SOUTHERN METROPOLITAN COASTAL WATERS STUDY (1991-1994)

SUMMARY REPORT

Perth, Western Australia
November 1996

Department of Environmental Protection
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Perth, Western Australia 6000

Department of
Environmental Protection

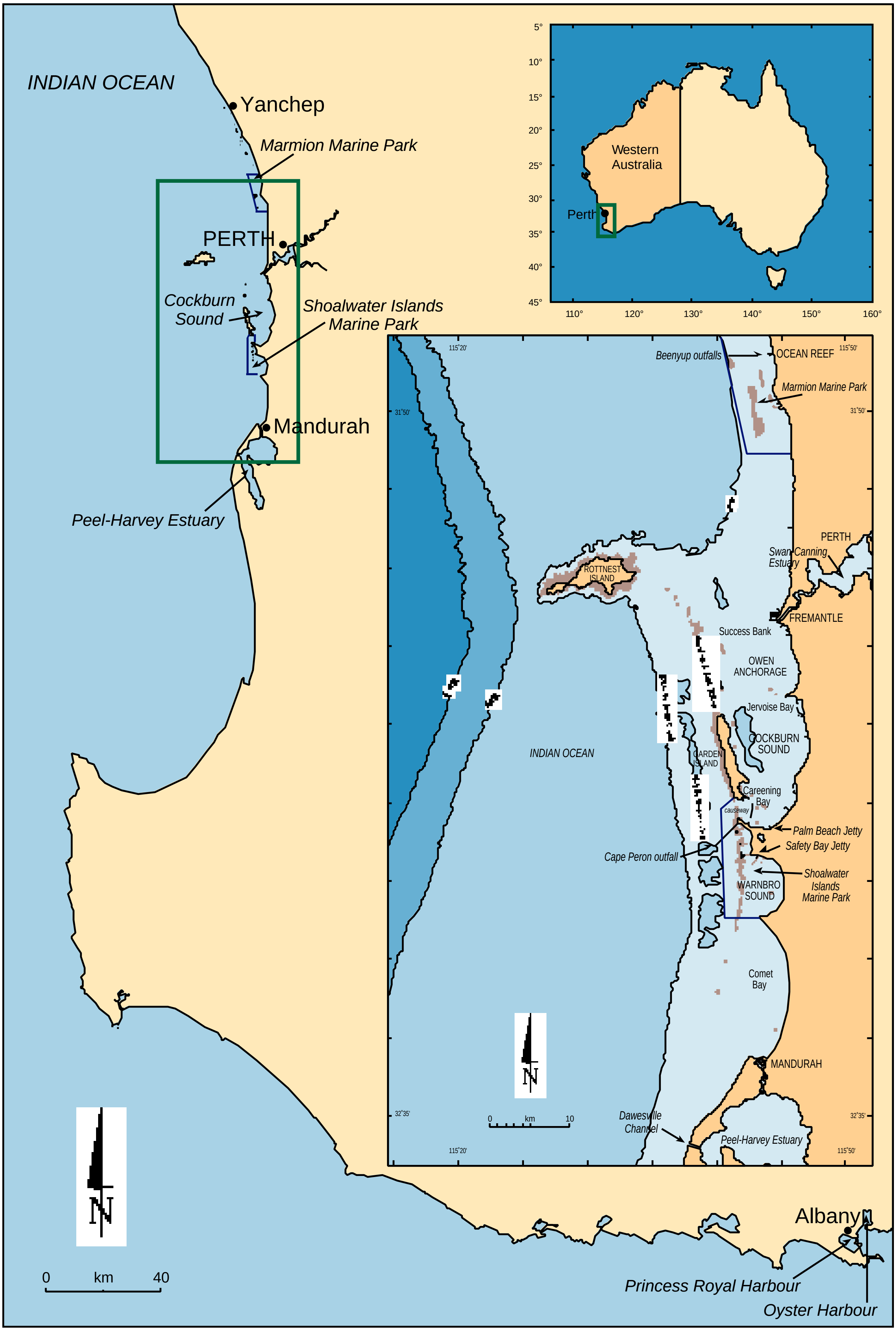

Figure 1. Location map

Introduction

West Australians love the beach. We love to swim, fish and play in the clear blue waters along the coast. In fact, more than 70 per cent of this State's entire population lives within 20 km of the metropolitan coastline — making our beaches some of the most used and 'valued' in the world.
Our beaches and coastal waters are already under pressure, and Perth's population is expected to increase by more than 50 per cent over the next 30 years. With the increasing number of people comes an increase in pressures on our coast from expanding urban and industrial developments and more recreational activity.

The most severely degraded marine area around Perth is Cockburn Sound (Figure 1). It was contaminated with heavy metals and had lost most of its seagrass meadows due to nutrient discharges that started in the mid-1950s. A major study in the late 1970s identified the causes of the problems in the Sound and a management plan was put into action to fix them. Management was initially successful in reducing waste discharges and the level of heavy metal contamination and nutrient-related algal blooms, but monitoring during the 1980s showed a gradual decline in water quality associated with increasing nutrient loads. This highlighted the need to improve the knowledge base and then to implement a more far-reaching approach to waste management issues in Western Australia's marine environment, and more specifically in Cockburn Sound.

The Environmental Protection Authority (EPA) recognised these current and potential pressures and realised that an improved understanding of the long-term environmental implications of waste inputs to our coastal waters was urgently required.

In response to this, the EPA asked the Department of Environmental Protection (DEP) to undertake a four-year comprehensive study of Perth's southern coastal waters. In mid-1991, work started on the Southern Metropolitan Coastal Waters Study (SMCWS).

Around the same time, the then Water Authority of Western Australia (WAWA - now the Water Corporation) wanted to build a second domestic wastewater ocean outlet off Ocean Reef, discharging into the Marmion Marine Park. This increased capacity was needed to cope with an increasing volume of domestic wastewater associated with the urban expansion to the north of Perth.

The EPA found that the implications of current and proposed domestic wastewater disposal practices on the long-term health of the northern coastal waters were unclear and requested that the WAWA address this information gap. Given the predicted population growth to the south of Perth as well, and that over 95 per cent of Perth's treated domestic wastewater is discharged to the ocean, the EPA also asked the WAWA to work toward developing an environmentally acceptable long-term strategy to cope with all of Perth's growing domestic wastewater disposal requirements into the next century.

As a result, the WAWA initiated a set of studies which included an investigation of alternatives to ocean disposal of wastewater and the Perth Coastal Waters Study (PCWS) which focussed on gaining a better understanding of the current and long-term consequences of domestic wastewater discharges to Perth's coastal waters in general and with particular focus on the northern metropolitan waters.

So, while the SMCWS focussed on the southern waters and waste inputs from a wide range of sources including industrial, groundwater, estuarine and shipping; the PCWS focussed on the northern waters and the effects of domestic wastewater inputs.

