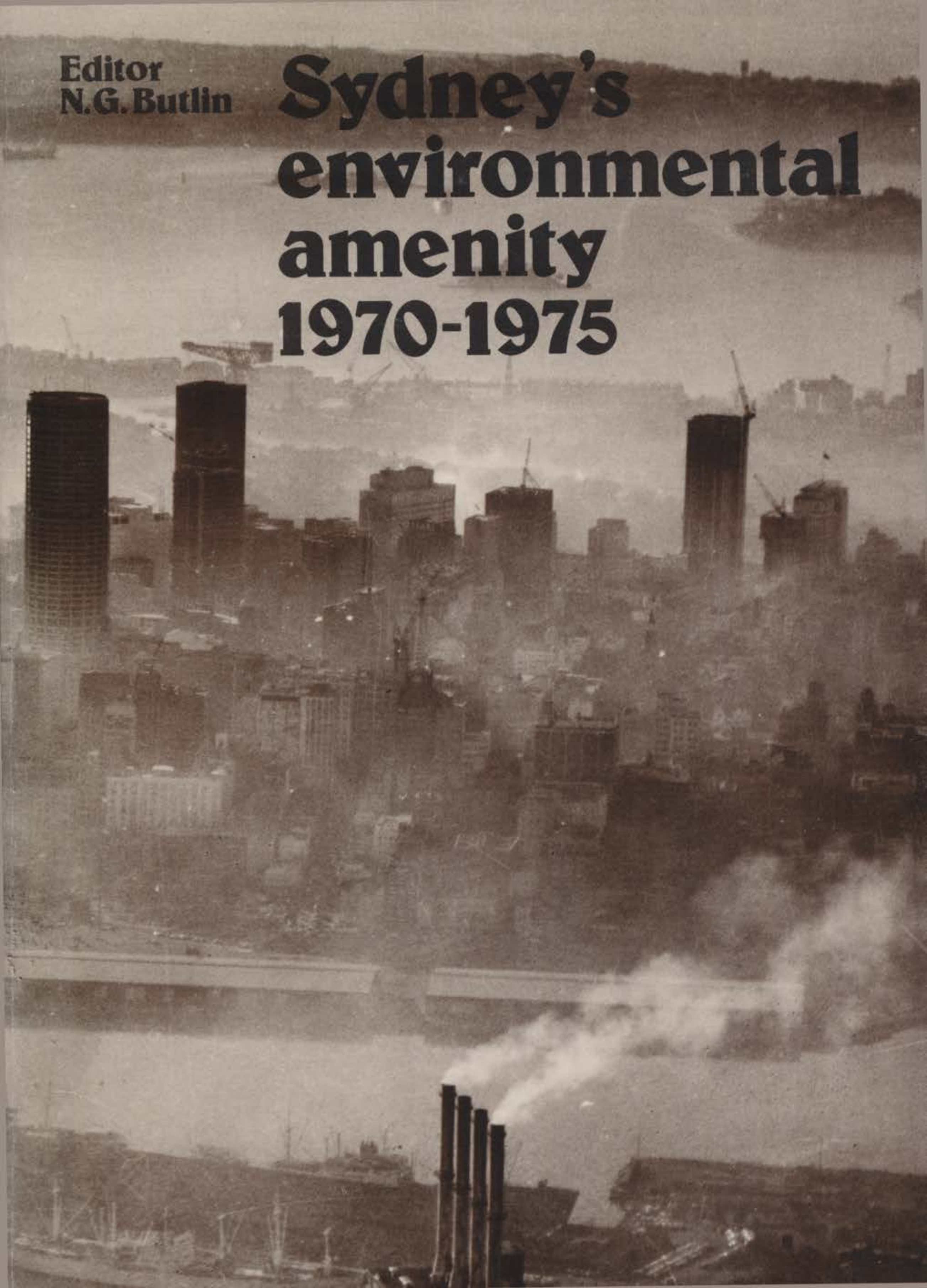
Editor
N.G. Butlin

# Sydney's environmental amenity 1970-1975



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# Sydney's environmental amenity 1970-1975

The Botany Bay Project Reports
Editor: N. G. Butlin
No. 1 Sydney's Environmental Amenity, 1970-1975

# Sydney's environmental amenity 1970-1975

## A study of the system of waste management and pollution control

Editor N. G. Butlin
The Australian National University

The Consultative Committee of
The Academy of Social Sciences in Australia,
The Australian Academy of Humanities, and
The Australian Academy of Science

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# Foreword

This Report has been prepared for the Botany Bay Project, an urban environmental study sponsored by the Australian Academy of Science, the Australian Academy of Humanities and the Academy of Social Sciences in Australia. It forms one of a series to be published covering a number of aspects of environmental problems and policies in Australia's oldest and largest metropolitan area.

The decision to investigate environmental policy in Australia followed an earlier joint enterprise of the three Academies concerned with problems of the management of the waters of the River Murray (*The Murray Waters*, edited by H. J. Frith and G. Sawer, 1974). It was believed that the complex nature of environmental issues provided special opportunities for collaboration among the disciplines represented in the three Academies and for a co-operative contribution to national policy. The Botany Bay region was selected for the case study as an area of past and future population growth in which there were large industrial, commercial, transport and residential complexes and in which significant natural resources were in danger of further damage from both population and economic growth. Botany Bay was also seen as the cradle of modern Australian society; as summarising the impact of successive stages of European settlement on the Australian continent.

The original concept of the Project was to attempt, through contract and staff research, to produce a series of studies covering different aspects of the urban environment and development, concentrating on the social values attached to urban environmental amenity. It was intended that these studies should aim at policy needs rather than abstract scientific analysis, and that the separate studies should be drawn together into a final single report on policy findings, relating these findings as far as possible not only to Sydney but also to other Australian urban areas.

Unfortunately, this concept had to be abandoned and the research plans greatly contracted. The Project had received an assurance of funding by the Australian Government in 1973, with the N.S.W. State Government offering access to basic information on the region. In August 1974, however, the N.S.W. Government reversed its original assurance of co-operation and, in consequence, the Australian Government reduced its funding to less than half that originally promised, and substantially reduced the period of time over which these funds were available to the Project. In some respects, at least, the Botany Bay Project was a casualty of the heightened political conflict in Australia during 1974 and 1975.

Despite this, Project contractors and staff members have carried out a considerable amount of investigation that will prove useful. Through the work of contractors, significant contributions to urban planning in New South Wales have been made in hydrology, water chemistry, meteorology, demography and in legal studies. This work, some of which is continuing beyond the term of the Botany Bay Project, will add considerably to the understanding of environmental problems in the southern half of Sydney, and will form the basis of Reports and papers to be issued during the next year. Staff research by the Project team has been advanced to a stage at which substantial Reports will be published during 1976 on the whole Sydney system of waste management and pollution control, on manufacturing as a source of wastes and pollutants of all types, on the problem of water quality in the Botany Bay Area, on re-development plans in Botany Bay itself, and on environmental aspects of health and mortality in the region.

There are, no doubt, lessons to be drawn from this essay in government-academic co-operation in real-world enquiry. There are also many lessons to be learnt from the positive results of the Botany Bay Project investigations. It is to these positive lessons that this series of Reports directs attention. The Reports are offered in this spirit, as a contribution to the better understanding of a major social and technological problem affecting the great mass of Australians and, indeed, many other countries.

F. H. GRUEN
Chairman, Consultative Committee of the
Academy of Social Sciences in Australia,
Australian Academy of Humanities, and
Australian Academy of Science

# Preface

This first Report of the Botany Bay Project has attempted to assess the implications for Sydney's environmental amenity of the policies and procedures adopted in Sydney to manage the city's wastes and to control pollution. The Botany Bay Project chose the Botany Bay Drainage Basin as a case study of a large and relatively long-settled urban area. In this Report, the Drainage Basin is dealt with to the extent to which separate treatment is possible. However, in this type of study, the system of waste management and pollution control must be examined and understood on a city-wide basis and much of the volume is, therefore, about Sydney as a whole.

In a study of this kind, events must overtake the writing. Some changes have occurred since the period covered. We chose 1970-75 as a definite phase during which the N.S.W. Coalition Government re-structured the pollution control administration. The basis of this structure is not likely to change radically over a short period and it is believed that the essential outlines presented will remain for a considerable time. In any event, problems represented in Sydney have close counterparts and one of our objectives was to provide some insights into city environment problems and policies for Australia as a whole. Sydney's story will continue to be relevant from this national point of view. Nevertheless, readers should be aware that some changes will have occurred between the time of writing and the date of publication.

Since the completion of the writing, the most obvious change has, of course, been the election of the Labor Government in May 1976. This implies some alteration in the political purposes of environmental management. Apart from this, the only expressed proposals of the new government have been the reforming of two bodies dealt with in this study and their transfer to separate Ministerial control. These bodies are the State Pollution Control Commission (S.P.C.C.) and the N.S.W. Planning and Environment Commission (P.E.C.). The proposal for these bodies makes, in fact, little difference to either the content or the conclusions of this volume. The new Minister for Lands and Environment has acquired all the regulatory functions of the S.P.C.C. So far as the pollution control system described in this volume is concerned, the reader may substitute the new authority's name for the other. Only the business and 'community' representation in the general policy direction of the S.P.C.C. disappears with the Commission. This change cannot be regarded as fundamental. So far as the P.E.C. is concerned, the very low profile of this Commission in our study makes its transformation of little relevance. Nevertheless, in our conclusions, we suggest that this Commission, because of its planning function, should play a more prominent role, in close association with environmental management. The appointment of Ministers for Local Government and Planning and for Conservation attenuates the association between city environmental management and city planning and as we have evaluated Sydney's environmental problem, this change is not an improvement. Nevertheless it has little relevance to our study. No changes have been made to the major waste management authorities. In substance, despite the changes in name, the show goes on under new management.

Originally as Director and subsequently as Editor, I have been fortunate in being able to depend on the work of a small group of staff and of academics working as contractors. Together they represented a wide range of disciplines in history, geography, economics, demography, government, law, biology, meteorology, engineering, public health, medicine, chemistry and chemical engineering. For the purposes of this particular Report, some fourteen working papers were available to me as Editor. I have to thank the persons concerned for their willingness to co-operate so very freely in an arduous program and for their intelligence and responsibility in carrying out the work.

The conduct of the research has not been easy. The problem that we took on is an extremely difficult one. In addition, after a brief period of co-operation by the Coalition Government in N.S.W., the State support was withdrawn and the work continued in the face of active opposition. We were not helped in the actual research by the attitudes of some Federal Labor Ministers. The task of University and Government research co-operation is not an easy one.

These are statements of fact and not an apologia. It is to be regretted that we have not been able to expose drafts to N.S.W. officials for prior criticism. We have had a great deal of help directly and indirectly from these officials and we are aware that some had more sympathy for our objectives than they were able fully to display. To those who provided assistance, a considerable debt is due.

The value of this Report depends, however, essentially on the hard work of the research staff and contractors. It is important to understand how the volume was assembled (and others are being prepared). Work projects were designed on a co-operative basis and tasks were distributed to individuals and small groups. In the preparation of papers, some of which ran to 200 pages, each person was free to pursue his or her own specialised objective, to examine city environmental policy as an instrument of social welfare. Co-operative discussions occurred on the design and on successive drafts of each paper and each was progressively amended by the authors to interrelate with other papers.

It was my task to put the papers together into a single volume. In this editorial work, I have had to rely on the authors for clarification and at times for the assembly of supplementary information. I have to thank them for their tolerance in responding to these requests. I owe a particular debt to Dr Dan Coward who has assisted me directly in the editorial work.

Because of the focus of the Report, with its concern for policy and social welfare, a good deal of the technical detail of some papers has been omitted. This is to be regretted because much of this information is very valuable and would help to clarify the condensed or simplified versions presented here. To cope with this, it was decided to produce, in cheap form, several of these papers as Working Papers in their original form. In the list below, an asterisk indicates that Working Papers are available from the Australian National University Press.

The merits of the volume depend on a mix of inter-disciplinary co-operation and individual effort. So that the contributions of individuals are not obscured, the list of contributors is indicated in this Preface. Papers have been amended and adapted editorially and the authors should not be blamed for the shortcomings and errors. In the last resort, the Report has been, throughout, a co-operative effort and all concerned have wished it to appear as such.

The contributors are:

| | |
|---|---|
| Introduction | Editor |
| Chapters 1 and 2 | Dr D. Coward |
| Chapter 3 | Editor |
| Chapter 4 | Mrs P. Coward* |
| Chapter 5 | Dr P. Nelson and Dr D. Coward |
| Chapters 6 and 7 | Dr C. Joy,* with Dr M. Buchanan* and Mr W. Hickson* |
| Chapters 8 and 9 | Mr W. Ryder* |
| Chapter 10 | Dr M. Buchanan |
| Chapter 11 | Editor |

In addition, work done by some contractors has been partially incorporated. We have to thank, particularly, Professor O. J. Firestone of Ottawa and Professor E. Linacre of Macquarie University. They are in no way responsible for the way in which their work has been used in this volume.

It should be stressed that the responsibility for the content of the Report lies with the study group and the individual authors, not with the sponsoring Academies. In the final preparation of this Report, we owe a considerable debt to Miss Elizabeth Jackson for the preparation of drafts and the final typing of the manuscript for publication.

Canberra
July 1976

N. G. BUTLIN
Editor and Head, Urban
Environment Study Group,
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# List of abbreviations of

**Institutions**

A.B.S. Australian Bureau of Statistics
A.C.I. Australian Consolidated Industries
A.E.C. Australian Enrironment Council
A.O.R. Australian Oil Refinery
A.P.A.C. Air Pollution Advisory Committee
A.P.C.B. Air Pollution Control Branch
A.T.A.C. Australian Transport Advisory Council
C.S.I.R.O. Commonwealth Scientific and Industrial Research Organization
H.C. Health Commission
M.B.W.S. & S. Metropolitan Board of Water Supply and Sewerage
M.S.B. Maritime Services Board
M.W.D.A. Metropolitan Waste Disposal Authority
M.W.S. & D.B. Metropolitan Water, Sewerage and Drainage Board
N.H.M.R.C. National Health & Medical Research Council
P.E.C. Planning and Environment Commission
P.I.E.C. Packaging Industry Environment Council
P.W.D. Department of Public Works
S.C. & S.S.H.B. Sydney City and Suburban Sewerage and Health Board
S.P.A. State Planning Authority
S.P.C.C. State Pollution Control Commission
T.A.C. Technical Advisory Committee
U.S.E.P.A. United States Environmental Protection Agency
W.H.O. World Health Organisation
W.P.C.B. Water Pollution Control Branch

**Other abbreviations**

A.A.V. Assessed Annual Value
A.D.R. Australian Design Rules
A.S.I.C. Australian Standard Industrial Classification
A.W.M. & C.C. Australian Waste Management and Control Conference
B.O.D. Biochemical Oxygen Demand
C.B.D. Central Business District
CO Carbon Monoxide
DO Dissolved Oxygen
H.C. Hydrocarbons
L.C. Local Councils
L.G.A. Local Government Area
N.E.P.A. National Environment Protection Act (U.S.A.)
N.F.R. Non Filtrable Residue
$NO_x$ Oxides of Nitrogen
S.A.T.S. Sydney Area Transportation Study
S.M.A. Sydney Metropolitan Area
S.S.D. Sydney Statistical Division
U.C.V. Unimproved Capital Value
V. & P. N.S.W. L.A. Votes & Proceedings of the N.S.W. Legislative Assembly

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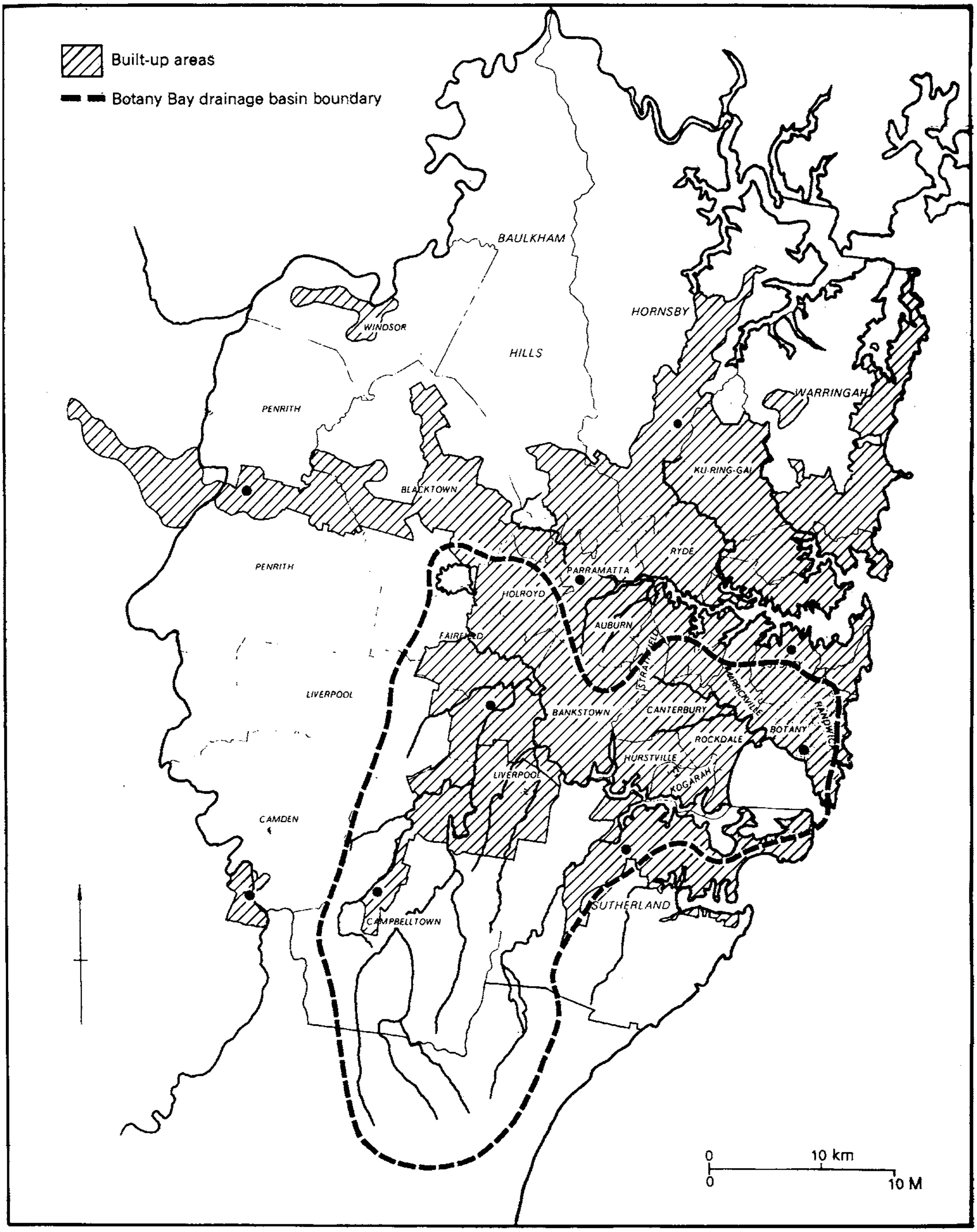



Sydney metropolitan area and the Botany Bay drainage basin

# Introduction

Cities are prolific consumers of energy and materials. Sydney, containing some 60 per cent of the population of New South Wales, is no exception. Energy and materials used up in activity (apart from those held in the form of physical and biological 'capital stock') are eventually emitted. Human and household wastes, manufacturing wastes, the litter of leisure, vehicle and other transport wastes, heat, noise and so on represent a flow of 'wastes' that enter the surrounding land, water and air environment.

Within limits, land, water and air resources may absorb these waste flows. Beyond some limits of waste flows, the surrounding urban environment becomes degraded. Natural scientists, not economists, introduced into environmental studies a basic economic concept of the scarcity of the surrounding environmental resource as a waste recipient. Emitted to the urban environment, wastes become potential damaging flows or pollutants. The declining quality of or the damage to land, air and water we take to be a process of pollution. For city dwellers, the degradation of their environment represents a loss of environmental amenity. It is the intricate relationship between human activity, waste emission, environmental damage and loss of amenity with which this volume is concerned, in the particular context of Australia's major city.

This volume is not intended as a technological treatise. It is customary in the growing numbers of reports, seminars and conferences on this subject to find discussion focused on technical characteristics of wastes, the technical aspect of damage or pollution processes and technical remedies. This is *not* what is represented here.

This study of Sydney's Environmental Amenity 1970-5 starts with the assumption that we are predominantly concerned, in a city, with *human* welfare and not, except by interrelated processes, with the viability of other species. A city, as a large, dense settlement, must degrade and disturb the natural environment and quite radically so. The degradation occurs through the effects of waste flows and the disturbances of natural environment by human structures — buildings, roads and other fixtures of city existence. Our assumption is that city dwellers seek a variety of satisfactions in city living which lead to conflicts. The quality of city life requires a balance between the demands of environmental amenity on the one hand and other amenities of productive, residential and leisure opportunities on the other.

It is, in effect, on the need for and attempts to achieve this balance that this volume is concentrated. More particularly we have focused on the attempts in Sydney, through political, legal, administrative, economic and technological processes, to manage the human waste flows and the alterations to natural flows because of human presence; and hence to control and limit the decline in environmental amenity. The first of these we take to be waste management; the second, pollution control. The dividing line is, however, not black-and-white. We have attempted to present the problem of protecting urban environmental amenity, within limits and in competition with other human satisfactions, as a system of control and management. This requires us to look across-the-board and not at specific particular problems or individual management and control acts. The management and control system relates to all forms of wastes and all major characteristics of the whole physical environment of air, water and land. But it also requires a great deal of attention to administration, legal provisions, the historical evolution of attitudes, economics and the technological procedures of control and management. For purposes of presentation we have had to subdivide the volume into particular chapters. *However, the reader should be aware that the study needs to be absorbed as a whole.*

The across-the-board perspective, the view of waste flows of all types in terms of the total waste cycle of generation, treatment, disposal and reuse, the assessment of the loss of 'environmental' amenity in all major areas of the environment in the context of complex city organisms is no easy task. We can profess only to have made a beginning towards this complex area of public policy. We have, almost certainly, made mistakes. But it *is* a beginning and, in Australian terms at least, a novelty. This volume is, therefore, an attempt to present the contours of this whole system. It is intended as a contribution to the understanding, by Sydney's residents rather than its technical experts, of the conflict between human enjoyment of city life and environmental degradation due to waste flows. We have attempted to represent the nature of and weaknesses in the public system of management and control that has been developed.

Two general points should be noted. We have found no panacea in the optimism of economists attached to the solution of 'making the polluter pay' through simple pricing procedures. The problem is far too complex and too serious for that. Nor, on the other hand, have we been receptive to the equally simple-minded notion of natural scientists that the problem is to be solved by 'stopping' growth. That the types of growth and activity and of energy consumed need to be controlled in relation to the volumes and types of wastes generated can scarcely be disputed. This rejection of a blanket prescription of stopping city growth does not, however, imply that continuous, indefinite growth is feasible or that Sydney, along with other countries, can continue indefinitely to grow as a vast energy consumer.

Indeed, one of the major themes of this volume is the failure, in Sydney, to incorporate waste management and pollution control in broader city planning. That Sydney has major environmental problems can scarcely be doubted. Though the simpler problems of air pollution have been curbed by competent technological management, the city has and will continue for a considerable time to have a serious photochemical smog problem. The palliative and limited approach to water pollution has largely transferred problems from one place to another, still leaving seriously degraded waterbodies in some areas and raising new water pollution problems for the future in what appear to be the more important waters from the point of view of human amenity. The problems of toxic wastes of industry have not been effectively solved. And the mounting garbage with dwindling landfill sites demands a more radical technological and administrative approach and less parochial control. The piecemeal procedures of technocratic engineers that control Sydney's policy making and administration and the step-by-step approach to problems and their solutions, combined with the inadequate coordination of administrative agencies, do not offer high promise that an effective system of control and management will be achieved and maintained. These are the areas on which we have focused. Others that are referred to, including such issues as noise or heat and radiation, have been left aside.

The narrow, technocratic, 'nuts-and-bolts' approach to policy making and implementation in Sydney has led to crucial weaknesses in the management and control system. Environmental goals are not specified other than in narrow, physical terms. No attempt is made, even in crude terms, to assess policy and action in cost/benefit terms. Further, basic data are not assembled in a way that permits the integration of waste flows and pollution damage with other available social and economic statistics or related information. Some of these problems require a fundamental readjustment of the attitude of public authorities and of politicians and a major change in the behaviour patterns of Sydney residents.

The N.S.W. Coalition government began the restructuring of the management and control system in 1970 with the extension of legislative controls and, subsequently, with the formation of the State Pollution Control Commission. The initial strategy was to inject environmental amenity criteria in all major city planning and action. This approach was replaced by transfering significant powers to the State Pollution Control Commission (S.P.C.C.), together with other major administrative changes. One advantageous result was to bring the protection of the whole physical environment under one authority. But the continued dominance of engineers with a narrow technocratic approach was and remains an outstanding problem in Sydney's environmental management. Improved management is not to be found simply in any changed complexion of political parties in control of government and still less merely in the broadening of the technocracy to include other skills of social scientists. Both these changes may be needed. But the core of the issue is in the need for effective city planning and management as a unit, the integration of social goals of environmental amenity as a major criterion in overall planning and management and the effective representation of Sydney's residents in both planning and environmental management. The problems are due to the existence of a city. They must be dealt with by an integrated city system of management and control.

It is not unreasonable, in fact, to say that this city planning and control system, incorporating environmental amenity, demands as its basic foundation a new structuring of information. This information needs to be geared to the needs of the environment and designed for regional metropolitan purposes. Information is the basis of understanding. It is this, above all, that is needed.

It is only through changes along these lines that reasonable environmental amenity can be sustained through restraint on the size, type and design of the city as the basic preventive control over the generation of wastes; and eventually on the progressive reuse of waste emissions. The current approach of removing wastes out of sight and mind is not a viable long-run policy. These are lessons that are relevant not only to Sydney or to other Australian cities but to most of the cities of the world.

# 1 From public health to environmental amenity, 1870-1970

## Introductory

From the human point of view, wastes become pollutants when they impair the human use of the air, water or land. The problem that faces city dwellers is that waste generation is concentrated in cities, but only limited space is available for waste disposal. Waste concentration provides some scope for pollution to occur, and hence a greater probability of pollution control becoming an important social and political issue. Nobody wants waste at his or her doorstep. To a great extent, therefore, the objective of urban waste disposal has been to transfer wastes within or from the city so as to avert or minimise or hide their impact upon people.

Environmental absorptive capacity is not standard and unchanging in a metropolitan area as large as Sydney. Moreover, population concentrations vary as between localities, creating differences in pressures on environmental resources. In addition, the sources of pollution and types of pollutants may be specially concentrated in particular parts of a city. To complicate the matter further, wastes and pollutants may be directed in such a way as to concentrate their environmentally degrading influences in particular localities.

As we shall see in both historical terms in this chapter and in later administrative and technical parts of this volume, there has been and is a strong tendency for the area of Sydney from the Parramatta River to the southern perimeter to be particularly important sources of wastes and pollutants and to be the most seriously affected by the pollutant processes. In part, this was the reason for choosing, in this Project, to concentrate on the drainage basin of the Botany Bay Region.

In studying the principles, techniques and methods of administrative control, however, these locational differences become blurred and are largely irrelevant. Management procedures and control approaches apply to the whole metropolitan area. At times, special solutions, particularly through local government action, are adopted for particular localities. But the city-wide system of management and control is the dominating approach for all areas including the Botany Bay area. Accordingly this study, together with this historical chapter, deals with Sydney as a whole in order to discuss the waste management and pollution control system adopted.

Within the Sydney metropolitan area the transfer technique of regulating the impact of wastes is becoming increasingly difficult and costly. As Table I-(1) shows, the process of urbanisation over the century 1871 to 1971 increased the population of the Sydney metropolis more than nineteen fold. Moreover, in the same period the metropolis increased its proportion of the State's population to near two-thirds as against just over a quarter of the total in 1871.

Table I-(1) Growth of Sydney: Population, occupied dwellings, factory employment

| Census year | Persons '000 | Percentage of State population | Expanding Area of metropolitan statistical district (Sq. Miles) | Occupied dwellings '000 | Factory employment |
|---|---|---|---|---|---|
| 1871 | 138 | 27.4 | — | 25 | — |
| 1891 | 383 | 34.0 | 120 | 70 | 27,000 |
| 1911 | 630 | 38.2 | 185 | 123 | 78,000 |
| 1933 | 1,235 | 47.5 | 244 | 288 | 113,000 |
| 1954 | 1,863 | 54.4 | 671 | 517 | 314,000 |
| 1961 | 2,183 | 55.7 | 671 | 610 | 350,000 |
| 1966 | 2,447 | 57.7 | 1573 | 707 | 392,000 |
| 1971 | 2,717 | 59.2 | 1573 | 828 | 394,000* |

* 1968/9
Sources: *Official Year Book of N.S.W.; Statistical Register of N.S.W.;* census data.

Urbanisation in nineteenth century New South Wales largely preceded the process of industrialisation.[1] Then, waste disposal problems occurred with biological wastes that were chiefly domestic sewage and animal (especially horse) excreta and, secondarily, liquid and malodorous wastes generated by animal rendering works and the processing of certain primary products. The momentum of both processes of urbanisation and industrialisation, particularly after 1945, in conjunction with social and economic changes such as the spread of greater wealth to a wider group of people and the rise of mass consumption of industrial products including motor vehicle ownership and usage, generated an ever-increasing volume of waste and encouraged even greater urban concentrations. During the twentieth century not only did more people mean more wastes, particularly since the second world war, they also meant the generation of an increasing variety of chemical wastes.[2] The latter problem became particularly important after the second world war. Metropolitan growth changed the scale of the problem; industrial growth changed its nature.

The scale of waste generation and the increasing variety of complex wastes needing disposal greatly strain the absorptive capacity — and hence the maintenance of the physical quality — of air, water and land. Given the current waste generation trends in Sydney, it is an accelerating difficulty. The area of the metropolis expanded by thirteen times in the period 1891-1966 (see Table I-(1)) to accommodate population growth, so that *some* localised addition to disposal capacity was achieved. But progressively activity became more concentrated in the metropolitan area. And, in addition, natural air and water flow process meant a convergence of waste flows into a limited pool of natural absorptive capacity. As the metropolis expands and concentrates so the supply of space (air, water, land) available for waste disposal diminishes. But the making of waste disposal policies on a metropolitan scale is an intricate problem that includes, for example, high costs, vested interests and entrenched social habits. The problem for policy makers is to devise measures for waste management that will be technologically feasible, economically justifiable, socially acceptable, politically possible and administratively effective.

Our perceptions of wastes help to shape the policies, legislative powers and administrative means that are organised to control their impact on urban communities. The activities of the two major waste management agencies that were founded in the late nineteenth century were shaped by the nature of the wastes accumulating in the growing Sydney metropolitan area and by contemporary perceptions of them. The statutory powers, objectives, and the specialised engineering and medical visions of the Water and Sewerage Board and the Board of Health, respectively, were geared to remedy and control urban conditions arising within an earlier society that was poorer, less populous, less urbanised and less personally fastidious than that of the later twentieth century. It is the objective of this chapter to provide a sketch, while awaiting a larger historical study, of some of the circumstances that helped in the founding of these two authorities, and of the limitations that blocked their respective capacities to manage the accumulating wastes generated by the twin process of urbanisation and industrialisation in post-1945 Sydney.

**The late nineteenth century focus on wastes: preventing disease**

The objective of environmental pollution control in the nineteenth century was to prevent deaths or sickness from infectious diseases; to some extent, complaints about offences of sight and smell prompted action. Some of the notable causes of mortality at this time arose from typhoid, cholera, diarrhoea, diptheria, scarlet fever, measles, smallpox, plague and tuberculosis, many of them tending to be diseases of the relatively young. British experience in disease control shaped Australian responses. It was possible, argued the British sanitary reformers during the mid-century, to prevent or reduce the incidence of disease by improving basic sanitation services. Their approach to better methods of waste disposal focused on the (to them) evident suffering of the poorer classes who lived and worked amid the accumulating muck of rapidly growing cities.

Contemporary scientific knowledge of disease causation fortified this approach. Atmospheric impurities ('miasmas') exuded from rotting organic matter, damp and filthy living conditions, and crowded dwellings, it was believed, were the direct causes of infection. Clean up the cities, institute ways to maintain their cleanliness and disease would diminish. But the miasma theory came to be progressively modified. Evidence collected by British medical men such as John Snow on cholera (1849-55) and William Budd on typhoid (1856-60) showed the role played by impure drinking water in the transmission of diseases. Thus filth came to be recognised not as the source but as the medium of transmission. Advances in microbiology in the 1880s proved the existence of microscopic organisms and their specificity in causing disease: the germ theory of disease causation displaced that of the miasma.

These conceptions of disease causation had political importance during the late nineteenth century, for the role and extension of government functions were then more hotly disputed. In Australia, as in Britain, the association between diseases and insanitary conditions helped to mobilise political agitation in order to press the government to embark on specific measures to prevent disease, namely to provide safe drinking water, comprehensive sewerage schemes and more adequate public control over garbage disposal. The Sydney City and

Suburban Sewage and Health Board which officially revealed the filthy condition of the metropolis in its reports during 1875-7, found it necessary, following the discovery that faeces had polluted Sydney's piped water supply, to declare: 'It may perhaps, be the opinion of ignorant persons that the contamination of water . . . (by faeces) however distasteful and disgusting, is not particularly dangerous to health.' General medical opinion, it went on, believed that pollution of drinking water by 'fecal[*sic*] matter is productive of many fatal diseases, and is supposed to be the readiest means by which epidemic and infective diseases are conveyed from one another.'[3]

## The reorganisation of public sanitation in Sydney in the 1880s and 1890s

The administrative reorganisation of Sydney's public sanitation in the late nineteenth century happened almost by accident. Separate disease epidemics prompted the government of the day to appoint two advisory boards to help it devise appropriate modes of disease control. A smallpox scare provoked the formation of the Board of Health in 1881, but it was not to acquire broad powers in public sanitation until 1896.[4] Earlier, a noticeable increase in deaths from typhoid in Sydney had precipitated the establishment of the Sydney City and Suburban Sewage and Health Board which drew up plans leading to the establishment of the Metropolitan Board of Water Supply and Sewerage.

*The Water and Sewerage Board and the Board of Health*

The broad objective of the Water and Sewerage Board and the Board of Health[5] was to remedy the insanitary conditions that had arisen from the accumulation of biological wastes in the growing metropolis. The Water and Sewerage Board, in addition to its functions of supplying water and controlling its quality, came to be, with the extension of the metropolitan sewerage and stormwater drainage systems, the major agency for the disposal of liquid wastes and was to remain so until today. Because of this latter function it was also, at least in a legal sense, a polluter. The Board of Health, which had State-wide jurisdiction, was the sovereign pollution control authority, but only in so far as liquid, solid and gaseous wastes impinged on the health of Sydney people. Despite the inherently contradictory functions of the Water and Sewerage Board, its sewerage system complemented the public health objective of the Board of Health: as sewers became connected to an ever-growing number of houses and buildings they appear to have helped to reduce the incidence of waterborne communicable diseases.

The particular statutory powers conferred on each Board directed their activities in contrasting ways: the Water and Sewerage Board provided metropolitan services; the Board of Health regulated the sanitary duties of each local government authority. As an engineer-oriented construction and maintenance agency with jurisdiction over a large coastal region that included large tracts of rural land,[6] the Water and Sewerage Board expanded in size as it progressively took over water supply, drainage and excreta disposal functions from the metropolitan local government authorities.[7] Employing only several hundred people in 1888, the Board had, by 1973, grown to 15,500 employees.

The New South Wales Parliament delegated broader discretionary powers upon the Board of Health. It was empowered to make regulations, applicable to the entire State or segments of it, that were relevant to a broadly defined notion of 'public health'. The Health Inspection Branch (originally the Sanitary Inspection Branch), a sub-unit of the organisationally complex and now defunct Department of Public Health,[8] exercised the supervisory public health (pollution control) functions of the Board. But the Branch remained relatively small: after the turn of the century it had five inspectors; by 1972 it had expanded to forty-three.

*The place of local government in metropolitan sanitary administration*

The advent of the State agencies, the Water and Sewerage Board and the Board of Health in the 1880s and 1890s, diminished the sovereignty of the metropolitan local government authorities in sanitary matters. The statutory superiority of the two Boards made them the overriding authorities in the public administration of wastes in metropolitan Sydney until that administration was reorganised in the 1970s. But it must be emphasised that local governments, although subject to periodic administrative changes dictated by Acts of the State Parliament, maintained for a long period their importance in waste management during this century.

Waste disposal has been of continuing political importance, particularly to local government authorities, who receive the impact of agitation when noticeable pollution problems arise. Local government representatives have always constituted part of the Water and Sewerage Board, but their relative strength has fluctuated. The highwater mark was 1924: of the reconstructed eighteen-man Board, seventeen were local government representatives. In 1935 their size was cut to five serving on a seven-member Board, the size of the original Board in 1888. The Board became eight strong following certain changes in 1972, but the local authority representation was reduced to three.

The Water and Sewerage Board, established as a specialised agency, took over the control and management of water and sewerage services from the Sydney City Council as well as the several sewers that had been begun by a few suburban councils. But until its sewerage system expanded, responsibility for the public disposal of excreta remained with the councils.

Empowered to enforce measures to prevent the spread of disease under the Public Health Act of 1896 and its successor Acts, the Board of Health regulated the sanitary functions of each local government; it also had power to investigate the public health aspects of the Water and Sewerage Board operations. Further, the Public Health Act designated each local government as a local public health authority and directed each to carry out the provisions of the Act. Thus each local government organised and financed sanitary services such as garbage and excreta removal, garbage tip control and street cleaning, but was governed by the conditions prescribed by the Board of Health and was periodically inspected by its officers.

Over time the Water and Sewerage Board's potential *monopoly* of metropolitan excreta disposal became increasingly realised as it gradually replaced local governments in the field. Simultaneously the need for the Board of Health to supervise local government excreta disposal operations diminished.

Thus the Water and Sewerage Board has become progressively a more powerful public authority. With the advent of water pollution control measures during the 1970s its sewers have become crucial for the disposal of liquid wastes generated by industry as well as for the disposal of household waste water. Today, the plans and activities of the Board in the provision of capital equipment and services, water supply, sewerage and drainage, make it an exceedingly important agency that influences the pattern of land use and rate of development in the Sydney metropolitan region. Before we consider further the evolution of the water and sewerage and public health administrations respectively and the problems that they encountered in the expanding metropolis during the twentieth century, let us turn for a quick look at the problem of excreta disposal in Sydney some hundred years ago and the expedients that were devised to cope with the problem in long and short term.

## Waste transfer: the objective of the Sydney sewerage system

### *The impact of water closets and cesspits*

By the 1870s the five sewers-cum-stormwater drains serving the northern draining slopes of the city of Sydney had proved too short. Twenty years earlier their building had been prompted by the increasing substitution of unconnected domestic water closets for cesspits by the richer citizens: domestic sewage, swelling yearly in volume, had been flushed into open drains leading to the Tank Stream already affected by industrial wastes. 'Private' convenience became a 'public' annoyance. Following protracted agitation, the city's first five sewer mains were completed in 1859 by the Sydney City Council.[10] But the sewers ended at the water's edge: the raw sewage poured into the harbour and there accumulated. The growing pile provoked further agitation for its removal. Some 3,800 affected citizens and waterside property owners declared in 1877 that the sewers had deposited 'all the filth of the city in the harbour, rendering all business occupations upon its shores disgustingly offensive', increased the sickness of the citizens and silted up navigable water.[11]

The problem for the municipal City of Sydney, as the Sydney City and Suburban Sewage and Health Board saw it, was essentially that of an inadequate sewerage system arising from a growing preference for a water-using privy system: the volume of liquid sewage requiring disposal was steadily increasing. But by far the worst hazards to the quality of life and health in the 1870s existed in the suburban areas of the metropolis where both the traditional cesspit system was almost universal and sewers and frequently surface drains did not exist. Cesspits, which were essentially a prolonged on-site excreta storage system, were unregulated as to their construction, siting and cleansing. Overflows onto unpaved streets were common. For example, on the south-draining slopes of Redfern and its adjoining suburbs, sewage seeped down to the extensive swampy ground at the head of Sheas Creek. Here the poorest dwelt. 'The whole of the subsoil of the low ground appears to be saturated with sewage, giving out the most offensive fumes', the Sewage and Health Board reported. 'Many of the houses have been constructed in what are now green foetid fields, and complaints of illness and mortality during the hot weather of last summer (1876/77) were general'. They concluded: 'No language can adequately describe the foul and noisome filth of the drains in the immediate vicinity.'[12]

*The long-run remedy: conversion to a metropolitan sewerage system*

The Board concluded that in order to abate the incidence of disease, a comprehensive metropolitan water carriage system of underground sewers was imperative. For this a more copious water supply was needed: 'No system of sewerage can be effectual unless the sewers are well flushed, so as to prevent the accumulation of organic matter.'[13] The Board expected that an ever-increasing number of people would install water-flushing privies in their houses in preference to cesspits. The anticipated conversion would raise the volume of water required for domestic purposes while increasing the volume of liquid sewage needing disposal. Hence sewers (and the water supply system) would need to be of a size to cope with an expanding water flow. Moreover, given the expected life of the sewerage mains, it was necessary to plan a sewerage system to serve demands, in terms of mains, far into the future.

The advice of the Sewage and Health Board as to the construction of a water carriage sewer system further justified the expense of a proposal to secure more adequate water supply for the expanding metropolis. Periodic droughts and increasing water consumption by a growing number of households and industries had diminished the reliability of the supply drawn from the nearby Botany swamps. A Royal Commission of 1867-9[14] had recommended a costly water supply scheme in which water was to be drawn from the Upper Nepean River, conveyed via some forty miles of canal and held in a vast storage reservoir near Prospect, a few miles west of Parramatta. Moreover the Sewage and Health Board also argued on public health grounds for tapping alternative drinking water sources. The Botany watershed lay near to built-up areas. As the city spread, the Board observed there would be ever-increasing difficulty in protecting the watershed from pollutants, and hence in safeguarding the quality of drinking water.[15]

To drain the northern slopes of the city, the Sewage and Health Board proposed to extend the existing sewerage system, redirect its flow and transfer the sewage yet further afield. By laying a major intercepting sewer across the city, the Board advised liquid wastes could be diverted from the harbour to the Pacific Ocean through an outfall near Bondi. This sewer began to flow in 1890 and has been flowing ever since.

On the slopes draining the south, the Board recommended that a sewer, laid in a southerly direction, should terminate at a sewage farm[16] which was to be located on a sandy tract of land at the mouth of the Cooks River. This site seemed ideal: the neighbourhood was almost uninhabited. Moreover, the Board believed that isolation could be preserved from the future southward spread of Sydney: it was bounded by 'useless creeks and swamps'[17] to the west, the river to the north, Botany Bay on the east. The sewage farm began its work in 1890. But its isolation was relatively shortlived. With the growth of the metropolitan population and the spread of the suburbs, houses came to be built near the once secluded sewage farm. Agitation began for its removal during the 1900s. Arncliffe and Rockdale residents complained of the stench, declared the farm 'a menace to public health', and denounced proposals to augment the existing sewage flow with that from the growing western suburbs. This plan would cause 'a big depreciation in the value of property'.[18] For a number of reasons, including its limited capacity, the sewage farm was closed when the completed main trunk sewer, which ended at the Malabar ocean outfall, began to drain the south and western suburbs in 1916.

*The interim remedy: public control over collection and disposal of excreta*

Traditional methods of disposing of household excreta still applied until the metropolitan sewerage system expanded. But the Sewage and Health Board initiated an important reform: it urged that public control over the disposal of excreta be established. The Board had discovered that 'nightcart' men,[19] upon obtaining a full load from their clients' cesspits, often dumped the excreta onto vacant land near the perimeter of the urban area and even onto the water reserve surrounding the Sydney water supply at Botany. When the excreta was sold as fertilizer to market gardeners on the urban fringe, its stench as it lay spread over the earth provoked frequent complaints from neighbouring householders. At the prompting of the Board the Nuisances Prevention Act was passed in 1875.

Briefly, the Act gave local government authorities extensive powers of regulation: householders were prohibited from emptying their own cesspits; that function now came under the control of the local authority. Moreover, each local council could make a range of by-laws regulating the construction and depth of cesspits and closets, the method of removal and disposal of excreta, and establishment of 'nightsoil' depots. But the application of the Act depended upon its proclamation within each municipality. Almost two years later the Sewage and Health Board reported that the Act had not been strictly enforced. Complaints of indiscriminate unloading of nightcarts had continued. Nonetheless they believed that such nuisances were decreasing. 'Until the Municipal authorities fully carry out the Act by themselves undertaking the duty of cleansing the cesspits', the Board continued, 'the evils complained of will never be entirely removed.'[20]

Nonetheless public control over excreta disposal was progressively extended, particularly with legislation passed at the turn of the century: the Public Health Acts of 1896 and 1902, consolidated Nuisances Prevention Act, 1897, and the Public Health (Night Soil Removal) Act, 1902. Removable pans displaced domestic cesspits in the metropolitan area,[21] but similar collection and disposal regulations still applied. Despite the extension of the sewerage system, large areas of Sydney remained unsewered largely because the spread of housing was too fast for the Water and Sewerage Board to keep up with demand. By 1959 there were five nightsoil disposal depots remaining in the Metropolitan Health District. The Director-General of Public Health observed in his report for that year: 'Nightsoil depots, because of the increased building development around them, are no longer satisfactory.'[22]

*Treatment on site: the septic tank*

The septic tank introduced an on-site method of liquid waste treatment for individual houses. Anaerobic bacteria[23] decomposed the organic waste in the tank and the treated effluent drained into an earthen ditch to be absorbed into the soil. The first recorded tank appears to be one installed in New South Wales in 1902: three years later there were 187 operating in the metropolis.[24] The early models had no flush toilets attached, but subsequent developments in septic tank technology and capacity enabled each tank to be connected to all sources of household waste water. The increasing rate of septic tank installation after 1945 in the unsewered areas of Sydney, coupled with social pressures upon local government authorities to permit the convenience of excreta and sullage treatment in septic tanks, helped to swell the volume of liquid pollutants at dwelling locations.[25] Most local authorities provided for the removal of accumulated effluents. But frequently the wastes from sullage and septic tank systems overflowed into the streets. The Metropolitan Medical Officer of Health observed in 1959 that in many places the sullage waters were discharged into street gutters which, if not kerbed and graded, caused stagnation, odour nuisance, mosquito breeding, and were thus regarded as a health hazard to nearby residents.[26]

Let us now turn to look at the evolution of the two waste management authorities that were founded in the late nineteenth century and the way in which each, together with the Maritime Services Board from 1935 onward, proved unable, for political, legal, economic and institutional reasons, to manage the rapid development of waste problems in Sydney after 1945.

## The evolution of the Water, Sewerage and Drainage Board

### *The Sewage and Health Board's proposal*

The Sewage and Health Board in its final report in 1877 proposed the formation of an agency that had scope to remedy all problems of public sanitation, not simply those of providing sewerage and a safe drinking water supply. They suggested that a permanent Board of Health and Works be established, that its membership be small, be granted both secure tenure in office and 'sufficient power, subject to the approval of the Government, to carry out necessary works and to compel the observance of sanitary laws'.[27] More importantly, the Board warned, the new agency should not be 'directly subject to popular control'. The investigations of the 1870s had revealed numerous instances where pliant officials had allowed private interests to triumph over public safety. Autonomy was justified: 'Sanitary laws will not be stringently administered by a body who have any dread of unpopularity.'[28]

As it happened the comprehensive public authority that the Sewage and Health Board had envisaged became two agencies: the Board of Health and the Metropolitan Board of Water Supply and Sewerage. The recommendations of the British civil engineer, W. Clark, who had been brought to New South Wales by the Government in 1876 to advise it on the proposed water and sewerage schemes, seem to have been influential in the eventual formation of the specialist, engineer-oriented M.B.W.S. and S. in 1888.[29]

### *The changing powers and functions of the Water and Sewerage Board*

As its original title suggests, the Board had only two duties: to manage metropolitan water supply and sewerage services within the County of Cumberland. In 1894, shortly after its birth, an amendment to its establishing Act made the Board responsible for the control and maintenance over nine main stormwater drains. Disease scares prompted their building. Sewage had collected into stagnant pools along natural watercourses and menaced the health of residents in several growing suburbs. Stormwater drains could be built more quickly than underground sewers; they thus served as temporary open sewers until the sewerage system could be extended. These drains formed one beginning of the metropolitan main stormwater drainage system.

On several occasions Parliament has modified the functions and powers of the Board. The most significant changes occurred following the passing of the Metropolitan Water Sewerage and Drainage Act of 1924, which altered the title of the Board to express its full range of responsibilities: Metropolitan Water Sewerage and Drainage Board. Its three functions were:

(a) the conservation, preservation and distribution of water for domestic and other uses;
(b) the provision of reticulation and other means for the discharge of sewage and its treatment and disposal;
(c) the construction, control and management of stormwater channels assigned to or vested in it.

The 1924 Act conferred a great degree of autonomy on the Board. Hitherto the major construction agency had been the Department of Public Works, so that the Board was chiefly a maintenance and administrative agency. Although a statutory corporation, the original Board had been controlled almost like a ministerial department in that it was subject to ministerial approval for its annual estimates of expenditure and for contracts over £100, while its revenue was paid to Treasury as consolidated revenue. The 1924 Act removed these limitations. It gave the Board sole responsibility for future construction of water supply, sewerage and drainage works throughout its area of operations, and placed the Board virtually in control of its own finances. Cabinet retained an important control in that it retained the power to approve borrowings and the raising of loans. The Board became responsible to Parliament: the Minister for Public Works acted as liaison between the two institutions. The Board retained its independence until 1972. In that year an amending Act returned it to the control of the Minister.

*The growing impact of the Board's service system*

As the Sydney metropolis sprawled ever further from its central business district, so the Board's water supply and sewerage system has gradually stretched after it. For example, Parramatta's water supply and sewerage was taken over by the Board in 1916. The extent of this expansion since 1888, which included Wollongong after 1903, is indicated by Table I-(2).

The role of the Water and Sewerage Board as the regional liquid waste management authority became more important as the city grew. Thus the Board's policies, construction program and its ability to finance new works had an increasing impact on the quality of water in the metropolitan area. Water pollution attracted greater attention during the 1950s and 1960s: thus four swimming enclosures in the Georges River near Bankstown were closed on

Table I-(2) Expansion of water and sewerage services 1888-1973

*Water supply*

| | Total length of mains (miles) | Population served | Improved properties with water main available |
|---|---|---|---|
| 1888 | 355 | 296,000 | 62,000 |
| 1928 | 3,289 | 1,251,000 | 291,000 |
| 1948 | 4,816 | 1,774,000 | 401,000 |
| 1973 | 9,422 | 3,063,000 | 862,000 |

*Sewerage*

| | Total length of sewers (miles) | Population served | Improved properties with sewer available |
|---|---|---|---|
| 1890 | 122 | 109,000 | — |
| 1928 | 1,577 | 925,000 | — |
| 1948 | 3,608 | 1,258,000 | — |
| 1973 | 7,774 | 2,600,000 | 726,000 |

Source: W.V. Aird, *The Water Supply, Sewerage and Drainage of Sydney*, Sydney 1961, Appendices 1 and 14. Metropolitan Water, Sewerage and Drainage Board *Annual Report 1973/74.*

grounds of health risks in 1961; that year the interdepartmental Standing Committee for the Control of Pollution of Waters in New South Wales was formed.

Of the several sources of pollutants affecting water quality, the activity of the Board affected several of the more important. First, the rising volume of inadequately treated effluent discharged from the ocean outfalls intermittently polluted Sydney's surf beaches. Second, sullage wastes arising from the backlog of unsewered houses eventually found their way into watercourses. Third, the establishment of inland treatment works like those at Liverpool and Glenfield, discharging effluent into the Georges River and its tributaries, reduced water quality. Fourth, the Board's policies limited the volume and kind of industrial liquid wastes that could be discharged into its sewers and stormwater drains.[30] Fifth, overloaded sewers occasionally discharged raw sewage from overflow vents during wet weather.

The disposal of industrial liquid wastes proved an intricate problem. Managers of industry disposed of their liquid wastes in a variety of ways: to Board sewers and stormwater drains or directly to watercourses, into municipal or private tips, or paid liquid waste contractors to remove and dispose of wastes and sludges where and as they wished. The closure of tips in the late 1960s and the growing concern for deteriorating water quality provoked a liquid waste disposal crisis. Waste generation continued but the supply of disposal points diminished. The Water and Sewerage Board could not accept all industrial liquid wastes: its sewerage system had been developed to dispose of waste water that consisted primarily of domestic excreta and waste water. To protect its workmen from danger and its sewers from corrosion and to enable its sewage treatment works to function adequately, the Board prohibited discharges of certain groups of industrial wastes because of their chemistry or toxicity.

Further, sewers sometimes did not exist near liquid waste generating sites, or else the capacity of existing sewers was too small to cope with large volumes of industrial wastes.

In the 1960s the Water and Sewerage Board thus found itself the subject of increasing pressures. It could not dispose of the large volume of liquid wastes, particularly industrial wastes. Nor could it adequately fulfil its statutory obligations to supply water sewerage and drainage, for their provision proved increasingly expensive as the urban sprawl moved further inland from the coast. To control pollution of the urban environment by domestic sewage and from industrial liquid wastes, public waste management needed to be reorganised. Similarly, the more varied activities of the Department of Health, despite adaptations to meet changing circumstances, proved inadequate to cope with the increasing volumes and kinds of wastes dumped into the air, water and land of the metropolis.

## The evolution of public health administration in New South Wales

*Urban growth and the public control of noxious trades*

In 1881 an outbreak of smallpox had impelled the passing of the Infectious Diseases Supervision Act which established the Board of Health as an advisory agency composed of lay and medical men.[31] The need to control offensive liquid and gaseous wastes helped to expand the Board's limited function. The advance of residences during the 1880s on to what was originally isolated rural land once occupied almost solely by industries, particularly animal-rendering works that emitted foul smells, provoked conflicts of interest. A politician told Parliament in 1882 of the predicament that faced boiling-down operators located south of Sydney near Sheas Creek. That site had been chosen for their factories, he declared, to prevent odour nuisances offending city dwellers: 'But during the mania for purchasing land, which sprang up in the last three or four years, population has gathered around their works . . . and these tradesmen have been persecuted and worried, many of them ruined . . .'[32]

Although the Government appointed a Royal Commission on Noxious and Offensive Trades in 1883, government regulation of the pollutants arising from these industries did not begin until the passing of the Noxious Trades and Cattle Slaughtering Act in 1894. Because of its limited pollution control objective, namely the abatement of strong smelling odours arising from biological wastes, the noxious trades legislation can be regarded as an extension of nuisance laws that were the traditional British response to the problem of abating the impact of specific offensive wastes within towns and cities.[33]

The Act empowered the Board of Health to advise the Government on suitable regulations to be applied to noxious industries within the County of Cumberland, that is the area that encompassed the Sydney metropolis. Operators of declared noxious trades were compelled to register their establishment for which they received an annual licence.[34] Their premises, material and machinery were subject to regular inspection, while regulations under the Act governed the disposal of offal and garbage and the sanitary rules to be observed by the declared trades. The local government authorities were empowered to police the Act and regulations. Further, the Act incorporated the Board of Health thereby enhancing its legal status. But more significant changes were soon to follow.

*The advent of the Public Health Act 1896*

New South Wales was the last of the Australian colonies to pass a comprehensive Public Health Act in 1896.[35] Through this Act, Parliament delegated quasi-legislative powers to the Board of Health: it could make regulations without the intervention of a Minister. The discretionary powers conferred upon the Board gave it broad authority to remedy insanitary conditions, which, if allowed to remain, would foster the spread of diseases. An outbreak of bubonic plague at Sydney in January 1900, which lingered until 1909, served to underline the importance of the rudimentary public health administration in controlling epidemics of communicable diseases and in preventing their spread. The plague led, amongst other things, to the Government assuming control of the Port of Sydney's wharves.

The notion 'public health' denotes those preventive measures adopted by government to diminish health risks in the community. As expressed by the Public Health Act, 1896, and its successor, the Public Health Act, 1902, 'public health' emphasised public control over the quality of aspects of the physical environment such as water, sewage, food and housing.[36] During the twentieth century the scope of preventive medicine undertaken by government came to include, for example, maternal and infant health, mass immunisation and school health services, so that the concept of public health was progressively widened beyond that of its initial concentration on public sanitation.

*The Board of Health and the Department of Public Health*

The evolution of the New South Wales Department of Public Health is an intricate story. Its history can be traced back to the founding of the government settlement at Sydney Cove in 1788, but its modern development begins with the Public Health Act of 1896. In that year significant administrative reorganisation occurred. Hitherto the President of the Board of Health had been an eminent physician either teaching at the University or in practice; now the post was combined with that of the senior medical position in the public service, namely the Chief Medical Officer to the Government.[37] The President thus became a permanent medical administrator and hence achieved dominance of the Board. Despite the status of the Board of Health under the Public Health Act, the focus of public health activity shifted to its administrative arm, the Chief Medical Officer's department, which subsequently became known as the Department of Public Health.[38]

In its organisation, the Department was an administrative hybrid exhibiting characteristics both of ministerial department and statutory authority. This arrangement arose through the divided responsibilities of the Director-General of Public Health, as the Chief Medical Officer came to be called in 1913. He was responsible to a minister through the permanent head of the department;[39] yet in his capacity as President of the Board of Health he had independent duties which were prescribed by statute.

*The Metropolitan Combined Sanitary District*

The Public Health Act provided for the establishment of sanitary districts (now called health districts) which enabled the decentralised administration of public health functions. However, authority, as distinct from function, remained centralised in the person of the Chief Medical Officer (Director-General of Public Health). In 1898, as the most urgent sanitary problems existed in Sydney and Newcastle, two sanitary districts were proclaimed: the Metropolitan Combined Sanitary District[40] and the Hunter River Combined Sanitary District. Legally qualified medical practitioners, entitled Medical Officers of Health, were appointed to take charge of public health matters in each district.

*The Health Inspection Branch*

The actual administration of public health sanitary Acts and regulations fell to the Inspectors who were appointed to assist the Medical Officer of Health in each district. The first inspector — then called a Sanitary Inspector — was appointed in December 1898; by 1904 there were five inspectors in what became known as the Sanitary Inspection Branch (later Health Inspection Branch) of the Department of Public Health.[41]

The inspectors were authorised to carry out the duties and to make inspections and reports on matters arising out of the administration of the Public Health Act, 1902, Noxious Trades Act, 1902, and their regulations, and subsequently the Local Government Act, 1919 and its ordinances. Accordingly, their chief function was to police the sanitary activities of local government authorities. In routine work, inspectors concentrated on obvious points at which health hazards could arise, such as at nightsoil depots and garbage dumps. However, the Branch also made occasional thorough inspections, which were called sanitary surveys, of individual local government areas. Both spot and comprehensive inspections helped to maintain standards of disposal of wastes and so minimise their impact on people and their physical environment. Thus, following a sanitary survey of the growing municipality of Liverpool in 1965, the Council was requested to implement remedial measures, particularly in regard to watercourse pollution, disposal of trade waste and garbage, noxious trades supervision and septic tank effluent disposal.

Despite some changes of emphasis during the century, the bulk of its statutory duties, and hence the routine work of the inspectors, remained much the same. Its duties were diverse. In 1969, for example, Health Inspectors in the Metropolitan Health District inspected shops, warehouses, hotels, motels, lodging houses, public halls, dilapidated buildings, noxious trades premises, abattoirs, cemeteries, crematoria, camping grounds; investigated complaints of nuisance; imposed conditions and inspected proposed sites of nightsoil and garbage depots and supervised their operation; inspected sewage treatment works and septic tanks; approved or rejected septic tank applications and their sites[42] and investigated cases of river and beach pollution.[43]

*Pollution control: the losing battle*

Because of its statutory powers and its routine duties, the Health Inspection Branch could observe at first hand the diminishing environment available for the disposal of solid and liquid wastes and the accumulating impact of those wastes. The Branch's official reports during the 1960s, brief though they were, showed that wastes were becoming unmanageable under the existing administrative system. Local government authorities that had no land for dumping their municipal wastes sought various solutions. Some chose to transport their garbage long distances for disposal. In 1965, two councils asked the Branch for approval to establish a joint incinerator for the disposal of their garbage. Councils that controlled waterside land bordering the Georges River dumped their garbage into swamps. 'The very large increase in the volume of garbage to be dealt with and a shortage of suitable sites', reported the Chief Health Inspector in 1967, 'has led to reclamation projects being developed in areas quite close to habitation.'[44] In order to prevent a public nuisance occurring, stringent operating conditions were required by the Branch before it gave its statutory approval for any disposal site. Earlier an ambitious scheme to 'reclaim' the north shore of Botany Bay by garbage landfill was abandoned when the then Commonwealth Department of Civil Aviation protested that seagulls flocking to the site would create hazards to aircraft that used the nearby Sydney airport.

Dumping garbage into swamps at first seemed a benefit to urban dwellers: the process 'has led to considerable diminution in mosquito breeding which is very much appreciated', wrote the Metropolitan Medical Officer of Health in 1959. When completely covered such sites became playing fields and parks. But problems were soon to develop. Rainwater that soaked through the buried garbage resulted in a highly offensive effluent that flowed from the base of the former tips and eventually found its way into watercourses. As the Government Analyst noted in 1969: 'Sometimes large volumes of polluted liquor are involved'.[45] We now know of a further implication. Salt water swamps play a vital part in the life cycle of fish: destruction of swamps reduces the area available to them for breeding.

During the 1960s the nature of its tasks made the Health Inspection Branch a leading public agency in its attempts to abate pollution, partly by its own efforts and partly through its attempts to coordinate pollution abatement activities through local government councils, State Government departments and statutory bodies. Following the formation of the Air Pollution Control Branch in the Department of Public Health in 1962, Health Inspectors concentrated their efforts upon the control of wastes dumped on land or discharged into water. The Chief Health Inspector reported in 1962 that investigation of sources of water pollution was a major activity of his inspectors. Thus in 1965 inspections were made of Cooks, Georges and Parramatta Rivers and Sydney beaches in an attempt to reduce water pollution. Following detection of major sources of pollution, the Branch requested local government authorities to require the abatement of the nuisance.

Septic tank administration grew in importance. The Branch examined plans and inspected proposed sites and the installed tanks. As the Water and Sewerage Board accumulated a growing backlog of unsewered areas in addition to its duty to service developing suburbs, the work of the Branch grew in importance during the 1950s and 1960s. As the Metropolitan Medical Officer of Health reported in 1963, the increase both in septic tank applications and complaints arising from unsatisfactory tank drainage disposal absorbed 'the greater portion of the Health Inspectors' time'.[46] In that year the Department of Public Health, through its Health Inspection Branch, formed a Standing Technical Committee on Septic Tanks, on which were also represented both the Local Government and Shire Associations and the Australian Institute of Health Surveyors. In 1968 the Department of Local Government established an interdepartmental committee, on which the Branch was represented, to discuss methods of remedying sullage disposal problems.

Table I-(3) Septic tank applications in the metropolitan health district submitted to the Health Inspection Branch

| Year | Applications No. | Year | Applications No. | Year | Applications No. |
|---|---|---|---|---|---|
| 1961 | 5,968 | 1964 | 9,925 | 1967 | 7,787 |
| 1962 | 7,868 | 1965 | 8,535 | 1968 | 8,178 |
| 1963 | 7,158 | 1966 | 7,963 | 1969 | 8,678* |

*Includes Western Metropolitan Health District.
*Note:* The Statistics on septic tank applications were not printed after 1969.
Source: Annual Reports of the Director-General of Public Health, 1961-9.

Through the 1960s the Branch discovered numerous instances of water pollution caused by industrial liquid wastes and sludges. Moreover, disposal sites for these wastes diminished. 'The Metropolitan Water, Sewerage and Drainage Board and most councils are not prepared to accept this type of waste into its sewers or garbage depots', wrote the Chief Health Inspector in 1968.[47] The following year the last council tip was closed for industrial liquid waste disposal.[48] The Health Inspection Branch, together with officers from the Departments of Local Government and of Decentralisation and Development, and liquid waste removal and disposal contractors met to discuss how the problems of collection and disposal of industrial liquid wastes could be resolved.

It is not surprising that the Health Inspectors attempted to control the growing variety and volume of pollutants in the Sydney metropolis. Their statutory powers were derived from Acts that had been designed to promote cleaner urban areas. But theirs was a losing battle. Their powers were limited. Public nuisance prosecutions were not very effective in abating pollutants, for they attempted to treat the effects of contamination rather than its prevention. For each offence detected there were many more that went undiscovered. Further, executive action under the Public Health Act to abate pollution was also constrained, or there was little, if any, firm scientific or legal evidence to show the causal association of pollutants with ill health. The Metropolitan Medical Officer of Health and Chief Health Inspector told the Senate Select Committee on Water Pollution in 1969 that the Branch had attempted to reduce or eliminate sources of water pollution: 'However, it has been found that a public health aspect of the pollution had to be clearly demonstrated in order to obtain effective remedial action'.[49]

The evidence of administrators in the field showed that accumulating wastes had become unmanageable for the public agencies that comprised the waste management administrative system in the Sydney metropolitan area.[50] Similarly, the Division of Analytical Laboratories,[51] a sub-unit of the

Department of Public Health whose function was to measure scientifically the constituents of samples submitted for analysis, on the basis of the growing evidence gathered during the 1960s could draw attention to the deterioration of environmental quality in Sydney. In 1969 the Division published some of its extreme biochemical oxygen demand (B.O.D.) test figures for that year as an illustration of the degree of water pollution occurring. It invited comparison in parts per million with typical figures for raw settled sewage (150-250), the final effluent from an efficiently operating sewage treatment works (5-10) and clean drinking water (1-2).

Table I-(4) Results of B.O.D. test on samples of water, Sydney metropolitan area, 1969

| Source of sample | | B.O.D. (p.p.m.)* |
|---|---|---|
| Campbelltown | final effluent from sewage treatment | 85 |
| Campbelltown | creek below garbage tip and effluent discharge | 100 |
| Villawood | effluent from factory | 7,500 |
| Bankstown | creek | 500 |
| Botany | wool scour effluent | 250 |
| Glenfield | laundry effluent | 450 |
| Botany | stormwater drain near factory | 2,000 |
| Yarra Bay | seepage from covered garbage tip | 5,000 |

* p.p.m. = parts per million
Source: *Report of the Director-General of Public Health*, 1969, p. 171.

*Pollution control in the work place*
The Division of Occupational Health, founded as the Division of Industrial Hygiene in 1923,[52] was the second branch of the Department of Public Health concerned with public control over the physical environment. The objective of the Division was to institute programs aimed at preventing sickness and death from pollutants generated in the workplace. Toxicological and pharmacological research in the field of occupational medicine helped to provide some of the basic knowledge of cause-and-effect and dose-response relationships between pollutants and adverse effects. The Division, through the nature of its work, had a particular interest in air pollutants (dust, fumes, gases) generated in the workplace. Its interest began to extend to the growing problem of urban air pollution.

An increase in the death rate following a severe smog in London in 1952 helped to stimulate investigation into the impact of air pollutants on health. In 1953 the then Division of Industrial Hygiene began to monitor dust deposition in the Sydney Metropolitan area.

## The advent of the Clean Air Act 1961

The Government appointed a Smoke Abatement Committee in 1955 to investigate the causes, extent and effect of air pollution, and to recommend preventive measures necessary to control air pollutants. The seventeen-strong

Committee, with representatives drawn from State Government agencies, local government, universities and business organisations, submitted their *Report on Air Pollution in New South Wales* in 1958.

In recent years, they declared, the nature and degree of air pollution had altered considerably: industry had expanded and diversified, while new technological processes had generated complex chemical emissions. Exhaust gases resulting from an 'enormous increase' in motor vehicle usage added further pollutants to the air. 'Whereas air pollution at one time was almost entirely a smoke problem',[53] they wrote, 'it now comprises smoke, dust, including fly ash, cinders and solid particles of any kind, invisible gases and even waste products from radioactive and atomic processes.'[54]

The existing patchwork of laws that controlled some forms of air pollutants were administered by various authorities which regarded control of air pollution as incidental to their major responsibilities.[55] To provide clear legal authority, the Committee advised the passing of a single Clean Air Act that would govern all forms of air pollution. But the quantities of waste discharged to the air needed continuous public attention. The technical nature of air pollution control demanded a permanent central control administration that would be capable of monitoring pollutants and controlling sources of pollution.

Air pollutants generated by industry were singled out for legislative control: the Committee recommended that industrial processes which made significant discharges of waste into the air should be registered and regularly inspected and that remedial measures for diminishing air pollution be enforced. Finally, the Committee drew attention to the large volume of air pollutants that government agencies produced. 'It would be wrong in principle if industry generally was compelled to incur expense in preventing pollution', declared the Committee, 'and if the public utilities and other agencies continued to offend.'[56]

The Clean Air Act was assented to in 1961 and an Air Pollution Control Branch formed within the Division of Occupational Health in 1962. Clean Air Regulations that were drafted by the Air Pollution Advisory Committee established by the Act were proclaimed in 1964; emission standards for scheduled industrial premises came into effect on 1 January 1965, close to ten years after the appointment of the Smoke Abatement Committee.

## The Maritime Services Board and the growth in water pollution

In 1936 the Maritime Services Board replaced and took over the functions of the Sydney Harbour Trust and the State Navigation Department,[57] which were both abolished. Among the numerous powers (which were provided in several Acts) needed to manage N.S.W. ports was included the power enabling the Board to control and conserve all navigable waters in the State. 'Navigable' has a broad definition that extends to those shallower waters where the smallest of water craft is able to float; therefore, this definition gave, in theory, a broad geographic scope to the powers of the Board which included inland as well as maritime waters. Thus the Board had power to control water pollution in many areas of the State.

Because of the Board's major function as the port management authority, its pollution control activities were in practice confined essentially to port operations. In particular, it concentrated on the routine but important task of keeping its ports and their shores clear of flotsam and jetsam. In addition to this housekeeping duty, the Board administered a series of regulations that had, as their general objective, control over water pollutants. The first of these was the Ports Authority (Inflammable Liquid and Dangerous Goods) By-Laws made under the provision of the Inflammable Liquid Act, 1915, as amended, which enabled the Board to control and supervise storage and transport of oil and other inflammable liquids to and from ship to shore. The power of the Board in this respect was strengthened by the Prevention of Oil Pollution of Navigable Waters Act, 1960.

To control other sources of water pollution the Board had gazetted in 1941 the Pollution of Navigable Waters Regulations made under the power of the Navigation Act. These regulations were exceedingly brief and archaic in their approach to water pollution control. The regulations prohibited the dumping, from ship or shore, of any sick or dead animal into navigable waters. Further, they prohibited owners or occupants of 'any manufactory, chemical work, slaughterhouse or other establishment' from allowing wastes to be dumped or discharged into navigable waters that lay 'in the vicinity of any city, town or municipality'. These were superseded by a more comprehensive Navigable Waters (Anti-Pollution) Regulations in 1955, which were made under the Maritime Services Act.

The new regulations were a recognition of the era of chemicals. As well as including a prohibition on any inflammable, dangerous or toxic substance being dumped on navigable waters or their shores, the regulations set maximum effluent standards by which, following the completion of a series of prescribed laboratory tests (e.g. B.O.D.; acidity and alkalinity; sulphur, ammonia and heavy metal concentration), the quality of a water body could be determined. However, the Board retained broad discretionary powers over the enforcement of its regulations. There were provisions allowing it to enforce more stringent effluent standards in particular waters that were or could be heavily polluted; persons wishing to discharge wastes into such waters were required to apply for a licence from the Board. On the other hand, the Board could relax its prescribed standards in certain localities where those standards caused waste dischargers 'utmost difficulty' and 'inordinate inconvenience and expense', or where lower effluent standards would not be unduly injurious to the receiving waters. The regulations further prescribed criteria that the Board would take into account when making decisions about altering its effluent standards, namely the effect of effluent upon waters, upon the 'comfort, convenience or health' of water users, and upon aquatic life.

The Navigable Waters (Anti-Pollution) Regulations marked the first attempt by a public bureaucracy in N.S.W. to provide a means of adjudicating conflicts arising from the increasing use of scarce water resources in urban areas, such as the demand for liquid waste disposal by sewerage authorities and industries, the desire for swimming and boating places, for fishing and for the navigation of ships. In the absence of a comprehensive legislative and administrative system to manage waterborne wastes, the Maritime Services Board was bound to have little impact. Its regulations attempted to control the end of the waste generation process, not the source. Moreover, its major administrative responsibilities were in port, not waste, management. So navigable waters like the Alexandra Canal continued to be used as open sewers. The need for water resource management was recognised in 1955. Fifteen years were to elapse before the passage of the Clean Waters Act.

## Preserving urban amenity: the changing focus on wastes

### *Managing the medium*

The Smoke Abatement Committee had been constituted partly through uneasiness about the impact of air pollutants on the health of city dwellers, and partly because of an increasing nuisance caused by smoke, ash and grit discharged from the smokestacks of Electricity Commission power houses located within the waterside inner suburbs of Pyrmont, Ultimo and Balmain. The Committee reported that there existed no satisfactory medical evidence on cause and effect relationships between air pollutants and ill health. The Committee's successful urging that air quality be put under public control was a significant change in policy. Despite the initial limited application of the Clean Air Act to only stationary industrial sources of air pollution, its general objective was to control the quality of one aspect of the physical environment. Thus there was an acceptance of the principle of management of the *medium* into which wastes were discharged as well as control over the wastes and waste sources themselves. From the human point of view, amenity began to displace public health as the primary justification for community management of the urban environment.

### *The rediscovery of pollution*

'Pollution' came back into common speech during the late 1960s. Several influences helped to revive public concern over the impact of wastes upon the urban environment, for example investigations into pollution problems by television, radio and press; the trend among industrial nations to enact pollution control legislation and to found new waste management authorities; the filtering through to a wider public of a glimmering of the biologist's concept of the ecosystem; agitation by conservation- and environment-conscious groups; and, of course, direct experience of the effects of wastes such as sewage washed onto surf beaches, empty cans and bottles littering the roadside and smog lingering in the urban air.

Official investigations illumined the growing impact of pollutants upon Australians. Two Senate Select Committees investigated pollution of air (1968-9) and water (1968-70). In general they discovered that air and water were used as free garbage dumps, thus degrading the quality of both media. Both Committees concluded that their specific pollution investigations were but isolated parts of a larger problem that demanded national concern and co-operation. The Select Committee on Air Pollution summarised this view: 'Air pollution is but one small part of man's contamination of his environment. Pollution of the water resources of the world, pollution of the soil, and in this mechanised world of ours, pollution of the environment by noise of man's activities, are all parts of the same problem'.[58]

## Disclosing the gaps in the metropolitan waste management system

*The Senate Select Committee*

The official pollution investigations provided opportunities for officers of New South Wales public agencies to explain their activities, to indicate administrative blocks and to suggest ways in which the existing organisation of waste management could be changed. The Clean Air Advisory Committee told the Senators that, although emissions from motor vehicles and shipping made significant contributions to air pollution, both sources lay outside the scope of the Clean Air Act. Further, they warned that projected population increases in Sydney in association with increases in the generation of industrial power and in the use of motor vehicles could result in unacceptable air pollution in the future. 'Overall planning of a city's development, as opposed to the divided approach which has occurred in the past', they urged, 'is the primary step required to solve the existing and potential problem'.[59] Nevertheless, the Air Pollution Control Branch activities remained concerned, necessarily because of limits on administrative authority, with technical solutions of specific emission control problems.

The Senate Select Committee on Water Pollution found that legislative control of water pollution in New South Wales was affected by at least thirty Acts, the principal ones being the Public Health Act, Noxious Trades Act, Local Government Act, Metropolitan Water Sewerage and Drainage Act, Maritime Services Act and the Prevention of Oil Pollution of Navigable Waters Act. Each of these laws had been enacted to remedy different problems arising at different times. Thus it was difficult, if not impossible, for the relevant public agencies to manage the impact of liquid wastes unless coordination was initiated through a clearly expressed legislative intention. Fragmented laws on water pollution had resulted in divided and unco-ordinated administration, particularly in the Sydney metropolitan area where the major impact of wastes had been, and is, concentrated and where combined action by numerous adjoining local government authorities was frequently needed (but not forthcoming) in order to abate common water pollution problems. Moreover, control over pollutants in Sydney was a secondary concern in relation to the major statutory tasks, for instance, of the Maritime Services Board, or in the case of the Metropolitan Water, Sewerage and Drainage Board, demands to extend its services were stronger than pressures to control the impact of the effluent discharged into the ocean.

The Metropolitan Medical Officer of health, Dr Hay, told the Senators that officers of the Department of Health looked upon themselves as 'coordinators, instigators and perhaps prodders'[60] of other public authorities. This role he illustrated with the example of the Inter-departmental Committee convened by his Department in September 1968,[61] whose job was to discuss ways of reducing the volume of wastes discharged into the heavily polluted Alexandra Canal. But inter-authority co-operation was one method of abating pollution that had proved ineffectual in the past, as Dr Hay confessed. His Department, he went on, had not been very successful in obtaining the co-operation of local government authorities to compel householders to treat their sullage before discharge.[62] More important was the need for new legislation: 'We need powers to prevent the situation arising where the water is likely to be polluted', he declared.[63] He was careful to point out that the objective of water management should be to control water quality: the metropolitan rivers, he said, must be used for the disposal of wastes, but 'we must treat the waste to the maximum possible limit before it is discharged into these waterways'.[64]

*The Barton Report*

A. E. Barton, who had had experience of waste management in Britain, was invited to Australia to investigate solid and liquid waste disposal operations in the Sydney metropolis for the State Government during 1970. He found that a number of authorities — local government authorities, Department of Public Health, Maritime Services Board and the Metropolitan Water, Sewerage and Drainage Board — had responsibilities for these wastes, but that none had a sole or specialised responsibility. He suggested a number of reforms and urged that they be implemented quickly. As his first main conclusion, he declared that jurisdiction and responsibility be defined by the State Government. He recommended that a single regional authority be established to manage liquid and solid industrial wastes and household garbage disposal, but that garbage collection could remain a responsibility of local councils.[65]

Barton made further suggestions: industries should be required by law to install plant to reduce their wastes; liquid waste generators and collection and disposal contractors should be licensed; and public authorities that were part of the waste management system should have sufficient staff. Comprehensive survey and planning for waste disposal were essential, he wrote, while anti-pollution action should be actively enforced.[66]

## The new administrative system 1970

The growing waste problem in the expanding Sydney metropolis that had been observed by public officials during the 1950s and 1960s became a political issue at the end of the 1960s. With general elections imminent, the Government acted. In December 1970, the State Pollution Control Commission Act, the Waste Disposal Act and the Clean Waters Act received the Governor's assent. The first two Acts enabled the establishment of two new bodies in June 1971: the State Pollution Control Commission and the Metropolitan Waste Disposal Authority. The third Act led to the establishment of the Water Pollution Control Branch, which, like the Air Pollution Control Branch, formed part of the Department of Health.

The coming of the new authorities made significant formal changes to the bureaucracy administering wastes. The Department of Health, which administered the Clean Air and Clean Waters Acts, increased its importance, but there occurred an internal shift in authority from the Health Inspection Branch to the now enlarged Division of Occupational Health and Pollution Control. Further, the Metropolitan Waste Disposal Authority (M.W.D.A.), as liquid residue and solid waste management authority, modified the powers of the Health Inspection Branch, although the latter retained a limited pollution control function under the powers of the Public Health Act. The Metropolitan

Water, Sewerage and Drainage Board (M.W.S. & D.B.) was made partner with the M.W.D.A. in the field of liquid waste disposal but was subject to oversight by the Water Pollution Control Branch and the State Pollution Control Commission. Similarly, other public agencies in the field of waste management, chiefly the local government authorities and the Maritime Services Board, had their powers diminished by the advent of the new agencies. The administrative and legislative gaps that had emerged with the accumulating impact of wastes during the 1960s were filled by the reorganisation of 1970-1. The problem now was for the interwoven public agencies to achieve an integration, at both policy and administrative levels, within their management system and so protect the physical environment of the Sydney metropolitan area. This is a central issue in the following chapter.

# 2 Reorganising waste management and pollution control, 1970-1975

## Introductory

Because of the often complex technology of pollution control and the diversity of pollution problems, broad discretionary powers to control pollutants have been delegated to public administrators by the New South Wales Parliament. This emerged essentially in the basic change in administrative organisation between 1970 and 1975. Accordingly, government pollution control agencies have statutory power to regulate polluting activities and in achieving benefits may impose significant costs on businesses, other government agencies and individuals. But these controls, by altering the distribution of benefits and costs, tend, therefore, to generate political activity. Partly to abate any political pressures the New South Wales Government has given some interest groups an influence in the making of pollution control policies, while at the same time ensuring that statutory authorities are more responsive to Government control. Thus, of the vast array of public agencies that govern the Sydney metropolis, the six major waste disposal and pollution control authorities that we are concerned with here have all recently been put under ministerial control. The State Pollution Control Commission (S.P.C.C.), the Metropolitan Waste Disposal Authority (M.W.D.A.), the N.S.W. Planning and Environment Commission (P.E.C.) and the Health Commission of N.S.W., all creations of the 1970s, have each been put under ministerial control by their respective establishing Acts, as have the two older statutory authorities, the Metropolitan Water, Sewerage and Drainage Board (M.W.S. & D.B.) and the Maritime Services Board (M.S.B.), which each lost much of its autonomy by amending Acts in 1972 and 1974 respectively.

The statutory innovations of the 1970s remodelled the government of the Sydney metropolis: administrative reorganisation is still in progress but the basic outlines were established by late 1975. The new Acts gave a strategic role to the State Government's agencies in managing the city's environment at the same time as they diminished the autonomy of the numerous local government councils, which, partly because of their limited geographic jurisdictions and inadequate financial resources, had shown themselves unable to cope with the scale of the problems posed by the ever-expanding volume of urban wastes. But there are conflicts of interest arising from the heterogeneous responsibilities of the various government agencies. Several public enterprises are either themselves significant generators of waste or through their activities make major impacts on the metropolitan environment. For instance, the Public Transport Commission railway yards are a source of oil polluting the Cooks River; the construction of the massive port at Botany Bay under the authority of the Maritime Services Board attracted a group of companies proposing to construct a loader for the export of coal, and other interests are seeking to use this port. These are the forerunners for many other demands in this locality for particular land uses that will create pressures on the environment. However, other public agencies are charged with statutory responsibility for protecting the quality of air, water and land, and so have power to affect the activities of government waste generators.

From what has been said, it is clear that the quality of Sydney's environment depends just as much on the overall aims and the effective co-operation between government agencies as on the administration of their respective responsibilities. However, information about the working relationships between authorities either goes unrecorded or else is mentioned in passing within official documents. What follows in this chapter is a description of the functions and powers and, where possible, the relationships between our six major waste disposal and pollution control authorities. Of equal if not more fundamental importance is the politics of pollution control, which raises questions of explicit objectives for urban areas, which in turn raises issues such as those of the allocation of resources among community groups and State Government control over metropolitan land use and industrial location. These questions, although not explored here in depth, are included because, as will be argued, the most fundamental problems arising in waste management are political, not administrative and technological: the focus of the debate on public policy relating to waste management should fall on the ends, not merely the means.

*But first a warning. It must be impressed upon the reader at this point so as to avoid boring repetition of the fact, that the public administration of wastes and pollutants in Sydney is reported as at 1975 and is still in the process of reorganisation. Events will overtake some of these words as they are published. Therefore, the reader must bear in mind that statutory, administrative or political changes may render parts of this text to some extent out of date as to fact or as to the emphasis or interpretation given to particular facts. The text, at all times, is used as an attempt to define a basic administrative restructuring occurring during 1970-5. It should also be stressed that, although a great deal of help was in fact provided by some State politicians and administrators, most of this study was carried out in the face of expressed opposition by the N.S.W. Coalition Government.*

## Waste disposal problems in Sydney in the 1960s

Official inquiries such as the nationwide disclosure of the extent of air and water pollution by two Senate Select Committees during 1968-9, and the investigation by A. E. Barton who reported on Sydney's liquid and solid waste disposal problems in 1970, helped to reveal the gaps in the administration of wastes in the Sydney metropolitan region.

The Clean Air Act, 1961 had been in force since 1965 under the administration of the Air Pollution Control Branch within the Department of Public Health, but neither similar legislation nor equivalent public agencies existed to protect water or land from the effects of an accumulating volume and growing variety of wastes. The Department, working through its Health

Inspection Branch, also had pollution control functions that originated from the first Public Health Act of 1896 and subsequent Acts. But early laws had been devised to meet the needs of a different society. During the 1960s the limitations of the Department's power to control pollution were revealed as inadequate. The control procedure was palliative rather than preventive, for pollution was treated as an isolated incident rather than as a recurring effect of a continuous process of waste generation. Moreover, the procedure was based predominantly on punitive measures that could be employed only after pollution of air, water or land had occurred. Thus failure to detect offenders through the policing of statutory prohibitions meant in the long run the cumulative degradation of the environment caused by the continuous and uncontrolled discharge of wastes.

Equally, waste disposal was not comprehensively regulated by public authority. For instance, the Clean Air Act was employed to reduce the discharge of wastes chiefly from industrial sources. Motor vehicle emissions, an important and ever-increasing source of air pollution, went largely uncontrolled. No public strategy existed for controlling the impact of liquid wastes on water quality. The Maritime Services Board had instituted regulations for controlling the discharge of wastes into navigable waters in 1941 and had substantially altered them in its Navigable Waters (Anti-Pollution) Regulations of 1955, but these prohibitions proved ineffective in maintaining the quality of the substantial body of navigable waters within the expanding Sydney metropolis. Industries dumped their liquid wastes at tips, into M.W.S. & D.B. sewers or stormwater drains, into natural watercourses, or had them taken away to known or unknown destinations for discharge by liquid waste removal contractors. The prohibition of industrial liquid waste discharges at council tips in 1969 provoked a disposal crisis, but no public authority existed that could direct the disposing of these effluents at particular locations and under conditions so as to minimise their impact on the urban environment.

Pollution caused by sewage in particular provoked public agitation. Sewage discharged from ocean outfalls periodically washed on to Sydney beaches; while, during heavy rainfall, sewage sometimes burst from overloaded sewers through overflow valves. Pollution also arose from a large number of unsewered properties that, owing to the rapidly expanding metropolis and the difficulty of coping with the sewerage backlog, were not connected to sewers. As with industrial liquid wastes, the supply of space in the metropolitan region for the disposing of solid wastes from households and industries grew ever smaller, but the area available for disposal varied in each of the urban local government authorities. These authorities, who, apart from the supervisory role of the Department of Public Health, bore the sole statutory responsibility for household garbage collection, lacked interest in combining to provide a collective solution to the problem by long term disposal of wastes or were unable to do so.

## The beginnings of reorganisation

The year 1970 marked the beginnings of some significant innovations in the administration of wastes in the Sydney metropolitan area. In that year the new laws which enlarged the scope for public intervention and the new institutions founded by their authority promised to fill the gaps in the existing system of management. In December, the State Pollution Control Commission Act, the Waste Disposal Act and the Clean Waters Act were assented to. The first two Acts, which in retrospect may have been prepared quickly to meet immediate political needs rather than to serve a carefully thought out administrative system, enabled the establishment of two new bodies in June 1971: the S.P.C.C. and the M.W.D.A. The third Act, which had had a relatively long gestation period within the Department of Health, caused the formation of the Water Pollution Control Branch (W.P.C.B.), which together with the existing Air Pollution Control Branch that administered the Clean Air Act, 1961 made up the pollution control structure of the Department of Health.[1]

The then Premier (later Sir Robert) Askin, at the second reading speech on the S.P.C.C. Bill in November 1970, declared that the State Pollution Control Commission would have two functions of coordinating and supervising the waste disposal and pollution control activities of other public agencies: it would, therefore, be oriented towards management. Further, the Commission was to investigate and report on the adequacy of waste disposal and pollution control measures, and to provide and encourage specialist guidance for other agencies to improve their control measures. The Commission's objective of protecting the physical environment, the Premier continued, would be achieved by its working through other agencies, and where co-operation was not possible, the Commission would have powers of direction. He concluded, saying that it was possible that pollution control functions might eventually be centralised in the Commission.

The S.P.C.C. Act enpowered the Commission to make policies and to undertake research for controlling pollution and disposing of wastes. It could consult and arrange with any public authority for that authority to employ its own statutory powers to control or abate pollution, to dispose of waste, or to protect the environment. But the Commission also held certain powers, which will be discussed later, that enabled it to intervene in the activities of other public agencies. It could direct, on the recommendation or with the concurrence of its Technical Advisory Committee, any public agencies and local government authorities to use their own powers to prevent or abate their own or other polluting activities.

In terms of formal pollution control organisation, the S.P.C.C. was nominally at the top. Its formal role was to coordinate the activities of that group of government departments and other public authorities that themselves had statutory powers to control or abate pollution, and so raise the priority of the newly perceived problems of the environment within the State bureaucracy at large.

An expert committee of the World Health Organization identifies three main ways by which wastes/pollutants controls are administered. They are:

(1) Leadership and responsibility are entrusted to or assumed by an existing authority
(2) A federation of agencies is formed without fully defined lines of authority or responsibility
(3) A new agency is superimposed on existing agencies but frequently without being given strong legal authority.[2]

The third model, that of a central agency, is a commonly chosen method of coordinating and directing government policies, as in the case of the S.P.C.C. in New South Wales, the Environment Protection Authority in Victoria, both founded in 1971, and the Department of the Environment in the United Kingdom and the Environment Protection Agency of the Federal Government in the United States of America, which were established in 1970.

## The changing status of the State Pollution Control Commission, 1971-4

*The rise and fall of the Department of the Environment*
From its foundation the S.P.C.C. had a rival. Following the State general election on 13 February 1971, the Askin-Cutler Government was returned. However, the electoral contest had provoked promises from both major parties to institute a super-department to coordinate all public environment protection activities. Mr J. G. Beale, M.L.A. for the South Coast, was sworn in as the first (and last) Minister for Environment Control on 11 March. The election over, he proceeded with plans to establish a new ministerial Department of Environment which, like the statutory S.P.C.C. founded in June, was to have powers of supervision and coordination over public authorities. The newly enlarged environmental protection system that was created by statutes and by subsequent administrative reorganisation inevitably created some disturbance of arrangements. The advent of the Department of Environment added further uncertainty among administrators. At the end of 1971 the Director-General of Public Health hoped that legislative and administrative adjustments would be made in order to diminish the existing competitive approach to pollution control. 'Considerable confusion exists', he wrote, 'between the relative roles and responsibilities of the Departments of the Environment, Health, Transport and the Maritime Services Board over control of environmental protection.'[3]

The S.P.C.C. remained a minor contestant in the process of administrative demarcation. The Minister for Environment Control gave the Commission client status by forcing it to rely upon the Department of Environment for both staff and funds obtained from the annual appropriations by Parliament. The Commission was prevented effectively from building up its administrative arm and thus in developing its statutory coordinating role. Moreover, in October 1972, the Minister 'advised' the Commission to limit its charter as conferred by its Act to those powers relating to pollution control and to suspend its general powers for protecting the environment. Protesting, but subject to ministerial control, the S.P.C.C. was forced to obey.[4] The squeezing out of the Commission from the activities which it was founded to coordinate forced it to become a dependent and largely impotent body. It is not clear how this early political experience has tempered the now enlarged administrative role of the S.P.C.C., and, in particular, its impact upon the outlook of its Director, who, as full-time administrator, bore the brunt of ministerial intervention.

Mr Beale retired from Parliament at the November 1973 General Election. The then J. B. M. Fuller, M.L.C.,[5] Country Party Minister for Decentralisation and Development during the years 1965-73, became the new Minister, but with a different title: Planning and Environment. Under his leadership, the pollution control/waste management administration underwent further reconstruction. In April 1974, the Planning and Environment Commission Act was passed by the New South Wales Parliament. This Act brought the S.P.C.C. to the centre of pollution control activity. First, it shifted the staff of the two pollution control branches and their Clean Air and Clean Waters Acts from the jurisdiction of the Health Commission into that of the S.P.C.C. itself. Second, it abolished the Department of Environment. Third, the new Act provided for the abolition of the State Planning Authority (S.P.A.) and its transformation into the New South Wales Planning and Environment Commission.

The Planning and Environment Commission (P.E.C.) came into being on 18 November 1974. Its functions and powers (1975) have yet to be fully determined and tested in practice. Some of the principles, which will be discussed later, emerged with the release in November 1975 of the *Report to the Minister for Planning and Environment*, which contains the Commission's recommendations for a new system of planning in New South Wales. Following the 1974 reorganisation, the general direction of the Government's policy for administering the physical environment is to separate the functions of prevention and policing into two agencies. Both the P.E.C. and the S.P.C.C. will protect the environment, 'the new Commission by planning the future environment, the State Pollution Control Commission by attending to the environmental problems of the day'.[6]

*The importance of the S.P.C.C.*

Despite its short history, the functions of the S.P.C.C. have been fundamentally changed since 1971. Its coordinating responsibility to ensure that adequate waste disposal measures are taken so as to abate pollution of the environment is now made direct through its acquisition of control over the Clean Air and Clean Waters Acts. Moreover, the gaining of the Air and Water Pollution Control Branches in May 1974 has greatly increased the administrative arm of the Commission. The Commission now wields considerable interventionist powers to control wastes and thereby regulate the quality of the physical environment of Sydney. By using its powers, it can exert a direct impact upon the operating costs of private business and public agencies alike — and indirectly upon the community — and thus can be expected to prompt political counter-pressures. This makes the composition of the Commission, and the executive position of its Director, important.

The twelve Commissioners were appointed on 16 June 1971; their five-year term of office ends in mid-1976. Only one, the Deputy Chairman, who is also the Director of the administrative arm of the Commission, is a full-time member. The remaining eleven Commissioners were: three members were senior public officials — the President of the M.W.S. & D.B., the Chairman of the Health Commission, and the Under-Secretary of the Department of Local Government; two members represented the Shires Association of N.S.W. and the Local Government Association respectively; the remaining members, with the exception of the Chairman (who is the Vice-Chancellor of the University of New South Wales) represented sectional interests — primary industry, secondary industry, commerce, conservation and recreational activities.

The concept of community representation on statutory authorities is long established in New South Wales, as is shown, for example, in the membership of the former Board of Health founded in 1881. The idea is based on the principle of providing a ready means of communicating between the government and the governed, so that politically workable policies can be devised by the government. Public pollution control policies of a punitive nature — that is those based on prohibition, time- and labour-consuming policing for the detection of offences and the risk of unsuccessful prosecution of offenders — by themselves proved ineffectual in preventing and in controlling environmental degradation in the past. Hence, it can be argued, affected and knowledgeable community representatives ought to be committed at some point in the policy-making process in the S.P.C.C., partly to diminish resistance and partly because of the economic impact of its decisions upon the community. Policies determined by this procedure might then have more significant effect in improving the quality of the urban environment, particularly in the long term. One problem raised by such representation is, of course, that some vested interests, if dominant, might unduly retard or resist the implementation of certain pollution control policies which might, in their opinion, be immediately injurious or disadvantageous directly or indirectly to the interests of their group; or others might exaggerate unduly the conservationist needs. This is not necessarily an improper consideration. But it is one of the factors to be reckoned with in the making of policy.

In practice all Commissioners in 1975 were drawn from influence-wielding sectors of society. Apart from the Chairman, the two local government representatives and the three senior public officials already mentioned, the remaining Commissioners were as follows. The Director, Mr Eric Coffey, until 1971, was both a Director of Caltex Oil Company and Manager of A.O.R. oil refinery at the entrance of Botany Bay; representing conservation, Mr F. S. Buckley, O.B.E., was New South Wales Manager, since 1952, of the chemical manufacturing company, Imperial Chemical Industries of Australia and New Zealand and Director of other chemical and plastics manufacturers (the Nature Conservation Council of New South Wales, in its Annual Report of 1971, denied that he was a representative of the conservationist movement.)[7] Representing recreational activities was an architect, Mr D. C. B. Maclurcan, K.C.S.G., F.R.A.I.A.[8] Mr G. I. Ferris, O.B.E. (who was also a local government councillor), representing secondary industry, was the Managing Director of radio, television and electronic instrument manufacturer, Ferris Industries Ltd. Mr C. Lloyd Jones, representing commerce, was the Chairman of the department store giant, David Jones Ltd, since 1963. Representing primary industry was Mr F. M. MacDiarmid, Country Party Member of the Legislative Council, Director of Land Newspaper Ltd, member of the Australian Wool Corporation and the International Wool Secretariat.

The Commission thus incorporated business, financial and administrative experience useful for its deliberations, but there was more uniformity in the backgrounds of its appointed members than the diversity of community interests as contemplated in the State Pollution Control Commission Act. Ultimately, the S.P.C.C. exists to serve the citizens of New South Wales. The Commission, observed the Chairman in his annual report for 1971/2, incorporates 'representative community interests' and, therefore, ensures 'a broad based and balanced evaluation of environmental issues which by their nature are highly subjective'.[9] However, public control of pollution means the regulation of economic interests. The question is: Is it possible for the regulated interests to regulate themselves? It could be argued that the interest groups as actually represented in the Commission rather than as formally laid out in the Act are too close to the policy- and decision-making processes and might perhaps be shifted by Parliament to the position, say of a ministerial advisory committee. Like the P.E.C., the S.P.C.C. might better serve the community, given its significant change of function in 1974, if it were reconstituted as a small body composed of a majority of relevant experts in addition to a lesser number of community representatives.

The S.P.C.C. has the power, on the recommendation or with the concurrence of its Technical Advisory Committee, to direct any public agencies and local government authorities to prevent or abate its own or other polluting activities. This power is significant, since a large number of public agencies generate or dispose of wastes, such as the Electricity Commission, the Public Transport Commission and the M.W.S. & D.B., or that have pollution control powers, such as the Health Commission and the M.S.B. The practical effect of the power is to establish a procedure that allows the S.P.C.C. to take the unusual course of intervening in the affairs of another public authority, and so enables a negotiating process to occur. However, this power is qualified by the fact that disputes between public agencies, as provided in the S.P.C.C. Act and other Acts, can be resolved by the Premier.

*The Technical Advisory Committee and the task of coordination*

The statutory Technical Advisory Committee (T.A.C.) provides the formal machinery to assist the S.P.C.C. in its role of coordinating the Government's environmental protection policies in N.S.W. Of the Committee's seventeen members, thirteen are drawn from a variety of public authorities, one of whom is the Director of the S.P.C.C. and also Chairman of the Committee. The other members are drawn from the following agencies:

Department of Agriculture
Fisheries Branch
Department of Decentralisation and Development
Department of Motor Transport
Health Commission of N.S.W.
Department of Public Works
Water Conservation and Irrigation Commission
National Parks and Wildlife Service
Metropolitan Water, Sewerage and Drainage Board
Maritime Services Board
N.S.W. Planning and Environment Commission

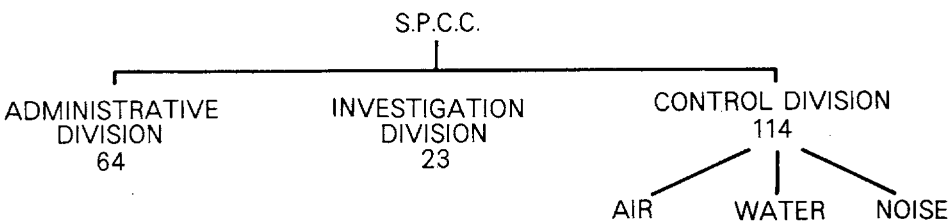
Of the remaining four members, one is a Health Inspector and the other three have appropriate technical qualifications.

