



CSIRO
AUSTRALIA

Institute of Industrial Technologies
Canberra Office

Limestone Avenue, Campbell, ACT. Postal Address: PO Box 225, Dickson, ACT 2602
Telephone: (06) 276 6510. Telex: AA62003. Fax: (06) 276 6410

CSIRO
Draft Strategy
on waste management
(1991)

Dr John Stocker

REPORT OF CSIRO WASTE TREATMENT RESEARCH TASKFORCE

This is to provide you with a draft Waste Management Research Strategy and recommendations on allocation of relevant funding for CSIRO waste management research.

Background

In June you requested I chair a Taskforce on Waste Treatment Research and report back to you with "a waste treatment strategy for CSIRO and recommendations for the distribution of funds for 1991/92 and proposals for the following year for about the same amount of funds." (Implementation of National Research Priorities, Paper presented to Executive Committee Meeting, 5 June).

At the September meeting of the Executive Committee it was agreed I would provide you with a draft waste treatment/waste management strategy by the end of November 1991. Agreed terms of reference for the Taskforce (which incorporated Directors comments and were cleared with you and Directors) were:

- Develop a framework for the CSIRO waste management research strategy
- Identify and prioritise the most important issues to be addressed
- Identify opportunities for CSIRO to address these issues, based on the Organisation's current research efforts
- Examine the value of an integrated program of research in waste management, based on current and prospective research in CSIRO, and appropriate management/coordination arrangements for such a research program
- Report by end of November, 1991.

DRAFT

CSIRO WASTE MANAGEMENT RESEARCH STRATEGY

1. BACKGROUND

This draft strategy has been prepared by an inter-Institute Taskforce* established in June 1991 following the first round of CSIRO's national priority setting exercise.

Terms of reference for the Taskforce were to:

- . Develop a framework for the CSIRO waste management research strategy
- . Identify and prioritise the most important issues to be addressed
- . Identify opportunities for CSIRO to address these issues, based on the Organisation's current research efforts
- . Examine the value of an integrated program of research in waste management, based on current and prospective research in CSIRO, and appropriate management/coordination arrangements for such a research program
- . Report by end of November, 1991.

The definition of waste management adopted by the Taskforce covers: "liquid, solid and gaseous wastes produced at industrial trade, agricultural and domestic sources and the control or management of these wastes using technological solutions. "

This research primarily falls within ABS SEO Classification *Economic Development: Environmental Aspects* (110000) and includes process-related instrumentation/monitoring equipment. It does not cover waste research such as:

- . off-site pathways and impacts
- . industrial and minesite rehabilitation
- . waste-related environmental planning.

The Taskforce comprised Dr Tom Spurling (IIT, Chair) Dr Graham Allison (INRE), Dr Warren Bond (IPPP), Dr Brett Bateup/Dr Dieter Plate (IAPP), Dr Geoff Robinson (IISE), Dr David Sutherland/Dr John Hall (IMEC) and Mr Garrett Upstill and Mr Nick Kariotoglou (Secretariat).

2. THE NATIONAL SETTING

In Australia and overseas in recent years there has been increasing public concern about waste management issues, based on an increased awareness of environmental and health impacts.

This has led to an increased government focus on waste management. This is reflected in current efforts to develop a national strategy for ecologically sustainable development which encompasses all the major economic sectors. In addition, the Commonwealth Government has recently released a Draft National Waste Minimisation and Recycling Strategy and there have been a number of related initiatives taken by State governments and through the Australia New Zealand Environment and Conservation Council (ANZECC). This increased government involvement is associated with ongoing changes to the regulations, economic incentives and administrative arrangements which govern the generation and control of waste.

These changes provide constraints and opportunities for Australian industries - constraints, in that new processes, new products, and new approaches will be needed to meet more stringent environment requirements; opportunities in new technologies and development of a new, vigorous internationally competitive Australian industry specialising in waste management and control.

Research has an important part to play in meeting these new challenges. The potential of research-based technology to contribute to the development of a fast-growing waste management industry was addressed in the paper Commercialising Opportunities in Waste Management presented to the Prime Minister's Science Council in May 1991. It notes the industry is growing at a rate of 10-12% per annum internationally to a total worldwide turnover of about A\$500 billion by the year 2000.

Moreover the central role of research and development has been expressly recognised in the draft Commonwealth National Waste Minimisation and Recycling Strategy and in the recent introduction of a research grants for Environment Technologies by the national IR&D Board.

The technological opportunities for minimising waste are set out in Figure 1. This shows a hierarchy with waste minimisation best achieved by measures, where practicable, which are higher on the list.

This Strategy covers all measures other than "product substitution" and "non-production of material" which, although appropriate approaches to waste minimisation in some cases, fall outside the ambit of the Strategy.

