CORKILL vs. FORESTRY COMMISSION OF NSW (OAKES S.F.)
CATBIRD ROAD, CPTS 168, 169 & 170.

as @ 14/5/'92

Contact information
Consultants and Advisers

Mr John R. Corkill, Applicant, NEFA co-ordinator, Sydney,
C/- NSW Environment Centre, 39 George Street, The Rocks. 2000.
Ph 02 2474 206 w, 02 660 3496 h, Fx 02 2475 945

LEGAL ADVISERS

Mr Mark Anderson, Barrister, junior counsel, 10th Floor,
Frederick Jordan Chambers, 233 Macquarie St, Sydney. 2000.
Ph 02 229 7358 w, 02 3311 616 h, Fx 02 221 6036, 221 6944

Mr Tim Robertson, Barrister, senior counsel, 8th Floor,
Frederick Jordan Chambers, 233 Macquarie St, Sydney. 2000.
Ph 02 229 7337 w, 02 810 1416 h, 018 644 670, Fx 02 221 6036

Mr Bruce Woolf, Solicitor, Woolf Associates,
10th Floor, 82 Elizabeth St, Sydney. 2000.
Ph 02 221 8522 w, 02 371 6015 h, Fx 02 223 3530

CONSULTANT SCIENTISTS

Dr Keith Bishop, Limnologist, Lot 4 Sugar Creek Rd,
Bungwahl. 2423. Ph 049 976 193 w+h, Fx 049 976 149

Phil Gilmour, Rainforest ecologist, Bishop's Ck Community,
Darkwood Road, Thora. 2454. Ph. 066 558 587 h,
Fx C/- Carty Co. 066 552 633, Ph 066 551377

Dr John McGarity, Pedologist,
Pedon Consultants P/L, 111 Faulkner Street, Armidale. 2350
067 733 040 UNE, 067 752 173 h ph+Fx, Fx 067 733 084 UNE

Mr David Millege, Wildlife Ecologist,
Upper Coopers Creek, via Lismore. 2480
Ph 066 882 148 h, Fx 066 22 676 C/- Big Scrub EC

Mr Philip Pells, Consultant Engineer,
Coffey Partners International P/L,
12 Waterloo Rd, North Ryde. 2113.
Ph 02 888 7444 w, Fx 02 888 9880

Assoc Prof Gerald Nanson, Dr Jacky Croke (Research fellow)
Fluvial Geo-morphologists
University of Woolongong, Department of Geography,
Ph 042 213 631 w, 042 846 461 h, Fx 042 213 764

FIELD ADVISERS

Ms Cath Eaglesham, NEFA Co-ordinator Belligen/Dorrigo,
North Bank Rd Belligen. 2454. Ph 066 551 128 h.

David and Joan Hurtado, local rainfall recorders,
Lot 18, North Arm Rd, Bowraville. 2449. Ph 065 644 033h

Cr Lyn Orrego, Nambucca SC, Nambucca Valley Cons. Assoc,
Macksville Rd, Bowraville. 2449.
Ph 065 647 808 w, 065 647 478 h,

Mr Trevor Pike, Acting Co-ord. Coffs Env. Centre,
4 Braithwaite Ave, Bellingen. 2454. Ph/Fx 066 551 869 h.

Mr Dailan Pugh, naturalist and forest researcher,
41 Breimba Street, Grafton. 2460. Ph Fx 066 439 074 h.

NEFA Radio Base camp: Terry Placing, 066 663 513 h+w.

OTHER RELEVANT CONTACTS

NPWS Dorrigo District Office, Rangers Robert Quirk, Mal
Dwyer, Chris Moon, John Hunter,
Dorrigo National Park, Mountain Top,
[P.O. Box 170] Dorrigo. 2453. Ph 066 572 309 w.

NPWS Northern Regional Office, Grafton,
Mr Ashley Love, Asst. Regional Manager,
49 Victoria Street, [P.O. Box 97], Grafton. 2460.
Ph 066 420 593, Fx 066 420 619.

NPWS Head Office, Hurstville,
Mr David Papps 585 6305, Ms Di Campbell
43 Bridge St, [P.O. Box 1967], Hurstville. 2220.
Ph 02 585 6300 sw, Fx 02 585 6455.

FCNSW Urunga District Office,
Foresters John Ball, Robert Onfray, Lachlan Isson,
Cnr Bowra and Orara Sts, Urunga. 2455.
Ph 066 556 203 w, Fx 066 556 277.

FCNSW Port Macquarie Regional Office,
Regional Forester Brian Salter,
1st Floor, 109 William Street, [P.O. Box 930]
Port Macquarie. 2444.
ph 065 837 100, Fx 065 849 507.

MEMORY STORAGE REPORT (APR 29 '92 03:32PM)

NSW ENVIRONMENT CTRE 02 2475945

(AUTO)

FILE	FILE TYPE	OPTION	TEL NO.	PAGE
024	MEMORY TX		G1:ABC RADIO NEWS	01
			G1:ABC 2BL SYD	
			G1:ABC NSW PARLT HOUSE	
			G1:2JJJ	
			G1:2MMM FM	
			G1:2DAY FM	
			G1:2SER FM	
			G1:2EA	
			G1:2GB	
			G1:2KY	
			G1:2SM	
			G1:2UE	
			G1:2UW	
			G1:2WS	
			G1:SUN HER SMH FIN REVW	
			G1:SMH BAILEY	
			G1:AAP	
			G1:AUSTRALIAN	
			G1:DAILY MT	
			G1:AGE	
			G1:HERALD SUN PIC	
			G1:COURIER MAIL	
			G1:BRISBANE SUN	
			G1:CANBERRA TIMES	
			G1:NEWCASTLE HERALD	
			G1:ABC	
			G1:7	
			G1:SBS	
			G1:9	
			G1:10	
			G1:ABC ENV REPORTER	
			G1:7.30 REPORT	
			G3:NORTHERN STAR LIS	
			G3:DAILY EXAMINER GRAFT	
			G3:COFFS HARBOUR ADVOC	
			G3:MACLEAY ARGUS KEMPSE	
			G3:GUARDIAN NAMBUCCA	
			G3:NTH DAILY LEAD TAMW	
			G3:NEW ENG ARMIDALE	
			G3:CHRONICLE TAREE	
			G3:NRNII/RTN8 COFFS	
			G3:NEW ENG 9/8 TAM	
			G3:ABC 2NR LISMORE	

IN THE LAND AND ENVIRONMENT COURT
OF NEW SOUTH WALES

No. OF 1992

BETWEEN:

JOHN CORKILL
Applicant

AND

ENVIRONMENT PROTECTION AUTHORITY
First Respondent

FORESTRY COMMISSION OF NEW SOUTH WALES
Second Respondent

APPLICATION CLASS 4

Messrs Woolf Associates
Solicitors,
10th Floor,
82 Elizabeth Street,
SYDNEY. NSW 2000
Tel: (02) 221 8522
Fax: (02) 223 3530
DX 1558

FULL NAME OF APPLICANT:
JOHN CORKILL
ADDRESS: 3 ALBERT STREET,
FOREST LODGE,
NSW 2037
OCCUPATION: ENVIRONMENTALIST

The Applicant claims the following relief:

1. A declaration that the Pollution Control Licence issued by the First Respondent to the Second Respondent on or about 7 May 1992 in relation to the Coffs Harbour Region, New South Wales, is invalid and the operations purported to be licensed by the First Respondent are likely to have a significant harmful effect upon the environment.

2. A declaration that the Second Respondent has failed to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the logging, burnings, and roading activities in the Oakes State Forest

No. 609 Compartment Numbers 168, 169, 170 inclusive in its consideration of the said activities.

3. A declaration that the said activities are likely to significantly affect the environment.

4. Alternatively to 2 above a declaration that the said activities have significantly affected the environment.

5. A declaration that the Second. Respondent by its servants, agents, licensees and contractors has failed to comply with the provisions of the Management Plan for the Macksville Management Area, and the Harvesting Plans made under that management plan relating to the management objectives 2.1.1, the General Management Strategy 2.1.2, the Harvesting Prescriptions 2.2.4.2, the Special Prescription Areas 2.3.4.1, the Harvesting Prescriptions 2.3.4.2, Roads and Trails 2.4.2.1 by reason of the logging, burning, roading, and road maintenance activities in the Oakes State Forest No. 609 Compartment Numbers 168, 169, 170 inclusive in the implementation and the carrying out of said activities.

6. A declaration that, the Second. Respondent by its servants, agents, licensees and contractors has negligently caused soil, rock, clay and organic matter to escape from the compartments 168, 169, 170 inclusive of the Oakes State Forest (609) by reason of the construction roading and logging activities in the said compartments into the catchment of the Bellinger River in such a manner that the said escape has harmed, or is likely to cause harm to the environment.

7. A declaration that, the Second. Respondent by its servants, agents, licensees and contractors has wilfully caused soil, rock, clay and organic matter to escape from the compartments 168, 169, 170 inclusive of the Oakes State Forest (609) by reason of the construction roading and logging activities in the said compartments into the catchment of the Bellinger River in such a manner that the said escape has harmed, or is likely to cause harm to the environment.

8. Alternatively to 5 and 6 a declaration that the Second Respondent by its servants, agents, licensees and contractors has negligently disposed of waste from the roading and logging activities within the compartments 168, 169, 170 inclusive of the Oakes State Forest (609) in a manner which harms or is likely to cause harm to the environment.

9. Alternatively to 5, and 6 ~~and 7~~ a declaration that the 2nd Respondent by its servants, agents, licensees and contractors has wilfully disposed of waste from the roading and logging activities within the compartments 168, 169, 170 inclusive of the Oakes State Forest (609) in a manner which harms or is likely to cause harm to the environment.

10. A declaration that the 2nd Respondent by its servants, agents, licensees and contractors has polluted the waters of the Catchment of the Bellinger River contrary to Section 16 of the Clean Waters Act 1970 by reason of the roading and logging activities in compartments 168, 169, 170 inclusive of Oakes State Forest (609) without holding a licence (or any valid licence) to so pollute the said waters.

11. A declaration that the said activities are likely to cause harm to the environment.

12. Alternatively to ~~10~~ 11. above, a declaration that the said activities have caused harm to the environment.

ORDERS

1. An order setting aside the Pollution Control Licence issued by the First Respondent to the Second Respondent on or about the 7 May 1992
2. An order that the Second Respondent by its servants, agents, contractors and licensees be restrained from carrying out or consenting to the carrying out of the said activities until it has complied with sections 111 and 112 of the Environmental and Planning and Assessment Act, 1979 including the preparation or obtaining, exhibition and consideration of a valid environmental impact statement.

ACTIVITY REPORT

TRANSMISSION OK

TN #	7303
CONNECTION TEL	3137770
CONNECTION ID	G3
START TIME	05/07 09:55
USAGE TIME	00' 32
PAGES	1

Second 4

3. An order that the Respondent rehabilitate vegetation disturbed by unlawful forestry operations in the said area referred to in paragraph 1 of this Application.

and retain + conserve soils + rock material

4. An order that the Respondent by its servants, agents, contractors and licensees be restrained from carrying out the logging, burning, roading, and road maintenance activities in the said compartments.

Second

5. Costs.
6. Any further or other order that the Court thinks fit.

COMPANY EXTRACT

05/05/1992 10:21:19 PAGE: 1

AUSTRALIAN SECURITIES COMMISSION

003 144 250 VEBKOT PTY LTD

DOCUMENT NO

Australian Company Number: 003 144 250
Incorporated in: NEW SOUTH WALES
Previous State Number: 37752411
Registration Date: 22/07/1986
Principal Activity:

Current Organisation Details

001 055 049

Name: VEBKOT PTY LTD
Name Start: /1987

CORKILL APP

Full name of Applicant: John Corkill
address: 3 Albert Street Forest Lodge NSW 2037
Occupation: Environmentalist

APPLICATION CLASS 4.

The Applicant claims the following relief.

1. A declaration that the Respondent has failed to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of ~~proposed~~ the logging, burning and roading activities in the Oakes State Forest No 609 Compartment Numbers 168, 169, 170 inclusive in its consideration of the said activities

2. A declaration that the said activities are likely to ~~could~~ significantly ~~have~~ affect the environment.

3. Alternatively to 2. above, a declaration that the said activities have significantly affected the environment

4. A declaration that the Respondent by its servants, agents, licensees and contractors has failed to comply with the provisions of the Management Plan for the Macksville Management Area, and the Harvesting Plans made under that management plan relating to the management objectives 2.1.1, the General Management Strategy 2.1.2, the Harvesting Prescriptions 2.2.4.2, the Special Prescription Areas 2.3.4.1, the Harvesting Prescriptions 2.3.4.2, Roads and Trails 2.4.2.1, by reason of the logging, burning, bedding, and road maintenance activities in the Oakes State Forest No 609 Compartment Numbers 168, 169, 170 inclusive in the implementation and carrying out the said activities

insert *

~~5~~. A declaration that the said activities are likely to cause harm to the environment.

~~6~~. Alternatively to ~~5~~ above, a declaration that the said activities have caused harm to the environment.

ACTIVITY REPORT

RECEPTION OK

TN #	6983
CONNECTION TEL	6220352
CONNECTION ID	G3
START TIME	04/02 12:31
USAGE TIME	00'46
PAGES	1

insert *[] A declaration that the Respondent by its servants, agents, licensees and contractors has negligently caused soil, rock, clay and organic matter to escape from the Compartments 168, 169, 170 of the Oakes State Forest (609) inclusive, by reason of the construction roading ~~road~~ roading and logging activities in the said compartments into the catchment of the Bellinger River in such a manner that the said escape is likely to cause harm to the environment has harmed, or

[] Repeat [] but insert "wilfully" instead of "negligently"

[] Alternatively to [] a declaration that The Respondent by its servants, agents, licensees and contractors has negligently / repeat with "wilfully" disposed of waste from the roading and logging ~~road~~ activities within The Compartments 168, 169, 170 inclusive of the Oakes State Forest (609) in a manner which harms, the environment, or is likely to cause harm to

[] a declaration that The Respondent by its servants, agents, licensees and contractors has polluted the waters of the Catchment of the Bellinger River contrary to section 16 of the Clean Waters Act 1970 by reason of the roading and logging activities in Compartments 168, 169, and 170 inclusive of Oakes State Forest (~~0~~609) without holding a licence to so pollute the said waters.

ACTIVITY REPORT

TRANSMISSION OK

TN #	6986
CONNECTION TEL	2586469
CONNECTION ID	G3
START TIME	04/02 15:05
USAGE TIME	01' 16
PAGES	3

ORDERS

1. An order that the Respondent by its servants, agents, contractors and licensees be restrained from carrying out or consenting to the carrying out of the said activities until it has complied with sections 111 and 112 of the Environmental Planning and Assessment Act, 1979 including the preparation or obtaining, exhibition and consideration of a valid environmental impact statement.

2. An order that the Respondent rehabilitate vegetation disturbed by unlawful forestry operations in the said area referred to in paragraph 1 of this Application.

3. An order that the Respondent by its servants, agents, contractors and licensees be restrained from carrying out the ~~clearing~~ logging, burning, roading, and road maintenance activities in the said compartments

4. Costs

5. Any further or other other that the Court thinks fit.

ACTIVITY REPORT

RECEPTION OK

TN #	6984
CONNECTION TEL	02 2814850
CONNECTION ID	G3
START TIME	04/02 14:34
USAGE TIME	04' 59
PAGES	8

for MWA re draft Appln for Oakes SF.

IN THE LAND AND ENVIRONMENT

COURT OF NEW SOUTH WALES

No. 40208 of 1990

JOHN CORKILL

Applicant

FORESTRY COMMISSION OF NEW SOUTH WALES

Respondent

AMENDED
APPLICATION
CLASS 4

Applicant's address for service:

HILLMAN & WOOLF
SOLICITORS
10th Floor
82 Elizabeth Street
SYDNEY NSW 2000
DX: 1558 SYDNEY

TEL: 221 8522
FAX: 223 3530
REF: BSW 2489/0

Full name of Applicant: JOHN CORKILL

Address: 3 Albert Street, FOREST LODGE NSW 2037

Occupation: Environmentalist

The Applicant claims the following relief:

1. A declaration that the Respondent has failed to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of proposed logging, burning and roading activities in the Washpool State Forest No. 355 Compartment numbers 686-694 inclusive, 697-699 inclusive and Billilimbra State Forest No. 815 Compartment numbers 679, 695, 696, 700-713 inclusive ("the said activities") in its consideration of the said activities.

2. A declaration that the said activities are likely to significantly affect the environment.

3. A declaration that the environmental impact statement prepared by the Respondent in 1980 is not a valid environmental impact statement complying with Part V of the Environmental Planning and Assessment Act, 1979 and Regulations thereunder in relation to the said activities.

4. A declaration that the determination of the Commissioner for Forests of 14 December, 1982 is invalid.

5. An order that the Respondent by its servants, agents, contractors and licensees be restrained from carrying out or consenting to the carrying out of the said activities until it has complied with Sections 111 and 112 of the Environmental Planning and Assessment Act, 1979 including the preparation or obtaining, exhibition and consideration of a valid environmental impact statement.

6. An order that the Respondent rehabilitate vegetation disturbed by unlawful forestry operations in the said area referred to in paragraph 1 of this Application.

BRIEF TO ADVISE IN CONFERENCE

I act for John Corkill, an environmentalist, and the North East Forest Alliance (NEFA)

Mr Corkill had instructed me to commence proceedings against the Forestry Commission, Thora Sawmilling Pty Ltd and any other person or corporation involved in contraventions of the Clean Waters Act, the Environmental Offences and Penalties Act and, possibly, other State environmental laws.

In April 1991, Thora Sawmilling commenced the construction of a temporary forest road between Killiekrankie Mountain and New England National Park. The road is within Oakes State Forest. Thora Sawmilling has a sawlog quota for areas including Oakes State Forest which as a matter of practice (although not law) entitles it to a timber licence to extract its annual quota of sawlogs from areas designated by the Forestry Commission. A timber licence is a statutory authority to fell timber issued under the Forestry Act 1916.

Before any logging can take place within a State forest, the Forestry Commission issues a harvesting plan for each compartment (a compartment is an administrative division of a State Forest - approximately 100-300 hectares). Harvesting plans contain the prescriptions by reference to which all logging and ancillary activities are to take place. Ancillary activities include the construction of what are called snigging tracks which radiate down slope from log dumps. Timber is felled down slope of the log dump and tree trunks are "snigged" or hauled up to the log dump by bulldozers where they are stacked on a platform for ease of loading on to logging jinkers (20 tonne trucks). The jinkers then transport the logs to the sawmill.

Whereas snigging tracks are constructed by the timber licensee (usually the sawmill holding the quota) or its contractors, forest roads are constructed either by the Forestry Commission or the sawmiller under contract to the Commission. The Forestry Commission designs, supposedly supervises and pays for the construction of forest roads, as well as their maintenance.

New South Wales is divided into Regions and each Region is divided into Districts. The forester responsible for day-to-day operations within a district is the District Forester. The forester responsible for policy and broader management of operations within a region is the Regional Forester. Oakes State Forest is within Port Macquarie region and Urunga district. Forests are aggregated in Management Areas. The Management Area may or may not correlate with a Forest District.

For each Management Area there is a Management Plan. This is a formal statutory document whose preparation is required by the Forestry Regulation 1983 and it must be available at all times for inspection by the members of the public. The plan sets out strategy for exploitation of the Forests, describes the commercial timber species available and contains a minimum of ecological information, usually in a standard form. As most State forests in New South Wales have never been surveyed for their environmental values, the ecological information tends to be derivative and not based upon site specific survey. The Forestry Commission has never recognised a legal or moral obligation to undertake pre-logging environmental assessments in northeastern New South Wales.

The Management Plan will broadly outline the intensity of logging in particular forest types (a term of art meaning a community of economic species which is known by the name of the dominant or co-dominant overstorey commercial species). Most compartments in Oakes State Forest have between 3 and 6 forest type within each compartment. Forest types maps are produced for each State forest which, compartment by compartment, describe the forest types. All economic assessment of resource is made on the basis of an average density of commercial species in each forest type. Forest types do not necessarily relate to any scientific or ecologically based system of floristic classification.

The Management Plan also contains prescriptions, that is, lists of restrictions which the Forestry Commission imposes upon logging or roading in particular areas in recognition of the multiple use values of State forests.

Some prescriptions purport to maintain fauna values, frequently by reserving between one and three "habitat trees" per hectare, often in clumps every five hectares. There is ample scientific evidence that this prescription, when applied in the faunistically rich forests of northeastern New South Wales, is hopelessly inadequate and has probably led to the local or regional extinction of sensitive forest-dependent species.

Another prescription is to maintain a certain percentage of canopy after logging, but this prescription is usually more related to maintaining visual catchment values than fauna values.

A third common prescription is the maintenance of unlogged areas as corridors through which fauna can move. Most such areas are in fact unloggable because they are too steep or because they follow drainage lines and are reserved from significant logging or tractor movement to prevent erosion of creek banks. The anti-erosion prescriptions are also recognised by scientists as inadequate for the high rainfall areas of New South Wales. Those prescriptions are called the Standard Erosion Mitigation Conditions (SEMC) and were most recently up-dated in 1990. They were originally developed by Mr Marshall of the Soil Conservation Service for logging in the Eden Management Area which has quite different rainfall intensivities to northeastern New South Wales.

Prescriptions which "zone" land in a forest into particular cases are denoted with numbers (for example, PMP 1.1.1) which are then transposed to a "PMP map" or a Preferred Management Priority map for the State forest. The map is formally signed by the Chief of the Management Planning Division (an SES appointee) and in doing so he gives the imprimatur of the Commission to the zoning decision contained on the plan. The areas of forest not subject to any special prescription are, by virtue of the Management Plan and the PMP system, available for maximum economic utilisation logging subject to the SEMCS and any logging prescriptions contained in the harvesting plans.

Harvesting plans are signed by the forester preparing them and countersigned by the District Forester. Under the Management Plan, no harvesting can take place without first issuing a harvesting plan. Although the harvesting plan should contain site specific ecological detail, most are prepared with only a cursory glance at the area in question, frequently by persons without any qualifications in environmental protection.

MEMORANDUM.

TO: BRUCE WOOLF, TIM ROBERTSON, JOHN CORKILL, DAILAN PUGH, TREVOR PIKE, PHILIP PELLS, JOHN McGARITY, KEITH BISHOP.

FROM: MARK ANDERSON

DATE: 10 APRIL 1992

RE: OAKES STATE FOREST

I have been asked to put together a summary of the evidence required for the interlocutory application to the Court for the benefit of the experts who will be attending the Forest. This is done with a view to the types of things they should notice, measure and comment upon in any affidavits and reports they make following their inspection of the Forest.

The Application to the Court will be based upon the evidence that there is a real or significant likelihood that the requirements for making an order under the Environmental Offences and Penalties Act 1989, section 25 will be satisfied. Those requirements are

A) that there is a breach, or a threatened or apprehended breach of the Clean Waters Act 1970, the Timber Industry (Interim Protection) Act 1992 ("TIIP Act") and

B) the breaches, or threatened or apprehended breaches, is, or are, likely to cause harm to the environment.

"Harm" means any direct or indirect alteration of the environment that has the effect of degrading the environment including a breach of the Clean Waters Act 1970, that is any act or omission which results in the pollution of any waters.

"Environment" means any aspect of the surroundings including the land, waters, and

atmosphere, animals, plants, and other forms of life, and includes the aesthetic appearance, sounds, smells, tastes, and textures.

The definition of pollute is very wide and covers the placing by a person, or corporation through its servants or agents, in or on any land a pollutant so that it can end up in the water as a direct result of its being where it is, whether or not it was intended to go into the waters.

The definition of pollute is satisfied if

A) the polluting matter can be introduced into or on the waters (whether through an act or omission or just by being where it is) so that the physical , chemical, or biological condition of the waters is changed; or

B) if any refuse, litter, debris, or matter present makes or is likely to make (including by chemical reaction with things already in the waters) the waters unclean, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters.

C) The types of "matter" which are prescribed for the purposes of the CWA's third definition of pollute by discharging that matter, or by discharging it without complying with the prescribed standards are (relevantly):

plant matter of any description including vegetable or fruit wastes, leaves, grass, trees, wood, sawdust, shavings, chips, bark or other forest products or refuse;

inorganic matter of any description including ashes, ballast, soil, earth, mud, stones,sand, clay residue or washings from any mineral processing or extractive operation or soil, spoil or washings from any dredging operation;

animal matter of any description including carcases of animals, parts or remains of animals, offal, flesh or bones;

chemicals or poisonous substances of any description.

****
*** ACTIVITY REPORT ***
****

TN #	MODE	CONNECTION TEL	CONNECTION ID	START TIME	USAGE T.	PAGES	RESULT
*6608	AUTO RX G3		G3	02/26 16:44	01'36	3	OK
*6609	AUTO TX G3	5809325	G3	02/26 17:06	00'43	1	OK
*6610	AUTO RX G3		G3	02/26 17:47	05'30	7	OK
*6611	AUTO RX G3	602 6601	G3	02/27 09:29	05'22	8	OK
*6612	AUTO TX G3	2311904	G3	02/27 10:57	00'34	1	OK
*6613	AUTO RX G3		G3	02/27 11:32	06'10	7	OK
*6614	AUTO RX G3	61 2 2234083	G3	02/27 11:38	06'30	12	OK
*6615	AUTO RX G3	066865749	G3	02/27 12:20	03'21	4	OK
*6616	AUTO RX G3	025692811	G3	02/27 12:59	01'33	2	OK
*6617	AUTO RX G3	02 391 9604	G3	02/27 13:01	02'52	4	OK
*6618	AUTO RX G3	61 2 271206	ACF SYDNEY	02/27 14:46	01'41	2	OK
*6619	AUTO RX G3	61 2 283 2059	G3	02/27 14:50	00'32	0	NG 0 ##293
*6620	AUTO RX G3	060 218225	G3	02/27 15:44	03'22	6	OK
*6621	AUTO RX G3	043 245193	G3	02/27 15:53	22'01	43	OK
*6622	AUTO RX G3	02 8585283	G3	02/27 16:18	01'13	2	OK
*6623	AUTO RX G3	02 2475945	G3	02/27 16:23	12'35	18	OK
*6624	AUTO RX G3	066512818	G3	02/27 16:55	16'33	17	OK
*6625	AUTO RX G3	02 3642782	G3	02/27 17:15	01'12	2	OK
*6626	AUTO RX G3	612 264 8005	G3	02/27 17:43	00'31	0	NG 0 ##293
*6627	AUTO RX G3	612 264 8005	G3	02/27 17:44	15'08	28	OK
*6628	AUTO RX G3	022371205	G3	02/28 08:12	02'55	5	OK
*6629	AUTO RX G3		G3	02/28 09:08	01'09	2	NG 2 ##292
*6630	AUTO TX G3	2471206	ACF SYDNEY	02/28 10:19	05'40	8	OK
*6631	AUTO RX G3		G3	02/28 12:35	01'00	1	OK
*6633	AUTO RX G3	61 2 2353099	G3	02/28 14:27	01'57	3	OK
*6634	AUTO RX G3	6123692356	G3	02/28 15:24	03'34	4	NG 4 #005
*6635	AUTO RX G3	6123692356	G3	02/28 15:28	01'39	1	NG 1 #005
*6636	AUTO RX G3	6123692356	G3	02/28 15:31	04'09	6	OK
*6638	AUTO TX G3	2351244	G3	02/28 15:42	01'23	3	OK
*6640	AUTO RX G3	38763604519	G3	02/28 15:51	01'16	2	OK
*6641	AUTO RX G3	068 820726	G3	02/28 16:14	03'30	6	OK
*6642	AUTO RX G3	61 2 626 3627	LOW & ASSOCIATES	02/28 16:21	04'55	7	OK
*6643	AUTO RX G3	61 02 602 7525	G3	02/28 16:32	00'29	1	NG 1 ##106
*6645	AUTO RX G3		G3	02/28 16:36	07'12	11	OK
*6646	AUTO RX G3	38763604519	G3	02/28 17:05	01'14	2	OK
*6647	AUTO RX G3	066512818	G3	02/28 17:07	00'53	1	NG 1 ##106
*6648	AUTO RX G3	066512818	G3	02/28 17:09	10'10	9	OK
*6649	AUTO RX G3		G3	02/28 17:20	08'23	13	OK
*6651	AUTO RX G3		G3	02/28 17:41	09'16	15	OK
6652	AUTO RX G3	61 3 5872002	G3	03/02 10:23	00'55	1	OK

"Waters" is defined in the CWA to be any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or part thereof, and includes water stored in artificial works, water in water mains, waterpipes and water channels, and any underground or artesian water, or any part thereof.

The TIIP Act, section 10, makes it mandatory for the person who carries out logging operations on Schedule 4 land to comply with the relevant Management Plan applying to that land and the Code of Logging Practices applying to the land. The Commission must comply with the Code of Logging Practices and the Management Plan which prescribe the Soil Erosion Mitigation Conditions.

The evidence can be stated to comprise then, merely as a guide to which can be added or subtracted according to the applicability in each relevant specialty:

1. The correct lithological description by soil types and erosivity of the soil and geological features having regard to the slopes and the observance or not of the Soil Erosion Mitigation Conditions applicable, by the logging operations which include the construction of the road.
2. The likely discharge rates for streams that drain the logging operations area, having regard to rainfall records and types of vegetation which are established and their requirements or preferred rainfall habitats.
3. Comments upon the co-efficient of runoff for the area in both the short term and the long term.
4. The known effects of roading, logging and post-logging burning on the mobilisation of sediments in forested catchments.
5. Methods by which disturbed sediments move into water courses over both the

ACTIVITY REPORT

RECEPTION OK

TN #	6655
CONNECTION TEL	2274792
CONNECTION ID	G3
START TIME	03/02 12:03
USAGE TIME	09'54
PAGES	20

short and long term.

6. As a result of the inspection , an estimate of the sediment yield likely during the various phases of operations, during storm events and over the long term.

7. Adequacy of the SEMC and special conditions contained in the Management Plan in preventing the movement of sediments into water courses.

8. The predictability or otherwise of rainfall events, fires, etc..and the complexities of safe forest management to minimise soil erosion, in the sense of Olive and Rieger (1988) published in Warner's tome. Specifically, what assurances can the Commission make that significant erosion and siltation of water courses will not occur.

9. The impact of mobilised sediments on :

    i) water quality

    ii) aquatic habitats of fish and invertebrates

    iii) birds or other animals.

10. Likely changes to the water retention capabilities of the catchments and the resultant effects on catchment water yields into the surrounding creeks and rivers in periods of low rainfall or drought, in both the short and long term post logging operations.

11. Current knowledge or lack thereof of aquatic species in the Bellinger river downstream of the affected creeks.

12. The potential direct effects of suspended sediments likely to be mobilised from roads and logged or cleared areas, (particularly in storm events) on known species.

13. The indirect resultant effects of alteration of the aquatic habitats due to the effects of the operations on aquatic species.

14. The ability or otherwise to predict such effects given the state of current knowledge of the impact of logging and associated activities on soils and the unpredictability of rainfall events. Are there seasonal factors of the biology of aquatic species (e.g. Spawning, migration, food availability etc) which need to be considered.

15. The extent to which the Management Plan or SEMC adequately considers this part of the environment any likely impacts of the activities and any measures to mitigate those impacts.

16. Cumulative effects upon the increases in sediment levels within the affected catchment.

17. Susceptibility to erosion and magnitude of peak discharges.

18. Increased hillslope erosion rates, if any, as a result of the road construction and stream banks or watercourses due to decreased vegetation.

19. Comments upon the frequency at which sediment is delivered to the drainage system.

20. Impact of the operations locally and regionally through any cumulative effects.

21. Effect upon the Ph level of the streams/creeks/river due to the presence of soils and other eroded matter and matter already present in the water.

22. The effect of runoff water upon the road constructed.

23. The amount of soil likely to be or in fact eroded having regard to the road construction and the terrain.

24. Where the runoff is likely to go, or if known where it has gone and the effect of that runoff upon the watercourses or other "waters".

25. The amount and the types of debris or other "matter" washed into the waters.

26. The effect upon the environment of the construction of the road having regard to the factors that are included in the definition of environment and harm.

27. The observed effects and the observed causes/opinions as to the causes of such degradation of the environment.

28. Whether it is likely that the harm will continue, and if so for how long and what steps should be taken to remedy the harm.

29. The likely effect of the pollution of the watercourses by soil and other matter upon animal, bird, aquatic or fish life in the immediate area and regionally.

30. The ways in which the construction of the roads and logging operations do not comply with the code of logging practices, management plan, and Standard Soil Erosion Mitigation Conditions 1990, and whether and in what respects, even if those documents were complied with, there would continue to be a real likelihood, or more, of continued harm to the environment or pollution of the waters.

M. Anderson.

Mark Anderson

10th April 1992

(copy) 24.

MEMORANDUM.

TO: BRUCE WOOLF, TIM ROBERTSON, JOHN CORKILL, DAILAN PUGH, TREVOR PIKE, PHILIP PELLS, JOHN McGARITY, KEITH BISHOP.

FROM: MARK ANDERSON

DATE: 10 APRIL 1992

RE: OAKES STATE FOREST

I have been asked to put together a summary of the evidence required for the interlocutory application to the Court for the benefit of the experts who will be attending the Forest. This is done with a view to the types of things they should notice, measure and comment upon in any affidavits and reports they make following their inspection of the Forest.

The Application to the Court will be based upon the evidence that there is a real or significant likelihood that the requirements for making an order under the Environmental Offences and Penalties Act 1989, section 25 will be satisfied. Those requirements are

A) that there is a breach, or a threatened or apprehended breach of the Clean Waters Act 1970, the Timber Industry (Interim Protection) Act 1992 ("TIIP Act") and

B) the breaches, or threatened or apprehended breaches, is, or are, likely to cause harm to the environment.

"Harm" means any direct or indirect alteration of the environment that has the effect of degrading the environment including a breach of the Clean Waters Act 1970, that is any act or omission which results in the pollution of any waters.

"Environment" means any aspect of the surroundings including the land, waters, and

atmosphere, animals, plants, and other forms of life, and includes the aesthetic appearance, sounds, smells, tastes, and textures.

The definition of pollute is very wide and covers the placing by a person, or corporation through its servants or agents, in or on any land a pollutant so that it can end up in the water as a direct result of its being where it is, whether or not it was intended to go into the waters.

The definition of pollute is satisfied if

A) the polluting matter can be introduced into or on the waters (whether through an act or omission or just by being where it is) so that the physical , chemical, or biological condition of the waters is changed; or

B) if any refuse, litter, debris, or matter present makes or is likely to make (including by chemical reaction with things already in the waters) the waters unclean, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters.

C) The types of "matter" which are prescribed for the purposes of the CWA's third definition of pollute by discharging that matter, or by discharging it without complying with the prescribed standards are (relevantly):

plant matter of any description including vegetable or fruit wastes, leaves, grass, trees, wood, sawdust, shavings, chips, bark or other forest products or refuse;

inorganic matter of any description including ashes, ballast, soil, earth, mud, stones,sand, clay residue or washings from any mineral processing or extractive operation or soil, spoil or washings from any dredging operation;

animal matter of any description including carcases of animals, parts or remains of animals, offal, flesh or bones;

chemicals or poisonous substances of any description.

"Waters" is defined in the CWA to be any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or part thereof, and includes water stored in artificial works, water in water mains, waterpipes and water channels, and any underground or artesian water, or any part thereof.

The TIIP Act, section 10, makes it mandatory for the person who carries out logging operations on Schedule 4 land to comply with the relevant Management Plan applying to that land and the Code of Logging Practices applying to the land. The Commission must comply with the Code of Logging Practices and the Management Plan which prescribe the Soil Erosion Mitigation Conditions.

The evidence can be stated to comprise then, merely as a guide to which can be added or subtracted according to the applicability in each relevant specialty:

1. The correct lithological description by soil types and erosivity of the soil and geological features having regard to the slopes and the observance or not of the Soil Erosion Mitigation Conditions applicable, by the logging operations which include the construction of the road.
2. The likely discharge rates for streams that drain the logging operations area, having regard to rainfall records and types of vegetation which are established and their requirements or preferred rainfall habitats.
3. Comments upon the co-efficient of runoff for the area in both the short term and the long term.
4. The known effects of roading, logging and post-logging burning on the mobilisation of sediments in forested catchments.
5. Methods by which disturbed sediments move into water courses over both the

short and long term.

6. As a result of the inspection , an estimate of the sediment yield likely during the various phases of operations, during storm events and over the long term.

7. Adequacy of the SEMC and special conditions contained in the Management Plan in preventing the movement of sediments into water courses.

8. The predictability or otherwise of rainfall events, fires, etc..and the complexities of safe forest management to minimise soil erosion, in the sense of Olive and Rieger (1988) published in Warner's tome. Specifically, what assurances can the Commission make that significant erosion and siltation of water courses will not occur.

9. The impact of mobilised sediments on :

   i) water quality

   ii) aquatic habitats of fish and invertebrates

   iii) birds or other animals.

10. Likely changes to the water retention capabilities of the catchments and the resultant effects on catchment water yields into the surrounding creeks and rivers in periods of low rainfall or drought, in both the short and long term post logging operations.

11. Current knowledge or lack thereof of aquatic species in the Bellinger river downstream of the affected creeks.

12. The potential direct effects of suspended sediments likely to be mobilised from roads and logged or cleared areas, (particularly in storm events) on known species.

13. The indirect resultant effects of alteration of the aquatic habitats due to the effects of the operations on aquatic species.

14. The ability or otherwise to predict such effects given the state of current knowledge of the impact of logging and associated activities on soils and the unpredictability of rainfall events. Are there seasonal factors of the biology of aquatic species (e.g. Spawning, migration, food availability etc) which need to be considered.

15. The extent to which the Management Plan or SEMC adequately considers this part of the environment any likely impacts of the activities and any measures to mitigate those impacts.

16. Cumulative effects upon the increases in sediment levels within the affected catchment.

17. Susceptibility to erosion and magnitude of peak discharges.

18. Increased hillslope erosion rates, if any, as a result of the road construction and stream banks or watercourses due to decreased vegetation.

19. Comments upon the frequency at which sediment is delivered to the drainage system.

20. Impact of the operations locally and regionally through any cumulative effects.

21. Effect upon the Ph level of the streams/creeks/river due to the presence of soils and other eroded matter and matter already present in the water.

22. The effect of runoff water upon the road constructed.

23. The amount of soil likely to be or in fact eroded having regard to the road construction and the terrain.

24. Where the runoff is likely to go, or if known where it has gone and the effect of that runoff upon the watercourses or other "waters".

25. The amount and the types of debris or other "matter" washed into the waters.

26. The effect upon the environment of the construction of the road having regard to the factors that are included in the definition of environment and harm.

27. The observed effects and the observed causes/opinions as to the causes of such degradation of the environment.

28. Whether it is likely that the harm will continue, and if so for how long and what steps should be taken to remedy the harm.

29. The likely effect of the pollution of the watercourses by soil and other matter upon animal, bird, aquatic or fish life in the immediate area and regionally.

30. The ways in which the construction of the roads and logging operations do not comply with the code of logging practices, management plan, and Standard Soil Erosion Mitigation Conditions 1990, and whether and in what respects, even if those documents were complied with, there would continue to be a real likelihood, or more, of continued harm to the environment or pollution of the waters.

Mark Anderson

10th April 1992

Copy

MEMORANDUM.

TO: BRUCE WOOLF, TIM ROBERTSON, JOHN CORKILL, DAILAN PUGH, TREVOR PIKE, PHILIP PELLS, JOHN McGARITY, KEITH BISHOP.

FROM: MARK ANDERSON

DATE: 10 APRIL 1992

RE: OAKES STATE FOREST

I have been asked to put together a summary of the evidence required for the interlocutory application to the Court for the benefit of the experts who will be attending the Forest. This is done with a view to the types of things they should notice, measure and comment upon in any affidavits and reports they make following their inspection of the Forest.

The Application to the Court will be based upon the evidence that there is a real or significant likelihood that the requirements for making an order under the Environmental Offences and Penalties Act 1989, section 25 will be satisfied. Those requirements are

A) that there is a breach, or a threatened or apprehended breach of the Clean Waters Act 1970, the Timber Industry (Interim Protection) Act 1992 ("TIIP Act") and

B) the breaches, or threatened or apprehended breaches, is, or are, likely to cause harm to the environment.

"Harm" means any direct or indirect alteration of the environment that has the effect of degrading the environment including a breach of the Clean Waters Act 1970, that is any act or omission which results in the pollution of any waters.

"Environment" means any aspect of the surroundings including the land, waters, and

atmosphere, animals, plants, and other forms of life, and includes the aesthetic appearance, sounds, smells, tastes, and textures.

The definition of pollute is very wide and covers the placing by a person, or corporation through its servants or agents, in or on any land a pollutant so that it can end up in the water as a direct result of its being where it is, whether or not it was intended to go into the waters.

The definition of pollute is satisfied if

A) the polluting matter can be introduced into or on the waters (whether through an act or omission or just by being where it is) so that the physical , chemical, or biological condition of the waters is changed; or

B) if any refuse, litter, debris, or matter present makes or is likely to make (including by chemical reaction with things already in the waters) the waters unclean, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters.

C) The types of "matter" which are prescribed for the purposes of the CWA's third definition of pollute by discharging that matter, or by discharging it without complying with the prescribed standards are (relevantly):

plant matter of any description including vegetable or fruit wastes, leaves, grass, trees, wood, sawdust, shavings, chips, bark or other forest products or refuse;

inorganic matter of any description including ashes, ballast, soil, earth, mud, stones,sand, clay residue or washings from any mineral processing or extractive operation or soil, spoil or washings from any dredging operation;

animal matter of any description including carcases of animals, parts or remains of animals, offal, flesh or bones;

chemicals or poisonous substances of any description.

"Waters" is defined in the CWA to be any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or part thereof, and includes water stored in artificial works, water in water mains, waterpipes and water channels, and any underground or artesian water, or any part thereof.

The TIIP Act, section 10, makes it mandatory for the person who carries out logging operations on Schedule 4 land to comply with the relevant Management Plan applying to that land and the Code of Logging Practices applying to the land. The Commission must comply with the Code of Logging Practices and the Management Plan which prescribe the Soil Erosion Mitigation Conditions.

The evidence can be stated to comprise then, merely as a guide to which can be added or subtracted according to the applicability in each relevant specialty:

1. The correct lithological description by soil types and erosivity of the soil and geological features having regard to the slopes and the observance or not of the Soil Erosion Mitigation Conditions applicable, by the logging operations which include the construction of the road.
2. The likely discharge rates for streams that drain the logging operations area, having regard to rainfall records and types of vegetation which are established and their requirements or preferred rainfall habitats.
3. Comments upon the co-efficient of runoff for the area in both the short term and the long term.
4. The known effects of roading, logging and post-logging burning on the mobilisation of sediments in forested catchments.
5. Methods by which disturbed sediments move into water courses over both the

short and long term.

6. As a result of the inspection , an estimate of the sediment yield likely during the various phases of operations, during storm events and over the long term.

7. Adequacy of the SEMC and special conditions contained in the Management Plan in preventing the movement of sediments into water courses.

8. The predictability or otherwise of rainfall events, fires, etc..and the complexities of safe forest management to minimise soil erosion, in the sense of Olive and Rieger (1988) published in Warner's tome. Specifically, what assurances can the Commission make that significant erosion and siltation of water courses will not occur.

9. The impact of mobilised sediments on :

    i) water quality

    ii) aquatic habitats of fish and invertebrates

    iii) birds or other animals.

10. Likely changes to the water retention capabilities of the catchments and the resultant effects on catchment water yields into the surrounding creeks and rivers in periods of low rainfall or drought, in both the short and long term post logging operations.

11. Current knowledge or lack thereof of aquatic species in the Bellinger river downstream of the affected creeks.

12. The potential direct effects of suspended sediments likely to be mobilised from roads and logged or cleared areas, (particularly in storm events) on known species.

13. The indirect resultant effects of alteration of the aquatic habitats due to the effects of the operations on aquatic species.

14. The ability or otherwise to predict such effects given the state of current knowledge of the impact of logging and associated activities on soils and the unpredictability of rainfall events. Are there seasonal factors of the biology of aquatic species (e.g. Spawning, migration, food availability etc) which need to be considered.

15. The extent to which the Management Plan or SEMC adequately considers this part of the environment any likely impacts of the activities and any measures to mitigate those impacts.

16. Cumulative effects upon the increases in sediment levels within the affected catchment.

17. Susceptibility to erosion and magnitude of peak discharges.

18. Increased hillslope erosion rates, if any, as a result of the road construction and stream banks or watercourses due to decreased vegetation.

19. Comments upon the frequency at which sediment is delivered to the drainage system.

20. Impact of the operations locally and regionally through any cumulative effects.

21. Effect upon the Ph level of the streams/creeks/river due to the presence of soils and other eroded matter and matter already present in the water.

22. The effect of runoff water upon the road constructed.

23. The amount of soil likely to be or in fact eroded having regard to the road construction and the terrain.

24. Where the runoff is likely to go, or if known where it has gone and the effect of that runoff upon the watercourses or other "waters".

25. The amount and the types of debris or other "matter" washed into the waters.

26. The effect upon the environment of the construction of the road having regard to the factors that are included in the definition of environment and harm.

27. The observed effects and the observed causes/opinions as to the causes of such degradation of the environment.

28. Whether it is likely that the harm will continue, and if so for how long and what steps should be taken to remedy the harm.

29. The likely effect of the pollution of the watercourses by soil and other matter upon animal, bird, aquatic or fish life in the immediate area and regionally.

30. The ways in which the construction of the roads and logging operations do not comply with the code of logging practices, management plan, and Standard Soil Erosion Mitigation Conditions 1990, and whether and in what respects, even if those documents were complied with, there would continue to be a real likelihood, or more, of continued harm to the environment or pollution of the waters.

Mark Anderson

10th April 1992

MEMORANDUM.

TO: BRUCE WOOLF, TIM ROBERTSON, JOHN CORKILL, DAILAN PUGH, TREVOR PIKE, PHILIP PELLS, JOHN McGARITY, KEITH BISHOP.

FROM: MARK ANDERSON

DATE: 9 APRIL 1992

RE: OAKES STATE FOREST

I have been asked to put together a summary of the evidence required for the interlocutory application to the Court for the benefit of the experts who will be attending the Forest. This is done with a view to the types of things they should notice, measure and comment upon in any affidavits and reports they make following their inspection of the Forest.

The Application to the Court will be based upon the evidence that there is a real or significant likelihood that the requirements for making an order under the Environmental Offences and Penalties Act 1989, section 25 will be satisfied. Those requirements are

A) that there is a breach, or a threatened or apprehended breach of the Clean Waters Act 1970, the Timber Industry (Interim Protection) Act 1992 ("TIIP Act") and

B) the breaches, or threatened or apprehended breaches, is, or are, likely to cause harm to the environment.

"Harm" means any direct or indirect alteration of the environment that has the effect of degrading the environment including a breach of the Clean Waters Act 1970, that is any act or omission which results in the pollution of any waters.

"Environment" means any aspect of the surroundings including the land, waters, and

ACTIVITY REPORT

RECEPTION OK

TN #	6649
CONNECTION TEL	
CONNECTION ID	G3
START TIME	02/28 17:20
USAGE TIME	08'23
PAGES	13

atmosphere, animals, plants, and other forms of life, and includes the aesthetic appearance, sounds, smells, tastes, and textures.

The definition of pollute is very wide and covers the placing by a person, or corporation through its servants or agents, in or on any land a pollutant so that it canend up in the water as a direct result of its being where it is, whether or not it was intended to go into the waters.

The definition of pollute is satisfied if

A) the polluting matter can be introduced into or on the waters (whether through an act or omission or just by being where it is) so that the physical , chemical, or biological condition of the waters is changed; or

B) if any refuse, litter, debris, or matter present makes or is likely to make (including by chemical reaction with things already in the waters) the waters unclean, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters.

C) The types of "matter" which are prescribed for the purposes of the CWA's third definition of pollute by discharging that matter, or by discharging it without complying with the prescribed standards are (relevantly):

plant matter of any description including vegetable or fruit wastes, leaves, grass, trees, wood, sawdust, shavings, chips, bark or other forest products or refuse;

inorganic matter of any description including ashes, ballast, soil, earth, mud, stones,sand, clay residue or washings from any mineral processing or extractive operation or soil, spoil or washings from any dredging operation;

animal matter of any description including carcases of animals, parts or remains of animals, offal, flesh or bones;

chemicals or poisonous substances of any description.

Office of the Director of Public Prosecutions

New South Wales

Street Address: 265 Castlereagh Street
Sydney South NSW 2000

Postal Address: Locked Bag 8
Sydney South NSW 2000

DX Number: 11525 Sydney Downtown

Fax Number: (02) 267-2227

Facsimile Transmission Cover Sheet

To: JOHN REIMER
FAX NO. 221 6944

From: KAREN STAFFORD
Office of the Director of Public Prosecutions
Telephone: (02) 285 - 8689

Concerning: R v PIETRZAK & DANIELSON
Statement of Pietrzak 15.10.89, ROI with Pietrzak, ROI with Danielson & PIB for Nicholls all to follow.

Total number of pages including this cover sheet: 48

WARNING

Facsimile thermal paper can be highly unstable. If the accompanying documents contain authorisation or other important information, they should be copied on to a good quality paper before filing or otherwise storing.

"Waters" is defined in the CWA to be any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or part thereof, and includes water stored in artificial works, water in water mains, waterpipes and water channels, and any underground or artesian water, or any part thereof.

The TIIP Act, section 10, makes it mandatory for the person who carries out logging operations on Schedule 4 land to comply with the relevant Management Plan applying to that land and the Code of Logging Practices applying to the land. The Commission must comply with the Code of Logging Practices and the Management Plan which prescribe the Soil Erosion Mitigation Conditions.

The evidence required then is :

1. The correct lithological description by soil types and erosivity of the soil and geological features having regard to the slopes and the observance or not of the Soil Erosion Mitigation Conditions applicable, by the logging operations which include the construction of the road.
2. The likely discharge rates for streams that drain the logging operations area, having regard to rainfall records and types of vegetation which are established and their requirements or prefferred rainfall habitats.
3. Comments upon the co-efficient of runoff for the area in both the short term and the long term.
4. The known effects of roading, logging and post-logging burning on the mobilisation of sediments in forested catchments.
5. Methods by which disturbed sediments move into water courses over both the short and long term.