As it stands, the T.A.C. has the *formal* capacity to integrate the divergent activities of a diverse group of public authorities. The functions of the Committee are twofold. First, it advises the Commission on matters arising from the Commission's administration of the Acts placed under its control. Second, it investigates matters referred to it by the Commission. Most of the above public agencies have State-wide responsibilities, while others are almost exclusively rural in their orientation. For this reason and because of its part-time membership, we might expect that the T.A.C. lacks any broad based capability to investigate waste management problems in urban areas in so far as they impinge on the activities of several of those agencies. This criticism can be in part rebutted because the T.A.C. is empowered by the S.P.C.C. Act to co-opt outsiders to aid any investigations by its sub-committees; accordingly, any lack of expertise in the complex field of urban waste management might be readily overcome. In the period June 1971 to June 1974 the T.A.C. established eleven sub-committees, most of which investigated the impact of urban-generated wastes on the environment. Fields of inquiry included, for instance, the effect of pollution on edible sea foods gathered from Botany Bay, of open air burning at garbage depots and industrial premises, of the use of non-returnable containers, of waste disposal by landfill and the administration of motor vehicle emissions by public authorities in N.S.W.

Working in this way the T.A.C. helps to clarify particular problems and to formulate policy, particularly in those areas where a need exists to coordinate the activities of several public agencies. Accordingly, the work of the Committee may be helpful in sorting out conflicts between those agencies and, in doing so, attempting to bring some consistency of purpose, in so far as this is possible, between various activities of government. Useful though it may be for dealing with immediate problems and devising short-term solutions, the T.A.C. is a completely inadequate organ for carrying the main weight of coordination of waste management between public authorities. The best that can be said for its function is that the T.A.C. offers an opportunity for the coordination of waste management activities among public authorities on an *ad hoc*, intermittent, part-time basis. Inter-authority co-operation and coordination is a notoriously difficult and intricate process; what is needed to advance this process is a full time, adequately staffed policy group, directed by a senior Minister, that can make explicit the objectives, conflicts in activity and priority within Sydney. As will be argued below, there is a strong case for granting this role to the N.S.W. Planning and Environment Commission; the fundamental difficulty in the way of achieving meaningful coordination in metropolitan waste management activities is the lack of a coherent and explicit objective.

Since the S.P.C.C. acquired new powers and expanded its staff in 1974, the

STRUCTURE AND STAFF OF S.P.C.C.
(30 June 1975)




*The Control Division has recently been divided and re-titled — Ed.

amount of investigatory work referred to the T.A.C. by the Commission may diminish because the Commission itself has established an Investigation Division as can be seen from the diagram showing the structure and staff of the S.P.C.C.

We now turn to a consideration of the public administration of air, water and land pollution and the control of noise in the Sydney metropolitan area.

## The public administration of air pollution*

*See Chapters 8 and 9 for detailed examination of air-borne emissions or their management.

*The expanding administrative control of air pollution*

Until the passing of the Clean Air Act in 1961, power to control air pollution was scattered among a number of Acts such as the Smoke Nuisance Abatement Act, 1902, Public Health Act, 1902, Noxious Trades Act, 1902, Local Government Act, 1919, Motor Traffic Act, 1909 and the Maritime Services Act, 1935. Diversity of Acts implied an air pollution control by a variety of public agencies that regarded control as subsidiary to their major tasks. The Clean Air Act centralised administrative control in one body, the Air Pollution Control Branch, which was formed in 1962 within the Department of Public Health. The Act originally applied chiefly to industrial premises. All sources were divided into two classes, major and minor air polluters. The first, termed scheduled (or licensed) premises, came under the Act when emission standards came into effect in declared areas of the State on 1 January 1965. Administration of these premises fell to the Air Pollution Control Branch, which was moved under the jurisdiction of the S.P.C.C. in May 1974. The second category, of non-scheduled premises, which came under the Regulations of the Act in July 1966, comprises the great majority of industrial establishments that individually have a relatively small volume of emissions. Control of this group rests with local government authorities.

The ambit of the Clean Air Act has been progressively widened since 1961: by 1975 all sources of air pollution in declared areas either came within the control of the Air Pollution Control Branch or could be placed under its control by ministerial proclamations. The work of the Branch increased correspondingly. The most significant change followed an amending Act of 1972, which enabled the Branch to regulate, by means of emission standards (that progressively will become more exacting), all new motor vehicles. A further amending Act of December 1974 foreshadowed control by the Branch of the vexatious problem of odour emissions drifting beyond the premises of the polluter; evidence of the offence being detection of odour emissions by an 'authorised officer relying solely on his sense of smell'.

Ministerial orders made under the authority of the Act have also aimed to control sources of air pollution. In February 1973 open air burning, with certain exceptions, was prohibited: one of the objects of the order was to eliminate the method of waste disposal employed particularly at garbage depots, wherein solid waste was partly disposed of by converting it into atmospheric wastes which drifted uncontrolled. In January of the same year, as a means of controlling the volume of sulphur dioxide emissions, a ministerial order prohibited the consumption of fuel oil containing more than 1 per cent sulphur in the *new* plants installed in the scheduled industrial premises in the metropolitan area.

Despite the changes made, considerable effort will be needed in the future to maintain and improve air quality. Administrators of air pollution controls face two conflicting pressures. First, in spite of large sums spent by industries in installing pollution control equipment and notwithstanding emission reduction at major pollution sources, the concentration of certain pollutants in the air of cities in New South Wales is regarded as too high by the Air Pollution Advisory Committee. It attributes the slow improvement in urban air quality to the increasing population concentration accompanied by rising motor vehicle usage and increasing industrial energy consumption. Second, the Committee reports that medical and aesthetic requirements for air quality have 'very substantially lowered' the acceptable levels of concentration of pollutants in the atmosphere. Accordingly, Sydney and other cities in the State have average air pollution levels that exceed those now offered as long-term goals by the World Health Organization.[10]

*The withdrawal of powers from the Air Pollution Advisory Committee*

The Air Pollution Control Branch, a sub-organisation of the State Pollution Control Commission, is the central authority in New South Wales for controlling air pollution through the delegation of powers by the Commission, which in turn derives its power from the Clean Air Act. Until the passage of the Clean Air (Amendment) Act in December 1974, the Air Pollution Advisory Committee, a statutory body under the Act, held important quasi-executive powers that gave it control over the routine administration of the Act. For example, the Committee once could add and remove certain classes of industrial premises to or from the list of scheduled premises, could review annual renewals of licences for such premises and could issue licences both for new establishments coming within its classification of premises and for new processes built on existing scheduled premises.

However, as it was, and is, a part-time body, the Committee depended on the information and reports submitted to it by the technical officers working in the Air Pollution Control Branch for the exercise of its statutory powers. During the early days of the Clean Air Act, the Advisory Committee, through its policies, shaped the activities of the Branch. As the latter grew in size and experience, the positions were largely reversed so that the Committee gradually came to perform a function that was largely formal. The 1974 amending Act in effect made the Branch the sole body administering air pollution and abolished its former administrative burden of reporting to and seeking the approval of the Advisory Committee. The Committee now became simply an advisory body, but with the change that it now advised the S.P.C.C. and not the Minister as it did previously. As before, the Committee could recommend any amendments to the Act itself and its regulations or their administration as necessary to control air pollution more effectively. But its capacity to advise has been greatly diminished. As it no longer received a flow of statutory information, it became less able to monitor the activities of the Branch and, accordingly, to influence policy formulation.

These exchanges in power were warranted, presumably, on the grounds that there would be a better use of the air pollution control expertise in the Branch. One further change has been the abolition of the Advisory Committee's requirement to submit annual reports to Parliament. This is to be regretted because it removes one of the two sources of official air pollution information available to the public on whose behalf air pollution policies are made. The remaining source, the Annual Report of the S.P.C.C., appears to have become more abbreviated to the point where the accounting of pollution control contains too much uninformative generalisation. In the past the Advisory Committee's reports provided a valuable review of the developing air pollution problems in Sydney. For instance, the Committee urged in several of its annual reports during the late 1960s that the Clean Air Act be extended to control emissions from motor vehicles and shipping. Further, it advocated preventing deterioration in air quality by incorporating, within the planning process, a consideration of the likely impact of air pollutants to be generated by proposed industries upon their surrounding locality.[11] In short, it advocated greater State Government control over land use. The Committee, therefore, anticipated an important question that faced the new Planning and Environment Commission. The Committee's advocacy grew from its experience of the establishment and expansion of large waste generators within existing industrial zones — such as along the valleys of the Parramatta and Cooks Rivers — that had significant concentrations of air pollutants affecting the surrounding residential areas. To help prevent air quality deteriorating in these poorly ventilated lowland areas (which also included the inland growth area of the West Sydney Basin), the Committee had urged that policy makers consider the possibility of locating new air polluting industries near the coast or on high ground either south of Sydney or in the largely non-industrial north.[12]

The thirteen members of the Advisory Committee were drawn from various interested parties affected by the administration of the Clean Air Act. Their Chairman, from May 1974, was the Director of the S.P.C.C. Two members represented industrial management, two represented employees, four had specialist air pollution qualifications, and four represented public authorities: the S.P.C.C.[13] (two members), the Health Commission, and a nominee of the Minister for Local Government, who could be either a representative from his Department or from local government. The Advisory Committee in several of its reports declared land use controls to be a necessary part of abating the impact of air pollutants. It is to be regretted, therefore, that during the reorganisation of functions the opportunity was not taken to widen the scope of its membership and add an urban planner and a meteorologist to the Committee.

### *The Air Pollution Control Branch*

The routine work of the Air Pollution Control Branch expanded to concentrate on Sydney, Newcastle and Wollongong, but particularly the first, which contains three-quarters of the State's manufacturing establishments (Sydney Statistical Division for 1971/2), and over half of the total motor vehicles registered in New South Wales (1971). The Branch, a body directed by engineers and chemists, controls air emissions from two sources, stationary and mobile, each of which demands different control procedures. By 1975 the emphasis of the Branch had shifted to abating the pollution problems generated by mobile sources.

The stationary sources of pollution administered by the Branch, that is the large-scale generators of air-borne wastes defined by statute as scheduled premises, are required to apply for a licence each year. Generally speaking, each licence has conditions attached. Hence the determination, alteration, revocation and policing of the prescribed conditions for applicants who wish to renew their licences or to establish new premises or new processes that come within the category of scheduled premises have made up much of the work of the Branch so far. The Branch aids and consults with industry as to their selection of pollution control equipment and, where necessary, directs that particular equipment be installed or that correct emission control procedures be employed. Ultimately its decisions may be backed by prosecution, the maximum penalty following the 1974 amending Act, for an offending corporation, being $10,000 in addition to a maximum of $2,000 for each day that the offence continues.

The regulation of scheduled premises is affected by policies originally introduced by the Air Pollution Advisory Committee when the Clean Air Act came into force in 1965. The Committee foresaw that the growth in the number of new scheduled premises and their increasing aggregate consumption of energy would add to the quantity of air pollutants despite the operation of emission controls. Thus, where it was judged to be technologically and economically practicable for an individual establishment to reduce its emissions below those prescribed in the regulations, the Committee — now the Branch — imposed further conditions requiring that this be done.[14] A second policy, more recently being modified according to the S.P.C.C., has been that of persuading and co-operating with industry in order to control the major stationary sources of air pollution: thus there was a period of grace up to January 1965 to provide time for industries to design or purchase control equipment. Following research and development in the decade of the sixties, equipment adequate to control emissions from all industrial processes had become available.[15] Accordingly, while adhering to its willingness to co-operate, the Branch has adopted during the seventies a greater readiness to coerce individual firms where persuasion proved fruitless: greater use of official directions to scheduled premises to install proper control equipment and to have it operating by a specified date has developed. This change in attitude, made stronger with the extension of control to emissions from motor vehicles together with the imminent enforcement of odour control, has been altering the emphasis of the Branch's function from an advisory and co-operative body to a directing and policing agency.

But government authorities that infringe the Clean Air Act, it seems, have continued to receive different treatment. Persistent air pollution was caused by the Public Transport Commission's Eveleigh railway workshops at Redfern despite the repeated complaints of the Air Pollution Advisory Committee. The inference to be drawn from the public disclosure, which appeared in the final report (1973/4) of the Committee (but not in the S.P.C.C. Annual Report of the same year), is that either, or a combination of both, ministerial intervention or the power of the Commission to resist the costly impositions demanded by other parts of the State's bureaucracy, postponed the abatement of this source of pollution.[16]

The New South Wales Government policy was to introduce over several years specified emission standards which will limit the concentration of the several constituents in the exhaust gases of *new* motor vehicles. Eventually the existing vehicles will be replaced by those which discharge smaller quantities of pollutants. But the implementation of this emission control policy does not necessarily mean that prevailing air quality will be improved substantially, for a rapid rise in the absolute number and use of motor vehicles may offset improvements. In short, once the Clean Air Act controlled motor vehicle emissions, the public administration of air pollution entered a new and more complicated phase.

More people than in any other part of the entire S.P.C.C. pollution control program will be directly affected by control of vehicle emissions. Motor vehicle ownership has increased in the post-war period. In 1950 there was one car to ten people in the County of Cumberland, but by 1971 this ratio had changed to one car to over three people (3.3).[17] This trend has a significant impact on social habits — place of living, journey to work, mode of transport to work — which, in turn, affect the rate at which the city spreads into the countryside and on metropolitan land use. But if cleaner air is desired by a majority of the community, then the work of several public authorities is of considerable importance in affecting the choices and hence the behaviour of people. A recent study of motor vehicle emissions by the Organisation for Economic Cooperation and Development, to which the Air Pollution Control Branch contributed, suggests that 'some of the best control measures involve long-term planning of cities' rather than the application of stringent emission standards.[18] In conjunction with this policy could be added improvements in public transport.[19] Thus the responsibilities of the Air Pollution Control Branch could induce the parent body, the S.P.C.C., to control air pollution by influencing the policies of several public authorities, for instance the Department of Main Roads and its metropolitan freeway construction program, the Public Transport Commission,[20] and the Planning and Environment Commission.

Motor vehicles are manufactured in other States, chiefly Victoria and South Australia, as well as New South Wales, so that control of emissions of new motor vehicles and the costs that it imposes become a matter where uniformity of policy across the nation is desirable for economic reasons. The coordinating body that recommends vehicle standards and regulations, including emission standards, is the Australian Transport Advisory Council, a body composed of State and Federal Ministers for Transport, and its subsidiary organ, the Committee on Motor Vehicle Emissions. No Ministers in charge of environmental issues were directly represented on the Council in 1975, which may account for the situation where, as the Federal Chamber of Automotive Industries contends, each State is devising differing pollution control standards for motor vehicles that are sold in a market that is nationwide.[21] Pollution control is a national problem, as the two Senate reports on air and water pollution remind us, and for this reason Federal Government authorities, as will be discussed later, became recently a determinant — with a modest administrative but significant financial role — in the public administration of pollutants in the Sydney metropolitan area.

*The Maritime Services Board and the Health Commission of N.S.W.*
Although the Air Pollution Control Branch became the central air pollution control agency, other authorities retained certain statutory powers that were developed to meet particular circumstances before the advent of the Clean Air Act. These powers became subsidiary to that Act, but provided a means for two authorities, the Maritime Services Board and the Health Commission of New South Wales, to complement the activities of the Branch.

The Branch acquired power to control emissions from ships, which, when excessive, affect foreshore residential areas. Perhaps the most effective method of limiting emissions of all ships that visit Sydney Harbour and Botany Bay would require international co-operation to ensure that standard pollution control installations were fitted on all ship's funnels. As this had not been forthcoming, administrative control of this source of air pollution relies on the less effective and time-consuming procedure of detecting random individual offences as they occur. Emissions from ships, the most visible being smoke and soot, are minor in comparison with the total quantity of emissions from other sources that require the attention of the Air Pollution Control Branch, so that, in practice, control in this field remained largely in the hands of the harbour authority, the Maritime Services Board, a function incidental to its major responsibilities. The Board developed its own regulations — the Port Authority (Smoke Control) Regulations — made under the Maritime Services Act empowering it to control emissions. These Regulations rely on prohibition and hence active policing by the Board's wharf patrol staff for their enforcement.

The Health Commission, as the successor to the Department of Health, once controlled air pollution in three ways. The most direct and far reaching of its controls over air quality, the Clean Air Act and its Air Pollution Control Branch, is now part of the S.P.C.C. Nonetheless, the Health Commission has retained within its Bureau of Environmental and Special Health Services two sub-organisations, the Health Inspection Branch and the Division of Occupational Health and Radiation Control, each including within their range of duties control over air pollutants. The objective of both bodies has been to prevent risks to health occurring, the Branch focusing on the general community and the Division on risks to people in the workplace. Prevention of health risks arising from polluted air has been more obvious in the work of the Division, in its attempts to control a variety and concentration of chemical gases and vapours manufactured within enclosed workplaces. The Health Inspection Branch, although assigned by the Clean Air Act to a subordinate position in the public control of air pollution, continued to exercise some control over local incidents of air pollution, particularly odours (which tend to be in the category of nuisances rather than health risks), generated by industries designated under the Noxious Trades Act, 1902 and its Regulations.

## The public administration of water pollution*

*See Chapters 6 and 7 for a detailed examination of activities.

*Social and administrative conflicts in water use*
Water bodies in the Sydney metropolitan area are used for a variety of purposes; drinking water supply, aesthetic enjoyment, recreation, commercial fishing, the

passage of ships, agricultural purposes, certain manufacturing processes, the disposal of liquid wastes and the reception of stormwater drainage. Accordingly, conflicts of use can arise, so that the process of administering water quality since the advent of the Clean Waters Act of 1970 has come to include the problem of allocating the priority of use. In short, water quality will vary among water bodies in the metropolitan area: some will be more degraded than others. Obviously there are many groups in the metropolis that have an interest in the determination of priorities because they affect operating costs, directly in the case of certain industries and public authorities or, for some individuals, the quality of their surroundings.

But the problem of deciding priorities according to different water users has been compounded by contradictions in the administration of water resources. The New South Wales Government authorities have two conflicting functions. On one hand, some authorities regulate the disposal of wastes into waters and, on the other, different authorities control the polluting impact of wastes upon those waters. The group that disposes of wastes which affect water quality comprises first, the Metropolitan Water, Sewerage and Drainage Board which is the primary disposal agency for the liquid wastes generated by households and industries; second, the M.W.D.A. which, in addition to its responsibilities in regard to solid waste disposal by local authorities, was given the task of regulating the disposal of toxic or other liquid wastes unacceptable to the Board's sewers. The central control of water pollution developed in the W.P.C.B., a sub-organisation of the S.P.C.C. The Branch's statutory function was superimposed on existing authorities, the Maritime Services Board and the Health Inspection Branch of the Health Commission, each of which continued to have subsidiary water pollution control functions. The M.W.S. & D.B. also retained a pollution control function as it has a statutory duty to provide safe drinking water, protecting by means of prohibitions and the policing of them its water catchments (most of which lie outside the Sydney metropolitan region), supply canals and reservoirs from pollution. Moreover, the Board also tightened its limits on entry of certain trade wastes into sewers and drains and moved to diminish the impact of its discharges into rivers and the ocean.[22]

As these differences among public authorities illustrate, there exist many and diverging goals in our society. Wastes, such as human excreta, need to be disposed of by the existing water carriage sewer system, so that there will be unavoidable effects on water quality at some stage.[23] Unless, of course, we all stop excreting. Of our group of public authorities, the contradictions in functions became greatest between the three major bodies, the W.P.C.B. (of the S.P.C.C.) on one side, and the M.W.S. & D.B. and the M.W.D.A. on the other. The M.W.S. & D.B. has by far the largest volume of effluents to discharge and so has the most noticeable impact on water bodies such as surf beaches. For this reason it has been much criticised. Less obvious for its impact on surface water bodies is a second statutory 'polluter', the M.W.D.A. Although the liquid wastes or garbage leachates* under its responsibility are smaller in volume than those discharged by the M.W.S. & D.B., their disposal poses difficult and costly problems. For example, concentrated acidic or alkaline wastes from an ecological point of view are severely damaging; from an economic point of view,

*Liquid effluent flowing from garbage dumps mainly due to rainwater dissolving or washing out garbage materials.

the generation of some of these wastes is necessary for a variety of industrial processes used in the making of products demanded by the community.

From the point of view of the process of waste transfer away from the community, these three agencies can be regarded by 1975 as having complementary functions. As well as controlling the impact of pollutants, the W.P.C.B. directed the flow of wastes, particularly to the M.W.S. & D.B.'s sewers, and thence to the ocean which has a much greater dispersion and dilution capacity than overloaded watercourses. Similarly, opposing pressures from the Branch and the Board, which prohibit the discharge of certain noxious wastes into water bodies and sewers respectively, affect the waste disposal practices of industry. In reaction to these pressures we might expect adjustments in the long term like recycling, resource recovery, technological changes producing less waste or on-site treatment of waste making them acceptable for disposal by sewer. But in many processes concentrated volumes of noxious liquids are left over as unwanted residue: the disposal of these wastes has fallen into the jurisdiction of the M.W.D.A.

The difficulty in reconciling the conflicting aims and functions of public authorities is further encumbered by property rights, the effect of which is to make the relevant public authority nominally responsible for maintaining the condition of the waters on its own property. The Cooks River drainage basin will serve to illustrate the problem of preserving or improving water quality. Pollution problems have been evident here at least since the late nineteenth century. The basin extends over more than 98 square kilometres; the waters flow via creeks, pipes and stormwater drains from ten local government areas. In particular, it drains some of the most heavily industrialised areas in Sydney, chiefly within the municipalities of Botany, South Sydney, Marrickville, Canterbury and Bankstown, which include the extensive Public Transport Commission railway yards and workshops sited variously at Chullora, Enfield and Eveleigh: waste oil discharged from the railways has been a continuing source of river pollution. All major stormwater drains, which include the upper part of the river, are owned by the M.W.S. & D.B. which is, therefore, responsible for the maintenance of these channels and the removal of rubbish from them. Some minor stormwater drains that are connected to the Board's drains are owned by local government authorities, which also control earthen channels and pipes discharging into the river system. The Department of Public Works, by the power conferred on it by the Cook's River Improvement Act, 1946, owns and controls the lower reaches of the river until its point of discharge into Botany Bay; it also owns most of the bed of the heavily polluted Alexandra Canal. The Maritime Services Board (M.S.B.), which owns and controls Botany Bay up to the highwater mark, has duties to prevent the pollution of navigable waters,[24] particularly by oil. Overriding the water pollution control authority of these agencies, except the M.S.B. in respect of oil pollution in navigable waters, is the W.P.C.B., which was formed in August 1971. It is responsible for water quality and has powers under the Clean Waters Act to direct public authorities or private organisations to rectify or abate their own or other's polluting activities. In 1975 the Branch formulated a water quality policy that was to apply to the Cooks River drainage basin. We now turn to a consideration of the functions of the Branch.

*The Water Pollution Control Branch and the Clean Waters Advisory Committee*

The Clean Waters Act of 1970 centralised in the Water Pollution Control Branch (from May 1974 a sub-organisation of the S.P.C.C.) the control over the discharge of all wastes — whether liquid, solid or gaseous — into any water bodies in New South Wales (though Sydney has been the dominant area for the Branch's activities).

The administrative system, derived from the strategy established by the Clean Waters Act, provided for a system of classification of waters and for the formulation of waste discharge standards that were to apply to each classification respectively. The Regulations which, together with the Act, came into force on 3 November 1972, prescribed six water classifications, as follows:

S Specially Protected Waters
P Protected Waters
C Controlled Waters
R Restricted Waters
O Ocean Outfall Waters
U Underground Protected Waters

The first four classifications provided categories in descending order of quality for inland surface waters. Specially Protected Waters, the only classification prohibiting any waste discharges, included those water bodies used for public water supplies, or in nature reserves, or of special scientific interest. Discharges permitted into Protected Waters were of drinking water quality. Controlled Waters, which might eventually flow into public water supplies, were to have discharge standards adequate to safeguard that use. The degree of protection afforded to Restricted Waters were to be adequate to sustain aquatic life.

The water quality classification to be assigned to a water body then determined the conditions attached to licences granted annually — a procedure enabling a review of the conditions prescribed — to waste generators wishing to discharge liquid wastes into waters. The licensing system thus became dependent upon the adoption of water body classification, unlike the air pollution control administration, which formally based its issue of annual licences to individual waste dischargers on the kind and volume of wastes emitted at that source and not on a predetermined minimum standard of air quality.[25] No detailed picture as to how water bodies may receive their particular classification had emerged up to the end of 1975, but it seems, because Sydney draws its water supply from outside its built-up area, that the W.P.C.B. regards waste discharge as a critical factor in the determination, for it affects many other water uses in Sydney. Thus the Branch considers the collective impact of waste generators (that is the existing and likely future users of the water disposal system) that discharge into each metropolitan water body when devising a classification for it. According to the head of the Branch, the waters of the metropolitan region, because they flow within a highly urbanised and industrialised area, are likely to be classified either as Controlled or Restricted Waters.[26] The Cooks River drainage basin, including both natural and artificial watercourses, became the first metropolitan water body to be classified under the Clean Waters Act when it was designated as Restricted Waters in June 1975, i.e. of a standard appropriate to aquatic life.

The work of the W.P.C.B. has been changing as the Clean Waters Act comes fully into operation. In 1971 and 1972 the Branch concentrated on monitoring and detecting existing sources of pollution. From November 1972, when the Act and Regulations came into force, existing waste dischargers, who had been granted temporary exemption from penalty provisions by the Act itself, individually had their immunity removed by the Branch and were directed to divert their wastes into sewers or to install and maintain adequate treatment appliances. The third control stage in the Sydney metropolitan area began with the water classification program, so that conditions attached to licences may be henceforth considered in relation to the designated classification. As there is provision for waste dischargers to object to the conditions of their licence, the work of the Branch is likely to include the giving of evidence on matters brought before the Clean Waters Appeal Board.

The Branch acquired power to require dischargers to provide detailed information relating to their liquid wastes and, on the basis of this, to direct them to connect to sewers, to cease polluting by a specified time and to monitor their own waste discharges. The Branch also developed its own monitoring program, serving both to check the effectiveness of water pollution controls that have been instituted and to provide a basis enabling water bodies to be classified.

The statutory Clean Waters Advisory Committee had as its Chairman the Director of the S.P.C.C. Of its eighteen members,[27] ten (including the Chairman) represented government agencies (as against four public agency representatives on the Air Pollution Advisory Committee), two represent local government, a further two had relevant professional qualifications, the remaining four represented primary and secondary industry respectively, and recreation and conservation interests. Like the longer lived Air Pollution Advisory Committee, the Clean Waters Advisory Committee until the Clean Waters (Amendment) Act of December 1974 had significant powers to influence water administration policy and routine control procedures and hence to shape the work of the Water Pollution Control Branch. By 1975 its powers had been reduced considerably: it existed as an advisory committee to the S.P.C.C. and not the Minister for Planning and Environment as formerly, and had no power to intervene in the administration of the Clean Waters Act. Similarly, its statutory obligation to submit to Parliament an annual report reviewing the workings of the Act was repealed.

*The Metropolitan Water, Sewerage and Drainage Board*

The giant Metropolitan Water, Sewerage and Drainage Board, founded in 1888 as the Metropolitan Board of Water Supply and Sewerage, is statutorily responsible for three services, indicated in its current title, that are essential for urban living. As a major construction agency and large-scale employer the Board has a significant impact on the direction and rate of urban development and, as the provider of sewers, on the quality of the city's physical environment. For these reasons the Board is a major and powerful agency within the public bureaucracy that governs Sydney. Further, its policies for the acceptance of chemical wastes from industry into its sewers — a system of disposal that was originally designed to cope with biological wastes, primarily human excreta —

influence first, the effectiveness of the metropolitan water quality improvement program of the S.P.C.C. (Water Pollution Control Branch), second, the quantity and kind of noxious liquid wastes that became the responsibility of the M.W.D.A. and, third, the costs to industry of waste treatment. No longer is the M.W.S. & D.B. administering in isolation the transfer of wastes away from the community. The interactions of these three public agencies have come to determine the direction of liquid waste transfer, the chemical composition and strength of liquid wastes and the volumes of such wastes and their ultimate location in the environment. It is of importance to policy making in these matters and underscores the economic significance of the water carriage system of liquid waste disposal that the President of the M.W.S. & D.B. is a member both of the S.P.C.C. and the M.W.D.A.

The Board has two sewage disposal areas: one into the ocean, the other into inland watercourses. The first is the most substantial as it drains the vast part of the metropolis. The sewage discharges into the Pacific Ocean at several points, the four major outfalls being at Bondi, Malabar (these discharge most of the metropolitan industrial effluents disposed of by way of the sewer), and Cronulla to the south of Port Jackson, and at North Head. There are, in addition, several minor sewer outfalls into the ocean. Together, ocean outfalls serve about 90 per cent of the estimated sewered population in the Sydney region. The second disposal area, the inland watercourses that drain into the Georges and Hawkesbury Rivers, receive effluent from inland sewage treatment works. These works were built at what once were isolated small towns, such as Campbelltown, Fairfield and Liverpool,[28] that have increased their population since 1945 and now have become incorporated into the Sydney urban agglomeration.[29] The two disposal areas used by the M.W.S. & D.B. are now regulated by the Clean Waters Act. The S.P.C.C.'s (Water Pollution Control Branch) water body classification program has been designed for Sydney's sewage to be discharged either into the special category of Ocean Outfall Waters or into either of the last two categories, Controlled and Restricted Waters, intended to apply to inland waters.

The volume of effluent discharged into ocean and inland waters is generated largely by households and industries. The economic and physical problems of extending the sewerage system on the ever-sprawling western edge of the metropolis are discussed in Chapters 6 and 7. So far as water pollution is concerned, the provision of sewerage 'solves' one problem by transferring it to another part of the environment. The expanding number of sewered houses in this region reduces the indiscriminate water pollution caused by effluent flowing from individual septic tanks and sullage pits: the volume of liquid wastes are concentrated at the inland treatment works so that water pollution becomes an administratively controlled act. The combined effects of geographical location, population and industrial growth imply that increasing volumes of sewage will be discharged from inland treatment plants. Maintenance of the water quality of inland watercourses, therefore, depends partly on the effectiveness of sewage treatment and sewage acceptance policies of the M.W.S. & D.B., partly on water body standards sustained by the S.P.C.C. (Water Pollution Control Branch) and partly on land use controls administered by the Planning and Environment Commission and local governments.

From the narrow point of view of waste disposal in isolation, the M.W.S. & D.B. and the S.P.C.C. seem to have opposing functions of statutory polluter and pollution controller. But from the point of view of Sydney's needs, their functions are complementary. This last proposition will become clearer when we consider briefly the particular problems of industrial liquid waste disposal. From its foundation, the Board attempted to cope with an increasing volume of household liquid wastes by providing sewers to new and existing suburban homes. Industrial liquid waste disposal, because of the chemical complexity and often toxicity of many of these wastes which similarly have been increasing in volume, is a relatively new problem: the M.W.S. & D.B. first introduced standards for industrial waste discharges into its sewers and stormwater drains in 1942.[30] These standards were more stringent for discharges into stormwater drains because the discharges flowed into natural watercourses and the drains were accessible to the public. The standards were revised in 1972 and progressively tightened.

Until 1972, the Board imposed on industrial establishments a charge based on the volume of liquid wastes entering its facilities; the revised standards added to this a further charge calculated on the chemical 'strength' of the effluent. But these standards have been used by the Board as a general guide. In practice the Board has considered the wastes of individual establishment in relation to several factors including the dilution capacity of the sewer at the particular location, the nature of the effluent and treatment works capacity. As two officers of the Board put it: 'Where unfavourable reaction in the sewer can be kept within acceptable limits, it is clearly in the community interest that a partial relaxation of the standards be granted'.[31]

It is undoubtedly the case that one effect of the Clean Waters Act has been to redirect the flow of a large proportion of liquid wastes away from stormwater drains and watercourses and into sewers. The industrial effluent policies of the M.W.S. & D.B. are, therefore, a crucial element in the S.P.C.C.'s task of diminishing the local sources of inland water pollution. The Ocean Outfall Water policies of the Commission affect the costs and operating procedures of the Board. The Commission has devised a policy for ocean outfall discharges, the objective of which is to 'provide an optimum solution for marine waste disposal which will protect the beaches and the aquatic environment at minimum cost to the community'.[32] This statement makes the role of the S.P.C.C. clearer. First, the Commission has assumed the statutory duty to control and abate the impact of pollutants. Second, in the performance of this task the Commission's officers have adopted a 'balancing' point of view, taking into account that existing community needs include both the disposal of wastes and control over the impact of those wastes. The difficulties are of course that 'community' is a vague conception and, therefore, open to debate; and that, in attempting to meet both sides of the problem of waste disposal, the S.P.C.C. may well diminish its capability to act as an advocate for environmental protection within the public bureaucracy.

*The Maritime Services Board and the Health Commission*

The advent of the Clean Waters Act and the W.P.C.B. diminished the water pollution control responsibilities of the Health Inspection Branch of the Health

Commission and the M.S.B. The Health Inspection Branch has become the lesser of the two in respect of water pollution control. Its officers on their routine duties have retained sufficient powers to prevent and detect contamination by effluents from houses, shops and factories.

Much more important are the water pollution control functions of the Maritime Services Board specifically to control oil spillages and more generally the day-to-day housekeeping tasks necessary to remove a variety of debris so as to keep navigable waterways clear for boats and ships. Under the powers conferred by the Prevention of Oil Pollution of Navigable Waters Act, the Board has the responsibility for preventing and cleaning up oil spills within the limits of navigable waters.

**The public administration of land pollution**

Traditionally both disposal of solid and liquid wastes on land and control over their polluting effects were the responsibilities of the numerous metropolitan local government authorities collecting and disposing of household and industrial wastes at their own tips or regulating private tips within their respective municipal areas. The Health Inspection Branch supervised the operation of tips so as to diminish health hazards such as rodent infestation, and to abate nuisances like unpleasant odours and smoke. But, in the long term, the trend has been one of a contraction in local government responsibility in favour of a regional administration of liquid and solid waste disposal. As the M.W.S. & D.B.'s sewers expanded across the metropolis, the few local government authorities collecting and disposing of household liquid wastes from unsewered homesites has gradually diminished. Further, as indicated above, a greater volume of industrial liquid waste has been diverted to sewers. But there remains a certain volume of highly concentrated liquid waste which, prevented from being discharged into waters and sewers, is disposed of in other parts of the environment such as on land or at sea, or else illegally and clandestinely dumped at convenient locations. Since May 1971 the responsibility for the disposal of this class of liquid waste and of all solid wastes generated within a statutorily designated metropolitan area, which consists of forty local government authorities, has been assumed by the M.W.D.A.

*The status and powers of the Metropolitan Waste Disposal Authority*

The Metropolitan Waste Disposal Authority* was founded partly to coordinate the disposal of wastes because of the increasing scarcity of tipping sites, particularly in the inner metropolitan suburbs. Throughout 1975 most of the solid wastes generated in Sydney were tipped at landfill sites, but the Authority was empowered to develop new waste disposal methods including recycling and recovery of materials from the waste stream. Under its enabling Act, the M.W.D.A. can control the three major parts of the waste disposal process by the issue of annual licences to the generators of waste, waste collection contractors and the supervisors of waste disposal points such as at tips and incinerators.

*The activities of the M.W.D.A. are discussed at length in Chapter 10.

The M.W.D.A. was established as an agency, first, to manage the disposal of wastes (solid and some industrial liquid wastes) currently being generated within its designated area and, second, to plan for waste disposal in the future. As the formulation of plans depend on adequate knowledge of existing and expected trends (volume, type of waste, location of waste generator, etc.) in metropolitan solid and industrial liquid waste generation, knowledge that did not exist in 1971, the Authority has spent its first years in gathering data and in determining its role within the bodies generating and administering the wastes of Sydney people.

The idea of the regional Authority was conceived in the context of existing public agencies and the need to create new ones to manage and control wastes. The M.W.D.A.'s waste disposal function is intertwined with those of the pre-existing M.W.S. & D.B. and the forty local government councils on one hand, and constrained by the policies of its contemporary (particularly since May 1974), the State Pollution Control Commission, on the other; and still, in certain conditions, subject to the Health Commission. The administrative interdependence of these public agencies is secured further by statutes. For instance, the seven members of the Authority (each appointed for a five-year term), included a full time Director and Deputy Director; two persons with special knowledge of waste disposal and, significantly, two local government council officers and the person holding office as the President of the M.W.S. & D.B. The Authority's subordination to the S.P.C.C. is outlined partly in its own founding Act, making it mandatory for it to seek permission from the Commission either for amending its statutory powers or for inquiring into the waste creation and disposal process. Further, the Commission was empowered to determine appeals against the Authority arising from its power to issue conditional licences to those engaged in the generation, transportation or disposal of waste. More importantly, the powers of the S.P.C.C. overrode the powers of the M.W.D.A.: wastes were to be dumped under conditions that prevent or minimise their polluting impact on the physical environment. These powers helped to establish priority among policies and consistency in their application and so, in theory, to coordinate environmental control activities. Finally, the M.W.D.A. was represented on the Technical Advisory Committee of the S.P.C.C.

*The disposal of noxious industrial liquid wastes*

The M.W.D.A. was made responsible for noxious industrial liquid waste not allowed into sewers or watercourses. The Authority, in 1975, operated a landfill depot for liquid waste disposal at Castlereagh to the west of Sydney from which certain types of toxic liquid wastes (such as heavy metals) were excluded, presumably because they might percolate through the earth and eventually contaminate waterbodies. This disposal site was a short-term solution pending a proposal for a central treatment plant to dispose of the noxious industrial liquid wastes generated in the Sydney region and not treated by business concerns.

The general tightening of pollution controls by public agencies during the 1970s induced waste generators to discharge their liquid wastes into the M.W.S. & D.B.'s sewers, rather than watercourses and drains. The Board itself encouraged firms to use its facilities by relaxing its discharge standards where practicable while, at the same time, tightening its general standards. Business responded by some additional in-plant treatment of wastes. It is impossible for us to ascertain, but this 'stick and carrot' method, employed by different parts of the bureaucracy to manage waste disposal, probably stabilised, if not reduced, the volume of industrial liquids *entering the jurisdiction of the M.W.D.A.* However, the existence of a public waste disposal system is no guarantee that all firms will in practice use it. Both the Board and the Authority levied charges for liquid waste disposal: these costs may deter certain firms from dumping their wastes at either the sewer or the tip. Short of closing down plants, processes or products, business may limit these costs by in-plant treatment or by illegal dumping. Both processes appear to have occurred. More firms are treating more of their own wastes and adapting their technology. But it appears still to be the case that a substantial though unknown volume of noxious liquid wastes, including those toxic wastes excluded from the Castlereagh tip, is still being dumped by clandestine methods. The policing and detection of these offenders is the responsibility of the S.P.C.C. As more knowledge about the volume, kind and location of industrial waste generation is acquired by licensing and monitoring procedures and, moreover, shared among the three relevant authorities, the S.P.C.C., the M.W.S. & D.B., and the M.W.D.A., if and when the Authority's central treatment begins operating, it may be that the unknown volume of noxious liquid wastes will be brought under administrative control.

## The public administration of noise

The Noise Control Act and Regulations, which came into force in 1975, added to the existing environmental legislation in New South Wales. Manmade noise arises from numerous sources such as industries, motor vehicles, ships, lawnmowers and loud music. Because of the random occurrence in time and place of many irritating noises, the enforcement of the Act may be divided among several public agencies.

Some control over noise has for a long time been exercised in relation to boats in navigable waters under the statutory powers of the Maritime Services Board. But the chief noise control agency designated under the Act is the S.P.C.C., which is specifically empowered to regulate the major sources of noise as well as administer the Act generally.[33] Activities that are continuously or frequently making noise exceeding a prescribed level are to be controlled by the Commission: the premises (such as factories and clubs) upon which these activities occur are to be designated as scheduled premises and made subject to a conditional licensing procedure each year. The Act also enables noise to be prevented by the Commission. The sale of articles, first, that exceed maximum noise levels (to be prescribed in the Regulations) and, second, that are required to be equipped with noise control appliances (such as mufflers), is prohibited.

Excessive noise may be policed and the Act enforced by various agencies through the use of three types of official prohibition: Noise Control Notices, Noise Abatement Orders, and Noise Abatement Directions. Notices may be issued to scheduled and unscheduled premises requiring the installation or repair of noise control equipment; or may restrict the time during which noisy industrial processes or articles may be used; or may prohibit the use of articles which create noise exceeding the prescribed maximum level. The S.P.C.C. can issue notices in any circumstances; local government councils can only control noise from unscheduled premises or in a public place, while the M.S.B. may issue Noise Control Notices to vessels on navigable waters. The second procedure provides an opportunity for occupants of any premises affected by a noise nuisance to apply to a Court of Petty Sessions for the making of a Noise Abatement Order. Noise Abatement Directions may be used when prompt control is needed, as in the case of noisy parties. Directions, which remain in force for six hours, may be given orally by authorised officers of the S.P.C.C., by the local government councils and by the Police Department. The officers of the last two authorities only have power to issue Directions between specified hours, but officers of the Commission are under no such restriction. To this new control administration must be added the existing work of the Department of Labour and Industry, which, through the Factories, Shops and Industries Act, regulates noise occurring in the workplace.

## Preventing environmental degradation

So far we have been considering the chief agencies established directly to control pollutants and manage wastes. There are other ways in which government agencies seek to manage Sydney's urban environment.

*Environmental impact statements*

In January 1972 the Premier of New South Wales declared that it was Government policy 'that before any action which could significantly affect the quality of the environment is undertaken its implications shall be expressly identified and evaluated'.[34] This evaluation was to be made in an 'environmental impact statement'. The purpose of this device was to make organisations or individuals, both private and public, consider in advance the implications of their proposed development and add any necessary environmental safeguards. Comprehensive impact statements were to be displayed at several locations for major or controversial projects so that interested citizens could be informed of the plans and, where necessary, submit objections to the determining authority.

Local government authorities and government agencies have significant powers to control development. By 1975, according to State Government policy, it had become mandatory for authorities to ensure that environmental factors, along with the traditional economic and social factors, were taken into account in development proposals. The impact statement has become in effect a formal means by which administrations check the consistency of the proposed development with plans and guidelines as required by the N.S.W. Planning and Environment Commission and the waste discharge standards prescribed by the S.P.C.C.

Apart from providing advice as to the procedures to be followed by developers or by the determining authority, the S.P.C.C. itself was given overriding powers in the making of impact statements. The Commission was empowered to make environmental investigations or to act as a determining authority either at its own discretion or by ministerial direction. The Commission has also acted as an arbitrator when two public authorities disagreed over the impact of a particular proposal; and in an unresolved dispute the public authorities were given a further right of appeal to the Premier. Sometimes the determining authority might be also the developer, in which case, with a proposal of special or controversial significance, that authority must refer the matter to the Commission. In October 1975 the Government foreshadowed its intention to give statutory force to its policy of requiring environmental impact statements for certain kinds of development. How the proposed Bill will affect the existing administrative situation is a matter for speculation, but it appears that it will strengthen the position of the S.P.C.C. as the chief decision-making authority in this field, while it may also remove elements of discretionary power from other public authorities.

The environmental impact statement by itself is an inadequate procedure to protect the metropolitan environment. It is an administrative device that induces thinking about very small parts of the urban system on a project by project basis, each at a particular place at a particular time. This has been most clearly displayed in the controversies over the Botany Bay Port development. Each impact statement does not take into account cumulative deterioration of the environment arising from a succession of individual developments at particular locations. A new organisation, the N.S.W. Planning and Environment Commission, established in November 1974, may constrain and direct pressures on the urban environment that arise from developments in the long term. Because of its broader outlook, particularly on the processes of urban growth, the P.E.C. may become a more suitable body than the S.P.C.C. to have overall supervision and authority over the environmental impact statement procedure.

*The advent of the N.S.W. Planning and Environment Commission*

The N.S.W. Planning and Environment Commission replaced the cumbrous sixteen-member State Planning Authority with a five-member agency: three as full-time Commissioners, two as part-time representatives of the local government associations and the community respectively. Under its statute the P.E.C. was given power to make a wide ranging investigation of the existing process of land-use planning and to recommend any legal, organisational and administrative changes to that process that it considered necessary. But in practice, the Commission, as it noted in its *Report to the Minister for Planning and Environment* of November 1975, restricted its terms of reference, and hence the options open for it to canvass, by taking into account the political wishes of the Government as they were expressed in Parliament and later by its Minister.[35]

The State Government wished to change the planning process that drew it into the onerous and time-consuming task of intervening in the details (particularly in Sydney) of local planning appeals and arguments between local government councils, developers and local residents. Accordingly, the State proposed to increase the planning powers of local government councils. While there are grounds for reform because of slowness in the existing decision-making process, in the light of recent criticisms of local government planning by the Commonwealth Commission of Inquiry into Land Tenures (1974) — whose head is Mr Justice Else-Mitchell, an eminent judge of the N.S.W. Land and

Valuation Court — and the State Inquiry into Local Government Areas and Administration (1973), the Government's intention is a retreat from the demonstrated need for a form of comprehensive government for Sydney.

In particular, there are disturbing implications for the planning of Sydney. Metropolitan town planning and its administration require a capability to manage complex issues. Existing local council areas in Sydney are too small and their access to resources too circumscribed. Accordingly, the numerous local councils are not in a position to assess the impact of their planning decisions on other parts of Sydney outside their jurisdiction. As will be argued below, proper consideration of issues of urban amenity require a conception of the metropolis as a region. It is too soon to judge what will be the status of the P.E.C. in Sydney government, but the thrust of the Report appears to diminish its function as a *metropolitan* planning body. This situation may be desired for short-term political reasons but is undesirable for managing the growth of Sydney in the long run.

The *Report* envisaged that there be planning at two levels: local plans, and State and regional plans, the first to be prepared by local councils in conformity with the State and regional plans prepared by the P.E.C. It may be that a regional plan for Sydney, if all public authorities were compelled to adhere to it, in combination with new legislation, will provide the P.E.C. with sufficient powers to compensate in part for the fragmentation of planning in the metropolis. However, the crucial problem will be the administration of local plans by local councils, so that the proposed new planning system, if implemented, would need to be accompanied by State Government action to expand local government areas in the metropolis, thereby reducing their number, and to provide councils with resources adequate to meet their added responsibilities.

The remaining objectives of the State Government that shaped the *Report* were less controversial. First, it wished to broaden the scope of planning to encompass social, economic and environmental factors; second, to foster participation of the community in the planning process; third, to simplify the whole system of planning in the State.

### *The Planning and Environment Commission and the growth of Sydney*

To incorporate environmental objectives into the planning of Sydney, the P.E.C. would need to assess the capacity of the existing metropolitan environment to absorb changes. For such objectives to be effective, the Commission would need to have the capability to control its metropolitan plan. There is a strong case for granting the P.E.C. the final planning powers within Sydney. Many 'pollution' problems occur when the generators of wastes, such as motor vehicles and factories, are being concentrated at particular locations. Further population and industrial growth in Sydney, if unregulated, will aggravate existing problems of pollution control, particularly in the southern half of the metropolis. Long-term control over pollution, therefore, should include greater control over land use and the location of activities within the whole metropolitan region. New South Wales civil servants have urged that there be greater public control over the structure of Sydney. To take an example, R. P. Murphy, who became Deputy Director of the S.P.C.C., wrote in 1970 that there are economic and technical limits on the degree to which air pollution may be controlled in any particular instance. Accordingly, we must expect, in almost all cases, a residual quantity of pollutant discharged to the air. Therefore, he continued, even with improvements being made to control existing sources, the point will be reached where continued growth will worsen air quality.[36] An officer of the P.E.C. gave us a similar warning in 1975. The best technology may prove inadequate to control sources of pollution that are heavily concentrated in urban areas, he writes: 'Economic and technological development and population growth could overwhelm programmes that were once effective'.[37] These views clash with those expressed in the *Sydney Region: Outline Plan* of 1968, where the State Planning Authority defined what it believed to be the political objective of the State Government in planning the growth of Sydney: to 'ensure that Sydney remains the foremost commercial centre and port in Australia'.[38] Under this plan, State resources were to provide necessary inducements — communications, water and sewerage, roads, railways, ports — to attract businesses and population to the metropolis. Today it would seem that these policies need revision and that there are some signs that some revision is occurring.

As we have seen, there is a labyrinth of government authorities that govern different aspects of Sydney. To clarify the status of environmental planning means the making of political decisions: first, about the need for comprehensive objectives and policies for the metropolis; second, about the division and hierarchy of powers among the public agencies governing Sydney. However, the *Report* dealt with the proposed planning system for the State as a whole, so that there were only scanty references to the Commission's likely role and relationships with other agencies in the planning of Sydney. First, the *Report* recommended that the Minister for Planning and Environment have powers to direct any local government council to review its local plan in order to make it conform to the relevant regional plan. Second, the P.E.C. specifically rejected the concept of its having overriding power to coordinate activities of the various State Government agencies. We assume that this would apply also in Sydney. The P.E.C. advocated as an alternative the establishment of an influential collaborative body, which was to be known as the Government Sector Policy Committee, to advise it, and proposed that its members should be, preferably, the heads of specified State Government authorities. Further, to match the structure of the Cabinet sub-committees that were established in 1975,[39] the *Report* proposed that the Policy Committee be subdivided into five groups containing selected Government agencies: Policies and Priorities, Natural Resources, Industrial Resources, Social Development and Local Government. In turn, each group is to be expanded into sub-committees containing a wider range of agencies. The arguments for the new Cabinet structure are to improve policy formulation; to foster interdepartmental coordination on problems that cut across the boundaries of the strong functional orientation of government departments; and to aid the setting of public expenditure priorities. So far as the proposed structure of the Commission's Policy Committee is concerned, there may be disadvantages in copying the Cabinet structure. For instance, our group of metropolitan environmental management authorities, whose activities the P.E.C. hopes to coordinate, are separated among the several groups. Thus, considering the groups and group sub-committees together, the S.P.C.C. and M.W.D.A. are to be allocated to the Natural Resources group, the M.W.S. & D. B. and the M.S.B. to the Industrial Resources group, and the Health Commission to the Social Development group.

On the other hand, the *Report* proposed the establishment of government sector regional policy committees in those regions where planning work justifies the need. On this basis, the Sydney metropolis may be regarded as a region and, accordingly, a regional policy committee established and so organised that some degree of coordination of metropolitan activities by government agencies attained. But, the Commission warned, 'very considerable autonomy should be given to regional representatives of Government departments'.[40] This could be taken to mean that the M.W.S. & D. B. retain its very considerable powers to operate independently of the metropolitan objectives of the P.E.C.

The *Report* made two further recommendations concerning its relations with other government agencies: first, that they should all be required to comply with environmental plans as adopted by the State Government; second, that each agency should consult the P.E.C. (and other agencies that are relevant) before determining its major program of works. If these two proposals are adhered to by the State Government, then the status of environmental objectives, in so far as they are incorporated into a metropolitan plan, *may* be raised so that they receive equal consideration alongside competing social and economic objectives.

As a further sign of the complexity of public policy inherent in the problem of environmental management, the Commission's *Report* proposed, in addition to its Government Sector Policy Committee, three other advisory committees. These are to be first, a Development Industry Committee to represent the private sector; second, a Conservation Advisory Committee (which is to be a reconstitution of the existing Historic Buildings and Sites Advisory Committee) to represent certain government agencies, such as the National Parks and Wildlife Service, and private bodies such as the National Trust and the Royal Australian Historical Society; third, a Planning Review Committee to be drawn from local governments, professional planners and academics.

**Pollution control and metropolitan management**

So far, beginning with the advent of the Clean Air Act, pollution control policy in New South Wales has been one of 'cleaning up' in order to remedy past neglect, that is to reduce the harmfulness of wastes discharged from individual sources. The main thrust of these controls has been aimed at the most obvious pollutants: those chiefly generated by industry. With the advent of the S.P.C.C. and P.E.C., control policy in Sydney entered a second and more complicated phase, partly because regulation extended to transport and houses as well as industry, and partly because the existing environmental control legislation, covering air, water, land and noise, became more comprehensive. Given the existence of Government intervention to protect the environment and the *de facto* recognition of public property rights over the use of air and water, the question arises as to whether this principle will be extended in respect of land-use rights. To what extent will the Government manage the process of urbanisation by owning or regulating these land-use rights? In this section we will look at the inequities arising from the differential impact of pollutants which are themselves the result of several related factors: of urbanisation, of social and economic pressures and of inadequate public control over land use in the past.

*Spatial differences in the impact of pollutants*

Questions that may be asked about the growth of Sydney are 'How does it affect the distribution of welfare?' 'Which groups benefit and which groups lose as a consequence of metropolitan expansion?' Welfare includes the provision of a range of services and facilities to which persons have access. In recent times, welfare has come to include the quality of the environment — or more generally, the quality of urban amenity and urban living.

Urban growth is typically accompanied by the development of industry and transportation which, under the existing private and public arrangements, must be expected gradually to exacerbate the problem of maintaining environmental quality. This problem arises because so many of the private decisions which affect the growth of Sydney take place without the guidance of comprehensive public plans and directions that take into account environmental factors. For instance, the decision to locate an industrial establishment within a particular urban area is largely a private decision which is influenced, presumably, by a rational consideration of access to markets, labour and transport. Sydney is attractive for these reasons. It will prove to be more so when the new Botany Bay port begins to work, and also if the proposed third oil refinery is located in the Sydney region. New establishments may now be expected to employ significantly less polluting technology, but their foundation in the industrial areas of south Sydney as designated by the Outline Plan will still add to those pollutants generated by existing establishments. As observed above, one critical aspect of the problem of pollution occurs when the total volume of pollutants exceed the capacity of the receiving medium adequately to absorb and dilute them. This problem may well apply more to air emissions than to wastes discharged to sewers which, in turn, discharge their liquids into the ocean. But the developing industrial zones on the western periphery of the metropolis — Campbelltown and the Parramatta-Penrith area — will discharge a large proportion of their liquid wastes into rivers via inland treatment works. Even with ocean disposal, radical degradation of Sydney's beaches may become avoidable only with exceedingly costly measures — costs that might be limited if effective urban planning can control the problems at source.

In our affluent society the acceptance of a degree of pollution — that is an environment degraded to a certain level — is a price to be paid for maintaining what is, historically speaking, a high standard of living in concentrated human settlements. This is the 'community' view, in which it is assumed that all or most persons share the benefits, although the shares may be unequal. The problem with such aggregating concepts is that they are only partially true. The impact of pollutants varies, for instance in space, time and according to the generating source. Urban dwellers are affected much more than are country people. Smog generated by an excessive number of motor vehicle emissions is an experience that is contributed to and shared at some time by the majority of Sydney households, for most possess a car. On the other hand unpleasant odours from oil refineries affect immediately those living in the vicinity. Pollutants, therefore, have different impacts on space, and, given the highly segregated social and economic character of Sydney, they tend to affect the poorer people to a greater degree. So far as air pollution is concerned, they have to bear not only the costs for cleaning clothes, furnishings and buildings, but also what is less easy to appraise, the long-term effects on their health. Of those living in the southern half of Sydney, it is probable that only a relatively small percentage will accumulate sufficient means to enable them to shift from dirtier to the cleaner and more pleasant suburbs in Sydney. Most people, it is contended, will be unable to escape to a better environment and, therefore, will continue to bear the burden of a greater degree of the pollution that exists because of the community's way of life.

It needs to be stressed that the pollution control measures that have been adopted so far give benefits to those living in the more industrialised half of the city. But these benefits are only ameliorative; they cannot adequately compensate for past policies of industrial location. The problem is, as has been argued above, to prevent the loss that may occur, through urban growth, of any gains in the reduction of pollutants that have already been made. By itself, the differing impact of pollutants on urban dwellers may be insufficient to justify an extension of Government intervention in the management of Sydney. However, the structure of the metropolis and the effects of its growth create a number of problems, some of them interrelated, which may be jointly 'solved' or, more likely, mitigated, through a comprehensive system of management. For instance, the time-consuming journey to and from work in private motor vehicles, which affects a great proportion of the Sydney workforce, has helped to foster heavy expenditure on freeways and roads (which compete with expenditures needed to maintain and expand public transport) in the hope of increasing accessibility. But being focused primarily on the central business district, these road systems attract excessive traffic and so increase air pollution and congestion. The question is not simply how to manage the process of urbanisation so that its bad effects are abated in *existing* urban areas, but also how to manage the environment in new urban areas.

Waste management is a more involved question than it might at first appear. In short, the social and economic impact of the current patterns of waste generation is such that waste management should be considered as a sub-problem of the general problem of managing the process of urbanisation.

*Political responsiveness to urban needs*

One of the functions of government is to allocate the community's scarce resources. But governments, despite our democratic ideology, do not represent the whole community: they are formed from political parties which represent particular interest groups. The political power exercised by interest groups influences first the formulation of policies and second the allocation of resources and changes in distribution among the functions of government and between the regions of the State. This conception of the political process emphasises the effects that scarce resources, ideology and political pressures have on the behaviour of governments. In New South Wales, government

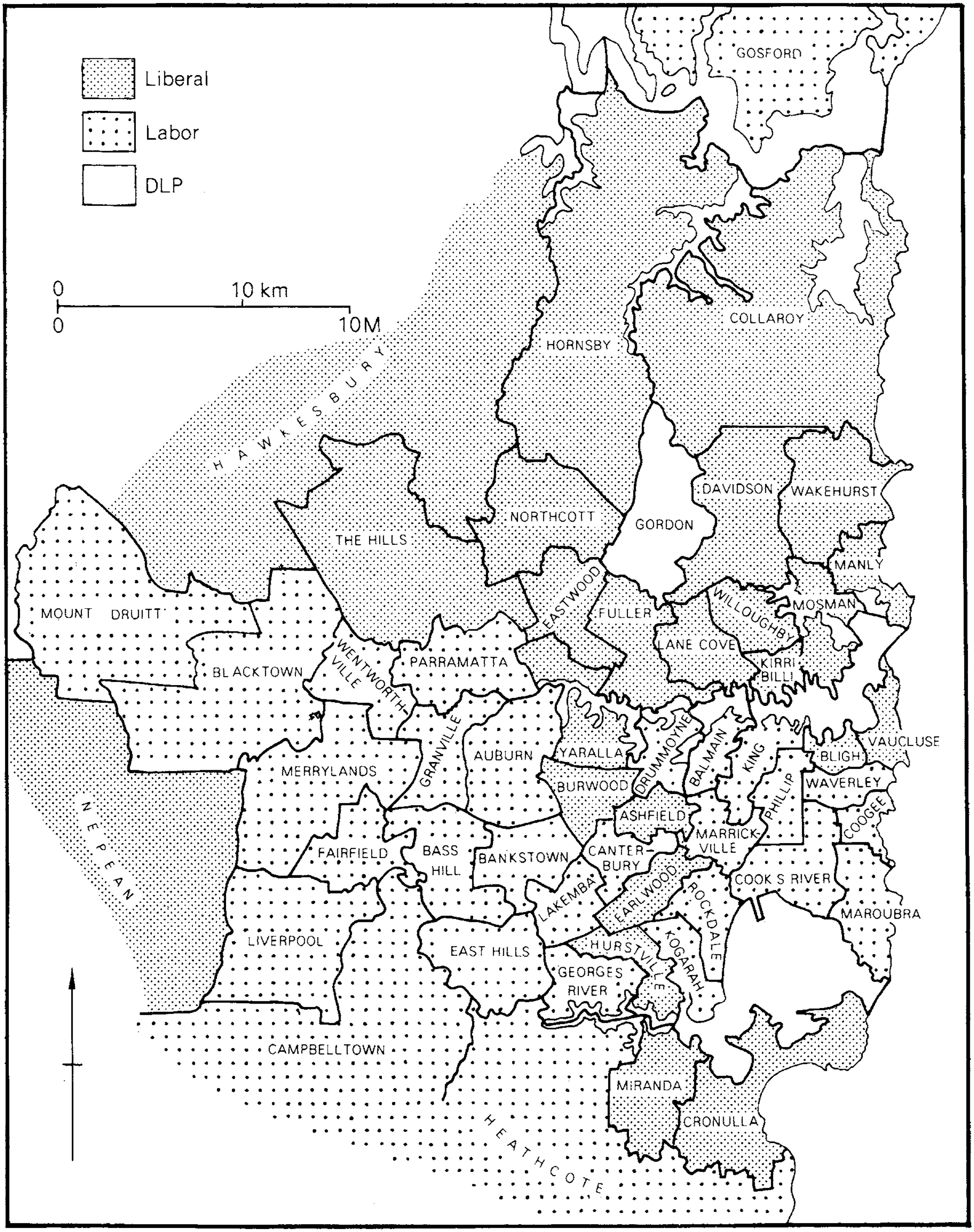



Fig. II (i) N.S.W. State electorates at November 1973 elections policies, and hence the distribution of resources, are affected by social and economic differences between regions. In particular, it appears that these differences have helped to avert the development of a coherent policy to cope with the impact of urbanisation of which our concern, control over pollutants, is a part.

The sheer size of New South Wales (801,400 sq. km.) and its widely scattered population has induced competition for scarce resources for development. The distribution of these resources available to the community has varied over time according to the relative political powers held by combinations of rural and urban groups. The dominating position of Sydney from the beginning of European settlement has exacerbated the contest: currently the metropolitan region holds about 60 and 75 per cent respectively of the State's population and manufacturing industry.

In the critical post-1945 period (during which the metropolitan region doubled its population so that it is now approaching three million), Sydney's income per head appears to have been little different from that in the rest of N.S.W. and public expenditure per head on social capital appears to have been significantly less than in the rest of N.S.W. These conclusions emerge from regional accounts developed by Botany Bay Project staff. These estimates conform to general appearance of the difficulties experienced by people arising within the fields of housing, education, transport and waste disposal, suggesting among other things, that inadequate resources to manage the problems of urbanisation may have been a major factor over the past quarter century.

If Sydney has received less than its share of resources, what can explain the paradox of population dominance but political weakness? In part, the answer lies in the highly segregated social and economic structure of Sydney itself, a pattern that is revealed in graphic form in a recent work by Davis and Spearritt, *Sydney at the Census: 1971 A Social Atlas*. Majority voting patterns within political units serve as a rough indicator of some of the social and economic disparities within a city. The map of the Sydney area (Fig. II-(i)) showing the results of the November 1973 State general elections illustrates this point. Taking this as an illustrative reference point, there is a striking split in political affiliation along the Port Jackson-Parramatta River axis. Of the fifty-three metropolitan seats (including parts of the rural-urban fringe but excluding Peats, Hawkesbury, Nepean), the Liberal Party held all fifteen seats on the north side[41] and Yaralla, which crosses the river, and eight seats in the south. These seats included the more desired living places and were dominantly non-industrial areas. The Labor Party dominated the southern half and most of the industrialised parts of Sydney. Its twenty-nine metropolitan seats include the older and poorer residential districts as well as the expanding far western and southwestern suburbs. Political affiliation is, therefore, further evidence that Sydney was and is a city of two halves.

While the political power of the Sydney community is divided, country interests have found it easier to exert greater power than their numbers would warrant because of a disproportionate number of country electorates. Under current legislation, there is a statutory division of the State into 'Central' and 'Country' areas, prescribing the numbers of seats in each area so as to ensure that the outcome of each redistribution will be fewer voters in the average country seat, whatever the redistribution commissioners might do. In practice the democratic principle (in so far as the fluctuations in the distribution of electors makes this practicable) of "one-man one-vote one-value" is violated. The political bargaining strength of rural interests has thus been institutionalised, a fact that has become of increasing political significance as the trend to greater urbanisation, and in particular the growth of Sydney, has continued. At the 1973 electoral redistribution, 73 per cent (2,662,096) of the electors in the central area (Sydney-Wollongong-Newcastle) were contained in two-thirds (66) of the electorates. The Sydney metropolitan area alone held about 61 per cent of the State's electors, but only 55 per cent of the seats. By contrast the country area with 27 per cent of the electors (713,021) held one-third of the electorates.[42] In short, the division of electorates favours rural interests and so tends to diminish political responsiveness to metropolitan needs.

Urban politics is subsumed within State politics. Each of the two major political parties, Liberal and Labor, hold mostly urban seats in addition to several rural seats, and, therefore, must balance their electoral strategy and political priorities to suit this apportionment. The Country Party, as its name suggests, represents rural sectional interests. From 1965 this party formed a coalition government with the Liberal Party. In the 1975 Lewis Cabinet, members of rural electorates (from both Liberal and Country parties) were numerically dominant; with the advent of the Willis Ministry in January 1976 this position was reversed, as can be seen from Table II-(1). However, of the group of public authorities directly related to environmental and waste

Table II-(1) Rural and urban representation in N.S.W. Coalition Cabinet (formed January 1976)

| | Portfolios held by urban members | | Portfolios held by rural members |
|---|---|---|---|
| 1 | Premier<br>Treasury | 11 | Deputy Premier*<br>Public Works<br>Ports |
| 2 | Attorney-General<br>Justice | 12 | Planning and Environment*†<br>Vice-President of the Executive Council |
| 3 | Labour, Industry and Consumer Affairs†<br>Federal Affairs | 13 | Transport*<br>Highways |
| 4 | Health | 14 | Local Government |
| 5 | Chief Secretary | 15 | Decentralisation and Development |
| 6 | Education | 16 | Mines and Energy* |
| 7 | Revenue<br>Assistant Treasurer | 17 | Agriculture and Water Resources* |
| 8 | Housing and Co-operative Societies | 18 | Lands and Forests* |
| 9 | Youth, Ethnic and Community Affairs | | |
| 10 | Culture, Sport, Recreation and Tourism | | |

* Country Party member
† Portfolio held by M.L.C.

management, only the Health Commission had a minister with an urban seat; and the Health Commission now performs relatively restricted waste management and environmental functions. Three Country Party ministers were in charge of the five remaining urban oriented agencies: the S.P.C.C., the P.E.C., the M.W.D.A., the M.W.S. & D.B. and the M.S.B.

The segregated social and economic patterns of land use in Sydney are mirrored in property rights and political affiliations. The dominant decisions affecting the generation of wastes are in the use of property rights by business concerns concentrated in the southern half of the city. By contrast with the Liberal Party, Labor dominates the poorer half of the city. It would seem, therefore, that it is best placed of all the political parties to marshal political forces to change the distribution of power within the existing process of planning so that the burdens of urbanisation and industrialisation do not fall disproportionately on those living in the south and west of the metropolis. However, the ability of the Labor Party to respond to problems of the urban environment is hampered by the conservatism and vested interests within its own local branches that are themselves oriented around the activities of local government councils.[43] In this political context, the wishes of the Minister for Planning and Environment to increase the planning powers of local government councils may accentuate the environmental problems (particularly those caused by industry and transport) that arise from the existing pattern of urban land use. The development of the vast Botany Bay port will generate political pressures on local councils that ring the shores of the Bay to expand the proportion and to intensify the development of land devoted to warehousing, industry and transport.

To sum up, the assumption underlying this writing is that the most fundamental decisions that will affect the long-term physical environment of Sydney are political, business and general planning ones, not administrative. Here we are concerned with political issues. Political decisions created the existing environmental legislation and shaped the activities of our group of agencies managing the disposal of wastes. These changes were responses to agitation among all community groups following the re-discovery of pollution in the late 1960s. But there are many pollution problems, some affecting most of the community, others having a spatial impact that varies in its incidence on groups of people. As has been argued, geography, the influence of interest groups, property rights and electoral divisions, among other factors, have diminished the capacity of the urban-based political parties to respond to the need to manage the process of urbanisation in a more rational manner so as to mitigate, if not avert, the sometimes adverse and unequal impact of that urban growth on poorer social groups.[44]

## The impact of the Commonwealth Government on urban management

### *Access to sources of revenue*

Apart from the social and political obstacles to managing the Sydney metropolis as a unit, there are also financial constraints upon the capacity of any New South Wales government to respond to the problems of urbanisation. The formulation of long-term and costly policies to cope with those problems requires not only political decisions as to the distribution of scarce resources between regions and between the various functions of government, but also access to sources of revenue. Here we strike a constitutional obstacle. Under the provisions of the Commonwealth Constitution, the legislative and administrative powers of the Commonwealth Government are restricted to certain specified functions, most of which are not exclusive to it but can be shared with the six States. All other functions (which are not specified in the Constitution) are State responsibilities. Accordingly, the Commonwealth's formal powers are limited. In reality it wields great power through the power of the purse. The Constitution gives it a monopoly of customs and excise duties, and also of retail sales taxes, which, as a result of High Court decisions, were deemed to be excise duties. Additionally, since 1942, the Commonwealth has raised all income taxes subject to transfers to the States.[45] In relation to its formal powers, the Commonwealth thus raises much more revenue than it deploys directly in administrative functions and the States directly raise much less.[46]

It may be that the financial dependence of the States will be diminished to some extent following proposals to change the way in which the share of resources is to be divided. Early in 1976 the Commonwealth Government, following the accession to power of the Liberal and Country parties in December 1975, promised to devise and introduce in the 1976/7 financial year a scheme whereby a fixed percentage of income tax revenue will be returned to the States as a general grant. Further, each State is to have the option to impose a tax surcharge or grant a rebate on the basic Commonwealth income tax rate to those residing in its territory. Important details, particularly the proportions of Commonwealth income tax that will be allocated to the States, have yet to be determined at the time of writing. Moreover, given the Commonwealth's proposal to adjust income tax rates to the rate of inflation ('tax indexation'), which, if introduced, will retard the growth in Commonwealth income tax revenues, there is some doubt on what the rate of growth of the States' share of income tax will be. It may be, therefore, that the result of automatic access to income tax revenues by the States will not yield sufficient additional income to confer significantly greater flexibility in resource allocation.

The ideas behind the Commonwealth initiative are, first, to provide an assured access to revenue because the States have direct constitutional responsibility for the vast range of Government functions. Second, so far as the capability to impose a surcharge on income tax is concerned, the notion is that the State Governments should justify to their respective electors the need to levy taxation to meet community needs. The 1976 initiative should be seen in the context of the long-standing debate about the respective powers and responsibilities of national and State governments. The constitutional debate, although so often put in terms of Federal encroachment on State sovereignty, derives its force from the conflict over the *political priorities* between the States and the Federal Government that are finally settled through the mechanism of conditional grants to the States. On one hand there is the argument that each State community should be free to decide its own spending priorities; on the other, that certain measures need to be implemented through the leadership of the Commonwealth Government in order to progress towards goals in the national interest. It seems realistic to expect that the two views will co-exist. Ostensibly the Commonwealth in 1976 is offering a greater degree of freedom to the States to manage their affairs. However, it is likely that Federal governments now and in the future will continue to grant funds with conditions on their spending, thus introducing into State action significant elements of Commonwealth political priorities. This statement holds regardless of which of the political parties holds office as the Federal Government, though one may expect political and social goals to differ. For instance, in 1950-1 the Federal Liberal-Country Party Government, influenced by the Country Party partner, stipulated that 35 per cent (raised to 40 per cent in 1954-5) of its road grants to the States was to be spent on minor rural roads.[47] This program continued to 1969, but was lowered to about 33 per cent in the quinquennium 1969-70 to 1973-4.[48] On the other hand, in the period 1972-5, when Labor held Federal office, its political priorities were reflected in an increase in resources allocated to urban areas via conditional grants. Included in these grants were funds for sewerage works, area improvement programs, land acquisition and development and assistance for urban areas designated as growth centres.

The broad area of public policy that is comprehended in control of the environment reaches into all levels of government: local, State and Federal. Although the State governments have direct constitutional responsibility for managing the environment, the numerous activities of the Commonwealth, in direct and indirect ways, affect that management. Indeed, the two Senate Select Committees on Air and Water Pollution respectively urged that the Commonwealth commit itself to aid the States in managing these problems. Although the Commonwealth may diminish its use of conditional grants to manage wastes and improve urban amenity, its own activities influence urban environmental policy in various ways.

*The role of the Commonwealth Government in managing urban wastes*

There are several ways in which the Federal Government itself can affect the management of wastes and so ameliorate existing problems. As the national government, it has an important role to play in developing uniform environmental protection standards among the States which compete with each other to attract investment and industrial development. For example, the strategy of the Sydney Region Outline Plan is to provide facilities to attract future industries and to maintain the metropolis as the primary urban centre in Australia. Thus, the lack of a uniform quality code for air, water and land which embraces all parts of Australia can induce a reluctance in State Governments to pursue certain pollution control measures lest industries within their jurisdiction find it cheaper in the long run to locate in a more complaisant State. The Commonwealth Government can seek uniformity of environmental codes in two ways. First, it may ratify international agreements, such as the Convention for the Prevention of Pollution of the Sea by Oil (1954) and the Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972), which may require complementary legislation by the States. Second, it may achieve uniformity and coordinate activities in certain areas through its membership of Federal-State consultative bodies, such as the Australian

Transport Advisory Council and the Australian Environment Council, each of which consists of the relevant State and Commonwealth Ministers.

The agency through which the Federal Government formulates it policy on the environment and coordinates its interest in environmental issues and policy objectives is the Department of Environment, Housing and Community Development. Among its many functions the Department has the capability to help devise common environmental goals (in so far as this is possible) among the States and the national Government. Currently, in conjunction with the States, it is establishing a coordinated plan for monitoring air pollution, which includes the founding of a National Air Monitoring Data Centre. In respect of water, following the advice of the Australian Water Resources Council, the Federal Government is to provide over $800,000 to the States during 1974-6 for the establishment of a network to assess the quality of water resources in Australia. A second function of the Department is to advocate the consideration of the implications of decision making on the environment. This role is now institutionalised because the Department administers the Environment Protection (Impact of Proposals) Act 1974. The objective of this Act is to provide for the making of environmental impact statements on and public inquiries into any proposal that is likely to have a significant effect on the environment. The power of the Federal Government under this Act may be much wider than might seen the case, for not only does it apply to the activities of Federal agencies, but also to activities of State and local governments that are funded either wholly or partly by Federal conditional grants.

The Federal Government has exclusive responsibility for making policies that govern air transport. Accordingly, it probably has authority overriding that of the States to control noise made by aircraft. It has not chosen to legislate to diminish noise from aircraft despite local agitation on the matter. Sydney airport was established in an area surrounded on three sides by residential and industrial suburbs. The noise problem developed over a period of time owing to technological changes in aircraft (the introduction of jet propelled aircraft) and, in particular, the increasing frequency of aircraft arrivals and departures arising from an increasing demand for air transport.[49] The location of the airport raises an equity issue arising from a particular land use that has become more intensive. In this case the costs of a pollutant, noise, are borne by residents living under the flight paths or adjacent to the airport, yet the major group of users of aircraft probably live in remote localities away from the airport, or outside Sydney itself. So far, aircraft noise has been controlled by prohibiting flights into or from Sydney airport at specified times during night hours and by increasing concentration on the north and south runway. Future technological changes may lead to a changeover to quieter aircraft engines and aircraft making shorter takeoffs and landings and, therefore, some reduction in the localised volume of noise. However, in view of the trend to greater use of air transport, the existing facilities at Sydney are limited. The question arises as to whether the use of the airport will be increased through an expansion of its landing strips or whether a second airport to serve Sydney or international services will be constructed at another location. The result of this decision by the Federal Government thus is one issue on which it can exert a direct influence on amenity in a Sydney locality. Neither Federal political group has shown much ability to exercise that influence.

The cost of disposing of each unit of waste is likely to continue rising so that there is an increasing incentive to explore new ways of reducing waste volumes, recovering wastes and disposing of wastes in accordance with environment protection policies. The Federal Government, because of its financial strength and national perspective, is best placed of the governments in our federation to undertake research on waste recovery and disposal methods and least well placed from the point of view of practical experience. As waste disposal problems, apart from those existing in the two Federal Territories, are essentially encountered in the States' metropolitan regions, there is scope for State experience to be joined with Federal resources in this field. Some degree of co-operation already exists. For example, the Division of Mineral Chemistry, a branch of the Commonwealth Scientific and Industrial Research Organization (CSIRO), is experimenting with a suitable industrial liquid waste incinerator which the M.W.D.A. has proposed to establish as a central treatment plant for the Sydney region.

Waste management, as argued above, ought to be considered as a component of the strategy for managing urban growth. Because the Federal Government, through its numerous activities, contributes to urban growth, it may, therefore, seek to have a long-term and indirect effect on waste management through its policies on the location of those activities. As an employer on a large scale it may relocate its own services as a first move in a concerted strategy by Federal, State and local governments that is needed to diminish both the spiralling concentration of economic activities into relatively small pockets of land and the impact of that concentration on the demand for transport. Thus, in order to reduce the proportion of its employees in the Sydney Central Business District, there exists a policy of relocating some of the Federal Government services in Campbelltown and Parramatta. This policy (assuming that it is adhered to by Federal agencies) is a drop in the bucket in its impact on the central district. However, the idea is that continuing growth in other centres in the metropolitan region will reduce the *rate* of aggregation in central Sydney. The effectiveness of the idea depends on complementary policies being adopted and sustained by the N.S.W. Government, and, more particularly, on that Government devising and implementing a comprehensive long-term strategy to manage metropolitan growth.

The value of the Department of Environment, Housing and Community Development lies not so much in the ameliorative policies that it may coordinate in respect of Federal activities in parts of the Sydney metropolis but in its political opportunity and ability to devise common strategies with the N.S.W. Planning and Environment Commission that will apply to new and existing areas of Sydney and that will be formulated in the context of other major urban centres in the State. As the Department warns, Sydney will probably face as much new urban development in the next twenty-five years as it did in the period 1945-75.[50] But now there is a new constraint: the physical environment is less capable of meeting the additional strains and must be protected from excessive degradation. The increasing costs of urban development, as the President of the M.W.S. & D.B. has warned us in respect of his agency alone,[51] will be enormous. Most recently, in 1975, the then Minister for Urban and Regional Development has conceded that the rate of planned sewering in Sydney may have to be slackened. The prospects of the future metropolis are dependent on agreement on objectives and priorities between the two levels of government and the committal of Federal funds to the cities in the long term. In turn, this depends on electoral comprehension of the problems and an *informed* public acceptance of goods, priorities and rates of expenditures.

The Federal Government affects the Australian economy and therefore the economy of the States in many areas and through these indirectly their environmental standards. Accordingly, its policies relating to such diverse fields as immigration, energy, trade, tariffs, taxation, interest rates, import of capital and loan raising can affect the level and rate of investment in both polluting activities and in pollution control measures by industries and State Government agencies, and hence influence the volume and kind of wastes generated within society and transmitted to the environment. There is a need, therefore, for the Commonwealth to take into account, within its policy formulation process, the implications of its decisions for waste generation in urban areas. These implications are now beginning to emerge in such areas as energy research or decisions by the Industries Assistance Commission. Fundamentally the issue is to induce the principle of concern for the environment and through it the quality of life to percolate through and become accepted in all areas of policy making. Then the environmental issue may achieve a proper perspective — as one important matter among the other competing goals of a complex society.

## Conclusion

The 'strategy' of waste management in Sydney has for long been to remove and *dispose* of wastes. For example, the history of the M.W.S. & D.B., through its provision of sewers and drains, has been essentially that of a waste *disposal* service. But the expanding metropolis, accompanied by a growing volume of wastes, has forced a reconsideration of the short-sighted perception of wastes simply as rubbish to be discarded at the cheapest cost in some part of the physical environment. Space within and on the periphery of the metropolis is finite: the polluting potential of our discarded wastes is likely to increase. Major damage — fortunately not yet wholly irreversible in the main — has been done.

The degradation of Sydney's environment was dramatised during the late 1960s. The spotlight fell on the methods used to dispose of liquid wastes generated by industry and of the solid wastes discarded by households, industry, transport and commerce. Now we are looking more closely at the need to regulate the emission of chemical wastes and to watch much more closely the development of novel toxic wastes as they emerge progressively from industrial operations. The political reaction to fears of pollution was to set up new controls and strengthen existing controls over the disposal of wastes. Thus pollution control measures as they apply in Sydney, which might be described as partial prohibition, are largely ameliorative; they are devised to regulate the impact of wastes as they are discharged at some point in the environment. Only in incidental and indirect ways do the control mechanisms affect the waste generation process itself. In short, the current administrative system does not aim to prevent in a systematic way the *generation* of wastes; it is oriented towards 'accepting' and coping with *existing* volumes of wastes and shifting partially treated volumes to different parts of the environment.

The passage of the Clean Air Act, 1961, followed by a series of Acts in the 1970s, extended the principle that had been recognised by the Metropolitan Water and Sewerage Act, 1880, and later the Public Health Act, 1896, namely that the disposal of wastes and the regulation of their polluting effects by public agencies was in the interest of the community. The novelty of State intervention in waste management today is that more sources of wastes, more types of wastes and their respective methods of disposal need to be controlled. Over the past three decades the speed of technological changes in our growing industrial-urbanised and wealthy society has greatly increased the volume and variety of chemicals that are being discharged and are accumulating in our urban air, water and land. On the threshold of the last quarter of the twentieth century the impact of our discarded wastes has forced us to consider the consequences for our future in the short term, and to take a longer perspective for people living after us. The question of time span is important. Too many glib statements are made about concern for 'the next generation'. A period of as long as a hundred years merely spans the period from the birth of a person to the death of his or her first child. These are scarcely remote relationships. We need to plan the management of wastes as a problem in a social continuum.

The N.S.W. Government has recognised the necessity to reorganise its administrative machinery so as to influence more effectively the disposal of wastes and the control of pollutants: it had, by mid-1975, divided the several aspects of waste management in Sydney among a group of public agencies. The bulk of this chapter has dwelt on the interdependent relations between those agencies and the conflicts that exist between the waste disposal function on one hand and the pollution control function on the other. If the trend of waste generation that has been evident, particularly since 1945, may serve as a guide to the trend in the future, then the public management of wastes will become more costly and more complex. Accordingly, the contradiction between waste disposal and pollution control is likely to increase.

In the period 1970-5 the State Government, particularly through the person of its Minister for Environment Control, subsequently its Minister for Planning and Environment, has been concerned to improve its instruments of control and management. Thus we have seen the addition to its administration of the Metropolitan Waste Disposal Authority, the removal (apart from its important role in monitoring public health) of the Health Commission of N.S.W. and its replacement by an enlarged S.P.C.C., and the transformation of the old State Planning Authority into the N.S.W. Planning and Environment Commission. But how have the conflicting aims and functions of our group of authorities been reconciled? The three major authorities, the M.W.D.A. and the M.W.S. & D.B., both service agencies, and the S.P.C.C., an interventionist body, have been forced into consultation because their respective Acts confer powers which overlap each other's. In the absence of common, explicit and understood objectives, what might be described as a process of mutual adjustments has occurred within and between the respective agencies, and will continue to occur because the role of the P.E.C. and its relationship with other agencies is yet to be clearly defined.

Because of the propensity of bureaucracies to contain their conflicts among themselves, these internal adjustments have two undesirable effects. First, it sets a tendency for each agency to pursue separately its own plans and objectives. Of necessity certain adjustments must be made without reference to ministerial authority. However, our understanding of the intricate relationships (technological, economic, legal, political, cultural, administrative) of waste management is still in its infancy, and the case for collaborative management is strong. In addition, the share of resources allocated to the management of wastes in Sydney is of such a magnitude that these agencies cannot and should not be left to determine policy for themselves by themselves. This leads us to the second point. The effect of confining policy decisions on waste management within the bureaucracy is that matters that should be debated in public are concealed. Political choices are inevitably part of the administration of wastes: the relative costs of those choices ought to be debated; the relative benefits properly investigated; and, however difficult the task may be, attempts must be made to assess, as openly as possible, the *net* advantages of the various choices open to us.

The tendency of political thinking in New South Wales has been to assume that the problem of waste management is to be solved largely by establishing public agencies to dispose of wastes and control pollutants, that is to push the problems away from the overt political process and into the hands of the technologists, the 'neutral' experts. This attitude may have met the needs of Sydney until the second world war. The men concerned have undoubtedly rendered valuable service. Greater size, greater wealth, greater demand for urban amenity, greater economic and social complexity sin 1945 have radically altered the problem of Sydney as of other Australian cities. There is a basic need for waste management activities to be coordinated not merely on an *ad hoc*, day-to-day basis among the agencies themselves but most importantly by reference to a coherent objective. That objective is inevitably a social and political objective, in the last resort, reflecting the desires of the affected and interested groups.

State Government management of wastes in the Sydney metropolitan area is inherently 'political', both in the partisan sense of that word and in the broader meaning that encompasses the complex relationship existing in the role of 'government' as the agent of social groups. This fact is evident from several points of view. To recapitulate: all governments rest on the support of interest groups which try to influence the choice of social objectives and the distribution of scarce resources. Waste management agencies affect in various ways the costs of businesses, individuals, groups of individuals and other government agencies themselves. To abate the potential for conflicts that might arise from the activities of our group of agencies, the government has given community and public authority representatives a role in the formulation of policy, notably in the case of the S.P.C.C., the membership of which has been heavily weighted in favour of the *status quo*. The political impact of waste management is also reflected by the action taken by the State Cabinet to place itself in a better position to direct and to coordinate policy — and decision making in that field of government. Thus the Government abolished the decision-making role of the advisory committees administering the Clean Air and Clean Waters Acts; it has put all our group of authorities, old and new, under ministerial control. Further, the financial relationship between Commonwealth and State Governments during 1972-5 and their conflicts over the direction and rate of spending arose chiefly from divergent political priorities. This illustrates a further dimension to the political aspect of waste management in Sydney.

This chapter has attempted to put forward the view that waste management should be comprehended as part of the problem of managing the process of urbanisation. The argument for this conception is that the generation of wastes is bound up with urban growth: as the city grows so does the volume and variety of wastes. To think in terms of a *process* of urbanisation, that is an on-going sequence of events within the metropolis, is to consider waste management in the dimensions of time and space of a larger social process. The Sydney metropolis is always encroaching on more rural land at its fringes. What are the implications for the M.W.S. & D.B., the M.W.D.A., the S.P.C.C., the N.S.W. P.E.C. in the growth and development of different land uses in the *new* metropolitan areas of Campbelltown-Liverpool-Penrith? What are the implications for waste generation in the *existing* urban area surrounding the developing Port at Botany Bay? To manage the process of urbanisation in Sydney would require an important social reform: the founding of a metropolitan planning agency with clear authority over all other public authorities. What is to be the strategy to cope with the *rate* of metropolitan growth and to cope with the structure of that growth? For our immediate concern here, city planning is a strategy for reducing the impact of wastes on people. What has to be stressed is the need for a coherent political objective, for the planning of Sydney includes the coordination of many smaller and individual plans. We might repeat again that many public agencies that govern aspects of Sydney, such as the Department of Main Roads, the Public Transport Commission, the Electricity Commission, the Maritime Services Board, affect in various ways the generation and geographical distribution of wastes and pollution now and in long term.

So far the argument for greater coordination in managing Sydney has turned on improving the effectiveness and efficiency of the sub-problem of waste management, because that management is a very costly business. Also of importance is the question of equity. As already outlined, waste disposal and pollution control are questions of general public interest, but perception of the issues at this aggregate 'community' level should not obscure the fact that disposal of certain wastes, particularly industrial wastes generated in the southern half of Sydney, have different impacts on different parts of the metropolis. Here we are drawing attention to the fact that the history of the growth of Sydney has imposed greater costs and discomforts on the poorer groups living particularly in the southern half of the metropolis. Urban growth has accentuated and will continue to accentuate social inequalities: the Sydney Region Outline Plan forecasts a growth from 2.7 to 5.5 million people in the period 1970 to 2000, a rate close to 100,000 people each year. This expansion now seems improbable; but large increases must be expected. For this reason waste management is a problem of social welfare; social problems require political responses and the devising of political objectives to meet those problems. However, at this time, the public administration of wastes in Sydney is geared largely to technological remedies administered by individual departments of technologists.

Reform is possible, as is demonstrated by the administrative changes introduced by the Liberal-Country Party Government during the early 1970s. That period of reform, as the N.S.W. Planning and Environment Commission defines its field of responsibility and its powers, may be drawing to a close.

# 3 Allocating resources to management and control

## Introductory

The Public Accounts of N.S.W. have a labyrinthine quality that even the Medici bankers of medieval Florence might have envied.[1] The Australian Bureau of Statistics, after one attempt in 1971/2 to estimate current and capital expenditures of the State Government on 'protection of the environment', withdrew its statistics for current outlays into the limbo of 'not available'. As well, indeed, it might, with an official calculation for that year of a mere $300,000 by all State authorities[2] — a remarkably implausible figure!

The obscurantism of the published accounts may derive from various sources — the confusion of public bodies, some subject to Public Service and Treasury control, others with varying degrees of statutory autonomy; lack of imagination in the possibility of presenting accounts in a variety of forms to reveal different functional purposes; deliberate concealment; a failure to appreciate the importance of accounts for policy purposes. In the specific case of 'environmental protection' of which this Report on waste management and pollution control forms a part, other factors may intervene — the novelty of the problem, a lack of appreciation of its importance, lack of sufficient interest, the very real problems of clarifying objectives and functions. Whatever the reasons — and some may be seen later to be important — two difficulties arise in this context. If these accounts were to form the basis of government policy making, they would give a wholly inadequate and actually a seriously misleading foundation for policy by government. In any event, no properly informed parliamentary control and no informed public discussion of policy objectives, priorities or achievements is possible. An immediate prerequisite is a specifically designed set of accounts adapted to environmental functions.

Potentially, the Public Accounts provide the means of measuring one of the flows of resource inputs into waste management and pollution control in the direct inputs of State authorities. In itself, this flow is a vital piece of information since it conveys the claims on the overall State public authority finances. There are, however, other flows, coming from the private sector. Private resource allocation for waste management might usefully be thought of, in the first instance, as made up of two components (the dividing line is not clear cut). One component might be taken as inputs made by private initiative not directly induced by government action. The other would be the product of some government intervention in the waste management and pollution control activities of the private sector. Government intervenes in a variety of ways — by conditional licensing of activities, by charging for waste disposal services, by the imposition of penalties and fines and by administrative direction leading to advice or instruction to private institutions to sustain certain standards, alter particular activities, products or inputs or change technology.

Government *policy* directly in respect of resource allocation to waste management/pollution control relates then to government's own direct inputs and to the management/control inputs that it induces from the private sector. Nevertheless, government policy more generally and less directly is concerned to oversee the extent to and direction in which resources are allocated to management/control on private initiative. The total of the flows make up the share of all social resources committed for these purposes. Variations in this share necessarily affect shares of all resources directed to other competing social purposes, so public policy becomes relevant in determining any compromise solution of these competing claims. Hence we need to be concerned in this chapter with the two general input streams — public and private. The two components need to be considered separately, particularly because it is now widely recognised that the 'private market' does not work effectively in meeting the needs of environmental amenity.

Direct resource inputs, of course, do not necessarily represent the 'sum of the costs' of waste management/pollution control activities. Other components of cost enter in the form of activities restricted or forgone or some benefit reduced or withdrawn. Again, offsets may occur in management/control operations by opening up new opportunities in technology, products, leisure activities, etc. Here we discuss only resource inputs into waste management and pollution control in very recent and current conditions.

Policy in resource allocation is concerned with changes in allocation: changes in priorities of environmental management versus other claims; changes in priorities as between different environmental problems. To determine such a policy would depend on the construction of a cost/benefit calculus within a specified framework of environmental management objective. No such calculus or even significant fragments of it exist or are in process in official organisations in Sydney; nor has any indication of any attempt at such a calculus even for one limited part of the whole waste management activity been detected. In an oblique form, the mode of operation by the M.W.S. & D.B. might be regarded as an exception, though it is doubtful if this is in fact so. Clearly any attempt would have to be limited, given the obscurity of measurement in important areas. But without some movement towards an approximate calculus along these lines, it is difficult to see how rational policy can be devised; the system of management degenerates, as it appears to have done in fact in Sydney, into largely hit-and-miss decisions in respect of disintegrated parts. Here we are concerned with preliminary and partial steps towards this calculus, steps that must, unfortunately, be related to Sydney as a whole and cannot be made with present information for the Botany Bay region.

## Aggregate resource allocation

The Sydney-wide estimates that follow in this chapter may conveniently be condensed to two single figures for a general indication of the level of existing commitment. The year 1971/2 is a base date. Some implied subsequent changes to 1975 are indicated later; and the 1971/2 resource inputs can be related to the order of magnitude of additional inputs that might be expected to be necessary to achieve and sustain reasonable standards. For the Sydney metropolitan area, the level of government outlays for waste management/pollution control in 1971/2 was approximately $153 millions (current outlays at $63 millions plus capital outlays at $90 millions). The level of private outlays is much more problematical but is estimated at an order of $130 millions.

These figures have more meaning in relation to some other aggregates. The obscurities and segmentation of the various public authority accounts make it as difficult for us to relate these public authority expenditures to State financial resources as it does for the N.S.W. Government to pursue a rationally calculated management/control policy. A more useful and more generally relevant relationship is the proportion of Sydney region incomes directed to management/control. For purposes of this study, an estimate was made[3] of the gross domestic product of the Sydney Statistical Division — substantially, the total of all wages and salaries, of the incomes of unincorporated businesses, of gross surpluses of incorporated enterprises and of imputed rents. In 1971/2, these amounted to approximately $8,250 millions.

The figure of $153 millions outlaid by public authorities represents, then, approximately 1.8 per cent of the total gross domestic product of the Sydney region. We have, in fact, omitted a miscellany of organisations with relatively minor functions — Fisheries, Mines, Education, Labour and Industry, etc. The inclusion of outlays by these bodies on waste management/pollution control could be expected to bring total outlays by all public bodies in the Sydney region to a round figure of 2 per cent of the region's gross domestic product.

The $130 millions estimated as committed by private enterprise and individuals are, accordingly, a little above 1.5 per cent of the region's gross product. In view of the uncertainties of this estimate, it would be unwise to claim to be very precise. It appears to be a reasonable approximation that total resource inputs in Sydney in waste management/pollution control in 1971/2 were in the range of 3-3.5 per cent of the region's income. With accelerated public capital outlays since 1971/2 and with some increase in real current expenditures, it would appear that total outlays in 1974/5 ran at least at the 3.5 per cent level.

This is a very large percentage for a single policy area. There are few other matters of social concern that would exceed this share of Sydney's income. On the national level, there are few separate policy issues for Australia as a whole that would claim a higher share of gross national product. It should not be concluded that less environmental pressures exist in non-metropolitan towns. Indeed, many non-coastal towns, with very restricted absorptive capacity in their local environment, may face higher claims against their local resources.

We can make a partial check on these estimates and, in the process, provide an additional useful measure of input commitment. Public agencies, in carrying out waste management/pollution control operations, employed approximately 21,000 persons in 1971/2. This excludes some labour inputs drawn into the public from the private sector through operations such as consultants' reports and services, external advice, etc. This employed workforce represented a total of 1.7 per cent of the total Sydney region workforce — reasonably consistent with the share of public outlays in gross product. Again, since 1971/2, employed workforce has risen relatively rapidly, particularly in such areas as land-borne waste disposal and water and air quality management and it is likely that the share of the workforce allocated to public authority waste management/control functions has risen slightly.

At about 3.5 per cent of gross domestic product, the nature, efficiency and equity of existing resource allocation warrants close inspection. This inspection needs to be made in full consciousness of the environmental problems that have not been resolved or that are likely to develop in Sydney and also of the difference in environmental amenity particularly as between the southern and northern halves of the city. The continued existence of blighted water bodies in Cooks River, Alexandra Canal and Parramatta River with related tributaries; the growing pressures on main sewer lines and the concentration of disposal flows in the southern half of the city; the increasing recognition of noise as a major pollutant; the development of a serious photochemical smog problem; the increasing costs and volumes of solid waste disposal and limited disposal locations; the progressive spread of pollution and related activities westward and particularly along the Georges River Valley; and, perhaps most important, the likely major land-use disturbance arising from the Botany Bay Port development — these exemplify the type of problems not dealt with by present levels of resource inputs even though some *present* allocations, such as sewerage extension, are designed to provide for transfer of *future* wastes. It seems likely, therefore, that overseas indications of the shares of gross product as *additional* allocations to achieve and sustain a *reasonable* standard of environmental amenity through waste management and pollution control are likely to be not too far off the mark for Sydney. The implied *additional* 2.5 per cent means, if added to the 1971/2 resource allocation, a total of some 6 per cent of gross product diverted for these purposes.

*This would be a very large allocation indeed and one that could not be undertaken lightly. It is essential that this level of outlay should not be attained by piecemeal additions to a management/control process. The mere size of the prospective claim makes this imperative.* But when it is realised that waste

Table III-(1) Australian Bureau of Statistics estimates: outlays for protection of the environment N.S.W. 1971/2 ($m)

| | I A.B.S. estimate N.S.W. | II Project estimate Sydney |
|---|---|---|
| **State authorities** | | |
| Final consumption expenditure | 0.3 | 35.5 |
| Expenditure on new fixed assets | 77.4 | 86.8 |
| **Local authorities** | | |
| Final consumption expenditure | 4.7 | 27.3 |
| Expenditure on new fixed assets | 10.7 | 3.5 |
| **Total** | 93.1 | 153.1 |

management and pollution control tend, often to a large extent, to change problems rather than to solve them, the geographical, efficiency and equity implications of these likely changes need to be considered as an overall problem. This is most important in the case of Sydney in which the southern half appears to stand out as suffering much more serious environmental problems at present and as exposed to much greater risk of further damage by the nature of expected metropolitan growth. It becomes all the more important, with this future prospect, to examine the character of present resource allocations. In this respect, it is perhaps worth noting that while many complaints from residents relate to conflicts of objectives and priorities — to things *not* done — many also are expressed as sectional complaints of shortcomings of existing management and control. In other words, a good many expressed problems may lie in the inefficiencies and inequities of present resource inputs and may possibly be resolved in part within these limits.

**The composition of public resource allocation**

In view of the dimension of our estimates, it is appropriate to note the composition of the total outlays as calculated by the Australian Bureau of Statistics for 1971/2. The implication is significant: if the Bureau had difficulties, so possibly have public authorities in Sydney in general policy determination; and certainly any Commonwealth concern could be seriously misinformed.

The Australian Bureau of Statistics reported outlays 'for protection of the environment' very similar to our concept (a broader coverage was actually taken in their case) as shown in Table III-(1), column I. The matching figures in our estimates are in the second column.

Our estimate of $153 millions is, then, two-thirds higher. Moreover, ours covers only the Sydney metropolitan area (or Statistical Division) whereas the Bureau estimate is for the whole of N.S.W. The implications of the differences might be brought out in terms of the much greater proportion of capital expenditures in the A.B.S. total and, contrariwise, the much greater proportion of current expenditures in ours; while, at the same time, there is no radical (even if still a significant) conflict in the size of capital outlays in both cases. New capital formation implies a flow of resources essentially in disposal capacity through the major replacement and the expansion of physical assets. The A.B.S. figure would yield the impression that minimal outlays were required for current servicing, policing, investigating and other activities. This is a false impression and is seriously misleading. On the basis of our estimates, current service inputs account for approximately 40 per cent of the total with only 60 per cent absorbed in new capital formation. The whole management operation would appear likely to be much less capital intensive on our figures than is suggested by the Bureau's implied approximate 5 per cent only flowing into current operations and as much as 95 per cent into capital outlays.

The composition of waste management/pollution control outlays by public authorities can most conveniently be looked at first in terms of particular active institutions. The estimates in Table III-(2) are confined to seven State or semi-government bodies and to forty local authorities falling in the Sydney Statistical Division.

