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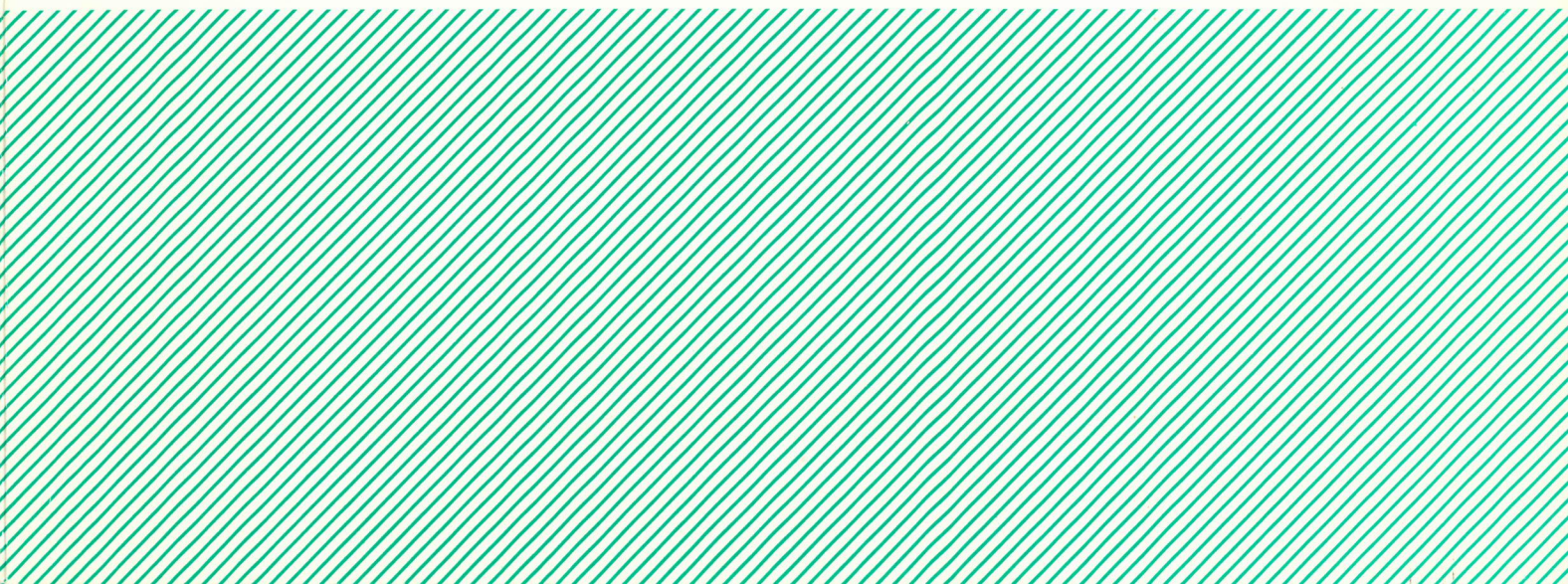
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State Pollution Control Commission

Lake Macquarie Environmental Audit

Annual Report 1989





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Abbreviations

The following abbreviations for official bodies are used throughout this report:

Elcom Electricity Commission of NSW
HWB Hunter Water Board
MSB Maritime Services Board
PWD Public Works Department
RTA Roads and Traffic Authority
SCS Soil Conservation Service
SPCC State Pollution Control Commission

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CONTENTS

Introduction	1
Sedimentation	3
Thermal Pollution	8
Nutrients	9
Toxic Trace Metals	12
Fish Productivity	13
Wetlands	14
Lake Management	16
Litter	17
Other Matters	19
Proposed Action 1989-90	21
Conclusions	29
Bibliography	31
Appendix I: Premises with Water Licences under the SPCC Act in the Lake Macquarie Catchment: 1988	32
Appendix II: Environmental Monitoring in Lake Macquarie	34

INTRODUCTION

It is now six years since the State Pollution Control Commission (SPCC) conducted the first audit of the environmental impacts affecting Lake Macquarie. The then Minister for Planning and Environment stated that the audit was designed to "assemble all the available information on the lake in one place, so that better informed decisions can be made on the measures needed to protect its environment". The present Minister for the Environment, Tim Moore, has continued to endorse the Forum and the preparation of its Annual Reviews.

The Environmental Audit of Lake Macquarie was undertaken for two reasons:

- . as a response to public concern about a perceived deterioration in the quality of water in the lake
- . to provide the Government with an overview of the lake and the issues involved in proper management of its water environment.

The audit process involved the compilation of all available relevant environmental data, definition of the problems identified from accumulated data and public concern, and the formulation of recommendations for improvement.

During the course of the audit the SPCC identified the following issues of prime environmental significance:

- . sedimentation
- . thermal effluents
- . nutrient discharges
- . toxic transition metals
- . fish productivity
- . protection of wetlands.

PURPOSE OF THE REVIEW

The audit recommended action by various State and local government bodies and progress has been steady since that time. Achievements were reviewed at a public seminar in February 1986 and the reports presented there showed that the various public authorities had accepted the intent of the audit's findings and recognised the need to ensure protection of the lake's environment.

Keeping in mind the importance of an ongoing review of the progress in achieving the recommendations of the audit, the SPCC established the Lake Macquarie Environmental Audit Review Forum to represent the relevant interests with the following terms of reference:

- . to review annually, with the responsible authorities, their programs for the environmental protection of Lake Macquarie
- . to review, with the identified authorities, their continuing actions towards implementing the recommendations made in the Environmental Audit of Lake Macquarie of December 1983
- . to ensure that all concerned public authorities act cooperatively in the environmental protection of Lake Macquarie
- . to coordinate future action in new policy areas that may be developed or devised.

Members of the Review Forum are:

- . State Pollution Control Commission (Chair and Secretariat)
- . Department of Planning (formerly Department of Environment and Planning)
- . Hunter Water Board (formerly Hunter District Water Board)
- . Public Works Department
- . Electricity Commission of New South Wales
- . Department of Lands
- . Maritime Services Board (Recreational Boating Services Branch)
- . NSW Agriculture and Fisheries (formerly Department of Agriculture and Fisheries)
- . Soil Conservation Service
- . Department of Housing
- . Lake Macquarie City Council
- . Wyong Shire Council
- . nominees of the elected representatives of Lake Macquarie and Wyong Councils.

WORK OF THE REVIEW FORUM

This is the third annual report of the Review Forum. The Review Forum reviewed the implementation of the audit recommendations to 30 June 1989 and proposed a program of action for 1989-90 to ensure ongoing progress.

The following report presents a summary of action undertaken and planned for each environmental issue by bodies with statutory responsibilities in each area. The elements of the activities are grouped for convenience under two columns: "PROPOSED ACTION 1988-89" and "PROGRESS 1988-89". The actions which are proposed for the year ahead, i.e. 1989-90 are contained in a section at the rear of the report. This year an additional section has been added outlining the monitoring activities of the various authorities and industry.

SEDIMENTATION

Sedimentation is a natural phenomenon which is substantially accelerated by urbanisation.

The effects of sedimentation in Lake Macquarie are most apparent at the northern end of the lake, particularly near major discharges of urban stormwater.

Urban stormwater and rural runoff carry not only suspended solids into waterways but also nutrients. Thus controlling the processes causing sedimentation can also contribute to a reduction in nutrient loads.