****
*** ACTIVITY MANAGEMENT REPORT TX ***
****

ACTY#	MODE	CONNECTION TEL	CONNECTION ID	START TIME	USAGE T.	PAGES	RESULT

****
*** ACTIVITY MANAGEMENT REPORT RX ***
****

ACTY#	MODE		CONNECTION TEL	CONNECTION ID	START TIME	USAGE T.	PAGES	RESULT
3737	AUTO RX	G3	089817183		28/02 12:46	00'41	1	OK
3738	AUTO RX	G3	0011 61 2 2298479		28/02 13:24	03'53	8	OK
3739	AUTO RX	G3	61 02 7962886	LEDLIN PARTNERS	28/02 13:32	00'28	1	OK
3740	AUTO RX	G3			28/02 14:01	02'19	1	NG
								1 ##201
3741	AUTO RX	G3	025887795	JOHNSTON VAUGHAN	28/02 14:16	01'19	4	OK
3742	AUTO RX	G3			28/02 14:21	04'08	5	OK
3743	AUTO RX	ECM	02 7244178		28/02 14:26	01'28	2	OK
3744	AUTO RX	G3	612 264 8005		28/02 14:29	03'37	8	OK
3745	AUTO RX	G3	046 551245		28/02 14:49	01'14	3	OK
3746	AUTO RX	G3	060 215364	DG SKINNER	28/02 15:00	02'31	5	OK
3747	AUTO RX	G3	02 9298038		28/02 15:04	00'52	2	OK
3748	AUTO RX	ECM	022195873		28/02 15:05	01'31	2	OK
3749	AUTO RX	G3	02 891 4323		28/02 15:16	02'54	7	OK
3750	AUTO RX	G3	61 3 6143250		28/02 15:22	01'45	4	OK
3751	AUTO RX	G3	5538445	SIMPSON HARRISO	28/02 15:24	02'52	4	OK
3753	AUTO RX	ECM			28/02 15:34	00'31	1	OK
3754	AUTO RX	G3	02 9762993		28/02 15:35	01'21	3	OK
3755	AUTO RX	ECM			28/02 15:37	00'48	2	OK
3756	AUTO RX	G3	4	W S W K	28/02 15:41	00'33	1	OK
3757	AUTO RX	G3	066 511205		28/02 15:45	07'21	7	OK
3758	AUTO RX	ECM	61 2 9593494	STEEVES LUMLEY	28/02 15:53	01'14	2	OK
3759	AUTO RX	G3			28/02 15:58	04'02	4	OK
3760	AUTO RX	G3			28/02 16:02	09'47	17	OK
3761	AUTO RX	G3			28/02 16:13	00'40	1	OK
3762	AUTO RX	G3	063 722736		28/02 16:15	01'40	3	OK
3763	AUTO RX	G3	044416953		28/02 16:18	11'12	18	OK
3764	AUTO RX	G3	2645596		28/02 16:29	02'11	5	OK
3765	AUTO RX	G3	61 02 602 7525		28/02 16:36	01'14	3	OK
3766	AUTO RX	G3	02 356 2723		28/02 16:40	00'50	2	OK
3767	AUTO RX	G3	61 2 7082334	THURLOW FISHER	28/02 16:46	00'43	2	OK
3768	AUTO RX	G3	61 2 2477118		28/02 16:49	01'24	3	OK
3770	AUTO RX	G3			28/02 16:59	07'13	12	OK
3771	MEMORY RX	G3	61 2 4361265		28/02 17:07	04'23	8	OK
3772	MEMORY RX	G3	066 56 1811		28/02 17:13	02'19	3	OK
3773	MEMORY RX	ECM	61 2 261 8886	MILES CLINTON	28/02 17:17	02'43	8	OK
3774	AUTO RX	G3	61 2 4361265		28/02 17:28	09'58	19	OK
3775	AUTO RX	G3	066 56 1811		28/02 18:14	00'54	1	OK
3776	AUTO RX	G3			01/03 20:25	00'37	1	OK
3777	AUTO RX	G3	02 5163779		01/03 21:59	00'32	1	OK
3778	AUTO RX	G3			02/03 09:23	10'35	12	OK

6. As a result of the inspection , an estimate of the sediment yield likely during the various phases of operations, during storm events and over the long term.

7. Adequacy of the SEMC and special conditions contained in the Management Plan in preventing the movement of sediments into water courses.

8. The predictability or otherwise of rainfall events, fires, etc..and the complexitiesof safe forest management to minimise soil erosion, in the sense of Olive and Rieger (1988) published in Warner's tome. Specifically, what assurances can the Commisiion make that significant erosion and siltation of water courses will not occur.

9. The impact of mobilised sediments on :

   i) water quality

   ii) acquatic habitats of fish and invertebrates

   iii) birds or other animals.

10. Likely changes to the water retention capabilities of the catchments and the resultant effects on catchment water yields into the surrounding creeks and rivers in periods of low rainfall or drought, in both the short and long term post logging operations.

11. Current knowledge or lack thereof of acquatic species ~~in the Oakes State Forest~~ in the Bellinger river downstream of the affected creeks.

12. The potential direct effects of suspended sediments likely to be mobilised from roads and logged or cleared areas, (particularly in storm events) on known species.

13. The indirect resultant effects of alteration of the acquatic habitats due to the effects of the operations on acquatic speciess.

14. The ability or otherwise to predict such effects given the state of current knowledge of the impact of logging and associated activities on soils and the

unpredictability of rainfall events. Are there seasonal factors of the biology of acquatic species (e.g. Spawning, migration, food availablity etc) which need to be considered.

15. The extent to which the Management Plan or SEMC adequately considers this part of the environment any likely impacts of the activities and any measures to mitigate those impacts.

16. Cumulative effects upon the increases in sediment levels within the affected catchment.

17. Susceptibility to erosion and magnitude of peak discharges.

18. Increased hillslope erosion rates, if any, as a result of the road construction and stream banks or watercourses due to decreased vegetation.

19. Comments upon the frequency at which sediment is delivered to the drainage system.

20. Impact of the operations locally and regionally through any cumulative effects.

21. Effect upon the pH level of the streams/creeks/river due to the presence of soils and other eroded matter and matter already present in the water.

22. The effect of runoff water upon the road constructed.

23. The amount of soil likely to be or in fact eroded having regard to the road construction and the terrain.

24. Where the runoff is likely to go, or if known where it has gone and the effect of that runoff upon the watercourses or other "waters".

25. The amount and the types of debris or other "matter" washed into the waters.

26. The effect upon the environment of the construction of the road having regard to the factors that are included in the definition of environment and harm.

27. The observed effects and the observed causes/opinions as to the causes of such degradation of the environment.

****
*** ACTIVITY REPORT ***
****

TN #	MODE	CONNECTION TEL	CONNECTION ID	START TIME	USAGE T.	PAGES	RESULT
*6607	AUTO RX G3		G3	02/26 16:40	02'33	5	OK
*6608	AUTO RX G3		G3	02/26 16:44	01'36	3	OK
*6609	AUTO TX G3	5809325	G3	02/26 17:06	00'43	1	OK
*6610	AUTO RX G3		G3	02/26 17:47	05'30	7	OK
*6611	AUTO RX G3	602 6601	G3	02/27 09:29	05'22	8	OK
*6612	AUTO TX G3	2311904	G3	02/27 10:57	00'34	1	OK
*6613	AUTO RX G3		G3	02/27 11:32	06'10	7	OK
*6614	AUTO RX G3	61 2 2234083	G3	02/27 11:38	06'30	12	OK
*6615	AUTO RX G3	066865749	G3	02/27 12:20	03'21	4	OK
*6616	AUTO RX G3	025692811	G3	02/27 12:59	01'33	2	OK
*6617	AUTO RX G3	02 391 9604	G3	02/27 13:01	02'52	4	OK
*6618	AUTO RX G3	61 2 271206	ACF SYDNEY	02/27 14:46	01'41	2	OK
*6619	AUTO RX G3	61 2 283 2059	G3	02/27 14:50	00'32	0	NG
						0	##293
*6620	AUTO RX G3	060 218225	G3	02/27 15:44	03'22	6	OK
*6621	AUTO RX G3	043 245193	G3	02/27 15:53	22'01	43	OK
*6622	AUTO RX G3	02 8585283	G3	02/27 16:18	01'13	2	OK
*6623	AUTO RX G3	02 2475945	G3	02/27 16:23	12'35	18	OK
*6624	AUTO RX G3	066512818	G3	02/27 16:55	16'33	17	OK
*6625	AUTO RX G3	02 3642782	G3	02/27 17:15	01'12	2	OK
*6626	AUTO RX G3	612 264 8005	G3	02/27 17:43	00'31	0	NG
						0	##293
*6627	AUTO RX G3	612 264 8005	G3	02/27 17:44	15'08	28	OK
*6628	AUTO RX G3	022371205	G3	02/28 08:12	02'55	5	OK
*6629	AUTO RX G3		G3	02/28 09:08	01'09	2	NG
						2	##292
*6630	AUTO TX G3	2471206	ACF SYDNEY	02/28 10:19	05'40	8	OK
*6631	AUTO RX G3		G3	02/28 12:35	01'00	1	OK
*6633	AUTO RX G3	61 2 2353099	G3	02/28 14:27	01'57	3	OK
*6634	AUTO RX G3	6123692356	G3	02/28 15:24	03'34	4	NG
						4	#005
*6635	AUTO RX G3	6123692356	G3	02/28 15:28	01'39	1	NG
						1	#005
*6636	AUTO RX G3	6123692356	G3	02/28 15:31	04'09	6	OK
*6638	AUTO TX G3	2351244	G3	02/28 15:42	01'23	3	OK
*6640	AUTO RX G3	38763604519	G3	02/28 15:51	01'16	2	OK
*6641	AUTO RX G3	068 820726	G3	02/28 16:14	03'30	6	OK
*6642	AUTO RX G3	61 2 626 3627	LOW & ASSOCIATES	02/28 16:21	04'55	7	OK
*6643	AUTO RX G3	61 02 602 7525	G3	02/28 16:32	00'29	1	NG
						1	##106
*6644	AUTO RX G3		G3	02/28 16:36	07'12	11	OK
*6646	AUTO RX G3	38763604519	G3	02/28 17:05	01'14	2	OK
*6647	AUTO RX G3	066512818	G3	02/28 17:07	00'53	1	NG
						1	##106
*6648	AUTO RX G3	066512818	G3	02/28 17:09	10'10	9	OK
*6649	AUTO RX G3		G3	02/28 17:20	08'23	13	OK
*6651	AUTO RX G3		G3	02/28 17:41	09'16	15	OK

28. Whether it is likely that the harm will continue, and if so for how long and what steps should be taken to remedy the harm.

29. The likely effect of the pollution of the watercourses by soil and other matter upon animal, bird, aquatic or fish life in the immediate area and regionally.

30. The ways in which the construction of the roads and logging operations do not comply with the code of logging practices, management plan, and Standard Soil Erosion Mitigation Conditions 1990, and whether and in what respects, even if those documents were complied with, there would continue to be a real likelihood, or more, of continued harm to the environment or pollution of the waters.

Mark Anderson

9th April 1992

****
*** ACTIVITY REPORT ***
****

TN #	MODE	CONNECTION TEL	CONNECTION ID	START TIME	USAGE T.	PAGES	RESULT
*6607	AUTO RX G3		G3	02/26 16:40	02'33	5	OK
*6608	AUTO RX G3		G3	02/26 16:44	01'36	3	OK
*6609	AUTO TX G3	5809325	G3	02/26 17:06	00'43	1	OK
*6610	AUTO RX G3		G3	02/26 17:47	05'30	7	OK
*6611	AUTO RX G3	602 6601	G3	02/27 09:29	05'22	8	OK
*6612	AUTO TX G3	2311904	G3	02/27 10:57	00'34	1	OK
*6613	AUTO RX G3		G3	02/27 11:32	06'10	7	OK
*6614	AUTO RX G3	61 2 2234083	G3	02/27 11:38	06'30	12	OK
*6615	AUTO RX G3	066865749	G3	02/27 12:20	03'21	4	OK
*6616	AUTO RX G3	025692811	G3	02/27 12:59	01'33	2	OK
*6617	AUTO RX G3	02 391 9604	G3	02/27 13:01	02'52	4	OK
*6618	AUTO RX G3	61 2 271206	ACF SYDNEY	02/27 14:46	01'41	2	OK
*6619	AUTO RX G3	61 2 283 2059	G3	02/27 14:50	00'32	0	NG
							0 ##293
*6620	AUTO RX G3	060 218225	G3	02/27 15:44	03'22	6	OK
*6621	AUTO RX G3	043 245193	G3	02/27 15:53	22'01	43	OK
*6622	AUTO RX G3	02 8585283	G3	02/27 16:18	01'13	2	OK
*6623	AUTO RX G3	02 2475945	G3	02/27 16:23	12'35	18	OK
*[illegible]	AUTO RX G3	066512818	G3	02/27 16:55	16'33	17	OK
*6625	AUTO RX G3	02 3642782	G3	02/27 17:15	01'12	2	OK
*6626	AUTO RX G3	612 264 8005	G3	02/27 17:43	00'31	0	NG
							0 ##293
*6627	AUTO RX G3	612 264 8005	G3	02/27 17:44	15'08	28	OK
*6628	AUTO RX G3	022371205	G3	02/28 08:12	02'55	5	OK
*6629	AUTO RX G3		G3	02/28 09:08	01'09	2	NG
							2 ##292
*6630	AUTO TX G3	2471206	ACF SYDNEY	02/28 10:19	05'40	8	OK
6631	AUTO RX G3		G3	02/28 12:35	01'00	1	OK
6633	AUTO RX G3	61 2 2353099	G3	02/28 14:27	01'57	3	OK
6634	AUTO RX G3	6123692356	G3	02/28 15:24	03'34	4	NG
							4 #005
6635	AUTO RX G3	6123692356	G3	02/28 15:28	01'39	1	NG
							1 #005
6636	AUTO RX G3	6123692356	G3	02/28 15:31	04'09	6	OK
6638	AUTO TX G3	2351244	G3	02/28 15:42	01'23	3	OK
6640	AUTO RX G3	38763604519	G3	02/28 15:51	01'16	2	OK
6641	AUTO RX G3	068 820726	G3	02/28 16:14	03'30	6	OK
6642	AUTO RX G3	61 2 626 3627	LOW & ASSOCIATES	02/28 16:21	04'55	7	OK
6643	AUTO RX G3	61 02 602 7525	G3	02/28 16:32	00'29	1	NG
							1 ##106
[illegible]4	AUTO RX G3		G3	02/28 16:36	07'12	11	OK
6646	AUTO RX G3	38763604519	G3	02/28 17:05	01'14	2	OK
6647	AUTO RX G3	066512818	G3	02/28 17:07	00'53	1	NG
							1 ##106
6648	AUTO RX G3	066512818	G3	02/28 17:09	10'10	9	OK
6649	AUTO RX G3		G3	02/28 17:20	08'23	13	OK
6651	AUTO RX G3		G3	02/28 17:41	09'16	15	OK

CONSULTANTS

Brief: originals!

1. SUMMARY

This code will apply to all harvesting operations controlled by the Port Macquarie Forestry Region.

Set out hereunder are codes of logging practice to ensure:-

- good standards of workmanship;
- safe working practices;
- protection of the forest and its environment;
- adequate accountability for products obtained.

All contractors and/or operators in State Forests and other Crown-timber lands are required to comply with the provisions of this code.

2.1 Operations on State
governed by various
provisions are descr

2.2 FORESTRY ACT 1916 AND
(administered by the

2.2.1 The Commissio
of timber and
other matters
areas under i

2.2.2 Arising from
with the Catc
prescribed St
for Logging a
all operations
Nothing expres
Standard Condi
is dated June,

2.2.3 All commercial
royalty value
Commission wil

Grade of Snig Track, extraction Extraction or Minor Road		Maximum Spacing of Banks along Track or Road	
Degrees	Percentage	Average Erosion Hazard	High Erosion Hazard
0 - 15	0 - 27	60 metres	50 metres
15 - 20	27 - 37	40 metres	30 metres
20 - 25	37 - 47	20 metres	15 metres
25 - 30	47 - 57	15 metres	no snig tracks to be constructed
Minimum Effective Height (unconsolidated) of all standard type cross-banks is 50 cms. Effective height of roll-over type cross banks is to ~~30~~ cms while the distance between the top of the bank and middle of invert is to be not less than 2 metres.			
Where there is a high erosion hazard, the grades of snig tracks, extraction tracks and minor roads shall be limited and shall be specified according to the erosion hazard, and in any event shall not exceed 25 degrees. Where the erosion hazard is less, the grade shall exceed 25 degrees only where specified.			

(iii) As far as is practicable, slash shall be retained on extraction tracks, timber extraction by walk-over techniques shall be used, and the construction of snig tracks shall be minimised. In any event the use of a blade shall only be permitted for removal of soil from a snig or timber extraction track during initial track construction and during track drainage. "Blading-off" shall be permitted only where track damage is minimal and subsequent drainage and repair is possible. Each "blading-off" operation must be specifically approved.

(iv) Where there is high erosion hazard, snigging and extraction of timber from areas with slopes over 30 degrees shall not be permitted if track construction is required. Where there is a low or moderate soil erosion hazard, snigging and extraction of timber from areas with slopes over 35 degrees shall not be permitted if track construction is required. Where specifically approved by the supervising officer, tracks may be constructed on slopes in excess of these limits where it is necessary to traverse these slopes for short distances to enable timber to be extracted from areas of lesser slope.

(v) Snig or timber extraction tracks shall not cross the beds of streams without application of the same conditions which apply to minor roads.

CONSULTANTS BRIEF TO ADVISE

draft 4 - 27 May 1992

MATTERS WHICH OUGHT TO BE TAKEN INTO ACCOUNT BY THE E.P.A. WHEN CONSIDERING APPLICATIONS FOR LICENCES FOR LOGGING OPERATIONS TO POLLUTE WATERS WITHIN FORESTED CATCHMENTS.

1. Please provide a written report, from within your field of expertise, advising what matters are relevant in making reasonable or reliable assessments of :

(a) the nature and the extent of pollution being or likely to be caused by logging operations (see definition below);

(b) the impact of the pollution on the environment;

(c) the practical measures which may be taken to prevent, control, abate or mitigate that pollution;

(d) the practical measures which may be taken to protect the environment from defacement, defilement or deterioration as a result of that pollution.

Further, please advise whether, in your opinion, consideration of the above matters

(e) could be adequately made from existing published material only, or would necessarily require the carrying out of site specific surveys.

If it is your opinion that site specific surveys would be required, please also advise:

(f) what field work should be undertaken within your field of expertise.

In addition, please advise:

(g) whether, in your opinion, the conditions of the licence issued to the Forestry Commission for the Coffs Harbour Forestry Region are likely to be effective in preventing, controlling, abating or mitigating that pollution or protecting the environment from defacement, defilement or deterioration as a result of that pollution in the Sunday and Scraggy Creeks catchments in the Oakes State Forest.

Finally, please advise:

(h) an appropriate standard of water quality for the Bellinger River with particular reference to its tributaries, incorporating in such a standard the following factors:
visual; biochemical and biological oxygen demand; pH levels <6.5 or >8.5; faecal coliforms counts; settleable matter; suspended solid concentrations; and any effect on aquatic life or water associated wildlife.

2. Confer with barristers Mr Tim Robertson and Mr Mark Anderson, senior and junior counsel respectively, on the drafting of this report

3. Confer with other consultants or professional colleagues as appropriate and where necessary.

4. Swear or affirm an affidavit for use in proceedings in the Land and Environment Court, to be settled by counsel, which incorporates your advice on the above matters and details of your current CV.

5. Be available to appear to give evidence, if necessary, in proceedings before the Land and Environment Court on dates which will be later advised at such times as may be convenient to you.

NB. **"logging operations"** means:

(a) the cutting and removal of timber from land;
(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and
(c) hazard reduction burning carried out on Crown-timber lands within the meaning of the Forestry Act 1916. [source: Pollution Control Licence, 7 May 1992]

jrc 27/5/'92

CLEAN WATERS REGULATIONS, 1972

Reprint of Regulations published in Government Gazette No. 117 of 3rd November, 1972. Headings to clauses in Pts I-V repealed by Gazette No. 64 of 1.5.81. Other amendments to the regulations extracted are noted below the particular regulation.

PART I

2. (1) In these Regulations, except in so far as the context or subject-matter otherwise indicates or requires—

"biochemical oxygen demand" means the quantity of oxygen utilised in the biochemical oxidation of organic matter in a sample of waters or of wastes, determined in accordance with the method specified in the Standard Methods;

"chemical oxygen demand" means the quantity of oxygen utilised to oxidise matter determined in accordance with the method specified in the Standard Methods;

"common drain" means any drain, other than a sewer, which is vested in, or is in the care, control or management of, or is on land occupied by, a person and which is or is likely to be used for the conveyance of any pollutant into waters from any other drain which is vested in, or is in the care, control or mangement of, or is on land occupied by, some other person;

"dangerous goods" has the meaning ascribed thereto in section19 (5) of the Inflammable Liquid Act, 1915;

"overflow drain" means any drain which is used or is likely to be used to divert any pollutant into any waters from another drain when that other drain is surcharged as a result of damage, excessive rainfall or any emergency;

"restricted substance" means any substance specified in column 1 of Schedule 2;

"Standard Methods" means "Standard Methods for the Examination of Water and Wastewater" (14th edition, 1975) as published jointly by the American Public Health Association, the American Water Works Association and the Water Pollution Control Federation;

"the Act" means the Clean Waters Act, 1970;

"thermal wastes" means any liquid which, after being used in or in connection with any manufacturing, trade or domestic process, is discharged into waters and which, immediately before it is so discharged, has a temperature of 2 degrees Celsius or more greater than the temperature, taken immediately before or immediately after the temperature of the liquid being discharged is taken, of any similar liquid immediately before it is used in or in connection with that manufacturing, trade or domestic process.

[*Definition of* "Standard Methods" *substituted, Gazette No.* 166 *of* 24.11.78.]

(2) the following matter is prescribed as matter for the purposes of paragraph (c) of the definition of "pollute" in section 5 of the Act:—

(a) without limiting the generality of paragraph (b), wastes—

(i) causing biochemical oxygen demand;

(ii) causing chemical oxygen demand;

(iii) containing non-filtrable residues;

(iv) containing gases (other than oxygen) or filtrable residues;

(v) containing any nitrogen compound;

(vi) containing any phosphorus compound;

(vii) containing methylene blue active substances;

(viii) containing any restricted substance;

(ix) containing any radioactive substance;

(x) containing faecal coliforms;

(xi) containing any pesticide or herbicide;

(xii) having a pH value of less than 6.5 or more than 8.5;

(xiii) containing oil, grease or floating solids;

(b) any matter of the following nature:—

(i) animal matter of any description including carcases of animals, parts or remains of animals, offal, flesh or bones;

(ii) plant matter of any description including vegetable or fruit wastes, leaves, grass, trees, wood, sawdust, shavings, chips, bark or other forest products or refuse;

(iii) inorganic matter of any description including ashes, ballast, soil, earth, mud, stones, sand, clay residue or washings from any mineral processing or extractive operation or soil, spoil or washings from any dredging operation;

(iv) night soil, excreta, manure, septic tank wastes or urine;

(v) any matter likely to be infectious;

(vi) scrap metal, glass, junk, paper, plastics, rubbish, motor or other vehicles, any industrial (liquid or solid) waste, and refuse of any other description;

(vii) oil or inflammable liquids of any description;

(vii) chemicals or poisonous substances of any description; and

(c) thermal wastes.

(3) Where in these Regulations a reference is made to any act, matter or thing as being an "approved" act, matter or thing, that reference is to any such act, matter or thing, as the case may be, as the Commission may from time to time approve.

[*Reg.* 2 (3) *amended, Gazette No.* 77 *of* 15.6.73.]

Definitions

"Commission": s. 5.
"wastes": s. 5.
"waters": s. 5.

3. (1) Where for the purposes of these regulations any test for determining the nature or concentration in waters or in wastes of any matter is carried out, that test shall be carried out in accordance with the appropriate method specified in Schedule 1.

(2) Notwithstanding clause (1), the person carrying out any test pursuant to that clause, may, where the result of the test would not be affected, vary the procedural details specified in the method utilised.

4. * * * * * *

[Reg 4 omit Gaz 174 21/12/90 11223.]

PART III

CLASSIFICATION OF WATERS

8. For the purposes of section 11(1) of the Act, waters shall be classified as follows:—

CLASS S: *Specially Protected Waters*—waters into which—

(a) no wastes are to be discharged; and

(b) only Class P waters flow.

CLASS P: *Protected Waters*—waters into which—

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of a sewer;

(c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged;

(d) organic wastes are not to be discharged unless they are so treated that the resulting effluent has—

(i) where the relative proportion of water to the wastes is 19:1 or more—a biochemical oxygen demand of not more than twenty milligrams per litre and a non-filtrable residue of not more than thirty milligrams per litre; or

(ii) where the relative proportion of water to the wastes is less than 19:1 and the oxygen content of the wastes is, or is likely to be, reduced as a result of the discharge—such a lower biochemical oxygen demand and non-filtrable residue as may be approved;

(e) wastes are not to be discharged unless the concentration of plant nutrients in the wastes is controlled so as to prevent excessive plant growth in, abnormal variation in dissolved oxygen or pH levels in, or degradation of the appearance of, the waters;

(f) infectious wastes or wastes in which faecal coliforms are likely to be present are not to be discharged unless—

(i) the wastes are treated in an approved manner; and

(ii) in the case of waters likely to be used for bathing—the faecal coliform density as determined in an approved manner after sampling at an approved location does not exceed 200 per 100 millilitres;

(g) wastes are not to be discharged unless they are visually free of grease, oil, solids and unnatural discolouration and free of settleable matter;

(h) wastes are not to be discharged if the resulting concentration of the wastes in the waters—

(i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;

(ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals; or

(iii) in the case of fresh water, is likely to affect the use of the waters for human consumption, domestic or industrial purposes, watering of stock or the irrigation of land;

(i) wastes are not to be discharged if the concentration of any restricted substance in the wastes exceeds the concentration specified opposite that substance in Schedule 2;

(j) wastes are not to be discharged into the waters if the pH value of the wastes is less than 6.5 or more than 8.5 or if the discharge induces a variation in the pH value of the waters of more than 0.2;

(k) wastes are not to be discharged if the radioactivity level of the wastes exceeds the levels specified in Schedule 3;

(l) thermal wastes are not to be discharged into the waters.

CLASS C: *Controlled Waters*—waters into which—

(a) wastes are not to be discharged except as provided in respect of this classification;

(b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of a sewer;

(c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged into the waters except in accordance with approved conditions;

State Pollution Control Commission
Northern Rivers Study No. 2

Water Quality in the Bellinger and Kalang Rivers

May 1987

Summary

The State Pollution Control Commission has conducted extensive water quality surveys of several rivers in the North Coast Region of New South Wales. The program was developed in response to increasing concern from the public and government organisations that point and diffuse sources of pollution were having detrimental impacts on aquatic environments and fisheries resources.

The program involved investigations of all major rivers in the North Coast Region including the Tweed, Richmond, Clarence, Bellinger, Kalang, Macleay, Brunswick, Hastings and Manning. The investigations commenced in November 1983 and data were collected until April 1986. Not all rivers were sampled over this whole period as the program was flexible; when sufficient information was collected on a specific river, some surveys were discontinued and new ones started. The timing and number of surveys conducted were designed to reflect a wide range of river flow conditions.

The study was partially funded from the Commission's resources and by the Commonwealth Government's Wage Pause (WPP) and Community Employment (CEP) Programs. This is the second in a series of reports summarising the investigations carried out under the Northern Rivers Water Quality Study.

The study was designed to collect a series of databases that would enable a review to be carried out of current land use and effluent disposal strategies in the Bellinger and Kalang Rivers. Data were collected in the following categories: background catchment details, land use activities, licensed discharges, rainfall, river flow and water quality characteristics.

Water quality in the Bellinger Valley was measured and found to be of an acceptable standard in terms of oxygenation, clarity and nutrient status. High nutrient levels were observed under low flow conditions at some locations during some surveys but the flushing and assimilative capacity of the river was sufficient to ensure water quality did not deteriorate.

Current licence conditions for the Bellingen sewage treatment works (STW) and Norco Dairy were adequate to protect river water quality. However, disposal of effluent from the Urunga STW into Urunga Lagoon – a body of water that develops poor water quality during dry-weather periods – was unsatisfactory. Future strategies should direct Urunga effluent to the river mouth for disposal on an ebb tide.

Gravel extraction proposed for the Bellinger River should be controlled to ensure deep holes are not created, particularly near the Norco Dairy, Raleigh.

Finally, investigations of the antimony mill found no contamination of Urunga Lagoon by trace metals.

6 CONCLUSIONS AND RECOMMENDATIONS

The water quality of the Bellinger and Kalang Rivers, and Urunga Lagoon were assessed under a wide range of flow conditions. During low flow conditions, nutrients are mainly from point sources of urban origin. During medium and high flows, nutrients are principally of diffuse agricultural origin. These agricultural inputs are a major factor affecting water quality in the lower catchment. Storms near towns such as Bellingen and Urunga cause pollution to flow into rivers with urban run-off. Point source discharges, from both the dairy and the sewage treatment works, cause localised impact with some assimilation taking place downstream of discharge locations. These zones were not extensive enough to affect the overall water quality within the system.

To summarise the status of major water quality components of the Bellinger and Kalang Rivers:

- oxygenation was good (>74 per cent saturation);
- clarity was good;
- assimilation zones were evident but not extreme;
- plant growths were minimal;
- nutrient concentrations were high in localised areas but generally below accepted threshold limits; and
- stratification, due to natural salinity gradients, was confined to the tidal section.

The current discharge licence conditions were found to be adequate in the Bellinger River where sufficient assimilative and flushing capacity was available to maintain acceptable water quality standards. Disposal strategies for effluent from the Urunga STW require review as the current discharge location, Urunga Lagoon, was found to be a relatively poorly flushed water body with poor water quality. Land use activities and licensed discharges, although producing measurable changes in water quality, were not found to be having long-term detrimental impact on water quality of the Bellinger and Kalang Rivers, even during dry conditions.

No further water quality investigations of the Bellinger and Kalang Rivers are required in the short term (five years) provided land use activities and industrial discharges do not change significantly. Augmentation of the Bellingen STW beyond current plans may require reassessment, particularly if calculated river nutrient values were to exceed previously discussed threshold concentrations. Further augmentation beyond existing proposals may require nutrient removal facilities to be installed. It is recommended that the Urunga STW discharge be to the river mouth as a staged ebb tide discharge to reduce possible impacts on Urunga Lagoon.

An alternative being investigated by the local council is disposal to wetlands. However these areas were recently designated under legislation to protect wetlands and they appear to be unsuitable for use for effluent disposal unless scientific investigation proves no long-term ill effects. The option of wetland disposal is therefore not recommended.

Gravel extraction proposed for the Bellinger River between Raleigh and Repton should be restricted so deep holes are not created in the river bed particularly adjacent to Norco Dairy. Extractive industries in assessing likely river bed depths should disregard a natural 10 m deep hole downstream of Repton rail bridge.

Bill / Contract Laboratory 9/1983

Standard Methods

For the Examination of Water and Wastewater

FOURTEENTH EDITION

(1975)

*ABN

DLC

TABLE 506:II. REPLICATE CCE-m ANALYSES FROM DIFFERENTLY EXPOSED ACTIVATED CARBON SAMPLES

Type of Carbon Sample	Analyst No.	No. of Replicates	Mean Weight of Extract /70.0 g Adsorbant *mg*	Standard Deviation *mg*	Coefficient Variation, Mean %
Unexposed activated carbon (from shipping container)	1	5	2.2*	0.1	4.5
	1	5	3.6*	1.0	28
Activated carbon exposed in large container, dried, mixed, and divided in 70.0-g portions.	1	6	87.0†	1.7	2.0
	1	6	86.6†	2.8	3.2
	2	6	66.3†	5.2	7.8
	2	4	63.8†	2.0	3.1
Activated carbon exposed to same water in separate minisamplers (collected by Analyst No. 3)	1	4	0.330‡	0.010	3.0
	2	6	0.503‡	0.013	2.6

* Extract weighed daily until Δ weight/day ≤0.1 mg.
† Extract weighed daily until Δ weight/day ≤ 1% previous day's weight.
‡ Extracts weighed daily until dry to constant concentration. See Procedure (drying of extract).

rected into the vial with a tube or in an unheated mechanical convection oven in which no other samples are being processed. After about 24 hr of drying, tilt the vial, using small forceps, to determine if the contents will still "flow." If "flow" is evident, continue drying and re-examine at 24-hr intervals.

If "flow" is not evident, weigh vial and calculate the CCE-m concentration. Place vial in a desiccator with $CaSO_4$ dessicant for 24 hr, reweigh, and recalculate the concentration. If it is unchanged report the calculated concentration. If the concentration has decreased, continue desiccator drying and daily reweighing until the concentration is the same on two successive days. If it is necessary to delay the start of extract drying cover the vial with aluminum foil and store at room temperature for 2 or 3 days.

If the extract is to be reprocessed for identification of components, test also an extract from blank activated carbon to insure that any compound identified did not originate from the activated carbon, the solvent, or the thimble.

5. Calculation

$$\text{mg/l CCE-m} = \frac{[(A-B)\times 1000]-C}{D}$$

where A=weight of vial plus extract, B=tare weight of vial, C=weight of CCE-m average blank, ## mg, and D=volume of water sampled. Express result to nearest 0.1 mg/l.

##CCE-m blanks are dried by the standard procedure of air followed by desiccator drying until their weight changes at successive 24-hr intervals are ≤0.1 mg.

6. Precision and Accuracy

Insufficient data are available to calculate precision, but some information on reproducibility is available. See Table 506:II. The concentrations in these data were calculated to three decimals and analyzed statistically.

Although percentage-recovery determinations with known compounds have not been made, the increase in extract yield[7] over that obtained by previous methods[5] indicates improved accuracy.

7. References

1. HEUPER, W.C. & W.W. PAYNE. 1963. Carcinogenic effects of raw and finished water supplies. *Amer. J. Clin. Pathol.* 39:475.
2. MCCABE, L.J. 1964. Life table analysis of Heuper's data. Interoffice memo, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio (unpublished).
3. Standard Methods for the Examination of Water and Wastewater, 13th ed. 1971. American Public Health Ass., New York, N.Y.
4. BOOTH, R.L., J.N. ENGLISH & G.N. MCDERMOTT. 1965. Evaluation of sampling conditions in the carbon adsorption methods. *J. Amer. Water Works Ass.* 57:215.
5. REID, B.H., H. STIERLI, C. HENKE & A.W. BREIDENBACH. 1965. Field Evaluation of Low-Flow-Rate Carbon Adsorption Equipment and Methods for Organics Sampling of Surface Waters. PHS Water Pollution Surveillance System Applications and Development Rep. No. 14, Div. Water Supply and Pollution Control, U.S. Dep. HEW, Cincinnati, Ohio (mimeo).
6. Installation, Operation, and Maintenance of Models No. LF-1 and LF-2, Organics Samplers for Water. 1967. Div. Pollution Surveillance, FWPCA, U.S. Dep. Interior, Cincinnati, Ohio.
7. BUELOW, R.W., J.K. CARSWELL & J.M. SYMONS. 1973. An improved method for determining organics in water by activated carbon adsorption and solvent extraction. *J. Amer. Water Works Ass.* 65:57 and 65:195.
8. CARSWELL, J.K., R.W. BUELOW & J.M. SYMONS. 1973. The Determination of Organics—Carbon Adsorbable in Water. Water Supply Research Lab., National Environmental Research Center, USEPA, Cincinnati, Ohio (mimeo).

507 OXYGEN DEMAND (BIOCHEMICAL)*

1. Discussion

The biochemical oxygen demand (BOD) determination described herein is an empirical test in which standardized laboratory procedures are used to determine the relative oxygen requirements of wastewaters, effluents, and polluted waters. The test has its widest application in measuring waste loadings to treatment plants and in evaluating the efficiency (BOD removal) of such treatment systems. BOD values cannot be compared unless the results have been obtained under identical test conditions.

The test is of limited value in measuring the actual oxygen demand of surface waters. The extrapolation of test results to actual stream oxygen demands is highly questionable because the laboratory environment does not reproduce stream conditions such as temperature, sunlight, biological population, water movement, and oxygen concentration.

Samples for BOD analysis may undergo significant degradation during

*BOD, biochemical oxygen demand.

handling and storage. Some of the demand may be satisfied if the sample is held for several days before the test is initiated; this results in a low estimation of the true BOD. The extent of change appears to be a function of the amount of organic matter (food supply) and the number and types of organisms (biological population). To reduce the change in oxygen demand that occurs between sampling and testing, keep all samples at or below 4 C and begin incubation not more than 24 hr after the sample is collected.

The amount of oxygen demand in the sample will govern the need for and the degree of dilution.

Aerate samples with low DO values to increase the initial DO content above that required by the BOD. Let air bubble through a diffusion tube into the sample for 5 min, or until the DO is at least 7 mg/l. Determine DO on one portion of the aerated sample; seed another portion only if necessary, and incubate it for the BOD determination.

Complete stabilization of a given waste may require a period of incubation too long for practical purposes. For this reason, the 5-day period has been accepted as standard. However, for certain industrial wastes it may be advisable to determine the oxidation curve obtained. Conversion of data from one incubation period to another can be made only if such special studies are carried out. Studies in recent years have shown that the exponential rate of carbonaceous oxidation, k, at 20 C rarely has a value of 0.1, although it may vary from less than one-half to more than twice this value. This fact usually makes it impossible to calculate the ultimate carbonaceous demand, L, of a sample from 5-day BOD values unless the k value has been determined on the sample. The exponential interpretation of BOD rate curves is a gross oversimplification; a good exponential fit is not obtained always.

The test measures the oxygen demand produced by carbonaceous and nitrogenous compounds, and immediate oxidation. All of these have a bearing on the oxygen balance of the receiving water and must be considered in the discharge of a waste to such water. Differentiation of the immediate dissolved oxygen demand is described in ¶4*j* below. Appropriate technics for the suppression of nitrification in tests for carbonaceous demand only are given elsewhere.[1-5] If nitrification suppression is used, state this clearly when reporting results. Bear in mind that some suppressors may also inhibit carbonaceous oxidation.

2. Apparatus

a. Incubation bottles, 250- to 300-ml capacity, with ground-glass stoppers. Clean bottles with a good detergent, rinse thoroughly, and drain before use. As a precaution against drawing air into the dilution bottle during incubation, use a water seal. Satisfactory water seals are obtained by inverting the bottles in a water bath or adding water to the flared mouth of special BOD bottles.

b. Air incubator or water bath, thermostatically controlled at 20 C±1 C: Exclude all light to prevent formation of DO by algae in the sample.

3. Reagents

a. Distilled water: Use only high-quality water distilled from a block tin or all-glass still. Alternatively, use deionized water. The water must contain less than 0.01 mg/l copper, and be free of chlorine, chloramines, caustic alkalinity, organic material, or acids.

b. Phosphate buffer solution: Dissolve 8.5 g potassium dihydrogen phosphate, KH_2PO_4; 21.75 g dipotassium hydrogen phosphate, K_2HPO_4; 33.4 g disodium hydrogen phosphate heptahydrate, $Na_2HPO_4 \cdot 7H_2O$; and 1.7 g ammonium chloride, NH_4Cl, in about 500 ml distilled water and dilute to 1 l. The pH of this buffer should be 7.2 without further adjustment. Discard the reagent (or any of the following reagents) if there is any sign of biological growth in the stock bottle.

c. Magnesium sulfate solution: Dissolve 22.5 g $MgSO_4 \cdot 7H_2O$ in distilled water and dilute to 1 l.

d. Calcium chloride solution: Dissolve 27.5 g anhydrous $CaCl_2$ in distilled water and dilute to 1 l.

e. Ferric chloride solution: Dissolve 0.25 g $FeCl_3 \cdot 6H_2O$ in distilled water and dilute to 1 l.

f. Acid and alkali solutions, 1N: For neutralization of caustic or acidic waste samples.

g. Sodium sulfite solution, 0.025N: Dissolve 1.575 g anhydrous Na_2SO_3 in 1,000 ml distilled water. This solution is not stable; prepare daily.

h. Seeding: The purpose of seeding is to introduce into the sample a biological population capable of oxidizing the organic matter in the wastewater. Where such microorganisms are already present, as in domestic wastewater or unchlorinated effluents and surface waters, seeding is unnecessary and should not be used.

When the sample contains very few microorganisms—as a result, for example, of chlorination, high temperature, or extreme pH—seed the dilution water. The standard seed material is settled domestic wastewater that has been stored at 20 C for 24 to 36 hr. Use sufficient seed to produce a seed correction (¶4*g*) of at least 0.6 mg/l.

Some samples—for example, certain industrial wastes—may require seeding because of low microbial population, but they contain organic compounds that are not readily oxidized by domestic wastewater seed. For evaluating the effect of such a waste in a treatment system, it is better to use specialized seed material containing organisms adapted to the use of the organic compounds present. Obtain such adapted seed from the effluent of a biological treatment process receiving the waste in question, or from the receiving water below the point of discharge [preferably 3 to 8 km (2 to 5 miles) below] if the waste is not being treated. When these sources are not available, develop adapted seed in the laboratory by continuously aerating a large sample of water and feeding it with small daily increments of the particular waste, together with soil or domestic sewage, until a satisfactory microbial population has developed. The special circumstances that call for the use of adapted seed also may require a seed concentration higher than the standard 1 to 2 ml/l. Decide on the kind and amount of seed required for such special-purpose studies on the basis of prior experience with the particular waste and the purpose for which the determination is being made.

Adapted seed also has been used in attempts to estimate the effect of a waste on the receiving water. (See Section 507.1).

4. Procedure

a. Preparation of dilution water: Before use, store the distilled water in cotton-plugged bottles long enough for it to become saturated with DO; or, if such storage is not practical, saturate the water by shaking the partially filled bottle or by aerating with a supply of clean compressed air. Use distilled water at 20±1 C.

Place the desired volume of distilled water in a suitable bottle and add 1 ml each of phosphate buffer, $MgSO_4$, $CaCl_2$, and $FeCl_3$ solutions/l of water. If dilution water is to be stored in the incubator, add the phosphate buffer just before using the dilution water.

b. Seeding: See ¶ 3*b* et seq, preceding. If the dilution water is seeded, use it the same day it is prepared.

c. Pretreatment:

1) Samples containing caustic alkalinity or acidity—Neutralize to about pH 7.0 with 1*N* H_2SO_4 or NaOH, using a pH meter or bromthymol blue as an outside indicator. The pH of the seeded dilution water should not be changed by the preparation of the lowest dilution of sample.

2) Samples containing residual chlorine compounds—If the samples stand for 1 to 2 hr, the residual chlorine often will be dissipated. Prepare BOD dilutions with properly seeded standard dilution water. Destroy higher chlorine residuals in neutralized samples by adding Na_2SO_3. Determine the appropriate quantity of sodium sulfite solution on a 100- to 1,000-ml portion of the sample by adding 10 ml of 1+1 acetic acid or 1+50 H_2SO_4, followed by 10 ml KI solution (10 g/100 ml) and titrating with 0.025*N* Na_2SO_3 solution to the starch-iodide end point. Add to a volume of sample the quantity of Na_2SO_3 solution determined by the above test, mix, and after 10 to 20 min test a sample for residual chlorine to check the treatment. Prepare BOD dilutions with seeded standard dilution water.

3) Samples containing other toxic substances—Samples such as those from industrial wastes—for example, toxic metals derived from plating wastes—frequently require special study and treatment.

4) Samples supersaturated with DO—Samples containing more than 9 mg/l DO at 20 C may be encountered during winter months or in localities where algae are growing actively. To prevent loss of oxygen during incubation of these samples, reduce the DO to saturation by bringing the sample to about 20 C in a partly filled bottle and agitating it by vigorous shaking or by aerating with compressed air.

d. Dilution technic: Make several dilutions of the prepared sample to obtain the required depletions. The following dilutions are suggested: 0.1 to 1.0% for strong trade wastes, 1 to 5% for raw and settled sewage, 5 to 25% for oxidized effluents, and 25 to 100% for polluted river waters.

1) Carefully siphon standard dilution water, seeded if necessary, into a graduated cylinder of 1,000 to 2,000 ml capacity, filling the cylinder half full without entrainment of air. Add the quantity of carefully mixed sample to make the desired dilution and dilute to the appropriate level with dilution water. Mix well with a plunger-type mixing rod, avoiding entrainment of air. Siphon the mixed dilution into two BOD bottles, one for incubation and the other for determination of the initial DO in the mixture; stopper tightly and incubate for 5 days at 20 C. Water-seal the BOD bottles by inverting in a tray of water in the incubator or by using a special water-seal bottle. Prepare succeeding dilutions of lower concentration in the same manner or by adding dilution water to the unused portion of the preceding dilution.

2) The dilution technic may be greatly simplified when suitable amounts of sample are measured directly into bottles of known capacity with a large-tip volumetric pipet and the bottles are filled with sufficient dilution water to permit insertion of the stopper without leaving air bubbles. Make dilutions greater than 1:100 by diluting the waste in a volumetric flask before adding it to the incubation bottles for final dilution.

e. Determination of DO: If the sample represents 1% or more of the lowest BOD dilution, determine DO on the undiluted sample. This determination is usually omitted on sewage and settled effluents known to have a DO content of practically zero. *With samples having an immediate oxygen demand, use a calculated initial DO, inasmuch as such a demand represents a load on the receiving water.*

f. Incubation: Incubate the blank dilution water and the diluted samples for 5 days in the dark at 20 C. Then determine the DO in the incubated samples and the blank using the azide modification of the iodometric method or a membrane electrode. Unless the membrane electrode is used, use the alum flocculation method for incubated samples of muds and the copper sulfate-sulfamic acid method for activated sludges. In special cases, other modifications may be necessary. Those dilutions showing a residual DO of at least 1 mg/l and a depletion of at least 2 mg/l are most reliable.

g. Seed correction: If the dilution water is seeded, determine the oxygen depletion of the seed by setting up a separate series of seed dilutions and selecting those resulting in 40 to 70% oxygen depletions in 5 days. Use one of these depletions to calculate the correction due to the small amount of seed in the dilution water. Do not use the seeded blank for seed correction because the 5-day seeded dilution water blank is subject to erratic oxidation due to the very high dilution of seed, which is not characteristic of the seeded sample.

h. Dilution water control: Fill two BOD bottles with unseeded dilution water. Stopper and water-seal one of these for incubation. Determine the DO before incubation in the other bottle. Use the DO results on these two bottles as a rough check on the quality of the unseeded dilution water. Do not use the depletion obtained as a blank correction; it should not be more than 0.2 mg/l and preferably not more than 0.1 mg/l.

i. Glucose-glutamic acid check: The BOD test is a bioassay procedure; consequently, the results obtained are influenced greatly by the presence of toxic substances or the use of a poor seeding material. Distilled waters frequently are contaminated with toxic substances—most often copper—and some sewage seeds are relatively inactive. The results obtained with such waters are always low.

The quality of the dilution water, the effectiveness of the seed, and the technic of the analyst should be checked periodically by using pure organic compounds

having known or determinable BOD. If a particular organic compound is known to be present in a given waste, it may well serve as a control on the seed used. For general BOD work, a mixture of glucose and glutamic acid (150 mg/l of each) has certain advantages. Glucose has an exceptionally high and variable oxidation rate with relatively simple seeds. When it is used with glutamic acid, the oxidation rate is stabilized and is similar to that obtained with many municipal wastes (0.16 to 0.19 exponential rate). In exceptional cases, a given component of a particular waste may be the best choice to test the efficacy of a particular seed.

To check the dilution water, the seed material, and the technic of the analyst, prepare a standard solution containing 150 mg/l each of reagent-grade glucose and glutamic acid that have been dried at 103 C for 1 hr. Pipet 5.0 ml of this solution into calibrated incubation bottles, fill with seeded dilution water, and incubate with seed control at 20 C for 5 days. On the basis of a mixed primary standard containing 150 mg/l each of glucose and glutamic acid, the 5-day BOD varies in magnitude according to the type of seed, and precision varies with the quality of seed, as shown in Table 507:I.

Except with the oxidized river water and effluents, a low seed correction resulted in an appreciably higher value for the standard deviation. Check each seed source to determine the amount required to obtain optimum precision. If results differ appreciably from those given in Table 507:I after the seed source has been considered, the technic is questionable.

j. Immediate dissolved oxygen demand: Substances oxidizable by molecular oxygen, such as ferrous iron, sulfite, sulfide, and aldehyde, impose a load on the receiving water and must be taken into consideration. The total oxygen demand of such a substrate may be determined by using a calculated initial DO or by using the sum of the immediate dissolved oxygen demand (IDOD) and the 5-day BOD. Where a differentiation of the two components is desired, determine the IDOD. The IDOD does not necessarily represent the immediate oxidation by molecular DO but may represent an oxidation by the iodine liberated in the acidification step of the iodometric method.

TABLE 507:I. EFFECT OF SEED TYPE AND QUALITY ON BOD RESULTS

Type of Seed	5-day Seed Correction *mg/l*	Mean 5-day BOD *mg/l*	Standard Deviation *mg/l*
Settled fresh sewage	>0.6	218	±11
Settled stale sewage	>0.6	207	± 8
River water (4 sources)	0.05-0.22	224-242	±7-13
Activated sludge effluent	0.07-0.68	221	±13
Trickling filter effluent	0.2-0.4	225	± 8

The depletion of DO in a standard water dilution of the sample in 15 min has been arbitrarily selected as the IDOD. To determine the IDOD, separately measure the DO of the sample (which in most cases is zero) and the DO of the dilution water. Prepare an appropriate dilution of the sample and dilution water and determine the DO after 15 min. The calculated DO of the sample dilution minus the observed DO after 15 min is the IDOD, in milligrams per liter, of the sample dilution.

5. Calculation

a. Definitions:

D_0 = DO of original dilution water
D_1 = DO of diluted sample 15 min after preparation
D_2 = DO of diluted sample after incubation
S = DO of original undiluted sample
D_c = DO available in dilution at zero time $= D_0p + SP$
p = decimal fraction of dilution water used
P = decimal fraction of sample used
B_1 = DO of dilution of seed control before incubation
B_2 = DO of dilution of seed control after incubation
f = ratio of seed in sample to seed in control $= \frac{\text{\% seed in } D_1}{\text{\% seed in } B_1}$

Seed correction $= (B_1 - B_2)f$.

b. Biochemical oxygen demand:

When seeding is not required,

$$\text{mg/l BOD} = \frac{D_1 - D_2}{P}$$

When using seeded dilution water,

$$\text{mg/l BOD} = \frac{(D_1 - D_2) - (B_1 - B_2)f}{P}$$

Including IDOD if small or not determined,

$$\text{mg/l BOD} = \frac{D_c - D_2}{P}$$

c. Immediate dissolved oxygen demand:

$$\text{mg/l IDOD} = \frac{D_c - D_1}{P}$$

The DO determined on the unseeded dilution water after incubation is not used in the BOD calculations because this practice would overcorrect for the dilution water. In all the above calculations, corrections are not made for small losses of DO in the dilution water during incubation. If the dilution water is unsatisfactory, proper corrections are difficult and the results are questionable.

6. Precision and Accuracy

At present there is no standard against which the accuracy of the BOD test can be measured. To obtain interlaboratory precision data, a glucose-glutamic acid mixture (¶4*i* preceding) with a theoretical oxygen demand value of 194 mg/l was analyzed by 73 participants, with each laboratory using its own seed material. The arithmetic mean of all results was 175 mg/l and the standard deviation of that mean was ±26 mg/l (15%).

7. References

1. RUCHHOFT, C.C., O.R. PLACAK & M.B. ETTINGER. 1946. Correction of BOD velocity constants for nitrification. *Sewage Works J.* 20:832.
2. HURWITZ, E. et al. 1947. Nitrification and BOD. *Sewage Works J.* 19:995.
3. BUSWELL, A.M., I. VAN METER & J.R. GERKE. 1950. Study of the nitrification phase of the BOD test. *Sewage Ind. Wastes* 22:508.

