



East Marine Planning Region



NON-FISHERIES RESOURCE USE ACTIVITIES IN THE EAST MARINE PLANNING REGION

- Final
- 4 November 2007





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Executive summary

This report examines non-fisheries marine resource use activities in the East Marine Planning Region (the 'Region') which includes Commonwealth waters extending from Bermagui on the New South Wales south coast to Cape York in north Queensland. The Region covers an area of approximately 2.4 million square kilometres between 3 nautical miles and the outer limit of the Australian Exclusive Economic Zone (approximately 200 nautical miles off the Australian coastline). Exclusive Economic Zones of Lord Howe Island and Norfolk Island are also included in the Region. Waters of the Great Barrier Reef Marine Park are not included in the Region as they are managed separately under the *Great Barrier Reef Marine Park Act 1975*.

The East Marine Planning Region is one of five planning regions that cover Australia's Commonwealth waters. In accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a Marine Bioregional Plan will be established for each region, including the establishment of a system of marine protected areas in Commonwealth waters.

Preparation of Marine Bioregional Plans is dependent upon a comprehensive scientific knowledge and understanding of the ecological, socio-economic and cultural values of the Region. An understanding and appreciation of these values will be achieved through the preparation of a regional profile for each marine planning region.

This report on *Non-fisheries Marine Resource Use Activities in the East Marine Planning Region* focuses upon the socio-economic values of the East Marine Planning Region. Information on the main marine commercial resource use activities in the Region was used to determine the socio-economic importance of the Region to coastal communities and the nation, and understand the challenges associated with managing these industries in an ecologically sustainable manner. The report has been prepared through a comprehensive review of available literature and data to provide a summary for future planning in the Region. It does not address activities in the Great Barrier Reef Marine Park in detail as this area is governed by a separate authority.

There are a number of existing and potential resource uses within the Region that encompass some of Australia's major marine-based industries. These include:

- Ports and shipping;
- Offshore oil and gas;
- Offshore minerals;
- Ocean waste disposal;
- Marine-based tourism;
- Defence and customs;



- Submarine cabling including energy transmission lines and communications networks; and
- Emerging industries including desalination and biotechnology.

These marine-based activities are described in this report from a social and economic perspective. Potential information gaps that need to be addressed to better manage marine resource use activities in the Region are also included to assist key stakeholders in identifying major resource use issues and their implications on the marine environment, the Australian economy and society.

The report forms part of a suite of products that will be used by the Department of the Environment and Water Resources to prepare a draft version of the East Marine Regional Profile. The final regional profile will provide valuable input for the development of the East Marine Bioregional Plan and preliminary identification of candidate marine protected areas (MPAs).

Key findings of this report are listed below.

Ports and shipping

For the period 2005-2006:

- Ports of the East Marine Planning Region accounted for 18% of coastal freight loaded and 67% unloaded by Australian ports
- Ports of the Region accounted for 42% of Australia's international exports and 51% of international imports by tonnage
- International imports through the Region primarily consist of petroleum oil and petroleum products, chemicals, iron ore and non-metallic mineral products.
- International exports through the Region primarily consist of mineral resources including iron
 ore, coal, crude minerals and aluminium ore products; and forestry products including cork and
 wood
- The Coral Sea shipping lanes are the busiest in the Region.

Offshore oil and gas

- There is currently no significant oil and gas production in the Region.
- Minimal explorations of offshore rises, plateaus and basins have occurred in the Region.
- The Lord Howe Rise, extending from southwest of New Caledonia to the west of New Zealand has the greatest potential for the discovery of petroleum reserves in the Region.
- Drilling conducted in the onshore zone of the Sydney Basin has produced a number of oil and gas shows which may also occur offshore, but require further investigation.
- The economic contribution of oil and gas within the Region will depend largely on the future exploration and success of the Lord Howe Rise and successful drilling in the Sydney Basin.

Offshore minerals

No offshore mining or exploration is currently taking place within the East Marine Planning Region, although many minerals within the Region have been identified and show promise for future offshore mining including:

- Sand mining off the New South Wales Central Coast;
- Base and precious metals on Lord Howe Rise;
- Manganese nodules off the New South Wales and Queensland coasts; and
- Phosphorites off the New South Wales north coast on continental margins and seamounts.

Currently the cost of extracting and treating these resources outweighs their commercial value but this may change as new technologies are researched and developed.

Ocean waste disposal

- Most permits issued for sea dumping in Australian waters are for dredge spoil and creation of artificial reefs.
- A total of 471 ocean waste disposal sites exist in the 14 provincial bioregions that comprise the East Marine Planning Region.
- Most of these sites are concentrated to the shelf provinces.
- Two reported incidents have occurred whereby humans have been exposed to chemicals dumped at sea.

Marine-based tourism

- Marine-based tourism within the East Marine Planning Region is difficult to quantify due to the aggregated nature of tourism statistics on Australian National Accounts.
- A broad range of land-based and vessel-based tourism activities take place in the East Marine Planning Region including water sports such as sailing, snorkelling, scuba diving, cruise lining, and whale and dolphin watching.
- Environmental impacts include pollution from boating activities and increased sewage outflow from island-based tourism, impacts associated with construction of island-based activities and potential impacts to aquatic biota as a result of diving, snorkelling and anchoring.

Defence and customs

- The Australian Government has allocated significant Australian Defence Force resources in a coordinated effort to protect offshore assets and to deter and respond to threats that may arise in areas such as the East Marine Planning Region.
- The Australian Defence Force works in collaboration with the Australian Customs Service to protect offshore areas, including the Region, from illegal activities such as illegal fishing, drug smuggling and people smuggling.



- Defence operations to protect Australian borders include surveillance, interception, legal action, preparedness and contingency planning (including combat training), fisheries law enforcement, search and rescue, hydrographic assessments and oceanographic data management.
- The Australian Government has established a number of conditions to minimise the environmental impacts associated with combat training and other defence activities within regions such as the East Marine Planning Region.

Submarine cables

- Submarine communications cables carry approximately 99% of Australia's international voice and data traffic.
- Their estimated worth to the national economy is in excess of \$5 billion yearly as they provide the critical link for the flow of information between Australia and other countries.
- Three operational submarine cables exist in the Region the Australia Japan Cable, the Southern Cross Cable and the Tasman 2.
- Cables are easily damaged by trawling and anchoring activities.
- The Australia Japan Cable and the Southern Cross Cable have been declared cables of national significance with the Australian government creating 1 nautical mile protection zones either side of the cables. Activities that may cause damage to the cables are prohibited or restricted in the protection zones.
- Sixteen other cables are located within the Region, all of which are no longer in service.
- Further research needs to be conducted into the longterm effects of cable laying, maintenance activities and the provision of habitat by decommissioned cables.

Emerging Industries

Marine biodiscovery

- Marine biodiscovery and biotechnology is a rapidly growing global industry and has large economic potential for the East Marine Planning Region due to the diversity of life that inhabits the ocean.
- A number of species have been harvested for their compounds including the cone shell (*Conus magnus*) whose peptides have been used to create a chronic pain treatment called Prialt (zirconitide).
- Queensland is investing significant funding into research and the development of the industry.
- Further research into marine biodiscovery is underway, but intellectual property rights inhibit disclosure of existing and potential locations.



• Due to a lack of knowledge regarding the abundance and life histories of target marine organisms, the environmental impacts and the sustainability of marine biodiscovery are largely unknown.

Renewable Energy

- There is currently no renewable energy production taking place in the Region; however a trial wave energy program is underway in State waters off Port Kembla, New South Wales.
- Advances in wave energy systems as a result of the Port Kembla wave energy program and the
 potential for development and installation of offshore wind farms may contribute to the growth
 of the industry in the future.

Aquaculture

- Few wild fisheries operate in the East Marine Planning Region as a majority of commercial species are classified as fully or over-exploited.
- The major aquaculture industries located in coastal waters adjacent to the Region include the farming of scallops, prawns, edible oysters and silver perch.
- In terms of value, the majority of aquaculture production is land-based; however there is a large amount of research being conducted into expanding the marine component of this resource.

Desalination plants

- At this stage, desalinisation plants are planned for major cities including Sydney and the Gold Coast which will utilise seawater from surrounding coastal environments to supply water for domestic and industrial uses.
- Potential impacts to the marine environment as a result of desalination include a reduction in water quality, localised impacts on aquatic habitats and changes to flora and fauna abundances.

1. Introduction

1.1 Marine Bioregional Plans

The East Marine Region is one of five planning regions identified in Commonwealth waters. Other planning regions include the South-east, South-west, North-west and North Marine Planning Regions (see **Figure 1-1**). As part of a Federal Government initiative to better manage the conservation and sustainable use of the marine environment and its resources Marine Bioregional Plans are being established for each of these regions in accordance with Section 176 of the EPBC Act. Each Marine Bioregional Plan will include the identification of candidate MPAs in Commonwealth waters. The final plans will be used by Ministers, government bodies and industry to prioritise conservation issues in each region.



Under the EPBC Act the environment of the 'Commonwealth Marine Area' is classified as a matter of 'National Environmental Significance'. Consequently, any activity that may or will significantly impact on the Commonwealth marine environment must, by law, undergo assessment and approval. Introducing regional marine planning in the form of Marine Bioregional Plans under the Act therefore streamlines the link between plans and the decisions that need to be made by the Minister in determining whether an activity is approved under the EPBC Act. These plans apply to Commonwealth waters between 3 and 200 nautical miles off the Australian coastline or to the outer limit of the Australian Exclusive Economic Zone.



Before a Marine Bioregional Plan can be prepared, a Regional Profile of each marine region must be established. This preliminary stage of the planning process captures the ecological characteristics, key species, human uses and heritages values of each marine planning region. Development of each Regional Profile will rely upon marine science studies and socio-economic research being conducted in Australia. The process of developing the Regional Profiles will involve the investigation of the marine environment, where possible, according to provincial bioregions. These are large biogeographical areas that are delineated by their ecological characteristics. Provincial bioregions were established under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4. Through IMCRA, Australia's oceans have been categorised into 41 provincial bioregions.

This report will form part of the Regional Profile of the East Marine Planning Region. It describes marine resource use activities, in particular, marine industries that significantly contribute to the Australian economy. Where appropriate, the East Marine Planning Region is discussed in terms of provincial bioregions.

1.2 The East Marine Planning Region

The East Marine Planning Region covers an area of approximately 2.4 million square kilometres, extending from Bermagui on the New South Wales south coast to Cape York in Far North Queensland (Coral Sea). The Region is also bound by the State – Commonwealth jurisdictional boundary 3 nautical miles off the coast, and the outer limit of the Australian Exclusive Economic Zone approximately 200 nautical miles offshore. The Region also includes waters around Lord Howe and Norfolk Islands. The latter is an external territory of Australia.

The Great Barrier Reef Marine Park, which comprises approximately 98% of the Great Barrier Reef Region, does not form part of the East Marine Planning Region. The park extends 2,300 kilometres along the Queensland coastline and includes 2,900 reefs, 900 islands and cays, and 70 distinct habitats, all situated within an area of 3,440,000 square kilometres. This extensive network of reefs and cays has its own legislation and is managed by the Great Barrier Reef Marine Park Authority.

The East Marine Planning Region is comprised of 14 provincial bioregions, which are identified in IMCRA Version 4 (see **Figure 1-2**). Their biodiversity is influenced by the East Australian Current (EAC) which moves from the tropical waters of the Coral Sea to the cool waters of the Tasman Sea.

IMCRA provincial bioregions located in the Region include:

- Cape Province;
- Northeast Transition;



- Northeast Province;
- Kenn Province;
- Kenn Transition;
- Central Eastern Transition;
- Central Eastern Shelf Transition;
- Tasman Basin Province;
- Lord Howe Province;
- Norfolk Island Province;
- Central Eastern Province;
- Central Eastern Shelf Province;
- Southeast Transition; and
- Southeast Shelf Transition.



1.3 Scope of this report

Sinclair Knight Merz (SKM) was commissioned by the Department of the Environment and Water Resources to provide a succinct report on marine resource use activities (excluding fisheries) in the East Marine Planning Region. This report has been prepared to provide the Department and stakeholders with a greater understanding of existing and potential marine resource use activities in the Region and the economic pressures that are faced by marine-based industries.

The marine resource use assessment describes existing and potential activities as well as the socioeconomic links with coastal communities dependent upon the Region's resources. Historical trends in major commercial activities including marine-based transport are outlined and an assessment of the economic contribution of the major resource use activities is included.

The resource assessment will form part of the Regional Profile of the East Marine Planning Region. The Regional Profile describes:

- key habitats and species;
- natural processes;
- heritage values; and
- human uses (fisheries and other marine resources).