Control measures may be temporary or permanent and therefore they have differing design limitations. It is quite possible for control measures to fail if rainfall events are more severe than reasonably expected or if the control measures are inadequately maintained. Some of the examples below reflect these problems.

The audit identified the need for retardation and sedimentation basins, together with other runoff controls such as foreshore buffer strips, in all new urban developments wherever possible. Runoff controls were also recommended for catchments in existing urban areas.

The audit also advised studying the option of dredging heavily silted areas.

PROPOSED ACTION 1988-89

Department of Housing

The Department will develop land at Gateshead, Mt Hutton, Wyee and Swansea, liaising closely with the SCS and the Council on sediment control in construction zones.

Public Works Department (PWD)

The PWD will provide funds and assistance to Lake Macquarie City Council for construction of gross pollutant traps.

State Pollution Control Commission (SPCC)

The SPCC will arrange for final draft ratification and publication of the *Pollution Control Manual for Urban Stormwater* in mid-1989.

PROGRESS 1988-89

Department of Housing

NO INPUT RECEIVED

Public Works Department (PWD)

The PWD provided \$350,000 to Lake Macquarie City Council for the construction of sediment/gross pollutant traps at Warners Bay (2), Eleebana (1), Speers Point (1) and Booragul (1), as well as a long-arm excavator to facilitate dredging and maintenance of silt traps.

State Pollution Control Commission (SPCC)

The SPCC completed and published the manual.

The Lake Management section of this report details action taken at Newstan Colliery.

PROPOSED ACTION 1988-89

Lake Macquarie City Council

The Council will:

- . remove accumulated sand and gravel from the mouths of additional piped outlets and open drains pending approval of \$162,000 for the 1989 Budget
- . construct silt traps using PWD and its own funds, according to the already assigned priorities, with major gabion traps proposed for North and South Creeks, Warners Bay
- . introduce development standards to control vegetation removal and sediment losses from individual building sites where development consent is not required
- . commence revision of its Construction Code to formalise improved erosion controls on unsealed road shoulders and batters
- . continue its support for appropriate environmental research programs within the lake and its catchment
- . continue its tree planting programs
- . produce pamphlets/brochures for community education if funds are allocated in the 1989 Budget
- . give final approval to the Subdivision Code.

PROGRESS 1988-89

Lake Macquarie City Council

The Council allocated a further \$156,000 to dredge drain outlets.

The Council spent \$400,000 (State grant of \$350,000) on:

- . lake restoration works by constructing sediment traps at Valentine, Eleebana, Warners Bay, Teralba and Speers Point
- . the removal of deltas from the mouth of Sheppards Creek and South Creek
- . the removal of nuisance organo-sedimentary debris from nearshore shallows at Warners Bay and Croudace Bay
- . the purchase of a long-arm grab to facilitate nearshore dredging.

The Council successfully sought an Australian Government grant of \$25,000 to part-fund a Catchment Erosion Project. Council has provided an additional \$36,000 of its own funds to support the project.

The Council adopted as a corporate objective the Greening of the City and continued its tree planting programs. It allocated \$35,000 to Council plantings of which \$12,000 funded the annual free tree giveaway to residents. Another \$1000 went to 19 local schools and community groups during Earth Week.

No funds were allocated for community education publications on sedimentation in the budget.

Development standards and local environmental plan amendments to control vegetation clearance and soil erosion during residential development were prepared as part of the Throsby Creek Total Catchment Management Study.

Formal revision of the Subdivision Code has not been completed although new controls are already being applied in the field. Temporary sediment traps were constructed at all new subdivisions with permanent structures installed at Caves Beach Road, Caves Beach and at Valentine Hills Estate.

PROPOSED ACTION 1988-89

Wyong Shire Council

The Council will continue to develop and implement existing lake and catchment management programs. Development standards and local environmental plan amendments to control vegetation clearance and soil erosion during residential development were prepared as part of the Throsby Creek Total Catchment Management Study.

Department of Planning

When processing local environmental plans and development proposals for lands within the Lake Macquarie catchment, the Department will assess their consistency with the Hunter Regional Environmental Plan 1989 and any other relevant environmental planning instruments and State policies.

PROGRESS 1988-89

Shoreline armouring works at Booragul to arrest persistent erosion were commenced by the Council at a cost of \$28,000.

The Council appointed an Environmental Engineer to oversee environmental aspects of Council works design and construction and to continue revision of its Engineering Codes for road drainage design and construction.

The Council allocated \$6220 to the SCS to part-fund a research project designed to measure runoff and soil losses from field plots in the Fennell Bay catchment.

The Council provided \$2650 to the University of Newcastle for a research project to determine rates of erosion from batters of selected roads in Lake Macquarie.

Wyong Shire Council

The Council:

- . has continued to develop and implement lake and catchment management programs
- . has had its Soil Conservationist review Council's Residential Subdivision Code, upgrading the requirements for sediment and erosion control
- . has undertaken ooze and sediment removal from the nearshore areas of Chain Valley Bay, adjacent to Lakeshore Avenue
- . has installed sediment and nutrient trapping structures on stormwater drains entering the Lake at Mannering Park.

Department of Planning

The Hunter Regional Environmental Plan 1989 was gazetted on 17 March 1989 with the requirement that councils take certain matters into account when processing local environmental plans and development applications. These include environmental (including pollution and hazards control), waste disposal, recreation, tourism and urbanisation issues likely to have an effect *inter alia* on sedimentation.

PROPOSED ACTION 1988-89

Soil Conservation Service (SCS)

The SCS will:

- . resolve issues on possible soil landscape mapping of the catchment and finalise land resource mapping and preparation of a report for local council
- . complete mapping of environmentally sensitive lands and arrange for proclamation and gazettal of protected lands within the catchment
- . arrange notification of the catchment as a Soil Conservation Project under the Soil Conservation Act, which will enable the SCS to give a higher priority and commit more resources to erosion and sediment control in the catchment and provide a more streamlined and effective approach to addressing these issues
- . finalise the program to evaluate computer models for prediction of sedimentation rates from urban lands
- . provide ongoing advice to councils, government departments, developers and their consultants, and landholders in general on appropriate erosion and sediment controls for all development and land use activities
- . continue consultancy with the RTA on the F3 Freeway construction on matters relating to erosion/sediment control and revegetation
- . undertake sediment monitoring in an urban catchment, subject to the availability of a suitable site
- . continue to support and promote Total Catchment Management within the catchment.

PROGRESS 1988-89

Soil Conservation Service (SCS)

A proposal to undertake soil landscape mapping of the Lake Macquarie catchment area at a scale of 1:25,000 has been developed, but approval to commence is dependent on a decision on the availability of additional resources to carry out the work.

Field mapping of "protected lands", including areas designated as "environmentally sensitive", has been completed and forwarded to the Catchment Areas Protection Board for consideration. Public exhibition of the maps is expected during 1989-90.

A recommendation to notify the Lake Macquarie catchment as a Soil Conservation Project under the Soil Conservation Act has been made. It is proposed that the project will form part of a Coastal Lakes Management Project with funding sought under the National Soil Conservation Program. An application has accordingly been made under this program and a decision is expected during 1989-90.

The program to evaluate computer models for prediction of sedimentation rates from urban lands is nearing completion with a final report prepared and forwarded to Council during December 1989.

The SCS has provided ongoing advice to Councils, government departments, developers and their consultants, and landholders in general on all aspects of erosion and sediment control and land degradation issues.

