

**Waste Management, Control
Recovery and Reuse**

N. Y. Kirov

Waste Management, Control Recovery and Reuse

Waste Management, Control, Recovery and Reuse

The International Edition of the 1974 Australian Waste Conference,
Held at the University of New South Wales

Edited by

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UNIVERSITY OF NEW SOUTH WALES

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THE CLEAN AIR SOCIETY OF AUSTRALIA & NEW ZEALAND
THE INSTITUTE OF FUEL (AUSTRALIA MEMBERSHIP)
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FOREWORD

Encouraged by the success of the earlier two Conferences held in 1967 and 1971, the Waste Disposal Committee decided to hold yet another — The 1974 Australian Waste Management and Control Conference.

The Conference will be held over three days on 17th to 19th July, 1974, in the Science Theatre in the University of New South Wales in Sydney. It is being organised by the Department of Fuel Technology of the University, in association with five other professional organisations: the Local Government Association of N.S.W., the Australian Institute of Health Surveyors, the Clean Air Society of Australia and New Zealand, the Australian Membership of the Institute of Fuel and the Local Government Engineers Association of N.S.W.

The Committee is indebted to the Honorable Sir John B. Fuller, M.L.C., the Minister for Planning and Environment, for so readily agreeing to officiate at the opening of the Conference and address the delegates.

Since the 1971 Conference many developments have taken place both in Australia and overseas and there has been a growing awareness and much public concern about the environment and its pollution. Consequently, the thirty-nine papers presented in this volume cover a wider range of subjects than was the case at the previous two Conferences. These papers are to be briefly presented by the authors at nine technical sessions, allowing ample time for discussion. The subjects to be considered include legislative aspects and waste management developments in the various Australian States, the Capital Territory, the U.K. and the U.N. Centre, surveys and advances in solid waste practices, waste collection and handling services, treatment and disposal of

liquid and industrial wastes, and salvage and resource recovery from wastes.

It is gratifying to note that several of the papers present research data and developments based on work carried out in Australia since our last Conference. Yet, in some ways, this could be considered as our first International Conference as several of the contributions discuss plants and processes in the U.K., Bangkok, Singapore, Hong Kong and the Philippines. There is an account of overseas developments in waste control, based on reports resulting from the five travelling scholarships which were awarded by the Conference Committee during 1972.

I am also happy to report that four of the contributions (21, 29, 30 and 31) are from students attending the M.App.Sc. course in Environmental Pollution Control at the University, and were initiated by class assignments in the subject "Unit Operations in Waste Management."

Finally, I wish to express my thanks and appreciation to the authors, the University, the members of the Organising Committee, the representatives of the associated organisations, and all those who, with their interest, advice and assistance in various ways, have made my task as an editor of the published papers and as Chairman of the Organising Committee, a very pleasant one. Their enthusiasm augurs well for the success of our third symposium — The 1974 Waste Management and Control Conference.

W. Y. KIROV,
Conference Chairman

Department of Fuel Technology,
The University of New South Wales,
Kensington, N.S.W., 2033.

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Wednesday, 17th July, 1974

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Address by The Hon. Sir John B. Fuller, M.L.C., N.S.W. Minister for Planning and Environment.

Reply on behalf of the University and the Organising Committee by the Vice-Chancellor and Principal of the University of New South Wales, Prof. R. H. Myers.

11.15 a.m.-12.45 p.m.: FIRST TECHNICAL SESSION — LEGISLATIVE ASPECTS

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- Paper 11: The Liquid Waste Survey in the Metropolitan Sydney Area — A. G. Forrester — Page 57
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PAPER 1

Development of the Sydney Region Waste Management Plan

By Richard Conolly*

1. Introduction

The disposal of solid and liquid wastes in large urban communities is a major problem of ever-increasing proportions. With increasing population densities and escalating solid waste generation rates, the greater quantities of solid waste produced for a given area are placing increasingly heavy demands on existing collection and disposal systems; particularly in today's environmental climate. These demands introduce problems involving the scarcity of available land for waste disposal, particularly in the inner city areas.