4. Montgomery, H.A.C. & B.J. Borne. 1966. The inhibition of nitrification in the BOD test. *J. Proc. Inst. Sewage Purif.* Part 4.
5. Young, J.C. 1973. Chemical methods for nitrification control. *J. Water Pollut. Control Fed.* 45:637.

8. Bibliography

Theriault, E.J. 1927. The oxygen demand of polluted waters. Pub. Health Bull. No. 173.
Theriault, E.J. 1931. Detailed instructions for the performance of the dissolved oxygen and biochemical oxygen demand tests. *Pub. Health Rep.* Suppl. 90.
Theriault, E.J., P.D. McNamee & C.T. Butterfield. 1931. Selection of dilution water for use in oxygen demand tests. *Pub. Health Rep.* 48:1084.
Lea, W.L. & M.S. Nichols. 1937. Influence of phosphorus and nitrogen on biochemical oxygen demand. *Sewage Works J.* 9:34.
Ruchhoft, C.C. 1941. Report on the cooperative study of dilution waters made for the Standard Methods Committee of the Federation of Sewage Works Associations. *Sewage Works J.* 13:669.
Sawyer, C.N. & L. Bradney. 1946. Modernization of the BOD test for determining the efficiency of the sewage treatment process. *Sewage Works J.* 18:1113.
Ruchhoft, C.C. et al. 1948. Variations in BOD velocity constants of sewage dilutions. *Ind. Eng. Chem.* 40:1290.
Abbott, W.E. 1948. The bacteriostatic effects of methylene blue on the BOD test. *Water Sewage Works* 95:424.
Mohlman, F.W. et al. 1950. Experience with modified methods for BOD. *Sewage Ind. Wastes* 22:31.
Sawyer, C.N. et al. 1950. Primary standards for BOD work. *Sewage Ind. Wastes* 22:26.

508 OXYGEN DEMAND (CHEMICAL)

The chemical oxygen demand (COD) determination is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. It is an important, rapidly measured parameter for stream and industrial waste studies and control of waste treatment plants. However, in the absence of a catalyst the method fails to include some organic compounds (such as acetic acid) that are biologically available to the stream organisms, while including some biological compounds (such as cellulose) that are not a part of the immediate biochemical load on the oxygen assets of the receiving water. The carbonaceous portion of nitrogenous compounds can be determined, but there is no reduction of the dichromate by ammonia in a waste or by ammonia liberated from the proteinaceous matter. With certain wastes containing toxic substances, this test or a total organic carbon determination may be the only method for determining the organic load. Where wastes contain only readily available organic bacterial food and no toxic matter, the results can be used to approximate the ultimate carbonaceous BOD values.

The use of exactly the same technic each time is important because only a part of the organic matter is included, the proportion depending on the chemical oxidant used, the structure of the organic compounds, and the manipulative procedure.

The dichromate reflux method has been selected for the COD determination because it has advantages over other oxidants in oxidizability, applicability to a wide variety of samples, and ease of manipulation. The test will find its major usefulness for waste control purposes after many values have been obtained and correlated with some other important parameter or parameters.

1. General Discussion

a. Principle: Most types of organic matter are destroyed by a boiling mixture of chromic and sulfuric acids. A sample is refluxed with known amounts of potassium dichromate and sulfuric acid and the excess dichromate is titrated with ferrous ammonium sulfate. The amount of oxidizable organic matter, measured as oxygen equivalent, is proportional to the potassium dichromate consumed.

b. Interference and inadequacies: Straight-chain aliphatic compounds, aromatic hydrocarbons, and pyridine are not oxidized to any appreciable extent, although this method gives more nearly complete oxidation than the permanganate method. The straight-chain compounds are oxidized more effectively when silver sulfate is added as a catalyst; however, silver sulfate reacts with chloride, bromide, or iodide to produce precipitates that are oxidized only partially by the procedure. There is no advantage in using the catalyst in the oxidation of aromatic hydrocarbons, but it is essential to the oxidation of straight-chain alcohols and acids.

The oxidation and other difficulties caused by the presence of chloride may be overcome by using a complexing technic for the elimination of chloride. This is accomplished by adding mercuric sulfate to the samples before refluxing. This ties up the chloride ion as a soluble mercuric chloride complex and greatly reduces its ability to react further.

Nitrite exerts a COD of 1.1 mg/mg N. Since concentrations of nitrite in polluted waters rarely exceed 1 or 2 mg/l the interference is considered insignificant and usually is ignored. To eliminate a significant interference due to nitrite, add 10 mg sulfamic acid/mg nitrite N in the refluxing flask. Add the sulfamic acid to the standard dichromate solution, since it must be included in the distilled water blank.

c. Application: The method can be used to determine COD values of 50 mg/l or more with the concentrated dichromate. With the dilute dichromate, values below 10 mg/l are less accurate but indicate the order of magnitude.

d. Sampling and storage: Test unstable samples without delay. Homogenize samples containing settleable solids in a blender to permit representative sampling. If there is to be a delay before analysis, preserve the sample by acidification with sulfuric acid. Make initial dilutions in volumetric flasks for wastes containing a high COD in order to reduce the error inherent in measuring small volumes.

2. Apparatus

a. Reflux apparatus, consisting of 500-ml or 250-ml erlenmeyer flasks with ground-glass 24/40 neck* and 300-mm jacket Liebig, West, or equivalent condensers† with 24/40 ground-glass joint, and a hot plate having suf-

*Corning 5000 or equivalent.
†Corning 2360, 91548, or equivalent.

ficient power to produce at least 1.4 W/cm² (9 W/in.²) of heating surface, or equivalent, to insure adequate boiling of the contents of the refluxing flask.

3. Reagents

a. Standard potassium dichromate solution, 0.250N: Dissolve 12.259 g $K_2Cr_2O_7$, primary standard grade, previously dried at 103 C for 2 hr, in distilled water and dilute to 1,000 ml.

b. Sulfuric acid reagent: conc H_2SO_4 containing 22 g silver sulfate, Ag_2SO_4, per 4 kg (9-lb) bottle (1 to 2 days required for dissolution).

c. Standard ferrous ammonium sulfate titrant, 0.1N: Dissolve 39 g $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ in distilled water. Add 20 ml conc H_2SO_4, cool, and dilute to 1,000 ml. Standardize this solution daily against the standard $K_2Cr_2O_7$ solution.

Standardization—Dilute 10.0 ml standard $K_2Cr_2O_7$ solution to about 100 ml. Add 30 ml conc H_2SO_4 and cool. Titrate with the ferrous ammonium sulfate titrant, using 2 to 3 drops (0.10 to 0.15 ml) ferroin indicator.

$$\text{Normality} = \frac{\text{ml } K_2Cr_2O_7 \times 0.25}{\text{ml } Fe(NH_4)_2(SO_4)_2}$$

d. Ferroin indicator solution: Dissolve 1.485 g 1,10-phenanthroline monohydrate, together with 695 mg $FeSO_4 \cdot 7H_2O$ in water and dilute to 100 ml. This indicator solution may be purchased already prepared.‡

e. Mercuric sulfate, $HgSO_4$, crystals.

f. Sulfamic acid: Required only if the interference of nitrites is to be eliminated (see ¶ 1*b* above).

‡G.F. Smith Chemical Company, Columbus, Ohio.

4. Procedure

a. Treatment of samples with COD values over 50 mg/l:

Place 50.0 ml sample or a smaller sample portion diluted to 50.0 ml in the 500-ml refluxing flask. Add 1 g $HgSO_4$,§ several boiling chips, and 5.0 ml H_2SO_4. Add the H_2SO_4 very slowly, with mixing to dissolve the $HgSO_4$. Cool while mixing to avoid possible loss of volatile materials in the sample. Add 25.0 ml 0.250 *N* $K_2Cr_2O_7$ solution and again mix. Attach the flask to the condenser and start the cooling water. Add the remaining acid reagent (70 ml) through the open end of the condenser. Continue swirling and mixing while the acid is being added. Mix the reflux mixture thoroughly before heat is applied; if this is not done, local heating occurs in the bottom of the flask and the mixture may be blown out of the condenser.

Alternatively, use sample volumes from 10.0 ml to 50.0 ml and adjust volumes, weights, and normalities accordingly. Consult Table 508:I below for examples of applicable ratios. Maintain these ratios and follow the complete procedure as outlined above.

Use 1 g $HgSO_4$ with a 50.0-ml sample to complex 100 mg chloride (2,000 mg/l). For smaller volume samples use less $HgSO_4$, according to the chloride concentration; maintain a 10:1 ratio of $HgSO_4$:Cl. A slight precipitate does not affect the determination adversely. As a general rule, COD cannot be measured accurately in samples containing more than 2,000 mg/l chloride.

§$HgSO_4$ may be measured conveniently by volume, using a reagent spoon (e.g., Hach Company No. 638 or equivalent).

Table 508:I. Reagent Quantities and Normalities for Various Sample Sizes

Sample Size *ml*	0.25*N* Standard Dichromate *ml*	Conc H_2SO_4 with Ag_2SO_4 *ml*	$HgSO_4$ *g*	Normality of $Fe(NH_4)_2(SO_4)_2$	Final Volume Before Titration *ml*
10.0	5.0	15	0.2	0.05	70
20.0	10.0	30	0.4	0.10	140
30.0	15.0	45	0.6	0.15	210
40.0	20.0	60	0.8	0.20	280
50.0	25.0	75	1.0	0.25	350

Reflux the mixture for 2 hr or use a shorter period for particular wastes if it has been found to give maximum COD. Cover the open end of the condenser with a small beaker to prevent foreign material from entering the refluxing mixture. Cool and wash down the condenser with distilled water.

Dilute the mixture to about twice its volume with distilled water, cool to room temperature, and titrate the excess dichromate with standard ferrous ammonium sulfate, using ferroin indicator. Generally, use 2 to 3 drops (0.10 to 0.15 ml) indicator. Although the quantity of ferroin is not critical, use a constant volume. Take as the end point the sharp color change from blue-green to reddish brown, even though the blue-green may reappear within minutes.

Reflux in the same manner a blank consisting of distilled water, equal in volume to that of the sample, together with the reagents.

b. Alternate procedure for low-COD samples:

Follow the standard procedure, ¶ 4*a*, with two exceptions: (i) Use 0.025*N* standard $K_2Cr_2O_7$, and (ii) back-titrate with 0.10*N* ferrous ammonium sulfate. Exercise extreme care with this procedure because even a trace of organic matter in the glassware or the atmosphere may cause a gross error. If a further increase in sensitivity is required, reduce a larger sample to 20 ml (final total volume 60 ml) by boiling in the refluxing flask on a hot plate in the presence of all reagents. Carry a blank through the same procedure. This technic has the advantage of concentrating the sample without significant loss of easily digested volatile materials. Hard-to-digest volatile materials such as volatile acids are lost, but an improvement is gained over ordinary evaporative concentration methods. As sample volume increases, chloride concentration also increases and more $HgSO_4$ is required.

c. Determination of standard solution: Evaluate the technic and quality of reagents with a standard solution of either glucose or potassium acid phthalate. See Precision and Accuracy, below, for reference to phthalate. Because glucose has a theoretical COD of 1.067 g/g, dissolve 468.6 mg glucose in distilled water and dilute to 1,000 ml for a 500-mg/l COD solution. Potassium acid phthalate has a theoretical COD of 1.176 g/g; therefore, dissolve 425.1 mg potassium acid phthalate in distilled

water and dilute to 1,000 ml for a 500-mg/l COD solution. A 98 to 100% recovery of the theoretical oxygen demand can be expected with potassium acid phthalate. This reagent has an advantage over glucose in that it can be standardized chemically. It is also stable over a period of time, whereas glucose may be decomposed biologically quite rapidly.

5. Calculation

$$\text{mg/l COD} = \frac{(a-b)N\times 8{,}000}{\text{ml sample}}$$

where COD = chemical oxygen demand from dichromate, a = ml $Fe(NH_4)_2(SO_4)_2$ used for blank, b = ml $Fe(NH_4)_2(SO_4)_2$ used for sample, and N = normality of $Fe(NH_4)_2(SO_4)_2$.

6. Precision and Accuracy

A set of synthetic unknown samples containing potassium acid phthalate and sodium chloride was tested by 74 laboratories. At 200 mg/l COD in the absence of chloride, the standard deviation was ±13 mg/l (coefficient of variation, 6.5%). At 160 mg/l COD and 100 mg/l chloride, the standard deviation was ±14 mg/l (10.8%).

The accuracy of this method has been determined by Moore and associates. For most organic compounds the oxidation is 95 to 100% of the theoretical value. Benzene, toluene, and pyridine are not oxidized.

7. Bibliography

Muers, M.M. 1936. Biological purification of whey solutions. *J. Soc. Chem. Ind.* (London) 55:711.

Moore, W.A., R. C. Kroner, & C.C. Ruchhoft. 1949. Dichromate reflux method for determination of oxygen consumed. *Anal. Chem.* 21:953.

Moore, W.A., F.J. Ludzack & C. C. Ruchhoft. 1951. Determination of oxygen-consumed values of organic wastes. *Anal. Chem.* 23:1297.

Medalia, A.I. 1951. Test for traces of organic matter in water. *Anal. Chem.* 23:1318.

Subrahmanyan, P., C. Sastry & S. Pallai. 1959. Determination of the permanganate value for waters and sewage effluent containing nitrite. *Analyst* 84:731.

Symons, J.M., R.E. McKinney & H.H. Hassis. 1960. A procedure for determination of the biological treatability of industrial wastes. *J. Water Pollut. Control Fed.* 32:841.

Dobbs, R.A. & R.T. Williams. 1963. Elimination of chloride interference in the chemical oxygen demand test. *Anal. Chem.* 35:1064.

509 PESTICIDES (ORGANIC)

Large-scale application of pesticides in agricultural and forest areas can contribute to the presence of these toxic materials in surface and groundwaters and ultimately in water supplies. Contamination can occur through drainage from the surrounding terrain, precipitation from the atmosphere, accidental spills of pesticides in the watershed area, or a cross-connection on a distribution system.

Gas chromatographic methods for the determination of the organochlorine pesticides and chlorinated phenoxy acid herbicides in water are presented here. A cholinesterase inhibition method is presented as a means of screening samples for organophosphorus and carbamate pesticides. The methods are applicable to both finished and natural surface waters.

509 A. Organochlorine Pesticides (TENTATIVE)

1. General Discussion

a. Principle: This gas chromatographic procedure is suitable for the quantitative determination of the following specific compounds: BHC, lindane, heptachlor, aldrin, heptachlor epoxide, dieldrin, endrin, Captan, DDE, DDD, DDT, methoxychlor, endosulfan, dichloran, mirex, and pentachloronitrobenzene. Under favorable circumstances, Strobane, toxaphene, chlordane (tech.), and others also may be determined. Certain organophosphorus pesticides, such as parathion, methylparathion, and malathion, which respond to the electron capture detector, also may be determined. However, the analyst must demonstrate the usefulness of the method for the organophosphorus or other specific pesticides before applying it to sample analysis.

In gas chromatography a mobile phase (a carrier gas) and a stationary phase (column packing) are used to separate individual compounds. The carrier gas is N_2, Ar, He, or H_2. The stationary phase is a liquid that has been coated on an inert granular solid, called the column packing, that is held in borosilicate glass tubing. The column is installed in an oven so that the inlet is attached to a heated injector block and the outlet is attached to a detector. Precise and constant temperature control of the injector block, the oven, and the detector is maintained. Stationary phase material and concentration, column length and diameter, oven temperature, carrier gas flow, and detector type are the controlled variables.

The sample solution is injected through a silicone rubber septum onto the column with a microsyringe. The pesticides are vaporized and moved through the column by the carrier gas. They travel through the column at different rates, depending on differences in the partition coefficients between the mobile and the stationary phase. As each component passes through the detector a quantitatively proportional change in electrical signal is measured on a strip-chart recorder. Each component is observed as a peak on the

STANDARD METHODS

For the Examination of Water and Wastewater

SEVENTEENTH EDITION

Prepared and published jointly by:

AMERICAN PUBLIC HEALTH ASSOCIATION
AMERICAN WATER WORKS ASSOCIATION
WATER POLLUTION CONTROL FEDERATION

Publication Office:
American Public Health Association
1015 Fifteenth Street NW
Washington, DC 20005

3. Reagents

*a. 1,1,2-trichloro-1,2,2-trifluoroethane**: See Section 5520B.3*b*.

b. Hydrochloric acid, HCl, 6*N*.

c. Filter paper.†

4. Procedure

a. Sampling: Collect samples at a place where there is a strong turbulence in the water and where floating material is not trapped at the surface. Fill floatable oil tube to mark by dipping into water. *Do not use samples taken to the laboratory in a bottle, because oil and grease cannot be redispersed to their original condition.*

b. Flotation: Support tube in a vertical position. Start flotation period at sampling site immediately after filling tube. The standard flotation time is 30 min. If a different time is used, state this variation in reporting results. At end of flotation period, discharge the first 900 mL of water carefully through bottom stopcock, stopping before any surface oil or other floating material escapes. Rotate tube slightly back and forth about its vertical axis to dislodge sludge from sides, and let settle for 5 min. Completely discharge sludge that has settled to the bottom or that comes down from the sides with the liquid. Scum on top of the liquid may mix with the water as it moves down the tube. If mixing occurs, stop drawing off water before any floatables have been lost. Let settle for 5 min before withdrawing remainder of water. After removing water, return tube to laboratory to complete test.

c. Extraction: Acidify to pH 2 or lower with a few drops of 6*N* HCl, add 50 to 100 mL trichlorotrifluoroethane, and shake vigorously. Let settle and draw off solvent into a clean dry beaker. Filter solvent through a dry filter paper into a tared 300-mL conical flask, taking care not to get any water on filter paper. Add a second 50-mL portion of trichlorotrifluoroethane and repeat extraction, settling, and filtration into the same 300-mL flask. A third extraction may be needed if the amount of floatables in sample exceeds 4 mg/L. Wash filter paper carefully with fresh solvent discharged from a wash bottle with a fine tip. Evaporate solvent from flask as described in Section 5520B.4. For each solvent batch, determine weight of residue left after evaporation from the same volume as used in the analysis.

5. Calculations

Report results as "soluble floatable oil and grease, 30 min (or other specified) settling time, mg/L."

Trichlorotrifluoroethane-soluble floatable oil and grease, 30 min settling time, mg/L

$$= \frac{(A - B) \times 1000}{\text{mL sample}}$$

where:

A = total gain in weight of tared flask, mg, and

B = calculated residue from solvent blank of the same volume as that used in the test, mg.

6. Precision and Bias

There is no standard against which bias of this test can be determined. Variability of replicates is influenced by sample heterogeneity. If large grease particles are present, the element of change in sampling may be a major factor. One municipal wastewater discharge and two meat-packing plant discharges, both containing noticeable particles of grease, were analyzed in triplicate. Averages for the three wastewaters were 48, 57, and 25 mg/L; standard deviations averaged 11%. An oil refinery made duplicate determinations of its separator effluent on 15 consecutive days, obtaining results ranging from 5.1 to 11.2 mg/L. The average difference between pairs of samples was 0.37 mg/L.

7. Bibliography

POMEROY, R.D. 1953. Floatability of oil and grease in wastewaters. *Sewage Ind. Wastes* 25:1304.

* Freon or equivalent.

† Whatman No. 40 or equivalent.

2540 SOLIDS*

2540 A. Introduction

The terms "solids," "suspended," and "dissolved," as used herein, replace the terms "residue," "nonfiltrable," and "filtrable" of editions previous to the 16th. Solids refer to matter suspended or dissolved in water or wastewater. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavorable physiological reaction in the transient consumer. For these reasons, a limit of 500 mg dissolved solids/L is desirable for drinking waters. Highly mineralized waters also are unsuitable for many industrial applications. Waters high in suspended solids may be esthetically unsatisfactory for such purposes as bathing. Solids analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with regulatory agency wastewater effluent limitations.

1. Definitions

"Total solids" is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature. Total solids includes "total suspended solids," the portion of total solids retained by a filter, and "total dissolved solids," the portion that passes through the filter.

The type of filter holder, the pore size, porosity, area, and thickness of the filter and the physical nature, particle size, and amount of material deposited on the filter are the principal factors affecting separation of suspended from dissolved solids.

"Fixed solids" is the term applied to the residue of total, suspended, or dissolved solids after ignition for a specified time at a specified temperature. The weight loss on ignition is called "volatile solids." Determinations of fixed and volatile solids do not distinguish precisely between inorganic and organic matter because the loss on ignition is not confined to organic matter. It includes losses due to decomposition or volatilization of some mineral salts. Better characterization of organic matter can be made by such tests as total organic carbon (Section 5310), BOD (Section 5210), and COD (Section 5220).

"Settleable solids" is the term applied to the material settling out of suspension within a defined period. It may include floating material, depending on the technique (2540F.3*b*).

2. Sources of Error and Variability

The temperature at which the residue is dried has an important bearing on results, because weight losses due to volatilization of organic matter, mechanically occluded water, water of crystallization, and gases from heat-induced chemical decomposi-

*Approved by Standard Methods Committee, 1985.

tion, as well as weight gains due to oxidation, depend on temperature and time of heating.

Residues dried at 103 to 105°C may retain not only water of crystallization but also some mechanically occluded water. Loss of CO_2 will result in conversion of bicarbonate to carbonate. Loss of organic matter by volatilization usually will be very slight. Because removal of occluded water is marginal at this temperature, attainment of constant weight may be very slow.

Residues dried at 180 ± 2°C will lose almost all mechanically occluded water. Some water of crystallization may remain, especially if sulfates are present. Organic matter may be lost by volatilization, but not completely destroyed. Loss of CO_2 results from conversion of bicarbonates to carbonates and carbonates may be decomposed partially to oxides or basic salts. Some chloride and nitrate salts may be lost. In general, evaporating and drying water samples at 180°C yields values for dissolved solids closer to those obtained through summation of individually determined mineral species than the dissolved solids values secured through drying at the lower temperature.

Results for residues high in oil or grease may be questionable because of the difficulty of drying to constant weight in a reasonable time.

Analyses performed for some special purposes may demand deviation from the stated procedures to include an unusual constituent with the measured solids. Whenever such variations of technique are introduced, record and present them with the results.

3. Sample Handling and Preservation

Use resistant-glass or plastic bottles, provided that the material in suspension does not adhere to container walls. Begin analysis as soon as possible because of the impracticality of preserving the sample. Refrigerate sample at 4°C up to analysis to minimize microbiological decomposition of solids.

4. Selection of Method

Methods B through F are suitable for the determination of solids in potable, surface, and saline waters, as well as domestic and industrial wastewaters in the range up to 20 000 mg/L.

Method G is suitable for the determination of solids in sediments, as well as solid and semisolid materials produced during water and wastewater treatment.

5. Bibliography

THERIAULT, E.J. & H.H. WAGENHALS. 1923. Studies of representative sewage plants. *Pub. Health Bull.* No. 132.

U.S. ENVIRONMENTAL PROTECTION AGENCY. 1979. Methods for Chemical Analysis of Water and Wastes. Publ. 600/4-79-020, Environmental Monitoring and Support Lab., U.S. Environmental Protection Agency, Cincinnati, Ohio.

2540 B. Total Solids Dried at 103–105°C

1. General Discussion

a. Principle: A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103 to 105°C. The increase in weight over that of the empty dish represents the total solids. The results may not represent the weight of actual dissolved and suspended solids in wastewater samples (see above).

b. Interferences: Highly mineralized water with a significant concentration of calcium, magnesium, chloride, and/or sulfate may be hygroscopic and require prolonged drying, proper desiccation, and rapid weighing. Exclude large, floating particles or submerged agglomerates of nonhomogeneous materials from the sample if it is determined that their inclusion is not desired in the final result. Disperse visible floating oil and grease with a blender before withdrawing a sample portion for analysis. Because excessive residue in the dish may form a water-trapping crust, limit sample to no more than 200 mg residue.

2. Apparatus

a. Evaporating dishes: Dishes of 100-mL capacity made of one of the following materials:

1) Porcelain, 90-mm diam.
2) Platinum—Generally satisfactory for all purposes.
3) High-silica glass.*

b. Muffle furnace for operation at 550 ± 50°C.

c. Steam bath.

d. Desiccator, provided with a desiccant containing a color indicator of moisture concentration.

e. Drying oven, for operation at 103 to 105°C.

f. Analytical balance, capable of weighing to 0.1 mg.

3. Procedure

a. Preparation of evaporating dish: If volatile solids are to be measured ignite clean evaporating dish at 550 ± 50°C for 1 h in a muffle furnace. If only total solids are to be measured, heat clean dish to 103 to 105°C for 1 h. Store dish in desiccator until needed. Weigh immediately before use.

b. Sample analysis: Choose a sample volume that will yield a residue between 2.5 mg and 200 mg. Transfer a measured volume of well-mixed sample to preweighed dish and evaporate to dryness on a steam bath or in a drying oven. If necessary, add successive sample portions to the same dish after evaporation. When evaporating in a drying oven, lower temperature to approximately 2°C below boiling to prevent splattering. Dry evaporated sample for at least 1 h in an oven at 103 to 105°C, cool dish in desiccator to balance temperature, and weigh. Repeat cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained, or until weight loss is less than 4% of previous weight or 0.5 mg, whichever is less.

4. Calculation

$$\text{mg total solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

where:

A = weight of dried residue + dish, mg, and
B = weight of dish, mg.

5. Precision

Single-laboratory duplicate analyses of 41 samples of water and wastewater were made with a standard deviation of differences of 6.0 mg/L.

6. Bibliography

SYMONS, G.E. & B. MOREY. 1941. The effect of drying time on the determination of solids in sewage and sewage sludges. *Sewage Works J.* 13:936.

*Vycor, product of Corning Glass Works, Corning, N.Y., or equivalent.

2540 C. Total Dissolved Solids Dried at 180°C

1. General Discussion

a. Principle: A well-mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids.

The results may not agree with the theoretical value for solids calculated from chemical analysis of sample (see above). Approximate methods for correlating chemical analysis with dissolved solids are available.[1] The filtrate from the total suspended solids determination (Section 2540D) may be used for determination of total dissolved solids.

b. Interferences: Highly mineralized waters with a considerable calcium, magnesium, chloride, and/or sulfate content may be hygroscopic and require prolonged drying, proper desiccation, and rapid weighing. Samples high in bicarbonate require careful and possibly prolonged drying at 180°C to insure complete conversion of bicarbonate to carbonate. Because excessive residue in the dish may form a water-trapping crust, limit sample to no more than 200 mg residue.

2. Apparatus

Apparatus listed in 2540B.2*a-d* is required, and in addition:

*a. Glass-fiber filter disks** without organic binder.

b. Filtration apparatus: One of the following, suitable for filter disk selected:

1) *Membrane filter funnel.*

2) *Gooch crucible,* 25-mL to 40-mL capacity, with Gooch crucible adapter.

3) *Filtration apparatus* with reservoir and coarse (40- to 60-μm) fritted disk as filter support.

c. Suction flask, of sufficient capacity for sample size selected.

d. Drying oven, for operation at 180 ± 2°C.

3. Procedure

a. Preparation of glass-fiber filter disk: Insert disk with wrinkled side up into filtration apparatus. Apply vacuum and wash disk with three successive 20-mL volumes of distilled water. Continue suction to remove all traces of water. Discard washings.

b. Preparation of evaporating dish: If volatile solids are to be measured, ignite cleaned evaporating dish at 550 ± 50°C for 1 h in a muffle furnace. If only total dissolved solids are to be measured, heat clean dish to 180 ± 2°C for 1 h in an oven. Store in desiccator until needed. Weigh immediately before use.

c. Selection of filter and sample sizes: Choose sample volume to yield between 2.5 and 200 mg dried residue. If more than 10 min are required to complete filtration, increase filter size or decrease sample volume but do not produce less than 2.5 mg residue.

d. Sample analysis: Filter measured volume of well-mixed sample through glass-fiber filter, wash with three successive 10-mL volumes of distilled water, allowing complete drainage between washings, and continue suction for about 3 min after filtration is complete. Transfer filtrate to a weighed evaporating dish and evaporate to dryness on a steam bath. If filtrate volume exceeds dish capacity add successive portions to the same dish after evaporation. Dry for at least 1 h in an oven at 180 ± 2°C, cool in a desiccator to balance temperature, and weigh. Repeat drying cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until weight loss is less than 4% of previous weight or 0.5 mg, whichever is less.

*Whatman grade 934AH; Gelman type A/E; Millipore type AP40; E-D Scientific Specialties grade 161; or equivalent. Available in diameters of 2.2 cm to 4.7 cm.

4. Calculation

$$\text{mg total dissolved solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

where:

A = weight of dried residue + dish, mg, and
B = weight of dish, mg.

5. Precision

Single-laboratory analyses of 77 samples of a known of 293 mg/L were made with a standard deviation of differences of 21.20 mg/L.

6. Reference

1. SOKOLOFF, V.P. 1933. Water of crystallization in total solids of water analysis. *Ind. Eng. Chem.*, Anal. Ed. 5:336.

7. Bibliography

HOWARD, C.S. 1933. Determination of total dissolved solids in water analysis. *Ind. Eng. Chem.*, Anal. Ed. 5:4.

U.S. GEOLOGICAL SURVEY. 1974. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. Techniques of Water-Resources Investigations, Book 5, Chap. A1. U.S. Geological Surv., Washington, D.C.

2540 D. Total Suspended Solids Dried at 103–105°C

1. General Discussion

a. Principle: A well-mixed sample is filtered through a weighed standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105°C. The increase in weight of the filter represents the total suspended solids. If the suspended material clogs the filter and prolongs filtration, the difference between the total solids and the total dissolved solids may provide an estimate of the total suspended solids.

b. Interferences: Exclude large floating particles or submerged agglomerates of nonhomogeneous materials from the sample if it is determined that their inclusion is not desired in the final result. Because excessive residue on the filter may form a water-entrapping crust, limit the sample size to that yielding no more than 200 mg residue. For samples high in dissolved solids thoroughly wash the filter to ensure removal of the dissolved material. Prolonged filtration times resulting from filter clogging may produce high results owing to excessive solids capture on the clogged filter.

2. Apparatus

Apparatus listed in Sections 2540B.2 and 2540C.2 is required, except for evaporating dishes, steam bath, and 180°C drying oven. In addition:

*Planchet,** aluminum or stainless steel, 65-mm diam.

3. Procedure

a. Preparation of glass-fiber filter disk: Insert disk with wrinkled side up in filtra-

*Available from New England Nuclear, Boston, Mass., or equivalent.

tion apparatus. Apply vacuum and wash disk with three successive 20-mL portions of distilled water. Continue suction to remove all traces of water, and discard washings. Remove filter from filtration apparatus and transfer to an aluminum or stainless steel planchet as a support. Alternatively remove crucible and filter combination if a Gooch crucible is used. Dry in an oven at 103 to 105°C for 1 h. If volatile solids are to be measured, ignite at 550 ± 50°C for 15 min in a muffle furnace. Cool in desiccator to balance temperature and weigh. Repeat cycle of drying or igniting, cooling, desiccating, and weighing until a constant weight is obtained or until weight loss is less than 0.5 mg between successive weighings. Store in desiccator until needed. Weigh immediately before use.

b. Selection of filter and sample sizes: See Section 2540C.3*c*. For nonhomogeneous samples such as raw wastewater, use a large filter to permit filtering a representative sample.

c. Sample analysis: Assemble filtering apparatus and filter and begin suction. Wet filter with a small volume of distilled water to seat it. Filter a measured volume of well-mixed sample through the glass fiber filter. Wash with three successive 10-mL volumes of distilled water, allowing complete drainage between washings and continue suction for about 3 min after filtration is complete. Carefully remove filter from filtration apparatus and transfer to an aluminum or stainless steel planchet as a support. Alternatively, remove the crucible and filter combination from the crucible adapter if a Gooch crucible is used. Dry for at least 1 h at 103 to 105°C in an oven, cool in a desiccator to balance temperature, and weigh. Repeat the cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until the weight loss is less than 4% of the previous weight or 0.5 mg, whichever is less.

4. Calculation

$$\text{mg total suspended solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

where:

A = weight of filter + dried residue, mg, and
B = weight of filter, mg.

5. Precision

The standard deviation was 5.2 mg/L (coefficient of variation 33%) at 15 mg/L, 24 mg/L (10%) at 242 mg/L, and 13 mg/L (0.76%) at 1707 mg/L in studies by two analysts of four sets of 10 determinations each.

Single-laboratory duplicate analyses of 50 samples of water and wastewater were made with a standard deviation of differences of 2.8 mg/L.

6. Bibliography

DEGEN, J. & F.E. NUSSBERGER. 1956. Notes on the determination of suspended solids. *Sewage Ind. Wastes* 28:237.

CHANIN, G., E.H. CHOW, R.B. ALEXANDER & J. POWERS. 1958. Use of glass fiber filter medium in the suspended solids determination. *Sewage Ind. Wastes* 30:1062.

NUSBAUM, I. 1958. New method for determination of suspended solids. *Sewage Ind. Wastes* 30:1066.

SMITH, A.L. & A.E. GREENBERG. 1963. Evaluation of methods for determining suspended solids in wastewater. *J. Water Pollut. Control Fed.* 35:940.

WYCKOFF, B.M. 1964. Rapid solids determination using glass fiber filters. *Water Sewage Works* 111:277.

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT. 1975. A Preliminary Review of Analytical Methods for the Determination of Suspended Solids in Paper Industry Effluents for Compliance with EPA-NPDES Permit Terms. Spec. Rep. No. 75-01. National Council of the Paper Industry for Air & Stream Improvement, New York, N.Y.

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT. 1977. A Study of the Effect of Alternate Procedures on Effluent Suspended Solids Measurement. Stream Improvement Tech. Bull. No. 291, National Council of the Paper Industry for Air & Stream Improvement, New York, N.Y.

TREES, C.C. 1978. Analytical analysis of the effect of dissolved solids on suspended solids determination. *J. Water Pollut. Control Fed.* 50:2370.

2540 E. Fixed and Volatile Solids Ignited at 550°C

1. General Discussion

a. Principle: The residue from Method B, C, or D is ignited to constant weight at 550 ± 50°C. The remaining solids represent the fixed total, dissolved, or suspended solids while the weight lost on ignition is the volatile solids. The determination is useful in control of wastewater treatment plant operation because it offers a rough approximation of the amount of organic matter present in the solid fraction of wastewater, activated sludge, and industrial wastes.

b. Interferences: Negative errors in the volatile solids may be produced by loss of volatile matter during drying. Determination of low concentrations of volatile solids in the presence of high fixed solids concentrations may be subject to considerable error. In such cases, measure for suspect volatile components by another test, for example, total organic carbon (Section 5310).

2. Apparatus

See Sections 2540B.2, 2540C.2, and 2540D.2.

3. Procedure

Ignite residue produced by Method B, C, or D to constant weight in a muffle furnace at a temperature of 550 ± 50°C. Have furnace up to temperature before inserting sample. Usually, 15 to 20 min ignition are required. Let dish or filter disk cool partially in air until most of the heat has been dissipated. Transfer to a desiccator for final cooling in a dry atmosphere. Do not overload desiccator. Weigh dish or disk as soon as it has cooled to balance temperature. Repeat cycle of igniting, cooling, desiccating, and weighing until a constant weight is obtained or until weight loss is less than 4% of previous weight.

4. Calculation

$$\text{mg volatile solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

$$\text{mg fixed solids/L} = \frac{(B - C) \times 1000}{\text{sample volume, mL}}$$

where:

A = weight of residue + dish before ignition, mg,
B = weight of residue + dish or filter after ignition, mg, and
C = weight of dish or filter, mg.

5. Precision

The standard deviation was 11 mg/L at 170 mg/L volatile total solids in studies by three laboratories on four samples and 10 replicates. Bias data on actual samples cannot be obtained.

2540 F. Settleable Solids

1. General Discussion

Settleable solids in surface and saline waters as well as domestic and industrial wastes may be determined and reported on either a volume (mL/L) or a weight (mg/L) basis.

2. Apparatus

The volumetric test requires only an Imhoff cone. The gravimetric test requires all the apparatus listed in Section 2540D.2 and a glass vessel with a minimum diameter of 9 cm.

3. Procedure

a. Volumetric: Fill an Imhoff cone to the 1-L mark with a well-mixed sample. Settle for 45 min, gently stir sides of cone with a rod or by spinning, settle 15 min longer, and record volume of settleable solids in the cone as milliliters per liter. If the settled matter contains pockets of liquid between large settled particles, estimate volume of these and subtract from volume of settled solids. The practical lower limit of measurement depends on sample composition and generally is in the range of 0.1 to 1.0 mL/L. Where a separation of settleable and floating materials occurs, do not estimate the floating material as settleable matter.

b. Gravimetric:

1) Determine total suspended solids of well-mixed sample (Section 2540D).

2) Pour a well-mixed sample into a glass vessel of not less than 9 cm diam using not less than 1 L and sufficient to give a depth of 20 cm. Alternatively use a glass vessel of greater diameter and a larger volume of sample. Let stand quiescent for 1 h and, without disturbing the settled or floating material, siphon 250 mL from center of container at a point halfway between the surface of the settled material and the liquid surface. Determine total suspended solids (milligrams per liter) of this supernatant liquor (Section 2540D). These are the nonsettleable solids.

4. Calculation

$$\text{mg settleable solids/L} = \text{mg total suspended solids/L} - \text{mg nonsettleable solids/L}$$

5. Precision and Bias

Precision and bias data are not now available.

6. Bibliography

FISCHER, A.J. & G.E. SYMONS. 1944. The determination of settleable sewage solids by weight. *Water Sewage Works* 91:37.

2540 G. Total, Fixed, and Volatile Solids in Solid and Semisolid Samples

1. General Discussion

a. Applicability: This method is applicable to the determination of total solids and its fixed and volatile fractions in such solid and semisolid samples as river and lake sediments, sludges separated from water and wastewater treatment processes, and sludge cakes from vacuum filtration, centrifugation, or other sludge dewatering processes.

b. Interferences: The determination of both total and volatile solids in these materials is subject to negative error due to loss of ammonium carbonate and volatile organic matter during drying. Although this is true also for wastewater, the effect tends to be more pronounced with sediments, and especially with sludges and sludge cakes. The mass of organic matter recovered from sludge and sediment requires a longer ignition time than that specified for wastewaters, effluents, or polluted waters. Carefully observe specified ignition time and temperature to control losses of volatile inorganic salts. Make all weighings quickly because wet samples tend to lose weight by evaporation. After drying or ignition, residues often are very hygroscopic and rapidly absorb moisture from the air.

2. Apparatus

All the apparatus listed in Section 2540B.2 is required except that a balance capable of weighing to 10 mg may be used.

3. Procedure

a. Total solids:

1) Preparation of evaporating dish—If volatile solids are to be measured, ignite a clean evaporating dish at 550 ± 50°C for 1 h in a muffle furnace. If only total solids are to be measured, heat dish at 103 to 105°C for 1 h in an oven. Cool in desiccator, weigh, and store in desiccator until ready for use.

2) Sample analysis

a) Fluid samples—If the sample contains enough moisture to flow more or less readily, stir to homogenize, place 25 to 50 g in a prepared evaporating dish, and weigh. Evaporate to dryness on a water bath, dry at 103 to 105°C for 1 h, cool to balance temperature in an individual desiccator containing fresh desiccant, and weigh.

b) Solid samples—If the sample consists of discrete pieces of solid material (dewatered sludge, for example), take cores from each piece with a No. 7 cork borer or pulverize the entire sample coarsely on a clean surface by hand, using rubber gloves. Place 25 to 50 g in a prepared evaporating dish and weigh. Place in an oven at 103 to 105°C overnight. Cool to balance temperature in an individual desiccator containing fresh desiccant and weigh.

b. Fixed and volatile solids: Transfer to a cool muffle furnace, heat furnace to 550 ± 50°C, and ignite for 1 h. (If the residue from 2) above contains large amounts of organic matter, first ignite the residue over a gas burner and under an exhaust hood in the presence of adequate air to lessen losses due to reducing conditions and to avoid odors in the laboratory.) Cool in desiccator to balance temperature and weigh.

4. Calculation

$$\% \text{ total solids} = \frac{(A - B) \times 100}{C - B}$$

$$\% \text{ volatile solids} = \frac{(A - D) \times 100}{A - B}$$

$$\% \text{ fixed solids} = \frac{(D - B) \times 100}{A - B}$$

where:

A = weight of dried residue + dish, mg,
B = weight of dish,
C = weight of wet sample + dish, mg, and
D = weight of residue + dish after ignition, mg.

5. Precision and Bias

Precision and bias data are not now available.

6. Bibliography

GOODMAN, B.L. 1964. Processing thickened sludge with chemical conditioners. Pages 78 et seq. *in* Sludge Concentration, Filtration and Incineration. Univ. Michigan Continued Education Ser. No. 113, Ann Arbor.

GRATTEAU, J.C. & R.I. DICK. 1968. Activated sludge suspended solids determinations. *Water Sewage Works* 115:468.

5010 INTRODUCTION

5010 A. General Discussion

Analyses for organic matter in water and wastewater can be classified into two general types of measurements: those that quantify an aggregate amount of organic matter comprising organic constituents with a common characteristic and those that quantify individual organic compounds. The latter can be found in Part 6000. The former, described here in Part 5000, have been grouped into four categories: oxygen-demanding substances, organically bound elements, classes of compounds, and formation potentials.

Methods for total organic carbon and chemical oxygen demand are used to assess the total amount of organics present. Gross fractions of the organic matter can be identified analytically, as in the measurement of BOD, which is an index of the biodegradable organics present, oil and grease, which represents material extractable from a sample by a nonpolar solvent, or total organic halide (TOX), which measures organically bound halogens. Trihalomethane formation potential is an aggregate measure of the total concentration of trihalomethanes formed upon chlorination of a water sample.

Analyses of organics are made to assess the concentration and general composition of organic matter in raw water supplies, wastewaters, treated effluents, and receiving waters; and to determine the efficiency of treatment processes.

5010 B. Sample Collection and Preservation

The sampling, field treatment, preservation, and storage of samples taken for organic matter analysis are covered in detail in the individual introductions to the methods. If possible, analyze samples immediately because preservatives often interfere with the tests. Otherwise, store at a low temperature (4°C) immediately after collection to preserve most samples. Use chemical preservatives only when they are shown not to interfere with the examinations to be made (see Section 1060). Never use preservatives for samples to be analyzed for BOD. When preservatives are used, add them to the sample bottle initially so that all portions are preserved as soon as collected. No single method of preservation is entirely satisfactory; choose the preservative with due regard to the determinations that are to be made. All methods of preservation may be inadequate when applied to samples containing significant amounts of suspended matter.

5020 QUALITY CONTROL

Part 1000 contains important information relevant to analyses included in Part 5000. Give particular attention to Sections 1020B (Quality Control), 1060 (Collection and Preservation of Samples), 1080 (Reagent-Grade Water), and 1090 (Safety), all of which are critical for many of the Part 5000 methods.

Take special precautions when analyses are performed by independent laboratories. Reliable use of independent laboratories deserves the same quality assurance procedures observed for in-house analyses: replicate samples, samples with known additions, and blanks.

Preparation of samples with known additions may not be feasible for certain analyses. In such cases, consider using a mixture, in varying ratios, of several samples. Use the reported concentrations in the samples and the proportions in which they were mixed to calculate the expected concentration in the mixture. Examine laboratory performance using externally prepared standards and check samples (see Section 1020B).

Type I reagent water (Section 1080) should give satisfactory results for most of the analyses in Part 5000, but additional purification steps may be needed for certain methods, such as total organic halide (TOX) and trihalomethane formation potential (THMFP).

5210 BIOCHEMICAL OXYGEN DEMAND*

5210 A. Introduction

1. General Discussion

The biochemical oxygen demand (BOD) determination is an empirical test in which standardized laboratory procedures are used to determine the relative oxygen requirements of wastewaters, effluents, and polluted waters. The test has its widest application in measuring waste loadings to treatment plants and in evaluating the BOD-removal efficiency of such treatment systems. The test measures the oxygen utilized during a specified incubation period for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous iron. It also may measure the oxygen used to oxidize reduced forms of nitrogen (nitrogenous demand) unless their oxidation is prevented by an inhibitor. The seeding and dilution procedures provide an estimate of the BOD at pH 6.5 to 7.5.

Although only the 5-d BOD (BOD_5) is described here, many variations of oxygen demand measurements exist. These include using shorter and longer incubation periods, tests to determine rates of oxygen uptake, and continuous oxygen-uptake measurements by respirometric techniques. Alternative seeding, dilution, and incubation conditions can be chosen to mimic receiving-water conditions, thereby providing an estimate of the environmental effects of wastewaters and effluents.

2. Carbonaceous Versus Nitrogenous BOD

Oxidation of reduced forms of nitrogen, mediated by microorganisms, exerts nitrogenous demand. Nitrogenous demand historically has been considered an interference in the determination of BOD, as clearly evidenced by the inclusion of ammonia in the dilution water. The interference from nitrogenous demand can now be prevented by an inhibitory chemical.[1] If an inhibiting chemical is not used, the oxygen demand measured is the sum of carbonaceous and nitrogenous demands.

Measurements that include nitrogenous demand generally are not useful for assessing the oxygen demand associated with organic material. Nitrogenous demand can be estimated directly from ammonia nitrogen (Section 4500-NH_3); and carbonaceous demand can be estimated by subtracting the theoretical equivalent of the reduced nitrogen oxidation from uninhibited test results. However, this method is cumbersome and is subject to considerable error. Chemical inhibition of nitrogenous demand provides a more direct and more reliable measure of carbonaceous demand.

The extent of oxidation of nitrogenous compounds during the 5-d incubation period depends on the presence of microorganisms capable of carrying out this oxidation. Such organisms usually are not present in raw sewage or primary effluent in sufficient numbers to oxidize significant quantities of reduced nitrogen forms in the 5-d BOD test. Many biological treatment plant effluents contain significant numbers of nitrifying organisms. Because oxidation of nitrogenous compounds can occur in such samples, inhibition of nitrification as directed in ¶ B.4*e*6) is recommended for samples of secondary effluent, for samples seeded with secondary effluent, and for samples of polluted waters.

Report results as $CBOD_5$ when inhibiting the nitrogenous oxygen demand. When nitrification is not inhibited, report results as BOD_5.

3. Dilution Requirements

The BOD concentration in most wastewaters exceeds the concentration of dissolved oxygen (DO) available in an air-saturated sample. Therefore, it is necessary to dilute the sample before incubation to bring the oxygen demand and supply into appropriate balance. Because bacterial growth requires nutrients such as nitrogen, phosphorus, and trace metals, these are added to the dilution water, which is buffered to ensure that the pH of the incubated sample remains in a range suitable for bacterial growth. Complete stabilization of a sample may require a period of incubation too long for practical purposes; therefore, 5 d has been accepted as the standard incubation period.

If the dilution water is of poor quality, effectively, dilution water will appear as sample BOD. This effect will be amplified by the dilution factor. A positive bias will result. The method included below contains both a dilution-water check and a dilution-water blank. Seeded dilution waters are checked further for acceptable quality by measuring their consumption of oxygen from a known organic mixture, usually glucose and glutamic acid.

The source of dilution water is not restricted and may be distilled, tap, or receiving-stream water free of biodegradable organics and bioinhibitory substances such as chlorine or heavy metals. Distilled water may contain ammonia or volatile organics; deionized waters often are contaminated with soluble organics leached from the resin bed. Use of copper-lined stills or copper fittings attached to distilled water lines may produce water containing excessive amounts of copper (see Section 3500-Cu).

4. Reference

1. YOUNG, J.C. 1973. Chemical methods for nitrification control. *J. Water Pollut. Control Fed.* 45:637.

*Approved by Standard Methods Committee, 1988.

5. Bibliography

THERIAULT, E.J., P.D. MCNAMEE & C.T. BUTTERFIELD. 1931. Selection of dilution water for use in oxygen demand tests. *Pub. Health Rep.* 46:1084.

LEA, W.L. & M.S. NICHOLS. 1937. Influence of phosphorus and nitrogen on biochemical oxygen demand. *Sewage Works J.* 9:34.

RUCHHOFT, C.C. 1941. Report on the cooperative study of dilution waters made for the Standard Methods Committee of the Federation of Sewage Works Associations. *Sewage Works J.* 13:669.

MOHLMAN, F.W., E. HURWITZ, G.R. BARNETT & H.K. RAMER. 1950. Experience with modified methods for BOD. *Sewage Ind. Wastes* 22:31.

5210 B. 5-Day BOD Test

1. General Discussion

a. Principle: The method consists of filling with sample, to overflowing, an airtight bottle of the specified size and incubating it at the specified temperature for 5 d. Dissolved oxygen is measured initially and after incubation, and the BOD is computed from the difference between initial and final DO. Because the initial DO is determined immediately after the dilution is made, all oxygen uptake, including that occurring during the first 15 min, is included in the BOD measurement.

b. Sampling and storage: Samples for BOD analysis may degrade significantly during storage between collection and analysis, resulting in low BOD values. Minimize reduction of BOD by analyzing sample promptly or by cooling it to near-freezing temperature during storage. However, even at low temperature, keep holding time to a minimum. Warm chilled samples to 20°C before analysis.

1) Grab samples—If analysis is begun within 2 h of collection, cold storage is unnecessary. If analysis is not started within 2 h of sample collection, keep sample at or below 4°C from the time of collection. Begin analysis within 6 h of collection; when this is not possible because the sampling site is distant from the laboratory, store at or below 4°C and report length and temperature of storage with the results. In no case start analysis more than 24 h after grab sample collection. When samples are to be used for regulatory purposes make every effort to deliver samples for analysis within 6 h of collection.

2) Composite samples—Keep samples at or below 4°C during compositing. Limit compositing period to 24 h. Use the same criteria as for storage of grab samples, starting the measurement of holding time from end of compositing period. State storage time and conditions as part of the results.

2. Apparatus

a. Incubation bottles, 250- to 300-mL capacity. Clean bottles with a detergent, rinse thoroughly, and drain before use. As a precaution against drawing air into the dilution bottle during incubation, use a water-seal. Obtain satisfactory water seals by inverting bottles in a water bath or by adding water to the flared mouth of special BOD bottles. Place a paper or plastic cup or foil cap over flared mouth of bottle to reduce evaporation of the water seal during incubation.

b. Air incubator or water bath, thermostatically controlled at 20 ± 1°C. Exclude all light to prevent possibility of photosynthetic production of DO.

3. Reagents

a. Phosphate buffer solution: Dissolve 8.5 g KH_2PO_4, 21.75 g K_2HPO_4, 33.4 g $Na_2HPO_4 \cdot 7H_2O$, and 1.7 g NH_4Cl in about

about 500 mL distilled water and dilute to 1 L. The pH should be 7.2 without further adjustment. Discard reagent (or any of the following reagents) if there is any sign of biological growth in the stock bottle.

b. Magnesium sulfate solution: Dissolve 22.5 g $MgSO_4 \cdot 7H_2O$ in distilled water and dilute to 1 L.

c. Calcium chloride solution: Dissolve 27.5 g $CaCl_2$ in distilled water and dilute to 1 L.

d. Ferric chloride solution: Dissolve 0.25 g $FeCl_3 \cdot 6H_2O$ in distilled water and dilute to 1 L.

e. Acid and alkali solutions, 1*N*, for neutralization of caustic or acidic waste samples.

