cyanides	50
Diborane	50
Dibromochloropropane	50
Diethyl sulphate	500
Disilane	50
Epichlorohydrin	50
Ethyl mercaptan	50
Ethylene dibromide	0
Ethylene dichloride	0
Ethylene imine	0
Ethylene oxide	50
Ferric chloride	1000
Fluorine	0
Fluoroacetamide	50
Formic acid	1000
Germane	50
Hydrazine anhydrous, hydrazine aqueous solutions	50
Hydrochloric acid	1000
Hydrocyanic acid	0
Hydrofluoric acid	500
Hydrogen chloride, all forms	500
Hydrogen peroxide	1000
Hydrogen selenide	50
Isocyanates	500
Lead tetra-ethyl and similar lead containing compounds	0

Substance	Qty (kg)
Metanil yellow (sodium salt of metanilylazo-diphenylamine)	5000
Methyl bromide	50
Methyl chloride	50
Methyl mercaptan	50
Monomethyltetrachloro diphenyl methane	0
Monomethyl-dichloro-diphenyl methane	0
Monomethyl-dibromodiphenyl methane	0
Nitric acid	1000
Nitric oxide	50
Nitrogen trifluoride	50
Oleum	50
Orange II (sodium salt of p-(2-hydroxy-1 naphthylazo) benzenesulphonic acid)	5000
Organic compounds of Mercury	0
Organic peroxides	500
Organo-tin compounds: cyhexatin	0
Perchloro methyl mercaptan	50
Phenols	500
Phosgene	0
Phosphides	50
Phosphine	50
Phosphorous compounds except dimethoate, diazinon, fenchlorphos, fenitrothion, phenthoate, profenophos, prothiophos, quinalphos	0
Phosphorus oxychloride	50
Phosphorus pentachloride	50
Phosphorus pentafluoride	50
Phosphorus trichloride	50
Polybrominated biphenyls	0
Polychlorinated biphenyls	0
Polychlorinated terphenyls	0
Potassium hydroxide	1000
Prochloraz	0
Propylene imine	50
Propylene oxide	500
Silane	50
Sodium hydroxide	1000
Styrene monomer	1000
#Sulphur in Diesel	-
Sulphur tetrafluoride	0
Sulphur trioxide	50
Sulphuric acid	1000
Titanium tetrachloride	1000
Tris(2,3-dibomopropyl)phosphate	0
Vinyl bromide	0
Vinyl chloride monomer	0

NB: Definition and exemptions of Poisons in Part II List will also be extended to the above list.

APPENDIX 12

TOXIC INDUSTRIAL WASTES CONTROLLED UNDER THE ENVIRONMENTAL PUBLIC HEALTH (TOXIC INDUSTRIAL WASTE) REGULATIONS 1988

List of Toxic Industrial Wastes
Acids 1. Spent inorganic acids Eg. hydrochloric acid, sulphuric acid, nitric acid, phosphoric acid, hydrofluoric acid, boric acid and pickling acid 2. Spent organic acids Eg. acetic acid, formic acid, benzoic acid and sulphonic acid
Alkalis 1. Spent alkaline solutions 2. Spent ammoniacal solutions 3. Metal hydroxide sludges and oxide sludges
Antimony and its Compounds 1. Spent antimony potassium tartrate
Arsenic and its Compounds 1. Timber preservative residues containing arsenic 2. Wastes containing gallium arsenide
Asbestos 1. Asbestos wastes from asbestos/cement manufacturing processes 2. Empty sacks/bags which have contained loose asbestos fibre
Cadmium and its Compounds 1. Plating effluents and residues containing cadmium 2. Wastes containing cadmium from Ni/Cd battery manufacturing
Chromium Compounds 1. Plating effluents and residues containing chromium 2. Timber preservative residues containing chromium 3. Spent and aqueous solutions containing chromium compounds 4. Tannery effluents and residues containing chromium
Copper Compounds 1. Plating effluents and residues containing copper 2. Spent etching solutions containing copper from printed circuit board manufacturing 3. Timber preservative residues containing copper