The SCS continued to act as a consultant to the RTA on the F3 Freeway regarding erosion/sediment control and revegetation.

No suitable site has been found to undertake a sediment monitoring program in an urban catchment of Lake Macquarie. As an alternative, the SCS and Lake Macquarie Council are establishing runoff plots on selected urban bushland sites. Soil loss, runoff and sediment properties due to sheet erosion will be monitored over two years at sites in the Fennell Bay area.

PROPOSED ACTION 1988-89

Roads and Traffic Authority (RTA)

The necessary environmental controls will be incorporated in the proposed reconstruction of the Pacific Highway between Murray Street and Mine Camp Road, Swansea, to begin in 1989.

Approvals for the F3 Freeway construction will be sought from the SPCC for each section between Wakefield and Minmi.

Hunter Water Board (HWB)

The HWB will continue to implement existing programs.

PROGRESS 1988-89

Development of Total Catchment Management (TCM) strategies has continued to receive strong SCS support. If the current application for National Soil Conservation Program support is approved, TCM will receive further impetus in the Lake Macquarie catchment.

The SCS implemented "on-the-ground" erosion and sediment controls under its Plant Hire and Consultancy Services.

Roads and Traffic Authority (RTA)

The following environmental protection measures were incorporated for the Pacific Highway reconstruction:

- . construction of eight sediment basins and three sediment traps
- . fencing and native seed collection for regeneration purposes
- . transplantation of a number of cabbage tree palms in an effort to save them.

The RTA obtained comment and conditions of approval from the SPCC to construct the F3 Freeway section between Wakefield and Minmi. Twenty-three sediment traps and 16 sediment basins were constructed.

Hunter Water Board (HWB)

Existing programs for erosion and sediment control were maintained during works at:

- . Buttaba Hills, Warners Bay and Valentine (water supply)
- . Macquarie Drive, Croudace Bay (sewerage).

THERMAL POLLUTION

The audit concluded that a slight elevation of water temperature had occurred at the southern end of the lake. The effect on benthic communities in this area was found to be limited with only localised losses of seagrasses in the vicinity of power station outlets. The effect of increased water temperature on floating organisms was not clear but it appeared that the availability of fish and prawns for commercial and recreational pursuits had not been affected by thermal discharges.

The audit therefore recommended further data analysis to assist in determining any changes in water quality or lake ecology. It also recommended a review of methods for avoiding thermal discharges above the then current licence conditions and a review of those conditions by the SPCC.

PROPOSED ACTION 1988-89

Electricity Commission (Elcom)

The fishery study, which will assess the effect of Eraring Power Station upon the commercial and recreational fishery of the lake, will be completed in 1989.

An ongoing study in 1989 into juvenile fish in seagrass beds is investigating the role of the beds in dispersing post-larval fish throughout the lake, and the influence of power stations upon this process and the growth of the juveniles.

The following studies will begin in 1989:

- . analysis of benthos data
- . a review funded by Elcom of all aquatic animal studies for Lake Macquarie, the Tuggerah Lakes and Lake Illawarra.

Routine monitoring of water quality, lake temperatures, seagrasses and zooplankton, as well as compliance monitoring and reporting to the SPCC, will continue in 1989.

State Pollution Control Commission (SPCC)

The SPCC will continue with the licence limits currently in place. Reporting procedures for environmental monitoring will be reviewed.

PROGRESS 1988-89

Electricity Commission (Elcom)

The study by the Fisheries Research Institute into the impact of Eraring Power Station on commercial and recreational fisheries of the lake was completed and publication is expected in early 1990.

The study into the role of seagrasses in the ecology of juvenile fish has continued.

Analysis of benthos data was not commenced (see "Proposed Action 1989-90").

The review of aquatic animal studies in the lake was commenced and was nearing completion at 30 June.

Routine monitoring of water quality, lake temperatures, seagrasses (winter only) and zooplankton density continued. Compliance monitoring and reporting to the SPCC for the power station discharges is continuing as required by the SPCC. There have been no exceedences of temperature limits at Vales Point with temperatures never rising above 34°C. Temperatures at Eraring exceeded 35°C for 81 hours and 36°C for 13 hours.

State Pollution Control Commission (SPCC)

The SPCC commenced review of Elcom licences with the aim of standardising and formalising monitoring requirements for all aspects of power station operations and their effects on the environment.

NUTRIENTS

The audit established that the nutrient load entering the lake was increasing as a direct result of urbanisation, particularly at its northern end. There were indicators of nutrient enrichment such as increased nitrogen, phosphorus, chlorophyll *a* and turbidity levels in these areas.

The audit recommended further analysis of available data as well as more data collection to confirm the cause of the increased turbidity. The audit also identified the need to look at nutrient control from point and diffuse sources.

PROPOSED ACTION 1988-89

Hunter Water Board (HWB)

The HWB will:

- . if necessary, design, install, operate and monitor works at Toronto sewage treatment works (STW) for chemical phosphorus removal after negotiations with the SPCC on licence conditions
- . establish and operate an effluent pumping system at Edgeworth STW for the disposal of effluent to be re-used by Rhondda Colliery, which should reduce the phosphorus load by approximately 70 per cent
- . continue monitoring lake water quality
- . exhibit and determine the environmental impact statement (EIS) for the Lake Macquarie Sewerage Scheme
- . implement the scheme in conjunction with the PWD
- . circulate the Environmental Investigation of Lake Macquarie report.

PROGRESS 1988-89

Hunter Water Board (HWB)

Investigations commissioned by the HWB identified practicable technology and achievable effluent phosphorus levels which formed the basis of an agreement between the SPCC and the Board on discharge requirements at Toronto STW.

Following negotiations between the HWB and R W Miller, agreement was reached and approval granted by the SPCC for discharge of effluent from Edgeworth STW to Rhondda Colliery for extinguishing fires within the mine.

Monthly monitoring of water quality by consultants J H and E S Laxton at a number of stations within Lake Macquarie has continued throughout the year.

The EIS for the Lake Macquarie Sewerage Scheme has been exhibited and determined.

Copies of the Environmental Investigation of Lake Macquarie report were circulated to relevant authorities.

Wyong Shire Council

Gwandalan and Mannering Park STWs have been connected to the Norah Head Ocean Outfall. Secondary treated effluent will no longer be discharged to Lake Macquarie from Wyong Shire's sewage treatment plants.

PROPOSED ACTION 1988-89**State Pollution Control Commission (SPCC)**

The SPCC will:

- . continue to audit and reduce, where possible, wastewater discharges to the waters of Lake Macquarie
- . assist and advise local councils on diffuse source control
- . continue its participation in Lake Macquarie Council's Research Grants Committee
- . compile, release and publish the results of its water quality survey data for Lake Macquarie
- . consult with Manly Hydraulics Laboratory on the tidal exchange of Lake Macquarie.

Public Works Department (PWD)

The PWD will:

- . complete the EIS on the Lake Macquarie Sewerage Strategy
- . commence detailed design
- . construct sediment/gross pollution traps in conjunction with Lake Macquarie City Council
- . remove nuisance aquatic growth.

PROGRESS 1988-89**State Pollution Control Commission (SPCC)**

The SPCC maintained its position with respect to discharge limits at Toronto STW and the diversion of effluent from the Teralba Sanitary Depot into Edgeworth STW. Monitoring results were audited and found to have a number of anomalies with respect to compliance and reporting. The Sedimentation section covers this topic.