We have been content to transfer as seemed most appropriate between the Sydney Statistical Division and the Sydney metropolitan area given the limited difference in area. Fortunately, most authorities were *specialised* to one or other of these two areas or their joint responsibilities could be aggregated to one or other. Problems arose, in practice primarly with the M.W.S. & D.B. partly because of its broader responsibilities outside metropolitan Sydney. The Board did not distinguish these and we have made a number of relatively small adjustments. One major one, however, was in the water waste transport supply regardless of location.[4]

One special weakness in available statistics lies in the local authority reporting of capital outlays. In this case, we have taken a figure, rounded, based on the Australian Bureau of Statistics estimate. The weakness of the

Table III-(2) Sydney metropolitan resource allocation by authority type, 1971/2* ($m)

| | | Current outlays | Capital outlays | Total outlays |
|---|---|---|---|---|
| A. | Local councils (S.S.D.)† | 27.30 | 3.50 | 30.80 |
| B. | (1) M.W.S. & D.B.‡ | 33.78 | 86.20 | 119.98 |
| | (2) M.S.B. (S.S.D.) | 0.20 | 0.10 | 0.30 |
| | (3) M.W.D.A. (S.M.A.)§ | 0.20 | 0.15 | 0.35 |
| C. | (1) Environment (S.M.A.) | 0.20 | — | 0.20 |
| | (2) S.P.C.C. (S.M.A.) | 0.10 | 0.10 | 0.20 |
| | (3) Health (S.M.A.) | 0.80 | 0.10 | 0.90 |
| | (4) P.W.D. (S.S.D.) | 0.20 | 0.10 | 0.30 |
| | **Total** | 62.78 | 90.25 | 152.98 |

*These estimates cover current and capital outlays for purposes of:

| | |
|---|---|
| Local councils | Garbage, sanitary services, drainage, park and beach protection, street-cleaning. |
| M.W.S. & D.B. | Sewerage, drainage services, industrial liquid effluent control, water supply for waste transport. # |
| M.S.B. | Unrequited outlays on oil spillages, control of ship discharges, noise control and harbour 'house-cleaning'. |
| M.W.D.A. | Provision for land disposed wastes. |
| Environment, S.P.C.C., Health | Monitoring, inspection, testing and analysing, policing pollutant discharges. |
| P.W.D. | Dredging and clearing channels. ¶ |

† S.S.D. means Sydney Statistical Division

‡ Board area less certain functions performed outside the metropolitan area

§ S.M.A. means Sydney metropolitan area

# There are a good many problems of estimation and brief reference is made here. Water supply by the Board is partly as a waste transport, partly for other consumption purposes. No estimates directly for Sydney exist, though it is important that some measurement should be made. Based on Melbourne data and after discussion with some Sydney engineers, we have taken a round and deliberately conservative figure of 40 per cent of all water consumed as due to waste transport. Accounts have been adjusted on this basis. Clearly much more information is needed in terms of capital costs of sewers versus water supply alone.

¶ It is not possible, from existing accounts, to go beyond these activities.

consequential estimate is indicative of the general difficulty of communication between Federal, State and local government bodies and of the effective incorporation of the latter in more clearly formed policy.

On the basis of our estimates, the M.W.S. & D.B. waste transport and disposal outlays dominate the total, accounting for some 78 per cent. The second largest component came from local authorities at approximately 20 per cent of the total. The tiny balance was provided by the remaining State and semi-government authorities.

The dominance of the M.W.S. & D.B. is due in very large measure to the scale of its capital outlays — the need to inject large-scale capital inputs into the management process, given the water-borne basis of the waste management technology, the relatively loud 'echo' effect of past backlog problems and recent pressures for extensive enlargement of sewerage facilities in new areas. Other capital demands were also significant, however, in the expansion of water storage facilities (of which only part is represented here). Capital inputs into drainage were slight.

This high level of capital input is not a passing phase although there are certain 'lumpy' elements in the Board's capital works program. Future pressure on facilities arising particularly from westward city expansion, much of it in the corridor in and beyond the Botany Bay drainage basin, provides the dominant source of additional capital needs; and this, together with future technical changes in respect to sewage outfalls and, more problematically, sewage overflows, can be expected to provide a relatively long-sustained commitment to high capital outlays for waste transfer purposes. A vital policy problem confronting Sydney, and especially the Botany Bay region, is whether the priorities required to service this population growth and its wastes can be sustained.

In terms of current as distinct from total outlays, the M.W.S. & D.B. does not figure nearly so prominently. In part, this fact derives from the capital intensiveness of the Board's operations substituting capital equipment for labour and other materials inputs. The Board's operations depend on a very low labour/capital ratio representing a highly automated waste transport system. But, in addition, the decline in the Board's share in current outlays is a reflection of the much greater prominence of local authorities in their garbage collection services and, less significantly, in local functions in respect of other waste and control processes. In current outlay terms, the M.W.S. & D.B. falls to approximately 54 per cent of the total current outlay and local authorities account for approximately 43 per cent. As the residual, the balance of authorities represented a tiny component of resource inputs. The prominence of local authorities in this respect to a large extent is indicative of the scale of the garbage disposal process and its labour intensive character. It may be noted that, in the future, some decline (it had not occurred in 1975) in local authority shares might follow the transfer of some parts of the garbage disposal process by the M.W.D.A. whose significance in resource allocation may grow. Nevertheless, some offsets to this anticipated change in responsibilities may develop. Recently stated objectives by Sir John Fuller, N.S.W. Minister for Planning and Environment, proposed (in 1974) a greater involvement of local authorities in environmental protection. This has yet to emerge.

Of the balance of the authorities, the Department of Health in 1971/2 accounted for the largest share in the remaining fragment of total outlays. This reflected the existing attachment to this Department of much of the responsibility for air and water quality control, now transferred, however, to the S.P.C.C. In 1974 it was the latter authority that moved to the fore. Moreover, since 1973, plans for substantial expansion of area of responsibility, function and staffing by the S.P.C.C. brought this authority into even greater prominence, though still minor in terms of direct resource use. It is not, of course, implied that share in resource allocation measures effectiveness or contribution to social welfare. Nevertheless, it should be reiterated that, in the longer term, the M.W.D.A. must be expected to rise in prominence relative to all these other authorities unless some special mode of operation is devised for or by it.

*Allocative decision making: financial powers*

Implicit in the shares of public resource allocation is the distribution of responsibility for decisions to allocate these resources. The relevant authorities divide into three groups, as arranged in Table III-(2). The first are forty local authorities with a significant degree of local operational responsibility in decision making but subject to ministerial control, most importantly in significant new policy departures in addition to similar control, in the last resort, over major revenue raising. The second group consists of authorities — the M.W.S. & D.B., the M.S.B. and the M.W.D.A. — that have or are planned to have a substantial degree of financial autonomy. The M.W.D.A., not yet in fully operational state, has not displayed its eventual financial character and, in 1971/2, relied on a State Treasury transfer. The accounts of the M.W.S. & D.B. do not pass through the State Budget and the Board has considerable revenue-raising powers in respect to loan funds and current revenues. The greater part of the M.S.B.'s finances are similarly separate, though a component is passed through the State Budget. The M.S.B.'s allocative powers rest relatively strongly on its actual ownership of water bodies and its proprietorial rights in respect of them.

The degree of financial autonomy is by no means unambiguous and fixed. The local authorities depend on State Government transfers and the M.W.S. & D.B. has received substantial loans from the State (or raised funds through State loans). Moreover, M.W.S. & D.B. rates are notified to the Minister and to Parliament though infrequently examined in detail in the House. Its recent change in rate basis attracted considerable public comment, chiefly because of equity considerations. To confuse the fiscal (resource allocation) process even further, the intervention of the Federal Government, particularly in relation to the M.W.S. & D.B., adds an additional and complicating dimension. Nevertheless, the other authorities — Health, Environment, S.P.C.C. and Public Works — all depended on budget authorisations.

This complex variety of financial responsibility and freedom, including mixes of Federal, State and local decision making and of budgetary and statutory power, does not necessarily imply an inefficient decision-making process. If politics is the art of the possible, this mix of authority may be an effective way of achieving policy objectives. Such a hypothesis is difficult to test and it is implausible given the absence of any clear environmental objective. However, some illustrations may support the view that a good many obstacles to satisfactory across-the-board decision making exist in this arrangement.

*Independent investment decisions, M.W.S. & D.B.*

An indication of some of the problems that arise may be made in terms of the M.W.S. & D.B. From tradition, rather than from recognition of the current flows of resources, the Board still tends to regard its primary function as one of water supply. Its statutory obligations are to display separate reports on revenue and expenditure in respect of water, sewerage and drainage. These obligations are, consequently, positive obstacles to environmental accounting and planning. Few, if any, valuable inferences about the Board's environmental role could be drawn directly from the Board's accounting statements. However, many of the Board's basic attitudes are conveyed in these statements.

Above all, the Board purports to be a non-'profit'-making public enterprise. In this vein, it recorded for 1971/2 a current account surplus of a mere $14,387.83 or only 0.01 per cent of total sales of services.

This presentation does less than justice to the Board's efficiency. At least as important from the point of view of resource allocation, it obscures an impressive shift towards large-scale self-financing. At the same time, it also helps to conceal some important issues of equity. It may also obscure serious accounting confusion. Though these characteristics are commented on, it does not necessarily mean that the procedure is undesirable or sub-optimal. What is of basic concern is that these decisions are largely left to the Board, with little check, and that it is difficult for persons outside the Board to evaluate the consequences of its actions. In other words, it is difficult to integrate sewerage priorities with those for other claims on Sydney's resources.

From another point of view, the Board might be willing to commend itself publicly, in present and prospective circumstances, for its finance of massive capital outlays in a developing city and for its capacity to meet heavy debt maturities. In practice, in any meaningful sense of the term, the Board made a surplus on current account in 1971/2, not of 0.01 per cent, but just over 60 per cent of total revenue — a total of $72.38 millions. It should be stressed that this figure is not represented as a Board 'profit'. The measurement of profit depends on the inclusion of accounting components not effectively displayed in the Board's accounts. The 'surplus' here is strictly a social accounting concept. To see the derivation of this accounting measure, we need to go through several steps of re-calculation. Some readers may prefer to skip to p. 81 to omit the following technical explanation.

> The Board's accounts confuse transfers to internal reserves of various sorts with actual expenditures and mixes capital with current outlays. We cannot expect to achieve a precise re-estimation without reference to detailed internal accounts. However, it appears possible to recalculate the main components fairly closely.
>
> The main problems, in this respect, arise in relation to the expenditure record for administration and management, long service leave[5] and provision for replacement. The last two combine transfers to reserves and actual annual expenditures. It is possible that the first item is similarly

confused but we can do nothing about it. Attention is confined to the last two items.

Readjustment of the Board's accounts depends on first transforming the Balance Sheets of 1970/1 and 1971/2 into a flow-of-funds format for 1971/2. This is shown in Table III-(3)

Attention is directed, first, to the large addition to capitalisation of assets from revenue and other sources. This might well mystify in the absence of any reference in the current account to expenditure on works. Part of the explanation derives from the provision of assets totalling $6.4 millions provided by developers and subdividers, flows that are presented outside the current account. This immediately raises questions of the relationship between Board services, urban expansion and equitable interests in providing for extension of Board facilities.

But part of the explanation also arises from the fact that the Balance Sheet item, provision for replacement and other services, actually fell — that is, was drawn upon — to the extent of $10.27 millions. At the same time, the current account statement records a transfer, in 1971/2, of $27.30 millions from revenue to 'replacement and other purposes'.

The inclusion of 'other purposes' defeats exact reconciliation. But a

Table III-(3) M.W.S. & D.B. flow-of-funds account, 1971/2 ($m)

| | | | |
|---|---|---|---|
| **Sources** | | **Uses** | |
| Board loans | 50.11 | Fixed assets | 113.49 |
| N.S.W. government loans | 11.32 | | |
| Other loans | 0.14 | **Investments** | |
| Loan repayment fund | 4.77 | C/w stock | 4.29 |
| Renewal, etc. fund | -10.27* | Semi-government | -5.37 |
| Long service leave | 0.77 | Fixed deposit | 13.25 |
| Sundry creditors | 4.54 | | |
| Advances of repayment | 10.93 | Accrued interest | 0.37 |
| N.S.W. loans free of repayment | — | | |
| | | **Current assets** | |
| | | Cash | -1.11 |
| **Asset reserves** | | Sundry debtors | 1.68 |
| Board loans | 7.87 | Stores | 0.21 |
| N.S.W. loans | 16.07 | Other securities | 3.67 |
| Other | 0.30 | | |
| Capitalisation of assets from revenue and other sources | 42.61 | | |
| **Less** Assets written off | 0.47 | | |

* minus sign = decline

Table III-(4) Sources of funds for increase in assets from revenue and other sources M.W.S. & D.B. 1971/2 ($m)

| | |
|---|---|
| Provision by developers and subdividers | 6.40 |
| Net drawings on replacement fund | 10.27 |
| Transfers from revenue to replacement and other purposes | 27.30 |
| TOTAL | 43.97 |
| Increase in assets from revenue and other sources | 42.61 |
| **Discrepancy** | 1.36 |

fairly close approximation is possible. The Board's accounts can be restated in the form of Table III-(4) showing a discrepancy in the reconciliation of only $1.36 millions in indicating sources of funds for increase in assets 'from revenue and other sources'.

In its Report, the Board mentions incidentally that a total of $29 millions of new works were financed from revenue. It must be expected that this is a rounded figure, not a precise one. This would invite recalculation of the reconciliation in the form in Table III-(5).

The issue is not greatly affected by choice between the last two figures. Accepting the lower (which is preferable for general accounting purposes), we would substitute in the Board's Current Accounts in 1971/2 in place of the item, 'Provision for renewal and other purposes, $27.30 millions the two entries —

1. Outlay on replacement $7.21 millions
2. Current year *surplus* invested in new works $20.09 millions

This, as with the contributions from developers and subdividers, also raises substantial issues of equity in the financing of service extensions. But it also implies an internal Board decision, through its general rate revenue policy on the rate of asset development. The fact that it is a 'plough-back of surplus' is to a large extent obscured.

The Board's general expenditure account is more appropriately conveyed, in place of its $14,000-odd 'profit', in the form of Table III-(6).

Table III-(5) Alternative reconciliation, M.W.S. & D.B. account 1971/2 ($m)

| | | |
|---|---|---|
| Increase in total assets from revenue | | 43.97 or 42.61 |
| **Less** | | |
| New works from revenue | 29.00 | |
| Provision by subdividers, etc. | 6.40 | 35.40 |
| Replacement outlays from current revenue | | 8.57 or 7.21 |

Table III-(6) M.W.S. & D.B. trading account 1971/2* ($m)

| | | |
|---|---|---|
| A **Operating Expenditures** | | |
| Maintenance outlays | | 26.50 |
| Administrative and management (inc. leave) | | 12.90 |
| Replacement outlays† | | 7.21 |
| Loan raising expenses | | 0.61 |
| | Total current | 47.22 |
| B **Surpluses** | | |
| Recorded surplus reinvested in new works | | 20.09 |
| Long service leave net accumulation | | 0.77 |
| Interest | | 37.74 |
| Sinking fund | | 14.02 |
| | Total surplus | 72.62 |
| | (Total proceeds | 121.84) |

*Whole area, all operations
†Replacement outlays are included here because of the obscurity of the distinction, in this case, from maintenance.

The whole rate revenue structure and, therefore, the Board's command over resources is open to much more significant question in this light from the point of view of capital works financing and not merely in terms of the Board's ability to sustain current services on a no-profit, no-loss basis. So, too, are the criteria of investment decision making by the Board, since it can no longer be seen to be operating in response to pricing. How the benefits and costs of capital expansion and rate charges fall across the metropolis are intricate questions that can only be explored after a good deal more work. It is not implied that the Board's policies are necessarily to be criticised. What is clear is that it is not disclosing a central issue affecting decision making — an attitude that is not atypical in the Board's affairs. Moreover, in so far as separate and independent allocative decisions are made by the Board, without the direct competition of alternative claims for resources, the question of whether resources are being allocated as between competing claims does not appear even to be asked, quite apart from being answered. This question, nevertheless, has a special significance in the light of the claim for another major waste stream — land disposed waste — currently being planned by a miniscule M.W.D.A. Looking further to the future, with the prospect of the latter authority, as a statutory body, acquiring appropriate substance and power, the division of major environmental responsibilities between three statutory bodies — the M.W.S. & D.B., the M.S.B. and the M.W.D.A. — does not provide an immediately reassuring expectation. If, to this, we add the separate statutory authority of the S.P.C.C. to require or induce *private* sector allocations on a substantial scale, the separation and exclusiveness of roles in resource allocation decisions of the future need to be considered with a good deal of care. It should be stressed that the options are extremely complex and it would be inappropriate to suggest any simple conclusions here.

But the matter is much more complex than this suggests. Again, the M.W.S. & D.B. accounts may be referred to though the principle applies to other authorities. Despite the large 'surplus' estimated for the M.W.S. & D.B. and despite the Board's belief that it has access to funds from current operations to finance extensive replacements and new works, we cannot conclude — and, more importantly, the Board cannot conclude — that transfer of such a large component of its social account surplus can be allocated to finance replacements and new works in this way. Several issues might be raised but the crucial and most difficult one is the valuation of fixed assets. Asset valuation becomes a matter of acute importance in an inflationary situation and the basis of the Board's valuation is not clear. Fundamentally, however, the valuations are based on historical cost summation, a procedure that, in present circumstances, drastically understates the Board's financial commitments to future replacement and future maintenance. Revaluation of the Board's assets and recalculation of depreciation rates and replacement commitments to allow for current inflation rates would radically alter its financial position. The consequence would be greatly to *reduce* the extent to which the Board's current revenue is sufficient to meet necessary replacement — i.e. to offset future depreciation.

What is implied is that the Board's decisions to allocate, at its own discretion, large sums for new works and replacement from current revenue are open to very serious doubt. Yet major income allocation decisions are made by the Board on this wholly unsatisfactory financial basis, from which neither it nor we can determine the extent to which it is raising current revenues sufficient to provide necessary replacements.

*Subsidised resource allocation, M.W.S. & D.B.*

Given the importance of the Board's rate revenue for capital works, in addition to current service provision, the composition of its current revenue sources is a matter of considerable interest. Confining attention to its waste transport functions, the shares of current revenue from these sold services are shown in Table III-(7), following the format of the Board.

The principles of rating are discussed later in this volume. As a self-financing institution, the Board must take, as one basic charging principle, the need to set rates at the beginning of the year to cover the planned current expenditures of the year, including debt servicing. It has been suggested that this principle has been amplified to include some planned capital works outlays. The Board has, however, the complex task of distributing charges as between its major current functions of water provision, sewerage and drainage services and the sale of rights to discharge liquid industrial effluent.

If we take the case of liquid waste discharge, it may appear, at first sight, that the Board places only a token charge on industry for the disposal of massive quantities of wastes, some of which are relatively costly to the Board. Again, the Board's accounts do not reveal the true charges, and their effluent rates are misleading. Since the wastes are water-borne, sewerage charges and a component of water rates paid by industry, added to the effluent charges, make up the total claims on industry for liquid waste disposal through sewers and drains. Re-estimating revenue shares from charged waste transfer services on this basis, we have the percentages shown in Table III-(8).

In 1971/2, the waste water discharges from households were approximately twice the volume of industrial waste effluent. In other words, while disposing of one-third of the total of liquid effluent, industry provided only about one-eighth of the total revenue from liquid waste transport services. Unless industrial waste was less costly to transport than household waste, the Board was not following the principle that 'the polluter pays'. In fact, on the contrary, the Board's view

Table III-(7) Shares of current revenue, waste transport services, M.W.S. & D.B. 1971/2 (%)

| | | | |
|---|---|---|---|
| Water rates | 30.0 | Drainage rates | 3.4 |
| Sewerage rates | 64.6 | Trade waste discharges | 2.0 |

Table III-(8) Re-estimated shares of current revenue from charged waste transfer services, M.W.S. & D.B. 1971/2(%)

| | | | |
|---|---|---|---|
| Non-industrial water transport | 27.0 | Drainage (unadjusted) | 3.4 |
| Non-industrial sewerage | 57.6 | Industrial transport water, sewer and trade waste | 12.0 |

was that industrial liquid waste was the more costly stream per gallon. Nevertheless, it made current services (resources) available to industry either below cost or on the basis of subsidies from other users. It is not intended to imply any devotion to 'the polluter pays' principle. The point rather is simply an explicit recognition that an undebated allocative decision of considerable social importance was made and that there is little evidence of any particular principles being adopted. Obvious environmental advantages of these conditions of providing Board services are to reduce the incentive to industry to engage in illegal dumping outside the rivers and drains. An example of an equally obvious disadvantage is that the larger the industrial effluent flow, the greater the risk of sewage overflow in wet weather conditions. The only things that are certain are that the conflict is not easy to resolve, and that the conflict is important and some attempt at resolution is needed. This issue is discussed at length in chapter 6 of Botany Bay Project Report No. 2, dealing with potential waste flows of manufacturing.

*Inadequacies in control inputs*

One could continue at much greater length with illustrations of the unresolved problems of resource allocation in the institutional circumstances of Sydney. It is by no means clear by what mechanisms major decisions are made to resolve allocative problems falling between authorities or encompassing the areas of responsibility of several. It appears that many 'decisions' are arrived at in the form of inaction or drastically incomplete appraisal.

It would be difficult to explain otherwise the continued state and more particularly the most recent proposals by the S.P.C.C. in respect of the Cooks River and Alexandra Canal. It would similarly be hard to explain the rapidly accumulating function of the Botany Bay port from oil port to bulk terminal to container port to coal port with increasing environmental consequences except in terms of independent and unrelated responses to opportunities for use without regard to the totality of claims, the efficiency of operation or the equitable effects. In this case, the confusions are compounded by the extraordinary use of separate environmental impact studies for each particular proposal, without looking at the issues as a whole.

There is, however, one other area of public allocative decision making to which brief reference should be made. This is in the field of action to compel or induce the private sector to commit resources for waste and pollution control. The M.W.S. & D.B. effluent charges provide some inducement and the Board's exclusion of certain wastes from sewers and drains add an additional dimension. But these are relatively minor compared with the influences exerted by the Air and Water Pollution Control Branches formerly of the Department of Health, now part of the S.P.C.C. The combination of these two Branches under the S.P.C.C. in 1974 might eventually lead to a more integrated consideration of resource allocation as between different pollutant sources and parts of the environment. But the miniscule public resource inputs into these authorities do not represent the weight of influence on the economy and society wielded by these bodies. In a later section, we take up the private sector allocations estimated to total $130 millions in 1971/2. *Whether these private inputs were adequate or excessive, or appropriately or inappropriately distributed were, in* *very large degree, determined by a tiny public resource input.*

It is with the nature of this public input that we are concerned. In this area, the objectives and strategy and techniques of policy in resource allocation become crucially important. The essentially health criteria that underlay policy in 1971/2 helped to limit consideration of the amount and type of public resources to be deployed. So, too, did the relative novelty and difficulty of some of the environmental problems. Public resources were provided largely to service a scientific and technological function — to establish standards, to monitor and test in a relatively rudimentary fashion and, in limited fields, to inspect, police, license, advise and direct industry. After direct encounter, one cannot doubt the motivation and quality of the small staffs concerned with this work. But it is not reasonable to believe that they can meet the intense pressures on them. This has emerged most clearly since 1971/2 as essentially health hazards gave way to other, somewhat wider, considerations in pollution control. The risk by 1974 appeared immediate that, with minimal resources, these excellent Branches faced the risk of conversion to a large degree to police operations. Even a planned two- or three-fold increase, the basis of which is not clear, could do little to escape this risk. Decision to allocate resources on this level, to conduct essentially scientific exploration, in 1971/2, may have been meaningful. In the conditions of 1974/5, the limited expansion in these slight resource inputs, with greatly increased demands on them, seems short sighted. It is not feasible that these resources are adequate in amount and kind to deal with the tasks that they face or to exercise the authority that they have over the private sector. We must come back to this in discussing private resource allocation. But it is necessary to register, here, the serious doubt whether the S.P.C.C. and its Minister or the State Government generally have been fully aware of the scale, complexity and importance of this function.

*The 1975 system of coordination*

The new system of coordination outlined in the *Report to the Minister for Planning and Environment* November 1975 does not appear to touch the issues raised here. The hierarchical structure of bodies leading to a Cabinet Sub-Committee, and including Treasury oversight, may contribute to some more complete review of expenditure proposals by certain groups of bodies concerned with environmental management. However, the segregation of different waste management and pollution control bodies in different committee structures appears to imply a disintegration of planning and expenditure proposals in the waste management area. In the light of the prospective total bill for Sydney, this does not seem to be very wise, more particularly since it is integration and not separation that is required. The fact that streams of proposals eventually come to Cabinet Sub-Committee and are vetted by Treasury is scarcely the relevant issue. One may well wonder whether the system of financial control in the new proposals does not specifically lead to the submergence of metropolitan needs in a State-wide framework. In practice, Sydney's claims are so large that it is essential that they be separately considered.

Moreover, the new planning proposals for Cabinet coordination appear to leave unaltered the problem of the varied statutory authority of different bodies, especially the M.W.S. & D.B., in the raising of current revenues and their allocation within the statutory enterprise. It is this which gives the bodies differing freedom of action and underwrites the ability to engage in separate and conflicting action. Coordination *might* be achieved either by very close oversight of rate fixation and charging or by the passage of revenues through the Consolidated Revenue Fund. The retention of statutory freedom creates, in effect, tied funds and limits flexibility in city planning and development, most directly in the waste management area.

This latter issue is made more important if the problem of asset valuation in an inflationary situation is taken fully into account. Revised accounting procedures, affecting the statutory bodies' financial results, would significantly alter the financial procedures. The new planning proposals leave this matter unaffected, though Treasury may be able independently to exert some influence in achieving revised accounting.

**Public authority workforce**

Before taking up private sector allocations in waste and pollution control, some aspects of the size and composition of public authority workforce may be noted. In any event, information on labour inputs is relevant to the concluding point in the preceding section. Figures are shown in Table III-(9).

Since 1971/2, considerable expansion has occurred in the M.W.D.A. (approximately five-fold) and planned expansion to approximately treble the staffs, particularly of the Air and Water Pollution Control Branches in 1975, imply very fast growth rates. Nevertheless, these increases make little impact on the relative shares of the different authority types in the total workforce in waste management/pollution control. The M.W.S. & D.B. is and remains the giant, the local councils concerned accounting for about one-quarter of the former's staff.

Size is not by any means a measure of quality of labour inputs. The two large employing groups employ substantial bodies of personnel with limited professional skills. In the case of the M.W.S. & D.B. about 70 per cent of the Board's workforce is made up of wage earners, and of the balance of salaried personnel the major part is in fact clerical. Strictly professional qualifications are represented by the relatively small fraction of key personnel.

Table III-(9) Metropolitan labour inputs into waste management/pollution control, 1971/2 (persons)

| | |
|---|---|
| Local councils | 4,375 |
| M.W.S. & D.B. | 16,148 |
| M.S.B. | (100) |
| M.W.D.A. | 10 |
| Environment ) S.P.C.C. ) | 40 |
| Health | 57 |
| P.W.D. | ? |
| Total | 20,730 |

By contrast, in the cases of the M.W.D.A., as operating in 1971/2 and in 1975, and of the present S.P.C.C. (Health in 1971/2), the very large component of staff is professional. In the Air and Water Pollution Control Branches, the core of staff is provided from scientific and technologically qualified persons. Transferred from the special institutional environment of the Department of Health in 1971/2 to the S.P.C.C. in 1974, the enlarged nucleus retains most of its earlier professional composition. But the objectives have changed from an essentially health, scientific and advisory role to the full spectrum of standards, monitoring, testing, analysing, interpreting, advising and policing. More significantly, the policing role has become increasingly significant, directing limited professional resources from the other operations.

One question that may arise immediately is whether this is the most efficient use of professional resources; or whether much more significantly expanded professional resources are needed to provide the full complement of associated functions. In addition, one may well doubt whether an organisation with the consequential impact on the private sector can adequately devise policies with the range of expertise at its disposal. This doubt reflects the essentially technological orientation of existing expertise. Essential as this is, it is even more necessary that official input of effort is calculated in a much wider context of the ramifications for the private sector in terms of costs, prices and profits, of the implications of different policies for different groups, sections and areas. It may be symptomatic that attempts by this Project to initiate work towards an elementary pollution input/output matrix were met with incomprehension and hostility. But these matters are better considered in the light of private sector allocations.

## Private sector allocation

### *Preliminary estimates*

A very small amount of survey work has been reported on the costs of 'pollution control' in Australia as met in the private sector. By far the best of this is R. P. Murphy's report, 'Air Pollution and Urban Development'. Unfortunately, this relates only to air-borne wastes and the survey material deals only with scheduled factories. The significant feature of these fragments of information is that they attempt to report the capital costs (excluding any current costs) of equipment installed to limit specified pollutant emission, primarily dust and particulates and largely to meet imposed standards. They represent control costs for specific purposes. It is valuable to have some guide to capital costs of control, even though the information is out-of-date and represents the costs for the relatively easily controlled emissions.

However, it is essential to recognise that this type of survey conveys the private sector resource inputs not into waste management and pollution control, but only into certain costs of some improved waste management through particular controls. We must start in a different direction to estimate the whole private sector input. Moreover, as in the case of public outlays, we need to estimate current in addition to capital items. In addition, we must arrive at two distinct types of estimate. One is the gross private sector sums for waste management/pollution control — i.e. costs as recognised by the sum of institutions in the private sector. However, part of these costs (a relatively large part) represents purchases of inputs from the public sector. When we consider issues from the point of view of social costs, these transfer purchases needed to be deducted so that separate public and private inputs can be aggregated to a social total.

These are novel calculations and there is little to guide us. Nevertheless we

Table III-(10) Private sector purchases for waste management/pollution control, 1971/2 ($m)

| | | |
|---|---|---|
| **I Capital Outlays** | | |
| (a) *Water-borne wastes* | | |
| New dwellings | 29.3 | |
| New factories | 5.5 | |
| Other new structures | 27.0 | |
| Dwellings renewals and replacements | 12.0 | |
| Factory renewals and replacements | 2.5 | |
| Other renewals and replacements | 1.8 | |
| Other alterations | 5.0 | |
| Gross capital outlay | | 83.1 |
| (b) *Air-borne wastes* | | |
| New factories | 2.0 | |
| Scheduled premises | 4.0 | |
| Non-scheduled premises | 2.0 | |
| Renewals and replacements | 2.5 | |
| Gross capital outlay | | 10.5 |
| (c) *Solid Wastes* | | |
| Factories and shops | 2.0 | |
| | | 2.0 |
| Total capital outlay | | 95.6 |
| **II Current outlays** | | |
| (a) *Purchases from the private sector* | | |
| Dwellings | 17.0 | |
| Factories incl. contract disposal | 7.5 | |
| Other | 12.0 | |
| Total private sector current purchases | | 36.5 |
| (b) *Purchases from the public sector* | | |
| Water as waste transport | 24.0 | |
| Sewerage | 58.9 | |
| Drainage | 3.5 | |
| Trade waste | 2.0 | |
| Licences and fees | 0.3 | |
| Sanitary and garbage | 8.5 | |
| Total purchases from the public sector | | 97.2 |
| **Gross outlays by private sector** | | **229.3** |
| *Less* purchases from public sector | | 97.2 |
| **Net outlays by private sector** | | 132.1 |

need to make the attempt to evaluate the full resource inputs into disposal and pollution control action. Moreover, administered pollution control costs imposed or induced by authority make more sense when seen as additions to a total waste transfer and control bill. It cannot be expected that this first attempt can have a very high order of accuracy but it is offered as an approximation to the magnitude needed.

Table III-(10) sets out the various component parts as estimated so that the construction of the total can be seen and the details varied as may seem more appropriate.

For the purposes of this discussion, the components of the estimates are presented in detail to minimise the need for comment. Items in I(a) and part of I(b) are based on records of major building and construction firms; the major items in I(b) are primarily Murphy's calculations (see earlier) adjusted for inflation; while I(c) is merely notional (it is clearly a small figure). Since Murphy anticipated in 1970 that outlays of the future would be larger in order to deal with more complex problems, it is possible that this section is an underestimate. Very little guidance is available on current outlays apart from some useful hints in the M.W.D.A. consultants' report on liquid wastes which provide some foundation in the case of factories. The dwelling maintenance figure is based on a minimal maintenance outlay basis and is almost certainly underestimated; similarly the maintenance for 'other structures' is likely to be an undercount. The purchases from the public sector are derived directly from sales data of public authorities, chiefly the M.W.S. & D.B. and local authorities.

*Some implications of the estimates*

At the risk of sounding unnecessarily apologetic, it must be reiterated that this estimate is offered in this form only as an 'order-of-magnitude' figure and that no great reliance can be placed on the total or, more particularly, the components. The full detail is intended to attract criticism — certainly more work is needed on the figures. Nevertheless, a few comments are appropriate, taking the main outlines of the figures at their face value.

(a) It seems likely that the total private outlays, net of transfers from the public sector, underestimate rather than overestimate. This suggests that private outlay on waste management/pollution control is at a level roughly approximating that of the public sector (the margin here is of about $20m p.a. below the public outlay of $153 millions).

(b) Outlays of all sorts in respect to dwellings account for approximately one-third of the total. This may direct attention into the area of households that may not appear to conform with the interests and estimates of controlling authorities. In fact, however, the activities of the M.W.S. & D.B. and the W.P.C.B. in stormwater run-off and in sewerage and sullage already deal directly with households; and so do the activities of council inspectors and garbage collectors. The problems that arise in relation to households and the scale of their outlays bring into prominence the significance of possibly misdirected detailed effort in waste management in which small technical changes (such as re-routing stormwater flow-off) may yield substantial improvements with little additional outlay; and in the case of new structures, implies opportunity for improved waste management with no additional and possibly even reduced outlays.

(c) Superficially, in terms of the activities of major control authorities, primary interest has been directed to air pollution control in recent government action. In fact, the combination of building regulation control and the links of structures to M.W.S. & D.B. facilities brings outlays on water waste management into much greater prominence. In turn, this feature suggests that the regulatory role of the various building and health inspectors of local authorities have a much greater economic significance than might ordinarily be thought; and would imply that public management and control has been carried a long way with respect to households and still, by comparison, little distance in other areas.

(d) Granted the likely high order of error in the present figures, other estimates that have been presented of the 'cost of pollution control' (quite apart from being confined to capital costs and to air pollution) represent only the 'tip of the iceberg' in relation to private sector outlays on waste management and pollution control.

It would be unwise to try to draw many inferences until these estimates are made firmer. A general observation, however, seems appropriate. Despite the current prominence of 'pollution control', it would appear that by far the greatest part of the intervention in the private sector that has occurred has been in respect of households and in relation to features that provide immediate personal amenities; and these controls have, in fact, emerged over a long period extending back at least over a century. The modern novelty is partly to recognise some of these amenities as yielding other problems and to widen the spectrum of control to other waste and pollutant generators. So far, these wider controls have not penetrated deeply in Sydney. It seems almost certain that further improvement must depend much more on the positive incentive of social control to induce greater resource input by the private sector; and that the public sector will shrink in relative importance.

*Inducements to private sector resource allocation*

It is instructive to register that the form of control of households leading to baths, sewers, basins, etc., are imposed controls that have come to be accepted as an essential convenience of living and, at times, a source of domestic decor. This represents — almost completely — absorption of control into consumer preference systems. Subject to oversight and within broad limits, it is left to householders to choose the objects and to arrange them as they think fit. Control, preferences and technology are in reasonable harmony.

By contrast with this, the basic principle of control approach in Sydney to induce private resource transfer is expressed in the form: establishment of physical standards of waste emission, official determination of best practicable means of remedy, licensing of establishments subject to supervision of emission and technological adjustments and the issue of directives (personal persuasion, advice, compulsory order) to install control devices and to attain and maintain standards. This has been and remains the approach underlying the resolution of air pollution from dust and particulates in Sydney and the proposals for rather complex control of automobile emissions in Sydney; it is at the basis of proposed controls of industrial waste of factories discharged to water; it reappears in a slightly different guise in sewage treatment plants by the M.W.S. & D.B.; and it was carried to the extreme by the M.W.D.A. consultants in designing a public facility for the disposal of liquid wastes of industry currently disposed of other than through sewers and drains and in proposing a system of compulsory charges on industry to pay for disposal.

There are several features of this type of approach that are worth comment. First, it relies on the definition of a physically measurable objective. Second, it relies on a specification of an officially preferred technology. Third, it deals with specific and separate problems. A fourth comment is relevant in the Sydney situation though it does not follow from this general statement. This approach has appeared to be successful in a situation in which the imposed costs have been relatively slight, in controlling dust and particulates. It has not been tested in circumstances in which the implied residual costs lead to much more complex and costly inroads into the private sector. In these circumstances, the objectives, strategies and techniques of control have more important consequences and are likely to lead to more significant debate than they have in the past. In this event, a broader and clearer and more integrated specification of objectives is needed, the need for balance and compromise in benefits and costs emerges more prominently, the equity implications become more prominent and a greater flexibility in control approaches is likely to be sought.

This change would represent an alteration from a predominantly technological solution to a technical and social compromise. It is perhaps almost inevitable that, with the representation of professional skills in N.S.W. control authorities so heavily weighted towards technology, the direct physical control approach would be preferred. Nevertheless, the persistence of this approach is one of the most serious shortcomings and points to one of the most serious social risks in the present control structure. Indeed, it is depressing that the options that receive significant attention in control strategies are merely the so-called 'best practicable means' and 'establishment of standards' approaches. Neither consider the wider objectives nor the need for an across-the-board balance and compromise. In turn, this type of approach rests on the essentially health orientation of environmental controls. In Sydney, the explanation of this approach goes back far into history in the nineteenth century concern for 'public health' and the prominence of health inspectors in State and local bodies. In the recent past, it is explicable in terms of the attachment of the Air and Water Pollution Control Branches, in particular, to the N.S.W. Health Commission.

It is doubtful, in fact, whether there is much hard and fast epidemiological evidence of the relationship between environmental conditions and health. It is even more doubtful whether health risks assume priority in the preferences of individuals and groups. The only matter that is clear is that if health standards are arbitrarily set, the technological prescription is relatively simple — unfortunately, perhaps, deceptively so.

Anyone interested in environmental questions and specifically control procedures is faced with a dilemma: should control processes operate on the basis of perceived risks, implying both an acceptance of knowledge and understanding of individuals and the desirability of a consensus; or should risk limits be set by authority and activities be restrained unless and until they are proven to conform to these limits?

It is obvious that there is no simple solution to these questions and it is improbable that any control process that relied on one extreme or the other would command widespread acceptance. Nor are the possibilities for and limits on control fixed as the experience with household controls shows. Like environmental degradation, the base-line conditions of control opportunities change continuously.

In the immediate future, the list of potential control areas in Sydney include such major items as:

(a) limits on the generation of solid waste
(b) restraints on industrial liquid waste discharged to water
(c) control of liquid waste disposal other than through sewers and drains
(d) control of stationary sources of smog
(e) control of vehicle emissions[8]
(f) noise pollution control
(g) control of stormwater run-off

These imply quite far-reaching and costly inroads into the private sector to induce transfer of resources for these purposes. It is not the purpose of this chapter to debate how these controls might operate. What is important is to observe that all are being approached, in essence, as separate technological problems with physically-defined objectives. This derives from the basic background of the existing personnel and the control experience of the past decade. It is an inadequate background and experience.

# 4 The law and the citizen

## Introductory

The law relating to pollution control consists of both the common law or the judge-made law developed by the courts over the years, and statute law enacted by Parliament. Over the past decade, in New South Wales statute law has become the dominant source of law so far as environment protection is concerned and it is this dominance and some of its implications with which this chapter deals.

Much of New South Wales legislation had its origin in British law, partly because of Australia's original colonial status, partly because of a tendency, until relatively recently, to follow British legislation. Traditionally, the British Alkali Act, 1863 may be regarded as the foundation of modern approaches to environmental protection and pollution control. One might trace a longer and more complex sequence through health legislation, factory legislation or Acts to establish waste management authorities.[1] Here we are concerned, for purposes of this chapter, with a narrower perspective relating to relatively recent legislation bearing most directly on the modern New South Wales approach. The object is to consider some general implications rather than discuss detailed legal provisions.

## Main legislative provision

The list of Acts referred to here should not be taken as in any sense exhaustive.[2] As in the British case, N.S.W. legislation developed gradually and haphazardly, with many relevant provisions scattered throughout a large number of unrelated Acts and Regulations. The most directly and immediately relevant to a discussion of the current Sydney situation are, in historical sequence:

(i) The Smoke Nuisance Abatement Act, 1902 (repealed 1961)
(ii) The Public Health Act, 1902 and Amendments
(iii) The Noxious Trades Act, 1902
(iv) The Local Government Act, 1919 and Amendments
(v) The Metropolitan Water, Sewerage and Drainage Act, 1924
(vi) The Maritime Services Act, 1935
(vii) The Prevention of Oil Pollution of Navigable Waters Act, 1960
(viii) The Clean Air Act, 1961 and Amendments
(ix) The Factories, Shops and Industries Act, 1962
(x) The Clean Waters Act, 1970
(xi) The Waste Disposal Act, 1970
(xii) The State Pollution Control Commission Act, 1970

(xiii) The Health Commission Act, 1972
(xiv) The New South Wales Planning and Environment Commission Act, 1974
(xv) The Noise Control Act, 1975

It is expected that these enactments will be supplemented by an Environmental Impact Assessment Act, being prepared as a Bill in 1975.

By the last twelve Acts, with relevant amendments, the New South Wales legislature provided the legal framework for its waste management and pollution control. It regulated and controlled the disposal of air-borne, water-borne and solid wastes, prescribed the powers and responsibilities of relevant authorities and defined the rights and obligations of industrial polluters. Many questions remain unresolved: problems that arise from the overlapping of functions of pollution controlling agencies and other statutory or government bodies; priorities that have to be established by the government of the day between the efficient functioning of industries and the need to control polluting activities; questions as to the desirable breadth of administrative or political discretion; conflicts between the efficiency of a legislative scheme of pollution control administered by government bodies as against a scheme more dependent upon citizens' initiative in using the courts and the common law to protect the environment.

The Acts, as listed, might be regarded as predominantly concerned with the establishment of management and control authorities and with a definition of their powers and functions, In so far as these provisions define a system of administration, they have been dealt with in Chapter 2. It is not our concern, here, to pursue the details nor to study the legal provisions in detail.

**The power of government authorities**

As a result of legislation since 1970, the N.S.W. Parliament has shown a clear intention to deal with pollution of the environment by means of a comprehensive legislative scheme of pollution control. Legislative control over pollution is a desirable method of pollution control in a highly industrialised country and one which is used to a high degree of government administration in the running of its day-to-day affairs. Each year since 1970 the legislative scheme of pollution control has been strengthened by new legislation and amendments to existing legislation to extend the scheme and to take into account new developments. All the problems in the scheme are by no means ironed out. Many pollution control agencies have overlapping functions and, due to the wide discretions vested in most agencies, there is a problem that some agencies might remain inactive if their functions can be performed by other agencies. There is also a problem of ensuring that the administration of the various statutes is carried out to prevent or reduce pollution rather than to prosecute and have a penalty imposed on the offender on each occasion an act of pollution occurs. The State Pollution Control Commission was established to coordinate the activities of the various pollution control agencies, and its existence is essential during the period it might take to overcome the administrative teething problems. A difficult problem to deal with arose from the fact of increasing Government participation, operating through its various statutory or government agencies, in the ownership and operation of industries and industrial processes, particularly transportation and energy production. These agencies themselves can cause pollution. The decision on whether or not they should on any occasion comply with the relevant environmental quality standards depends upon the government of the day, its policy and priorities, and the state of the economy.

Emerging from the legislative scheme of pollution control in N.S.W. are two trends in particular. First is the tendency to grant government authorities or government-created agencies wide powers to be used at the agencies' discretion. Second, there is a tendency in most of the legislation to require the consent of the Minister or some authorised person before a person or company can be prosecuted for breaching a statute. The wide powers vested in the N.S.W. pollution control agencies together with the wide discretions vested in these agencies on whether or not they should exercise their powers, have resulted in a legislative pollution control scheme entirely dependent upon policy priorities of the government of the day. The success of the scheme depends upon the vigour or discrimination with which government bodies administer and enforce the laws. Should the administrators not be vigorous in enforcing the pollution control standards, there is little room in the scheme for citizens to enforce compliance with the standards prescribed in the statutes. On the other side, citizens have little opportunity to urge restraint other than through broader political processes on over-zealous officials. The advantages and disadvantages of these tendencies and their effect upon the success of pollution control can be discussed using the Clean Air Act of 1961, the Clean Waters Act and the Waste Disposal Act of 1970 as examples.

In all three Acts the provisions relating to pollution control, the breach of which is an offence, are broadly framed. Under the Clean Air Act, for example, it is an offence for an occupier of scheduled premises (chiefly industrial establishments) not to hold a licence in respect of those premises.[3] It is an offence for an occupier of any premises to carry on a trade or industry which permits emissions of air impurities in excess of prescribed standards.[4] Similarly, the Clean Waters Act provides that it is an offence to 'pollute any waters or cause or permit any waters to be polluted',[5] A person licensed to discharge wastes must not pollute waters in contravention of any of the conditions of the licence.[6] Under the terms of the Waste Disposal Act a person occupying a depot to which waste is transported will commit an offence unless he holds a certificate of registration.[7] Under the three Acts key words such as 'pollute',[8] 'air-impurities',[9] and 'depot'[10] are broadly defined. In addition, the State Pollution Control Commission has wide powers under the Clean Air and Clean Waters Acts with respect to imposing conditions on licensees. It can require a licensee under the Clean Air Act to install or repair certain equipment for the purpose of reducing emission of air impurities.[13] It is an offence under these Acts to disobey any of the provisions of an Act, a condition of a licence, or a requirement or order made by an authority pursuant to the Act. Framing the offences so broadly provides a basis upon which a comprehensive system of pollution control can be instituted, in a legal system in which the common law does not adequately cover the area. Once a prosecution has been laid the breadth of the Act leaves limited room for a successful defence.

The effect of the granting of wide powers under these Acts is offset to an extent by the discretion vested in the relevant authorities on whether or not or to what extent they should exercise their powers. A breach of an Act or a regulation is a crime. A citizen could, therefore, prosecute a polluter, say for a breach of the Clean Air or Clean Waters Act, if the S.P.C.C. failed to do so. However, the provisions of the Clean Air Act, Clean Waters Act and the Waste Disposal Act, serving positively to discourage citizens' actions reserve power to the Commission or the Authority. The breadth of these Acts together with the requirement that the prosecution must be consented to by the relevant Minister or the Director of the administering authority or the S.P.C.C. or some authorised person indicates that the legislature intended the administering authority to undertake prosecutions.

The powers granted to the administering agencies under the three Acts are broad enough to allow the agency to take whatever action is necessary effectively to control pollution. It is, therefore, left to the agency's discretion which powers, if any, should be invoked. In the Clean Air Act, for example, section 20 states in part that 'the local authority *may* by notice in writing require the occupier of such premises . . .' to install or repair equipment on his premises.

To overcome the problem of possible government inertia, the State Pollution Control Commission Act, 1970, set up the S.P.C.C. to co-ordinate the activities of the various bodies and to act as watchdog over their use of power. Under section 13 of the enabling Act, the Commission may from time to time:

> by order, direct any public authority to do anything within the powers of that authority which will, in the opinion of the Commission, contribute to the prevention, control, abatement or mitigation of the pollution of the environment the disposal of waste or the protection of the environment from defacement, defilement or deterioration . . . .

But reliance upon the Commission to ensure the efficient administration of legislation affecting the environment has some drawbacks. First, this power itself is discretionary, and depends on the Commission's opinion of what action is necessary for pollution control. Second, the Commission is a government statutory body itself, and might be reluctant to act for the same reasons as a local government body. Third, if it does take action under section 13, and in so doing comes into conflict with a public authority, its enabling Act provides that the Premier will be the ultimate arbiter of the dispute. The outcome of such conflict might well depend upon the political situation or economic factors of importance which exist at the time. Finally, the Commission itself administers the Clean Air and Clean Waters Acts, and is responsible for determining the conditions of licences; instituting prosecutions; and taking other action for pollution control. It is, to that extent, a watchdog over itself.

Where wide powers are granted under an Act they might be abused and the requirement of the Minister's consent prior to commencement of prosecution proceedings might prevent an over-zealous official from making officious prosecutions. According to Weinberg the rationale in enacting the consent requirement is a fear that private persons might institute frivolous and vexatious prosecutions.[14] Further, an increase in citizens' prosecutions which might occur as a result of the spate of new environmental legislation might also have the effect of inducing industries to make their operations and methods of manufacture more secret. The restriction upon citizens instituting proceedings for breaches of environmental legislation has probably been imposed, therefore, so as not to over-complicate administration of the legislation by the relevant pollution control agencies. Under section 33 of the Clean Air Act, a prosecution shall only be instituted with the written consent of the Minister or, in some circumstances, the Commission or local authority. Any proceedings brought for an offence against the Clean Waters Act (section 33 (2)) requires the written consent of the Minister or a member or officer of the S.P.C.C. authorised in writing by the Minister. Under the terms of the Waste Disposal Act a prosecution cannot proceed without the written consent of the Director of the Authority, or an officer of the Authority authorised in writing by the Director (section 55 (2)). (The Victorian Environment Protection Act, 1970, is more specific. Proceedings under this Act can only be taken by a person authorised by the Environmental Protection Authority or a protection Agency.)[15] None of these Acts lay down any guide lines or rules for the instruction of the Minister (or Director) as to the grounds upon which he should grant or withhold his consent. A Minister has many conflicting interests to cater for, and economic and political factors must influence his decisions. Very often his concern may be for the short term, and the long-term effects of political decision making on the environment may not be given sufficient consideration. The historical experience with prosecutions is given in Chapters 7 and 9.

Of course it is not an accurate test of government vigilance to look to the number of successful prosecutions relating to statutory offences against the environment. Many other factors are relevant. First, successful administrative actions may be taken by pollution control agencies that do not involve prosecution. Second, prosecutions are often dropped if the offender takes the required steps to reduce his polluting activity. Third, the very breadth of these Acts have caused many potential offenders, such as companies and industries, to modify their equipment or production lines at the outset rather than run the risk of being put to a greater expense at a later date. However, the deterrent effect of penalties may be diminished by a decision to prosecute the bulk of offenders before the Court of Petty Sessions, which can impose a limited fine, rather than before the Supreme Court where a higher maximum penalty can be imposed. The decision to take proceedings in this Court or in the Supreme Court is apparently being exercised solely by the particular police prosecutor from the Crown Solicitor's Department in charge of the case.

The tendency to enact wide powers of prosecution and to have those powers exercised subject only to the consent of some authorised person is not a desirable development in administrative law. It could lead to encroachment on individuals' and companies' civil rights; and it tends to place the ultimate power of prosecution in the hands of politicians, rather than civil servants, which could lead to an inconsistent use of the power depending upon the policy of the government of the day. However, the main effect is to put the matter of environment control in the hands of government administrators to the virtual exclusion of the public at large, and this result might be necessary for the long-term administration of environmental legislation in accordance with the laid out policy without interference from the public.

There is, clearly, a potential conflict between planning and development objectives and the participation of affected individuals. This is not an easy conflict to resolve. It may be necessary to exclude citizen participation in the enforcement of statutory standards of environmental control. Nevertheless, citizens should not be excluded from participating in all areas of the environmental control process. Citizens can play a valuable supplementary role if they are encouraged both to participate in policy formulation relating to matters of the environment and to enforce standards of pollution control other than those prescribed in the specific environmental legislation. Weinberg, for example, says that the Clean Waters Act, New South Wales, alone is 'an inadequate legal control mechanism and ought to be strengthened by granting the private citizen a definite supplementary role in the battle against pollution of our most precious resources'.[15] He puts forward as examples to be followed the Massachusetts and Michigan State laws.[16] Lanteri suggests that the most satisfactory solution to strengthening citizens' rights to participate in pollution control would be specifically to create by statute a private course of action appropriate to environment protection cases.[17] A statutory basis for a citizen's action would overcome the present problem of being able to have standing to sue. This solution might allow the citizen to fill the gap and play the role of watchdog on government administration of statutory controls over the environment. It would also allow a further development in the common law area of class actions.

If a comprehensive legislative scheme of pollution control is to be successful, it is essential that it does not exclude citizen participation and interest in it. The trend to eliminate citizens from participating in enforcing the prescribed standards is offset to some extent by the recent encouragement given to citizens of most States of Australia to participate in the policy formulation stages. But it is suggested that the pollution control scheme in N.S.W. should be strengthened by the extension of citizens' rights to take legal proceedings relating to matters concerning them and the environment. It was concern for the quality of the environment as reflected by the various activities of private citizens in environmental matters which has been largely responsible for the enactment of legislative standards for control of pollution and the protection of the environment. We may, therefore, look in more detail at the possibilities open to citizens.

## The role of the citizen

It is reasonably clear that the legislative scheme of pollution control in New South Wales which is contained in the Clean Air Act of 1961, the Clean Waters Act and the terms of the Waste Disposal Act of 1970 and other post-1970 environmental legislation discourages citizens from participating in the enforcement of the pollution control standards established by those Acts. The requirement that the consent of a Minister, the State Pollution Control Commission or some specially authorised person be required before a charge can be laid may be explained in terms that the consistent and efficient administration of a legislative pollution control scheme depends upon a tight control on the circumstances in which action is to be taken against persons breaching the Acts. There are other practical constraints on a citizen. A citizen does not have before him the relevant files or records to find out if an apparent polluter is licensed to do so, or, if so, whether he is within the conditions of his licence. Even if the records were available to him, the citizen would require expert scientific knowledge and scientific equipment to test the level of pollution before he laid a complaint. The discretion to prosecute or to carry out any function under the Act virtually prevents a citizen from taking mandamus action in a court to force the relevant agency to take action against a polluter. The writ of mandamus is used where an official charged with a public duty can be called upon to perform his duty when he has not acted. It must be shown, however,that the official has a duty to act. Thus, the local authority could successfully defend proceedings for mandamus by showing that its decision not to take action was a reasonable use of its discretionary power. The expedience of the scheme of pollution control in this respect is discussed below.

A citizen does, however, have rights at common law, and by the exercise of these he could participate to some extent in the enforcement of pollution control standards established by the Courts. His rights at common law are severely limited, but a study of the law relating to pollution control would not be complete without referring to them. 'Common law' has been described as:

> those principles and rules which judges have recognised and will recognise as law, by virtue of their application of their common sense and their 'judicial approach' to the facts of the cases which come before them.[18]

The common law is, therefore, 'unenacted or judge-made law'.[19] If there were no legislative controls over pollution the only legal controls would be those existing under the common law which could be enforced by citizens in the Courts. Redress for an act of pollution, such as smoke or soot emissions into the air, or waste disposal into waters, or the dumping of solid waste on land, depends upon whether it is a type of action which the Courts would recognise as a 'legal wrong' or a 'tort'. Actions which are wrongs against the State, like the crime of public nuisance, are criminal wrongs, and will be discussed later. Civil wrongs are wrongs against particular individuals for which an affected individual might sue. The wrong or tort of private nuisance and the Ryland *v.* Fletcher tort (the collection and escape of material which causes damage) are the most important legal wrongs in the control of pollution under the common law.[20]

The common law by itself is an unsuitable instrument for the control of environmental pollution. A citizen's success in an action for private nuisance depends upon many factors. He must show that the wrong done to him was a consequence of the wrongdoer's action and that he has suffered some physical injury or economic loss as a result of the activity before he has legal standing to take proceedings. As he can often only prove his case after the damage has been caused, his remedy is normally compensation for his loss. If the injury or damage is imminent, or recurring, he might seek an injunction from the Court to prohibit the activity, if he can show it is likely to cause damage. However, an injunction is not easy to obtain. To prevent the activity occurring before the case is heard by the Court, it is often necessary to apply to the Court for an interlocutory injunction which, if granted, would prohibit the activity complained of until the substantive case could be heard. Before granting an interlocutory injunction, the Court will weigh the possible damage which might be caused by the activity against the inconvenience and economic loss to the wrongdoer of his having to cease the activity that is the subject of the dispute. In an action for private nuisance the defendant may have a good defence is he can show that he has done everything reasonable to abate the nuisance,[21] or that his activity is authorised by the law. The uncertainty of winning an action is a prohibitive factor when a citizen considers taking legal proceedings for nuisance. Whether a nuisance exists at law depends on the facts of each individual case, and a test case is unlikely to assist others in determining their chances of success. The expense and delay involved in each separate action for nuisance further prohibits reliance upon the common law for pollution control in any given area.[22]

A citizen could take an action for damages against a polluter if the act arose out of the negligent emission of the defendant. The plaintiff has the additional burden of showing that the defendant ought to have foreseen that the plaintiff would be affected by the emission; that the defendant acted negligently; and as a result of the negligence, the plaintiff suffered damage to his property, or injury to himself. In an action under the Rylands *v.* Fletcher doctrine — for damages caused by the escape of a dangerous thing, or material — the plaintiff must show that the defendant brought something onto his land which is not naturally there; which is likely to be dangerous if it escapes; and that damage resulted to him from its escape. In this action it is not necessary for the plaintiff to prove that the defendant could foresee the possibility of damage. This type of action is available to a citizen who can prove the emission of toxic pollutants, for example, but cannot show negligence on the part of the defendant.[23]

Public nuisance is a crime at common law. It is a wrong against the public as a whole or a recognised class of the public. Public nuisance has been defined as 'an act or omission which materially affects the reasonable comfort and convenience of life of a class of Her Majesty's subjects'.[24] The nuisance must affect a sufficient number of persons to constitute a class in every case. It is not necessary to prove every member of a class has been injuriously affected. It is sufficient to show that the conduct would probably cause 'annoyance, inconvenience or discomfort to the public; whether or not any person can be shown to have been so affected'.[25] Actions by citizens to prosecute individuals, companies, statutory bodies or governments for public nuisance have much scope. However, there are many practical difficulties which make actions for public nuisance an ineffective weapon on its own for the protection of the environment. First, citizens' proceedings for public nuisance must be brought, on behalf of the public, by the Attorney-General, who is a member of the Government. The citizens who initiate the action become the 'relators' in the proceedings. They must first obtain the consent of the Attorney-General to bring the proceedings. The consent is not always easy to obtain. The relators must show that the case is for the benefit of the public, and that the prospects of success are reasonable. Second, the government itself, because of the activities of any of its numerous agencies, might be one of the polluters. If the government is responsible for creating the nuisance that is the subject of the citizens' prosecution, not only do they have to overcome the problem of persuading the

Attorney-General to grant his fiat to prosecute his own ministerial colleagues and his government, but they must overcome any problems in running the case which the politics of the situation might present. One difficulty is that the Attorney-General's legal advisers are employed in the same department as the lawyers presenting the case on behalf of the Ministers and the government. In this situation the relators are powerless to prevent the conflict of interest which arises within the Attorney-General's Department itself. The relators cannot be assured that the Attorney-General, through his advisers, is directing the proceedings in the case in their interests.[26] In a recent case in Canberra the embarrassment to the Federal Government in having an action brought by the Attorney-General at the relation of a group of citizens against some of his own Ministers and the Commonwealth,[27] caused the Government to pass a special Ordinance before the case opened declaring that the Attorney-General's name is to be removed from all such relator actions.[28] The Ordinance states, however, that the change in the title of proceedings does not affect the Attorney-General's right to keep control of the proceedings. Third, from the time that the fiat is obtained, the Attorney-General controls the proceedings and must consent to the grounds upon which the case is fought. The relators are thus not free to run the case in accordance with their legal advice, yet they are responsible for retaining a lawyer, preparing the case, paying the legal costs and generally doing all things which would be necessary in a private action. The action is, therefore, expensive and time-consuming for the citizens. Finally, success on the part of the relators might bring a fine upon the defendant or an injunction order restraining him for carrying on his polluting activity. An injunction is particularly difficult to obtain if it involves, for example, the closure of a factory, loss of production or mass unemployment. Further, the action does not usually bring speedy results,[29] and the outcome is always far from certain.

In the various States of the United States of America the development of the concept of 'class actions' has substantially assisted citizens in fighting pollution through the Courts. In a class action, one person whose interest is invaded may sue, not only on his own behalf but also on behalf of all other persons similarly affected. The interested citizens, though not parties to the action, are more inclined to support the action by underwriting the legal costs, since they stand to benefit from the Court's decision. Further, the development of the public trust doctrine which affirms that the State holds its natural resources in trust for the public, grants to the citizens of the United States greater opportunity to prosecute corporations whose activities threaten to damage public property. The successful use of these doctrines has aided the development of a comprehensive body of common law in the United States dealing with pollution of the environment. But the whole legal system of the United States with reference to environmental control developed from an entirely different historical basis from that in Australia.[30]

At this late stage of Australia's development we cannot afford to wait for a full development of the common law relating to the environment before taking care of Australia's pollution problems. The development of common law in Australia has been slow and will continue to be slow partly as a result of the relatively high degree of administration it received as a British colony. Clark points out the active managerial role of the State governments in Australian environment control. He says:

> Basic decisions were taken by Australian society in the nineteenth century about the machinery for controlling the allocation of our natural resources. These decisions are now, I think, irreversible. The roles played by the different branches of government under our system are so fundamentally different from the situation which prevails in the United States as to render much of American theorising about the role of institutions practically irrelevant.[31]

He refers to the greater potential role of the Courts in the planning process in America and points out that the greater the government role is in granting administrative rights, the fewer rights individuals have against each other. Under our system, he says, individuals tend to think more in terms of rights against the government as grantor of resources than against their neighbours. He admits that the weakness in our system is the citizen's limited access to the courts to challenge government decisions.[32] So, given Australia's conditions and development, the most efficient way of dealing with its growing pollution problems is by the enacting in each State of comprehensive pollution control schemes.

Even in the United States the development of the law of pollution has been aided by the broadly based legislative enactments in the various States relating to all facets of the environment. Specific limits have been placed upon the emission of pollutants. Powerful government agencies have been established to enforce legislative standards and to apply substantial penalties against offenders. Time does not permit a study of the various State schemes for the control of pollution, a more detailed study of which is produced elsewhere.[33] It is interesting to note, however, that both Federal and State legislation in the United States of America cater for citizen participation in enforcing the enacted environmental standards. Citizen enforcement of the National Environment Protection Act, 1969 (N.E.P.A.), through Court action has been one of the main forces in making the Act's intended reforms a reality, according to the Third Report (1972) of the United States Council on Environmental Quality.[36] Some States (Massachusetts, Michigan and Indiana) have recognised the benefits of citizens' actions and assisted the development of the common law in the area of environmental quality by enacting legislation guaranteeing class actions and private citizens' law suits against public and private bodies. The Michigan Environmental Protection Act, for example, gives every public or private entity the right to sue any other public or private entity in State courts to protect the environment and the 'public trust' therein.

By contrast, as has already been pointed out, the tendency of the legislatures of the Australian States is to exclude the citizen from enforcing enacted environmental pollution control standards. There has been no legislation in N.S.W. granting citizens the standing they require to increase their rights to bring environmental law suits under the common law. However, there has been a growing trend in the Australian States and at the Federal Government level to encourage citizen interest and participation in policy and decision making as to matters which might affect the quality of the environment. For example, under section 5 and 10 of the Federal Environment Protection (Impact of Proposals) Act, 1974, a person may require the Minister to provide information as to what action, if any, has been taken for ensuring consideration of the environmental aspects of matters undertaken by the Australian Government or with the assistance of Australian Government funds which might significantly affect the environment. The Act provides for a full examination of those matters, and the Minister may, under section 11 of the Act, direct that an inquiry be conducted or an environmental impact statement be furnished in respect of any of them. Provision is made for taking evidence of witnesses for the purposes of an inquiry. In N.S.W. an Environmental Impact Statement Bill has been prepared. In most Australian States invitations are made to the public or any interested groups to provide written submissions relating to major works programs. Inquiries and Commissions have been set up prior to the formulation of proposals which might affect the environment, or to the carrying out of works and other projects. The tendency is, therefore, to encourage citizen participation and interest in community developments, programs and works before they affect the environment, and to discourage citizen participation in enforcing environmental quality standards in respect of the operation of existing works and industries.

# 5 The State versus local authorities

'I want to see planning restructured so that the central planning body can concentrate on broader policy issues, while the detailed implementation of policy is decentralised as much as possible', declared the Minister for Planning and Environment in 1974.[1] Just over a year later, in November 1975, the New South Wales Planning and Environment Commission (P.E.C.) published its *Report to the Minister for Planning and Environment,* which proposed that greater land-use planning powers and discretions be conferred upon local government councils. The new system was to apply over the entire State. It is ironic that although much of the administrative burden placed upon the Minister and his Commission arose from the rapidity of metropolitan growth and development, the *Report* did not single out the special planning and administrative needs of the Sydney region. Indeed, the P.E.C. declared at the beginning of its Report that one of its 'main difficulties' was the uncertainty existing over the form and function of regional agencies established under the Regional Organisation Act 1972. In short, was there to be an intermediate level of government interposed between the existing local and State governments? Accordingly, it appears that this uncertainty influenced the Commission to regard the option of a planning agency for the metropolitan region as a political question upon which it should not canvass opinion. Thus the forty-odd local government councils governing the 2,808,000 people (1971 census) in Sydney were to administer land-use controls in isolation from each other. They were to be guided by the 1968 Sydney Region Outline Plan, which is to be revised by the Commission. Here we are concerned to evaluate some of the consequences of this new planning system upon the existing local government administration that, in conjunction with State government agencies, manages wastes and controls pollutants in the metropolis.

## The government of the metropolis

The State Government provides the most important urban services in Sydney. These services include the provision of water and sewerage facilities, fire prevention and control, public transport, the provision of major roads and bridges, public schools and hospitals, port and wharfage facilities and police protection. Thus, as shown in Chapter 2, a vast array of State Government agencies administer the metropolis and affect activities in council areas. The more important of these agencies are the Metropolitan Water, Sewerage and Drainage Board, Metropolitan Waste Disposal Authority, State Pollution Control Commission, N.S.W. Planning and Environment Commission, Public Transport Commission, Department of Main Roads, Public Works

Department, Department of Education, N.S.W. Health Commission, Maritime Services Board, Police Department and the Housing Commission of N.S.W. The activities of these State agencies, considered together, have a major impact on metropolitan land use. Individually and collectively, these agencies will make decisions at the strategic metropolitan level that will generate overriding constraints on land use that, in turn, each local government council will find very difficult to modify to any significant degree, but for which it will have to share political responsibility. The assumption underlying the proposed new planning scheme is that each local government council is competent in powers, finance and expertise to cope with the pressures for urban change. This assumption is mistaken. In the light of the real powers held by the State Government agencies over land use in Sydney, it is unrealistic to expect that the proposals will be an improvement in the administration of Sydney planning. On the contrary, it seems that the Coalition Government scheme would significantly worsen the administrative system of Sydney. The agencies listed are functionally segregated in their respective activities, and in order to get their jobs done, policy making and decision making in relation to Sydney local government councils will be increasingly disintegrated rather than more integrated. The State Coalition Government recognised the interrelationship of land-use planning and its environmental consequences through the establishment of the N.S.W. Planning and Environment Commission. But it did not acknowledge publicly that, politically speaking, the major decisions about Sydney were to be taken under this new scheme at State, not metropolitan or local level. The building of the new port at Botany Bay is an obvious example of this political reality. The logical step would have been to grant significant powers of coordination over State agencies to the P.E.C., not to disaggregate and disperse decision making to local councils.

The numerous metropolitan activities pursued by State agencies leaves little to be done by local government. Those functions remaining for local governments to administer in Sydney are 'house-keeping' tasks delegated by the State Government. These include maintenance of local roads, gutters and footpaths, public health, nuisance and safety controls, enforcement of building codes, garbage collection and disposal, and in some unsewered areas excreta collection and disposal, and provision of minor welfare and recreation facilities. As already indicated there is a proposal to confer greater powers and responsibilities upon local governments for local land-use planning.

But the division of tasks to be performed by the two levels of government, State and local, is not the full administrative story. The State Government governs local government. State Government agencies supervise, to varying degrees, the activities of each local government council. The N.S.W. Health Commission, as did its predecessor, oversees local councils in their work of protecting public health and controlling nuisances. As shown in Chapter 1, this represents an early phase in pollution control. Further, the S.P.C.C., the P.E.C. and the M.W.D.A. in their own spheres of interest each have a strong interest in aspects of local government administration in Sydney that are of direct relevance to us here. Additionally, the Department of Local Government exercises a close supervisory role over local governments. It audits local government accounts, supervises their raising of loans (which in turn must be coordinated with Commonwealth and State borrowings) and their elections, enforces minimum staff qualifications and minimal road maintenance and adjudicates inter-council disputes. Moreover the Department makes ordinances under the Local Government Act of 1919 which set out in detail the way in which local government is to work. Any council may be dismissed by the Minister for Local Government for inefficiency, suspected corruption and malpractice, and an Administrator may be appointed in its place to run its affairs.

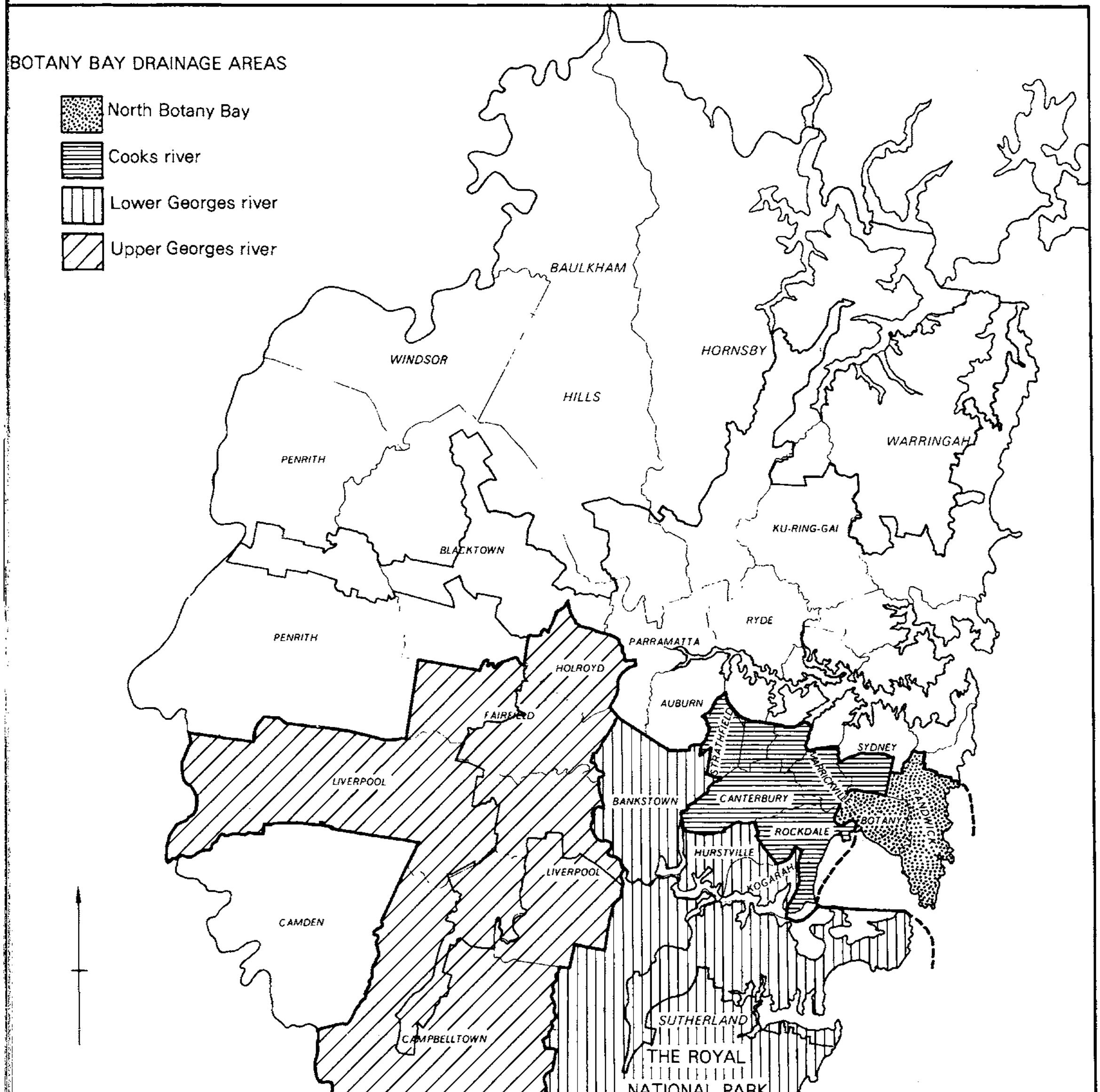
Local governments individually are constrained in what they might do by the existence of powerful State agencies, statutes, restricted incomes and staff numbers. But collectively they are important in managing wastes and controlling pollutants. The aggregate activity of the councils in these areas is, in fact, very large. As Chapter 3 shows, the combined outlays of the forty local authorities in the Sydney Statistical Division on pollution control/waste management amounted to $30.8 million in 1971/2. This expenditure was approximately 20 per cent of the total on these functions for the metropolitan region. It ranked second in importance to the M.W.S. & D.B., which spent $119.8 million, and far above the expenditures of the then Department of Health, in third place with a mere $0.90 million.

## Waste generation in the Botany Bay drainage basin

The seventeen local government councils in the Botany Bay drainage basin have been grouped into four drainage areas which we have called Cooks River, North Botany Bay, and Lower and Upper Georges River (see Fig. V-(1). This grouping is consistent with that used elsewhere in this volume.

Because of its land use and population characteristics this southern area of Sydney generates large volumes of wastes. These wastes, as in any large city, need to be managed comprehensively in long term if their polluting impact upon urban amenity is to be mitigated or avoided, because only limited urban space is available for waste disposal. We may obtain a broad picture of the concentrations of wastes generated in the Botany Bay drainage basin by comparing it with the Sydney Statistical Division. We use statistics from the 1971 census. Our seventeen local governments occupy 35 per cent of the area of the Division, but contain about 48 per cent of its population, 47 per cent of the total occupied private dwellings, 50 per cent of manufacturing establishments, and about 46 per cent of the estimated private motor vehicles. About 14 per cent of the dwellings in the basin are without sewerage, compared with about 18 per cent for the Division as a whole.

This aggregate picture masks the wide variations in area and land use, and hence the kind and severity of pollution control problems existing in individual local government areas in the Botany Bay drainage basin. Thus we see from Table V-(1) that South Sydney, the third smallest in area, has about 51 per cent of its area devoted to industrial land use; Botany, the fifth smallest, has about 20 per cent of its land occupied by industry. Nine local governments, including the two smallest (Ashfield, Burwood) and the three largest (Sutherland, Liverpool, Campbelltown) have less than 5 per cent of their land area under industrial land use. The table illustrates industrial concentration in another way: five local governments have less than 60 occupied dwellings for each manufacturing establishment within their respective areas. At the other end of




ig. V (i) Sydney region local government areas the scale, a further five councils have over 140 dwellings for each manufacturing establishment. Table V-(2) illustrates the share of some waste generating sources among the seventeen local governments. The Cooks River drainage area has one-third of the population in the Botany Bay Basin but well over three-fifths of the manufacturing establishments; its private dwellings are almost entirely sewered. The Lower Georges River drainage area takes second place in population and manufacturing, but has the largest proportion of unsewered dwellings and private motor vehicles.

But the table shows a static picture: the pressures of urban growth on the western edge of Sydney make the Upper Georges River drainage area potentially a much more significant source of wastes from households, industry,

Table V-(1) Botany Bay drainage basin: general characteristics of local government areas, 1971.

| | Area (sq km) | Population | Total occupied private dwellings | Manufacturing establishments | Total occ. private dwellings/ manufacturing establishments | Industrial land as % of total LGA land use | Estimated private motor vehicles garaged at dwelling | % of occupied dwelling on mains sewer |
|---|---|---|---|---|---|---|---|---|
| 1. Cooks River drainage area | | | | | | | | |
| South Sydney | 10.53 | 38,916 | 12,273 | 642 | 19.1 | 51.7 | 5,261 | 95.0 |
| Marrickville | 16.48 | 96,796 | 30,455 | 681 | 44.7 | 11.2 | 17,855 | 94.0 |
| Ashfield | 8.29 | 44,910 | 14,990 | 83 | 180.6 | 2.6 | 11,240 | 96.5 |
| Burwood | 7.25 | 31,888 | 10,005 | 70 | 142.9 | 3.6 | 8,104 | 97.3 |
| Strathfield | 14.07 | 27,167 | 7,992 | 102 | 78.4 | 11.9 | 8,950 | 98.0 |
| Canterbury | 33.39 | 130,446 | 41,165 | 364 | 113.1 | 6.2 | 41,140 | 98.1 |
| Rockdale | 29.33 | 84,232 | 27,446 | 343 | 80.0 | 4.8 | 28,892 | 98.0 |
| | 119.44 | 454,355 | 144,326 | 2,285 | 63.2 | 11.2 | 121,442 | 96.7 |
| 2. North Botany Bay drainage area | | | | | | | | |
| Botany | 17.89 | 38,236 | 11,801 | 402 | 29.4 | 20.3 | 11,305 | 97.0 |
| Randwick | 34.36 | 123,865 | 40,208 | 130 | 309.3 | 5.9 | 33,955 | 97.3 |
| | 52.25 | 162,101 | 2,009 | 532 | 97.8 | 11.2 | 45,260 | 97.2 |
| 3. Lower Georges River drainage area | | | | | | | | |
| Bankstown | 77.78 | 162,730 | 44,251 | 797 | 55.5 | 8.5 | 48,746 | 88.4 |
| Hurstville | 24.77 | 67,143 | 20,554 | 399 | 51.5 | 3.9 | 24,333 | 93.8 |
| Kogarah | 19.51 | 47,197 | 14,897 | 172 | 86.6 | 1.2 | 18,376 | 97.8 |
| Sutherland | 370.37 | 151,574 | 43,529 | 371 | 117.3 | 1.3 | 54,673 | 48.1 |
| | 492.43 | 428,644 | 123,231 | 1,739 | 70.9 | 2.6 | 146,128 | 76.2 |
| 4. Upper Georges River drainage area | | | | | | | | |
| Holroyd | 39.25 | 77,317 | 21,491 | 176 | 122.1 | 15.3 | 23,631 | 86.3 |
| Fairfield | 96.27 | 113,053 | 28,944 | 340 | 85.1 | 2.6 | 30,183 | 72.3 |
| Liverpool | 313.82 | 82,447 | 18,649 | 129 | 144.6 | 0.6 | 18,183 | 73.4 |
| Campbelltown | 311.78 | 34,235 | 8,665 | 38 | 228.0 | 0.1 | 9,965 | 40.7 |
| | 761.12 | 307,052 | 77,749 | 683 | 113.8 | 1.4 | 81,962 | 72.9 |
| Total Botany Bay | 1425.2 | 1,352,152 | 397,315 | 5,239 | 75.8 | 3.0 | 394,792 | 85.8 |
| Total Sydney Statistical Division | 4075 | 2,807,828 | 845,714 | 10,475 | 80.7 | 2.1 | 850,515 | 82.1 |

Source: 1971 Census; *Sydney Area Transportation Study,* Vol. 1, p. II-6, N-31.

retail establishments and transport than would appear from these statistics. As Table V-(3) shows, this drainage area contains 88 per cent of the non-urban and vacant land in the Botany Bay drainage basin. As the metropolis expands this land will change from rural to urban uses. Houses, shops, factories and transport will generate wastes that will have an impact on the existing air, water and land environments. Some of these wastes, notably in the case of wastes discharged to air and water, will spill over from the local government area in which they were generated. This certainty illustrates the fundamental difficulty in the proposal to transfer greater land-use planning responsibilities to local governments. Land-use planning is a means of regulating growth and change in the metropolitan region, on the assumption that uncontrolled urban growth

Table V-(2) Sub-area shares for selected statistics as a percentage for the Botany Bay drainage basin, 1971

| | Population | Occupied private dwellings | Unsewered private dwellings | Private motor vehicles | Manufacturing establishments* |
|---|---|---|---|---|---|
| 1. Cooks River drainage area | | | | | |
| South Sydney | 2.9 | 3.1 | 0.4 | 1.3 | 12.3 |
| Marrickville | 7.2 | 7.7 | 0.9 | 4.5 | 13.0 |
| Ashfield | 3.3 | 3.8 | 0.3 | 2.8 | 1.6 |
| Burwood | 2.4 | 2.5 | 0.1 | 2.1 | 1.3 |
| Strathfield | 2.0 | 2.0 | 0.1 | 2.3 | 1.9 |
| Canterbury | 9.6 | 10.4 | 0.6 | 10.4 | 6.9 |
| Rockdale | 6.2 | 6.9 | 0.3 | 7.3 | 6.5 |
| | 33.6 | 36.4 | 2.7 | 30.7 | 43.6 |
| 2. North Botany Bay drainage area | | | | | |
| Botany | 2.8 | 3.0 | 0.3 | 2.9 | 7.7 |
| Randwick | 9.2 | 10.1 | 0.8 | 8.6 | 2.5 |
| | 12.1 | 13.1 | 1.1 | 11.5 | 10.2 |
| 3. Lower Georges River drainage area | | | | | |
| Bankstown | 12.0 | 11.1 | 9.7 | 12.3 | 15.2 |
| Hurstville | 5.0 | 5.2 | 2.3 | 6.2 | 7.6 |
| Kogarah | 3.5 | 3.7 | 0.4 | 4.7 | 3.3 |
| Sutherland | 11.2 | 11.0 | 44.7 | 13.8 | 7.1 |
| | 31.7 | 3.10 | 57.1 | 37.0 | 33.2 |
| 4. Upper Georges River drainage area | | | | | |
| Holroyd | 5.7 | 5.4 | 5.7 | 6.0 | 3.4 |
| Fairfield | 8.4 | 7.3 | 14.9 | 7.6 | 6.5 |
| Liverpool | 6.1 | 4.7 | 8.4 | 4.6 | 2.5 |
| Campbelltown | 2.5 | 2.2 | 10.2 | 2.5 | 0.7 |
| | 22.7 | 19.6 | 39.2 | 20.7 | 13.1 |
| | 100.1 | 100.1 | 100.1 | 99.9 | 100.1 |

Source: 1971 Census; *Sydney Area Transportation Study*, vol. 1, p.II-31 Sydney, 1974; Australian Bureau of Statistics, *N.S.W. Handbook of Local Statistics 1974*, Sydney 1974.
* 1971/72.

produces undesirable social, economic and physical effects. Today we see clearly some of these undesirable effects in the processes that generate pollutants. As pollution is a condition arising from discarded wastes being concentrated at particular locations, then obviously one preventive device is to employ control over land use to constrain the development of pollution problems. Individual local government councils, even if they possessed the resources and expertise, and, as pointed out above, the power to influence the numerous State Government agencies administering the metropolis, are fundamentally incapable of evaluating the capacity of the existing metropolitan environment to absorb changes because they administer only a small part of Sydney. Each local council has a local eye-view, not a metropolitan-wide vision. Indeed, the force of the argument for State regional agencies rather than local councils administering particular urban activities is recognised in the existence of the M.W.S. & D.B. and, more recently, the founding of the Metropolitan Waste Disposal Authority in 1971.

Table V-(3) Botany Bay drainage basin: land use, 1971 (%)

| | Residential | Industrial | Retail | Office & commercial | Other committed | Non-urban and vacant | Total |
|---|---|---|---|---|---|---|---|
| 1. Cooks River drainage area (7 LGAs) | 27.37 | 30.87 | 32.09 | 41.35 | 4.32 | 0.46 | 8.25 |
| 2. North Botany drainage area (2 LGAs) | 7.32 | 15.21 | 13.18 | 8.46 | 4.52 | 0.83 | 4.05 |
| 3. Lower Georges River drainage area (4 LGAs) | 40.61 | 28.55 | 33.46 | 31.08 | 48.36* | 10.71 | 32.24 |
| 4. Upper Georges River drainage area (4 LGAs) | 24.70 | 25.37 | 21.27 | 19.11 | 42.80* | 88.0 | 55.46 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Total hectares | 26,418 | 4,162 | 621 | 335 | 56,357 | 51,792 | 139,685 |
| Per cent of total | 18.91 | 2.98 | 0.44 | 0.24 | 40.35 | 37.08 | 100.00 |

Calculations Derived from *Sydney Area Transportation Study*, vol. 1, p. II-6, Sydney, 1974.
* Includes land in Royal National Park and for military reserve.

## Local government resources in the Botany Bay basin

A perennial difficulty for each local government is that of obtaining funds to pay for their community services. On the one hand local governments are faced with spiralling costs from wage determinations, fuel price increases, construction material price rises and other inflationary pressures which are beyond local control. On the other hand many have instituted new services for their communities, especially in social welfare. Consequently local budgets have become strained. Local government expenditures in the Botany Bay drainage basin for 1973 are displayed in Table V-(4). The proportion of expenditure under each head for each drainage area is roughly the same: about 8-9 per cent on administration, 14-15 per cent on public services, about 21-2 per cent on public health administration with the exception of Upper Georges River (about 15 per cent). The share of expenditure on public works is about 38-41 per cent, with Lower Georges River spending about 34 per cent.

Table V-(4) Local government council expenses, Botany Bay drainage basin, December 1973 ($)

| | Administration | Public works | Public Health administration | Public services | Other expenses | Total council expenses |
|---|---|---|---|---|---|---|
| 1. Cooks River drainage area (7 LGAs) | 2,174,485 | 10,335,485 | 5,878,099 | 3,810,074 | 4,371,757 | 26,570,108 |
| 2. Northern Botany Bay drainage area (2 LGAs) | 732,889 | 3,280,396 | 1,852,321 | 1,335,482 | 1,356,630 | 8,557,718 |
| 3. Lower Georges River drainage area (4 LGAs) | 2,419,309 | 9,022,062 | 5,931,794 | 4,223,226 | 5,085,100 | 26,681,491 |
| 4. Upper Georges River drainage area (4 LGAs) | 1,610,947 | 7,090,882 | 2,621,382 | 2,507,679 | 3,249,539 | 17,080,429 |
| **Total** | 6,937,630 | 29,729,033 | 16,283,596 | 11,876,461 | 14,063,026 | 78,889,746 |

Source: Australian Bureau of Statistics, unpublished data.

The financial alternatives faced by councils are to limit or curtail services, increase borrowings, or obtain additional revenues. The first is difficult, given the public demand for an extension of local services. Second, increased borrowing would require a higher proportion of the rates being allocated to service the debt burden, as has occurred already.[2] From a local perspective, then, the most attractive alternative is to obtain additional revenues by an alteration of the present financial system. Under the new personal income tax sharing arrangements being devised in 1976, the Commonwealth supports the principle of granting assistance to local governments. However, for the immediate future, the magnitude of this financial assistance will depend upon the priority this outlay is accorded in the Commonwealth budget. In long term there may be prospects for a relative increase in the share of funds passed from the Commonwealth through the States to their respective local governments. The question is whether such grants will represent a significant proportion of local government revenues. If they do not, then local governments will continue to rely on property rates, from which the bulk of their income is drawn, to finance their services. This raises issues of effectiveness and equity. As the secretary of the Local Government Association of N.S.W. put it: 'the rating system is simply not capable of meeting the cost of the range of services expected of local government today'.[3]

Local governments have little control over the basis of their principal form of taxation: the State Valuer-General's Department assesses the unimproved capital value (U.C.V.) of properties in each council area. Assessment is a slow process. Accordingly there has been a time-lag of several years in the up-dating of valuations to accord with changes in property values, though this lag is being reduced. Hence local governments are unable to increase their potential income to keep pace with the rate of increase in their expenditures. Individual local councils may increase the rate paid in the dollar, but there are political risks in their so doing. The inequality of this form of taxation has been pointed out elsewhere. We refer readers to *A Handbook of the Botany Bay Region.*[4] It is sufficient to state here that property rates tend to be regressive in their incidence, that is, lower income earners tend to pay proportionately more by way of property rates than do higher income earners. Not only is this tax regressive between property earners within a municipality but also between municipalities themselves in the metropolitan region generally. The marked residential segregation of rich and poor is a geographical feature graphically displayed by Davis and Spearritt in their social atlas *Sydney at the Census: 1971.*[5] In short, the tendency is that in the areas of greatest need, land valuations are lowest, while in areas of least need valuations are highest. The implication of this for the less well endowed local councils in the southern half of Sydney is that they will lack the resources to cope with the increased planning powers proposed for them by the State Government. The valuations, rates and income of the councils in the Botany Bay drainage basin are displayed in Table V-(5). Moreover, given the concentration of waste-generating activities, particularly industry, in southern Sydney, the need for greater access to resources is greatest if urban environmental quality is to be ameliorated in long

Table V-(5) Botany Bay drainage basin: valuations, rates and income of local government councils, 1971

| | Unimproved capital value $000 | U.C.V. per capita | General rate in $ on U.C.V. (cents) | Total rates levied (general and special) | Total rates per capita |
|---|---|---|---|---|---|
| 1. Cooks River drainage area | | | | | |
| South Sydney | 137,639 | 3536.8 | 2.100 | 2,878,152 | 73.96 |
| Marrickville | 168,870 | 1744.5 | 1.830 | 2,985,072 | 30.84 |
| Ashfield | 71,271 | 1587.0 | 1.900 | 1,326,439 | 29.54 |
| Burwood | 83,602 | 2621.7 | 1.390 | 1,150,459 | 36.08 |
| Strathfield | 63,201 | 2326.4 | 1.450 | 917,886 | 33.79 |
| Canterbury | 249,640 | 1913.7 | 1.600 | 3,782,845 | 29.00 |
| Rockdale | 182,839 | 2170.6 | 1.400 | 2,600,500 | 30.87 |
| 2. North Botany drainage area | | | | | |
| Botany | 91,214 | 2385.5 | 1.600 | 1,491,357 | 39.00 |
| Randwick | 198,361 | 1601.4 | 1.400 | 2,911,869 | 23.51 |
| 3. Lower Georges River drainage area | | | | | |
| Bankstown | 214,476 | 1318.0 | 2.300 | 4,991,408 | 30.67 |
| Hurstville | 139,312 | 2074.8 | 1.250 | 1,914,769 | 28.52 |
| Kogarah | 145,075 | 3073.8 | 0.918 | 1,294,235 | 27.42 |
| Sutherland | 289,332 | 1908.8 | 1.548 | 4,466,099 | 29.46 |
| 4. Upper Georges River drainage area | | | | | |
| Holroyd | 121,510 | 1571.6 | 1.700 | 2,032,694 | 26.29 |
| Fairfield | 115,305 | 1020.0 | 2.300 | 2,564,876 | 22.69 |
| Liverpool | 151,798 | 1814.2 | 1.750 | 2,722,594 | 33.02 |
| Campbelltown | 151,798 | 1058.7 | 2.432 | 1,300,553 | 37.99 |

Source: N.S.W. Statistical Register, *Local Government 1971*, Australian Bureau of Statistics, Sydney, 1974.

term. At this point the argument for a metropolitan land use planning agency which is able to look beyond existing land uses within a single municipality acquires greater force.

We now turn to human resources. Obviously the ability of each local council to recruit qualified and experienced planners is constrained by the availability of finance. There may be greater difficulties for the future given that administrative costs are rising disproportionately to other council costs.[6] Moreover, there are insufficient planners. In 1975 the Planning and Environment Commission admitted: 'A shortage of planning staff must be contemplated for some time to come'.[7] Despite this fundamental deficiency, the Commission recognised the concentration of planning activity in the metropolis. Councils in the Sydney region employed about three-quarters of all qualified planners working in local government in New South Wales. Further, about two-thirds of Sydney councils had separate planning departments, while the average workload of metropolitan councils in respect of processing development consents was over twice the average of all councils in the State.[8] The need for planning in Sydney is accepted: under the circumstances of existing scarce resources, the obvious step could have been to pool council planning resources within the metropolis. Again, this points to a metropolitan planning agency.

It is strange that the N.S.W. Planning and Environment Commission neglected the views of a recent State Government inquiry. If the State Government wishes to increase local government responsibility for planning, then, as a minimum requirement, it would need to make additional changes to ensure that local councils had adequate resources and larger planning areas. Indeed, these changes were argued in 1973 by the Barnett Report on local government administration: 'Planning is assuming an ever increasing importance with population growth and the expansion of urban areas and it is vital that councils have the areas and resources that will enable them to make proper planning decisions.'[9] It is hard to escape the conclusion that the State Government has been merely tinkering with the existing planning system as a means of transferring political odium from itself to local government.

Arguments may be advanced on the ground of public interest, that local council powers be diminished, not increased. The Barnett Report itself reported the evidence of the former chairman of the State Planning Authority who had said that many councils had failed to discharge their planning responsibilities effectively. 'Many councils made planning decisions without proper technical advice', the Report declared; 'few councils had adequate technical organisations to discharge their responsibilities under the statutory planning provisions of part XIIA of the Local Government Act, 1919.'[10] The Commonwealth Commission of Inquiry into Land Tenures, chaired by a Judge of the N.S.W. Land and Valuation Court, also questioned the effectiveness of existing local government planning: 'Because of their subordinate level in government and small size, local authorities find it difficult to recruit staff on a scale and at a level which will support high standards of planning and development controls'.[11]

The Commonwealth Inquiry put its finger on one of the difficulties of the existing system: 'Local government planning controls are also notoriously subject to political pressures and uncertainty'. Land-use planning, by its very nature, in general requires a long-term perspective. Thus, local councillors, who are elected for a short term of office, may be required by their planning officers to hold in their minds as it were, a self-denying ordinance. In practice, short-term gains may frequently prove more attractive. Moreover, as Loveday suggests, despite the rhetoric about local government being closest to the people, the councillors elected appear to be drawn overwhelmingly from the sections of the population that have significant land-use interests to protect and advance.[12] In short, private interests may tend to override public interest. This raises the issue: how representative, and, therefore, how responsive to needs, are metropolitan local councils of groups living within their boundaries? In so far as some local councils are not sufficiently responsive or representative, partly through the council electoral system favouring well-organised groups, partly through the unexciting, routine nature of local government activity, partly through the apathy of voters at local elections, then a likely consequence of the Coalition Government proposal to grant increased local planning powers would be to accentuate the powers of groups that are primarily interested in using the institution of local government for their own narrow, if legitimate, ends.

**Local government waste management activities**

The thrust of the argument in this chapter is that the management of the Sydney metropolis is so complex and the planning of land use so fundamental to effective management that local councils are inappropriate agencies in terms of their small size, limited resources, experience, outlook and dominance by certain groups to acquire greater planning powers. This argument is stronger given the current concern to protect the urban environment by incorporating this objective into planning. Further, the existence of separate State agencies has substantial impact upon metropolitan land use which individual local councils are powerless to manage. The decision of the Maritime Services Board to construct a port on the northern shores of Botany Bay illustrates this problem. The real need is for an agency that has overriding powers to coordinate State agencies to ensure that they work within a common strategy, chiefly to attempt to avoid serious mistakes.

However, there is an important role for local councils to play in the provision and delivery of local services. Of relevance here are controlling and managing wastes. Generally speaking each local council is organised into departments of Health and for Building, Town Planning and Engineering according to that council's needs, objectives and resources. The Health Department in each council, which is staffed by qualified health inspectors, is concerned with routine pollution control and waste management. The responsibilities of inspectors are diverse, including control over nuisances in general as well as controlling immediate threats to public health. Nuisances may include howling dogs, trucks bypassing major roads, fire hazards, illegal dumping of offal, noise from building sites and so on. In co-operation with officials from the Health Commission, local inspectors conduct routine investigations of, for example, shops and restaurants, abbattoirs, theatres and public halls, garbage tips, drains and sewers and excreta disposal depots.

It is important to stress the existing administrative system: State Government agencies formulate policies and standards and their officers supervise local council activities. In many respects the line between State and local levels of government is blurred: local government functions as an arm of the State administration. This administrative system is clearly seen in the areas of public health, pollution control and solid waste management, which are the areas of responsibility of the Health Commission, S.P.C.C. and the M.W.D.A. respectively.

Following the recommendations of the Barton Report in 1970, the administration of solid waste management in Sydney was changed. The M.W.D.A., founded in 1971, is given responsibility 'with respect to the transport, collection, reception, treatment, storage and disposal of waste' within the Sydney metropolis.* Local governments are, therefore, in the position of an administrative arm of the Authority: they retain responsibility, if not power, for the operation of the garbage collection service. The Authority has power to direct councils to dump their wastes at new or existing garbage tips, or at waste transfer depots for temporary storage pending their transport to a tip, or to the Waverley-Woollahra incinerator.

* For a discussion of the M.W.D.A. in the State administrative context, see Chapter 2, and as a waste management authority, see Chapter 10.

Theoretically speaking, the M.W.D.A. is the key policy- and decision-making agency for metropolitan solid wastes. Because of its recent establishment it has had no dramatic impact on councils' waste disposal activities. Its immediate concern is to ensure that all Sydney councils have adequate disposal facilities for the short term 1975-8, which it designates as Phase I of its management planning. Phase II is to cover the longer term up to the 1990s. The Authority, in exerting its powers of persuasion and direction in order to fulfil its strategy of coordinating solid waste disposal in the metropolis, has encountered political difficulties because of the division of responsibilities between the councils and the Authority. Not only are there substantial differences in geographical

Table V-(6) Full-time council employees and salaries, 28 November 1973

| | Administration | Construction and maintenance | Sanitary and garbage | Others | Total employees | Total gross salaries $000 |
|---|---|---|---|---|---|---|
| 1. Cooks River drainage area (7 LGAs) | 508 | 944 | 480 | 580 | 2,512 | 13,630 |
| 2. Northern Botany Bay drainage area (2 LGAs) | 142 | 263 | 189 | 184 | 778 | 4,363 |
| 3. Lower Georges River drainage area (4 LGAs) | 512 | 875 | 321 | 397 | 2,105 | 12,157 |
| 4. Upper Georges River drainage area (4 LGAs) | 391 | 464 | 102 | 328 | 1,285 | 7,313 |
| | 1,553 | 2,546 | 1,092 | 1,489 | 6,680 | 37,463 |

Source: Department of Local Government, Ordinance 96, Return of Persons Employed and Salaries and Wages Paid.

perspective, the local as against the metropolitan, and in powers but also in financial responsibility. Each council bears the political responsibility for imposing garbage service charges on its rate-payers. As garbage collection is labour intensive, costs for this service will rise. Table V-(6) indicates the number of workers employed by councils in garbage and excreta collection, but it does not show an accurate picture of costs as the table does not show the employees of private garbage contractors. Moreover, as available landfill sites diminish in the inner areas of Sydney, many councils will have to bear additional costs of transportation to more distant landfill sites on the edge of the sprawling metropolis. In short, the implementation of a regional plan will affect councils differently: it burdens some but assists others. The problem of equity arising from solid waste management costs might eventually favour the introduction of a uniform charge for the disposal of household garbage.

The position of the Canterbury Council, lying largely within the Cooks River drainage area, may be cited as an example of the impact of the Authority in implementing Phase I of its management plan. In 1974, the Council purchased a $600,000 garbage shredder for its own use and planned to install a magnetic separator to extract tin plate. These purchases were designed to extend the life of their tip at Salt Pan Creek (a backwater of the George's River) to 7-10 years, accelerate bacterial decomposition while reducing liquid run-off (leachate) and odour problems, and offset tipping costs through the sale of tin plate and other recovered scrap metals. Canterbury also had a leasing arrangement with Concord municipality, whereby the latter sent its wastes to Salt Pan Creek for an annual fee. Phase I, however, directs the wastes from Ashfield, Rockdale, Burwood and Canterbury municipalities to Salt Pan Creek and diverts Concord's wastes to a depot transfer station in Strathfield municipality. This proposal may increase liquid run-off, odour and public health nuisances at the tip site if existing facilities are overloaded. It additionally shortens the tip life by 5-7 years, which will later force Canterbury to pay higher transport costs to dump at outlying areas, although the council is permitted to receive disposal fees from councils using its tip.

Councils are fairly uniform in the garbage services provided to households. In general, collections are twice weekly. Officially one can for each household is allowed per trip, although in practice this limitation is not imposed in most areas. Clean-up campaigns, in which residents leave bulky items for free removal every three or four months, are also conducted by some local councils. In other municipalities a schedule system is used, whereby residents arrange for a 'free' removal by appointment. Special services include the removal of yard cuttings, free (or minimal charge) access to tips and the opening of tips for longer hours. These latter services are designed to reduce backyard burning and roadside dumping. Councils are also responsible for maintaining the condition of their garbage dumps and for deciding what form of waste may be accepted at their respective dumps, subject, of course, to the overriding powers of the Health Commission and the S.P.C.C. In 1969, for example, the forerunner of the Health Commission prevented the dumping of industrial liquid wastes at council land fill sites. Solid trade wastes are generally accepted at local tips on payment of a fee. Councils either provide their own garbage disposal services to commercial establishments at profitable rates or ensure that private contractors meet local collection and disposal standards.