The SMCWS and the PCWS are complementary studies which together serve to identify both current and potential problems, and address ways we can all work together to protect our coastal waters from Yanchep to south of Mandurah in the long-term.

This summary report will briefly outline the findings of the SMCWS. More detailed information is contained in the SMCWS Final Report (DEP Report 17, 1996) and supporting technical reports. Information on the PCWS and associated studies can be obtained from the Water Corporation.

Southern Metropolitan Coastal Waters Study

The SMCWS was initiated by the EPA to address the increasing threats to the environmental quality of the coastal waters from Fremantle to Mandurah. Particular emphasis was placed on the ‘core’ areas of Cockburn Sound, Owen Anchorage and the Shoalwater Islands Marine Park, including Warnbro Sound.

The study sought to provide a clearer understanding of the present state of the coastal waters in relation to waste discharges and to identify, as far as possible, the long-term ecological consequences of projected future discharges.

In very general terms, the SMCWS found that the southern metropolitan coastal waters of Perth are in ‘close to pristine’ condition except for areas of Cockburn Sound, eastern Owen Anchorage and in the vicinity of the Cape Peron wastewater outfall and the estuarine entrances.

Findings

The studies identified several important issues which are summarised below.

Nutrient inputs, water quality and seagrass health

A large part of the research was aimed at assessing the effects of nutrient inputs to the southern coastal waters. This involved physical, chemical and biological water quality monitoring of the ‘core’ areas coupled with studies aimed at better understanding the key ecological processes that link nutrient inputs to ecosystem health (see page 4).

Research on the wider metropolitan coastal waters found that during high river-flow periods in winter, the Peel-Harvey and Swan-Canning estuary outflows were spread widely (Figure 2) and elevated the seawater nutrient concentrations over much of the near-shore study area. The export of nutrients from the land-catchments of these estuaries to the ocean is estimated to have increased about 4-fold over the last 50 years.

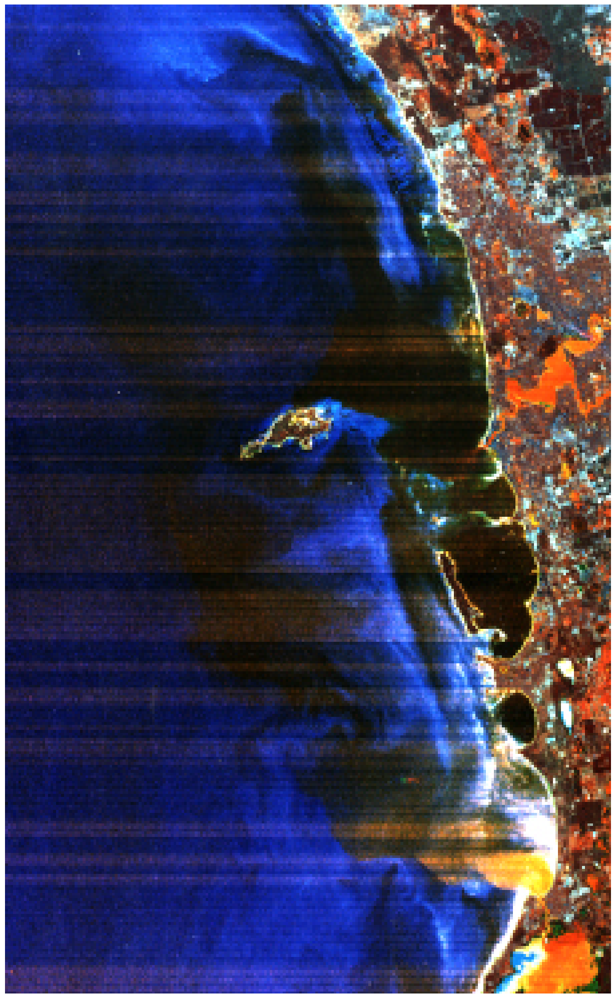

Figure 2. Satellite image of Perth’s coastal zone showing the wide-spread distribution of ‘stained’ water discharged from the Swan-Canning and Peel-Harvey estuaries.

The phytoplankton and zooplankton of Perth’s coastal waters during summer are typical of temperate coastal waters around Australia and have remained largely unchanged since the late 1970s. In contrast, the make-up of the plankton communities in winter is unusual and appears to have changed; the phytoplankton is now dominated by a ‘silicoflagellate’ (Figure 3) and the zooplankton by an unusual ‘radiolarian’. These species are not considered toxic or harmful but are highly unusual and in northern European waters the gradual increase in occurrence of a closely related silicoflagellate has been linked to gradual and broad-scale nutrient enrichment.

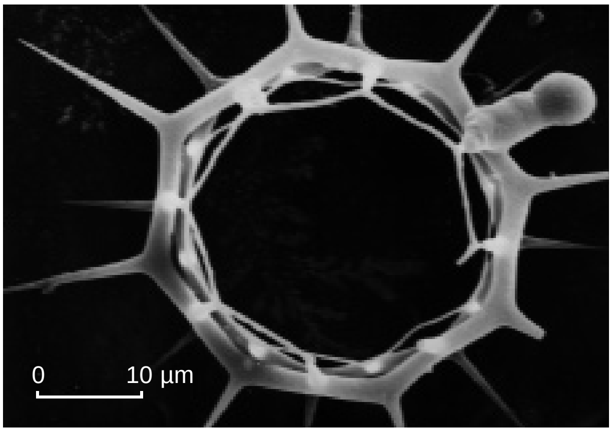

Figure 3. Scanning electron micrograph of the 'unusual' silicoflagellate, Dictyocha octonaria which dominates the phytoplankton of Perth's coastal waters during winter. (Photograph: J. John)

Assuming current wastewater treatment and land-use practices continue, projections indicate that annual nitrogen loadings to Perth's coastal waters will increase from 6000 to 10,000 tonnes by 2021, mainly from domestic wastewater disposal and estuarine discharges. The long-term effects of these increases on our marine environment are uncertain and require further investigation but on the basis of the findings of this study it is clear that extreme caution should be exercised in considering further proposals involving nutrient discharge to these waters.

Cockburn Sound

In relation to impacts from nutrients, Cockburn Sound's water quality improved during the early 1980s but is once again approaching the 1970s levels when it was at its poorest state. Although direct industrial discharges of nutrients to the Sound have been significantly reduced in recent years, groundwater sources are now contributing 70 per cent of the total amount of nitrogen entering the Sound from land-based sources. About 80 per cent of the nutrient-enriched groundwater comes from contaminated areas underneath industrial estates (Figure 4) and steps are being taken by industry to treat the contaminated groundwater.