Participation in Lake Macquarie Council's Research Grants Committee continued.

Water quality data logging continued but report drafting was not commenced.

Consultation with Manly Hydraulics Laboratory over tidal exchange in the lake was given further consideration but not finalised.

HWB licences were reviewed and amended to conform with new and standardised conditions.

Public Works Department (PWD)

The EIS for the Lake Macquarie Sewerage Scheme was completed and determined in January 1989.

Detailed design for the sewerage scheme was commenced as was detailed consideration of alternative sewage pipeline lake crossings.

Seven sediment/gross pollutant traps were constructed by the Council with State Government funds.

Nuisance aquatic growth was removed from the foreshore areas of Warners Bay, Belmont Bay, Myuna Bay, Croudace Bay, Speers Point, Fennell Bay and Toronto by the Council with funds provided by the State Government.

PROPOSED ACTION 1988-89**Lake Macquarie City Council**

The Council will:

- . continue present levels of funding for lake foreshore maintenance and develop a higher public awareness of this work
- . with PWD grants and Council funding, clear dead seagrass, accumulated organic detritus and other nuisance aquatic growths from the shallow, nearshore zones of some popular recreational bays around the lake to reduce stored nutrient loads and improve recreational amenity.

PROGRESS 1988-89**Lake Macquarie City Council**

The Council:

- . examined alternative sewage disposal options in anticipation of the proposed closure of Boolaroo depot
- . unsuccessfully sought HWB support for removal of accumulated algal debris from Blackalls Lagoon on Mudd Creek
- . removed accumulated nuisance aquatic plant debris from 1100 metres of the southern shallows of Warners Bay
- . established a permanent clean-up crew to remove accumulated organic debris from lake foreshores at a cost of \$210,000
- . introduced a flat-rate sewage pumpout charge which resulted in a 35 per cent increase in weekly sewage volumes collected
- . allocated \$10,000 to the University of Newcastle to accelerate a previously established research project on nutrient speciation in shallow waters and surface lake sediments in Lake Macquarie
- . allocated \$2500 to the University of Newcastle to relate diffuse pollution effects to algae populations in the lake.

TOXIC TRACE METALS

The audit found that metallic contaminants in the northern section of the lake were higher than expected, suggesting the influence of past activities rather than present. High lead and cadmium concentrations were found in hairy mussels and Sydney cockles.

The audit recommended further studies to determine the rate of mobilisation of heavy metals from sediments in the northern end of the lake and the extent to which contamination levels in organisms can be attributed to sediment or current discharges. The need for a review of lead sources was identified. It also suggested an examination of the feasibility of dredging and removing the contaminated sediment layer and an audit of the monitoring of effluent from the Sulphide Corporation.

An assessment of any adverse public health effects due to the taking and eating of contaminated organisms was also recommended.

PROPOSED ACTION 1988-89

State Pollution Control Commission (SPCC)

The SPCC will continue to liaise with the Sulphide Corporation to ensure minimum discharge of toxic metals to air and water as required by its licence conditions.

Exceedences of ambient air monitoring conducted by the company have been reported since October 1988 in the first of the SPCC licence reporting reviews.

The SPCC will make recommendations to NSW Agriculture and Fisheries regarding closure of part of the lake to the taking of shellfish.

Sulphide Corporation

Research on the use of sodium carbonate dosing will continue with SPCC liaison.

The company will continue self-monitoring of the ambient air environment and discharges to the lake, and commission the baghouse and monitor its performance.

PROGRESS 1988-89

State Pollution Control Commission (SPCC)

Liaison with the Sulphide Corporation on all emission control programs continued.

The company also continued to report to the SPCC any exceedences of the ambient air quality goals required by its licence.

No recommendations were made to NSW Agriculture and Fisheries. However the Commission commenced a study into the source of metal contamination of shellfish, i.e. whether this is from dissolved metals in the water column or the intake of metal-contaminated sediment.

Sulphide Corporation

Research on sodium carbonate dosing continued successfully and neared completion.

The results of monitoring by the company showed annual discharges to be well within licence limits.

The company participated in the SPCC shellfish study.

FISH PRODUCTIVITY

The audit concluded there had been no significant impact on the availability of fish or prawns for commercial or recreational fishing. It recommended a further survey, following full commissioning of Eraring Power Station and continued regulation by NSW Agriculture and Fisheries of the harvesting of fish and prawns.

PROPOSED ACTION 1988-89

Electricity Commission (Elcom)

There will be an examination of the feasibility of redesigning the return water system, and fish catches on screens will be monitored.

NSW Agriculture and Fisheries

The Elcom-sponsored studies undertaken in 1987-88 were finalised in late 1988 with reports to be presented to Elcom in early 1989. Further research plans will be formulated based on these studies.

PROGRESS 1988-89

Electricity Commission (Elcom)

Discussions with NSW Agriculture and Fisheries took place and the feasibility of changes discussed.

The monitoring program for screened fish was commenced.

A large fish kill occurred in the Eraring intake canal when the cooling system was shut down. Although considerable precautions, including the use of professional fishermen, were taken, new procedures were subsequently developed to avoid future recurrences.

NSW Agriculture and Fisheries

The final report on the impact of Lake Macquarie power stations on the fish and fishery of the lake was presented to Elcom. Recommendations from this report call for investigation and modification of the screens and inlet canals to reduce entrainment and death of fish. Further studies were recommended but no research plans have been formulated.

NSW Agriculture and Fisheries received an application for a prawn farm lease in Lake Mannering which will use hot water discharged from a power station, a new type of aquaculture for the State.

Lake Macquarie City Council

Council allocated \$2500 to the University of Newcastle to fund an Honours degree project of relevance to the Lake Macquarie fishery. This extends a previously funded investigation of seagrass ecology in selected bays, particularly the effects sediment characteristics have on promotion or inhibition of seagrass growth.

WETLANDS

The value of the wetlands of the lake and its catchment as a habitat for many forms of wildlife and breeding areas for fish was confirmed by the audit. To preserve these areas, the development and implementation of conservation plans for existing wetlands was recommended.

PROPOSED ACTION 1988-89

Department of Planning

No new initiatives are scheduled for 1989. [The Department supplied expanded input for this but it is not included here as it was not published.]

Lake Macquarie City Council

The Council will:

- . revise and expand wetland protection in its five-year review of the Lake Macquarie Local Environmental Plan
- . maintain liaison with the Hunter Wetlands Trust and Shortland Wetlands Centre
- . install interpretive signs at Belmont Lagoon, Five Islands and Toronto wetlands.

Department of Lands

The Department, in association with NSW Agriculture and Fisheries, will continue to seek rehabilitation through further legal action.

PROGRESS 1988-89

Department of Planning

Developments in wetlands classified under State Environmental Planning Policy No. 14 (SEPP 14) and which therefore require consultation with the Department included:

- . dredging in Lake Macquarie by Lake Macquarie City Council
- . filling for caravan park extensions at Belmont.

Under the requirements of SEPP 14, the Department continued its concern for catchment protection of classified wetlands.

Lake Macquarie City Council

The Council:

- . received the completed inventory of Lake Macquarie wetlands commissioned from Shortland Wetlands Centre
- . allocated \$6940 to Shortland Wetlands Centre for a research project which will examine estuarine wetlands in Lake Macquarie with particular reference to links between seagrass, saltmarsh and mangrove communities and the changes in these assemblages during the last 45 years
- . deferred installation of interpretive signs pending development and approval of management plans for nominated wetlands.