Traditionally, local authorities have had the responsibility for collecting and disposing of solid waste. However, over the past decade or so there has been a growing realisation that isolated action by individual municipalities is not the best solution. The concept of a regional approach whereby technical knowledge and physical resources are pooled to mutual advantage, has been accepted and implemented by a number of major cities throughout the world.

The concept of a regional approach to waste disposal was mooted at the two previous Australian Waste Disposal Conferences in 1967 and 1971. In fact, at the termination of the 1971 Conference, the Hon. J. B. M. Fuller (now the Hon. Sir John Fuller) announced the formation of the Metropolitan Waste Disposal Authority.

The Authority has jurisdiction over the Sydney region of N.S.W., and its function can best be described by the introduction of the Act:

"An Act to provide for the constitution of a corporation to be called the 'Metropolitan Disposal Authority'; to confer and impose on the corporation responsibilities, powers, authorities, duties and functions with respect to the transport, collection, reception, storage and disposal of waste within the Metropolitan Waste Disposal Region; and for purposes connected therewith."

With the formation of the Authority, the entire Metropolitan area can now be considered as a unit and, accordingly, the waste disposal

system can be provided at least cost to the Metropolitan community as a whole. Because of its sheer size, this involves many permutations and combinations of options both in systems, location of facilities, processes and alternative directions between generation and disposal locations. Considerable economy is potentially available but the process of evaluation is complicated and time consuming.

Since its inception in June, 1971, and the appointment of senior technical staff in 1972, the Authority has been preparing the ground work necessary for the development of the Sydney Region Waste Management Plan. It should be pointed out that, in addition to solid waste, the term "waste" also covers liquid waste.

In this paper it is intended to outline the approach adopted by the Authority in developing the three key areas of the plan:

- Solid Waste Management Plan.
- Establishment of a central liquid waste treatment plant.
- Registration and licensing provisions of Part V of the Act.

The registration and licensing provisions of the Act will be the "teeth" to ensure the orderly implementation of the solid and liquid waste management plans.

2. Solid Waste Management Plan

It is highly desirable that proposed facilities and systems comprising the Management Plan be formulated on the basis of a thorough technical, financial and political understanding of all the matters involved. As it requires considerable time and effort to prepare the data base to gain this understanding, and as new facilities are required in the immediate future, the Authority resolved to attack the problem in two phases.

Phase 1: to develop a short-term plan for the period 1974 to 1978, based on the best information available to the Authority in 1973-74;

* Director and Chairman, Metropolitan Waste Disposal Authority.

Phase 2: to conduct a major study to develop a comprehensive long-term waste management plan for the period to the 1990's.

There is no dividing line between the Phase 1 and Phase 2 studies and those described as Phase 1, or "short-term", relate to the urgent first conclusions of a continuing study.

2.1. Present Situation

With the exception of the waste incinerated at the Waverley/Woollahra plant, all solid waste generated in the Region is currently disposed of by the landfill method. At this time, only 14 of the Council-operated depots and 9 of the commercially-operated depots have significant remaining capacity (life in excess of 2 years).

2.2. The Problem Defined

Based upon the best data currently available to the Authority, it is estimated that the current rate of solid waste generation per head of population is 0.68 tonnes per year. This rate is expected to escalate to 1.06 per tonnes per year by the year 2000. The increase in the per capita rate of generation, when coupled with the expected population increase to 4,400,000 by 2000, represents a disposal problem of staggering magnitude. For example,

- If landfill were the only method of solid waste disposal from now to the year 2000, an additional disposal capacity of approximately 210 million cubic metres would be required.
- If a policy of maximum incineration (i.e., the method requiring least space) were adopted now, the additional space requirements to the year 2000 (for non-combustible waste and ash) would be approximately 80 million cubic metres. (Nine incinerators each of 1000 tonnes per day capacity, double that of the Waverley/Woollahra plant, would be required by the year 2000 to bring about this result. At current prices, this would represent a capital expenditure exceeding \$100 million.)