Increasing costs of providing garbage services are forcing councils to make administrative and financial changes. For example, some councils are changing from day-labour to contractual arrangements with private garbage collectors as a means of reducing costs, absenteeism and strikes. Other councils are using compaction vehicles in order to reduce transportation costs.

Of diminishing importance with the spread of the M.W.S. & D.B.'s sewers is the collection and disposal of excreta and household waste water by local councils. Within the Botany Bay region the two localities that have significant proportions of unsewered dwellings are the Lower and Upper Georges River drainage areas (see Table V-(1)), in particular the local governments of Bankstown, Sutherland, Holroyd, Fairfield, Liverpool and Campbelltown. There are two forms of council collection service: first, a regular pump-out collection by tanker from septic tanks filled with household waste water and excreta; second, the collection of excreta contained in what are colloquially called 'dunny' cans. Both forms of waste are disposed either into sewer mains or by burial in the earth.

**Local council pollution control activities**

As we indicated above, local government councils, in conjunction with State public health authorities, have traditionally been responsible for controlling wastes which had become nuisances or potential health hazards to residents within their respective localities. This policing function had once been intermittent, dealing with diverse problems. With the advent of the Clean Air Act, 1961, the Clean Waters Act, 1970, and the Noise Control Act, 1975, and the accompanying build-up of pollution control specialists, particularly in the S.P.C.C. during the last few years, the policing role of local government officers has become more specific towards particular sources of wastes and correspondingly more important as an administrative network for the State in the detection of offenders. Further, local governments have statutory responsibilities concurrent with those of the S.P.C.C., as for example the control over industrial establishments which are minor sources of air pollution and control over 'offensive noise', which by its nature may be random in its occurrence in time and place.

Given the complexity of pollution and its control, such as the cumulative process of chemical degradation of air and water, the variety of waste sources and their particular geographic concentration within the metropolis, individual local governments by themselves are inadequate control authorities even within their own boundaries. As indicated above, metropolitan local governments are relatively small in size, have restricted financial resources and limited legislative powers. Moreover, the most appropriate pollution control officers under the existing administrative arrangements within local government are health inspectors. The professional training and administrative duties of these officers are oriented to ameliorative rather than preventive goals. For example, health surveying courses, as they are called, stress competence in building construction theory, food hygiene, the keeping of records, community relations and public administration. Further, health inspectors spend only a small fraction of their time in waste control activities. On the other, the N.S.W. pollution control legislation is technologically-oriented, demanding a highly specialised staff who are concerned with the setting of standards, the monitoring of pollutants, gathering data on sources of pollution and policing their Acts and Regulations. Despite the centralisation of policy making within the S.P.C.C. the existing system is dependent upon co-operation from local government in reporting offenders and in helping to enforce standards.

Inspection duties within local governments are routine. Specific problems and complaints by residents are coped with as they arise. Local officers fit in together on their rounds of inspection of air- and water-borne waste sources, inspection of garbage dumps and building investigations. Specialisation in pollution control is, therefore, limited. In general these inspections are conducted to control immediate nuisances and public health hazards rather than to prevent the emergence of future waste and pollution problems. When offenders are discovered the preferred control technique is persuasion. Occasionally, intermittent offenders are first contacted and requested to cease their offending activities, a procedure that is successful for most households and the majority of businesses. A more stringent order is to serve notice, which requires compliance by a specified date after which time prosecution is threatened. Although councils may serve notice on the occupants of households, shops or industrial establishments, or initiate legal proceedings under the head of statutory nuisances, the time, expense, the technical expertise required from specialist witnesses as well as loopholes in laws make prosecution a cumbersome and often an unsuccessful process. Where offences are adjudged to warrant stronger action beyond the powers of local government, council officers inform the S.P.C.C. of the violation.

Local health inspectors by training and experience are more familiar with public health aspects of water quality than other types of pollution. Specific water-borne waste or control activities include the surveillance of water courses and council stormwater drains, the serving of notices regarding the discharge of liquid wastes into council property, and the removal of debris. Water samples are collected for a variety of purposes, such as a check on the faecal contamination of bathing waters (river, sea and swimming pools), on the quality of watercourses, and on the liquid run-off from garbage dumps and excreta disposal depots.

As Chapter 6 shows, water-borne wastes come from diverse sources: unsewered houses and commercial and industrial premises, illegal discharges and dumping of rubbish into waterways, accidental spillages, sewer overflows and urban run-off from paved surfaces during wet weather. The nature of these man-made and wet weather sources are such that management by local councils is impossible. For example, sewer overflows occur after severe storms and vary in frequency and intensity between years. Moreover, local governments have little impact on the extension of sewers and the location of overflow valves and pumping stations. Some water-borne wastes affecting particular municipalities are discharged in adjoining or more distant local government areas. The four councils comprising the Lower Georges River drainage area (Bankstown, Hurstville, Kogarah and Sutherland) face problems from algal blooms stimulated by nutrients in sewage effluents discharged from upstream treatment works at Glenfield and from turbid water caused by sand mining at Chipping Norton in the Liverpool municipality, housing subdivision and river bank erosion.

Because councils are concerned with their responsibilities within their own geographic area there are no strong working relationships at an official council level in water pollution control. However, health inspectors jointly patrol adjacent waterways and exchange information on offenders or major pollution problems in that vicinity. But there are organs for inter-council co-operation. Thus, the Georges River Combined Councils Water Pollution Control Committee, comprising Liverpool, Rockdale, Kogarah, Sutherland, Hurstville and Bankstown, although not a legally constituted body, is concerned primarily with controlling the flourishing growth of alligator weed in the river, a phenomenon that is caused, according to the councils, by nutrients from sewage treatment works. Similarly, the Municipal Assembly (Rockdale, Sutherland, Kogarah, Hurstville) was brought into being to coordinate council views on common problems, in this case the environmental impact of the developing Botany Bay port. These committees meet infrequently (three or four times a year), have inadequate funds and insufficient power and political support to negotiate directly with State authorities. A further weakness is that they are organised around single issues or for one waterbody only.

More important are the working relations between individual councils and State agencies, chiefly the S.P.C.C., M.W.S. & D.B., M.S.B. and Health Commission. So far as water pollution is concerned, the first two are the most important: pollution complaints, advice on development applications, and effluent standards are referred to the Water Pollution Control Branch of the S.P.C.C.; joint patrols on stormwater channels, extension of sewers and sewer overflows are discussed with the M.W.S. & D.B.

There are a variety of conflicting uses of Sydney's waterways: recreation (swimming, boating), fishing, and liquid waste disposal, while river banks are used for picnic sites, playing fields, parks and bushwalking trails. Clearly, there is a need, as argued in other chapters of this book, for the formulation of social and economic priorities of water use, particularly in the case of Georges River, which is being subjected to increasing impacts by the expansion of Sydney to the west. Because of the number and location of water pollution sources, which are frequently outside the boundaries and, accordingly beyond effective control, of any affected local council, it is unlikely that priorities of water use can be decided and managed adequately by local governments. This is not to say that they should be excluded from such an important area of public policy that is of obvious importance to the welfare of residents, in particular, who live in or near waterside municipalities. Moreover, there is a powerful State agency degrading water quality in accordance with its statutory duty to dispose of sewage, namely the M.W.S. & D.B., so that any policy formulation would necessitate action by the State Government and by Parliament to give a new or existing State authority overriding power to formulate and administer a management plan for Georges River and its foreshores, and to coordinate public authority and private uses of water.

The major sources of air pollution in the Sydney metropolitan area are motor vehicles and those industrial establishments emitting relatively large volumes of waste. These last, about one-tenth of N.S.W. manufacturing establishments, are designated as 'scheduled premises'. Both these mobile and stationary sources of air emissions are regulated solely by the S.P.C.C. Local governments have responsibility for controlling air pollutants (chiefly smoke and particulates) generated by households and by minor industrial emitters known as 'non-scheduled premises'. Household air pollution, chiefly caused by backyard burning of waste, may be controlled by councils extending opening hours of local garbage dumps, household clean-up campaigns and by relaxing charges for the dumping of rubbish. The numerous minor industrial establishments are more difficult to regulate, since they pollute in several ways, for example by illegal open burning, by malfunctioning of fuel burning equipment or incinerators. Non-scheduled premises include non-manufacturing establishments which have incinerators or fuel-burning equipment, as well as factories which emit air pollutants on a small scale. The category also includes garbage depots, mostly owned by local councils, which use open burning as a technique for reducing solid waste volume. Here the policeman is the offender, so that control of this source relies ultimately on the S.P.C.C. Individual local councils

Table V-(7) Estimated distribution of 'scheduled' and 'non-scheduled' premises in Botany Bay drainage basin, 1971/2

| | Scheduled premises (manufacturing) | Non-scheduled premises (manufacturing) | Total |
|---|---|---|---|
| 1. Cooks River drainage area | | | |
| South Sydney | 72 | 570 | 642 |
| Marrickville | 24 | 657 | 681 |
| Ashfield | 1 | 82 | 83 |
| Burwood | 11 | 59 | 70 |
| Strathfield | 6 | 96 | 102 |
| Canterbury | 11 | 353 | 364 |
| Rockdale | 19 | 324 | 343 |
| 2. North Botany drainage area | | | |
| Botany | 29 | 373 | 402 |
| Randwick | 5 | 125 | 130 |
| 3. Lower Georges River drainage area | | | |
| Bankstown | 54 | 743 | 797 |
| Hurstville | 8 | 391 | 399 |
| Kogarah | 2 | 170 | 172 |
| Sutherland | 27 | 344 | 371 |
| 4. Upper Georges River drainage area | | | |
| Holroyd | 8 | 168 | 176 |
| Fairfield | 16 | 324 | 340 |
| Liverpool | 11 | 118 | 129 |
| Campbelltown | 0 | 38 | 38 |
| Total Botany Bay Basin | 304 | 4935 | 5239 |
| Total Sydney | 523 | 9952 | 10475 |

Source: Estimation made by Project staff from S.P.C.C. data.

have authority to direct minor air polluters to install suitable emission control equipment, as well as to regulate the minimum height of chimneys so as to ensure adequate dispersion of fumes and dust particles.

Health inspectors police the Clean Air Act within their local areas in addition to their other duties. However, policing still requires certain technical expertise and measuring equipment in relation to non-scheduled premises, so that in practice effective air quality control at local government level, especially in areas where manufacturing activity is concentrated, depends upon the Air Pollution Control Branch of the S.P.C.C. (see Chapter 9). Air pollution monitoring stations are operated by the S.P.C.C. with local assistance, the stations being located predominantly in industrial zones. Quarterly reports obtained from the monitoring system are sent to local councils.

The distribution of non-scheduled manufacturing premises in the Botany Bay drainage basin is displayed in Table V-(7). Although the table does not indicate the types of manufacturing activity from which we may deduce the number of potential air polluters within the category of non-scheduled manufacturing premises, it does show clearly the differences in the work load of policing by local health inspectors. Thus, South Sydney, Marrickville and Bankstown have large numbers of non-scheduled premises, in addition to relatively large numbers of major air polluters (scheduled manufacturing premises) within their respective municipalities, in contrast to the position in Ashfield, Burwood, Strathfield and Campbelltown.

Apart from the policing of existing waste sources by health inspectors, local governments have a second role to develop in controlling waste generation by planning. As already argued, this task of prevention by land-use control is one requiring an agency with a metropolitan perspective. However, local governments still would have a limited but useful role. Thus, councils may prevent the erection of tall buildings, such as blocks of flats, in the vicinity of existing chimney stacks, or the construction of industrial plant adjacent to a residential district. At the present time local government planning staffs have access to technical assistance from the S.P.C.C. when considering applications for new building developments which contain equipment that generates air emissions.

Local governments, because of their small geographic area relative to the total metropolitan region can only have a limited impact on air pollution control by land-use planning. The idea here is to prevent the over-centralisation of waste generators within a particular locality, as has occurred in the Cooks and Parramatta River valleys, for collectively those generators, despite the fact that individually all may meet the technical standards required by the S.P.C.C., may create a significant air pollution problem. Local governments may exercise a positive influence by prohibiting the establishment of new major air polluters within their areas. The formulation and adherence to this policy is of considerable importance in the developing western areas of Sydney, which includes the Upper Georges River drainage basin, because, as shown in Chapter 8, that district is poorly ventilated and so permits the accumulation of air pollutants. So too is a deterrent policy of importance in the older, inner industrial areas of Sydney that are subject to redevelopment pressures leading to the establishment of new industries, as might occur, for example, in the hinterland around Botany Bay as a consequence of the development of the Botany Bay port. A further possibility is that, over time, existing industries clustered in these older urban localities may expand their plant capacity and thus increase their energy consumption or alter their fuel type so that even without a rise in the total number of manufacturing establishments caused by changes in land use, air pollution may worsen.

But this argument assumes that individual local governments have the capacity, experience and expertise to control land use in its area. However, many local councils are in a weak position in managing industrial location or redevelopment: new industry provides much needed local revenue. So constrained are local government incomes under the existing financial system that industrial development is likely to be an attractive short-term proposition. Further, because of the existing residential segregation in Sydney, the richer and dominantly residential municipalities will prevent significant industrial location within their areas in order to preserve and enhance the property values of their residents. Thus the prospects are that under the existing administrative system the existing pattern of land use and industrial air pollution concentration is likely to continue in the long term. Indeed, the State's proposal to grant local governments stronger planning powers is likely to accentuate that pattern and, further, to undermine the objective of having environmental factors seriously incorporated within planning criteria.

As with other pollution control legislation, the State Government has given overriding authority to the S.P.C.C. in respect of the Noise Control Act, 1974 (see Chapter 2). Thus premises, upon which loud noise is made constantly or frequently and affects the community, are to be designated 'scheduled' premises subject to noise level standards, noise abatement and policing by the Commission. Occupational noise as it affects people in their work place is regulated by the Department of Labour and Industry. However, because much irritating noise occurs randomly in time and place, the statutory power to abate noise, officially termed a 'Noise Abatement Direction', is also given to local government authorities as well as to the Police Department and the Maritime Services Board. This change may be regarded as a strengthening of the traditional local government power to control general neighbourhood nuisances. However, from an administrative point of view, once again local governments have had imposed upon them more detailed statutory powers but without any real consideration as to whether the existing local financial and staffing structure is competent to use those powers.

## Conclusion

The State Coalition Government was proposing to increase local government responsibilities in planning without taking into account the administrative dominance of Sydney by agencies with State-wide responsibilities. On one hand, metropolitan local governments are constrained by finance, small areas and inability to recruit trained staff; on the other, many powerful State Government agencies govern aspects of the metropolis against which individual local councils have relatively little in the way of bargaining power. Already the State

Government has imposed pollution control responsibilities upon local governments. The S.P.C.C. observed in 1972/3: 'Many local government authorities lack the staff resources and knowledge needed to define their problems and to initiate and carry through the programmes needed to overcome them.'[13] Although this comment applies to councils generally throughout the State, the facts are that waste generation and hence pollution control efforts are predominantly urban problems. If added planning responsibilities are to be given to local councils, then a similar observation applies. Indeed, the P.E.C. remarked in its 1975 *Report*. 'The large majority of local councils, would, however, have to employ more qualified planning staff and to accept extra costs if they wished to improve and to extend the range of their environmental planning work and to provide a better interaction with their community'.[14] This is merely wishful thinking. As we noted above, recent official inquiries have criticised *existing* local government planning. If environmental objectives are to be considered along with other planning criteria, then, at a minimum, the organisation, financing and staffing of metropolitan councils would have to be radically reconstructed.

More importantly, waste management and pollution control are the means of managing environmental amenity. The scale, cost and complexity of these activities, as argued throughout this volume, are such that they should be comprehended as a regional problem. Environmental planning, is, in principle, a long-term method at best of preventing, or at least of minimising, the degradation of urban amenity caused by the over-concentration of waste generating activities in particular localities. It follows that, if environmental planning is to be an effective means of managing the process of urbanisation, it should also be comprehended as a regional activity. Looked at from another way, planning developments in one municipality have direct and indirect implications for the whole metropolitan region as well as for surrounding municipalities, but the effects of these fall outside the jurisdiction of the council that initiated the development. Individual local councils are circumscribed by their small geographical size, and hence are neither competent nor able to adopt a metropolitan view. Moreover, as indicated above, there are considerable variations in the concentration of waste-generating sources between local governments in Sydney; hence there will be disproportionate costs in coping with the impact of wastes within any municipality as well as with the spillover impact in surrounding municipalities. Accordingly, there is an argument of equity for conducting environmental planning at the metropolitan level.

Local governments, in some form, in the metropolis will remain important for the administration and delivery of services to the people in their respective districts. Under the existing State Government administration of Sydney, where local governments function as an arm of the various State agencies, in particular for managing wastes, there is a strong case to be made for local government as policeman, but none for them as planner.

# 6 Rivers, bays and ocean

## Introductory

In Sydney, as in other large and growing centres, city populations degrade the quality of the natural environment in two main ways as already suggested. First, they create massive waste flows in a restricted area that has a limited capability to assimilate them. Heavy stress on the natural environment leads to a large variety of environmental damage and the loss of environmental amenity in the city. Though Sydney has not suffered in this respect as badly as many other cities in the world, the damage has become serious and it appears that these stresses will increase in the future. The second form of degradation comes from the physical displacement of the natural environment by the creation of structures and the alteration of normally permeable and naturally drained land areas by the construction of roads, footpaths, parking areas, drains, pipes and other facilities.

Both these man-made changes are particularly relevant to the question of liquid waste flows and related water quality problems in Sydney. Two broad types of liquid waste flow might be identified initially. One is the strictly man-made liquid wastes from households and other productive activity. These liquid wastes have a variety of damaging effects on the amenity of water environment of the city. The second is in the drastically altered volume, direction and nature, within the city boundaries, of rainwater discharges. Heavy rains scour wastes from impermeable city surfaces and frequently discharge them into the waterbodies that are least able to bear the resulting stress or that are most important as amenities for human beings; or by penetrating waste disposal systems, particularly sewers and to a lesser extent garbage dumps, heavy rains disrupt managed waste disposal and, again, the liquid waste discharges reduce environmental amenity in more populated areas or in waterbodies least able to tolerate them.

Both these flows have inflicted and continue to inflict serious damage on Sydney's waterbodies, reducing environmental amenity for city residents and disrupting management and control systems. Large volumes of liquid wastes are an inevitable consequence of human settlement. We must properly ask how far all or some wastes may be reduced at source; how far the reuse of waste may be developed; how complete can be the management of liquid wastes transferred away from human contact or from the areas used by city dwellers; how efficient or complete the 'disposal' system should be; how far treatment of liquid wastes should be carried before discharge to the environment? But eventually massive liquid discharge to the water environment must occur. There can be no possible expectation that wastes can be eliminated, that environmental damage will be completely avoided, or that city environmental amenity can be wholly preserved.

Given the existence of large and varied liquid waste flows and the dependence on waterbodies for ultimate reception and assimilation, it cannot be too often repeated that the crux of the management and control system lies in the need to strike a balance. In the broadest terms, this is the balance between, on the one hand, the controlled reduction in water quality and environmental amenity arising from the use of natural waterbodies as 'disposal' media, and on the other hand, the demand by city residents for environmental amenity and the claims of other and broader benefits in city life and activities. *In other words, the central issue is the degree to which reduced environmental amenity will be acceptable to a city population and not the presence or absence of degraded water resources.* Here we may identify two interlocking areas of public policy which need to be formulated for Sydney: liquid waste management and water resource management.

This issue quickly becomes an extremely tricky matter to resolve and it is, to say the least, not surprising that fully satisfactory solutions are rare throughout the world and that Sydney's management and control system is similarly only partially successful. In determining an 'acceptable' degree of water quality, the wants and desires of affected groups of people, the benefits of improved environmental amenity and the sharing of these benefits amongst different groups within the city, the associated costs provide a basic but very difficult calculus that should come increasingly to underlie all policy decisions in management and control.

The costs of management and control are very large. Sydney's population is not an anonymous and uniform group. The city's water resources are not used in a standard way. Their assimilative capacity is not uniform. The scale and form of environmental stress vary greatly over place and time. The city is not an unchanging entity but growing and altering in character. Liquid waste management and water control authorities are subject, directly and indirectly, to a large number of other, proper, pressures arising from the many-sided benefits of city activities.

To date, waste management in Sydney has essentially concentrated on providing specific technical solutions to specific and 'isolated' problems (often very large). As we have already argued, authorities have tended to hold a narrow conception of waste management, regarding it simply as 'getting rid' of wastes. They have concentrated on evaluating the direct costs of waste management technologies, such as the cost of a sewerage reticulation system, and have largely left aside the costs imposed on and benefits accruing to different disadvantaged and advantaged groups of people.

Following the establishment, in the S.P.C.C., of the Water Pollution Control Branch, there has been increasing pressure to broaden the approach to liquid waste management in Sydney. In general terms, waste management might be divided into five interrelated areas — the control of the generation of liquid wastes at source, the organised treatment of liquid wastes, the systematic reuse of waste components, the organised disposal of wastes (discharge to environment) and the control of the assimilation process in the environment. Recent approaches in Sydney have come to give more attention to the sources and types of liquid wastes, to their treatment, and to the direction of liquid waste discharges into the environment.

This has represented an important step. Nevertheless, these newer approaches have been similarly technological and based, at best, on an assessment of cost-effectiveness. The controls of the S.P.C.C. have, essentially, consisted of control of liquid waste treatment and waste disposal, leaving many problems to re-emerge in a different form or location. Only limited effort has yet been made to reduce liquid wastes or to encourage waste recycling.

More importantly, no clear objectives in the standards of water environmental amenity have been established. The lack of such objectives makes the pursuit of liquid waste management and water quality control uncertain and stumbling. Given the very high costs of waste management and water quality control, mistaken policies, ineffective policies, or policies that turn out unacceptable to residents can be very serious indeed. A recent study of the Delaware River in the United States, heavily polluted by the effluent of Philadelphia, Washington, Trenton and other cities, advances strong reasons for believing that the $700 million being spent to 'clean up' a 150-kilometre stretch of the river may be largely ineffective and seriously misdirected.[1] Elsewhere in this volume calculations imply that Sydney is currently spending at the level of 3.5 per cent of its total income on all waste management and pollution control. Sewage treatment plants in Sydney presently under construction are alone estimated to cost some $150-200 million. Costly sewerage outfalls into deeper ocean waters are being contemplated. Later we will refer to a recent report on the proposed restoration of water quality in the Cooks River-Alexandra Canal, and reflect on the apparently lower priority given to a comparable report and proposal on Georges River. It is, we would suggest, the latter that is exposed to massive stress in the immediate future, in whose basin far larger populations are being established and which has far greater amenity potential. Its effective management requires particularly careful study. Yet only the most limited knowledge exists of water uses, prospective benefits, the relative significance of man-made and rain-generated wastes in this drainage system. Like many generals of the past, the city's controllers may be winning the last war and losing the next.

## Sydney's water resources

Sydney's physical environment, including its water resources, has been outlined in *A Handbook of the Botany Bay Region*,[2] produced for the Botany Bay Project. Accordingly, only a summary outline is given here. Located on the coast, Sydney has the ocean immediately on its eastern perimeter. As a vast sink, the ocean offers Sydney a water resource with a very large capacity to assimilate wastes, particularly liquid wastes, a resource which is exploited without much immediate concern about the possible effects of these wastes on other human populations. In this respect, Sydney has an important advantage over cities along inland river systems, especially those overseas, which are forced to use the same waterbody for water supply and waste disposal purposes.

Two major sea inlets, Port Jackson and Botany Bay, lie within the metropolitan boundaries of Sydney. Flowing into these inlets, three rivers, with their tributaries, provide the main natural drainage of the city. Parramatta

River flows into Port Jackson; Cooks and Georges Rivers into Botany Bay. South of the city, Port Hacking River, and west and north of the city, the

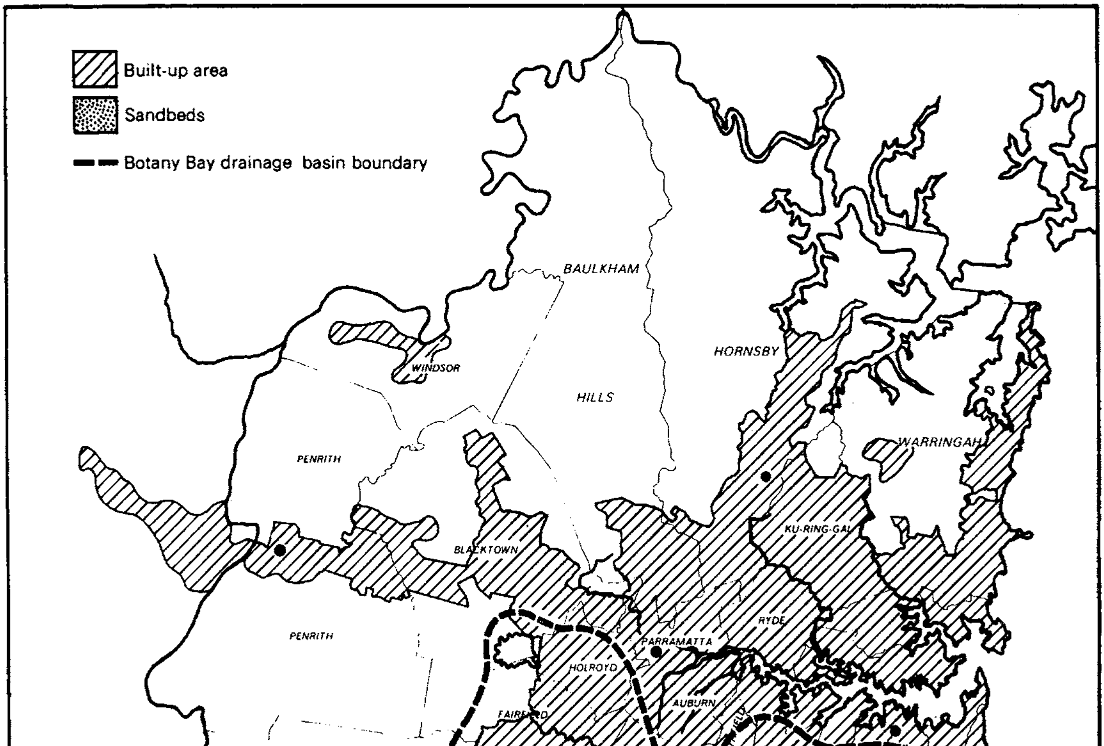



Fig. VI (i) Sydney's water resources

Hawkesbury-Nepean Rivers provide some minor, natural drainage of the metropolitan area. In the immediate future, it must be expected that the Hawkesbury-Nepean Rivers, with their tributaries, will become increasingly important in the natural drainage of the westward expanding metropolitan area. This river system discharges into the ocean at Broken Bay, north of the existing metropolitan area.

These streams and their ocean outlets are shown in Fig. VI(i) which also shows the approximate area of the sand-beds at Kurnell and north of Botany Bay, a source of underground water. Apart from these sand-beds, which supply a small proportion of Sydney's industrial water supply, the city draws relatively little of its piped water supplies from streams within its own metropolitan boundaries. Because of this, Sydney has another advantage compared with many other cities in that only very limited sections of the rivers within the metropolitan borders need to be protected at the standard appropriate to drinking water supplies.

The rivers and their tributaries passing through the metropolitan area are all short coastal streams with no significant population pressures on them, other than those of Sydney. Again, this points to two advantages for Sydney relative to many other cities in the world. First, Sydney residents are not subjected to the liquid wastes of other urban populations and do not depend on the effectiveness of liquid waste management and control by external authorities. Second, in so far as Sydneysiders foul their own nest, they have their remedies in their own hands.

Here, however, any advantages end. The streams, even the major water courses, are not only short but have highly variable flows. Sydney's rainfall is highly variable, almost all of it occurring in brief periods of relatively heavy rain on a small number of days. For example, the rainfall during a total of about twenty days a year accounts, on an average, for approximately 95 per cent of *the total yearly* flow in the Georges River.[3] For long periods of the year, then, the rivers tend to be stagnant or slowly flowing, with a very low capacity to withstand the stresses of human settlement.

In part, these low stream flows are offset by the tidal movements in lower reaches of the rivers. However, the tides are relatively poor agents in flushing wastes out of the rivers and into the sea and, with the possible exception of the lower reaches of the Georges River, do not provide any major increase in the capacity of the rivers to assimilate wastes. It is only in the larger and deeper areas of Port Jackson and Botany Bay that the volumes of seawater and movements of tide, winds and currents provide a substantial capacity to assimilate wastes.

## The uses of Sydney's surface water resources

The ocean, harbour and bay, and the city's streams are all used in various ways and to varying degrees as a means of liquid (and other) waste disposal. The extent and manner of these waste disposal uses are changing and have changed over time. But the dependence on the different water resources as a means of liquid waste disposal collides with the alternative uses of these waterbodies. To appreciate this collision and the problems of liquid waste management and water quality control, we need first to discuss briefly the nature and extent of the uses of waterbodies for purposes other than waste disposal.

Little information has been gathered about the human use of the water resources of Sydney. In itself, this raises the most serious doubts about the ability to devise effective and efficient policies for liquid waste management and water quality control. Until the demands for the benefits of environmental amenity in city waterbodies are reasonably clearly established, it is not possible to define the basic objectives of management and control. Action must not be confined, as it has been to date, to the provision of technological 'solutions' to separate and particular problems viewed in isolation. For effective policy purposes, it is important to attempt to assess, even if only indirectly, the value that city residents (and even visitors) place on their uses of or benefits from city water resources. More particularly, we need to know the value they place on increased, improved or varied uses if costly measures are to be taken to improve or protect water quality. There is, to say the least, little evidence that city planners take much account of these issues or try to make the essential assessments. There is not even useful information on the numbers of persons benefiting from different uses. The only comments that can be made relate to the broad types of benefits or uses, with some general judgments on the size of affected groups.

In a great many ways, natural waterbodies permeate the aesthetic qualities and leisure and recreational potential of the city. But their contribution is by no means uniform, implying some priority ordering. In the most general terms, the main surface waters in the metropolitan area add greatly to the beauty of the Sydney environment as a whole. This aesthetic scenic quality offers benefits to large numbers of Sydney residents, whether as part of their residential environment or in travelling around the city. It provides the most general and pervasive 'use' of Sydney's natural waters, a use that may be limited by degradation of colour or smell (as in Cooks River) or by man-made intrustions (such as the airport and marine port in Botany Bay).

Somewhat more intimately, sea, bay and river edges provide a variety of opportunities for leisure and relaxation. Accessibility, the quality of the bordering land environment and the quality of the water are important constraints on these benefits. In large areas of Port Jackson, accessibility is severely limited; in Botany Bay the developing marine port is reducing accessibility severely, while on the southern side spoliation by sand mining and illegal garbage disposal, together with industrial development, greatly limit the potential attractions of Kurnell. The emasculation of Cooks River and the degradation of its water quality minimises the benefits of this area despite the forty parks and reserves, four golf courses and one racecourse along its banks. Dwelling intrusion to the edge of parts of Georges River has limited accessibility, but large stretches of the river have remained protected by reserves on both sides; in some of the more preferred picnic places, garbage dumps offend and liquid effluent degrades water quality. Ocean, harbour and bay beaches provide opportunities for recreation and relaxation — subject to sewer and oil wastes and, more recently in Botany Bay, to storm and current disturbances of beaches.

Traditionally, perhaps, ocean surfing has been the Sydneysiders' recreation that has received most notice. Harbour, bay and river swimming also provides another water use bringing direct body contact with the natural waters. Accessibility to the different locations has become an increasingly important determinant of the mode and location of swimming recreation as the city has expanded. But because of direct contact with the water, aesthetic issues of colour, smell and taste, and fears of health risks from wastes constrain choice. Somewhat less direct in terms of contact, but a type of use that has increased very rapidly in the past two decades, is boating on the harbour and bay and, to a much less extent, Georges and Parramatta Rivers. Water quality is less a constraint with boating since the frequency and duration of body contact is less. In practice, both sailing and power boats concentrate on Port Jackson and Botany Bay because of area and depth of water, factors which both contribute greatly to the assimilative capacity of these waters and to the natural preservation of water quality.

Clearly linked to these water uses are other indirect benefits. Clubs develop around boating, fishing and swimming activities and extend recreational opportunities. Tourist facilities are encouraged and tourist industries developed.

Apart from amateur fishing, Sydney's waters are a moderate source of seafoods. Neither Parramatta nor Cooks River provides supplies because of degraded water quality. During 1972/3, Botany Bay, Port Jackson, Pittwater and the Hawkesbury River provided about 8 per cent of the commercial finfish catch and 10 per cent of the commercial prawn catch of New South Wales. However, the most important seafood was oysters, about 40 per cent of the total New South Wales commercial oyster yield coming from the Georges and Hawkesbury Rivers in 1972/3. In that year, the value of this seafood production was approximately $4 millions and accounted for about one-quarter of the total commercial catch from all estuaries and ocean waters in the State.[4]

Apart from the Hawkesbury, river fishing is essentially amateur in nature. In addition to other constraints, special characteristics of water quality become critically important if the consumption of marine life is not to present a health risk to humans. The propensity for certain types of marine life, particularly shellfish and crustaceans, to absorb heavy metals can limit their usability as human foods. Degradation of water quality in some areas, particularly Alexandra Canal and parts of Cooks River, has severely reduced the populations of marine life; however, fish and other marine life are reported to be returning to these waterbodies as their quality improves.

Another, though specialised, human use of the water resources is for the mining and dredging of sand. Sandmining operations on Kurnell Peninsula and on the floodplain of the Georges River at Chipping Norton are major sources of Sydney's construction sand. A lake of some 160 hectares in the middle reaches of the Georges River will be the legacy of the operations at Chipping Norton.

Finally, both Port Jackson and Botany Bay are important harbours and ports. Apart from local ferries on Port Jackson, Sydney handled some 3,700 ships during 1972/3 and shipped 16 million tonnes of imports and 9 million tonnes of exports. The gross value of this trade was $2,827 millions or 35 per cent of the total incomes of Sydney residents. The economic scale of this activity has had a large impact on the priority of uses of Sydney waters. It has led to the extensive man-made displacements in Botany Bay for marine port development, to the detriment of other uses and users. This displacement, now a *fait accompli*, raises most directly the ordering of priorities concerning other water uses in other areas.

Only a close investigation of the value of the various uses of waterbodies and an assessment in terms of the suitability of different waterbodies would make such an initial ordering possible. This investigation appears to us to be an extremely important task for the Planning and Environment Commission. Such an ordering is essential in order to clarify the standard of water quality to be aimed at in Sydney waters, the choice of particular waterbodies to be dealt with and the priorities in time for improving or preserving different water resources. The type of questions that must be faced include: whether a city of the size and complexity of Sydney can expect to preserve *all* its waters at, for example, aesthetic, bacterial and other levels appropriate to public swimming; on which waterbodies should effort be concentrated; should planners reasonably aim to sustain *all* estuarine waters at a quality to permit commercial production of seafoods? The variety of water quality standards implicit in the various uses is reasonably clear. The differences in the costs of remedying existing degradation and preserving different levels of quality are large and are not to be undertaken lightly. Priorities based on valuations of alternative uses by different groups of residents do not finally resolve the actions to be taken; but they are one of the essential policy steps that need to be taken, and are not being taken, in Sydney.

**The disposal uses of Sydney's waterbodies**

The disposal of liquid wastes represents the other main competing use of Sydney's water bodies. No precise figures of liquid waste flows for Sydney are available but strictly man-made liquid wastes in 1972/3, generated in the Sydney metropolitan area, were of the order of 300,000 million litres.

It is worth registering the relative magnitude of this figure even if in only approximate terms. Despite the size of this figure, city dwellers, even in a centre as large as Sydney, add remarkably little to the total of liquid flows in the area. Yet it is this small supplement, because of its composition and distribution rather than its volume, that is responsible for serious degradation of water quality and water amenity. Rainfall on the metropolitan area — the natural means of liquid injection into the city — can be approximately estimated at 4,000,000 million litres per year (under conditions of average rainfall). In other words, the liquid wastes of city residents added less than 10 per cent to this total.

The contribution of city residents was, however, larger than this. A significant volume of rainfall in the form of surface run-off — perhaps as much as 650,000 million litres — discharged into the waterbodies around the city. Much of this volume arises from the impervious nature of city surfaces and is a liquid waste in its own right, scouring and collecting wastes as it drains into waterbodies. Even if all this run-off is ascribed to human manipulation of the city environment, then, together with man-made wastes, it accounts for a little less than one-quarter of the natural rainfall volume.

It is important to recognise that even in the circumstances of a large city, natural processes continue to predominate. The natural disposal mechanisms of evaporation and transpiration dealt with about 80 per cent of rainwater falling on the Sydney area; and this natural process also disposed of a significant fraction of water imported by water mains into the city, namely the component used for garden watering.

Rain-generated wastes and man-made wastes are almost entirely disposed of to natural waterbodies. And herein lies the problem: although liquid waste flows form only a small proportion of the total liquid flow through the city, and although most of these liquid wastes are predominantly water — for example, about 99.5 per cent of sewage (on a weight-to-weight basis) is water; the remainder, about 0.5 per cent, is actual waste matter — the small quantities of waste matter they contain can have major detrimental impacts on the quality

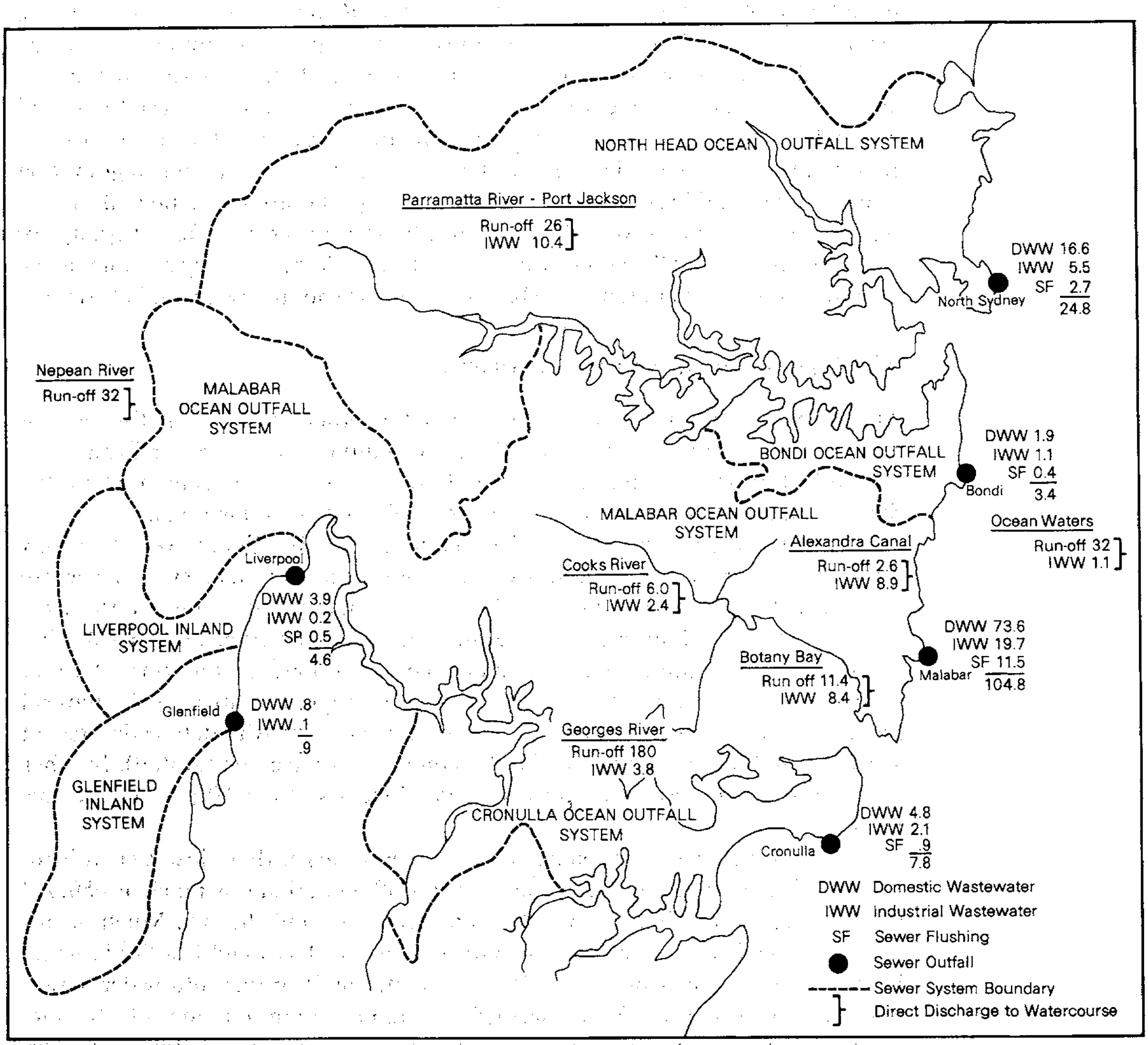



Fig. VI (ii) Diposal of the liquid wastes generated in the Botany Bay drainage basin and amenity of waterbodies, impacts that are out of all proportion to the relative quantity of this waste matter. In terms of liquid volume, the strictly man-made wastes generated in Sydney amount to about one-third of the total liquid flow into waterbodies. A minute fraction is dealt with by other means.

Table VI-(1) shows in more detail the pattern of disposal for liquid flows entering the Botany Bay drainage basin, taking the seventeen local government areas shown in Fig. VI(ii) as approximately corresponding to the basin.

Thus the ocean is the *direct* liquid waste sink for a little less than one- third of liquid flows not evaporated or transpired; the remaining two-thirds flow, in the first instance, to inland waters. This discharge process is traced in somewhat more detail for the basin in Table VI-(2), and in Fig. VI(ii) we show the approximate geographical distribution of these discharges.

The fact that a fraction was discharged outside the drainage basin reflects the slight divergence between the basin area and the boundaries of the local government areas chosen. A broad picture emerges. The great mass of household liquid flows discharged as wastes went direct to ocean via sewer mains and ocean outfalls; almost all the rain-generated wastes flowed to inland waters and predominantly to rivers; and factory liquid wastes were disposed about equally to inland waters and direct to the ocean via outfalls. The disposal routes for factory wastes have changed a little since 1972/3, with more diverted to ocean and this diversion is likely to continue for some time.

Mere volumes of liquid wastes are not effective indicators of potential stress on waterbodies and later we will deal briefly with waste types and their origins. Volumes are, however, important as masses to be disposed of by man-made pipes and drains. Almost 80 per cent of all Sydney's man-made wastes were discharged via sewer into the ocean in 1972/3 (see Table VI-(2)). This represented a massive man-made divergence away from inland waters by sewer connectors, sewer mains and ocean outfalls. Sewerage disposal of wastes arising in the Botany Bay Basin is shown in Table VI-(3).

It will be seen that only two tiny flows were (and are) routed via sewers into rivers. These flows are both to Georges River. (There are also small discharges into Georges River from the several small treatment plants operated by the Commonwealth Government.) A basic problem constraining this flow to the river is the very high cost of treatment plants required to treat sewage to levels regarded as appropriate in the light of the very limited assimilative capacity of the Georges River and the frequent complaints by residents about health risks to swimmers. In practice, however, additional volumes of sewage are intermittently diverted to the river in the form of sewer overflows during rainy periods. Current sewer flows must be regarded as only a small fraction of the expected future discharges into the Georges River. Population and activity growth in Sydney will be concentrated in the areas served by these two inland sewer systems which must be expected to carry most of the liquid household and factory wastes of the expanding areas. Although tertiary treatment has been installed and provision made for a large treatment capacity at the Glenfield plant, it seems almost certain that the enlargement of these flows will place heavy stress on the river in the future. The installation of tertiary treatment is, in part, a response to residents' pressure for river water at a quality regarded as appropriate for swimming. However, even tertiary treatment does not remove

Table VI-(1) Disposal of liquid flows from the Botany Bay drainage basin 1972/3 (thousand million litres)

| | Rain-generated flows | Man-made flows | Total |
|---|---|---|---|
| Evaporation and transpiration | 890 | 43 | 933 |
| To inland waters | 264 | 31 | 295 |
| To ocean via sewers | 4 | 107 | 111 |
| Other disposal | — | 14 | 14 |
| Total | 1,158 | 195 | 1,353 |

Table VI-(2) Discharge routes from the Botany Bay drainage basin 1972/3 (thousand million litres)

| | Rain wastes | Man-made wastes | Sewer flush | Total |
|---|---|---|---|---|
| Flows to ocean | | | | |
| Direct | 28.0 | 1.1 | — | 29.1 |
| By sewer— | | | | |
| within basin | 4.0* | 91.7 | 9.6 | 105.3 |
| outside basin† | — | 3.2 | 1.9 | 5.1 |
| Flows to inland waters | | | | |
| Cooks River/Alexandra Canal | 8.6 | 11.3 | — | 19.9 |
| Georges River | 180.0 | 8.8 | 0.5 | 189.3 |
| Botany Bay | 11.4 | 8.4 | — | 19.8 |
| Outside Botany Bay basin‡ | 36.0 | 2.4 | — | 38.4 |
| Total | 268.0 | 127.0 | 12.0 | 407.0 |

* Estimated stormwater infiltration into sewer system
† North Head ocean outfall system
‡ Parramatta and Nepean Rivers

Table VI-(3) Sewage disposal of Botany Bay basin liquid wastes, 1972/3 (thousand million litres)

| | Rain infiltrating sewers | Domestic wastes | Factory wastes | Sewer flush | Total | Percentage |
|---|---|---|---|---|---|---|
| Malabar outfall | | 67.2 | 16.0 | 8.8 | 96.0 | 83 |
| North Head outfall | 4.0 | 2.8 | 0.4 | 1.9 | 5.1 | 4 |
| Cronulla outfall | | 4.8 | 2.1 | 0.6 | 7.5 | 6 |
| Bondi outfall | | 0.8 | 0.8 | 0.2 | 1.8 | 2 |
| Total outfalls | 4.0 | 75.6 | 19.3 | 11.5 | 110.4 | 95 |
| Liverpool inland system | — | 3.9 | 0.2 | 0.5 | 4.6 | 4 |
| Glenfield inland system | — | 0.8 | 0.1 | — | 0.9 | 1 |
| Total inland systems | — | 4.7 | 0.3 | 0.5 | 5.5 | 5 |
| Total sewers | 4.0 | 80.3 | 19.6 | 12.0 | 115.9 | 100 |

all the major sources of stress, such as aquatic nutrients and some heavy metals. Moreover, tertiary treatment cannot cope with many of the problems arising from the discharge of liquid factory wastes to sewer. Georges River, at present, is subjected to relatively little factory wastes; nevertheless, it will receive much larger volumes as activity in the western and southern reaches of the river develops.

The relative shares of sewer flows to ocean outfalls and inland rivers must be expected to alter progressively, with the latter rising in significance in the long run. The rate of change will depend largely on the rate of growth of settlement in the western part of the Botany Bay basin and the degree to which sewerage extension is able to progress. As at now, the dominant flow of sewage through mains to ocean outfalls represents a very heavy capital outlay in trunk mains. The benefits gained are diversion of sewage from inland waters and the avoidance of heavy expenditures on inland treatment plants. At present, ocean outfalls predominantly discharge raw sewage to the ocean (sometimes after limited treatment). The result is to channel and focus the disposal of over 90 per cent of sewage discharge on four ocean points, allowing waves, current and the large volumes of seawater to disperse the discharge. The main benefit at risk is the acceptability of Sydney's beaches as bathing areas. As can be seen from Table VI-(3), the great concentration is on the Malabar outfall which discharges some three-quarters of all sewage from the Botany Bay basin. The other outfalls on the south side of Sydney (Bondi and Cronulla) are more regionally specialised and limited in their present and potential sewered populations.

The end result of all these ocean outfalls has been qualified technological 'success'. Though the mass of wastes is dispersed, periodic deposits of solid matter, greasy materials and some sludge on beaches and floating materials in the surf have led to complaints from beach-goers. The immediate result is that all ocean outfalls are being up-graded to primary treatment level. The prospect of greater discharges and the cost of more extensive treatment has induced consideration of piping the discharges considerable distances (several kilometres) to sea, into deep water. This would be a very costly undertaking.

The long-distance sewer mains across the city which feed the ocean outfalls are of limited capacity, especially when subject to intrusion of rainwater. The ability of the ocean outfalls to cope with an expanding population is limited unless heavy new expenditures are made to duplicate these mains. We have already suggested that the use of the Glenfield and Liverpool sewers will place growing and severe stress on Georges River in the future despite all the extremely costly efforts made to limit the problem by sewer trunks to the ocean and tertiary treatment plants inland.

The rivers, and not only Georges River, are in any event exposed to even greater discharges. As Table VI-(2) shows, volumes of the order of 190,000 million litres of rain wastes discharge into the Georges and Cooks Rivers systems, directed there from street surfaces by gutters and street drains, and from house and other roofs by pipes and man-made stormwater drains. Little is known in Sydney about these flows; even less action to control them is being taken. By their nature — being derived from rainfall across the city — they are extremely difficult to manage. Acquiring a special waste load through the scouring of man-made wastes from city surfaces, the volumes and directions of flow depend on the basic factors of city layout, design, road and building materials and human activity: they tie massive liquid waste flows intimately into city development and planning. Their lack of control can vitiate other expensive management and control provisions. Relative to its size and normal flow, the Cooks River system is the most exposed, partly because of the predominance of built-up areas and extensive impermeable surfaces. The Georges River system, despite its much larger drainage area, is better protected because it passes through areas which are much less densely settled and it has better natural barriers of permeable land along its banks. Here, too, the future holds problems in that the development of suburban streets and stretches in the western end of the basin will generate greater run-off and increased volumes of scoured human wastes. It is to be expected, too, that urban development in these areas will also enhance stormwater intrusion of sewer mains with added disruption of the management system and rising incidence of sewer overflows.

In the light of recent changes in Sydney's control approaches, it is possible that rain-generated wastes may become the city's biggest and most difficult liquid waste problem. Its solution depends on more careful investigation than has so far been given to it. The S.P.C.C. proposal for the control of these wastes in Cooks River (discussed at length in the next chapter) may be a technically practicable, if expensive, solution which may, however, yield increased problems in Botany Bay itself. For newly-developed areas, a basic planning ingredient is the need to preserve more natural barriers to filter these rain wastes before they enter main waterbodies. This would be an important condition in the future protection of the Georges River, especially its upper reaches.

Over the past two or three decades, liquid factory wastes have been the major factor imposing increased stress on inland waters. And it is this liquid waste component that has been receiving closest attention over the past few years (predominantly since 1972). The nature of these wastes is discussed later. In volume terms, about half these flows are discharged to ocean via sewers. Of the remainder, as much as 40 per cent were discharged into the Cooks River system in 1972/3 (including Alexandra Canal). This situation has existed for many years and is the primary reason why Cooks River and Alexandra Canal are so degraded. Recent efforts by the S.P.C.C. have succeeded in diverting considerable volumes from Cooks River tributaries into sewers.

Control of factory liquid wastes discharged into Alexandra Canal was, by the end of 1975, less successful. In the relatively near future, it is expected that extensive shifts to sewers and outfalls may be seen in this area. Diversion of factory wastes to sewer requires pre-treatment to protect sewer workmen from health risks, to prevent excessive damage to the sewer system, and to prevent toxic and other harmful wastes from interfering with sewage treatment processes. The concentrated wastes generally produced by these pre-treatment processes are disposed of in other ways, typically by burial or dumping on land. At times, 'pre-treatment' has consisted merely of diluting the wastes with water, with a consequent increased in the volume of liquid to be disposed, and flushing the lot down the sewer.

The discharge of less than 10 per cent of all Botany Bay basin liquid factory wastes into the Georges River system implies less pressure on its waters from this source. However, this pressure has been increasing with the westward movement of settlement and must be a growing risk for the future. This is more particularly the case in so far as the control approach, emphasising diversion to sewer after pre-treatment, leads in this case to river discharge. Treatment, both at factory and sewage treatment plant, will reduce the detrimental effects on river water, but exceedingly costly procedures may be required to limit the degradation.

Degradation needs to be seen in terms of offsetting benefits. In Sydney, the control process and the resulting discharge routes are designed, first, to eliminate illicit dumping, on land or in water, of highly dangerous wastes. They are also designed to allow industry, where feasible, to install pre-treatment processes at moderate cost, thereby restraining rises in costs and prices of goods consumed by city residents (and others). In the process, the problems are being modified and shifted from river-dwellers and river-users to beaches and beach-users, leading to the further prospect of heavy outlays to extend sewer outfalls into the ocean or to duplicate sewer mains; the form and location of the problems are being changed, with different types of stresses being placed on different parts of the rivers; and the unevaluated but large problem of rain-generated wastes in the rivers is left largely in abeyance. It is by no means clear that the solutions being pursued are effective, or that the resources devoted to control are adequate or directed in the most desirable directions. This is an almost inevitable consequence of incomplete information and technolgical solutions largely designed in the absence of their broader social context.

## Water supply for waste flushing and removal

Water is not only used as a medium to receive discharges. It is the primary means of carrying wastes away to eventual discharge locations. A large part of Sydney's total water consumption is for these purposes — in dwellings, factories, shops and offices, in city cleaning, in sewer main flushing and in human beings themselves. To 'drive' the whole liquid waste disposal system, very large amounts of water must be supplied.

Water supply is, essentially, drawn from outside the metropolitan limits (though westward-moving settlement is increasingly encroaching on catchment limits). The construction of reservoirs and water mains represents a very large capital cost to secure the benefits (and the costs!) of the liquid waste disposal process. This alteration to the natural environment may represent a cost in the constraint imposed on human activity in the areas declared as water supply catchments. With the expansion of Sydney's consumption and supply, this latter cost is being imposed on new areas progressively farther from the metropolitan area. The most recent is the Shoalhaven Valley. Often, however, it is not possible fully to control human activities in water supply catchments, and extensive water treatment facilities are required to ensure a safe and potable water supply.

Were it possible to constrain water consumption, either for waste disposal or other purposes, it would be possible to defer new reservoir and mains construction or to bring smaller reservoirs into supply systems. With growing water consumption per head and an expanding population, new capital outlays to supplement supplies must be made earlier (depending on the rate of growth of consumption per head of population). Possibilities such as water recycling, more careful water usage, and the use, where feasible, of more degraded water could defer these outlays. But the M.W.S. & D.B. appears to disregard the possibility of inducing regular constraint on water consumption and to accept the largely unchecked water consumption trends as the determinant of supply needs.

Accepting these trends, the Board has estimated future consumption, based on population projections, as shown in Table VI-(4).

The growth of the Sydney water supply system since 1902 is shown in Table VI-(5). With the completion of Warragamba Dam in 1959, the system was capable of meeting the growing demand for water until 1975, when the 'safe draft' capacity of 1,600 million litres per day was exceeded. The response to growth of consumption after 1959 was the adoption of the Shoalhaven Scheme in 1968, with a first stage scheduled for completion in 1976. The second stage, with scheduled completion in 1984, will raise the safe draft to 3,182 million litres per day — about 15 per cent above the projected 1995 consumption in Table VI-(4).

Estimates of future consumption are clouded by uncertainties in the projections of population and water consumption per head shown in Table VI-(4). By erring on the safe side, the Board appears to be somewhat lavish in committing large capital outlays for future water supply reservoirs and head-works. Even more lavish, however, is the Board's approach in attempting to

Table VI-(4) Future demand on Sydney water supply system

| Year | Population served (millions) | Average daily consumption Million litres per day | Litres per head per day |
|---|---|---|---|
| 1965 | 2.66 | 1,210 | 455 |
| 1975 | 3.18 | 1,650 | 518 |
| 1985 | 3.70 | 2,150 | 582 |
| 1995 | 4.23 | 2,730 | 645 |

Source: M.W.S. & D.B., 'Estimation of Water Supply Demand', in *International Training Course in Public Health Engineering* (Department of Foreign Affairs, 1970) vol. 1, sub-section 6.1.

Table VI-(5) Major Sydney reservoirs, 1975

| Reservoir | Construction begun | Construction completed | Storage capacity of each dam million cubic metres | Storage capacity of system million cubic metres | Safe draft of system million litres per day |
|---|---|---|---|---|---|
| Cataract | 1902 | 1907 | 94 | 94 | 82 |
| Cordeaux | 1918 | 1926 | 94 | 188 | 150 |
| Avon | 1921 | 1927 | 214 | 402 | 274 |
| Nepean | 1926 | 1935 | 81 | 483 | 353 |
| Woronora | 1927 | 1941 | 72 | 555 | 404 |
| Warragamba | 1946 | 1959 | 2,057 | 2,612 | 1,600 |

Source: W. Aird, *The Water Supply Sewerage and Drainage of Sydney* (M.W.S. & D.B. Printer, 1961) Appendix 3.

eliminate or minimise the risk of an inadequate supply to meet the unchecked consumption. Sydney's rainfall is highly variable and the influence of drought periods is vital to water supply planning.

It is the eight critical years of the 1934-42 drought, currently the worst on record for Sydney, that determine the safe draft and required water storage needed to meet any given level of consumption. This drought has been estimated to recur, on an average, once in every 300 to 3,000 years.[5] Even the lower estimate suggests that the Board's engineers are highly unwilling to take risks or highly willing to commit public funds to capital programs. This approach protects the Board from the opprobrium of special water restrictions, but at considerable social cost. The approach is also explicable in terms of the peculiar statutory obligations on the Board, with its priorities favouring water supply. This may suggest that the statutory provisions, as well as the engineers' attitudes to risk-bearing, should be revised. Indeed, it seems probable that commitment to capital works for water supply development was one factor in the increasing sewerage backlog that developed during the 1950s and 1960s and contributed to the water quality degradation that occurred in the city.

Because it has a significance for the cost of Sydney's water supply, the variability of Sydney's rainfall has, then, another important bearing on the cost of liquid waste disposal. While existing technology and prevalent attitudes to water consumption for waste generation and disposal remain, this added cost, in the form of larger, earlier capital outlays in reservoir and mains construction, needs to be taken into account in the liquid waste context. The tendency of the Board to think in the three separate compartments of water, sewerage and drainage, partly imposed by statutory requirement, needs to be adjusted as much by statutory alterations as by attitudinal changes.

Policy towards the extent of water use for waste generation and disposal needs to be given much higher prominence. In past episodes of water supply constraint, the tendency has been to direct attention predominantly to household garden use of water. This clearly is a large component of consumption, but the use of water for waste disposal is much larger and may be more amenable to restraint by altered pricing and administrative policies of the Board. In general, the Board's approach, in accepting the prevailing choices of consumers of all types in a situation where very limited price incentives are offered, has encouraged the continuous per capita rise in water consumption.

We would strongly suggest that the combination of inadequate price inducements to water constraint and the extreme caution of the Board in setting water supply requirements have led to an over-supply situation. The remedies exist for restraint on water consumption in waste disposal and other areas. If these remedies were adopted, it seems improbable that the second stage Shoalhaven Scheme would be needed at the time or on the scale at present planned. Reconsideration and deferment of this second stage could release substantial resources towards other activities, including those to protect water quality in Sydney, through the more rapid extension of sewerage in new areas, the more rapid reduction of the sewerage backlog, or in the changes that may be needed in the outfall disposal of sewage. There are, it would appear, considerable opportunities for constraint and for changed disposal. Very little has been attempted in this area in a systematic way to encourage industrial recycling of water or to encourage reduction of liquid waste generation. These possibilities need to be pursued. But before taking the matter further, we need to look at the sources and types of liquid wastes.

## The generation of liquid wastes

The main immediate beneficiaries of the use of waterbodies as a disposal medium are the local generators of man-made liquid wastes — the persons and institutions who create both the wastes and the demand for their disposal. Less directly, persons spread more widely, both throughout and from outside the city, also benefit from this form of disposal in that goods and services are supplied at lower prices to consumers and at higher profits to producing firms. These benefits are obtained by imposing some of the wastes, together with their environmental costs, on persons using waterbodies for purposes other than waste disposal.

Table VI-(6) The generation and source of liquid waste flows — Sydney and Botany Bay drainage basin 1972/3

| | Sydney statistical division | | Botany Bay drainage basin | |
|---|---|---|---|---|
| Generator-source | thousand million litres | % division | thousand million litres | % basin |
| *Man-made* | | | | |
| Residential | 138 | 46.0 | 67 | 45.3 |
| Factory | 86 | 28.7 | 45 | 30.4 |
| Business | 50 | 16.6 | 26 | 18.0 |
| Other | — (small) | — (small) | — (small) | — |
| Sewer flush | 26 | 8.7 | 12 | 6.3 |
| *Total man-made* | 300 | 100.0% | 150 | 100.0% |
| *Rain-generated* | | | | |
| Surface run-off | 650 | | 264 | |
| Sewer penetration | 7(?) | | 4(?) | |
| Other | ? | | ? | |
| *Total rain-generated* | 657 | | 268 | |
| Total flow | 957 | | 418 | |

Individual liquid waste generators can be grouped conveniently, in the first instance, into the categories of households, factories, non-factory business, and 'other' sources, together with the special item of sewer flushing. Table VI-(6) shows the estimated volumes of liquid wastes from each group in 1972/3. The table also shows the volumes of rain-generated wastes, predominantly a communal product of the physical layout and character of the city.

In percentage terms, the distribution of man-made liquid wastes amongst the various sources is very similar between the Botany Bay basin and the whole of Sydney. In simple volume terms, Sydney residents, in their dwellings, generated by far the largest share of 'man-made flows', slightly less than half the total. Factory liquid wastes represented the second largest component, accounting for about one-third of the total. Most of the remainder was non-factory business wastes, so that business as a whole, including factories, accounted for about half the total man-made waste flow. Sewer flushing activities by sewerage authorities generated the small remnant. (A very small amount, not accounted here, originated from farms, public gardens and miscellaneous sources.)

Human wastes generated in households are individually small sources of liquid waste scattered according to the distribution of settlement. Although differences from person to person occur, the volumes per person are not, generally, highly variant. Table VI-(7) shows the area distribution of population and household liquid waste generation in the sub-basins of the Botany Bay basin. Population data are from the 1971 Census; volumes of household waste are estimated from household water consumption in 1972/3.

As will be seen by comparing this area distribution of household waste generation with the area disposal of sewage shown in Table VI-(3) and Fig. VI(ii), the managed disposal of these wastes moves the vast proportion of them away from their point of origin and re-locates them in a radically different manner. Their environmental costs are imposed on other areas, often long distances away from the source of the wastes, and tend to be concentrated on water users elsewhere in Sydney. For example, as we have seen, ocean outfall sewers transport about 85 per cent of Sydney's liquid household wastes away from their points of generation and discharge them into ocean waters where they interfere with the enjoyment of beach-goers; only a relatively small proportion of the large population group in the Upper Georges River sub-basin is connected to sewer systems discharging into the Upper Georges River.

As far as the waste matter itself is concerned, human excreta, coupled with wastes from kitchen, laundry, bathroom and house cleaning activities, make up the dominant waste load in liquid waste flows from households. Small supplements in the form of cleaning agents, pharmaceuticals, etc. are also present. The predominant waste yield from households is organic matter, heavily diluted with water, carrying with it the risk of transfer of disease-carrying organisms.

The advantages of comfort, convenience and cleanliness in homes must,

Table VI-(7) Area distribution* of population and household liquid waste generation

| Area | Population (1971) ('000) | | Household liquid wastes (1972/3) (millions of litres) | |
|---|---|---|---|---|
| Botany Bay drainage basin | 1,352 | | 67,200 | |
| (i) Cooks River drainage area | | 454 | | 21,800 |
| (ii) North Botany Bay drainage area | | 162 | | 8,100 |
| (iii) Lower Georges River drainage area | | 429 | | 23,300 |
| (iv) Upper Georges River drainage area | | 307 | | 14,000 |
| Rest of Sydney | 1,457 | | 71,300 | |
| TOTAL | 2,809 | | 138,500 | |

* The drainage areas of the Botany Bay Drainage Basin consist of the following municipalities:

| | |
|---|---|
| Cooks River Drainage Area | : South Sydney, Marrickville, Ashfield, Burwood, Strathfield, Canterbury, Rockdale |
| North Botany Drainage Area | : Botany, Randwick |
| Lower Georges River Drainage Area | : Bankstown, Hurstville, Kogarah, Sutherland |
| Upper Georges River Drainage Area | : Holroyd, Liverpool, Fairfield, Campbelltown |

therefore, be weighed against the costs of treating these waste flows and the degradation of water quality in receiving areas. For residents in the Botany Bay drainage basin, these receiving areas are essentially the ocean and the Upper Georges River.

Non-factory business liquid wastes are *broadly* similar in character to

Table VI-(8) The generation of liquid factory wastes by sub-areas (millions of litres), 1972/3

| A.S.I.C. classification | Industry group | Upstream Georges River drainage area | Downstream Georges River drainage area | North Botany Bay drainage area | Cooks River drainage area | Total Botany Bay drainage basin | Rest of Sydney | Total Sydney |
|---|---|---|---|---|---|---|---|---|
| 21-22 | Food, beverages, tobacco | 1,186.5 | 1,331.2 | 955.0 | 4,225.2 | 7,698 | 7,813 | 15,511 |
| 23 | Textiles | 304.8 | 762.0 | 566.0 | 1,741.6 | 3,374 | 2,309 | 5,683 |
| 24 | Clothing and footwear | 50.9 | 79.1 | 32.8 | 281.4 | 444 | 792 | 1,236 |
| 251 | Wood and wood products | 115.9 | 213.2 | 50.5 | 226.3 | 606 | 488 | 1,094 |
| 252 | Furniture and mattresses | 74.1 | 267.7 | 90.8 | 284.4 | 717 | 558 | 1,275 |
| 261 | Paper and paper products | 197.5 | 671.5 | 592.5 | 2,133.0 | 3,595 | 1,772 | 5,367 |
| 262 | Printing and publishing | 66.0 | 270.5 | 57.5 | 547.4 | 941 | 1,522 | 2,463 |
| 271 | Basic chemicals | 270.4 | 991.3 | 1,532.0 | 1,081.4 | 3,875 | 3,154 | 7,029 |
| 272 | Other chemicals | 235.2 | 730.4 | 569.5 | 829.5 | 2,365 | 3,723 | 5,088 |
| 273-274 | Petroleum products, coal products | 320.6 | 480.9 | 320.6 | 480.9 | 1,603 | 1,763 | 3,366 |
| 282 | Clay products | 249.6 | 274.6 | 25.0 | 773.8 | 1,323 | 749 | 2,072 |
| 28-282 | Other non-metallic mineral products | 603.0 | 804.0 | 201.0 | 743.7 | 2,352 | 2,553 | 4,905 |
| 291 | Basic iron and steel | 77.7 | 233.1 | 44.4 | 177.6 | 533 | 433 | 966 |
| 292 + 293 | Basic non-ferrous | 113.3 | 377.7 | 50.4 | 465.8 | 1,007 | 378 | 1,385 |
| 3111 | Fabricated steel products | 121.1 | 145.3 | 24.2 | 148.8 | 439 | 149 | 588 |
| 31-3111 | Other fabricated metal products | 485.5 | 1,237.4 | 248.2 | 1,127.9 | 3,099 | 2,245 | 5,344 |
| 321 | Motor vehicles and parts | 329.0 | 693.3 | 47.0 | 658.0 | 1,727 | 951 | 2,678 |
| 322 | Other transport equipment | 234.5 | 1,072.0 | 100.5 | 469.0 | 1,876 | 3,383 | 5,259 |
| 333 | Industrial machinery and equipment | 173.0 | 488.8 | 118.4 | 426.8 | 1,207 | 710 | 1,917 |
| 331 + 332 | Other machinery and equipment | 177.3 | 898.3 | 165.5 | 1,075.6 | 2,317 | 2,039 | 4,356 |
| 342 | Rubber products | 54.6 | 40.9 | 27.3 | 136.4 | 259 | 423 | 682 |
| 343 | Plastic and related products | 311.7 | 907.9 | 230.4 | 1,016.3 | 2,466 | 2,438 | 4,904 |
| 341 + 344 | Other miscellaneous products | 81.8 | 305.0 | 226.9 | 505.9 | 1,120 | 1,390 | 2,150 |
| | TOTAL | 5,834 | 13,276 | 6,276 | 19,557 | 44,943 | 40,735 | 85,678 |

Table VI-(9) Rank order of industry groups as liquid waste generators, 1972/3

| Order | Cooks River drainage | Upper Georges River drainage | Downstream Georges River drainage | North Botany Bay drainage |
|---|---|---|---|---|
| 1 | Food, beverages, tobacco | Food, beverages, tobacco | Food, beverages, tobacco | Basic chemicals |
| 2 | Basic chemicals | Other non-metallic mineral products | Fabricated metal products | Food, beverages, tobacco |
| 3 | Paper, paper products | Other fabricated metal products | Other transport equipment | Textiles |
| 4 | Clothing and footwear | Motor vehicles and parts | Plastics and related products | Paper, paper products |
| 5 | Other fabricated metal products | Petroleum, coal products | Other machinery and equipment | Other chemicals |
| 6 | Plastics and related products | Plastics and related products | Other non-metallic mineral products | Petroleum, coal products |
| 7 | Other chemicals | Textiles | Textiles | Other fabricated metal products |

household wastes and no special comments are called for. Factory wastes, as the second largest component, are, however, very different in kind and conditions of generation. In this case, some 5,000 factories (using Economic Census classification) generated waste flows equivalent to over half the volume of liquid waste flows from almost 400,000 dwellings. Factories, as relatively large liquid waste generators, are, individually, very significant sources of liquid wastes and major beneficiaries of managed waste disposal to waterbodies. The volumes of waste flows vary greatly from factory to factory. And, perhaps most importantly, the types of wastes generated vary according to materials used, processes, technology and commodities produced. Until very recently, many Sydney factories have been allowed to dispose of liquid wastes into nearby waterbodies, so that the advantages accruing to the whole community from the flow of industrial products were reaped against the loss of amenity most directly affecting residents of areas relatively close to factory locations. This position has been altering progressively, particularly since 1972, through the increasing diversion of liquid factory wastes into ocean outfall sewers and the increasing imposition of their environmental costs on ocean users.

Readers are referred to *A Handbook of the Botany Bay Region*[6] for information on factory activity. Here we provide estimates of the volumes of liquid waste flows, by specified areas, from factories. Because of the variability of these volume flows with manufacturing type, Table VI-(8) subdivides manufacturing into twenty-three categories based on the Economic Census classifications.

The Botany Bay drainage basin accounted for a little over half of the total volume of liquid factory wastes of Sydney. Generation in the rest of Sydney was heavily concentrated around the Parramatta River drainage basin and in Parramatta City in particular. Within the Botany Bay basin, the Cooks River drainage area (including Alexandra Canal) — an area of long-established and densely located industrial activity — accounted for approximately 40 per cent of the liquid factory wastes generated in the Botany basin. A further 30 per cent was generated in the area draining into the downstream Georges River; about 12 per cent was generated in the Upper Georges River drainage area; and the remnant, some 18 per cent, was generated in another old industrial area to the north of Botany Bay.

About half of all factory wastes generated in 1972/3 was discharged directly into inland waterbodies. The other half was discharged to sewer, the great bulk to ocean outfall sewers. Policies developed by the W.P.C.B. and the M.W.S. & D.B. in the recent past will alter this pattern to some extent.

Within each drainage area, different industry types are responsible for the main volume of liquid factory wastes. Throughout the whole Sydney area, the industrial group consisting of food, beverages and tobacco is usually the major source of liquid wastes. It is only in the area north of and draining into Botany Bay that this industrial group yields first rank to another, that of basic chemical manufacture. Apart from food, beverages and tobacco, significantly different industrial groups are responsible for most of the liquid factory wastes in each subsidiary drainage area of the Botany basin. Some idea of this is indicated in Table VI-(9), which lists the seven first-ranked industry groups.

Thus, four groups represented in the first seven in the Cooks River drainage area — basic metals; paper; clothing and footwear; and other chemicals — do not appear in the first seven as major liquid waste generators in the area draining into the Upper Georges River. In their place we find other non-metallic mineral products; motor vehicles and parts; petroleum, coal and related products; and textiles. This contrast may reflect the relative youth of much of the manufacturing in the latter area. It may, however, be partly due to the greater accessibility of water supplies in the former area, giving some inducement to heavy water consumers and large liquid waste generators to concentrate in this older drainage settlement.

Liquid wastes emerge in manufacturing activity in a variety of ways and with widely differing composition. Possibly the biggest consumption of water is for cooling purposes, a use which results in the accumulation of generally small quantities of grease, oils and metallic wastes, in addition to waste heat. Water is also used in large quantities as a process liquid in a wide variety of manufacturing and industrial operations, during which it becomes contaminated with a vast range of impurities, such as organic wastes, particularly from food processing; dyes and inks; oils; paints; varnishes; resins and emulsions; diluted acids and alkalis; metal compounds including mercury, cadmium, lead, zinc, copper and others. In the whole Botany Bay basin, some 400 industrial establishments account for approximately 60 per cent of the total volume of liquid effluent and many of these are responsible not only for very large volumes but also for the more toxic or concentrated wastes which have the greatest potential to degrade water quality. Some of these highly concentrated or toxic wastes are unacceptable for disposal in natural waterbodies or sewers and must either be pretreated, disposed of by the factories internally, or dealt with by special disposal arrangements under M.W.D.A. control. In the past, their illicit dumping has been a serious problem in Sydney. Controls over them have tightened in recent years (since 1971), but illicit dumping appears to remain a serious matter.

The ability to discharge wastes, at limited cost, into stormwater channels, directly into waterbodies or into sewers yields significant advantages to industrial establishments and through them to consumers and shareholders. In the past, the absence of control led to serious cases of water pollution, particularly in the Parramatta and Cooks Rivers. Receiving waters were an uncontrolled 'public good' and treatment and special disposal costs could be avoided by discharge to the environment. Once again a balance, which requires clarification, needs to be struck between the effects on users of natural waterbodies in the city and the lower prices of industrial products consumed by city residents, including water users.

The category of 'other' generative sources of liquid waste in Table VI-(6) has no estimate entered. This component includes farms on the edge of the city, which generate liquid wastes containing fertilisers, pesticides, weedicides and animal wastes. It is expected that a considerable proportion may infiltrate into inland waterbodies, particularly the upstream Georges River. The volumes are very difficult to estimate, though almost certainly small. However, their effects on water quality may be significant given the composition and concentration that appear to exist in some cases. Unfortunately very little is known of this matter.

Farm wastes may be expected to be a declining component in city liquid wastes. But there is another closely related flow which carries with it similar waste components. This is the run-off and seepage from residential gardens, which may be expected to carry quantities of fertiliser, pesticides and insecticides. Once again, little is known about the volumes and quantities of these wastes.

Surface run-off is one form of rain-generated waste that is predominantly communally derived. It is a waste yield of city living that stems in large part from the comfort and convenience arising from the high quality, smooth, impermeable road surfaces on which we drive, the footpaths on which we walk, the gutters and drains that allow us all-weather access to our dwellings, places of work and recreation, and the parking lots where we park our motor vehicles. The special significance of surface run-off comes from the fact that city dwellers also spread a large variety of wastes across these surfaces — paper and foodscraps discarded as litter, cardboard, grease, oil, carbon, rubber and asbestos from cars and so on. Some of these wastes originate from business and transport activities; but a great deal arises from laziness, carelessness and the unthinking habit of widespread littering that appears to be part of the city dwellers' habitat.

A similarly communal derivative of rainfall is one of the most concentrated wastes of all. Rain falling on and seeping through garbage dumps dissolves and washes out some of the wastes to produce a highly concentrated flow, technically known as leachate, that often discharges into water bodies. Although the volumes are quite small in most conditions, the concentrations in this particular flow, the product of bad garbage management, are such that they can pose very serious threats to waterbodies. Most Sydney garbage management, in this sense, has been bad.

The other waste flow generated by rainfall is less communal in origin and to a large extent takes us back to the waste source with which we began. The penetration of rain into sewers can cause them to overflow. Apart from being aesthetically offensive, this discharge of raw sewage may present some health risk to those immediately affected. To a certain extent, these effects are mitigated by the dilution of the sewage with rainwater and the occurrence of most overflows into watercourses. A major factor producing the problem is, however, the behaviour of individual householders or builders in making illegal connections of stormwater pipes from buildings into the sewer. Only detailed and costly inspections could reveal the full extent of this behaviour.

It is, indeed, most unfortunate that so little effort has been made to investigate the problem of rain-generated wastes in Sydney. Only the most general 'guesstimates' of volumes are available. The specific associations of terrain, type of surfaces, structure of pipes and drains, mixtures of permeable and impermeable surfaces and other physical city characteristics should be studied in some depth together with the volumes of surface run-off to be able to begin an effective control program. It is important to know, also, the dimension and composition of scoured wastes accompanying rainfall run-off. Only when reasonable information along these lines has been gathered can appropriate policy be designed. The poverty of the work so far done on this problem in Sydney is sharply in contrast to the scale of the flows involved. Clearly, at this point, the broad processes of city planning are intimately related to the volumes and composition of flows. This relationship cannot be ignored.

Land-based sources of wastes are not the only sources in Sydney. So far, in fact, we have concentrated on wastes that are in the main mixed with or carried by water in the process of dispersal. In the two ports in Sydney, ships become a supplementary source of wastes discharged into harbours and oceans. Generally, the waste components are small in volume, and include human wastes, bilge water, oil and grease. Oil is by far the most significant. Regular small spillages in ship fuelling are common. Accidental spillage of large amounts has occurred in Sydney, both in Port Jackson and in Botany Bay. It must be expected that this risk will increase considerably in the Bay as oil tankers dock there in increasing numbers and size as the marine port develops. Supplementing this input, kerosene from aircraft at Mascot adds to the petroleum liquids falling into Bay waters. These sources, as discussed in the next chapter, represent a special management and control problem separate from most of the other liquid wastes.

## The degradation of water quality

There has been something of a fetish, derived from natural scientists' concern

Table VI-(10) Water quality measures in waterbodies in around the Botany Bay drainage basin, 1971

| Waterbody | Statistic | B.O.D. (mg/1) | D.O. (% saturation) | Suspended solids (mg/1) | Turbidity (JTUs) | *E. coli* (per 100 ml) | Sampling details |
|---|---|---|---|---|---|---|---|
| Botany Bay | Minimum | 1.5 | 93 | nil | 1.2 | nil | 8 samples collected over Bay on 13 Oct. 1971 |
| | Mean (Std. Dev.) | 2.1 (0.7) | 102 (5) | 1.8 (1.7) | 2.8 (1.1) | — | |
| | Maximum | 3.5 | 108 | 4.6 | 5.0 | 8 | |
| Cooks River | Minimum | 2.0 | 20 | 1.6 | 2.5 | nil | 11 samples collected over lower 11 km on 9 Sept. and 28 Oct. 1971 |
| | Mean (Std. Dev.) | 7.6 (4.8) | 77 (37) | 8.3 (10.2) | 6.5 (3.3) | — | |
| | Maximum | 16.8 | 140 | 38.0 | 14.0 | 424 | |
| Alexandra Canal | Minimum | 11.6 | nil | 8.4 | 7.5 | nil | 5 samples collected over length of Canal on 9 Sept. and 28 Oct. 1971 |
| | Mean (Std. Dev.) | 66.2 (57.1) | 18 (30) | 19.1 (6.9) | 13.3 (3.8) | — | |
| | Maximum | 128 | 70 | 26.0 | 18.0 | 24,600 | |
| Georges River | Minimum | 1.2 | 55 | 1.2 | 2.0 | nil | 17 samples collected between Liverpool Weir and Dolls Point on 7 Sept. and 14 Oct. 1971 |
| | Mean (Std. Dev.) | 2.1 (1.3) | 88 (28) | 6.1 (4.3) | 5.5 (3.5) | — | |
| | Maximum | 6.6 | 173 | 18.9 | 14.5 | 320 | |
| Prospect Creek | Minimum | 1.4 | 70 | nil | 2.7 | 12 | 6 samples collected over lower 7 km on 5 Oct. 1971 |
| | Mean (Std. Dev.) | ~31.8 (30.5) | 112 (58) | 33.1 (24.4) | 18.4 (14.5) | — | |
| | Maximum | > 70 | 167 | 60.0 | 34.0 | 150 | |
| Salt Pan Creek | Minimum | 1.5 | 75 | 3.0 | 3.0 | nil | 8 samples collected along creek on 29 Sept. 1971 |
| | Mean (Std. Dev.) | 10.7 (11.2) | 113 (33) | 12.8 (12.5) | 6.0 (1.6) | — | |
| | Maximum | 32.4 | 165 | 37.0 | 8.0 | nil | |
| Upper Parramatta River | Minimum | 2.5 | nil | 2.0 | 3.0 | nil | 8 samples collected upstream on Ryde Bridge on 7 Oct. and 9 Nov. 1971 |
| | Mean (Std. Dev.) | 7.1 (4.1) | 43 (30) | 6.2 (3.0) | 5.6 (1.7) | — | |
| | Maximum | 13.0 | 75 | 10.8 | 8.0 | 10,480 | |

Source: 'Water Quality Surveys of the Waters of New South Wales, An Explanatory Foreword', Water Pollution Control Branch, Division of Occupational Health and Pollution Control, December, 1971.

with environmental quality, over the need to preserve or restore the full biological web of creatures that inhabit waterbodies. This concern has had an eminently valuable educational impact and has served to alert us to the dangers of traditional modes of waste disposal and the increasing stresses imposed on waterbodies of limited assimilative capacity. We do not begin with the assumption that city waterbodies can be preserved at some hypothetical, pristine condition. Their *inevitable* degradation in the wake of the intense human pressures on them leaves us with two types of policy questions: At what standard can we hope to preserve water quality in different city locations given potential amenity, costs of remedial action and the benefits accruing from waste generation and disposal? And at what points in city development should increasing stress through further growth be constrained?

In reaching any resolution of these questions, we need to generate information of a technical sort which establishes, amongst other things, the existing quality of waterbodies and the relationship between waste discharges and water quality. This information is crucial to the formulation of policy concerning liquid waste management. But water quality information of this type is only valuable if it is purposefully gathered towards a particular and specific end. We need to ask critically what information is required to resolve these types of questions and how will it be used. With the monitoring apparatus available today, it is possible to obtain huge volumes of data. Indeed, many water resource studies appear to gather vast masses of data without devoting sufficient effort to their interpretation. At times unimportant characteristics are measured in great detail, while more important aspects are not measured at all. This confusion, inefficiency and ineffectiveness arises principally from failing to clarify the objectives of a monitoring program and the type of question that one seeks to answer. To a certain extent, this has happened in Sydney, where water quality objectives have not been clarified; where much of the recent monitoring effort has been focused on the gathering of data rather than their interpretation; and where, up until very recently, several important quality characteristics were not monitored and little attention was paid to the contribution of the different sources of liquid wastes to overall levels of pollution.

It is only over the past five years or so that water quality has been monitored on a reasonably systematic basis in Sydney. However, there does not appear to be any clear purpose to guide the monitoring process. Until 1970, most measurement was conducted in an *ad hoc* manner. Individual water samples were frequently gathered haphazardly by persons or organisations seeking to protest about some local water problem; many were provided by local government bodies to evaluate suspected health risks. Attempts to establish some evidence of base-line water quality conditions were initiated in 1971 by the then Department of Health. We cannot show all the measures here, but Table VI-(10) indicates some of the values derived from measures made at approximately similar times for inland waterbodies in 1971. These do not represent all the measures taken in 1971 or later. In a separate Report, we attempt to cover the full range of water quality measures taken and to evaluate the implications of them.

The various water quality measures shown in Table VI-(10) are explained in some detail in a separate Report. Here we attempt to give a brief non-technical explanation. Though they help to throw light on a number of different problems concerning waste discharges and water quality conditions, the measures of Table VI-(10) are essentially the traditional ones used to assess the impact of sewage effluent on waterbodies.

The assimilation of sewage in waterbodies leads to a reduction in the level of dissolved oxygen in their waters. (The bacteria responsible for this assimilation use dissolved oxygen to break down the organic matter in the sewage.) It is for this reason that we speak of sewage and other organic wastes as exerting a Biochemical Oxygen Demand (B.O.D.). Dissolved Oxygen (D.O.) is essential for most forms of aquatic life. If the level of dissolved oxygen is inadequate, not only is aquatic life threatened, but the water itself may become aesthetically offensive — blackish in colour and reeking with an odour of rotten eggs or bad fish. Factors other than sewage also affect the D.O. content of a water body. For example, the excessive growth of aquatic plants, such as occurs during an algal bloom, results in an over-abundance of dissolved oxygen during the daytime ('supersaturated' levels) and the possibility of inadequate levels during the night time. Thus, while the amount of B.O.D. is a measure of the effect of organic waste material on D.O. levels, the D.O. measure itself is an indicator of the potential risks to aquatic life and the general 'health' of the waters.

The measures of suspended solids and turbidity are, to some extent, indicators of waste inputs to waterbodies, although the natural processes of wind and wave action, in stirring up bottom sediments, also markedly influence these measures. Suspended solids is a measure of the concentration of suspended matter in the waterbody; turbidity is a measure of the ability of the water to transmit light. High levels of suspended solids and turbidity make water appear murky and are often associated with large-scale waste discharges. Turbidity is also an indicator of potential damage to the aquatic environment in so far as the limited entry of light into water can affect the survival of aquatic life and the production of dissolved oxygen by aquatic plants.

*E. coli* are a group of bacteria that inhabit the intestinal tracts of man and other warm-blooded animals. The measure of *E. coli* provides some indication of the degree of contamination of a water body with human wastes. This measure is often regarded (we do not make this inference) as in some sense indicating the level of health risks to persons swimming in contaminated waters.

Thus the base-line measures of Table VI-(10) are an amalgam of some limited waste type indicators, water quality damage measures and human health risk monitors. These measures do not appear to have been selected with any clear purpose in mind, although the risk to human health from direct bodily contact with affected waterbodies appears to be one factor in their selection. Nevertheless, this set of measures, in spite of certain limitations and omissions, provides a reasonably adequate starting point for initial base-line surveys of water quality. (Some comments on other measurement needs are made later.)

The results of Table VI-(10) give some indication of the differences in water quality between the major inland waterbodies in Sydney at 1971, and subsequent measures made by the Health Commission and the W.P.C.B. reinforce this base-line comparison. Within the limits of the measures themselves, and the shortcomings of characterising the quality of a waterbody by the mean or average value of a particular quality characteristic, the ranking was as follows: Botany Bay had clearly the best water quality with low average levels of B.O.D., suspended solids, turbidity and *E. coli* and excellent D.O. values. Georges River was next best, though with significantly lower average D.O. values and higher average values of suspended solids, turbidity and *E. coli.* Illustrative of the differences that occur in parts of the same general system, the quality of Salt Pan and Prospect Creeks were markedly worse than the Georges River with significantly higher average levels of B.O.D. and suspended solids.

The maximum dissolved oxygen levels recorded in Georges River and Salt Pan and Prospect Creeks indicate the influence of algal blooms on D.O. levels. Such blooms are nourished and stimulated by the inflow of nutrients from sewage, factory wastes and rainfall run-off. Discharge from the Fairfield Sewage Works was a major damaging influence on the quality of water in Prospect Creek.

The upper Parramatta River had significantly lower levels of D.O. than waterbodies in the Georges River system, implying a greater damage to its waters and their inhabitants from organic wastes. Well below the standard of all these waterbodies were Cooks River and Alexandra Canal, the latter representing the most degraded waterbody of all. The Canal, from its headwaters to its confluence with Cooks River, was a putrid, almost totally dead waterbody whose state affected a significant stretch of Cooks River.

Some of these waterbodies have since been improved through joint action by the W.P.C.B. and the M.W.S. & D.B. But their ranking remains similar if not the same today. The biggest improvements have occurred in Parramatta River, as indicated by an increase in fish movement; and some improvement has been achieved in Cooks River. The improvements appear to be mainly due to tighter control over the discharge of factory wastes into inland waters and the diversion of some of these wastes to ocean outfall sewers. The nature of these

Table VI-(11) Frequency and level of pollution occurrences at beaches close to the Bondi and Malabar ocean outfalls

| | | Frequence of occurrence (% of days of year) | | | Extractable grease | | |
|---|---|---|---|---|---|---|---|
| | | Coliform content MPN/100 ml* | | | Parts per 10,000 | | |
| Location | Beach No. | Greater than 1000 | Greater than 2000 | Discrete particles visible on beach | min. | mean | max. |
| Adjacent to Bondi outfall | (1) | 22 | 15 | 63 | 0.1 | 4.1 | 182 |
| | (2) | 29 | 17 | 30 | 0.03 | 1.1 | 36 |
| Adjacent to Malabar outfall | (3) | 33 | 28 | 47 | 0 | 3.3 | 117 |
| | (4) | 51 | 36 | 47 | 0.1 | 6.9 | 945 |
| Control† | | 1 | 1 | 3 | 0 | 0.2 | 5 |

*MPN = Mean Probable Number
†The control beach was remote from any sewer outfalls.
Source: M.J. Flynn and D.K.B. Thistlethwayte, 'Sewage Pollution and Sea Bathing', *Air and Water Pollution*, vol. 9, 1965, pp. 641-52.

improvements is discussed at length in the separate report on the interpretation of water quality measures in Sydney.

The improvement of inland water quality through the diversion of wastes to ocean outfall sewers transfers the stress to ocean waters. However, ocean waters are more able to withstand this stress because of their large dilutional and assimilative capacity. Nevertheless, the discharge of wastes from ocean outfall sewers has also created problems, the main one being the fat, grease and other floating debris that washes back onto nearby beaches and reduces the amenity of the beaches and the enjoyment and satisfaction of beach-goers. Well before 1971, attempts were made to measure pollution at popular and heavily used beaches adjacent to the Bondi and Malabar outfalls. The measures, made for the M.W.S. & D.B. in the early 1960s, are shown in Table VI-(11).

The four beaches adjacent to the outfalls are seen to be frequently polluted, both in terms of coliform levels of seawater (a generally accepted standard for body contact recreation is that the number of coliforms should not exceed 200 per 100 millilitres of water), and in terms of occurrence of discrete grease particles on the beach. Moreover, in terms of the mean level of grease, three of the beaches showed *average* levels that could be expected to yield significant discomfort; the maximum levels for all beaches implied major contamination at some times.

It should be noted that since these measures were taken, the volumes of sewage issuing from the outfalls, particularly from Malabar, have increased greatly. Unfortunately, no systematic measures of the increase in waste levels in the ocean and on the beaches are available to us. It is regrettable that these are not publicly accessible as are such reports from the Environment Protection Authority in Victoria.

Reverting to the inland water measures, the degradation of Alexandra Canal and Cooks River reflects a very long period of abuse primarily through the injection of large masses of industrial wastes, some local sewage and large quantities of rain-generated run-off from a densely settled and heavily industrialised area. Unfortunately, the base-line measures paid little attention to several additional measures of water quality both of which are becoming increasingly relevant to these streams — measures of toxic wastes, such as heavy metals, and measures of nutrients.

In the preceding section of this chapter, we have seen the concentration of factory wastes in the Cooks River drainage area. These wastes contain not only large masses of organic matter which lower oxygen levels in the Canal, but also large quantities of heavy metals, particularly mercury, cadmium, zinc, lead and copper. The discharge of heavy metals into the Canal in 1973 was estimated by the W.P.C.B. to be some 400 kilograms per day.[7] Apart from organic wastes and heavy metals, oil was discharged into the Canal at the rate of some 1,300 kilograms per day in 1973.[8] These waste loads, together with the poor assimilative capacity of the Canal, account for its highly polluted waters.

Recent action by the W.P.C.B. and M.W.S. & D.B. has somewhat improved the quality of Cooks River so far as organic, oil and grease wastes are concerned, but little has been revealed about the control of heavy metal and other toxic discharges. 'Improvement' has led to a return of some marine animals, but we have found no public information concerning any health risk they present to humans. Given the high heavy metal discharges into the Canal, and the heavy metal content of its sediments, the presumption must be that some hazards are likely to arise from the human consumption of fish from this area. Nevertheless, no warning is posted to amateur fishermen. Marine animals from the Cooks River system were noticeably absent from surveys recently made by the N.S.W. State Fisheries and Health Commission of the heavy metal content of fish and shellfish from Sydney waterbodies.[9,10]

Publicity has occurred on occasions of accidental spillage of highly toxic compounds, particularly during the fish kill episode following the recent accidental discharge of a cyanide compound into Cooks River. However, it is the long-term lower levels of toxic discharges — which are not publicised — which may well present the greater health risk.

Many of the prevalent attitudes to Georges River and its tributaries reflect past history and a somewhat exaggerated concern with potential human health risks in direct body contact with the river. At the same time, they fail to recognise the changing nature of the degradation occurring in the river.

Let us refer to past history first. Until the early 1970s the river was subjected to serious sewage flows that preoccupied local residents, visitors and officials. In part these were due to inadequately disposed effluent from households not connected to sewer, especially in the Bankstown and Liverpool areas. In addition, inadequately treated sewage was discharged into the river from the Liverpool and Fairfield treatment plants (operated by the M.W.S. & D.B.), from the Holsworthy military establishment and several small sewage works in the area (a Commonwealth Government responsibility). During periods of wet weather, sewer overflows deposited additional quantities of sewage into the river and tributaries. To these inputs, surface run-off and the leaching of garbage dumps adjacent to the river also contributed considerable quantities of organic and other wastes.

In 1962, the level of faecal bacteria was judged to be a threat to swimmers in *public* baths on the River and four Bankstown baths were closed. Improved sewage treatment, the sewering of unsewered properties, and the diversion of effluent from the Fairfield plant into the Malabar ocean outfall subsequently reduced the problem. Nevertheless, sewer overflows have continued to prompt complaint and restrictions on public swimming in some locations. It is doubtful, in fact, if there are any substantial areas of the Georges River where water quality is so affected by sewage as to create a significant human health risk (as opposed to being aesthetically unpleasant). It is doubtful, moreover, if this ever was to to any significant degree, or if it will be the major water quality problem facing the Georges River in the foreseeable future.

Commercial oyster beds around the lower reaches of the River were also exposed to risk from human sewage. A 1967 survey found that bacterial levels in Georges River oysters often exceeded the maximum permissible limits adopted in several overseas countries.[11] This problem has also been eliminated by improved sewerage facilities. Future risks to these beds lie more from heavy metal and other toxic discharges into Georges River and from oil spills in Botany Bay. At present the heavy metal concentrations in these oysters, as determined in the State Fisheries and Health Commission Survey referred to earlier, do not present a health risk to human consumption. However, with increasing residential and industrial development in the tributary areas of the upper and middle reaches of the river, heavy metal discharges can also be expected to increase, both from industrial liquid wastes and from rainfall run-off. The frequency and size of oil spills can be expected to increase with the new port development on the northern shores of Botany Bay. Apart from oil, spillages of other bulk commodities to be handled at the port may also have ill-effects on the oysters.

More important for Georges River, however, is the effect of aquatic nutrient inflows and the prospect of much greater inflows in the immediate future. The nutrients of concern are the various phosphorus and nitrogen compounds that stimulate and nourish plant life. They originate from many sources in the Georges River Basin. Household, non-factory business and factory wastes all contain significant quantities. Even if these wastes are discharged to sewer, the tertiary treatment processes employed at treatment works discharging effluent into Georges River are relatively ineffectual at nutrient removal. Rainfall run-off, especially from unsewered areas with faulty septic tanks and from agricultural areas, also carries significant quantities of nutrients into the river. Sewer overflows and the leachate from garbage dumps also contribute.

High and sustained levels are a crucial factor encouraging the development of algae and other aquatic plants. The excessive growth of aquatic plants can take the form of the unpleasant green slimes that have developed over areas of the bottom of Georges River and its tributaries; or it can be exhibited as the excessive growth of microscopic plants, as in algal blooms, or as the excessive growth of larger rooted plants, such as alligator weed. Algal blooms occur in the Georges River on a fairly regular basis. The climax of a large bloom late in 1972 completely de-oxygenated the river around the Liverpool-Bankstown area for a period of four days killing thousands of fish which were washed up along the river banks.[12] Nutrients appear to be a major factor in the excessive growth of alligator weed in the smaller tributaries and freshwater reaches of the Georges River. Rooting in the river banks, the weed spreads in thick mats over the water. During heavy rainfall conditions in 1974, large masses of weed were uprooted, washed downstream and deposited on river beaches in Kogarah, where they rotted to produce an offensive mess. Kogarah Council had to employ several dump trucks and frontend loaders for a period of eight weeks to remove the weed to a garbage tip. Growth of alligator weed is difficult to control because it is capable of sprouting from small broken nodules and tends to spread rapidly when disturbed manually.

The major and most easily controlled source of nutrients in the Georges River appears to be sewage effluent. Surface run-off appears to be a less significant source. A recent study shows that while nutrient levels rose dramatically during run-off from heavy rain,[13] they appear to have been rapidly flushed downstream and out of the river by the increased river flows or otherwise assimilated. The installation of nutrient removal processes at the treatment plants discharging into the Georges River would do much towards reducing the nutrient inflow.

A problem of increasing concern in Georges River is the erosion and siltation of the river bed and banks that is occurring in some sections of the waterway. Overall, a constantly adjusting balance of sediment movement is attained, but if the existing patterns of water currents and sediment loads are markedly altered.

a significantly different balance is likely to result. This, in fact, is occurring in Georges River and Botany Bay, where the patterns of current movements and the sediment loads have been or are being markedly altered by:

(i) The massive reclamation and dredging of large areas of Botany Bay undertaken some ten years ago for the extension of Sydney Airport and currently being undertaken for the new marine port development.

(ii) The extensive sand mining operations in the Georges River at Chipping Norton.

(iii) The filling in of bays, backwaters and mangrove swamps along the Georges River for residential development, landfill sites, provision of playing fields, etc. It has been estimated that some 250 hectares of tidal zone along the river have been reclaimed in this fashion and that, along the middle reaches, some 3 kilometres of mangroves have been removed and replaced with erodible sand.[14]

(iv) The growing urban and industrial development in the catchment area of the Georges River. This has increased both the volume and rate at which run-off enters the river and the amount of sediment it contains.

Currently, the rate of bank erosion along the middle reaches of the Georges River appears to be accelerating. Apart from the factors mentioned above, the problem is heightened by the highly erodible nature of the river banks in this area, by residential development in close proximity to the river (bank erosion has actually threatened to undermine some river bank properties), and by the waves from passing speed boats. This eroded material, together with spoil from the sandmining operations and the sediment load from urban run-off, is causing increased rates of siltation in the lower reaches of the river, where the mouth of tributaries, such as Salt Pan Creek, are silting up.

Erosion has also caused problems in Botany Bay itself. Altered wave patterns caused by dredging for the runway extension at Sydney Airport were responsible for the heavy erosion of beaches around the Brighton-le-Sands area on the western foreshores of the Bay during a storm in 1966. Over $1 million was spent by the Commonwealth Government to restore and protect these beaches. Currently, erosion appears to be increasing around Dolls Point area in the mouth of the Georges River, where beaches were washed away and roadways threatened during storms in 1974. These altered current patterns could conceivably cause increased levels of salinity in Woolaware Bay, as is thought to be occurring by oyster fishermen.

On the basis of the evidence available it is not possible to single out the most important cause of erosion and siltation problems. However, it is clearly evident that the sandmining operations at Chipping Norton and the reclamation and dredging programs undertaken for both the airport extension and for the new port development must markedly alter current patterns in both Georges River and Botany Bay. This, together with the other contributing factors, indicates that erosion and siltation are likely to remain problems in Georges River and possibly in the Bay itself for a considerable time to come.

Apart from erosion and siltation, oil spillage appears, on the basis of water quality measures available, to be the only other significant water quality problem in Botany Bay itself. It appears almost inevitable that oil spillage will become an increasing and possibly a severe problem for the Bay and surrounding residents.