Once the Regional Profile for the East Marine Planning Region is prepared, it will be published and reviewed by stakeholders in the preparation of the East Marine Bioregional Plan. The Regional Profile will be used to gain further understanding of the ecological, cultural, social and economic values of the East Marine Planning Region. A draft plan will be developed, which will address the legislative framework and policy tools available to manage the current and future threats to the marine region.

The following sections of the report detail the major marine resource use activities undertaken in the East Marine Planning Region. These are:

- Ports and shipping;
- Offshore oil and gas production;
- Offshore minerals exploration;
- Ocean waste disposal;
- Tourism;
- Submarine cables;
- Defence and customs; and
- Emerging industries.

This report provides an overview of marine resource uses in the Region but excludes fishing activities.



2. Ports and shipping

2.1 Background

Shipping is the primary mode of transporting international freight to and from Australia. Total trade for the period 2005-2006 was \$79.7 billion, a significant contribution to the Australian economy (see **Table 2-1**). As ports provide the critical infrastructure for marine-based transport of Australian commodities, effective movement of cargo across Australian wharves is paramount. However, continuing growth in world trade is placing pressure on Australian ports to expand, with the mass tonnage of sea freight increasing significantly over the past twenty years (see **Figure 2-1**). To accommodate these increases investment in port expansion has become a priority for the Australian Government and ports corporations. In order to remain competitive and meet marine transport needs in a global market, sea freight trade is being shifted away from major ports such as Sydney to less developed ports. Major port expansion activities are also underway to ensure that the growing volume of sea freight can be accommodated.

Table 2-1 Total international freight for 2005-2006

	Air	Sea	Total
Total trade (\$billion)	79.7	249.0	328.7
Loaded (\$billion)	28.3	128.5	156.8
Discharged (\$billion)	51.3	120.5	171.8
Total trade ('000s tonnes)	676.0	695,351.0	696,627.0
Loaded ('000s tonnes)	270.0	624,481.0	624,751.0
Discharged '000s tonnes)	406.0	71,470.0	71,876.0

Source: Adapted from BTRE (2007a)





Figure 2-1 International sea freight by tonnage between 1983 - 2006

2.2 Regional activity

2.2.1 Ports

Commercial ports in the East Marine Planning Region include (see Figure 2-2):

- New South Wales Coffs Harbour, Yamba/Grafton, Newcastle, Port Kembla and Sydney
- Queensland Abbott Point, Brisbane, Bundaberg, Cairns, Gladstone, Hay Point, Lucinda, Mackay, Rockhampton and Townsville.

For the period 2005-2006, ports within the East Marine Planning Region accounted for 18% of coastal freight loaded through Australian ports and 67% unloaded. The latter relates to the higher population density on the east Australian coastline compared to other coastal areas in Australia and the associated demand for supply of goods and services.

In terms of international sea freight movements, ports in the Region accounted for 42% of exports and 51% of imports by tonnage. Six ports within the Region were ranked in the top ten Australian ports for total tonnage crossing wharves for the period 2005-2006. These included Newcastle, Hay Point, Gladstone, Brisbane, Sydney and Port Kembla (see **Table 2-2**).

At the regional level Newcastle port processed the highest mass tonnage of sea freight for the period 2005-2006, including the largest international exports by weight which was in excess of 82 million tonnes (see **Table 2-2**). For the period 2005-2006, Sydney was the largest international

Source: Adapted from BTRE (2007)



importer in the region by weight with over 15 million tonnes of imports, whilst Gladstone loaded and unloaded the greatest tonnage of coastal freight.

International imports for the 2005-06 period primarily consisted of petroleum oil and petroleum products, chemicals, iron ore and non-metallic mineral products. International exports primarily consisted of mineral resources including iron ore, coal, crude minerals and aluminium ore products; and forestry products including cork and wood (see **Appendix A**).



		Coastal Loaded	Coastal Unloaded	International Exports	International Imports		National	Regional
State	Port	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)	Total (Tonnes)	Rank	Rank
NSW	Coffs Harbour			96	646	742	78	21
	Newcastle	285,572	1,713,346	82,835,442	1,027,709	85,862,069	3	1
	Other Ports NSW			8,858	1,012	9,870	72	18
	Port Kembla	2,269,372	7,190,711	13,954,890	1,909,559	25,324,532	10	6
	Sydney	819,891	5,104,198	4,880,631	15,023,548	25,828,268	9	5
	Yamba/Grafton	3,267	515			3,782	75	19
QLD	Abbot Point			11,962,085		11,962,085	13	7
	Brisbane	1,846,840	3,646,736	10,057,695	10,875,231	26,426,502	8	4
	Bundaberg	227,831	29,528	129,606	5,974	392,939	59	15
	Cairns	66,607	542,629	352,275	380,523	1,342,034	40	11
	Gladstone	3,430,348	13,219,711	48,527,781	2,101,525	67,279,365	5	3
	Hay Point		12,469	80,344,974		80,357,443	4	2
	Innisfail			770,244		770,244	49	13
	Karumba	407,859		736,316		1,144,175	41	12
	Lucinda			620,636		620,636	50	14
	Mackay	253,908	369,268	2,324,423	496,567	3,444,166	25	9
	Mourilyan	36,003				36,003	68	16
	Other Ports Qld			1,344,450	597	1,345,047	39	10
	Port Alma		16,155			16,155	69	17
	Rockhampton			981	393	1,374	76	20
	Townsville	711,068	876,001	3,896,417	4,698,517	10,182,003	17	8
Total	East Marine	9,950,707	36,882,850	262,011,484	36,521,801	341,205,258		
	National	55,249,318	55,082,707	624,480,923	71,470,046	806,282,994		

• Table 2-2 Coastal and international sea freight through ports in the East Marine Planning Region

Source: Adapted from BRTE (2007c)

2.2.2 Shipping

Shipping lanes around Australia form sublinks to the major shipping lane around the world between Europe and Asia. Vessels from overseas ports use these sublink shipping lanes to access Australia's 65 ports including ports within the coastal waters adjacent to the East Marine Planning Region. Coastal and offshore movements may change as the countries that Australia trades with change through time (Australian State of the Environment Committee, 2001).

At present, shipping activity in the East Marine Planning Region encompasses coastal and international ship movements which primarily use the Coral Sea shipping lanes. Freight ships and cruise liners use these routes. The Australian Maritime Safety Authority monitors ship movements for the majority of the East Marine Planning Region, except the Norfolk Island Exclusive Economic Zone (EEZ) for practical reasons, being the remoteness of the island from the Australian mainland. Instead, Maritime New Zealand monitors ships in these waters.

The busiest shipping routes traverse the Northeast Province, Central Eastern Transition, Central Eastern Province and Central Eastern Shelf Province (see **Figure 2-3**). Coastal shipping movements are generally confined to the Central Eastern Shelf Province and the Central Eastern Province, State waters within 3 nautical miles from the coastline and the inshore zone of the Great Barrier Reef system, which does not form part of the East Marine Planning Region. International shipping movements cover a wider area but generally traffic the Coral Sea shipping lanes.

Cruise ships

For the period 2005-2006, the cruise ship industries experienced an increase in the number of ports visited from 15 to 20; an increase in the number of visiting cruise ships from 23 to 28; and an increase in the number of cruise ship visits to Australian ports from 325 to 415 (CDU, 2006). Cruise ship visits in New South Wales included the ports of Sydney, Newcastle and Eden, whilst Queensland visits included Brisbane, Whitsunday, Cairns, Mackay and Townsville ports (CDU, 2006). Shipping lanes used to reach these ports cross the East Marine Planning Region. However, these figures have been used as an indication of the increase in cruise ship activity, and while no ports occur within the East Marine Planning Region it is anticipated that vessels utilise the shipping lanes within the Region.



2.3 Economic context

Sea freight

International sea freight crossing Australian wharves has significantly increased over the past twenty years (see **Figure 2-4**) with international trade for the period 2005-2006 totalling \$79.7 billion (BRTE, 2007a). The continued growth in international imports and exports is placing pressure on the capacity of Australian ports to accommodate freight movements. Consequently, strategies are being developed to expand major ports and distribute ship traffic (refer to **Section**

Figure 2-4 Value of international sea freight per quarter between 1983-2007



Source: BRTE (2007b)

International sea freight for the period 2005-2006 reached a peak with major ports of Queensland and New South Wales heavily reliant on shipping lanes crossing the East Marine Planning Region. The Region supported Australia's first and second largest importing states by weight (Queensland and New South Wales respectively) and largest importing state by value (see **Figure 2-5**). Queensland also accounted for the second largest exporting state by weight and value (see **Figure 2-5**).





Figure 2-5 International seaborne imports and exports by value and weight for the period 2005-2006

Source: BTRE (2007c)

Ports of the East Marine Planning Region accounted for 51% of total Australian international imports by value (\$61.4 billion) and 45% of total international exports (\$56.2 billion) for the period 2005-2006. Sydney was the largest importer by value, followed by Brisbane with \$39.8 billion and \$18.2 billion respectively for the period 2005-2006 (see **Table 2-3**). Hay Point, Queensland followed by Sydney, were the largest importers by value for the period 2005-2006, with total values of \$11.3 billion and \$10.3 billion respectively (see **Table 2-3**).



•	Table 2-3 International imports and exports by New South Wales and Queensland ports
	for the period 2005-2006

Port	Value (\$'000s) Import	Value (\$'000s) Export	Total Value (\$'000s)	Tonnes Imports	Tonnes Exports
Coffs Harbour	825	4,317	5,142	646	96
Grafton	-	-	-	-	-
Newcastle	597,593	7,148,445	7,746,038	1,027,709	82,835,442
Port Kembla	284,831	3,785,370	4,070,201	1,909,559	13,954,890
Sydney	39,776,688	10,258,250	50,034,938	15,023,548	4,880,631
Other Ports (NSW)	1,329	13,640	14,969	1,012	8,858
Abbot Point	-	938,471	938,471	-	11,962,085
Brisbane	18,178,150	9,252,742	27,430,892	10,875,231	10,057,695
Bundaberg	1,774	60,335	62,109	5,974	129,606
Cairns	456,761	521,770	978,531	380,523	352,275
Gladstone	741,996	7,440,590	8,182,586	2,101,525	48,527,781
Hay Point	-	11,333,765	11,333,765	-	80,344,974
Innisfail	-	255,234	255,234	-	770,244
Lucinda	-	228,015	228,015	-	620,636
Mackay	354,062	518,657	872,719	496,567	2,324,423
Rockhampton	1,023	626	1,649	393	981
Townsville	999,630	4,478,319	5,477,949	4,698,517	3,896,417
Other Ports (Qld)	2,720	22,393	25,113	597	1,344,450

Source: BTRE (2007c).

Cruise ships

The Australian cruise ship industry is experiencing considerable growth and continues to contribute to national, state and regional economic growth. The Australian cruise ship industry is the fastest growing sector of tourism in the country, estimated to contribute approximately 0.6% of the tourism industry's total economic contribution to the Australian economy. The national economic impact of cruising (including direct expenditure, employment and value added) was equal to approximately \$3.6 billion in 2005-6 (CDU, 2006).

The expenditure associated with NSW cruise shipping in 2005-6 was \$149.1 million (**Table 2-4**), which includes total expenditure by domestic and international passengers and crew for the Sydney Harbour and Newcastle ports (CDU, 2006). For Queensland, expenditure in 2005-6 was \$61.3 million for the ports of Brisbane, Whitsundays, Cairns, Mackay and Townsville. The latter four ports lie directly adjacent to or within the Great Barrier Reef Marine Park but have been included due to the cruise ships' routes throughout the East Marine Planning Region.



 Table 2-4 Cruise ship visits and associated expenditure for New South Wales and Queensland ports for the 2005-06 period

Ports	Visit Days	Total Expenditure
NSW Ports		
Newcastle	1	0.1
Eden	7	0.6
Sydney Harbour	97	148.9
QLD Ports		
Brisbane	49	51.6
Whitsundays	21	2.3
Cairns	79	7.1
Mackay	0	0.0
Townsville	3	0.6
Total	257	211.2

Source: CDU (2006)

2.4 Impacts on the environment

Shipping can have significant impacts on the marine environment and needs to be carefully managed especially in the East Marine Planning Region, which includes a number of sensitive reef systems in the tropical waters off Queensland. Impacts on the marine environment from shipping can be extensive and may result from collision with large marine life, introduced pests, and leaks and spills of oil or other noxious or hazardous substances.

Collision with marine life

Increasing traffic in shipping lanes is affecting marine cetaceans and other large marine creatures, especially in the Coral Sea shipping lane. Risk of collisions with these creatures is increasing as ship movements through the main shipping lanes rise to accommodate increasing imports and exports (Ward and Butler, 2006). In the waters off the coast of Queensland, there were 65 reported cases of turtle strikes and 7 reported cases of dugongs strikes in 2006 (Ward and Butler, 2006).