2.3. Short-Term Plan

At the time of preparation of this paper, the following alternative short-term solutions were under detailed evaluation:

- (a) *That as Councils exhaust their own facilities they make use of regional transfer stations and/or regional landfill sites operated by the Authority.* The adoption of this solution would involve the opening of new regional

facilities, both landfill and transfer stations, at an early date to operate at a small, and therefore possibly less economic, scale.

- (b) *That Councils use up all existing space in their sub-region before transferring to regional facilities.* This would necessitate the direction of waste by the Authority to existing Council depots from other areas until all local facilities were exhausted. In selecting those existing sites that have a regional potential, environmental aspects must be taken into account. The adoption of this solution would result in an increased scale of operation at existing facilities used for regional purposes, and at new regional facilities when they commence operation, with consequent economy of scale. While increased transportation costs can be expected in certain cases, overall economic benefits are likely. The present operator (Council) of a potential regional facility will, in most instances, have invested considerable funds on the development and would seek some return from either the Authority or the other Councils who would use the facility.
- (c) *That Councils use existing small depots for weekend tipping only and all other wastes be directed to other large existing depots or to regional facilities.* This is, in effect, a variation of alternative (b) that makes provision for weekend tipping by residents. Approximately 18% of the total waste received at depots in the Region is accepted during the weekend and there will be a continuing need to provide a facility for this purpose in order to reduce the likelihood of indiscriminate dumping of waste.
- (d) *That the putrescible and non-putrescible waste streams be separated and directed to selected existing and/or proposed facilities.* This procedure could be adopted in a number of instances where facilities are more suited, on environmental grounds, to the receipt of one or other type of waste. The provision of satisfactory leachate treatment facilities will prove to be expensive in the future and it is therefore desirable to minimise the number of depots requiring treatment plants.

It would be necessary in some instances to differentiate between the general non-putrescible wastes and the selected hard-fill wastes, i.e., brickbats and other demolition material. This would permit the ultimate use of certain sites, with a hard foundation, for building purposes.

As a general policy, the Authority will consider directing the various classes of waste to the most suitable available disposal facility — such facilities to become Regional depots. The criteria for such decisions will be to achieve overall long-term community benefits, with particular reference to cost and environmental considerations.

It is intended to finalise the short-term plans by mid-1974 and it will be possible at the Conference to elaborate on the details of the plan adopted.

2.4. *Long-Term Plan*

Approximately two million tonnes per year of solid waste is currently handled by Councils and private contractors at a transportation, processing and disposal cost of between \$3 and \$10 per tonne. This represents an expenditure of between \$6 and \$20 million per year. If the cost of collection is taken into account, the direct community cost is probably of the order of \$30 million per year for the removal, transportation and disposal of solid waste.

When one considers that the \$30 million per year solid waste management business is plagued by erratic patterns of waste movement, rapid depletion of remaining landfill sites, long lead times for major processing facilities and extensive pollution problems, the necessity for effective long-term planning and central control is self-evident.

Considerable progress has been made by the Authority in developing the long-term plan, although it is expected to take a further two years to finalise the detailed study. The main elements of the study are referred to in the following paragraphs.

In 1973, an intensive systematic search of the Region was conducted to locate sites suitable for the establishment of regional landfill depots. Over 200 sites have already been examined. After detailed assessment on economic and environmental grounds and discussion with the other affected departments or instruments of Government, most were rejected. Some 14 remaining sites are still under investigation. The Authority's first regional depot, Jack's Gully, is currently being developed in conjunction with Camden Council.

The Northern Sector is at present the subject of a particular study by the Authority's officers to evaluate cost and performance of existing disposal methods in relation to other options available in both the short and long term. Much of the information gained will be directly applicable to the remainder of the Region. While, during this study, particular attention will be given to landfill and incineration as disposal methods, other methods will also be carefully examined in developing the overall regional plan.