At present, most oil spills result from accidents during the fuelling (bunkering) of vessels and during transfer of petroleum products to and from oil tankers. Damage to underwater pipe lines has also led to the discharge of oil into the Bay. Oil can also escape from land-based establishments. In Sydney, the biggest incident of this type was the discharge of 400,000 litres of oil in Berrys Bay from a ruptured storage tank. Oil is also washed into waters in surface run-off from roadways. Power boat fuels are discharged into Bay waters, and kerosene falls into them during the takeoff and landing of aircraft.

Future problems in Botany Bay will be even more severe. The arrival and departure of tankers of the order of 200,000 dead-weight tonnes implies the regular transfer of huge volumes of oil and petroleum products. The possible establishment of another refinery south of the Bay adds additional risks. The port development with large storage facilities established by the Bay also increases the risks of more frequent and larger oil spills.

Planned development of the Bay as a bulk port to handle commodities such as cement and coal (in massive amounts) introduces novel problems. It is not immediately obvious why the State Coalition Government was planning to undertake an expensive and essentially scientific investigation of marine animals and plants in the face of problems that are essentially of significance to human rather than the fish residents of the Bay. Changes of the magnitude proposed will generate severe stresses on the amenity of the Bay itself and on the amenity of its hinterland, stresses that will have a marked social and economic impact on residents living in these areas. One would have expected the Government to be more concerned about these problems than the effect of the changes on marine life.

# 7 Of sewers and drains

## Introductory

Possibly as many as twenty different authorities participate in some way in the management of liquid wastes in Sydney and in influencing their effects on the environment. The role of many of these is either minor or very indirect. Here we concentrate on a limited number. They are:

(i) The State Pollution Control Commission
(particularly the Water Pollution Control Branch)

(ii) The Metropolitan Water, Sewerage and Drainage Board

(iii) The Metropolitan Waste Disposal Authority

(iv) The Health Commission of N.S.W.
(The Health Inspection Branch)

(v) Local government authorities of which there are forty-two in the Sydney Statistical Division and seventeen in the Botany Bay catchment.

Some of the more important omissions from this are the State Fisheries, the

A. Managing disposal/treatment

| Type of Liquid Waste | Public Authority |
|---|---|
| **1. Wet weather wastes** | |
| Surface run-off | Metropolitan Water, Sewerage and Drainage Board; local governments |
| Sewer overflows | Metropolitan Water, Sewerage and Drainage Board |
| Garbage leachate | Metropolitan Waste Disposal Authority, local governments |
| **2. Man-made wastes** | |
| Sewage effluent (domestic and industrial) | Metropolitan Water, Sewerage and Drainage Board |
| Industrial liquid wastes discharged to stormwater drains | Metropolitan Water, Sewerage and Drainage Board |
| Industrial liquid wastes unacceptable to sewers and drains | Metropolitan Waste Disposal Authority |
| Domestic waste water from unsewered properties | Local government |
| Oil wastes in port waters | Maritime Services Board |

B. Controlling disposal and protecting water quality

| Function | Authority |
|---|---|
| 1. Environmental management | State Pollution Control Commission (Water Pollution Control Branch) |
| 2. Public health management | Health Commission (Health Inspection Branch) |

Water Conservation and Irrigation Commission and the Department of Public Works.

Several influences, including the historical evolution of government administration, the entry of public authority into environmental management, the variety of uses of waterbodies, the large-scale physical assets in water supply, sewerage and drainage, have bequeathed divided responsibility among this selected group of authorities in the management of liquid wastes and water quality. The formal structure is shown in stylised form in Fig. VII(i). The division is by no means clearcut, and at the simplest dissection there is a good deal of overlapping or intersecting responsibility. There is also a good deal of obscurity in certain of the divisions.

As between managing liquid wastes on the one hand and water quality on the other, the structure of administration can be summarily defined as above.

## Basic approaches

The essential thrust of action in Sydney is along two lines. First is the management, upkeep and extension of the public sewers, dominantly directing a vast flow of water-borne wastes to the ocean. Second, water quality management is primarily dependent on the control over and policing of liquid waste disposal (including sewer discharge), a control that relies fundamentally on a physical re-direction of the liquid waste flows into sewers, subject to some treatment constraints.

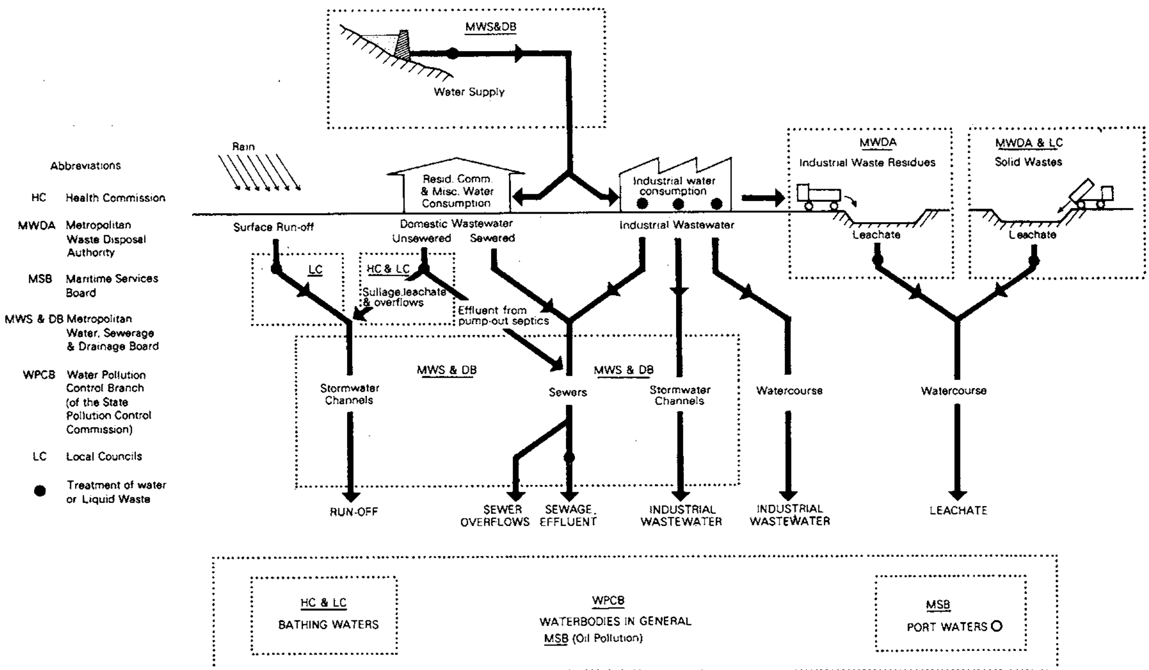



Fig. VII (i) Major authorities responsible for the management of liquid wastes in Sydney, : 1975

Other activities appear as part of the work of these authorities. The S.P.C.C. control over environmental impact statements for major new developments implies the potential if not the realisation of preventive action. The introduction of charging for factory waste discharge into sewers and the provision for penalties for illegal disposal imply some pressure through a form of pricing to induce businesses to limit waste generation, to treat wastes or to reuse them. The declaration of principles of classifying waters is some sign of the clarification of environmental objectives. The proposal to undertake studies of major waterbodies and to propose overall plans of restoration of past damage indicates another line of future protective behaviour that may become significant. The monitoring of water quality offers the potential for a major input of information into the decision-making process in environmental management.

These are, however, comparatively small qualifications to the definition of the major management and control activities. In fact, the emphasis derives from the scale of the sewerage and drainage task and the technological dependence on water transport and disposal of large volumes of man- and rain-made wastes. It is explicable in terms of the fact that the technically competent W.P.C.B. was cast, under administrative and public pressures, into a controlling and policing function with inadequate resources to develop other possible functions.

The concentration of activity along a very narrow and specialised — possibly an eventually self-defeating — front of palliative and remedy raises fundamental problems. Actions taken by authority or imposed by it on private individuals and institutions are expensive (see Chapter 3). Action taken or not taken can have an important effect on the quality of residential living, recreation and leisure that determines much of the well being of many of Sydney's residents. Have the right priorities been adopted? Is the preferred control option to be one to restrict the generation of wastes, to require waste treatment, to encourage waste reuse or to protect some waterbodies at the expense of others by re-routing flows? At what stage and cost and for whose benefit are restorative plans for some waterbodies to be carried out? For what reason and for whose benefit are different waterbodies to be accorded different quality goals?

The control and much of the management activity in Sydney was undertaken in the absence of much of the basic knowledge that should underlie public policy on liquid waste management. This is no criticism if the mode of present procedure is a short-term, emergency response to serious water degradation in some areas (particularly the Parramatta River and Cooks River).

However, during 1970-5, there was, as we have seen, little understanding of the various uses of the Sydney waterbodies and the value that residents placed on them. Regrettably, it appears that the S.P.C.C. has not sought to develop this understanding. Moreover, there was and still is very limited information on the contribution of various types of wastes to the overall levels of water quality decline, a limitation accentuated by the policing function into which the W.P.C.B. has been forced. Third, there is little evidence of any attempt to relate control of water-borne waste flows and water quality management to wider processes of city planning and development.

Apart from inadequate understanding, this selected group of authorities, despite their collective interest in liquid waste management, operate together largely on an *ad hoc* day-to-day basis without reference to any clearly defined objectives. Technical aims are specified; but the essential socio-political ends are notable by their absence. Obviously, under these conditions, inter-authority co-operation and coordination, which is necessary to administer *two basically conflicting functions of liquid waste management and water quality management,* must be extremely limited without clear ends or priorities. Unfortunately, the recent (1975) proposals for administrative organisation in N.S.W. appear, for reasons that are not immediately obvious, to encourage an even greater separation of these bodies. This is the more unfortunate given the central position and the power of the M.W.S. & D.B., the manager of the system around which most of the control approaches revolve.

## The Metropolitan Water, Sewerage and Drainage Board

As the constructor, owner and operator of the water supply, sewerage and major drainage facilities of Sydney, the M.W.S. & D.B. is of particular importance for the disposal of domestic and industrial wastewater, as well as for the disposal of surface run-off and hence, also, for water quality in Sydney. If we take the volume of liquid waste that it accepts, the Board is the largest 'disposal' authority in Sydney and (legally), the largest 'polluter'. Essentially, the Board influences the management of liquid wastes in three ways: the provision of water supply, the provision of sewerage facilities, and the management of wastes discharged to its sewers. The Board is much less preoccupied with the management of liquid wastes discharged to its stormwater channels: ultimate control over the volume and kinds of wastes discharged by this means is now the responsibility of the W.P.C.B.

### *The provision of sewerage*

Sewerage facilities cannot be considered wholly in isolation. The water supply activities of the M.W.S. & D.B. were outlined summarily in Chapter 6. They are of importance to the management of liquid wastes in Sydney for two reasons. First, the Board's internal allocation of funds between the competing requirements of water supply and sewerage has a major effect on the rate at which additional sewerage facilities can be provided and existing facilities upgraded. It appears that a major factor contributing to the increasing backlog of unsewered properties that developed up to the 1960s was the large-scale allocation of funds towards the provision of a reliable water supply system rather than the provision of an effective sewerage system. Second, the Board's policies on supply of water, such as the price charged for water consumed and the implementation of water conservation measures, are means of imposing controls on the quantity of wastewater generated.

We must stress, by repetition, a major problem. A reliable water supply system is essential for any modern city. Reliability is principally dependent on the demand for water; the capacity of the storage reservoirs; and the likelihood of occurrence and the length of droughts. If a water supply authority is risk-averse, it provides a large storage capacity in relation to the demand for water and the likelihood of droughts. Such a policy results in large capital expenditures on reservoirs in return for minimal water supply restrictions during times of drought. Thus, a basic policy question for water supply authorities in Australia is the balance to be struck between capital expenditures

Table VII-(1) Details of sewer systems serving the Sydney region, June 1974

| System | Length of sewers (km) | Estimated population served |
|---|---|---|
| **1. Sewers serving Botany Bay drainage basin** | | |
| *Major ocean outfalls* | | |
| Malabar | 3,925 | 1,029,000 |
| Bondi | 670 | 225,000 |
| Cronulla | 603 | 100,000 |
| | 5,198 | 1,354,000 (54.3%) |
| *Inland treatment plants* | | |
| *(i) Draining to Georges River:* | | |
| Liverpool | 324 | 27,000 |
| Glenfield-Campbelltown | 309 | 26,000 |
| | 633 | 53,000 ( 2.1%) |
| *(ii) Draining to Malabar ocean outfall:* | | |
| Fairfield | 417 | 51,000 ( 2.1%) |
| SUB-TOTAL | 6,248 | 1,458,000 (58.5%) |
| **2. Other Sydney sewer systems** | | |
| *Major ocean outfalls* | | |
| North Head | 5,059 | 890,000 |
| Warriewood (under construction) | 12 | — |
| | 5,071 | 890,000 (35.8%) |
| *Minor ocean outfalls* | | |
| Diamond Bay | 8 | 2,500 |
| Vaucluse | 34 | 6,000 |
| | 42 | 8,500 ( 0.3%) |
| *Inland treatment plants* | | |
| *(i) Draining to Nepean-Hawkesbury Rivers:* | | |
| St Marys | 371 | 70,500 |
| Quakers Hill | 229 | 34,000 |
| Hornsby | 58 | 15,000 |
| Richmond | 37 | 7,000 |
| Camden | 31 | 4,000 |
| West Thornleigh | 16 | 2,500 |
| Warragamba | 19 | 2,000 |
| Castle Hill | 28 | 500 |
| | 789 | 135,500 ( 5.4%) |
| *(ii) under construction:* | | |
| Kellyville | 2 | — |
| West Hornsby | 7 | — |
| West Camden | 2 | — |
| SUB-TOTAL | 5,913 | 1,034,000 (41.5%) |
| **TOTALS** | 12,161 | 2,492,000 (100.0%) |

Source: M.W.S. & D.B. *Annual Report for 1973/4* for additional reservoirs, on the one hand, and the supply restrictions acceptable to consumers on the other (see Chapter 6).

As suggested in Chapter 6, the M.W.S. & D.B. tends to provide a large storage capacity, with attendant high capital expenditures on reservoirs and other headworks, to ensure that there are minimal supply restrictions during times of drought. This is understandable in the light of the severity with which droughts have interfered with the Sydney supply system in the past. However, it may be argued that the M.W.S. & D.B. has over-reacted in providing a 'reliable' water supply system. Accordingly, as already stated, the second stage of the Shoalhaven Scheme should be examined again to determine whether it would not be better to adopt a lesser degree of reliability by deferring its construction to a later date. In this way funds for the construction of the second stage would be freed for other purposes, most importantly for the sewerage backlog program and for the complete sewering of new areas.

The availability of sewers is obviously a critical element in liquid waste and water resource management in Sydney. The extension of Sydney's sewerage network does not match the geographical spread of its water supply system. Thus, in 1973/4, the M.W.S. & D.B. reported that 881,000 occupied properties were served with water, as against 754,000 supplied with sewerage, a difference of 127,000[1], that is 14.4 per cent of occupied properties with water supply had no sewerage. Only a small fraction of this difference is due to technical problems.

Obviously the place and method of liquid waste disposal has an impact on water use. Judging from the estimated population served by the respective sewer systems, Table VII-(1) indicates that the bulk of the liquid wastes (over 90 per cent of the volume) generated in Sydney is discharged from ocean outfalls. Data showing the actual annual volume of liquid wastes discharged at particular locations are not published by the M.W.S. & D.B. and were not made available to the Project staff. Further, any deductions made from Table VII-(1) about volumes discharged are misleading because they emphasise the flow of household wastes only. Nonetheless, given the location of industry in the southern half of Sydney, a large and increasing proportion of industrial liquid wastes is presumably discharged at ocean outfalls, particularly at Malabar. As Sydney expands on its western edges, it may be expected that the absolute and relative volumes of liquid wastes discharged from treatment plants into inland streams will increase. Not only does this projection stress the need for the formulation of policies governing the use of inland streams, but also for the closer integration of land use planning with liquid waste management. It may be expected that the future location of industries that generate increasing volumes of liquid wastes, particularly noxious wastes and nutrient materials, will be increasingly affected by the policies of the W.P.C.B. in conjunction with those of the M.W.S. & D.B. and the M.W.D.A.

Not only is the Georges River the disposal point for inland sewage treatment works, but also the ultimate drain for a proportion of household wastes that are not discharged to sewer (see Chapter 6). As Table VII-(2) shows, close to one-quarter of the dwellings in the Lower and Upper Georges River drainage areas, encompassing over 47,000 dwellings in eight local government areas, are not connected to sewer. Roughly half these dwellings have septic tank systems, some of the effluent from which percolates through to natural water courses. The remainder have sanitary pan services, the contents from which are collected and discharged, in the main, into the sewers or buried. There are no published data on the volumes of industrial liquid wastes generated, or their point of discharge, or the number of industries connected to sewer. However, we have estimated that half the volume of industrial liquid wastes in 1972/3 was discharged directly to drainage and water courses. Over half of the factory wastes generated in Sydney have their origin within the Cooks River drainage area, so that we can deduce that about 25 per cent of Sydney's liquid wastes of factories were discharged into the Cooks River system. With the advent of the W.P.C.B. and its policy to redirect wastes into sewers (see later), this proportion will have changed to some extent, but we have no knowledge of how far this diversion has occurred, beyond the fact of long delays in making sewer connections.

Table VII-(2) Household liquid waste disposal in Botany Bay drainage basin, 1971

| | Total occupied private dwellings | | Dwellings with mains sewer | | Dwellings with separate system* | Dwellings with sanitary pan |
|---|---|---|---|---|---|---|
| | No. | Share of Total % | No. | % on mains sewer | No. | No. |
| 1. Cooks River drainage area (7 LGAs) | 144,326 | 36.3 | 139,610 | 96.7 | 1,196 | 117 |
| 2. North Botany Bay drainage area (2 LGAs) | 52,009 | 13.1 | 50,564 | 97.2 | 451 | 116 |
| 3. Lower Georges River drainage area (4 LGAs) | 123,231 | 31.0 | 93,947 | 76.2 | 17,110 | 10,928 |
| 4. Upper Georges River drainage area (4 LGAs) | 77,749 | 19.6 | 56,690 | 72.9 | 6,716 | 12,495 |
| **Total Botany Bay drainage basin** | 397,315 | 100.0 | 340,811 | 87.4 | 25,473 | 23,656 |
| **Total Sydney** | 845,714 | — | 694,365 | 83.1 | 90,494 | 42,610 |

*mainly septic tank
Source: 1971 Census

*The management of sewered wastes*

*Sewer overflows.* Sewer overflows not infrequently produce local offence on land and in streams, especially in Georges River. There are three basic ways to reduce the frequency and volume of overflowing sewage: (i) to reduce the volume of stormwater inflow into the sewer system; (ii) to construct sewers of greater hydraulic capacity; and (iii) to reduce the volume of sewage requiring disposal. Activities of the M.W.S. & D.B. aimed at reducing the inflow of stormwater include the inspection of properties for the illegal connection of roof drainage to sewer and studies to evaluate the effectiveness of more watertight pipes and joints for the connection between property and mains sewer. One factor contributing to the illegal connection of roof drainage to sewer, at least in certain areas of Sydney, appears to be a lack of stormwater drainage.[2]

For more effective control, however, closer and more detailed co-operation between local authorities and the Board is needed. The local authority powers with respect to building control and inspection could be used more extensively to assist in this problem.

The construction of sewers to increase hydraulic capacity is an expensive undertaking and perhaps difficult to justify when a significant proportion of occupied dwellings are still not connected to sewer. Reduction of sewage volumes is not likely to be an effective means of controlling sewer overflows. Since some three-quarters of the capacity of Sydney's sewers are set aside for stormwater inflow, a reduction in the one-quarter used for 'dry weather' sewage flow will not greatly increase the effective capacity of the sewer. Currently, the M.W.S. & D.B., in conjunction with the W.P.C.B., is investigating various methods, such as the construction of storage ponds, for dealing with the overflows themselves.

*Sewage treatment.* The objective of the M.W.S. & D.B. is to provide full primary treatment on all ocean outfall systems and treatment to the tertiary level plus effluent chlorination on all inland systems. To this end, the level of treatment provided at most of the sewage treatment works in Sydney is currently being upgraded. One major, and in the future an increasingly serious shortcoming, of this policy is the lack of specific nutrient removal processes at the inland treatment works, especially those discharging into the Georges River.

The provision of primary treatment at all ocean outfall systems should greatly alleviate nuisance problems on the ocean beaches, though it will not affect the growing risk of contamination of marine life as industrial effluent flows increase because of W.P.C.B. action (see later). As a further measure, the M.W.S. & D.B. is currently investigating the feasibility and effectiveness of 'extended ocean outfalls' to discharge sewage effluent into the colder deeper waters some distance off the coast. After discharge, the effluent would mix with the colder bottom waters and tend to remain submerged. Initial investigations suggested that the North Head ocean outfall would need to be some three kilometres long and discharge into a 60 metre depth of water to achieve this submarine effluent field.[3] A comprehensive 2-year study of the feasibility and effectiveness of deep water submarine outfalls at six sites on the Sydney coastline was recently completed by consultants to the Board, but to date no decision has been made on whether or not they are to be constructed. Again, the basic need is for a careful assessment of the balance between added costs (large capital costs would be required for submarine outfalls) and the *additional* benefits, chiefly cleaner beaches and, possibly, reduced treatment costs.

*Industrial wastewater.* The discharge of industrial wastewater to sewer is a key factor in the management of liquid wastes in Sydney. We will return to this problem in discussing the activities of the W.P.C.B. and M.W.D.A. in a broader context. These wastes can have detrimental effects on sewerage facilities and sewage treatment processes and can present health and safety threats to men working in the sewers. Despite precautions such as protective clothing and forced ventilation, workmen from the M.W.S. & D.B. 'have been overcome by hydrogen sulphide, sulphur dioxide, carbon monoxide and trichlorethylene. They have been burned by white phosphorus, intoxicated by volatile solvents and had their eyes seared by acrolein'.[4] In fact, the illegal discharge of industrial wastes to sewer has been 'a major curse in the operation of sewage treatment works and ocean outfalls'.[5] In the past, firms have been detected discharging, for example, as much as half a ton of sulphuric acid; hundreds of gallons of fuel oil; a spoiled batch of paint resins; and fats in amounts of a ton or more.[6] Apart from these extreme examples, there are numerous other illegal discharges of a lesser nature which are cumulatively significant in their threat to the safety of workmen and their interference with the operation of sewerage facilities.

For these reasons the M.W.S. & D.B. sets standards for the acceptance of industrial waste discharges into sewer (and stormwater channel) systems (see

Table VII-(3) Standards for acceptance of trade wastes to sewer and stormwater channel (M.W.S. & D.B.)

| | Standards for sewer | | Standards for stormwater channel |
|---|---|---|---|
| Temperature | Not to exceed 37°C if the waste contains grease or fats. Otherwise not to exceed 50°C. | Temperature | Not to exceed 37°C. |
| | | pH | Within the range 5.5 to 9. |
| | | B.O.D. (5-day value) | Not greater than 10 mg/l. |
| pH | Within the range 6.8 to 10. | Suspended solids | Not greater than 15 mg/l. |
| Grease | Not to exceed 200 mg/l. | Dissolved oxygen | Not less than 30% saturated. |
| B.O.D. (5-day value) | Not to exceed 600 mg/l. | Colour | Not noticeable at 100 dilutions. |
| Suspended solids | Not to exceed 600 mg/l. | Grease and oil | To be absent except for stable dispersions containing not more than 10 mg/l. |
| Sulphides | Not to exceed 50 mg/l. for an interim period expiring on 30.6.76 and thereafter not to exceed 10 mg/l. | Heavy metals | Total not to exceed 3 mg/l. including not more than 0.5 mg/l. of copper or zinc. The discharge of mercury to stormwater channels is forbidden. |
| Toxic substances (max. limits) | mg/l. | | |
| Arsenic | 100 | | |
| Cadmium | 30 | | |
| Chromium | 100 | | |
| Cobalt | 200 | | |
| Copper | 5 | | |
| Cyanide | 7 | | |
| Lead | 10 | | |
| Nickel | 100 | | |
| Zinc | 30 | | |
| Organic herbicides | 5 | | |
| Organic insecticides | 5 | | |

NOTES:
1. No mercury may be discharged.
2. When two or more heavy metals are discharged together, the total concentration shall be limited to that applicable to the most toxic component, except where otherwise authorised.
3. Cyanide baths are only accepted after detoxification. (The acceptable level of 7 mg/l in the table above refers to rinses only.)
4. Volatile solvents shall not be discharged unless miscible with water and then only with special approval. The use of solvents in discharging the contents of grease traps to the sewer is prohibited.
5. Ferruginous pickling wastes will be accepted with pH not less than 5.5 in certain cases.

Source: E.W.T. Pierce & C.S. Ralph 'Principles & Practices Relating to the Acceptance of Industrial Wastes in the Board's System', *Industrial Wastewater, A Symposium of Recent Developments*, University of New South Wales, 1972, pp. 10-12.

Table VII-(3). These two sets of standards were last revised in the late 1960s, the significant alteration being the inclusion of restrictions regarding the discharge of toxic substances and sulphides. The necessity for these restrictions has arisen because of the increasing use, particularly after 1945, of toxic chemical substances in industrial processes which, when discharged to sewer, can interfere with biological treatment processes used at sewage treatment works. The biological processes of inland works are more sensitive to toxic substances than those to be used at ocean outfall works. For this reason, the M.W.S. & D.B. attempts to encourage industries with potentially troublesome wastes to establish their premises in areas draining to ocean outfalls. Both sets of discharge standards employed by the M.W.S. & D.B. are broadly similar to those of other sewerage and drainage authorities in Australia. As noted above, the discharge of industrial wastewater into the Board's stormwater channels must also be approved by the W.P.C.B., whose standards for discharge may be more stringent than those of the Board.

The M.W.S. & D.B. uses its standards (Table VII-(3)) only as guidelines, each application to discharge industrial wastes being treated on its own merits. For example, the residual hydraulic capacity of the sewer may determine whether or not large volumes of waste of 'acceptable' concentrations can be discharged into the sewer. Alternatively, the dilutional capacity of the sewage itself may determine whether or not a small volume of highly concentrated waste can be discharged into the sewer. Here it should be mentioned that some of the Board's policies appear to encourage industrial establishments to dilute their wastes, and also to discourage water economy. Quite apart from these aspects, the M.W.S. & D.B. is prepared to accept 'over-strength' wastes to sewer if the firm is prepared to meet a reasonable proportion of the operating costs involved in accepting such wastes.

No firm may discharge industrial waste into the Board's sewers or stormwater channels without prior written approval of the Board. The type and concentration of waste materials in the waste must be acceptable to the Board, and in approving discharge applications the Board can attach conditions relating to the maximum rate of discharge, the hours of discharge and the size, hydraulic capacity and means of discharge. Officers of the Board often informally advise a firm of the type of pre-treatment facilities required to produce an effluent acceptable for discharge. The required facilities are often simple in nature, such as retention tanks to provide cooling and sedimentation, grease traps, screening, etc. In some cases, however, more involved types of pre-treatment are necessary to produce a satisfactory effluent.

The regular inspection of premises discharging industrial wastes to sewer or stormwater channel is a key activity in the Board's control of illegal discharges. Trade Waste Inspectors of the M.W.S. & D.B. may enter premises discharging wastes into the Board's systems for inspection purposes or to collect samples for analysis. They are equipped with simple field kits which give approximate indications of the acidity, alkalinity and concentration of heavy metals in the wastes. If these approximate results indicate that the trade waste standards are being violated, the inspector then collects an additional sample for more exact analysis by the Board's Chemical Laboratory. The frequency with which an individual firm is inspected depends upon both the quantity and type of wastes being discharged. Several large industrial undertakings are inspected up to several times weekly, while smaller installations are checked once every three months, where possible, and at least once every six months. The number of inspections and trade waste samples analysed by the Board's Chemical Laboratory over a 3-year period are shown in Table VII-(4).

Table VII-(4) The control of illegal industrial waste discharges into sewers.

| Activity | 1971/2 | 1972/3 | 1973/4 |
|---|---|---|---|
| Factory inspections | 24,395 | 30,000 | 33,102 |
| Samples analysed | over 600 | over 3,500 | 4,901 |
| Number of violations rectified on request | 200 | 526 | 413 |
| Number of violations requiring reprimand letters | 105 | 62 | 194 |
| Number of prosecutions | 4 | 3 | 19 |
| Reimbursement for damage to sewers or treatments works | $4,359 | $9,390 | $19,872 |

Source: M.W.S. & D.B. Annual Reports

The Board uses a variety of measures to gain an offending firm's co-operation in rectifying violations of its discharge standards. In order of increasing severity, these include an oral request to rectify the matter; the sending of a reprimand letter to the firm; prosecution for breaches of the trade waste by-laws; and as a last resort, used very infrequently, disconnection of an offending firm from the sewer. Fines and recovery of clean-up and maintenance costs are other means by which the Board controls trade waste violations. If prosecuted, a firm can be fined up to a maximum of $100 for each breach of the trade waste by-laws. (Firms are often prosecuted for a number of simultaneous breaches of the by-laws, the current record standing at thirty-nine.) While these penalties are inadequate to act as a deterrent, the threat of prosecution is often enough to obtain a firm's co-operation in correcting the violation. When an illegal trade waste discharge interferes with the normal operation of sewerage facilities and the offending firm can be identified (this is often difficult), the Board sues for recovery of costs necessary to repair damage to the system. Table VII-(4) also shows the extent of these activities. There are, however, some organisations, such as public authorities, that cannot be penalised in this manner.

## The M.W.S. & D.B. potential for trade waste control

The Board's attitude to trade wastes is essentially self-protective. However, its approach has a much wider implication for liquid waste and water quality management. First, in so far as it rejects wastes as unacceptable to sewers, the need arises to find some other solution — and creates a problem elsewhere. Second, because it provides valuable services of water supply and waste removal by sewers, the Board has the opportunity to introduce a much stronger market element to induce individual decisions in liquid waste management by waste generators — by treatment in plant, by recycling and reuse. In view of the significance of industrial wastes in degrading environmental amenity, this potential for action by the Board is very important indeed. It has the pricing power and the administrative capability which, if used effectively, could make it the most important instrument of water quality protection in Sydney, utilising processes that would leave to business the task and the initiative of finding appropriate solutions in the light of the Board's pricing policy. Nevertheless, it is a two-edged weapon. Administrative control is needed to ensure that business does not evade pricing influences by moving outside the market — into illegal dumping. This is a problem of the M.W.D.A. whose pricing policy needs to be devised carefully to provide effective inducement for in-plant action.

The primary influence of the Board so far has been as a major factor in determining the boundaries of a task for the M.W.D.A. We can, therefore, usefully refer briefly to this issue first.

## The M.W.D.A. and industrial liquid wastes

The M.W.D.A. was established in 1971 partly in response to the urgent need to find a satisfactory solution to the management of an unknown quantity of industrial liquid residue wastes. This problem was revealed in acute form following the closure of local government landfill tips to a range of particularly difficult industrial wastes that were highly concentrated and/or toxic. This closure led to widespread dumping of these wastes in watercourses, in the sea and on land, often in an indiscriminate and damaging manner. At best, concentrated organic materials, with very high B.O.D. values, were dumped into drains and water courses, reducing the dissolved oxygen of streams. At worst, toxic sludge dumped in open country, reserves and parks exposed people, birds and other animals to risk. Control of this type of liquid waste became a highly important part of the management of liquid wastes.

The actions of the M.W.S. & D.B. by administrative refusal to accept wastes, by progressively tightening these standards, by increasing charges for entry of trade wastes to sewers and drains and by discriminating in its charges against the more toxic wastes, were, in themselves, an appropriate procedure. It required, however, separate administrative control of illegal dumping and action to solve the consequential problems of alternative treatment procedures. It was this supplementary control responsibility that was passed to the M.W.D.A. This authority became, and remains the residual legatee of the sewerage authority which could, in effect, enlarge or reduce the M.W.D.A.'s task by fiat. This potential conflict was limited in the initial stages, but only for a short time, by placing both Authorities under the one control during the formation stages of the M.W.D.A.

The M.W.D.A. was not merely dependent on actions by the M.W.S. & D.B. As we shall see, the S.P.C.C. through its W.P.C.B. became active in requiring industrial waste generators to divert flows out of drains and natural water courses, with the formal requirement to connect to sewer. In so far as these wastes were unacceptable to sewer or were acceptable only at prices that were not acceptable to business, they became an added responsibility for the M.W.D.A. In addition, however, action by the M.W.D.A. for this phase of liquid waste management was subject to environmental constraints imposed by the S.P.C.C. and health constraints by the Health Commission. Last, but not least, the Authority faced the politics of private business in Sydney.

As its name implies the M.W.D.A. is a disposal-oriented authority, that is, the *recipient* of discarded wastes, not the *controller* of waste *generation.* The shortcomings of this role and the major activities of the Authority are discussed in Chapter 10. In so far as liquid waste management is concerned, the Authority provides and operates a landfill site, the Castlereagh Liquid Waste Depot, for the disposal, by controlled land burial, of non-toxic industrial liquid waste residues.

Despite the protective controls of this Depot, this represents one remaining and critical gap in the provision of effective regulation over the disposal of *toxic* industrial liquid waste residues. A curious silence surrounds the mode by which these are currently handled. The M.W.D.A. investigated the possibility of establishing a central treatment plant at which industrial liquid wastes, including toxic wastes, would be broken down by chemical, biological or physical means. Because of the relatively high charges it proposed to impose for the use of this facility, the Authority believed that individual establishments would treat more of their own wastes on site, thus diminishing the demand for the proposed plant. So the project in this form lapsed.

The potential for greater public control over the disposal of toxic wastes remains. The M.W.D.A. requires that all occupiers of industrial or business premises generating waste in the Sydney region apply for a certificate of registration of their premises by 1 April 1976. Unless they produce hazardous wastes, premises employing fewer than twenty-one persons are exempt from this requirement. From this registration process, in conjunction with the registration of collectors of industrial wastes and of waste disposal sites, it should be possible to monitor the flow of industrial liquid wastes and to determine which establishments are dumping their wastes outside the public disposal system of sewers, stormwater channels, and the Castlereagh Depot.

Knowledge is power and possibly the most powerful instrument at the hands of the Authority. The M.W.D.A.'s power in influencing private business can be most effective by inducing action to treat these wastes, by encouraging recycling and match-making of different business needs. The first two procedures can be enhanced through pricing influences. These depend on the ability of the M.W.D.A. to proceed, if necessary, with its original treatment concept. The forecast costs of treatment in 1974 prices was of the order of 4 cents per litre, a very high charge compared with the charges of the M.W.S. & D.B. of a basic 9 cents per *thousand* litres, rising to an *average* for high-strength wastes of approximately $1.30 per *thousand* litres for trade wastes admitted to sewer or, more relevantly, the $15 per *thousand* litres charged for sludges acceptable at the Castlereagh Tip. The business response to the M.W.D.A. concept was that in-plant treatment was possible at costs to private enterprise considerably below the Authority's costs. Elements of a price system had, then, been introduced into the management procedures in these highly concentrated and toxic wastes. It remains to be seen how effective they will be.

### The M.W.S. & D.B. trade waste and other pricing

The special group of highly concentrated and toxic wastes dealt with by the

M.W.D.A. is a very important but relatively small volume flow. The M.W.S. & D.B. continues to receive the great mass of trade wastes into its sewers and drains. As we shall see, diversion of these wastes from drains into sewers is being pursued by the W.P.C.B. and hence the sewerage authority will receive progressively more of these wastes, many of them relatively concentrated, dangerous or toxic. The Board has a responsibility and an opportunity which it can seize with considerable potential advantage to Sydney.

Its attitude to pricing of its services has been ambivalent, reflecting a variety of conflicting objectives. However, sewerage trade waste disposal charges are the final link in a chain involving the purchase of water rights; the price for waste removal should not be confined to that for sewerage services.

The costs of sewage collection and treatment can be classified and distributed to users according to three variables:

(i) a flat amount per user
(ii) water or waste volume
(iii) waste strength factors such as biochemical oxygen demand.

The complexity of the array of prices is illustrated in the range of charges levied by the Board over the past decade. Sydney appears to be in advance of most Australian cities from which similar complex structures could be cited.

In Sydney the charging system for domestic sewage removal is confined to a flat rate based until 1975 on the assessed annual value of the property. In the case of industrial effluent discharged to public sewers and drains, most of the major authorities throughout Australia now levy an additional 'trade waste' charge. The general sewerage rate applicable to both types of customers has been increased by one-third over the past decade with the result that sewerage rates have been providing an increasing share of the Board's revenue.[7]

Charges for the disposal of industrial wastes into the Sydney Water Board's systems have shown an increasing tendency to be related to the value of service received by users, although the allocation of costs amongst beneficiaries may raise significant equity implications. Before 1972 the Board's charges for industrial wastes accepted into its systems were confined to the ordinary sewerage rate and a volumetric charge. The latter was applied to the volumes of waste discharged in excess of a given allowance determined by the ordinary sewerage rate. This discharge allowance was calculated on the basis of the quantity of water which the water rate would purchase at the current meterage charge. In calculating actual effluent volumes, an agreed 'discharge factor' in relation to water intake (usually 92 per cent) is commonly arrived at. In most cases, the volume of wastes discharged to sewer is not measured.

The current volumetric charge of 30c per 1,000 gallons is intended to recognise the higher operating costs to sewerage treatment works from receiving industrial wastes. However, officers of the Board have noted that 'if trade waste charges to be levied by the Board are based on the cost of treatment, it can be expected that many firms discharging strong wastes will be required to pay very much more than the present charge of 30 cents per thousand gallons'.[9] *Until 1972,* then, industrial waste treatment appears to have been heavily subsidised and there was little incentive in the rate structure for firms to reduce the strength of their wastes.

In the case of industrial discharges to stormwater channels, the Board's policy is to permit these 'where a consistently high quality waste can be guaranteed and where the sewer would not be over-loaded by the quantities involved'.[10] The two-part tariff consists of the ordinary drainage rate based on the Assessed Annual Value of the rateable industrial property supplemented by a volumetric charge which is applied to the total waste volume (i.e. no allowance is given). The Board does allow certain concessions in its standards for discharge to stormwater channels for which it levies a higher volumetric charge of 30c per 1,000 gallons (equivalent to that for the sewerage service).

In 1970, partly in anticipation of the introduction of anti-pollution legislation, the M.W.S. & D.B. set up a Trade Waste Committee to examine the regulations governing the discharge of liquid wastes into its sewers and stormwater systems and the charges imposed upon the acceptance of such wastes.[11] The Board was aware that there existed a 'substantial number' of industries whose discharges did not comply with its standards. These resulted in the Board bearing a disproportionate share of the cost of disposal together with the cost of damage caused to sewers by illegal discharges. In 1969 the Board commented that 'one large industrial undertaking is contributing approximately 60 per cent of the total B.O.D. load to the Bondi Sewerage Treatment Works'.[12]

The Trade Waste Committee found that the Board's trade waste standards were not uniformly observed and enforced. It noted that the maximum penalty for breaches of the Trade Waste By-Laws was inadequate and recommended that it be substantially increased to be consistent with the Clean Waters Act. A classification system for wastes was devised but no change was made to the maximum fines for breaches of the standards.

By 1972 demands for more stringent pollution control measures, coupled with the rising costs of sewerage treatment, caused the Board to re-examine its trade waste policy. The Board, having experienced some difficulty in policing its standards, decided to accept relatively high-strength wastes subject to an extra charge being paid.[13] In July of that year a strength charge was introduced. This was to be levied on that portion of the content of grease, suspended solids and B.O.D. which exceeded the Board's standards (see Appendix I). The charges were set at a level to recover 'a reasonable proportion of the operating costs involved' in treatment, although no attempt was made to amortise the investment in treatment facilities.[14]

The Board's philosophy towards the acceptance of trade wastes remains that of providing 'where possible a service to the community'.[15] In doing so, it has been under increasing pressures from the local community and from other pollution control authorities. Given these pressures it is not without reason that the desire to protect the Board's sewers, treatment works and workers from damage or harm, rather than a commitment to improving the quality of watercourses, remains an important determinant of the conditions imposed upon the acceptance of trade wastes.

### General implications of trade waste charges

Confronted by escalating trade waste charges and by a discriminating pricing system for discharge, what response might be expected from industry? A firm faced with strength charges has five legal options:

(i) It can pay the appropriate strength charges to the authority for public treatment.

(ii) It can alter its technology in order to reduce the volumes of wastes and waste water discharged.

(iii) It can reduce the strength of its waste water to the required strength by measures adopted either at the production stage or after the point of waste generation. Examples of the second type of response would be in-plant treatment, effluent reuse or by-product production (e.g. the use of waste to generate energy). It may carry such in-plant treatment to the point where no effluent is discharged into the sewer.

(iv) It can dilute its waste water to the required strength and thus incur a higher water bill. If water is relatively cheap in relation to the sewage surcharge, this alternative may be preferred.

(v) In an extreme exigency, it could shut down its plant.

One stated objective of the excess strength charge was to encourage pre-treatment by firms. The principle has thus been established that the firm should bear the responsibility for reducing its own strong wastes.

Two implications of a differential pricing system may be mentioned. The first is that, under the quantity-quality approach, an industry may have limited incentive to reduce its waste load *beyond* the strength standards *set by the Authority*. In other words, the procedure still has a definite administrative element. Nevertheless, it represents the least-cost and most flexible method of inducing rapid response to meet the standards which are laid down. Effluent charges reduce the incentive to delay which is often the best policy for industry to adopt when total reliance is placed upon a system of regulation by enforcement.

The second point is that waste strength charges are not a complete substitute for regulations which might be (and are, in Sydney) imposed upon untreatable toxic wastes and other industrial pollutants that cannot be handled conveniently at public sewage treatment facilities. Restrictive regulations to prevent entry of some wastes must form part of the pricing system (as they do in Sydney). But it follows that corresponding restraint needs to be placed to restrain not only illegal dumping in sewers but also illegal dumping elsewhere. Sewage authorities need the active legal support of other environmental authorities in controlling the problem as a whole.

In practice, in Sydney, the strength charge does not, as yet, appear to have extracted a large contribution from industry and commerce towards waste treatment costs of the Sydney Board (see Table VII-(5)). In 1973-74 revenue from trade waste charges (i.e. the volumetric and strength levies) totalled \$2.26 million or 2.9 per cent of the Board's aggregate sewerage and drainage revenue in that year. This can be compared with a figure of 1.0 per cent in 1966. These pay-for-use charges represent 25.0 per cent of total industry payments for Board-supplied waste removal services but this source of revenue may be expected to increase in importance as the strength charge is phased in. Moreover, in 1972-3 total payments by industry for sewerage and drainage services in the Sydney region constituted only 0.1 per cent of total factory turnover and 0.3 per cent of the cost of all factory inputs. Such evidence tends to suggest that even a substantial increase in the price of sewerage services will have only a marginal effect on firms' total costs.

Whilst one stated objective of the sewerage strength charge is to encourage the on-site treatment of industrial wastes, the water pricing structure may, in fact, be encouraging the continued reliance upon a water-based technology for the disposal of wastes. The Sydney Board, like most authorities, continues to supply water of drinking quality standard to industry.

By implication, the Sydney Board, in this case, was charging industry significantly below the *average* charge made for discharge services and was according deliberately or otherwise, a relative advantage to industry. This position has not changed significantly since that time. Whether the *total* cost of disposing of trade wastes is less than that required to dispose of household and other business wastes is not certain. The current costs for trade wastes are clearly higher. One would need to be able to measure the capital costs for industry as against other liquid waste generators to determine whether an actual as distinct from a relative subsidy is provided to industry. It would be helpful if the Board were to make the necessary calculations public. It would appear that the economies in sewerage provisions to industry would need to be large if the possibility of a subsidy to industry is to be ruled out.

It may be noted that in other countries the reversal of this procedure appears often to exist. The equity issues implicit in these types of procedures are not easy to resolve either in a phasing-in process or in a 'final' pricing structure. Sewerage authorities, particularly those committed to large-scale capital expenditure tasks, are faced with a conflict of objectives. Revenues must be raised to cover anticipated current and capital commitments; services must be sustained in operationally efficient form. To these 'internal' objectives the actions of sewerage authorities in pricing expose them to risk of criticism in influencing distribution of costs, prices and resources between community groups, in alleged failure to provide for waste and other resource conservation and in commitment to limited environmental protection technology. These conflicts of objectives are not easy to resolve in real terms. It would be unwise for economists to press optimal solutions in situations of several conflicting objectives.

Table VII-(5) User charge component in sewerage and drainage revenue, Sydney statistical division, 1972/3 ($ million)

| | Property rates* | Trade waste charges | Total | Trade waste charge as % of total |
|---|---|---|---|---|
| Residential | 35.00 | — | 35.00 | 51.9 |
| Industrial | 8.80 | 1.75 | 10.55 | 15.7 |
| Business | 17.71 | 0.22 | 17.93 | 26.6 |
| Other | 3.79 | 0.14 | 3.93 | 5.8 |
| **TOTAL** | 65.30 | 2.10 | 67.41 | 100.0 |

*Estimate derived as a residual after imputation of water rates for unmetered properties.
Source: M.W.S. & D.B., Statistics of Metered Properties, 1972/3, Property Classification — Analysis of Revenue, 1972/3.

Nevertheless, the M.W.S. & D.B. has moved only a short distance towards the use of pricing as a positive control device. It would be unfortunate if short-sighted political pressures were to deter it in any further progression. In the context of Sydney's business community, the advantages of using the pricing system are large, particularly in that they leave to private initiative the decision on the precise manner in which responses to price incentives are made. The present approach of highly bureaucratic and technocratic directives is a very blunt instrument.

**The S.P.C.C.: Water Pollution Control Branch (W.P.C.B.)**

The W.P.C.B. was formed initially within the former Department of Public Health in 1971, it was transferred to the S.P.C.C. in 1974. Subsequently it was re-styled and reorganised into Division form. For convenience only, we retain the reference to the original name.

The W.P.C.B. cannot be considered wholly apart from the general body of S.P.C.C. Obviously, the Branch acquires its powers and functions from the Commission. But the Commission, separately from the Branch, performs or is able to perform certain functions relevant to water pollution control. Amongst these broader functions of the Commission is the control of Environmental Impact Statements and enquiries which may include constraint on water quality degradation. This general function, with its vital *preventive* potential, does not appear to have been effectively used (see Chapter 2).

The W.P.C.B. was, from its inception, concerned with the management of water quality, predominantly in terms of the flow of wastes into waterbodies. Under the Health Department, it had developed water quality monitoring. With its transfer to the S.P.C.C., the Branch's officers continued to operate under the Clean Waters Act, 1970, with overriding powers to control water quality degradation caused by waste flows. In carrying out its tasks under the S.P.C.C., the Branch became, during 1974, deeply involved in direct control of waste emissions and the policing of these controls. In particular, special emphasis was placed on control of industrial waste emissions. The concentration of activity on emission control and policing meant that other functions were either curtailed or restrained.

This emphasis needs to be clearly appreciated in a review of the Branch's role in administering the Clean Waters Act in order to give proportion to other functions carried out by the Branch. For the same reason, the dominant mode of operation needs to be understood. The Branch's work was heavily committed to 'control' by changing the physical direction of liquid waste flows, above all by routing these flows to sewer and away from open drains and waterbodies other than the ocean. These actions have *initiated* steps towards protecting waterbodies but have made little impact on the generation of waste flows. What they did, predominantly, was to pass the flows to sewerage authorities who had the task of 'disposal' under S.P.C.C. environmental oversight. Where sewer facilities were not available, the approach was to require treatment by waste-generating establishments before discharge to drains or waterbodies. These actions will take a considerable time to become fully effective. Potentially, they place the sewerage authorities astride most of the flows, except those unacceptable to sewer. Hence, potentially, the sewerage authorities become an agent capable of exercising control not merely over waste disposal but also over pre-treatment, reuse and the generation of wastes.

Given this perspective, the Branch's functions may be indicated summarily as:

(a) The classification of waterbodies
(b) The control of private and public waste generating sources by —
  (i) inspection of premises
  (ii) sampling of liquid wastes
  (iii) directives to waste generators to install treatment facilities and/or connect to sewer
  (iv) prosecution of waste generators
  (v) monitoring of waste emissions
(c) The input of information on quality of waterbodies by a considerable number of quality and waste input measures through a monitoring process
(d) The development of proposals to remedy water quality degradation of major waterbodies as overall systems.

*The Clean Waters Act and Regulations*

The Clean Waters Act, 1970, is the key piece of water pollution control legislation in N.S.W. With the exception of the Prevention of Oil Pollution of Navigational Waters Act, 1960, the Act overrides all other pieces of water pollution control legislation. Moreover, because of the definitions attached to 'waters' and 'pollute', the scope of the Act is very broad. 'Waters' are defined as: 'any river, stream, lake, lagoon, natural or artificial watercourse, dam, tidal waters (including the sea) . . . and any underground or artesian water . . .' The definition of 'pollute' is equally comprehensive. It includes the placing of any matter (solid, liquid or gaseous) in or on waters or the dry bed of a watercourse; or in such a position that it is *likely* to fall or be conveyed into any waters. It includes changes that occur in the physical, chemical or biological condition of waters or any impairment of the waters for subsequent use. The final part of the definition is important for the use of waterbodies for the disposal of liquid wastes: 'pollute' includes the addition of any matter which contravenes any standard prescribed for discharges of waste. As the Act further specifies, a person can pollute any waters if he holds a licence to do so and if he does not infringe the conditions of that licence.

As these words imply, the Act establishes machinery which enables the W.P.C.B. to regulate the flow of liquid wastes. This machinery consists of five parts:

(i) The classification of waters.
(ii) A licensing system for the discharge of wastes into classified waters.
(iii) The requirement for industry to seek approval to install or modify water pollution control apparatus.
(iv) The power to direct waste dischargers to install pollution control apparatus or to divert their wastes to sewer.
(v) A system of surveillance to detect offenders.

The machinery is backed by penalties which may be applied for offences against the Act. For example, prosecution may be initiated where a person fails to secure a licence, or to obtain written approval for installing or modifying any pollution control apparatus, or when the conditions of a licence have been breached.

*The classification of waterbodies*

The classification of waterbodies is intended as a central provision of the Clean Waters Act: it would determine the extent to which they are allowed to be polluted by liquid wastes. In effect, the classification of a waterbody and the consequent restrictions upon the discharge of waste matter into it were envisaged as an attempt to achieve and maintain some predetermined level of water quality and to ensure that the waterbody can be used satisfactorily for other purposes. As senior officers of the W.P.C.B. put it, the object in classifying water is:

> to maintain or achieve standards of purity of waters consistent with their use for domestic, industrial, agricultural, and pastoral water supplies, for the protection and propagation of fish, aquatic life and wildlife, and for recreational and other legitimate uses. No waters will be classified to allow their use as open sewers, although the reasonable and necessary use of waters in the final distribution of the community's water-borne wastes must be recognised. Waste discharges will be required to be treated so as to prevent the unnecessary or unreasonable impairment of natural water quality.[16]

The various classifications proposed to be applied to waterbodies throughout N.S.W. are:

Class S — Specially Protected Waters
Class P — Protected Waters
Class C — Controlled Waters
Class R — Restricted Waters

There are also two additional classes:

Class O — Ocean Outfall Waters
Class U — Underground Protected Waters

It is one thing to devise a classificatory system. It is a different matter to apply different gradings to particular waterbodies. Each classification carries different restrictions and some are shown in Table VII-(6). On the other hand, with some exceptions, the classification applied to any waterbody implies the possibility of certain discharges being made into it. Provision is made for licensing of establishments that may discharge wastes into these waters.

Classification depends on the uses to which each waterbody is put or proposed to be put. It defines the water quality objective that the W.P.C.B. proposes to attain by control of discharge and/or by remedial and restorative action. This objective is an elementary preliminary stage necessary to define the degree of control over different types and volumes of discharges, the nature and cost of discharge control imposed on waste-generating establishments and the nature and cost of public restorative action. The assessment of each waterbody by authority may, however, collide with different interested groups, some wishing to continue discharge, some anxious to avoid discharges. Political and group pressures become a significant factor restraining and confusing action by the Branch.

Classes O and S are, perhaps, the easiest to declare. In particular, Class S is

Table VII-(6) Restrictions on the discharge of wastes into classes R, C, P & S wastes

| Classification of waters | Class R | Class C | Class P | Class S |
|---|---|---|---|---|
| Wastes to sewer | Wastes (if acceptable) to be diverted to sewer (if capacity is available) | | | |
| Sewer overflows | Subject to approval | Subject to approval | None | |
| Thermal wastes | Subject to approval | Subject to approval | None | |
| Organic wastes | Wastes:water < 5%<br>75% D.O. saturation in waterbody<br>5%<Wastes:water<10%<br>B.O.D.$_5$ 20 mg/l<br>N.F.R. 30 mg/l (in waste)<br>Wastes: water > 10%<br>60% D.O. saturation in waterbody | Wastes:water < 5%<br>B.O.D.$_5$ 20 mg/l<br>N.F.R. 30 mg/l (in waste)<br>Wastes:water > 5%<br>70% saturation in waterbody | Wastes:water < 5%<br>B.O.D.$_5$ 20 mg/l<br>N.F.R. 30 mg/l (in waste)<br>Wastes:water > 5%<br>Subject to approval | No wastes are to be discharged into Class S waters.<br><br>Only Class P waters flow into Class S waters. |
| Faecal coliforms in representative portions of water | 1000 per 100 mls | 200 per 100 mls | 200 per 100 mls<br>(in bathing waters) | |
| pH of wates<br>Induced pH variation in waters | 6.5-8.5<br>< 0.5 | | 6.5-8.5<br>< 0.2 | |
| Restricted substances | Concentration in water < specified concentration | | concentration in waste < specified concentration | |

Source: Clean Waters Regulations, 1972.
B.O.D.$_5$ — 5-day biochemical oxygen demand
D.O. — dissolved oxygen
N.F.R. — non-filtrable residue (dissolved solids)

intended to apply essentially to water catchment streams. Class O, in the case of Sydney, is designed for the waters around ocean sewer overfalls.

The real problems of classification, in Sydney, apply to Classes P, C and R with very considerable differences implied in amenity standards, control requirements and control and restorative costs. It is, perhaps, symptomatic of the problems that, at the time of writing, only the Cooks River and Alexandra Canal system had been classified — as Class R — within the metropolitan boundaries. Yet, until these classifications are made, the environmental objectives remain undeclared and unspecified. As was suggested in Chapter 6, the crux of decision making in water quality management is: To what degree is a waterbody to be degraded? The S.P.C.C. has so far largely failed to face up to this central question.

The restrictions placed on the discharge of wastes into classified waters (see Table VII-(6)) are derived from a mixture of what are known as 'effluent standards' and 'stream standards'. An effluent standard specifies the allowable quantity and type of waste materials in the *effluent;* whereas a stream standard specifies the allowable concentration and type of waste materials in the *waterbody,* or the extent to which wastes are permitted to cause detrimental effects. For many years there has been considerable discussion as to which standard is more appropriate for managing liquid wastes and controlling water pollution.[17] Although management authorities have tended to adopt exclusively either one standard or the other, in actual fact the standards are not independent. If an effluent standard is used to control the *rate* at which waste materials are discharged into a waterbody, the resultant level of pollution and its relationship to a stream standard is determined by the assimilative capacity of the waterbody. In other words, the assimilative capacity of a waterbody relates one standard to the other.

Moreover, flexible and effective control of liquid waste disposal requires a mix of both types of standards. After all, the basic object is to control pollution in the waterbody (hence the relevance of stream standards) but, with few exceptions, the *means* of doing so is by limiting the rate of waste material discharge (and hence the necessity for effluent standards). In formal terms, the restrictions placed on the discharge of wastes into classified waters are potentially one flexible and effective means of water pollution control as distinct from liquid waste management. But until the Branch establishes and applies its classification, it has no specified objective in realising the control potential.

*The measurement of water quality in Sydney*

Before the advent of the W.P.C.B., the measurement of water quality in Sydney was taken at random times and places by a multiplicity of public authorities. Frequently these measurements were taken to detect sewage pollution in bathing areas; hence only a limited range of water quality indices such as bacterial counts of *E. coli*, dissolved oxygen and biochemical oxygen demand were employed. Since its formation the W.P.C.B. has undertaken regular water quality surveys of waterbodies in the Sydney region. Thus, these surveys represent the first comprehensive attempt to provide a background of baseline data of existing water quality. However, after the Clean Waters Act came into force in November 1972, the Branch concentrated its efforts on controlling and policing pollution sources, particularly those of industrial liquid waste generators, rather than on conducting an extensive program of monitoring water quality.

The monitoring program of the W.P.C.B., which includes physical, chemical, biological and bacteriological measurements, covers the following waterways in the Sydney region: Port Jackson, Parramatta River, Botany Bay, Cooks River and Alexandra Canal, Georges River and its major tributaries and Port Hacking. More than 400 principal and intermediate monitoring stations have been established in Sydney. A greater range of quality measure is taken at principal stations, the purpose of the intermediate stations being to provide a wider spatial coverage of a more limited number of measures. Surveys are carried out on a monthly, semi-quarterly or quarterly basis, the poor quality sectors generally being surveyed more frequently than those of better quality. Measures at all stations include salinity, temperature and dissolved oxygen concentrations, all of which can be measured at the station site by electronic devices. Additional measures at principal stations include pH (a measure of acidity or alkalinity of water), which is measured on site; suspended solids, turbidity and biochemical oxygen demand which are determined in the W.P.C.B.'s laboratory; and bacterial levels, which are determined at the

Division of Analytical Laboratories of the Health Commission. In addition, nutrients, heavy metals, pesticides and other quality indices are measured as required.

The data obtained from the monitoring program are used by the W.P.C.B. for several purposes: first, to assess the appropriate classification to be assigned to a waterbody; second, to determine the permissible volume and composition of liquid wastes and their rate of discharge into water; third, as a means of obtaining feedback about the effectiveness of pollution control measures. In short, the data help to establish the appropriate degree of pollution control to be applied by the Branch, and thus affect the treatment to be applied to liquid wastes before their discharge, and, therefore, in turn, the volume and composition of the liquid waste flow.

Several questions may be addressed to the future of the W.P.C.B.'s monitoring program. Obviously, a data-gathering system which measures specific pollutants and the impact of pollutants on water quality to a high level of accuracy at frequent intervals of time can create a costly diversion of resources. Several measures of water quality such as biochemical oxygen demand, dissolved oxygen, turbidity and pH, all relate, to a large degree, to the question whether a river can be permitted to 'live', in an ecological sense, and sustain a range of aquatic life. Although they are indices of the health of a river, these measures may not be applicable to an urban water system that is continually subject to a range of human pressures.

As argued in Chapter 6, the fundamental and knotty issue to be resolved by policy makers is the range of uses to which any metropolitan waterbody is to be put. Once this has been determined then the specific tests needed to check the quality of water required for that use may be decided. Thus in the case of body contact activities, the water needs to be safe in health terms and aesthetically pleasing: the measures needed to check and monitor the quality required for that use obviously will need to be of a different order than for a waterbody that is deliberately permitted to be degraded because it is to serve as a drain for man-made liquid wastes.

Changes in the flow of Sydney's liquid wastes also dictate the need for measuring other pollutants. Many of the more complex wastes arising from the generation of industrial liquid wastes, because of the pollution control activities of the W.P.C.B., are now discharged into sewers and thence into the ocean. These wastes in the sewage effluent are incorporated in food for fish, which, in turn, may be consumed by humans. It is imperative for the State Fisheries and the Health Commission to establish a monitoring program that includes, for example, measures of heavy metal and pathogenic bacteria concentrations in marine life. Further, residents should be kept informed of the results of such monitoring, not only to enable them to avoid eating contaminated fish but also to permit them to exercise more effectively their political rights in pressing for effective control of waste flows. The growing necessity for this action and the need for its publicity contrast with the extraordinary secrecy of the State Fisheries in its investigatory activities.

*Policing the Clean Waters Act*

The activities of the W.P.C.B., for practical reasons, have been concerned with remedial and palliative rather than preventive water pollution control measures. The extent of these activities, as shown in Table VII-(7), illustrates the rapid growth of the Branch and its increasing importance in managing liquid wastes, particularly industrial wastes. Thus its activities include inspections of factories; the serving of notices requiring information on the manufacturing processes employed at an establishment (and hence, the liquid wastes generated); and the serving of notices to bring an establishment under the provisions of the Clean Waters Act. The time devoted by Branch officers to some of these activities may diminish in the future because they were inaugural tasks necessary for obtaining basic data and for bringing the Act into operation. Thus it is likely that the Branch will shift the weight of its activities to policing the Act, monitoring water

Table VII-(7) Activities of the Water Pollution Control Branch in regard to the implementation of the Clean Waters Act and Regulations

| Item | 1971* | 1972/3† | 1973/4‡ |
|---|---|---|---|
| Staff | 6 | 31 | 69 |
| Premises inspected | 52 | 635 | 1,077 |
| Samples analysed§: | | | |
| (i) Industrial wastes | 51 | — | — |
| (ii) Water quality | 300 | — | — |
| (iii) Total | 351 | 1,650 | 1,918 |
| Applications to install or modify pollution control apparatus: | | | |
| (i) Pending | — | 86 | 94 ($352 million)¶ |
| (ii) Approved | — | 23 | 33 ($2.4 million)¶ |
| (iii) Approved in principle | — | — | 27 ($7.6 million)¶ |
| Notices served requiring information of industrial processes, etc. | — | 22 | 85 |
| Notices served on premises removing exemption from the Act | — | 27 | 337 |
| Directions served to: | | | |
| (i) Divert wastes to sewer | — | 31 | — |
| (ii) Install or modify pollution control apparatus | — | 13 | — |
| (iii) Total | — | 44 | 189 |
| Prosecutions under the Act and Regulations: | | | |
| (i) Commenced | — | — | 17 |
| (ii) Complete (fines) | — | — | 14 ($8,250) |

*Applies for the twelve months to the end of December 1971. Source: *Report of the Director-General of Public Health, 1971.*
†Applies for the twelve months to the end of June 1973. Source: *Report of the Clean Waters Advisory Committee for the Year Ending 30 June 1973.*
‡Applies for the twelve months to the end of June 1974. Sources: *Report of the Clean Waters Advisory Committee* and *Report of the State Pollution Control Commission for the Year Ending 30 June 1974.*
§These are the number of tests performed in the Branch's laboratories and do not include bacteriological tests by the Division of Analytical Laboratories of the Health Commission.
¶ Estimated cost.

quality and investigating and classifying waterbodies and implementing its procedures for licensing liquid waste discharges.

The complexity of the industrial liquid wastes generated is illustrated by the range of industrial premises inspected by the Branch: petroleum refineries, petrochemical refineries, pharmaceutical plants, steel and metal manufacturing plants, textile, concrete-mixing and glass-making factories, abattoirs, fruit and vegetable canneries, wool scourers and metal plating works. Many of the waste materials originating from these and modern industrial processes are potentially toxic to living organisms. Such materials include heavy metals such as chromium, zinc, lead, copper, mercury, and arsenic; cyanide compounds; acids and alkalis; some of the organic pesticides and weedicides; and numerous other organic and inorganic chemical compounds. Other industrial wastes, such as organic matter from food-processing work, by aiding the depletion of oxygen in waterbodies, render water unpleasant in colour and odour. Where sewer capacity is available, the policy of the Branch is to direct industry to approach the M.W.S. & D.B. for permission to connect their discharges to sewer. Discharge arrangements then become a matter for negotiation between the M.W.S. & D.B. and the establishment affected. Since the four major industrial areas of Sydney are served by ocean outfall sewers, the effect of this policy is to transfer wastes out of the inland waters and into ocean waters, the same 'solution' that was adopted in principle with the passage of the Metropolitan Water and Sewerage Act in 1880. As the Liverpool-Campbelltown area grows, the same process will transfer nutrients and some industrial wastes into the upper reaches of the Georges River. Where no sewers are available the Branch directs that appropriate pollution control apparatus be installed so that the effluent discharged is in conformity with the Clean Waters Act and Regulations.

As the Branch gave priority to the most polluted areas, its activities, particularly since the Act came into force in November 1972, have been concentrated in the Sydney region, particularly the southern half of the city. For example, of the seventy-one notices and directions that were served in the twelve months to June 1973 to remove exemptions from the Act or to treat or divert wastes to sewer, some sixty-eight were served in the Sydney metropolitan area. Of these, twenty-four related to the discharge of industrial wastes into the Parramatta River, nineteen to discharges into Cooks River and Alexandra Canal, fifteen to discharges in the Georges River and seven to discharges into the northern waters of Botany Bay.

The high cost of abating pollution is apparent from Table VII-(7): the estimated cost of the ninety-four applications to install or modify pollution control apparatus pending at June 1974 was some $352 million. By far the greatest proportion of this sum arises from applications by the M.W.S. & D.B. for the construction of sewage treatment works. For example, the primary treatment plants being constructed on the Malabar and North Head ocean outfall systems are estimated to cost some $80 million by themselves. The size of these outlays once more underscores the necessity for a comprehensive assessment of existing and likely future uses of Sydney's waterbodies before expensive water pollution controls are applied.

Up to June 1974, some fourteen offenders had been successfully prosecuted for offences against the Clean Waters Act or its regulations. Of these, the most important case involved the pollution of Cooks River with potassium cupro-cyanide by the Sunbeam Corporation Limited. The case was heard in the Supreme Court of N.S.W., with the W.P.C.B. alleging that Sunbeam actually *caused* the pollution and the defence arguing that the pollution was *accidental.* The prosecution was successful and Sunbeam was fined $3,000 plus $600 costs, thus setting a precedent whereby a firm is subject to the provisions of the Clean Waters Act even if the pollution is accidental.

Apart from its major activity in controlling liquid wastes discharged by industrial establishments, the W.P.C.B. has investigated other sources of water pollution which impinged on the activities of other public authorities. In conjunction with the M.W.S. & D.B., the W.P.C.B. carried out an investigation of possible methods to alleviate the polluting effects of sewer overflows. Methods considered include improved overflow structures, redirecting the overflow into waters with greater assimilative capacity, and the ponding of overflows for subsequent discharge back into the sewer system. The W.P.C.B. has attempted to exert some control over the illegal dumping of industrial liquid waste residues on land. Until August 1974, four liquid waste cartage contractors had been prosecuted under the provisions of the Act and prosecutions were pending against a further four. The Branch also surveyed landfill sites in the metropolitan area of Sydney to determine which were significant sources of leachate. In this regard, the two worst sites in Sydney are the Belrose and Menai tips. The responsibility for the control of leachate at landfill sites has subsequently been assumed by the M.W.D.A.

*Restorative planning*

Under this function, the Branch has proposed to attempt a series of interpretive studies of major waterbodies, including Georges River, Botany Bay, Parramatta River and Cooks River. Only the last had been dealt with at time of writing.

In May 1975 the S.P.C.C. published a first version of a detailed study by its W.P.C.B. entitled *Investigation into Pollution of the Cooks River and its Tributaries.* This is said to be the first of a series of similar studies. Such an investigation is required before any program of alleviating water pollution is implemented. However, it illustrates the difficult problem of integrating policies relating to liquid waste management with those relating to the management of water resources in the absence of explicit environmental and water use objectives. The *Investigation* has one major shortcoming, namely that the costs and benefits of cleaning up the Cooks River drainage system are not assessed. This river is both the most polluted and least used (other than for waste disposal) waterway in Sydney. Before undertaking the ambitious and presumably expensive constructions proposed by the study, various existing and likely future uses of the waterway should be evaluated thoroughly and not merely given token recognition as in the *Investigation;* environmental objectives should be clarified and specifically stated; the effects of the proposed constructions on the level of water quality should be estimated; and the costs and benefits of achieving these levels of quality should be assessed. If this is not done, then in terms of net social welfare, the resources devoted to 'cleaning up' the Cooks River system may be 'wasted' — any improvement in water quality may not be reflected in a higher utility or greater use of the waterways, as is apparently occurring with the Delaware 'clean-up' program in the U.S.A. Further, the proposed constructions may constrain some potential recreational use such as boating. Moreover, the effects of the policy of encouraging aquatic life to return to these waters may represent a dangerous half-way house. Large deposits of toxic heavy metals lie on the floor of Alexandra Canal, which through natural processes and disturbance may become concentrated in the flesh of fish that are caught and eaten by humans.

The Cooks River study makes some attempt to assess the contribution of various types of liquid wastes to the level of pollution; and it makes a small concession to the need to study the land catchment area. The latter part of the Report is, however, painfully brief. The Cooks River drainage basin is some 10,000 hectares in extent with a population of 380,000; it contains about 2,100 industrial establishments (about 20 per cent of those in the Sydney Metropolitan Area) which employ approximately 100,000 people (about one-quarter of the Sydney manufacturing and industrial workforce).

The study confirmed what had been patently obvious for many years, namely that water quality in Cooks River and its tributaries, especially Alexandra Canal, was very poor indeed. The Canal was found to experience extreme dissolved oxygen problems, high concentrations of heavy metals and high concentrations of aquatic nutrients; its sediments were found to be high in organic matter, oil and heavy metals. (The W.P.C.B. estimated that, in the immediate past, some 400 kilograms of heavy metals and 1,300 litres of oil were discharged daily into the Canal.) The water quality problems in other areas of the Cooks River system was found to be significant, but less extreme than those of the Canal. A major source of these problems was found to be the liquid waste discharges from the many industries in the area, but the W.P.C.B. estimates that a significant pollutant load — perhaps *equal* to that of the industrial discharge — originates from urban run-off. Sewer overflows and landfill leachate also contribute to quality problems in the Cooks River system, the former being the more important. Also, an unsewered area along Alexandra Canal contributes to pollution. On the basis of their findings in the Cooks River Basin, the Branch is investigating in greater detail the contribution of both urban run-off and sewer overflows to pollutant loads.

To control pollution, the *Investigation* recommends that industrial wastes be diverted to sewers (where capacity is available) or satisfactorily treated before discharge into the drainage system (to this end 107 notices have been served on industries in the area); that highly contaminated liquid wastes and sludges be disposed of at the Castlereagh liquid waste depot; that unsewered areas be sewered; and that certain stormwater drains be enlarged. The control of wet weather wastes, the study concludes, could be achieved through the construction of three impoundments — one each on the upper Cooks River, Wolli Creek and Alexandra Canal — to allow the controlled diversion (presumably through tunnels or pipes) of the impounded water into the lower reaches of Cooks River (or perhaps even Botany Bay itself) where the assimilative capacity is greater. These recommendations are not related to proposals for oil pipeline construction on one side of Cooks River and major road building on the other.

There is no indication in the *Investigation* on the priority to be given to Cooks River as compared with other waterbodies. For policy purposes, the *Investigation* fails, therefore, to provide the essential evaluation necessary for environmental decision making. Such studies have a bearing on two interrelated aspects of public policy for urban areas: water resource management and liquid waste management. The W.P.C.B. has emerged with the central role of coordinating the activities of other liquid waste management authorities not only in Sydney but also in the rest of N.S.W. Because this alone is a demanding task, given the complexity of water resource management, such as evaluating and regulating waterbody uses, there may be a case for establishing regional or basin authorities which could operate in conjunction with the W.P.C.B. in each major drainage area. Other alternatives might be preferred. For example the expertise within the S.P.C.C. needs in any event to be enlarged to change the emphasis of that Commission from an engineer-oriented agency that is geared, primarily, to investigating technological options to one of pollution control largely in isolation from relevant social, economic and political factors. Alternatively, given that water resource management requires a perspective similar to that of land-use management, it may be appropriate to allocate this function to the Planning and Environment Commission.

### The Health Commission of N.S.W. and local government councils

With the advent of the S.P.C.C. and the M.W.D.A., the Health Commission and the local government authorities now play subordinate roles in influencing the management of liquid wastes (see Chapter 2). The Health Commission is concerned with the control of public health and public nuisance aspects of domestic waste water that is improperly discharged. Its activities which are relevant to this function include the examination of applications for the installation of septic tanks and other types of facilities used to dispose of domestic waste water from unsewered properties; the inspection of night soil depots, the provision and operation of which is generally the responsibility of local councils; and monitoring of the level of faecal contamination in bathing waters. The responsibility for the sampling of bathing waters usually rests with local councils, but the Health Commission, through its Division of Analytical Laboratories, carries out the actual bacterial analysis of the samples.

Local government councils have the responsibility for controlling the disposal of domestic liquid wastes not discharged to sewer, either directly by operating a disposal service or through a private contractor. However, as indicated above, local councils act under the policies and the supervision of the Health Commission. In terms of volume of liquid wastes generated in Sydney, both the Health Commission and local councils are of local rather than metropolitan significance. As Table VII-(2) shows, there are nearly 50,000 dwellings (1971 census), about 14 per cent of the total, in the Botany Bay drainage basin that are not connected to the M.W.S. & D.B.'s sewerage system. Of this number, over 25,000 have, chiefly, septic tanks installed; the remainder have a sanitary pan system for the removal of excreta. Wastes from septic tanks are either discharged to watercourses by percolating through soil or are regularly pumped out into tanker trucks and then conveyed to and discharged into sewers. Excreta from sanitary pans are buried in earth or, as is now increasingly the practice, discharged into one of the M.W.S. & D.B.'s sewage treatment works. Except in cases where topography and ground type make sewer construction too costly, these two methods of liquid waste disposal by households will diminish in importance as the sewerage network expands.

Local councils have some limited potential to control liquid waste flows within their own areas by applying the provisions relating to water pollution in the Local Government Act and Regulations. Moreover, recent amendments to the Clean Waters Act allow local councils to prosecute water polluters under the much stricter provision of this Act.

## The Maritime Services Board

The major responsibility of the M.S.B. in managing liquid wastes is in the prevention and mitigation of oil pollution through the provisions and regulations of the Prevention of Oil Pollution of Navigable Waters Act, 1960. Although this Act applies to all navigable waters in N.S.W., the M.S.B. only undertakes activities in relation to the prevention and mitigation of oil pollution in the port waters under its control. Thus, in Sydney, the major responsibility of the M.S.B. is for the prevention and mitigation of oil pollution in Port Jackson and Botany Bay.

*Prevention of oil pollution*

Activities undertaken by the M.S.B. in attempting to prevent the occurrence of oil pollution include:

(i) the keeping of records of the movement of oil or oily wastes

(ii) the inspection and approval of apparatus used for the transfer and disposal of oil

(iii) directions to ships and refineries to install treatment facilities and safeguards to prevent the escape of oil

(iv) the provision of disposal facilities for oily wastes

(v) prosecutions and recovery of costs

The M.S.B. can require records to be kept on the ballasting of cargo and fuel tanks and any disposal of oily residues from vessels, and the transfer of oil to or from land facilities and the operation of facilities to dispose of oily residues. Such records enable the disposal of oily residues and ballast water to be checked. The penalty for falsifying records is a fine of up to $5,000.

Officials of the M.S.B. can board ships or enter premises on land for inspection purposes, to examine records, and to test equipment used for the transfer of oil and the disposal of oily residues. The Board has five oil inspectors stationed at Sydney Harbour and another five at Botany Bay. Notice must be given to them of any operations involving the handling and pumping of oils (both fuel oil and cargo) to and from vessels in port. The oil inspectors approve such operations, and in some cases are actually present to inspect the connection and disconnection of hoses. The penalty for hindering an inspector in his duties is a fine of up to $2,000.

The M.S.B. can require that ships be fitted with equipment to prevent the discharge of oil or oily wastes, that the equipment be of an approved type, and that it is subsequently inspected and tested. The penalty for contravention of these regulations is a fine of up to $10,000. In order to prevent likely oil pollution from places on land or from oil transfer apparatus, the Board can serve notice requiring the installation of treatment facilities, safeguards, etc. If such requirements are not met within a stated time, offenders are liable to a fine of up to $50,000.

The M.S.B. provides facilities — 44-gallon drums at the wharfside — for the disposal of oily wastes from vessels in port. However, they are only used several times a year. The M.S.B. can also direct refineries to provide a disposal system for the oily wastes from tankers.

Reports of oil pollution are investigated immediately by the Board's officers with two considerations in mind — minimising the effects of the pollution, and the acquisition of evidence for subsequent prosecution. Cases of oil pollution are reported by the Board's own wharf patrol staff, which consists of approximately ninety people at Sydney Harbour and ten people at Botany Bay, by private citizens, or by the persons responsible for the pollution itself. (If a person knowingly causes and does not report oil pollution he is liable to a fine of up to $10,000.) The penalty for oil pollution in the navigable waters of N.S.W. is a fine of up to $50,000. Thus, quite apart from the other preventive measures, a fine of this potential magnitude is a significant financial incentive not to pollute. The number of prosecutions for oil pollution in Sydney and Botany Bay during the years 1965-74 are shown in Table VII-(8). The origin of the oil discharge — land source, vessels or oil transfer apparatus — is also shown as is the number of prosecutions for failure to report oil spills.

On the basis of Table VII-(8), the most common sources of oil discharges are vessels (70 per cent) and land-based activities (25 per cent). The greater number of prosecutions for oil discharges from vessels reflects the many small spills that

Table VII-(8) Prosecutions* under the Prevention of Oil Pollution of Navigable Waters Act, 1960 (1965-74)

| Location | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sydney** | | | | | | | | | | | |
| *Source of oil discharge —* | | | | | | | | | | | |
| Land | | | | 7 | 1 | 4 | 7 | 4 | 4 | 3 | 30 |
| Vessels | 3 | 3 | 1 | 5 | 5 | 8 | 9 | 20 | 12 | 12 | 78 |
| Oil transfer apparatus | | | | | | | | | | | — |
| Failure to report pollution | | | | 1 | | | 3 | | | 1 | 5 |
| **Botany Bay** | | | | | | | | | | | |
| *Source of oil discharge —* | | | | | | | | | | | |
| Land | | | 1 | | | | 5 | | | | 6 |
| Vessels | | | 1 | 1 | 1 | 5 | 3 | 1 | 1 | 1 | 14 |
| Oil transfer apparatus | | | 1 | | | | | | | | 1 |
| Failure to report pollution | | | | | | | | | | | — |
| **TOTAL** | | | 3 | 1 | 1 | 5 | 3 | 1 | 1 | 1 | 21 |

*Prosecutions are for the 12-month period ending 30 June of the year shown.
Source: M.S.B. (private communication).

result from accidents during bunkering and ballasting operations. The greater number of spills in Sydney Harbour as compared with Botany Bay reflects the greater number of vessels that pass through the harbour.

*Mitigation of oil pollution*

The methods employed to clean up oil spills depend to a large extent on the size of the spill. Table VII-(9) shows the estimated size of thirty-seven spills that occurred in the port waters the M.S.B. controls during the period September 1972 to June 1973. These data illustrate that the size of individual spills is generally small — some 70 per cent of the spills involve less than 200 litres of oil.

Table VII-(9) Estimated size of oil spills in port waters (September 1972 to June 1973)

| Size (litres) | Number of spills |
|---|---|
| less than 50 | 6 |
| 50-200 | 11(+9)* |
| 200-450 | 5 |
| 450-700 | 2 |
| 700-4,500 | 4 |
| | 37 |

*No estimate of size, but probably less than 200 litres.
Source: M.S.B., (private communication).

The M.S.B. has its own clean-up crews and equipment for dealing with oil spills. These crews are employed as construction workers in the Construction Branch of the Board and are only seconded to clean-up operations as required. The Board's clean-up equipment consists of supplies of detergent to emulsify and disperse spilt oil, some 1,000-1,500 feet of oil boom to contain spilt oil for subsequent removal, and blankets of polystyrene fibre which absorb or 'scavenge' spilt oil. Other clean-up equipment, apart from that provided by the Board, is also available. Under the National Plan for the Control of Oil Pollution, the Commonwealth Department of Transport provides an additional stock of detergent, pumps, etc. in Sydney. Also, the oil refineries and terminals in Botany Bay and Sydney Harbour have their own supplies of detergent, workboats, oil skimmers, etc.

## Conclusion

The triumvirate of public authorities, the S.P.C.C. (W.P.C.B.), M.W.S. & D.B. and the M.W.D.A. share power and jointly influence the direction of flow of man-made wastes and the composition of industrial liquid wastes.

Of less influence are the M.S.B., the Health Commission and local government councils. Despite the common interest in the same policy field, there exist no clearly defined objectives for managing liquid wastes in Sydney. If coordination of policies and activities (such as data gathering, monitoring of water quality and licensing procedures) are not to be merely notional and *ad hoc*; if duplication of effort is to be avoided; if individual authorities are not to pursue their functions independently, then there is a need to formulate explicit objectives, which, in turn, may be employed in evaluating the priority of use of particular metropolitan waterbodies. Underlying the need for clear objectives is not only the fact that a large proportion of resources is allocated to managing liquid wastes, but also the conflict in functions that exists between the major authorities. The S.P.C.C. is concerned to control the generation of wastes and the impact of their disposal upon the environment; the M.W.S. & D.B. and the M.W.D.A. are disposal-oriented agencies, the latter in a dependent and derivative relationship.

Liquid waste-management policies, particularly those regarding industrial wastes, must be integrated with broader urban policies and objectives. There is already a shortage of undeveloped industrial land in the areas served by the ocean outfall sewerage system. Consequently, most of Sydney's future industrial expansion will be served by sewer systems draining to inland treatment plants. These plants employ sensitive biological treatment processes and discharge effluent into inland waters, such as the Georges River, which have limited waste assimilation capacities. Thus the human pressures on inland streams can be expected to increase. This emphasises, as argued in Chapter 6, the need to evaluate the uses to which waterbodies should be put. Obviously there is a need to devise a policy regarding industrial location, a need that is also raised elsewhere as a long-term measure for managing industrial air pollution. For instance, land-use controls might be applied to shepherd potentially damaging industries into areas served by ocean outfall systems and to encourage 'cleaner' industries into the inland areas. Here there is a need for the Planning and Environment Commission to formulate policies in conjunction with the S.P.C.C., other relevant government agencies, and interested parties.

The combined activities of the S.P.C.C. and M.W.S. & D.B. in managing industrial wastes will foster the separation of liquids from waste residue, and so generate a volume of concentrated and/or toxic wastes which cannot be discharged into sewers or waterbodies. A proportion of this is dumped or disposed of outside the existing system of public disposal facilities. In part the lack of public control over this aspect of liquid waste management may arise from inadequate or non-existent data concerning the generation, collection, transport and disposal of toxic wastes. Further, the M.W.D.A. has become too preoccupied with *disposal* in contrast to overall management. There appears to be scope for formulating policies that encourage the recycling and reuse of toxic waste materials and thereby reduce pressures on the environment.

Understandably much of the recent activity in regulating the liquid waste flow has concentrated on man-made liquid wastes. As these sources of waste are gradually brought under control, urban run-off and sewer overflows will increasingly dictate the ultimate level of water quality that can be attained in the inland waterbodies. Of these two wet weather wastes, urban run-off is the more difficult to control and probably has the greater detrimental effect on water quality. A study is required to evaluate first, the contribution of both these wet weather wastes to pollution problems and, second, the feasibility and costs and benefits of their control.

In the longer run, the need to emphasise preventive measures — limiting the generation of wastes and recycling of wastes — will increase. This is not merely a matter of water quality management, important as this is. It is also a question of energy and resource management. There is a strong case for a much more sensitive approach that can be adopted now and brought to bear increasingly on private and public waste generators. This approach depends on reducing the role of technological directives by authority and substituting pricing processes particularly through the instrumentality of the M.W.S. & D.B. Any such approach would leave the technological initiative much more to waste-generating sources and so mean much less interference in the affairs of private institutions. It would require, however, a sea-change in the structure, staffing and philosophy of the M.W.S. & D.B.

## Appendix I: M.W.S. & D.B. rates and charges, 1966-74

| | 1965/6 | 1966/7 | 1967/8 | 1968/9 | 1969/70 | 1970/1 | 1971/2 | 1972/3 | 1973/4 | 1974/5 | 1975/6 | 1976/7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Water rates** | | | | | | | | | | | | |
| Ordinary (cents in $ of A.A.V.) | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | | |
| Allowance charge | | Same as meterage charge | | | | | | | | | | |
| Meterage (excess) charge per '000 galls. | 30c | 30c | 30c | 33c | 33c | 33c | 45c | 45c | 47.7c | 47.7c | | |
| Minimum amount of rate — | | | | | | | | | | | | |
| occup. land | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $25 | $25 | | |
| unoccup. land | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $15 | $15 | | |
| **Sewerage Rates** | | | | | | | | | | | | |
| Ordinary (cents in $ of A.A.V.) | 3.95 | 3.95 | 4.45 | 4.45 | 4:45 | 4.45 | 5.25 | 5.25 | 5.25 | 5.25 | | |
| Minimum amount of rate — | | | | | | | | | | | | |
| occup. land | $10 | $10 | $15 | $15 | $15 | $15 | $15 | $15 | $35 | $35 | | |
| unoccup. land | $10 | $10 | $15 | $15 | $15 | $15 | $15 | $15 | $21 | $21 | | |
| **Drainage rates** | | | | | | | | | | | | |
| Ordinary (cents in $ of A.A.V.) | 0.52 | 0.52 | 0.52 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | | |
| Minimum charge | | | | | | | | | $10 | $10 | | |
| **Trade waste charges** | | | | | | | | | | | | |
| Sewer — | | | | | | | | | | | | |
| Volumetric (excess) charge per '000 gals | 15c | 15c | 15c | 15c | 15c | 15c | 15c | 30c | 30c | 30c | | |
| Minimum charge | | | | | | | | $30 | $30 | $30 | | |
| Excess strength charges (cents per kilogram) | | | | | | | | | | | | |
| | | | | | | | | | | | (Expected) | |
| B.O.D. | | | | | | | | 0.022 | 0.044 | 0.11 | 0.22 | 0.44 |
| Suspended solids | | | | | | | | 0.132 | 0.44 | 1.10 | 2.20 | 3.30 |
| Grease | | | | | | | | 4.40 | 4.40 | 4.40 | 4.40 | 4.40 |
| S.W. channel — | | | | | | | | | | | | |
| Volumetric charge per '000 galls | | | | | | | | 10c | 10c | 10c | | |
| Minimum charge | | | | | | | | $10 | $10 | $10 | | |
| Excess strength charge | | | | | | | | 30c (min $30) | 30c (min $30) | 30c (min $30) | | |

# 8 From dust to smog

### Introductory

In Sydney, as in other concentrated city settlements, some degradation of air quality is inevitable. As for water quality management, the essential questions to be asked are: What degree of degradation is acceptable and to whom? And at what cost will some imperfect standard of air quality be sought? Degradation of air quality, as of water quality, follows a basic pattern: the emission of man-made wastes to an environmental resource with limited assimilative capacity; and the displacement of the natural environment by human activity. There are, however, some important contrasts and comparisons between air and water quality problems. The differences are often differences in degree rather than in kind and should not be overstressed, at any rate in the circumstances of Sydney.

In both air-borne and water-borne wastes, population settlement in Sydney makes relatively small volume changes in the natural flows. Yet it is these small changes that generate major alterations in environmental quality. Air quality is disturbed in the most pervasive and general manner directly by energy use in a city, through the consumption of petroleum products, coal, gas, other fuels and electricity with their yields of combustion and consumption wastes. In addition, lesser volumes of other wastes are emitted to the atmosphere from the processing of materials in the course of human activity, primarily in manufacturing; these are special 'process wastes'. Water quality problems, by contrast, tend to be related more (not exclusively), in Sydney, to wastes that may be regarded as process wastes, including human wastes.

A second difference arises in the manner of disturbing the natural environment. Both rainwater and air flows are significantly altered. As we have seen, rainwater run-off increases, moving man-made wastes into waterbodies. The erection of city structures, especially high-rise buildings in a city centre, tends to constrain natural air flow and concentrate air-borne wastes in the vicinity of their source by limiting natural ventilation. This is particularly important in the carbon monoxide problem in Sydney's central business district.

Subject to these man-made intrusions, degraded air in or close to the metropolitan area tends to disperse more widely and is generally less constrained by limited flow paths than is degraded water. As a result, widespread city areas, distant from the points of origin of air-borne waste emissions, may be affected more generally and more variably than in the case of water-borne wastes. In the simplest terms, it is much more difficult to describe natural air 'drainage' basins than it is to delimit a natural water drainage. There are many qualifications to this point. Many air-borne wastes affect only local conditions; and air flows do follow general prevailing paths. Moreover, degraded air from the combination of manufacturing and transport activity tends to be concentrated in the southern half of Sydney and, in very broad terms, the Botany Bay water drainage basin has a relatively similar though more loosely defined air flow counterpart, particularly in the context of photochemical smog problems. Some of these characteristics have become evident from the scientific studies of the Botany Bay Project.

In the case of air quality degradation, the chemical reactions of wastes with the natural environment and with each other have a much greater significance for Sydney residents than do comparable reactions of water-borne wastes in water. This is partly related to differences in the frequency and seasonality of air flushing as compared with river and bay flushing. The development of 'secondary pollutants' occurs in water and is important in water quality degradation at present, particularly in Parramatta and Cooks River. In the main water amenity in the Botany Bay area, the outstanding problems lie more in the near future, through the expected input of nutrients into the Georges River. The significance of photochemical smog as an immediately current problem in Sydney and the likely high costs of its control make the issue of 'secondary pollution' much more important and immediate in air quality management.

The major source of the primary wastes that have led to photochemical smog in Sydney is motor transport. This points up two other contrasts between air and water quality problems. First, the sources of the primary *critical* wastes are much more numerous and are mobile, depending on the use very large numbers of Sydney residents make of motor vehicles. In turn, this makes control much more difficult. The most serious wastes affecting water are factory wastes and these are physically easier to control, though they introduce continually changing problems. Vehicle waste control is different in kind from the task of trapping and diverting human sewage from households: little can be done about limiting generation of these wastes, but the 'disposal' process for sewage is well established; whereas in dealing with the wastes from combustion in motor vehicles, disposal processes are not obviously available and the management task is primarily preventive to control waste generation. Second, public authorities participate directly in the circumstances that yield motor vehicle wastes. By the provision of road systems and transport facilities, public authorities play a major role in determining both the volumes and kind of major wastes emitted in road transport. They have, correspondingly, the more immediate capability to constrain the generation of these wastes or to alter their type by varying the road or other transport use.

A final contrast should be noted. Despite Tom Lehrer, people must drink water and must breathe air; and so must other animals and plants in a city environment. But Sydneysiders have a much greater degree of flexibility in their dependence on natural water resources than they have on their ambient air. Given access to drinking water supplies from outside the metropolitan area, they may accept or reject the opportunities to swim in, boat on, picnic by, fish in or otherwise enjoy their natural water resources. Sydney's air, particularly in the Botany Bay area, is seriously degraded. Some individuals may partly escape degraded ambient air in air-conditioned buildings or in selected residential or work locations. But most must live in prevalent atmospheric conditions. The necessity for direct contact with available air quality by the mass of people means exposure to a variety of risks, of premature death, ill health, irritants, damage to clothing, structures and other belongings, deposition of dust in dwellings and other buildings, damage to plants, less clear skies and less bright sunlight, or reduced visibility.

The potential physiological risks have led to the predominance of health criteria in Sydney's air quality management. In turn, these criteria have led to a physical specification of management objectives and to an emphasis on technical 'solutions' to these physical problems. The awareness of these elemental risks has been heightened by incidents elsewhere, in London and Los Angeles in particular, of special, different smog crises that have been credited with the premature deaths of significant numbers of people. The likelihood of health risks should not be underestimated. Nevertheless, the medical evidence on the incidence of death and disease related to ambient air quality in Sydney has not been fully investigated and is not conclusive. On the one hand, it may be wise to be cautious; on the other hand, it is essential to recognise that the preservation of life and health, along with clean houses, clear skies and good visibility are benefits that individuals may value in a manner quite differently from hygiene-oriented authorities. This does not imply, necessarily, less concern about air quality. It may imply more.

What is at issue is the manner of approach to the problem. As with water quality, air quality management is a matter of a complex cost-benefit procedure that is not being attempted, even in the most elementary form, in Sydney. The approach to control is essentially technological and authoritarian, however limited the authority. The essential condition is omitted that air is a common

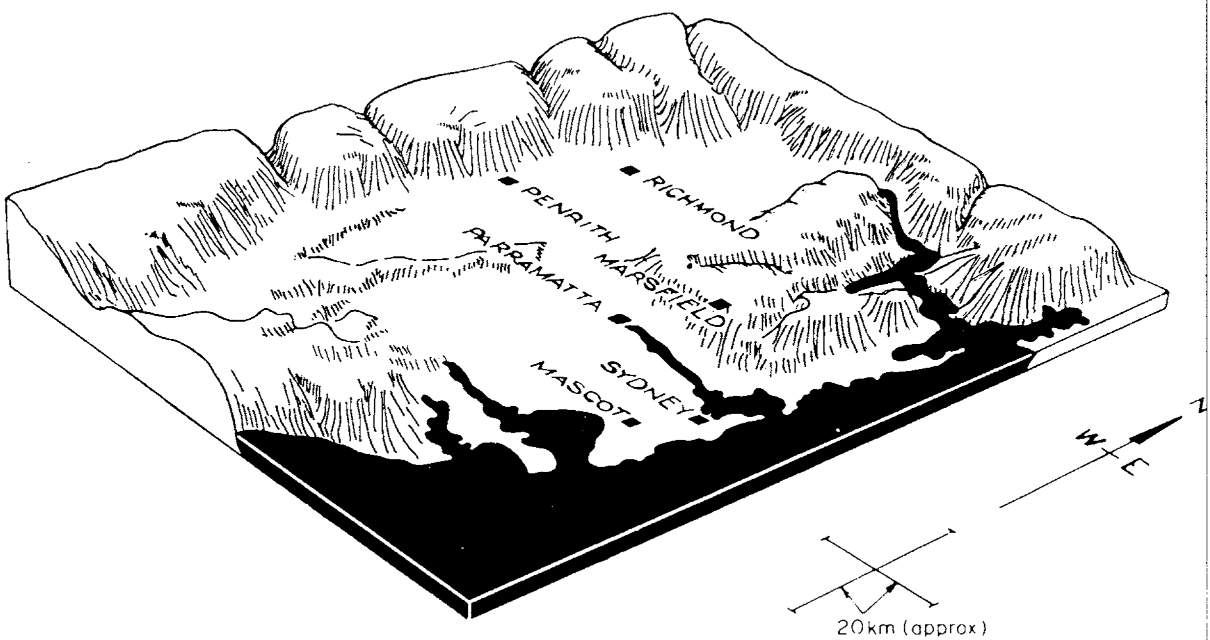



Fig. VIII (i) Topography of the Sydney region property resource and that it needs to be brought as far as possible into the calculus of the individual and of city planners. This implies the need for a mix of incentives and penalties to induce individual air users, whether as consumers of air or generators of air-borne wastes, to respond, as far as is reasonable, to the specific stimuli of measured costs and benefits arising from reduced waste emissions, reduced air quality degradation and enhanced air quality benefits.

In this light, it may be suggested that air quality problems, far from being downgraded in importance, appear to be perhaps the outstanding natural environmental problem of Sydney in the immediate future. The presence of a photochemical smog problem, despite proposed but not yet fully enacted controls, is likely to continue to afflict Sydney for at least the next decade. Delay in the development of motor vehicle technology or in changed transport provision may extend this prospect. While residents are largely left ignorant of risks known to Sydney authorities and are allowed to behave in ignorance of the consequences of their activities, the risks are correspondingly increased. In decision making, information is the basic ingredient. But information must be a two-way flow, to authorities and to the affected city community.

## Sydney's atmosphere

The Sydney Basin (Fig. VIII(i)) has often been likened to the Los Angeles Basin, notorious for its smog problems. There are many parallels — broadly similar areas, a coastal city location, mountains on the inland side, long periods of sunshine, temperature inversions at night — which help to generate some similarity in air quality for the two cities. But Sydney is relatively fortunate in at least three significant respects. It has a better natural ventilation system in the daytime; the mountains behind Sydney are considerably lower, providing less cold air masses at night to affect metropolitan air layers; and there are smaller volumes of primary air-borne wastes emitted in the Sydney area. Nevertheless, these fortunate aspects do not allow Sydney to escape air quality problems. Nor are they uniform in their effects throughout the Sydney area; in particular, the advantages become less significant as one moves into Sydney's main growth areas.

Air movements cannot be considered in terms simply of the Botany Bay area. A broader pattern of conditions must be considered. Sydney's air-flow system is very much more complicated and variable than the natural water flows. Air flows are not adequately established, though work being carried out at Macquarie University, partly for the Botany Bay Project, is significantly increasing our understanding.*

A highly simplified outline of Sydney's natural ventilation, subject to many qualifications, may be presented in terms of gradient winds, surface winds, sea breezes and night air flows. Each has a particular significance in the determination of air quality.

Gradient winds, measured in the Botany Bay area at Mascot at heights above 300 metres, have a broad pattern. In general, strong northerly winds blow during October and February and, with about equal prevalence, strong southerlies occur throughout the year. During April to October, the dominant

* For more detailed information see *Environment '75*. Second International Conference 1975, Vol. III, pp. 19ff. (organised in association with N.S.W. State Pollution Control Commission); and *Smog '76. Occurrence & Control of Photochemical Pollution* Paper V (Proceedings of Symposium and Workshop Seminars, Macquarie University, Sydney, Feb. 1976). The outline presented here is based on these papers.

gradient winds are westerlies. Subject to limits that may develop in air-mixing at different altitudes, the gradient winds provide upper level ventilation. The stronger these higher level winds become, the further they penetrate to ground level providing, in these circumstances, full ventilation.

Surface winds tend to be more localised in their direction but more immediately relevant to the city's ventilation system. Measured at Mascot, the surface winds in the mornings tend to be dominantly north-westerly in the colder months (April-October), with little morning wind during January to March. In the afternoons, the general surface wind flow moves between south-east to north-east during November to March and shifts to a prevailing westerly movement during May to July.

Coupled with these surface winds, sea breezes provide a critically important supplementary ventilation, typically as afternoon relief. They vary greatly according to season and distance from the coast. On an average these breezes occur, at the coast, on half the days of the year, as cool, moist air movements. They are felt most immediately at Botany Bay and gradually extend inland. Arriving later at inland locations, their effects are briefer in time. But in addition, by the time the western limits of the metropolitan area are reached they are often spent and, on average, arrive (as measured at Richmond) in only one day in four. They are, therefore, of greatly reduced ventilating importance in Sydney's growth areas.

These wind flows are significant partly in counteracting and partly in dispersing a different flow, the common nocturnal air movements. The two together, sea breezes and nocturnal air flows, are particularly important in the process of smog development. Cold air masses above the 1,000-metre high Blue Mountains move back during the night towards the warmer city area. This is generally a slow transfer. Cold air drains down from the mountains, gradually fills the Hawkesbury valley and, in a broad mass stream, overflows out of this valley eastward towards the coast. One large stream passes along the Parramatta River valley. A second flow fills the Liverpool basin at the western edge of the Botany Bay area. Here a stagnant pool tends to accumulate, filling the Liverpool basin and overflowing into Botany Bay itself.

The tendency to form stagnant pools has an important bearing on processes of waste emissions in these growth areas. More generally important, however, is the interrelated process of the formation of cold layers of air at intermediate altitudes at night. These form over the low-lying areas of the whole of Sydney but specially in the southern half, including particularly the Botany Bay area. Generally under anti-cyclonic conditions, temperature inversions occur forming stable, stationary cold masses that limit the mixing of air bodies. There is as yet only limited knowledge of the levels at which these stable cold air masses form, their thickness and their frequency of occurrence. It is suggested that these layers may be most commonly in a band between about 80 and 190 metres above the land surface. Their stability and effects are conditioned considerably by the strength of gradient winds above them. Typically after sunrise, these nocturnal inversions are broken down largely by surface heating. However, their persistence until later in the day is sufficiently frequent to provide Sydney with the conditions for photochemical smog.

Located at 34°S, on the coast, Sydney has a mean annual shade temperature of about 17° Celsius. With most of its rainfall occurring in brief heavy rain, Sydney has long periods of sunlight. The annual average daily sunshine is recorded at almost seven hours. This implies the circumstances that enhance the beauty of Sydney in terms of blue skies and bright sunlight. But the prevalence of prolonged sunlight, combined with temperature inversions, has a complex effect on air quality in the presence of certain air-borne wastes, leading to the photochemical smog familiar to Los Angeles.