Introduced marine pests

Exotic marine pests enter Australian waters through the process of range expansion or through human related activities. Range expansion is the natural process of species expansion into similar habitats with comparable environmental conditions to their original habitat (water temperature, light, turbidity, tides etc.). Human related activities such as ship fouling, ballast water, accidental and deliberate introduction of marine species for mariculture are the primary introduction vectors of marine pests. Over 129 exotic marine species and 209 cryptogenic species (of unknown origin) have been identified by scientists in Australian waters (Hayes *et al*, 2005.)

Ships entering Australian waters from overseas and even from other coastal areas within Australian waters can introduce marine pest species which can be transported in ballast water or attached to

the vessel. They can have serious impacts on human health, fisheries and aquaculture, shipping and ports, tourism, biodiversity and ecosystem health. Examples of introduced marine pests in the East Marine Planning Region include (Hewitt *et al*, 2002):

Asian green mussel (*Perna viridis*)

The Asian green mussel was identified in Cairns harbour in 2002. It was introduced accidentally through ship ballast water and attachment to ships hulls. Impacts including clogging of water systems, fouling of vessels, and mariculture equipment, and out-competing many other fouling species which can lead to change in community structure and trophic relationships

Aquarium caulerpa (Caulerpa taxifolia)

Caulerpa was identified in New South Wales waters in 2000. Incursion of the native species is the result of range expansion. The aquarium strain out-competes other species for food and light. The aquarium species has reduced native species diversity and fish habitat.

An Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions has been signed by the Federal government and state and territory governments. Under the agreement, the parties will develop, implement and continuously improve the National System for the Prevention and Management of Marine Pest Incursions in Australia. The National system will help reduce the risk of introduction and translocation of marine pests, provide emergency response procedures for new incursions and translocations, and provide ongoing management of existing marine pests (DEH, 2006).

High risk cargo

Cargo which poses a threat to the marine environment includes oil and other noxious and harmful substances which are transported by sea. In most cases, dangerous goods, chemicals and other noxious and hazardous goods are transported in specialised chemical tankers, in bulk containers in vessels, or packaged in some form (AMSA, 2006a). Accidental or deliberate releases can result in these substances entering the marine environment which can have serious implications for water quality, marine flora and fauna and humans.

A National Plan was developed to provide a framework for the prompt clean up of these substances in the event of a leak or spill. The Australian Maritime Safety Authority (AMSA) is responsible for managing the implementation of the *National Plan to Combat Pollution to the Sea by Oil and Other Noxious and Hazardous Substances* in Commonwealth waters Collaboration with state government and shipping, oil and chemical industries should maximise the capability of Australian emergency teams to respond marine pollution events (AMSA, 2006a).

No major oil spills or other chemical spills have occurred in the East Marine Planning Region (between 3 and 200 nautical miles). However, one major oil spill occurred in New South Wales State waters and three oil spills have occurred off Queensland (AMSA, 2006b):

- On the 3 August 1999, approximately 200 tonnes of oil leaked from *Laura D'Amato* was berthed at Shell Gore Bay, Sydney Harbour. The spill was confined to Gore Cove and Ball Head as a result of southerly winds and a flood tide.
- On the 25 January 2006, an incident occurred at Gladstone where 25 tonnes of oil spilled from *Global Peace*6. The harbour master quickly responded with the implementation of the Port Oil Spill Contingency Plan.
- The other two spills that occurred included a slick that extended more than 70km across the Great Barrier Reef Marine Park, and an incident off Holbourne Island where less than 100 litres of oil was spilt.

Stranding of the Pasha Bulka

During a series of severe storms the Pasha Bulka was stranded on Nobbys Beach, Newcastle on the 8th June 2007. The bulk carrier awaiting a shipment of coal ran aground, after attempting to seek refuge from large swell.

The ships hull was damaged during the incident and concerns were raised regarding the leakage of fuel. To reduce the potential for fuel leakage, fuel was transferred to other areas of the ship until a damage assessment could be conducted and the ship transported off the beach into deeper water.



Source: AMSA (2007)

2.5 Future uses

The Bureau of Transport and Regional Economics (BTRE) developed a forecast of ship movements for major Australian ports over a twenty year period: The *Container Ship and Ship Movements through Australian Ports 2004-05 to 2024-05* (BTRE, 2006). The working paper presents national and port level forecasts of container and ship movements for major ports including Sydney and Brisbane. Growth in international trade and its affects on port activity was a key feature of the report. BTRE (2006) reports that the current capacity of Brisbane and Sydney will need to be increased to accommodate the forecast volume of freight for the twenty year period.

The Ports Corporations and government bodies are developing strategies to manage the forecast volumes of containerised and non-containerised trade. In order to manage the large volume of

cargo crossing Sydney wharves, the NSW Government introduced the *NSW Future Ports Growth Plan* in October 2003. This plan forms the framework for managing the activity of major ports in NSW including Sydney Harbour, Port Botany, Port Kembla and the Port of Newcastle.

Cruise ships

Cruising is identified as a key growth area with the number of days in which cruise ships with international tourists are spending in port rising 28% from 2004-05 to 2005-06 to 415 days (CDU, 2006). Several factors account for the positive growth in this industry, more notably increases to the number of visiting cruise ships, receiving ports, visits to ports and passenger and crew capacities.

Cruising is expected to grow, primarily due to the expected increase in the number of ship visits to ports and the associated passenger and crew expenditure. The opening of Brisbane's new Portside Wharf will increase cruise visits and the construction of a proposed new wharf may begin in Townsville. The Queensland Government is also exploring options into the construction of an international cruise terminal at the Gold Coast.

Port Kembla

Port Kembla is situated approximately 30km south of Sydney. Historically the port was used for transport of coal, iron ore and grain. In 2003, the port was identified in the *NSW Future Ports Growth Plan* as an opportunity to shift trade from Sydney Harbour. Port Kembla harbour will be expanded to accommodate shifts in cargo from Sydney Harbour including container carriers and vehicles imports.

The Port Kembla Port Corporation is in the process of developing a Shipping Strategy to accommodate the transfer of trade from Sydney Harbour under the Ports Growth Plan.

Port infrastructure development forms the cornerstone of the strategy. Completion of a 130 metre extension of the port's multipurpose berth in 2005 is one of a number of infrastructure development designed to expand the port's capacity.

Development consent has been approved for a general cargo facility in the inner harbour and planning for additional berths is underway.



Source: NSW Department of Lands

Once the expansion works are completed an estimated 250 additional ships will be able to use the port each year. Port Kembla Ports Corporation (2006)

2.6 Information gaps

The Bureau of Transport and Regional Economics compiles annual reports regarding sea freight activity through Australian ports. However the availability of data for minor ports located within the East Marine Planning Region varies each year to the extent that historical trends are generally not comparable unless these values are compared at state level. In addition, the reports do not cover freight movements through the port of Norfolk Island which generally relies on lighterage between ships and the island. At the time this report was prepared, data on lighterage to and from Norfolk Island was obtained from Norfolk Island Customs office. Data did not include values for the financial period 2005-2006 for which data was available for other major ports from the Bureau of Transport and Regional Economics. For this reason, port activity for Norfolk Island was not included in this report.

More detailed information on freight movements through minor ports would be useful to determine the future trends of shipping activity and potential changes in shipping lanes through the East Marine Planning Region. Cruise liners may play a vital role in the growth of minor ports, depending upon trends in the tourism industry and the popularity of different destinations.

Information on ship movements through major shipping lanes is also limited within the East Marine Planning Region as the Australian Maritime Safety Authority only monitors ships within the Australian Search and Rescue Area which does not extend to the Norfolk Island Exclusive Economic Zone. This area is managed by Maritime New Zealand. Data on ship movements in the Norfolk Island Exclusive Economic Zone was not available at the time that this report was produced.

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3. Offshore oil and gas production

3.1 Background

Australian oil and gas resources include crude oil, condensate, liquefied petroleum gas and natural gas. Exploration and production can be an expensive process because petroleum resources are extremely difficult to find and are complicated to extract, process and distribute to the community, primarily because they are often located in inconvenient locations (Australian Institute of Petroleum, 2002a). Nonetheless, identification of these resources is essential to the growth of the industry (APPEA, 2007).

According to the Australian Petroleum Production and Exploration Association (APPEA, 2007) exploration in offshore waters has remained relatively constant over the past ten years in terms of the number of wells drilled. This exploration in offshore waters in very important considering offshore drilling contributes approximately 85% of Australia's petroleum production. The majority of Australian oil and gas production is sourced from Commonwealth waters adjacent to Western Australia (APPEA, 2007). Other significant production wells are located in the Bass Strait and Timor Sea (Australian State of the Environment Committee, 2001). Although offshore oil and gas exploration is particularly expensive and often futile, it is important to Australia's resource and economic future (Australian Institute of Petroleum, 2002b).

3.2 Regional activity

At the time this report was written, no major offshore oil and gas production occurred in the East Marine Planning Region. This may be associated with offshore areas within the Region being largely underexplored; however locations exist where potential petroleum reserves occur. **Table 3-1** lists the basins within the East Marine Planning Region where potential reserves exist. As minimal exploration of these offshore areas has occurred there is limited survey data available. Data is available for one well on an offshore island in the Nambour Basin and a petroleum well in the Sydney Basin. In the 10 years prior to 2003, no offshore drilling took place in Commonwealth waters off the New South Wales and Queensland coast (Quinn *et al*, 2005). In most cases, the prospect of gas and oil production is low, although some areas are highlighted for further investigation. In the 1960s wells were drilled off the Queensland coast, but subsequently abandoned due to producing no oil or gas shows.

The Lord Howe Rise, extending from southwest of New Caledonia to the west of New Zealand has the greatest potential for the discovery of reserves. Symonds and Wilcox (1989) estimated that the Lord Howe Rise has potential petroleum reserves of 4.5 million barrels.

Table 3-1 Basins, plateaus and rises explored within the East Marine Planning Region

Basin	Offshore Area (km²)	Details / Prospectivity
Capricorn Basin	45 000	Mostly within the Great Barrier Reef Marine Park where exploration is prohibited. This offshore basin is poorly explored with three wells having been drilled (all dry) and no exploration since 1968.
Clarence Moreton Basin	1 000+	A possible offshore extension of the onshore basin. The Solitary Islands Marine National Park and Reserve near. Offshore basin lies under a whale migration path. One offshore survey conducted, 2 of 30 onshore wells flowed sub-economic gas, basin has abundant oil-prone organic matter. No onshore wells.
Eastern Plateau	31 000	Plateau comprising offshore and onshore. Little known about eastern area but offshore area thought to be 1000 km ² , 19 onshore wells have been dug with many unconfirmed oil and gas shows but no commercial discoveries. No offshore exploration.
Lord Howe Rise	1 500 000	Knowledge is sparse, but has been recognised as having long term hydrocarbon potential. Potentially prospective sedimentary basins underlie much of western half and eastern flank. Fairway Basin considered a frontier hydrocarbon province.
Lorne Basin	-	Unknown if extends offshore and if so, based on onshore information, prospectivity is very low.
Maryborough Basin	15 500	Limited information. Basin offshore and onshore. Five onshore wells (all dry except for gas shows in one), none offshore. The offshore Maryborough Basin underlies whale migration paths for several months of the year.
Nambour Basin	2 500	Offshore and onshore. The offshore basin lies under a whale migration path for several months of the year. One petroleum well on an offshore island. Minor gas shows onshore but unlikely to contain commercial quantities of hydrocarbons.
Sydney Basin	28 000	Offshore and onshore. The offshore basin lies under a while migration path for several months of the year. 115 onshore wells and 0 offshore. Onshore contains rich coal deposits and natural gas and minor oil shows.
Townsville Basin	450 x 20-120 km	The western part of the Townsville Basin lies within the Great Barrier Reef Marine Park, in which petroleum exploration activity is prohibited. The rest of the basin is also in a sensitive area due to its proximity to the Park. No wells have been drilled.

Source: Geoscience Australia (2007).

Lord Howe Rise - Capel and Faust Basins

The northern area of the Fairway Basin on the Lord Howe Rise in the Tasman Sea is a known region of petroleum potential and therefore interest lies in the potential of petroleum in the neighbouring areas within Australian waters.

A survey carried out in 2001 on the vessel RV *Franklin* supported earlier beliefs that the region shows oil and gas potential. Evidence of gas hydrates in the northern region of the Fairway Basin had been detected within New Caledonian jurisdiction but further seismic profiling suggested petroleum potential also existed in the southern region of the basin in Australian jurisdiction (Exon, 2002).

Recent investigations into other features in the region provided promising results. The Capel and Faust Basins are deepwater basins located approximately 800km east of Brisbane, Queensland the Lord Howe Rise. Between November 2006 and January 2007, a seismic survey of the basins was undertaken by Geoscience Australia as part of the Big New Oil initiative aimed at opening offshore frontier areas for exploration.