For the purpose of developing a solid waste management plan, the Region can be considered as a system comprising 40 Local Government areas generating domestic waste, some also generating large quantities of industrial waste; potential regional landfill sites on the outskirts of the Region; potential transfer station sites throughout the Region as well as possible incinerator (or other process plant) sites; with a variety of collection and transportation methods. The number of permutations and combinations of possible solutions to the problem is huge and a mathematical model (MADIS) has been prepared to assist in solving the problem. Using the Control Data 6600 computer, alternatives can be rapidly evaluated to generate a theoretical least-cost solution. This technique will assist in developing the most appropriate long-term system of transportation and disposal.

The Authority has gained the co-operation of the National Materials Handling Bureau to assist in studying solid waste handling methods. It is hoped that this expert group will be able to help us devise the most efficient waste handling and transportation system.

2.5. *Other Continuing Studies*

A comprehensive scheme for the disposal of obsolete motor vehicles has been prepared and furnished to the Joint Government Members Committee set up by the Government to enquire into the general question of the disposal of abandoned and derelict motor vehicles. At the time of preparation of this paper, the scheme was still under study by the Committee.

Preliminary investigations into recycling indicate that, in Sydney, the rate of recycling of solid waste is already significant and at near maximum for certain materials. Paper is being recycled at a rate higher than for most other Western Countries and with existing plant, there is virtually no additional capacity for waste paper. A similar situation exists with respect to glass, although some spare capacity for cullett is available. We are all aware of the cry for

more recycling of waste. However, from a community benefit point of view, it has not been established that recycling more waste is the best answer. In a recent article, the Director of Sanitation of the City of Los Angeles analysed the situation and concluded that the potential recyclable materials in domestic solid waste are amongst the most abundant in the earth's crust. In most cases, the materials and energy needed to collect and process such materials exceed that to mine and process them from natural resources. On the other hand, those materials in short supply (e.g., copper, tin, lead) are not present in large amount in solid waste. The question of increased recycling, therefore, is one of great complexity and requires deep study.

Leachate from landfill sites is a potential environmental hazard of considerable proportions and is perhaps the major factor hindering the establishment of regional putrescible landfill sites. Design studies have been conducted into engineering design and drainage of large putrescible depots in order to minimise the formation of leachate. As a matter of urgency, a research programme has been initiated by the Authority into improving methods of leachate treatment.

3. Liquid Waste Treatment Plant

In May, 1970, the Barton Report highlighted the fact that Sydney was facing a critical situation with regard to the disposal of liquid wastes. At the time it was known that considerable amounts of liquid wastes were being placed in the Water Board sewers, both legally and illegally, and that many gallons of liquid wastes were being disposed of by generators and contractors in watercourses and bush areas. The above facts, the projected closing down of various disposal sites and the introduction by the Board of far more stringent requirements for liquid waste disposal into its sewers, made it imperative to determine the true extent of the present liquid waste situation in Sydney.

The Authority commissioned consultants to carry out a detailed survey of liquid wastes generated in the Waste Disposal Region, to prepare projections of generation into the future and to propose the type of treatment plant needed for the disposal of these wastes and the plant's location. Further, preliminary plant designs and capital and treatment cost estimates were to be provided. The consultants' report was received in May 1973 and the results of the survey are discussed in detail elsewhere in this conference (see Paper 11 by A. G. Forrester).

After detailed examination of the consultants' proposals and an appraisal of industry's reaction to the predicted treatment charges, the Authority resolved to adopt the concept of a "minimum plant". This concept envisages a plant of as simple construction as possible, designed to treat most wastes expected in the early years of operation, with the capacity of evolving to meeting future requirements.