## The generation of air-borne wastes

It is a common misconception that urban air, as a storehouse of gases of oxygen, nitrogen and a few inert gases, is degraded primarily by human wastes emitted to the air. We suggested, for water quality, that the degradation of Sydney's water resources was due predominantly to a quite small quantity of man-made wastes. For air quality, many of the substances that are emitted to the atmosphere as man-made wastes also derive from natural sources, volumes from which, with some exceptions, are much greater than those from human activity. In Sydney, bush fires, dust storms, pollen and other natural circumstances periodically supply massive quantities of particulates; 'background' volumes of other natural wastes are not well established for Australia, but large volumes of oxides of carbon, sulphur and nitrogen exist along with hydrocarbons, etc. Nevertheless it is those wastes that are added by man that are, for the most part, responsible for much of air quality degradation in cities. It is the very modesty of human waste inputs and the major degrading consequences that accentuate the need for control of human activity.

Man-made wastes, as generated directly from human activity, include chiefly particulates (dust, soot, ash, smoke, etc.), oxides of sulphur, of nitrogen and of carbon, hydrocarbons, lead and asbestos. In addition there is a mass of man-made wastes much smaller in volume, including inorganic compounds of copper, iron, cadmiun, sulphur, fluorine, chlorine, various acids, toxic and non-toxic odours that are usually organic in origin, and radioactive substances. One of the outstanding problems in this area is that urban and especially manufacturing technology is progressively enlarging the list of wastes and, in the process, introducing an important element of uncertainty. It must be expected that the types of wastes will change progressively over time. Two special air-borne wastes, noise and heat, are not dealt with in this study.

Another misconception sometimes held is that wastes, once emitted, remain for long periods in the atmosphere. This may be true for some wastes, on an essentially global basis. A great deal is removed from the air, even globally, by natural particulate settlement or by natural rainfall flushing. There is, therefore, a definite inter-connection between air and water quality, a relationship that has been ignored in Sydney until recently. Of the balance of the wastes that remains globally, some, such as nitrous oxide, hydrocarbons, carbon dioxide and monoxide, may reside in the atmosphere for several years. Others have brief residence periods of, at most, a few days. For a city such as Sydney, in the southern hemisphere, the natural ventilation system, in particular, ensures that most wastes are dispersed after brief periods with unmeasurably small global consequences, though some drift out and return to the city area by air flow processes; dust deposition and rainfall provide other natural local 'disposal'. Relatively brief periods of residence in the local, city atmosphere do not, however, mean that their damaging effects are similarly limited in time. The long-term effects of most air pollutants are largely unknown.

Wastes emitted directly by man do not all remain unaltered in the atmosphere. This gives rise to an important distinction of 'primary' and 'secondary' wastes. Primary wastes are those, as listed, in their man-made form. In certain cases, reaction with the atmosphere and between wastes significantly changes the form and the effects of substances so that they become 'secondary' wastes. This is often a very complex chemical process, by no means fully understood. The most common reactions are those in the formation of oxidants leading to photochemical smog. The production of high concentrations of oxidants, chiefly ozone, depends on several factors, so that the mere emission of appropriate man-made wastes does not necessarily lead to the full reactive process. In particular, appropriate absolute and relative levels of hydrocarbons and nitrogen oxides are needed; and suitable meteorological states, particularly temperature inversions, low wind speeds and adequate amounts of ultra-violet light (sunlight) are pre-conditions. The uncertainties in the reaction process unfortunately lead to corresponding uncertainties in control and prevention.

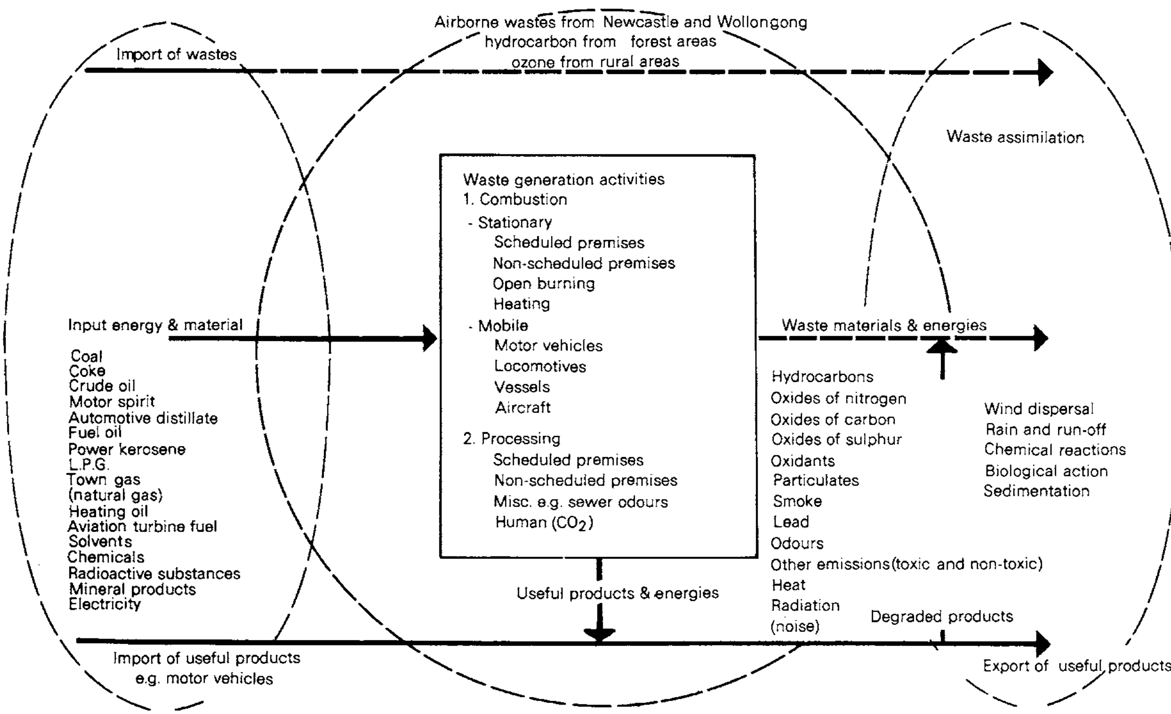



Fig. VIII (ii) Air-borne wastes - The Sydney Region

Solutions that are relevant at one place or time may not be satisfactory at others.*

* The determinants of the Sydney problem are presently being studied by the Sydney Oxidant Study (see Chapter 9).

Figure VIII(ii) presents a simple model of the flow of air-borne wastes into and through the atmosphere, showing the potential sources of air-borne wastes (energy and materials), the sources of emissions (waste-generation activities) and their general methods of removal (waste assimilation) in the Sydney basin. The

Table VIII-(1) Shares of air-borne man-made wastes by source (%)

| Source | Particulates | Sulphur dioxide | Carbon monoxide | Hydro-carbons | Nitrogen oxides |
|---|---|---|---|---|---|
| **Combustion waste sources** | | | | | |
| *Mobile* | | | | | |
| Road | 6.0 | 1.5 | 95.0 | 55.0 | 50.0 |
| Utility engines | 0.5 | —* | 1.5 | 2.5 | —* |
| Air, rail, shipping | 0.5 | 0.5 | 0.5 | 0.5 | 2.0 |
| *Total mobile* | 7.0 | 2.0 | 97.0 | 58.0 | 52.0 |
| *Stationary* | | | | | |
| Manufacturing— | | | | | |
| Scheduled premises | 55.5 | 70.5 | — | 0.5 | 34.0 |
| Non-scheduled premises | 6.0 | 13.0 | — | — | 6.0 |
| Total manufacturing | 61.5 | 83.5 | — | 0.5 | 40.0 |
| Non-manufacturing | | | | | |
| Power stations | 20.0 | 2.0 | — | — | 3.0 |
| Other scheduled premises | 6.5 | 2.0 | — | — | 2.0 |
| Non-scheduled premises† | ? | ? | ? | ? | ? |
| Total non-manufacturing | 26.5 | 4.0 | — | — | 5.0 |
| Incineration | 2.0 | 0.5 | 2.0 | 1.0 | 1.0 |
| *Total stationary* | 90.0 | 88.0 | 3.0 | 3.0 | 46.0 |
| TOTAL COMBUSTION SOURCES | 97.0 | 90.0 | 100.0 | 61.0 | 98.0 |
| **Process waste sources** | | | | | |
| Manufacturing— | | | | | |
| Refineries | 3.0 | 10.0 | — | 22.0 | 2.0 |
| Storage, transfer | — | — | — | 3.0 | — |
| Total petroleum | 3.0 | 10.0 | — | 25.0 | 2.0 |
| Other | ? | ? | ? | ? | ? |
| Total manufacturing | 3.0 | 10.0 | — | 25.0 | 2.0 |
| Non-manufacturing | | | | | |
| Solvent evaporation | — | — | — | 10.0 | — |
| Service stations | — | — | — | 2.0 | — |
| Dry cleaning | — | — | — | 2.0 | — |
| Other | ? | ? | ? | ? | ? |
| Total non-manufacturing | ? | ? | ? | 14.0 | ? |
| TOTAL PROCESS SOURCES | 3.0 | 10.0 | — | 39.0 | 2.0 |
| **GRAND TOTAL** | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*A dash (—) indicates that either the proportions contributed are too small to be shown but do appear in the totals or that no emissions occur in this category and therefore do not appear in totals.
†A query (?) indicates that emissions do occur from these sources but it has not been possible to estimate them.

figure is not intended to be exhaustive but to indicate the main stages leading to degraded air quality.

The list of inputs indicates that the chief potential source of air-borne wastes from human activity in the Sydney region is the consumption of energy and its related activities. More specifically, it is the use of petroleum-based products and coal that gives rise to the main air contaminants. In addition, certain manufacturing processes and uses of certain chemicals and solvents lead to local problems in the form of emissions that may or may not be toxic. Odours may also arise from energy consumption or related activities. We may, therefore, usefully distinguish man-made wastes due to energy consumption (combustion wastes) and others due to processing activities, chiefly manufacturing (process wastes).

Another distinction in the source of wastes is that of mobile versus stationary sources. This distinction arises partly because of the characteristics of different types of sources, partly because of control problems distinguished for the two types. Factories are perhaps the main stationary sources in Sydney; the dominant mobile source is the private motor vehicle. Neither is the exclusive source of combustion or process wastes, though vehicles are the dominant source of the former and factories of the latter.

*Major waste sources*

There is a large number of different types of air-borne emissions that arise from human waste-generating activities. Table VIII-(1) presents estimates of the potential relative contributions of the sources of some important wastes as matters of current concern in Sydney. The estimates presented vary greatly in accuracy because of the differences in the sources and accuracy of original data and hence should be regarded only as preliminary approximations. Nevertheless, the estimates give reasonable indications of the relative importance (percentage shares) of each of the different sources, subject to those components for which no estimate is given.

It will be seen that mobile sources, chiefly private motor vehicles, contribute the dominant emissions of carbon monoxide and hydrocarbons and, less dominantly, of nitrogen oxides. Nevertheless, stationary sources contributed almost half the latter and a little over 40 per cent of hydrocarbons; and these sources yielded the mass of particulates and sulphur dioxide. It should be noted that the relatively small presence of sulphur dioxide is due to the low sulphur content of indigenous crude oil. Were local supplies to fall and more imported oil used, the sulphur dioxide problem would become more prominent.

Of the stationary sources, scheduled manufacturing establishments dominated the waste flows of sulphur dioxide and nitrogen oxides and were responsible for more than half the particulates. Other scheduled (non-manufacturing) premises were significant sources, especially of particulates.

Process wastes, as distinct from combustion wastes, are particularly important stationary source flows of hydrocarbons and a significant source of sulphur dioxide. Petroleum refining, as might be expected, contributed over half these process hydrocarbons; the other major process sources were in solvent evaporation, particularly in painting activity. Other significant hydrocarbon sources are to be found in petroleum storage and distribution and in dry cleaning.

*Area sources of air-borne waste emission*

In dealing with the generation of wastes, the distinction between primary and secondary wastes is important and makes difficult any attempt to provide a simple outline of waste origins. The original area sources of primary wastes need to be established. However, the area location of secondary wastes, and the concentration in the atmosphere, depend on the movement of air masses and atmospheric chemical reactions and the times of day at which the primary

Tables VIII-(2)-(4) Potential emissions of wastes to the atmosphere by area source, 1971/2 (tonnes per day)*

VIII-(2) Motor vehicles

| | Particulates | Sulphur dioxide | Carbon monoxide | Hydro-carbons | Nitrogen oxides | Total |
|---|---|---|---|---|---|---|
| Cooks River | 1.9 | 0.3 | 203.0 | 37.7 | 11.2 | 254.1 |
| North Botany | 0.5 | 0.1 | 46.8 | 8.7 | 2.6 | 58.7 |
| Lower Georges River | 2.2 | 0.4 | 234.2 | 43.5 | 12.9 | 293.2 |
| Upper Georges River | 1.5 | 0.2 | 156.2 | 29.0 | 8.6 | 195.5 |
| Total Botany bay area | 6.1 | 1.0 | 640.2 | 118.9 | 35.3 | 801.5 |
| Rest of Sydney | 8.7 | 1.5 | 919.8 | 171.1 | 50.7 | 1151.8 |
| **TOTAL SYDNEY** | 14.8 | 2.5 | 1560.0 | 290.0 | 86.0 | 1953.3 |

VIII-(3) All scheduled premises plus other manufacturing

| | Particulates | Sulphur dioxide | Carbon monoxide | Hydro-carbons | Nitrogen oxides | Total |
|---|---|---|---|---|---|---|
| Cooks River | 9.1 | 24.2 | 1.0 | 0.6 | 9.2 | 44.1 |
| North Botany | 88.0 | 19.9 | 0.7 | 0.4 | 11.1 | 120.1 |
| Lower Georges River | 4.8 | 34.8 | 0.9 | 0.7 | 11.0 | 52.2 |
| Upper Georges River | 2.8 | 4.3 | 0.2 | 0.1 | 2.1 | 9.5 |
| Total Botany Bay area | 104.7 | 83.2 | 2.8 | 1.8 | 33.4 | 225.9 |
| Rest of Sydney | 102.0 | 53.0 | 3.1 | 1.6 | 27.7 | 187.4 |
| **TOTAL SYDNEY** | 206.7 | 136.2 | 5.9 | 3.4 | 61.1 | 413.3 |

VIII-(4) Refinery process, incineration and evaporative hydrocarbon sources

| | Particulates | Sulphur dioxide | Carbon monoxide | Hydro-carbons | Nitrogen oxides | Total |
|---|---|---|---|---|---|---|
| Cooks River | 1.3 | 0.7 | 13.0 | 14.8 | 1.3 | 31.1 |
| North Botany | 0.7 | 0.9 | 1.7 | 15.0 | 0.1 | 18.4 |
| Lower Georges River | 5.3 | 9.8 | 4.3 | 67.2 | 1.5 | 88.1 |
| Upper Georges River | 0.4 | 0.1 | 3.1 | 9.7 | 0.1 | 13.4 |
| Total Botany Bay area | 7.7 | 11.5 | 22.1 | 106.7 | 3.0 | 151.0 |
| Rest of Sydney | 4.8 | 6.4 | 14.8 | 81.9 | 1.2 | 109.1 |
| **TOTAL SYDNEY** | 12.5 | 17.9 | 36.9 | 188.6 | 4.2 | 260.1 |

*Sources and calculations of emissions as detailed in Botany Bay Project Report No. 2.

wastes are emitted. The period 6-9 a.m. is particularly important in respect of nitrogen oxides and hydrocarbons. In this section, attention is confined to area sources of primary air-borne wastes.

The most common representation of area location is through 'grid squares' definition. We are interested in control processes and it is of some value in this report to relate primary wastes emission to the river and bay drainage basins dealt with in Chapters 6 and 7, particularly since these drainage basins have air flow counterparts that are not radically dissimilar. It should be stressed that this delineation does not imply correspondingly degraded air in *these* areas.

This is an important implication in so far as proposals for marine port development and airport expansion may be expected to increase traffic flows in the area, expand petroleum refining and storage and add to particulates. This area seems likely to become, on this basis, an acutely important source of air-borne wastes, particularly because the sea breeze flows push air-borne wastes into the inland metropolitan growth areas.

Tables VIII-(2)-(4) present estimates of *potential* waste flows by area source, based on the assumption of no controls and given the levels of activity in 1971/2.

It should be noted that controls have operated in Sydney achieving significant reductions in particulates. It appears, however, that the relative significance of each area in terms of other waste flows may not have been radically varied from an uncontrolled situation.

The Botany Bay catchment, on the basis of Tables VIII-(2), (3) and (4), appears then to account for about 40 per cent of motor vehicle wastes, 55 per cent of all manufacturing and non-manufacturing scheduled-premises waste flows and some 60 per cent of the measured process wastes that are air borne. There are other flows not included in these estimates but those represented are particularly important as potential sources of smog.

The separate sub-areas of the Botany Bay catchment varied greatly in relative importance according to waste sources and type of source. The western segment, designated Upper Georges River, already may have accounted for as much as 25 per cent of the motor vehicle emissions of the whole Botany Bay Region on these preliminary estimates. The old industrial area in the northern Botany Bay catchment shows a very small contributor of vehicle wastes (the figures are almost certainly an underestimate). The predominant source of motor vehicle wastes lay in the Lower Georges River and, almost equally, in the

Table VIII-(5) Hydrocarbons and nitrogen oxides by area source (tonnes per day 1971/2)

| | Hydro-carbons | Nitrogen oxides |
|---|---|---|
| Cooks River | 53.1 | 21.7 |
| North Botany | 24.1 | 13.8 |
| Lower Georges River | 111.4 | 25.4 |
| Upper Georges River | 38.8 | 10.8 |
| Botany Bay region | 227.4 | 71.7 |
| Rest of Sydney | 254.6 | 79.6 |
| **TOTAL SYDNEY** | 482.0 | 151.3 |

Cooks River basin. In the light of planned Botany Port development, it should be noted that these three areas bordering the Bay contributed 75 per cent of all vehicle wastes.

The northern Botany Bay catchment, by contrast, dominated the stationary source flows from all scheduled premises and other (non-scheduled) manufacturing, accounting for over half the total Botany Bay catchment flow. The flows from Cooks River and Lower Georges River were not greatly dissimilar and these, with the northern Botany Bay area accounted for almost all these waste flows.

The calculated process wastes were yielded predominantly from lower Georges River, particularly due to hydrocarbon flows from this sub-region (in which Kurnell is included). However, the Cooks River basin generated some 20 per cent of the calculated process wastes and between them, these two sub-areas, with North Botany, were responsible for about 90 per cent of process wastes of the Botany Bay drainage basin.

In the light of Sydney's smog problem, it may be worth re-arranging the estimates of hydrocarbons and nitrogen oxides as in Table VIII-(5).

Thus, the Botany Bay catchment as a whole accounted for a little less than half the Sydney total of both wastes, reflecting predominantly the lower motor vehicle source in the catchment. But the derivation of these wastes, in this area, is particularly important because of Sydney's air flow, topographical and inversion characteristics. The Upper Georges River area was a minor source in both cases. The area immediately round Botany Bay itself was the dominant source of hydrocarbons while nitrogen oxide flows were more evently dispersed around the three sub-regions surrounding the Bay with Cooks River basin and North Botany catchment accounting for a little over half the Botany Bay Drainage Basin flows.

*Mobile sources of air-borne wastes*

The generation of air-borne wastes by vehicles may be regarded as a product of vehicle technology, manner (essentially idling and variation in speed) of use and extent (mileage) of use. In turn, use and mileage are related to the type of road systems available (freeways, arterial and sub-arterial roads) affecting traffic concentrations and speeds; and to the patterns of land-use distribution in terms of relationship between work and residence, which affect the demand for vehicle trips. Independently of these factors, the supply of alternative modes of transport, particularly acceptable alternative public transport systems in road and rail services, together with informal arrangements such as car pools, affect directly the specific demand for vehicle trips in the private motor vehicle, the dominant source of air-borne wastes. The factors determining the generation of air-borne wastes by motor transport are, then, a complex of vehicle technology, individual behaviour patterns and public authority transport policy and land-use design. It is wholly inappropriate, as appears to have been the case in Sydney until recently, to focus predominantly on vehicle technology, accepting the other determinants as incapable of variation or beyond the powers of controlling authorities. It is possible that the recently formed Urban Transport Study Group will make some alteration in this emphasis; a change in attitude is undoubtedly vital.

The approximate relative contributions to the total emissions from petrol-driven motor vehicles without emission controls are:

| Exhaust | Crankcase blowby* | Fuel tank & carburettor evaporation |
|---|---|---|
| 100% of the nitrogen oxides<br>55% of the hydrocarbons<br>100% of the carbon monoxide<br>100% of the lead smoke<br>Smoke | 25% of the hydrocarbons | 20% of the hydrocarbons |

* A means of emitting waste gases from the crankcase to the atmosphere. The 1970 controls compelled the recirculation of these gases to be reburnt.

Except for the emissions of particulates, the absolute values for these estimations are related to engine design and operating conditions. Some small amounts of carbon monoxide and nitrogen oxides are also emitted from the crankcase blowby. More than 99 per cent of the nitrogen oxides emitted from the exhaust pipe is nitric oxide. The nitrogen dioxide is formed as the nitric oxide is diluted by air. In addition to the above contaminants some small amounts of sulphur dioxide are exhausted along with odorous exhaust gases. Motor vehicles also produce asbestos particles from brake linings and rubber particles from tyres.

Diesel powered vehicles produce different ratios of these pollutants.[1] The emission of hydrocarbons from the crankcase, fuel tank and carburettor are probably less than 10 per cent of those from gasoline engines. The hydrocarbons and carbon monoxide emitted from the exhaust are less than from gasoline engines while the nitrogen oxide emissions are higher. In addition, the emissions from diesel engines cause two familiar problems — smoke and odours. Tests carried out in areas of high traffic density have shown that high concentrations of carcinogenic compounds are contained in the smoke of motor vehicles, particularly that from diesel vehicles.[2]

It is important to recognise that the major emissions of carbon monoxide, nitrogen oxides and hydrocarbons are speed-related. The first is dominant at low speeds and while idling; the latter two during acceleration. A sustained faster traffic flow reduces the problems arising from all emissions per vehicle; but improved road systems tend to increase car use, offsetting many gains.

The Sydney Area Transportation Study estimated that, in 1971, vehicle miles travelled daily in Sydney by road transport amounted to some 18 million miles apart from some minor local roads. S.A.T.S. projection of vehicle miles by the year 2000 is almost certainly an overestimate in the light of more recent population projections.[3] The projected mileage increase to 44 million miles per day by 2000 A.D. (on major roads only) needs to be scaled down. Nevertheless, unless major changes are made in transport and road systems and land-use associations, it seems improbable that the vehicle mileage driven then will be less than twice the 1971 figure. The S.A.T.S. projection also omitted consideration of the marine and air port development in Botany Bay, with consequential transport growth in the area north of the Bay and along the Cooks River valley. Although emissions per vehicle may be reduced in the next decade, increased vehicle use can be expected to reduce the gains from technical emission controls.

Commercial vehicle movement in the transport of goods and materials and in business service travel accounted for a significant fraction of the total. In terms of numbers of trips, business vehicles in 1971 accounted for about 20 per cent of private individual trips. The scale of individual movement makes this demand for transport services in individuals' own cars acutely important. Of the total person trips of almost 6 millions per day in 1971, slightly over one-third was due to travel between home and work; school trips contributed almost 18 per cent, shopping approximately 14 per cent. Social and recreational activity accounted for slightly over 10 per cent.[4] However, trips to and from work were, on an average, longer so that vehicle use for this purpose accounted for 50-55 per cent of all urban travel in motor vehicles.

Land-use design has a significant part to play in determining these demands for trips. Although S.A.T.S. projections of a doubling of person trips by the year 2000 may need to be scaled down somewhat, it is clear that land-use design and city planning, associating residence, work and shopping, in particular, may have a very important consequence for the generation of increased air-borne wastes in the future. Moreover, since public transport accounted for only a little over one-quarter of all person trips in 1971, the lack of adequate public transport is an important part of the conditions yielding air-borne wastes from vehicles.

Other mobile sources of air-borne wastes are small contributors by comparison with the private motor vehicle. Of the various types — utility engines (especially lawn-mowers), aircraft, locomotives and shipping — the last three account for approximately 0.5 per cent and 2.0 per cent of, respectively, hydrocarbons and nitrogen oxide emissions. It is possible that supersonic passenger aircraft may introduce new risks, including noise. The Australian Academy of Science has tentatively concluded that the Concorde will not have significant atmospheric effects. Much more down to earth, utility engines, essentially domestic lawn-mowers, are responsible for small but significant fractions of hydrocarbon emissions — about 2.5 per cent of the total. This is a larger fraction than the total due to all industrial combustion (excluding petroleum refining) and almost equivalent to the entire hydrocarbon emissions of the whole of manufacturing other than petroleum refining and storage from fuel combustion and processing activity. Small as it is, the hydrocarbon contribution from householders needs to be considered as a supplement to the more usually noted noise of petrol-driven lawn-mowers.

*Stationary sources of air-borne wastes*

By far the most important stationary source of air-borne wastes in Sydney is manufacturing. Thanks to the efforts during the 1960s of the Air Pollution Control Branch, particulates arising from inefficient combustion are not a major issue in Sydney except for a few localised and largely short-term cases.* Manufacturing air-borne waste emissions are important for several reasons. First, and most immediately, it is still a major source of nitrogen oxides, accounting for over one-third of the total. In view of the significance of these oxides to photochemical smog formation, this is a major problem. Second, sulphur dioxide emissions come almost entirely from manufacturing. This is more important if the supply of relatively low sulphur Australian crude oil

* A significant area problem, as distinct from local, industrial sources, remains in the Marrickville area; and some problems persist with coal-fired electricity stations whose phasing-out will occur in the near future. It may be noted that Sydney has transferred a serious particulate fall-out from coal-fired electricity generation to country areas by re-locating these stations.

presently available to the Australian market were to dwindle. The increased use of imported crude would greatly aggravate the problem. Third, manufacturing is the source of a very large number of largely localised and sometimes very serious irritants in acid fumes, toxic gases, odours, etc. Fourth, and perhaps most important of all, manufacturing is the main potential source of new air-borne wastes that can arise from new processes, new materials and new products. Particularly since these emissions have in the past included the most toxic, irritant or carcinogenic substances, and may do so in the future, manufacturing development introduces the outstanding element of uncertainty into the knowledge of waste emissions.

Manufacturing is more important in combining process wastes with combustion wastes. Unfortunately, even less is publicly available, coherently, on these air-borne process wastes than exists on the specially difficult water-borne process wastes of manufacturing. One indication, though it is a limited one, is in the composition of these manufacturing establishments given special attention by the Air Pollution Control Branch in the form of 'scheduled premises'.

Table VIII-(6) Sydney potential manufacturing air-borne combustion emissions, 1971/2 (tonnes per annum)*

| ASIC Code | Industry | Cooks River | North Botany | Lower Georges | Upper Georges | Total Botany Bay | Rest of Sydney | Total Sydney |
|---|---|---|---|---|---|---|---|---|
| 21+22 | Food, beverages and tobacco | 663.55 | 1,910.92 | 202.24 | 86.00 | 2,862.71 | 13,806.05 | 16,668.76 |
| 23 | (a) Textiles | 75.83 | 24.65 | 33.18 | 13.27 | 146.93 | 314.22 | 461.15 |
| 24 | (b) Clothing and footwear | 236.03 | 27.49 | 66.35 | 42.66 | 372.53 | 719.47 | 1,092.00 |
| 251 | (a) Wood and wood products | 202.95 | 25.59 | 108.06 | 58.77 | 395.38 | 266.36 | 661.74 |
| 252 | (b) Furniture and mattresses | 125.13 | 36.02 | 106.17 | 29.39 | 296.70 | 203.80 | 500.50 |
| 261 | (a) Paper and paper products | 36.97 | 18,727.77 | 50.85 | 4.74 | 18,820.33 | 61.99 | 18,882.33 |
| 262 | (b) Printing and publishing | 262.03 | 24.70 | 120.39 | 29.39 | 436.50 | 671.94 | 1,108.45 |
| 271 | Basic chemicals | 208.56 | 12,308.54 | 50.83 | 1.23 | 12,569.15 | 3,745.69 | 16,314.83 |
| 272 | (a) Other chemicals | 123.15 | 41.24 | 1,410.81 | 17.97 | 1,593.16 | 1,659.73 | 3,252.88 |
| 273+274 | (b) Petroleum refining, petroleum and coal products, N.E.C. | 2.69 | 4,894.95 | 13,932.61 | 13.74 | 18,843.99 | 11,253.77 | 30,097.76 |
| 282 | (a) Clay products | 2,973.14 | 0.95 | 482.27 | 814.26 | 4,270.62 | 5,180.59 | 9,451.20 |
| 28-282 | (b) Other non-metallic mineral products | 4,204.50 | 15.06 | 570.04 | 28.44 | 4,818.05 | 1,559.76 | 6,377.82 |
| 291 | (a) Basic iron and steel | 4,367.25 | 208.71 | 632.46 | 967.74 | 6,176.15 | 1,403.40 | 7,579.55 |
| 292+293 | (b) Basic non-ferrous metal products | 292.04 | 11.22 | 159.75 | 54.34 | 517.35 | 423.06 | 940.41 |
| 3111 | (a) Fabricated structural steel products | 27.49 | 6.64 | 39.81 | 35.07 | 109.01 | 280.85 | 389.86 |
| 31-3111 | (b) Other fabricated metal products | 569.03 | 154.17 | 331.20 | 152.87 | 1,207.27 | 562.02 | 1,769.29 |
| 321 | (a) Motor vehicles and parts | 694.07 | 3.79 | 55.93 | 28.16 | 781.96 | 134.03 | 915.98 |
| 322 | (b) Other transport equipment | 11.38 | 2.84 | 30.33 | 6.64 | 51.19 | 111.85 | 163.04 |
| 333 | (a) Industrial machinery and equipment | 220.87 | 59.72 | 246.32 | 87.21 | 614.11 | 452.47 | 1,066.58 |
| 331+332 | (b) Other machinery and equipment | 201.38 | 70.84 | 212.54 | 207.47 | 691.72 | 424.67 | 1,116.38 |
| 342 | (a) Rubber Products | 9.48 | 1.90 | 2.84 | 2.84 | 17.06 | 1,433.53 | 1,450.59 |
| 343 | (b) Plastic and related products | 71.10 | 15.18 | 63.51 | 782.10 | 931.89 | 183.47 | 1,115.36 |
| 341+344 | (c) Other miscellaneous manufacturing | 221.89 | 57.82 | 77.73 | 20.85 | 378.30 | 399.18 | 777.49 |
| | Total manufacturing | 15,800.51 | 38,634.79 | 19,019.12 | 3,486.50 | 76,902.54 | 45,249.54 | 122,152.08 |

*Columns and rows do not add exactly to totals because of rounding.

Those which are of importance in degrading Sydney's air quality are:
— ferrous and non-ferrous metal works from which arise such wastes as metallic fumes and smoke (and various gases from the combustion of fuel);
— ceramic works (e.g. brick kilns) from which various dusts arise as well;
— chemical works including oil refineries from which arise a large range of specific chemical products (in addition this group accounts for a major portion of fuel consumption and, therefore, the wastes from its combustion);
— a large variety of manufacturing activities which are chiefly scheduled because of their use of specified volumes of fuel. Primary among these are electricity generation, food processing and metal products works of various types, together with establishments concerned with textiles, paper and paper products, rubber products and wood and wood products;
— a significant number of premises in which large volumes of particulate matter arise. In Sydney the chief sources are concrete batching works, although establishments where grinding (or milling) of food products or glass or minerals (quarries), etc. is conducted may also be of concern.

Supplementing these factory establishments, there are various other waste-generating activities — incineration in municipal incinerators, shops and homes. One additional source is important, in the light of the photochemical pollution problem. It appears that some service establishments, particularly

Table VIII-(7) Sydney manufacturing potential emissions/unit fuel, 1971/2 (tonnes per annum/$10^{13}$ Joules)*

| ASIC Code | Industry | Cooks River | North Botany | Lower Georges | Upper Georges | Total Botany Bay | Other Sydney | Total Sydney |
|---|---|---|---|---|---|---|---|---|
| 21+22 | Food, beverages and tobacco | 9.21 | 19.13 | 3.24 | 9.15 | 11.74 | 27.42 | 22.30 |
| 23 | (a) Textiles | 6.46 | 6.47 | 6.47 | 6.47 | 6.47 | 9.37 | 8.20 |
| 24 | (b) Clothing and footwear | 6.46 | 6.47 | 6.47 | 6.46 | 6.47 | 6.47 | 6.47 |
| 251 | (a) Wood and wood products | 8.70 | 6.46 | 6.47 | 6.47 | 7.45 | 6.47 | 7.02 |
| 252 | (b) Furniture and mattresses | 6.47 | 6.47 | 6.47 | 6.47 | 6.47 | 6.47 | 6.47 |
| 261 | (a) Paper and paper products | 6.46 | 36.33 | 4.64 | 6.49 | 35.31 | 3.86 | 34.39 |
| 262 | (b) Printing and publishing | 6.40 | 6.45 | 6.47 | 6.47 | 6.43 | 6.45 | 6.44 |
| 271 | Basic chemicals | 6.36 | 26.32 | 10.11 | 5.35 | 24.85 | 13.85 | 21.02 |
| 272 | (a) Other chemicals | 6.51 | 6.39 | 9.35 | 5.69 | 8.88 | 12.16 | 10.29 |
| 273+274 | (b) Petroleum refining, petroleum and coal products, N.E.C. | 3.28 | 12.36 | 7.15 | 2.77 | 8.01 | 6.58 | 7.41 |
| 282 | (a) Clay products | 10.21 | 6.33 | 7.93 | 7.51 | 9.27 | 11.11 | 10.19 |
| 28-282 | (b) Other non-metallic mineral products | 11.46 | 5.44 | 6.11 | 6.46 | 10.31 | 7.28 | 9.36 |
| 291 | (a) Basic iron and steel | 10.47 | 4.94 | 15.00 | 13.55 | 10.78 | 15.65 | 11.44 |
| 292+293 | (b) Basic non-ferrous metal products | 8.15 | 4.09 | 3.63 | 10.63 | 5.90 | 6.21 | 6.04 |
| 3111 | (a) Fabricated structural steel products | 6.47 | 6.45 | 6.46 | 6.47 | 6.47 | 7.81 | 7.38 |
| 31-3111 | (b) Other fabricated metal products | 7.78 | 8.68 | 6.29 | 7.07 | 7.31 | 6.56 | 7.05 |
| 321 | (a) Motor vehicles and parts | 8.33 | 6.42 | 6.47 | 5.79 | 8.03 | 7.96 | 8.02 |
| 322 | (b) Other transport equipment | 6.47 | 6.45 | 6.47 | 6.45 | 6.46 | 6.47 | 6.47 |
| 333 | (a) Industrial machinery and equipment | 6.47 | 6.46 | 6.44 | 6.46 | 6.45 | 6.49 | 6.47 |
| 331+332 | (b) Other machinery and equipment | 6.50 | 6.27 | 5.83 | 11.08 | 7.10 | 5.96 | 6.62 |
| 342 | (a) Rubber products | 6.45 | 6.55 | 6.45 | 6.45 | 6.46 | 11.01 | 10.92 |
| 343 | (b) Plastic and related products | 6.54 | 6.46 | 6.47 | 9.15 | 8.58 | 5.93 | 7.99 |
| 341+344 | (c) Other miscellaneous manufacturing | 8.86 | 6.47 | 6.47 | 6.46 | 7.69 | 6.47 | 7.01 |
| | Total manufacturing | 9.65 | 24.04 | 7.16 | 8.96 | 12.23 | 10.47 | 11.52 |

*Columns and rows do not add exactly because of rounding.

petrol stations that are significant sources of hydrocarbons, should be included in this list. These arise primarily in the filling of petrol tanks of motor vehicles at the petrol pump. Table VIII-(6) presents estimates of combustion wastes of manufacturing as potential flows derived from 1971/2 data. These flows have been varied by controls in Sydney though it is likely that significant errors arise only in the case of particulates. Table VIII-(7) shows the volumes of waste flows per unit of energy consumed. The derivation of these estimates is given in Botany Bay Project Report No. 2 dealing with waste flows of manufacturing. The data have been organised in terms of the Australian Standard Industrial Classification and grouped in terms of the sub-metropolitan areas used elsewhere in this volume.

The ranking of the different industrial categories according to their waste flows varies significantly as between the Botany Bay catchment and the rest of Sydney. The differences may be illustrated by comparing the first seven ranked categories in each part of Sydney.

**Ranking by Combustion Waste Flows**

| *Ranking* | *Botany Bay Area* | *Rest of Sydney* |
|---|---|---|
| 1 | Petroleum, etc. | Food, etc. |
| 2 | Paper, etc. | Petroleum, etc. |
| 3 | Basic chemicals | Clay products |
| 4 | Basic iron, etc. | Basic chemicals |
| 5 | Other non-metallic mineral products | Other c ehemicals |
| 6 | Clay products | Other non-metallic mineral products |
| 7 | Food, etc. | Rubber products |

Within the Botany Bay catchment, even more striking contrasts occur. Thus, in Cooks River catchment, the dominant manufacturing categories are basic iron and steel and clay products; in North Botany, paper and paper products and basic chemicals are the outstanding waste sources; in Lower Georges River catchment, petroleum refining stands far above other categories, while in the Upper Georges River area, plastics and related products need to be included as a significantly large source, along with basic iron and steel and clay products.

The ranking in the volumes of waste flows per unit of energy consumed differs significantly from the ranking simply in terms of waste flows. The differences reflect different fuel mixes as well as technological differences in fuel usage. In the Botany Bay catchment, the greatest volume of air-borne wastes per unit of fuel consumed was from paper and paper products (reflecting coal consumption); the next highest coefficient appears in basic chemicals, followed by food, beverages and tobacco, basic iron and steel, other non-metallic mineral products, other chemicals and plastics. It may be noted that petroleum refining does not appear in this ranking because of its extreme use of relatively 'clean' refining gas; nevertheless, it generates very large volumes of wastes because of the volumes of energy consumed.

## Sydney's air quality problems

Monitoring of air-borne wastes began in Sydney in 1953.* Measurement has developed through several phases. Originally only dust deposition was

* Extended to Newcastle and Wollongong in 1954. Some localised and intermittent monitoring occurred earlier.

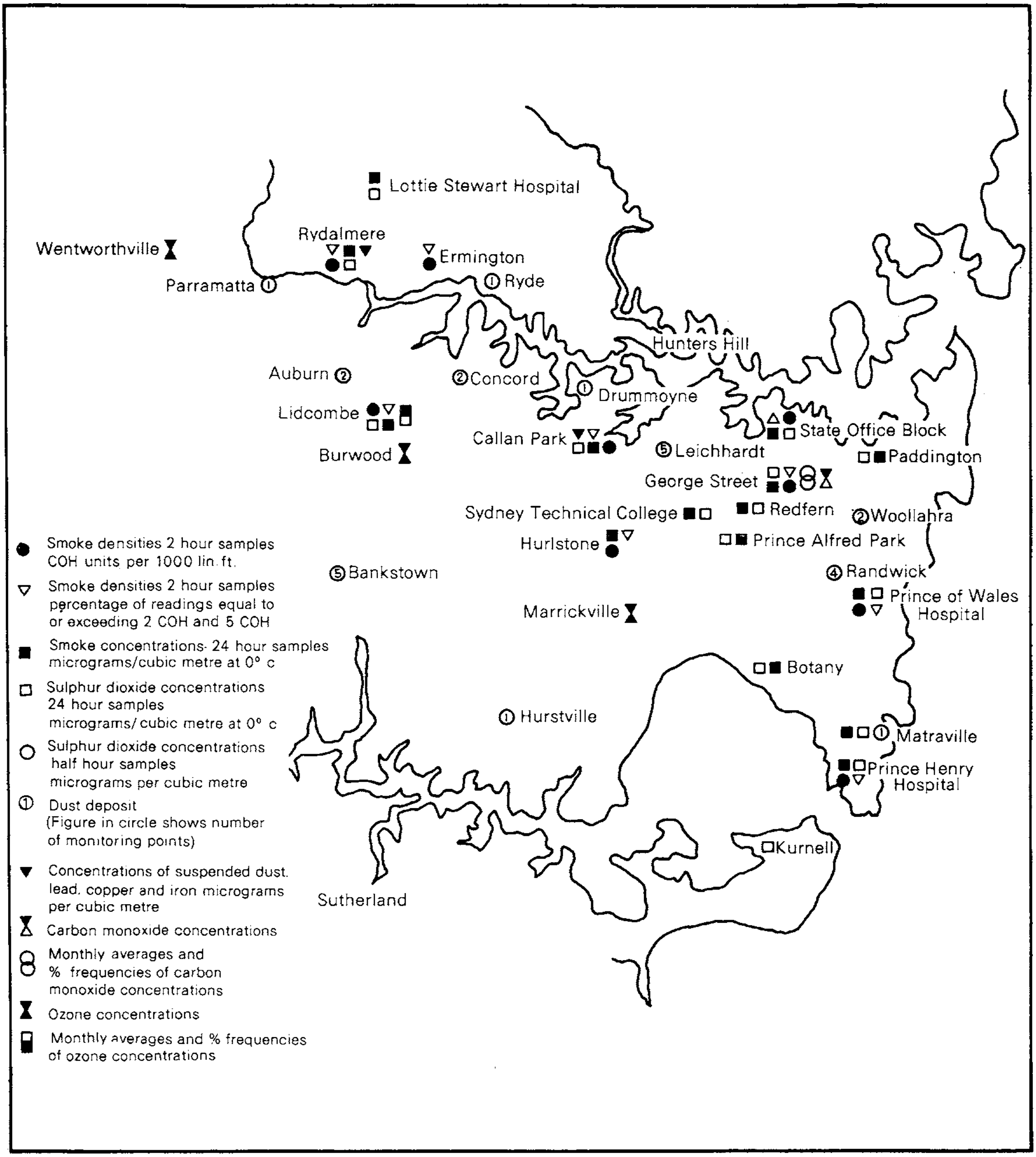



Fig. VIII (iii) Concentration of monitoring sites in southern Sydney.

measured. Later, smoke, haze and sulphur dioxide concentrations were monitored. The next step was taken with the measurement of wastes related to photochemical smog, nitrogen oxides, hydrocarbons and ozone. In the later stage, the fixed monitoring sites have been supplemented, in 1975 and 1976, to include mobile monitors.

The locations of monitoring sites, given in Fig. VIII(iii), point to the areas predominantly affected by degraded air quality. These are essentially in the southern half of the city, covering the main emission sources, the regions of low-lying ground, and the sections of the city particularly influenced by the interaction of night air flows and daytime sea breezes. Nevertheless, as a qualification to the following discussion recent measurements outside these areas, including some a considerable distance to the west of the metropolitan boundaries, suggest that Sydney's degraded air may be significantly more widely dispersed inland than has hitherto been thought.†

† This comment is still speculative; much more investigation needs to be done into rural air quality to establish the frequency and the basis of air quality problems.

The general conclusions to be drawn from these monitoring results are:

(i) Sydney, and particularly the southern half, has a serious photochemical smog problem; this has existed for the past five years, shows no signs of abating and some signs of intensifying.

(ii) On a more restricted area basis, Sydney also has a significant carbon monoxide problem particularly related to the central business district and this, too, may increase in the future.

(iii) Dust deposition, smoke and, in themselves, sulphur dioxide concentrations are no longer major elements in degrading Sydney's air quality, though the status of sulphur dioxide wastes is uncertain, subject to future sources of Sydney's fossil fuels.

(iv) Reduced visibility, despite the very considerable reduction in dust deposition and factory smoke that is to the credit of the A.P.C.B., is often marked. In so far as this is partly related to smog, this problem seems likely also to become worse.

(v) There are many man-made wastes that are not monitored in Sydney. Little is known of the concentrations of hydrogen sulphide, chlorine, hydrochloric acid gases, chorinated hydrocarbons, mercaptans, asbestos or other substances that are almost certainly in Sydney's atmosphere. Some are essentially local in their incidence. Moreover little is known of the tendencies in the development of these emissions. Discussion must be confined to those air-borne primary and secondary wastes that are measured. Nevertheless, it should be noted that many of these wastes are industry-related and therefore predominantly likely to affect the southern half of the city.

*Photochemical smog, primary and secondary wastes*

The sequence of nitrogen oxides and hydrocarbons in combination with appropriate atmospheric conditions leading to photochemical oxidants should not be judged in isolation, separate from other air contaminants. Nevertheless, because the process of air quality degradation is so complex, it is convenient to discuss photochemical smog problems in Sydney within a limited context of the two primary air-borne wastes.

The atmospheric concentrations of nitrogen oxides and hydrocarbons, both mainly primary combustion wastes, do not provide measures of photochemical smog. They are, in themselves, both contaminants as irritants, the latter also because of its odour. Moreover nitrogen oxides are believed to be part of the brown haze that not infrequently affects Sydney and greatly reduces visibility. As contributors to (precursors of) photochemical smog, their presence in appropriate absolute and relative concentrations provides an indication of the *potential risk* of photochemical smog incidents, *subject to the weather.* Measures of these two wastes in the atmosphere are important for their own sake and as indication of this potential risk. Moreover, the trend levels of concentrations could help to give guidance on the longer-term potential risk of smog incidents.

Unfortunately, the available monitoring results of both primary wastes are virtually useless for any of these purposes. Few sites have been monitored and the results are disjointed. Hydrocarbon measures available are slightly more meaningful. These, taken at Lidcombe in the first quarter of 1975, show seriously elevated concentrations. For the critical 6-9 a.m. period, monitored readings for Sydney give concentrations approximately 3-5 times the U.S. Environmental Protection Agency Standard (W.H.O. has no goal). At other monitoring sites, close to refineries, the readings, as might be expected, are much higher. Their presence, at these levels, implies high levels of primary wastes sufficient (with nitrogen oxide) to ensure continuing risk of smog incidents in appropriate weather circumstances. Air contamination by other wastes, including particulates, appears to have some significance for smog formation but the discussion of these is taken up later.

The monitoring of ozone, the key 'secondary' waste, was carried out intermittently in Sydney between 1965 and 1970. The results were inconclusive because of limited monitoring devices, though the inference was that no significant photochemical smog problem existed. In 1971, however, significant readings were recorded. The readings were associated with an early-warning alert in 1971 when ozone-sensitive plants, petunias, suffered extensive damage. Since then, the record has become clearer, perhaps as much because the problem is being more thoroughly studied as from any trends in experience.

Sydney's record should be placed in some perspective. There is, unfortunately, no very simple indicator of the significance of photochemical smog problems. In 1972 the emissions of the relevant primary wastes, hydrocarbons and nitrogen oxides, appear to have been only a little less in Sydney than in Tokyo, a city with a recognised smog problem; they were only one-eighth the volumes of Los Angeles'. However, if we adopt the secondary waste measures, oxidants in the atmosphere, two alternative comparisons may be drawn. We can measure the number of days when these oxidants exceed 0.15 parts per million — a level 2.5 times the World Health Organization goal. In doing so, we have to use different dates. However, over the one year 1972, Tokyo recorded 25 days with more than this concentration. Sydney, during the two years, 1972-3, using only three monitoring sites, recorded as many as 15 days. It is not completely certain but almost so that a larger number of sites would have picked up additional incidents in Sydney. Los Angeles during 1964-7 recorded 150 such incidents.

It is, however, relatively short peak values that most need to be taken into account. We may, therefore, compare maximum readings of oxidant concentrations as parts per million of the atmosphere in the three cities. In 1970, Los Angeles' maximum was 0.70 and Tokyo's was 0.34. In 1973, Sydney's was only slightly below Tokyo at 0.28. Since 1973, some higher readings have been recorded in Sydney. On the given figures, however, Sydney's maximum recording was as much as 40 per cent of that of Los Angeles and over 80 per cent that of Tokyo. Not only were these Sydney records derived from a small number of sites but, in addition, the early recordings were made by relatively inefficient instruments tending to understate ozone concentrations.*

* In December 1971 an instrument, the Chemiluminescent Ozone Monitor, specific to ozone, was developed and constructed by the A.P.C.B. In 1973 a second was installed at Wentworthville (July) and a third at Marrickville (September).

Between 1971 and mid-1975, there were twelve occasions when an ozone 'episode' occurred in Sydney. An episode was defined as 'an occurrence when an hourly ozone concentration of 0.10 parts per million was equalled or exceeded on three or more consecutive days.'[6] The most prolonged episode on record was at Lidcombe during 26-30 March 1972 inclusive. The other incidents were, in order, 9-11 January 1972, 29 April - 1 May 1972, 12-14 April 1973, 16-19 October 1973, 16-18 November 1973, 20-22 January 1974, 4-7 March 1974, 10-13 November 1974, 7-10 February 1975 and 15-17 March 1975.

It will be noted that all these incidents occurred in the warmer months of the year. This is typical of smog events and was related to anti-cyclonic conditions in the Sydney area, bringing light winds and temperature inversions for several days. It is important to note, however, that excessive ozone concentrations have been recorded throughout the year.

These long sustained episodes are not the only occasions of significant smog problems. One way to represent these briefer occurrences is to measure the frequency with which W.H.O. goals were exceeded. These goals are given as oxidant concentrations averaged over either one-hour or eight-hour periods of the day. The one-hour goal is set at an average of 0.06 parts per million for any one-hour period as the maximum average hourly reading. During 1974, there were four months in which ozone readings exceeded these goals for more than 5 per cent of the time — February, March, November and December. This implies that these goals were exceeded for a considerably larger fraction of daylight hours. At Marrickville, in the Botany Bay area, the most persistent readings above W.H.O. goals occurred and, in five months of the year, March, April, May, November and December, these goals were exceeded on at least one-third of the days of these months. In December, over half the days attained an hourly average above W.H.O. goals.

There is a general pattern of the timing throughout the days when these briefer smog concentrations developed. Marrickville, close to the central business district and to the industrial areas north of Botany Bay and located in the Cooks River valley, attained its maximum for the day generally between noon and 1 p.m. Lidcombe, to the west, followed one hour later; while Wentworthville, further inland, an hour later still. This sequence follows the temporal pattern of transport and industrial activity, with its hydrocarbon and nitrogen oxides concentrations earlier in the day, and the passage of sea breeze to the inland during the afternoon.

There may be also a longer-term progression over time. There is some suggestion of a tendency for maximum hourly concentrations of ozone to rise since 1971. We cannot be too sure of the implications in terms of ozone concentrations because the chemical interactions of the primary wastes in the atmosphere depend on meteorological conditions. Rising primary concentrations may be offset fortuitously by weather conditions; and falling primary concentrations may yield accentuated smog problems because of the weather. Nevertheless, Sydney has only recently begun to take action with respect to the primary emissions from motor vehicles and, at the same time, vehicle use is increasing. Given the time-lag in the U.S.A. between effort to control vehicles and improvement in air quality, it seems likely that, subject to good fortune with the weather, smog problems are likely to become worse before they get better. The risks at this level might be indicated by the measures of the primary wastes, hydrocarbons and nitrogen oxides, the so-called precursors.

Unfortunately, it is not possible to draw any trend inferences about increasing primary conditions providing the potential for photochemical smog because of data limitations.

*Carbon monoxide*

Carbon monoxide is also predominantly a combustion waste of automobiles. Unfortunately only one monitoring site provides records in Sydney over a sufficient period to give some guide, for that site, to changing carbon monoxide concentrations in the atmosphere. This is at the Queen Victoria Building in the central business district. Other sites have shown higher readings and it is probable that extensive downtown areas in the region of the Harbour Bridge would frequently have higher concentrations. It is also possible that regional shopping centres may show excessive levels.

The available site does, at least, offer a relatively highly trafficked, stop-start situation. The general implication of the measures suggest serious contamination by carbon monoxide, more serious than appears on the surface of the official recording. We may take, as the S.P.C.C. does, one W.H.O. goal as reference standard. This goal is the average for any 8-hour period of the day. As measured at Queen Victoria Building, carbon monoxide concentrations throughout 1973-5 were considerably above the W.H.O. goal.

The W.H.O. goal was exceeded, according to record, during 220 days in 1972, 131 days in 1973 and 117 days in 1974.* This implies a considerably degraded atmosphere. But we need to take into account the periods of time when the monitor was not functioning. In 1973, it did not function for 24 per cent of the time so that the 'excessive' days should be related, in effect, to a 288-day year equivalent. This means that above-goal readings over 8-hour periods occurred on approximately 80 per cent of the monitored days. A similar adjustment is necessary in 1974 so that excesses were recorded on a little over half of the monitored days. However, it is probable that readings are best on Saturdays and Sundays with reduced traffic. Hence every work-day in 1973 showed excees readings; and in 1974 at least three days in every week were similarly in excess of W.H.O. goals.

* Excluding December.

In addition, however, the Sydney readings throughout these years, were successively 4.8 times, 4.0 times and 2.7 times the W.H.O. 8-hour goals — a considerable excess even in 1974. This 'trend' in carbon monoxide concentrations may suggest declining contamination. This may be the appropriate inference for this particular site. In 1973/4 the S.P.C.C. believed the problem was, in fact, worsening.[7] It seems likely, indeed, that the chosen site was progressively less representative of central business district carbon monoxide concentrations. The growth of high rise buildings away from this site, the development of large parking areas on the edge of the C.B.D. and the increased traffic on routes leading to bridges adjacent to the C.B.D. may have shifted concentrations. It seems possible that higher readings elsewhere in the C.B.D. and possibly in other areas on the edge of the C.B.D. may have developed. In addition, with growing arterial and sub-arterial traffic elsewhere in the city, it is possible the carbon monoxide problem was spreading and becoming progressively less a C.B.D. phenomenon.

*Particulates, smoke, haze and visibility*

Visibility is often seriously reduced in the metropolitan area and different forms of obscuring air contamination have developed. Comparatively little is known of some of these conditions. In the past, the atmospheric haze was ascribed to particulates and smoke. In addition to this problem, photochemical smog may be detected as a whitish haze. Third, a brown contamination often develops in the mornings, particularly over the C.B.D. and south to Botany Bay.

Fall out of particulates, smoke concenrations and haze were the first generation of wastes that attracted control and measurement attention in N.S.W. and particularly in Sydney. The S.P.C.C. continues to report, in vast detail, measures of dust deposition from some fifty-eight monitoring sites in Sydney* and smoke (suspended solids) concentrations from twenty Sydney sites. There has been a profound decline in dust deposition and suspended solids in Sydney (an even more marked achievement was made in Newcastle). The fall-out diminished from an average of 9.5 grams deposited per square metre per month in 1956 to 2.5 grams per square metre per month of insoluble solids in 1973. The values differ somewhat, but not markedly, as between the Botany Bay area and the rest of Sydney. The achievements reported by the 1973 levels should be stressed.† They approach a level as low as could reasonably be expected in a city environment and only small areas remain where significant additional improvement could be attempted.

* In addition, there were seventy-eight sites in Newcastle, Wollongong, Lake Macquarie, Lithgow, Shellharbour, Bowral and Nowra in 1973.

† It may be noted that concentrations of specific particulates of lead, copper and iron are all below the U.S. Environment Protection Agency standards (W.H.O. has no stated goal).

The decline is due to a variety of factors. The relocation of coal-fired electricity generators in rural areas, the substitution of oil for coal in furnaces, the technological control over smoke and particulate emissions were all major contributors.

Similarly, a substantial but less marked decline in smoke concentrations has occurred since 1959, though high maximum figures continue to be recorded. Recent controls of open burning have significantly reduced smoke, supplementing the earlier successes of the A.P.C.B. Nevertheless, reduction in smoke has not been as marked as it has for particulates, possibly because photochemical smog appears to contribute to suspended solids.[8] There is also an additive process involved with sulphur oxides and suspended solids, and sulphur oxide emissions have varied over time because of periodic changes in fuel sources. Generally, sulphur oxide concentrations had been reduced below W.H.O. standards by 1974.[9]

Dust and smoke have been measured by physical processes at defined sites, but these measures do not cope with the task of establishing the significance of haze and reduced visibility that arises from other factors. Current haze represents a second generation contaminant problem. Unfortunately, comparatively little is known about these newer haze problems. Recent attempts with photographic measurements at Macquarie University suggest an alternative to the longer-established 'coefficient of haze' that has been provided for several years by the A.P.C.B.

There is, however, a very simple and crude measure that raises an issue of some importance. Attempts to measure the distance over which landmarks in Sydney can be seen without distortion extend back over more than sixty-five years. Daily recordings at 9 a.m. show interesting fluctuations over time. The general trend is one of progressively improving visibility, though the measures confuse the effects of haze, humidity and other weather conditions. Adjusting for days of rain, the records show that visibility worsened steadily after the second world war until about 1960 and has since progressively improved. However, it is of some significance that the number of days of poorest visibility up to the end of the 1960s was significantly more than at the close of the second world war. Distortion of visibility beyond a 2-kilometre limit was still much more frequent despite the improvement during the 1960s; and distortion beyond the 6- and 8-kilometre limit was significantly more frequent at the end of the 1960s.

This long-range comparison is of some significance since base-lines tend to be adjusted through the change in customary standards. The improvement that has occurred since 1960 is too often taken as the critical test. Reliance on this test might be taken to imply a longer-term acceptance of degraded atmosphere. *The willingness to accept degradation because we grow accustomed to it may be one of the most important obstacles to the preservation of environmental amenity.*

## The effects of air-borne wastes

Air-borne wastes affect human welfare in a variety of ways ranging from reduced visibility and odours to effects on physical property and personal convenience and, eventually, to health and mortality. Problems of toxicity, and respiratory effects of irritants, cardiovascular implications of carbon monoxide

Table VIII-(8) W.H.O. long-term ambient air quality goals

| Pollutant | Standard | |
|---|---|---|
| Sulphur oxides* | Annual mean | 60 micrograms per cubic metre |
| | 98% of observations below† | 200 micrograms per cubic metre |
| Suspended particulates* | Annual mean | 40 micrograms per cubic metre |
| | 98% of observations below† | 120 micrograms per cubic metre |
| Photochemical oxidants | 8-hour average | 60 micrograms per cubic metre |
| | 1-hour average | 120 micrograms per cubic metre |
| Carbon monoxide | 8-hour average | 20 milligrams per cubic metre |
| | 1-hour average | 40 milligrams per cubic metre |

*Values for sulphur oxides and suspended particulates apply only in conjunction with one another.
†Permissible 2% of observations over this limit may not fall on consecutive days.

and similar issues have been given prominence in a variety of studies and their implications for human health are being explored throughout the world. Comparatively little has been attempted in Sydney in an orderly scientific way, partly due to the complexity of the problem, partly due to the lack of basic data and, perhaps, partly because so little attention has been given, throughout Australia as a whole, to the closely related problems of occupational health as a matter of serious and sustained enquiry. There is, also, the much broader and elusive question of the quality of environmental amenity and its effects on 'total health', the wider social, emotional, psychological and physical well-being.

It has been largely in recognition of health risks that the W.H.O., the U.S. Environmental Protection Agency and, more recently the National Health and Medical Research Council and others have attempted to suggest long-term goals or standards for concentrations of air-borne wastes in the ambient atmosphere. So little is known of the associations of contaminated air and health in *epidemiological terms* that it is almost impossible to say whether the various standards are too high or too low. There are also problems of the additive effects of the presence of two or more wastes so that any single standard in isolation may be inappropriate in particular circumstances. The type of standards proposed for several major air-borne wastes are indicated in Table VIII-(8).

Sydney's monitoring data have shown concentrations significantly in excess of these levels for carbon monoxide, ozone, nitrogen oxides and hydrocarbons, especially in the Botany Bay catchment area and the central business district.

Evidence of health and mortality risks has developed in a variety of ways throughout the world. Clinical and laboratory findings have pointed to the problems arising from lead in blood, the inhalation of carbon monoxide, the irritant properties of nitrogen oxides and hydrocarbons on mucous linings of the respiratory system and eyes. Studies of occupational disease, disorganised as they are, have demonstrated similar associations together with health and death risks from asbestos, dust, and a large range of toxic industrial substances emitted to the air.

Smog incidents have added to the range and variety of medical evidence. Toxic fogs in London in recent years, especially in 1948, 1952, 1956, 1959 and 1962, were associated with abnormally high mortality among certain groups in the population. In New York, studies covering the years 1962-4 pointed to five special periods of high mortality rates and high concentrations of atmospheric pollution. Other epidemiological studies in Europe and North America have suggested that the incidence of respiratory diseases and of allergies, particularly asthma, has increased in association with the growth of industrialised towns. Recurrent and persistent evidence of irritation of mucous linings of eyes, nose and throat in the Los Angeles air, saturated with motor vehicle emissions, has been assembled.

Regrettably, relatively little has been attempted in Sydney in the area of environmental health problems. Some recent efforts have been made by the N.S.W. Health Commission including studies of blood lead levels of policemen in the central business district, carbon monoxide levels in blood of a sample of Sydney residents, and the eye irritant reactions from ozone. These studies were taken to suggest that problems in Sydney were not at a level to warrant immediate concern on health grounds.

The inferences that have been drawn from these studies cannot be accepted. The methodology of these studies was poor; the data were incompletely evaluated; and the criteria adopted were limited. The study of ozone was conducted by requesting 169 pedestrians at a busy street intersection in Marrickville 'to state whether they suffered from any degree of eye irritation'. The conclusion that ozone problems were not sufficient to affect health was remarkable. The choice of a busy intersection implied the presence of nitric oxide, which tends to destroy ozone in the immediate vicinity.

Similarly, the study of carbon monoxide levels in the blood of 253 persons sampled in the city drew the conclusion that it 'is conceivable that the carbon monoxide concentrations . . . are sufficient to increase the risk for patients with cardiovascular disease'.[10] In fact W.H.O. goals are based on blood level concentrations that are half the concentration test levels adopted, on the grounds that this lower level is sufficient as a threshold producing reduced responses. There is evidence of lower level concentrations impairing higher nervous functions in prolonged exposure. It is of some importance that high concentrations in city streets imply high concentrations amongst office and shop workers. This is as true in air-conditioned buildings as in other buildings.

Similarly, medical reports suggest much more complex health risks arising from blood lead concentrations well below those found in Sydney city police. The complexity of the problems of environmental health is all the more reason for a continuing and full-scale study of the problem in Sydney. This study requires a thorough medical statistical expertise with attention to proper sampling processes including the representation of individuals, locations, contaminant concentrations, and durations of exposure and is not merely a task for the medical profession. The only inference that can be drawn from Sydney studies is that they were inadequate, poorly devised and reached largely irrelevant and unwisely optimistic conclusions. In the light of overseas medical studies, there appears to be significantly more reason for concern than was suggested by these Sydney 'investigations'. There is also the much broader question, beyond physical health, of the problems of the impact of degraded environment on total health, the broader social, emotional, psychological and physical wellbeing of city residents.

Problems of health inevitably acquire special prominence in relation to air pollution since residents must be generally exposed to ambient air conditions. Nevertheless, there are other effects in human welfare that need to be investigated and to be taken into account in setting air quality standards and in pursuing emission controls. Odorous emissions appear to be the most common complaint of local authorities. These affect, particularly, the more industrialised areas of the southern half of Sydney and especially the older areas of the Botany Bay catchment. Despite the effective action of the Air Pollution Control Branch in particulate control, the frequency of haze problems in Sydney has led to considerable complaint on a more general risk. Air-borne wastes may corrode metals, crack paints and degrade rubber. Clothes are soiled by air-borne wastes. Property values are affected by the reduced attractiveness of the areas most seriously degraded by air-borne emissions.

These effects carry with them significant costs to residents, few of which have been examined to any significant degree in Sydney. Many of the more damaging wastes, in these terms, appear to be related to industrial activity. It would follow that the major costs are imposed on residents in the southern half of Sydney. The discriminating consequences are, however, largely speculative until the problem is investigated. Until the scale of the costs imposed on individuals is established, if only as a reasonable order of magnitude, it is not possible to devise effective air quality control objectives. It should not be assumed, as it tends to be, that health criteria provide quality standards that will accommodate other costs imposed in Sydney. In fact, Sydney control approaches are operating in the dark in terms both of health and other consequences of degraded air quality.

# 9 Towards air quality management?

On simple physical tests, air pollution authorities in Sydney have had a considerable success in the control of particulates, smoke and dust chiefly from factory air-borne emissions. However, their success, in economic and social terms, even in this limited area, has never been tested. More recently accumulating and more complex problems arising from air-borne waste emissions have been recognised and the evidence of achievement is less obvious in dealing with such issues as hydrocarbons or nitrogen oxides from factories. Even less obvious is the effectiveness of control over the very large number of small waste sources — little factories, domestic incineration, etc. — that have essentially local implications for air quality.

The wider and more complex problems of photochemical smog formation derived primarily from primary and secondary wastes of motor vehicles and the wider issues of urban air pollution have required resort to a broader range of supporting activity — by universities and some Federal agencies, particularly CSIRO, the Australian Transport Advisory Council and by the National Health and Medical Research Council and others. In approaching these smog problems, the narrow technical bias of the State Pollution Control Commission and its restricted administrative and policing capability appear as major limitations in its pursuit of cleaner air by control over both vehicles and factories.

The Clean Air Act, presented as a Bill to the N.S.W. Parliament in 1960, was passed after a rough passage in 1962. From then until the beginning of 1974, the Act was administered by the N.S.W. Department of Public Health (subsequently the Health Commission) in association with the Air Pollution Advisory Committee. The key agency of control was the Air Pollution Control Branch of the Department of Public Health established in 1962 with a staff of three. Growth of staff and of experience with control established a tradition and pattern of behaviour that persisted beyond the transfer of the Branch to the State Pollution Control Commission.* As its experience developed, the Branch was progressively less subject to active oversight by the Air Pollution Advisory Committee (A.P.A.C.) which, for a considerable time, played a large role in control decisions.

Under the S.P.C.C., the Branch's experience has ensured that it has retained a high status. The status of the Branch has been most recently recognised by its elevation to a Division. In the following discussion, this recent elevation is largely left aside in order to avoid confusion in describing the development of controls and reference is made mainly to the Air Pollution Control Branch in discussing the evolving administration of the Act. The Commission itself, in addition to the powers that derive through it to the Branch, has significant powers with respect to air-borne waste problems, for example in exercising

* This Branch is now called the Clean Air Branch. Together with a newly established Noise Control Branch they form a new Division structure of the S.P.C.C.

oversight over plant location and in the conduct of environmental impact statements and public enquiries into major new development proposals.

In confronting the first generation air-borne waste problems of particulates, dust and smoke, the Branch developed, not wholly inappropriately, a technical approach to deal with specific physical objectives. Persistence with this attitude as more complex problems were encountered led progressively to resort to remedial and palliative measures that, nevertheless, took little regard for economic and social considerations and largely avoided broader preventive approaches. Under the S.P.C.C. the narrow technical bias of the Branch has become more obviously limiting and the inability to move towards broader preventive solutions or to plan for wider social goals has become more serious. This is particularly the case as the problem of protecting Sydney's air amenity has come to focus increasingly on photochemical smog, whose primary wastes are derived largely from motor vehicles. The reliance on palliative and remedial methods to solve specific, narrowly defined physical objectives, under S.P.C.C. direction, has allowed the major social determinants of the problem of reliance on the private motor vehicle largely to go by default.

One of the crucial weaknesses of air-borne emission abatement and, therefore, of the position of the S.P.C.C. and the Branch in the execution of plans of air-borne waste control is the absence of supporting disposal, administrative or policing agencies. In administering control over water-borne wastes, the S.P.C.C. can fall back on the planning, disposal, management and policing activities of the M.W.S. & D.B. and the M.W.D.A., together with the local authorities. No such disposal systems are possible in the case of air-borne wastes. To some extent, support from the other very weak reeds of local authorities is possible and a good deal of parochial responsibility is left with them. Policy must, however, be concentrated on preventing the escape of wastes to ambient air. The purposes of control and the possible methods of prevention become much more directly relevant as matters for the S.P.C.C. itself.

This challenge has not been accepted. The management of the broader environmental impact procedure has been ineffective. The consideration of social values of ambient air quality has not seriously been undertaken. Objectives of prevention in terms of the broader ways of life — e.g. work-shopping-residence relationship, private versus public transport services — have not been pursued. The Commission, in determining basic policy, has been prepared to act in a derivative manner, accepting physical objectives largely taken from outside sources and has attempted to apply palliative measures to the growing Sydney air problems. While this approach may have been reasonably acceptable in the past, it is unacceptable as a continuing means of policy formulation.

The combined effects of particular and chiefly engineer-specified physical objectives, inadequate policing support and the absence of feasible disposal procedures for most air-borne wastes exposes Sydney's residents to a great many risks from the Commission's general approach. At one level, there is the positive suggestion of obscuring the problems — such as reported Ministerial statements minimising the importance of photochemical smog problems. At another level, the use of bureaucratic direction as a basic management procedure has become increasingly prevalent. These directives obscure the question whether these directions are acceptable, whether the measures proposed are sustainable in practical terms, whether the considerable expenditure of resources will in the end achieve their objectives. They ignore options of attempting, by more flexible, especially market procedures, to achieve acceptable ends. They omit the essential educational process necessary to secure wider acceptance of the needs for control. Increasingly, the tendency is to move along the path of advice, direction and legal prosecution rather than of active co-operation; and, at the same time, to acquiesce in major new developments that seem inevitably to be major contributors to smog, congestion and noise problems.

Changes in these approaches depend on the adoption of a much wider perspective by the Commission. It is not enough to adopt, for example, W.H.O. goals for air quality. These standards convey very little about the value placed on air amenity in the particular conditions of Sydney; the costs that its residents will tolerate in meeting air amenity objectives; the extent to which benefits and costs are shared differently between areas and groups; or the preventive options in social behaviour, city planning and technical prescriptions available to achieve objectives. W.H.O. goals are merely physical objectives which can be achieved along a variety of social, political, economic and technical paths. To move towards a more flexible approach with a wider, social objective, requires a sea-change in both the thinking and staffing of the S.P.C.C. and the A.P.C.B. (Clean Air Branch).

In discussing air-borne waste control and the protection of air amenity, it is convenient to use the division between stationary and mobile sources of wastes. This is partly because it is important to understand the evolution of experience of the A.P.C.B. In addition, the control problems, the policing procedures and the physical objectives are different in the two types of sources. Separation is not, however, complete. Both sources contribute to photochemical smog.

## Stationary source control

### *Legal provisions*

Environmental control over stationary sources is exercised under the N.S.W. Clean Air Act[1] and under the provision for environmental impact statements and enquiries. The latter procedure has been ineffective. In the enquiries into proposed users of the Botany Bay Port, little attention was paid to major pollution problems, despite the importance of the area as a potential source of smog for large areas of Sydney. Control procedures over stationary sources revolve, therefore, around the Clean Air Act.

Basically, the Act, its regulations and administration were designed, until recently, to deal with a very narrow range of air-borne wastes — essentially particulates, smoke, dust, and sulphur oxides together with toxic wastes, essentially local in their incidence. The Act provided for classification of waste-generating establishments into two types — 'scheduled' and 'non-scheduled' premises, the latter being less important but nevertheless significant waste sources. The Act was initially focused on particulates, sulphur oxides and a number of process wastes. This emphasis has changed, particularly since 1970.

Increasing attention is being given to hydrocarbons and nitrogen oxides as wastes providing the potential for photochemical smog, but there is still a good deal of indecision concerning the extent to which control measures should be carried. Control over 'scheduled premises' was allotted to the A.P.C.B. and over 'non-scheduled premises' to local authorities though the A.P.C.B. may set standards for and oversee control of the latter.

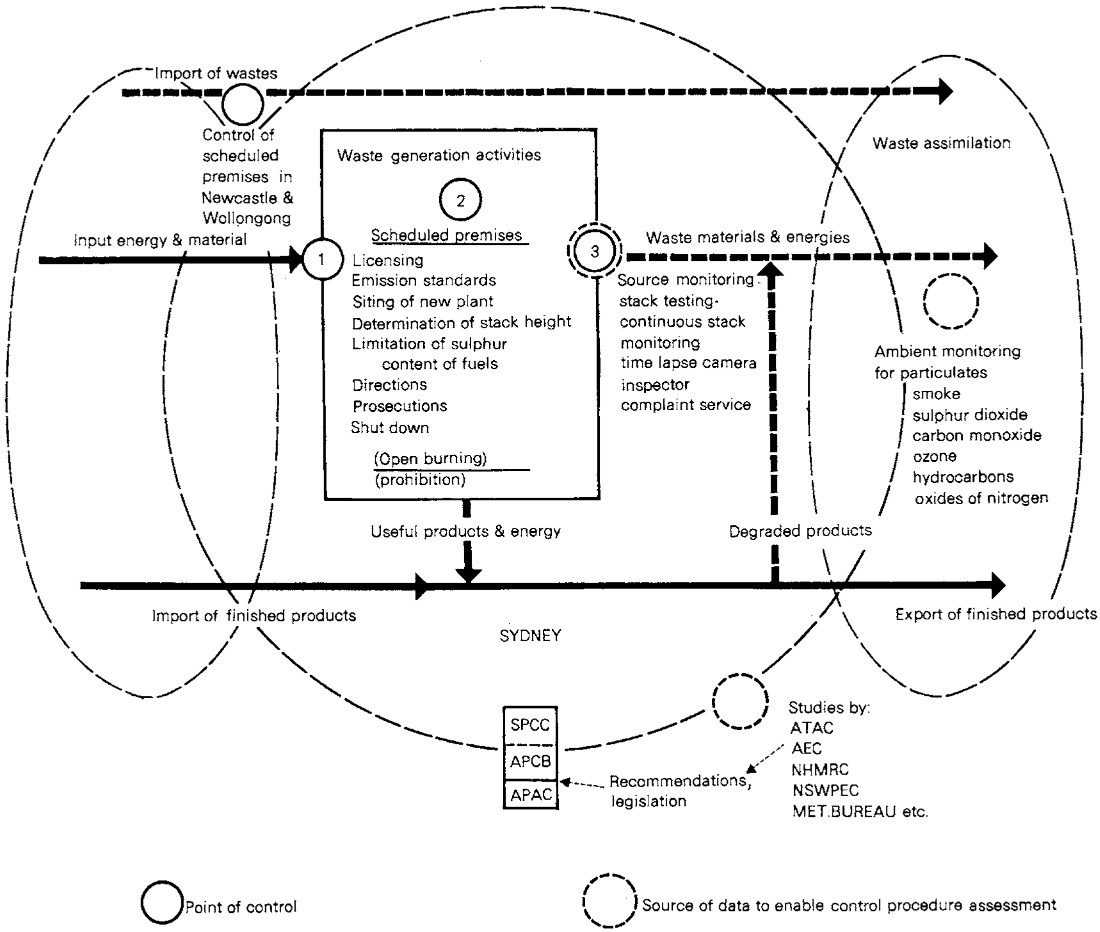



Fig. IX (i) Control of scheduled premises - Air Pollution Control Branch

The controls on activities which produce air-borne wastes are discussed later. Three basic control points have been indicated in this Figure. Control point one might be some form of restriction on the type of fuel to be consumed. The limitation of the sulphur content of fuel oils is one present example. Federal Government energy policy is potentially the major influence of the future. Control point two might be a change in the production process to alter the volume or type of emissions produced. Control point three might be the enforcement of emission standards and the subsequent incorporation of control measures.

The data sources to enable assessment of control procedures are basically of two types — monitoring of pollutants and technical studies. The monitoring of pollutants is discussed in detail later. Source monitoring aims to determine the volume and type of emissions being rejected from an air pollution source. Ambient monitoring aims to determine the concentration of the pollutants after dilution, i.e. the contamination of the air to which the public is exposed. Technical studies and other management information arise from many sources.

*Scheduled Premises: A.P.C.B.* The form of control is indicated in Fig. IX(i). Provision was made for licensing of 'scheduled premises', with fees varied according to volume of output or fuel consumed, a rating indicative of the importance placed on combustion wastes. Emission standards were set to be 'sufficiently stringent to provide the maximum possible removal of air impurities' but this engineer specification was qualified by stating that it was 'important that the [Air Pollution Advisory] Committee could assure itself that the standards were attainable'.[2] The original regulations under the Act (1965) limited controlled emissions to smoke, sulphur trioxide,[3] solid particulates, the

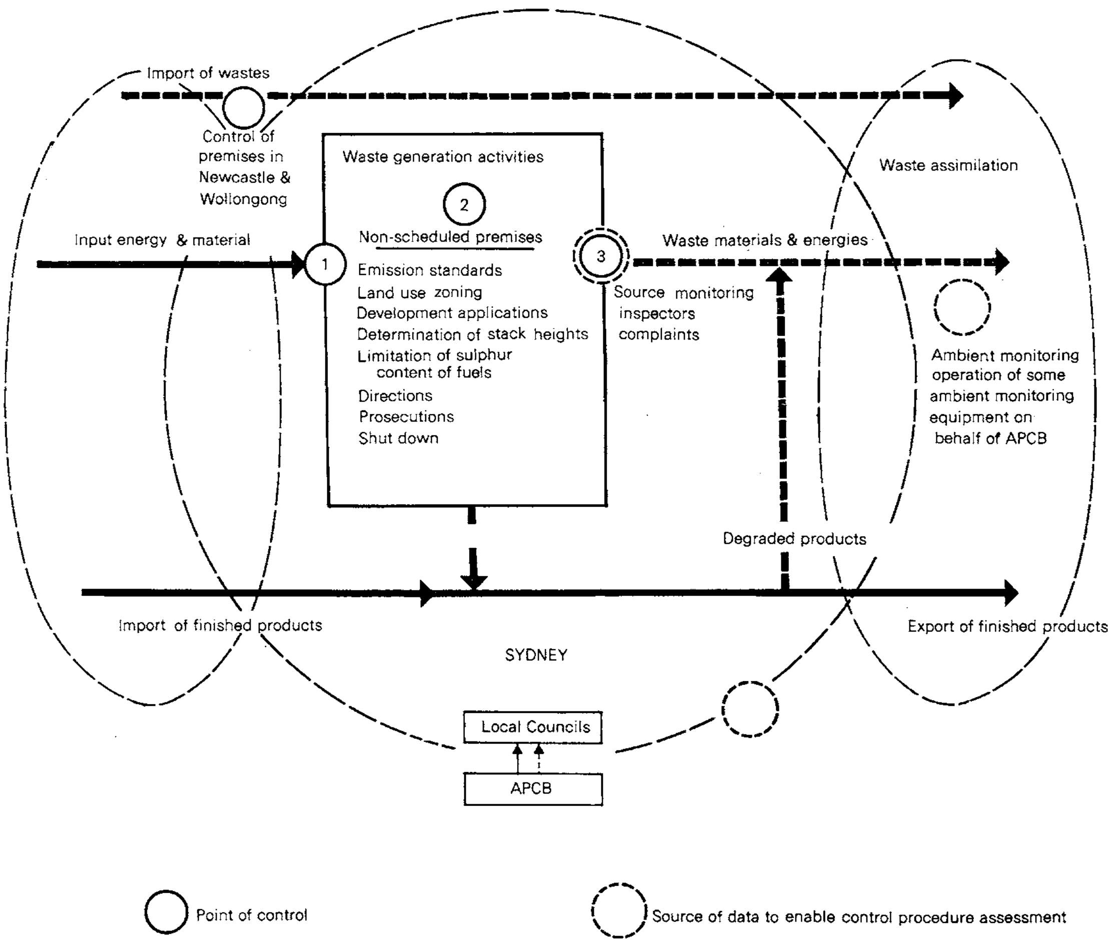



Fig. IX (ii) Control of non-scheduled premises - local government authorities

Because local government authorities have basically the same powers as the A.P.C.B. in controlling air pollution sources, the points one, two and three are controls similar to those indicated in Figure IX(i).

The sources of data directly available to local government authorities are far fewer than those available to the A.P.C.B. However, data relevant to local controllers is provided by the A.P.C.B. and this is indicated by the inclusion of the A.P.C.B. on this diagram. The direct and indirect influences that the A.P.C.B. have over local authority action in air pollution abatement are indicated by the broken and unbroken arrows. These aspects are discussed later.

heavy metals, chlorine gas, fluorine and its compounds and some sources of nitrogen dioxide. In 1971, controls were extended to soot and hydrochloric acid gas. More effective control of odours was prescribed in 1974.

Exemptions granted by the control authority were permitted to meet particular technical control or financial obstacles but the control authority was given the power to direct the installation of control equipment, a power supported by small fines of $400 plus $10 per day for continuing offences. These penalties were raised in 1975 to $10,000 plus $5,000 per day, in line with the Clean Waters Act and Regulations.

The Act also gave to the authority control over new plant or major modifications to existing plant such that these would qualify as 'scheduled premises'. In the light of increasing experience of available technology, the emission standards for new or modified plant were made more stringent in 1972. Provision was also made for control over the location of new plant, a provision strengthened in 1974 in terms that the site of a proposed plant might be a valid reason for withholding a licence. So far as is known, these latter provisions have not been used in Sydney. Particular powers were also given to control stack heights, based on predetermined ground levels of waste concentration. This provided an alternative or supplementary measure to the use of 'add on' control equipment, particularly for gaseous wastes. As an extension of technological options, the power to limit the sulphur content of fuels was provided in 1973 for new and modified plant and in 1974 for existing scheduled premises. The ultimate control, the power to shut down establishments, was reserved to the Minister, a power that was strengthened in 1974.

*Non-scheduled premises: local authorities.* The form of control is indicated in Fig. IX(ii).

Until 1966, the large number of non-scheduled premises were required to use 'such practicable means as may be necessary to prevent or minimise pollution'. By their nature these premises include not only a large number of smaller factories but also many non-factory establishments. The control authority at that time considered these practicable technological means should restrict levels of waste emissions within the limits set for scheduled premises. Since almost all chemical works are scheduled premises, the only significant emissions of concern from non-scheduled premises were smoke and solid particles. For these reasons, when emission limits were laid down in 1966, specifically for non-scheduled premises, they were aimed at the control of boilers, incinerators and other fuel-burning equipment and were the same as those laid down for scheduled premises. The day-to-day control of non-scheduled premises is the responsibility of each local government authority. As is the case for the A.P.C.B. and the scheduled premises, the local council has the authority to direct these lesser waste sources to install suitable control equipment, if co-operation is not forthcoming from the managements. In addition, there is the authority to determine and direct stack heights. The regulations limiting the sulphur content of fuel consumed also apply to non-scheduled premises. The fines laid down in the Act are general provisions and, therefore, similarly applicable to non-scheduled premises.

In a similar manner to that of scheduled premises, use could be made of local land-use zoning regulations to limit the siting of industry, although to be an effective method of long-range pollution control such procedures need to be incorporated in metropolitan planning schemes. Ministerial authority to shut down industry also applies to non-scheduled premises.

*The open burning amendment* (Fig. IX(i))
The aim of this amendment was to prohibit the common practice of the burning of matter (usually waste) by open burning, either in a container or on open ground. While it is a common method of disposal of domestic wastes on private property, the major aim was to halt burning at municipal garbage dumps, some scheduled premises, especially scrap metal recovery works, and non-scheduled premises. Therefore, the Act exempts the following activities from restriction:
(i) agricultural burn-off
(ii) recreational and domestic activities
(iii) fire prevention and demonstration, and
(iv) disposal of gaseous wastes
Both the Branch and the local authorities are responsible for the administration of these amendments to their respective premises.

*The administration of scheduled premises control*
The structure of the A.P.C.B., as defined in May 1975, is indicated in Fig. IX(iii). Except in name and numbers of staff, it has not changed significantly. In addition to this organisation, the S.P.C.C. has added a legal section reinforcing the prosecuting powers of the Branch. As will be seen, the Branch is structured in terms of technical operations and its staff are predominantly technical. This is evidence of the initial and continuing policy that it should act as a technically

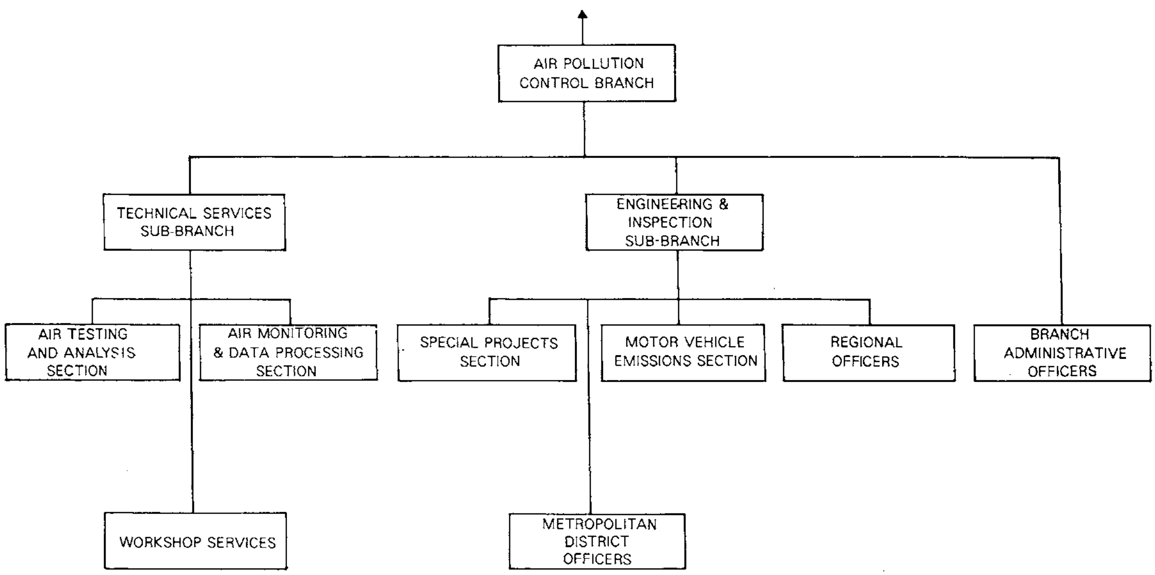



Fig. IX (iii) Staff organisation, Air Pollution Control Branch, State Pollution Control Commission, May 1975 competent body to advise and direct industry in dealing with air-borne waste emissions. The *a priori* assumption of the importance of health criteria together with the Branch's original incorporation in health administration has meant that no public health expertise is directly represented. The Branch is confined to technical and physical problem-solving, administration and policing. For all its tasks, in late 1974 it had a staff of only thirty-seven persons. This number has since approximately doubled but still represents a small staff. The Branch's links with A.P.A.C., important in the past, are not shown because the

Table IX-(1) N.S.W. scheduled premises

| | No. of scheduled premises in 1974 | % | Directions since 1965* | Prosecutions since 1965† |
|---|---|---|---|---|
| Cement works | 6 | 0.5 | 2 | — |
| Ceramic works (brick, pottery, glass) | 95 | 8.2 | 11‡ | 8 |
| Chemical works (classes I & II) | 114 | 9.9 | 13 | 1 |
| Coke works | 3 | 0.2 | 3 | — |
| Ferrous and non-ferrous works | 252 | 22.1 | 3‡ | 5 |
| Gas works | 7 | 0.6 | 2 | 1 |
| Grinding and milling works | 188 | 16.6 | 5‡ | 1 |
| Oil refineries | 5 | 0.4 | 2 | — |
| Primary metallurgical works | 6 | 0.5 | 3 | — |
| Scrap metal recovery works | 23 | 2.0 | 7‡ | 2 |
| Fuel burning equipment using > 300kg fuel/hr | 196 | 17.0 | —‡ | 2 |
| Railway Dept. workshops | 13 | 1.1 | — | — |
| Government transport workshops | 20 | 1.7 | — | — |
| Pre-mix bitumen plants | 13 | 1.1 | — | — |
| Petroleum product storage or processing works | 29 | 2.7 | — | — |
| Coal industry works | 21 | 1.8 | — | — |
| Concrete batching works | 156 | 13.5 | 2 | — |
| **TOTAL** | 1147 | 100.0 | 53 | 20 |

*The total number of directions given in Table IX-(1) represents only 45 per cent of the total number of directions known to have been given since 1965 — Table IX-(3). Published reports do not give a detailed enough breakdown to be able to complete this table and thus give an indication of the relative difficulties of applying controls to the different industry classes.
†These are all the prosecutions of scheduled premises that have been made since 1965.
Source: A.P.C.B.: A.P.A.C. Report 1973/74.
‡Known to be more than the indicated number of directions.
Source: A.P.A.C. Reports 1962/3-1973/4.

Table IX-(2) Sydney Metropolitan area, scheduled premises to December 1974

| | Manufacturing | Non-manufacturing | Total |
|---|---|---|---|
| Cooks River | 215 | 30 | 245 |
| North Botany | 57 | 15 | 72 |
| Lower Georges River | 132 | 9 | 141 |
| Upper Georges River | 76 | 4 | 80 |
| Total study area | 480 | 58 | 538 |
| Rest of Sydney | 417 | 79 | 496 |
| Total S.S.D. | 897 | 137 | 1,034 |

Committee's role has changed from relatively close executive oversight to the assumption more of an advisory role to the Minister and the Branch.

It is important to recognise that the Branch's responsibilities are not confined to Sydney, despite the obvious relevance of waste emissions to limited areas and physical basins. The selection of premises for inclusion has changed under a number of influences. The initial listing in 1965 included some 700 establishments in the whole State, chosen partly on grounds of their assumed or known significance in smoke and particulate production, partly in recognition of limited ability of a small staff to control large numbers of waste sources. The list grew gradually as some problems were brought under control and new ones could be tackled and as new problems were recognised. By 1974, the list had risen to approximately 1,100 in the State as shown in Table IX-(1), though some had been dropped from the list. The gross additions to the list have been relatively large since 1970.

In the Sydney metropolitan area the scheduled premises as at December 1974 are shown in Table IX-(2) according to particular sub-areas. Out of a total of approximately 1,000 establishments, 87 per cent were manufacturing concerns. Of the factories, 53 per cent of Sydney's scheduled factory premises were in the Botany Bay catchment. Illustrating a particular area problem, as many as 45 per cent of the Botany Bay catchment's scheduled factories were in the Cooks River valley.

Although some establishments are included specifically because of odorous, irritant or toxic wastes, they may also be included because of their processing or consumption of fuels and the consequential generation of particulates, smoke, sulphur oxides, nitrogen oxides and hydrocarbons. Chemicals and petrochemicals provide a major group in which other criteria are particularly important. Despite their small numbers, these and related types of establishments are the dominant fuel users.

It is unfortunate that the Clean Air Act and, therefore, the Branch uses its own classificatory system and does not adopt the Australian Bureau of Statistics classification. Were this adopted, it would be possible to link directly with a large mass of socio-economic statistics and to relate control requirements with business operations. This is an elementary barrier to the consideration of the economics of air-borne waste control. On the other hand, the Australian Bureau of Statistics has adopted an extraordinarily narrow definition of activity for each establishment in its records, resulting, in some cases (particularly oil refining), in a gross understatement of fuel consumed. Despite these problems, we have estimated the fuel consumption of the scheduled premises for Sydney at approximately 75-80 per cent of the total factory energy consumption of Sydney, excluding electricity. By implication, a significant fraction of fuel consumed, other than electricity, is still to be found amongst the non-scheduled premises.

It is not our purpose here to detail the technical controls. They are operated essentially on a case-by-case basis. The control possibilities vary a great deal. In some cases, as in oil refineries, the problems are very many and not easily resolved. In many cases, the control equipment is highly specialised and costly; in others it may be very simple, ranging from changed furnace or firing techniques to something as simple as tar-sealing a dusty factory yard. The specialised equipment is generally 'end-of-pipe' technology, representing an essentially remedial approach to the whole problem of air-borne wastes: accepting their generation and endeavouring to trap them prior to emission to the atmosphere. An important qualification is the control over the sulphur content of fuel used. In addition, some opportunities for reuse of wastes have developed either for use by the establishment or for sale to other enterprises.

Initially, the approach of the A.P.C.B. was to advise and to suggest methods of abatement. Where establishments resisted or delayed, controllers could resort to bluff. As their expertise developed, and political pressures mounted, the emphasis shifted increasingly towards positive direction. A recent development has been one in which the Director of the S.P.C.C. formally issues the directives. The technical expertise of the Branch is very considerable and their technical competence in exercising the directive powers is increasingly difficult to challenge. The day-to-day links with establishments is handled by field engineers working, in Sydney, in three control regions (there are five others in the rest of N.S.W.). These engineers are men with considerable industrial experience and they have provided a great deal of valuable advice, as well as direction, to industry. The outstanding result in Sydney (as in Newcastle) has been a major decline in particulates, smoke and dust in the atmosphere.

The field engineers also play an important part in relation to new plant location and in major plant modification, again on a case-by-case basis, preparing reports on applications, advising on emission control technology to be incorporated, supervising installation and checking performance. Similar testing of performance is made of controls introduced in existing establishments through inspection and local source monitoring. The engineers follow up complaints and it is reported that approximately half their visits to plants is in response to public complaints to the Branch.

Because of its expertise, the Branch has assumed increasing authority in specifying control technology and in insisting on performance. So far as the first is concerned, establishments tend to be encouraged to install equipment that will reduce emissions below the prescribed standards. Though this is a policy of safety, it is an unresolved issue — and one that cannot be resolved by the Branch's mode of operation and the information at its disposal — whether unduly large resources are being put into certain forms of air-borne waste controls. This may be particularly so for particulates. On the other hand, a great deal of care is needed in cases of complex establishments. There is often little relationship between the effort at control and the success achieved. This is particularly true of the chemical and petrochemicals group where, it appears, limited improvement has been made. The S.P.C.C.[4] appears to regard the effort as disproportionate. The effort was directed particularly to control of hydrocarbons and toxic and non-toxic odours that represent part of the second-generation wastes that concern the Branch today. The problems encountered may suggest the importance of other approaches through market influences to induce establishments to find their own solutions. The Clean Air (Amendment) Act of 1974 included a provision for the further control of odours, though this provision was not proclaimed immediately.[5] Some control over odours has been achieved in the past although the successes have been limited, partly because of the technological difficulties of control, but also because many firms have resisted, knowing that extreme difficulties existed in proof of odorous emissions.

In addition, the demands on the Branch for work on the much larger problems associated with photochemical smog control affected the attitude of the engineers.

The difficulties in quantification of odours have inhibited the promulgation of adequate odour control in the past. Odours are often aesthetic problems, and it is difficult to provide objective evidence of the need for control. These problems have been partly overcome in the new legislation. The provision is not based on whether the odour is pleasant or unpleasant, but whether or not it can be detected by smell.[6] Therefore, the amendment relies on the concept that industries should not allow any odours, irrespective of strength or quality, to leave their premises so as to be detectable in the immediate vicinity. The only instrument required to make this detection is an 'authorised nose', i.e. an authorised officer relying solely on his sense of smell. This approach, necessitated by the technical difficulties of odour measurement, means that *intermittent* release of odours, as often occurs, may not be detectable if the 'authorised nose' does not arrive before the odour ceases. However, technical knowledge of the nature of industry operations allows some prediction of releases so that an authorised officer (nose) may be present at appropriate times.

This provision has an important aspect. There is a basic change in approach by the control authorities. The onus for detecting and controlling odorous emissions is placed on the shoulders of the polluter. In the past, for other pollutants, the Branch has tended to locate and solve the problems for industry. Now, for odours, this responsibility will belong to those producing the emissions. The essential question is whether this will induce more flexible but effective methods of encouraging remedial or preventive measures or whether controls will be lax or will lapse.

Table IX-(3) suggests a marked trend in behaviour by the Branch in insisting on performance as shown in the number of directions, prosecutions and exemptions given each year. The small number of legal directions given before 1971 was partly due to the reluctance to resort to these methods and the apparent lack of need for this approach, i.e. it was considered to be sufficient if *some* effort was made to control emissions. Exemptions were given if the

Table IX-(3) Exemptions, directions and prosecutions relating to scheduled premises for the period 1965/6 to 1973/4.

| | Exemptions | Directions | Prosecutions |
|---|---|---|---|
| 1965/6 | 11 | — | — |
| 1966/7 | 10 | 1 | 1 |
| 1967/8 | 15 | 2 | — |
| 1968/9 | 12 | 2 | 1 |
| 1969/70 | 11 | 5 | — |
| 1970/1 | 3 | 12 | 1 |
| 1971/2 | 3 | 32 | 8 |
| 1972/3 | 1 | 29 | 5 |
| 1973/4 | — | 38 | 4 |
| | 66 | 121 | 20 |

Source: A.P.A.C. Annual Reports 1962/3-1973/4.

required controls were unavailable or were technically difficult to evolve, or if the firm was experiencing financial hardships. However, as controls have become increasingly available and the unco-operative firms have become more obvious, the attitude of the control authorities has hardened, resulting in a marked decrease in the number of exemptions allowed and a marked increase in the number of directions and prosecutions. This attitude was stated in the 1970/1 A.P.A.C. report — exemptions would only be given if insurmountable technical difficulties were encountered. The following A.P.A.C. report, 1971/2, indicated a 'peak' year for directions and prosecutions to confirm this statement. Table IX-(1) gives some indications of the distribution of these legal powers among the various categories of premises.

In the past, the A.P.C.B. has found that it has required a large input of time and energy to gain successful prosecutions.[7] This has been due to many factors, not the least of which have been unfamiliarity with legal requirements, an Act which did not easily lend itself to use in prosecution and the need to gain Ministerial consent. In addition, the fines imposed have often been small. The 1974 amendments to the Clean Air Act appear to have removed many of the previous obstacles. A considerable portion of the Amendment Act was devoted to general provisions which had the effect of 'streamlining' the Act, making it more easily applicable. The amendments also contained a provision for the Minister to delegate his authority for prosecutions to selected persons. It appears reasonable that this power should be delegated to the respective Principal Engineers of the Air and Water Pollution Control Branches of the S.P.C.C. The creation of a Legal Services Branch within the S.P.C.C. is also likely to increase legal force.

These tendencies bring the Branch into a more direct conflict situation and underline the need to choose carefully between the social benefits of greater air pollution abatement and the capital and operating costs of the establishments affected. Effective decision making in administering controls requires much greater attention to a more complex cost/benefit assessment than the Branch appears to have made so far. Moreover, it may be doubted whether the Branch is equipped to carry out this difficult social and economic as well as technological assessment. More than a technologically expert administration is needed. This question is highlighted by the problem of control of toxic and non-toxic odours.

Some peculiar problems of control arise when public authorities are waste generators, as for example the Electricity Commission. Power-generating stations are potentially major sources of wastes. However, the Sydney metropolitan power stations are at present being run down, and it is rational that the Electricity Commission has not been required to spend large amounts of money on emission controls for establishments with short expected lives. Other power generating plants were consistently grouped among the 'worst offenders'[8] against the Act and yet have apparently never been issued with directions. A similar situation exists with Eveleigh Railway Workshops which, in an inner city location, continue to breach the emission standards set down in the Act, seemingly without penalty. The Waverley-Woollahra incinerator also indicates the difficulties of strict application of the Act. Not long after commissioning, the incinerator began to malfunction, causing excessive emissions. It was allowed to continue operating because the problems associated with garbage accumulation were considered greater than the air pollution problems; and technical improvements in its operation were recognised to be in process. In these cases, the Branch faces obstacles of a wider sort, of opposition from senior officials in other public agencies, Ministerial delays and protestations of budgeting constraints. Pleas that are often unacceptable from private enterprise become valid when made by Government.

*Non-scheduled premises control*

While the local authorities have the major responsibility for control, there is provision in the Act for the Branch, through the Minister, to control non-scheduled premises. This control is also exerted at a less formal level. Because of the general lack of technical expertise within the local governments regarding environmental matters, the A.P.C.B. has made itself available to give these groups advice on the best means of controlling emissions. In addition, the A.P.C.B. formulated and recommended standards for incinerators which many local authorities have readily adopted. These were originally presented in 1968 and revised in 1973 to recommend standards for commercial and industrial incinerators designed to burn less than 300 kg of waste per hour. These aspects, plus the regulation of sulphur content of oil fuel, provide the Branch with some significant controls over non-scheduled premises.

It should be borne in mind that these premises are very numerous and, generally, small concerns, although in the aggregate they are significant consumers of fuels. In some areas their total effect is important in a variety of air pollutants but, in many cases, they may be expected to cause local irritation rather than major air pollution problems.