List of Toxic Industrial Wastes
Cyanides 1. Plating effluents and residues containing cyanides 2. Heat treatment residues containing cyanides 3. Spent quenching oils containing cyanides 4. Spent processing solutions containing cyanides from photographic processing
Fluoride Compounds 1. Timber preservative residues containing fluorides 2. Spent ammonium bi-fluoride
Isocyanates 1. Spent di-isocyanates Eg. toluene di-isocyanate (TDI) and methylene di-isoc-yanate (MDI) from polyurethane foam-making process
Laboratory Wastes 1. Obsolete laboratory chemicals 2. Toxic chemical wastes from chemical analysis
Lead Compounds 1. Sludges containing lead oxide/sulphate 2. Spent organo-lead compounds Eg. tetraethyllead (TEL) and tetramethyllead (TML) 3. Waste lead-acid batteries, whole or crushed
Mercury and its Compounds 1. Effluents, residues or sludges containing mercury from chlor-alkali industry 2. Wastes containing mercury from equipment manufacturing involving the use of metal mercury 3. Spent catalysts from chemical processes containing mercury 4. Spent organo-mercury compounds
Metal Catalysts 1. Spent metal catalysts from chemical processes and petroleum refining Eg. catalysts containing chromium and cobalt
Nickel Compounds 1. Plating effluents and residues containing nickel

List of Toxic Industrial Wastes

Organic Compounds containing Halogen

1. Spent halogenated organic solvents
   Eg. trichloroethylene, 111-trichloroethane, perchloro-ethylene, methylene chloride, tetra-chloromethane and 112-trichloro-122-trifluoroethane
2. Residues from recovery of halogenated organic solvents
3. Packaging materials or residues containing chloro- benzenes and/or chlorophenols and their salts

Organic Compounds not containing Halogen

1. Spent non-halogenated organic solvents
   Eg. benzene, toluene, xylene, turpentine, petroleum, thinner, kerosene, methanol, ethanol, isobutanol, iso-propanol, methyl ethyl ketone, methyl isobutyl ketone, isopropyl ether, diethyl ether, hexane, dimethyl sulphide and dimethyl sulphoxide
2. Residues from recovery of non-halogenated organic solvents

Other Wastes

1. Obsolete/abandoned chemicals and pesticides from storage, manufacturing and trading activities
2. Used containers, bags and process equipment contaminated by chemicals and pesticides from storage, manufacturing and trading activities
3. Wastes/residues containing unreacted monomers, eg. vinyl chloride and styrene monomers, from polymer manufacturing processes
4. Tar residues from distilling and tarry materials from refining
5. Wastes from toxic waste treatment processes Eg. wastes and residues from solidification, fixation and incineration processes
6. Wastes from toxic chemical drums and tank cleaning activities
7. Chemical and oil slops from ship tankers
8. Wastes from the production, formulation and use of resins, latex, plasticisers, glues/adhesives containing solvents and other contaminants.
9. Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish containing organic solvents, heavy metals or biocides.

Pathogenic Wastes

1. Pathogenic wastes from hospitals

List of Toxic Industrial Wastes

Phenolic Compounds

1. Sludges/residues from paint stripping using chemicals containing phenols
2. Residues containing unreacted phenol and formaldehyde from adhesive industry

Polychlorinated Bi-phenyl (PCB) including
Poly-chlorinated Ter-phenyl (PCT)

1. Spent transformer oil containing PCB and/or PCT
2. Retrofilled transformer contaminated with PCB and/or PCT
3. Electrical equipment and parts containing or contaminated with PCB and/or PCT
   Eg. Capacitors and transformers
4. Containers and all waste materials contaminated with PCB and/or PCT

Polyvinyl Chloride (PVC)

1. All waste materials containing PVC
   Eg. PVC insulated wires, PVC pipes and trunking, PVC parts, PVC upholstery and PVC resins