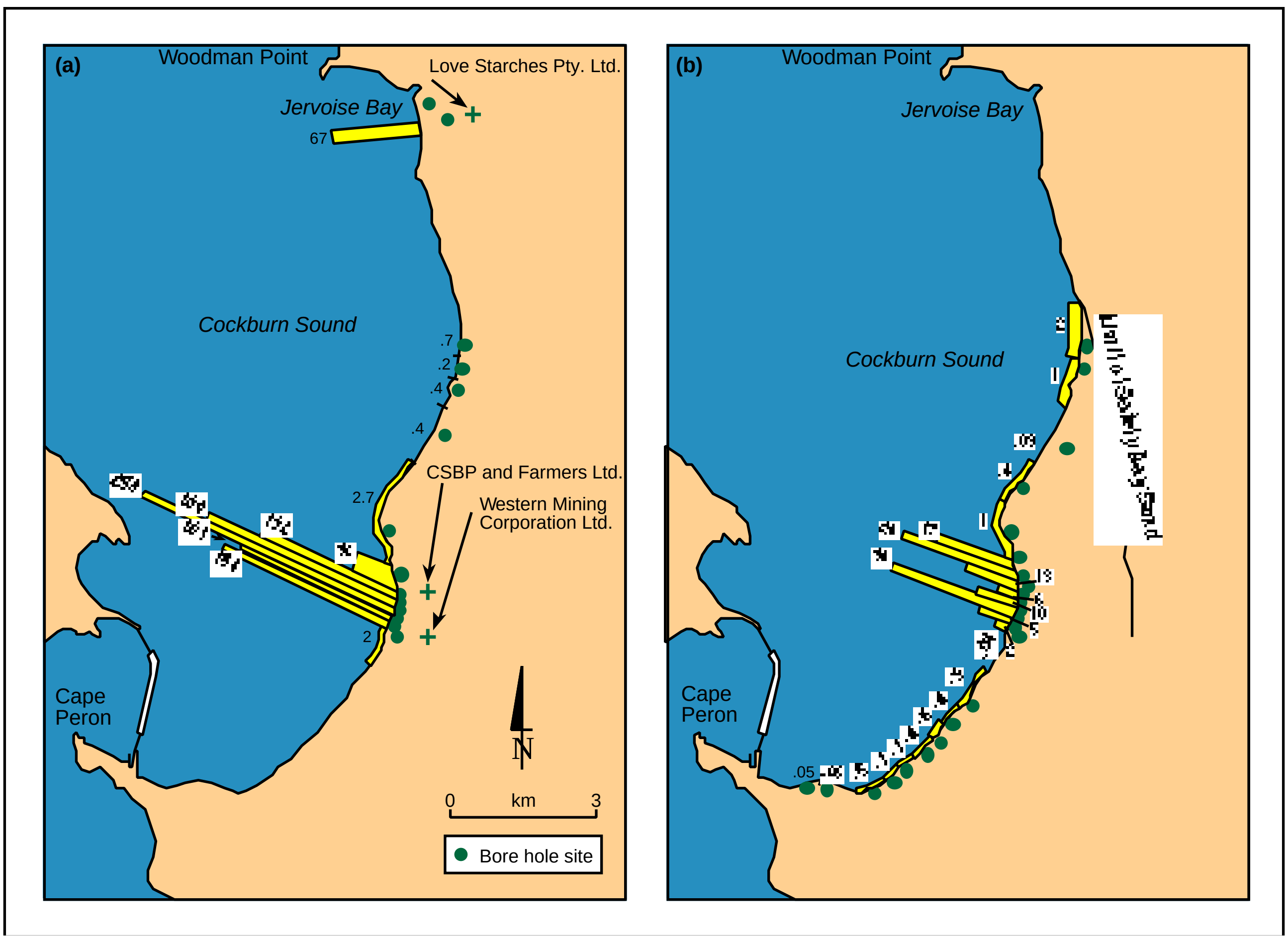

Figure 4. Groundwater nitrogen loads into Cockburn Sound from (a) the Tamala Limestone and (b) the Safety Bay Sand. Loads are in tonnes of nitrogen per kilometre of coastline per year.

Nutrients, light and seagrass — a sensitive relationship

Seagrasses play several important roles in our coastal environment. Among other things, they stabilise the ocean floor and provide feeding and breeding grounds for aquatic animals. Like other plants, seagrasses need sufficient light for photosynthesis to ensure their survival. But once meadows of the large Posidonia seagrasses are lost, they are effectively lost for good because, unlike most other plants, re-establishment is extremely slow and could take many decades, if it occurs at all. Light starvation was responsible for the widespread loss of seagrasses in Cockburn Sound in the 1960s and 70s (Figure 5).

Perth's coastal waters are nutrient-poor and the plants and animals are adapted to these conditions. When excessive amounts of nutrient-rich wastes enter these waters the natural balance is upset; microscopic algae (phytoplankton) can bloom and cloud the water and larger algae (epiphytes) can grow rapidly and coat the leaves of the seagrass. These effects can combine to reduce the amount of light to such a level that the plants are no longer able to photosynthesise and they die (Figure 6).

Research work done in the SMCWS has established the minimum light requirements of seagrasses and the conditions that characterise a clear, healthy water body. Together, these pieces of information form the basis of proposed indicators called "environmental quality criteria" to help managers keep the waters clean and healthy. These criteria or benchmarks provide ecologically-based targets and allow us to judge the performance of programs to manage nutrient loads. By monitoring these indicators, undesirable trends can be identified early and measures taken to restore the health of the water body before the seagrasses themselves become unhealthy or die. This early warning system will help managers and users ensure the long-term health of our coastal ecosystems.