1) Acid—Slowly and while stirring, add 28 mL conc sulfuric acid to distilled water. Dilute to 1 L.

2) Alkali—Dissolve 40 g sodium hydroxide in distilled water. Dilute to 1 L.

f. Sodium sulfite solution: Dissolve 1.575 g Na_2SO_3 in 1000 mL distilled water. This solution is not stable; prepare daily.

g. Nitrification inhibitor, 2-chloro-6-(trichloro methyl) pyridine.*

h. Glucose-glutamic acid solution: Dry reagent-grade glucose and reagent-grade glutamic acid at 103°C for 1 h. Add 150 mg glucose and 150 mg glutamic acid to distilled water and dilute to 1 L. Prepare fresh immediately before use.

i. Ammonium chloride solution: Dissolve 1.15 g NH_4Cl in about 500 mL distilled water, adjust pH to 7.2 with NaOH solution, and dilute to 1 L. Solution contains 0.3 mg N/mL.

4. Procedure

a. Preparation of dilution water: Place desired volume of water in a suitable bottle and add 1 mL each of phosphate buffer, $MgSO_4$, $CaCl_2$, and $FeCl_3$ solutions/L of water. Seed dilution water, if desired, as described in ¶ 4*d*. Test and store dilution water as described in ¶s 4*b* and *c* so that water of assured quality always is on hand.

Before use bring dilution water temperature to 20°C. Saturate with DO by shaking in a partially filled bottle or by aerating with organic-free filtered air. Alternatively, store in cotton-plugged bottles long enough for water to become saturated with DO. Protect water quality by using clean glassware, tubing, and bottles.

b. Dilution water check: Use this procedure as a rough check on quality of dilution water.

If the oxygen depletion of a candidate water exceeds 0.2 mg/L obtain a satisfactory water by improving purification or from another source. Alternatively, if nitrification inhibition is used, store the dilution water, seeded as prescribed below, in a darkened room at room temperature until the oxygen uptake is sufficiently reduced to meet the dilution-water check criteria. Check quality of stored dilution water on use, but do not add seed to dilution water stored for quality improvement. Storage is not recommended when BODs are to be determined without nitrification inhibition because nitrifying organisms may develop during storage. Check stored dilution water to determine whether sufficient ammonia remains after storage. If not, add ammonium chloride solution to provide a total of 0.45 mg ammonia/L as nitrogen. If dilution water has not been stored for quality improvement, add sufficient seeding material to produce a DO uptake of 0.05 to 0.1 mg/L in 5 d at 20°C. Incubate a BOD bottle full of dilution water for 5 d at 20°C. Determine initial and final DO as in ¶s 4*g* and *j*. The DO uptake in 5 d at 20°C should not be more than 0.2 mg/L and preferably not more than 0.1 mg/L.

c. Glucose-glutamic acid check: Because the BOD test is a bioassay its results can be influenced greatly by the presence of toxicants or by use of a poor seeding ma-

*Nitrification Inhibitor 2579-24 (2.2% TCMP), Hach Co., or equivalent.

terial. Distilled waters frequently are contaminated with copper; some sewage seeds are relatively inactive. Low results always are obtained with such seeds and waters. Periodically check dilution water quality, seed effectiveness, and analytical technique by making BOD measurements on pure organic compounds and samples with known additions. In general, for BOD determinations not requiring an adapted seed, use a mixture of 150 mg glucose/L and 150 mg glutamic acid/L as a "standard" check solution. Glucose has an exceptionally high and variable oxidation rate but when it is used with glutamic acid, the oxidation rate is stabilized and is similar to that obtained with many municipal wastes. Alternatively, if a particular wastewater contains an identifiable major constituent that contributes to the BOD, use this compound in place of the glucose-glutamic acid.

Determine the 5-d 20°C BOD of a 2% dilution of the glucose-glutamic acid standard check solution using the techniques outlined in ¶s 4*d-j*. Evaluate data as described in ¶ 6, Precision and Bias.

d. Seeding:

1) Seed source—It is necessary to have present a population of microorganisms capable of oxidizing the biodegradable organic matter in the sample. Domestic wastewater, unchlorinated or otherwise-undisinfected effluents from biological waste treatment plants, and surface waters receiving wastewater discharges contain satisfactory microbial populations. Some samples do not contain a sufficient microbial population (for example, some untreated industrial wastes, disinfected wastes, high-temperature wastes, or wastes with extreme pH values). For such wastes seed the dilution water by adding a population of microorganisms. The preferred seed is effluent from a biological treatment system processing the waste. Where this is not available, use supernatant from domestic wastewater after settling at room temperature for at least 1 h but no longer than 36 h. When effluent from a biological treatment process is used, inhibition of nitrification is recommended.

Some samples may contain materials not degraded at normal rates by the microorganisms in settled domestic wastewater. Seed such samples with an adapted microbial population obtained from the undisinfected effluent of a biological process treating the waste. In the absence of such a facility, obtain seed from the receiving water below (preferably 3 to 8 km) the point of discharge. When such seed sources also are not available, develop an adapted seed in the laboratory by continuously aerating a sample of settled domestic wastewater and adding small daily increments of waste. Optionally use a soil suspension or activated sludge, or a commercial seed preparation to obtain the initial microbial population. Determine the existence of a satisfactory population by testing the performance of the seed in BOD tests on the sample. BOD values that increase with time of adaptation to a steady high value indicate successful seed adaptation.

2) Seed control—Determine BOD of the seeding material as for any other sample. This is the *seed control*. From the value of the seed control and a knowledge of the seeding material dilution (in the dilution water) determine seed DO uptake. Ideally, make dilutions of seed such that the largest quantity results in at least 50% DO depletion. A plot of DO depletion, in milligrams per liter, versus milliliters seed should present a straight line for which the slope indicates DO depletion per milliliter of seed. The DO-axis intercept is oxygen depletion caused by the dilution water and should be less than 0.1 mg/L (¶ 4*h*). To determine a sample DO uptake subtract seed DO uptake from total DO uptake. The DO uptake of seeded dilution water should be between 0.6 and 1.0 mg/L.

Techniques for adding seeding material to dilution water are described for two sample dilution methods (¶ 4*f*).

e. Sample pretreatment:

1) Samples containing caustic alkalinity or acidity— Neutralize samples to pH 6.5 to 7.5 with a solution of sulfuric acid (H_2SO_4) or sodium hydroxide (NaOH) of such strength that the quantity of reagent does not dilute the sample by more than 0.5%. The pH of seeded dilution water should not be affected by the lowest sample dilution.

2) Samples containing residual chlorine compounds—If possible, avoid samples containing residual chlorine by sampling ahead of chlorination processes. If the sample has been chlorinated but no detectable chlorine residual is present, seed the dilution water. If residual chlorine is present, dechlorinate sample and seed the dilution water (¶ 4*f*). Do not test chlorinated/dechlorinated samples without seeding the dilution water. In some samples chlorine will dissipate within 1 to 2 h of standing in the light. This often occurs during sample transport and handling. For samples in which chlorine residual does not dissipate in a reasonably short time, destroy chlorine residual by adding Na_2SO_3 solution. Determine required volume of Na_2SO_3 solution on a 100- to 1000-mL portion of neutralized sample by adding 10 mL of 1 + 1 acetic acid or 1 + 50 H_2SO_4, 10 mL potassium iodide (KI) solution (10 g/100 mL), and titrating with Na_2SO_3 solution to the starch-iodine end point for residual. Add to neutralized sample the relative volume of Na_2SO_3 solution determined by the above test, mix, and after 10 to 20 min check sample for residual chlorine. (NOTE: Excess Na_2SO_3 exerts an oxygen demand and reacts slowly with certain organic chloramine compounds that may be present in chlorinated samples).

3) Samples containing other toxic substances—Certain industrial wastes, for example, plating wastes, contain toxic metals. Such samples often require special study and treatment.

4) Samples supersaturated with DO—Samples containing more than 9 mg DO/L at 20°C may be encountered in cold waters or in water where photosynthesis occurs. To prevent loss of oxygen during incubation of such samples, reduce DO to saturation at 20°C by bringing sample to about 20°C in partially filled bottle while agitating by vigorous shaking or by aerating with clean, filtered compressed air.

5) Sample temperature adjustment—Bring samples to 20 ± 1°C before making dilutions.

6) Nitrification inhibition—If nitrification inhibition is desired add 3 mg 2-chloro-6-(trichloro methyl) pyridine (TCMP) to each 300-mL bottle before capping or add sufficient amounts to the dilution water to make a final concentration of 10 mg/L. (NOTE: Pure TCMP may dissolve slowly and can float on top of the sample. Some commercial formulations dissolve more readily but are not 100% TCMP; adjust dosage accordingly.) Samples that may require nitrification inhibition include, but are not limited to, biologically treated effluents, samples seeded with biologically treated effluents, and river waters. Note the use of nitrogen inhibition in reporting results.

f. Dilution technique: Dilutions that result in a residual DO of at least 1 mg/L and a DO uptake of at least 2 mg/L after 5 d incubation produce the most reliable results. Make several dilutions of prepared sample to obtain DO uptake in this range. Experience with a particular sample will permit use of a smaller number of dilutions. A more rapid analysis, such as COD, may be correlated approximately with BOD and serve as a guide in selecting dilutions. In the absence of prior knowledge, use the following dilutions: 0.0 to 1.0% for strong industrial wastes, 1 to 5% for raw and settled wastewater, 5 to 25% for biologically treated effluent, and 25 to 100% for polluted river waters.

Prepare dilutions either in graduated cylinders and then transfer to BOD bottles or

prepare directly in BOD bottles. Either dilution method can be combined with any DO measurement technique. The number of bottles to be prepared for each dilution depends on the DO technique and the number of replicates desired.

When using graduated cylinders to prepare dilutions, and when seeding is necessary, add seed either directly to dilution water or to individual cylinders before dilution. Seeding of individual cylinders avoids a declining ratio of seed to sample as increasing dilutions are made. When dilutions are prepared directly in BOD bottles and when seeding is necessary, add seed directly to dilution water or directly to the BOD bottles.

1) Dilutions prepared in graduated cylinders—If the azide modification of the titrimetric iodometric method (Section 4500-O.C) is used, carefully siphon dilution water, seeded if necessary, into a 1- to 2-L-capacity graduated cylinder. Fill cylinder half full without entraining air. Add desired quantity of carefully mixed sample and dilute to appropriate level with dilution water. Mix well with a plunger-type mixing rod; avoid entraining air. Siphon mixed dilution into two BOD bottles. Determine initial DO on one of these bottles. Stopper the second bottle tightly, water-seal, and incubate for 5 d at 20°C. If the membrane electrode method is used for DO measurement, siphon dilution mixture into one BOD bottle. Determine initial DO on this bottle and replace any displaced contents with sample dilution to fill the bottle. Stopper tightly, water-seal, and incubate for 5 d at 20°C.

2) Dilutions prepared directly in BOD bottles—Using a wide-tip volumetric pipet, add the desired sample volume to individual BOD bottles of known capacity. Add appropriate amounts of seed material to the individual BOD bottles or to the dilution water. Fill bottles with enough dilution water, seeded if necessary, so that insertion of stopper will displace all air, leaving no bubbles. For dilutions greater than 1:100 make a primary dilution in a graduated cylinder before making final dilution in the bottle. When using titrimetric iodometric methods for DO measurement, prepare two bottles at each dilution. Determine initial DO on one bottle. Stopper second bottle tightly, water-seal, and incubate for 5 d at 20°C. If the membrane electrode method is used for DO measurement, prepare only one BOD bottle for each dilution. Determine initial DO on this bottle and replace any displaced contents with dilution water to fill the bottle. Stopper tightly, water-seal, and incubate for 5 d at 20°C. Rinse DO electrode between determinations to prevent cross-contamination of samples.

g. Determination of initial DO: If the sample contains materials that react rapidly with DO, determine initial DO immediately after filling BOD bottle with diluted sample. If rapid initial DO uptake is insignificant, the time period between preparing dilution and measuring initial DO is not critical.

Use the azide modification of the iodometric method (Section 4500-O.C) or the membrane electrode method (Section 4500-O.G) to determine initial DO on all sample dilutions, dilution water blanks, and where appropriate, seed controls.

h. Dilution water blank: Use a dilution water blank as a rough check on quality of unseeded dilution water and cleanliness of incubation bottles. Together with each batch of samples incubate a bottle of unseeded dilution water. Determine initial and final DO as in ¶s 4*g* and *j*. The DO uptake should not be more than 0.2 mg/L and preferably not more than 0.1 mg/L.

i. Incubation: Incubate at 20°C ± 1°C BOD bottles containing desired dilutions, seed controls, dilution water blanks, and glucose-glutamic acid checks. Water-seal bottles as described in ¶ 4*f*.

j. Determination of final DO: After 5 d incubation determine DO in sample dilutions, blanks, and checks as in ¶ 4*g*.

5. Calculation

When dilution water is not seeded:

$$\text{BOD}_5,\ \text{mg/L} = \frac{D_1 - D_2}{P}$$

When dilution water is seeded:

$$\text{BOD}_5,\ \text{mg/L} = \frac{(D_1 - D_2) - (B_1 - B_2)f}{P}$$

where:

D_1 = DO of diluted sample immediately after preparation, mg/L,
D_2 = DO of diluted sample after 5 d incubation at 20°C, mg/L,
P = decimal volumetric fraction of sample used,
B_1 = DO of seed control before incubation, mg/L (¶ 4*d*),
B_2 = DO of seed control after incubation mg/L (¶ 4*d*), and
f = ratio of seed in diluted sample to seed in seed control = (% seed in diluted sample)/(% seed in seed control).

If seed material is added directly to sample or to seed control bottles:

f = (volume of seed in diluted sample)/(volume of seed in seed control)

Report results as $CBOD_5$ if nitrification is inhibited.

If more than one sample dilution meets the criteria of a residual DO of at least 1 mg/L and a DO depletion of at least 2 mg/L and there is no evidence of toxicity at higher sample concentrations or the existence of an obvious anomaly, average results in the acceptable range.

In these calculations, do not make corrections for DO uptake by the dilution water blank during incubation. This correction is unnecessary if dilution water meets the blank criteria stipulated above. If the dilution water does not meet these criteria, proper corrections are difficult and results become questionable.

6. Precision and Bias

There is no measurement for establishing bias of the BOD procedure. The glucose-glutamic acid check prescribed in ¶ 4*c* is intended to be a reference point for evaluation of dilution water quality, seed effectiveness, and analytical technique. Single-laboratory tests using a 300-mg/L mixed glucose-glutamic acid solution provided the following results:[1]

Number of months:	14
Number of triplicates:	421
Average monthly recovery:	204 mg/L
Average monthly standard deviation:	10.4 mg/L

In a series of interlaboratory studies,[2] each involving 2 to 112 laboratories (and as many analysts and seed sources), 5-d BOD measurements were made on synthetic water samples containing a 1:1 mixture of glucose and glutamic acid in the total concentration range of 3.3 to 231 mg/L. The regression equations for mean value, $\overline{X}$, and standard deviation, S, from these studies were:

$\overline{X}$ = 0.658 (added level, mg/L) + 0.280 mg/L
S = 0.100 (added level, mg/L) + 0.547 mg/L

For the 300-mg/L mixed primary standard, the average 5-d BOD would be 198 mg/L with a standard deviation of 30.5 mg/L.

a. Control limits: Because of many factors affecting BOD tests in multilaboratory studies and the resulting extreme variability in test results, one standard deviation, as determined by interlaboratory tests, is recommended as a control limit for individual laboratories. Alternatively, for each laboratory, establish its control limits by performing a minimum of 25 glucose-glutamic acid checks (¶ 4*c*) over a period of several weeks or months and calculating

the mean and standard deviation. Use the mean ± 3 standard deviations as the control limit for future glucose-glutamic acid checks. Compare calculated control limits to the single-laboratory tests presented above and to interlaboratory results. If control limits are outside the range of 198 ± 30.5, re-evaluate the control limits and investigate source of the problem. If measured BOD for a glucose-glutamic acid check is outside the accepted control limit range, reject tests made with that seed and dilution water.

b. Working range and detection limit: The working range is equal to the difference between the maximum initial DO (7 to 9 mg L) and minimum DO residual of 1 mg/L multiplied by the dilution factor. A lower detection limit of 2 mg/L is established by the requirement for a minimum DO depletion of 2 mg/L.

7. References

1. KENNEY, W. & J. RESNICK. 1987. Personal communication with J. C. Young. Water Pollution Control Plant, Davenport, Iowa.
2. U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF RESEARCH AND DEVELOPMENT. 1986. Method-by-Method Statistics from Water Pollution (WP) Laboratory Performance Evaluation Studies. Quality Assurance Branch, Environmental Monitoring and Support Lab., Cincinnati, Ohio.

8. Bibliography

SAWYER, C.N. & L. BRADNEY. 1946. Modernization of the BOD test for determining the efficiency of the sewage treatment process. *Sewage Works J.* 18:1113.

RUCHHOFT, C.C., O.R. PLACAK, J. KACHMAR & C.E. CALBERT. 1948. Variations in BOD velocity constant of sewage dilutions. *Ind. Eng. Chem.* 40:1290.

ABBOTT, W.E. 1948. The bacteriostatic effects of methylene blue on the BOD test. *Water Sewage Works* 95:424.

SAWYER, C.N., P. CALLEJAS, M. MOORE & A.Q.Y. TOM. 1950. Primary standards for BOD work. *Sewage Ind. Wastes* 22:26.

YOUNG, J.C., G.N. MCDERMOTT & D. JENKINS. 1981. Alterations in the BOD procedure for the 15th edition of Standard Methods for the Examination of Water and Wastewater. *J. Water Pollut. Control Fed.* 53:1253.

5220 CHEMICAL OXYGEN DEMAND (COD)*

5220 A. Introduction

The chemical oxygen demand (COD) is used as a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. For samples from a specific source, COD can be related empirically to BOD, organic carbon, or organic matter. The test is useful for monitoring and control after correlation has been established. The dichromate reflux method is preferred over procedures using other oxidants because of superior oxidizing ability, applicability to a wide variety of samples, and ease of manipulation. Oxidation of most organic compounds is 95 to 100% of the theoretical value. Pyridine and related compounds resist oxidation and volatile organic compounds are oxidized only to the extent that they remain in contact with the oxidant. Ammonia, present either in the waste or liberated from nitrogen-containing organic matter, is not oxidized in the absence of significant concentration of free chloride ions.

*Approved by Standard Methods Committee, 1985.

1. Selection of Method

The open reflux method (B) is suitable for a wide range of wastes where a large sample size is preferred. The closed reflux methods (C and D) are more economical in the use of metallic salt reagents, but require homogenization of samples containing suspended solids to obtain reproducible results. Ampules and culture tubes with premeasured reagents are available commercially. Follow instructions furnished by the manufacturer.

Determine COD values of >50 mg O_2/L by using procedures 5220B.4*a*, C.4, or D.4. Use procedure 5220B.4*b* to determine, with lesser accuracy, COD values from 5 to 50 mg O_2/L.

2. Interferences and Limitations

Volatile straight-chain aliphatic compounds are not oxidized to any appreciable extent. This failure occurs partly because volatile organics are present in the vapor space and do not come in contact with the oxidizing liquid. Straight-chain aliphatic compounds are oxidized more effectively when silver sulfate (Ag_2SO_4) is added as a catalyst. However, Ag_2SO_4 reacts with chloride, bromide, and iodide to produce precipitates that are oxidized only partially. The difficulties caused by the presence of the halides can be overcome largely, though not completely, by complexing with mercuric sulfate ($HgSO_4$) before the refluxing procedure. Although 1 g $HgSO_4$ is specified for 50 mL sample, a lesser amount may be used where sample chloride concentration is known to be less than 2000 mg/L, as long as a 10:1 ratio of $HgSO_4$:Cl^- is maintained. Do not use the test for samples containing more than 2000 mg Cl^-/L. Techniques designed to measure COD in saline waters are available.[1,2]

Nitrite (NO_2^-) exerts a COD of 1.1 mg O_2/mg NO_2^--N. Because concentrations of NO_2^- in waters rarely exceed 1 or 2 mg NO_2^--N/L, the interference is considered insignificant and usually is ignored. To eliminate a significant interference due to NO_2^-, add 10 mg sulfamic acid for each mg NO_2^--N present in the sample volume used; add the same amount of sulfamic acid to the reflux vessel containing the distilled water blank.

Reduced inorganic species such as ferrous iron, sulfide, manganous manganese, etc., are oxidized quantitatively under the test conditions. For samples containing significant levels of these species, stoichiometric oxidation can be assumed from known initial concentration of the interfering species and corrections can be made to the COD value obtained.

3. Sampling and Storage

Preferably collect samples in glass bottles. Test unstable samples without delay. If delay before analysis is unavoidable, preserve sample by acidification to pH ≤ 2 using conc H_2SO_4. Blend samples containing settleable solids with a homogenizer to permit representative sampling. Make preliminary dilutions for wastes containing a high COD to reduce the error inherent in measuring small sample volumes.

4. References

1. BURNS, E.R. & C. MARSHALL. 1965. Correction for chloride interference in the chemical oxygen demand test. *J. Water Pollut. Control Fed.* 37:1716.
2. BAUMANN, F.I. 1974. Dichromate reflux chemical oxygen demand: A proposed method for chloride correction in highly saline waters. *Anal. Chem.* 46:1336.

5220 B. Open Reflux Method

1. General Discussion

a. Principle: Most types of organic matter are oxidized by a boiling mixture of chromic and sulfuric acids. A sample is refluxed in strongly acid solution with a known excess of potassium dichromate ($K_2Cr_2O_7$). After digestion, the remaining unreduced $K_2Cr_2O_7$ is titrated with ferrous ammonium sulfate to determine the amount of $K_2Cr_2O_7$ consumed and the oxidizable organic matter is calculated in terms of oxygen equivalent. Keep ratios of reagent weights, volumes, and strengths constant when sample volumes other than 50 mL are used. The standard 2-h reflux time may be reduced if it has been shown that a shorter period yields the same results.

2. Apparatus

Reflux apparatus, consisting of 500- or 250-mL erlenmeyer flasks with ground-glass 24/40 neck* and 300-mm jacket Liebig, West, or equivalent condenser† with 24/40 ground-glass joint, and a hot plate having sufficient power to produce at least 1.4 W/cm^2 of heating surface, or equivalent.

3. Reagents

a. Standard potassium dichromate solution, 0.0417*M:* Dissolve 12.259 g $K_2Cr_2O_7$, primary standard grade, previously dried at 103°C for 2 h, in distilled water and dilute to 1000 mL.

b. Sulfuric acid reagent: Add Ag_2SO_4, reagent or technical grade, crystals or powder, to conc H_2SO_4 at the rate of 5.5 g Ag_2SO_4/kg H_2SO_4. Let stand 1 to 2 d to dissolve Ag_2SO_4.

c. Ferroin indicator solution: Dissolve 1.485 g 1,10-phenanthroline monohydrate and 695 mg $FeSO_4 \cdot 7H_2O$ in distilled water and dilute to 100 mL. This indicator solution may be purchased already prepared.‡

d. Standard ferrous ammonium sulfate (FAS) titrant, approximately 0.25*M:* Dissolve 98 g $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ in distilled water. Add 20 mL conc H_2SO_4, cool, and dilute to 1000 mL. Standardize this solution daily against standard $K_2Cr_2O_7$ solution as follows:

Dilute 10.0 mL standard $K_2Cr_2O_7$ to about 100 mL. Add 30 mL conc H_2SO_4 and cool. Titrate with FAS titrant using 0.10 to 0.15 mL (2 to 3 drops) ferroin indicator.

$$\text{Molarity of FAS solution} = \frac{\text{Volume } 0.0417M\ K_2Cr_2O_7 \text{ solution titrated, mL}}{\text{Volume FAS used in titration, mL}} \times 0.25$$

e. Mercuric sulfate, $HgSO_4$, crystals or powder.

f. Sulfamic acid: Required only if the interference of nitrites is to be eliminated (see 5220A.2 above).

g. Potassium hydrogen phthalate (KHP) standard: Lightly crush and then dry potassium hydrogen phthalate ($HOOCC_6H_4COOK$) to constant weight at 120°C. Dissolve 425 mg in distilled water and dilute to 1000 mL. KHP has a theoretical COD[1] of 1.176 mg O_2/mg and this solution has a theoretical COD of 500 µg O_2/mL. This solution is stable when refrigerated for up to 3 months in the absence of visible biological growth.

4. Procedure

a. Treatment of samples with COD of > 50 mg O_2/L: Place 50.0 mL sample (for samples with COD of > 900 mg O_2/L, use smaller sample portion diluted to 50.0 mL) in a 500-mL refluxing flask. Add 1 g $HgSO_4$, several glass beads, and very slowly add 5.0 mL sulfuric acid reagent, with mixing to dissolve $HgSO_4$. Cool while mixing to avoid possible loss of volatile materials. Add 25.0 mL 0.0417*M* $K_2Cr_2O_7$ solution and mix. Attach flask to condenser and turn on cooling water. Add remaining sulfuric acid reagent (70 mL) through open end of condenser. Continue swirling and mixing while adding the sulfuric acid reagent. CAUTION: *Mix reflux mixture thoroughly before applying heat to prevent local heating of flask bottom and a possible blow-out of flask contents.*

Cover open end of condenser with a small beaker to prevent foreign material from entering refluxing mixture and reflux for 2 h. Cool and wash down condenser with distilled water. Disconnect reflux condenser and dilute mixture to about twice its volume with distilled water. Cool to room temperature and titrate excess $K_2Cr_2O_7$ with FAS, using 0.10 to 0.15 mL (2 to 3 drops) ferroin indicator. Although the quantity of ferroin indicator is not critical, use the same volume for all titrations. Take as the end point of the titration the first sharp color change from blue-green to reddish brown. The blue-green may reappear. In the same manner, reflux and titrate a blank containing the reagents and a volume of distilled water equal to that of sample.

b. Alternate procedure for low-COD samples: Follow procedure of ¶ 4*a*, with two exceptions: (*i*) use standard 0.00417*M* $K_2Cr_2O_7$, and (*ii*) titrate with 0.025*M* FAS. Exercise extreme care with this procedure because even a trace of organic matter on the glassware or from the atmosphere may cause gross errors. If a further increase in sensitivity is required, concentrate a larger volume of sample before digesting under reflux as follows: Add all reagents to a sample larger than 50 mL and reduce total volume to 150 mL by boiling in the refluxing flask open to the atmosphere without the condenser attached. Compute amount of $HgSO_4$ to be added (before concentration) on the basis of a weight ratio of 10:1, $HgSO_4$:Cl^-, using the amount of Cl^- present in the original volume of sample. Carry a blank reagent through the same procedure. This technique has the advantage of concentrating the sample without significant losses of easily digested volatile materials. Hard-to-digest volatile materials such as volatile acids are lost, but an improvement is gained over ordinary evaporative concentration methods.

c. Determination of standard solution: Evaluate the technique and quality of reagents by conducting the test on a standard potassium hydrogen phthalate solution.

5. Calculation

$$\text{COD as mg } O_2\text{/L} = \frac{(A - B) \times M \times 8000}{\text{mL sample}}$$

where:

A = mL FAS used for blank,
B = mL FAS used for sample, and
M = molarity of FAS.

6. Precision and Bias

A set of synthetic samples containing potassium hydrogen phthalate and NaCl was tested by 74 laboratories. At a COD of 200 mg O_2/L in the absence of chloride, the standard deviation was ±13 mg/L (coefficient of variation, 6.5%). At COD of 160 mg O_2/L and 100 mg Cl^-/L, the standard deviation was ±14 mg/L (coefficient of variation, 10.8%).

7. Reference

1. PITWELL, L.R. 1983. Standard COD. *Chem. Brit.* 19:907.

8. Bibliography

MOORE, W.A., R.C. KRONER & C.C. RUCHHOFT. 1949. Dichromate reflux method for determination of oxygen consumed. *Anal. Chem.* 21:953.

MEDALIA, A.I. 1951. Test for traces of organic matter in water. *Anal. Chem.* 23:1318.

MOORE, W.A., F.J. LUDZACK & C.C. RUCHHOFT.

*Corning 5000 or equivalent.
†Corning 2360, 91548, or equivalent.

‡GFS Chemical Co., Columbus, Ohio.

1951. Determination of oxygen-consumed values of organic wastes. *Anal. Chem.* 23:1297.

DOBBS, R.A. & R.T. WILLIAMS. 1963. Elimination of chloride interference in the chemical oxygen demand test. *Anal. Chem.* 35:1064.

5220 C. Closed Reflux, Titrimetric Method

1. General Discussion

a. Principle: See 5220B.1*a*.

b. Interferences and limitations: See 5220A.2. Volatile organic compounds are more completely oxidized in the closed system because of longer contact with the oxidant. Before each use inspect culture-tube caps for breaks in the TFE liner. Select culture-tube size for the degree of sensitivity desired. Use the 25- × 150-mm tube for samples with low COD content because a larger volume sample can be treated.

2. Apparatus

a. Digestion vessels: Preferably use borosilicate culture tubes, 16- × 100-mm, 20- × 150-mm, or 25- × 150-mm, with TFE-lined screw caps. Alternatively, use borosilicate ampules, 10-mL capacity, 19- to 20-mm diam.

b. Heating block, cast aluminum, 45 to 50 mm deep, with holes sized for close fit of culture tubes or ampules.

c. Block heater or oven, to operate at 150 ± 2°C. NOTE: Severe damage of most culture tube closures from oven digestion introduces a potential source of contamination and increases the probability of leakage. Use an oven for culture-tube digestion only when it has been determined that 2 h exposure at 150°C will not damage the caps.

d. Ampule sealer: Use only a mechanical sealer to insure strong, consistent seals.

3. Reagents

a. Standard potassium dichromate digestion solution, 0.0167*M:* Add to about 500 mL distilled water 4.913 g $K_2Cr_2O_7$, primary standard grade, previously dried at 103°C for 2 h, 167 mL conc H_2SO_4, and 33.3 g $HgSO_4$. Dissolve, cool to room temperature, and dilute to 1000 mL.

b. Sulfuric acid reagent: See Section 5220B.3*b*.

c. Ferroin indicator solution: See Section 5220B.3*c*.

d. Standard ferrous ammonium sulfate titrant (FAS), approximately 0.10*M:* Dissolve 39.2 g $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ in distilled water. Add 20 mL conc H_2SO_4, cool, and dilute to 1000 mL. Standardize solution daily against standard $K_2Cr_2O_7$ digestion solution as follows:

Add reagents according to Table 5220:I to a culture tube containing the correct volume of distilled water substituted for sample. Cool tube to room temperature and add 0.05 to 0.10 mL (1 to 2 drops) ferroin indicator and titrate with FAS titrant.

$$\text{Molarity of FAS solution} = \frac{\text{Volume } 0.0167M\ K_2Cr_2O_7 \text{ solution titrated, mL}}{\text{Volume FAS used in titration, mL}} \times 0.10$$

e. Sulfamic acid: See Section 5220B.3*f*.

f. Potassium hydrogen phthalate standard: See Section 5220B.3*g*.

4. Procedure

Wash culture tubes and caps with 20% H_2SO_4 before first use to prevent contamination. Refer to Table 5220:I for proper sample and reagent volumes. Place sample in culture tube or ampule and add digestion solution. Carefully run sulfuric acid reagent down inside of vessel so an acid layer is formed under the sample-digestion solution layer. Tightly cap tubes or seal ampules, and invert each several times to mix completely. CAUTION: *Wear face shield and protect hands from heat produced when contents of vessels are mixed. Mix thoroughly before applying heat to prevent local heating of vessel bottom and possible explosive reaction.*

Place tubes or ampules in block digester or oven preheated to 150°C and reflux for 2 h. Cool to room temperature and place vessels in test tube rack. Remove culture tube caps and add small TFE-covered magnetic stirring bar. If ampules are used, transfer contents to a larger container for titrating. Add 0.05 to 0.10 mL (1 to 2 drops) ferroin indicator and stir rapidly on magnetic stirrer while titrating with 0.10*M* FAS. The end point is a sharp color change from blue-green to reddish brown, although the blue-green may reappear within minutes. In the same manner reflux and titrate a blank containing the reagents and a volume of distilled water equal to that of the sample.

TABLE 5220:I. SAMPLE AND REAGENT QUANTITIES FOR VARIOUS DIGESTION VESSELS

Digestion Vessel	Sample *mL*	Digestion Solution *mL*	Sulfuric Acid Reagent *mL*	Total Final Volume *mL*
Culture tubes:				
16 × 100 mm	2.5	1.5	3.5	7.5
20 × 150 mm	5.0	3.0	7.0	15.0
25 × 150 mm	10.0	6.0	14.0	30.0
Standard 10-mL ampules	2.5	1.5	3.5	7.5

5. Calculation

$$\text{COD as mg } O_2/\text{L} = \frac{(A - B) \times M \times 8000}{\text{mL sample}}$$

where:

A = mL FAS used for blank,
B = mL FAS used for sample, and
M = molarity of FAS.

6. Precision and Bias

Sixty synthetic samples containing potassium hydrogen phthalate and NaCl were tested by six laboratories. At an average COD of 195 mg O_2/L in the absence of chloride, the standard deviation was ±11 mg O_2/L (coefficient of variation, 5.6%). At an average COD of 208 mg O_2/L and 100 mg Cl^-/L, the standard deviation was ±10 mg O_2/L (coefficient of variation, 4.8%).

5220 D. Closed Reflux, Colorimetric Method

1. General Discussion

a. Principle: See Section 5220B.1*a*. Colorimetric reaction vessels are sealed glass ampules or capped culture tubes. Oxygen consumed is measured against standards at 600 nm with a spectrophotometer.

b. Interferences and limitations: See Section 5220C.1*b*.

2. Apparatus

a. See Section 5220C.2.

b. Spectrophotometer, for use at 600 nm with access opening adapter for ampule or 16-, 20-, or 25-mm tubes.

3. Reagents

a. Digestion solution: Add to about 500 mL distilled water 10.216 g $K_2Cr_2O_7$, primary standard grade, previously dried at 103°C for 2 h, 167 mL conc H_2SO_4, and 33.3 g $HgSO_4$. Dissolve, cool to room temperature, and dilute to 1000 mL.

b. Sulfuric acid reagent: See 5220B.3*b*.

c. Sulfamic acid: See Section 5220B.3*f*.

d. Potassium hydrogen phthalate standard: See Section 5220B.3*g*.

4. Procedure

a. Treatment of samples: Measure suitable volume of sample and reagents into tube or ampule as indicated in Table 5220:I. Prepare, digest, and cool samples, blank, and one or more standards as directed in Section 5220C.4.

b. Measurement of dichromate reduction: Invert cooled samples, blank, and standards several times and allow solids to settle before measuring absorbance. Dislodge solids that adhere to container wall by gentle tapping and settling. Insert unopened tube or ampule through access door into light path of spectrophotometer set at 600 nm. Read absorbance and compare to calibration curve. Use optically matched culture tubes or ampules for greater sensitivity; discard scratched or blemished glassware.

c. Preparation of calibration curve: Prepare at least five standards from potassium hydrogen phthalate solution with COD equivalents from 20 to 900 μg O_2/L. Make up to volume with distilled water; use same reagent volumes, tube, or ampule size, and digestion procedure as for samples. Prepare calibration curve for each new lot of tubes or ampules or when standards prepared in ¶ 4*a* differ by ≥ 5% from calibration curve.

5. Calculation

$$\text{COD as mg } O_2\text{/L} = \frac{\text{mg } O_2 \text{ in final volume} \times 1000}{\text{mL sample}}$$

6. Precision and Bias

Forty-eight synthetic samples containing potassium hydrogen phthalate and NaCl were tested by five laboratories. At an average COD of 193 mg O_2/L in the absence of chloride, the standard deviation was ±17 mg O_2/L (coefficient of variation 8.7%). At an average COD of 212 mg O_2/L and 100 mg Cl^-/L, the standard deviation was ±20 mg O_2/L (coefficient of variation, 9.6%).

7. Bibliography

JIRKA, A.M. & M.J. CARTER. 1975. Micro semi-automated analysis of surface and wastewaters for chemical oxygen demand. *Anal. Chem.* 47:1397.

HIMEBAUGH, R.R. & M.J. SMITH. 1979. Semimicro tube method for chemical oxygen demand. *Anal. Chem.* 51:1085.

5310 TOTAL ORGANIC CARBON (TOC)*

5310 A. Introduction

1. General Discussion

The organic carbon in water and wastewater is composed of a variety of organic compounds in various oxidation states. Some of these carbon compounds can be oxidized further by biological or chemical processes, and the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) may be used to characterize these fractions. The presence of organic carbon that does not respond to either the BOD or COD test makes them unsuitable for the measurement of total organic carbon. Total organic carbon (TOC) is a more convenient and direct expression of total organic content than either BOD or COD, but does not provide the same kind of information. If a repeatable empirical relationship is established between TOC and BOD or COD, then TOC can be used to estimate the accompanying BOD or COD. This relationship must be established independently for each set of matrix conditions, such as various points in a treatment process. Unlike BOD or COD, TOC is independent of the oxidation state of the organic matter and does not measure other organically bound elements, such as nitrogen and hydrogen, and inorganics that can contribute to the oxygen demand measured by BOD and COD. TOC measurement does not replace BOD and COD testing.

To determine the quantity of organically bound carbon, the organic molecules must be broken down to single carbon units and converted to a single molecular form that can be measured quantitatively. TOC methods utilize heat and oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants to convert organic carbon to carbon dioxide (CO_2). The CO_2 may be measured directly by a nondispersive infrared analyzer, it may be reduced to methane and measured with a flame ionization detector, or CO_2 may be titrated chemically.

2. Fractions of Total Carbon

The methods and instruments used in measuring TOC analyze fractions of total carbon (TC) and measure TOC by two or more determinations. These fractions of total carbon are defined as: inorganic carbon (IC)—the carbonate, bicarbonate, and dissolved CO_2; total organic carbon (TOC)—all carbon atoms covalently bonded in organic molecules; dissolved organic carbon (DOC)—the fraction of TOC that passes through a 0.45-μm-pore-diam filter; nondissolved organic carbon (NDOC)—also referred to as particulate organic carbon, the fraction of TOC retained by a 0.45-μm filter; purgeable organic carbon (POC)—also referred to as volatile organic carbon, the fraction of TOC removed from an aqueous solution by gas stripping under specified conditions; and nonpurgeable organic carbon (NPOC)—the fraction of TOC not removed by gas stripping.

In most water samples, the IC fraction is many times greater than the TOC fraction. Eliminating or compensating for IC interferences requires multiple determinations to measure true TOC. IC interference can be eliminated by acidifying samples to

*Approved by Standard Methods Committee, 1985.

CODE OF LOGGING PRACTICES

Crown Timbered Lands

PORT MACQUARIE REGION

FORESTRY COMMISSION OF N.S.W.

JUNE 1988

INDEX

1. SUMMARY

This code will apply to all harvesting operations controlled by the Port Macquarie Forestry Region.

Set out hereunder are codes of logging practice to ensure:-

- good standards of workmanship;
- safe working practices;
- protection of the forest and its environment;
- adequate accountability for products obtained.

All contractors and/or operators in State Forests and other Crown-timber lands are required to comply with the provisions of this code.

2. LEGAL

2.1 Operations on State Forests and other Crown Lands are governed by various Acts. The Acts and their principal provisions are described briefly herein.

2.2 FORESTRY ACT 1916 AND REGULATIONS UNDER THE ACT (administered by the Forestry Commission of N.S.W.)

2.2.1 The Commission is empowered to control the removal of timber and products, the use of fire and many other matters relevant to the proper management of areas under its control.

2.2.2 Arising from 2.2.1, the Commission in conjunction with the Catchment Areas Protection Board has prescribed Standard Erosion Mitigation Conditions for Logging and Clearing in New South Wales and all operations shall conform to these conditions. Nothing expressed in this Code shall affect these Standard Conditions, the latest edition of which is dated June, 1984.

2.2.3 All commercial harvesting operations involving a royalty value above an amount specified by the Commission will be authorised by Timber Licences.

2.2.4 Contractors who engage operators must hold current Contractors Licences.

2.2.5 Operators engaged by holders of Timber Licences or Contractors Licences must hold current Operators Licences.

2.2.6 Timber, Contractor and Operator Licences contain conditions binding on the holders. Nothing expressed in this Code shall affect the conditions attached to any of these licences.

2.2.7 The non observance of an instruction issued by an authorised officer or a breach of licence condition, which embraces inter alia a breach of this Code may lead to the imposition of sanctions. These could include a warning letter, a penalty notice, a suspension of licence, prosecution, cancellation of licence or non renewal of licence.

2.2.8 (i) An operator or contractor suspended from operating by verbal direction from an authorised officer or employee is to cease work immediately. The operator or contractor has a right to make representations to the Regional Forester Port Macquarie within 24 hours.

(ii) If the Regional Forester is of the view that the suspension should stand after consideration of the District Forester's report and any representations made, suspension advice will be served on the operator or contractor as soon as is practical.

2.3 WORKERS COMPENSATION ACT 1987

(Administered by the Workers Compensation Commission)

All employees engaged in harvesting must be insured under the provision of the Workers Compensation Act.

2.4 OCCUPATIONAL HEALTH AND SAFETY ACT

(Administered by the Department of Industrial Relations)

All persons engaged in the Timber Industry are required to comply with the provisions of this Act. The Forestry Commission as "owner" of State Forests has a special responsibility under Sections 16(1) and 17(1) of the Act to ensure that no one is exposed to risks to their health or safety whilst in the forest environs.

2.5 FACTORIES SHOPS AND INDUSTRIES ACT, 1962 and TIMBER INDUSTRY (HEALTH AND SAFETY) REGULATIONS 1983

(Administered by the Department of Industrial Relations)

All persons involved in the Timber Industry are required to comply with these regulations. Included in the provisions are requirements covering the proficiency of workers, first aid, machinery, felling and logging and hand tools.

2.6 MOTOR TRAFFIC ACT 1909 AND STATES ROAD ACT 1919

(Administered by the Department of Motor Transport)

2.6.1 All motorised vehicles engaged in the haulage of timber on roads open to the public in State Forests and Crown timber lands are required to be registered in accordance with provisions of the Motor Traffic Act and to comply with the provisions of the Regulations made under the [redacted] Roads Act.

2.6.2 Logging plant other than vehicles described in 2.6.1 above shall be covered by an Unregistered Vehicles permit for the Operation of Logging Vehicles issued by the Department of Motor Transport.

2.6.3 All drivers of vehicles operating in State Forests and Crown Timber lands are required to be licensed in accordance with the Act.

2.7 LOCAL GOVERNMENT ACT 1919

2.7.1 Littering. It is an offence to deposit litter in State Forests. Forestry officers are authori[redacted] to take action under this Act.

2.7.2 Load Limits. All vehicles using for[redacted]ads shall comply with the Ordinances under the Local Government Act. In regard to load limits these are Ordinances 30C and 30D.

2.8 NATIONAL PARKS AND WILDLIFE ACT 1974

(Administered by the National Parks and Wildlife Service)

2.8.1 Aboriginal Relics. Any relic discovered is to be left undisturbed and reported to the District Forester.

2.8.2 Fauna. Almost all native mammals, birds and reptiles are protected fauna and may not be taken or killed.

2.8.3 Protected Native Plants. Protected native plants may not be picked or removed unless authorised by a licence issued by the Commission.

2.9 SURVEYORS ACT 1929 and SURVEY CO-ORDINATION ACT 1949

No unauthorised person may deface or interfere with any survey mark.

3. SAFETY

3.1 All work performed in the Forest shall be in accordance with the Timber Industry (Health and Safety) Regulation, 1982 and the Occupational Health and Safety Act, 1983 and nothing in this Code shall affect the provisions of this legislation.

3.2 An employee shall comply with all reasonable directions given by the employer pertaining to safety and report to the employer without delay any work situation or vehicle or tool condition which has become or is likely to become a source of danger.

3.3 Industry supervisors shall give effect to Section 5a of the Regulation by ensuring that an employer does not permit an employee to undertake any work unless that employee has been adequately trained and instructed as to

. any dangers associated with that work and

. in any safety precautions which ought to be taken.

3.4 Industry supervisors shall give effect to Section 5b of the Regulation by ensuring that an employer does not permit an employee to operate without competent supervision any power-driven tool, machine or equipment unless the employee has been adequately trained and instructed in its operation and is capable of safely operating it without supervision.

3.5 Employers shall provide their employees with, contractors shall provide themselves with:

a) an approved safety helmet;

b) suitable heavy-duty footwear, having firm ankle support and non-slip soles.

Such equipment shall be worn whilst on the Forest and shall be maintained in a serviceable condition.

3.6 Employers, contractors and employees shall comply with the hearing conservation provisions of Section 7 of the Regulation.

3.7 Employers shall provide first-aid chests

a) at each logging site within reasonable distance of every employee;

b) on every vehicle used by or on behalf of the employer to transport any person to or from the site of logging work.

These first-aid chests shall be equipped, marked and maintained as in the Regulation.

3.8 Operators in the timber industry shall not, as far as is reasonably practical, work beyond calling distance of another person and in any event, the well being of an operator shall be ascertained at least once during the period of work as well as at the completion of the work period.

3.9 Other specific safe working conditions and practices are provided elsewhere in this code.

3.10 All work injuries are to be reported as soon as practicable to the injured person's supervisor.

4. PLANNING OF HARVESTING OPERATIONS

4.1 Where provided for in Wood Supply Agreements, the Forestry Commission shall provide an Order of Working for each calendar year for the supply of timber to that Industry no later than 30th October of the preceding year.

4.2 It is the responsibility of industry to ensure that it holds sufficient levels of log stocks to allow its mill to continue operation during periods of wet weather logging constraints. Such log stocks should be in the order of 6 - 8 weeks reserve.

4.3 Areas of suitable wet weather logging country are very limited and the operational application of planned Orders of Working will be directed towards minimising the use of such areas.

4.4 Harvesting plans will be prepared in advance for all logging areas. Such plans will include all essential features required to enable logging to proceed, such features to include

- the definition of boundaries of the logging area
- description of product(s)
- tree marking prescription, if applicable
- identification of logging tracks and dump sites
- identification of filter strips as defined in the Standard Erosion Mitigation Conditions

- identification of subunits within the logging area where logging is precluded or modified
- any special features required for the logging area
- assessed erosion hazard as defined in the Standard Erosion Mitigation Conditions.

4.5 Harvesting plans for new logging areas will be issued to the appropriate holders of Timber Licence(s), Contract Licence(s) and Operators Licence(s) prior to commencement of operations in that area.

4.6 The Timber Licensee shall endorse the harvesting plan as a practical plan or shall consult with the supervising Forester to seek amendments judged necessary. No changes to harvesting plans may be made without the prior approval of the supervising Forester.

5. TREE MARKING

5.1 Forestry Commission supervisory staff are the only personnel authorised to mark trees for removal or retention.

5.2 The identification of trees to be retained will be described in the harvesting plan applicable to the area. All unmarked trees judged to meet minimum log standards are to be felled unless it is considered unsafe to do so.

5.3 The identification of trees to be removed, whether as a follow up marking to 5.2 or as an initial marking will be described in the harvesting plan. All trees so marked are to be felled unless it is considered unsafe to do so.

5.4 No person other than the supervising Forestry Officer shall deface or cancel any mark on a tree. The supervising Officer shall inform contractors or operators the identification of a cancelled mark.

6. FELLING

6.1 No person shall operate a chain saw unless holding an accreditation certificate acceptable to the Forestry Commission appropriate to the class of timber in which he is working, unless the operator holds a licence endorsed to the effect that chain saw operation is permitted under adequate supervision from a fully accredited person.

6.2 The holder of the contractors licence or the timber licence shall be responsible for erecting signs in conformity with AS1319-1979 indicating "Tree Felling in Progress" so that they are clearly visible to oncoming traffic from either direction when felling is in progress.

6.3 Stump heights shall be kept to the minimum, consistent with safe working practices and with maximum recovery of utilisable timber. Subject to these considerations, stump height should normally not exceed 50% of stump diameter.

6.4 Directional felling, including the use of wedges shall be used to both minimise damage to retained stems and to comply with safe and efficient felling practice.

6.5 All trees over 20 cm D.B.H.O.B. shall be felled using a scarf and back cut.

6.6 A minimum distance of twice the height of the tree being felled shall be maintained between persons or groups working.

6.7 Trees lodged or partially cut shall be completely felled or otherwise made safe as soon as practicable.

Any marked tree felled in error is to be reported as soon as is practicable to the Commission's supervisor.

6.9 All trees felled shall be processed to achieve maximum utilisation. Minimum log specifications for all products will be ascertained. Minimum quota sawlog specifications for Port Macquarie Region are given in Appendix 1 of this Code.

6.10 Filter strips as defined in the Standard Erosion Mitigation Conditions shall be identified in harvesting plans together with any additional constraints or conditions, (often associated with felling), deemed necessary.

No tree shall be deliberately or negligently felled into a stream within a filter strip. Accidental cases of heads lodging into such a stream shall be reported to the Commission to determine whether their removal is justified. Any removal of the head should minimise disturbance to the bed and the bank of the stream.

6.12 Trees shall not be felled across roads, tracks, (including road batters, table drains and inverts of drainage structures), or other improvements or structures unless authorised by the Commission. Where such trees are felled under authority, the trees together with associated slash and debris shall be removed as soon as practicable and repairs effected immediately.

7. SNIGGING AND DUMPING

7.1 All operations shall be carried out in such a manner as to minimise soil disturbance, water pollution and environmental damage generally. Disturbance to drainage lines not designated as filter strips should be afforded special protection, and on completion of operations crossings of dry streams by minor roads or snig tracks shall have the sites of the crossing restored to its original condition as closely as possible.

7.2 Snig track construction is not permitted on slopes over 35°, (30° for High Erosion Hazard) unless specifically authorised.

7.3 Grades on snig tracks shall not exceed 25° unless specifically authorised.

7.4 Mechanical logging equipment shall not enter filter strips except to provide access for approved crossing points of drainage lines.

7.5 Where possible, surface vegetation shall not be removed from snig tracks, and as far as is possible snigging shall be uphill.

7.6 "Blading Off" on minor roads and snig tracks is prohibited unless specifically authorised.

7.7 Construction of snig tracks will aim at minimising damage to retained stems, including regeneration.

7.8 Snigging across or along roads or trails will not be permitted except as authorised by the Commission.

7.9 Harvesting plan areas shall be worked in a systematic manner, as directed by a Forest Officer, to ensure that minimum number of snig tracks and dumps are worked at any one time.

7.10 Drainage of snig tracks and minor roads, other than permanent fire trails, shall be carried out in conformity with the Standard Erosion Mitigation Conditions. The required frequency of cross drainage banks will be prescribed in the harvesting plan. Drainage shall be carried out progressively on each track upon completion of, or temporary cessation of, operations.

7.11 Drainage of fire trails or non piped other roads shall be by crossfall (outfall) drainage or, where run off cannot be controlled, by open cross drains. Works shall be undertaken in conformity with the "Guidelines of Planning Construction and Maintenance of Trails (1983)", issued jointly by the Commission and the Soil Conservation Service.