Department of Lands

The unauthorised foreshore development at Kilaben Bay has yet to be rehabilitated.

PROPOSED ACTION 1988-89**Wyong Shire Council**

The proposal for special wetland zoning went to Council in late 1988 for approval, exhibition and comment. This proposal will be circulated to relevant State government departments and Lake Macquarie City Council at that time.

State Pollution Control Commission (SPCC)

The SPCC will publish its *Discharges to Natural Wetlands Policy*.

PROGRESS 1988-89**Wyong Shire Council**

The Council has released a draft Local Environmental Plan and draft Development Control Plan for wetlands in the Shire proposed for special 7(g) Wetland Management zoning.

State Pollution Control Commission (SPCC)

The policy was published and is available on request.

LAKE MANAGEMENT

Submissions received from resident groups called for the establishment of a lake management body or panel. World-wide experience has shown that such authorities are not successful. Powers already exist for the various authorities concerned to take the necessary action in all identified issues. The audit recommended against the establishment of a separate lake management authority either by representation from existing authorities or by statute.

PROPOSED ACTION 1988-89

Lake Macquarie City Council

The Council will maintain its Planning, Technical and Environmental Advisory Panel.

Department of Lands

On receiving the EIS for dredging Swan and Village Bays, the Department will submit a Development Application to Lake Macquarie Council. After Council approval, the Department will grant a Permissive Occupancy to the company and consent to the lodgment of the Development Application with Lake Macquarie City Council. The Department will also:

- . coordinate and compile charts of foreshore locations according to the respective degree of concern of those authorities with responsibility for the lake's management
- . commence an ongoing foreshore review on a priority basis in order to rationalise existing occupations and detect any unauthorised occupations.

PROGRESS 1988-89

Lake Macquarie City Council

The Council maintained its Planning, Technical and Environmental Advisory Panel as a forum for the exchange of views and information relating to development proposals within the City and as an advisory body to Council. Other agencies represented on the panel during the year included:

- . Wyong Shire Council
- . Department of Lands
- . Public Works Department
- . Department of Planning
- . Department of Minerals and Energy
- . NSW Agriculture and Fisheries
- . Department of Health
- . State Pollution Control Commission
- . Electricity Commission
- . Hunter Water Board
- . Mines Subsidence Board
- . Soil Conservation Service
- . Maritime Services Board
- . National Parks and Wildlife Service
- . University of Newcastle
- . Eastlakes Environmental Protection Group.

Department of Lands

Initial approval was provided to Belmont Sands Pty Ltd to carry out a dredging operation within Swan and Village Bays.

The Department has continued to carry out foreshore reviews that identify unauthorised structures and rationalise existing occupations.

LITTER

Public submissions also raised the issue of litter. A clean-up campaign was suggested using service clubs and community service groups.

PROPOSED ACTION 1988-89

Lake Macquarie City Council

The Council will:

- . pursue opportunities to use juvenile offenders and other convicted persons with community service obligations to undertake clean-up operations at targeted lakeshore sites
- . organise a further lake clean-up in 1989.

PROGRESS 1988-89

Lake Macquarie City Council

The Council:

- . continued to pursue opportunities to clean up foreshore reserves using persons with community service obligations
- . organised the second community lake clean-up day with the "Make it Shine in 89" campaign in March
- . continued implementation of the "Slob Watch" scheme
- . continued its participation in the Tidy Schools competition with visits, assessments and presentations at participating schools
- . concluded its trial of source sorting of domestic garbage in Cardiff which yielded a disappointing participation rate of less than 20 per cent
- . continued installation of lidded "Wiz Bins" along City streets and reserves
- . appointed an additional full-time Ordinance Inspector to police unauthorised dumping of rubbish in the City
- . commissioned an assessment of the City by the Keep Australia Beautiful Committee
- . installed trash collection devices at Croudace Bay (2) and Teralba (1)
- . purchased and operated an additional motorised litter vacuuming machine to service footpaths and pedestrian malls in City shopping areas (\$103,000 compared with \$49,000 in 1987-88)
- . operated two sweeping machines at a cost of \$304,000 to collect street sediment and litter (1987-88: \$216,000).

PROPOSED ACTION 1988-89**State Pollution Control Commission
(SPCC)**

The SPCC will continue with assistance to local government through the Litter Reduction Campaign.

PROGRESS 1988-89**State Pollution Control Commission
(SPCC)**

Coordination and assistance with the campaign continued.

Wyong Shire Council

Council supported the "Central Coast Aquatic Clean-Up" held in June 1989.

OTHER MATTERS

PROPOSED ACTION 1988-89

Lake Macquarie City Council

The Council will allocate an additional \$700,000 (refund of contributions to the West Lakes Sewerage Scheme) to lake restoration works. Priorities for such works will be decided during the coming year.

Maritime Services Board (MSB)

The MSB will:

- . continue the review and inspection of all boat moorings in the lake subject to the availability of funds
- . maintain ongoing surveillance of pollution from vessels.

Public Works Department (PWD)

The PWD will release the marina sites study report.

PROGRESS 1988-89

Lake Macquarie City Council

The Council:

- . continued its participation in Earth Week activities with visits to schools, talks to students and distribution of trees to participants
- . commenced lake sector planning reports for the five-year review of the Lake Macquarie Local Environmental Plan
- . allocated another \$40,000 to fund environmental research projects related to the lake and its catchment
- . added the \$700,000 refund of Council's contributions to the West Lakes Sewerage Scheme to its Sewerage Deficiency Reserve to meet existing sewerage liabilities to the HWB
- . created a \$430,000 Lake Clean-Up Reserve Fund from general Council funds and recovery of outstanding rates
- . participated in the Greenhouse Symposium conducted by the Board of Environmental Studies, University of Newcastle, with a presentation on possible greenhouse impacts upon Lake Macquarie
- . allocated \$2500 to the University of Newcastle to apply a previously developed computer model of water circulation in Lake Macquarie to heat exchange within lake waters.

Maritime Services Board (MSB)

The review of boat moorings was not commenced because funds were not available.

Surveillance of pollution from vessels continued.

Public Works Department (PWD)

The PWD released the Lake Macquarie Marina Sites Study report in November.

PROPOSED ACTION 1988-89

State Pollution Control Commission (SPCC)

The SPCC will:

- . pursue the development of suitable policies on mine subsidence through the Audit Review Forum and the Mines Subsidence Board
- . pursue avenues of control with the Wallarah Colliery company and its consultants
- . pursue further diffuse source controls on discharges by the Newstan Colliery company.

Department of Minerals and Energy

The Department served notice on all mines working coal reserves beneath the perimeter of Lake Macquarie that current approvals for total and partial extraction of coal would be subject to re-evaluation.

The Department also initiated action to classify the perimeter of Lake Macquarie with respect to permissible subsidence that may result from mining.

PROGRESS 1988-89

State Pollution Control Commission (SPCC)

The SPCC received clarification that areas of mining which will subside are determined by the Department of Mineral Resources and not the Mines Subsidence Board (see below).

Ongoing liaison and discussion led to the Wallarah Colliery company developing a cost-effective strategy for reducing the iron content of its minewater discharge.

Elcom engaged consultants and the SCS to survey Newstan Colliery and prepare a program of remedial works for the problem areas as requested by the SPCC.