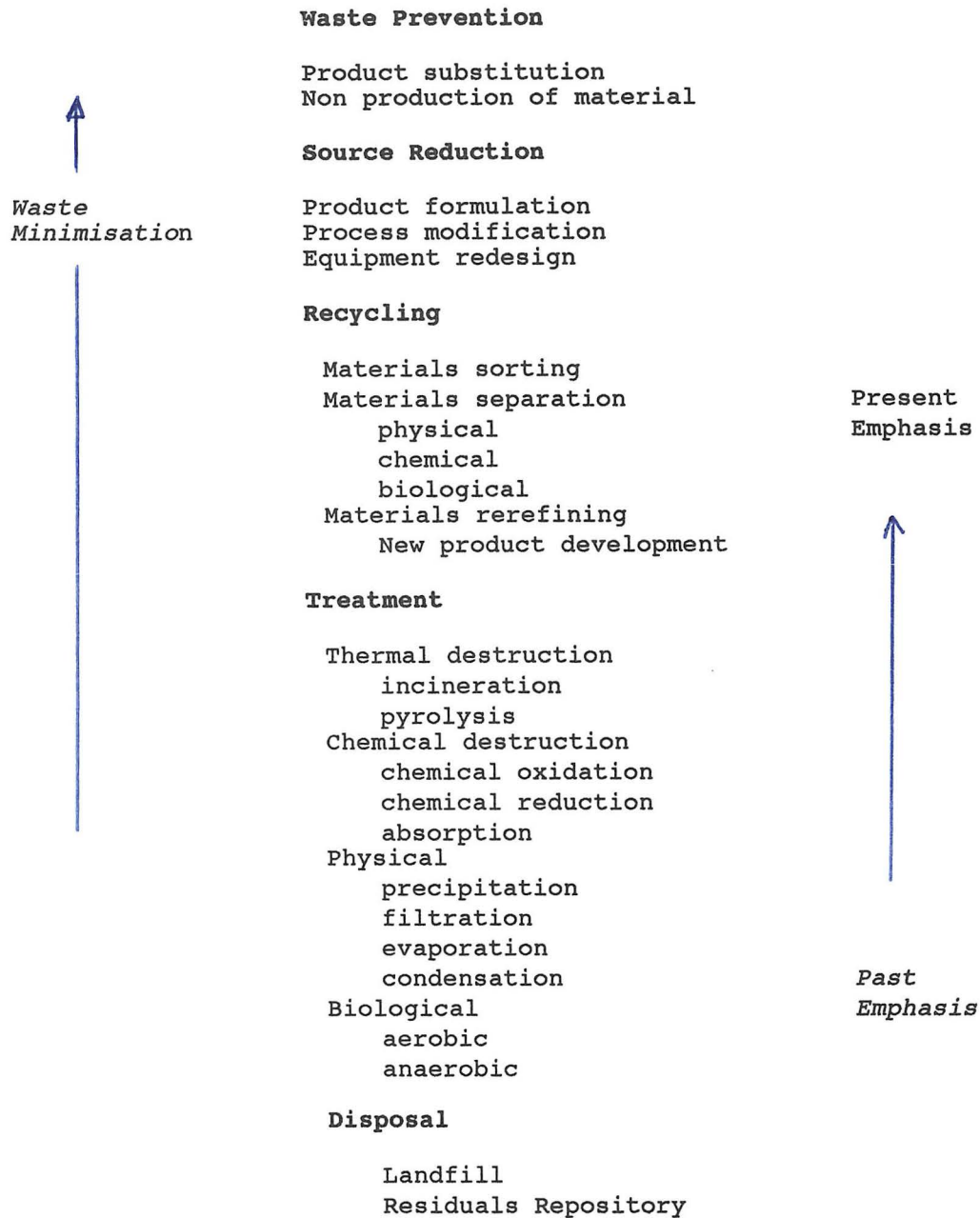


Figure 1 From DITAC, Waste Management Technologies, AGPS, August 1990.

3 THE CONTRIBUTION OF CSIRO RESEARCH

CSIRO capabilities in the area of waste research represent a significant national resource. The purpose of this strategy is to strengthen coordination and provide a focus so as to ensure maximum return to Australia on CSIRO's research dollar.

This requires recognition that research does not offer the solution to all the challenges faced in waste management. In some cases administrative changes may hold the key, in others established and satisfactory technologies are already available "off the shelf".

Moreover, CSIRO is just one player in the field of waste management research. It currently conducts approximately \$16M waste management research per year of an estimated national total of some \$50M.

These factors require a selective approach to waste management research, where there is a likelihood of significant return to Australia. This requires:

- . it addresses a significant problem
- . the problem is amenable to technology/research solutions
- . there is a "receptor" to ensure benefits are captured within Australia.

Annex 1 sets out the CSIRO Priorities Framework which encapsulates this thinking and provides the methodological setting for this Strategy. Following Sections address significant problem areas (*the Potential Benefits of research*), receptor organisations (*Ability to capture*) and CSIRO research capabilities (*R&D Capacity*).

4. SIGNIFICANT PROBLEM AREAS

Table 1 sets out a Taskforce overview of Australia's waste management problems. These are listed by ABS SEO (research purpose) classification; this provides an end user, rather than technology, focus for research to address these problems.

Key problem areas shown by aggregated end-user group include:

Resource Based Processing

- . Wool scouring
 - trace pollutants
 - scour sludge
 - need for water recycling
- . Metals processing
 - NO_x, SO₂ emissions
 - particulates in exhaust gases
- . Pulp and paper
 - improved process technology for pulp production
- . Mining
 - metals/ organics in mine waters
 - fine powder emissions/ dust and fumes
- . Tanneries
 - chromium in dyeing and tanning,
 - dye liquors
- . Food processing (meat, wine, canneries etc)
 - nutrient rich, high BOD and often saline liquids

Rural Production

- . Intensive agriculture
 - chemical(nutrient) run-off
 - saline drainage
 - nutrient and organic-rich wastes from feedlots, piggeries etc
 - aquaculture
- . Productive use of forestry wastes

Strategy

The draft CSIRO strategy as developed by the Taskforce is attached. Drafts of this Strategy were circulated to Institute Directors in early November for comment and as background documentation to calls for funding bids for 1992/93 under the CSIRO Priorities Scheme.

I suggest you may wish to forward this draft Strategy to the Executive Committee for comment with a view to formal adoption by the Organisation.

Priority Bids

The funding for waste management proposals was:

- . 1991/92 recurrent \$606K (of which \$320K was allocated at the September EC meeting to wool scouring and plasma waste projects)
- . 1992/93 recurrent \$606K
- . 1992/93 and 1993/94 non-recurrent \$590K

The recommendations for allocation of funds were developed by the Taskforce in the light of the Draft CSIRO Strategy. A total of 17 bids were considered by the Taskforce and grouped, unanimously, as follows :

Group A

WM1(P2) Effluent Irrigated Plantations \$360K IAPP/INRE
100% EDEA

Group B

- ✓ WM2 Sulphate Wool Processing Effluent \$180K IAPP
100% EDEA
- ✓ WM6 Coagulants from Water and sludge 200K IIT
100%EDEA
- ✓ WM7 Fixing of Heavy metals 120K IMEC 100%
- WM8 (2y~~1~~) Caustic Magnesia 100K IMEC 50% EDEA
50% Minerals
- ✓ WM10 Constructed wetlands 160K INRE
- WM12 (2y) Soil Slotting 330K (INRE 200, IPPP 130)
- WM14 (2y~~1~~) In Situ Biotreatment 130K INRE 100% EDEA
- WM16 (2y) Plasma Destruction of Halons 150K IIT 100%
EDEA

Group C

WM3 Salinity in Tannery effluent
WM5 Wood Preservation Chemicals
WM9 Use of industrial ByProducts
WM11 Intensive rural Industries
WM13 Landfill Sites
WM15 Nitrogen/Phosphorus Removal

Group D

WM17 Microbial Treatment of Liquid Wastes

The Taskforce supports allocation of CSIRO Priority Levy Funds in accord with the priorities set out above. In the light of the high ranking of WM1 it favours this project be funded from 1991/92 recurrent funds. Projects suitable for non recurrent funding are also indicated.