Follow-up discussions with the major generators has vindicated the "minimum plant" concept as, faced with a substantial increase in disposal charges, many companies are now studying their waste stream with a view to minimising waste quantities, providing in-plant treatment or otherwise reprocessing their wastes. A good example is a chicken processor who, at the time of survey, generated large quantities of a high B.O.D. waste. The waste is now converted into a high protein feed for chickens and virtually no waste leaves the premises.

One aspect of the discussions with industry is of particular interest. On the advice of Authority officers, a large company which had been storing a particularly unpleasant waste for some time, could well enter into an agreement with an interstate company which would use the waste as a raw material for its process.

Design data for the plant is being finalised in conjunction with our consultants and the plant is expected to be "on line" early in 1976. Initially, our physiochemical treatment and incineration facilities will be provided, although the plant can evolve to include biological treatment, resource recovery and solid waste treatment facilities. The selection of a suitable system for the incineration of mixed liquid wastes still represents a considerable problem and a research programme is currently being conducted at the C.S.I.R.O. Division of Mineral Chemistry, North Ryde, to assist in developing the most suitable incinerator configuration.

To provide a disposal point for liquid waste until the plant is completed, an interim liquid waste disposal depot has been constructed by the Authority at Castlereagh, some 30 miles west of Sydney. This is basically a landfill operation where liquid waste is absorbed on solid waste under carefully controlled conditions to ensure proper environmental protection.

4. Registration and Licensing Provisions

Part V of the Act, which deals with registration and licensing, was excluded when the Act was proclaimed. As proclamation of this

Part is anticipated in mid-1974, it is of specific interest at the time of this conference.

The objective of Part V is to establish control over the waste stream by means of a system of registration and licensing; that is by:

- the registration of both solid and liquid waste treatment, storage and disposal depots,
- the licensing of persons who transport waste for fee or reward, and
- the registration of premises on or in which trade waste is created.

This system will give the Authority control over the generation, transportation and disposal aspects for most of the waste stream (see Fig. 1); control which will be used to ensure the orderly implementation of the regional waste management plan.

Licences and certificates of registration will be issued subject to conditions, such conditions to be set according to minimum standards laid down by the Authority for handling and disposal of waste. The minimum standards are based on good housekeeping practice and environmental considerations.

Licences and certificates of registration will be subject to an annual fee. The scale of registration and licensing fees are designed to provide only sufficient revenue to meet costs. The major cost component of operating Part V will be the inspectorate necessary to provide day to day control.

Part V also provides for the inspection of premises and penalties for breaches of conditions attached to certificates or licences. Maximum penalties range from \$1000 to \$5000 with daily penalties for continuing breaches, ranging from \$200 to \$2000.