Silver Compounds

1. Spent processing solutions containing silver from photographic processing

Used, Contaminated Oil

1. Used mineral, lubricating and hydraulic oil from machine cylinders, turbines, switch gears and transformers
2. Spent motor oils from petrol and diesel engines
3. Spent quenching oil from metal hardening
4. Oil recovered from solvent degreasers
5. Spent oil water emulsions
   Eg. Spent coolants from metal working industries
6. Oil water mixtures (mainly oil)
   Eg. Oily ballast water from ship tankers
7. Oil and sludge from oil interceptors
8. Tankers sludges and oil sludges/residues from storage tanks
9. Oil sludges containing acid from recovery and recycling of used oil

Zinc Compounds

1. Plating effluents and residues containing zinc

APPENDIX 13

BOUNDARY NOISE LIMITS FOR FACTORY PREMISES

The maximum permitted boundary noise levels are as follows:

Type of affected premises	Maximum permitted noise level (reckoned as the equivalent continuous noise level over the specified period) in decibels (dBA)		
	Day 7 am – 7 pm	Evening 7 pm – 11 pm	Night 11 pm – 7 am
Noise Sensitive Premises	60	55	50
Residential Premises	65	60	55
Commercial Premises	70	65	60

Type of affected premises	Maximum permitted noise level (reckoned as the equivalent continuous noise level over 5 minutes) in decibels (dBA)		
	Day 7 am – 7 pm	Evening 7 pm – 11 pm	Night 11 pm – 7 am
Noise Sensitive Premises	65	60	55
Residential Premises	70	65	60
Commercial Premises	75	70	65
Factory Premises	75	70	65

APPENDIX 14

MAXIMUM PERMISSIBLE NOISE LEVELS FROM CONSTRUCTION SITES

Since 1 Oct 2001, the permissible noise limits for evening (7 pm to 10 pm) and night time (10 pm to 7 am) for construction sites located within 150 m from any residential areas have been tightened. The old and new permissible noise limits with respect to residential areas are as shown:

<table>
<tr><th colspan="2">Existing Noise Limits
(Commenced before 1 Oct 2001)</th><th colspan="2">Existing Noise Limits
(Commenced on or after 1 Oct 2001)</th></tr>
<tr><th>Time</th><th>Noise Limits</th><th>Time</th><th>Noise Limits</th></tr>
<tr><td>7 am to 7 pm</td><td>Leq 12 hr – 75 dBA
Leq 5 min – 90 dBA</td><td>7 am to 7 pm</td><td>Leq 12 hr – 75 dBA
Leq 5 min – 90 dBA</td></tr>
<tr><td rowspan="2">7 pm to 7 am</td><td rowspan="2">Leq 12 hr – 65 dBA

Leq 5 min – 70 dBA</td><td>7 pm to 10 pm</td><td>Leq 1 hr – 65 dBA
Leq 5 min – 70 dBA</td></tr>
<tr><td>10 pm to 7 am</td><td>Leq 1 hr – 55 dBA
Leq 5 min – 60 dBA</td></tr>
</table>

APPENDIX 14

AMBIENT AIR QUALITY STANDARDS

Pollutants	Averaging Time	USEPA Primary Air Quality Standards		WHO Air Quality Guidelines	
		Concentration	Method	Concentration	Method
GASEOUS POLLUTANTS					
Sulphur Dioxide	Annual Mean 24 Hours	80 µg/m^3 (0.03 ppm) 365 µg/m^3 (0.14 ppm)	Pulsed Fluorescence	50 µg/m^3 (0.019 ppm) 125 µg/m^3 (0.048 ppm)	–
Carbon Monoxide	8 Hours 1 Hour	10 mg/m^3 (9 ppm) 40 mg/m^3 (35 ppm)	Non-dispersive Infrared Spectrometry	10 mg/m^3 (9 ppm) 30 mg/m^3 (26 ppm)	Non-dispersive Infrared Spectrometry
Nitrogen Dioxide	Annual Mean 24 Hours	100 µg/m^3 (0.053 ppm) –	Chemiluminescence	40 µg/m^3 (0.02 ppm) –	–
Ozone	1 Hour 8 Hours	235 µg/m^3 (0.12 ppm) 157 µg/m^3 (0.08 ppm)	Ultraviolet Photometry	– 120 µg/m^3 (0.06 ppm)	Ultraviolet Photometry
PARTICULATE POLLUTANTS					
PM10 (Particles that are 10 micrometers or smaller)	Annual Mean 24 Hours	50 µg/m^3 150 µg/m^3	1) High Volume Sampling 2) Continuous Filter-Based Mass Measurement 3) Beta Attenuation	–	–
Lead	3 Months 1 Year	1.5 µg/m^3 –	Atomic Absorption Spectroscopy	– 0.5 µg/m^3	–