Tom Spurling

Chairman, Waste Management Taskforce

27 November 1991

Page 1-4
Missing
include refer
to Annex 1

Manufacturing

- . Gaseous, liquid and solid waste reduction and control
- . Intractable wastes

Service Industries (sewage and water treatment, solid waste disposal, municipal waste)

- . Waste water
 - urban and small scale treatment
- . Sewage treatment
 - improved treatment technologies
 - sludge disposal or application
- . Municipal Waste
 - plastics, tyres
 - sanitary landfill design and management
 - composting of putrescible wastes
- . Water treatment
 - improved technologies to reduce/recycle sludge
 - productive disposal of water treatment residuals
- . Collection and disposal of toxic wastes

4.1 Potential Benefit of CSIRO Research

Not all of the areas identified are appropriate for CSIRO attention. Some are not critically dependent on new technology for resolution; others are best suited to research by the private sector.

The potential benefit of waste management research is two-fold in character (i) non-monetary benefits associated with improved environmental quality and health resulting from reduced waste emissions (relative to the baseline of current practice) and (ii) economic benefits either through cost savings or increased commercial returns.

Economic benefits will arise from, for example:

- . cost savings associated with replacement waste treatment technologies or improved production processes or prevention of costly environmental damage
- . expansion of production that could not otherwise have been achieved, due to environmental constraints. (eg value-adding to natural mineral or rural resources through potentially high-waste processes.)
- . new markets for new technologies or marketable practices - in Australia and overseas
- . use and commercial exploitation of wastes

In addition to the potential benefit attention also needs to be given to the effective exploitation of successful research and on the ability of CSIRO to mount a competitive research team in the area. The latter factors are addressed below.

5 RECEPTOR ORGANISATIONS

If CSIRO research in waste management issues is to be effectively exploited there is a need for early consideration of the needs of end users, the key customers for new technology within the resource-based processing, rural production, manufacturing and service industries.

The end-user organisations are the key to effective targetting of research.

- . they operate in an environment determined by local, state and federal regulatory agencies
- . they are principal customers for
 - supply and construction of new plant equipment
 - specialist waste technology and equipment
 - waste consulting services
- . many conduct research in their own right

(Annex 2 shows a list of end-user and subsidiary organisations in Australia's waste management industry.)

While research may involve collaboration with "intermediate" industries, eg. consultants, contractors or specialist suppliers it needs to be framed in terms of the end user needs and linked to adoption by the end-user early in the development of the research. Early collaboration is also helpful in guiding and tailoring the research so as to maximise its potential usefulness.

As noted in other CSIRO documentation, the characteristics of a good commercial collaborator are:

- superior management capabilities
- capacity to accept and manage technology
- national and international marketing expertise
- access to long term capital and financial management capability

Factors important for government and semi-government bodies include:

- recognition of the need for improved technology based on scientifically justified standards
- responsibility for large waste management sectors
- ability to implement technology changes

Table 1. The Relationships between SEO Activities and Waste Management Problems.

Task Force Overview:

SEO Sub-Division	SEO Group/Class	WASTE MANAGEMENT PROBLEM								
		Atmosphere & Odour Emission	Fresh Water Pollution	Ocean Pollution	Soil & Land pollution	Industrial & Chemical Wastes	Intractable & Toxic Wastes	Solid Wastes	Nature disturbance & damage of natural resources	Global Issues
Plant Production & Primary Products	Crops		○		○				○	
	Forestry		○	○					●	●
	Primary Plant Prod.		○							
Animal Production & Primary Products	Livestock	○	●						●	
	Fish/Aquaculture		○							
	Primary Animal Prod.	○	●		○					
Rural-Based Manufacturing	Food & Beverage	○	●			○		●		
	Wool Scouring		●			●		●		
	Textiles		●					●		
	Pulp & Paper		●	●		●	●	●		
	Skins & Leather	○	●			●	●	●		
Minerals Industry	Mining	○	●	○			●	●	●	●
	Mineral Processing	○	●	○	○			●		
	Basic Metal Products	○	●							
Energy Resources	Mining & Extraction	●	●	●	○	○		○	○	
	Refining	●			○	●				
Energy Supply	Energy Transfer	●								●
Manufacturing Industries	Fabricated Metal Prod.	○	○			○		●		
	Chemicals & Pharms	○	●	○	●	●	●	○		●
	Petroleum/Coal Prod.	●	○		●	●		●	●	●
	Machinery & Equip.		○	●		○				
	Other manufacturing	○				○		●	●	
Information & Comm.	Info. & Comm. Equip.									
Transport Industry	Ground Transport	●								●
	Water Transport		○	●						
	Air Transport	○								
Construction Industry	Construction	○						●		
Commercial Services	Utilities	●	●	●	●	●	○	●	●	●
Eco. Dev.-Env. Asp.	Sewage Treatment	●	●	●		●	○	●	●	●
	Recycling	○						○		
Health	Hospitals & Others					○	●			
Defence	Equip. & Weapons				●	○	○	○		●

Major Contributor ●

Minor Contributor ○

6 CSIRO RESEARCH CAPABILITIES

Waste management research covers a range of disciplinary fields. CSIRO has a wide skill base in areas related to waste management and experience in a range of technology applications.

Current CSIRO research in waste management is listed in Annex 3, with a brief project-by project summary. Current projects total some \$16M per annum and are summarised in Table 2 below.

Analysis of current CSIRO research shows:

- . approximately 30% may be categorised as Source Reduction, 20% Recycling and 50% Treatment & Disposal (Refer Fig. 1)
- . the bulk of the research involves liquid rather, than solid or gaseous wastes. (A recent DITAC report notes this is an area of strength in Australian waste research, reflecting Australia's geography and natural resource base)
- . an emphasis on support for Resource-Based and Water & Sewage industries.
- . much of the research is sector-specific, and there is limited inter-Divisional or inter-Institute collaboration. (This reflects a "business system approach" but also points to opportunities for greater cross-organisational collaboration)

Factors important in future waste management research are that selected projects be backed by team of above critical size, which is internationally competitive, and which draws fully on CSIRO's interdisciplinary research strengths. There may be opportunity for extension and consolidation of the research base through increased interaction with tertiary institutions, which account for a significant proportion of current Australian research.

7 CSIRO ACTION

All the evidence points to waste management being an issue of increasing public and government concern and a major focus for public sector research in coming years. It is likely to be a matter high on the agenda of all industries in the face of pressure for cleaner processes and low waste products, and industry measures listed higher in Figure 1, that "prevent, rather than cure" waste. Meeting these pressures will be central to maintaining viable internationally competitive industries in Australia.