The SPCC finalised the report on pollution from recreational vessels and joined the interdepartmental committee formed by the State Government to investigate this matter further.

Mines Subsidence Board

The Board clarified the position regarding determination of areas to be subsided. This rests with the Department of Minerals and Energy.

PROPOSED ACTION 1989-90

SEDIMENTATION

Department of Housing

No input was received from the Department.

Public Works Department

The Public Works Department will:

- . provide further funds and technical assistance to Lake Macquarie City Council for construction of sediment traps to further reduce the discharge of sediment into the lake and remove nuisance aquatic material from the lake foreshore
- . require provision of approved and adequate silt and gross pollutant traps, where necessary, at construction sites in documentation for the West Lakes Sewerage Scheme.

Lake Macquarie City Council

Lake Macquarie City Council will:

- . continue removing gravel and sand from drainage outlets
- . seek additional State Government support, particularly for construction of sediment traps at larger drainage outlets around the margin of the lake
- . appoint an additional Science graduate as temporary Environment Officer to enable full-time work on the Catchment Erosion Project which will review and correct deficiencies in controls on land use practices of individuals, Council and other government agencies throughout the catchment
- . commence implementation of the Greening the City program which will not only bring aesthetic benefits but will assist in protection of catchment ground surfaces
- . produce pamphlets and brochures for community education as part of the Catchment Erosion Project
- . address application of these controls to Lake Macquarie as part of the Catchment Erosion Project
- . continue to provide financial support for environmental research projects focusing upon the lake and its catchment.

Soil Conservation Service

The Soil Conservation Service will:

- . commence soil landscape mapping of the Lake Macquarie catchment area at a scale of 1:100,000 as part of a State mapping program and, subject to approval and the availability of resources, will commence similar mapping at the more detailed scale of 1:25,000
- . recommend to the Catchment Areas Protection Board that early action is taken to proclaim and gazette the "protected lands" within the catchment of Lake Macquarie

- . subject to availability of additional resources, arrange for notification of the Lake Macquarie catchment as a Soil Conservation Project under the Soil Conservation Act
- . finalise the program to evaluate computer models for prediction of sedimentation rates from urban lands and present an appropriate report to Council during December 1989
- . provide ongoing advice to councils, government departments, developers and their consultants, and landholders in general, on appropriate erosion and sediment controls for all development and land use activities.
- . continue consultancy arrangements with the RTA on the F3 Freeway on matters relating to erosion/sediment control and revegetation
- . undertake monitoring of soil loss, runoff and sediment properties from selected plots in urban bushland at Fennell Bay
- . subject to availability of a suitable site, develop and commence an economic appraisal and cost/benefit analysis on installing the necessary erosion and sediment controls on a developing urban site
- . continue to support and promote TCM within the catchment of Lake Macquarie.

Wyong Shire Council

Wyong Shire Council will:

- . have its Soil Conservationist review requirements for sediment and erosion controls for single allotment developments within the Shire
- . complete the re-instatement of the foreshore reserve at Lakeshore Avenue, Chain Valley Bay
- . hold a workshop in November to promote sound catchment management practices within the Shire which will be attended by government bodies and authorities involved in construction and maintenance activities, as well as private housing and construction industries
- . continue installation of sediment and nutrient trapping structures on all new and existing drainage lines which flow into Lake Macquarie.

State Pollution Control Commission

The State Pollution Control Commission will continue pressing for erosion and sediment controls in all areas where it has responsibility for environmental protection and, in particular, where it must give statutory approval.

Roads and Traffic Authority

The necessary environmental controls will be incorporated in the following projects:

- . reconstruction of the Pacific Highway between Murray Street and Mine Camp Road, Swansea
- . construction of the F3 Freeway between Palmers Road and Wakefield
- . construction of the Charlestown West Bypass between the Pacific Highway and Lookout Road.

Controls will include:

- . catch and contour drains to divert and retard flows
- . temporary berms and drains plus diversion drains to minimise the impact of access tracks, haul roads and other ongoing earthworks

- . sediment traps downstream of construction sites
- . maintenance of sediment traps
- . a minimisation of vegetation clearance
- . revegetation as soon as possible after earthworks are completed utilising collected native seed and chipped trees and brushwood from construction areas where practicable, e.g. the Pacific Highway reconstruction south of Swansea.

Department of Planning

The Department of Planning will continue to assess consistency of rezoning and development proposals with the provisions of the Hunter Regional Environmental Plan 1989, and to monitor important issues.

Hunter Water Board

As previously, the Hunter Water Board will continue to implement its existing programs for erosion and sediment control in the Lake Macquarie catchment.

THERMAL POLLUTION

Electricity Commission

The Electricity Commission will:

- . continue monitoring water quality, lake temperatures, seagrasses and zooplankton on a routine basis
- . continue compliance monitoring and reporting to the SPCC
- . commence the analysis of the benthos data collected over the period 1980 to 1989
- . publish the results of the study into the impact of Eraring Power Station on commercial and recreational fish
- . continue monitoring fish mortalities on Eraring intake screens
- . make progress on changes to inlet operations to minimise fish mortalities.

State Pollution Control Commission

The State Pollution Control Commission will:

- . continue its review of Elcom monitoring data as well as finalise the review and amendment of its licences
- . review the Lake Macquarie Fish Study and consider whether there are implications for power station operations and licensing
- . pursue with Elcom the exceedance of licence temperature limits at Eraring Power Station.

NUTRIENTS

Hunter Water Board

The Hunter Water Board will:

- . install chemical dosing equipment to remove phosphorus at Toronto STW
- . commission the effluent pumping system to convey effluent from Edgeworth STW to Rhondda Colliery, which will reduce phosphorus discharge from these works by approximately 70 per cent
- . continue monitoring lake water quality on a regular basis
- . continue investigation and design of the Lake Macquarie Sewerage Scheme in conjunction with the PWD
- . complete the Killingworth Sewerage Scheme with effluent to be treated at the Edgeworth STW
- . commence sewer reticulation in the Rathmines area with the effluent to be treated at the Toronto STW.

State Pollution Control Commission

The State Pollution Control Commission will:

- . determine appropriate licence levels for nutrients in new and existing sewage treatment works
- . complete computerisation and publish the assessment of its water quality data for the lake
- . continue with revision of licences to bring them into line with other similar licences throughout the State
- . continue to pursue diffuse source controls where possible.

Public Works Department

The Public Works Department will:

- . continue detailed design of the Lake Macquarie Sewerage Scheme, including the completion of design work for the major headworks components of the Toronto STW and effluent transport system to Belmont, the submarine section of the effluent pipeline crossing of Lake Macquarie and the Rathmines to Toronto sewage transportation system
- . commence construction of the sewage pipeline crossing of the lake
- . commence investigation and concept design for the ocean outfall at Belmont.

Lake Macquarie City Council

Lake Macquarie City Council will:

- . install a pipeline to transfer effluent from its Boolaroo depot to the HWB's Edgeworth STW to reduce loadings on Stockton Borehole Swamp and Cackle Creek
- . continue to press for a HWB clean-up of Mudd Creek
- . continue to remove accumulated nuisance aquatic plant debris from nearshore shallows at approved locations if adequate funding is made available.

Wyong Shire Council

The Chain Valley Bay residential area will be connected to sewer in late 1989, completing sewerage installation for residential areas of Wyong Shire in the Lake Macquarie catchment.