Image: Geoscience Australia

The survey gathered 5920 km of two

dimensional data with line spacing of 30 km. The data is currently being processed but the size and shape of some of the basin structures are appear favourable for hydrocarbons (Kroh, 2007).

As part of the Big New Oil program, investigations will continue within this region in the hope of discovering a new oil province.



Image: Geoscience Australia (2007)

Despite the offshore area of Sydney Basin not having been tested for reserves in the past, it is regarded as a potential source of gas and petroleum. This is due to the number of wells drilled in the adjacent onshore Sydney Basin from which gas and oil shows have been encountered. The company, Bounty Oil and Gas NL, has been given approval for offshore drilling within the Basin; however, drilling has not commenced to date (Hutt, 2007).

3.3 Economic context

Australian oil and gas production is valued at approximately \$15 billion per year (Eard and Butler, 2006). As outlined in **Section 3.2**, no production occurs in the East Marine Planning Region, therefore the Region does not contribute to the value of Australia's oil and gas production.

National expenditure on oil and gas exploration is shown in **Table 3-2.** Expenditure on offshore oil and gas exploration between 2001 and 2006 rose by 26.2%, or \$188 million, to \$906.1 million (Australian Bureau of Statistics, 2007). As a proportion of total expenditure for offshore and onshore exploration over this time period, offshore expenditure was down 9.6%. However, for the

period 2005-06 there was significantly more investment in exploration with offshore exploration expenditure increasing 17% from the previous year (and onshore expenditure increasing 32%).

Year	Onshore exploration (\$m)	Offshore exploration (\$m)	Total	Offshore as proportion of total (\$m)
2001-02	164.5	718.1	882.6	81.4
2002-03	191.3	803.7	995	80.1
2003-04	230.5	713.5	944	75.6
2004-05	270.1	774.6	1044.7	74.1
2005-06	355.8	906.1	1262	71.8
% change since 2001-02	116.3	26.2	43	-9.6

Table 3-2 National expenditure on oil and gas exploration between 2001 and 2006

Source: Adapted from Australian Bureau of Statistics (2007)

With respect to the East Marine Planning Region, the most recent records indicate that in 2004, there was no expenditure on oil and gas exploration offshore of Queensland, whilst \$1.95 million was spent on two dimensional surveying offshore of New South Wales (Geoscience Australia, 2006).

The economic contribution of oil and gas within the Region will depend largely on the future exploration and success of the Lord Howe Rise and the success of the Bounty Oil and Gas NL's drilling of the Sydney Basin (PEP 11). Seismic investigations from one prospect in the northern region of the permit area, named *Biggus*, indicate that there are potential recoverable reserves in excess of 1.2 trillion cubic feet (MEC, 2006). If successful, this well is expected to provide enough gas to meet Sydney's needs for the next decade, which is estimated to generate in excess of US\$450 million (MEC, 2006).

3.4 Impacts on the environment

Oil and gas production and exploration can significantly impact the surrounding environment if it is not carefully managed. The main concerns (Australian Institute of Petroleum, 2002a) are associated with:

- Ship movements;
- Seismic surveys;
- Drilling rig placement;
- Drilling;
- Anchoring;
- Platform placement;
- Emissions and discharges;



- Sewage; and
- Oil spills.

More information on potential environmental impacts is provided in Table 3-3.

 Table 3-3 Potential impacts of offshore oil and gas exploration and production on the marine environment

Issue	Potential impacts
Ship movements	Possible hazards include sedimentation at coastal facilities from propeller disturbance, introduction of invasive species from ballast water release, disposal of produced and process waters that may have raised salinity and hydrocarbons, collisions at sea (Black <i>et al</i> , 1994), potential to alter animal movements and oil spills.
Seismic surveys	Concerns that sound waves causing mortality, sublethal injuries or modify feeding or mating activity of marine mammals, fish and other organisms. Evidence suggests the seismic sound waves do alter the behaviour of some species and may cause damage to the hearing organs. Whales have also been known to avoid noise associated with surveys even at a distance of 7-12 km (Australian State of the Environment Committee, 2001, McCauley <i>et al</i> , 2000).
Drilling rig placement	Possible localised damage from the placement of rig.
Drilling	Modifications to the benthic faunal communities, even up to 11 months after drilling (Currie & Isaacs, 2005), drill cuttings discharged overboard, increased suspended sediments in water column, drilling fluids containing harmful constituents potentially released into environment.
Anchoring	Localised physical damage.
Platform placement	Habitat disturbance, however platforms may act as artificial reef attracting marine and bird life. The decommissioning of the equipment may involve only the partial removal of platform, although they may be left to act as an artificial reef.
Emissions and discharges	Produced formation water with hydrocarbon traces and at an elevated temperature released into the environment, cumulative effects on organisms from long exposure to low levels of particular hydrocarbons. Greenhouse gas emissions (mostly carbon dioxide and methane) are released but exploration and production combined contribute only 3% to Australia's total emissions.
Sewage	Elevated water column nutrients may increase the numbers of some organisms
Oil spills	Smothering and toxic effects for organisms and cascading impacts along the food chain.

Source: Australian Institute of Petroleum (2007a)

Over the past 25 years four billion barrels have been produced, 900 of which were spilt. This represents a 0.00002% rate of spillage over the past 25 years (Australian Institute of Petroleum, 2002a). Although historically there is a low incidence of spillage occurring, there are risks of a major incident occurring in the future (Australian State of the Environment Committee, 2001).

With respect to the East Marine Planning Region, risk of environmental impacts form production and exploration is low due to the lack of production and minimal exploration activities taking place in the Region. While few surveys and little exploration drilling has been carried out within the Region, future production activities do have the potential to cause adverse environmental impacts if not properly managed.
3.5 Future uses

Australia has accessed approximately half of its oil resource potential but less than 10% of it's gas reserves with limited exploitation to date, despite comparable resources to oil (Ronalds, 2006).

Offshore production may be classified into two water depth categories: moderate which is less than 500m and deepwater which is greater than 500m (Ronalds, 2006). Deepwater production in Australian waters is limited as most discoveries have been gas fields, but as gas is of lesser value than oil and not always cost-effective due to complex processing issues, these resources have not been utilised (Ronalds, 2006).

Australian scientists, research institutions, the industry, companies and international partners are collaborating towards the *National Research Flagship Program*, designed to help Australia develop six key national objectives to further economic growth and sustainability. As part of the *Wealth from Oceans Flagship*, investigations into new platform-free technologies for offshore oil and gas extraction are being undertaken. This will allow access to deposits that currently cannot be economically recovered. These technologies have the potential to hasten opportunities for industries and possibly lower the cost of resources for the consumer, thus reducing initial capital investment and operational costs by 75%. If successful, large gas reserves may be accessed in remote offshore locations while reducing the environmental and safety issues associated with platform operations (CSIRO, 2005).

Production in the future is expected to reduce as current reserves of oil and gas are insufficient to sustain present levels of production (Powell, 2001). However, Geoscience Australia's *Big New Oil Program* is a major four year data acquisition program (2003-2007) designed to assist the petroleum exploration industry in the search for a new oil province. It was recently extended to 2011, with an additional \$75 million contribution (Foster, 2006) by the Australian Government. This program directly affects the East Marine Planning Region because the northern Lord Howe Rise has been identified as a Big New Oil study area. A report will be released on the petroleum potential of the basins in the region following a reconnaissance mission.

3.6 Information gaps

There is limited information on offshore oil and gas exploration and production within the East Marine Planning Region. This is largely due to the undeveloped nature of the industry along the east coast, with the area minimally explored. Few seismic surveys and no drilling have occurred so the extent of potential petroleum reserves is not well understood. It is therefore also difficult to determine potential economic benefit from the industry in the Region.

It is anticipated that information gaps will be filled as research is carried out into Australian offshore exploration and production and as additional seismic data is gathered along the eastern Commonwealth waters.



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4. Offshore mineral exploration

4.1 Background

Seafloor mining was pioneered in the 1970s, primarily to access manganese nodules and the nickel, copper and cobalt they contain (McDonald, 2005). The mining of offshore phosphate nodules subsequently followed throughout the 1980s. Despite these activities, there is limited information available regarding offshore minerals. Available data has primarily been obtained by private companies and through reconnaissance surveys undertaken by federal and state geoscience agencies (McKay *et al*, 2005). The main focus of these explorations and mining activities to date has been extraction of construction material, heavy mineral sands , and high value placer deposits of gold and diamonds (McKay *et al*, 2005)..Other minerals potentially available for extraction from the sea bed include sulphide rich in copper, gold and zinc located around hydrothermal vents, carbonate sands and phosphate and manganese nodules. Many of these minerals are located offshore in Commonwealth waters including the East Marine Planning Region (greater than 3 nautical miles from the coastline), although minerals may also be located in the nearshore environment within State waters.

Two major offshore extraction operations currently take place in Australian waters. These include sand dredging in Moreton Bay, Queensland and lime-sand dredging off Fremantle, Western Australia (McKay *et al*, 2005). Only a handful of minerals exploration licences (MELs) are in existence. This is in stark contrast to the 40,000 onshore documented mineral occurrences, highlighting the potential that may exist within Australia's marine environment (McConachy *et al*, 2005).

Applications for Mineral Exploration Licences (MELs) can be made in accordance with the Offshore Minerals Act (1994). The initial MEL lasts for four years (Geoscience Australia, 2006). Between 1990 to May 2006, 74 offshore MEL applications were submitted throughout Australia, however, there are currently only two (2) active MELs. They are for exploration off Tasmania and Western Australia (Geoscience Australia, 2006).

4.2 Regional activity

No major offshore mining or exploration operations currently take place within the East Marine Planning Region, although many minerals within the Region have been identified and show promise for future offshore mining. A major sand dredging operation does exist in adjacent State waters off Brisbane.

These are currently no active Mineral Exploration Licences within the East Marine Planning Region. However there is potential for sand mining in both the nearshore and offshore zone, particularly within state waters adjacent to the East Marine Planning Region.



Nearshore Minerals

Sand from sand mining or extraction is largely used for beach nourishment and construction (lime, cement) purposes. Traditionally, sand for construction purposes has been derived from terrestrial sources. However, exhaustion of these resources led to identification of alternative sources including marine sand. Nearshore sources have been utilised due to their proximity and accessibility as opposed to offshore sources. However, many of Australia's nearshore sand mining operations have ceased over the past few decades due to an increase in environmental concerns and exhaustion of resources. For example, a mining operation for shell sand (primarily calcium carbonate) off Cockburn, Western Australia has been relocated due to concerns about the seagrass within the area, whilst Brisbane's lime sand operation has ceased (McKay *et al*, 2005).

Recent interest in nearshore sand/carbonate mining is largely focussed around the Sydney region in State waters adjacent to the East Marine Planning Region, although offshore sand is also known to occur from The Entrance in New South Wales to Rockhampton, Queensland (Salt, 2001).

Other nearshore minerals that occur in State waters adjacent to the East Marine Planning Region include:

- Mineral sands (rutile, zircon, ilmenite, monazite) off southern Queensland and central and northern New South Wales coasts (McKay *et al*, 2005); and
- Offshore extensions from onshore deposits such as coal off Newcastle, New South Wales have been mined from shore using underground methods from onshore (McKay *et al*, 2005).

Offshore Minerals

Sand mining is considered a viable offshore mining option in Commonwealth waters offshore of New South Wales. With sand resources known to exist in Commonwealth waters between Wollongong and Newcastle, a number of companies have applied for marine aggregate (sand) exploration licences to extract the sand (Geoscience Australia, 2007). These include Metro Mix Pty Ltd and Sydney Marine Sand Pty Ltd. Unsuccessful with their first application, Sydney Marine Sand Pty Ltd submitted another application in August 2006 for the exploration of 180km² of seabed approximately 5.5km off the New South Wales central coast. The outcome is not yet known.

Other potential mineral resources within the East Marine Planning Region include:

- Base and precious metals on Lord Howe Rise (McConachy *et al*, 2006).
- Manganese nodules off the New South Wales and Queensland coasts (Salt, 2001).
- Phosphorites off the northern New South Wales coast, on continental margins and seamounts (Geoscience Australia, 2007; Salt, 2001).

Sulfides associated with hydrothermal vents are located around mid ocean ridges and therefore none are likely to occur in Australian waters.

4.3 Economic context

Offshore mineral exploration expenditure in Commonwealth waters in the past has only amounted to \$17 million, significantly less than the \$800 million expenditure involved in onshore exploration (McConachy *et al*, 2006).

Due to the difficulty and expense of offshore mining, the feasibility of seafloor mining depends largely on the discovery of minerals with a high value per tonne. Although diamonds, other gemstones and minerals such as gold are mined from the seafloor within other marine regions, to date only phosphorite and manganese nodules have been discovered within the East Marine Planning Region. Phosphorites nodules found off northern New South Wales are thin and low grade, thereby limiting their economic potential (Geoscience Australia, 2007). In the past, the cost of extracting and treating the resources has outweighed their commercial value but this may change as new technologies are researched and developed. In fact, minerals obtained from hydrothermal fields have shown to have economic prospects equal to or even higher than terrestrial mines (McDonald, 2005).