Business System Focus

The 1988 reorganisation of CSIRO along business system lines is well suited to tackling waste management problems in line with the hierarchy of Figure 1. Many of Australia's waste problems are associated with the production and processing of primary products- wool, hides, timber, pulp and paper, mining and mineral processing and intensive agriculture. The solution of waste management problems associated with these industries

Table 2 Current CSIRO Waste Management Research (\$K p.a.)

Wool & Textiles

Mordant Dyeing	260
Pesticide Removal	370
Insect Proofing	760
Shrinkproofing	1100
Scour Waste Disposal	890
Tracking	440
Wool Dust	80

Pulp & Paper

Kraft Pulp Mill Effluent	500
Waste Paper	130

Hides

Processing Technology	360
-----------------------	-----

Timber Industry

Timber Preservation	500
Sawmill Waste for Australia	300
Use of Small Forest Trees	500

Agriculture

Intensive Rural Industry	250
--------------------------	-----

Manufacturing

In Situ Biomediation	400
Plasma Waste Treatment	1300
Portable Extractor	630

Mining & Minerals

Slags	40
Tailings treatment	550
Mineral Processing	300
Gold Processing	570

Energy Resources & Supply

Methane Drainage	150
Gas precipitators	50
Power Station Ash Leaching	50
Power Station Aqueous Emissions	200
Briquetting	205

Water and Sewage Treatment

Wood Production/Effluent Reuse	750
Land Application of Wastes	200
Artificial Wetlands Treatment	500
Coagulation Processes	780
Flotation Treatment	530
Adsorption Processes	470
Biological Processes	1060
Slotting Treatment	300
Caustic Magnesia	500

requires a detailed knowledge of the processes used within the industry and are best addressed by Divisions devoted to support of these industries, drawing on support as required from elsewhere in CSIRO.

Attention needs to be given to the key players within these industries, that is the leading edge customers which are able to articulate research needs and provide signals on longer term research opportunities.

Water and Sewage Industries

One business system which is not primarily represented by one Institute or Division is the water and sewage industry, as represented by state and regional management authorities. This is a fast growing industry worldwide, addressing a number of pressing urban and regional problems, and with local authorities/companies with the potential to compete effectively in international markets.

Work appropriate to this industry is carried out by Divisions in four Institutes, each of which concentrates on different technical aspects of the industry. The Taskforce believes there is scope for more effective collaboration between the Divisions involved to better serve the needs of the industry and gain access to the large markets for these technologies in Asia and other foreign markets.

Developing a more Integrated Approach

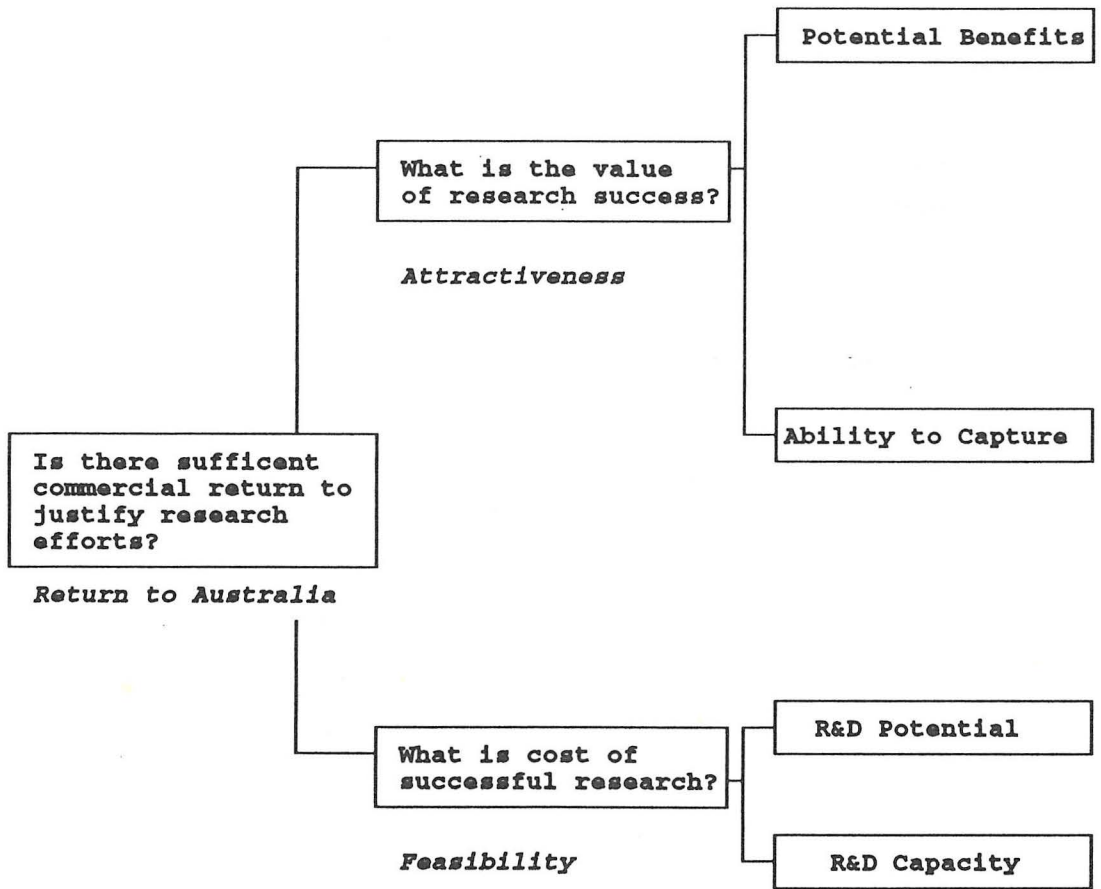
Divisions which are expert in particular industries cannot reasonably be expected to be fully conversant with all possible treatment technologies. Expertise and technologies developed in one Division may be useful in the solution of a problem from another area.

Improved networking of waste management research would increase the possibility of fruitful cross-fertilisation whether in relation to cross industry applications or interdisciplinary collaboration. The Taskforce does not favour a rigid program structure for CSIRO waste research, bearing in mind its sector-specific character, but improved communication and contacts across Divisions.