7.12 Log dumps shall be located as specified in the harvesting plan and shall not be located closer than 10 metres from a filter strip or drainage line. The location of additional or alternative dumps require specific approval.

7.13 Dump size will be minimised subject to efficient operations.

7.14 On completion of operations dumps are to be drained, ripped if directed and unless otherwise authorised shall be levelled and have stockpiled topsoil replaced.

7.15 Unless otherwise authorised by the Commission, bark accumulated at roadside or dump shall be either returned to the forest floor and dispersed or buried in a manner as to not create a fire hazard for retained trees.

7.16 Logs requiring inspections at dump shall be left in a safe position.

7.17 In integrated operations, product segregation will be as directed by the Commission's supervisor.

7.18 Log stacks will be constructed so that they are stable and pose no risk to those working in the dump area.

8. LOG MEASUREMENT, MARKING AND RECORDING

8.1 Unless otherwise authorised by the Commission each item of timber shall be

a) marked to identify the area on which it was cut, and

b) measured, with such measurements marked on the item before it is removed from the area.

8.2 No timber shall be removed from the area unless the timber has been branded with a Commission brand or its removal has been otherwise authorised by the Commission.

8.3 Unless logs have been tallied by the Commission, delivery dockets in a format approved by the Commission shall be completed in relation to each load before it is removed from that area.

8.4 Markings on logs as in 8.1, shall not be altered, defaced or removed unless otherwise authorised by the Commission.

9. ROAD HAULAGE AND USE OF ROADS

9.1 Road haulage vehicles shall conform with Regulations prescribed under the Motor Traffic Act, comply with load limits imposed under the Ordinances of the Local Government Act and safety aspects prescribed under Timber Industry Regulations.

9.2 Roads may be closed to haulage vehicles when in the opinion of the supervising Forestry Officer damage to the road formation or its structure are expected to occur.

9.3 The Commission will carry out normal maintenance to forest roads following completion of operations. However the relevant licensee will be responsible for repair of excessive damage caused by irresponsible actions.

9.4 No vehicle shall be loaded whilst standing on or within 10 metres of a permanent road without the prior approval of the supervising Forester.

9.5 All loads are to be securely bound by a minimum of two binding chains, wire ropes or other devices prior to leaving the log dump.

9.6 No haulage tracks other than those allowed for in the harvesting plan will be constructed without the permission of the supervising Forest Officer.

10. WET WEATHER LOGGING OPERATIONS

10.1 Application

Wet weather constraints on log extraction and haulage will apply to all operations. Automatic closures will apply under certain defined circumstances. Closure other than automatic closures will be applied when in the opinion of the supervising Forester, either roads and tracks are likely to be damaged by operations, or the quality of water entering drainage lines is adversely affected.

10.2 Automatic Closures

Automatic closures will apply to vehicles engaged in log haulage whenever/whilever water commences/continues to flow on road surfaces, other than bitumen or gravelled, including natural gravel. Such closures shall continue until active run off is confined to table drains. No notification to industry will be necessary.

10.3 Notified Closures

10.3.1 Where in the opinion of the supervising Forester closures in addition to automatic closures are required, timber licensees will be advised orally of declarations, terminations and specific constraints relating to notified closures. Timber licensees shall advise contractors and operators of such closures, except in the case of integrated operations where notice shall be given by the Commission.

10.3.2 The Forestry Commission reserves the right to notify operators in the forest direct where it is not possible to immediately advise the Timber Licencee of declarations of notified closures. In such cases the Timber Licencee will be advised as soon as possible.

11. FIRE PRECAUTIONS

11.1 GENERAL

11.1.1 Restrictions on the use of fire on State Forests and Timber Reserves are prescribed in Clauses 21-35 of the Forestry Regulation 1983.

11.1.2 Welding or the use of oxy-acetylene equipment should only be carried out on machinery positioned on ground which has been cleared of inflammable material.

11.1.3 The Commission may suspend logging when the fire danger is high to extreme. The supervising Forester will advise all concerned when these conditions prevail.

11.1.4 All licensees are required to report any unauthorised fire and to assist in its control if required.

11.2 MECHANICAL PLANT AND EQUIPMENT

11.2.1 The electrical and exhaust systems of all motorised equipment shall be maintained in good order to prevent electrical fires or fires from defective exhaust systems.

11.2.2 Machinery is to be kept free of surplus oils, dust impregnated with oil and vegetative matter.

11.2.3 The exhaust system of any equipment working in a fixed position shall be directed away from any inflammable material.

11.2.4 During the Bush Fire Danger Period, all crews engaged in falling or snigging shall have available a serviceable fire extinguisher or knapsack spray filled with water plus a rakehoe.

11.2.5 Defective machinery shall be withdrawn from use until the supervising Forestry Officer is satisfied the defect has been rendered safe.

11.3 FUEL STORAGE

Bulk fuel or oil storage units with a capacity of over 20 litres shall be located on an area which has been cleared of flammable material for a distance of not less than 4.5 metres. Such units should be:

(a) capable of instant removal from site in an emergency; and

(b) well maintained, free of leaks and free of accumulated debris.

11.4 USE OF FIRE

Fires for heating, preparing meals, boiling water or for any other purpose may be lit in a fireplace of a type approved by the supervising Forester. Any such fire should be not less than 4.5 metres from any log, stump or tree and the ground within 1.5 metres of the fire at all points shall be cleared of all flammable matter. Any such fire should be completely extinguished when being left, either temporarily or otherwise.

12. MISCELLANEOUS

12.1 ABORIGINAL SITES

Any aboriginal site or artifact found within the area shall be avoided and reported to the District Forester. Unintentional damage to sites or artifacts will be reported to the District Forester.

12.2 FIRE ARMS

Fire arms or any other hunting device shall not be carried by a licensee unless authorised by a Hunting Permit under the Forestry Act.

12.3 AESTHETIC AND RELATED CONSIDERATIONS

12.3.1 All litter, rubbish or garbage associated in any way with the operation shall be properly disposed of or removed from the area.

12.3.2 Camping sites associated with harvesting shall be sited only in locations approved by the District Forester and shall be maintained and left (when vacated) in a condition deemed satisfactory by the District Forester.

12.3.3 Sites required for further processing following extraction shall be sited only in locations approved by the District Forester and shall be maintained and left (when vacated) in a condition deemed satisfactory by the District Forester.

12.4 ACCESS

12.4.1 The lawful rights of access of any person to the area shall not be interfered with.

12.4.2 Any gates opened to give access to the area shall be closed immediately after use.

12.5 COMMENCEMENT AND TERMINATION OF OPERATIONS

The Commission shall be informed when operations on an area or part of an area are nearing completion to enable the undertaking of relevant inspections. No operations are to be commenced on any new areas or parts of existing areas unless authorised by the Commission.

APPENDIX 1

QUOTA SAWLOGS
COMPULSORY UTILISATION STANDARDS
PORT MACQUARIE REGION - FROM 1ST JANUARY 1987

MINIMUM SIZE SPECIFICATIONS

Min. butt diameter	Min. length	Min. smallend diameter under bark
- Lengths 4m and over	2.4m	- Regrowth Forests 25cm
Regrowth Forests 34cm		- Mature Forests 30cm
Mature Forests 40cm		
- Lengths < 4m		
Regrowth Forests 45cm		
Mature Forests 50cm		

MAXIMUM DEFECT BY LOG DIAMETER

Log Diam. (cm)	Maximum Pipe (cm)	Minimum Net Wood Thick-ness (cm)	Maximum Defect Percent (incl. length allow-ance)	Log Diam. (cm)	Maximum Pipe (cm)	Minimum Net Wood Thick-ness (cm)	Maximum Defect Percent (incl. length allow-ance)
<26	Nil	(12)	25	94	60	(17)	64
26	2	(12)	25	96	62	(17)	65
28	4	(12)	27	98	64	(17)	65
30	6	(12)	29	100	64	(18)	65
32	8	(12)	31	102	66	(18)	65
34	10	(12)	33	104	68	(18)	65
36	12	(12)	36	106	68	(19)	65
38	14	(12)	38	108	70	(19)	65
40	16	(12)	40	110	72	(19)	66
42	18	(12)	43	112	74	(19)	66
44	20	(12)	45	114	74	(20)	66
46	22	(12)	47	116	76	(20)	66
48	24	(12)	49	118	78	(20)	67
50	26	(12)	51	120	80	(20)	67
52	28	(12)	53	122	80	(21)	67
54	30	(12)	54	124	82	(21)	67
56	32	(12)	56	126	84	(21)	67
58	34	(12)	58	128	84	(22)	67
60	36	(12)	59	130	86	(22)	67
62	38	(12)	60	132	88	(22)	67
64	38	(13)	60	134	90	(22)	67
66	40	(13)	60	136	90	(23)	67
68	42	(13)	60	138	92	(23)	67
70	42	(14)	60	140	94	(23)	68
72	44	(14)	61	142	94	(24)	68
74	46	(14)	62	144	96	(24)	68
76	48	(14)	62	146	98	(24)	68
78	48	(15)	62	148	100	(24)	68
80	50	(15)	62	150	100	(25)	68
82	52	(15)	63	152	102	(25)	68
84	54	(15)	63	154	104	(25)	68
86	54	(16)	63	156	104	(26)	68
88	56	(16)	64	158	106	(26)	68
90	58	(16)	64	160	108	(26)	68
92	58	(17)	64	180	122	(29)	68

POLLUTION CONTROL LICENCE

POLLUTION CONTROL ACT 1970

Licence in respect of section 17A(b)

In pursuance of section 17D of the Pollution Control Act 1970, the Environment Protection Authority grants the Licence set out below.

Licensee:	The Forestry Commission of New South Wales
Land covered by Licence:	Land in the Coffs Harbour Region, being the land described at the end of this Licence.
Activity covered by Licence:	Logging operations as defined at the end of this Licence.
Date of Licence:	7 May 1992
Duration of Licence:	1 year from date of Licence.

CONDITIONS OF LICENCE

1. (1) The Forestry Commission must carry out logging operations covered by this Licence in accordance with the relevant provisions of the Code of Logging Practices prepared under the Forestry Act 1916 applying, as at the date of this Licence, to the land. A Code which applies is the "Code of Logging Practices - State Forests - Coffs Harbour Region" and the relevant provisions are those which will prevent or minimise the pollution of waters.

(2) If no Code of Logging Practices applies to any of the land, the Forestry Commission must not carry out logging operations on the land except in a manner generally in accordance with the relevant provisions of a Code of Logging Practices under the Forestry

Act 1916 approved by the EPA as appropriate for application to the land. The Forestry Commission must not carry out logging operations on the land until the EPA approves a Code for application to the land.

2. (1) The Forestry Commission must carry out logging operations on the land in accordance with the "Standard Erosion Mitigation Conditions for Logging in NSW July 1990", as amended from time to time, published jointly by the former Soil Conservation Service of NSW and the Forestry Commission.

(2) The Forestry Commission must notify the EPA about any proposed amendments to that document.

(3) Those amendments do not have any effect for the purposes of this condition until they are approved by the EPA in writing.

3. The Forestry Commission must comply with any special site specific conditions agreed to by the Forestry Commission and the Director-General of the Department of Conservation and Land Management concerning additional soil conservation works to be undertaken in carrying out logging operations on the land.

4. All matter and substances on the site of logging operations must be handled, moved and stored in a proper and efficient manner for the purpose of preventing the pollution of waters.

5. The transport and storage of fuel and the re-fuelling of equipment must be carried out in a manner to prevent the pollution of waters as a result of spillage.

6. All servicing and repairs of equipment must be carried out in a manner to prevent the pollution of waters.

7. Hazard reduction burning must be carried out in a manner which preserves all filter strips to the greatest extent practicable.

8. Bark removal operations must not be carried out within, or within 10 metres of, any filter strip.

9. Stripped bark must not be placed within, or within 10 metres of any filter strip.

10. (1) The Forestry Commission must notify the closest Regional Office of the EPA if it becomes aware of any pollution of waters which may have been caused by logging operations and the pollution:

(a) makes, or may be reasonably expected to make, those waters noxious or poisonous; or

(b) makes, or may be reasonably expected to make, those waters harmful or potentially harmful to the health, welfare, safety or property of human beings; or

(c) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life; or

(d) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to plants or other vegetation.

(2) The Forestry Commission must notify the EPA not later than 24 hours of becoming aware of the pollution, or if this is not practicable, as soon as practicable after that time.

(3) The Forestry Commission is to be taken to be aware of the pollution of waters if an employee of the Commission at or above the rank of District Forester is aware of the pollution.

11. If the EPA so requests, the Forestry Commission must provide a written report to the EPA about pollution notified to the EPA under Condition No. 10. The written report must be provided not later than 21 days after the request.

12. Any licence issued by the Forestry Commission under the Forestry Act 1916 which authorises the holder to carry out any logging operations covered by this Licence must be issued subject to conditions which require the holder of the licence to comply with Condition Nos. 1-9 of this Licence in the same way as the Forestry Commission must comply with those conditions.

13. The Forestry Commission must monitor compliance with the conditions referred to in Condition No. 12.

14. Copies of the following documents must be made available at all district offices of the Forestry Commission within the Coffs Harbour Region for inspection by any person and must be produced on demand to an officer of the EPA:

- this Licence;
- the Codes of Logging Practices referred to in

POLLUTION CONTROL LICENCE - COFFS HARBOUR REGION

Condition No. 1;

- any approval given by the EPA under Condition No. 1(2);
- the document entitled "Standard Erosion Mitigation Conditions for Logging in NSW July 1990" as amended by amendments to that document approved by the EPA.

Nothing in this Licence permits logging operations in contravention of the Timber Industry (Interim Protection) Act 1992.

Definitions:

"EPA" means the Environment Protection Authority.

"land in the Coffs Harbour Region" means the land designated as being within the Coffs Harbour Region under the Forestry Regulation 1983 as at 18 March 1992.

"logging operations" means:

(a) the cutting and removal of timber from land;

(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and

(c) hazard reduction burning carried out on Crown-timber lands within the meaning of the Forestry Act 1916.

"pollution" has the same meaning as under the Clean Waters Act 1970.

NEIL SHEPHERD
Director-General
Environment Protection Authority

1.

POLLUTION CONTROL LICENCE

POLLUTION CONTROL ACT 1970

Licence in respect of section 17A(b)

In pursuance of section 17D of the Pollution Control Act 1970, the Environment Protection Authority grants the Licence set out below.

Licensee:	The Forestry Commission of New South Wales
Land covered by Licence:	Land in the Coffs Harbour Region, being the land described at the end of this Licence.
Activity covered by Licence:	Logging operations as defined at the end of this Licence.
Date of Licence:	7 May 1992
Duration of Licence:	1 year from date of Licence.

CONDITIONS OF LICENCE

1. (1) The Forestry Commission must carry out logging operations covered by this Licence in accordance with the relevant provisions of the Code of Logging Practices prepared under the Forestry Act 1916 applying, as at the date of this Licence, to the land. A Code which applies is the "Code of Logging Practices - State Forests - Coffs Harbour Region" and the relevant provisions are those which will prevent or minimise the pollution of waters.

(2) If no Code of Logging Practices applies to any of the land, the Forestry Commission must not carry out logging operations on the land except in a manner generally in accordance with the relevant provisions of a Code of Logging Practices under the Forestry

Act 1916 approved by the EPA as appropriate for application to the land. The Forestry Commission must not carry out logging operations on the land until the EPA approves a Code for application to the land.

2. (1) The Forestry Commission must carry out logging operations on the land in accordance with the "Standard Erosion Mitigation Conditions for Logging in NSW July 1990", as amended from time to time, published jointly by the former Soil Conservation Service of NSW and the Forestry Commission.

(2) The Forestry Commission must notify the EPA about any proposed amendments to that document.

(3) Those amendments do not have any effect for the purposes of this condition until they are approved by the EPA in writing.

3. The Forestry Commission must comply with any special site specific conditions agreed to by the Forestry Commission and the Director-General of the Department of Conservation and Land Management concerning additional soil conservation works to be undertaken in carrying out logging operations on the land.

4. All matter and substances on the site of logging operations must be handled, moved and stored in a proper and efficient manner for the purpose of preventing the pollution of waters.

5. The transport and storage of fuel and the re-fuelling of equipment must be carried out in a manner to prevent the pollution of waters as a result of spillage.

6. All servicing and repairs of equipment must be carried out in a manner to prevent the pollution of waters.

7. Hazard reduction burning must be carried out in a manner which preserves all filter strips to the greatest extent practicable.

8. Bark removal operations must not be carried out within, or within 10 metres of, any filter strip.

9. Stripped bark must not be placed within, or within 10 metres of any filter strip.

10. (1) The Forestry Commission must notify the closest Regional Office of the EPA if it becomes aware of any pollution of waters which may have been caused by logging operations and the pollution:

(a) makes, or may be reasonably expected to make, those waters noxious or poisonous; or

(b) makes, or may be reasonably expected to make, those waters harmful or potentially harmful to the health, welfare, safety or property of human beings; or

(c) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life; or

(d) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to plants or other vegetation.

(2) The Forestry Commission must notify the EPA not later than 24 hours of becoming aware of the pollution, or if this is not practicable, as soon as practicable after that time.

(3) The Forestry Commission is to be taken to be aware of the pollution of waters if an employee of the Commission at or above the rank of District Forester is aware of the pollution.

11. If the EPA so requests, the Forestry Commission must provide a written report to the EPA about pollution notified to the EPA under Condition No. 10. The written report must be provided not later than 21 days after the request.

12. Any licence issued by the Forestry Commission under the Forestry Act 1916 which authorises the holder to carry out any logging operations covered by this Licence must be issued subject to conditions which require the holder of the licence to comply with Condition Nos. 1-9 of this Licence in the same way as the Forestry Commission must comply with those conditions.

13. The Forestry Commission must monitor compliance with the conditions referred to in Condition No. 12.

14. Copies of the following documents must be made available at all district offices of the Forestry Commission within the Coffs Harbour Region for inspection by any person and must be produced on demand to an officer of the EPA:

- this Licence;
- the Codes of Logging Practices referred to in

Condition No. 1;

- any approval given by the EPA under Condition No. 1(2);
- the document entitled "Standard Erosion Mitigation Conditions for Logging in NSW July 1990" as amended by amendments to that document approved by the EPA.

Nothing in this Licence permits logging operations in contravention of the Timber Industry (Interim Protection) Act 1992.

Definitions:

"EPA" means the Environment Protection Authority.

"land in the Coffs Harbour Region" means the land designated as being within the Coffs Harbour Region under the Forestry Regulation 1983 as at 18 March 1992.

"logging operations" means:

(a) the cutting and removal of timber from land;

(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and

(c) hazard reduction burning carried out on Crown timber lands within the meaning of the Forestry Act 1916.

"pollution" has the same meaning as under the Clean Waters Act 1970.

NEIL SHEPHERD
Director-General
Environment Protection Authority

POLLUTION CONTROL LICENCE

POLLUTION CONTROL ACT 1970

Licence in respect of section 17A(b)

In pursuance of section 17D of the Pollution Control Act 1970, the Environment Protection Authority grants the Licence set out below.

Licensee:	The Forestry Commission of New South Wales
Land covered by Licence:	Land in the Batemans Bay Region, being the land described at the end of this Licence.
Activity covered by Licence:	Logging operations as defined at the end of this Licence.
Date of Licence:	
Duration of Licence:	1 year from date of Licence.

CONDITIONS OF LICENCE

1. (1) The Forestry Commission must carry out logging operations covered by this Licence in accordance with the relevant provisions of the Codes of Logging Practices prepared under the Forestry Act 1916 applying, as at the date of this Licence, to the land. The relevant provisions are those which will prevent or minimise the pollution of waters. These Codes include:

   (a) Code of Logging Practices - Native Forest Areas - Batemans Bay Region

(b) Code of Logging Practices - Conifer Plantations - Batemans Bay Region

(2) If no Code of Logging Practices applies to the land, the Forestry Commission must not carry out logging operations on the land except in a manner generally in accordance with the relevant provisions of a Code of Logging Practices under the Forestry Act 1916 approved by the EPA as appropriate for application to the land. The Forestry Commission must not carry out logging operations on the land until the EPA approves a Code for application to the land.

2. (1) The Forestry Commission must carry out logging operations on the land in accordance with the "Standard Erosion Mitigation Conditions for Logging in NSW July 1990", as amended from time to time, published jointly by the former Soil Conservation Service of NSW and the Forestry Commission.

(2) The Forestry Commission must notify the EPA about any proposed amendments to that document.

(3) Those amendments do not have any effect for the purposes of this condition until they are approved by the EPA in writing.

3. The Forestry Commission must comply with any special site specific conditions agreed to by the Forestry Commission and the Director-General of the Department of Conservation and Land Management concerning additional soil conservation works to be undertaken in carrying out logging operations on the land.

4. All matter and substances on the site of logging operations must be handled, moved and stored in a proper and efficient manner for the purpose of preventing the pollution of waters.

5. The transport and storage of fuel and the re-fuelling of equipment must be carried out in a manner to prevent the pollution of waters as a result of spillage.

6. All servicing and repairs of equipment must be carried out in a manner to prevent the pollution of waters.

7. Hazard reduction burning must be carried out in a manner which preserves all filter strips to the greatest extent practicable.

8. Bark removal operations must not be carried out within, or within 10 metres of, any filter strip.

9. Stripped bark must not be placed within, or within 10 metres of any filter strip.

10. (1) The Forestry Commission must notify the closest Regional Office of the EPA if it becomes aware of any pollution of waters which may have been caused by logging operations and the pollution:

    (a) makes, or may be reasonably expected to make, those waters noxious or poisonous; or

    (b) makes, or may be reasonably expected to make, those waters harmful or potentially harmful to the health, welfare, safety or property of human beings; or

    (c) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life; or

    (d) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to plants or other vegetation.

    (2) The Forestry Commission must notify the EPA not later than 24 hours of becoming aware of the pollution, or if this is not practicable, as soon as practicable after that time.

    (3) The Forestry Commission is to be taken to be aware of the pollution of waters if an employee of the Commission at or above the rank of District Forester is aware of the pollution.

11. If the EPA so requests, the Forestry Commission must provide a written report to the EPA about pollution notified to the EPA under Condition No. 10. The written report must be provided not later than 21 days after the request.

12. Any licence issued by the Forestry Commission under the Forestry Act 1916 which authorises the holder to carry out any logging operations covered by this Licence must be issued subject to conditions which require the holder of the licence to comply with Condition Nos. 1-9 of this Licence in the same way as the Forestry Commission must comply with those conditions.

13. The Forestry Commission must monitor compliance with the conditions referred to in Condition No. 12.

14. Copies of the following documents must be made available at all district offices of the Forestry Commission within the Batemans Bay Region for inspection by any person and must be produced on demand to an officer of the EPA:

    - this Licence;
    - the Codes of Logging Practices referred to in Condition No. 1;
    - any approval given by the EPA under Condition No. 1(2);
    - the document entitled "Standard Erosion Mitigation Conditions for Logging in NSW July 1990" as amended by amendments to that document approved by the EPA.

    Nothing in this Licence permits logging operations in contravention of the Timber Industry (Interim Protection) Act 1992.

Definitions:

"**EPA**" means the Environment Protection Authority.

"**land in the Batemans Bay Region**" means the land designated as being within the Batemans Bay Region under the Forestry Regulation 1983 as at 18 March 1992.

"**logging operations**" means:

(a) the cutting and removal of timber from land;

(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and

(c) hazard reduction burning carried out on Crown-timber lands within the meaning of the Forestry Act 1916.

"**pollution**" has the same meaning as under the Clean Waters Act 1970.

NEIL SHEPHERD
Director-General
Environment Protection Authority

POLLUTION CONTROL LICENCE

POLLUTION CONTROL ACT 1970

Licence in respect of section 17A(b)

In pursuance of section 17D of the Pollution Control Act 1970, the Environment Protection Authority grants the Licence set out below.

Licensee:	The Forestry Commission of New South Wales
Land covered by Licence:	Land in the Batemans Bay Region, being the land described at the end of this Licence.
Activity covered by Licence:	Logging operations as defined at the end of this Licence.
Date of Licence:	
Duration of Licence:	1 year from date of Licence.

CONDITIONS OF LICENCE

1. (1) The Forestry Commission must carry out logging operations covered by this Licence in accordance with the relevant provisions of the Codes of Logging Practices prepared under the Forestry Act 1916 applying, as at the date of this Licence, to the land. The relevant provisions are those which will prevent or minimise the pollution of waters. These Codes include:

   (a) Code of Logging Practices - Native Forest Areas - Batemans Bay Region

(b) Code of Logging Practices - Conifer Plantations - Batemans Bay Region

(2) If no Code of Logging Practices applies to the land, the Forestry Commission must not carry out logging operations on the land except in a manner generally in accordance with the relevant provisions of a Code of Logging Practices under the Forestry Act 1916 approved by the EPA as appropriate for application to the land. The Forestry Commission must not carry out logging operations on the land until the EPA approves a Code for application to the land.

2. (1) The Forestry Commission must carry out logging operations on the land in accordance with the "Standard Erosion Mitigation Conditions for Logging in NSW July 1990", as amended from time to time, published jointly by the former Soil Conservation Service of NSW and the Forestry Commission.

(2) The Forestry Commission must notify the EPA about any proposed amendments to that document.

(3) Those amendments do not have any effect for the purposes of this condition until they are approved by the EPA in writing.

3. The Forestry Commission must comply with any special site specific conditions agreed to by the Forestry Commission and the Director-General of the Department of Conservation and Land Management concerning additional soil conservation works to be undertaken in carrying out logging operations on the land.

4. All matter and substances on the site of logging operations must be handled, moved and stored in a proper and efficient manner for the purpose of preventing the pollution of waters.

5. The transport and storage of fuel and the re-fuelling of equipment must be carried out in a manner to prevent the pollution of waters as a result of spillage.

6. All servicing and repairs of equipment must be carried out in a manner to prevent the pollution of waters.

7. Hazard reduction burning must be carried out in a manner which preserves all filter strips to the greatest extent practicable.

8. Bark removal operations must not be carried out within, or within 10 metres of, any filter strip.

9. Stripped bark must not be placed within, or within 10 metres of any filter strip.

10. (1) The Forestry Commission must notify the closest Regional Office of the EPA if it becomes aware of any pollution of waters which may have been caused by logging operations and the pollution:

    (a) makes, or may be reasonably expected to make, those waters noxious or poisonous; or

    (b) makes, or may be reasonably expected to make, those waters harmful or potentially harmful to the health, welfare, safety or property of human beings; or

    (c) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life; or

    (d) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to plants or other vegetation.

    (2) The Forestry Commission must notify the EPA not later than 24 hours of becoming aware of the pollution, or if this is not practicable, as soon as practicable after that time.

    (3) The Forestry Commission is to be taken to be aware of the pollution of waters if an employee of the Commission at or above the rank of District Forester is aware of the pollution.

11. If the EPA so requests, the Forestry Commission must provide a written report to the EPA about pollution notified to the EPA under Condition No. 10. The written report must be provided not later than 21 days after the request.

12. Any licence issued by the Forestry Commission under the Forestry Act 1916 which authorises the holder to carry out any logging operations covered by this Licence must be issued subject to conditions which require the holder of the licence to comply with Condition Nos. 1-9 of this Licence in the same way as the Forestry Commission must comply with those conditions.

13. The Forestry Commission must monitor compliance with the conditions referred to in Condition No. 12.

14. Copies of the following documents must be made available at all district offices of the Forestry Commission within the Batemans Bay Region for inspection by any person and must be produced on demand to an officer of the EPA:

- this Licence;
- the Codes of Logging Practices referred to in Condition No. 1;
- any approval given by the EPA under Condition No. 1(2);
- the document entitled "Standard Erosion Mitigation Conditions for Logging in NSW July 1990" as amended by amendments to that document approved by the EPA.

Nothing in this Licence permits logging operations in contravention of the Timber Industry (Interim Protection) Act 1992.

Definitions:

"**EPA**" means the Environment Protection Authority.

"**land in the Batemans Bay Region**" means the land designated as being within the Batemans Bay Region under the Forestry Regulation 1983 as at 18 March 1992.

"**logging operations**" means:

(a) the cutting and removal of timber from land;

(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and

(c) hazard reduction burning carried out on Crown-timber lands within the meaning of the Forestry Act 1916.

"**pollution**" has the same meaning as under the Clean Waters Act 1970.

NEIL SHEPHERD
Director-General
Environment Protection Authority

POLLUTION CONTROL LICENCE

POLLUTION CONTROL ACT 1970

Licence in respect of section 17A(b)

In pursuance of section 17D of the Pollution Control Act 1970, the Environment Protection Authority grants the Licence set out below.

Licensee:	The Forestry Commission of New South Wales
Land covered by Licence:	Land in the Batemans Bay Region, being the land described at the end of this Licence.
Activity covered by Licence:	Logging operations as defined at the end of this Licence.
Date of Licence:	
Duration of Licence:	1 year from date of Licence.

CONDITIONS OF LICENCE

1. (1) The Forestry Commission must carry out logging operations covered by this Licence in accordance with the relevant provisions of the Codes of Logging Practices prepared under the Forestry Act 1916 applying, as at the date of this Licence, to the land. The relevant provisions are those which will prevent or minimise the pollution of waters. These Codes include:

   (a) Code of Logging Practices - Native Forest Areas - Batemans Bay Region

(b) Code of Logging Practices - Conifer Plantations - Batemans Bay Region

(2) If no Code of Logging Practices applies to the land, the Forestry Commission must not carry out logging operations on the land except in a manner generally in accordance with the relevant provisions of a Code of Logging Practices under the Forestry Act 1916 approved by the EPA as appropriate for application to the land. The Forestry Commission must not carry out logging operations on the land until the EPA approves a Code for application to the land.

2. (1) The Forestry Commission must carry out logging operations on the land in accordance with the "Standard Erosion Mitigation Conditions for Logging in NSW July 1990", as amended from time to time, published jointly by the former Soil Conservation Service of NSW and the Forestry Commission.

(2) The Forestry Commission must notify the EPA about any proposed amendments to that document.

(3) Those amendments do not have any effect for the purposes of this condition until they are approved by the EPA in writing.

3. The Forestry Commission must comply with any special site specific conditions agreed to by the Forestry Commission and the Director-General of the Department of Conservation and Land Management concerning additional soil conservation works to be undertaken in carrying out logging operations on the land.

4. All matter and substances on the site of logging operations must be handled, moved and stored in a proper and efficient manner for the purpose of preventing the pollution of waters.

5. The transport and storage of fuel and the re-fuelling of equipment must be carried out in a manner to prevent the pollution of waters as a result of spillage.

6. All servicing and repairs of equipment must be carried out in a manner to prevent the pollution of waters.

7. Hazard reduction burning must be carried out in a manner which preserves all filter strips to the greatest extent practicable.

8. Bark removal operations must not be carried out within, or within 10 metres of, any filter strip.

9. Stripped bark must not be placed within, or within 10 metres of any filter strip.

10. (1) The Forestry Commission must notify the closest Regional Office of the EPA if it becomes aware of any pollution of waters which may have been caused by logging operations and the pollution:

(a) makes, or may be reasonably expected to make, those waters noxious or poisonous; or

(b) makes, or may be reasonably expected to make, those waters harmful or potentially harmful to the health, welfare, safety or property of human beings; or

(c) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to animals, birds, wildlife, fish or other aquatic life; or

(d) makes, or may be reasonably expected to make, those waters poisonous, harmful or potentially harmful to plants or other vegetation.

(2) The Forestry Commission must notify the EPA not later than 24 hours of becoming aware of the pollution, or if this is not practicable, as soon as practicable after that time.

(3) The Forestry Commission is to be taken to be aware of the pollution of waters if an employee of the Commission at or above the rank of District Forester is aware of the pollution.

11. If the EPA so requests, the Forestry Commission must provide a written report to the EPA about pollution notified to the EPA under Condition No. 10. The written report must be provided not later than 21 days after the request.

12. Any licence issued by the Forestry Commission under the Forestry Act 1916 which authorises the holder to carry out any logging operations covered by this Licence must be issued subject to conditions which require the holder of the licence to comply with Condition Nos. 1-9 of this Licence in the same way as the Forestry Commission must comply with those conditions.

13. The Forestry Commission must monitor compliance with the conditions referred to in Condition No. 12.

14. Copies of the following documents must be made available at all district offices of the Forestry Commission within the Batemans Bay Region for inspection by any person and must be produced on demand to an officer of the EPA:

- this Licence;
- the Codes of Logging Practices referred to in Condition No. 1;
- any approval given by the EPA under Condition No. 1(2);
- the document entitled "Standard Erosion Mitigation Conditions for Logging in NSW July 1990" as amended by amendments to that document approved by the EPA.

Nothing in this Licence permits logging operations in contravention of the Timber Industry (Interim Protection) Act 1992.

Definitions:

"**EPA**" means the Environment Protection Authority.

"**land in the Batemans Bay Region**" means the land designated as being within the Batemans Bay Region under the Forestry Regulation 1983 as at 18 March 1992.

"**logging operations**" means:

(a) the cutting and removal of timber from land;

(b) the provision of access roads necessary to enable or assist the cutting and removal of the timber; and

(c) hazard reduction burning carried out on Crown-timber lands within the meaning of the Forestry Act 1916.

"**pollution**" has the same meaning as under the Clean Waters Act 1970.

NEIL SHEPHERD
Director-General
Environment Protection Authority

ISSUES FOR DISCUSSION WITH E.P.A. 29.4.1993

What consideration has been given to implications of ss.111 & 112 of the EPA Act in EPA's issue of 'pollution control licences'? Should an Environmental Impact Statement have been prepared?

Dr McGarity recommends a complete moratorium on logging on slopes greater than 25 degrees and advocates very close monitoring of logging of slopes between 20 and 25 degrees.
Will EPA refrain from issuing 'pollution control licences' to FCNSW or private operators for any logging or road construction activities on slopes greater than 25 degrees?

Does EPA agree that catchments which produce high water quality should never be licensed to permit 'legal' pollution within them;

Does EPA agree that consideration of 1993 applications for renewal of FCNSW's 'pollution control licences' should allow:

a) public participation;
b) consultation with other public authorities including, NSW Fisheries, NPWS, Water Resources Commission, Soil Conservation branch of Department of CaLM, etc; and
c) external verification and validation of any conditions and monitoring procedures by relevant practising scientists;

Will EPA carry out it's functions under s.17D of the Pollution Control Act 1979 in a transparent and publicly accountable manner consistent with the public interest in the protection of the environment, by a public authority?

Does EPA agree that FCNSW has demonstrated that it is unable to be relied upon to identify and report pollution incidences? What conditions will be applied to licences relating to enforcement of compliance with conditions? Monitoring?

Does EPA agree that FCNSW's 'pollution control licences' should be publicly exhibited for one month and the views of members of the public, public authorities and relevant scientists be sought in the form of submissions? Will these submissions then be taken into account in EPA's consideration of the licence renewal applications?

Has EPA Board considered, as a matter of Policy, the broader question of the role of public participation, public authority consultation and scientific validation in the activities of the Authority relating to pollution licensing?

National Forest Policy Statement requires that in the review of Codes of Logging Practice community views be actively sought. Will EPA participate in review/redraft the Code? Is compliance with Code of Logging Practice again to be a condition of the licence?

EPA prosecution of FCNSW over Oakes SF. Why is expert evidence being rejected? Will shake-up within Department of C&LM affect the strength of prosecution evidence?

MEETING WITH NEIL SHEPPARD
24 JUNE 1992
(Messer)

Sheppard: "Historical Context": Why we (EPA) issued licences:

Past: FC had a free rein protected from prosecution by *"historical immunity"* applied to all statutory authorities) - lifted by Government in last 12 months.

- FC sought licence under Pollution Control Act.
- EPA thought this = positive initiative to affect FC and water quality (not just OGF).
- From statutory view point, pine plantations just as important.
- Change from past (point source focus)
- Diffuse source issue by relying on code of practice to enshrine behaviour to achieve water quality.
- Would seek to *"rework those codes"*.
- Already a proposal for FC to rework *"those codes"* because of north coast high rainfall.
- FC cannot change codes of practice within licence situation.

The contractors: FC notice that they will be required to incorporate water quality monitoring in licence.

- Does not remove ability to prosecute where codes are breached.
- After consideration of above, decided to issue licences.
- Regional basis: May go to localised areas if codes of practice and monitoring does not work (standards of water quality) later but thinks crux is major shift in behaviour.

JA What is the standard?

WF Licences relate to logging practices.
Phase 2 - premature to be talking about water quality at catchment/sub-catchment level.

- Task is to identify standards and monitoring.

NS Phase 1 - present requirement = notify if water quality standard is broken.

JA How will they know if there is deterioration?

NS On-site inspection would reveal difference.

- *"Licence to pollute"* says if *"you have adhered.... and pollution occurs then you are protected"*
- But EPA will have to change standards and conditions.
- If we complain to EPA it would require them to prosecute.
- EPA can prosecute even if pollution did not occur (but could have).

JC Is NS aware of particular activities in a specific area eg. Coffs Harbour?

NS No, aware in general.

- Does not know if list of works etc specified were included.

WF Says they did not need to have special knowledge of specific areas.

JA Why did they move so quickly?

Table 7.8 Lucas Heights Landfill Review
Development Year, Expected Leachate Flows as a Percentage of Annual Rainfall (%)

Leachate Flow	Wet Year (1978)	Median Year (1985)	Dry Year (1980)
Stage 1	59%	56%	23%
Stage 2	35%	32%	13%
Stage 3	36%	31%	13%

When judged against annual rainfall percentages, these values are all consistent with Knight's work and values quoted from European cases.

Table 7.6 also clearly illustrates the variation in equilibrium leachate generation between years and throughout any year. Figure 7.4 which follows, illustrates these effects by plotting for the Stage 2 results, the annual leachate quantities for the 12 years of record and the monthly leachate quantities for the Stage 2 median year, 1985.

The figure shows a seven fold variation in annual quantities for the 12 years. For the median year (1985), the months of April, May, June and July represent 85% of the annual total. Both summaries are useful in illustrating the volume of the balancing storages required between years and within years.

The quantities are, however, as Table 7.7 clearly indicates, well in excess of any quantities pumped to date from Lucas Heights or the annual figure (22,000m^3 or 22 ML) that limits discharge to the ANSTO sewer.

The 22,000m^3 annual figure has never been exceeded and if it represents say 6% of incident rainfall (ignoring for the moment the missing 94%), the impact of such large leachate figures has not been discussed in the EIS.

For example, 6% of average annual rainfall for the Stage 2 development, represents 116,000m^3 or 5 times the present allowance. The matter of negotiating a new agreement with ANSTO and the SWB for these new rates has not been discussed.

If the real leachate generation figure is 32% rather than 6%, the disposal problem is significantly larger.

The difference between the two figures is sufficient grounds for a major investigation of inflows and outflows, particularly additions to groundwater and the monitoring of groundwater plumes.

SENSITIVITY TESTING

The leachate model is fundamentally a water balance model. The major assumptions of the balance are that:

1) the surface runoff coefficient is 0.2
2) evapotranspiration rates vary according to cover conditions

WF EPA did not think about impact on steep slopes when application came in (but aware of since 1985).

WF When the application came into SPCC in January - focused on opportunity to advance control of diffuse point pollution situation.

JC Should be yes or no? Did NS consider whether to or not issue licence?

NS Yes, he did consider refusal but if he refused there would be another chance to issue a licence (why not, JM?)

JC Killiekrankie seemed perfect area to refuse licence.

- What conditions would apply to refuse licence to "*diffuse point pollution*".

NS Can change licence conditions in 12 months

NS Discussion with FC re necessary changes over time.

- First step = to implement licence then exercise control.

JC We support licences but this is the wrong way.

JA NS (EPA) chose broad point of entry which will not stop pollution in first instance.

JC EPA has a statutory duty (s.17D) to consider certain matters.

- Says NS does not know those necessary.

NS *"We believe that conditions will mitigate pollution"*

- Condition will have to be revised
- Standards for north coast in R/F [rainforest] areas do need review.
- Where there is evidence of failure to meet conditions EPA can act.

WF Standard Erosion Mitigation Conditions (SEMC 1990) has had *"dramatic impact on erosion from foresting"*

EDO(JR) EPA should have staged the licences.

NS Saw it as opportunity to subject FC to licence requirements from which they could not escape - furthering objectives = first application x FC due to previous immunity.

- EPA will develop a policy on this.

SW How much monitoring is EPA carrying out re logging?

NS Very little - WF is working up "*conditions*"

- Also working up remote sensing logging/water quality.
- Potential audit technique.

SW Cannot tighten up without additional information.

NS Want monitoring system paid for by FC

(off paper).....

- Under what conditions?

NS Should operate on pre-post water quality situation (determination)

- Will prosecute FC if licence is breached.

WF Difficult re monitor/audit programme.

- Peak situations - they want help from us.
- Methodology

JC Why did not licence process go to EPA Board?

NS Believed it was an *"obvious step"* in the right direction

- "*We*" are the people responsible
- In light of hindsight would have taken it to Board.

To undertake a sensitivity analysis of the model requires these parameters to be examined. The surface runoff coefficient of 0.2 is considered to be high, Knight (1978) and Australian Rainfall and Runoff (1985) use a figure of 0.12 and are therefore conservative in terms of the leachate being produced. Changing surface runoff coefficient to a more realistic 12% would result in between 0 - 8% more leachate being produced.

Surface runoff figure used in Maunsell model is therefore conservative in terms of leachate production. When more detailed leachate collection system is designed for landfill it will be important to identify most accurate surface runoff coefficient so that leachate quantity can be best estimated.

Monthly evaporation rates as a percentage of incident rainfall for median year is shown in the next Table 7.9. This table shows that evapotranspiration ranges between 12% and 100% of the incident rainfall, averaging around 70%. In comparison with a value of 52% chosen by Knight (1978). Evapotranspiration in Maunsell model being high is also shown to be conservative, in terms of leachate generation.

It was found that by increasing Z by 3 for all uses (ie. Z=6 for daily cover, Z=9 for interim cover and Z=13 for final cover), the percolations and therefore the leachate volume decreased by a maximum of 12% during the median year. These results are shown in Table 7.10 a) to c) and lead one to conclude that the calculated leachate volumes are fairly robust.

The sensitivity testing also indicates that more work needs to be done at Lucas Heights in monitoring leachate quantities and groundwater additions.

7.3 Liner Technology

Most major landfills around the world utilise liner systems to:-

- limit groundwater pollution from landfill leachate
- monitor leachate generation rates and qualities
- encourage a high engineering standard in landfill operations
- provide a large degree of containment of a treatment facility that will continue to degrade deposited waste for a further 20 to 30 years

The systems vary a great deal around the world but in general they consist of the following features, in whole or in part:-

- a hydraulically tight basement of metres thickness, say, permeabilities of $1x10^{-7}$ m/s at least 3m thick
- a clay liner, usually compacted, permeability $1x10^{10}$ m/s
- geofabric and plastic liner, permeability $1x10^{-15}$ m/s
- geofabric protective liner
- filter gravel at say 3% slope to drain leachate toward the collection pipes
- fine shredded material

In some cases, there may be a second liner in order to monitor the performance of the collection liner.

In the following paragraphs, recently constructed liner systems are described in order to provide a contrast to the system proposed for the Lucas Heights Landfill Extension.

- Did equal policy shift from point source to diffuse sound.

NS Board was informed "..." before the licences were issued.

JJ Who is "*we*"?

NS Authority acts through D-G.

WF D-G and "*different advisers*".

NS Final issue = "*by me*".

- Does not normally "*sign out*" licences.

JA Why were they issued on May 7?

- On what basis?

NS Because EPA had gone as far as it could go without losing the opportunity to control FC.

NS Aim = to prevent water pollution cf "*your*" aim = water quality and OGF.

JA Why didn't NS refuse to licence moratorium areas?

NS No point/ moratorium exists.

- Can change if EIS was to proceed.

AR Blanket determination implies OK situation.

NS Are investig. with view to prosecution re: Killiekrankie.

JC South coast licences issued after complaints about pollution.

JA Appropriate signal should have been no licence for sensitive areas prior to EIS/other determinations etc = wrong signal.

NS Accepts wrong signal/tighten conditions over time/intend to move fairly quickly.

SW What steps are going to be taken?

NS EPA are "*working on conditions*".

NS Option to not renew licences at the end of the year.

RB Statewide licence in the end applies to each coupe.

NS That would = waste of time

- Will never get it

JA How would you protect Mount Royal except by varying the licence?

JC SEMC are almost never adequately implemented.

NS Failure to implement = a breach.

JC Who will detect?

JA How will they ensure W/Q after determination? Will the licence be varied?

EDO(JJ) EPA is a determining authority under Part 5.

- So is Minister for Planning.
- Did EPA consider effect was likely to have significant effect on environment?

NS SPCC always took position that Part 5 did not apply when they issued licences.

JA Issue of licences is not/should not be subject to political intervention. What will he do about Mount Royal?

NS Reserves comment until he sees it.

- Will on occasion refuse/revoke licences.
- EPA will review conditions over the next 12 months.
- FC were put on clear notice (letters went with the licences).
- Fundamentally different ways to same goal (JC & NS).

7.3.1 Germany

Reference: Address by Professor Reiner Stegman at the UNSW, 2nd April, 1992

- All landfills are now lined
- All landfills are developed above ground level to avoid groundwater additions
- Basement, $1x10^{-7}$ m/s, at least 3m thick
- Liner-clay, $1x10^{-10}$ m/s, 0.75m thick
- Liner-plastic, $1x10^{-15}$ m/s
- Leachate drain
- Geofabric protector
- Filler gravel, at 3% slope
- Fine shredded material

7.3.2 Australia

Gurulmundie Secure Landfill, Queensland

- Reference - design documents issued by Brisbane City Council
- Basement - low permeability/stable and non-reactive clay layer
- Secondary leachate drain - 100 dia HDPE
- Drainage layer - Gravel drainage medium enclosing secondary collection drain, 300mm thick Permeability not less than $1 X 10^{-4}$ m/s with maximum developed head of 0.3m
- Membrane - Flexible member liner (FML) 2mm thickness protected above and below by geotextile
- Primary leachate drain - 100 dia HDPE
- Drainage layer - Gravel drainage medium enclosing primary leachate collection drain 300mm dia permeability $1 X 10^{-4}$ m/s, maximum developed head 0.3m
- Upper geotextile - separating the upper drainage layer from the engineered fill above.

Henderson Landfill, Perth, W.A.

- Reference - Maunsell reports and construction drawings
- Basement - Perth sands
- Liner base - 100mm sand bedding
- Impervious membrane - 2mm HDPE liner followed by 300 drainage layer and 300mm cover
- Drainage pipes - Fed by 100-200 dia slotted PVC pipes, diameter 300mm, grade 0.67%, connected via upper and lower sumps with manholes carried through to final top surface of the landfill

While relatively new in Australia, practice in Northern America has encouraged lined landfills for many years. Another report in this series prepared by Golder Associates (1992) lists recent American and Canadian landfills and their lining and drainage systems. Additional Australian examples are also described.

The cost of the comprehensive lining systems as now used in say Germany is considerable. Figures approaching $\$A150/m^2$ are common and this cost can add considerably to development costs of major landfills. For Lucas Heights and assuming that the liner system would only be applied to the new areas, this cost would be A$224 Million, and would add a further $9/tonne to the cost of disposal.

NS His statutory objective is to prevent pollution.

NS Reiterated he would have discussed with Board on hindsight but not with any necessary change in outcome.

NS When they know the specific soil types they will become more and more specific to more refined SEMC.

JM Why not 1000's of licences (eg, industrial/commercial).

NS 9 licences = best way/least bureaucratic.

WF Says EPA is being "innovative"

- First attempts at non point source pollution control.

JM Lack of consultation.

NS Is setting up consultation process.

JC Will they release information?

NS Put in FOI and see what happens.

JA Access to information and..... public involvement is critical

- Public advertisement
- Public think they are conned.

JC Lack of good faith/letters and advice but no hint of appl...

- Issued licence instead of prosecute and EPA will investigate and prosecute if necessary.

JC Did not disclose matters of licences.

JA PR is crappy

SW (blank)

NS FC is required to ensure that subcontractors comply

- But subcontractors are not protected.
- Have to apply separately

No applications have been lodged by bulldozer drivers (neither individual or co-op)

AR If bulldozer driver causes pollution does this exempt FC from responsibility?

NS Need to take advice but if SEMC or code of practice not observed it would be accountable.

JM Who/how responsible - individual/licensee?

NS Land and Environment Court do not want "*multiple charges*" (?....) re: one incident/ should seek "most culpable" or "most responsible".

Inherent in the design of any new liner system is the need for long term containment. Equally important is the need for conservative design in all pipe collection systems as once landfill is placed, pipes cannot (except with great difficulty) be replaced by larger diameters. Minimum pipe diameters should be 300mm and all pipe intersections should be monitored through extendable manholes and/or inspection openings.

Should a liner system be introduced at Lucas Heights, the liner must be extended to include any tip-face leachate collection pond. In fact, it is poor engineering that the present collection ponds are not lined. Monitoring of pond inflows and outflows should also be part of the leachate collection system.

7.3.3 Disposal Options

In the following table, a comparison is made of typical leachate qualities from Lucas Heights and the 1994 "standards of acceptance" of chemical trade wastes into Sydney Water Boards sewers.

Table 7.11 Lucas Heights Landfill Review
Leachate Qualities and Trade Waste Standards (mg/L)

Feature	Typical Leachate Analysis at Lucas Heights	1994 "Standards of Acceptance"
pH	6.7*	7 to 10
Arsenic		1
BOD5 mg/L	1928*	**
Cadmium mg/L	0.01	1
Chromium mg/L	0.09	3
Cobalt mg/L		5
Copper mg/L	0.24	5
Cyanide mg/L	<0.05	1
Grease & Oil ...		50
Lead mg/L	0.36	2
Mercury mg/L	<0.001	0.03
Halogenated Hydrocarbons		
Ammonia (as N)		50
Suspended Solids mg/L	2033*	200
Zinc mg/L	1.7	5
Sulphide...		5
Total phosphate mg/L		50
Pesticides		
Aldrin mg/L	Tested to 0.001 & not detected	less than 0.1

NATURE CONSERVATION COUNCIL OF NSW

THE NATURE CONSERVATION COUNCIL OF NSW
39 GEORGE STREET,
SYDNEY, NSW 2000.
PHONE: (02) 27 2228/27 4206.
PHONE: (02) 247 4206/247 2228
FAX: (02) 247 5945

7/7/92

attention
Tim Robertson
from
Judy Messer

Faxed to: 221-6944

13 pages

NOTIFIED
YES
NO/REASON
TIME 2.50

CONFIDENTIAL!
Jm

Meeting ⊂ Shepherd 24-2-92

Shepherd

"Historical context": why we (EPA) issued licenses:

Past · FC had a free rein
· protected from prosecution by "historical immunity" (applied to all stat. auth.)
- lifted by Gov last 12 months
⇒ FC sought licence under Pollution Control Act

- EPA thought this = positive initiative to affect FC & water quality (not just OCF)

- from stat. v point pine plantations - just as important

= Change from past (point source focus)

⇒ diffuse source issue by reliance on code of practice to enshrine behaviour to achieve water quality

- would seek to "rework those codes"
- already a proposal for FC to rework "those codes" because of NE. Coast hi rainfall

FC can't change codes of practice in license situation

- re contractors:

- FC to notify that they will be req. to incorp. water quality monitoring in license
- does not remove ability to prosecute where codes are breached
- after consid. of above decided to issue (~~on a reg~~) licenses
  - ⇒ regional basis
    - ⇒ may go to localised areas later but thinks case is major shift in behaviour
    - ⇒ if codes of practice & monitoring does not work (standards of water quality)

JA - What is the standard?
WE - licenses relate to (oggi -) practices
- premature to be talking about w/quality at catchment / sub-catchment level
- task is to identify standards

(Phase 2)

3

insonito

(Phase I)

NS - present requirement = notify if water quality standard is broken

JA - how will they know if there is deterioration?