There is a high demand for lime in the mineral processing industry with the majority sourced from Western Australia. However, this means that lime prices in the Eastern States tend to be higher due to the smaller production volumes (Hegge *et al*, 2005).

4.4 Impacts on the environment

As most sand extraction occurs in nearshore regions, environmental concerns are those that may not directly impact the East Marine Planning Region. However, an example of the concerns include impacts to benthic flora and fauna, disruptions to migratory marine mammals, the risk of vessel collisions and increased suspended sediments (Hegge *et al*, 2005; EPA & DSDI, 2005). Sensitive environments are often at risk, including seagrass beds and coral communities. Coastal impacts from sand mining have also been raised and include changes to the nesting behaviour of turtles, shorebirds and other nesting species, adverse impacts to invertebrates and changes to coastal processes.

The impacts of offshore manganese and phosphorite mining are not well understood due to the limited nature of offshore mining at the present time. However, environmental impacts associated with nearshore mining, such as vessel collisions, suspended sediments and disruption to fauna, are also relevant to offshore mining.

4.5 Future uses

Nearshore Mining

The demand for carbonate sands for the construction industry is high and growing, especially as terrestrial sources diminish. Existing land-based licence operations are unlikely to meet future demand while new operations face opposition due to the environmental impacts. Annual



consumption of construction sand in Sydney was 6-6.5 million tonnes (Mt) in 2000 and is expected to keep rising to reach approximately 6.6 Mt by 2020 (Hudson, 2005). South-east Queensland relies heavily on its offshore sand extraction within Moreton Bay and the Government has approved further extraction over the next 15 years. As demand increases further and current resources diminish, the opportunities for sand extraction in Commonwealth waters may be realised.

Offshore Mining

Interest in mining of the seafloor is likely to increase as exploration and technological advances progress the accessibility and economic feasibility of seafloor minerals. In addition, as terrestrial resources diminish, there will be a greater need to source minerals from offshore sources. While the cost of offshore mining has been a concern in the past, future increases in production will reduce unit operating costs (McDonald, 2005).

Although the future of deep sea manganese mining is uncertain, increased demand and a reduction in available terrestrial resources may see the development of nodule mining offshore by 2020 (Glasby, 2002). However, the feasibility of nodule mining in Australia will depend on the mineral content of the nodule and their value per tonne.

4.6 Information gaps

Despite the potential mineral resources in the Region, little is known about the actual presence of minerals. Further exploration and mining of resources has not occurred primarily due to the limited information about the resources and the difficulty and expense in procuring the minerals. Therefore, additional scientific research is required into the feasibility of offshore seafloor mining in Commonwealth waters within the East Marine Planning Region. Knowledge gaps remain about known and unknown offshore minerals, their locations and their potential economic contribution (McKay *et al*, 2005).

Additional data must also be collected on the environmental impacts that may be associated with offshore mining if this is to become a growing industry within Australia. This is especially true because of the high biodiversity within the ocean and the recovery time of disturbed communities, which is considered slower than in shallower waters (Ahnert & Borowski, 2000).

The limited number of described species and the restricted knowledge of their distribution add to the difficulty in predicting impacts of sea floor mining (Ahnert & Borowski, 2000).

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5. Ocean waste disposal

5.1 Background

Dumping at sea has historically been a common practice as it was perceived to minimise the impacts of land-based waste disposal on population centres, and awareness of potential environmental impacts was uncommon. Additionally, waste disposal at sea may have also been a cheaper and less regulated alternative to land-based waste management.

The *Beaches, Fishing Grounds and Sea Routes Protection Act 1932* was enacted in response to concerns regarding pollution of beaches situated in major coastal cities and uncontrolled dumping resulting in obstruction of ship passage. Under the Act, the Federal Government designated fourteen dumping grounds, which were isolated from major shipping routes. Permits were required for the dumping of vessels and permission was required from the Director of Quarantine for the dumping of organic waste or garbage (Plunkett, 2003a).

In recent years, the practice of dumping at sea has been further regulated by the Australian Government to minimise environmental degradation and protect human health. The Australian Government signed the international *Convention on the Prevention of Sea Dumping of Wastes and Other Matter 1972* (The London Convention). As a signatory of the London Convention, the Australian Government introduced the *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) to increase regulation of sea dumping in Australian waters, including the seas surrounding Australia's seven external territories (Phunkett, 2003a). This Act repeals the *Beaches, Fishing Grounds and Sea Routes Protection Act 1932*. The Australian Defence Force was exempt from the Act and could continue to dump at sea in appropriate areas.

The London Convention (1972) was updated by the 1996 Protocol. The Protocol to the Convention is much more restrictive and lists materials permissible for dumping under Annex 1. Permissible materials include (International Maritime Organisation, 2002):

- Dredge material;
- Sewage sludge;
- Fish waste, or material resulting from industrial fish processing operations;
- Vessels and platforms other than made structures at sea;
- Inert, inorganic geological material;
- Organic material of natural organ; and
- Bulky items, primarily comprising iron, steel, concrete and other similar unharmful materials for which the concern is physical impact and limited to those circumstances, where such



wastes are generated at locations, such as small islands with isolated communities, having no practical access to disposal options other than dumping.

Permits for the disposal of any of the above listed materials must be obtained before dumping takes place. Nowadays permits are most commonly issued for dumping of uncontaminated dredge spoil (Plunkett, 2003a).

Regulations apply to the two broad waste sources including:

- Land-based waste disposal; and
- Dumping of waste at sea.

Land-based marine pollution can result from a range of activities including sewage outflows, industrial production by-products and stormwater runoff. It can potentially affect the water quality of coastal and marine environments, especially sensitive reef systems in the tropical waters off Queensland. Dumping of waste at sea can also have significant localised environmental implications depending on the nature of the material being dumped, the location and depth in which it is dumped and oceanic conditions (Plunkett, 2003a).

5.2 Regional activity

Sea dumping sites in the East Marine Planning Region can be categorised into four broad groups:

- Ammunitions sites;
- Boat dumping sites;
- Chemical dumping sites; and
- Miscellaneous waste sites.

These sea dumping sites are represented by provincial bioregions in **Table 5-1** and are illustrated in **Figure 5-1.** There is a total of 471 ocean waste disposal sites in the 14 provincial bioregions that comprise the East Marine Planning Region. Most of these sites are concentrated to the shelf provinces (see **Figure 5-1**). The Central Eastern Province has the highest number of ocean disposal sites including the highest number of ammunitions, boat and chemical dumping sites, whilst the Central Eastern Shelf Province has the highest number of miscellaneous dump sites in the Region. No registered dumping sites were identified in the Cape Province, Kenn Province, Kenn Transition, Tasman Basin Province or Lord Howe Province.

There is one chemical dump site in the Norfolk Island Province. However, sea dumping defined under the *Environment Protection (Sea Dumping) Act 1983* is not permitted off Norfolk Island (Plunkett, 2003). Management of waste generated on the island generally involves incineration.



Provincial Bioregion	Ammunition sites	Boat sites	Chemical dump sites	Miscellaneous sites	Toral
Cape Province	0	0	0	0	0
Northeast Transition	2	0	0	1	3
Northeast Province	0	0	2	0	2
Kenn Province	0	0	0	0	0
Kenn Transition	0	0	0	0	0
Central Eastern Transition	5	1	5	4	15
Central Eastern Shelf Transition	16	59	2	31	108
Tasman Basin Province	0	0	0	0	0
Lord Howe Province	0	0	0	0	0
Norfolk Island Province	0	0	1	0	1
Central Eastern Province	72	81	76	10	239
Central Eastern Shelf Province	9	36	8	27	80
Southeast Transition	4	0	10	0	14
Southeast Shelf Transition	7	2	0	0	9

Table 5-1 Sea dumping sites by provincial bioregion

Source: Adapted from Australian Hydrographical Services (2007)

Chemical dump sites

Chemicals permissible for sea dumping have been further restricted since the enactment of the *Sea Dumping Act* in 1981 due to human exposure and environmental impacts. The main reason for human contact with submerged chemicals was the lack of regulation when the substances were dumped, which allowed dumping to occur at depths where fishing trawler nets could snag the material. Plunkett (2003b) identified two incidents that have occurred in the East Marine Planning Region (before the planning region was created):

- The first incident took place in April 1973, approximately 15 nautical miles off Sydney, when a fishing trawler snagged twelve 44 gallon drums of vinyl chloride (contaminated hydrocarbons) when trawling at a depth of 115 fathoms. The ship deck and fish catch were exposed to the contaminated hydrocarbons during the incident.
- The second incident took place off Brisbane in 1983 when a trawling vessel snagged a 1 ton canister of mustard gas.

Submerged drums could still pose a threat to humans through trawling activities, especially where the location and depth of the material is unknown (Plunkett, 2003b). In particular, a significant threat exists from industrial waste products dumped before the enactment of the *Sea Dumping Act 1981*, after which time they may have been removed from the list of permissible substances for sea



dumping. Such materials could be hazardous and records of their location may not be available or may not exist.



Table 5-2 provides a list of chemicals and industrial waste that have been dumped in the EastMarine Planning Region. Hydrocarbons represent the most frequently dumped chemical in theRegion in the past.

Table 5-2 Chemicals dumped in the East Marine Planning Region

Description	Sites in the East Marine Planning Region
Arsenic Solution	1
Black Liquor	1
Carbonate/Cyanide	1
Caustic Soda	1
Chemical Warfare Agent	3
Chlorinated Hydrocarbons	14
Contaminated Hydrocarbons	2
Cyanide	6
Cyanide Residue	4
Cyanogen Bromide	1
Electric Plating Vats	1
Exhaust Valves	4
Hydrocarbons	21
Medical Stores	1
Medical Stores/Sulphur Drugs	1
Methyl Parathion	1
Mustard Gas	3
Mustard Gas Cylinders	1
Phosphorous Trichloride	2
Phosphorous Oxychloride	1
Polymerised Ethylene Oxide	1
Pyrotechnics	1
Rapidech Crystallised Chemicals	1
Shep Dip	1
Sodium	1
Sodium Exhaust Valves	2
Solvents	1
Spent Caustic Soda	12
Spent Sulphuric Akulation Acid	3
Sulphonamides & Antihistamines	1
Toxic Sludge	1
Unknown	4
White Spirit/Perchloroethylene	1
TOTAL	100

Source: Data sourced from Australian Hydrographical Services (2007). Material dumped within disposal areas proclaimed under the *Beaches, Fishing Grounds and Sea Routes Protection Act 1932* and permits issued under the *Environment Protection (Sea Dumping) Act 1981*.



Ammunition sites

Before the enactment of the *Sea Dumping Act*, disposal of obsolete ammunitions was a common practice, particularly after World War II. Dumping of ammunition at sea was viewed as a safer practice than land-based disposal. Chemical warfare munitions including mustard gas bombs have been dumped off the New South Wales and Queensland. One of fourteen dumping sites proclaimed under the *Beaches, Fishing Grounds and Sea Route Protection Act 1932* is located approximately 12 nautical miles of Cape Moreton, Queensland (Plunkett, 2003b). The site was originally designated for dumping of general waste. However, it became the official Australian Army dumping position for unserviceable ammunitions (Plunkett, 2003b). The site, which had a diameter of 5 nautical miles, was replaced with another designated dump site with a centre point approximately 25 nautical miles off Cape Morton (Plunkett, 2003b).

Another dump site designated under the *Beaches, Fishing Grounds and Sea Route Protection Act 1932* is located approximately 18 nautical miles off Sydney where the Defence Force dumped ammunitions following World War II (Plunkett, 2003b).

Spent ammunition from training exercises taking place in the Jervis Bay and Shoalwater Training Areas is also present on the seabed in the East Marine Planning Region.

Artificial reefs

Scuttled boats

Creation of artificial reefs from dumped inert material has been a common practice in the past with appropriately 75 boats used as the foundation for artificial reefs in Australian waters (Plunkett, 2003a). As shown in **Figure 5-2**, there are 15 records of scuttled boats used for the creation of artificial reefs off New South Wales, and 42 records for creation of artificial reefs located off Queensland. A number of these reefs occur in the East Marine Planning Region.

Permits for the creation of artificial reefs must be obtained from the Department of the Environment and Water Reefs, Great Barrier Reef Marine Park Authority or from the relevant state agency, depending upon the location of the proposed reef. Once a permit for an artificial reef is issued, the site is incorporated into maritime charts and can be a valuable asset to the tourism industry once the reef is established. The artificial reefs are mostly used for recreational diving and fishing.