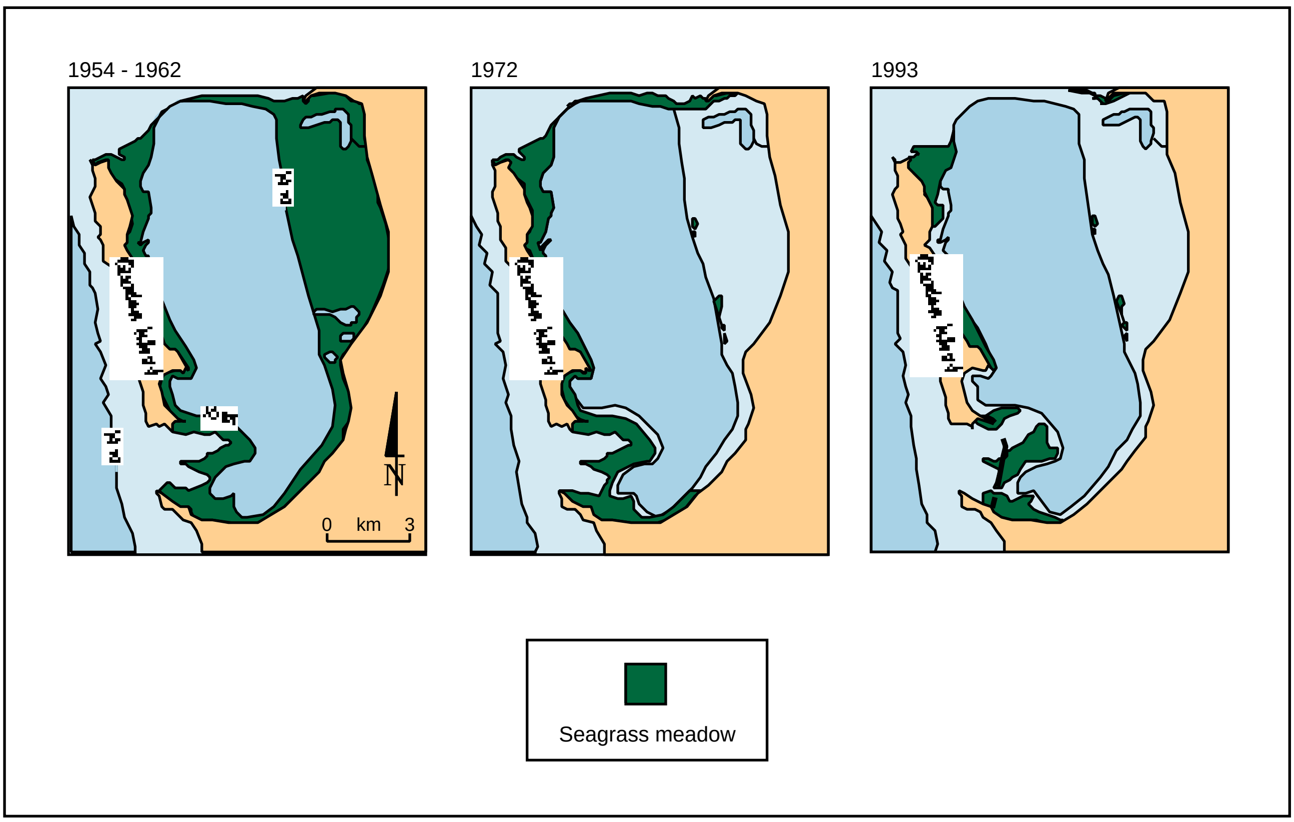

Figure 5. Broadscale changes in the seagrass meadow area of Cockburn Sound from the 1950s to the 1990s.

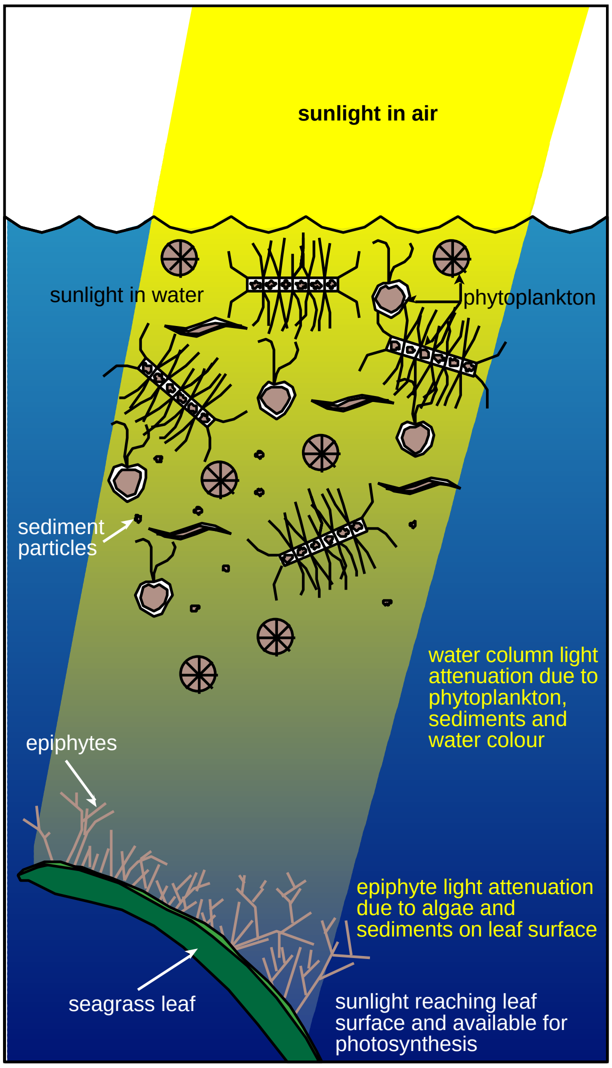

Figure 6. A diagram showing how phytoplankton, sediment particles and epiphytes reduce the amount of light reaching the leaves of seagrasses.

Owen Anchorage

The waters of Owen Anchorage have improved significantly since the 1970s, with the virtual elimination of direct nitrogen input from surrounding industries. Despite this, seagrasses continue to be lost by shellsand mining operations, smothering by mobile sand sheets and, on the eastern side of the anchorage, by nutrient loadings mainly from the Swan-Canning Estuary.

Shoalwater Islands Marine Park

Warnbro Sound water quality is still near-pristine, but nutrient inputs to the sound, brought by ocean currents from the Peel-Harvey Estuary some 30-40 km to the south, may have important implications for the long-term management of the Shoalwater Islands Marine Park. Seagrass meadows in these areas are still in good health.

Sepia Depression

Research on the Sepia Depression concentrated on the area within about five kilometres of the Cape Peron outfall which is the largest single point-source of nutrients in the region. Water flow in Sepia Depression is largely wind-driven but is also constrained by the Garden Island Ridge system to the east and the shallow Five Fathom Bank to the west (Figure 1). In summer, winds are typically from the southeast in the morning swinging to southwest under the influence of the afternoon sea-breeze and so water flow in Sepia Depression is predominantly northward. Water quality monitoring during the summer months found that phytoplankton concentrations were low overall, but generally higher to the north (down-current) of the outfall than to the south. Nutrient loadings from the Cape Peron outfall are expected to increase rapidly over the coming decades unless improved treatment and disposal practices are implemented.

Water quality declined in Comet Bay and along most of Sepia Depression in the winter months due to the influence of outflows from the estuaries.

Dawesville Channel

Nutrient levels are elevated between the Dawesville Channel and the southern part of Comet Bay as a direct result of outflows from the Peel-Harvey Estuary. The effect of nutrient-rich outflows from the Dawesville Channel on marine life is currently unknown.

Toxic contamination

During the study, researchers undertook extensive surveys of pesticides, polychlorinated biphenyls (PCBs), hydrocarbons, organotin compounds and heavy metals in the sediments and edible mussels.

Pesticides, PCB's and hydrocarbons

The concentrations of these substances in sediments and mussels were generally very low throughout the study area, but high levels of some of these substances were detected in harbours and marinas and near wharves and ship maintenance facilities. All mussel samples showed levels well below the proposed ecological and human health criteria. The sediments were relatively uncontaminated with these substances apart from PCBs (at two sites) and the pesticide DDT which was more widespread. In Cockburn Sound/Owen Anchorage DDT was largely confined to harbours/marinas and the vicinity of wastewater outfalls. DDT was more widespread in Warnbro Sound/Comet Bay suggesting it originated from domestic and agricultural practices and entered the coastal waters through stormwater drains and estuarine outflows. An Australia-wide ban on DDT and other organochlorine pesticides has been in place since mid-1995, but DDT does not degrade quickly and will still be found in the environment long after inputs cease.