NS - on site inspection would reveal difference

- "license to pollute" says "if you have adhered ..... & pollution occurs then you are protected"
- but EPA will have to change standards & conditions

- if we complain to EPA it would require them to prosecute
- EPA can prosecute even if pollution did not occur (but could have)

JL - is NS aware of particular activities in a specific area eg. COP's H?

NS - no; aware in general
- does not know if last 3 words, etc (specified) were included

WF - says they did not need to

have special knowledge of specific areas?

DA, WF | Why did they move so quickly? GPA did not think about impact on steep slopes when applic. came in (but aware of since 1985)

WF | - when the applic. came in to SPEC in Jan. focused on opportunity to advance control of diffuse point pollution situation

DL | Q should be yes or (now) no? did N.S. consider whether to or not issue license?

NS | - yes, he did consider refusal, but if he refused there would not be another chance to issue a license (why not? Jm)

DL | Killiekrankie seemed perfect area to refuse license = what conditions would apply to refuse license to "diffuse point pollution"?

NS | - can change license conditions

5

& 12 months

NS Discussion & F.C. re necessary changes, overtime
- first step = to implement licence then exercise control

SC - we support licences but this is the wrong way

EA - NS (EPA) chose broad point of entry which will not stop pollution in first instance

EL EPA has a stat. duty (S.17D) to consider certain matters
- say N.S. does not know more necessary

NS - "we believe that conditions will mitigate pollution"
- cond. will have to be revised
- standards for NTh & ~~HRP~~ in R/A areas do not reviewed
- where there is evidence of failure to meet conditions EPA can act

WF - Standard Emission Mitig Conditions (S.C.S.) (1990) has had

"dramatic" impact on erosion from forestry

EDO (SR) - EPA should have staged the licenses

NS - saw it as opport. to subject FC to license requirements from which they could escape
⇒ lessening % objectives
- first applic x FC due to previous immunity

- EPA will develop a policy on this

SW - how much monitoring is EPA carrying out re logging?

NS - very little
- WF is "working up" conditions
- also " " remote sensing x [logging / water quality]
- potential audit technique

SW - can't tighten up without add info

NS - want monitoring system paid for by FC

- under what conditions?

NS - should operate on pre-post water quality situation (deterioration)
- will prosecute F.C. if license is breached

WF - difficult re (monitor / audit) program
- peak situations
- methodology
- they want help from us

SL why didn't license process go to EPA Board?

NS - believed it was an "observation step" in the right direction
- "we" are the people responsible
- in light of hindsight would have taken it to Board
- did (be) equal policy shift from point source to diffuse source

NS Board was informed "marginally" before the licenses were issued

JJ - who is "we"?
NS - authority acts thru D-G
WF - D-G & "different advisors"

NS - final issue = "by me"
- does not normally "sign out" licenses

SA - Why were they issued on may 7?
- on what basis?

NS - because EPA had gone as far as it could go & not losing the opportunity to control F.C

NS - aim = to prevent water pollution
cf "your" aim = w/Q + OGF

SA - why didn't NS refuse to license mid atorium areas?

NS - no point / moratorium exists
- can change if EIS was to proceed

AR - blanket determination implies ok sit. nation

NS - one investig. is view to prosecution re Killiekrankie

SE - 5th Coast licenses issued after complaint about pollution

SA - approp. signal should have been no license for sensitive areas prior to EIS / other determinations, etc
= wrong signal

NS - accept wrong signal / tighten

9

conditions over time / intend to move fairly quickly

SW - what steps are going to be taken?
NS - EPA are "working on conditions"

NS - option to not ~~renew~~ renew license at the end of the year

RB - statewide license in the end applies to each coup

NS - that would = waste of time - will never get it

FA - how would you protect wt Royal except by varying the license?

SL - SEMC are almost never adequately implemented
NS - failure to implement = a breach

SL - who will detect?

SA - how will they ensure W/Q after determination? will the license be varied?

EDO(JT) EPA is a determining authority under Pt V
- so is min for Planning

- did EPA consida effect was likely to have a sig. effect on envir.?

NS - spec always took position that Pt V did not apply when they issued licenses

SA - issue of licenses is not/should not be subject to political intervention ... what will he do about Mt Royal?

NS - reserves comment until he sees it

- will on occasion refuse/revoke licenses

- EPA will review conditions over the next 12 mnths

- FC were put on clear notice (letters went i the licenses)

- fundamentally diff ways to same goal (JEC & NS)

NS - his statutory objective is to prevent pollution

NS reiterated he would have discussed i Board on hindsight but not i

any necessary change in outcome

NS - when they know the specific soil types they will become more & more specific to ⇒ more offered S.E.m.e

Jm why not 1000's of licenses (eg industrial/commercial)?

AS

NS 9 licenses = best way / less bureaucratic

WA - says EPA is being "innovative"
- just attempts at non point source pollution control

Jm - lack of consultation

NS - is setting up consultation process

JL - will they release info?

NS - put in FOI & see what happens

JA - access to info + broad public involvement is critical
- public advertisement
- public think they are consulted

JL - lack of good faith / letters & advice but no limit of appeal.
- issued license instead of pros-

prosecution
+ EPA will investigate & find if necessary

SE - did not disclose misrep. of licenses
JA - PR is crappy

SW -
NS - FC is required to ensure that subcontractors adhere,
- but subcontractors cannot protected
- have to apply separately
- no applications have been lodged by bulldozer drivers (neither individual or co-op)
AR - if bulldoze driver certain position does this exempt FC from responsibility?

NS - need to take action.
- but if some or code of practice met should be responsible

Sm - Who/how responsible - train/license

NS - L & E Ct. don't want "multiple charges" re one incident / should seek "most culpable" a "most responsible".

MEETING WITH NEIL SHEPPARD
24 JUNE 1992
(Anne Reeves)

(continuation of Anne Reeves' typed notes)

- .....distinguishing natural background and best practice.
- Also source/mechanisms - need to address these issues - because conditions need you people to help.

JC (amazed) - Even EPA Board - cf March v. Jan(?)

- Real concern re invitations to participate - should have been to Board.
- How do you answer this?

NS We believed an obvious step in right direction therefore we, ie the organisation, took the decision (also because responsible for issuing licences)

- With benefit of hindsight would have been better to have discussed before hand*
- Remember very new, using mechanisms from point to move to diffuse sources - discussion on Board
- We would maintain where shifts

JC Won't be revisited?

- Board doesn't want discussion few decisions record

NS Don't argue after event - Board role but no opportunity to consider.

- What I am saying where a policy shift then it goes to Board.

JJ Who are the EPA?

- We, the organisation - the Authority acts through Neil Sheppard.
- Who is the "*we*" essentially, the Director General and advisers and whoever, a number of
- "EPA" - find issue (decided) was by NS - actual considered of sufficient importance for NS to sign.

JA Why on 7 May?

NS Had gone as far as could usefully go - and still get FC licensed.

- Trade off, hang about and get details in place, then FC could slip away for ever
- Or get their licence now and would be harder for them to get away.

NS Believes best way to go now taken forward

- Prevention pollution from logging.

JC But what do you understand old growth forest to mean?

JA Under Timber Act - various schedules -

- What stopped your sending from the moratorium ... - some wont be pre EIS.

JC If decision post EIS - why not reserve powers -

NS If wait to perfect.... - EIS - come to common end point to tie to more and be more specific.

JA What about (Killiekrankie)?

NS Investigations with view to prosecution - investigating officers sent back.

JC What about SE? Les Farrell complaints. No investigation complaints, licences, issue.

As with most (if not all) Australian hydrology and water quality, it is unwise to separate water quality issues from streamflows and ultimately rainfall. As the existing record does not report flows, some simple tests were attempted between local rainfall and the reported quality parameters.

The most significant test is shown in Figure 7.5 which plots accumulated rainfall against accumulated TDS and accumulated rainfall and TDS against time. The TDS record does have gaps (and it is unlikely that these gaps can now be closed) but nevertheless it is possible to conclude:

(i) high TDS readings are obtained during periods of low rainfall;
(ii) low TDS readings are obtained during periods of high rainfall;
(iii) the average relationship between TDS and rainfall prior to the start of landfilling has increased more than might be expected during a period of generally lower rainfall.

A second drawing, Figure 7.6 which shows monthly values of TDS and rainfall, also exhibits the same trends.

The tentative conclusion from Table 7.13 and Figures 7.5 and 7.6 would be that qualities recorded at MC1 are deteriorating with time. It therefore behoves the managing authority to increase the frequency of sampling and install some measure of water flow at both stations.

Given the incised nature of the lower reaches of Mill Creek it is of course possible that groundwater contaminated by leachate, is the cause of the deterioration.

7.5 LONG TERM MONITORING

7.5.1 Need for Program

Water quality monitoring, both groundwater and surface water is now an important part of the operation of most landfills in Australia. There are clear deficiencies in the surface record at Lucas Heights and a major effort is required on groundwater qualities, even for the existing approved area.

7.5.2 Surface Water Monitoring

Sutherland Shire Council have collected additional water quality samples to add to the record and to encourage the operator to take a more regular and comprehensive look at water quality in the area. Seven sample locations have been chosen for surface sampling in initial survey. These are:

- Deadmans Creek (DCI) - a possible control station in an adjacent undisturbed catchment
- MCI to MC4 - stations along Mill Creek as have been monitored in CPI (1991)
- Sediment Pond (SED) - to see if any leachate or contaminated runoff is bypassing leachate ponds.
- Leachate Pond (LPI) - to monitor leachate composition

The location of these sampling locations are shown on Figure 7.7.

Results of this water quality testing are shown in Table 7.17 below. An estimate of creek flows is also shown in the table.

JA Our concern re signals (that are being given out) - feel best conditions make it seem as if OK

- Very little will happen or be very slow - but same and very sensitive, licence to pollute even pre-logging EIS gives 'wrong signal'.
- You will have to be convincing re serious conflict.

NS I can accept you have difficulty with this - intend to tighten over time - several forests already doing this - don't resile from what we've done. Proof when conditions change and SEMs review is completed.

SW And when confident effective monitoring system in place and uneasy because not hearing what step.

NS No, because EPA are working on conditions that are required for water quality monitoring - need to do enough but not too much - timing and location very significant.

JA My understanding EPA lack resource and budget. Do you have the resources to meet what we are (off page....)?

- Eg. why cannot buy, beg, borrow from Water Board - what is?

NS Really need, what is needed? then make it be done.

WF Will take time because are still building.

JA But if you have the money and political commitment can be quick - ..... in absence will take years.

NS Option at end year not to issue licence - but would be retrograde - better to move forward or will prosecute ad hoc.

RB With licences - a general licence, yet ultimately comes to soil type.

NS Never get to coupe by coupe basis

JA What about Mt Royal? What will you do to investigate for conditions? Vary the reg. and licence?

NS First have a look at it.

JC SEMs but utterly inadequate - also almost never put in place.

NS If not applied then a breach of licence conditions.

JC Who will detect?

NS Number of ways, eg JC will tell.

JA How will you ensure protected Mt Royal?

- eg. EPA can or not insist/change licence

NS .....

JC Could in some cases could log and prevent pollution.

NS .....

JJ Fits in with another problem - EPA is part of determining authority - Part 5 EPA Act so what - but EPA will also have to consider. Min. Planning.

- FC has already decided has.....in regional EIS logging so far - did you turn your minds....

SPCC Part 5 believed not applying when licences issued. Mixed signals.

JA Can you say response to Mt Royal?

7.5.3 Groundwater Monitoring

Comments on the Lucas Heights Extension EIS were received from 12 government departments. The most outspoken comments came from the NSW Department of Water Resources and their main criticism concerned the absence of a local and regional groundwater investigation and monitoring program.

It is strongly recommended that such a program be instituted as a matter of urgency as:-

- the question of a liner system relies on this part of the hydrologic cycle being better defined; and
- the existing leachate collection system at Harringtons would appear not to collect all the generated leachate.

The adopted groundwater program should include an assessment of the proposed sandstone extraction operation particularly the use of explosives to fracture the sandstone blocks.

7.6 CONCLUSIONS AND RECOMMENDATIONS

7.6.1 Landfill

- The engineering of the landfill extension has been poorly documented to date
- Serious omissions in the present EIS include:-
  - details of the leachate collection system
  - landfill management plan showing progressive locations of drains and diversions and sedimentation ponds
  - the planned rehabilitation measures
- Further consideration should be given before any approvals to:-
  - the incorporation of a world standard liner system at Lucas Heights
  - the cost and impact of larger leachate disposal quantities being sent to the Water Board sewers
  - measures to recover landfill gas from the tip to feed the waste industries and to protect any revegetation measures.

7.6.2 Regional Water Impacts

- It is considered that regional water impacts, particularly groundwater and surface water flows have been poorly studied and reported to date.
- The need for more attention to be given to surface water quality and quantities has been argued in this paper. This attention should include:-
  - flow measuring stations
  - more frequent water quality tests

NS Cannot answer until EIS and issues cannot decide how, let's wait, certainly, re: not being prepared to refuse licences eg. for whatever reasons.

JC What conditions would up to no logging be the answer?

- Decided to take opportunity to advance, FC on clear notice to say conditions to be reviewed or water quality conditions would be imposed. All should be picked up as are defined.

NS Diffi (sic) is likely to arrive at some position.

- Different route - as a Saturday objective - there .....

WF Capacity stronger than where no licences.

JC Admit

NS With benefit of hindsight would have been discussed by Board. Maybe outcome not have been changed.

NS All there specific things.

RB Licences now regional

- Nine regions - within those nine, probably very different number and some of the same soil types.

NS Once conditions and which clearly identify catchment or soil type then can include within licences. - eg particular soil type.

- Objective over time more and more specific re particular site issues as should COPs, ie since catchments which are point sources.

NS What need that people doing what they ? to

JJ If single polluter within catchment

NS/WF Yes

JA Why so reluctant to pin point one agency?

- (Is there) 1 rule for primary, another for individual/community?

NS No, several ways to tackle.... (off page) ultimately end up with most logical basis can achieve objectives.

WF When we come to meet new activity, eg individual pollution, what is attempted here is novel, basically pollution worldwide.

JA Problems re public participation, eg if come in at an early stage.

NS Wouldn't ask Board to rubber stamp anything.

NS Donna, first task, Minister's list - need regular meetings to discuss, eg on quarterly basis.

JC Will you release FC documentation etc?

NS Place fairly open.

JA One thing we want to discuss is Stage 2, should turn minds to broad public involvement - if eg had advice - would have observed certain key elements.

JC Is a lack of good faith - solution have made number of complaints, eg, while we're involved in this - you, Dr Sheppard failed to disclose.

NS Hang on, wrote said if you want to take action. OK we said we would investigate with determining - whether should prosecute. Licence does not affect that.

JC Lack of faith.

SW Confused licence - FC and May Board Minutes - logging contractors.

- Groundwater resources and quality tests been largely neglected to date. An urgent program should be instituted to measure groundwater levels and qualities for a further 12 months before any judgements are taken at Lucas Heights. The groundwater levels and qualities should be the basis of simple modelling of gradients and flow lines in order to confirm the movement of any plume and to help in locating any inflows into the surface streams.

7.6.3 Long Term Management

- Any landfill management plan prepared under section 7.6.1 must recognise the need for monitoring (and thus the real need for remedial work) through to the year 2020. The monitoring should cover:

  - leachate quantities and qualities
  - settlement of the landfill
  - surface water qualities and quantities
  - gas generation and/or use
  - rehabilitation program progress

NS Two elements. FC must require of its contractors must observe conditions but are not protected by same licence. Sub-contractors need to obtain own licence - as opposed to being a "servant of the community" therefore aggregation of eg bulldozer drivers of a co-operative - at this stage unaware of issuing any licences - did seek to impose - got to impose.

NS If found EPAs or CoPs not observed would deal with driver and FC.

JA Under EPA accountability v. licensee?

NS Court has said ie do not bring in on multiple charges, select one or 2 properly selected charges - so for most culpable as responsible what really want to do is to understand good deterrent effect.

Meeting closed at 5.40pm

Note: Some of discussion not recorded, including where this recorder (AR) raised questions, which included dilemma of independent unbiased appraisal of EIS where licence already in place.

assessment of compensation, and can only be elements of "value to the owner".

Because special value must be assessed as at resumption date, in many cases it is difficult to assess consequential disturbance. However, the actual costs incurred or quotes received to relocate and re-establish the business are often a useful guide as to what the dispossessed owner would have estimated them to be: cf *Charles McDonald Pty Ltd v Housing Commission of New South Wales* (1957) 2 LGRA 160. In appropriate circumstances, even though new premises and equipment are inevitably better or worse and more or less valuable than that resumed, it is still only a question of fact and degree whether such relocation and costs of reinstatement are reasonable.

The subject premises undoubtedly had a value to Brown Bros over the market value in that it was particularly suitable for their business because of the nature of the building and location of the site. However, in my opinion, neither the building, the subject land, nor the business carried out thereon, was so special or unique as to make this an appropriate case for assessment by the reinstatement method. I am satisfied that at date of resumption the assessment of compensation by the selling approach should be preferred, and would enable the proper determination of the full value to the owner of the land taken.

Mr Wood used the selling approach and added special value to the market value. In his opinion, special value comprised two elements, that is, an arbitrary 20 per cent added value to market value, either as industrial or residential, plus relocation expenses and consequential losses.

Such items of disturbance were not really separately assessed by any valuer, and were based on the claims and particulars supplied by Brown Bros.

As an item of disturbance Brown Bros claim expenditure for expert advice which, apart from valuers, in my opinion was of little, if any, assistance to them, and certainly of no assistance to this Court in the assessment of compensation.

In particular, I totally reject any claims in respect of Mr M J P Nolan, and do not take the costs of his services into account in the assessment of consequential losses. Mr Nolan initially rendered invoices exceeding $235,000 for advice and negotiations in the relocation of the business and, not surprisingly, they have never been paid. I am unpersuaded that Mr Nolan actually rendered the services claimed and, in any event, most were in areas beyond his expertise and altogether of no assistance to Brown Bros or the Court in the assessment of compensation. Mr Nolan could not substantiate such invoices, and Brown Bros ultimately reduced the combined claim for Mr Nolan and Mr P J Marsh to $45,590. Mr Marsh was engaged to arrange finance, but purported to review and advise as to the appropriateness of replacement of industrial properties, notwithstanding his admitted lack of expertise in that field. I reject claims for the services of Mr Marsh, except to arrange finance for the acquisition of Tomago.

It is common ground, and I accept that as a consequence of the obligation to quit the resumed land, it was reasonable that Brown Bros acquire suitable alternative premises in order to continue the relocated business. I accept that they attempted to find alternative premises in the Balmain area, but most of [illegible] were obviously unsuited for the relocation of

should not reasonably have been expended on investigations of most of the said sites.

However, I accept that notwithstanding its lesser value and distance from Sydney and particularly from the Alexander Street premises, the initial selection of the Tomago site was reasonable in the circumstances for the relocation of Brown Bros' business. If a dispossessed owner is otherwise compensated for the special value of the land for the business conducted thereon, a component may be relocation expenses to land which is of different value. Care must be taken to avoid double accounting if loss of trade or profits is taken into account arising from a less valuable alternative business site.

However, I do not accept the reasons given for, or the reasonableness of the return to Sydney of part of the business and associated equipment, the split of the activities, and the purchase of the patently unsuitable Alexandria premises. It follows that I reject claims for costs to relocate thereto, or the assessment of disturbance by Pannell Kerr Foster (Mr A R Farrar).

The Alexandria site in my opinion is unsuited for Brown Bros' purposes in almost every respect, particularly location and design of the buildings thereon. In my opinion, costs involved in acquisition of the Alexandria property, return thereto of part of the business from Tomago, or the alteration of the Alexandria premises, are not reasonable or related to the resumption of the subject land.

However, I accept that relocation to Tomago would also compel some upgrading of the existing facilities at Alexander Street to continue the business previously jointly conducted with that on the resumed premises.

In these proceedings, it is the duty of the Court to find only one sum in accordance with s 124 which reflects properly the value to the owner of the land compulsorily acquired. In the selling approach, the starting point to arrive at the appropriate figure is the market value of the land. I prefer the opinions of land value given by Mr Woodley and accept his sales and methodology. I accept that as zoned industrial the market value of the subject land at resumption date was $900,000. If the industrial zoning is ignored for the reason that its retention was a step in the resumption process (cf *E M Power v Department of Education* (Land and Environment Court, 29 August 1989, unreported), its value for purposes permitted by a likely residential zone is $1,200,000. However, in my opinion the latter figure would not exceed the value to the owner for the continuation of the non-conforming use. I have no doubt that Brown Bros as the owners and occupiers of the premises at resumption date would not have been willing to sell except for a sum substantially more than any amount that would be offered by a purchaser merely for residential development.

On the other hand, if residential development and not the continuation of the non-conforming Brown Bros business had been the highest and best use of the subject land, and compensation was assessed on that basis, that price could only be obtained with vacant possession and the dispossessed owner would not have been also entitled to consequential losses related to the extinguishment or relocation of the business: cf *Bergman v Holroyd Municipal Council* (1988) 66 LGRA 68.

For the above reasons, I am satisfied that Brown Bros as owners and occupiers were entitled to compensation not only for the market value of the land, but also special value. However, under existing legislation the

NATURE CONSERVATION COUNCIL OF NSW

THE NATURE CONSERVATION COUNCIL OF NSW
39 GEORGE ST
THE ROCKS NSW 2000
PHONE: (02) 247 4206/247 2228
FAX: (02) 247 5945

Attention Tim Robertson.

Notes from mtg with Neil Shepherd et al.

Haven't time to complete typing so have written over some items

Can complete typing next week.

NB semi-verbatim bt 'gaps'

As with Judy, no quotes without consulting me — eg if necessary to subpoena as a 'hostile' ? witness.

Anne Reeves
7/7/92

13 pages follow:

Neil
7/7.

NOTIFIED
YES
NO/REASON
TIME 3.35

(1)

NOTES TAKEN by Anne Reeves AT MEETING WITH EPA/ENV GPS ON ISSUE OF LICENCES TO FORESTRY COMMISSION held 24/6/92 on level 20, 100 William St, due to commence 4.00 pm, concluded 5.40 pm

Present: NS WF DC D
from EPA: Dr Neil Sheppard, Mr Warwick Forrest, Donna Campbell, Donna R
from Env Gps: Sid Walker (EO of NCC), Judy Messer(Chair of NCC), Jeff Angel (TEC), John Corkill(NEFA), James Johnson (EDO), Ross Blick (ACF), Anne Reeves(NPA)

....Sheppard explaining background to date...

(...AR arrived after Shepperd had begun..)

..licence sought in writing by FC - details of this can be obtained..
~~positive aspects~~ thought as positive given FC brought under pollution controls, first opportunity for controls under relevant legislation with respect to water quality
(of course EPA) interested in all types of forestry practices - water quality generally - but do understand some groups will take greater interest in particular types activity, greater interest in old growth forests rather than pine plantations.

now was to be a change in way pollution controls issued, could have broadly interpreted, whereas in past deal with 'point sources' ie drains, smoke stacks
way to tackle - look at relying on ~~Codes~~ Codes of practice, standard mitigation moving to 'code of behaviour' approach to ensure standard water quality to be maintained
would seek to re-work codes and standard erosion mitigation (SEM) measures
already a proposal to requre rework of SEMs. because as understood ... concern re higher rainfall - also needed - not to change Codes of Practice (CoP) on initiative of Forestrty Commission and to be within licence.
also required - some needs for CoP and SEM revision - FC on notice, will require water quality monitoring so need exactly water quality conditions needed from FC.

Therefore see this as a major step forward - does not remove liability to prosecution where terms breached, where leads to deterioration of water quality, therefore lots of gain over the long term
After had considered application then decided to issue licence
done on regional basis as appropriate
may in time come to smaller areas, even perhaps SEPPs - different for regions, never however to level of individual creeks or catchments
trying to get major shift in behaviour

JA - so environment seen as big or bigger than catchments?

NS may come to smaller areas, depnding on whether CoPs and SEMs actually protect

how do you protect?

NS if evidence that water quality is deteriorating, plus CoPs and SEMs shown to be defective

JA - so what kind of water quality?

NS licences relate to logging practices - its premature to talk about subcatchment/catchment level - need a quality control mechanism, which is written into the licence
task - to identify performance standards that are going to lead to quality control standards
bottom line is change from pre to post logging

JM - (this) therefore imposes conditions on how behave?
yet WF indicated conditions per se - so how will they do this,

- that Phase 2

Now, notify where practice going to cause deterioration

(2)

JA - who is going to know these standards?

NS - normal way, if go upstream of drain then quality = x, then downstream =x + any change. Inspectors where called would have to look to above/below, then if obvious change as a result of activity ..

JJ - licences are licences to pollute

NS - that is the way you choose to put it, we see it ...

JJ but ie if adverse effects, if water pollution still occurs, not prevent water pollution, plus not protected water quality ...

JA acceptable pollution is that that inevitably arises from SEMs

NS not necessarily inevitable

NS depends on conditions from particular areas, the FC acknowledges for example with respect to high rainfall areas ..
therefore another set (of conditions may be more relevant)

JA but if went to old growth forests, there would therefore be no case for claiming offence?

NS - but then would start working on changing conditions, we are aiming for long term benefit also we have advice that we can prosecute if for example failed to comply, that is for failure (to comply,) that is to breach the conditions of licence

JC looking then at long term application under EPA, what about Phase 2 and is there to be a Phase 3? what are the phases?

NS a continuing process as find there is a failure to protect water quality

JC ... and in what forests at what intensity?

NS no not personally

JC but are you aware of what inputs are required?

NS well - Warwick Forrest is an ex forester,

- one thing is to get a list, an intended list - don't ...

JC then it is not part of your consideration when issuing licences?

WF in generic sense, not compartment by compartment

NS practices known to officers of our organisation

JC - yet impacts are surely site specific?

NS inevitably site specific - if logging being undertaken -

JC take say a 30 degree, no 35 degree slope , say between one area and another, because there is of course natural variation ..

NS precisely what we are acknowledging , therefore SEMs need to be taken into account

JC so no site specific conditions set up front ?

WF did not need to have this

(3)

JA actually need to fill bond to give licences? given you are working from within a fairly poor bases - so why not wait 12 months, why now<

WF - EPA didn't start to think about this when the application came in. Of course regional officers well aware of forest and the array of activities. we have strengthened the position to deal with non point source control
so it is on record for the first time
eg in 1985 SPCC .... published on this, some information on variation of impacts ... started to look at cotton, other industrial activities, from a long term perspective

When the January application received by the SPCC, focussed on application to take account of, to open concern re non point sources, advcancing one step forward

- if regulate the activity, then control (and) little likelihood of impact - beneficial therefore must be seen as a first step

JC thinks yes, a first step - bu did you consider should a licence be issued at all? Yes or No? Have you ever considered NOT issuing a licence

N "um"

JC and on what basis?

NS it seemed if refused a licence for the FC perhaps there would not be a change again, not a licence needed for all sorts -

JC if FC believed polluted -

NS could be a means of prosecution

JC take example, Killiecrankie, the Oaks forest, position (described ...)
also important as a drinking water supply, surely very reasonable condition to forbid any pollution? therefore under what circumstances would you refuse an application?

NS trying to put diffuse into same category as point source
yet here we are talking about a different situation - in order to prevent water pollution -
if can be shown pollution occurred -
then need to change and can do this within 12 months

JC so what has been done to ensure the terms are adequate?

NS these matters were discussed, believed adequate as a first step, then necessary to monitor quality and then change the conditions ..

JC so discretion reserved to a later time?

NS yes

JC yet surely you are under a statuatory obligation

NS remember why we are doing this - some sensible controls over logging practice..
far bigger

JC think should be, but currently unsatisfactory

JA broad general approach, we are having problems as to why chose that point of entry (ie time of licencing)?

JM - could you not have issued a licence over just a small area?

WF - nothing to stop us prosecuting..

JA but if SEMs followed and still (logging) activity caused pollution?

WF but these circumstances would have applied irrespective of whether or not a licence was granted..

JC there are requirements under the legisation .. as a preliminary see Section 17(D)
seems to be evidence you do not know the extent of pollution, therefore are unable to assess the factors ..

NS no we don't agree

NS we believe issue will in fact mitigate pollution
conditions will need to be revised over time,
we do need to review

JC is there a reasonable question in your mind whether will (..lead to pollution)

N where we get evidence of failure then those conditions should be reviewed as a matter
earlier we had nothing at all
tried to do so in logical manner

WF SEMs set by Soil Conservation Service - whatever version now, had its origins in Soil Con - current version derives from same

JC but 1990 and 1984 very different

WF whatever version - each has had dramatic (effect in leading to improvements)

JA - what is the evidence for this?

JM - little..

WF FC before/after logging

JA but there has been actual pollution, the situation has got worse

WF application of SEMs - better than none

NS needs to be (tightened)

JJ this has been a big thing to have dumped on the EPA, therefore why not a staged approach? EPA would not do same if say 30 major industries all applied simultaneously?

WF - but in fact did exactly this , eg when Clean Waters Act first introduced did exactly ...

NS from out point of view seemed good opportunity to have FC (brought under EPA Act) once licenced always licenced, and can continue to tighten down -

JC ?(then this was seen as) an importasnt step forward?

NS yes, for us in water pollution control

JC never happened before

JJ want to raise question about some particular areas

NS wouldnt be better to continue to disagree?

JJ has a licence every been refused?

(5)

WF yes, I could..
NS EPA will look at this once, in issue of policy-

SW how much monitoring of logging (is done)

NS - very little - techniques of water quality monitoring
right now WF's people are working up conidtions, requiring them to monitor logging operations,
and in final stages (looking at such possibilities as) remote sensing
do need to look at changes

SW so how could you tighten up in absence of the necessary information?

NS water quality monitoring - would like auditing mechanism, on the ground -

AR - what standards would you apply?

NS should look at pre/post logging water qulaity, won't have the information until above systems in place, then if can show change ..

WF inordinately complex
every activity has some level of pollution, in wilderness -
3 -4 levels, erosion a factor
if logging etc to be allowed within best practible available - then additional levels
where things staged
level "unacceptable" 2 sorts of difficult
audit

(6)

* distinguishing natural
distinguishing ~~dist~~ background
+ best practice

also source/ mechanisms —
need to address these issues — ∴ conditions —
need your people to help

JC — amazed — ~~the~~ E.P.A. Board —
of March v. Jan (?) —
legal concerns re inc. Fed. to participate — Should
there have been to Board
how do you address this?

NS — we believed an obvious step in right direction
∴ we (ie, the organisation) took the decision
(also ∴ responsible for issuing licences)
& benefit of hindsight Wd have been better to
* have discussed beforehand
remember very early point to move to
using mechanisms from ~~the~~ diffuse sources —
discussed in Board
will would maintain where there shifts —

JC — won't be revisited?

Board doesn't want discussion just decision record

NS — don't argue after event — Board role
no stop opportunity to consider B role but
what I am saying where a policy stuff → Board (goes to)

JJ — who are the EPA — ?
'We' — the organisation — the Authority acts thru Neil Sheppard
who is the "we" essentially the DG + Director General!
whoever + advisers +
a number of,

(7)

"EPA" — (decided) final issue was by NS — importance
actual considered of sufficient ~~of~~ for NS to argue

JA — why an 7 day?

NS — had gone as far as could safely go —
+ still for F.C. licenced
trade off — hang about + get details in place,
then FC could skip away for ever
OR get them licenced now and would be in harder
for them to get away
NS — believes best way to go
now take forward

prevention pollution
~~Prevention path~~ from logging

old growth forest to mean?
JC — but what do you understand ~~of~~ ?

JA — under Timber Act — various schedules —
what stopped you standing from the moratorium
areas —
— some could be pre - E.I.S. —

JC if discuss post EIS —
why not reserve powers —

NS if wait til perfect ---

EIS —
come to common end point — to tie to more
+ be more specific

?
JA — Did does (Killiecrankie)
NSC investigations in vision to

(8)

investigating officers sent back —

JC — Not about SE — Leo Farrell complaints —
no investigation
complaints
& licences issue
(that are being given out)

JA — our concern re signals — fear lest conditions
make it as if seem OK
very little will happen & be v. slow —
but some areas v. sensitive,
licence to pollute even pre-bagging EIS given
'wrong signal'
you'll have to be convincing us,
serious conflict

NS — I can accept you have difficulty with C date —
intend to tighten over time —
several forests already doing this —
don't recede from what we've done.
proof when conditions change + SEMS review is
completed

SW — + when confident effective monitoring system in
place — + uneasy : not knowing what step

NS — re: EPA are working on conditions that are
required for water quality monitoring — need to do
enough
adequate but not too much — timing + location
very significant

JM — my understanding EPA lack resources + budget.
do you have the resources to meet what we are

(9)

eg why cannot 'buy / lease / borrow from w Board — what is

NS — really need, what is needed? then make it be done

WF — will take time; yes. Still building —

JM — but if you have the money + political commitment can be quick — W in Obama will take yrs

NS — optimum at end year and yr NoT to issue licences — W will be retrograde retrograde — better better to move forward

eg will prosecute prosecute and ad hoc.

RB — ē licences — a general licence, yet ultimately comes to soil type

NS — need to go to coupe by coupe basis coupe by coupe soils

JH — what about Mt Royal? what will you do to investigate investigate for conditions? vary vary the required licence?

NS — 1st First look at it —

JC — SEPs — but W utterly inadequate inadequate — also almost never put in place put in place —

NS — if not applied then a breach of lic. cond.

JC — who will direct?

NS — number of ways — eg JC will tell

13

(10)

At Royd —

JA - Royd will your views protected —
eg EPA can or not insist / change licence —

NS — ...

JC — cannot in some cases cannot log and log + prevent pollution pollution

NS — ...

JJ — fits in with another problem
another problem —
EPA is part of determining quality — Pt 5 EPA Act
so what — but EPA will also have to consider + Rur Planning
FC — has already decided, has a ....
regional EIS logging so far did you turn
in regard EIS logg so far — did you turn
your minds minds —

SPCC — Pt V believed not apply in these licences issued.
mixed signals —
JA - can you say response to At Royd?

NS — cannot answer until answer until EIS + issues and issues cannot decide Royd
let's wait wait.
Certainly
we not being
we not being prepared to refuse licences —
eg for whatever reasons

JC — Drop of what conditions, would up to NO LOGGING be the answer?
cond → NO LOG answer —

decided to take opportunity opp to advance
FC a clear notice to say, conditions reviewed
water quality conditions would imposed
begin that cond will be imposed
all shld be picked up as are defined
all shld be picked up as are defined

NS — duff is like to arrive at same pos.

14

(11)

NS diff route — as a Stat. Obj — different Statutory Objective
these natures of
WF capacity stronger than where when no licences
JC — accurate

NS with benefit of hindsight would have
discretion Board
maybe of course not have been changed
have been changed —

NS — are there specific things —

RB — licences now regional

9 Regions very different
within those 9 probably number and some of
our 9 prob tend to be same soil types —

NS — once condition and which clearly identify catchment
or soil type
then can include within our licences —
particular
eg pollic soil types
obj/obj over time more and more specific re particular site issues
as SMD C.D.P.
CoPs

ie series catchments which are point sources

NS who need, that people doing what they ? to
need this people doing what they are to

JJ — if single pollutant within catchment
single pollutant our catch

NS/WF — yes — —

JM — Why so reluctant to pin point one agency?
(is there) / rule for primary another individual/community?

NS — No — several ways tackle ultimately

12

end up with most logical basis can achieve objectives

WF - when we come to meet new activity eg individual
pollution
pollution — what is attempted here(is) novel, basically
world wide
world wide —

JM — problems re Public participation
eg if come in at early stage

NS — wouldn't ask Board to rubber stamp anything —

NS — Donna — 1st task — Ministers list —
need reg mtgs to discuss, eg on quarterly basis
regular meetings,

JC — will you release FC documentation
doc etc
NS — place fairly open

JA — one thing we want to discuss is Stage 2 —
Shld turn minds to broad Public involvement —
if eg had advice — would certain
eg had adv — Shld have observed certainly key
elements —

JC — is a lack of good faith — solution — have number of complaint
lack
— eg while we're involved in this eg we've made no complaint
— eg while we're involved in this — you Dr Shepperd failed
disclose —

NS — hang on — wrote
hang on — wrote said if you want to take action
would
OK — we said we Shld investigate — determining — whether
Should prosecute
Shld prosecute
licence doesn't affect that
licence doesn't affect that —

JC — lack of faith

SW — confused Licence → FC
+ Roy B Minutes — keep in contractors —

13

NS – 2 elements

FC must require of its contractors must observe conditions
Contractors but are not protected by same licence

Sub-contractors need to obtain own licence as
Contractors must to obtain own licence – as opposed to being a "servant of the community"

aggregation of
aggregation of eg bulldozer drivers or a
cooperative –
at this stage unaware issuing any
@ the stage unaware of issuing any licences –

seek to impose got to impose
and seek to impose – got to impose –
CoPs
NS – if std EIS or CoLP not observed –
driver
and dual ē duce
+ F.C.

JN – under E.P.A – due diligence +
accountability v. licensee ?

Count
Ct he said
ie do not bring in multiple charges select
NS – One of 2 properly selected charged –
selected
so far most culpable as responsible
responsible –
what really want to do is to understand
good deterrent effect –

Meeting closed @ 5.40 pm.

Note: some of discussion not recorded, including where this recorder (AR) raised questions, which included dilemma of independent unbiassed appraisal of EIS where licence already in place.

Parliament of New South Wales

1990

REPORT

OF THE

STATE POLLUTION CONTROL COMMISSION

FOR THE

YEAR ENDED 30 JUNE 1990

Ordered to be printed 22 November 1990

AUTHORISED BY
THE PARLIAMENT OF NEW SOUTH WALES-1990

CHAIRMAN AND DIRECTOR'S REVIEW

My introduction to the Commission — first as Chairman and more recently as Director — has come during one of the organisation's most turbulent passages. The challenge of change is being encountered at all levels: from the community rightly exerting strong pressure for greater attention to the environment, to the Government's launching of appropriate new initiatives, to the Commission re-ordering its operations to implement those initiatives and, finally, to the organisation itself, adjusting internally to meet these new demands.

One significant aspect of change is reflected in the circumstances of my own appointment. The Government has created, through new legislation, three Environmental Trusts to accumulate funds for grants to projects on environmental research, education, and restoration and rehabilitation. My predecessor, Peter Standen, relinquished his directorship to take charge of those trusts and, with the re-organisation, the Commission is now under new leadership. May I take this opportunity, personally and on behalf of Commission staff, to wish Peter well in this exciting new venture.

A major catalyst for change in environmental management in New South Wales has been more intense and penetrating community scrutiny of the environment and those responsible for its protection. The public is protesting, not only at health risks, but at the wider ecological and environmental implications of sewage pollution, chemical incidents and excessive industrial emissions, to name but a few concerns. There are heightened expectations regarding environmental standards, including that industry should strive towards "zero discharge" of toxic pollutants. The public and the media have become concerned about global issues such as greenhouse warming and depletion of the ozone layer. They are also interested in the concept of sustainable development, questioning what might be the long-term effects of environmental damage on the resource base, the economic viability of various activities and, ultimately, on the well-being of future generations.

This public scrutiny has targeted both pollution itself and the manner in which the Government and its agencies deal with pollution and polluters. In an era of open government — with that openness now legally enforceable under the Freedom of Information Act — the Commission is increasingly carrying out its operations within glass walls.

It is possible to point to a few simple, direct indicators of mounting public expectations of the Commission. Formal complaints to the Pollution Line have increased from about 5500 in 1985-86 to over 9000 last financial year. When we add requests for information, the figure for telephone contact rises to some 23,000 calls a year. A third category of daily calls from all sectors of the media pushes that figure still higher. The number of letters to the Minister which are referred to the Commission for advice is also rising rapidly, from under 100 a month in 1987-88 to over 140 a month last year.

Though it has often come in the form of criticism of the Commission, increasing community interest is a welcome spur to greater investment of resources in environmental protection. Additional resources for the Commission have made recent times both an era of significant achievement as well as one of upheaval. The flow of benefits from this influx of resources will accelerate as systems are fully established and recruitment and training of staff are completed.

In the current climate of public concern, it is essential to satisfy the community that both public and private enterprise are improving their environmental performance. A major initiative to ensure the environmental integrity of a public operator has seen an end to the Water Board monitoring its own operations and the vesting of that surveillance role in the Commission. The Marine Waters Branch has been set up within the Commission to conduct the Environmental Monitoring Program, which is assessing the impact of the deepwater sewage outfalls being constructed by the Board, and the Beachwatch program, which advises the public on pollution levels at Sydney beaches. The Marine Waters Branch also audits the Board's six major coastal sewage treatment works to ensure licence limits on pollutants are being met.

A commitment to curb abuses of the environment is reflected in the new Environmental Offences and Penalties Act, introduced in November 1989. This Act creates new pollution "offences" and contains mechanisms to restrain polluting activities once legal action has commenced and to freeze company assets

so possible fines and clean-up costs can be met. Its most noteworthy features include heavy penalties and personal culpability for offenders. Companies face fines of up to $1 million plus all clean-up costs, and individuals convicted of offences (including company directors and managers) can be fined up to $150,000 with a maximum seven years' gaol. A number of prosecutions under the tough new Act are already under way.

The impact of the Environmental Offences and Penalties Act was felt even before it became law with industries approaching the Commission for advice on improving their environmental performance. The Act has yielded other indirect benefits, too, by encouraging national discussion of tougher, higher penalties and greater severity by the courts in dealing with polluters. In recent months, fines awarded in all categories of pollution charges in both the Land and Environment Court and the Local Court have risen substantially. For example, the highest fine imposed on a particular water pollution offence was $3000 in 1986-87 while last financial year it had risen to $35,000 for a comparable offence, even though the maximum possible penalty remained unchanged at $40,000 throughout the period.

The Government envisages that the Environmental Offences and Penalties Act will ultimately cover three categories of offences — aggravated, standard and minor — with the last type dealt with by the issue of infringement notices. The Commission is at present paving the way for the wider use of these notices which will enable administrative and minor environmental offences to be dealt with more simply and speedily rather than through prosecution. This will in turn increase the Commission's enforcement capability by freeing up resources for its other important activities.

As the basis of a sterner stance on enforcement and prosecutions, the Commission is making a major effort to overhaul its licensing system. A vital element in this process will be establishment of a computerised approvals, licences and notices system. The Commission is also implementing the recommendations of a discussion paper which the Minister and I wrote earlier this year. Future licences will contain realistic, enforceable conditions and, where necessary, pollution reduction programs to ensure a continual lifting of standards as technology warrants. A system of performance bonding will ensure industries adhere to the programs, which are based on negotiated, realistic time frames. The new system will create a steady platform from which the Commission can launch a vigorous prosecutions program. Already the Commission is pursuing a much more active prosecutions role with the number nearly trebling in the last two years.

Among internal changes, the Commission will work with a new organisation structure taking effect from July 1990. The new structure reflects the strong focus on regulatory and enforcement activity by grouping together branches responsible for similar regulatory action. For example, there will be a new division concentrating entirely on the Sydney Region.

Other changes looming for the Commission include establishment of the new Environment Protection Authority (EPA) which will operate from July 1991. Though the final form of the EPA has yet to be announced, it is known that it will absorb the functions of the Commission in their entirety. The Minister has appointed me to continue as Director (and Chairman) until the advent of the EPA, when I will take up chairmanship of the new authority.

Commission staff are also preparing for the move of Head Office from the Sydney Central Business District to Bankstown, expected in December 1990. During the transition to the EPA and in preparation for the physical move to Bankstown, the Commission is concentrating on smoother, tighter operations. An internal review is in progress aimed at overcoming the stresses created by change and ensuring that an efficient, cohesive organisation with high staff morale is ready to meet the challenges still in store. One of my ambitions during this period is to give greater priority to the needs of staff, particularly in the areas of training and staff development opportunities.

The emphasis on a more stringent regulatory and enforcement role in the lead-up to the EPA should not be allowed to overshadow the Commission's commitment to environment protection in its widest sense. As demonstrated by the list of highlights in this report, the Commission continues to be active in research, development and the implementation of strategies which address the full range of pollution and environment protection issues. Research is crucial for providing a basis for competent and balanced control measures in the future. It is important, too, not to lose sight of the over-arching role of education as the main tool in environmental protection. Effective and visible enforcement should be seen as only one aspect of education. Ultimately, only effective education of industry, government and the whole community will guarantee long-term environmental quality. And this will be a key priority as we move further into the 1990s.

JOHN NILAND
Chairman and Director

ORG

Technical Advisory Committee
Clean Waters Advisory Committee
Hazardous Chemicals Advisory Committee

Executive
Technical and Regional Activities Committee
Administration and Finance Committee

Executive Unit
Occupational Health and Safety

Administration Division
Chief: Terry Meredith

Human Resources and Equal Employment Opportunity Branch
- Personnel

Management Services Branch
- Administrative Services

Finance Branch
- Finance
- Licensing

Inland, Services a Natural Resources Division
Chief: David Leece

South-West Branch
- Queanbeyan Office
- Albury Office

North-West Branch
- Bathurst Office
- Armidale Office

Natural Resources Bra
- Resources Policy
- Resources Monitorin

Chemistry Laboratory
- Water Chemistry
- General Chemistry

Community Relations Branch
- Education and Information
- Publications
- Community Prograr

SPCC Report for year ending 30 June 1990 (No 228)

CORPORATE GOALS AND OBJECTIVES

The goals and objectives pursued by the Commission in its operations are contained in the organisation's Strategic Plan. They are the following:

AIR

Goal:

To achieve air quality throughout New South Wales that will, for present and future generations, adequately protect health, natural resources, amenity and property, and support economic activity.

Objective:

Ambient concentrations of air impurities below levels listed in the schedule to the Commission's Strategic Plan and otherwise, as practicable, consistent with the community's overall availability of resources.

WATER

Goal:

To achieve protection of the State's waters for the greatest present and future benefit.

Objectives:

Water quality which meets or substantially approaches classification goals in designated catchments by the times indicated in the schedule to the Commission's Strategic Plan.

Maintenance and improvement of existing water quality by the application of best practicable means of control and encouraging a high standard of catchment management in all other catchments as resources allow and needs dictate.

NOISE

Goal:

To achieve the quietest environment practicable.

Objectives:

Environmental noise levels in the vicinity of transportation which do not exceed those specified in regulations or the *Environmental Noise Control Manual.*

Environmental noise levels in the vicinity of products which do not exceed those specified in regulations or the *Environmental Noise Control Manual.*

Environmental noise levels such that noise emissions from specific premises or in public places do not exceed background noise levels plus five decibels as qualified by regulations or the *Environmental Noise Control Manual.*

CHEMICALS AND WASTES

Goal:

To achieve protection of the environment from the impact of chemicals and wastes.

Objective:

Control the manufacture, use, transport and disposal of environmentally hazardous chemicals and move towards optimal waste management.

LAND AND ECOSYSTEMS

Goal:

To achieve land, biota and ecosystems either preserved in their natural condition or conserved and sustainably utilised for the benefit of present and future generations.

Objective:

Achievement and maintenance of the best practicable level of land protection throughout New South Wales.

VISUAL AMENITY

Goal:

To achieve socially acceptable visual amenity throughout New South Wales. (In the main, this goal is achieved through the implementation of the other programs. The Commission responds to specific issues as they emerge from time to time.)

MANAGEMENT

Goal:

To achieve an enthusiastic, efficient and effective organisation with sound strategic direction.

Objectives:

Strategic policies appropriate to the times.

Enthusiastic, well-trained and suitably deployed staff.

Efficient and effective allocation and use of achievable financial resources.

Efficient administration and effective management information systems.

Efficient and effective technical and legal support services.

COMMUNITY RELATIONS

Goal:

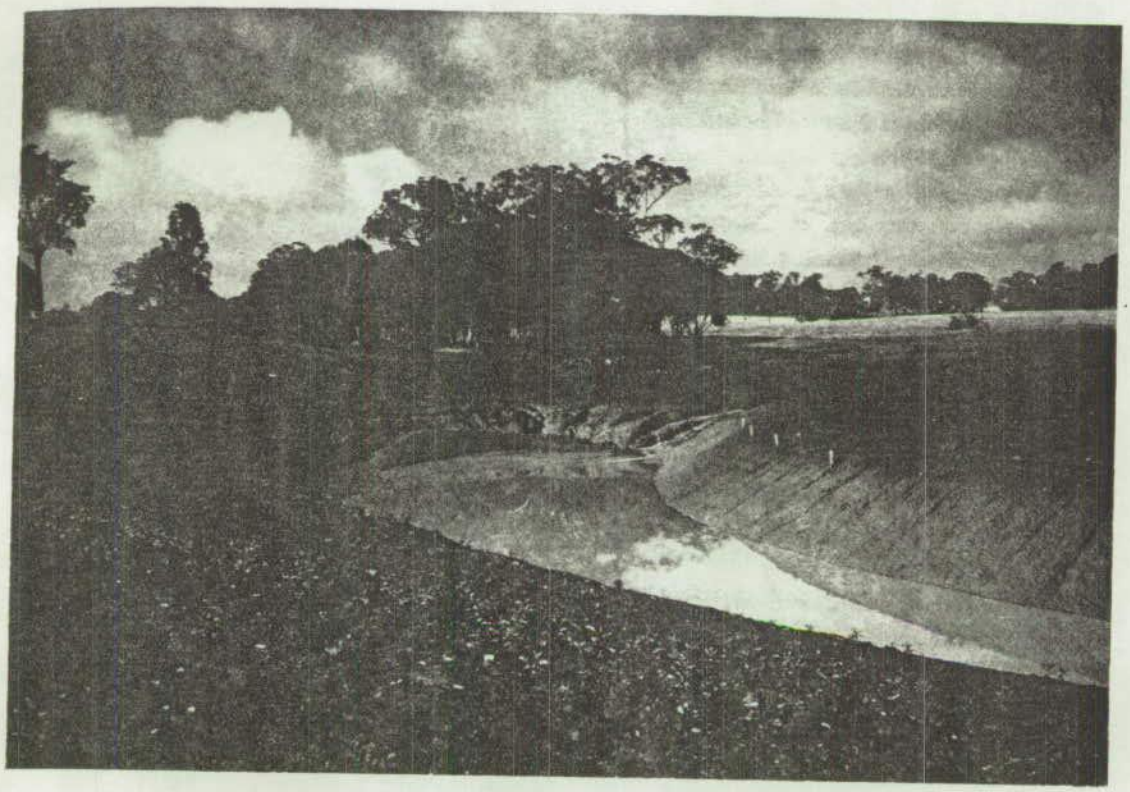
To achieve a high level of understanding throughout the community of environmental issues and how these may be best addressed.