Miscellaneous materials

Miscellaneous materials such as tyres, cars, pipes and slabs, and concrete blocks are also used in the creation of artificial reefs. Approximately 21 separate material dumps have been used in the construction of artificial reefs off Queensland. There have been 7 recent dumps used in the expansion of Cochrane Artificial Reef located between 2.5-3 nautical miles of Bundaberg, Queensland (BADARAI, 2007).

Cochrane Artificial Reef, Bundaberg

Cochrane Artificial Reef located approximately 2.5 to 3 nautical miles off Bundaberg, Queensland borders the East Marine Planning Region. The artificial reef, located within Woongarra Marine Park, extends for 400m by 800m. The Bundaberg and District Artificial Reef Association Incorporated (BADARAI) coordinate the management and deployment of materials for reef construction. The association must obtain approval from a number of government bodies before deployment of materials can take place. They have also received funding from the Department of Agriculture, Forestry and Fisheries (DAFF) under the Recreational Fishing Community Grants Program for deployment of concrete fish habitat.

Due to the proximity of the site to the mainland, it is frequently visited by fishermen and recreational scuba divers.



Source: BADARAI (2007)



Source: BADARAI (2007)

A historical overview of deployments is provided below:

- Oct 1992: First deployment 350 tonne gravel dredger "Ceratodus II"
- Nov 1992: Concrete pipes and steel modules
- Dec 1994: Steel pyramids and steel modules
- Oct 1996: Two Mohawk aircraft
- Jun 1997: A 15-seater Kingair plane and steel tanks
- Feb 1998: Concrete modules, steel pipe prisms and steel modules
- Jul 1998: Discarded pontoon and modified water tank
- May 1999: Landing barge
- Oct and Dec 1999: 3500 concrete house blocks for bommies
- Sept 2000: Two 140 tonne Lightships
- Nov 2005: Gravel barge "Porteur"
- Dec 2006: Concrete cubes, steel prisms, concrete pipes and small trawler "Nirvana"

Source: BADARAI (2007)

5.3 Economic context

The economic context of ocean waste disposal is difficult to quantify for the East Marine Planning Region as the historical records of sea dumping are incomplete. Therefore, an economic assessment of land-based and ocean-based waste disposal is not feasible. However, assumptions can be made regarding the economic constraints and benefits of artificial reef construction. The practice can be



quite expensive due to establishment and monitoring costs. However, a major economic benefit of artificial reefs is the potential for habitat creation and, in turn, fishing and tourism prospects.

5.4 Impacts on the environment

Potential impacts of ocean waste disposal on the marine environment include localised effects on water quality and destruction of habitat, both of which can have devastating effects on marine ecosystems (Plunkett, 2003a). Impacts of ocean waste disposal also extend to humans who may ingest contaminated seafood or snag dumped material through trawling. Another impact which primarily occurred before records of sea dumping sites were charted was ship collisions with dumped material (Plunkett, 2003a).

To combat the issues that arise from land-based pollution, the Federal Government developed *Australia's National Programme of Action for the Protection of the Marine Environment from Land Based Activities* (DEH, 2006). The programme builds upon the *National Cooperative Approach to Integrated Coastal Zone Management,* which is being implemented by Federal, State and Local Governments to combat land-based pollution.

However, management of impacts arising from waste dumped at sea is more difficult due to the limited data available on historical sea dumping events and their locations. Nonetheless, the Australian Government now has a database of dump sites and permits issued for disposal of permissible materials (Plunkett, 2003a). These sites have been charted to minimise the incident of snagging by trawlers and ship collisions. In addition, the 1996 Protocol to the London Convention (1972) provides further regulation on the nature of materials dumped at sea. Increased restrictions enforced by the Protocol will help minimise the potential environmental impacts of ocean waste disposal.

5.5 Future uses

Ocean waste disposal in the East Marine Planning Region will continue to occur in accordance with the *Environment Protection (Sea Dumping) Act 1983*. However, the current legislative framework has made the approval process more stringent and environmentally focused. Under the current application process, each proposed deployment is subject to an environmental impact assessment that describes the implications, if any, that dumping of material would have on the marine environment (Plunkett, 2003a). This is particularly important for dredge spoil substrates that may contain heavy metals.

As most of Australia's harbours will continue to require dredging to maintain the passageway for ships to offload and pick up their cargo (Plunkett, 2003a), the majority of dumping episodes that will occur in the East Marine Planning Region will most likely be uncontaminated dredge spoil.



According to Plunkett (2003b), major existing chemical warfare dump areas (chemical and ammunitions sites) do not coincide with environmentally sensitive areas, therefore it is unlikely that major environmental impacts would occur. However, material could be transferred from the original dump sites through floatation on currents or through unintentional human interactions such as snagging the material whilst trawling (Plunkett, 2003b). In such situations, there could be a number of risks associated with exposure to dangerous chemicals. Consequently, it is important for dump sites to be charted to minimise the risk of exposure.

5.6 Information gaps

In order to manage ocean waste disposal in the East Marine Planning Region, additional data capture of pre-Sea Dumping Act activities would be beneficial, particularly with regard to the location of chemical warfare agents. Plunkett (2003b) emphasises that increased public knowledge of such dump sites would reduce the possibility of contact incidents. Additionally, further information on the location of dump sites in general would also be useful to minimise the potential for shipping accidents to occur in the East Marine Planning Region, Further information could be charted and used to manage the forecast increases in ship visits to Australian ports.

5.7 References

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6. Tourism

6.1 Background

Tourism is a major contributor to the Australian economy. In 2005, tourism was valued at \$37.9 billion and the tourism Gross Value Added (GVA) for this period was worth more than the total of agriculture, fishing and forestry; electricity, gas and water; and communication services (Tourism Research Australia, 2007b). By 2016, it is expected that the tourism industry will be valued at over \$100 billion with 8.9 millions of inbound tourists arriving in Australia (Tourism Research Australia, 2007a).

Due to the aggregated nature of tourism statistics on Australian National Accounts, marine-based tourism is difficult to quantify (The Allen Consulting Group, 2004). The Australian National Accounts amalgamate land based and marine based activities for a number of reasons, mainly because a large proportion of the industry sectors overlap. Likewise, it is also difficult to distinguish between activities occurring within State waters and Commonwealth Waters. Nonetheless, The Allen Consulting Group (2004) used methodology developed by the Review Committee on Marine Industries and Science Council to quantify marine tourism and other marine industries based on value added and employment statistics for the periods 1995-96 to 2002-03. The Allen Consulting Group found marine tourism to be one of the largest marine industries.

Marine-based tourism in Australia comprises a broad range of activities that can be land-based or vessel-based:

- Water sports such as sailing;
- Surfing;
- Snorkelling;
- Scuba diving;
- Whale and dolphin watching; and
- Cruise ships.

Water sports and surfing are generally restricted to State waters as they are land-based activities.

6.2 Regional activity

Tourism in the East Marine Planning Region consists primarily of nature-based activities including dolphin and whale watching, and adventure based activities such as snorkelling and scuba diving. Most of these activities are expected to be seasonal, due to the time of year that marine life are active (ie whale migration timing) and if weather conditions are favourable for water based activities such as snorkelling and diving, yet are important contributors to the regional and local economy and employment market. Marine tourism in the region is primarily concentrated to the mainland of Australia due to transport linkages and accommodation needs of tourists. Therefore,

the majority of tourism activities operate from State waters and travel into Commonwealth waters, including the East Marine Planning Region.

The Great Barrier Reef Marine Park also supports an extensive tourism industry; however the marine park is not included in the Region as it has its own legislative framework – the *Great Barrier Reef Marine Park Act 1975*.

Cruise ships

Cruise ships were addressed in Section 2.2.2: Shipping.

Whale watching

A number of activities that take place in the East Marine Planning Region can be defined as nature based activities. Nature based activities as classified by Tourism Research Australia includes whale and dolphin watching which is an important marine tourism activity in the Region. Whale and dolphin watching along the east coast of Australia occurs at a number of locations off New South Wales and Queensland coasts.

According to a study conducted by the International Fund for Animal Welfare (IFAW, 2004) there was a total for 43 operators in Queensland and 28 in New South Wales in 2003 (see **Table 6-1**). Since the activity is seasonal, most of these operators run other businesses during off peak seasons (IFAW, 2004).

State	Operators	Boat-based tourists	Land-based tourists	Total
Queensland	43	140,133	89,035	229,168
New South Wales	28	319,706	616,924	936,630
Victoria	10	21,200	118,048	139,248
Tasmania	3			
South Australia	9	30,580	129,320	159,900
Western Australia	197	46,717	106,364	153,081
Northern Territory	0			
Total	290	558,336	2,059,691	2,618,027

Table 6-1 Whale watching activity in 2003

Source: Adapted from IFAW (2004)

The proportion of boat based operators and watchers conduct whale and dolphin watching activities within State waters, but may enter Commonwealth waters of the East Marine Planning Region when searching for whales. As this practice is dependent on whale movements it is difficult to quantify the proportion of operators working within the East Marine Planning Region. Nonetheless, data from IFAW (2004) provides an indication of boat based operations in Queensland and New South Wales regions that may include areas in the East Marine Planning Region.

In 2003, Queensland experienced the greatest number of whale watching operators to date with a total of 43 operators compared to 24 in New South Wales (see **Table 6-2**). However, New South Wales had a greater total number of tourists participating in boat based whale watching.

State/Region	Operators	Boat-based tourists	Land-based tourists
QLD Regions			
Great Barrier Reef Marine Park	27	60,000	Not available
Hervey Bay and South	16	159,168	Not available
Total (QLD)	43	229,268	Not available
NSW Regions			
North Coast	2	2,075	600,000
Central Coast	10	47,450	Not available
Sydney	3	20,181	16,924
Soiuth Central	9	319,706	Not available
South Coast	4	186,000	Not available
Total (NSW)	24	319,706	616,324

Table 6-2 Whale watchers (no. of persons) in Queensland and New South Wales for 2003

Source: Adapted from IFAW (2004)

The number of tourists participating in the activity has increased significantly since 1998. IFAW (2004) estimate a 37% increase for New South Wales between 1998 and 2003, and an 8% increase for Queensland during this period.

Snorkelling and Scuba Diving

The number of visitors participating in snorkelling and scuba diving in the East Marine Planning Region is difficult to quantify due to the manner in which tourism statistics are displayed on Australian National Accounts. Nonetheless, Tourism Research Australia (2007b) used available data from the National Visitor Survey to quantify domestic adventure based activities including snorkelling and scuba diving for 2006 (see **Table 6-3**).

In 2005, approximately 393,000 visitors to Queensland participated in snorkelling, whilst 95,000 participated in scuba diving (see **Table 6-3**). It is most likely that the majority of snorkelling and scuba diving occurred in the Great Barrier Reef Marine Park. New South Wales accounted for 159,000 visitors involved in snorkelling and 40,000 visitors involved in scuba diving. However, it is most likely that the majority of these trips would have taken place in State waters.



Activity	Visitors to QLD	AAGR (Yea End Dec 04 – Year End Dec 05)	Visitors to NSW	AAGR (Yea End Dec 04 – Year End Dec 05)
Bushwalking, rainforest walks	138,000	3.6%	2,279,000	9.5%
Water activities or sports	681,000	5.4%	967,000	3.8%
Other outdoor activities	535,000	-21.0%	693,000	-23.5%
Surfing	408,000	8.7%	704,000	10.6%
Snorkelling	393,000	9.5%	159,000	18.1%
Scuba diving	95,000	3.9%	40,000	17.4%
All adventure activities	2,758,000	0.3%	4,131,000	2.4%

Table 6-3 Domestic adventure tourism nature-based activities for 2006

Source: Adapted from Tourism Queensland (2007)

6.3 Economic context

Originally the tourism industry was not included in Australian National Accounts as the industry is depended upon the consumer not on industry outputs like other industry listed in Australian National Accounts. In 2000, the Australian Bureau of Statistics developed the Australian Tourism Satellite Account (TSA) to overcome this issue and quantify the contribution of tourism to the Australian economy. The TSA presents growth rates based on current price terms, taking into consideration the underlying volume of tourism activity for a given period.

Use of the TSA for understanding the economic contribution of marine-based tourism is limited as land-based and marine-based tourism industry sectors are not differentiated in the TSA. Nonetheless, the TSA provides an overview of the economic status of tourism in Australia.

For the period 2005-2006, tourism accounted for \$37.6 billion of Australia's Gross Domestic Product (GDP). The 2005-2006 period accounted for a 5.5 per cent increase over 2004-2005 (ABS, 2007).

The Allen Consulting Group (2004) attempted to value Australian marine tourism for the period 2002-2003. Based on value added, employment and exports, marine-based tourism for the period 2002-2003 contributed \$11.3 billion to the Australian economy (The Allen Consulting Group, 2004). The Allen Consulting Group (2004) also examined marine tourism by State for the same period:

 New South Wales was estimated to be worth \$4.5 billion and provided employment to approximately 82% of all NSW marine industry employees; and



• The Queensland industry was valued at \$2.2 billion and employed 76.9% of marine industry employees, although tourism in the Great Barrier Reef Marine Park is likely to have a significant role in these figures.