Tributyltin

Tributyltin (TBT) is the active ingredient of certain marine anti-fouling paints which are used to stop marine plants and animals building up on the hulls of vessels. This substance is extremely toxic to marine life and has been banned in WA since 1992 for use on vessels less than 25m in length.

The SMCWS has found that TBT contamination in sediments and mussels of the study area is widespread with the highest contamination in harbours, marinas and near industrial and naval wharves (Figure 7). TBT concentrations exceeded proposed health criteria in mussels collected from the Fremantle Fishing Boat Harbour, near most of the jetties and wharves in Owen Anchorage and Cockburn Sound, and from near the naval facilities in Careening Bay. This means that there is a risk to human health in eating mussels collected from these areas.

Mussels — the filterers of the sea

Some marine animals feed by filtering seawater through their body tissue to extract small food particles, and in the process can accumulate contaminants in their bodies. These animals are known as 'filter-feeders' and the concentration of contaminants in their flesh provides useful information about the state of contamination of the waters in which they live.

It is often very difficult and expensive to determine the levels of potentially harmful toxicants in the environment from spot samples of seawater because the contaminants are often at low concentrations and difficult to detect and also they can be very patchy in their distribution, depending both on the location of the contaminant source and the variability of water currents with time. A far better option is to test 'filter-feeders' which have been growing in that water body as these 'filter-feeders' have been sampling the water at their growing site on a practically continual basis. In this sense they are natural 'integrators' of water quality and the concentration of contaminants in their flesh is closely related to the level of contaminants in their surrounding environment.

The blue mussel (Mytilus edulis) is common throughout Cockburn Sound and Owen Anchorage and was used in this study as an indicator of the extent of contamination of these waters. An added bonus of testing these animals is being able to compare the results against accepted food standards to determine the level of risk to human health associated with eating shellfish and other seafood collected from these waters.

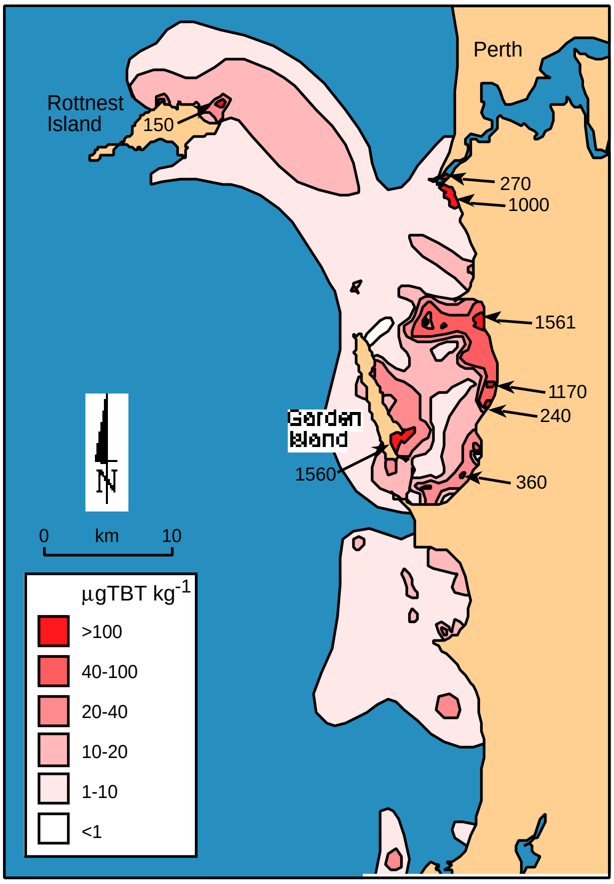

Figure 7. Tributyltin (TBT) in sediments of the southern metropolitan coastal waters of Perth in 1994.

The prevalence of the sexual deformity 'imposex' in marine snails is a bio-indicator of TBT contamination. Imposex was widespread in a common marine snail (called *Thais orbita*) collected from Perth reefs and was highest in the Fremantle/Cockburn Sound region reflecting the location of the major ship mooring areas (Figure 8). The levels of TBT in sediments from these areas are among the highest recorded in Australia.

Since the restrictions on TBT use were put in place for small vessels, tributyltin contamination has reduced slightly in areas only used by small boats. But there are no TBT restrictions on larger commercial vessels and international ships visiting WA ports, and in the areas frequently used by these large vessels, the level of contamination continues to rise. Other than the occurrence of imposex, the ecological significance of TBT contamination in Perth's coastal waters is unknown but clearly this is an issue of extreme concern.

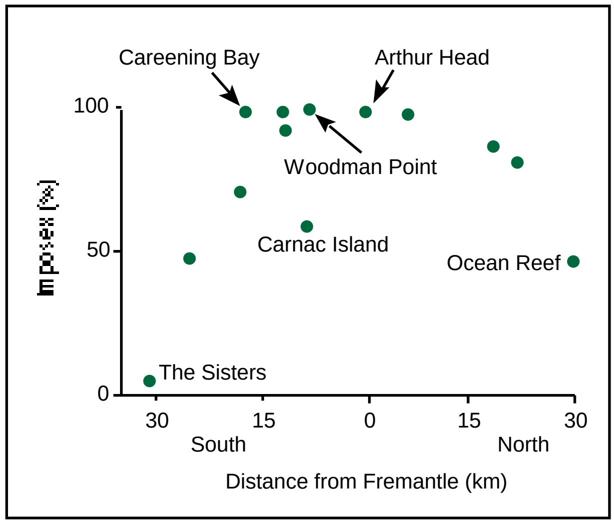

Figure 8. Frequency of the sexual deformity 'imposex' in the marine snail Thais orbita in 1993.

Heavy metals

Heavy metal concentrations in sediments and mussels are generally low, and have decreased significantly in Cockburn Sound and Owen Anchorage since the late 1970s in response to a general reduction in contaminant loads (Figure 9). The concentrations of heavy metals in mussel flesh do not pose a risk to human health. Although the concentrations of individual metals are below levels where impacts on the aquatic life might be expected, there is evidence to suggest that the combination of heavy metals and other contaminants may be working together to have a negative influence on the structure of the animal communities found in the soft-sediment in the deeper parts of Cockburn Sound.

The concentration of zinc in mussels throughout Cockburn Sound and eastern Owen Anchorage was slightly elevated, as were concentrations of arsenic and mercury in sediments. Arsenic was also elevated in Warnbro Sound sediments; the principal source of arsenic to Warnbro Sound appears to be from stormwater drains.