Despite the several controls available to local authorities over air polluting premises, the application of these controls varies considerably. One informed person, F.J. Purdue, a former Mayor of Newcastle, argues that the local authorities 'tend to evade their responsibilities in the field of atmospheric pollution control',[9] citing evidence of deterioration when State officials withdraw from intervention. There are other reasons. The health inspectors responsible have numerous duties apart from air pollution control and they are not experts. In addition, the large number, small size and wide diffusion of the problem establishments present many difficulties. The magnitude and importance of the inspectors' other duties, e.g. water pollution control, shop inspections, etc., will determine the time available for air pollution control. This constraint is only one factor. Larger problems may arise with the practical application of the Act. As for scheduled premises, the control of air-borne wastes emission is based on an emission standard. The local authorities do not have the required expertise or equipment to be able to carry out the necessary tests to implement these standards. In other provisions, the basis of control is inadequate. For those local governments that do attempt to implement the Act, the main recourse is diplomacy that, in the last resort, is bluff.[10] In the Sydney City local government area, at least, it appears that this tactic has sometimes been successful in persuading establishments to implement control measures. The 1972 amendments to the Clean Air Act empower the local authorities to control open burning from non-scheduled premises. Some local authorities have been reluctant to control this practice[11] and there have been suggestions that the regulations may be reviewed to correct this situation.

Generally, there is little information available on legal action in respect of non-scheduled premises. No data are available concerning the need to resort to directions or prosecution to ensure that non-scheduled sources of air pollution reduce emissions to acceptable levels. However, it is clear that there have been some barriers to prosecution. The local authorities have, in the past, been reluctant to make use of the Clean Air Act to launch prosecutions because of unfamiliarity with its provisions and the need to gain the consent of the Minister. Generally, they have tended to use the more familiar Local Government Act. Even with its disadvantages, some successful prosecutions have been recorded by the use of public nuisance provisions of the Local Government Act. Botany Council has successfully used the Clean Air Act to win a prosecution but the fine was small — $30. Other local authorities (Leichhardt, Manly, Concord, Strathfield) have considered using the Clean Air Act to prosecute, though it appears that little action has yet been taken.

The recent 1974 amendments may bring some changes in use of legal powers by local authorities. A provision in the amendments allows the Minister to delegate his power of authority in matters of prosecution to 'a servant of a local authority'. Additionally, the non-scheduled premises were made subject to the same fines as the scheduled premises — $10,000 plus $5,000 daily for a continuing offence. The severity of these fines may cast some doubt on the wisdom of this delegated extension as a global provision.

*Evaluation of controls*

Comments on the technical bias and limitation of approach taken in social terms have already been made. The data base that would be essential for a determination of the degree of physical control achieved by industry is largely unavailable. However, an important part of the information needed is available in records provided by the network of monitoring equipment — the measurement of concentrations of wastes in the Sydney atmosphere. Some general comments concerning monitoring results have been made in the preceding chapter. It is relevant to indicate here some of the results that relate to stationary sources.

(i) There has been a marked decrease in the recorded annual average levels of smoke and dustfall since the introduction of the Clean Air Act. Nonetheless, despite the decrease in the average annual smoke concentration, high peaks of smoke concentration still occur.

(ii) The same success has not yet been achieved with regard to the sulphur dioxide problem. Although it is understood that the 1974 annual average concentration has decreased from the 1973 peak, the general trend in background concentration shows an increase. The relative lack of success in this problem is not due to lack of effort by the Branch but lies in part in the origins of the problem in factors over which these groups have limited control, i.e. the nature and amount of imported oil. The conversion of many coal-fired furnaces to oil firing had the effect of decreasing smoke and dustfall and may even have decreased the sulphur dioxide content of the air. However, when the major external source of crude oil was changed from Indonesia to the Middle East, the sulphur dioxide content of the air increased as a result of the use of higher sulphur fuels. The production and consumption of indigenous oils in factories would help to alleviate the problem, but unless major new discoveries are made the effect could not be lasting. The implications for sulphur dioxide levels of the atmosphere depend, to some extent, on the introduction of natural gas to Sydney.

(iii) Controls that have been placed on specific emissions from industrial processes have led to some control over odours in the past. However, greater control may be achieved in the future from new odour control regulations.

(iv) The magnitude of the present and future photochemical pollution problems is altering the emphasis of control. Although the problems of (i) - (iii) above will continue to require control, the sources of the primary wastes leading to smog are being given increasing attention. The first steps towards reducing the industrial contribution of wastes to the photochemical reactions have been taken with the scheduling of petroleum product storage or processing works. Controls on these premises have yet to become effective.

(v) Although motor vehicles make the major contributions of nitrogen oxide and hydrocarbon wastes, there are significant contributions made by stationary sources. While the present state of indecision exists as to the most beneficial controls to apply to stationary sources to reduce photochemical smog, the best practicable means of abatement procedures are being adopted. This means that hydrocarbon emission sources will be the subject of initial controls for two reasons. First, control of hydrocarbons is more technically advanced and cheaper than is control of nitrogen oxides. Second, control of hydrocarbons conserves energy. The Sydney Oxidants Study is presently examining the determinants of the local photochemical pollution problem. The results of this study should indicate whether or not controls on factory sources of nitrogen oxides will be necessary. Petroleum product storage or processing works (sources of hydrocarbons) have been scheduled. It appears that before 1980 several other sources of hydrocarbon emissions may also need to be controlled — service stations, dry cleaners and some users of lacquer.[12] Although these sources may then become scheduled premises, the responsibility for control may need to rest with the local government bodies because of the large number of establishments involved. As indicated above, the need to apply relatively expensive nitrogen oxide controls is being studied. Meanwhile, the Branch has completed tests of a significant number of fuel-burning plants to determine the nitrogen oxide emissions, so that some guidance may be obtained as to the possible advantages in applying controls to boilers and furnaces. The results indicate that the majority of the sources tested were within guidelines recommended by the N.H. & M.R.C. for new plant. Some sources had extremely high emissions, well above the N.H. & M.R.C. guidelines, but this has been found due to the nature of the process being conducted in the establishments. An emission limit for nitrogen oxides is laid down in the Clean Air Act, but it refers to emissions from chemical plant processes and is not related to combustion gases. This limit would not be applicable to the boilers and furnaces referred to in the above discussion.

(vi) Open burning of wastes has been significantly reduced, though some difficulties have been experienced. These problems have mainly arisen with open burning on non-scheduled premises where the local authorities, in some cases, appear to have been reluctant to enforce the provision of the Act, and the legislation may need to be made more effective in the future. The 1974 S.P.C.C. report indicates that substantially *all* incineration may be banned in certain areas that are indicated to be particularly susceptible to some aspects of air pollution such as the very densely populated area of Kings Cross-Elizabeth Bay, where the only incineration acceptable may be domestic barbecues.

(vii) When new plant is installed, an agreement is reached between the control authorities and the management concerning the sulphur content of the oil fuel to be consumed. Recent checks have shown that this level may sometimes be exceeded for special short-term reasons, e.g. strikes, and that the fault has often been with the supplier, not the consumer. The 1974 S.P.C.C. report warned suppliers that legislation may be promulgated to take action against the supplier as well as the user if such practices continue. This would introduce a new element in control and, indeed, raises the possibility of greater Commonwealth Government intervention through its powers over imported goods.

## Mobile sources

As indicated in Chapter 8, the overwhelming source of air-borne emissions from mobile sources is from motor vehicles yielding, in particular, nitrogen oxides and hydrocarbons, as the primary waste sources of photochemical smog, together with carbon monoxide, lead and, in smaller quantities, particulates, asbestos, rubber particles, etc. It is with the first three waste emissions that we are primarily concerned here.

Stationary sources, factories and some non-manufacturing industries, are significant generators of nitrogen oxides and hydrocarbons so that their waste emissions join the family of wastes from motor vehicles in smog formation. The entry of the motor vehicle into the scene, and its growing use, has important consequences for processes required to protect environmental air amenity. A significant part of vehicle engine technology is derived from outside Australia and most from outside Sydney. The population of Sydney's vehicles is continuously altering; the manner, direction and location of use is variable. Any control approach impinges directly on the final consumer and hence on the values and day-to-day behaviour of most individual Sydney residents. These behaviour patterns and values are, in part, conditioned by social overhead capital of transport and road systems. The individual sources (vehicles) produce small fragments of total waste flows. Control options arise in dealing with the provision of transport and road systems and their routes, the individual vehicles and their use of the technology of vehicle manufacture: the continued efficiency of control equipment depends on effective maintenance of vehicles in use by very large numbers of owners whose actions are difficult to police. Choice of control strategies and evaluation of controls depend heavily on a monitoring network to provide an input of information not only of waste generation but also of meteorological characteristics and of chemical reactions of wastes with the atmosphere and with each other. Some of the technical control solutions lead to a conflict in reducing waste emissions at the expense of increased energy consumption.

The development of controls has followed several paths. The S.P.C.C. and the Air Pollution Control Branch provide the key means of adopting and scheduling specific technical measures and of conducting relevant ambient air monitoring. They have also participated in some research work and investigations by government, business and university bodies. They receive advice from State, Federal and private bodies on air quality goals and control procedures. Amongst these external bodies are or have been Macquarie and Sydney Universities, Sydney Area Transportation Study, the Sydney Oxidant Study, the Urban Transport Study Group, the Australian Transport Advisory Council (A.T.A.C.) with its sub-committee, the Committee on Motor Vehicle Emissions (representing many relevant groups), the Australian Environment Council, the National Health and Medical Research Council, the Commonwealth Department of Minerals and Energy, and the Federal Chamber of Automotive Industries.

A number of major studies of Sydney's photochemical smog problem are proceeding. These may contribute to a strategic approach to control. While awaiting the outcome of the studies, the S.P.C.C. and the Branch have pursued the path of introducing a series of progressively tightened technical controls to be applied to motor vehicles. Unlike the control approach to factories, the technical controls have not been the 'end-of-pipe' variety. Rather, they have usually been associated with some broad form of engine modification.

*Technical controls for vehicles in Sydney*

The Professor of Botany at the University of Sydney reported findings of ozone damage to plants in Sydney gardens in the beginning of the 1960s, as recorded in the 1962 *Annual Report* of the Director-General of Public Health.[13] The then Head of the A.P.C.B. warned of 'an incipient photochemical' smog problem, though not one 'of pressing importance'. This opinion appears to have prevailed throughout the sixties. Indeed A.P.A.C. took the position in 1967 that there was no photochemical problem in Sydney and that there would not be such a problem until around 1992.[14] In 1968, only the carbon monoxide levels in the inner city were regarded as evidence of problems arising from vehicles.

Throughout the sixties, control of motor vehicle emissions was not under the health authorities and, therefore, not included in the Clean Air Act. Such nebulous regulations as existed were set out in the Motor Traffic Act. A report prepared in 1968 at the instigation of the Minister for Health nevertheless recommended controls on some vehicle emissions. The Senate Select Committee on Air Pollution (1970) also pressed for control of motor vehicle emissions, and with increasing evidence of atmospheric ozone levels these emissions became regulated by the Clean Air Act in 1971.[15] Controls passed, therefore, to the A.P.C.B. and hence, in 1974, came under the S.P.C.C.

Throughout the sixties and into the early seventies the illusion that no or little problem existed in Sydney stemmed from several factors. First, a lack of understanding of the chemical and meteorological conditions led to the choice of inappropriate monitoring sites. Second, the monitoring equipment was not very sensitive and, looking back, the A.P.C.B. believed that monitored readings may have been low because of other wastes, especially sulphur dioxide, in the

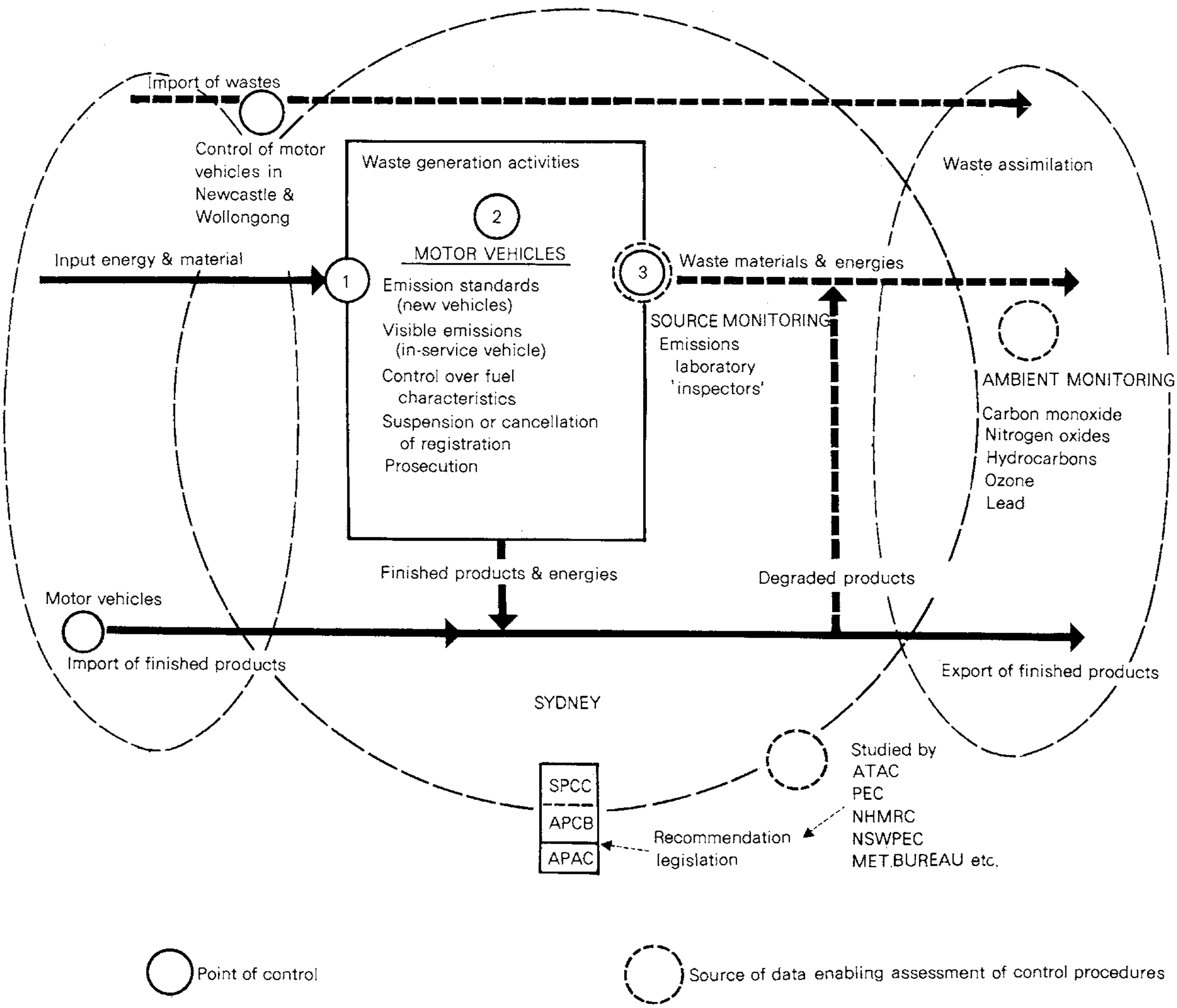



Fig. IX (iv) Control of motor vehicle emissions - Air Pollution Control Branch

Control point one, as for the stationary sources, might be control over characteristics of the fuel consumed. Limitation of lead in petrol is the obvious example. Control point two might be the promulgation of emission standards and the subsequent application of control measures. Control point three might be emission regulations, and application of control measures to imported vehicles.

The 'inspectors' of source monitoring might be those staff noting the registrations of diesel vehicles with excessive emissions of smoke. The details of ambient monitoring are discussed later.

atmosphere.[16] Third, comparisons of Sydney monitoring results with those elsewhere in the world, especially Tokyo and Los Angeles, were influenced excessively by the large differences in the concentrations and did not sufficiently recognise that the levels in these two cities were extremely high.

The system of control adopted by the Branch is indicated in Figure IX(iv). Here we are concerned immediately with the technical controls over vehicles. The Australian position has been to adopt overseas (European and American) standards of emissions from vehicles with an appropriate vehicle design prescription. These standards are usually described as Design Rules and the Australian standards as Australian Design Rules (A.D.R.)

The adoption of these standards or design rules requires agreement by members of A.T.A.C. and they have no legal standing until incorporated into State legislation. Initially, design rules were used to introduce safety factors, but they were the obvious means of obtaining the co-operation of vehicle manufacturers in controlling vehicle emissions. Australian Design Rules before 1974 were little more than gentlemen's agreements between the Federal body

Table IX-(4) Controls over and reductions of motor vehicle emissions*

| Date of implementation | Control | Oxides of nitrogen (NOx) | Hydrocarbons arising from: Exhaust | Evaporation | Crank-case | Carbon monoxide (CO) |
|---|---|---|---|---|---|---|
| 1.6.70 | Positive crankcase ventilation | † | | | 100% | † |
| 1.1.72 | CO limited to 4.5% by volume exhaust gases | ‡ | | | | 10-15% |
| 1.1.74 | Reduction in exhaust emissions of HC & CO | ‡ | 15% | | | 50-55% |
| 1.1.75 | Evaporative emission control for HC | | | 100% | | |
| 1.6.76§ | Reduction in exhaust emissions of NOx, HC & CO | 38% | 80% | | | 69% |
| 1975¶ | U.S.E.P.A. | 38% | 90% | | | 83% |
| 1976 | Motor vehicle | 60% | 97% | | | 96% |
| 1977 | Emission standards | 92% | 97% | | | 96% |

*Reductions from uncontrolled or pre-1970 vehicles. Variations in reductions are due to source of data. Readers are referred to R.W. Bilger, 'The War Agaonst Exhaust Pollution', *Current Affairs Bulletin*, **50,** 347, also published in R. Dempsey (ed.), *The Politics of Finding Out*, Victoria, 1974; General Motors-Holden, *What You Should Know About G.M.H. No. 3 Vehicle Emissions*, issued by the G.M.H. Public Relations Department; G.W. Roberts, 'What's The Future for Automotive Emission Control?', *Proceeding of the International Clean Air Conference*, Rotorua, February 1975.

†Because very small volumes of nitrogen oxides and carbon monoxide were emitted from the crankcase blowby, the positive crankcase ventilation served also to reduce their emission.

‡The process of reducing carbon monoxide emissions increased emissions of oxides of nitrogen. It is considered (A.P.C.B., personal communication) that the increases resulting from e 1972 controls were negligible, but that 1974 controls may have given rise to increases up to 15 per cent.

§Because of absence of local data, these estimates are based on United States experience. The actual percentage reductions, especially for nitrogen oxides, will be determined by local factors (A.P.C.B., personal communication).

¶The U.S.E.P.A. 1975, 1976 and 1977 standards are presented for comparison. Major difficulties in emission control have recently resulted in a decision to postpone the 1977 standards for at least one year. The deadline may be extended until 1982. (A.J. Mayer and J. Bishop Jr., 'Environment: Unexpected Hazard', *Newsweek*, 17 March, 1975.)

(A.T.A.C.) and Australian car manufacturers. When the N.S.W. Clean Air Act included control over vehicle emissions, A.T.A.C. guidelines were adopted as regulations for *new* vehicles. The first regulation gazetted prohibited the emission of visible smoke from a registered motor vehicle for more than ten seconds — invoked particularly in relation to diesel vehicles. The subsequent regulations applied or proposed to be applied to *new* vehicles are listed in Table IX-(4), together with an approximate indication of the claimed likely reductions in waste emissions.

*Application of controls*

Motor vehicle controls have been applied or proposed at various stages of the fuel combustion process, designed to limit the escape of wastes, to return gases to be more fully used, to improve injection systems, to achieve suitable engine adjustment. In this sense, they have not been literally an 'end-of-pipe' technology.

These emission controls are required only on new vehicles. Their effectiveness depends on several factors. First is the ability of manufacturers to meet control specifications for all new cars. This problem arose most acutely with the proposed July 1976 control proposals. The Federal Chamber of Automotive Industries claim that new engines vary greatly and it is extremely difficult to meet a uniform standard as specified. Second, the emission controls deteriorate with age of vehicle and equipment and there is a major problem of policing and of requiring the maintenance of control equipment to sustain emission standards. There has been a good deal of dispute between the manufacturers, the S.P.C.C. and A.T.A.C. over relevant requirements. In 1975 A.T.A.C. proposed that vehicles be tested after completing 6,400 kilometres, while the N.S.W. regulations apply to vehicles with zero mileage. It is unclear who is to bear the penalty — the manufacturer or the owner — in the event of failure to conform to standards. This type of conflict became most obvious with diesel trucks when A.T.A.C. rejected the regulations adopted by N.S.W. for diesel exhaust controls and these regulations were accordingly opposed by manufacturers.

The S.P.C.C. appears reluctant to attempt to control vehicles already in operation, and it would, indeed, be hard pressed to provide for this method of applying controls. The Branch is endeavouring, through the use of facilities at Email Limited and more recently at its own emissions laboratory, to assess testing equipment and determine the rates of deterioration for different cars' emission controls. The only option, in practice, appears to be the Californian method of random sampling of vehicles. These procedures do not offer a very secure future for vehicle emission control.

Penalties are provided in the Act for owners of vehicles with excessive emissions. These penalties for offences under the Act are $10,000 plus $2,000 per day for continuing offences where the vehicle is owned by a corporate body and $1,000 plus $200 per day for a private owner. For offences under the Regulations the penalties are halved. Registration may also be suspended or cancelled. These penalties are so high as to imply that there can be little intention to apply them. Action has been taken mainly in relation to diesel trucks and buses, mainly by advising owners of faulty vehicles on the best means of remedying the problems. Some vehicles have been called in for testing but, so far as we are aware, no penalties have been imposed. In fact, in several cases, it would appear that very simple tampering or accidental alterations of motor vehicle emission reduction equipment may make the devices ineffective.

It is not easy to force manufacturers into line by regulation. It is almost impossible, however, to police the regulations in application to individual car owners. There is some disagreement on even the simplest of the controls in terms of their effectiveness. Birrell reported, from tests on new 1972 model cars, that 25 per cent failed to meet carbon monoxide standards.[17] On the other hand, the A.P.C.B. claimed that 1974 standards for both carbon monoxide and hydrocarbons were being met on *new* cars. Given the frequency of deterioration when in use, the cost of the controls against their *real* effectiveness in use becomes very important. These costs take two forms. There is the cost of installation, amounting, at times, even to several hundred dollars. Secondly, there is the potential of increased fuel consumption. Both these costs may be substantial. If to these is to be added a closer inspection system for vehicle owners and operators, the total social cost could become very large.

There is significant disagreement[18] about the likely outcome of the actual and proposed controls. The problems arise from the fact that controls applied to new vehicles affect the total vehicle stock slowly; controls deteriorate in use; and the numbers of vehicles and vehicle miles driven are increasing. There appears to be broad agreement, however, on the proposition that Sydney is unlikely to attain American goals for carbon monoxide and ozone standards for ambient air until the late 1980s. There are, however, significantly different projections of the separate wastes of carbon monoxide, nitrogen oxides and hydrocarbons. One recent suggestion is that the 1976 controls may do no more than merely arrest a worsening situation,[19] leaving the possibility that Sydney may face a continuing significant risk of smog episodes and continuing exposure to the particular air contaminants at a level considerably above American or W.H.O. goals.

The prospect, however, appears to be somewhat more pessimistic than these commentaries suggest. It is doubtful if adequate allowance has been made for the particular major expansion of manufacturing, transport and port-generated activities in the southern half of Sydney, including westward expansion. These form an acutely important part of the total, particularly of smog formation in Sydney, both by their location and by the nature and scale of planned development. Unless greater restraint on activity and on waste emissions from these stationary and mobile sources is imposed, it seems likely that Sydney's smog problem may worsen for several years into the future despite growing control over and cost of individual vehicles. This issue leads naturally to the consideration of alternative strategies.

*Alternative approaches*

In referring to alternative approaches, it is not implied that the S.P.C.C. should necessarily be responsible for them or that it is deficient in failing to adopt these alternatives. Nevertheless, the Commission could play a more important role in pursuing alternatives other than specific technical remedies applied to individual vehicles.

The S.P.C.C. and its controlling Branch liaise with a large number of Federal, State and local bodies and have made some moves towards alternatives. The Branch's staff has criticised the Sydney Region Outline Plan prepared in 1968 for the failure to take account, for example, of air pollution likely to derive from major industrial development in the Parramatta-Penrith area.[20] Despite persistent commentary in the A.P.A.C. Reports in the late sixties, it was not until 1970 that fruitful liaison with the State Planning Authority was achieved. Then the specific issues were industrial development at Campbelltown and Jervis Bay. At the same time, for related reasons, the Branch established contact for planning purposes with the Meteorological Bureau. The A.P.A.C. proposed that this liaison should be formalised by promulgating suitable provisions in the then State Planning Authority Act, the Local Government Act and the Clean Air Act. However, it was not until November 1974, twelve years after the proposal to combine environmental considerations in city planning, that the relationship was formalised in the establishment of the Planning and Environment Commission.

The broader planning processes offer an opportunity for a more general preventive approach to air pollution problems as an alternative to the remedial technological control of vehicle emissions. The Planning and Environment Commission has not exercised any profound influence on relevant policy issues. These relate to location of major industrial development, the planning of a residence-work-shopping relationship, the type and routing of road facilities, the conditions of access to certain areas or routes, the provision of priority lanes, the development of alternative non-motorised transport, the improvement and increased versatility of public motor transport. Beyond these major city issues lies the larger strategic question of effective decentralisation out of the Sydney area as a whole.

In terms of ambient air quality, the basic objective in preventive planning terms is to reduce the vehicle mileage driven in the metropolitan area and particularly in special parts of the city. If we accept that direct measurement and policing of waste emissions from individual vehicles en masse are likely to be extremely difficult and costly, there appear to be only three broad alternatives. One is to encourage, through greater understanding by city residents of the problems they face, a change in values and behaviour patterns in vehicle use. Car pooling is one example. The second is to make the use of vehicles more costly through pricing processes, through increased charges on vehicles or fuel. The third is conscious planning and arrangement of the physical relationships of the city that induce vehicle trips. There may be some merit in combining all three.

The S.P.C.C. has in fact made some attempts to develop a program of education, primarily through education of children under the aegis of the Department of Education. This may yield some long-term benefit, and some commentators regard this approach as the most valuable.[21] Other literature has been prepared for adults and literature has been distributed to motor vehicle mechanics on the technical aspects of emission control and maintenance. Unfortunately, little of this activity is such as to bring home to car owners and users the nature and scale of the costs that their activities impose. Moreover, the reluctance of political figures to acknowledge the existence of problems not only weakens any such attempt but is in opposition to it. Further, the other activities of the S.P.C.C., particularly in its control of environmental impact statement procedure, appear to have minimised the significance of air pollution problems and even, at times, to have condoned public and private plans to develop major waste-generating sources. It would be inappropriate to decry attempts to educate and to change behaviour patterns. There appear to be a good many ways in which individuals could, without undue inconvenience, adopt this behaviour and, in the last resort, it is this conscious individual choice that is likely to provide the firmest basis of an effective solution.

As a contributory process, pricing procedures offer a great many options. Possibilities are not limited to the extravagant nominal penalties that have not actually been imposed. Pricing procedures could be introduced to apply to petrol consumed, through higher registration charges, taxes on vehicles and parts, through parking fees, extension of tolls in particular locations. Subsidy methods might be adopted in terms of reduced public transport charges or improved public transport services for given charges. Some of these procedures tend to be discarded, without much thought, as politically unacceptable. Unwillingness to consider these possibilities reflects, in part, a lack of political imagination and not merely a lack of political will. The cost of air pollution control is very large and this cost appears certain to increase very considerably. The prospect that Australia will become increasingly exposed to oil shortages and must economise on energy makes measures of this type important for energy conservation, quite apart from air amenity problems. The important political task is to persuade car users of the relevant personal and social balance sheet. At this level, any pricing procedures merge with the need for effective social education (and not merely technical education).

Neither the Planning and Environment Commission nor the S.P.C.C. showed any marked flair for the development of city planning and the incorporation of environmental considerations in planning approaches. In a social organisation as complex as Sydney, it would be unwise to place too much emphasis on positive planning in the expectation that planners' designs will be capable of full execution. It is, indeed, likely that private individuals' decisions and activities will subvert a great deal of the planners' best intentions. The first essential step is the acceptance of environmental considerations as a basic criterion in planning procedures. So far, despite lip-service, there is unfortunately little concrete evidence that more than nominal regard is paid to environmental issues. The second important matter is to attempt to avoid environmentally costly mistakes. The most obvious example of this elementary planning desideratum appearing not to have been achieved is in the projected uses of the Botany Bay Port and the related major land-use changes and transport developments associated with them. But as environmental conditions become better understood, there are many preventive planning options open not only to these two Commissions but to many public agencies in Sydney. In planning terms it is perhaps the education of all the city's public agencies on the environmental implications of their activities that may be more fruitful than a grand strategy dimly perceived and inadequately executed.

*Understanding Sydney's atmospheric environment*

The waste emissions from motor vehicles are not the sole reason why it is so very important to gain a more thorough understanding of Sydney's atmospheric environment. Nevertheless, they make this understanding very much more important than was the case with stationary source emissions of particulates, dust, smoke and many of the toxic and non-toxic emissions of manufacturing establishments. Vehicle emissions are much less localised in their source and their dispersion. The chemical reactions, particularly of nitrogen oxides and hydrocarbons with each other and with the atmosphere, occur in the ambient air and in moving with air flows. Meteorological characteristics need to be understood with much greater precision in anticipating the effects of these

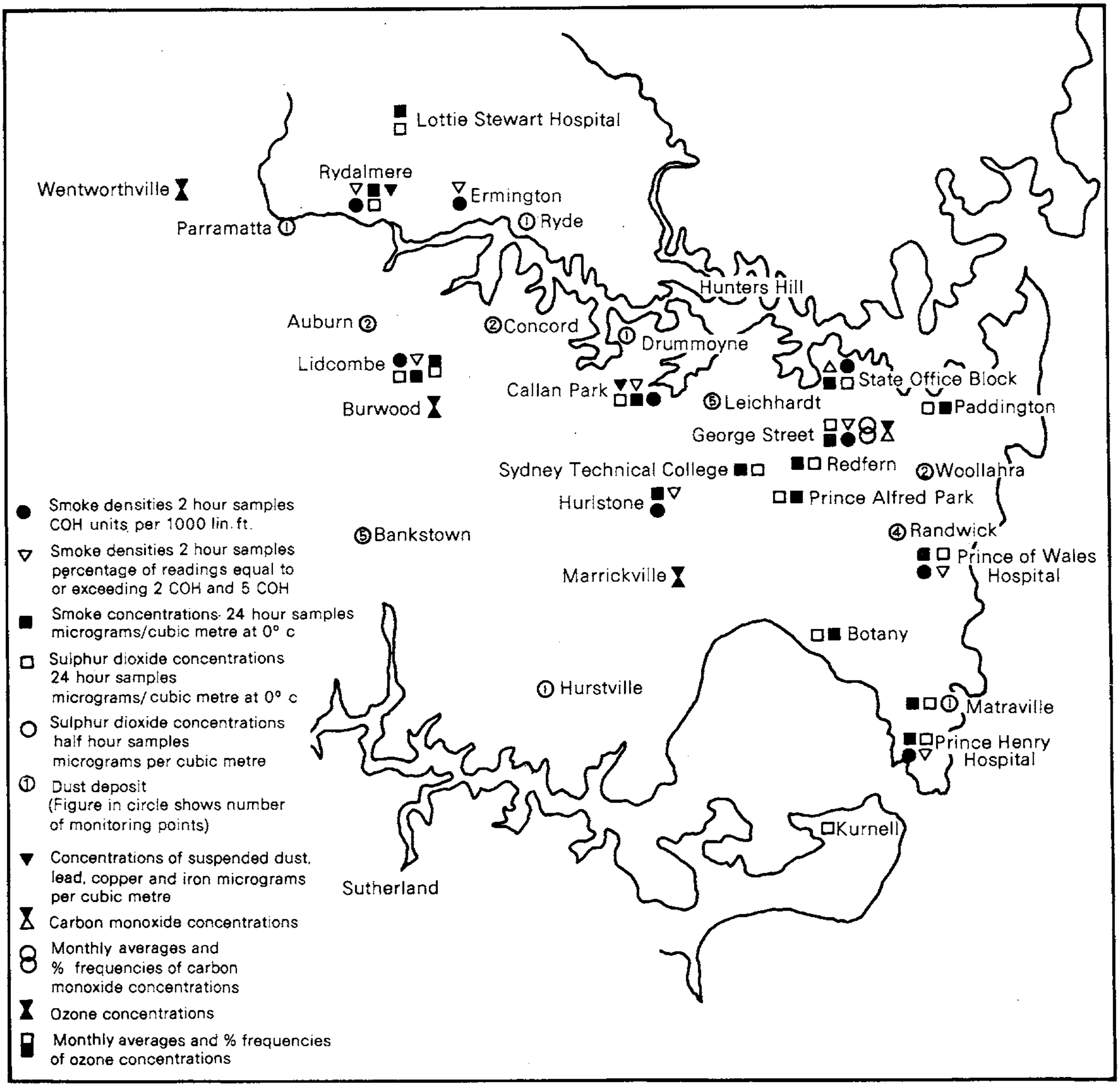



Fig. IX (v) Location of air monitoring sites in Sydney wastes on different city areas and in defining the more undesirable areas of different waste concentrations. Because transport links places of work, shopping, leisure and residence, this understanding of atmospheric characteristics feeds back to planning strategies for land-use associations.

*Ambient air monitoring.* As distinct from source monitoring at or close to emission sources, ambient air monitoring provides an areal pattern of waste concentration as an input into decision making. It provides a means of assessing the areal effects, after dispersal by air flows, of waste emissions on ambient air quality and of evaluating trends in concentrations and the consequences of control procedures. In fact, ambient air monitoring data do not provide a simple detective or evaluation source since other facets apart from human wastes and selected controls affect the results.

Figure IX(v) shows the system of monitoring sites established in the Sydney metropolitan area as at the end of 1974.[22] The metropolitan area in 1974 had five regular fixed monitoring sites measuring coefficients of haze, sixteen each measuring suspended matter and sulphur dioxide, fifty-six measuring dust deposition, three measuring lead, copper and iron suspended solids, one measuring carbon monoxide, three measuring ozone and two each measuring nitrogen oxides and hydrocarbons. As the figure shows, the sites are predominantly located in the southern half of Sydney, partly reflecting industrial concentrations and partly the low lying areas in the southern half. The low number of monitors in the northern half does not reflect the use of motor vehicles in this area and the emissions of nitrogen oxides and hydrocarbons. In addition to the fixed monitoring sites, the A.P.C.B. moved, in 1975, to develop some mobile monitors.

The monitoring data have a great many weaknesses. Ozone, nitrogen oxides and hydrocarbons monitoring is very limited and the results appear to be inadequate guides to these ambient waste concentrations. By contrast, the proliferation of data on suspended matter, sulphur dioxide and especially dust monitors suggests an excessive preoccupation with some wastes. More seriously, the data have until recently been published very slowly, with delays as long as two years. The attempt, in 1975, to produce quarterly monitoring results has yielded an incomplete collection of material that is less practically useful but may serve some public relations purposes. The statistical indicators presented, leaving aside the discontinuities, display a marked lack of interest in sampling measures that would convey meaningful information to those who might wish to use it. In fact, unless the data are used with considerable care, seriously incorrect inferences can easily be drawn from them.

*Emissions inventory.* During 1972 the A.P.C.B. embarked on an emissions inventory related to stationary sources. In this the Branch sought to obtain from the scheduled premises listed the types and volumes of emissions. This was based on specification of volumes and types of fuels used, using emission coefficients based on overseas experience. The complete assessment covered particulates, nitrogen oxides, sulphur oxides, carbon monoxide and hydrocarbons. Only the first two were adjusted to allow for particular technological considerations in Sydney.

This inventory was an invaluable information input for control purposes. It was limited to the year 1971/2 and to the scheduled premises. Supplementing the stationary source inventory, the Sydney Area Transportation Study incorporated, apparently as an afterthought, volumes of emissions from vehicles. This study related to the base year 1971, so that the A.P.C.B. and S.A.T.S. studies may be reasonably combined to provide the volumes, types, sources and area locations of these major waste emissions to the ambient air. These studies represent, together, an invaluable array of potential emissions at this base date. S.A.T.S. also included, with questionable assumptions, projections of vehicle emissions to the year 2000.

S.A.T.S. has been superseded by the Urban Transport Study Group. This Group is incorporating air-borne waste emissions in its continuing studies, though up to the time of writing attention had been chiefly concentrated outside Sydney.

*Ozone studies.* The Organisation for Economic Co-operation and Development requested, in 1973, studies of ozone concentration in different countries. Four were prepared of which one was for Sydney, carried out by the A.P.C.B. in association with universities in Sydney. For this report, the Branch relied on its scheduled premises emissions inventory and the S.A.T.S. study. The basis of the work was the completion of emissions of nitrogen oxides and hydrocarbons, providing an approximate basis on which to establish control priorities. Emissions were determined on a 2 x 2 miles grid square to facilitate use of diffusion models. Emissions were calculated for two periods, the morning peak traffic period of 7 to 10 a.m. and the daily totals.

This study identified three major area sources of the primary wastes contributing to photochemical smog:

(i) North Sydney-City-Pyrmont-Waterloo due to high vehicle density and high industrial activity
(ii) Kurnell-Phillip Bay-Matraville with low vehicle density but very high industrial activity
(iii) Parramatta-Clyde-Silverwater-Ryde with moderate vehicle density and high industrial activity

*Meteorological investigations.* The Australian Meteorological Bureau provides data on high level (gradient) winds, and since 1970 the A.P.C.B. has maintained liaison with this Bureau. However, gradient winds provide only a part of the total pattern of air movements. Other necessary information covers surface winds, breezes and night air flows, all part of the smog formation process. These more detailed air movement studies have been initiated at Macquarie University and have been supported by the Botany Bay Project and by the S.P.C.C. through funding arrangements. Some of the general findings have been indicated in the preceding chapter. Air movements need to be understood in detail, both geographically and diurnally, to provide necessary input into air quality modelling as part of a broader control process.

*Sydney Oxidants Study.* The preceding three groups of data provide basic input into one mode of approaching the strategic issues of air quality management through modelling processes. The Sydney Oxidants Study, a co-operative undertaking of the A.P.C.B. and other expert institutions, including Sydney and Macquarie Universities, combines meteorological and emission characteristics with computer modelling. Models provide for prediction of passages of wastes around different areas of Sydney in relation to the sources, types and values of emissions and other meteorological characteristics.

The results of this study have yet to be published (at time of writing). It remains to be seen whether they will provide an advance on the essentially descriptive air movement study at Macquarie University. Potentially, the modelling approach might go beyond specific questions of waste emission control and provide basic relationships that would be an input into city planning. In this event, there may be the opportunity for conscious preventive action to be taken through planning procedures to provide for improved air quality. It is partly in the light of these possibilities that consideration has recently been given to expanding the ambient monitoring network. In order to provide a better data base, this expanded network has been envisaged as encompassing not merely waste concentration but, in addition, a variety of meteorological measures such as wind movements, temperature, humidity, cloud phenomena, etc.

*The need for a broader perspective.* These developments towards a more thorough understanding of Sydney's atmospheric conditions have moved the S.P.C.C. away from the earlier concentration on the attack on stationary sources of wastes and from a separate attack on the technology of mobile sources to what is potentially a basically different stance: the approach to air quality management.

Air quality management cannot be very satisfactorily operated through the specific *ad hoc* technical procedures that have characterised the development of the A.P.C.B. The Branch has been highly successful through this procedure in the control of particulates, smoke and dust. Once the nature of Sydney's air environment is perceived as a system, the options for control strategies extend beyond these technical specifics. In the past two or three years, the photochemical smog problem has overshadowed others in the work of the Branch. It remains to be seen whether response to this problem will lead to a reappraisal of its methods of devising control approaches in determining objectives and choosing technology, in its relationships with other authorities, in its evaluation of air quality changes and in its staffing.

The attempts to understand Sydney's atmosphere will be largely purposeless unless radical change is made in all these areas. The Branch's task, if it is to be the manager of Sydney's air quality rather than the controller of Sydney's air-borne waste emissions, becomes far larger and far more socially intrusive than it has so far appeared to be.

The location of stationary sources of air-borne wastes is determined by specific market responses by industry in choosing locations; by changes in products, materials and technology in generating different wastes at a given location; and by planning restraints on land use. In turn, there are conflicts over residential, commercial, industrial, recreational and other uses of different areas, all of which affect the dispersion of waste sources around Sydney. The flows of traffic are determined by these market responses and land-use planning provisions which determine the need for trips by Sydney residents; and by the availability of different modes of transport available to those making trips.

These elementary characteristics of the city have fundamental consequences for the behaviour patterns and welfare of city residents. They are not merely determined by vehicle and control technology but are a matter, however restricted, of the individual preferences of consumers and business. Interference with these preferences by technologically designed solutions to the particular problems of air quality may quickly lead to collision between controllers and residents. This type of collision has been dramatised recently by the proposed Botany Bay port development.

There appears to be a strong case for more effective action to protect Sydney's ambient air quality and this means restraint on existing residents' behaviour, most importantly in petroleum-consuming vehicle use. The S.P.C.C. cannot expect or be expected to undertake this task. It is not equipped for it and lacks the effective power; where it has the power, it appears on several occasions to have failed to use it. The social relevance of the changes needed to achieve reasonable air quality standards does not make the task any easier. On the contrary, the basic change needed in Sydney is for a much greater recognition that the task is much more difficult and much more related to social considerations than has been perceived. It is the integration of environmental criteria in the variety of Sydney's planning and management agencies rather than in the enforcement of specific controls that is essential. This approach was suggested when the first and only Minister for Environment Control was appointed. It has been lost from sight.

Unless a simpler and cheaper control is developed for motor vehicle emissions, the present approach will remain costly and of uncertain achievement. It is possible that change in energy sources in the future may cope with the specific problems of air pollution. The availability of new technology to remove dependence on fossil fuels is uncertain. This, in itself, suggests the importance of a more socially-oriented planning approach for preventive purposes. But, in any event, the need to conserve energy, particularly in cities, is likely to be an increasing problem for the rest of this century. There are other reasons, apart from the physical environmental issues on which we have focused, which lead to the same conclusion. Road congestion, inefficiencies of transport, the demands on available land from road transport systems, traffic accidents, the problems of accessibility in a city combine as additional issues to lead to the need for positive city planning policies, not merely specific technical controls.

# 10 Dumping on land

## Introductory

In all areas of pollution control the price is being paid for 'mistakes' made in the past. We hope similar mistakes can be avoided in the future through greater foresight and greater understanding of the interrelations between different urban planning areas and the environmental repercussions of our activities. Attitudes to waste management issues have often been *laissez-faire*, with little attention given to resource conservation and to the limited capacity of the environment to absorb waste materials. 'Out of sight, out of mind' appropriately sums up much of waste management 'policy' in the past. The size of the population is the key independent variable in any pollution problem whether applied to a city, a region, a nation or to the world as a whole. As population pressure on the resource base increases, the impact of the environment intensifies and a process of degradation, in some cases irreversible, may set in. Technology has given man the power to make significant alterations to the environment but at the same time it has speeded up the process of environmental degradation. Added to this, the importance given to economic growth and to material benefits has encouraged uncritical use of natural resources.

The traditional method of on-land disposal of wastes, both solid and liquid, is known as sanitary landfill or controlled tipping. This, the conventional method, is now seem to have a number of shortcomings. However, in the past, when amounts of waste were smaller and had a lesser impact on the environment and when less was known about alternatives to landfill, it was generally considered acceptable to rely on this method of disposal. As urban areas like Sydney continue to expand and to become more densely populated, as manufacturing increases and standards of living rise, it becomes increasingly difficult for wastes to be absorbed. Problems of waste management become more urgent. The feasibility of continuing to use landfill is often severely curtailed by the lack of suitable sites. The whole waste cycle must be re-evaluated: ways must be sought to control and restrain the generation of wastes; efficient means of waste transport must emerge; traditional methods of waste disposal must be re-examined and alternatives explored if further environmental degradation and threats to public health are to be avoided. On-land disposal of wastes must be seen in the context of the total waste management system. Wastes disposed of on land do not affect only the land: leachates from poorly designed landfill sites can pollute surface and underground waters; odour and smoke problems occur where landfill sites are inadequately covered or where incinerators malfunction.

In addition to new technology, new forms of management and control — for example, new public authorities or new powers for existing authorities, new laws, new standards, new limits on waste generation and new waste pricing policies — may need to be introduced in order to control pollution. Politically, waste management is a contentious area often involving friction amongst authorities, partly because their responsibilities conflict and partly because their regions of control differ. The management of land-borne wastes is fraught with problems similar to those which affect the waste management system as a whole — uncertainty in planning, lack of definition of objectives, lack of absolute decision-making authority. Typically, waste management issues are not clear cut; for example, the location of a landfill site or other disposal facility in one locality may be highly advantageous in a regional context but greatly displeasing to the residents in areas immediately adjacent. The various public authorities who manage the wastes generated in Sydney are currently facing the need to re-evaluate technological and management issues.

In this chapter, the focus, in terms of final responsibility for disposal, falls on one institution, the Metropolitan Waste Disposal Authority (M.W.D.A.), and the role which the Authority has played in coping with current waste management problems and in formulating future plans for the Sydney region over the period 1971 to 1975.

The major issues confronting the M.W.D.A. are:

(i) existing and potential waste management technology and some of the difficulties encountered in applying this technology;

(ii) the environmental threats posed by inadequately controlled disposal of domestic and industrial solid wastes;

(iii) the need for firm control by an authority or authorities with adequate resources, expertise and foresight to deal with waste management problems, to evaluate alternative strategies and to make decisions which will protect the best interests of the community;

(iv) the need for increased public and industry awareness of waste management issues, acceptance of higher costs and higher prices where necessary and greater participation at individual and community levels in attempts to overcome some of the current waste management difficulties.

This chapter is concerned with two forms of waste disposed of on land in Sydney — *solid* wastes generated by households and industries, and certain *liquid* waste residues generated by industries. Wastes disposed of on land constitute a very significant part of the total quantity of wastes to be handled within any unit of time. It is estimated that the weight of household garbage alone is approximately ten times greater than the weight of waste materials (excluding the water) contained in domestic sewage in the Sydney region. Quantities of household garbage are approximately equal to the quantities of trade, commercial and industrial solid wastes measured on a *per capita* basis.[1] The industrial liquid wastes dumped on land pose formidable problems for the M.W.D.A. and for industry. Of the total volume of industrial liquid wastes generated in Sydney, the vast part are discharged into sewers, stormwater drains or natural watercourses. The remaining small proportion of industrial liquid wastes (estimated to be about 227 million litres each year, or less than 0.5 per cent of the estimated quantity of all liquid wastes generated each year in Sydney)[2] are either extremely toxic or highly concentrated. Such wastes are unsuited to sewerage systems for technical reasons.[3] Further, with the advent of water pollution control policies in New South Wales there are restrictions on their discharge into open waterbodies because of their adverse impact on part of the environment.

## Waste disposal in Sydney: background to the 1970s

The decades of the 1950s and 1960s may be broadly described as a period when waste disposal problems and their impact on the environment in Sydney became more pressing and more generally acknowledged by the community. Yet there was an inability and an unwillingness to make changes necessary to cope with the emerging problems. It is not our task to analyse all the obstacles to reform; it is sufficient to state that at the heart of the failure to respond lay the social and economic differences existing between local councils in the evergrowing metropolis. Some of these differences are discussed in Chapter 5.

The first official attempt to cope with Sydney's waste on a city-wide basis began with a survey of available landfill sites in the metropolitan region by the Cumberland County Council in 1958 (the area of the County contained the metropolis and rural land for its future expansion). The Council's report was optimistic: it forecast that there was sufficient landfill capacity to absorb the solid wastes generated in Sydney for up to thirty-five years from 1958.[4] The County Council's investigation was interested in the *quantity* of the wastes to be discarded. There does not appear to have been a corresponding interest in the nature of the wastes to be discarded, the *sources* and location of the wastes that were generated, and the impact that such wastes had on the urban environment. The growth of industry in Sydney generated new forms of chemical wastes which were discharged to air, water and land. The Smoke Abatement Committee in its Report on *Air Pollution in New South Wales*, which was released in 1958, was instrumental in securing intervention by the government to control industrial air pollutants by means of the Clean Air Act, 1961. This Act provided for one part of the waste problem. As the Director-General of Public Health wrote, also in 1958, 'Atmospheric pollution and disposal of effluents from factories give rise to many complaints'.[5] The problem of pollution caused by industrial effluents discharged onto land and into water was deferred until 1969. In that year local government councils in Sydney banned the dumping of industrial liquid wastes at their garbage dumps. The ban forced an assessment at State government level of the total problem of on-land disposal of the solid and liquid wastes generated by households and industries in Sydney. Ultimately this assessment, which was conducted in 1970 by a British waste disposal adviser, A. E. Barton, prompted the establishment of a new State government agency, the Metropolitan Waste Disposal Authority in 1971.

### *Local government councils and waste disposal in the 1960s*

Local government councils in Sydney have been the traditional authorities responsible for regulating the disposal of wastes within their municipal boundaries. Their chief, if not sole, concern was with the volume of wastes discarded by households. The actual arrangements for the collection, transport and disposal of household garbage varied among councils; most operated their own garbage disposal service, but some engaged private contractors to remove and dump the garbage whilst retaining the formal power to supervise all aspects of that activity. The numerous local government areas in the Sydney metropolis showed marked differences in population, in area and in the level of industrial activity. Hence there were variations in the volume and kind of wastes generated and in the sites available for discarding wastes within the respective municipal boundaries. Despite the optimistic forecasts of the Cumberland County Council on the availability of landfill sites for the disposal of the *aggregate* household wastes generated in Sydney, a large group of local government councils encountered ever-increasing problems in disposing of their area wastes during the 1960s. First, disposal sites in the 'inner' and older parts of Sydney grew scarcer. Moreover, as the margins of the metropolis sprawled further across the County of Cumberland, the distances of available disposal sites from the sources of waste generation in 'inner' areas increased. The increase in time and cost of transporting wastes to outlying disposal sites that was imposed by distance was added to by growing traffic congestion. Second, the variations in waste disposal problems among individual local government councils meant that there was no common pressure operating that could foster regional co-operative endeavours to manage the disposal of wastes on land. Political pressures removed the one body that might have provided the machinery — despite its imperfections — for local government co-operation in the metropolis. The replacement of the Cumberland County Council (ten councillors elected by metropolitan local councils) by the State Planning Authority in 1964 eliminated the metropolitan focus and Sydney's only metropolitan planning authority in favour of a statutory authority with State-wide planning responsibilities. Yet metropolitan planning and management of wastes became increasingly urgent during the 1960s. Symptomatic of this state of metropolitan affairs was the publication of the Sydney Region Outline Plan by the State Planning Authority in 1968. This document was not a statutory plan but an advisory strategy which sought to foster the economic growth of Sydney as Australia's leading urban region up to the year 2000. It contained no advice for managing any of the wastes generated within the metropolis, let alone the wastes disposed of on land. During this decade a new constraint was added to local government waste disposal. The introduction and the gradual implementation of the Clean Air Act 1961, which was given added political impetus by the rediscovery of 'pollution' in the late 1960s, put greater pressure on local governments to abandon the practice of burning their garbage, either accidentally or intentionally, in order to reduce its volume, and to employ disposal methods which were smokeless and odourless.

In the absence of a metropolitan agency to manage waste disposal, those local governments that lacked adequate sites to accommodate their future waste volumes grouped together to investigate the urgent problems confronting them. In 1963 a committee drawn from the eastern suburbs of Botany, Randwick, Waverley and Woollahra reported on the possibility of dumping their household garbage on the north foreshore of Botany Bay, thus 'reclaiming' the land. The site of this scheme lay close by Sydney airport. Following objections from the then Commonwealth Department of Civil Aviation that putrescible household wastes would attract flocks of seagulls and so create an aircraft hazard, the Botany Bay land reclamation scheme was abandoned.[6] In 1967 two of the councils, Waverley and Woollahra, composed of well-to-do suburbs, commissioned a detailed survey of wastes generated. The results of the survey helped them to plan the establishment of a jointly-operated incinerator at Waterloo in an adjoining municipality (now South Sydney).[7] Other councils were similarly interested in coordinating waste disposal within a limited area. In 1965, the Canterbury Council called a conference on waste disposal; this meeting led to the formation of the Western Suburbs' Refuse Disposal Committee.[8]

*Further investigations on a city-wide basis*

The pressure of events impelled certain local government councils to search for alternative means for disposal of municipal wastes. However, the lack of data on wastes effectively prevented a realistic assessment of the problem. In 1968 another attempt was made to view waste disposal problems from the perspective of the metropolis as a whole. The Local Government Association of N.S.W. commissioned two investigations into garbage disposal in the County of Cumberland.[9]

Both studies, which were conducted by private consultants, reported that garbage disposal costs would increase greatly. For example, one estimated a rise from $2 million in 1967 to $50 million in 1987. However, such estimates should be treated with caution, for both studies emphasised that there were no adequate data on the quantities and nature of domestic refuse. Using some local and overseas data, attempts were made to estimate the volume of Sydney garbage. These figures, which show weight and volume, are summarised in Table X-(1). Neither study attempted to assess the opportunities to reduce waste flows, and hence to reduce the volume of wastes for disposal. In short, the symptoms not the causes of waste problems were investigated.

Each report also urged that local government councils co-operate in disposing of their wastes. Outer city councils might have to reserve relatively large areas as disposal sites in order to cope with the disposal problems of inner city councils which no longer had space available for their wastes. Residents of inner city areas would face increasing costs for waste disposal services and might also find that the services had to be reduced. Both reports advocated that, ideally, a solution to the waste management problems should be sought in the form of an overall plan for the Sydney region. Some of the recommendations of each of these reports, such as the phasing in of new facilities, were later adopted by the M.W.D.A.

Table X-(1) Estimated total weight and volume of Sydney refuse, 1967 and 1987.

| Weight/Volume | 1967 | 1987 | Change % |
|---|---|---|---|
| Population | 2.5 m | 3.5 m | + 40 |
| Cubic metres/1000/week | 27,500 | 120,600 | +340 |
| Tonnes/1000/week | 5.4 | 14.7 | +173 |
| kg/cubic metre | 199.5 | 126.4 | - 37 |
| Cubic metre/kg | .005 | .008 | + 60 |
| Tonnes/week | 13,475 | 51,450 | +280 |
| Cubic metre/year | 6,288,000 | 37,466,000 | +510 |

Source: P.A. Management Consultants Pty Ltd, *Sydney's Refuse Disposal Problem* Sydney, 1968, p. 22.

*The State Government intervenes: the Barton Report*

These moves by the Local Government Association were followed in May 1970 by the commissioning of the Barton Report by the New South Wales Government Cabinet Sub-Committee on Waste Disposal.[10] The Report covered the disposal of liquid and solid industrial wastes as well as the disposal of household garbage. It included short descriptions of several council tipping areas and pointed to their shortcomings — in some instances the extreme proximity to private homes was noted. Of a total of twenty-one tips examined, only eight received favourable comments at all.[11] The remaining 13 tips examined were all criticised on the basis of one or more unsatisfactory aspects.[12] Particularly bad were two of the Homebush sites, the one at Bressington Park and the Maritime Services Board site, and the Auburn Council tip. These sites were badly maintained, they were badly drained and located (leachate problems), burning was not infrequent and vermin and odour problems also existed.

In addition to assessing the then waste disposal situation in Sydney, the Barton Report drew attention to the waste disposal problems which the city was likely to face in the not too distant future. The point was made that the Sydney Region Outline Plan does not contain any plans for the disposal of industrial and household wastes. The population of Sydney was then expected to rise to approximately 5 million by the year 2000. Even if actual population numbers fall short of expected levels, as seems possible from recent estimates in the First Report of the National Population Inquiry in 1975, the total amount of garbage is still likely to increase significantly as *per capita* quantities of waste continue to grow. It has been estimated that the weight of domestic and municipal garbage in Sydney may increase from 1.2 kg per person per day in 1971 to 3.6 kg per person per day by 2000[13] (Table X-(2)). Although these estimates may be rather high — they assumed an annual growth rate of 4 per cent in the quantity of waste generated — quantities of wastes seem likely to double at least by the end of the century even with considerable constraint on waste generation.

The Barton Report also stressed the lack of data both on domestic and on industrial wastes in Sydney and proposed a system of registration and licensing of all waste disposal services. Data collected by registered and licensed services could provide the foundation for the planning and management of disposal

Table X-(2) Increases in per capita waste generation — domestic and municipal (kg per person per day)

| City | 1971 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|
| Sydney | 1.2 | 1.3 | 1.5 | 1.9 | 2.3 | 2.8 | 3.6 |
| Melbourne | 1.0 | 1.2 | 1.4 | 1.8 | 2.2 | 2.8 | 3.6 |
| Brisbane | 1.0 | 1.1 | 1.3 | 1.5 | 1.9 | 2.3 | 2.9 |
| Perth | 1.1 | 1.2 | 1.4 | 1.6 | 2.0 | 2.2 | 3.0 |
| Adelaide | 0.8 | 1.0 | 1.2 | 1.5 | 1.8 | 2.2 | 2.8 |
| Hobart | 0.8 | 0.9 | 1.1 | 1.3 | 1.6 | 2.0 | 2.5 |
| Canberra | 0.7 | 0.8 | 0.9 | 1.1 | 1.4 | 1.8 | 2.3 |
| Darwin | 0.7 | 0.8 | 0.9 | 1.1 | 1.4 | 1.8 | 2.3 |

Source: J.J. Varjavandi, and T.J. Fischof, 'A Survey of Community Solid Waste Practices in Australia', *Proc. of the 1974 A.W.M. and C.C.*, Sydney, 1974, p. 70.

facilities. Basing his recommendations on the results of research carried out in London, Barton proposed that the collection and disposal of garbage should be considered as two entirely separate activities. The collection could remain the responsibility of a local authority but a central body should be charged with the responsibility of planning, coordinating and administering the disposal facilities. According to Barton this sytem would have the advantage that elected representatives are responsible to ratepayers for the removal of household wastes, which he calls 'a very personal service'.[14] In discussing the large projected increase in the quantities of domestic garbage to be disposed of, Barton said:

> the present method of garbage disposal by tipping will have to be reconsidered and very much larger sites obtained or . . . the system changed to one that is capable of reducing all bulk by the maximum amount. It is not a difficult problem but one that will not wait.[15]

The Barton Report went on to highlight the problems of industrial liquid waste disposal in Sydney. At the time when the Report was commissioned, industrial liquid wastes were commonly disposed of in municipal garbage tips, the solid matter being used to absorb the liquids. The Barton Report recommended that this practice be discontinued as soon as possible and that the control of industrial liquid and solid wastes be treated as an urgent matter. The view was expressed that this control should be placed in the hands of a single authority and that the authority should also be responsible for the disposal of household garbage. The main advantages of this sytem would be that such an

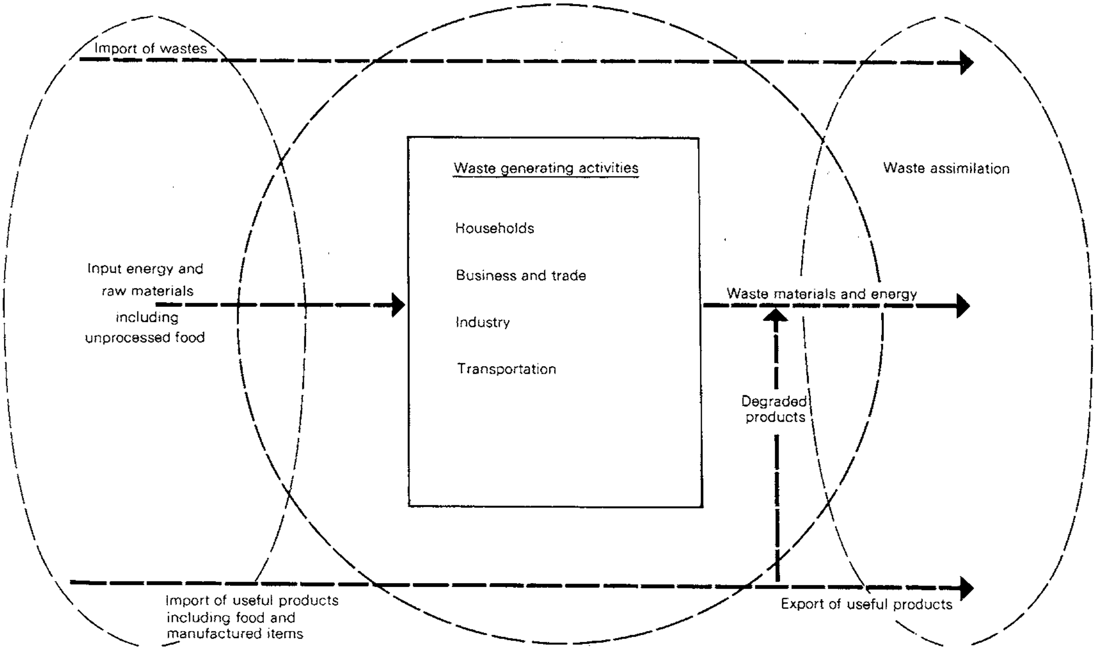



Fig. X (i) Solid waste flows

authority would devote all its energies to waste disposal, not being distracted by other functions, and that forward planning of disposal facilities could be carried out on a regional basis.

## Solid waste cycle

Materials and energy enter a city region (or urban system) from a number of different sources and in a number of different forms (Figure X(i)). Materials entering a city are essentially of two types — processed and unprocessed. These materials at the end of their useful life constitute the major proportion of solid wastes which must be discarded in or near the city region. In the case of unprocessed materials, including food, the production processes used to convert them into usable goods and the energy used in production are additional sources of waste. Although probably of insignificant proportions and in any case difficult to estimate, waste materials may also enter a city region in the atmosphere; for example, dust from an industrial activity may be carried into an adjacent area and deposited there; wind-blown waste materials can easily enter a region.

Within a city region, solid wastes are generated by industry, by households, by business and commercial enterprises and by transportation activities. In a

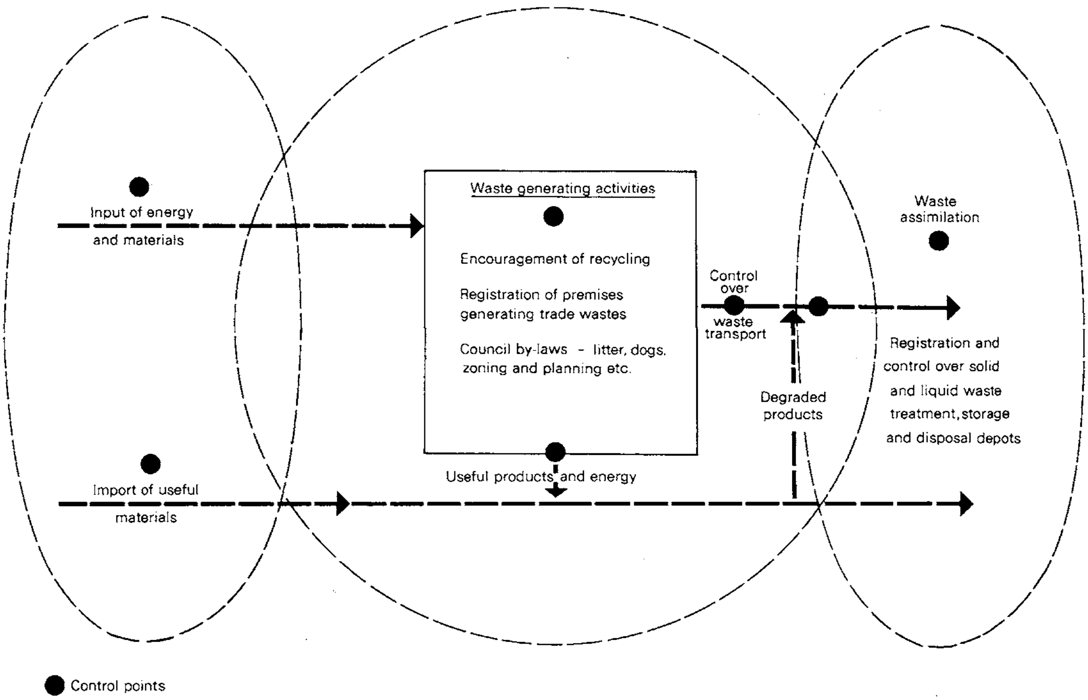



Fig. X (ii) Controls on the solid waste cycle large industrial urban area such as Sydney, the total quantity of industrial waste generated each year will approximately equal the quantity of domestic waste. However, because many industrial concerns dispose of, or recover and recycle their own waste materials, the waste disposal activities of local council and other authorities tend to concentrate on the disposal of domestic and trade (or commercial) wastes, and the public is generally more aware of the existence of these wastes and the problems of controlling their polluting impact on the urban environment.

Waste materials and waste energy may be dealt with in a number of ways, each of which has a greater or lesser impact on the environment (Figure X(ii)). For example, industries can be encouraged to recycle waste materials at various stages in the production process, thereby reducing the quantities of waste to be disposed of outside the factory. Steps can be taken to reduce quantities of solid wastes from trade and commercial premises and from households by

Table X-(3) Composition of domestic refuse from various countries (weight %)

Part A

| Component | Australia (Sydney) | Canada | France (Paris) | Israel | Sweden | U.K. | U.S.* |
|---|---|---|---|---|---|---|---|
| Ashes and dirt | 3.0 | 5.0 | 24.3 | 1.8 | — | 30-40 | 10.0 |
| Mixed paper | 35.0 | 70.0 | 29.6 | 24.0 | 55.0 | 25-30 | 42.0 |
| Putrescible matter and garden waste | 35.0 | 10.0 | 24.0 | 71.3 | 12.0 | 10-15 | 22.5 |
| Metal | 6.0 | 5.0 | 1.2 | 1.1 | 6.0 | 5-8 | 8.0 |
| Glass | 16.0 | 5.0 | 3.9 | 1.0 | 15.0 | 5-8 | 6.0 |
| Rags, plastic, etc. | 5.0 | 5.0 | 14.0 | 1.8 | 12.0 | 5-10 | 11.5 |
| Weekly vol. of refuse produced per family (kg) | 18.2 | 21.8 | 15.5-18.6 | 10.9 | 11.8 | 14.1-17.3 | 40.0 |
| Kg *per capita* per day | 0.7-0.9 | 1.0 | 0.8-1.0 | 0.4 | 0.6 | 0.7-0.8 | 1.5-1.9 |

*Includes commercial and industrial wastes.
Source: E. van den Broek and N.Y. Kirov, 'The Characterization of Municipal Solid Wastes', *Proceedings of the 1971 Australian Waste Disposal Conference*, Sydney, 1971, p. 25.

Part B

| Component | Sydney | U.K. |
|---|---|---|
| Mixed paper | 36.6 | 60.0 |
| Putrescibles | 32.8 | 11.0 |
| Plastics | 1.6 | 2.3 |
| Rags and miscellaneous | 2.7 | 2.4 |
| Tins and metals | 7.0 | 6.0 |
| Glass | 6.4 | 2.3 |
| Salvageable bottles | 12.9 | 16.0 |
| Kg *per capita* per day | 0.4 | 0.5 |

Source: J.E. Williams, 'Management and Disposal of Wastes Generated in 30-40 Storey Blocks of Flats', *Proc. of the 1974 A.W.M. and C.C.*, Sydney, 1974, p. 88.

introducing returnable containers and by encouraging the separation of recyclable materials such as paper from non-recyclable materials. Those wastes which are not recovered and reused within a factory can be disposed of in a number of ways, the main ways being sanitary landfill, composting, incineration, pyrolysis and ocean dumping. The use of any one or more of these methods of disposal in an urban region is determined by a large number of factors. These include the density of settlement in the region, the availability of suitable sites for landfill, the location of the region (coastal or inland), the degree of technological development in the region, and the social and economic characteristics of the region.

There are essentially three points in the waste cycle: generation, collection and disposal. At each point controls may be imposed to regulate the quantity and quality of waste materials and the methods of handling them. The control system and the methods and rigidity with which it is applied can vary greatly and depend on the physical, social, economic, political and technological characteristics of the region. The degree of environmental consciousness prevailing in the region may also be reflected in the strictness and application of the controls on waste management. For example, the response to complaints by residents affected in some way by pollution may be an increase in the supervision of the source of pollution and legal action may even be taken if the problem persists. In general, Sydney has made very few steps towards control of generation, reuse and recycling of wastes.

*Generation of wastes in Sydney*

The household waste stream is complex from a number of points of view.[16] The number of sources is very large and each generates a relatively small proportion of the total waste. The material is heterogeneous and difficult to sort, making recovery and reuse difficult. There are many points in the management of household wastes at which decisions can be made and research and technology applied (Fig. X(ii)).

The components of household garbage are essentially glass, paper, tins, plastics, food scraps, dust and ashes and cloth (Table X-(3)). The composition of garbage does not show many significant variations from country to country although within any area there are subtler variations in the composition of garbage which depend on factors such as socio-economic status and ethnic origin of the people. For example, southern Europeans generally consume more fresh fruit, vegetables and crustaceans than northern Europeans; hence the garbage of southern Europeans usually contains a higher proportion of putrescible matter. Variations are also attributed to the composition of the household and the employment status of the wife. If the wife is employed outside her home, it is likely that her family will use more pre-packaged foods and greater quantities of labour-saving commodities. Seasonal variations in the composition of domestic garbage may also be quite marked. It is clear from Table X-(3) that the largest proportion of garbage (metal, glass, paper) is derived from the packaging of goods and it is worthwhile focusing on this issue briefly.

The generation of solid wastes does not really begin at the individual household level; it begins in the factories and processing plants where pre-packaged goods are prepared for sale. A fundamental part of any successful waste management system should involve a consideration of this important source of wastes. It seems that any attempts to reduce *per capita* volumes of garbage generated on a day-to-day basis should emphasise a reduction in the amount of packaging materials used. Fundamentally, packaging is predominantly derived from so-called labour-saving technology in factories and shops. This technology, convenient for business, ends in a labour-intensive and environmentally damaging disposal process.

But this is a complex issue. Shoppers are now almost completely dependent on supermarkets where goods placed on display must be securely packaged for health reasons, for safe and easy transfer to trolleys and checkouts, and for protection from damage and theft. The situation is further complicated by the fact that packaging has been a rapidly expanding and highly lucrative industry in its own right. Manufacturers have vied with each other to produce attractively packaged items and there seems to be little end to the sophistication and elaborate nature of packaging.

By comparison with the United States, the packaging industry in Australia is relatively small. Twenty-one companies in Australia belong to the Packaging Industry Environment Council (P.I.E.C.) which was formed in 1971. The main aim of the Council is to serve as a pressure group. In the context of the debate on waste generation, the Council puts the case for the benefits conferred upon the community by the packaging industry. The industry claims to be involved in research into resource recovery and solid waste management, in an attempt to see packaging in the wider context of waste management issues.[17] However, the question one is left with is whether enough effort is being devoted to seeking ways of reducing and simplifying the current elaborate packaging. Greater bulk buying by the consumer could possibly be one way to reduce packaging but its success would be dependent on radical changes in consumer behaviour. Moreover, the modern home, particularly a flat or home-unit, does not generally provide adequate storage space for bulk purchases of food and other commodities.

A recent development in Australia is the establishment of a Packaging Centre within the framework of the National Materials Handling Bureau.[18] The general aim of the Packaging Centre is to assist industry and government departments in the development and use of efficient packaging techniques. The Packaging Centre is also interested in the reuse and recycling of packaging materials. The Centre has been in operation for about two years. It has equipment for testing packaging materials and during 1975 proposals for new and extended laboratory facilities were being discussed. The role of the Packaging Centre is to act independently of both manufacturers and consumers in determining whether or not articles are over- or under-packaged. In all its functions and research programs, the Centre maintains a close association with the Australian Institute of Packaging.[19]

Data on solid wastes generated by industrial establishments are very difficult to obtain. The Australian Consolidated Industries (A.C.I.) survey contained estimates of total solid refuse including trade and industrial wastes.[20] *Per capita* industrial waste generated was estimated at .795 kg per day.[21] However, no attempt was made to differentiate the industrial component of 'municipal' wastes;[22] hence the figures must be treated with caution. In Sydney many industries have private arrangements with councils and contractors for the disposal of waste materials and other industries use private land as disposal sites. There is a real need for the M.W.D.A. to undertake research into the generation and disposal of industrial solid wastes.

*Collection of garbage in Sydney*

There are many options for the collection of household garbage; it may be sorted into its various components prior to collection or it may be collected unsorted. It is generally considered impractical to encourage a high degree of sorting of garbage at the individual household level and the majority of systems today favour sorting at some central point or recycling unit. Separation of garbage at the individual household or local community level has generally taken the form of collection of items such as newspapers, bottles, tin cans, etc. by a voluntary organisation or a local council authority.

Various types of trucks are used for the collection of garbage in Sydney, large compaction type vehicles now being increasingly common. Special arrangements are made for the bulk removal of wastes from high rise blocks of flats. However, few innovations have been made at the collection stage even in new housing areas and new buildings.

Despite the various moves during the 1960s and early 1970s to establish regional control of solid waste management the responsibilities for collection of garbage have remained with local councils and private waste disposal firms. The establishment of the Metropolitan Waste Disposal Authority (M.W.D.A.) in 1971 has not so far significantly altered solid waste collection practices in the Sydney region. The success of this administrative innovation is very much in the balance.

Collection of domestic solid waste is handled either by local council labourers or by waste disposal contractors working for the councils. In a number of instances, councils do not wish to operate garbage collection services, preferring to leave this to a contractor or contractors.[23] Because of the nature of the work, garbage services are characterised by high rates of labour turnover and high absenteeism. It has been the experience of some councils that the use of day labour by a council for garbage collection services is more costly than the use of

Table X-(4) Estimate of solid waste — commercial tenancies — Sydney 1971

| Use | Rate cubic metres | Floor area square metres |
|---|---|---|
| Office space | 42,450 | 92.9* |
| Retail store | 56,600 | 92.9† |
| Department store | 226,400 | 92.9† |
| Supermarket | 458,460 | 92.9† |
| Theatres | 31,130 | Screening/100 seating |
| Car park | 7,075 | 92.9† |

*Lettable area
†Gross area
Source: H.R. Healey, 'Bulk Removal of Waste Local Government Services, *Proc. of the 1974 A.W.M. and C.C.*, Sydney, 1974, p. 96.

contract services and that absenteeism tends to be greater amongst day labourers than amongst contract workers.[24]

Garbage services offered in each of the local councils throughout the Botany Bay region are similar: household garbage is collected twice weekly, and six-monthly or annual 'clean-ups' (removal of discarded heavy household items) are usually carried out.[25] It was estimated that 35 per cent of collection vehicles used in Sydney in 1972 were large capacity compaction vehicles manned by teams of three including the driver.[26] Numbers of vehicles per council vary depending on the size of the area to be covered and the density of population in the municipality.[27] The section on local government in this volume contains further information on the role of local councils in waste disposal services and includes a discussion of the costs of these services.

Most councils also operate trade waste collection services, again either with contractors or with council day labour. Healey produced data on quantities of solid wastes generated by commercial activities in Sydney (Table X-(4)).[28] He estimated that a commercial development of 372 square metres comprising a supermarket, five shops and two floors of offices would generate approximately 2.3 cubic metres of solid wastes per day. According to his estimates,[29] such quantities warrant on-site compaction and would require removal every two or three days by a container or bulk loading service. Such equipment is, however, costly to obtain and not all local councils have adequate resources to provide efficient trade waste disposal services. Another problem is that many large developments, commercial, industrial and residential, in inner areas of the city are prevented from using efficient methods of bulk waste removal because of poor access to service areas and narrow service lanes.[30] It was suggested that councils should provide a set of specifications for new and renovated buildings which would enable them to utilise newly developed bulk waste removal facilities.

*Waste transportation in Sydney*

In most Sydney local councils, wastes are trucked directly to a disposal site without the use of an intermediate transfer point. The only councils using transfer stations are Canterbury and Leichhardt. Most of the wastes are currently disposed of in sites within the area of the council or in an adjacent council area and transport distances to disposal sites are not very great. Exceptions are Ashfield, which uses a depot in Strathfield, a distance of less than 5 km; Concord, which uses a depot in Canterbury, a distance of approximately 8 km; Drummoyne, which uses a depot in Auburn, a distance of approximately 8 km; and Leichhardt, which uses a depot at Engadine in Sutherland, a distance of approximately 25 km. Both Marrickville and Randwick use the Waverley-Woollahra incinerator in South Sydney for putrescible wastes[31] and the Alexandra Brickpit in South Sydney for non-putrescible wastes. Although few councils are faced with the need to transport waste over long distances at present, this situation is expected to alter considerably over the next few years as inner city councils use up existing tips and have to seek disposal facilities in less densely developed areas.

Transport of wastes is a costly component of the total waste disposal process. A clear picture of the logistics of transporting garbage in the Sydney region

Table X-(5) Estimated solid waste disposed of annually in each local government area, Sydney, 1971

| Local government area | Population 1971 '000 | Putrescible wastes '000 tonnes | Non-putrescible wastes '000 tonnes |
|---|---|---|---|
| **1. Botany Bay drainage area** | | | |
| *Cooks River drainage area* | | | |
| South Sydney | 38.9 | 11 | 17 |
| Marrickville | 96.8 | 30 | 4 |
| Ashfield | 44.9 | 8 | 3 |
| Burwood | 31.9 | 8 | 9 |
| Strathfield | 27.2 | 6 | 1 |
| Canterbury | 130.4 | 32 | 20 |
| Rockdale | 84.2 | 21 | 30 |
| *North Botany drainage area* | | | |
| Botany | 38.2 | 7 | 3 |
| Randwick | 123.9 | no data | |
| *Lower Georges River drainage area* | | | |
| Bankstown | 162.7 | 27 | no data |
| Hurstville | 67.1 | 16 | 150 |
| Kogarah | 47.2 | 20 | 30 |
| Sutherland | 151.6 | 23* | 30 |
| *Upper Georges River drainage area* | | | |
| Holroyd | 77.3 | 14 | 20 |
| Fairfield | 113.1 | 12 | 39 |
| Liverpool | 82.4 | 8† | 15† |
| Campbelltown | 34.2 | 5 | 8 |
| SUB-TOTAL | 1,352.0 | 248 | 379 |
| **2. Rest of Sydney** | | | |
| Auburn | 48.7 | 18 | no data |
| Parramatta | 111.0 | 7‡ | 20‡ |
| Concord | 26.1 | 13 | 4 |
| Drummoyne | 31.3 | 8 | 3 |
| Leichhardt | 71.3 | 25 | 1 |
| Sydney | 62.5 | 74 | 1 |
| Waverley | 65.6 | 13 | 3 |
| Woollahra | 60.0 | 16 | 4 |
| Baulkham Hills | 57.4 | 16 | 11 |
| Blacktown | 156.8 | 24§ | no data |
| Camden | 11.2 | 10 | 6 |
| Penrith | 60.3 | 2 | 39 |
| Windsor | 15.5 | 4 | 1 |
| Hornsby | 96.9 | 14 | 208 |
| Hunters Hill | 14.1 | 12 | 11 |
| Ku-ring-gai | 98.6 | 21 | 81 |
| Lane Cove | 28.7 | 35 | 28 |
| Manly | 39.3 | 13 | 3 |
| Mosman | 29.4 | 6 | 4 |
| North Sydney | 53.3 | 11 | 3 |
| Ryde | 88.8 | 14 | 12 |
| Warringah | 156.9 | 37 | 141 |
| Willoughby | 54.0 | 13 | 16 |
| SUB-TOTAL | 1,437.7 | 406 | 600 |
| **TOTAL** | 2,789.7 | 654 | 979 |

*Figures inaccurate because wastes received from other councils are not divided into putrescible and non-putrescible.
†Includes wastes from other councils, quantities unknown.
‡Includes soil covering over waste.
§Includes non-putrescible wastes.

The data in this Table were obtained from D. J. Dwyer and Associates, *Report on the Disposal of Solid Wastes for the Metropolitan Waste Disposal Authority*, Sydney, 1972. Solid waste figures have been rounded to the nearest thousand. As explained in the text, local councils as a rule do not keep detailed records on wastes disposed of in their jurisdiction.

requires data on the type and quantity of wastes generated in each municipal area and on distances to available disposal sites and other facilities. Such data are still difficult to obtain, as the M.W.D.A. discovered when it began investigations into solid waste management. It was estimated recently that the total cost of waste collection and disposal in the Sydney region in 1972 was $19.1 million of which $16.8 million (87.8 per cent) were spent on collection services and the remaining $2.2 million on disposal activities.[32] Quantities of refuse generated in the various local councils vary between 5,000 and 225,000 tonnes per year (Table X-(5)); at $14.08 per tonne for collection and $2.87 per tonne for disposal, costs to councils vary between $7,000 and $3,200,000 for collection and $14,000 and $640,000 for disposal.[33] *Per capita* collection and disposal costs averaged $10.20 and $2.08 over the whole region. Other estimates of the costs of transporting wastes are not easy to find but the M.W.D.A. recently published a figure of $2.77 per tonne for collection and transport and $5.52 per tonne for disposal in 1975.[34] These figures are very different from those discussed above yet both appear to refer to the same processes. This discrepancy illustrates the difficulties caused by the lack of data, a problem stressed above.

*Waste disposal and resource recovery*

There are essentially two aspects involved in the final stage of the solid waste cycle: waste disposal, and resource recovery from wastes. The two are not

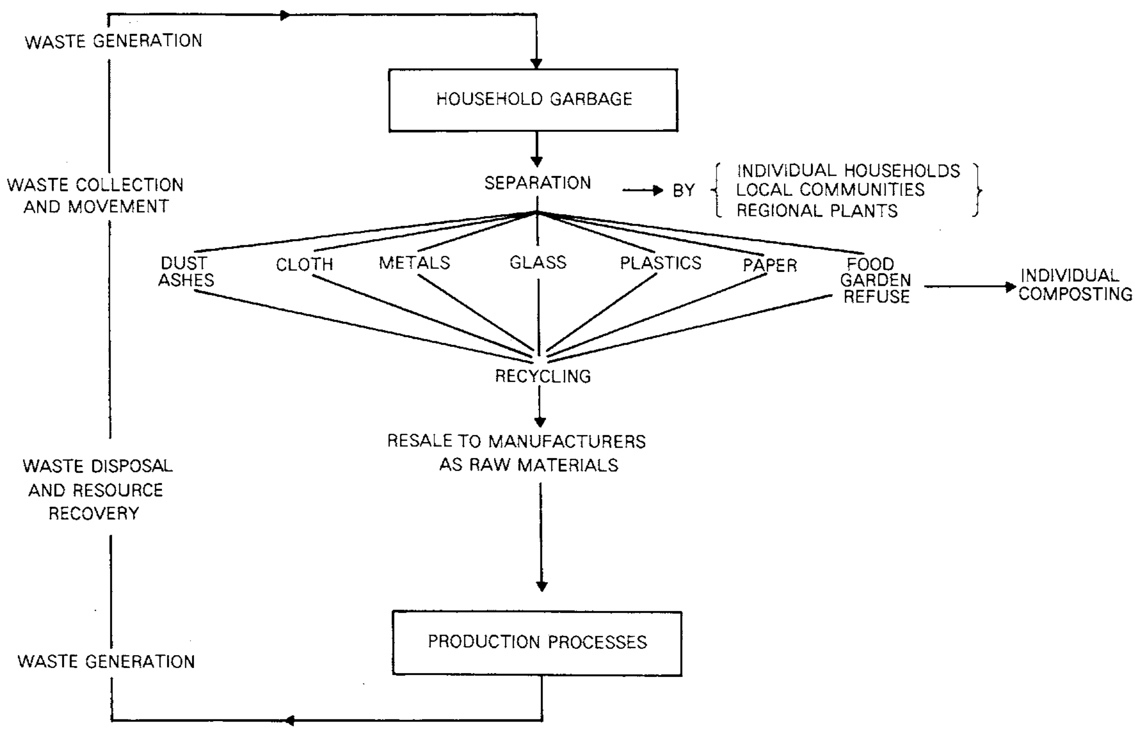



Fig. X (iii) Resource recovery from domestic wastes mutually exclusive, as few recycling procedures retain all of the original material, generally leaving some residue to be disposed of. Additionally, it should be remembered that wastes which are 'disposed of' by some means such as landfill or incineration have not really 'disappeared' — they have been transferred to another part of the environment. The realisation of the limited capacity of the environment to absorb wastes has been marked by a world-wide interest in recycling and the reuse of wastes as an alternative to straightforward disposal. However, a changeover from disposal of wastes to recycling is not always simple and some of the reasons for this are worth examining.

If it were feasible to collect from each household all garbage neatly sorted, then it is possible to envisage a series of collection points where the various materials would be transferred to the respective recycling plants (Fig. X(iii)). In most instances technology is adequate to enable salvaging and recycling to be carried out satisfactorily and, provided adequate markets are available for the recycled material, the mechanics of recycling would appear to be feasible.[35] However, there are a number of problems associated with this. First, although some separation of garbage may be feasible, it is not easy and probably not desirable to encourage individual householders to separate all their garbage; hence some form of separation at a central plant is usually necessary before materials can be recycled. Second, manufacturers are not always ready to accept materials for recycling or materials which have been reprocessed; the latter are frequently more costly than raw materials. A third problem is associated with the costs involved in recycling materials; until such time as stringent controls are imposed on industry to make resource recovery obligatory or until industry is assisted in the recovery process, it is likely that new materials will continue to be used in preference to recycled ones.

Increasing pressure from society will possibly speed up the use of recycling processes, but society must be prepared to recognise that increased costs are incurred by recycling. Increased costs result from the fact that, as yet, credits for recycled materials are not sufficient to offset the high operating costs of resource recovering processes. In addition, transport costs are increased because a high degree of centralisation is necessary for efficient resource recovery. On the other hand, society gains by avoiding normal garbage disposal costs. The estimation of *net* social costs of recycling is very difficult and certainly much more complex than many assessments would suggest. When the avoided garbage disposal and environmental degradation costs are included in the balance sheet, it is probable that the advantages of recycling are very much larger than may appear immediately. Certainly it is inappropriate to rely simply on unaided private business calculations of profit and loss.

There is an increasing trend, particularly in industry, towards recycling as a means of reducing quantities of solid wastes and as a means of resource and energy conservation. Much of the work on recycling is at the experimental stage only; as researchers have observed, a great deal of further investigation remains to be done.[36] It is almost certain that increased technological investigation will, in the future, widen the scope for recovery and reduce costs. In principle, it would appear that it is in this direction that society needs to look for substantial relief from massive solid waste problems in the future.

*Waste disposal and resource recovery: Sydney*

All the councils in the Sydney region, with the exception of those using the Waverley-Woollahra incinerator for the disposal of putrescible wastes, are using sanitary landfill as the only means of solid waste disposal. In most cases garbage is deposited directly into the landfill area without prior compaction, sorting, shredding or other modification. Canterbury council has recently opened a garbage shredding plant at their Salt Pan Creek depot. The plant will be able to process 50,000 tonnes of garbage annually and is expected to extend the life of the tip, estimated at seven years in 1972,[37] to between seven and ten years, provided that it is used only by Canterbury and Concord. Part of the processing at this plant will include the magnetic separation of metals, estimated to comprise 7 per cent of the volume of the garbage and valued at $60-$70 per tonne. Arrangements have been made with Australian Iron and Steel Pty Ltd, at Port Kembla, to purchase the recovered scrap metal.[38] The council hopes to extract approximately 2,000 tonnes of scrap metal annually, the revenue to be used to offset the costs of operating the shredder. These operating costs are estimated at $32.00 per hour for electricity alone. It is also anticipated that leachate problems from the tip will be minimal as shredding increases the rate of decomposition of putrescible wastes.

The survey carried out for the M.W.D.A.[39] and interviews with local council health inspectors[40] give some indication of the expected life of the disposal depots used by each of the councils. However, it is unwise to attach too much importance to the results of the survey. In many instances local councils do not keep accurate records of quantities of wastes disposed of in the tips; hence much of the information in the survey is based on local council estimates. Of the forty councils in the M.W.D.A. study, twenty-seven were reported to have adequate facilities at existing depots for the next five years (from 1972), provided that leases were not discontinued and provided that arrangements between councils for the acceptance of garbage were maintained. Some of these sites are undesirably located near streams and yield serious water pollution problems. The remaining thirteen councils in the region were likely to require additional capacity within five years from 1972. The sites in these two categories are listed in Table X-(6).

Table X-(6) Solid waste disposal facilities in the Sydney region: Councils in the Sydney region with adequate and inadequate solid waste disposal facilities (including incineration) for the 5 years 1972-6.

| Adequate facilities: inner city | | |
|---|---|---|
| Ashfield | Manly | South Sydney |
| Auburn | Marrickville | Strathfield |
| Botany | Mosman | Strathfield |
| Canterbury | North Sydney | Sydney |
| Drummoyne | Randwick | Waverley |
| Leichhardt | Rockdale | Woollahra |

| Adequate facilities: outer city | | |
|---|---|---|
| Bankstown | Hornsby | Penrith |
| Blacktown | Hurstville | Sutherland |
| Holroyd | Kogarah | Warringah |

| Inadequate facilities: inner city | |
|---|---|
| Burwood | Concord |

| Inadequate facilities: outer city | | |
|---|---|---|
| Baulkham Hills | Fairfield | Ku-ring-gai |
| Camden | Hunters Hill | Parramatta |
| Campbelltown | Lane Cove | Windsor |
| | Liverpool | Willoughby |

Source: D.J. Dwyer and Associates, *Report on the Disposal of Solid Wastes for the Metropolitan Waste Disposal Authority*, Sydney, 1972.

Of the thirteen councils with inadequate disposal facilities, all except two were outer areas and further investigations were expected to reveal potential sites for disposal depots either within the areas or in adjacent areas. Only four of the areas — Campbelltown, Fairfield, Liverpool and Parramatta — are located within the Botany Bay catchment (Parramatta only partially), suggesting that there is a disproportionate number of local councils in the northern part of Sydney without adequate garbage disposal facilities. It is also worth noting that Camden and Campbelltown, both areas where considerable population expansion is planned, featured as areas without adequate disposal facilities. This emphasises the inadequate planning of garbage disposal facilities for the expanded population of the Sydney region. This was also referred to in the Barton Report.[41] It also emphasises the need for new approaches to compaction, pyrolysis and recycling and to restraint on generation of wastes.

In addition to providing garbage collection and disposal services, many of the council tips are open to residents of the area who are permitted to dump any

Table X-(7) Volumes of liquid wastes not acceptable to Water Board sewers in Sydney, 1972

| Waste category | Million litres (per annum) |
|---|---|
| Paints, inks, solvents | 8.2 |
| Oils | 25.5 |
| Latex/water emulsions | 0.9 |
| Organic (food) wastes | 73.0 |
| Organic (chemical) wastes | 4.1 |
| Acids | 10.9 |
| Alkalis | 24.6 |
| Neutral salts and neutralised acids | 37.8 |
| Other inorganic wastes | 44.0 |
| **TOTAL** | 229.0 |

Source: Crooks, Michell, Peacock, Stewart Pty Ltd, *Sydney Region Liquid Waste Survey and Liquid Waste Treatment Plant Proposal,* Sydney, 1973, vol. 1.

Table X-(8) Industrial liquid wastes removed by private contractors

| Waste category | Million litres (per annum) |
|---|---|
| Paints, inks, solvents | 2.3 |
| Oils | 10.8 |
| Latex/water emulsions | 0.7 |
| Organic (food) wastes | 4.8 |
| Organic (chemical) wastes | — |
| Acids | 7.7 |
| Alkalis | 1.6 |
| Neutral salts and neutralised acids | — |
| Other organic wastes | 5.6 |
| **TOTAL** | 33.5 |

Source: *Report by A.E. Barton upon . . . the Problem of Waste Disposal. . .*, N.S.W. Parliamentary Paper 152, 190, pp. 35-8.

excess household and garden refuse, including bulky items, free of charge. Although amounts of garbage dumped in this way may be relatively small, the practice increases the difficulty of recording accurately quantities of garbage disposed of in tips. In addition, the system is frequently abused, with people coming from outside the local council area to make use of the disposal facilities. Some council provide separate collection areas at the tips for newspapers and bottles which are then removed for recycling.

*Role of private waste disposal firms in Sydney*

Private waste disposal firms continue to play a relatively important role in waste disposal in Sydney, particularly in the disposal of industrial, trade and commercial wastes. Unfortunately, data on the quantities of wastes removed by private firms and other aspects of their activities, such as the disposal depots used, are not easy to obtain. The consultants carrying out the survey of solid waste disposal for the M.W.D.A. endeavoured to investigate the activities of private waste disposal firms but were unable to obtain much information.[42] Responses were received from only four organisations out of a total of fifteen approached. The M.W.D.A. expects shortly to introduce new registration and licensing regulations covering all individuals or firms involved in any form of solid or liquid waste management; it is to be hoped that these new controls will enable the Authority to obtain reliable information on solid waste disposal which so far has been lacking. Until they are under direct supervision, private contractors might be significant sources of inadequate and undesirable dumping.

Private contractors have continued to play an important role in industrial liquid waste disposal in Sydney, but the picture is changing. The Barton Report contains a description of the operations of four major contractors in 1970. They were handling a total of less than 15 per cent of the volume of liquid wastes not discharged to sewers, as estimated by the M.W.D.A. (Tables X-(7) and X-(8)). The Barton Report also noted that the volumes of liquid wastes dealt with by the private contractors had declined quite markedly immediately prior to 1970. Higher disposal costs have encouraged industries to use other methods of disposal and there has been a tightening of the restriction placed on the disposal firms themselves. For example, industrial liquid waste disposal has been prohibited at local council depots since 1960. The fact that the four main companies are now less important in liquid waste disposal or have discontinued this service could mean that their places have been taken by smaller companies or individual contractors about whose activities much less is known. Once again, the provisions made by the M.W.D.A. to license all operators should provide better information on current practices.

## Role of the Sydney Metropolitan Waste Disposal Authority

*Establishment of the Authority*

Barton's report to the N.S.W. Government was instrumental in the establishment of a new Government agency in Sydney in 1971, the Metropolitan Waste Disposal Authority. Barton had advocated that:

> consideration should be given urgently to the formation of a single

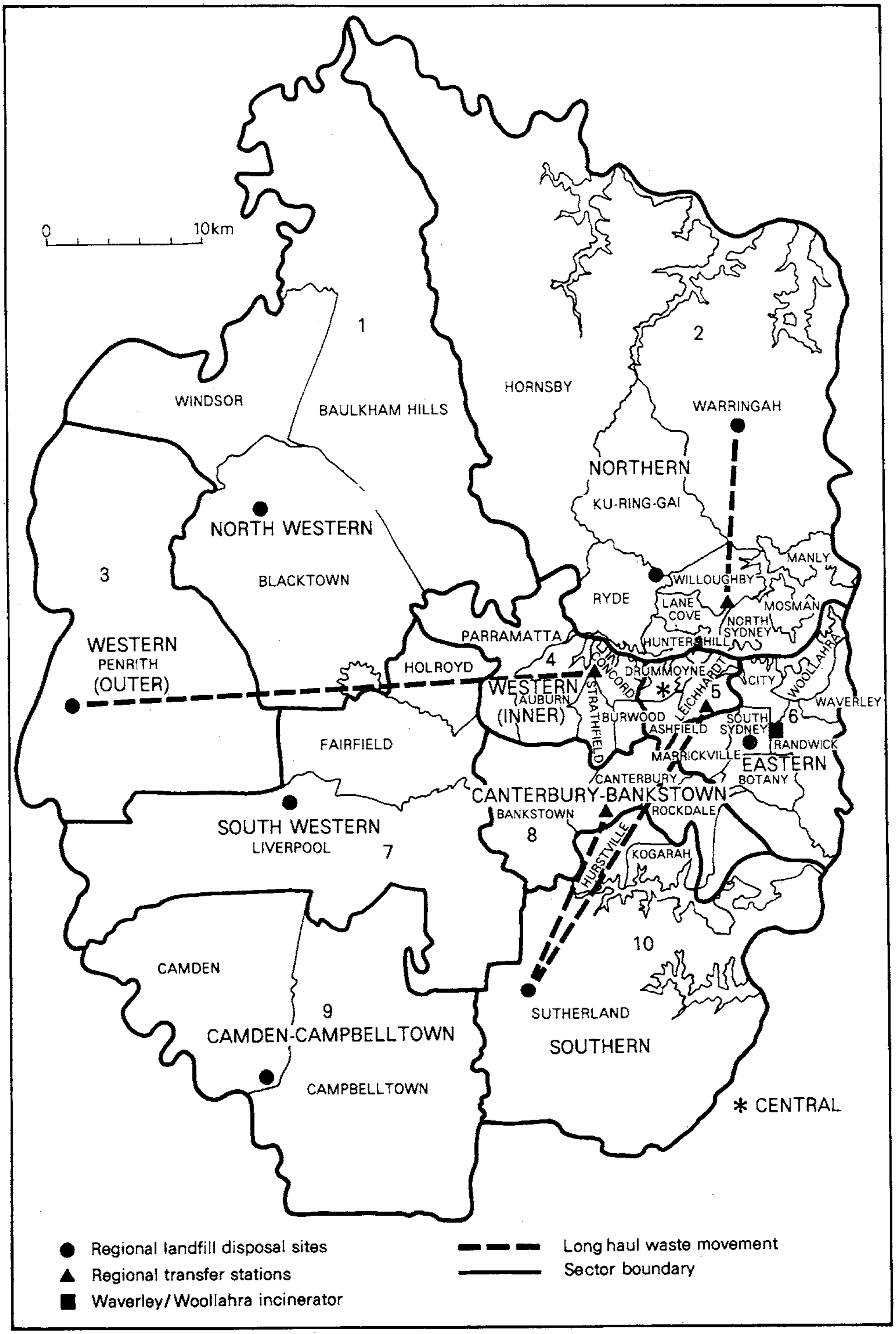



Fig. X (iv) Sydney region solid waste management plan, phase I

> authority which would have the responsibility for controlling the whole of liquid and solid industrial waste and the disposal of household garbage in all its forms.[43]

The founding of the M.W.D.A. has several implications, the most important being the shift away from small-scale, unrelated local council operations to sub-regional or regional solutions for waste management in Sydney. Theoretically this should allow the responsibility for policy and strategy to be focused on one body; this is not to say that local governments will have little influence on the decisions of the Authority. On the contrary, their political powers are considerable. Moreover, the activities of the M.W.D.A. are also affected by the S.P.C.C. and the M.W.S. & D.B. and by the Health Commission; these relationships are discussed elsewhere in this report. The M.W.D.A., according to its statutory duties, is responsible for the transport, collection, reception, treatment, storage and disposal of waste within the Metropolitan Waste Disposal Region. The waste disposal region (Fig. X(iv)) covers the whole of the Sydney metropolitan area which in June 1971 had a population of 2.8 million and an estimated population of 2.9 million by 1974. Most of the inner and eastern parts of the region are fairly heavily built up but considerable stretches of vacant land are still to be found on the northern, western and southern fringes.

As a new authority, the M.W.D.A. had to appoint a completely new staff. By 1975 the total had reached approximately forty-five. The technical staff consisted of engineers and trainee engineers, technical officers and draughtsmen. They were divided into two main groups, a solid waste group and a liquid waste group. The management staff have been appointed largely from local government officers in the region. On the whole they are not highly qualified in data handling, planning and management and least of all in research and planning in respect of restraint on generation and encouragement to recycling. This is an unfortunate circumstance as these are the areas in which the Authority stands to make its greatest impact. The remainder of the staff (approximately twenty-three) was made up of an accountant and clerical and secretarial staff.