APPENDIX 16

THE SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL (OZONE DEPLETING SUBSTANCES) REGULATIONS 2000

ANNEX A

Group I		
$CFCl_3$	CFC-11	Trichlorofluoromethane
CF_2Cl_2	CFC-12	Dichlorodifluoromethane
$C_2F_3Cl_3$	CFC-113	Trichlorotrifluoroethane
$C_2F_4Cl_2$	CFC-114	Dichlorotetrafluoroethane
C_2F_5Cl	CFC-115	Chloropentafluoroethane
Group II		
CF_2BrCl	Halon-1211	Bromochlorodifluoromethane
CF_3Br	Halon-1301	Bromotrifluoromethane
$C_2F_4Br_2$	Halon-2402	Dibromotetrafluoroethane

ANNEX B

Group I		
CF_3Cl	CFC-13	Chlorotrifluoromethane
C_2FCl_5	CFC-111	Pentachlorofluoroethane
$C_2F_2Cl_4$	CFC-112	Tetrachlorodifluoroethane
C_3FCl_7	CFC-211	Heptachlorofluoropropane
$C_3F_2Cl_6$	CFC-212	Hexachlorodifluoropropane
$C_3F_3Cl_5$	CFC-213	Pentachlorotrifluoropropane
$C_3F_4Cl_4$	CFC-214	Tetrachlorotetrafluoropropane
$C_3F_5Cl_3$	CFC-215	Trichloropentafluoropropane
$C_3F_6Cl_2$	CFC-216	Dichlorohexafluoropropane
C_3F_7Cl	CFC-217	Chloroheptafluoropropane
Group II		
CCl_4		Carbon tetrachloride
Group III		
$C2H_3Cl_3$		1,1,1-trichloroethane (methyl chloroform)

ANNEX C

Group I		
$CHFCl_2$	HCFC-21	Dichlorofluoromethane
CHF_2Cl	HCFC-22	Chlorodifluoromethane
CH_2FCl	HCFC-31	Chlorofluoromethane
C_2HFCl_4	HCFC-121	Tetrachlorofluoroethane
C_2HF2Cl_3	HCFC-122	Trichlorodifluoroethane
$C_2HF_3Cl_2$	HCFC-123	Dichlorotrifluoroethane
C_2HF_4Cl	HCFC-124	Chlorotetrafluoroethane
$C_2H_2FCl_3$	HCFC-131	Trichlorofluoroethane
$C_2H_2F_2Cl_2$	HCFC-132	Dichlorodifluoroethane
$C_2H_2F_3Cl$	HCFC-133	Chlorotrifluoroethane
$C_2H_3FCl_2$	HCFC-141	Dichlorofluoroethane
CH_3CFCl_2	HCFC-141b	1,1-dichloro-1-fluoro-ethane
$C_2H_3F_2Cl$	HCFC-142	Chlorodifluoroethane
CH_3CF_2Cl	HCFC-142b	1-chloro-1,1-difluoro-ethane
C_2H_4FCl	HCFC-151	Chlorofluoroethane
C_3HFCl_6	HCFC-221	Hexachlorofluoropropane
$C_3HF_2Cl_5$	HCFC-222	Pentachlorodifluoropropane
$C_3HF_3Cl_4$	HCFC-223	Tetrachlorotrifluoropropane
$C_3HF_4Cl_3$	HCFC-224	Trichlorotetrafluoropropane
$C_3HF_5Cl_2$	HCFC-225	Dichloropentafluoropropane
$CF_3CF_2CHCl_2$	HCFC-225ca	1,1-dichloro-2,2,3,3,3-pentafluoropropane
CF_2ClCF_2CHClF	HCFC-225cb	1,3-dichloro-1,2,2,3,3-pentafluoropropane
C_3HF^6Cl	HCFC-226	Chlorohexafluoropropane
$C_3H_2FCl_5$	HCFC-231	Pentachlorofluoropropane
$C_3H_2F_2Cl_4$	HCFC-232	Tetrachlorodifluoropropane
$C_3H_2F_3Cl_3$	HCFC-233	Trichlorotrifluoropropane
$C_3H_2F_4Cl_2$	HCFC-234	Dichlorotetrafluoropropane
$C_3H_2F_5Cl$	HCFC-235	Chloropentafluoropropane
$C_3H_3FCl_4$	HCFC-241	Tetrachlorofluoropropane
$C_3H_3F_2Cl_3$	HCFC-242	Trichlorodifluoropropane
$C_3H_3F_3Cl_2$	HCFC-243	Dichlorotrifluoropropane
$C_3H_3F_4Cl$	HCFC-244	Chlorotetrafluoropropane
$C_3H_4FCl_3$	HCFC-251	Trichlorofluoropropane
$C_3H_4F_2Cl_2$	HCFC-252	Dichlorodifluoropropane
$C_3H_4F_3Cl$	HCFC-253	Chlorotrifluoropropane
$C_3H_5FCl_2$	HCFC-261	Dichlorofluoropropane
$C_3H_5F_2Cl$	HCFC-262	Chlorodifluoropropane
C_3H_6FCl	HCFC-271	Chlorofluoropropane