The Taskforce recommends:

- . that waste management research continue to be funded as a priority area within the CSIRO Research Priorities Exercise over the period to 1994/95.
- . the Executive Committee form a committee comprised of the Chiefs of Division of Water Resources, Chemicals & Polymers, Building, Construction & Engineering and a SIROTECH representative to coordinate research for the water and sewage industries and develop a marketing approach for Asian and other export markets. (Secretariat support for Group to be provided by participating bodies)
- . that CSIRO waste management research be more strongly networked. This would include development of coherent business planning, where appropriate, and an internal/external communication strategy - inter alia it would involve production of a newsletter on current approaches and technologies available within CSIRO. (Institute Director or nominee to effect, with Institute Office support).

KEY DISCRIMINANT QUESTIONS



How will new technology give research "customer" a competitive advantage?

How will the new technology affect the industry structure and performance?

How will the research outcome contribute to increased productivity/sustainability of the target industry?

What is the amount of avoided damage that could potentially result from the research outcome?

What is the enhanced social amenity, and health and safety improvements that could flow from the research outcome?

What are the incentives for adoption of the research outcome, by either commercial enterprises or the public sector?

Does the research "customer" have the necessary end-user relationships to compete?

Can new technology be protected by patent?

Will the "window of opportunity" close before benefits can be realized?

How far are we from the physical and technical limits?

What are prospects for new developments, breakthroughs?

How do our research skills compare with those of similar efforts elsewhere?

How does the level of resource commitment compare with other research organisations?

ANNEX 2

KEY PLAYERS IN AUSTRALIAS WASTE INDUSTRY

Waste Producers

- Aluminium production
- Chemical Industry
- Hospitals
- Intensive Rural Industries (Abattoirs, Canneries, Feedlots, Piggeries, Tanneries, Wineries, Wool Scourers, other processors of agricultural products)
- Irrigation
- Manufacturing Industry
- Minerals and Energy Resources Industry
- Motor vehicles
- Municipal councils
- Paper/pulp industry (primary and recycled)
- Petroleum and Coal miners/processors/producers
- Water & Sewage Boards

Some examples of major producers are: BHP, ICI, Caltex, Warkworth Mining, Costain Australia, Greenleaf, Blue Circle, Sulphide Corporation, ADI, Peko-Wallsend, Elders Resources, Pancont mining, North Broken Hill, CRA, Comalco, Placer Dohme Inc, Alcan, Metals Exploration, Bougainville, Western mining, Battle mountain, Nth Kalgurli mines, Homestake gold, Oakbridge, Costain Aust, Bligh Coal, Muswellbrook Energy, Energy Res of Aust, Woodside Petroleum, Santos, Aust Gas Light Co, Weeks Petroleum, Bridge Oil, CIG, Incitec, Gibson Chemicals, Australian Chemical Holding, Goodman Feider, Arnotts, BTR, Pacific Dunlop, Amcor, Hitek, Mitsubishi, Fletcher Challenge, CSR, Caltex, Shell, Ampol, BP, Esso, Mobil, Unilever, Colgate, Bunge, Pasminco, Coal & Allied, Rechitt & Coleman, etc

Waste Treaters

- Above producers
- Fertiliser manufacture
- Local councils
- Mining companies
- Public water authorities
- Recyclers of paper, glass, tyre, oil and plastic
- State water boards
- Waste management authorities

Some examples of Treaters are: Visyboard, Smorgans, Simsmetal, Amgrow, Comalco, SEPA, Vaqua, ProMinent & Fluid Controls, Permutit-Boby Australia, Nearartic, BTR (ACI), Burwell, Cryogenic Crumb Rubber, ICI Plastics, National Waste Co, Pratt Group, Scholer Incineration, Siddoms Ramset,

Regulators

- Dept of Environment and Heritage
- Dept. of Health
- Dept. of Primary Industries
- EPA

- Federal Cabinet
- Local councils
- Murry Darling Basin Commission
- SPCC
- State Government
- State mines dept
- Water Boards

Consultants/Contractors

- ADI
- Amdel Environmental Services
- ANSTO
- Australian Chamber of Manufacturers
- BHP engineering
- Biocycle
- Brambles (Cleanaway)
- Cambell Environmental
- Camp Scott Furphy
- Collex
- Coopers & Lybrand
- Davy McKee
- EMIAA (Enviromental Managers Industry Association)
- Envirocycle
- Envirosciences
- GCEC
- Geo & Hydro Consultants
- ICI engineering
- Jancassco
- Kinhill
- Lohning International Group
- Maunsell
- Minproc
- Pacific Waste
- Philcor
- PPK Consultants
- Simsmetal
- Sinclair Knight & Partners
- TEEMA
- TNT
- Trans Waste
- Waste Management Liquid Waste Services

Technology Suppliers (AWWA magazine has listing of wastewater companies)

- ABB Kent Taylor
- Austep
- BHP
- CRA
- IBM
- ICI
- IMA
- Memtec
- SEPA

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
WOOL & TEXTILES			
Mordant Dyeing (IAPP)	Reduction of the total amount of chromium wool dyeing effluent from suitable process modifications systems.	Wool dyeing industry.	\$260K
Pesticide Removal from Wool Products (IAPP)	Development of technology to minimise the presence of pesticide residues in wool products.	Pharmaceutical companies	\$370K
Insectproofing (IAPP)	Establish new principles of mothproofing which avoid the production of polluting effluent by either product replacement or by modifying current processes to reduce waste discharge.	Wool textile processing industry.	\$760K
Wool Silver Shrinkproofing (IAPP)	Development of improved processes for continuous shrink-resist treatments for wool silver which minimise environment threats from process effluents. Pilot scale trials are being conducted in collaboration with the International Wool Secretariat in England.	Wool textile processing industry.	\$1100K