These estimates are based on income from such industries as accommodation, tour operator services, air and water transport, restaurants and food outlets, hotels and bars and other retail outlets.

However, a research paper by the Productivity Commission (2005) suggests that the estimates by the Australian Bureau of Statistics are inflated due to the inclusion of expenditure by Australian travellers on items such as food which would be incurred regardless of whether they are travelling. Business travel is also included in value estimates such as from accommodation, which would also inflate tourism output estimates in such areas. It is also suggested by the Productivity Commission (2005) that while an important contributor to the economic output from tourism, revenue generated by industries such as accommodation, restaurants/cafes, air passenger transport and taxi transport, is made up by a smaller percentage from tourism than is generally predicted.

Nonetheless, tourism is agreed to contribute significantly to the Australian economy, and regardless of what method of analysis is used to understand the nature of the tourism sector, this industry is very important to East Marine Planning Region.

Whale and dolphin watching

An estimated expenditure of approximately \$1.9 million was spent directly on whale watching activities based from inshore regions from the East Marine Planning Region in 2003 (IFAW, 2004). Total direct expenditure for NSW increased 52% from \$5.8 million to \$10.1 million between 1998 and 2003. Similarly in Queensland, direct expenditure totalled \$11.3 million, which is a 49% increase over the same period (IFAW, 2004).

In 2005, an estimated 41,000 people enjoyed the spectacle of whale watching in Sydney alone. Whale watching in Sydney has developed into a significant tourism attraction worth around \$2.9 million to the local tourism economy annually (NSW DECC, 2007).

Snorkelling and scuba diving

A number of marine-based tourism activities are categorised under the domestic adventure tourism market, such activities include water activities or sports, surfing, snorkelling and scuba diving. A major component of the Queensland statistics for snorkelling and diving would relate to tourism on the Great Barrier Reef, which is outside the East Marine Planning Region.

6.4 Impacts on the environment

Impacts of marine tourism on the marine environment have been broadly categorised by Harriott (2002) including:

- Coastal tourism development and associated construction impacts such as increased suspended solids;
- Island based tourism infrastructure including sewage outflow;
- Marine-based tourism infrastructure;
- Damage as a result of boating activity including ship grounding and waste discharge; and
- Wildlife interactions which can include cetacean collisions.

More detailed impacts for a number of tourism activities that occur in the East Marine Planning Region are provided below.

Whale and dolphin watching

Impacts associated with whale and dolphin watching are direct impacts on the whales and dolphins themselves. The animals may be disturbed by the presence and noise of people in boats, aircraft or in the water. The potential impacts resulting from these disturbances include (Natural Resource Ministerial Council, 2006):

- Behaviour changes (eating, resting, mating)
- Displacement from habitat areas
- Reduced breeding success
- Stress and injury.

To minimise distress and impacts to the animals, The Australian National Guidelines for Whale and Dolphin Watching 2005 (Natural Resource Ministerial Council, 2006) have been created to assist governments in making policy or legislation decisions regarding whale and dolphin watching, and allows operators to ensure safe distances are kept and speed and vessel numbers are controlled. Swimmers and aircrafts are also included in the guidelines.

Other potential environmental impacts associated with the industry include waste and emissions from vessels and aircraft and collisions between vessels.

Snorkelling and scuba diving

Traditionally ssnorkelling and scuba diving was not considered environmentally damaging. However, increasing dive numbers has resulted in physical and ecological damage to the marine environment. The major environmental impacts associated with the scuba diving and snorkelling industry are:

- Damage to coral reefs;
- Disturbance to marine life stress, injury, change in behaviour and ecology; and
- Waste and pollution from the operating boats.



One of the largest impacts of snorkelling and scuba diving on the environment is the direct damage to coral reefs through accidental contact with the divers' or swimmers' fins and feet (Zakai & Chadwick-Furman, 2002). Small areas of coral reefs are located within the East Marine Planning Region but the largest proportion of scuba diving and snorkelling tourists visit the neighbouring Great Barrier Reef Marine Park. Therefore the greatest damage to corals is likely to be concentrated within the Park off the coast where the largest contingent of dive operators are found, including reef areas offshore from Cairns, Port Douglas, Townsville, Mackay and the Whitsunday Islands.

Stress and injury to other marine life through contact with divers and swimmers may also be an adverse impact resulting from this industry. Feeding of fish, which is not unusual during dives, has the potential to cause adverse ecological effects by attracting predators and scaring smaller fish (Davenport & Davenport, 2006).

Other potential environmental impacts associated with the industry include waste, littering and emissions from diving and snorkelling boats. However, there is a growing awareness of the need to educate scuba divers and snorkellers, rotate dive sites and rotate routes to minimise cumulative damage.

6.5 Future uses

Whale and dolphin watching

Reports have suggested that whale and dolphin watching is a rapidly growing industry. The demand for the whale and dolphin watching is increasing at an average annual growth rate between 10-15% (IFAW, 2004). Numerous media releases from the NSW Department of Environment and Conservation (now the NSW Department of Environment and Climate Change) have indicated that whale migration numbers in Australian waters are rising. Subsequently, record sightings by the NPWS official whale watching program at Cape Solander have increased most years. The increase in whale numbers equates to growth of the industry for the Region, with whale and dolphin sightings likely to increase tourist numbers.

Snorkelling and scuba diving

Scuba diving and snorkelling are the two of the fastest growing past times, with an estimated one (1) million recreational divers being trained each year. These divers are primarily attracted to warmer waters commonly found in north eastern Australian regions (Davenport & Davenport, 2006). The increase in divers and snorkellers is likely to result in the establishment of additional dive sites and locations to reduce the pressure on existing sites. Some of these new sites may occur within the East Marine Planning Region. In addition, successful artificial reefs are being studied and may be used as a template for potential additional artificial reefs. If such reefs are created within the Region, there is capability for greater economic benefits, however the increase in these

dive and snorkelling activities will require more stringent controls to minimise impacts to both the physical and biological environment.

SCUBA Diving on the Cochrane Artificial Reef, Bundaberg

Cochrane Artificial Reef is located approximately 2.5 to 3 nautical miles off Bundaberg, Queensland. The artificial reef is located within Woongarra Marine Park and extends for 400m by 800m, bordering the East Marine Planning Region. The reef consists of ships, airplanes, steel structures and concrete pipes and has become a top local dive site. Abundant fish life inhabits the reef as most of the wrecks are now well covered in growth. Large shoals of fish, turtles, dolphins and rays are frequently encountered. There are three access points to the reef and local dive operators run regular dive trips several times a week. Source: BADARAI (2007)



Source: Bargara Dive (2007)

6.6 Information gaps

Information on marine tourism is limited due to the nature in which data is reported on the Australian Tourism Satellite Account. Therefore, data used in this report was primarily sourced from the National Visitor Survey which was conducted by Tourism Research Australia (2007). However, the National Visitor Survey does not provide a true indication of the marine tourism industry in the East Marine Planning Region as categories are very broad and data on water based activities such as scuba diving includes data for the Greater Barrier Reef Marine Park. The Great Barrier Reef Marine Park encompasses the majority of tourists involved in scuba diving in Queensland and therefore the figures for the East Marine Planning Region are expected to be significantly smaller.

Similarly, data provided on cruise ship expenditure are largely based on port calls in New South Wales and Queensland and not primarily on expenditure during ship passage through the East Marine Planning Region. However, the data cited within this report does provide an overall view of the expenditure, visitation and cruise ship traffic throughout the Region.



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7. Defence and Customs

7.1 Background

Australia's Oceans Policy highlights that Australia is geographically defined by oceans, which are critical to the nation's security (Commonwealth Government, 1998). Australia has approximately 30,000 kilometres of coastline and 15 million square kilometres of offshore maritime area (Australian Customs Service, 2007). Two key agencies play an important role in protecting these borders and monitoring activity in Australia's offshore marine areas. These include the Australian Defence Force and the Australian Customs Service. The Australian Defence Force (ADF) contributes some 450 personnel to a whole-of-government operation for military maritime enforcement activities within Australia's Exclusive Economic Zone (Australian Department of Defence, 2007a), an area that encompasses the East Marine Planning Region. Whilst the Australian Customs Service, 2007). The Australian Government has allocated these significant resources in a coordinated effort to protect offshore assets and to deter and respond to threats that may arise in Australian waters.

A number of defence and customs activities are known to occur in the East Marine Planning Region, including national security; surveillance, interception, and legal action (Forbes, 2002). In addition to maritime surveillance and response, the ADF also undertake a range of other tasks (Snushall, 2003), which are directly relevant to the East Marine Planning Region and they include:

- Preparedness and contingency planning
- Fisheries law enforcement
- Search and rescue
- Hydrographic assessments
- Oceanographic data management.

National Security

Surveillance

Maritime surveillance is described as the systematic observation of maritime areas to locate, identify and track ships, submarines and other craft above, on or under the sea, to determine the extent, nature and purpose of their movement. This surveillance activity can be undertaken by satellite, aircraft, surface ship, submarine, land-based radar or fixed wing sonar arrays and is considered to involve four processes:

- Detection
- Positioning



- Classification
- Assessment.

Interception

The ability to react or respond to a sighting and therefore intercept a security breach, is considered an essential follow-on step to surveillance and in the case of the East Marine Planning Region can offer the following outcomes:

- Enforcement of sovereignty
- Conservation of resources
- Environmental monitoring
- Protection of assets
- Enforcement of Commonwealth laws

Legal action

Members of the ADF are sworn as 'officers' under certain Commonwealth laws and this allows them to undertake law enforcement activities. These powers are also provided to the ADF under the United Nations Convention on the Law of the Sea 1982 which allows the commander of a Commonwealth vessel to request the boarding of any ship within waters to which this applies.

7.2 Regional activities Defence activities

A number of Defence activities are known to occur in the East Marine Planning Region including: demolition of explosives, firing, which occurs close to shore at scattered locations near New South Wales and Queensland waters, firing, bombing and radar tracking near Sydney and the ACT, training in flying, military flying laser operations training, and ignition of radar flares. The majority of these activities occur within the Central Eastern and Eastern-shelf Transition Provinces and the Central Eastern Province of the East Marine Planning Region due to the locality of major training bases such as Shoalwater Bay Training Area off Rockhampton and the Jervis Bay Training Area off the south coast of New South Wales (see **Figure 7-1**).

Any number of Security Operations can be underway within the Region at a time. For example, Operation RESOLUTE, which commenced in July 2006, contributes to whole-of-government efforts to protect the marine environment. The operation consolidates previous ADF operations such as Operation CRANBERRY which focused on illegal fishing and smuggling, and Operation MISTRAL which involved ocean patrols. Operation RESOLUTE is commanded by the Border Protection Command (BPC), which has assumed responsibility for operational coordination of both civil and military maritime enforcement activities in the Australian marine areas.



Other military activities in the East Marine Planning Region include the general movement of ADF and foreign vessels and over flying aircraft, search and rescue, hydrographic survey work and the conduct of joint and combined training exercises involving the firing of weapons, the use of sonar, and the detonation of explosives. Due to the classified and sensitive nature of Defence activities, details of location and types of exercise can not be confirmed. **Table 7-1** lists training exercises that may occur in the East Marine Planning Region.

Table 7-1 Australian Defence Force joint and combined exercises

Exercise	Australian Force	Participating Country	Objective
ASWEX	Navy, Air Force	New Zealand	To practice collective ADF anti-submarine warfare concepts, tactics and procedures
Tamex	Navy, Air Force	United States	Combined maritime patrol aircraft anti-submarine warfare/anti-submarine surveillance exercise

Source: Australian Department of Defence (2007a)

Talisman Sabre

Talisman Saber is a series of exercises that are conducted biennially in Australia with the United States and is designed to train Australian and US Forces in planning and conducting Combined Task Force operations, which will help improve ADF/US combat readiness and interoperability.



Talisman Saber focuses on operational level warfighting with training based on fictional scenarios that vary according to location between ground, air and marine activities in conjunction with simulated exercises. Each exercise involves around 30 ships, 100 aircraft and 20,000 personnel.

Talisman Saber is conducted off eastern Australia in the Coral Sea which is in the East Marine Region. Environmental management is the number one consideration for Talisman Saber exercises and involves a rigorous environmental risk assessment process.



Source: Australian Department of Defence Image Library (2007)

Customs

Australia Customs Service works in collaboration with four other government agencies to protect Australian borders from entrance of illegal and harmful goods and unauthorised people. These agencies include (Australian Customs Service, 2007):

- Australian Federal Police;
- Australian Quarantine and Inspection Service;
- Department of Immigration and Citizenship; and
- Department of Defence.