TOXIC TRACE METALS

State Pollution Control Commission

The State Pollution Control Commission will:

- . continue its study into the source of metal contamination of bivalves in the lake
- . continue to liaise with and audit the Sulphide Corporation in order to seek reductions in all pollution emissions where practicable.

Sulphide Corporation

Sulphide Corporation will:

- . continue trial dosing with sodium carbonate at the effluent treatment plant in an effort to achieve further reductions of toxic metal concentrations in its wastewaters
- . continue with analytical assistance and participation in the SPCC shellfish study.

FISH PRODUCTIVITY

Electricity Commission

The Electricity Commission will:

- . assess the progress and results of the fish mortality study at the Eraring cooling water intake
- . finalise analysis of benthos data.

NSW Agriculture and Fisheries

NSW Agriculture and Fisheries will inspect screens and inlet facilities at the power stations and provide design specifications to Elcom to mitigate the problems of entrainment and fish deaths.

The Department will also monitor the prawn farm development closely if the conditional lease offered is taken up by the applicant.

WETLANDS

Department of Planning

The Department of Planning will continue to assess and monitor development proposals involving clearing, draining, filling or the construction of levees in classified wetlands. The concurrence of the Director of Planning, the preparation of an Environmental Impact Statement and the consent of Lake Macquarie City Council is required for such proposals. Although some changes to wetland boundaries in coastal areas of the State are proposed for the Minister's approval, none are anticipated for Lake Macquarie.

Lake Macquarie City Council

Lake Macquarie City Council will:

- . incorporate the results of the wetland inventory into the five-year review of the Lake Macquarie Local Environmental Plan
- . support Toronto Wetlands Group in preparing a management plan for Toronto and Fennell Bay wetlands and continue to assist the Belmont Lagoon Restoration Committee in finalising its proposals for improvements to that wetland
- . maintain liaison with the Shortland Wetlands Centre and the Hunter Wetlands Trust.

Wyong Shire Council

Wyong Shire Council will:

- . carry out public and staff education programs on the rezoning of selected wetlands and the implementation of the Development Control Plan for wetlands in the Shire
- . commence monitoring of wetlands using aerial photographs to establish a database for the assessment of long-term changes to these areas
- . finalise and release the Draft Development Control Plan for wetlands subject to Council approval
- . incorporate the Local Environmental Plan for wetlands into the Shire's Open Space Plan providing for acquisition of wetlands where possible.

Elcom Collieries

Elcom Collieries will:

- . arrange for rehabilitation of estuarine wetlands affected by mine subsidence at Karignan Creek, Chain Valley Bay
- . arrange for further erosion control works at Newstan Colliery.

LAKE MANAGEMENT

Lake Macquarie City Council

Lake Macquarie City Council will maintain its Planning, Technical and Environmental Advisory Panel as a forum for the exchange of views and information relating to development proposals within the City and as an advisory body to the Council.

Department of Lands

The Department of Lands will:

- . issue a Permissive Occupancy for the dredging operations to be carried out in Swan and Village Bays and monitor the project over this and ensuing years
- . continue to carry out foreshore reviews on a priority basis
- . carry out investigations in order to increase the efficiency of dealing with applications for domestic foreshore occupancies which will involve the preparation of plans that indicate the relative concerns held by those authorities with responsibility for the lake's management

- . continue to seek restoration of the illegally reclaimed area at Kilaben Bay.

State Pollution Control Commission

The State Pollution Control Commission will continue to service the Lake Macquarie Environmental Audit Review Forum in order to monitor progress in implementing the recommendations of the audit. Regular reviews of progress will be published.

LITTER

Lake Macquarie City Council

Lake Macquarie City Council will:

- . conduct a "Clean-the-City" exercise as an extension of its "Make it Shine in 89" campaign
- . present a range of submissions to the Local Government Association Conference on establishing recycling depots at all landfill sites, a statewide policy on disposal of tyres and redeemable fees on disposal of vehicles and white goods
- . promote private enterprise collections of recyclable materials throughout the City
- . attempt to secure the introduction of a regional centre for shredding used tyres.

State Pollution Control Commission

The State Pollution Control Commission will continue to conduct the NSW Litter Reduction Campaign.

Wyong Shire Council

Wyong Shire Council will:

- . continue to remove litter from wetland filters as part of routine maintenance programs and to support local and other community-based waterway clean-up programs
- . commence a public education and publicity campaign to reduce nutrient inputs to the lakes resulting from dog faeces and litter and will investigate options for introducing increased fines for dog and litter offences.

OTHER MATTERS

Lake Macquarie City Council

Lake Macquarie City Council will:

- . examine the potential for Council use of products made from recycled materials
- . participate in an "intractable waste" collection day in conjunction with the SPCC and the HWB to enable safe disposal of pesticides, herbicides and other toxic wastes by members of the public.

Mines Subsidence Board

The Mines Subsidence Board will complete restoration of foreshore areas affected by mine subsidence at Chain Valley Bay.

Maritime Services Board

The Maritime Services Board will:

- . conduct a review of moorings on Lake Macquarie
- . continue its surveillance of pollution from vessels.

State Pollution Control Commission

The State Pollution Control Commission will:

- . participate in the interdepartmental committee established to identify areas of risk and avenues of control for pollution from recreational vessels
- . seek clarification and development of appropriate policies regarding mine subsidence under the lake and consider the environmental implications of these policies
- . monitor progress in the implementation of the catchment rehabilitation program at Newstan Colliery
- . introduce and assist coordination of the intractable waste clean-up days.

Public Works Department

The Public Works Department will continue to monitor tidal and flood flows in Lake Macquarie by the use of automatic water level recorders.

Hunter Water Board

The Hunter Water Board will fund the intractable waste clean-up days.

CONCLUSIONS

During 1988-89 it was demonstrated again that the Audit Review Forum provides an important focus for examining the environmental issues associated with the management of Lake Macquarie. The Review also demonstrates that all participating bodies are attempting to protect the lake and its environs in a committed and coordinated manner.

During the year the issue of sedimentation received increased attention and Lake Macquarie City Council continued to develop and implement control programs as well as complementary monitoring and research. Of particular note was the budgetary allocation of nearly \$1.3 million (including a \$350,000 State Government grant) by Lake Macquarie City Council toward lake restoration works and sediment control structures. Also of significance was the receipt of a Commonwealth Government grant of \$25,000 to part-fund a catchment erosion study (an additional \$36,000 was provided by Lake Macquarie City Council), the appointment of an Environmental Engineer for erosion and sediment control works and provision of funding for other studies into sediment sources in the Fennell Bay catchment and from selected road batters.

Over the past year significant progress has been made in tackling the longstanding problem of erosion and siltation at Newstan Colliery. With the identification of the particular problem areas and the development of a control strategy, the problems should be brought under control progressively. In its environmental impact statements the Roads and Traffic Authority is now requiring the installation of erosion and sediment controls.

Studies funded by the Electricity Commission advanced the understanding of the impact of cooling water discharges to the lake and led to changes which will further reduce the impact of these discharges on fish mortalities, in particular. Exceedances of temperature limits at Eraring power station will require attention and the State Pollution Control Commission will pursue this matter.