Objectives:

A high level of awareness and understanding in the community of the environmental management issues listed in the schedule to the Commission's Strategic Plan and of other issues which emerge from the Commission's work program from time to time.

A high level of public satisfaction with the Commission's operations and with handling of Pollution Line and other inquiries, and ministerial correspondence.

POLICY DEVELOPMENT: WATER POLLUTION



This siltation pond at the Norwest Business Park is helping to control a common urban runoff problem.

Water pollution and water quality remain high on the environmental agenda in New South Wales and Australia. At the centre of interest last year were the Sydney sewage outfalls. They continued to hold public attention, especially with the introduction of the State Government's new Beachwatch service for swimmers.

But public concern was raised even further, this time over industrial water pollution, when the environmental group Greenpeace dramatically blocked off the effluent pipes of a major oil refinery and a steelworks, accusing both of excessive pollution. The two incidents illustrated an unfortunate tendency, which has developed over many years, to set Commission licence limits for pollutants at desirable rather than achievable levels.

The overhaul of the Commission's licensing regime to correct this type of fault, which was begun several years ago, has been given new impetus by these incidents. The licences held by the Water Board and many major industries have now been reviewed to represent immediately achievable and "prosecutable" reality. At the same time the Commission's enforcement capability has been strengthened.

A further major Government initiative was to transfer the Environmental Monitoring Program of the extended ocean outfalls from the Water Board to the Commission. While the financial resources for the program were also transferred, only one member of the Board's staff came across to the Commission. This placed considerable strain on the Commission's already slender resources in water quality management. Much effort was expended during the year in building up an effective specialist staff from 18 to 45.

The heightened interest in water quality has led to heavy demands by industry, government instrumentalities, regulatory agencies, educational establishments and consultants on the pool of personnel skilled in the field. This has placed great strain on the capacity of all parties to respond to government and public demands for clean water. The situation is not unique

to NSW and is expected to continue for some time. Educational institutions, with encouragement from the Commission, are gearing up to meet the new demand, but cannot be expected to produce "instant" experience.

Development of a new water classification proposal moved a stage further during the year with endorsement in principle by the Clean Waters Advisory Committee, the Commission and the NSW Water Resources Council. Classification is the process by which water quality goals and objectives will be established for all the State's waters. It will be a central input to the process of water quality management as it finds expression through both licensing and catchment management.

In parallel with this development, the Commission had a substantial input in the consideration of national water quality criteria through the Australian and New Zealand Environment Council (ANZEC). These criteria are aligned to those being developed for NSW under the revised classification system. The end-result is likely to be a consistent set of water quality criteria Australia-wide, endorsed by both ANZEC and the Australian Water Resources Council. This is a highly desirable outcome, since under the federal system, primary environmental responsibility lies with the States and Territories.

The Commission continued to play a central role in the development of catchment management in NSW. Regional and local catchment committees are now being set up under the Catchment Management Act which was passed in 1989. The Act also established the State Catchment Management Coordination Committee.

EFFLUENT RE-USE

The Commission has begun several initiatives to improve the knowledge and practice of effluent re-use. Its *Design Guide for the Disposal of Wastewaters (WP-6)* was revised for issue as an Environmental Guideline called *Design Guide for the Application of Wastewaters*. This extended the original's focus on the disposal of high-strength wastes by incorporating secondary-treated municipal effluent following disinfection.

A contract was let for the preparation of a design manual which will promote the re-use of treated municipal sewage effluent in agricultural irrigation and provide sound technical advice to farmers on irrigation using such wastes. The manual's working title is *Agricultural Re-Use of Effluent* and it is expected to be released early in 1991.

The Commission is also involved in two projects in progress which are expected to yield valuable information on effluent re-use. They are:

- an urban recycled water pilot study – under way at Shoalhaven Heads – which will determine the feasibility of using treated municipal wastewater effluent in domestic, non-potable applications
- a study into the effects of recycled water in urban re-use applications in which the University of NSW's Centre for Wastewater Treatment is researching the effects of effluent on soil and the potential hazards of viruses.

URBAN RUNOFF

The *Pollution Control Manual for Urban Stormwater* was released in August 1989. Demand by local and State government authorities and engineering consultants has been encouraging with over 500 sold to date.

As the first step in a stormwater-drain pollution abatement program, options are being developed for the licensing of stormwater drains, including those owned and operated by the Sydney Water Board. The Board has installed trash booms in several stormwater canals.

The Commission is continuing to research urban stormwater quality, gathering water quality data and developing mathematical models to predict changes.

CLASSIFICATION

Throughout the year, the Commission has been working on a major proposal to revise classification of the State's waters. The basis of the scheme is a set of protection categories, a selection of which will apply to any given waterway and determine the permitted contamination levels. The government will work with the local community to set water quality goals that would form the basis of the Commission's licensing and enforcement program. The proposal is due for release and extensive public comment in the second half of 1990 before legislative amendments are submitted for approval.

TOTAL CATCHMENT MANAGEMENT

In late 1989 the State Catchment Management Coordinating Committee (SCMCC) was established under the recently introduced Catchment Management Act. The committee comprises representatives of government and independent bodies, including the Commission.

The Act also establishes and specifies representation of management committees for specific catchments. The formal establishment of these under the Act is expected to take some time, with the guidance of the SCMCC.

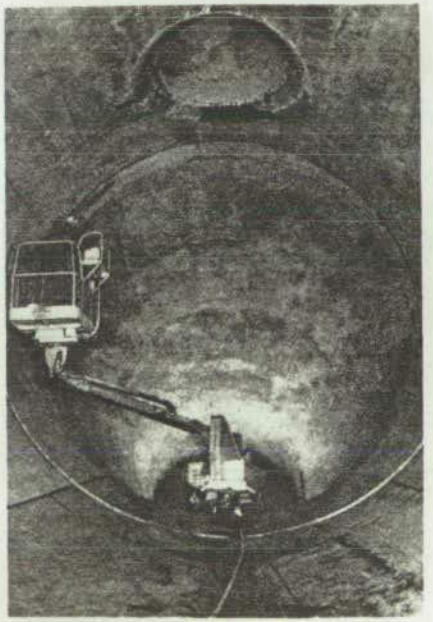
Legislative weight is also given to principles of catchment management outlined by the previous interdepartmental committee. Within this framework, the Commission will:

- provide water quality goals through classification of waters under the Clean Waters Act with input from each catchment community
- continue to control point-source discharges through licensing and approvals under the State Pollution Control Commission Act or its replacement when the Environment Protection Authority takes over from the Commission
- deal with those diffuse sources of pollution to which the licensing provisions of the Act can be applied, such as sewer overflows and stormwater in urban areas
- provide water quality monitoring/survey information on the achievement of objectives.

The Regional Operations section reports on Commission participation in specific catchment management activities.

SYDNEY DEEPWATER SEWAGE OUTFALLS

The five-year Environmental Monitoring Program (EMP) is providing an assessment of the impact of the deepwater sewage outfalls now being built off Sydney. It was developed by the Water Board in 1988 as a requirement of the Commission's approval for the construction of the three outfalls. The EMP has three phases: pre-commissioning (two years), commissioning (one year) and post-commissioning. Responsibility for the EMP passed from the Board to the Commission on 1 January.



A glimpse inside the new Bondi sewage outfall gives an idea of the scale of the project.

The short-term objective of the EMP is to establish base-line data on near-shore and offshore ocean water environments related to the location of sewage discharges.

In the longer term, the objectives will be to:

- assess the nature and extent of the environmental impact of the offshore disposal of sewage effluent
- evaluate how appropriate and effective are contemporary environmental standards and discharge limits, and whether they need to be changed.

The EMP comprises studies involving fish and macro-invertebrate community structures, accumulation of contaminants in marine organisms and sediments, water quality and the suitability of beaches for recreation. Oceanographic studies are also being conducted to understand sewage plume behaviour and assist in the design and interpretation of other EMP studies.

BIOLOGICAL STUDIES

The deepwater outfalls may cause nutrient enrichment and settlement of effluent particles near the discharge sites, which would affect the diversity and population of fish and invertebrates in the area. Baseline monitoring of these populations commenced in early 1989 to assess any temporal or spatial variation. Samples have been collected using netting, line fishing and grabs at selected locations and water depths off Sydney.

Fish species covering all evolutionary, migratory, reproductive and dietary types have been caught. The results to date reveal fish are most abundant at the shallower depths. Both high and low catch rates were observed in areas now feeling the impact of sewage effluent.

WATER QUALITY AND CONTAMINANT STUDIES

The deepwater outfalls should improve water quality close to the shore and on the beaches, but they may have an adverse effect near the outfalls.

Water samples from various depths are being collected in an ongoing program at inshore and offshore sites for analysis of a range of properties. The results will be compared with samples taken after the new outfalls are commissioned.

Commission studies in 1987 and 1988 confirmed that certain contaminants had bio-accumulated in some species of fish caught near the existing outfalls. The current studies will establish the concentrations of these contaminants in a greater range of fish, invertebrates and sediments. A study of contaminants in the top 50 micrometres of the ocean will determine the extent to which toxic pollutants are concentrated and transported in this so-called "micro-layer".

Because it is difficult to find a technical solution for odour from the industry, this problem, in particular, has caused public complaint, sometimes from as far as 10 kilometres away from a large facility. The Commission is currently gathering feedlot information from within Australia and overseas to understand better the factors which contribute to excessive odour. Feedlot siting and stocking density are already known to be important.

On another front, the Commission is participating in a joint research program with Queensland and Victorian authorities to establish more quantitative methods of odour measurement, dispersion modelling and odour impact prediction. The work is funded in part by a grant from the Australian Meat and Livestock Research and Development Corporation.

The Commission has revised its 1977 guideline publication, *Environmental Management of Cattle Feedlots*. A draft of the new guide, circulated in 1990, addresses site selection, feedlot layout and construction, waste management and odour control. It differs little conceptually from its predecessor, but adds a wealth of technical detail to assist feedlot proponents, consultants and regulatory bodies. After a period of public review, the draft will be revised and published. The information should serve as a guide to sound environmental, agronomic and animal husbandry practice.

The Commission joined a recently formed interdepartmental Feedlot Advisory Unit which has prepared a manual for potential developers to assist them in selecting suitable sites for feedlots. The unit is also drawing up a common regulatory approach for the NSW, Queensland and Victorian Governments.

As well as their involvement in approvals and licensing activities, Commission officers are advisors and educators, participating in seminars to inform industry and local government of the environmental aspects of cattle feedlotting.

IRRIGATION FARMING

Irrigation farming is highly reliant on applications of water and agricultural chemicals and thus it has a great potential to pollute land and water. To ensure environmentally sound irrigation farming, the Commission will follow the strategy of preparing technical bulletins and environmental guidelines, introducing a code of practice, as well as education and enforcement.

The Commission is working with NSW Agriculture and Fisheries and the Department of Water Resources to produce a draft environmental guideline for managing irrigation farms. The guideline will outline recommended management practices and the statutory requirements applicable to the industry.

A joint Commission-industry code of practice, which will briefly summarise positive actions constituting good environmental practice in irrigation agriculture, is also planned. This code should form a sound basis for industry self-regulation and contribute to the development of sustainable irrigation farming systems in NSW.

The Commission continued its study of cotton farming in north-western parts of the State. A technical bulletin, *The New South Wales Cotton Industry and the Environment*, will be released in November 1990. It reviews the environmental impact of established practices of the cotton industry and highlights issues such as tailwater management, pesticide application and disposal of chemical wastes.

FORESTRY

Forestry is a significant part of the economic development plan for NSW. The Commission has been working to ensure the operations of the forest industries are environmentally sustainable and sound. However it has been concerned that many of the State's native forests, with important multi-use and conservation values, are not being adequately conserved in national parks or nature reserves.

The Commission's review and submission on the NSW Pulp and Paper Industry Taskforce report highlighted a number of areas of concern including:

- the potential environmental impacts of large-scale forest operations needed to sustain a bleached eucalypt Kraft pulp mill of world scale if one or more mills are established
- the availability of the State's timber resource
- the sustainability of intensive logging in the State's native forests.

The Commission also made a submission to the Commonwealth's Resource Assessment Commission inquiring into Australia's forest and timber resources. The submission expressed an interest in investigating sustainable development, resolving the environmental effects of forest management practices, developing an inventory of timber resources and developing forest management guidelines.

Both submissions raised concerns about forests on private lands. While the Forestry Commission of NSW is required to manage forests and lands under its control in an environmentally sound manner, the only controls over forests on private lands are those under the Soil Conservation Act 1938. Standard erosion mitigation conditions (SEMC) were issued in 1977 by the Catchment Areas Protection Board and the Forestry Commission. These SEMCs apply to all Forestry Commission lands and protected areas on private lands.

Meanwhile, a working group comprising the State Pollution Control Commission and other government agencies has been reviewing the SEMCs. This group has already made a number of recommendations aimed at improving the effectiveness and enforcement of the current SEMCs.

APPENDIX 7: SENIOR OFFICERS

The senior officers of the Commission at 30 June 1990 were:

Chairman and Director
Professor John Niland, BCom (Hons), MCom, PhD, FASSA

Deputy Director
Dr Warwick Forrest, BScFor, MA, PhD

Chief: Central Sydney, Air and Noise Division
Mr Michael Mowle, BTech

Chief: Outer Sydney, Chemicals and Wastes Division
Mr Peter Yates, BScChemEng

Chief: Coastal and Water Division
Mr John Court, BA, BSc, MAppSc, MA

Chief: Inland, Services and Natural Resources Division
Dr David Leece, RFD, ED, MScAgr, PhD, CBiol

Secretary and Chief: Administration Division
Mr Terry Meredith

Manager: Corporate Services
Ms Joan Wilcox, MScEcon

Manager: Air
Mr Len Ferrari, BSc

Manager: Noise and Transport
Mr Chris Eiser, BEng(Hons), MAppSc

Manager: Chemicals and Wastes
Dr Harley Wright, MSc, PhD, DipEnvStud

Manager: Ecotoxicology
Vacant

Manager: Water
Vacant

Manager: Marine Waters
Dr Robin Macdonald, BSc, PhD

Manager: Natural Resources
Vacant

Regional Manager: Central Sydney
Mr Alan Crapp, BEng

Regional Manager: Northern Sydney
Mr Warren Hicks, BEng

Regional Manager: Southern Sydney
Mr Tony Hewett, CEng

Regional Manager: Hunter and North Coast
Mr Bruce Gibbs, BScChemEng

Regional Manager: South Coast
Mr Joe Woodward, BSc, ME(Hons)

Regional Manager: North-West
Dr Richard Whyte, BSc, MSc, PhD

Regional Manager: South-West
Mr John O'Gorman, BSc, BScTech, MMgt

Manager: Chemistry Laboratory
Ms Lorraine Plues, AssocAnalChem, MSc, GradDipChem

Manager: Community Relations
Mr Richard Guest

Manager: Human Resources and EEO
Mr Fred Hollis, BBus

Financial Controller
Mr Wayne Baker

Senior Officer: Management Services
Mr Gary Haines

APPENDIX 8: THE COMMISSION'S REGIONS

The local government areas which comprised the Commission's administrative regions at 30 June 1990 are listed below.

CENTRAL SYDNEY REGION

Ashfield Municipality
Auburn Municipality
Bankstown City
Botany Municipality
Burwood Municipality
Canterbury Municipality
Concord Municipality
Drummoyne Municipality
Hurstville Municipality
Kogarah Municipality
Leichhardt Municipality
Lord Howe Island
Marrickville Municipality
Parramatta City
Randwick Municipality
Rockdale Municipality
Strathfield Municipality
Sydney City
Waverley Municipality
Woollahra Municipality

NORTHERN SYDNEY REGION

Baulkham Hills Shire
Gosford City
Hawkesbury Shire
Hornsby Shire
Hunters Hill Municipality
Ku-ring-gai Municipality
Lane Cove Municipality

No. 565

Parliament of New South Wales

1988-89-90

REPORT

OF THE

STATE POLLUTION CONTROL COMMISSION

FOR THE

YEAR ENDED 30 JUNE 1989

Ordered to be printed 7 December 1989

BY AUTHORITY
G. J. COSTELLOE, ACTING GOVERNMENT PRINTER-1989

There has been a dramatic increase in the public's demand for better water quality over the past year. Most attention has focused on control of sewage discharges near Sydney beaches, the effectiveness of the new extended ocean outfalls under construction at Malabar, Bondi and North Head and the monitoring program which will accompany their operation.

Elsewhere the Commission has recognised the threat posed by pollution from diffuse sources. As towns and cities grow, great damage can be caused by urban stormwater. In response the Commission is promoting the use of urban runoff controls in all new areas and their installation where practicable in developed areas.

The Commission is also working on a new system of classifying waterways by setting goals and objectives which, if achieved, will allow them to be used for certain desirable activities.

A particularly effective technique to deal with the many and varied sources of modern-day pollution is Total Catchment Management. The Commission has been a very active proponent of this valuable tool in a growing number of catchments throughout the State.

Beach Protection

Media attention

Sustained media attention on Sydney's sewage outfalls in early 1989 galvanised public opinion on water pollution to a pitch not experienced since the first "environmental awakening" of the late sixties and early seventies. In reality there has been little major change in pollution entering the sea from the Malabar, Bondi and North Head outfalls, but the level of public concern is an illustration of the rapid growth in environmental consciousness.

Much of the attention focused on the present unsatisfactory near-shore discharge of sewage. As a result many critics seemed willing to pre-judge the effectiveness of the extended outfalls now being built by the Water Board in place of today's system. These new, longer outfalls will discharge primary treated sewage from the three major Sydney plants into water 60-70 metres deep and between 1.7 and 3.6 kilometres offshore. The Commission approved the work after assessing that it would bring a great reduction in bacterial contamination of the city's beaches. Approval for the new facilities included the requirement for an extensive environmental monitoring program to decide if any further onshore controls were needed.

International review

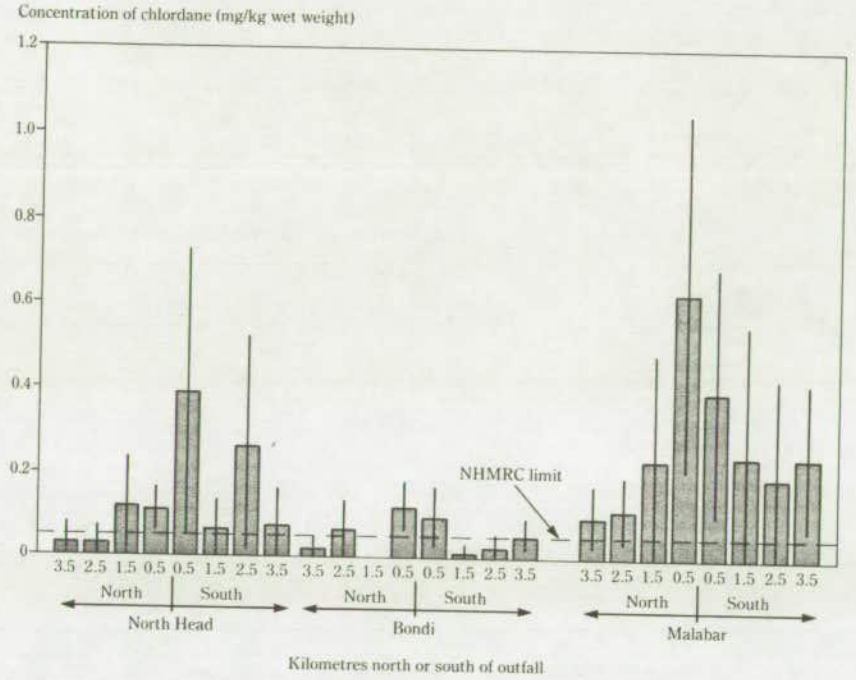
In February 1989 the New South Wales Government called international tenders to review the effectiveness of measures planned to control and mitigate pollution from the extended outfalls. Camp Dresser & McKee International of Boston were selected to report by 30 September 1989. The consultants are considering alternatives to the controls chosen; predicting the performance of various controls in meeting acceptable environmental criteria; looking at ways to further upgrade treatment, including a review of trade waste management; and assessing the suitability of operating and monitoring practices.

The Commission has presented two submissions to the review. One outlined its past involvement in regulating the operational design of the extended outfalls, the other its intention to progressively require further controls if monitoring shows there is a need, especially where toxic substances and grease are involved.

Bioaccumulation

A second study into the bioaccumulation of organochlorines and metals in marine life near the present Sydney outfalls was completed this year. This research and a previous study were both initiated by the Commission and funded by the Water Board. They were conducted before the environmental monitoring program is introduced to assist in its design and to give an early indication of any likely problems. Two reports covering the Commission's component of the work were released by the Minister for the Environment, Tim Moore, in March 1989.

Mean concentration of chlordane (mg/kg wet weight) in muscle tissue of red morwong plus 95 per cent confidence limits for all sites (n=8) (1988)



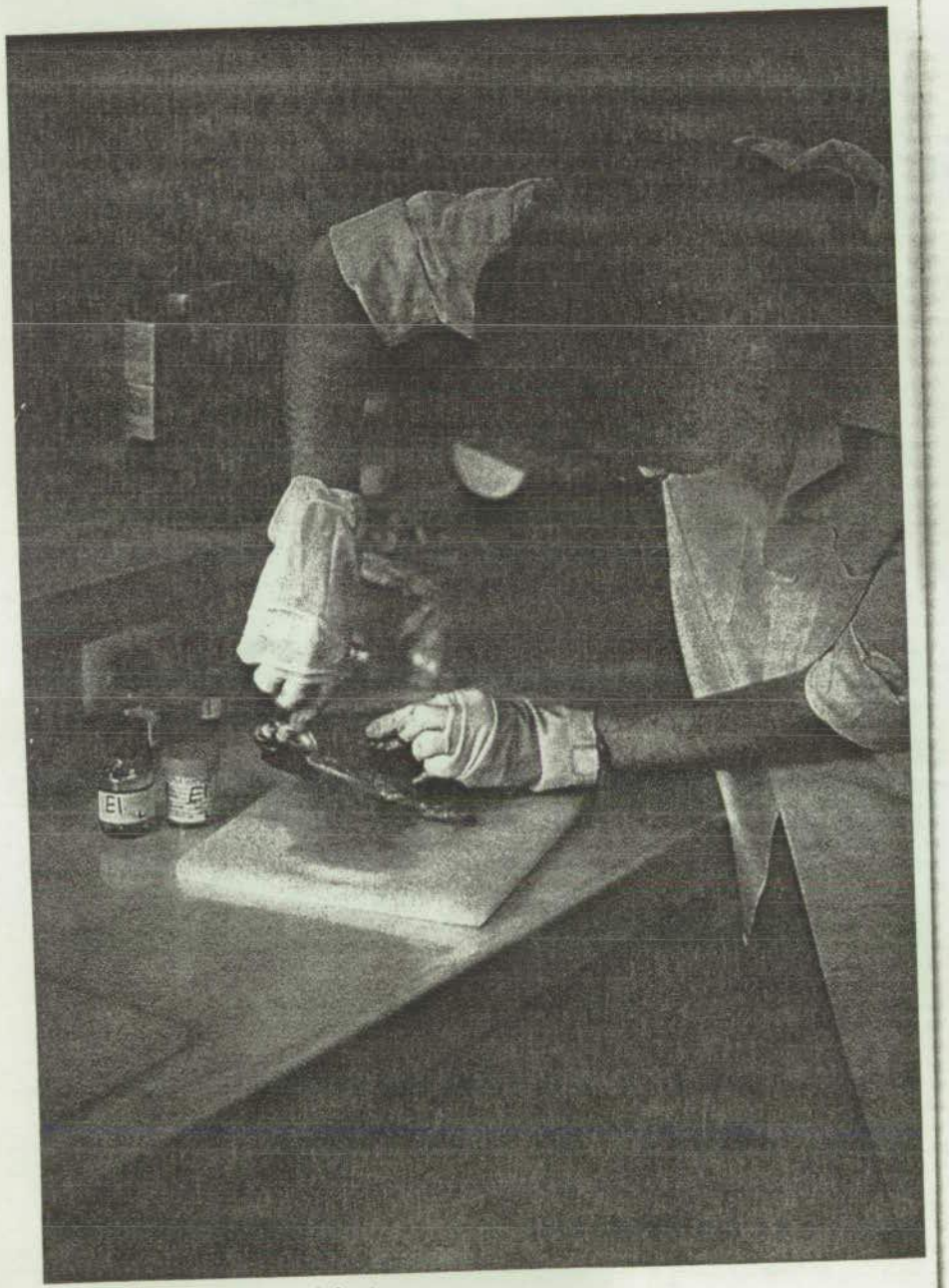
During 1987 contract divers from The Ecology Lab Pty Ltd worked with Commission officers to collect mature specimens of six aquatic organisms near the Malabar outfall. Red morwong, blue groper and rock cale were the fish species sampled, together with several invertebrates, the red bait crab and black lip abalone, and the cunjevoi. Control samples were also taken at Port Hacking and Terrigal.

The muscle tissue of the red morwong showed mean concentrations of two pesticides, benzene hexachloride and heptachlor epoxide, which were 122 and 52 times respectively the National Health and Medical Research Council's (NHMRC) maximum residue limits. Trace metal concentrations varied substantially between species and sites.

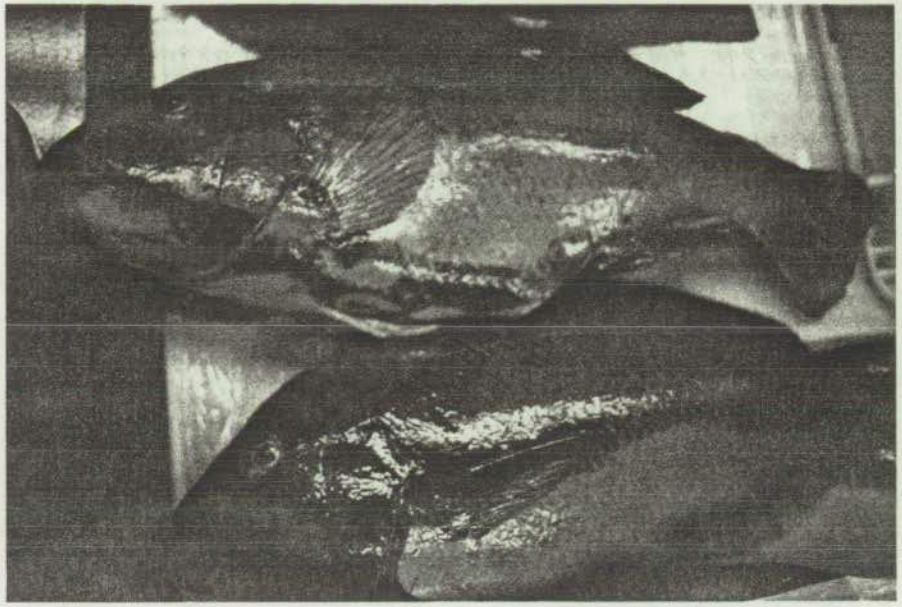
In the later study of 1988, red morwong (a territorial species) were again sampled, this time at fixed intervals of 0.5, 1.5, 2.5 and 3.5 kilometres from the Malabar, Bondi and North Head outfalls. Analysis of the muscle tissue of the fish for organochlorines detected chlordane and hexachlorobenzene above the NHMRC's maximum residue limits at sites close to the three outfalls. Benzene hexachloride and heptachlor epoxide, however, were not found above the recommended limits in this study.

An interlaboratory study was also conducted as part of the 1988 exercise to establish the reliability of the analytical results. The contract laboratory performed well, although further method development is desirable for these difficult analyses.

The Water Board analysed the same fish samples for metals and it found mercury was on average slightly above the NHMRC's maximum residue limit only at either side of the Malabar outfall.



Russell Hopkins of the Chemistry Laboratory dissecting a red morwong caught near a Sydney outfall for analysis of the concentration of pesticides and heavy metals.



The blue groper was one of six marine species sampled off the Malabar outfall in the 1987 bioaccumulation study.

The strong implication from these studies is that the outfalls are a major source of organochlorine and trace metal contaminants in fish. Preliminary sampling also revealed organochlorines in the sludges and effluents discharged at Malabar. A better understanding of the biological pathways and patterns of discharge to the environment is needed, however, before a full explanation of the variations observed in these studies can be attempted.

Following the bioaccumulation studies, the Minister for Agriculture and Rural Affairs banned fishing within 500 metres of the three Sydney outfalls.

Environmental monitoring program

An environmental monitoring program (EMP) to provide an ongoing assessment of the impact of the extended outfalls was a requirement of their approval. A draft proposal for the EMP was submitted by the Water Board in September 1988. Review of the proposal by the Commission and others was assisted by the visit of Dr Jack Anderson, Director of the Southern California Coastal Water Research Project, in March 1989. A steering committee with representatives from the Board, the Commission, the Department of Health, New South Wales Agriculture and Fisheries, and professional and conservation interests will manage the EMP.

The EMP will monitor water quality using familiar parameters: microbiology, nutrients, chlorophyll, dissolved oxygen, temperature, salinity, pH, turbidity, suspended solids, etc. Aquatic ecologic health will be gauged by studying plankton, pelagic and demersal fish, and soft and hard substrate invertebrates. Other aspects covered by the EMP will include assessment of the bioaccumulation of toxic substances, oceanography, plume dispersion studies and the aesthetic effects of the outfalls. Collection of base-line information has already commenced.

Licences for primary treatment plants

Operating licences for the Water Board's primary treatment plants at North Head, Bondi, Malabar, Cronulla, Bellambi and Port Kembla now require the monitoring of additional contaminants in their discharge effluents. For the first time the plants' 1989-90 licences require monitoring of organochlorines, polynuclear aromatic hydrocarbons, an extended range of metals and other compounds as well as the previously

No 565 Report of SPCC for year ending 30/6/1989

monitored solids, grease and metals.

Stringent limits have also been set for benzene hexachloride, hexachlorobenzene, chlordane, heptachlor and mercury, all compounds with values above the NHMRC's recommended limits in the bioaccumulation studies.

The Board was unable in the short term to upgrade its capacity to monitor pollutants in effluents and process streams so it was necessary to stage implementation of the licences over six months. Monitoring at the Malabar plant has taken priority because it carries the largest component of industrial waste. Monitoring of toxic substances in effluents for which new limits have been set is required from July 1989.

The additional data generated will provide not only badly needed information on pollutants entering the sea, but also detail of the concentrations of toxic substances in sludge and other waste streams, for which alternative means of environmentally sound disposal are being sought.

Revision of design criteria for ocean discharge

The Commission has commenced a revision of the design criteria for works which discharge effluent to ocean waters. Requirements were first set in the mid-1970s. Design criteria to be covered include bacterial, toxic and aesthetic requirements. The revision, however, has been delayed by a lack of Commission resources. It will be completed when a review by Camp Dresser & McKee is available and in light of the revised classification system discussed below.

Classification of Waterways

Work continued this year on the revised system for classifying waters under Part III of the Clean Waters Act, although progress was slow because of diversion of water quality staff to Sydney beach pollution and outfall matters.

Clean Waters Regulation 8, the first classification system introduced in 1974, essentially regulates discharges *into* waters from point sources such as industrial facilities and sewage treatment works. It does not adequately specify the desired quality to be achieved *in* the waters. Rational programs to control the problems caused by diffuse pollution with its many sources can only be formulated by setting quality objectives *in* waters.

There are three components to the new classification system:

- **Water quality criteria** will be set for a range of beneficial uses of waters. These will establish desirable quality parameters to be achieved and limit the concentrations of pollutants in receiving waters.
- Specific **beneficial uses** will be designated for water bodies.
- Designation of beneficial uses will mean **water quality objectives** can be specified for all water bodies. These objectives will correspond to the most stringent concentrations to match the beneficial uses chosen.

Classification will be undertaken in two stages. Initially all waters in the State will be classified according to zones of geographic similarity. This Stage I classification will provide general guidance on desirable water quality. More comprehensive Stage II classification will follow sequentially as the detailed requirements for the beneficial uses of specific catchments are assessed and determined. Some survey work will be necessary in Stage II because of the paucity of the water quality database in New South Wales. Survey work is presently under way in the Namoi, Macquarie and Kosciusko catchments with a view to early Stage II classification.

The classification process will provide a primary input to catchment managers as they develop the catchment management plans and programs discussed in the next section. The Commission will rely primarily on the community structures established for catchment management to indicate the beneficial uses desired for specific waters in Stage II.

A notable feature of the system is that not all waters will satisfy their classification goals and objectives, that is, some waters will not reach the quality the community within the catchment desires. This should not impede existing uses which do not comply, but rather help organisations with a role in catchment management to set targets for action plans to reach the desired quality. It will certainly be a significant factor in assessing new projects within catchments.

Total Catchment Management

The Commission has actively supported the development of Total Catchment Management (TCM) in New South Wales together with other departments and authorities, most notably the Soil Conservation Service. The determination of appropriate water quality objectives under the classification system discussed above will be a major input to the catchment management process. The Commission's traditional role of controlling point source pollution through licensing will be another major input. This strong support for TCM comes from the realisation that water quality cannot be managed solely by controlling licensed, point source pollution; diffuse pollution from the many diverse activities in a catchment requires the coordinated planning and action offered by the TCM process.

At the catchment level regional staff contributed to many TCM activities. The report of the Hacking River TCM Committee, convened by the Commission, was released in March 1989 by the Minister for the Environment, Tim Moore. The Commission initiated the formation of a TCM committee structure for the Georges River. Steady progress in the management of Lake Macquarie was also reported in the latest annual report by the lake's Environmental Audit Review Forum, another TCM activity conducted under the auspices of the Commission. The Regional Operations section of this report has further details of Commission participation in TCM activities in Lake Illawarra, the Hawkesbury-Nepean River, Throsby Creek in Newcastle, the Cooks River, and the Namoi-Gwydir and Macquarie-Bogan-Castlereagh catchments among others.

Urban Runoff

Manual

The Commission's *Pollution Control Manual for Urban Stormwater* is nearing publication after its circulation in draft form to allow comments from State and local government bodies, and environmental and conservation groups. It should go on sale in August 1989. A separate "plain language" summary and descriptive brochure outlining the main controls will also be available.

The manual describes engineering measures that can control urban runoff pollution. Although it does not prescribe the adoption of such measures, the Commission expects local government, planning and construction bodies to begin to require and implement the controls in new and, where feasible, existing developments.

Overseas and local data

There is a growing body of overseas information on the effects of urban runoff, the development of control techniques, the application of controls and suitable administrative models. This material suggests that the main pollution concerns are copper, zinc, lead, bacterial contamination, solids, nutrients and polynuclear aromatic hydrocarbons. The contribution made by other contaminants such as organochlorines will have to be confirmed locally, since overseas data do not implicate urban runoff as a major source.

A proposal by the United States Environmental Protection Agency to license urban drainage systems may be a useful administrative method to further the control of urban runoff. The initial phases of the US program will involve collecting monitoring data as a licence condition and adopting proven management practices related to city size. The Commission will be exploring this option for New South Wales as resources allow.

The collection of pollution data for runoff from urban catchments at Jamison Park near Penrith,

Sediment movement is a major problem in newly developing residential areas.

Camden, Cranebrook and Berowra, has highlighted the variability of this type of pollution. Some very fine clay particles (those less than two micrometres) were found to carry significant quantities of organic matter and nutrients in some catchments and these are not amenable to efficient removal by conventional settling.

Modelling

There has been some preliminary success in applying Australian, American and Danish computer models to the data collected in the local urban catchments which have so far been monitored. Models will have to be adapted and calibrated in order to quantify the degree of control and hence the cost of mitigating urban runoff pollution. The build-up of debris and litter in the monitored catchments peaked after only two days and the modelling confirmed that nutrients associated with fine particulates are not readily removed by "standard" settling techniques. Another interesting finding was the higher-than-expected input of atmospheric deposition for some pollutants. These developments will be explored further in data collection and modelling.

The Commission is involved with the Department of Housing in a project to monitor runoff and pollution from a "green-field" urban subdivision at South Narellan which incorporates modern urban runoff controls. Data from this and the other catchments will provide valuable new understanding of this difficult form of pollution.

The Commission convened an ad hoc workshop of researchers and government authorities interested in all aspects of urban runoff and also actively participated in a professional seminar on modelling and its control. While these meetings demonstrated the availability of local expertise and skills, they also highlighted the dearth of sound local data, apart from limited Commission material, and the shortage of funds for research, government or private. Unfortunately the Commission may also have to curtail its activities in this area because of other water quality demands and general stringency.

Sewer overflows

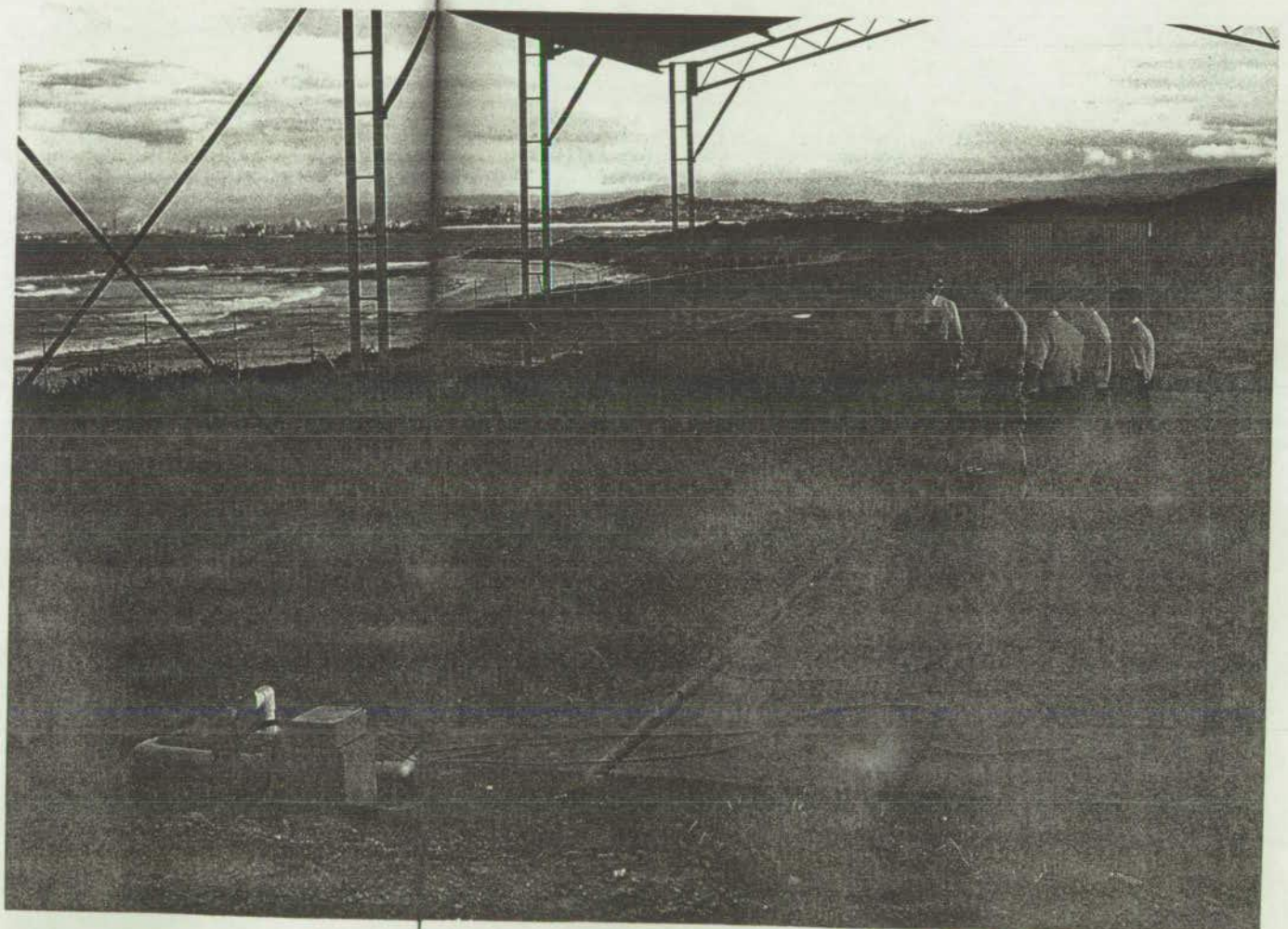
Overflows from sewerage systems which exceed their capacity, frequently during rain, contribute substantially to urban runoff pollution. After extensive liaison with the major sewerage authorities in the State, the Commission now requires all new sewer overflow structures to be approved and all existing overflows to be licensed under the State Pollution Control Commission Act. These overflows had previously been considered wet weather discharges and were not licensed.

The practicability of licence conditions, which will aim initially to identify the extent of the sewer overflow problem, will be assessed in trials in the Water Board's West Hornsby sewerage catchment. The proposed licence conditions will generally require reporting, monitoring and practical remedial action. When trials have established what are suitable licence conditions, they will be applied statewide.

Meanwhile the Commission is exploring local and overseas alternatives to screening to retain gross floatable solids in sewer overflow structures during discharges. Screening is not favoured because there is a risk of blockages and upstream surcharges.

Sewage Sludge Management

A subcommittee of the Clean Waters Advisory Committee is developing strategies and guidelines for the disposal of sewage sludge. An interim report in April 1988 outlined current sludge disposal practices, detailed the concerns of each member organisation and listed the impacts and environmental and practical constraints applying to various sludge disposal methods. Options under consideration include the proven techniques of land



Sludge composting is being trialled at Bellambi near Wollongong.

application, composting and incineration, and other more experimental methods such as thermal conversion to oil. A final report is expected towards the end of 1989.

Sludges contain high levels of pathogenic organisms and possibly significant concentrations of heavy metals and chlorinated organics. The risk to human and animal health and to the environment can be high if sludge is not disposed of properly.

Sydney's sewage treatment plants produce approximately 100 tonnes of sludge per day (dry-weight basis) and about 70 per cent of this is discharged to the ocean, mostly from the Bondi and Malabar outfalls. The remainder is incinerated, composted or applied to agricultural land. However extension of treatment at the major ocean plants beyond the present level of primary treatment would produce significantly greater quantities of sludge for disposal.

About 100 tonnes of sludge per day is produced in country centres and most of this is disposed of in landfill sites after anaerobic digestion, lagooning and de-watering. The Hunter region generates another five tonnes per day, although the largest treatment plant at Burwood Beach in Newcastle does not currently separate sludge before discharging screened sewage to the ocean. The Illawarra region's four tonnes per day is disposed of by land rehabilitation or composting.

Cattle Feedlots

The cattle feedlot industry has expanded rapidly recently in response to the growing demand for grain-fed beef for the export and domestic markets. The Commission is preparing new environmental guidelines for cattle feedlots, replacing those previously published in 1977. They will address feedlots' siting, design, construction and operation to minimise adverse impacts on the community and the environment. Many of the proposals coming forward are for large facilities and there is concern about their potential to pollute surface and groundwaters and to generate odours.

Specific developments in this growing industry are discussed in the Inland Regional Operations section.

Other Activities

Industry self-monitoring

As part of its promotion of self-monitoring and self-regulation by industry, the Commission is reviewing its licensing system for water discharges. The aim of the review is to:

- remove inconsistencies in water licence conditions
- produce a set of standard licence conditions
- review the type and extent of source self-monitoring required by licences
- review the requirements for reporting source monitoring data
- produce an easy-to-follow format for licences.

The changeover of individual licences to the new format is under way and should be completed in late 1989. In conjunction with the new-format licences, the Commission is developing appropriate auditing and compliance inspection methods that will complement the certificates of compliance.

The Commission is also evaluating what options are available for industry to contribute to the monitoring of the ambient water environment.

Oil spill contingency planning

Atlases designed to help deal with oil spills at Newcastle, Port Kembla and Twofold Bay will soon extend a well-established series of publications. The atlases are prepared by the Commission with funding from the Commonwealth through the National Plan to Combat Pollution of the Sea by Oil.

Newcastle is a major industrial port with areas extremely sensitive to the effects of oil located very close to the docks. In particular, Kooragang Island is an important breeding wetland for birds protected under international agreements. At Port Kembla, important seabird colonies are found offshore on the Five Islands and arrangements for cleaning and rehabilitating oiled birds have been reviewed in detail. Twofold Bay at Eden is the State's largest fishing port and particular attention was given to the impact of oils and dispersants on fisheries.

Fish kills

There has been an upsurge in the number of fish kills reported to the Commission and a coordinated approach is being developed to enable field officers to identify the cause of a kill. Chemical analysis is ineffective unless the fish are fresh and correct sampling procedures are used. A protocol and sampling kit is being prepared so field officers can speed up and standardise their response to kills.

Contingency plans to manage oil spills in the Port of Newcastle are now available with publication of another oil spill atlas.

No. 140

Parliament of New South Wales

1988
(Second Session)

REPORT

OF THE

STATE POLLUTION CONTROL COMMISSION

FOR THE

YEAR ENDED 30 JUNE 1988

Presented to Parliament pursuant to the Annual Reports (Departments) Act 1985 and printed 24 November 1988

BY AUTHORITY
D. WEST, GOVERNMENT PRINTER, NEW SOUTH WALES—1989

81222-42621 1988—463 (86)

Self-monitoring by industries with noxious emissions is now well established with regular data reports from industry in Sydney, Newcastle, Port Kembla and Broken Hill. The Commission's policy requires industries to monitor and publicly account for the impact of their emissions on the environment. This year the policy has been taken a step further with development of an audit scheme to ensure the Commission's monitoring requirements are being met.

Water Pollution and its Control

Once point discharges of pollution have been controlled, water quality becomes heavily dependent on management of the land within any catchment. Activities during the year have concentrated, on the one hand, on promoting the need for input to **total catchment management** while, on the other, improving the efficiency of the established **control of point discharges**.

The Commission's role in classifying waters under the Clean Waters Act will be important in the general process of catchment management and in overcoming water quality problems. In particular, work commenced on the development of a **classification system** which will set water quality goals for each waterway. This will be a modification of the existing system which has focused primarily on point sources of water pollution.

A new policy now protects **natural wetlands** from excessive nutrient enrichment by effluents while another policy has been developed to control pollution from **houseboats and recreational craft**. The Commission has also taken the lead role in developing guidelines for the management and disposal of **sewage sludge**, a growing problem particularly in the Sydney region.

A review of the **licensing and approvals system** which controls water pollution is continuing. This should result in improved efficiency and productivity in controlling point sources of pollution. Greater responsibility for monitoring and public reporting of performance will rest with the polluters while the Commission plays a surveillance and auditing role. This should provide much better environmental quality control and yield more data than previously and also apply the principle of "polluter pays".

Noise and its Control

This year saw a significant redirection of the Commission's efforts in noise control. While maintaining its concern about **environmental noise**, especially from industrial premises and noisy products, the Commission has moved to develop and implement programs to control **traffic noise**. More than 350,000 Sydney people currently face excessively high levels of traffic noise in their homes and unless stringent controls are introduced, over half a million residents will be affected by the year 2000.

The problem is being addressed in two ways: by controlling noise from **individual vehicles** and by **non-vehicular means**. A committee chaired by the Commission recently released the results of an exhaustive study into non-vehicular controls which showed that while some highly effective noise control techniques are available, their ultimate success depends on site-specific factors. The report recommended development of a State plan to co-ordinate introduction of traffic noise control strategies. At the local level, councils will be urged to implement controls based on the guidelines provided by the State plan. It will be incumbent on the Commission to seek and co-ordinate the active co-operation of the many traffic and land use control authorities if the problem is to be tackled successfully.

The progressive introduction of **licensing of premises** under the Noise Control Act has continued throughout the year. This control by the Commission of noise from scheduled premises, and through licensing and approval of noise-generating works and activities, has effectively minimised the number of complaints about offensive noise from these premises.

Noise from **non-scheduled premises** and from the inconsiderate use of **noisy products** in or near residential areas or public places continues to be a major concern. While these problems are primarily the responsibility of local government, the police and the Maritime Services Board, the Commission has provided their personnel with a great deal of **training and other technical assistance**.

The Commission has continued to try to reduce **product noise**. New chainsaws and grass cutting machines are now required to be labelled, indicating the noise they generate in operation. It is hoped that this will encourage consumers to buy the quietest product. The new requirements were introduced smoothly and, with the number of products now regulated in this way, New South Wales has one of the most comprehensive noise labelling programs in the world.

Chemicals, Wastes and their Control

In the two years since the Environmentally Hazardous Chemicals Act came into effect, the Commission has assessed the chemicals and chemical wastes of most concern, identified contaminated sites and developed programs to decontaminate and rehabilitate them. Policies and procedures for dealing with **chemical incidents** were outlined in the *Chemical Incidents Procedures Handbook* published this year. Another priority area has been the establishment of guidelines for the **disposal of industrial wastes as landfill**.

The Commission played a major part in the work of the **Joint Taskforce on Intractable Waste**, an initiative of the Commonwealth, New South Wales and Victorian Governments. Phase 1 of its brief to recommend the safest, most effective means of solving Australia's intractable waste disposal problems was completed this year. The taskforce recommended

Part 2

Water Pollution and its Control

Catchment Management

Total Catchment Management Development

Non-urban

One of the major goals of Total Catchment Management (TCM) is to provide and protect water of good quality. An important Commission role in TCM is to set water quality goals. To this end the Commission has embarked on a program to define what water quality is required to allow the beneficial use of waterways, including environmental amenity. It is planned to progressively classify all New South Wales waters and produce an atlas of water quality goals for each waterway. The basis for the program already exists under the Clean Waters Act although the planned new scheme differs from the Commission's earlier classifications which tended to focus on point source discharges.

Following classification, those areas where water quality falls significantly short of the goals can then be identified and, in concert with other parties, remedial measures investigated and implemented.

The Commission has continued its membership of TCM committees in the Macquarie-Bogan-Castlereagh and Namoi-Gwydir systems. The Macquarie-Bogan-Castlereagh committee has already developed an action strategy, while the Commission has conducted several extensive water quality surveys in the Namoi-Gwydir system. More surveys are planned and the results will be valuable in the classification exercise described above. The data collected so far suggest that excessive algal and aquatic plant growth, caused by elevated concentrations of nitrogen and phosphorus, is one of the major water quality issues in the system. Sources have not been positively identified at this stage but agricultural runoff and sewage discharges from local towns are implicated.

The Commission is also a member of the Catchment Areas Protection Board (see the section on Vegetation Conservation), a further contribution to TCM.

Urban

During the year the Commission contributed to the development of proposed legislation to protect urban rivers and lakes. The concept for specific protection of urban water bodies came from an understanding of the environmental problems that have accompanied urban development along coastal waterways as opposed to those in rural waterways. The main concerns in rural areas are turbidity, nutrient enrichment from fertilisers, pesticide runoff and salinity. In contrast, waterways in built-up areas suffer from urban runoff, litter, industrial pollution and discharges of sewage effluents.

The object of the legislation would be to co-ordinate and promote protection and enhancement of urban lakes and waters for their environmental, recreational and economic value to present and future generations.

The question of funding remedial and corrective pollution control work has been a difficult one. Much of the burden currently rests with local government. There is no formal structure for the provision of funds either directly or on a dollar-for-dollar basis from State finances. The proposed legislation could provide the necessary structure for the co-ordination and allocation of funding with greater local participation in the planning processes.