The work of the M.W.D.A. to date has largely involved the formulation of plans for a waste disposal system to service the entire region. The three main parts of the system which have received attention are:

(i) Planning proposals for solid waste management in the period 1975 to 1978
(ii) The establishment of central treatment facilities for noxious and toxic industrial liquid wastes
(iii) The registration and licensing provisions which the M.W.D.A. has statutory power to establish.

The activities of the M.W.D.A. in the few years since its establishment can conveniently be considered under these three headings.

*Solid waste management investigations*

The M.W.D.A. took early action to investigate the growing problems of solid waste disposal which local government councils were encountering in Sydney. In 1972 the Authority commissioned two studies to be undertaken by Dwyer and Associates. The first study was to examine the disposal of solid wastes in Sydney; the other, the use of landfill as a means of solid waste disposal. The latter set out the design specifications, operating conditions and evaluation procedures for the satisfactory management of a landfill site. The bulk of the discussion which follows is derived from the first study, *Report on the Disposal of Solid Wastes.*

The consultants' brief for the first study was: 'To investigate and examine the life of existing solid waste depots. The study to include existing and future depots, existing and future incineration plants, and existing and future transfer stations.'[44] The report included a brief review of current solid waste disposal practices and a comparison of the composition of domestic wastes in different countries. The high proportion of glass in Sydney's waste was noted (Table X-(3)). Information from the questionnaires sent to each of the councils in the waste disposal region provides a general overview of the solid waste disposal situation in Sydney in 1971 (Table X-(5)). However, there were marked variations from council to council in the quantities of waste generated; these variations were too large to be accounted for solely by variations in socio-economic status and differences in housing type and must in some instances be attributed to inaccurate weighing and recording procedures at some tips and to the lack of any recording data at others. *Per capita* amounts of solid waste (household and trade) ranged from less than 1.0 to 2.5 kg per day with the domestic component varying from 0.3 to 1.0 kg *per capita* per day. The following statements summarise the main findings of the study and highlight the problems associated with some of the sites:

> There is considerable scope for improvement in the operation of many depots and action is necessary to introduce higher standards to improve their efficiency and appearance.
>
> At a number of depots there was evidence of leachates of a polluting nature for which adequate treatment facilities were not installed and remedial action is considered to be unnecessary.[45]

The surface terrain of much of the Sydney region increases the likelihood of problems of offensive liquid flows (leachate) at landfill sites. Particular reference was made to problems at the putrescible depot near Peter Meadow Creek in Campbelltown, the depot at Ashford Avenue in Bankstown which is on the banks of the Georges River, the Canterbury Council depot adjacent to Salt Pan Creek and Sutherland Shire Council depot at Menai. Other particularly

Table X-(9) Typical costs of disposal and short haul for regional solid waste management planning

| Method of disposal | Estimated total cost in 1975 |
|---|---|
| Landfill (including transfer where necessary) | 100 units |
| Pulverising | 115 |
| Baling | 120 |
| Incineration | 130 |
| Railroad transportation to a distant point | 200 |
| Pyrolysis | 130 (estimated) |

*Disposal includes and intermediate processing or transportation. Short haul transportation costs are included because it is necessary to take account of the balance of centralising and decentralising tendencies in calculating the optimal disposal solution for a given technique.
Source: M.W.D.A. Engineers, pers. comm.

unfortunate dumps occur, for example, on the banks of the Georges River at Liverpool. Pressure from local people and from the Water Pollution Control Branch (a part of the State Pollution Control Commission) has led to the installation of treatment facilities for leachate at some sites. A scheme for treatment of the leachates is in operation at Menai but so far is proving ineffective. At the Porters Creek depot in Ryde a chlorination scheme for treatment of leachates has also proven ineffective. The M.W.D.A. has started a pilot scheme at the Belrose tip in Warringah; the leachate is treated with lime and sprayed back onto the landfill area for anaerobic digestion.

Despite the problems associated with landfill and the unsatisfactory operation of a number of sites in the Sydney region, the consultants concluded that:

> for the immediate future and for at least five years, and subject to strict control and coordination of all operations under a central authority, the disposal of solid wastes by the landfill method supplemented by some incineration will be satisfactory.[46]

It is very doubtful if the optimism in this judgment can be sustained. Landfill was also found to be the most economical method of disposal (Table X-(9)). Further cost advantages over other methods of disposal are obtained if councils have low-cost land available which is suitable for tipping (land which is unsuitable for building or other purposes). The survey revealed lack of uniformity in council activities and the need for co-operation between councils; these findings prompted the consultants to stress the need for strict controls on landfill operations and the adherence of all disposal authorities, private, local council or regional, to standardised procedures. Provision was being made by the M.W.D.A. for the introduction of standardised landfill procedures.[47]

The *Report on the Disposal of Solid Wastes* referred to the need for careful selection of disposal sites so that good land is not spoiled by landfill operations and so that the community may derive the maximum benefit from a reclaimed area. Solid waste could provide a better 'fill' if treated in some way, for example by pulverisation or incineration, and it was suggested that further research into this be carried out. There is only one pulverisation plant currently operating in Sydney — the one at Canterbury. The report also recommended that the capacity of the Waverley-Woollahra incinerator should be increased and that all putrescible and combustible wastes be collected from as large a radius as possible to achieve the maximum capacity of the incinerator.

The recommendations end with a discussion of recycling and processes for resource recovery. The report advocates that:

> recycling and the recovery of materials in all its forms should be the subject of a campaign to educate the community and especially industrialists in the advantages and the potentials of this operation.[48]

The collection of materials for recycling is mainly undertaken by voluntary organisations in Sydney and the report recommends that:

> Every assistance and encouragement should be given to those organisations and industries attempting this task and the expansion of such operations should be the aim of the campaign referred to above.[49]

It is very doubtful whether 'campaigns to educate' have much impact on promoting recycling or on reducing waste generation. Even in the short term it seems desirable that the M.W.D.A. should take more than a passive approach to these issues. It is understood that some of the staff of the M.W.D.A. are currently engaged on research into resource recovery.[50] Positive action on an experimental basis could include the separation by householders of specific items for recycling, the introduction of separate collections for waste paper, etc., or bottle and can recovery schemes and the initiation of schemes for public authority/private enterprise co-operation. Deliberate action to provide financial support and inducement to firms interested in recovery needs to be considered.

Resource recovery on a larger scale in Sydney appears to be made more difficult by the reluctance of industry to co-operate.[51] Problems arise in the glass industry and the steel and aluminium industries which are vertically integrated and are involved in the extraction, transportation and processing of virgin materials. Thus while it is possibly more economical *from the community's point of view* to recycle one glass bottle many times than to produce many 'one-way' bottles, the industry may find that this actually reduces its profits due to the decrease in extraction and transportation activities. A vertically integrated concern could lose in such a situation. Melbourne's experience with glass recycling is the reverse of Sydney's. In Melbourne independent glass recyclers compete successfully with manufacturers of new bottles, the success being attributed to the greater decentralisation and lack of vertical integration of the glass industry. Clearly one cannot propose a reorganisation of industry only for reasons of recycling. Nevertheless, if there are social and economic advantages in an integrated industry, some positive inducement may need to be offered to encourage further recycling, recognising the social advantage and reduced disposal costs.

*Solid waste management plan*

In 1973, the M.W.D.A. asked a team of consultants to report on the actions which would be required to implement a solid waste management plan in the Authority's area. This report emphasised the role of the Authority as a key policy- and decision-making body in the area of waste management.[52] The report recommended that collection and short haul movement of solid wastes should continue to be the responsibility of local government and private enterprise and that transfer operations, processing, long distance haul and disposal of solid wastes should be the responsibility of the Authority. The report specified the locations of new transfer stations and new regional disposal sites and recommended that the Authority go ahead to establish these facilities. Considerable emphasis was placed on the need to obtain the co-operation of the local councils in the implementation of the plan. If this co-operation were not forthcoming, the report went on, the authority would have overriding powers under its Act. The report included a recommendation that reception areas for recyclable items be established at all transfer stations and disposal areas operated by the Authority and that the public should have access to all of these.

Following the recommendations in the three commissioned reports on solid wastes,[53] the M.W.D.A. produced Phase I of a Solid Waste Management Plan for the Sydney Region.[54] Phase I covers the short term (1975 to 1978), while Phase II of the plan will cover the period up to the 1990s. The rationale behind the division of the study into the two phases was that plans had to be made urgently to ensure that all councils had adequate disposal facilities for the immediate future; in the meantime the M.W.D.A. is reviewing the longer term situation.[55]

The objectives of Phase I of the plan can be summarised as follows:

(i) To rationalise the movement and disposal of waste in the region providing both economic and environmental advantages;

(ii) To improve the standards of transportation and disposal of waste so that environmental problems are minimised;

(iii) To develop a least-cost solution for the region as a whole using both new and existing disposal facilities;

(iv) In Phase I to adopt only those solutions requiring a small capital investment and a short period of preparation;

(v) To make plans so that the transition from the existing situation to Phase I and then to Phase II can take place smoothly.[56]

Within Phase I, it is not proposed to use any new disposal techniques such as incineration, pyrolysis or large-scale resource recovery but to concentrate on landfill and simple non-compaction transfer stations.

The criteria for the development of the least-cost solution (point (iii) above) were that:

> the solid waste transportation and disposal system must comply with current and future environmental standards and . . . be provided at least cost to the metropolitan community as a whole.[57]

In other words, existing and potential landfill sites which were considered environmentally suitable for putrescible and non-putrescible wastes were to be selected and wastes were to be allocated to the sites on a least-cost basis. Economies of scale should enable the Authority to introduce environmental protection at the lowest possible *per capita* cost. However, waste transportation costs tend to increase as centralisation proceeds and wastes are brought from greater distances to increase the through-put at major disposal centres. Thus a balance must be struck between economies of scale and transportation costs.

A computer-based mathematical simulation model was used to evaluate the options for each of the forty Local Government Areas in the Waste Disposal Region. Twenty-two possible transfer stations could be used or wastes could be trucked direct to forty-nine existing or future landfill sites. A theoretical least-cost solution was derived and various alternatives and the effects of a number of external constraints on the system were also examined. In a number of cases, the least-cost solution was not feasible and a 'second-best solution' had to be adopted; one example of this was the situation in which one council had entered into a contractual arrangement with another council to use waste disposal facilities.

In order to derive the least-cost solution three stages in the solid waste system were considered:

(i) Waste generation and collection

(ii) Waste movement

(iii) Waste disposal

*Waste generation and collection.* The results of the earlier solid waste survey provided information on the quantities of waste generated in each local government area and these data,[58] together with State Planning Authority data on population growth,[59] plus a 2 per cent per annum increase in the *per capita* rate of waste generation were used to forecast the likely quantities of wastes over the period 1974 to 1978. As part of the input to the least-cost model, sixty-six districts defined in the Sydney Area Transportation Study (1974) (with some modifications) were used as the basic units of waste generation, the centre of each unit being measured on the basis of land use. It was assumed that throughout Phase I the collection of waste would continue to be the responsibility of the local councils and data were obtained from the councils and from contractors on the costs of waste collection and transport.

*Waste movement.* The types of vehicles used and the costs of three different stages in the movement of wastes were examined. The three stages were: short hauls — movements from points of generation to 'suitable' disposal points; transfers — from small vehicles to larger vehicles at transfer stations; long hauls — movements from transfer stations to disposal sites. The model was calibrated using travel times derived partly from unpublished Department of Main Roads data and partly from M.W.D.A. experience. This permitted a mathematical examination of the balance between centralising forces (economies of scale) and decentralising tendencies (increased short haul costs).

*Waste disposal.* The waste disposal stage involved the examination of all existing and potential landfill sites (over 200) from the point of view of environmental impact, capacity, accessibility, ability of the operator to handle more waste and benefits of more rapid filling and closure. The sites were classified into three groups:

(i) Sites with little remaining capacity where additional capital expenditure is not justified
(ii) Sites with substantial remaining capacity which are potential regional sites
(iii) Sites with some remaining capacity but requiring high capital investment to attain acceptable environmental standards.

Sites in categories (i) and (ii) were to be phased out of operation as soon as possible and it was anticipated that a period of two to three years would have to elapse before the environmental standards and economies outlined in Phase I of the Solid Waste Management Plan were attained. For example, it was considered that during this period it would be necessary to continue to use a number of the existing depots which were rated environmentally unsatisfactory.

The Solid Waste Management Plan is based on a regional approach and its success depends on its implementation as such. In turn, this depends on its political acceptability to local authorities in the area. If successful, the plan should, over a moderate time horizon, achieve a distribution of costs on a regional basis. The Waste Disposal Region has been divided into nine sub-regions (Fig. X(iv)) and within each of these is a major disposal facility or a transfer station, its location based on the least-cost movement and disposal principle. The Waterloo incinerator is included in the plan as a major facility for the disposal of putrescible wastes in the Eastern Sector (Fig. X(iv)). During 1974, the M.W.D.A. discussed the plan with local councils concerned and sought the co-operation upon which the success of the plan relies heavily. Although some councils are reputed to have responded favourably to the plan in public, it is believed that, privately, many councils object to it. In a recent series of discussions,[60] while several councils stated that they were relying on the M.W.D.A. to provide a satisfactory solution to their problems of solid waste disposal, others felt that they could cope adequately and efficiently with their own landfill capacity. Clearly, regional politics come into play here and it is possible that the plan may be exposed to risk for political reasons. Phase I of the Solid Waste Management Plan is a parochial first — but only a first — step towards rationalising the solid waste problem in Sydney, and one of its most significant features is the attempt to move away from the traditional approach to waste management based on individual council activities. It is still, nevertheless, simply a landfill approach. For the immediate future there is little large-scale option. The longer-term future depends on the adoption of radical changes — such as separation and recovery of wastes, incineration and pyrolysis and prevention of waste generation. To have any long-term success, the M.W.D.A. will need to commit considerable resources in this direction. If it is subjected to extensive political intervention, which could warp the short-run solutions, the longer term and much more drastic solutions will be exposed to correspondingly greater jeopardy.

*Industrial liquid waste disposal*

As in the case of solid wastes, no authority in Sydney has been concerned solely with the disposal of industrial liquid wastes. Liquid wastes were disposed of in several ways: by private contractors, by the industries themselves and by the M.W.S. & D.B. Thus the M.W.D.A., as well as attempting to coordinate the activities of existing disposal agencies, was faced with the need to fill the gaps created by the lack of a unified control and to define its role in liquid waste management with reference to other State and local government authorities partially involved in this activity. In assuming this responsibility, the M.W.D.A. became dependent on action by the M.W.S. & D.B. and S.P.C.C., the former in restricting waste entry to sewers, the latter in re-routing wastes out of drains and waterbodies.

In addition to the lack of control over industrial liquid waste disposal, the Barton Report had emphasised the acute shortage of facilities for the disposal of industrial liquid wastes in the Sydney region. Thus there was immediately considerable pressure on the M.W.D.A. to take emergency measures to provide disposal facilities. The M.W.D.A. began by examining a number of different methods of disposal; these were land disposal, discharge into the M.W.S. & D.B. sewers and dumping at sea.[61]

*Land disposal*

The following different types of land disposal were considered:
(i) The use of old mines
(ii) The use of old brickpits
(iii) The use of solid waste tips to absorb liquid wastes
(iv) The opening of new areas for ground disposal.

*Mines.* The investigation of abandoned underground and/or open-cut coal mines revealed that there were none in the region suitable for the disposal of industrial liquid wastes. The disused Balmain Colliery was unsuitable for several reasons: water was present in some parts of the mine implying that groundwater movement would permit wastes deposited in the mines to escape; some of the old workings were sealed and new shafts would have had to be sunk at considerable cost; in addition, the underground workings were designed to collapse after a period of time thereby limiting the amount of space available for waste disposal. Other old coal mines in the Lithgow and Cessnock-Wallsend areas were found to be subject to similar problems and there were no metalliferous mines available within a suitable distance of Sydney. The N.S.W. Department of Railways was willing to co-operate in the transport of liquid wastes from Sydney to a disposal site. However, no estimates of the costs of transport, construction of special tankers and transfer station development could be prepared without a precise location for the disposal site, and the matter was not pursued.

*Brickpits.* A survey was carried out of sixty brickpits in the metropolitan area but all were found to be unsuitable for liquid waste disposal. Some were still in use, some were unsuitable geologically, being located on permeable rocks, some were within M.W.S. & D.B. catchments and others were located too close to residential areas.

*Solid waste disposal sites.* The use of solid waste disposal sites to absorb the liquid wastes was rejected because the likelihood of water pollution at these sites was high. Moreover, local council tips had already been closed to liquid wastes since the end of 1969. At that point councils had been forced to stop accepting liquid wastes following advice from the then Board of Health and because of local complaints. An area at Menai being used as a landfill site for dry wastes by a private waste disposal company, Industrial Waste Collection Pty Ltd, was also rejected on the grounds that the site was too small and the amount of dry matter available for filling was insufficient to absorb the liquid wastes efficiently. It was thought that reserves of land held by the Department of Main Road could provide a disposal site but the Department maintained that all its reserves lay within important river catchments where pollution could result from surface run-off or groundwater flow. It was also maintained that disposal of chemicals on the ground could obstruct future road construction programmes. The construction of a tip similar to the one at Menai on land held by the Department of Army at Holdsworthy was also considered, but the Department declined to release any land. The Commonwealth Government may have some responsibility to reconsider this decision.

*New dumping areas.* The fourth possibility was the opening of new areas for land disposal. In 1970, the M.W.S. & D.B. and the Maritime Services Board (M.S.B.) had begun preliminary investigations for the establishment of a liquid waste disposal site. The M.W.S. & D.B. was anxious to avoid the disposal of noxious liquid wastes in sewers and stormwater channels and also to prevent pollution of natural watercourses. The M.S.B. was similarly concerned about the danger of pollution of harbours and estuaries. This concern had been heightened by the closure of solid waste tips to industrial liquid wastes. The M.W.S. & D.B. had estimated that the volume of industrial waste being generated in the Sydney metropolitan area at the time (1970) was at least 1.4 million litres per week.

The plan, if a new site were opened, was to construct a specially designed disposal facility for liquid wastes such that water pollution and other forms of nuisance such as odours and visual pollution would be minimised. Two possible sites were examined at Luddenham and Castlereagh. The Luddenham site was unsatisfactory because of its undulating nature and the need to provide expensive drainage control. The Castlereagh site, although more suitable than the one at Luddenham, was also rejected on the grounds that the depth of excavation was limited by the presence of underlying tertiary gravels and that there was no means of concealing the operations from nearby houses. The M.W.S. & D.B. and the M.S.B. did not proceed further with their plans.

Two years after the initial investigations had been carried out at Luddenham and Castlereagh, the M.W.D.A. approached the Department of Mines about the use of the area for liquid waste disposal. The M.W.D.A. proposed the investigation of an 8-hectare site within the area previously examined at Castlereagh and arrangements were made to lease that site from the Department of Lands. The Department of Mines Geological Survey, carried out in 1970 for the M.W.S. & D.B., had recommended that extensive drilling be carried out at the Castlereagh site but this drilling program was not undertaken at that time. In 1972 a series of detailed investigations was begun by the Department of Mines and these led to the recommendation that the area was suitable for liquid waste disposal provided that trenches were dug and lined with an impermeable clay material. The precise mode of operation of the disposal site devised by the M.W.D.A. is discussed later.

*Disposal of liquid wastes in the M.W.S. & D.B. sewers*

The M.W.D.A. held many discussions with the M.W.S. & D.B. about the possibility of liquid wastes being disposed of in the Water Board sewers. The Water Board maintained that the operation of sewage treatment plants would be adversely affected if industries were to place increased quantities of non-toxic liquid wastes in the sewers. Hence, disposal in the sewers could not be considered as a possible solution to the problem.

*Dumping of liquid wastes at sea*

Dumping at sea is another possible method of disposing of industrial liquid wastes and has been described as 'the best method of disposal from the point of view of minimising pollution to existing facilities'.[62] The meaning of this is somewhat obscure — existing facilities must, it seems, refer to water supply, recreation areas, harbour areas, etc. The wastes have to meet standards laid down by the International Convention on the Dumping of Wastes at Sea.[63] In Australia, dumping at sea is controlled by the Department of Transport and is illegal without the consent of the Department. Risks to marine life apart, one difficulty associated with this method of disposal is the high cost involved. It is necessary to provide relatively complex terminal and transport facilities, including specially constructed ocean-going barges which allow wastes to be properly disposed of in all weathers at least fifty kilometres off the coast. The statement was made in the M.W.D.A. report on the investigation of dumping at sea that 'unknown quantities of waste prevent detailed costing of the operation'.[64] This emphasises the inadequate data base on which all plans for liquid waste disposal were being formulated. Additionally, it was felt that there could be public opposition to dumping at sea and so this method was not considered feasible in the short term.

*Castlereagh liquid waste disposal site*

The M.W.D.A. liquid waste disposal site at Castlereagh, approximately fifty-eight kilometres west of Sydney, began operation early in 1973. It must be emphasised that this site was considered only as an interim solution to the liquid waste disposal problem and was expected to operate for a maximum of 2-3 years.

Reference was made above to the stringent operating requirements at the disposal site which would have to be met in order to minimise environmental damage and these can now be examined in more detail. The site is a former gravel pit of the Department of Main Roads, measuring approximately 440 m by 190 m, an area of about 8 ha. The original plan was that three cells would be excavated and a number of smaller cells constructed in each of these, separated by clay walls.[65] The smaller cells were to be 15 m by 30 m and 0.6 - 1 m deep. Where permeable material was exposed during excavation this was to be covered by a clay blanket 0.6 m thick. Municipal or other refuse would be placed in the cell and liquid waste poured in. Each cell would be sufficient for one day's intake of liquid waste and would be covered at the end of the day with a layer of compacted clay 0.2 m thick. As one layer of cells was completed, additional layers would be placed on top until the level was within 1 m of the finished level. However, only one of the cells was prepared and used in this way before the mode of operation was altered.

In the new procedure adopted the entire boundary of the site was excavated to a depth where the impermeable clay was to be found.[66] The excavation was then backfilled with impermeable clay from a stock pile and a wall about 1 m high was constructed. This had the effect of completely sealing the site. A back hoe machine is used to dig a hole 5.5 m deep, 4.5 m wide and 15 m long. Garbage trucks dump their loads into the hole and liquid waste is added. At the end of the day the hole is covered. The advantages of this method of operation are that:

(a) Large volumes of rainwater do not accumulate in the working area; also, rainwater falling onto the site remains uncontaminated and is allowed to drain off the site
(b) The total storage capacity of the site is increased
(c) Operating costs are lower
(d) The operations are tidier and better controlled.

As a final stage of the operation it is planned to cover the area with soil and to plant pine trees. Monitoring in test wells and surface streams around the site will reveal any pollution resulting from the disposal activities. However, if the site is properly managed, the proposed pine forest will be an asset to the area, providing recreational facilities, a nature conservation area and a source of timber. This should be considerably more acceptable than the present 'rubbish dump type conditions' of the area.[67]

The wastes dumped at the site must conform to the M.W.S. & D.B. definition of non-toxic industrial liquid wastes. The following wastes are unacceptable: chlorinated hydrocarbons, phenols, pesticides, organic peroxides, and wastes containing arsenic, cadmium, mercury or lead. From an operational point of view strong acids (greater than 15 per cent strength) are not acceptable at Castlereagh as they can have adverse reactions with the clay. Similarly, cyanides unless detoxified are unacceptable. Sulphides present a similar problem. Before any dumping is allowed, approval must be obtained from the M.W.S. & D.B., this approval being granted or not on the basis of the type of waste and factory of origin. The M.W.D.A. is required to keep records of all deliveries to the site — haulier, type of waste and factory of origin — and samples are taken from every tanker arriving at the site to ensure that the wastes fall within the standards set. The wastes received comprise large quantities of pickling acids and sludges, oils, brewery wastes, cement and stone slurries and small quantities of greasetrap wastes.

As an interim solution to the liquid waste disposal problem the Castlereagh depot appears to be fulfilling a useful role. However, as the depot receives only non-toxic wastes, the question of the disposal of toxic wastes remains unanswered. It must be assumed that these are currently being disposed of in one or more of the following ways:

(i) In-plant disposal and/or recycling
(ii) Dilution before disposal in the Water Board sewers and/or stormwater channels;
(iii) Dilution before disposal at the Castlereagh depot
(iv) Illegal dumping.

Data on the disposal of toxic wastes are not easily obtained although this is a central issue in the field of waste management. A survey of industrial liquid waste generators carried out by the M.W.D.A. is one source of data for the Sydney region but even this has some severe limitations.

The Castlereagh depot is, at the time of writing, handling about 350,000 litres of industrial liquid wastes per week, considerably more than the volume planned which was approximately 114,000 litres per week. This must have important implications for the expected life of the depot but the M.W.D.A. has not commented on this. Despite the wide margin between anticipated and actual volumes of wastes handled at the depot, it is felt that there are industries which are not using the new facilities.[68] It should be possible to match the data on type, volumes and sources of non-toxic wastes now being collected at the depot with the results of the M.W.D.A. survey and to identify those industrial liquid waste generators who are not using the new depot. Follow-up investigations could then ascertain whether adequate arrangements have been made for the disposal of wastes not sent to Castlereagh. Some industries may be discouraged from using the depot by the 1.5c per litre charge for wastes delivered and by the considerable distance of the depot from many parts of Sydney. The depot is reasonably well situated to serve industries in the Bankstown-Parramatta area but is less accessible to industries in, for example, Botany and Marrickville.

*Liquid waste survey and liquid waste treatment plant proposal*

In 1972, as part of a longer term plan for industrial waste management, the M.W.D.A. commissioned a survey of industrial liquid wastes in the Sydney region.[69] The final objective of this study was the construction of a central plant to treat the industrial wastes of the Sydney region. The consultants employed by the M.W.D.A. were asked to carry out a detailed questionnaire survey of industrial liquid waste generators, to analyse the survey results, to project future waste generation levels and to make recommendations concerning the location and type of treatment plant required for the disposal of liquid wastes. For the purpose of the survey a liquid waste was defined as:

> a liquid slurry or sludge which is not reprocessed and which may not be discharged (a) into a sewer, or where a sewer is not available (b) into a stormwater channel, under the newly gazetted M.W.S. and D.B. regulations.[70]

A total of 10,000 questionnaires were sent out and from the returns it was estimated that approximately 230 million litres of liquid wastes requiring treatment outside the factory were generated every year in the Sydney region (Table X-(7)). However, many of the respondents had not been informed by the M.W.S. & D.B. prior to the survey whether or not any effluent being discharged into the sewers and/or stormwater channels was in fact acceptable and, as a result, there was considerable confusion over the definition of liquid wastes.

The consultants' report contained detailed design proposals for the treatment plant. The estimated cost of the plant, which would comprise sections for physiochemical and biological treatment and incineration of wastes, was $8.6 million and the cost of treating wastes was estimated at up to 3c per litre. The consultants recommended the purchase of a site at Homebush Bay, Auburn, on Sydney Harbour for the plant and the M.W.D.A. has gone ahead with this acquisition proposal. However, the plans for the treatment plant have been subject to considerable revision and work has not yet proceeded.[71]

Since the survey, officers of the M.W.D.A. have discussed with the major liquid waste generators in the region the plans for the treatment plant and the likely costs of treating the wastes. As a result of these discussions, a number of the industries are reputed to have made plans to dispose of their own wastes by in-plant treatment or recycling. Some firms have also entered into 'match-making' agreements with other industries; 'matchmaking' involves the exchange of wastes among industries, as what is waste material in one process may be valuable as a raw material input to another. Matchmaking has been facilitated in Sydney by the liquid waste survey data; matches which seemed feasible from questionnaire returns were further investigated and in several instances successfully arranged. Although the number of firms actually involved in matchmaking is very small at present, the potential exists for this to become a more important means of recycling wastes.

The increase in in-plant treatment and recycling have led to a significant reduction in the total volume of liquid wastes which a central treatment plant could expect to handle. The volume was estimated unofficially to have fallen from 137 million litres to 46 million litres per annum.[72] This change in the dimension of the waste disposal problem together with the high capital and operating costs associated with the original plant proposed have caused the M.W.D.A. to reformulate their plans and the consultants have been asked to prepare specifications for a modified plant. Until plans are finalised, no further details of costs are available and no further decisions have been reached concerning any of the following:

(a) Pricing policy for treatment of wastes — that is, whether all wastes are to be charged for equally
(b) The operation of the plant — whether by the M.W.D.A. or by a contractor
(c) The transportation of liquid wastes to the plant — it is expected that all

carriers of liquid wastes will be licensed in order to facilitate the policing of waste movement and to prevent illegal dumping.

The M.W.D.A.'s situation in planning for the disposal of liquid wastes is further complicated by the fact that any alteration in the standards used to control the quality of industrial effluent discharged to the M.W.S. & D.B. sewers and/or stormwater channels, or a more stringent enforcement of the regulations, could have important implications for the capacity of a central liquid waste treatment plant. The consultants recognised that this could be a problem and allowed for an additional 65 per cent of the total volume of liquid wastes (Table X-(7)) in their original designs for the treatment plant.[73] The possible increase in the volume of liquid wastes to be treated at a central plant can be gauged from M.W.S. & D.B. data on trade waste discharged.[74] The volume of wastes discharged untreated to the sewers in the Botany Bay catchment alone has been estimated at approximately thirteen times the volume discharged over the whole of the metropolitan area after treatment. The volume discharged to the sewer after treatment is in turn approximately eight times the volume estimated in the M.W.D.A. survey to require treatment in a central plant (Table X-(7)). Thus, transfer of even a relatively small proportion of the wastes currently disposed of by industries, either with or without treatment, could significantly alter the dimensions of the liquid waste disposal problem faced by the M.W.D.A. As far as any future planning for the management of industrial liquid wastes is concerned, the M.W.D.A. is placed in a difficult position because of the uncertainty surrounding the Water Board standards for trade wastes. This serves to illustrate that the M.W.D.A. has yet to cement its relationships with other government authorities involved in waste management and to form coherent waste management policies.

As well as suggesting that the M.W.D.A. has yet to clarify many of its waste management policies, the above account appears to indicate that the Authority, by encouraging industries to deal with their own wastes and advocating a smaller version of the liquid waste treatment plant, may be sidestepping some of the issues which it should be facing. Unless it can be established that *all* industries have installed adequate treatment and/or recycling facilities and are using them efficiently, it will become increasingly difficult to police the regulations governing trade waste discharges. This will lead to a persistence of the present unsatisfactory situation in which liquid wastes are disposed of illegally in bush-land and waterways around Sydney. The actions of the M.W.D.A. so far seem to imply that the Authority considers the responsibility of waste disposal to lie largely with the industries. This is in direct conflict with the recommendations of the Barton Report which called for immediate and strict control over 'nasty' industrial wastes. The chemicals used in most industrial processes are relatively expensive and are usually only discarded when they are so heavily contaminated that no useful material can be extracted. No materials can be recycled indefinitely; in each recycle operation it may be possible to recover up to 95 per cent of the original material while the remaining 5 per cent is heavily contaminated. It is this residue which is most dangerous and for which adequate disposal procedures must be provided.

There are various steps which the Authority could take. For example, it might consider accepting wastes free from industries, or even buying wastes, and recycling and/or treating them for resale to other industries. Although such an operation would generate some income for the Authority, it would probably require further subsidy by the community; this leads to controversies over whether the polluter or the consumer should pay, or whether industries should have to risk closure if they cannot meet their environmental responsibilities. The complexity of these issues and the industrial liquid waste disposal situation in Sydney, which was described as a 'crisis' in 1969, make it imperative that the M.W.D.A. take immediate action to establish itself as a central controlling body.

*Registration and licensing*

Reference to Fig. X(iii) indicates that there are many points in a waste management system at which controls may be applied. Some of these controls may take the form of registration and licensing of the various operators and activities involved, and this is the third area in which the M.W.D.A. has been active since its establishment. Part V of the Act constituting the M.W.D.A. provides for the registration and licensing of:

(a) The occupiers of liquid and solid waste depots
(b) The transporters of wastes
(c) The occupiers of any premises where trade wastes are generated.

The Act also gives the M.W.D.A. the right to inspect premises and to penalise any infringement of the conditions of the certificate of licence. Although it is difficult to see how the M.W.D.A. with its present small staff could undertake this degree of supervision, it is considered that the registration and licensing provisions give the Authority the 'teeth' with which to ensure that its plans are carried out.[75] The regulations give the Authority control over the full waste cycle — generation, transportation and disposal — a big advantage over the present system in which the responsibilities are divided amongst several authorities and other operators. The new regulations were expected to be in operation by the end of 1975.[76] Once again, however, the potential of the new regulations will only be fully realised without political interference, and their success depends on a clarification of the respective roles of the M.W.D.A. and other authorities such as the M.W.S. & D.B.

*Summary of M.W.D.A. activities*

In summary, the establishment of the M.W.D.A. represents an attempt, the first in Australia, to provide an overall system for the management of solid wastes and certain industrial liquid wastes in a large urban region. This system is to encompass all aspects of the waste cycle — generation, collection and disposal. The M.W.D.A. has faced a number of problems in its efforts to provide this overall system. These problems appear to stem largely from:

(a) The lack of adequate data on which to base planning and management decisions
(b) The need for the M.W.D.A. to take immediate action to solve certain critical issues, possibly at the expense of adequate consideration of the longer term
(c) The lack of power which the M.W.D.A. has to carry through its management decisions.

The M.W.D.A. has made considerable efforts to rectify the data problem. Several consultant surveys have been carried out and other sources tapped for information on the generation, transport and disposal of wastes. The two critical issues facing the M.W.D.A. at its establishment were the lack of any suitable means of disposing of industrial liquid wastes and the shortage of space for disposal of solid wastes by landfill. The Authority took action promptly over the issue of liquid waste disposal with the establishment of the Castlereagh Depot. However, it has been emphasised that this depot provides only a partial and short-term solution; a longer-term solution is still at the planning stage and a number of basic issues in the control system have yet to be resolved. As far as the management of solid wastes is concerned, the role of the Authority to date has essentially been one of planning. The first phase of the Solid Waste Management Plan is in the early stages of acceptance and implementation, and work has begun on the second phase.[77] The M.W.D.A. is hampered in its activities by the fact that several branches of the Government, notably the M.W.S. & D.B. and the S.P.C.C. have *de facto* veto power over decisions of the M.W.D.A. It is essential that the waste management activities of the M.W.D.A. be an integral part of the total waste management/pollution control activities of the Sydney region; until this is achieved the capacity of the M.W.D.A. must remain limited.

## Conclusion

Attitudes towards pollution in Australia have been characterised by a complacency which may be attributed to the size of the continent in relation to its small population and to the apparent abundance of natural resources.[78] Technological developments and economic growth have enabled the majority of the population to enjoy high standards of living. However, the basic causes of environmental degradation — ignorance, attitudes, population growth, technological development, economic growth — are well exemplified in the Australian situation. From the descriptions of current waste management procedures in Sydney the conclusions that must inevitably be reached are that waste management policy in Sydney has not yet progressed beyond elementary 'corrective' measures or to tackle the causes of pollution. There are clearly strong arguments for greater emphasis in research and more control on the first stage of the waste cycle — the generation of wastes — and on the recovery and reuse of waste materials.

Solid waste management and control can be viewed from a number of angles — technological, economic, administrative, political. While it is convenient to discuss these aspects separately, in reality they are closely interrelated. Technological development has largely been responsible for many of the current waste problems, particularly industrial wastes, and in general terms it can be said that technology is capable of solving most waste problems.

As far as the technology of solid waste management in Australia is concerned, there are many alternative solutions to waste management problems from which Australia could choose. For example, authorities in Sydney may elect to pursue a policy geared towards the use of pyrolysis as a major means of disposal, rather than incineration. As advanced technology has not generally been applied to waste management problems in Australia, Australians can learn much from overseas experiments and experience. In Sydney, there is room for improvement at every point of the waste cycle. There is scope for reducing the generation of wastes by focusing attention on the packaging issues; as has been shown, the largest proportion of household garbage (metal, glass, paper) is derived from the packaging of goods. In turn, this suggests the importance of using a pricing and subsidy approach rather than a technological one. In waste collection and waste transport, improvements ranging from pneumatic collection systems in blocks of flats to modern collection vehicles and transfer stations could be introduced. At the disposal stage of the waste cycle there is much that could be done to increase resource recovery and reuse.

On the political and administrative side of waste management, two types of overall control can be distinguished: the first is control over the *whole* waste management system — land, water and air-borne wastes as illustrated in Fig. X(i); the second is *uniform* control throughout a country or state. Fragmentation of either one or both types of control, as experienced in Australia, only increases the difficulty of maintaining adequate control. There is a strong case to be made in Australia for Federal or State co-operation in formulating policies to cover all aspects of waste management, but given the current three-tier system of government — federal, state and local — of the country, this would not be achieved easily. Throughout this chapter many references have been made to the difficulties arising in Sydney because of the absence of centralised control over waste management and to the need for waste management and urban planning to be integrated over the city region as a whole. Apart from the involved question of political objectives, given the necessary expertise and an adequate data base, formulating physical plans can be relatively straightforward; it is the successful implementation of plans and policies which is the more difficult task.

Neither the technology nor the administration of waste management can be divorced from considerations of the costs of pollution control. Many decisions in the field of waste management can have high social costs. For example, stringent anti-pollution measures may force the closure of industrial enterprises which cannot meet the stricter standards, thus forcing employees to seek other jobs. As far as industry is concerned, costs arise if production processes have to be altered to include recycling of materials or to incorporate salvaged materials. The consumer in turn faces higher prices if increased production costs are passed on to him. In short, these issues lead back to the fundamental question of political objectives.

The waste management problems specific to Sydney fall into each of the categories considered — technological, administrative, political and economic. The need to find alternatives to landfill may be more urgent in Sydney than in other cities of comparable population because of the extent of Sydney's urban sprawl and because of the underlying Hawkesbury sandstone which increases the danger of water pollution from landfill areas. So far, only one concrete move and not a very successful one, the establishment of the Waverley-Woollahra incinerator, has been made towards an alternative to landfill. Some moves have been made to encourage the recycling of materials, for example car bodies and steel cans, but economic factors impede further developments in this area. On the administrative and political side, while the establishment of the M.W.D.A. can be seen as a major step towards improving solid waste management in Sydney, the impact of the Authority is limited until its continued existence is assured and its role clarified and integrated with those of other authorities. Clearly, it suffers at the moment because of its small staff and its limited financial resources. As emphasised earlier in this chapter, the role of the M.W.D.A. to date has essentially been one of planning for both industrial liquid waste and solid waste management. Successful implementation of the plans, which at this point is by no means certain, depends on the determination of the Authority to tackle the political difficulties confronting it and to handle the formidable problem of political reaction to its proposals. Although technology and rational planning should be able to provide economic solutions to the problems of an environmentally acceptable waste management system, the major hazard is the unwillingness of the Authority to make politically unpopular moves such as tackling waste problems at the source, effectively policing waste streams, making sections of the Sydney community which are 'well-off' with reference to waste disposal share the problems of less fortunate areas in the metropolis, and implementing fair and rational approaches to paying for waste disposal.

# 11 Some findings and some comparisons

## Findings from Sydney

In the planning and administration of urban environmental protection through waste management and pollution control activities, we have suggested that a good many significant obstacles exist in the re-structured Sydney system. The problems of the urban environment in all its aspects are complex and difficult to resolve. The officials concerned with these problems have undoubtedly provided Sydney residents with highly responsible and valuable services. The problems of managing a large city like Sydney are very demanding. Inevitably, one is very reluctant to be critical. We offer the following comments with the intent to be constructive rather than critical, aware that a broader view of Sydney's social and technological problems, not merely the environmental ones, modify some of our suggestions. These suggestions form, essentially, an alternative to the approach adopted by predominantly technological administrators and, indeed, by a city community that accepts technological values.

1. There appears to be a common impression that the quality of Sydney's environment is progressively deteriorating. This view has been disputed by public figures in specific cases. There can be little doubt but that Sydney's officials are attempting, with a high sense of public service, to improve the metropolitan environment. Yet the impression remains. The impression may not always be well-founded. However, it appears that some environmental problems become more prominent as others are 'solved'. It is possible that the official approach, concentrated on shifting wastes and changing their form, merely ends in different individuals and areas being subjected to environmental degradation. In addition, noise, congestion and delays in movement around Sydney are now increasingly irritant. In either case, a more coherent view of the physical environment in the context of total city activities appears to be required.
2. Sydney has the most serious immediate water quality problems in Parramatta and Cooks Rivers and their tributaries. These waters are very seriously degraded but, thanks to the activities of the Water Pollution Control Branch, improvements are occurring. In the long run, the basic problems appear to centre around Georges River because of the growth of westward settlement, at the ocean beaches and possibly in Botany Bay due to port development. At present, it appears that the quality of Botany Bay water, apart from areas immediately around the mouths of Georges and Cooks Rivers, is very high.
3. Sydney's man-made smoke, particulate and dust problems have largely been resolved thanks to the competence of the Air Pollution Control Branch during the 1960s. However, this has been the easiest air pollution control

task and one for which specific physical controls proposed by public authority are most appropriate. Possibly the outstanding environmental problem of Sydney today and for the immediate future is the development of photochemical smog due, in a primary form, to the extensive use of motor vehicles and petroleum fuels and, to a less but significant extent, to factory activity. The reliance on vehicle emission control is a useful, short-term approach; effective control depends on broader, preventive measures. Alternative energy sources may cope with air pollution but leave the problems of congestion and related environmental difficulties untouched.

4. The most damaging wastes of manufacturing, the concentrated liquid waste residues and the more troublesome air contaminants, have not been successfully controlled in Sydney. The delay in their control reflects partly the technical difficulties and the relatively high costs that would be imposed in these cases.
5. A regional scheme of solid waste disposal has been evolved by the Metropolitan Waste Disposal Authority, essentially on a short-term basis, to rationalise existing land-fill sites and to control the use of the more inappropriate sites. Nevertheless, control over the latter has been very limited; and serious obstacles to the execution of the M.W.D.A. plans have been introduced by resistance from local authorities. Plans that exist are short-term and cannot be expected to cope with Sydney's long-run needs. Some of these long-run needs are being considered by the Authority.
6. There are many localised physical environmental problems. The failure to resolve these must be regarded as due partly to the conflicting aims of metropolitan and local planning interests and partly to the limits on the ability of local authorities to exercise effective constraint over waste sources.
7. Efforts to control noise have only very recently begun and we have not considered them at length in this study. Noise is a leading environmental problem in Sydney.
8. Goals of urban waste management and pollution control need to be specified in terms of society rather than technology. Existing management objectives are essentially technical engineering prescriptions with no clear social objective. The technical prescriptions lead to the step-by-step consideration of particular issues, often in isolation, and the separate 'solution' of each problem. Both prescriptions and 'solutions' are predominantly bureaucratically-defined. They tend to concentrate on symptoms rather than the sources of urban environmental problems.
9. The habit of governments in New South Wales has been to confine policy making on waste management within the public bureaucracy, to push knotty issues away from the political process into the hands of technologists, the 'neutral' experts. The strength of bureaucratic control is reinforced by the legal foundations that define powers predominantly in terms of the responsibilities and functions of authorities and limit by statute the behaviour of individuals.
10. The separation, in Sydney, of particular management and control activities is greatly widened by the existence of a number of powerful and semi-independent statutory bodies. They operate within imposed specific horizons, with limited integration of their functions and with no adequate coordination in terms of city planning and administration.

11. The specification of environmental objectives solely in physical terms may have been more acceptable in the distant past when urgent health problems dominated management and control approaches (e.g. typhoid in the nineteenth century). The gradual, though incomplete, movement towards a concept of environmental quality as a social amenity for residents requires the adoption of planning and administrative principles that will permit a means of ordering both social and technological priorities and assessing net benefits of action.
12. A basic need in administration and planning is to adopt a definite and consistent assessment system: we need to be able to choose between alternative policies; to analyse the outcome; and to provide the basis for allocating resources to environmental protection as a whole and to separate areas of waste management and pollution control. This depends on the procedure, limited and defective as it is, of cost/benefit assessment, including a great many uncertain criteria.
13. The specification of these criteria depends on more than the formal *recognition* of social goals by the existing technocratic agencies. It would perhaps be facilitated to some extent by a significant broadening of professional representation in planning and administration. But it depends basically on the effective incorporation of residents' values by community representation (as distinct from a few select pressure groups) in policy and administration.
14. Sydney's approach to waste management is based essentially on the philosophy of 'disposal' — of the transfer of wastes away from their place of generation to some chosen disposal site, using publicly managed transfer facilities. Very little is done in the way of influencing the generation of waste or its reuse. This approach applies alike to liquid and solid wastes, the former relying on the ocean as a sink, the latter on the land as an area for dumping. Very serious defects arise from these approaches. In both cases, they are very costly. Land-fill sites are increasingly limited, garbage volumes are growing and longer and longer distances are required for waste transport. In the case of water-borne disposal of wastes, the use of the ocean has serious consequences for Sydney's beaches. And, despite expensive waste treatment, the future will lead to increasing pressures on inland water resources, especially the high amenity Georges River Valley.
15. Similarly, in the case of pollution control, the basic philosophy is to accept waste-generating behaviour and to try, in a piecemeal manner, to limit the consequential damage. Restrictions on land dumping sites, transfer of liquid wastes from inland waterbodies to sewer and the control of vehicle emissions cover the main spectrum of activity. The costs are high, the achievements uncertain, even in the short run. In the long run, these approaches are not viable. Policy needs to shift to the alteration of behaviour that leads to waste generation and to recycling and reuse of wastes.
16. Three broad possibilities of management and control strategy exist:
    (a) To retain the existing divided technocracy but to pursue different social and preventive ends
    (b) To adopt flexible procedures that will induce individuals to change their behaviour patterns

(c) To broaden and integrate the system of city government, incorporating environmental amenity as a major policy issue.

17. The first option does not imply a disregard of technology. Technological solutions are an important ingredient in preventive management and control. But, fundamentally, wastes are generated and pollution results from *the behaviour of people*. It is this behaviour that needs to be examined. The existing technocracy is preoccupied with remedial rather than preventive action to channel individual and group behaviour in different directions so that waste flows may be reduced and wastes reused. To begin with, this option would need a radical restructuring of professional skills in the public agencies.

18. Within this first possibility, there are many adjustments of public action that could be taken to induce more attention to prevention and recycling. The 'waste disposal' authorities — the Metropolitan Water, Sewerage and Drainage Board and the Metropolitan Waste Disposal Authority — are in a better position to introduce preventive controls and inducements because they stand astride these major waste flows. Unfortunately, no such management authority exists in the case of air-borne wastes. However, this first option, by itself, is not a promising possibility in the long run. To be effective, it depends on either of the other alternatives for reinforcement. The adoption of the 'polluter pays' principle in a pricing approach by these waste management authorities would be one flexible principle of management. It would be desirable that the relevant agencies should move in this direction, in any event, in order to induce business and individuals to find appropriate solutions. Related to this type of approach, educative campaigns could be used to bring environmental needs and the relationship between existing behaviour, wastes and damage to public attention.

19. Approaches along these lines would be useful. But suggestions of this type beg the questions: How much is environmental amenity to be valued? Who should benefit from improvement? Who should bear the costs? These questions are not answered by a magical formula either of pricing procedures or of educational campaigns. The answer must be found in the values of Sydney residents. Neither prices nor educational campaigns can be determined merely or primarily by authority. Either approach requires the overall selection of goals by democratic procedures.

20. In the light of para. 19, we must recognise the necessity for an overall system of city government. Since the problems of declining environmental amenity arise from the existence of the city, they should be dealt with on a city basis.

21. City government is not, in itself, a simple solution. But the present system in Sydney is far from this prescription. A large number of parochial local authorities, with narrow horizons; a few statutory bodies primarily concerned with Sydney as such; a large number of other authorities that make basic city planning and administrative decisions as an adjunct of much larger State-wide responsibilities — this is an invitation to confusion in the management of city needs.

22. The concept of a specialised environmental protection agency as one among *such a variety* of agencies, is inconsistent with the nature of the process of urban environmental degradation. There are many authorities in transport,

public works, harbours, labour and industry and others that make decisions that have a vital bearing on the generation of wastes. Most of these bodies become, in fact, even if not necessarily in law, capable of defeating environmental objectives of a specialised protection agency. But, most importantly, environmental amenity should not be considered as a separate end in the broader quality of life of a city. It needs to be integrated as one criterion amongst others in the policy-making and administrative processes of all agencies.

23. This condition could be achieved by an effective system of city government with city agencies possessing overriding powers over the actions of other (State) authorities within metropolitan limits. This is, of course, merely an administrative prescription. The need for the infusion of environmental amenity as an end in city planning and administration would remain. But it cannot be too strongly urged that this infusion faces severe obstacles with the existing administrative arrangement.

24. Prevention of degraded environmental amenity should be sought above all through effective land-use planning, through the designed arrangement of the component parts and activities of the city, through the efficient and the equitable arrangement of dwellings, business, transport and leisure to reduce waste flows. A great deal of the burden of environmental protection is to be achieved by avoiding major mistakes or persistent misdirection.

25. Basically, environmental amenity is to be pursued in terms of the size and type of city to be developed, the rate of its expansion, the location and composition of its activities. These objectives cannot be left to the market partly because the market, by itself, cannot effectively incorporate environmental values, partly because the opportunities for individual choice are constrained by so many indivisible elements — types of roads and transport systems, land-use zoning by different authorities, etc. — as to channel individual responses into narrow alternatives that end in greater environmental damage.

26. Provided preventive action can be incorporated into the overall system of city planning and administration, with an integrated set of agencies directly subject to city government, other specific elements of waste management, pollution control and the technical prescriptions for recycling, reuse and treatment of wastes may be made more rational; so too can the attempts at specific restorative action to recover degraded parts of the city environment.

27. Environmental protection is not merely a matter of technical efficiency or, more broadly, of economic and social efficiency. Equity considerations are a basic issue. The social distinctions in Sydney are plain to see with a general, though not wholly precise, division of the city into two halves north and south of Parramatta River and Port Jackson. It is the southern half that has most to gain from waste management and pollution control; it is the northern half that has the larger wealth with which to support action to improve the environment.

28. Fundamentally, it is essential to establish an attitude: *urban* and particularly large city environmental amenity is for human enjoyment. The preservation of this amenity is not only a matter for natural and applied science and health experts, biologists, engineers, though they have

important contributions to make. The conservationist approach has a very limited role in a city situation such as that of Sydney. Similarly, despite the merits of much of the emotive attitudes of 'greenies' or of local action groups, the *city* environment is the product of a complex system over a large area and needs to be treated as such. Moreover, the socio-technological problems of city environment are too complex to be resolved by simplistic formulae of economists. What is suggested is that urban environmental protection is one of the important routine elements of city management and needs to be incorporated as an ordinary part of orderly management.

## Sydney and other Australian cities

The problems of Sydney are not special to it. Many of its characteristics in terms of waste sources, the approaches to waste disposal, the pattern of discharges of liquid wastes, the use of the ocean as an eventual sink, the methods of solid waste disposal, all re-emerge in basic form in the major coastal cities.

Table XI-(1) Some waste sources and waste flows for five cities, 1972

| | Sydney | Melbourne | Brisbane | Canberra/ Queanbeyan | Albury-Wodonga |
|---|---|---|---|---|---|
| **Latitude (°S)** | **33° 55′** | **37° 49′** | **27° 28′** | **35° 19′** | **36° 06′** |
| **Area (sq. km)** | **1,421** | **1,322** | **726** | **133** | **47** |
| **Waste sources** | | | | | |
| Population (millions) | 2.851 | 2.547 | 0.707 | 0.174 | 0.042 |
| Dwellings (thousands) | 897 | 791 | 212 | 48 | 12 |
| Manufacturing establishments | 10,475 | 9,432 | 1,818 | 188 | 104 |
| Vehicle mileage (millions p.a.) | 9,429 | 7,767 | 2,513 | 600 | ? |
| % Persons using public vehicles going to work | 29.7 | 24.4 | 20.8 | 8.7 | — |
| **Wastes (per year)** | | | | | |
| Domestic wastewater (million litres) | 225,000 | 195,000 | ? | 20,000 | 4,000 |
| Industrial wastewater (million litres) | 95,000 | 87,000 | 45,000 | <1,000 | <1,000 |
| Solid wastes (million tonnes) | 2.25 | 2.17 | 0.47 | 0.10 | 0.01 |
| **Waste disposal (per year)** | | | | | |
| Wastewater discharged to: | | | | | |
| Sewers (million litres) | 245,000 | 215,000 | ? | 20,000 | 4,000 |
| Waterbodies (million litres) | 45,000 | 40,000 | 30,000 | — | — |
| *Percent* discharged to: | | | | | |
| Rivers | 7 | 5 | 30 | 100 | 100 |
| Coastal waters | 93 | 95 | 70 | — | — |
| *Percent* properties sewered | 84 | 77 | 74* | 95+ | 83 |
| **Indicators of assimilative capacity** | | | | | |
| Average monthly river flows (million litres) | 3,400† | 42,000‡ | 95,000 | 38,000 | 348,000 |
| Minimum monthly river flow (million litres)§ | 0 | 6,600 | 1,200 | 6,300 | 90,000 |
| Average wind speeds (metres/sec) | 3.18 | 3.48 | 3.05 | 1.62 | 1.64 |

*% sewered in 1975, 96.
†Georges River only.
‡Yarra River only.
§As estimated at 10 per cent level of occurrence.

Significantly different issues confront inland cities, particularly because the ocean is no longer available as a sink and the impact of these settlements is on inland streams. This latter problem arises not only from liquid waste flows but also from leachate flows from solid waste land-fill sites. In addition, even in the inland settlements, with very much smaller populations than in the coastal cities, significant air pollution problems have arisen or are emergent, partly because of poorer air ventilation.

Inland towns in Australia introduce to this country a basic problem common elsewhere in the world but not significantly represented in Australian coastal cities. This is the effect of a series of settlements along river courses, each town successively affected by waste flows from upstream. But there is an added problem in Australian inland city locations. The wide variations in river flow and assimilative capacity of the inland streams makes these rivers and the environmental quality of these towns particularly sensitive to the stresses of human settlement. The necessity to avoid or to limit these stresses is much more important than in the coastal cities and the costs of protection much higher per person. The significance of these environmental constraints for attempts to decentralise inland will be obvious.

What is less obvious is that the one relatively successful act of decentralisation, the establishment of Canberra, has not adequately revealed the costs and the risks because of the nature of Canberra as the national capital. The availability of Commonwealth funding, the adoption of full-scale land-use planning and the control over the nature of the city in the substantial elimination of industrial activity, have been major factors preserving the quality of the environment. Despite these factors, the national capital has not succeeded in escaping air pollution problems. The city lies in a natural basin and experiences frequent inversion conditions. In addition, affluence and the reliance on the private motor vehicle appear to be major factors. To a less marked extent, water pollution problems have developed, constrained by heavy outlays on sewerage treatment and water supply.

Table XI-(1) presents an impressionistic bird's-eye view — certainly not an array of information adequate to convey the full comparisons — of some of the relevant factors for five cities, three coastal and two inland. Brisbane and Melbourne have been chosen to compare directly with Sydney; Canberra has been combined with Queanbeyan so that some of the special characteristics of Canberra are masked; and Albury-Wodonga has been included as an inland growth centre. Reference particularly to Chapters 6-10 will make it plain that far more information is needed for these other cities in order to provide the foundation of any real understanding of their respective environmental problems. The table nevertheless indicates, for the three coastal cities, a broad similarity of waste sources in dwellings, factories and vehicles and a not very dissimilar reliance on private vehicles. These cities show large flows of industrial and domestic wastewater and a *broadly* similar picture of large amounts of solid wastes generated per head. These cities also dispose of significant fractions of wastewater discharged directly to waterbodies and rely basically on the sea as the ultimate sink. One feature of Brisbane is not revealed: the remarkable increase in the proportion of dwellings sewered between 1971 and 1975, one of the considerable feats of the Brisbane City Council. The three coastal cities are all well ventilated but only Brisbane is reasonably well served in terms of river flows.

In essential respects, these coastal cities face the same basic problems and hence the order of similarity has been stressed. There are, of course, many and significant differences — Brisbane's location inland along the river; Melbourne's dispersion in an arc around Port Phillip; both Melbourne and Brisbane are physically less constrained by topography than Sydney; sprawled extensively as all Australian cities are, Brisbane excels in the great Australian sprawl; the composition of industry and hence of the type of industrial wastes differ significantly.

In terms of waste disposal processes, all three coastal cities rely on sanitary land-fill for solid waste disposal. Though less formalised than the M.W.D.A. *plan* for Sydney, both Melbourne and Brisbane have a more coherent *working* system of garbage disposal. In Brisbane, the City Council is responsible for garbage collection and disposal (through contractors) for substantially the whole built-up area. Plans are in progress for large sites on the outskirts of the city and for the establishment of transfer stations. Basically the same physical flow arrangement and the same problem of high transport costs confront Sydney and Brisbane. In Melbourne these problems are replicated. Organisationally, Melbourne has developed a regional system working through four regions, the local authorities in each region forming a joint management. Transfer stations have been established to move garbage increasingly to sites on the edge of the city. Again, the mounting cost of garbage transport confronts Melbourne, as it does in Sydney and Brisbane, because increasing garbage volumes have to be moved over longer distances.

Sydney and Melbourne, and to a less extent Brisbane, discharge the bulk of their sewage into coastal wasters. In Brisbane, outfalls occur near the mouth of the Brisbane River; in Melbourne, sewage is discharged predominantly (75 per cent) into Port Phillip Bay (after land treatment at Werribee) and to a less extent into Bass Strait. Unlike Sydney's, the discharge points in Melbourne and Brisbane are further from major swimming beaches. Nevertheless, significant water pollution problems have developed. In Brisbane, a significant issue arises from low dissolved oxygen at the mouth of the Brisbane River; in Melbourne, local nutrient problems have developed in Port Phillip Bay close to the sewage farm and, at times, the farm has a pronounced odour. Melbourne, in this respect, faces the most serious problems and the need for a very large resource outlay to improve treatment at the farm and for new main construction to the farm.

All three cities have experienced serious problems from liquid waste discharges, particularly of industrial wastewater into inland streams. Many of the smaller tributaries are seriously degraded. All cities have the difficult task of dealing with industrial liquid waste residues though the problem is less acute in Brisbane. All three coastal cities have serious stormwater run-off problems; and all are afflicted by sewer overflows. In the past five years, Brisbane's problems with industrial wastewater flows have been significantly alleviated as a result of the successful sewerage program resulting in an almost completely sewered city. Both Melbourne and Brisbane appear to be less afflicted by the difficulties due to the discharges of industrial wastewater to sewers. In Melbourne, this may be due to the robust nature of the Werribee Farm; in Brisbane, it is predominantly due to the composition of industrial activity. All three cities, however, are moving to direct the mass of industrial wastewaters to sewers. Sydney appears to be much the most advanced in its approach to 'trade wastes' and to the control of and charging for these flows.

In the three coastal cities, a relatively similar concentration on control of particulates and dust has been made. All three cities now face a common problem — photochemical smog. In each case, the same basic source of primary wastes, the motor vehicle, is the dominant mode of transport. Melbourne's problems appear to be similar to those of Sydney. Peak concentrations of oxidants are only slightly below those of Sydney, though they appear to occur less frequently. Melbourne has a rather lower annual vehicle mileage, a lower incidence of sunlight, a less topographically constrained area and is better ventilated. Although Brisbane's smog problem is significantly less than those in Sydney and Melbourne, its recorded ozone levels have recently exceeded World Health Organization goals by a considerable margin on several occasions. However, the matter may be worse than existing measures imply because the monitoring location in the Brisbane central business district has not been the most appropriately chosen location.

This illustrative outline is intended to confirm the essential generality (with some differences) of the environmental problems in these cities. It is not offered as a detailed account of similarities and differences.

It is interesting that, in all three coastal cities, steps were taken to establish special environment protection administrations at very similar times. In 1970, the Environmental Control Council was established in Queensland and in New South Wales, the State Pollution Control Commission. Prior to these dates, Clean Air Acts were passed in Victoria in 1958, New South Wales in 1961 and Queensland in 1963. Public Health Departments administered these Acts initially in all three states.

The formation of special agencies was supplemented by other legislation and broadening approaches. The N.S.W. provision for water pollution control, noise control, the waste disposal legislation and the planning and environment legislation during 1970-5 have been discussed (see Chapter 2). In Victoria, the Environment Protection Act, 1970, provided for control of air, water, land and noise pollution and was followed by the Ministry of Conservation Act, 1972, Ministry of Planning Act, 1973, and the State Coordination Council Act, 1975. In Queensland, a Clean Waters Act, 1971, was followed by an omnibus Act, the State and Regional Planning and Development, Public Works Organisation and Environmental Control Act, 1971. No comparable legislation exists for Canberra.

In both Melbourne and Sydney, the statutory and administrative approaches have been a response to the seriousness of environmental problems in the three coastal cities. Neither has represented much more than improvisation without much regard for the relations between the Acts and the tasks of authorities in relation to existing city agencies and their responsibilities. In all cases, an attempt has been made to graft a specialised body on to a complex of local, metropolitan and State bodies. The same basic conflicts of interest — conflicts between authorities — can be recounted for Melbourne and Sydney. Sydney appears, in fact, to be more aware of the technical problems of environmental damage and in advance of Melbourne in air pollution control and liquid waste management. Melbourne's history of environmental administration appears to have been particularly unhappy. In Brisbane, the Queensland Government chose to deal with State environmental problems by adding to the functions of existing departments. In addition, the design was influenced by the existence of only one large local government authority, the City of Brisbane Council. The Brisbane metropolis is administered as a region by this Council. The Council is the water supply and sewerage construction authority; the waste disposal authority for both sewage and garbage; the pollution control authority; and the town planning authority. The Council is, however, subject to the monitoring of its activities and the determination of many of its major policies by superior State Government agencies. This is not an ideal design. Nevertheless, it is not irrelevant that, in the course of five years, basically from its own resources, Brisbane raised the percentage of its city properties sewered from only 74 to almost 100.

None of these administrative experiments can be regarded as particularly successful. All represent approaches dominated by a 'disposal' attitude as the basic philosophy. None has effectively integrated environmental criteria in wider planning and administrative approaches. All confront political rivalries of the miscellany of agencies that bear significantly on the quality of the environment. None has escaped technocracy and the dominance of engineers. Each can point to useful amelioration. None can claim any remarkable success. Though the detailed characteristics of Sydney are special, the basic lessons of this volume are nation-wide. The problem to be solved in managing urban environmental quality is not the difficulty of finding technologically viable solutions. The real obstacles lie in politics, administration and social behaviour.

# Notes

## Notes to Ch. 1: From public health to environmental amenity

1 In the period 1901 to 1967/8 the number of factories in New South Wales rose from 3,367 to 24,884; and persons employed in factories from 62,000 to 531,000. The bulk of the factories and their employees concentrated into the metropolitan area; in 1967/8 66 per cent and 75 per cent respectively of the State total in each category were in the Sydney Statistical Division.

2 The increase in the annual Australian consumption of petroleum products illustrates the qualitative and quantitative changes in wastes generated this century: the annual national consumption rose from 584 million gallons in 1938/9 to 7,152 million in 1972/3. In 1928 the first oil refinery in the Sydney region began production at Clyde; the second at Kurnell in 1956. By 1973 there were twelve petrochemical plants in operation in Sydney, which produced chemicals for a wide variety of products, including plastics, rubber, paints and solvents.

3 Sydney City and Suburban Sewage and Health Board (S.C. and S.S.H.B.), 'First Progress Report', in *Votes and Proceedings* of the New South Wales Legislative Assembly (*V. & P.* N.S.W.L.A.) session 1875, Vol. 4, p. 336.

4 The first Public Health Act in Britain was enacted in 1848 in reaction to a cholera scare. Its inadequacy and those of its successor Acts (Local Government Act, 1858, Sanitary Act, 1866) led to agitation from sanitary reformers which culminated in the appointment of the Royal Sanitary Commission. The Commissioners' report in 1871 helped to shape the Public Health Act of 1872; the whole body of health laws were consolidated in the Public Health Act of 1875.

5 The Metropolitan Water and Sewerage Act, which constituted the Board, was passed in 1880, but the Board was not appointed until the completion of the Upper Nepean water supply scheme. It may be noted, as a matter of interest, that the incidence of typhoid in Sydney fell greatly after the 1860s and some of the fears may, by the eighties, have been exaggerated.

6 The power to construct works was granted to the Board under the Metropolitan Water, Sewerage and Drainage Act, 1924.

7 The jurisdiction of the Water and Sewerage Board also included Wollongong.

8 The Department was transformed into the Health Commission in 1973.

9 W. V. Aird, *The Water Supply, Sewerage and Drainage of Sydney*, Sydney, 1961, p. 4.

10 The construction of the sewers was begun by the three City Commissioners who replaced the City Council in the years 1854-7.

11 Petition 'Sewerage of the City', in *V. & P.* N.S.W.L.A. session 1876-7, Vol. 3, p. 685.

12 S.C. and S.S.H.B., 'Second Progress Report', in *V. & P.* N.S.W.L.A. session 1875-6, Vol. 4, p. 701.

13 Ibid., Appendix A, 'Twelfth and Final Report', in *V. & P.* N.S.W.L.A. session 1876-7, Vol. 3, p. 785.

14 Three of the five Royal Commissioners who had investigated Sydney's water supply also served on the fifteen-man Sydney City and Suburban Sewage and Health Board.

15 S.C. & S.S.H.B., 'Sixth Progress Report', in *V. & P.* N.S.W.L.A. session 1875-6, Vol. 5, p. 372.

16 Sewage farms at that time, like most sewage disposal systems, were at an experimental stage. The Sewage and Health Board considered that the existing population to be served by sewer was too small to justify the expense of terminating the south-drainage sewer at an ocean outfall.

17 S.C. & S.S.H.B., 'Fifth Progress Report', in *V. & P.* N.S.W.L.A. session 1875-6, Vol. 5, p. 351.
18 Petition from 5,672 citizens of the Illawarra suburbs, in *V. & P.* N.S.W.L.A. second session 1908, Vol 2, p. 1005.
19 The term 'night cart' and the euphemism 'nightsoil' originated because the time of collection of household excreta, other than between the night hours of 10 p.m. and 5 a.m., was forbidden by law.
20 S.C. & S.S.H.B., 'Twelfth and Final Report', in *V. & P.* N.S.W.L.A. session 1876-7, Vol. 3, p. 700.
21 Under Section 48 of the Public Health Act, 1896, local government councils within declared Sanitary Districts were compelled to make by-laws, which, among other things, prohibited the use of cesspits.
22 *Report of the Director-General of Public Health* for 1959, p. 133.
23 Bacteria that exist without oxygen.
24 N.S.W. Department of Health, 'The Development of the Health Inspection Branch 1888-1972', unpublished typescript, p. 9.
25 Sullage includes all household waste water (e.g. sink, bath, shower and laundry) other than excreta.
26 *Report of the Director-General of Public Health* for 1959, p. 133.
27 S.C. & S.S.H.B., 'Twelfth and Final Report', in *V. & P.* N.S.W.L.A. session 1876-7, Vol. 3, p. 702.
28 Ibid., 'Eleventh Progress Report', in *V. & P.* N.S.W.L.A. session 1875-6, Vol. 5, p. 489.
29 Letter from W. Clark to Colonial Secretary of N.S.W., 17 July 1877, in *V. & P.* N.S.W.L.A. session 1876-7, Vol. 3, pp. 881-2.
30 The Board first imposed an industrial liquid waste charge based on waste volume in 1942.
31 Other contemporary Acts relating to disease control were the Dairies Supervision Act, 1886, the objective of which was to prevent the transmission of typhoid fever through milk, and the Leprosy Act, 1890.
32 N.S.W. *Parliamentary Debates*, series 1, session 1882, Vol. 7, p. 1202.
33 A consolidated Noxious Trades Act was passed in 1902.
34 Activities declared as noxious trades were: fat extractor and melter, bone boiler and grinder, blood boiler and drier, glue maker, pig keeper, poultry farmer, knacker, gut scraper, rag picker, rag dealer, flock maker, manure maker.
35 Public Health Acts were enacted in Victoria 1854, Queensland 1872, South Australia 1873, Tasmania 1884, Western Australia 1886.
36 The relevant parts of the Public Health Act, 1896, are headed: Part III Notification and Prevention of Infectious Diseases; IV Common Lodging Houses; V Building Areas and Buildings; VI Nuisances; VII Polluted Water Supply; VIII Unwholesome or Adulterated Food and Drugs; IX Dairies; X Cattle Slaughtering; XI Supplemental. The parts of the Act of 1902 are similarly headed, but with a new Part IV entitled Crematories.
37 The first occupant of these dual positions was Dr Ashburton Thompson, who had arrived in N.S.W. in 1884. He was the sole draftsman of the Dairies Supervision, Leprosy, Noxious Trades and Cattle Slaughtering Acts and co-author, with lawyer B. R. Wise, of the Public Health Act of 1896. As an epidemiologist he achieved fame for his demonstration (1900-1), that plague epidemics were spread by infected rats (the infection is then passed on through the bite of their fleas).
38 The title of the Department has changed several times. From the early 1900s the Chief Medical Officer's Department became known as the Department of Public Health; from 1913 as the Office of the Director-General of Public Health. Until 1939 it had been a sub-department of the Chief Secretary's Department; in that year it became a separate unit, the Department of Public Health. From 1 January 1971 it was called the Department of Health; following a structural reorganisation it became the Health Commission after 1 April 1973.
39 Until 1904 the President of the Board of Health was responsible to the Colonial Treasurer but as the Chief Medical Officer to the Colonial Secretary; thereon both posts were responsible to the latter Minister until 1914, when the first portfolio of Public Health was created.
40 Subsequently renamed the Metropolitan Health District. In 1969 the western section separated to become the Western Metropolitan Health District. Further subdivision occurred

in 1972 to produce three metropolitan regions: Western, Northern and Central, and Southern. At this reorganisation a fourth metropolitan region was foreshadowed.

41 'Health' replaced 'Sanitary' in the title of the Branch and of the inspectors in 1948/9.

42 Under the By-laws of the Local Government Act, 1919, Health Inspectors have to approve the site, type and operation of each septic tank.

43 *Report of the Director-General of Public Health* for 1969, p. 50.

44 Ibid., for 1967, p. 57.

45 Ibid., for 1969, p. 171.

46 Ibid., for 1963, p. 159.

47 Ibid., for 1968, p. 50.

48 A. E. Barton states in his *Report . . . Upon Investigations Into The Problem of Waste Disposal . . .*, Sydney, 1970, p. 10, that the order to close the tips was given by the councils partly on the advice of the Board of Health.

49 *Senate Select Committee on Water Pollution, Minutes of Evidence*, Vol. 8, p. 1568.

50 Ibid., p. 1568.

51 Before 1969 known as the Government Analyst Branch.

52 The Division of Industrial Hygiene was renamed Occupational Health in 1959, Occupational Health and Pollution Control in 1970, and the Division of Occupational Health and Radiation Control in 1974.

53 The New South Wales Parliament passed a Smoke Nuisance Abatement Act in 1866 which was slightly modified in 1902.

54 *Report on Air Pollution in New South Wales*, p. 5, in N.S.W. *Parliamentary Papers*, third session, 1957-8, Vol. 3.

55 Until the passing of the Clean Air Act in 1961, air pollution in N.S.W. was governed by the Smoke Nuisance Abatement Act, 1902, Public Health Act, 1902, Local Government Act, 1919 and Ordinance 58 made under that Act, Maritime Services Act, 1935, Motor Traffic Act.

56 *Report on Air Pollution in New South Wales*, p. 11.

57 The establishment of the Sydney Harbour Trust in 1901 was prompted by the outbreak in Sydney of bubonic plague that had been brought ashore by infected rats from overseas ships. In order to control the plague, the State Government, through its new agency, bought all private wharves and warehouses, thus making the Trust the owner as well as the operator of the Port of Sydney.

58 *Report from the Senate Select Committee on Air Pollution Part I*, Canberra, 1970, p. 64.

59 Ibid., *Part II, Minutes of Evidence*, Canberra, 1970, p. 32.

60 *Senate Select Committee on Water Pollution, Evidence, Sydney, 12-13 March, 1969*, Vol. 8, p. 1573.

61 According to the Metropolitan Medical Officer of Health, the Inter-departmental Committee had representatives from the Department of Public Health, the Department of Public Works, the M.W.S. & D.B., Maritime Services Board, South Sydney Council and Marrickville Council.

62 *Senate Select Committee on Water Pollution*, Vol. 8, p. 1581.

63 Ibid., p. 1577.

64 Ibid., p. 1585.

65 Barton, *Report . . . Upon Investigations Into The Problem of Waste Disposal in the Metropolitan Area of Sydney*, Sydney, 1970, p. 3.

66 Ibid.

## Notes to Ch. 2: Reorganising waste management and pollution control, 1970-1975

1 From 1 January 1971 the Department of Public Health became known as the Department of Health; following a structural reorganisation and amalgamation with the Hospitals Commission, it became known as the Health Commission after 1 April 1973.

2 W.H.O. Expert Committee, *Health Aspects of Environmental Pollution Control: Planning and Implementation of National Programmes*, World Health Organization, Technical Report Series No. 554, Geneva, 1974, p.40.

3 *Report of the Director-General of Public Health*, 1971, p. 11.

4 *Report of the State Pollution Control Commission*, 1972/3, p. 9.
5 J. B. M. Fuller was knighted in 1974.
6 *Report of the State Pollution Control Commission*, 1973/4, p. 13.
7 Robert Dempsey and John Power, 'The Politics of the Environment' in Amos Rapoport (ed.), *Australia As Human Setting*, Sydney, 1972, p. 260.
8 From 18 October 1973 replacing Sir Robert Crichton-Brown, whose directorships include the Commercial Banking Company of Sydney Ltd. and tobacco company, Rothman's Pall Mall (Aust.) Ltd. Sir Robert is (1975) also the Treasurer of the Federal Liberal Party organisation.
9 *Report of the State Pollution Control Commission*, 1971/2, p. 10.
10 *Report of the Air Pollution Advisory Committee*, 1972/3, p. 7.
11 Ibid., 1964/5, p. 4; 1966/7, p. 6; 1967/8, pp. 11-12.
12 Ibid., 1967/8, p. 12. See also R. P. Murphy, 'Air Pollution and Urban Development', in *Roy. Aust. Planning Institute Journal*, July 1970, pp. 67-76.
13 One current (1975) representative is the Assistant Director of the S.P.C.C., Mr R. P. Murphy, a former head of the Air Pollution Control Branch.
14 *Report of the Air Pollution Advisory Committee*, 1965/6, p. 3.
15 Ibid., 1972/3, p. 10.
16 During the 1960s the Advisory Committee reported similar difficulties in applying the Clean Air Act to another government authority, the Electricity Commission of N.S.W., whose power generating stations in the Sydney metropolitan area are being phased out of operation.
17 *Sydney Area Transportation Study*, Vol. 1, pp. 11-30, Sydney, 1974.
18 *Report of the State Pollution Control Commission*, 1973/1974, p. 25.
19 The O.E.C.D. report suggests that the development of energy conservation will aid the development of public transport.
20 Following ministerial changes in January 1975, the Department of Main Roads and the Public Transport Commission have been under the control of one Minister who holds the portfolios of Transport and of Highways. Thus the opportunity to coordinate policy in these areas is enhanced.
21 *Australian Financial Review*, 'Automotive Industry Feature', 5 May 1975.
22 Other public agencies, because of their particular responsibilities, play minor roles in controlling metropolitan water pollution. For this reason they are not considered here. These agencies are the State Fisheries Branch, the Public Works Department and the Water Conservation and Irrigation Commission.
23 In some circumstances treated sewage effluent can be chemically and biologically 'purer' than the waters into which it is discharged.
24 Navigable waters are given a broad definition by the M.S.B. as those waters capable of being navigated in a rowing boat.
25 The Air Pollution Control Branch may in practice take into account the spatial concentration of waste emitters and hence the local air quality, when prescribing emission standards — where practicable — of a quality better than that required by the Clean Air Regulations.
26 J. J. Wright, 'Progress in Water Pollution in N.S.W.', in *Environment '75*, Sydney, 1975, Vol. 2, p. 122.
27 The Clean Waters (Amendment) Act, 1974, increased the Advisory Committee membership from sixteen to eighteen.
28 The sewage treatment works at Campbelltown and Fairfield commenced operating in 1941, that at Liverpool in 1952.
29 The M.W.S. & D.B. Annual Report for 1973/4 lists fourteen inland sewerage treatment works, three of which were being constructed.
30 See also the Maritime Services Board's Navigable Waters (Anti-Pollution) Regulations which set standards based on the chemistry of liquid wastes in 1955.
31 E. W. T. Pierce and C. S. Ralph, 'Principles and Practices Relating to the Acceptance of Trade Wastes into the Sydney Water Board's Systems', in *Industrial Waste Water*, Sydney, 1972, p. 12.
32 *Report of the State Pollution Control Commission*, 1973/4, p. 29.
33 One major source of noise, namely aircraft, is not specifically included within the Noise Control Act.
34 State Pollution Control Commission, *Principles and Procedures for environmental Impact Assessment in New South Wales*, Sydney, 1974, p. 7.

35 N.S.W. Planning and Environment Commission, *Report to the Minister for Planning and Environment*, Sydney, 1975.
36 R. P. Murphy, 'Air Pollution and Urban Development', in *Roy. Aust. Planning Institute Journal*, July 1970, pp. 75-6.
37 Bryan Talty, 'The Approach to Environmental Planning in New South Wales', in *Environment '75*, Sydney, 1975, Vol. 1, p. 39.
38 State Planning Authority, *Sydney Region: Outline Plan 1970-2000 A.D.*, Sydney, 1968, pp. 10-11.
39 See Barry Moore, 'Machinery of Government Changes in New South Wales', *Public Administration* (Sydney), Vol. XXXIV, 2, June 1975, pp. 113-27.
40 N.S.W. Planning and Environment Commission, *Report to the Minister for Planning and Environment*, Sydney, 1975, p. 86.
41 Gordon, normally a safe Liberal seat, is included in this total although it is now held by the Democratic Labor Party through the failure of the then sitting Liberal to register his official candidature.
42 Calculations derived from Malcolm Mackerras, *New South Wales Elections*, Canberra, 1973, p. 193.
43 See series of articles by Paul Gardiner in *Australian Financial Review*, 16-19 October 1973.
44 There is a growing body of literature which discusses various political aspects of urbanisation in Australia; see, for example, Hugh Stretton, *Ideas for Australian Cities*, Melbourne 1970; Bernard Barrett, *The Inner Suburbs*, Melbourne, 1971; R. S. Parker and P. N. Troy, *The Politics of Urban Growth*, Canberra, 1972; Frank J. B. Stilwell; *Australian Urban and Regional Development*, Sydney, 1974; Peter Harrison, 'Urban Planning', in Roy Forward (ed.), *Public Policy in Australia*, Melbourne, 1974; Leonie Sandercock, *Cities for Sale*, Melbourne, 1975.
45 In 1974/5, expressed as a percentage of total Commonwealth Budget receipts, income tax (individuals) was 50.5%; company tax 16%; sales tax 7.6%, excise duty 11.3%, customs duty 5.5%; Commonwealth *Budget Speech 1975-76*, Budget Paper No. 1, 1975/6, p. 123.
46 R. L. Mathews and W. R. C. Jay, *Federal Finance: Intergovernmental Financial Relations in Australia Since Federation*, Melbourne, 1972, p. 2.
47 An indication of the magnitude of this allocation of resources can be seen in recent estimates of public capital expenditure by function for all levels of government (Federal, State and local) in the period 1964/5 to 1974/5: the share of expenditure on roads was consistently about 22 per cent, far above the shares of other major functions such as education and communications. See *Urban and Regional Development 1975-76*, Commonwealth Budget Paper No. 9, 1975/6, p. 19.
48 Robert Jay, 'The Shift to Specific Purpose Grants: From Revenue Sharing to Cost Sharing', in R. L. Mathews (ed.) *Responsibility Sharing in a Federal System*, Canberra, 1975, pp. 49, 71-4.
49 Sydney airport is the busiest in Australia; Melbourne is second. Their number of passengers and aircraft movements respectively for 1973 were: Sydney, 5.7 million and 101,074; Melbourne, 3.9 million and 73,644. Source: Commonwealth Department of Transport, *Australian Transport 1973-74*, Canberra, 1974, p. 173.
50 *Urban and Regional Development 1975-76*, Commonwealth Budget Paper No. 9, 1975/6, p. 27.
51 E. J. Walder, 'Water Supply and Sewerage in an Expanding Metropolis', in *Public Administration* (Sydney), Vol. 28, 2-3, June-September 1969, pp. 171-80.

## Notes to Ch. 3: Allocating resources to management and control

1 Once upon a time, the N.S.W. Accounts were excellent sources of information. Their progressive degradation is not sensibly explained by the increased scale and complexity of government.
2 A.B.S.: *Public Authority Finance: State & Local Authorities, 1972/73*, p. 28.
3 By W. Hickson, as an unpublished Project staff paper.
4 This is, of course, subject to adjustment of area responsibility. In general, the ratio of extra-metropolitan population, sewer lines and drainage channels to their metropolitan counterparts were used to adjust respectively for water, sewerage and drainage outlays.

5 This is relatively small and is not discussed.
6 *Royal Australian Planning Institute Journal*, July 1970, p. 67.
7 Ibid.
8 Some controls and design rules have been introduced since 1970, and proposals for successive improvements announced in respect of new vehicles. So far, outlays have been minimal and have been ignored in this paper. See chapters 8 and 9.

## Notes to Ch. 4: The law and the citizen

1 See e.g. D. Alastair Bigham, *The Law and Administration Relating to Protection of the Environment*, London, 1973.
2 To illustrate various other enactments concerned with health of the population or with some aspect of environmental protection, one might include enabling legislation dealing with several N.S.W. public bodies, with the Water Act, 1912; Forestry Act, 1916; Fisheries and Oyster Farms Act, 1935; Rivers and Foreshores Improvement Act, 1948; Radioactive Substances Act, 1957; National Parks and Wildlife Act, 1967; Aerial Spraying Control Act, 1969 and others. The issues relevant to this chapter are adequately contained in the limited list most directly concerned with current pollution control in Sydney.
3 Clean Air Act, 1961, as amended, section 10.
4 Clean Air Act, section 15 in respect of scheduled premises; section 19 in respect of non-scheduled premises.
5 Clean Waters Act, 1970, as amended, section 16 (i).
6 Clean Waters Act, section 16 (vi).
7 Waste Disposal Act, 1970, section 22 (i).
8 See the Clean Air Act, definition of 'air pollution' section 5 (i); Clean Waters Act, definition of 'pollute' section 5 and section 16 of that Act.
9 Clean Air Act, definition of 'air impurity' section 5 (i).
10 Waste Disposal Act, definition of 'depot' section 5.
11 Clean Air Act, section 11.
12 Ibid., section 25.
13 Ibid., section 20.
14 Mark Weinberg, 'The Legal Rights of the Citizen in Respect of Water Pollution', In B. W. Gould (ed.), *Proceedings of the Symposium, Water Pollution and the Environment*, University of New South Wales, Sydney, 1974, p. 6.
15 Ibid., p. 7.
16 For Michigan Environmental Protection Act, see text above. In Massachusetts a citizen possesses rights to enforce state and local environment laws.
17 Annemaree Lanteri, 'Environment Protection Through the Law', in Amos Rapoport (ed.), *Australia as Human Setting — Approaches to the Designed Environment*, Sydney, 1972, p. 275.
18 K. E. Lindgren, 'The Corporation and Control of the Physical Environment at Common Law', in Lindgren, Mason and Gordon (eds.), *The Corporation and Australian Society*, Sydney, 1974, p. 155.
19 Ibid., p. 155.
20 Ibid., p. 156.
21 Although the Court's prime concern is not the reasonableness of the defendant's activity so much as the unreasonableness of the discomfort being suffered by the plaintiff. See Daily Telegraph Co. Ltd *v.* Stuart (1928) S. R. (N.S.W.) 291; Munro *v.* Southern Dairies Ltd. (1955) V.C.R. 332.
22 The general rule is that each individual affected by some person's activity must bring a separate action against the defendant. However, if a group of people are affected by the same conduct and can meet the stringent requirements of the procedural rules of the Courts of each State, for a joinder of parties, they can bring one representative action. See Weinberg, op. cit., at p. 4, which sets out the relevant rule of the Supreme Court of N.S.W. (Rule 13 (1)), which states each person must have 'the same interest' in the proceedings before a representative action can be brought. He points out that 'the same interest' has been construed so strictly that representative actions are a rarity.
23 See Lanteri, op. cit., p. 273 for a description of the nature of the various private actions affecting the protection of the environment.

24 A.G. *v.* P.Y.A. Quarries Ltd. (1957) 2 A.B. 169, at 184.
25 Smith *v.* Cornish (1971) L.G.R.A. 87, per Neasey J. at 93.
26 See W. K. Hancock, *The Battle of Black Mountain — An Episode of Canberra's Environmental History*, Department of Economic History Monograph, Australian National University, Canberra, 1974, in which he describes the problems involved in seeking the Attorney-General's fiat for the purpose of prosecuting the Government, and the hindrances which prevented an expeditious hearing of the case.
27 Kent and Ors. *v.* Johnson and Ors. (1974) A.L.J.R.
28 The Enforcement of Public Interests Ordinance (1973) No. 24 of 1973 gazetted 5 July 1973. The Ordinance was gazetted one day before the case, *The Attorney-General for the Commonwealth at the relation of Bruce Kent and Ors. v. Cavanagh, Minister of State for Works; Bowen, Postmaster-General of the Commonwealth of Australia and the Commonwealth of Australia*, came on for hearing in the Supreme Court of the Australian Capital Territory. The case, therefore, became entitled 'Kent and Ors. *v.* Cavanagh, etc. . . .' (Due to a change in portfolios, the case later became known as Kent and Ors. *v.* Johnson, Minister of State for Works etc.)
29 Kent and Ors. *v.* Johnson and Ors. was commenced in the Supreme Court of the A.C.T. on 6 July 1973, with interlocutory proceedings. The hearing proper came before the Supreme Court on 31 August 1973, and concluded exactly two months later. An appeal by the Government was lodged, which resulted in the filing of a cross-appeal by the citizens. It came before the High Court of Australia on 1 May 1974. The High Court delivered its judgment on 17 February 1975. By this time the construction of a tower on Black Mountain in the A.C.T., against which Government activity an injunction was being sought, was well under way.
30 See Sandford D. Clark, 'Conservation and Government: Towards an Understanding of Roles', in *Search*, Vol. 5, No. 6, June 1974, p. 241.
31 Ibid., p. 242.
32 In the United States of America there has been a development of the use of the writ of mandamus by which a citizen can seek a review of an administrative action.
33 See, for example, *Managing the Environment — Nine States Look for New Answers*, Haskell, Price, Matthews, Cook, Davidson and Booth, Washington, 1971.
34 United States Council on Environmental Quality, *Environmental Quality: Third Annual Report*, Washington, 1972, p. 248.

## Notes to Ch. 5: The state versus local authorities

1 *The Australian*, 21 September 1974.
2 Geoffrey Hawker, 'The Australian Government and Local Government: What is Happening?', *Current Affairs Bulletin*, 1 June 1975, pp. 23-4.
3 Graham Miles, 'Is the Honeymoon with Labor Over?', *Australian Financial Review*, 9 June 1975, Local Government Feature, p. 10.
4 T.V. Matthews, K. Turner, Sylvia Geddes, 'Government and Politics', in D.J. Anderson (ed.), *A Handbook of the Botany Bay Region*, Sydney, 1974, pp. 76-90. See also I. Manning, *Municipal Finance and Income Distribution in Sydney*, Canberra, 1973.
5 J.R. Davis and Peter Spearritt, *Sydney at the Census: 1971*, Canberra, 1974.
6 *Report of the Committee of Inquiry into Local Government Areas and Administration in N.S.W.* (Barnett Report), Sydney, 1974, pp. 36, 42.
7 N.S.W. Planning and Environment Commission, *Report to the Minister for Planning and Environment*, Sydney, November 1975, p. 102.
8 Ibid., p. 129.
9 Barnett Report, p. 36.
10 Ibid.
11 Commission of Inquiry into Land Tenures, *Report*, Canberra, 1973, p. 65.
12 Peter Loveday, 'Citizen Participation in Urban Planning', in R.S. Parker and P.N. Troy (eds.), *The Politics of Urban Growth*, Canberra, 1972, p. 141.
13 *Report of the State Pollution Control Commission*, 1972/3, p. 10.
14 *Report to the Minister for Planning and Environment*, *op. cit.*, p. 107.

## Notes to Ch. 6: Rivers, bays and oceans

1 B. A. Ackerman, *et al.*, *The Uncertain Search for Environmental Quality*, New York, The Free Press, 1974.

2 D. J. Anderson (ed.), *A Handbook of the Botany Bay Region*, Sydney, The Botany Bay Project Committee, 1974.
3 R. F. Warner, 'Rivers of the Botany Bay Region', in *A Handbook of the Botany Bay Region.*
4 New South Wales, *Report of the Chief Secretary on Fisheries in New South Wales for the Year Ended 30th June, 1973.*
5 F. C. Bell, 'The Acquisition, Consumption and Elimination of Water by the Sydney Urban System', in H. A. Nix (ed.), *The City as a Life System, Proc. Ecol. Soc. Aust.*, 7, Canberra, 1972.
6 *A Handbook of the Botany Bay Region.*
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8 Ibid.
9 J. W. G. Neuhaus, *et al.*, 'Mercury and Organochlorine Pesticides in Fish', *Med. J. Aust.*, **1**. pp. 107-110, 1973.
10 N. J. Mackay, *et al.*, 'Heavy Metals in Cultivated Oysters (*Crassostrea commercialis* = *Saccrostrea cucullata*) from Estuaries of New South Wales', *Aust, J. Mar. Freshwat. Res.*, **26**: pp. 31-46, 1975.
11 C. C. Wells and R. A. Edwards, *A Survey of Sewage Pollution in George's River Oysters*, Department of Food Technology, University of New South Wales, 1967.
12 *Report of the Municipal Health Surveyor*, Bankstown Municipal Council, 26 March 1974.
13 I. C. Smalls, 'Nutrient Effects of Stormwater on Lakes and Rivers', *Water in the Urban Environment*, Aust. Water and Wastewater Association, Summer School, Canberra, 1975.
14 *Report of the Municipal Health Surveyor,* op. cit.

## Notes to Ch. 7: Of sewers and drains

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2 *Northern Suburbs Ocean Outfall Sewer*, Report prepared by Brown and Caldwell, Consulting Engineers for the Metropolitan Water, Sewerage and Drainage Board, 1967.
3 Ibid.
4 E. Pierce and C. Ralph, 'Principles and Practices Relating to the Acceptance of Industrial Wastes in the Board's Systems', in *Industrial Wastewater, A Symposium on Recent Developments*, University of New South Wales, 1972.
5 M. J. Flynn, in *Senate Select Committee on Water Pollution*, 1969, p. 1499.
6 Pierce and Ralph, op. cit.
7 The contribution of sewerage rates to the total revenue to the Board was 49 per cent in 1973-4, as compared with 62 per cent of total capital expenditure which new sewerage works now absorb. (M.W.S. & D.B. *Annual Report, 1974*). In 1968-9 the latter proportion was 55 per cent.
8 The volumetric charge was introduced in 1942 when a survey estimated that trade waste amounted to 17 per cent of the total sewage flow. It was then felt that excessive discharges 'rightly involved some further charge and that the charge would encourage industry to economise on the use by installing recirculation facilities' (M.W.S. & D.B., 1950, p. 1). The Board also argued that 'the purpose of the charge was not to obtain additional revenue but to provide a more equitable distribution of the cost of the sewerage system between domestic and industrial users' (p. 2). The efficacy of the volumetric charge was limited by the decision to impose a charge (6d per 1,000 gallons) that did not cover the full cost of disposal. Thus, the domestic ratepayer continued, in part, to subsidise the industrial discharger.
9 E. Pierce and B. Parkes, 'The Control and Treatment of Trade Wastes in Sewerage Systems', Report on Visit to Europe, South Africa and Singapore, 1970, p. 10.
10 Pierce and Ralph, op. cit., p. 16.
11 According to the Board, the strength charge represented 'a partial relaxation of the standards which had previously applied' (Pierce and Ralph, op. cit., p. 12). In fact, these standards had been breached continually before 1972.
12 Conference of Engineers Representing Authorities Controlling Water Supply and Sewerage Undertakings Serving the Cities and Towns of Australia, Conference 1969, p. 68.

13 In fact, it appears that the excess industrial flows tended, between 1943 and 1960, to shift towards discharges into stormwater drains. The revenue from excess charges for wastes discharged to the sewer rose to about 3.7 times their 1943 level and from drainage to about 6.5 times the 1943 level. It would be worth exploring to determine whether this shift arose from the movement of factories to less fully sewered areas or whether the introduction of trade waste charges provided a positive incentive for firms to discharge into drains. The volumetric charge for the discharge of industrial wastes to stormwater channels has been consistently less than that for sewers, although in the case of discharges to stormwater channels no 'free' allowance is given (see W. V. Aird, *The Water Supply, Sewerage and Drainage of Sydney*, Sydney, 1961).

14 Pierce and Ralph, op. cit., p. 15.

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17 See, for example, E. J. Cleary, 'Effluent Standards Strategy: Rejuvenation of an Old Game Plan', *J. Water Pollution Control Federation*, **46** (1), 9-17; and M. G. Wolman, 'Stream Standards: Dead or Hiding?', *J. Water Pollution Control Federation*, **46** (3), 431-7.

## Notes to Ch. 8: From dust to smog

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2 State Pollution Control Commission, *Air Pollution from Motor Vehicles*. Publication No. MV-1.

3 S.A.T.S. Report, Vol. 2, pp. vii-3 and 4.

4 Ibid., p. III-39.

5 Australian Transport Advisory Council, Committee on Motor Vehicle Emissions. *Air Pollution and the Motor Vehicle in Australia — 1974 Review*. Australian Department of Transport, June 1974.

6 L. M. Ferrari, 'Photochemical Smog — The Sydney Scene', *Environment '75* (Second International Environment Conference), Vol. III, Sydney, July 1975. Ferrari states that there were thirteen episodes. This does not appear to be supported by his tables.

7 *Annual Report of the State Pollution Control Commission 1973/74.*

8 *Annual Report of the Air Pollution Advisory Committee 1972/73.*

9 Air Pollution Control Branch (personal communication).

10 A. G. Cumpston, 'Medical Aspects of Air Pollution', *Environment '75* (Second International Environment Conference), Vol. III, Sydney, July 1975, p. 53.

## Notes to Ch. 9: Towards air quality management?

1 The New South Wales Clean Air Act, 1961 (as amended).

2 *Annual Report of the Air Pollution Advisory Committee 1963/64.*

3 Controls placed on sulphur trioxide usually, but not always, also mean control of sulphur dioxide. Sulphur trioxide is considered, in some cases, to be more dangerous.

4 *Annual Report of the State Pollution Control Commission 1973/74.*

5 The provision applies only to odours emanating from stationary sources, not from motor vehicles or other mobile sources.

6 J.D. Court, 'Odour Control in N.S.W.', *Environment '75* (Second International Environment Conference), Vol. III, Sydney, July 1975.

7 Air Pollution Control Branch (personal communication).

8 *Annual Report of the Air Pollution Advisory Committee 1967/68.*

9 'Local Authority Action to Control Air Pollution', *Environment '75* (Second International Environment Conference), Vol. III, Sydney, July 1975.

10 Public Health, Engineering and Research Office of the Sydney City Council (personal communication).

11 See note 4.
12 Ibid.
13 N.H. White, 'Observations on Air-Oxidant Injuries to Plants in Sydney Metropolitan Area', *Proceedings of the Clean Air Conference*, Paper No 7, University of N.S.W. Press, Sydney, 1962.
14 *Annual Report of the Air Pollution Advisory Committee 1966/67.*
15 The Parliament of the Commonwealth of Australia. Report from the Senate Select Committee on Air Pollution. Part I — *Report*, Part 2 — *Minutes of Evidence.* Commonwealth Government Printing Office, Canberra, 1970.
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17 R. Birrel, 'Environment Decisions: The Political Context', in R. Dempsey (ed.), *The Politics of Finding Out*, Victoria, 1974.
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21 E.T. Linacre, 'Air Pollution in Los Angeles', *P.A.C.E.*, August 1974, p. 1.

## Notes to Ch. 10: Dumping on land

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2 Crooks, Mitchell, Peacock, Stewart Pty Ltd, *Sydney Region Liquid Waste Survey and Liquid Waste Treatment Plant Proposal* (Report for the M.W.D.A.), Sydney, 1973.
3 The standards (chemical content, etc.) used to control the disposal of industrial liquid wastes vary from country to country and depend on a number of factors such as the capacity of the sewers, the sewage treatment works through which the effluent will pass, trade waste pricing policies and so on.
4 Cumberland County Council, *Refuse Disposal in the County of Cumberland*, Sydney, 1959.
5 *Report of the Director-General of Public Health* (N.S.W.), 1958, p. 123.
6 *Report of the Department of Local Government*, 1963/4, pp. 48-9.
7 N. Y. Kirov and E. van den Broek, *An Evaluation of Municipal Refuse as a Fuel*, Report by Unisearch Ltd to the Councils of Waverley and Woollahra, 1969; E. van den Broek and N. Y. Kirov, 'The Planning of a Solid Waste Evaluation Survey', *Proceedings of the 1971 Australian Waste Disposal Conference*, Sydney, 1971, pp. 17-22.
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9 P.A. Management Consultants Pty Ltd, *Sydney's Refuse Disposal Problem*, Sydney, 1968; W. D. Scott and Company Pty Ltd, *A Programme to Plan, Establish and Operate the Best Refuse Disposal Facilities for the County of Cumberland*, Sydney, 1968.
10 *Report by A. E. Barton upon Investigations into the Problem of Waste Disposal in the Metropolitan Area of Sydney*, N.S.W. Parliamentary Paper 152, 1970.
11 The eight Council tips were: Audley tip at Homebush; Bestic Street, Rockdale, Magdala Road, Ryde; Marsfield Park, Ryde; Porters Creek, Ryde; Silverwater, Parramatta; Liverpool City; Terrey Hills.
12 The thirteen were: Concord; Bradshaw, Homebush; Bressington Park, Homebush; Maritime Services Board, Homebush; Auburn; Burwood; Smithfield, Fairfield; Bankstown; Menai; Canterbury; Crozier Street, Warringah; Careel Bay, Palm Beach.
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15 Ibid., p. 17.
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17 J. D. Honeysett, 'The Packaging Industry and Solid Waste Management', *Proc. of the 1974 A.W.M. and C.C.*, Sydney, 1974, pp. 163-6.

18 The National Materials Handling Bureau is part of the Australian Department of Transport.

19 The Australian Institute of Packaging is a voluntary association of people interested in the packaging issue. The group meets at the National Materials Handling Bureau in Sydney.

20 Australian Consolidated Industries Ltd (A.C.I.), *Report on the First National Survey of Community Solid Waste Practices Australia, 1972-73*, Sydney, 1973.

21 Ibid., p. 87.

22 Ibid.

23 This information was obtained during interviews conducted in the latter part of 1974 and the early part of 1975. The Project staff visited a total of twenty-two local councils in the Botany Bay catchment and discussed with health inspectors in each the waste management problems experienced by the council.

24 For example, Ashfield Council, personal communication from Mr W. C. Harrison, Municipal Health Surveyor.

25 Discussions with local council officials were confined to those councils in the Botany Bay catchment.

26 Australian Consolidated Industries, *Report.*

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29 Ibid., p. 96.

30 Ibid.

31 Closure of the incinerator for repairs during 1975 meant that councils using the incinerator had to make alternative arrangements for garbage disposal.

32 Australian Consolidated Industries, *Report.*

33 Ibid.

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37 Dwyer and Associates, op. cit.

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56 M.W.D.A., *Sydney Region Solid Waste Management Plan*, p. 6.
57 Ibid., p. 8.
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63 Ibid.
64 Ibid.
65 Ibid.
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70 Ibid., p. 3.2.
71 Ibid.
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