In Sepia Depression, the concentrations of mercury in water exceeded the health guideline for taking of seafood within 1 km of the Cape Peron outfall on occasions, but the nearest sentinel mussels (2 km from the outfall) were within acceptable limits for mercury.

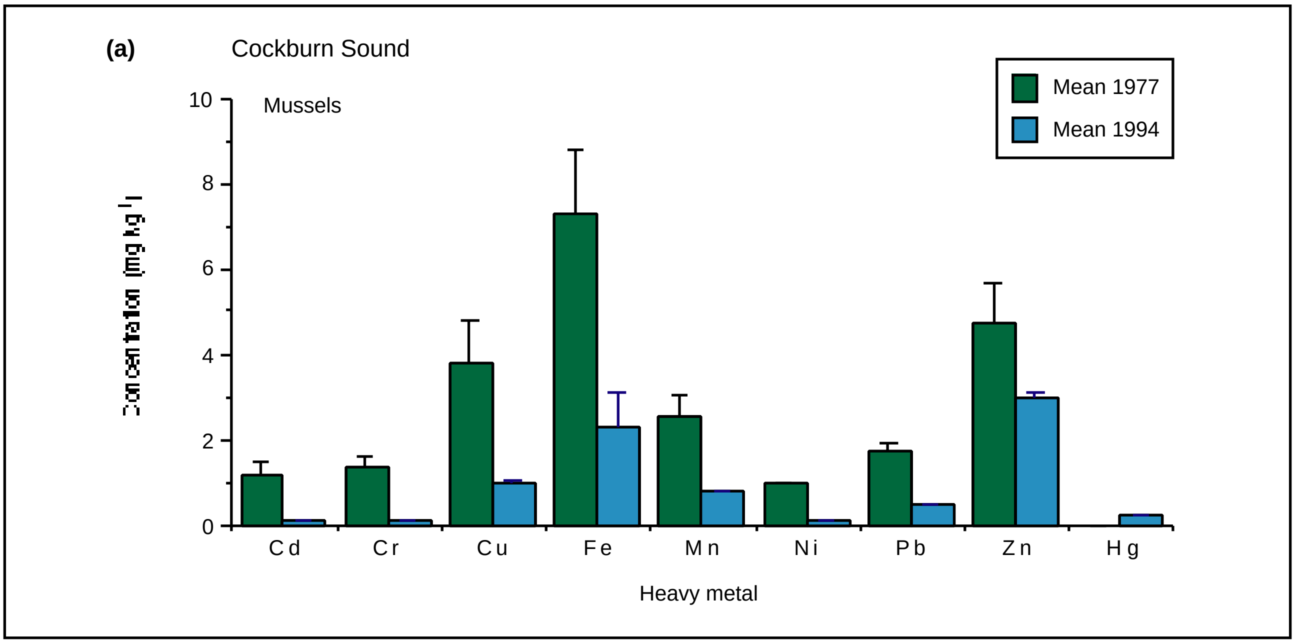

Figure 9. Concentration of heavy metals in mussels collected from Cockburn Sound showing a marked reduction between 1977 and 1994.

Cadmium and zinc in sentinel mussels were elevated at distances up to 4 km from the outfall but concentrations of these metals were still within public health limits.

Microbiological quality of coastal waters and beaches

The study also considered the impact of faecal coliform bacteria on people using the southern metropolitan waters for swimming and for collecting and consuming seafood. Regular monitoring by the Health Department and the City of Rockingham shows that the risk to people who use the beaches for recreational activities like swimming or boating is extremely low.

Bacterial concentrations in the waters off Palm Beach and near the Safety Bay jetty indicate that eating seafood collected from these areas may pose a health risk at times, but elsewhere, there does not appear to be a health risk associated with eating seafood from these waters (Figure 10).

Water Corporation surveys show that faecal coliform concentrations in water in the Sepia Depression are occasionally above human health criteria for swimming and collecting of edible seafood, at distances of up to about two and four kilometres from the end of the Cape Peron outfall respectively.

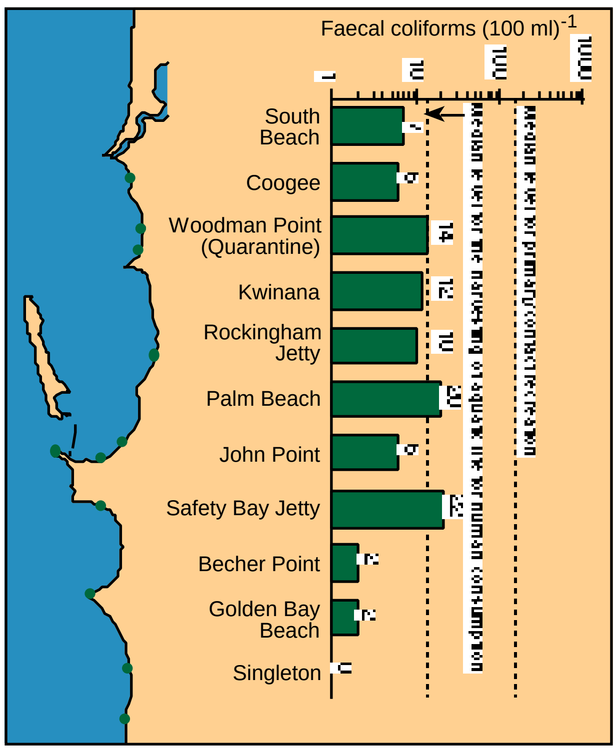

Figure 10. Median faecal coliform levels for Perth's southern metropolitan coastal beaches between 1991 and 1994, compared with guidelines for bathing and collecting edible seafood.

Introduction of foreign organisms

The introduction of foreign organisms was not initially seen as a major focus of the SMCWS, but investigations into filter-feeders uncovered some unwelcome surprises in the form of *Sabella* cf. *spallanzanii* — a highly visible polychaete worm thought to have been introduced from the Mediterranean Sea (Figure 11).

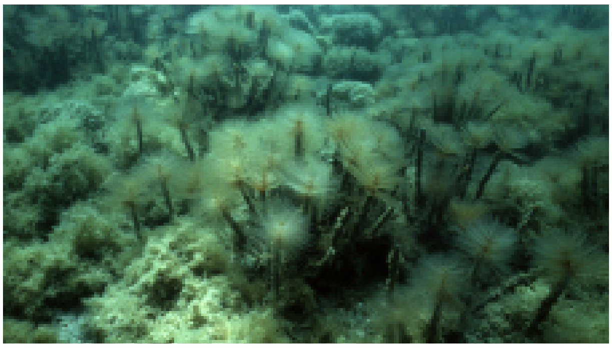

Figure 11. The introduced polychaete fan worm, Sabella cf. spallanzanii, in Cockburn Sound. (Photograph: D. Evans)

Three major issues stand in the way of solving this problem — the massive amounts of untreated ships' ballast water dumped into Perth's waters each year, the absence of a comprehensive database of local marine flora and fauna, and a lack of jurisdiction over international shipping. The study has found that foreign organisms present a significant threat to the ecological and cultural values of the metropolitan coastal waters of Perth and has suggested approaches to tackle this difficult problem.