The Commission is well experienced in managing urban catchments, particularly as far as water quality is concerned. This past involvement and close liaison with local government has meant the Commission is well placed to further TCM in urban areas. It has co-ordinated catchment management in Lake Macquarie and the Hacking and Georges Rivers, and progress in these areas is reported elsewhere. The Commission has also been actively involved in managing the catchments of the Hawkesbury-Nepean and Cooks Rivers, Throsby Creek and Lake Illawarra through local co-ordinating committees. It has given advice to the urban runoff study in the Hawkesbury-Nepean and has also taken initiatives to control litter in the Cooks River catchment.

Local government and construction authorities will be guided by the *Pollution Control Manual for Urban Stormwater*

(see below) prepared by the Commission and to be released soon. To supplement this practical work, the Commission is continuing its own research and study of pollution from urban runoff in selected sub-catchments in western Sydney.

It has now become clear that a more structured co-ordination and funding mechanism is needed to advance TCM, especially for urban rivers and lakes. There is a need to devolve significant authority and responsibility to local government, with some State Government oversight and input, and for a more secure funding arrangement.

Classification of Waters

Pollution from diffuse, rather than point, sources is now often the dominant problem in the aquatic environment, particularly in rural areas. It is clear that significant environmental improvements will not be achieved by continuing to concentrate on controlling point sources of pollution. In order to shift attention from point source control and to broaden environmental protection, the Commission is developing a new waterways classification system.

"Classes" of waters will be defined according to the beneficial uses to which they can be put when certain water quality objectives are attained. The level of protection required to maintain good water quality in each waterway will also be defined. Where there are a number of beneficial uses for a particular waterway, the objectives will be set to suit the most sensitive use. This system will be the basis for correcting present deficiencies in the development of water quality improvement strategies throughout New South Wales and will assist all land and water management authorities involved in this area.

The new classification system differs from the earlier system because it targets certain water quality criteria. Follow-up monitoring will then be able to identify areas of water quality degradation as well as where improvements are achieved. It should prove particularly useful in rural areas for identifying those land use practices which lead to a decline in water quality.

Policy and Guidelines

Pollution Control Manual for Urban Stormwater

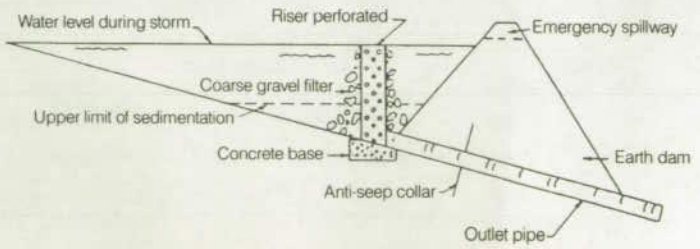
Progressive application of the Clean Waters Act since the early 1970s has led to a marked reduction in the impact on waters from point sources such as discharges from industry and sewage treatment works. This success has, however, highlighted the problem of water pollution from non-point or diffuse sources.

Diffuse source pollution occurs when contaminated surface runoff from urban and rural areas discharges into watercourses, mainly during and after wet weather. In New South Wales urban runoff has become a major source of pollutants in waterways and is now the dominant factor in determining water quality in built-up areas. Substantial quantities of sediment, suspended matter, oxygen-demanding materials, nutrients, oil, trace metals and litter enter urban waterways each year through stormwater drains and sewer overflows.

Controlling this form of pollution is considerably more difficult than the control of pollution from point sources and a co-ordinated approach by local and State Government advisory, planning and regulatory authorities is required. Recognising the technical and administrative complexity of the issue, the Commission established a working group under its Local Government Liaison Committee to prepare a manual outlining planning and engineering techniques to control the quantity and quality of urban stormwater.

A draft of the *Pollution Control Manual for Urban Stormwater* was issued for comment in July 1987. It provides urban planners, drainage engineers and developers with planning guidelines and management techniques which are designed to:

- reduce the amount of urban runoff;
- encourage the design of stormwater systems which help the natural assimilation of water pollutants;
- integrate schemes to control both water flow and quality;
- discourage the use of canalised stormwater drains; and
- reduce the quantities of pollutants deposited in urban areas.



The draft Pollution Control Manual for Urban Stormwater *recommends the use of sedimentation basins, as shown in cross-section above, to remove sediment-laden runoff from construction sites.*

Thermal pollution has been a water quality problem in Lake Macquarie. Here, a Commission officer measures the temperature of the lake's waters near the outlet of Eraring power station.
Reproduced courtesy of the *Newcastle Herald*

The manual emphasises the need to consider in detail the appropriate controls for urban runoff at the planning stage of development. It also outlines management schemes and controls for the construction and post-development stages in newly developing urban areas as well as what is achieveable in older urban areas where the scope for fitting controls retrospectively is limited.

Comments on the draft manual have been considered by the working group and publication is expected in late 1988.

Wetlands Policy
Over the past 10 years the Commission has promoted the need to reduce the level of plant nutrients, especially phosphorus and nitrogen, which enter the State's waterways. Nutrient enrichment can lead to excessive aquatic plant growth or "eutrophication" in water bodies and this has an adverse impact on their value as a resource. The Commission's strategy to date has been to progressively restrict the discharge of nutrients in treated sewage effluent where the receiving waters are likely to suffer.

Now that stringent requirements on discharges are in place, attention has been focused on the ability of both natural and artificial wetlands to remove nutrients. The nutrient concentrations of effluents can be reduced by uptake or filtering in wetlands and this protects other bodies of open water from eutrophication. Increased community awareness of the value of wetlands has led to other Government moves to protect them, as in State Environmental Planning Policy No. 14. The Commission's policy on wetlands, therefore, complements the endeavours of other authorities in protecting them, while at the same time allowing some scope to use wetlands for their filtering properties. The policy, *Discharges to Natural Wetlands*:

- affirms the Commission's desire to protect natural wetlands;
- generally disallows the discharge of high nutrient loads or suspended material to natural wetlands;
- recognises that sometimes the discharge of an effluent to a particular wetland may have overall benefits; and
- identifies information which will have to be supplied by anyone proposing a discharge to a natural wetland.

The policy will be applied in determining all licence applications for discharges to natural wetlands. Drainage authorities will also need to take account of the policy when considering stormwater discharges.

Action in Specific Catchments

Lake Macquarie
Sedimentation and littering are still major causes for concern in Lake Macquarie, according to the first Annual Report of the lake's Environmental Audit Review Forum. The Forum is chaired by the Commission and was established to review the progress of environmental protection programs for the lake proposed by the Environmental Audit of 1983. The Annual Report concluded that a broad commitment from the community is needed to tackle the problems of sedimentation and littering.

Another area of concern was Lake Macquarie's nutrient load. Further discussions have been held with the Public Works Department on disposal of nutrient-rich wastewaters from existing and proposed sewage treatment works. The Commission has tightened licence limits on nutrient concentrations in discharges from Hunter District Water Board sewage treatment works and has also acted to reduce nutrient discharges from the Teralba sanitary depot.

With Commission input, Lake Macquarie City Council funded a research program, primarily into wetlands, sedimentation and urban runoff.

Hacking River
Deterioration in the water quality of the Hacking River, which flows through the Royal National Park south of Sydney, has largely been attributed to point and diffuse sources of pollution from the Helensburgh area which is outside the park.

Water quality in the Hacking has improved recently because of increased control of point sources of pollution and extension of the sewerage system throughout Helensburgh. Many diffuse sources of pollution, however, still remain uncontrolled.

The Commission has set up an interdepartmental Total Catchment Management committee which has community representation. The committee is investigating potential sources of pollution such as land clearance for residential and other developments, weed infestation, coal refuse, garbage disposal and extractive industries in the catchment above Audley Weir. The committee's recommendations for management are expected in late 1988.

Botany Bay
A second progress report on the Water Resource Management Plan for Botany Bay is nearing publication. After five years, only 12 of the plan's original 43 recommendations for protection and management of the bay have not been completed and most of these are being implemented.

Oil spills still pose the most serious threat to the bay's environment and the Oil Spill Action Plan has been revised and improved. A fixed boom mooring site has been installed off Bonna Point and negotiations are continuing over construction of the crude oil berth in Port Botany.

Recreational opportunities have improved on Kurnell Peninsula and the visual quality of Botany Bay is now protected by zoning controls in regional and local environmental plans. At Port Botany a four-lane boat ramp has been constructed and foreshore access for anglers enhanced.

Management plans are being prepared for the wetlands of Lachlan Swamps and the Mill Stream, and for Barton and Scarborough Parks, while the mangroves, saltmarshes and freshwater wetlands of Kurnell Peninsula are included in the Towra Point Nature and Aquatic Reserves. Sand nourishment has not yet been carried out at Towra Point but seagrasses were transplanted into barren sand areas and thrived until severe storms destroyed them.

Net samples are collected from lagoons near cotton farms in the Namoi Valley to see whether small fish and invertebrates are affected by the pesticides used in the industry.

Water Quality Surveys

Western Rivers Study: Namoi Valley
Water quality in the Namoi Valley was intensively surveyed by the Commission this year as part of its State-wide water quality classification program. The study set out to understand the processes which affect water quality in the valley and to determine, in particular, if land use is an important factor. The preliminary findings of two sampling trips indicate that land use does have a significant impact on the water quality of Namoi streams.

Excessive nutrients leading to the unwanted growth of aquatic plants is a major problem which seems to have caused distinct changes to the valley's stream ecology.

The Namoi study is the first intensive catchment-wide water quality survey undertaken west of the Great Dividing Range in the last decade. The Commission intends eventually to survey water quality in all New South Wales catchments and to include the findings in the classification program.

Narara Creek
For the past decade Narara Creek on the Central Coast has been the cause of much complaint because of discharges of wastewater into the stream from an abattoir and a sewage treatment works. In late 1987, however, the last major discharges into the creek were diverted to Kincumber sewage treatment works and then to ocean outfall.

The Commission's monitoring of Narara Creek in 1988 has indicated acceptable concentrations of nutrients and dissolved oxygen, typical of a tidal creek receiving urban runoff. The offensive odours and highly nutrient-rich waters of previous years have been substantially eliminated and the ecological and recreational amenity of the creek restored.

Georges River
There are now no major nutrient discharges to the Georges River after the dry weather discharges from Liverpool sewage treatment works were diverted to ocean outfall in January 1988. The consequent fall in phosphorus and nitrogen concentrations is expected to decrease the intensity and frequency of algal blooms which have in the past discoloured the water, particularly between Liverpool and East Hills.

Stormwater runoff from urban and disturbed areas continues to carry high loads of suspended material into the river. The upper reaches of the estuary often remain turbid for many weeks after rain.

Land use controls are needed to reduce the impact of runoff and these require a co-ordinated effort by all authorities with planning or operational functions within the catchment. The Commission is working on plans for the establishment of a Total Catchment Management body to oversee all activities in the Georges system which may impinge on its water quality.

Pollution Control

Self-monitoring

The Commission is reviewing its system of licensing effluent discharges. Under a new system, industry and public utilities will initially monitor their own wastewater discharges while at a later stage, they will be publicly accountable for broad environmental monitoring of the impact of their activities.

The major objectives of this self-monitoring program are:

- to shift the prime responsibility for environmental monitoring of discharges from the Commission to the polluters thereby extending the amount of environmental data available;
- to maintain more efficient surveillance of polluters so they are encouraged towards self-regulation; and
- to generally extend monitoring of the ambient environment of the State.

There are, however, constraints upon achieving these objectives:

- The Commission's operating costs for environmental monitoring must be reduced or at least contained.
- The Government's requirement to reduce the financial burden on industry must be satisfied as far as possible.
- The data from self-monitoring must be adequate to allow the Commission to efficiently manage the environment.
- The public must be assured that, despite some concerns, the extent and quality of environmental monitoring is not being reduced through this involvement of industry.

Some of these constraints are opposed to each other: cutting direct government costs while at the same time easing the cost burden on industry which has to meet new government requirements, for instance. This means that an appropriate balance must be struck.

A set of model discharge licence conditions and guidelines for industry self-monitoring is being prepared to support the new system.

The Commission is now studying how to audit the self-monitoring data to ensure that industry and the public utilities comply with their licence conditions and collect reliable data on the quality of their discharges. A number of methods for establishing an efficient auditing function are being assessed.

Licensing policy for wastewater discharges from coal mines in the Hunter Valley has been reviewed and a new policy of staged discharges will be discussed with the Department of Water Resources and the mining industry. This will require mine operators to discharge wastewater only when river flows are high enough to allow adequate dilution. The policy, if adopted, will also require mines that discharge wastewater to monitor the ambient environment, namely the Hunter River and specified tributaries.

Cotton Farming

The farming of cotton has an extremely high potential to pollute land and water, especially with the widespread and intensive use of pesticides in its cultivation. Surveys by the Commission in recent years have revealed pesticides in many water samples collected from cotton growing areas. They probably enter watercourses through the discharge of pesticide-contaminated tailwaters, careless application by aerial spraying, the indiscreet handling of pesticides and the disposal of empty containers and residues.

The Commission favours a "code of practice" as the best strategy to control this pollution. The draft code incorporates techniques to minimise the release of pesticides into the environment by using buffer zones, aerial spraying under favourable weather conditions only and tailwater dams large enough to retain contaminated waters.

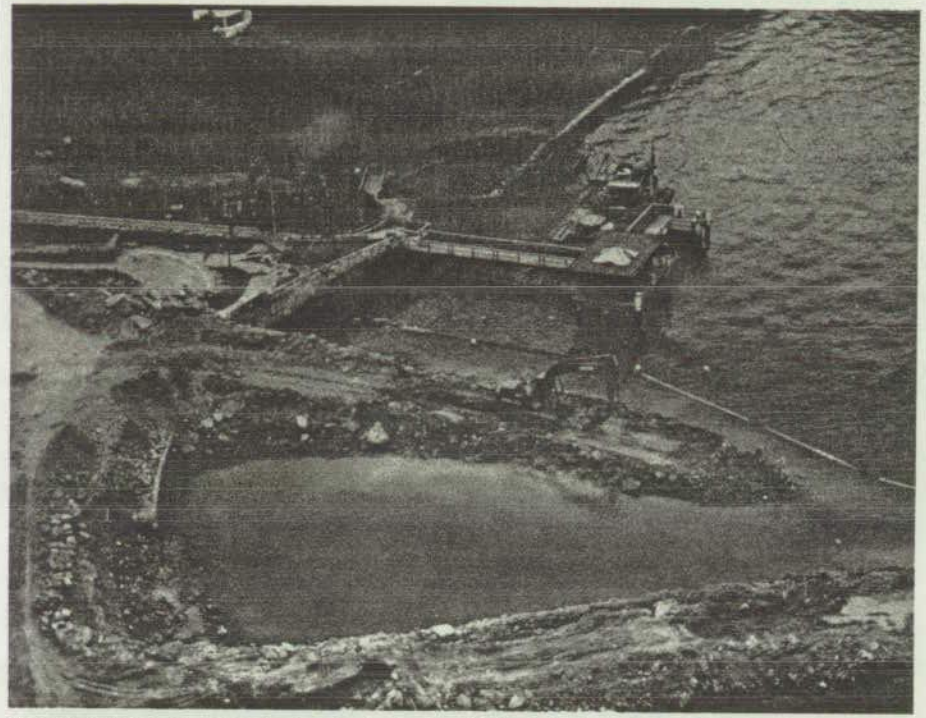
Many aspects of the code have proved controversial in discussions with the industry and interested bodies. Talks are continuing, however, to develop a code acceptable to both cotton growers and the public.

Other agricultural activities with a high potential to cause water pollution will also be investigated and codes of practice developed as needed.

Houseboats and Recreational Vessels

Pollution caused by discharges from vessels has been of concern to the Commission and other authorities for many years. The River Murray had special problems, and regulations were introduced there in 1983 requiring certain vessels which operate in three defined "pump-ashore zones" to use sewage holding tanks. Increasing public and government concern about sewage disposal from vessels in general has prompted action on a number of fronts, including the operation of ferries on Sydney Harbour. For its part the Commission established a subcommittee of the Clean Waters Advisory Committee to investigate the control of pollution from houseboats and other recreational vessels.

The subcommittee's investigations included what types of pollution were involved, their effects on waterways, the legislative controls on the River Murray and elsewhere, the efficacy of pump-ashore facilities and any feasible alternatives. Local councils and other interested groups, including boat and equipment manufacturers, were consulted on appropriate requirements and their practicability.



The Sydney Harbour Tunnel construction site showing the cofferdam in the foreground and, behind it, the boom designed to minimise pollution of the harbour.

The subcommittee found there was not enough evidence to demonstrate that discharges from houseboats and other recreational vessels cause water quality problems. The presence of visible sewage matter, however, was of concern. The most satisfactory means of controlling this pollution are sewage holding tanks on vessels, and conveniently located and well designed pump-ashore facilities. These solutions can be provided at a reasonable cost.

The Commission has decided that controls on pollution from houseboats and other recreational vessels should be introduced throughout New South Wales. The type of controls for each waterway will depend on its beneficial uses, flushing capacity and boat usage patterns. Furthermore, new vessels should be required to be fitted with sewage holding tanks or other approved marine sanitation devices during manufacture. Hire and houseboat operators, marina operators and local councils will be encouraged to provide and promote pump-ashore facilities in appropriate locations.

Any strategy to implement these controls must take into account financing arrangements. The Commission is consulting relevant authorities and the boating industry, which has been requested to prepare specifications, design guidelines and suggested amendments to legislation.

Sydney Harbour Tunnel

Construction of the Sydney Harbour Tunnel has posed a number of potential water pollution problems. Of particular concern are the discharge of sediment-laden waters and the increased turbidity from the construction at the Kirribilli site and dredging.

After the project was given the go ahead, the Commission issued approvals to Sydney Harbour Tunnel Company Limited for the construction of the casting basin at Port Kembla and to carry out work at Bradfield Park, Kirribilli. The latter approval covers establishment of the site, relocation of services, excavation of an open cut and construction of a cofferdam, jetty and pilot tunnel. The approvals were conditional on compliance with a number of specific water pollution control measures, including sediment control basins.

The works at Port Kembla were installed satisfactorily, but problems arose in the early stages of construction of the cofferdam at Bradfield Park. This temporary structure will exclude water from around the area where the underground and underwater sections of the tunnel meet, thus facilitating construction. The licence for the works specifies how the approved water pollution control facilities should operate and

where to place a boom and filter fabric curtain around the construction area to minimise pollution of harbour waters. In the event, the controls provided were not adequate and the company was issued with a notice under the Clean Waters Act requiring improvements to the boom. Legal action is being taken and the Commission has instituted regular inspections and meetings to ensure that its requirements are being met.

Assessment of what controls will be required for the proposed dredging is continuing. The Commission has advised that the company will need to adopt the "best practicable technology" available to control sediment discharges from the dredging of the harbour between Bradfield Park and Bennelong Point. The Commission has suggested a new type of overflow system which has been used in Japan and which the company is now investigating.

Oil Spill Contingency Planning

A coastal resource atlas to deal with oil spills in Jervis Bay is ready for publication in late 1988. The atlas addresses the distinctive problems of a port which handles primarily diesel fuel oil. Particular attention has been paid to the way in which rough seas may drive oil to the seabed in toxic concentrations. This has been a problem in diesel spills overseas and is very difficult to control.

Jervis Bay is an ecologically sensitive area which is being subjected to several environmental impact assessments for a proposed naval base. The new atlas will make a useful contribution to these inquiries.

Another atlas is being prepared for the Port of Newcastle and the adjacent coast. Arrangements have been made for this and future atlases to be funded by the Commonwealth under the provisions of the National Plan to Combat Pollution of the Sea by Oil, which should accelerate the work.

Ocean Outfalls: Bio-accummulation

During the year the Commission conducted a Water Board-funded study into the retention or "bio-accumulation" of organochlorine and trace metal compounds in rocky reef aquatic organisms near the Malabar shoreline ocean outfall. The results were compared with control sites at Port Hacking and Terrigal.

Further detailed investigations are now under way with the Water Board and the Department of Agriculture and Fisheries to establish the nature and extent of any problem, its origin and any remedial action which may be necessary.

Nutrients

Discharges from sewage treatment works may often increase nutrient concentrations in receiving waters to levels that promote undesirable aquatic plant growth. This problem can generally be avoided if discharges are located where the effluents are flushed from the estuary to oceanic waters or if effluents are re-used. In some areas these solutions may not always be practicable and nutrient removal facilities may have to be built into the works. Facilities of this sort have been discussed with Byron, Bellinger and Hastings Shire Councils.

Generally the Commission requires new or augmented works, with discharges causing eutrophication in receiving waters, to reduce mean total nitrogen and phosphorus concentrations to no more than 15 milligrams and 1 milligram per litre respectively. If it can be shown, however, that in low flow conditions the mean concentrations of nitrogen and phosphorus will be less than 500 and 50 micrograms per litre respectively, less stringent requirements may be possible. These nitrogen and phosphorus concentrations are similar to those recommended by the Commission for the Hawkesbury-Nepean system and in the Australian Environment Council report, *Nutrients in Australian Waters.*

Strategies to reduce the level of nutrients in discharges from sewage treatment works are being implemented in the Hawkesbury-Nepean River (summarised in the box), the waterways of Kosciusko National Park and the River Murray at Albury, and improvements in receiving water quality have already been observed in some catchments.

Strategy for Reducing Nutrient Discharges from Sewage Treatment Plants in the Hawkesbury-Nepean River

Parameter	June 1989 Objective
Total phosphorus (P)	Phosphorus removal facilities at large and medium sized plants, and at small plants located in sensitive areas, so that total phosphorus concentrations do not exceed a 90 percentile value of 1 milligram per litre
Ammonia nitrogen (NH_4-N)	Nitrification facilities at large and medium sized plants, augmented existing plants and all new plants, so that ammonia concentrations (as NH_4-N) do not exceed 50 and 90 percentile values of 2 and 5 milligrams per litre respectively
Total nitrogen (N)	Limited denitrification facilities at large and medium sized plants, augmented existing plants and all new plants, so that total nitrogen concentrations are reduced by about 50 per cent at existing plants during summer months and 90 per cent at augmented or new plants

The Commission's latest atlas for managing oil spills, this time in Jervis Bay, will be invaluable if the naval base there is upgraded.

Many of the sewage treatment works in the Hawkesbury-Nepean catchment have shown substantial nutrient reductions following installation of additional control facilities. Table 3 shows that at the Quakers Hill sewage treatment plant, for example, the mean total phosphorus load has been reduced by over 75 per cent while the mean total nitrogen load has been reduced by about 30 per cent. Further reductions are anticipated in the catchment as the Water Board installs automatic pickle liquor-dosing facilities and fully implements nitrification and denitrification programs. The Water Board will need to fully maintain this effort to meet the Commission's June 1989 objectives.

Sewage Sludge

Sewage sludge contains high concentrations of organic carbon and nutrients, and potential human and animal pathogens. Toxic trace metals and persistent synthetic organic chemicals may also be present.

Most of the sludge produced in New South Wales is generated in the Sydney region and most is disposed of by shoreline discharge from the North Head, Bondi and Malabar outfalls. The quantities of sludge requiring disposal will increase significantly in the next 20 years.

In order to develop a State-wide policy for the disposal of sludge, the Commission has set up a subcommittee of the Clean Waters Advisory Committee. The subcommittee also has members from the Water Board, the Metropolitan Waste Disposal Authority, the Hunter District Water Board, and the Departments of Public Works, Health, and Agriculture and Fisheries. It will report on the major options for disposal of sludge and the other by-products of sewage treatment. The options being assessed include ocean disposal, land application, sanitary landfill, composting/fertiliser production and incineration.

Table 3
Nutrients Discharged from Hawkesbury-Nepean Sewage Treatment Plants

Sewage Treatment Plant	Mean Concentrations (mg/L)*		
	Total Phosphorus	Ammonia Nitrogen	Total Nitrogen
Large plants:			
Quakers Hill	2.1	7.3	13.4
St Marys	4.7	4.0	23.8
Penrith	9.3	24.6	0.8
Medium sized plants:			
Castle Hill	2.1	9.6	11.8
Glenbrook	5.1	35.1	2.4
Hornsby Heights	8.9	33.2	1.5
Riverstone	8.2	0.6	30.0
West Camden	8.1	4.7	21.2
West Hornsby	7.2	13.1	14.9
Winmalee	10.7	4.0	5.6

*Milligrams per litre

No. 300

Parliament of New South Wales

1986–87

REPORT

OF THE

STATE POLLUTION CONTROL COMMISSION

FOR THE

YEAR ENDED 30 JUNE, 1986

Ordered to be printed 26 February, 1987

BY AUTHORITY
D. WEST, GOVERNMENT PRINTER, NEW SOUTH WALES—1987

70310-12308 1986-87—47

occurred in areas where soil stability was marginal. The Commission, with the co-operation of the developers involved, including the Department of Housing, is actively exploring corrective measures which might be incorporated in future developments.

The Commission is also undertaking studies to ascertain the quality of urban stormwater and the possible impacts of future development in selected local government areas in the Sydney and Illawarra Regions. A major study of the Hacking River revealed serious implications for the waters and headwaters of the Royal National Park from the proposed development of some areas near Helensburgh. The Wollongong City Council is currently re-assessing these proposals in light of the Commission's report entitled "Investigation into the Impact of Urban Development at Helensburgh on Water Quality of the Hacking River". In related work the Commission is undertaking a study for the Australian Environment Council on urban runoff water quality and has also joined a major study in the Hawkesbury-Nepean catchment with local councils and the MWS&DB.

A study of Lake Illawarra, a shallow lake of 35 square kilometres in the developing urban areas south of Wollongong, revealed a water body seriously affected by urbanisation. Siltation, nutrient enrichment and excessive growth of aquatic plants, resulting in a stinking black ooze, have combined with poor tidal flushing to produce an urban water body under threat. Turbidity has increased in the past decade while phosphorus concentrations, a measure of nutrient enrichment, have doubled. The already shallow lake is losing large foreshore areas because of siltation from urban development. The main cause of this deterioration has been inadequate control of stormwater runoff. There are few licensed discharges.

Remedial measures have included harvesting excessive growths of aquatic plants, replanting aquatic and terrestrial vegetation in appropriate areas, and selective dredging to improve water circulation. Longer-term measures involve restoration and rehabilitation of tributary channels and floodplains, stringent control on the use of floodplains, avoidance of construction of new channel works in the floodplains, and incorporation of silt traps, flood retardation and sedimentation basins in all new developments and, wherever possible, in existing developments. The erosion control measures recommended by the Soil Conservation Service of NSW should be applied. Infiltration, using porous surfaces and other means, should be used where practicable. These findings are summarised in the Commission's "Wollongong-Port Kembla Pollution Control Study" and in more detail in its "Lake Illawarra Environmental Audit".

3.2.2 Rural Runoff

The report "Priority Issues Involved in the Diffuse Pollution of Waterways Especially by Agricultural Chemicals" published by the Commission in June 1985 outlined the broad range of problems facing the State from agricultural practices. Corrective action and the appropriate government agencies to implement or control that action were identified. The report paid special attention to intensive chemical use in the Namoi Valley and on the far North Coast.

While soil erosion is the major contributor to diffuse pollution of rural

waterways, the use of pesticides and fertilisers in intensive cropping contributes significantly to eutrophication and levels of toxic materials in waters. A range of planning and regulatory mechanisms can be applied under existing statutes. Given the limited resources of all authorities involved, however, close co-ordination of activities is essential to achieve satisfactory control. The Soil Conservation Act, Clean Waters Act and Pesticides Act, in conjunction with the established planning instruments, provide the necessary legislative tools. Education in the farming industry could also assist in the avoidance of undesirable practices.

The Commission together with the Water Resources Commission is exploring modifications to the Clean Waters Regulations to allow them to be more readily applied in the control of tailwater discharges and the use of herbicides in waters and channels to limit aquatic weed growth.

The Commission undertook studies of pesticide levels in Boobera Lagoon and adjacent waters in the Moree district. These studies revealed levels of Endosulfan in the range 0.03 to 0.30 micrograms per litre with one reading as high as 2.1. Fish kills have been observed in the area but it has not been possible to determine whether agricultural chemicals or oxygen depletion following heavy rains was the principal cause. The matter is under review. A survey of cotton farming practices in the Moree district revealed that there are some discharges of tailwaters which warrant further regulation under the Clean Waters Act. It is generally agreed by the Commission and the Water Resources Commission that tailwater recirculation should be maximised.

For several years the Commission has been studying the impact of open-cut coal mining on the quality of water in a tributary creek of the upper Hunter River. Although data collection and analysis is continuing, early results indicate that water quality is dominated by local hydro-geochemistry rather than directly by mining activities. At this stage no conclusions about the long-term impact of open-cut mining are possible but the Commission's existing management policies are likely to be effective during the operating life of mines.

3.3 WATER RESOURCE MANAGEMENT IN BOTANY BAY

3.3.1 Progress Report

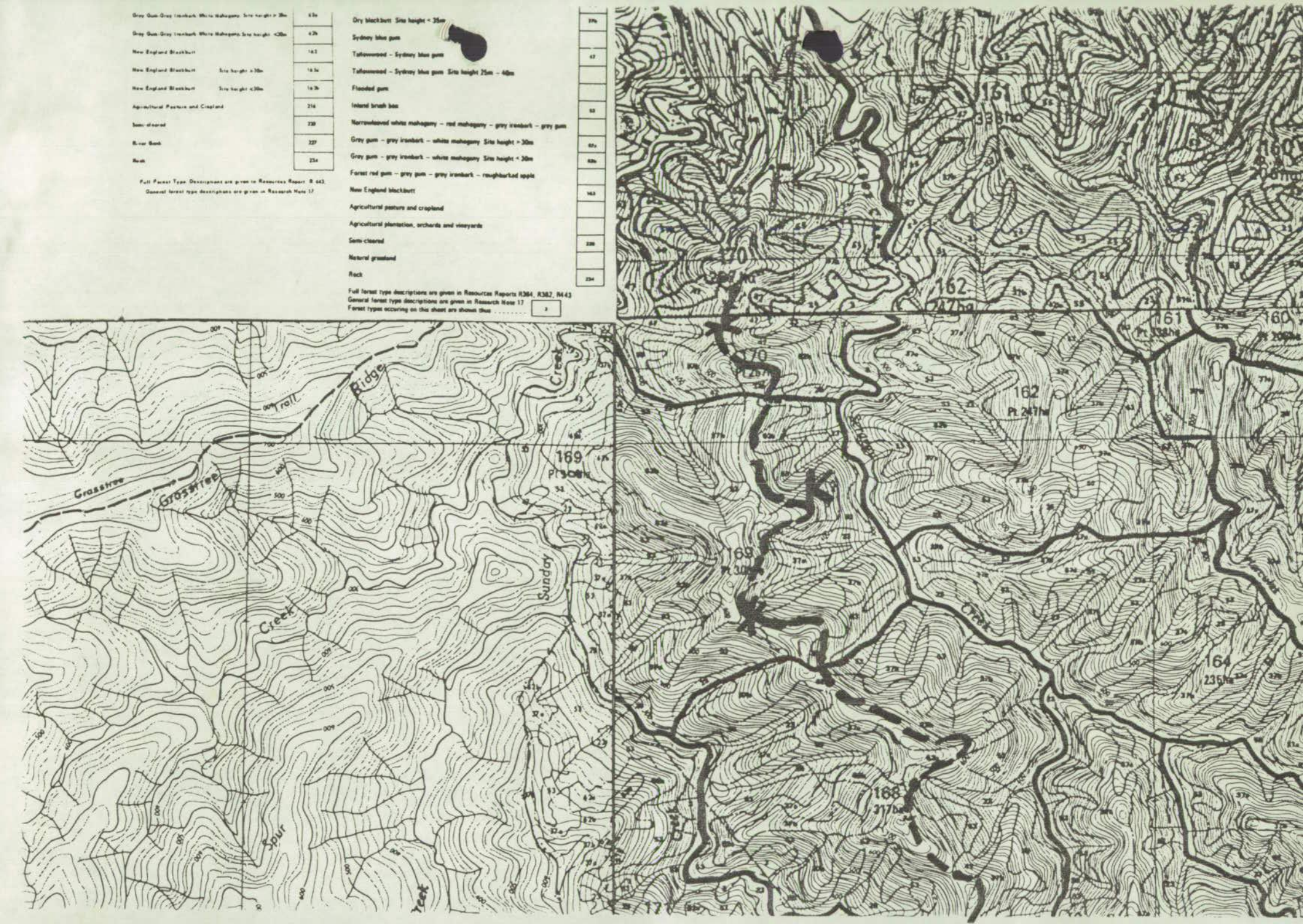
The first progress report on the Commission's Botany Bay Environmental Management Plan was published in September 1985.

The most important recommendation of the report is for the construction of a sheltered crude oil berth within Port Botany. The facility is urgently needed to better protect the bay's more environmentally sensitive areas from oil spills. The issue was taken up by the State Government on publication of the report. Negotiations with the operator of the existing berth, the Caltex Refining Co. Pty Ltd, have proceeded on the basis that environmental damage from oil spills has occurred more often than could be considered reasonable and the general community should not pay for damage resulting from the activities of a private company. An option that may be considered by the Government is to legislate to ensure the future protection of the environment.

Your Forests ... Who Cares ?

We do!!!

Forestry Commission of New South Wales


Grey Gum-Grey Ironbark-White Mahogany Site height > 35m
Grey Gum-Grey Ironbark-White Mahogany Site height <35m
New England Blackbutt
New England Blackbutt Site height >30m
New England Blackbutt Site height <30m
Agricultural Pasture and Cropland
Semi-cleared
River Bank
Rock
Full Forest Type Descriptions are given in Resources Report R 443.
General forest type descriptions are given in Research Note 17
Dry blackbutt Site height < 35m
Sydney blue gum
Tallowwood - Sydney blue gum
Tallowwood - Sydney blue gum Site height 25m - 40m
Flooded gum
Inland brush box
Narrow-leaved white mahogany - red mahogany - grey ironbark - grey gum
Grey gum - grey ironbark - white mahogany Site height > 30m
Grey gum - grey ironbark - white mahogany Site height < 30m
Forest red gum - grey gum - grey ironbark - roughbarked apple
New England blackbutt
Agricultural pasture and cropland
Agricultural plantation, orchards and vineyards
Semi-cleared
Natural grassland
Rock
Full forest type descriptions are given in Resources Reports R364, R382, R443
General forest type descriptions are given in Research Note 17
Forest types occuring on this sheet are shown thus
Ridge
Creek
Grassree
Grassree
Creek
Sunday
Spur
Creek
161
338ha
162
247ha
160
169
164
235ha
168
317ha
17

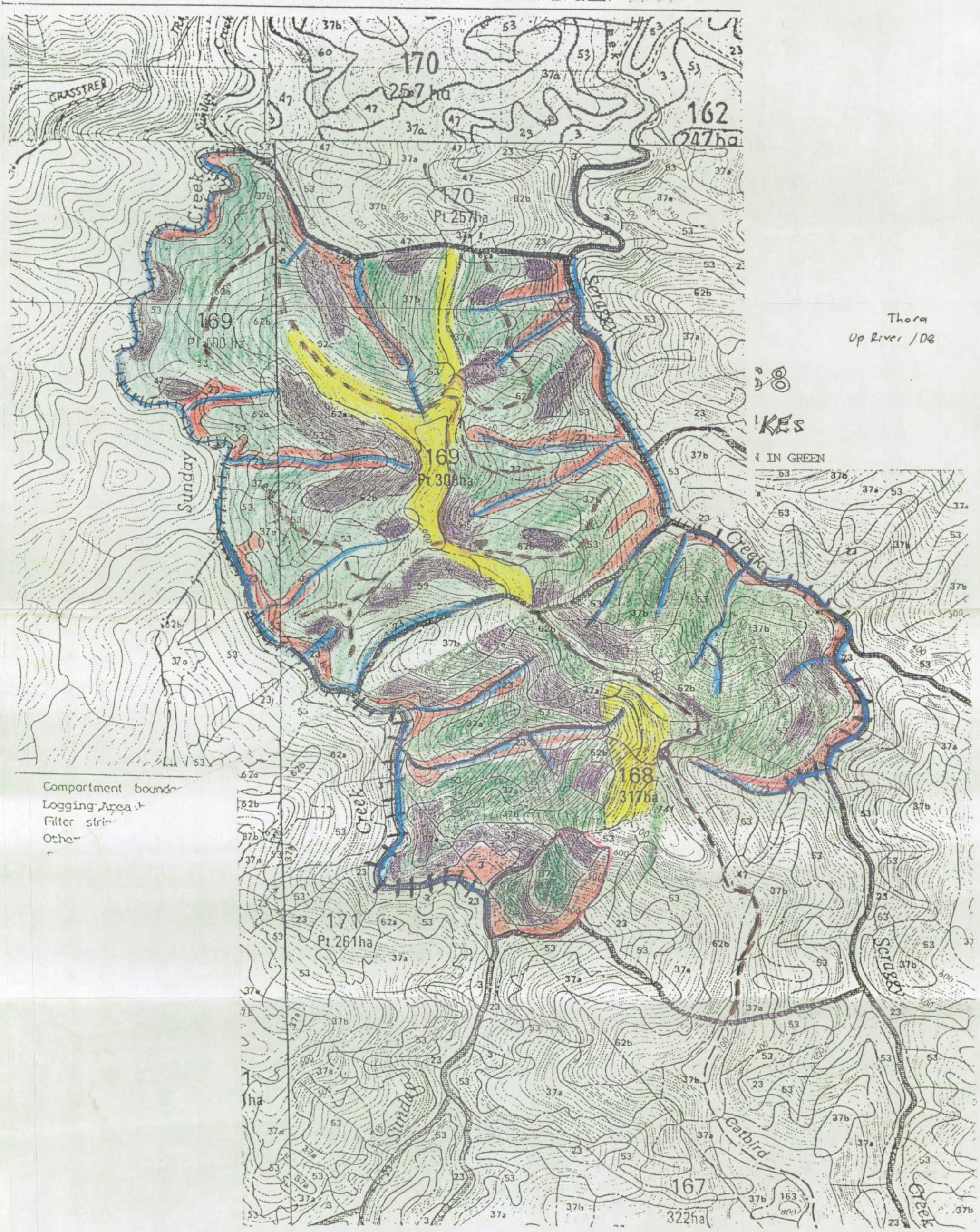
Compartment 169

Scale — 1:15 000

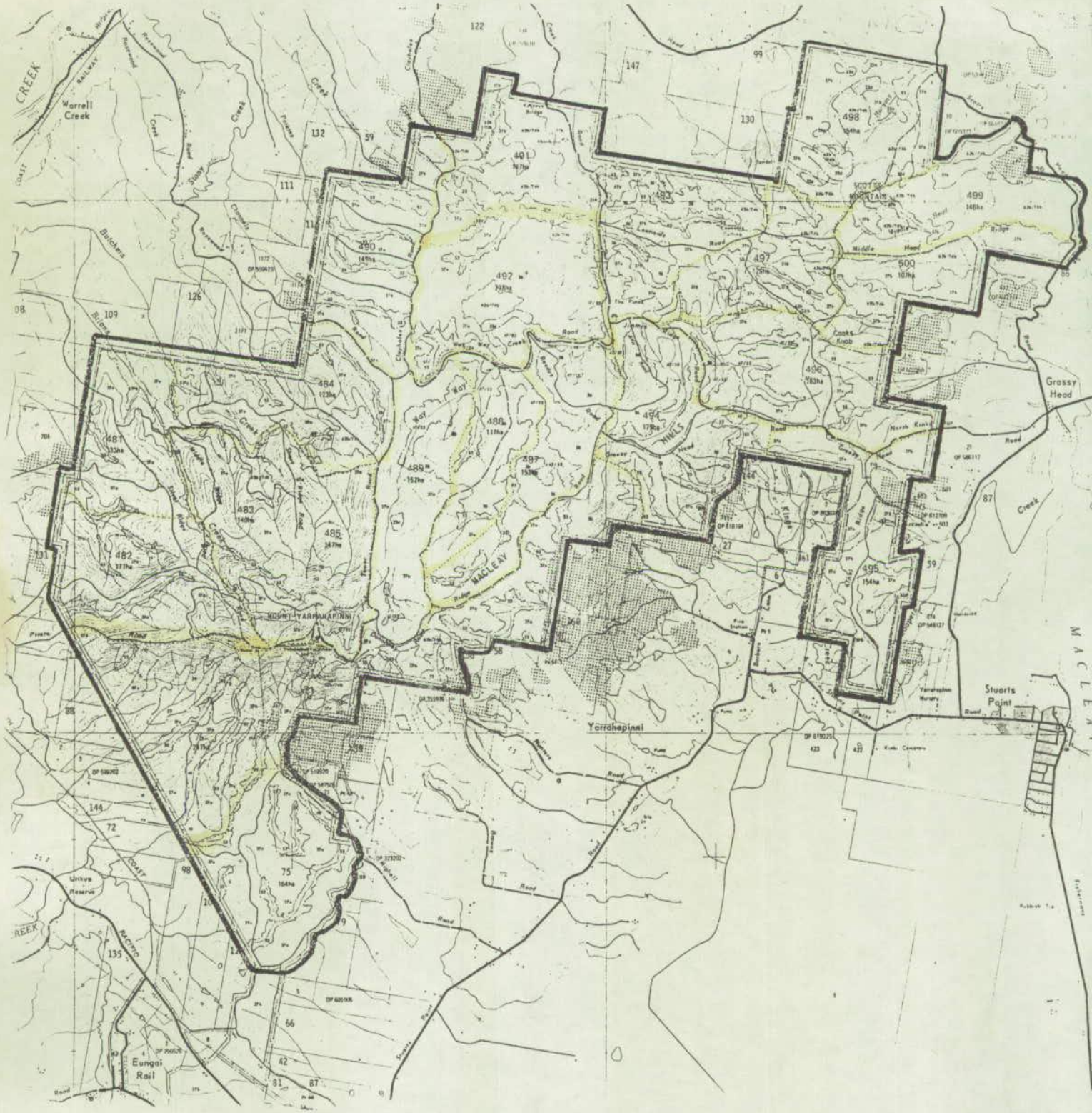
0 0·5 1 km.

STATE FOREST: OAKES No. 609

S.F. BOUNDARY SHOWN IN GREEN



Thora
Up River / DB


Warrell Creek
Stuarts Point
Yarrahapinni
Grassy Head
Eungai Rail
MACLEAY
Creek
Road


MACLEAY HILLS
MOUNT YARRAHAPINNI
SCOTTS MOUNTAIN
Yarrahapinni
Grassy Head
Grassy Beach
CREEK
Tower Road
Middle Ridge
Silver Ridge
Short Ridge Road
Clayholes Road
Reedys Creek Road
Grassy Head Road
Jimmys Ridge Road
Hunters Road
Browns Road
Mighell Road
Barbers Lane
Kings Ridge
Coopers Creek
Cooks Knob
North Kinki Spur
Leonards Road
Scotts Gully
Middle Head
Brians
Channels Creek
Rosewood
Donoheys Road
Fire Station
Stuarts Point
Gully

Grassy Head
Grassy Beach
Scotts
Scotts Mountain
Morrows
Middle Head
Cooks Knob
North Kinki Spur
Kinki Ridge
Coopers
Arcadia
Kings
Barbers Lane
Stuarts Point
Fire Station
Yarrahapinni
Hunters
Browns
Mighell
Road
Creek
Grassy Head
Macleay Hills
Ridge Road
Jimmys Ridge
Allis Road
Reedys
Way Way Creek
Way Way
Clayholes
Leonards Cutting
Leonards
Tower Road
Donohues
Mount Yarrahapinni
Short Ridge Road
Middle Ridge
Creek Road
Silver Ridge
Brians
Rosewood
Channels
Gully
Head

Scotts Head
Grassy Beach
Grassy Lookout
Grave
Grassy Head
Road
Ridge
Creek
Gully
Scotts Head Road
Scotts Mountain
Middle Head
Middle Head Road
Cooks Knob
North Kinkill Spur
Kinkill Ridge
Arcadia
Cooper's Creek
Leonards Road
Leonards Cutting
Jimmys Ridge Road
The Pines
Allis Road
Kings Creek
Kings Lane
Barbers Road
Fire Station
Reedys Creek
Reedys Road
Clayholes Road
Gully
Creek
Channels
Rosewood
Short Ridge Road
Middle Ridge Road
Silver Ridge
Tower Road
Donohoes
Hunters Road
Browns Road
Mighell Road
Yarrahapinni Road
Pump Site
Yarrahapinni Lookout
MACLEAY HILLS
MOUNT YARRAHAPINNI
Waterfall Way
Lane
Brians
Woodfield
Sandpit
Quarry
Aerodrome
Trig Station
Pt 1
Pt 2
Pt 40
Pt 69
Pt 70
Pt 71
Pt 72
Pt 73
Pt 74
Pt 75
Pt 76
Pt 77
Pt 78
Pt 79
Pt 80
Pt 81
Pt 82
Pt 83
Pt 84
Pt 85
Pt 86
Pt 87
Pt 88
Pt 89
Pt 90
Pt 91
Pt 92
Pt 93
Pt 94
Pt 95
Pt 96
Pt 97
Pt 98
Pt 99
Pt 100
Pt 101
Pt 102
Pt 103
Pt 104
Pt 105
Pt 106
Pt 107
Pt 108
Pt 109
Pt 110
Pt 111
Pt 112
Pt 113
Pt 114
Pt 115
Pt 116
Pt 117
Pt 118
Pt 119
Pt 120
Pt 121
Pt 122
Pt 123
Pt 124
Pt 125
Pt 126
Pt 127
Pt 128
Pt 129
Pt 130
Pt 131
Pt 132
Pt 133
Pt 134
Pt 135
Pt 136
Pt 137
Pt 138
Pt 139
Pt 140
Pt 141
Pt 142
Pt 143
Pt 144
Pt 145
Pt 146
Pt 147
Pt 148
Pt 149
Pt 150
Pt 151
Pt 152
Pt 153
Pt 154
Pt 155
Pt 156
Pt 157
Pt 158
Pt 159
Pt 160
Pt 161
Pt 162
Pt 163
Pt 164
Pt 165
Pt 166
Pt 167
Pt 168
Pt 169
Pt 170
Pt 171
Pt 172
Pt 173
Pt 174
Pt 175
Pt 176
Pt 177
Pt 178
Pt 179
Pt 180
Pt 181
Pt 182
Pt 183
Pt 184
Pt 185
Pt 186
Pt 187
Pt 188
Pt 189
Pt 190
Pt 191
Pt 192
Pt 193
Pt 194
Pt 195
Pt 196
Pt 197
Pt 198
Pt 199
Pt 200
Pt 201
Pt 202
Pt 203
Pt 204
Pt 205
Pt 206
Pt 207
Pt 208
Pt 209
Pt 210
Pt 211
Pt 212
Pt 213
Pt 214
Pt 215
Pt 216
Pt 217
Pt 218
Pt 219
Pt 220
Pt 221
Pt 222
Pt 223
Pt 224
Pt 225
Pt 226
Pt 227
Pt 228
Pt 229
Pt 230
Pt 231
Pt 232
Pt 233
Pt 234
Pt 235
Pt 236
Pt 237
Pt 238
Pt 239
Pt 240
Pt 241
Pt 242
Pt 243
Pt 244
Pt 245
Pt 246
Pt 247
Pt 248
Pt 249
Pt 250
Pt 251
Pt 252
Pt 253
Pt 254
Pt 255
Pt 256
Pt 257
Pt 258
Pt 259
Pt 260
Pt 261
Pt 262
Pt 263
Pt 264
Pt 265
Pt 266
Pt 267
Pt 268
Pt 269
Pt 270
Pt 271
Pt 272
Pt 273
Pt 274
Pt 275
Pt 276
Pt 277
Pt 278
Pt 279
Pt 280
Pt 281
Pt 282
Pt 283
Pt 284
Pt 285
Pt 286
Pt 287
Pt 288
Pt 289
Pt 290
Pt 291
Pt 292
Pt 293
Pt 294
Pt 295
Pt 296
Pt 297
Pt 298
Pt 299
Pt 300
Pt 301
Pt 302
Pt 303
Pt 304
Pt 305
Pt 306
Pt 307
Pt 308
Pt 309
Pt 310
Pt 311
Pt 312
Pt 313
Pt 314
Pt 315
Pt 316
Pt 317
Pt 318
Pt 319
Pt 320
Pt 321
Pt 322
Pt 323
Pt 324
Pt 325
Pt 326
Pt 327
Pt 328
Pt 329
Pt 330
Pt 331
Pt 332
Pt 333
Pt 334
Pt 335
Pt 336
Pt 337
Pt 338
Pt 339
Pt 340
Pt 341
Pt 342
Pt 343
Pt 344
Pt 345
Pt 346
Pt 347
Pt 348
Pt 349
Pt 350
Pt 351
Pt 352
Pt 353
Pt 354
Pt 355
Pt 356
Pt 357
Pt 358
Pt 359
Pt 360
Pt 361
Pt 362
Pt 363
Pt 364
Pt 365
Pt 366
Pt 367
Pt 368
Pt 369
Pt 370
Pt 371
Pt 372
Pt 373
Pt 374
Pt 375
Pt 376
Pt 377
Pt 378
Pt 379
Pt 380
Pt 381
Pt 382
Pt 383
Pt 384
Pt 385
Pt 386
Pt 387
Pt 388
Pt 389
Pt 390
Pt 391
Pt 392
Pt 393
Pt 394
Pt 395
Pt 396
Pt 397
Pt 398
Pt 399
Pt 400
Pt 401
Pt 402
Pt 403
Pt 404
Pt 405
Pt 406
Pt 407
Pt 408
Pt 409
Pt 410
Pt 411
Pt 412
Pt 413
Pt 414
Pt 415
Pt 416
Pt 417
Pt 418
Pt 419
Pt 420
Pt 421
Pt 422
Pt 423
Pt 424
Pt 425
Pt 426
Pt 427
Pt 428
Pt 429
Pt 430
Pt 431
Pt 432
Pt 433
Pt 434
Pt 435
Pt 436
Pt 437
Pt 438
Pt 439
Pt 440
Pt 441
Pt 442
Pt 443
Pt 444
Pt 445
Pt 446
Pt 447
Pt 448
Pt 449
Pt 450
Pt 451
Pt 452
Pt 453
Pt 454
Pt 455
Pt 456
Pt 457
Pt 458
Pt 459
Pt 460
Pt 461
Pt 462
Pt 463
Pt 464
Pt 465
Pt 466
Pt 467
Pt 468
Pt 469
Pt 470
Pt 471
Pt 472
Pt 473
Pt 474
Pt 475
Pt 476
Pt 477
Pt 478
Pt 479
Pt 480
Pt 481
Pt 482
Pt 483
Pt 484
Pt 485
Pt 486
Pt 487
Pt 488
Pt 489
Pt 490
Pt 491
Pt 492
Pt 493
Pt 494
Pt 495
Pt 496
Pt 497
Pt 498
Pt 499
Pt 500


Grassy Head
Grassy Beach
Scotts
Scotts Mountain
Middle Head
Cooks Knob
North Kinki Spur
Arcadia
Coopers
Kinki Ridge
Kings
Stuarts Point
Barbers Lane
Fire Station
Yarrahapinni
Hunters
Browns Road
Macleay Hills
Grassy Head Road
Reedys Creek
Jimmys Ridge
Leonards Road
Clayholes Creek
Channels Creek
Rosewood
Tower Road
Short Ridge Road
Middle Ridge
Silver Ridge
Brians
Mighell
Mount Yarrahapinni
Donohoes Road