ANNEX 3

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Scour Waste Disposal (IAPP)	Development of a holistic approach to the treatment of wool scour effluent and subsequent disposal of solid and semi-solid waste produced during the scouring process. Several pilot plants have been built and are being assessed by local industry.	Wool scouring industry.	\$890K
Environmental Tracking Project (IAPP)	Determine the occurrence and persistence of trace contaminants present in scour effluent treatment processes. After risk assessment, to determine optimum methods of risk reduction by suitable waste management strategies.	Wool processing industry, sewage authorities.	\$440K
Characterisation of Wool Dust (IAPP)	Identify appropriate analytical methods to determine the nature, concentration and size distribution of dusts emanating from different wools and processing routes. This data will be used as the basis of a program to initially assess and reduce if necessary the health risk or airborne dusts in commercial wool processing environment.	Wool processing industry.	\$80K
HIDES			
Hide Processing Technology (IAPP)	Modification of the processing of cattle hides and woolly sheepskins to reduce the impact of tannery effluent on the receiving environment. Several modified processes are being commercialised at present.	Tanning industry.	\$360K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
PULP & PAPER			
Bleached Kraft Pulp Mill Effluent (IPPP)	Reduction of organo chlorine emissions from bleached Kraft pulp mills eucalypt resource. The project has three components: extending pulping to reduce need for chlorine bleaching, alternative technologies chlorine, and effluent characterisation.	Pulp industry, external funding	\$500K
Waste Paper in Paper and Other Products (IPPP)	Research into addition of waste paper to existing paper and other uses etc. buikling and horticultural products.	Pulp and paper industry	\$130K
TIMBER INDUSTRY			
New Timber Preservatives and Glues (IPPP)	Alternatives to copper-chrome-arsenic wood preservatives and phenolic resins are being investigated to minimise disposal of off-cuts and shavings from treated timber.	Timber industry	\$500K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Sawmill Wastes Used for Activated Carbon Production (IPPP)	Sawing hardwood logs produces only a 50% yield of sawn timber and often wastes are incinerated. Research to co-produce heat and charcoal from sawmill residues using fluidised bed technology. (The heat is used in timber drying). It has progressed to the stage of producing highly priced activated carbon to be used to replace imported product used in gold extraction. Some pilot plant work has been undertaken.	Sawmill industry	\$300K
Use of Small Forest Trees and Poor Quality Logs (IPPP)	Research on making composite materials from thinnings and a smaller project aiming to use poor quality but large old growth logs for timber. (The need to make profitable use of smaller and more defective trees is an ongoing research need of the forest products industry).	Forest products industry	\$500K
AGRICULTURE			
Waste Management in Intensive Rural Industries (INRE)	Development of infrastructure such as waste holding ponds and land based applications of wastes, and evaluation of land data set which must be developed for any proposed disposal area. These data will be used in water, nutrient and salt balance calculations to ensure the adequacy of any proposed system within the framework of the climate and nearness to major river systems etc. It will also be necessary to evaluate the	NSW Dept of Water Resources and Sydney Water Board, Murray-Darling Basin Commission, the Lot Feeders Assoc. of Australia, QDPIE, NSW SCS.	\$360K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Waste Management in Intensive Rural Industries (INRE) (cont'd)	possible off-site effects in the event that any of the infrastructure such as waste holding ponds fails. Emphasis will be given to considering wastes as a resource and models will be developed to ensure optimum loading to maximise plant production and minimise nutrient leaching.		
MANUFACTURING			
In Situ Bioremediation (INRE)	Investigation of the extent and persistence of contamination of groundwater and soils from the leakage of petroleum fuels and chlorinated solvents stored in tanks both above and below ground. Study of the natural degradation of individual hydrocarbons both in the field and in the laboratory with heavy reliance on microbiological work. Work is also underway for enhancing in situ biodegradation of hydrocarbons. An off-shoot of this work is the development strategies for tapping methane from sanitary landfills, an issue of increasing commercial importance.	BHP, Atlas, landfill operators and petrol companies.	\$400K
Plasma Waste Treatment (IIT)	Use of electrically generated plasmas for treatment of intractable organic liquid wastes. This novel technology involves high temperature destruction of wastes with potential for superior effectiveness relative to conventional means and development of in-line units operating on-site.	Siddons Ramset and Nufarm Ltd.	\$1300K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Transportable Supercritical Fluid Extractor for Soil Treatment	Development of a commercial prototype for the cleanup of hydrocarbon contaminated soils using supercritical fluid extraction. The unit is designed to be transportable from one site to another. In this process, the contaminants are stripped the soil, concentrated on primary and secondary adsorbents, and then transported off-site for disposal or destruction.		\$630K
MINING & MINERALS			
Slags for Safe Disposal of Toxic Metals	Develop methods that lock this toxic metal materials in an inert matrix so that disposal may be carried out safely ensuring long term stability. Toxic metals such as As, Sb, Pb, Zn, Cd, Hg & Se are an increasing problem as environmental pressures mount and some newer ore bodies are treated. Dumping at sea and storing in dams is an unsatisfactory solution and will not be possible for much longer.	Mining industry.	\$40K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Improved treatment of fine tailings from Mineral Processes, including Red Mud	Research into treatment of tailings waste notably red mud from alumina processing with a view to recovery of soda which is a major contributor to mud problems. Soda is a fully imported reagent into Australia and at present vast amounts are consumed and discarded by the alumina industry (of the order of \$500m per year). It is technically feasible to recover the soda but it is not economically viable at present.	Mining industry.	\$550K
Mineral Processing	Investigation into waste minimisation/prevention in upgrading of mineral sands.	Mineral processing industry	\$300K
Alternatives to Sulphur Dioxide - Emitting Processes in the Gold Industry	Development of alternative processes to the roasting of pyritic ores which produce SO ₂ emissions to recover gold from refractory gold ores. Electrochemical Mediated Slurry Oxidation (EMSO), shows potential for dissolving arsenopyrite under ambient conditions of temperature and pressure and has the potential to produce sulphur as a by-product.	Mining Industry	\$570K
ENERGY & RESOURCES SUPPLY			
Methane Drainage Technologies for Waste Gas Utilisation & Greenhouse Emission Control	Methodology being developed to drain methane from coal seams and collected into a pipeline system for combustion & recovery of energy.	Coal, energy industry	\$150K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
ENERGY & RESOURCES SUPPLY			
Methane Drainage Technologies for Waste Gas Utilisation .	Methodology being developed to drain methane from coal seams and collected into a pipeline system for combustion & recovery of energy.	Coal, energy industry	\$150K
Electrostatic Precipitation Cleaning of Power Station Gas (IMEC)	Research into the operation of electrostatic precipitators collecting the flash in pulverised coal-fired power stations burning Australian thermal coals and to extend the use of electrostatic precipitators to advanced power cycles.	Coal producers and electricity generating authorities.	\$500K
Leaching of Disposed Ash from Power Stations	Investigation if ash from various coalmines/power stations for propensity to release toxic elements as part of development the most appropriate disposal strategy. Ash from power stations represents a very large and continuous waste stream requiring disposal. Contact with water in the environment leaches out toxic that contaminate groundwater, surface waterstand sediments.		\$50K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Aqueous Emissions from Power Stations & Impact on Receiving Waters & Sediments	Investigations on the mechanisms of release and transport of pollutants in order to develop management strategies to minimise the discharges and remediate already contaminated aquatic system. Power station operations discharge pollutants to rivers lakes & estuaries from coal stockpile runoff, cooling waters and leachate from ash disposal sites.		\$200K
Briquetting to Utilise Coal Fine & Biomass Otherwise Disposed of as Waste	Briquetting is applicable to a wide variety of source materials of low & moderate cost, including waste materials. Process development covering briquetting technologies, product and combustion/utilisation characteristics.		\$205K
SEWAGE & WATER TREATMENT			
Wood-Production Plantations for Land re-use of Effluent (IPPP)	Examine the effectiveness and sustainability of plantations for absorbing nutrients, transpiring large volumes of water, and achieving high growth rates when irrigated with secondary-treated municipal effluent. (Need to minimise the contamination of waterways with nutrients while producing marketable wood).	Local government, effluent treatment regulators. Partnership with NSW Public Works Dept. and Wagga Wagga City Council. Sponsorship by LWRRDC and Basin Commission.	\$750K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Land Application of Wastes (IPPP)	The project incorporates fundamental process studies, field-scale waste disposal research and extension to solve particular land application problems. The major focus is the improvement of guidelines and management practices of the productive and sustainable land application of wastes. Emphasis is on the efficiency of treatment of the waste ie. the ability of the soil-plant system to retain or recycle contaminants.	Waste producers, waste regulators & consultants.	\$200K
Artificial Wetlands Treatment (INRE)	Investigation of the chemical biological and physical processes which influence the rhizospheres of various macrophytes in wetlands in the development of an alternative sewage treatment process. Pilot studies are being carried out at Coffs Harbour and elsewhere in Eastern Australia. There has been considerable interest generated in this project water authorities by councils, feedlot developers and private householders.	C. Cassegrain & Co. Coffs Harbour City Council, Hastings Council. The Sydney Water Board is interested in undertaking collaboration.	\$500K
Coagulation Processes (IIT)	Development of colagulation processes based on the use of magnetite or other coagulants for applications in the treatment of potable water and domestic and industrial wastewaters. A pilot plant for sewage treatment using magnetic particle technology has been proven under extended trial at Malabar NSW, and is to form the basis for the construction of an intermediate stage 5Ml/day plant there by the Sydney Water Board.	Davy McKee	\$90K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Flotation Treatment (IIT)	Application of the principles of colloid and surface chemistry to the development of new processes for the treatment of waters and wastewaters, especially flotation processes in relation to the removal of organic contaminants.	BHP (Under the BHP/CSIRO MOU) and Australian Wool Corporation	\$530K
Adsorption Processes (IIT)	Development of adsorption processes based on the use of polymers, including magnetic polymeric microparticles for application in product recovery and in purifying industrial wastewaters. The technology in Australia is unique to CSIRO with potential demonstrated for metals recovery from waste streams and in treating electroplating rinsewaters to ensure acceptable disposal of effluents.	ICI	\$470K
Biological Processes (IIT)	Utilisation of microbial reactions for removal of nutrients from sewage and industrial wastewaters without the use of chemicals, to allow for inland effluent disposal. Developing of anaerobic processes for the treatment of industrial effluents. For nutrient removal, the competing processes for P and N removal are not achieving performance criteria in Australia.	BHP and MMBW.	\$1060K