Direct impacts

Cockburn Cement Ltd is currently mining shellsands from Success Bank for the manufacture of lime and cement. Since operations began in 1972, about 100 ha of seabed have been modified and 90 ha of seagrass meadows have been removed. Because the environmental implications of this mining are being assessed through a separate EPA process, this report makes no recommendations on the issue.

Unwelcome hitchhikers and stowaways

Foreign marine organisms have caused biological and commercial impacts around the world. For example, the Zebra mussel was introduced to the Great Lakes in the USA, fouling pipes and blocking water inlets and outlets, to the extent that US$500 million is spent annually to control this pest. Toxic algae, thought to have been introduced via the discharge of ships' ballast water and tank sediments, have caused serious problems for shellfish aquaculture industries in Tasmania, causing several closures over the years and expensive monitoring to protect public health. A Japanese kelp (seaweed) has affected the Tasmanian abalone industry, attaching to rocks that are abalone feeding sites. This kelp competes with the abalone for space and also makes it difficult for divers to locate any that remain.

An exotic fan worm, Sabella, has invaded Port Phillip Bay on the east coast of Australia, all but closing the scallop industry in the Bay. On a more local front, this worm is threatening our own marine life in Cockburn Sound and the Albany Harbours. At this stage, over 60 foreign species are known to have established in Australian coastal waters, with at least 18 of these found in Perth's waters.

These foreigners or 'exotics' as they are sometimes called are like unwelcome hitchhikers or stowaways from elsewhere in Australia or overseas. They 'hitch' a ride by attaching to ships' hulls or come as 'stowaways' hidden in ballast water tanks and, if conditions are favourable where they arrive, they take up residence in our waters.

From the examples given above, it is clear that, at best these exotics compete with the original inhabitants for food and space and disturb the ecosystem they invade. At worst, they may completely change the ecosystem and cause massive damage or loss to marine-based industries amounting to many millions of dollars.

Management

Environmental management framework

As well as identifying the problems, the study provided a model environmental management framework for Perth's coastal waters. This framework requires clearly defined Environmental Quality Objectives (EQOs), based on what people believe are the ecological and societal values of these waters, now and in the future. The EQOs are the environmental management targets or goals for these waters.

The ecological EQOs are aimed at ensuring the continued health and productivity of the natural ecosystem by protecting *biodiversity* and *ecosystem integrity*. The societal EQOs are aimed at protecting human uses by ensuring that it is safe to *swim* and *eat seafood* collected from these waters and that the general environment is *aesthetically pleasing*.

In practice it will not be possible or practical to protect all values everywhere so it will be necessary to designate exclusion zones where some or all of these ecological and cultural values will not be protected. The overall objective of management will be to ensure that impacts are effectively contained within the exclusion zones, that the combined size of these zones is small and, most importantly, that the agreed and designated values and uses of the broader ecosystem are not compromised.

Environmental quality criteria (EQC) are the benchmarks that can be used to assess whether the EQOs are being achieved or maintained. For example, it is considered safe to swim in water when faecal bacteria concentrations are below the criterion of 150 per 100 ml of water and safe to eat seafood where the bacterial concentrations are below the criterion of 14 per 100 ml. So if bacterial concentrations are maintained below 14 per 100 ml, the waters are considered *both* safe to swim in and to take seafood from and consume it.

By and large, maintaining the highest possible environmental quality will ensure the greatest range of possible uses, but often there is a cost associated with maintaining a high quality.

Consultative process

The full report of the SMCWS outlines *draft* EQOs and *draft* EQC proposed by the EPA/DEP. As part of a consultative process (Figure 13), the EPA will be asking members of the community and key stakeholders to help decide the future management of Perth's coastal waters and determine the *final* EQOs, their corresponding EQC and where they should apply. How do we strike a balance between the needs and desires of industry, community, aquaculture, recreation, conservation and shipping in Cockburn Sound for example? Should it be the same or different in Warnbro Sound or Sepia Depression?

It will be important that all views are aired so they can be considered during the consultative process. A discussion paper on Environmental Values and Environmental Quality Objectives for Perth's coastal waters will be produced by the EPA early in 1997 providing more information on the proposed management framework and seeking the views of the general community and stakeholders.
As shown in Figure 12, the findings of the SMCWS and the Water Corporation's PCWS and Wastewater 2040 Strategy are important sources of information that will feed into this process.

Integration

Currently there is no formal integrating management framework for these waters. Instead environmental management is the responsibility of numerous individual agencies, operating across four jurisdictions, ranging from local Government by-laws to international treaties. The current situation does not provide the level of integration necessary to ensure the multiple use of these waters is both socially equitable and ecologically sustainable.