Group II		
$CHFBr_2$		Dibromofluoromethane
CHF_2Br	HBFC-22B1	Bromodifluoromethane
CH_2FBr		Bromofluoromethane
C_2HFBr_4		Tetrabromofluoroethane
$C_2HF_2Br_3$		Tribromodifluoroethane
$C_2HF_3Br_2$		Dibromotrifluoroethane
C_2HF_4Br		Bromotetrafluoroethane
$C_2H_2FBr_3$		Tribromofluoroethane
$C_2H_2F_2Br_2$		Dibromodifluoroethane
$C_2H_2F_3Br$		Bromotrifluoroethane
$C_2H_3FBr_2$		Dibromofluoroethane
$C_2H_3F_2Br$		Bromodifluoroethane
C_2H_4FBr		Bromofluoroethane
C^3HFBr_6		Hexabromofluoropropane
$C_3HF_2Br_5$		Pentabromodifluoropropane
$C_3HF_3Br_4$		Tetrabromotrifluoropropane
$C_3HF_4Br_3$		Tribromotetrafluoropropane
$C_3HF_5Br_2$		Dibromopentafluoropropane
C_3HF_6Br		Bromohexafluoropropane
$C_3H_2FBr_5$		Pentabromofluoropropane
$C_3H_2F_2Br_4$		Tetrabromodifluoropropane
$C_3H_2F_2Br_4$		Tetrabromodifluoropropane
$C_3H_2F_3Br_3$		Tribromotrifluoropropane
$C_3H_2F_4Br_2$		Dibromotetrafluoropropane
$C_3H_2F_5Br$		Bromopentafluoropropane
$C_3H_3FBr_4$		Tetrabromofluoropropane
$C_3H_3F_2Br_3$		Tribromodifluoropropane
$C_3H_3F_3Br_2$		Dibromotrifluoropropane
$C_3H_3F_4Br$		Bromotetrafluoropropane
$C_3H_4FBr_3$		Tribromofluoropropane
$C_3H_4F_2Br_2$		Dibromodifluoropropane
$C_3H_4F_3Br$		Bromotrifluoropropane
$C_3H_5FBr_2$		Dibromofluoropropane
$C_3H_5F_2Br$		Bromodifluoropropane
C_3H_6FBr		Bromofluoropropane
Group III		
CHClBr		Bromochloromethane

ANNEX E

Group I		
CH_3Br		Methyl bromide