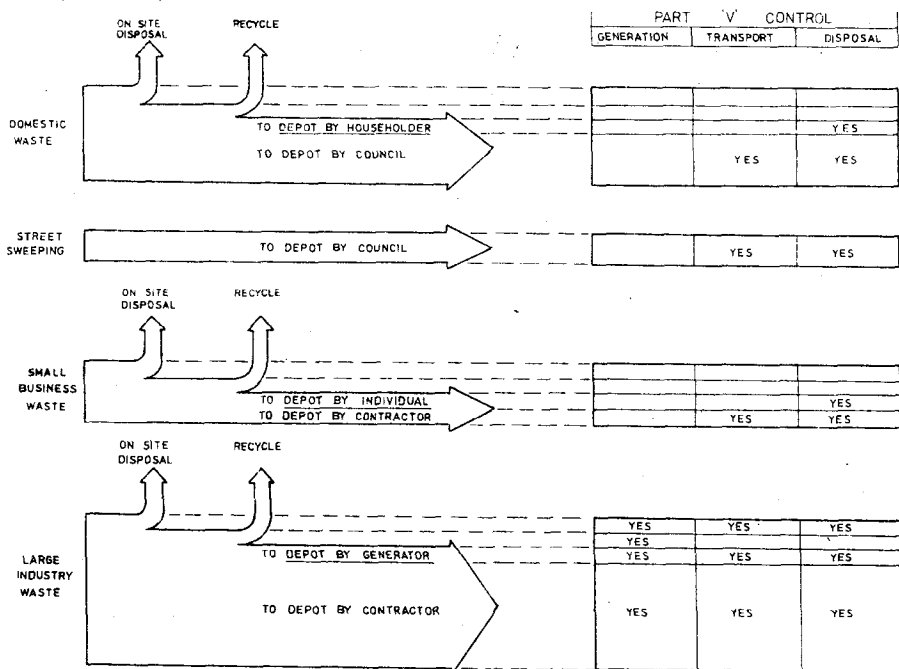
4.1. Depots

A 'depot' is defined as "any premises, other than a regional depot, to which waste is transported from any other premises for treatment, storage or disposal." Therefore, all landfill depots, transfer stations and incinerators must be registered with the Authority.

In general, conditions will be imposed so that the operation of landfill depots will progressively improve to comply with the Authority's

Fig. 1

Simplified Representation of the Waste Stream — GENERATION TRANSPORTATION DISPOSAL



Standard Conditions of Operation S.W. 1A as applicable.

4.2. *Transporters*

A person who transports waste into, out of or within the Region for fee or reward must be licensed with the Authority. This licensing requirement is also extended by the Act to cover any public authority which transports waste and any registered generator of trade waste who transports trade waste.

In general, conditions will be imposed requiring the licensee to discharge wastes at registered depots which are authorised to accept such wastes, maintain all vehicles in a clean and roadworthy condition and, in certain cases, use such routes as determined by the Authority.

4.3. *Generators*

Premises (not being approved premises) on or in which trade waste is created must be registered with the Authority. "Trade Waste" is defined "as any matter or thing, whether solid, gaseous or liquid or a combination of any solids, gases and liquids, which is refuse from any industrial, chemical, trade or business process or operation, including any building or demolition work".

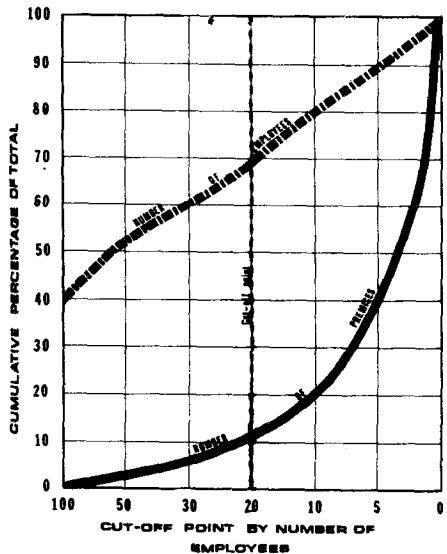
Under the above definition, some 80,000 premises in the Region would be classed as generators of trade waste; a large proportion of these generate relatively harmless wastes such as paper or packing materials in small quantities. It is not the intent of the Authority that such small businesses or shops should be registered. In order to achieve exemption of certain generators of trade waste from registration, the Act provides for "approved premises" to be defined by the Authority by order in the Gazette.

A system based on the number of employees has been adopted to classify generators of trade waste and the line dividing small and large generators has been set at 20 employees. Thus, premises on or in which trade waste is created with fewer than 20 employees are defined as "approved premises" and are not required to be registered with the Authority. However, as some small premises can generate significant quantities of toxic or otherwise hazardous wastes, all generators of hazardous trade waste must be registered with the Authority. If it is assumed that the quantity of trade waste generated on premises is directly proportional to the number of employees (generally true although other factors are also important), it can be seen from figure 2 that by adopting a cut-off

point of 20 employees, the Authority gains direct control over almost 70 per cent of the trade waste stream by registering only about 10 per cent of the generators.

Fig. 2

REGISTRATION OF TRADE WASTE GENERATORS



Conditions applicable to generators of trade waste will generally relate to good housekeeping practice for storage of waste, provisions to ensure that waste is removed only by licensed transporters or that on-site treatment facilities are satisfactory.