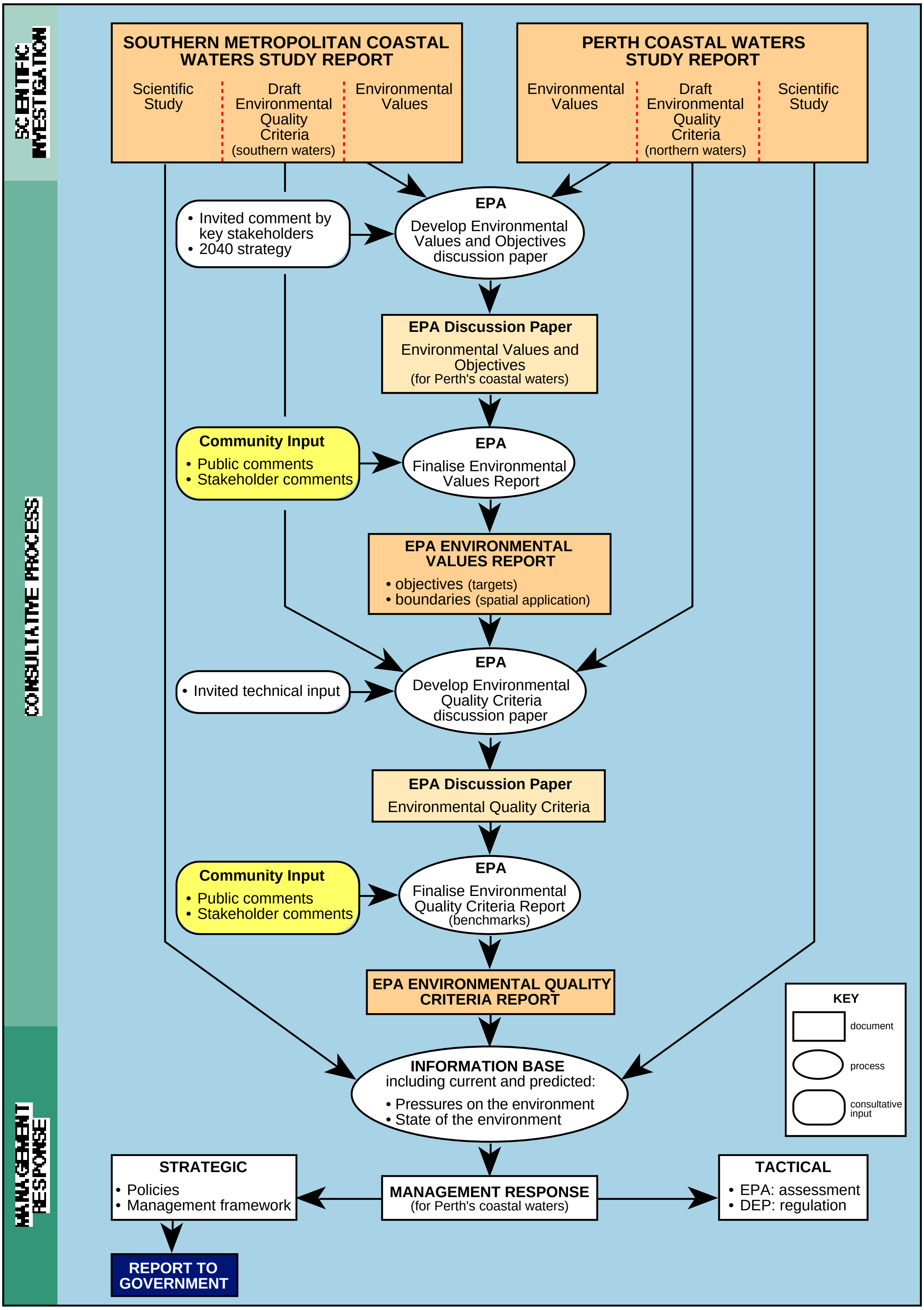

Figure 12. Flow diagram showing how the Southern Metropolitan Coastal Waters Study and the Perth Coastal Waters Study will be integrated and, with stakeholder and community consultation, used to set Environmental Quality Objectives and Criteria and provide the information needed to develop an integrated management response in relation to waste inputs to Perth's coastal waters. Points where community input will be sought are shaded yellow.

The SMCWS has highlighted the important linkages between a wide range of land-based human activities, occurring both in urban and rural catchments, and the environmental quality of the coastal waters. The study has also demonstrated that the transport and cumulative ecological effect of wastes discharged to Perth's coastal waters can extend across boundaries between jurisdictions (e.g. between state and commonwealth waters). An integrated management approach would better address these issues.

Recommendations and action items

The SMCWS proposed the basis for an extensive consultative process to develop environment values, objectives and criteria for the management of Perth's coastal waters. It has also set out draft recommendations and actions to address existing environmental problems and concerns.
These recommendations and actions will be further developed into strategic management and policy directions following the consultative process. Action may take place sooner on some of the more immediate problems subject to Government endorsement and EPA approval.

The full report outlines 41 action items and 11 recommendations, but this summary document will only touch on some of the major issues.

There is a clear need to limit cumulative impacts and to apply environmental management at an 'ecosystem' level as well as at the individual project/discharge level. A key element of this approach is to place greater responsibility for the costs of monitoring and the development and implementation of management plans on the major dischargers and users of the environment, within the framework of agreed EQOs.

The recommendations to the EPA are primarily concerned with the adoption of policy positions aimed at addressing specific environmental issues or problems identified in the Study, as well as the broader need for long-term protection of the marine environment through coordinated environmental management of Perth's coastal waters. These recommendations include:

- not approving any proposals to increase nutrient loads to the southern coastal waters;
- using environmental protection policies and integrated catchment management strategies to minimise nutrient inputs to coastal waters from estuarine catchments;
- closer coordination of the roles of State and Federal governments in the environmental management of Perth's coastal waters;
- developing an environmental protection policy for Perth's coastal waters and formally reviewing the policy every seven years; and
- recommending that the WA government establishes a formal management framework to coordinate environmental management within Perth's coastal waters and between these waters and their land catchments.

Action items focus on the things the Department of Environmental Protection will do in response to the findings of the study. These include using the Environmental Protection Act to:

- control discharges of contaminants into the southern waters;
- address the problems of ongoing TBT inputs from shore-based sources; and
- ensure dischargers of contaminants monitor the broader environment and develop waste management strategies to ensure the agreed environmental quality objectives are met and maintained.

Addressing ballast water and TBT issues associated with shipping requires coordinated efforts at the international level. To this end the DEP will recommend through the Minister for Environment that the Australian Government requests the International Maritime Organisation and other international agencies to:

- require new ships to have upgraded ballast water management systems;
- research and implement strategies to minimise risks of introductions of foreign organisms; and

- prohibit or more strictly limit the use of TBT-based antifouling paints on all vessels.

At the state and national level the DEP will recommend that incentives be established to:

- encourage 'TBT-free' ships; and
- encourage ships with appropriate ballast water management systems.

Although the study has filled information gaps with respect to many issues, it has also identified areas that need further or ongoing investigation and monitoring. In response, the DEP intends to:

- further investigate the significance of the winter silicoflagellate blooms;
- monitor the health and distribution of seagrass meadows;
- monitor the state of the environment with respect to TBT contamination; and
- maintain a contaminant inputs inventory.

The most important outcome from the study is that we, as a community, now have the basic information needed to plan for a clean and healthy future for our coastal waters. In the main our coastal waters are healthy, but if we are to avoid the degradation that has occurred in the coastal waters next to most other large coastal cities of the world, then we cannot be complacent. We have to be pro-active and plan sensibly using a clearly defined and agreed set of objectives for guidance. We must also be vigilant, monitoring both the environment and the pressures upon it.

We will need to consider the needs and wants of each other, as well as the intrinsic needs of the environment itself. If we don't proceed and make the hard decisions now, then at some point it will be too complicated and too late. Our only option left then may be to accept the expensive cost of remedial action. If we follow that path then at best we may end up with an environment that is 'tolerable', but certainly not one that we would call 'desirable'.

At the end of the day it is our choice and it will be made through the consultative process. The outcomes from this process will provide the vision needed to guide decision making and define what is acceptable and what is not in our coastal waters. The long-term objective will be to make sure the agreed vision becomes a reality. The choices we have are many and varied and so too are the implications. There will be costs, but if shared equitably, they will be far outweighed by the benefits to current and future generations.

The consultative process is outlined in Figure 12 and the points where you can have your say are highlighted in yellow. The first discussion paper on Environmental Values and Environmental Quality Objectives will be prepared and released by the EPA for public comment in early 1997. Your views and the views of the rest of the community are important, so make them heard by participating in this process and help shape the long-term future of our coastal waters.

Enquiries about the Southern Metropolitan Coastal Waters Study or the community consultation process may be directed to the Marine Management Branch, Department of Environmental Protection (Ph: (09) 222 7000).