The issue of nutrient discharges was addressed through the environmental impact assessment process with the final decision to build two new sewage treatment works on the western side of Lake Macquarie, to close three of the existing works, and to dispose of all effluents via an extended ocean outfall at Belmont. This will provide one of the best sewage treatment and disposal systems in Australia because the effluent will be treated to secondary standard and will be available for re-use at four locations should consumers desire. The diversion of effluent from Cockle Creek and the northern-most areas of the lake has had a noticeable effect on clarity and the dissolved oxygen regime in Cockle Creek, even though effects on water quality can still be measured. Some of this effect is attributable to the residual nutrients in the creek sediments as well as the remaining discharges from Teralba sanitary depot and West Wallsend sewage treatment works.

Emission controls by the Sulphide Corporation continued to operate well with monitoring results showing that total air and water emissions to the environment are within State Pollution Control Commission licence limits. The risk to health of eating contaminated shellfish is still unresolved though a study commenced by the Commission will give some insight into the effectiveness of pollution controls and the possible need to dredge contaminated sediments.

Protection and management of the lake's wetlands was further enhanced by initiatives from both Councils which established wetland databases, and monitoring and education programs. While development in and around wetlands continues to be contentious, these initiatives should provide a sounder basis for decision-making and hopefully a greater degree of protection.

The issue of mine subsidence beneath the waters of the lake and its ecological consequences moved some way toward clarification with initiatives by the Department of Mineral Resources.

A number of clean-up activities were conducted but it appears that the general incidence of littering and dumping is still high. Attempts at source-sorting domestic garbage have attracted little public support, suggesting that community attitudes and motivation to reduce this type of pollution is still unsatisfactory. Three litter or trash collection devices have been constructed within the catchment at Croudace Bay (2) and Teralba (1).

Lake management was further enhanced by the results of studies carried out under Lake Macquarie Council's Research Grants. The value of these studies is considerable, not only to the Council but also to the development of local scientific expertise.

The issue of unauthorised dredging and reclamation at Kilaben Bay has highlighted the difficulty of certain aspects of lake management when the best efforts of authorities are thwarted by legal difficulties.

The members of the Forum were disappointed at the slow (and in one case nil) response of some members but nonetheless they agreed on the body's continued valuable contribution to lake management and the continuation of its activities.

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APPENDIX I

Premises With Water Licences Under the SPCC Act in the Lake Macquarie Catchment: 1988

(Licences may be examined at the Newcastle office of the SPCC.)

I = Disposal of effluents by irrigation onto land

D = Disposal by licensed discharge to the Lake Macquarie catchment

Bethshan Holiness Mission, Wyee (I)

Pacific Copper Ltd:

Stockton Borehole colliery and coal preparation plant, Boolaroo (D)

Teralba Colliery (D)

West Wallsend No. 2 Colliery, Killingworth (D)

Carynia Oaks Pty Ltd, Cooranbong (I)

Coal and Allied Operations Pty Ltd:

Chain Valley Colliery, Doyalson (D)

Wallerah Colliery (D)

Elcom Collieries Pty Ltd:

Awaba State Coal Mine (D)

Newstan Colliery, Fassifern (D)

Wyee State Coal Mine, Vales Point (D)

Newvale Colliery, Vales Point (D)

Electricity Commission of NSW:

Eraring Power Station (D)

Vales Point Power Station (D)

G. & M. Solano and Company Pty Ltd, Chain Valley Bay (I)

Greenleaf Pty Ltd:

Cockle Creek works, Boolaroo (D)

Hunter Water Board:

Dora Creek sewage treatment works (I)

Edgeworth sewage treatment works (D)

Marmong Point sewage treatment works (D)

Toronto sewage treatment works (D)

West Wallsend sewage treatment works (D)

Hunter Region Mental Health Services:

Department of Health, Morisset (D)

Inghams Enterprises Pty Ltd, Morisset (I)

Lake Macquarie Caravan Park:

R.C., E.A., P.J. and L.J. Miller, Morisset (D)

Lake Macquarie City Council:

Wyee effluent disposal depot (I)

Macquarie Shores Mobile Home Village:

Petola Pty Ltd, Lake Munmorah (I)

R.W. Miller:
Rhondda Colliery (D)

Newcom Collieries Pty Ltd:
Myuna Colliery, Wangi Wangi (D)
Cooranbong Colliery (D)

Sanitarium Health Food Company:
Australasian Conference Association Ltd, Cooranbong (I)

St Joseph's Primary School:
Parish of St Joseph's, Kilaben Bay, Toronto (I)

Sulphide Corporation Pty Ltd, Boolaroo (D)

Wangi District Workers Club Ltd (D)

APPENDIX II

Environmental Monitoring in Lake Macquarie

The following is a summary of the environmental monitoring conducted on Lake Macquarie and its tributaries. These activities are distinct from the monitoring carried out as part of SPCC licence requirements and are mostly performed voluntarily.

Parameters	Locations	Frequency	Duration	Comment
ORGANISATION: State Pollution Control Commission				
Water quality (nutrients)	Lake M: 15 stations Cockle Creek: 9 stations Dora Creek: 9 stations	Irregular Irregular Irregular	Ongoing as needed Ongoing as needed Ongoing as needed	Dry weather conditions
Water quality (runoff)	Lake M: 6 stations	Occasional	Ongoing as needed	High rainfall only
Biota (metals)	Lake M: 3 stations	Bi-monthly	1-2 year project	
ORGANISATION: Hunter Water Board				
Water quality (nutrients, clarity, micro-organisms)	Lake M: 15 stations Cockle Creek: 4 stations LT Creek: 1 station Marmong Creek: 3 stations	Monthly Monthly Monthly Monthly	Ongoing till 1992 Ongoing till 1992 Ongoing till 1992 Ongoing till 1992	
ORGANISATION: Electricity Commission				
Water quality (temperatures, nutrients, clarity, zooplankton)	Lake M: 7 stations	Monthly	Ongoing	Southern lake only
Seagrasses	Bonnells, Myuna, Wyee and Chain Valley Bays	Annually	Ongoing	Winter only
Benthos	Lake M: 14 stations	Annually	1980-89	Continuation depends on outcome of data analysis
Fish, prawns (juvenile, commercial, recreational)	Whole lake or southern half	Occasional	As required	

Parameters	Locations	Frequency	Duration	Comment
ORGANISATION: Lake Macquarie City Council				
FCB, nutrients, NFR, turbidity, temperatures	Swamp outlet at Cockle Creek	Weekly	Ongoing	
FCB, NFR, temperatures, turbidity	Freshwater Creek (William Street), Teralba	Monthly	Ongoing	HWB effluent ex-Rhondda Colliery
Faecal coliforms (FCB)	62 lakeside sites Dora Creek: 1 station Cockle Creek: 1 station	Quarterly (more in summer)	Ongoing	Public bathing areas
ORGANISATION: Public Works Department				
Erosion and sediment movement	Swansea Channel and lake shores	Bi-annually	Ongoing	Aerial surveillance photographic record
Lake water levels	Whole of lake	Continuous	Ongoing	Automatic flood levels
ORGANISATION: Sulphide Corporation				
Water quality (metals, pH, temperatures)	Cockle Creek: 20 stations Lake M: 1 station	Bi-annually	Ongoing (since 1974)	Not within 2 weeks of rain
Biota	Cockle Creek and lake	Occasional		Not for some years
ORGANISATION: Wyong Shire Council				
Water quality (faecal coliforms)	Bathing areas in Shire	Monthly	Swimming season	
BOD and COD	Gwandalan tip leachate	Intermittent	Ongoing	