<u>RESEARCH TITLE</u>	<u>DESCRIPTION</u>	<u>END USER</u>	<u>RESOURCES</u>
Slotting for Sewage Sludge Disposal (INRE)	Development of slotting technology to improve degraded soils by deep incorporation of dry sewage sludge to depths of up to a metre. As much as 300 tonne per hectare of sewage sludge can be incorporated into soils in this way. This technique of land disposal offers great advantages over the more traditional techniques of involving injection of slurries which lead to soil degradation and often considerable run-off of contaminants as well as locally very high concentrations of heavy metals. Field trials are now being undertaken in several locations.	Sydney Water Board, Hunter Water Board, GC Cassegrain/CASSIRO.	\$300K
Environmental Applications of Caustic Magnesia (IMCC)	Research into use of caustic magnesia in effluent treatment. Involves investigation of processes by which the sludges form, and by which they remove heavy metals. A better understanding of the chemistry involved will allow a more effective use of starting material and extend to a wider range of effluents. Caustic magnesia possesses surface properties that result in the production of dense sludges that are easy to filter. The deposition of heavy metal contaminants, indicating that heavy metals can be removed from effluents by passing them through beds of magnesia.		500k

x Botes

CSIRO
INSTITUTE OF INDUSTRIAL TECHNOLOGIES
Canberra Office

☎(06) 276 6103 Fax (06) 276 6410

TO : Dr Tony Priestley /Dr Tom Spurling (03) 543 8160
FROM : Garrett Upstill, Manager,
Policy, Planning & Evaluation
DATE : 12 June 1992
SUBJECT Waste Management Priorities Bid

The current state of funding of waste management research under the priorities process is as follows, I believe:

Round I: Recurrent Annual funding beginning 1/7/91

Wool Scouring \$160K
Plasma waste disposal \$160k
Effluent-Irrigated Wetlands \$286K recurrent

Round II: Recurrent annual funding beginning 1/7/92

Sulphate wool processing effluent \$165K
Coagulants from Water and sludge \$184K
Fixing of Heavy Metals \$100K
Constructed Wetlands \$147K

Non recurrent funding

Caustic Magnesia \$95K
Soil Slotting \$314K
In situ biotreatment \$123K
Plasma destruction of Halons \$140K

Note: I understand the non recurrent funding is for two years, ie 1992/93 and 1993/94, (confirmed by INRE) but this has to be 100% confirmed.

Also attached is draft format for the 2-3 pagers for 1 July EC meeting plus a model.

Note that it is expected about 8-9 proposals will be funded from \$4.5m pool available for recurrent funding from 1992/93. The July EC will distil some 12 or so proposals from an expected 25-30 bids; these will be brokered into detailed proposals over the following three months.