5. **Conclusion**

It is clear that waste disposal in all its aspects is one of the major problems confronting large cities throughout the world today. Research aimed at discovering new or improved methods of disposal and resource recovery are being conducted at many levels and must result, at the least, in producing improved technology.

Sydney has seen the introduction of the Metropolitan Waste Disposal Authority since the 1971 Waste Disposal Conference. This Authority is the first of its type in Australia, and, indeed, one of the first in the world.

In the brief period since its inception, the Authority's planning for future disposal on a regional basis, in both the short and long term, has reached an advanced level. The compre-

hensive studies which have been completed in the region have formed a sound base for this planning, and we look forward, as a consequence, to the operation of an efficient, well co-ordinated system of disposal/treatment.

The cost of proper disposal is, in many cases, high. Therefore, it is necessary to educate the community to accept the fact that it must be prepared to pay for environmentally-acceptable waste disposal methods.

The registration and licensing provisions of the Act give the Authority the "teeth" to en-

sure orderly implementation of the Sydney Region Waste Management Plan. Environmental considerations are basic to the plan and, therefore, as one arm of the State's environmental control programme, the Authority is making a significant contribution to environmental protection and improvement.

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PAPER 2

Environmental Control in Queensland

By P. L. Ellis* and R. G. Hoare†

Introduction

The Queensland Government has, in recent years, passed several Acts associated with environmental control, in response to social attitudes that call for maintenance and improvement of our quality of life. While it is true that social attitudes have changed and are continuing to change, it is important to realise that recent legislation does little more than co-ordinate and rationalise environmental control measures that have long been established through many Acts in the Statute Books and in By-Laws brought down by Local Authorities. Specific legislation such as the Clean Air Act 1963 and Clean Waters Act 1971 with their Regulations did introduce specific standards for pollution control and therefore must be classed as innovative legislation. However, virtually every licence, lease, permit, or authority issued by a State Department or Local Authority attracts conditions, many of which include an environmental parameter.

Environmental matters such as waste disposal; soil, water and mineral conservation; flora and fauna protection; and forestry, agriculture and fisheries management have been subject to control through relevant Acts and By-Laws for many years.

It was the recognition that so many Acts singularly and often unilaterally affected environmental management and planning, that led the Queensland Government to develop the administrative machinery needed to co-ordinate the activities of the numerous Authorities.

Co-ordination of Environmental Control in Queensland

As mentioned above, many State Government Departments and Local Authorities have been involved in environmental management for many years. The co-ordination of their respective activities has been achieved through the State and Regional Planning and Development, Public Works Organisation and Environmental Control Act 1971-73.

This Act does two main things: firstly, it provides a systems approach to long term

regional planning and, secondly, it provides within this planning framework, for environmental matters to be considered in the decision-making process. In effect, it established machinery to help the Queensland Government, with the help of Statutory Bodies and Local Authorities, to solve the complex problems of today and of the future in a co-ordinated, integrated and systematic fashion.

The Environmental Control Council

Under the above-mentioned Act, the Environmental Control Council, first established in 1970, continued in existence. The Council, chaired by the Co-ordinator-General, and including senior representatives of most State Departments, meets about four times per year. It is charged with the co-ordination of environmental-orientated works by State Departments, Local Authorities, Statutory Bodies and Independent Bodies; liaison with these groups in the fields of environmental control and improvement, reviewing on a continuous basis the state of the environment; investigation of submissions made to it; co-ordination of environmental education; making recommendations to State or other bodies concerned with environmental matters; and advising the Government on matters dealing with environmental control.

Also, the Environmental Control Council co-ordinates environmental research and makes recommendations to the Government on the basis of technical data supplied to it by its Technical Advisory Committees, Statutory Bodies and other governmental committees. The role of each of these in environmental management in Queensland is discussed below.

(a) Technical Advisory Committees

Three Technical Advisory Committees have been established to cover the fields of Waste Disposal on Land, Noise Control, and Land

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