**PROFORMA FOR 1993-94 PRIORITIES RESEARCH PROPOSALS -
RECURRENT FUNDING**

RESEARCH PROPOSALS FOR CONSIDERATION BY EC AT THE JULY WORKSHOP

1. SEO SUB-DIVISION

2. SEO GROUP

3. RESEARCH TITLE

4. RESPONSIBLE DIRECTOR

5. PROPOSED BROKER

6. PROPOSED PARTICIPANTS (*CSIRO participants and external collaborators*)

7. MAJOR OBJECTIVE/KEY OUTCOMES

8. BACKGROUND

9. ATTRACTIVENESS OF THE RESEARCH PROPOSAL

- Potential Benefits
- Ability to Capture

10. FEASIBILITY OF THE RESEARCH PROPOSAL

- R&D Potential
- R&D Capacity

(From note by John Stoker
to Institute Directors - sent on to chiefs)

PRIORITIES CRITERIA

SOME KEY DISCRIMINANT QUESTIONS

POTENTIAL BENEFITS

- * what industry will benefit from successful research. How will the "customers" benefit.
- * what is the size of the potential markets in Australia and overseas.
- * are there any other important benefits - environmental (damage avoided), social (social amenity, health and safety)

ABILITY TO CAPTURE

- * how will successful research be captured in Australia what is Australia's ability to exploit the results.
- * are there potential commercial partners.
- * what are the incentives/imperatives for adoption by the commercial or public sector.
- * can Australian users compete internationally.

R&D POTENTIAL

- * how close are the physical and technical limits in this field of research.
- * is the field mature or developing rapidly.
- * what are the prospects for developing commercially valuable intellectual property, breakthroughs
- * what are the prospects of achieving technical success within a reasonable timeframe.

R&D CAPACITY

- * would the proposed team be internationally competitive in the field (in terms of quality of researchers and critical mass of research team).
- * what is CSIRO's competitive edge.
- * is the area relevant to CSIRO.
- * does CSIRO have the capacity to deliver the R&D (skills, facilities, timeframe for effective application).

RESTRICTED

DRAFT

PLEASE DO
NOT COPY

DIVISION OF APPLIED PHYSICS

1993-94 CSIRO PRIORITIES RESEARCH PROPOSALS:
RECURRENT FUNDING

• BIOSENSOR TECHNOLOGY

1. SEO SUB-DIVISION

Manufacturing Industries

2. SEO GROUP

Processed food products and beverages (0501) 50%
Instrumentation (0514) 50%

3. RESEARCH TITLE

'Biosensor Technology'

4. RESPONSIBLE DIRECTOR

Dr C.M.Adam (IIT)/Dr A.D.Donald (IAPP)

5. PROPOSED BROKER

Dr J.T.A.Pollock (DAP), ?

6. PROPOSED PARTICIPANTS

CSIRO:	Applied Physics	- IIT
	Food Processing	- IAPP
	Chemicals and Polymers	- IIT
	Plant Industry	- IPPP
	Biomolecular Engineering	- IIT
	Animal Health	- IAPP

External:	AMBRI Consortium	- Nucleus (Pacific Dunlop)
		- AWA
		- Bioclone
		- MEMTEC

Other companies have been identified but are yet to be approached.

7. MAJOR OBJECTIVES

Preamble:

The \$15 billion world market for sensing and diagnostic technologies includes health care \$9.0 billion, food processing \$4.8 billion, other \$1.2 billion. Of this total biosensors currently account for about \$900 million and are expected to rise to an estimated \$2.4 billion by the year 2000 (DITAC Sensor Technology Report 1990).

CSIRO is currently developing biosensors in two separate projects, based on molecular sensing using gated ion-channel transduction (AMBRI consortium) and Surface Acoustic Wave/Enzyme-Linked Immunosorbent Assay (SAW/ELISA) technologies.

Many problems and challenges are common to both approaches and this proposal is aimed at providing a base of technology in support of both groups.

Objectives:

The proposed program will focus on biomolecular detection and transduction, with particular emphasis on the development of solid-state thin-film transduction devices and associated electronics (DAP, DCP) in close collaboration with biochemists (DFP, DPI, DAM and DBE).

Planned Outcomes:

- Short term (1 year) - medium sensitivity SAW and piezo-electric prototype devices
- Medium term - medium sensitivity gated ion channel prototype devices
- Long term - high sensitivity SAW, piezoelectric and ion-channel devices

Devices aimed at a wide range of chemicals (e. g. phomopsin in lupins, organophosphate residues, peptide hormone, glucose, amino acids, antibodies, phenols) of importance in the agricultural, medical, environmental monitoring and food processing industries will be developed.

8. BACKGROUND

The AMBRI work is carried out within a consortium of the CSIRO Divisions of Food Processing and Applied Physics and the Australian companies, AWA, Bioclone, MEMTEC and Nucleus (Pacific Dunlop). It has recently become the major partner in a successful second round CRC, "The Centre for Molecular Engineering and Technology".

The AMBRI gated ion-channel sensor technology operates on similar principles to the signalling mechanisms found within cell membranes. The sensing components, however, are principally synthetic or modified biological extracts. Selective attachment of an analyte alters ion flow, providing an output signal.

SAW/ELISA biosensors are specialised electronic chips which are coated with antibodies, chemical receptors developed in the immune system of a mammal or developed synthetically. The electrical output from the chip is changed when a specific analyte is attached to the antibody layer modifying the characteristics of an acoustic wave propagating in the surface of the chip.

The SAW/ELISA project was established in 1990 and involves 25 scientists (16-person-years per annum) from the CSIRO Divisions of Applied Physics, Food Processing, Plant Industry, Chemicals and Polymers, Biomolecular Engineering and Animal Health. The project has avoided commercial involvement in the first instance to improve its position with respect to intellectual property, but is now ready for more formal management and collaboration with one or more industrial partners.

These two groups are investigating different basic transduction mechanisms: surface acoustic wave (SAW) and ion-channel gating. They have in common many areas of device fabrication technology and synthesis of molecular thin films.

9. ATTRACTIVENESS OF THE RESEARCH PROPOSAL

- Potential Benefits

Biosensors developed in this program will find application in the food, agricultural, medical and environmental protection industries in the detection of low concentrations (parts per billion) of contaminants.

The world market for in vitro medical diagnostic and sensing devices exceeds \$9 billion per annum. Australia has an opportunity to build a sophisticated export industry in this area, based on a new generation of technologies utilising biomolecular recognition and electronic detection and signal processing in miniaturised, portable devices.

Similarly the use of biosensors in the food processing and agricultural industries is expected to achieve a market of \$5 billion per annum. Many specific tests are needed to address this market. For example, the detection of phomopsis in lupins would require 100,000 - 150,000 tests per year to regulate Australia's one million tonnes of crop, and would generate \$1.5 million per year assuming development of a \$10 field test usable by non-technical staff.