In order to cover the large area of Australian waters, Australian Customs Service partnered with the Defence Force to form the Border Protection Command (BPC). The BCP monitors offshore maritime areas using aircraft and vessels. Important activities undertaken by the BPC include capture of drug smugglers and illegal fishing vessels, and interception of people-smugglers (Australian Customs Service, 2007). The Australian Defence Force contributes to the security of the East Marine Planning Region through Royal Australian Navy (RAN) surface patrols and Royal Australian Air Force (RAAF) maritime aerial surveillance.

Australian Customs Vessels associated with the BCP, operate in conduction with Customs Coastwatch and are often deployed in the joint operations involving Coastwatch aircraft and naval patrol boats. Coastwatch work closely with the BCP to provide aerial surveillance of Australia's maritime borders. Aerial surveillance reports from Coastwatch are used by the BCP National Surveillance Centre to respond to illegal or suspicious activities (Australian Customs Service, 2007). Where necessary, BCP can send Customs or Defence Force vessels to investigate reported activities.

7.3 Economic context

The economic resources of the ADF are significant and provide services to the civilian Government agencies that manage the East Marine Planning Region. From 2007-08 the Australian Government estimates that it will spend \$51.6 million over four years on defence activities (Australian Department of Defence, 2007b).

7.4 Impacts on the environment

In recent years, there has been some attempt to determine the impact of military activities on the environment in the East Marine Planning Region and much of this has been associated with the conduct of a combined Australian and United States military training exercise in the Coral Sea known as *Talisman Saber*. In 2004, the Australian Government determined that *Talisman Saber 05* was likely to have a significant impact on the environment. In 2005, the Australian Government approved the training exercise subject to a set of conditions (Australian Government, 2005), some of which were relevant to the East Marine Planning Region and they included the following:



- All ships must maintain a watch for whales (using binoculars if field view is limited) and maintain a minimum separation distance of 500 yards when underway.
- Replenishment at sea must be conducted in the area designated for the activity in accordance PS5 of the Maritime Exercise Area Environmental Management Plan.
- No training activities for the *Talisman Saber 05* exercise will occur inside 10 nautical miles (nm) of the seaward boundaries of the Commonwealth Marine Reserves at Coringa-Herald and Lihou Reefs.
- Ships with ballast tanks, arriving to the *Talisman Saber 05* exercise from international waters, must be flushed a minimum of three times while enroute to Australia waters, after departure from the last port of call. Ballast tanks and associated equipment must then be flushed at least once in the Coral Sea within a distance of 200nm, but greater than 50nm from the Great Barrier Reef World Heritage Area.
- All vessels using anti-submarine warfare active sonar systems must not use sonar equipment between the Australian coastline and 15nm seawards of the 100 metre bathymetric contour.

In 2007, another *Talisman Saber* exercise is planned. Potential impacts of the exercise on the marine environment have been identified in a Public Environment Report (Maunsell Australian Pty Ltd, 2007). It is considered that some of these impacts are relevant to the East Marine Planning Region and these are listed in **Table 7-2**.

Table 7-2 Potential impacts from defence activities on the marine environment

Possible Impact	Risk Level
Vessel accidents (between naval vessels) that may result in spills that may cause pollution	Low
Accidental fires/explosions from ammunition handling, transport or storage on vessels	Low
Damage or disturbance to marine fauna through the use of mid-frequency sonar or sonar buoy during anti-submarine warfare activities	Medium
Disturbance to flora or fauna due to vessels grounding in sensitive areas	Medium
Damage to flora and fauna through use of high explosive ordnance	Low
Inappropriate disposal of waste (garbage/litter overboard) or release of waste water from naval vessels	Low
Release and inadvertent loss of non-explosive stores into the sea	Low
Introduction of marine pests	Medium

7.5 Future contribution

It is considered that the future presence of the military in the East Marine Planning Region will remain and that the most significant contribution will be from the RAN given its operational role in sea control, sea denial, maritime power protection, and sea lines of communication. Outlined in **Figure 7-2** is a diagram taken from RAN doctrine which shows the span of the maritime tasks
undertaken by the RAN (Sea Power Centre, 2005). It is considered that most of these tasks apply to the East Marine Planning Region.

Figure 7-2 Span of Maritime Tasks



The RAN is required to be capable of conducting combat operations in defence of merchant shipping and to undertake other measures as are necessary to protect that shipping. This means that the RAN must acquire and maintain the capability to monitor all merchant shipping within marine areas such as the East Marine Planning Region, as well as all shipping outside the area.

It is expected that in the future the ADF, especially the RAN, will continue to undertake activities in the East Marine Planning Region and that these will include:

- Operations to provide surveillance and law enforcement support including air and surface patrols (Operation RESOLUTE).
- Conduct of joint and combined exercises to train forces and evaluate force capability.
- Defence assistance to the civil community including counter-disaster and emergency assistance.
- Non-emergency assistance and non-emergency law enforcement.
- Support to national search and rescue authorities.

7.6 Information gaps

It is considered that more information about military activities would be useful to the management of the East Marine Planning Region. Such information that would be beneficial includes:

- Post military training exercise reports documenting environmental incidents, near-incidents and remedial actions to repair environmental damage applicable to the East Marine Planning Region.
- Planned hydrographic surveys within the East Marine Planning Region.
- Defence spending directly applicable to the East Marine Planning Region through Operation RESOLUTE.
- Annual number and type of regular RAN vessel movements through the East Marine Planning Region.
- Annual number and type of regular RAAF flights over the East Marine Planning Region.
- Annual number and type of regular foreign naval vessel movements through the East Marine Planning Region.
- Annual number and type of regular foreign air force flights over the East Marine Planning Region.
- Annual number and type of regular non-emergency assistance and non-emergency law enforcement activities in the East Marine Planning Region.

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8. Submarine cables

8.1 Background

Communications cables are the only submarine cables within the East Marine Planning Region. They include cables of national significance and several out-of-service cables.

Three operational cables dissect the East Marine Planning Region, being the Australia Japan Cable, the Southern Cross Cable and the Tasman 2. The Australia Japan Cable and Southern Cross Cable support most of the voice and data traffic and are vital to Australia's national infrastructure. Because submarine cables are vulnerable to damage from commercial fishing activities such as trawling and large vessels, leading to significant data and financial losses and serious delays in the flow of information to and from Australia, the government introduced new legislation; the *Telecommunications and Other Legislation Amendment (Protection of Submarine Cables and Other Measures) Act 2005.* This has allowed the Australian Communications and Marine Authority (ACMA) to propose protection zones over those cables of national significance, effectively prohibiting or restricting activities that may cause damage to cables 1 nautical mile either side of the cable.

8.2 Regional activity

All three operational cables within the East Marine Planning Region are linked to Sydney locations (see **Figure 8-1**). The Australia Japan Cable links Sydney to Guam and Japan and has been in service since December 2001. It branches in two about 150 km off the NSW coast and lands on both the southern and northern sides of Sydney. The Southern Cross Cable consists of two cable routes, linking Sydney to USA via New Zealand and Sydney to the USA via Fiji. The Australia Japan Cable and the Southern Cross Cable are considered cables of national significance leading to the ACMA proposing protection zones above the cables.

The Tasman 2 cable is a 2,195 km long communications cable that runs from Sydney to Auckland, New Zealand and has been operational since March 1992. It is not considered a cable of national significance.

Sixteen other cables are located within the Region, all of which are no longer in service (see **Figure 8-1**). They are detailed in **Table 8-1**.



Table 8-1 Submarine cables in the East Marine Planning Region

Cable	In Service	Out of Service	Details
La Perouse - Wakapauka	1876	1932	Telegraph cable from La Perouse, Sydney, Australia to Wakapauka, New Zealand
La Perouse - Nelson	1890	1956	Telegraph cable from La Perouse, Sydney, Australia to Nelson, New Zealand
Auckland - Sydney	1912	1964	Telegraph cable from Bondi Beach, Sydney, Australia to Auckland, New Zealand
Southport - Sydney	1923	1964	Telegraph cable from Sydney, NSW, Australia to Southport, Qld, Australia
Norfolk Is Southport	1902	1964	Telegraph cable from Southport, Australia to Norfolk Island
New Zealand - Norfolk Is.	1902	1964	Telegraph cable from Anson Bay, Norfolk Island to Doubtless Bay, Kaitaia, New
Norfolk Is Fiji	1902	1964	Telegraph cable from Norfolk Island - Fiji - Fanning Island thence to Bamfield, Canada
Norfolk Is Fiji	1926	1964	Telegraph cable from Norfolk Island - Fiji - Fanning Island thence to Bamfield, Canada
Norfolk Is Sydney	-	-	No traffic carried, was formed by joining the Sydney-Southport and the Southport- Norfolk Island Cables in 1970.
Bundaberg - New Caledonia	1893	1895/1898	Telegraph cable from Mon Repos, Bundaberg, Queensland, Australia to New Caledonia
COMPAC Commonwealth Pacific Cable	1962/1963	1983/1984	Vancouver, British Columbia, Canada Port Alberni, Vancouver Island, British Columbia, Canada Keawaula, Oahu, Hawaii USA Suva, Fiji Auckland, New Zealand Sydney, Australia
SEACOM	1966	1986	Cairns, Australia Madang, Papua New Guinea Tumon Bay, Guam Deep Water Bay, Hong Kong Kota Kinabalu, Malaysia
Tasman 1	1976	2001	Sydney, Australia Auckland, New Zealand
ANZCAN Australia - New Zealand - Canada	1984	2002	Port Alberni, British Columbia, Canada Keawaula, Hawaii Vatuooaqa, Fiji, Anson Bay, Norfolk Island Sydney, Australia
PacRimWest	1995	2004	Tumon Bay, Guam Sydney, Australia
A-PNG Australia - Papua New Guinea	1976	2006	Cairns, Australia Port Moresby, Papua New Guinea

Source: Adapted from UN-Oceans (2007).

Southern Cross Cable

The Southern Cross Cable is a high capacity cable consisting of two routes that link communications systems between Australia (Sydney) and important trading partners including New Zealand and USA. It has been in service since November 2000 and consists of 30 500 km of cabling. The cable is the most direct route to the USA and passes through the Hawaiian Islands. Its capacity between Australia and the Hawaiian Islands for both the northern and southern route is 480 Gb/s and between the Hawaiian Islands and USA, it is 640 Gb/s. The cable's susceptibility to breakage from activities such as certain fishing methods, dredging and and anchoring, and its importance to Australia's economy has seen the 1nm surrounding the cables proposed as protected zones, from the low-water mark to 2000 m depth.



Photo: Southern Cross Cables

8.3 Economic context

Australia's submarine communications cables carry approximately 99% of the international voice and data traffic and are estimated to be worth more than \$5 billion yearly to the national economy (AMCA, 2006). Australia's bandwidth use has tripled since 2004 to 157 Gb/s, supported by three main cables, two of which include The Australia Japan Cable and The Southern Cross Cable, which dissect the East Marine Planning Region.

The Australia Japan Cable is considered of high economic value due to linkage with one of Australia's largest trading partners, Japan, which constitutes 33.2% of the country's international trade (ACMA, 2006).

Likewise, the Southern Cross Cable is considered a cable of national significance due to its link with the USA and New Zealand. These sizable trading partners are worth 24.2% and 11.4% of Australia's total international trade, respectively.



8.4 Impacts on the environment

While there is limited information on the effect of the laying and maintenance of submarine cables, evidence suggests various installation methods potentially cause adverse effects on the near shore environment including geomorphic alterations and seagrass loss (Austin *et al*, 2004).

However, it is envisaged that with the introduction of cable protection zones, a secondary benefit would include the protection of marine organisms through the exclusion of fishing and other potentially detrimental activities. In addition, older, obsolete and unburied submarine cables attract a variety of species through the provision of habitat and may be utilised in artificial reef construction (Wagner, 1994).

8.5 Future uses

Planned cable installations include the New Caledonia to Sydney fibre optic submarine cable. The planned laying of the 2,000km cable was scheduled to begin in June 2007.

8.6 Information gaps

There is limited information regarding the operational life expectancy of existing cables. This is thought to be largely due to the rapidly evolving nature of the telecommunications industry, making long term forecasting difficult. Additionally, information is difficult to obtain regarding planned cables, their use and locations within the East Marine Planning Region. Further research needs to be conducted into the long term effects of cable laying, maintenance and the provision of habitat in decommissioned cables.

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9. Emerging industries and research

Australia's marine resources provide a number of opportunities for emerging industries due to the vastness of the ocean and its high biodiversity. This section addresses emerging industries in the East Marine Planning Region including biodiscovery, renewable energy, water resources and aquaculture.

9.1 Marine biodiscovery

9.1.1 Background

Biodiscovery is the investigation of biological resources such as plants and animals, for properties or characteristics that have a commercial value or some other wider application. Products such as drugs, agrichemicals and industrial enzymes may be created from biological resources and used in a number of applications (PMSEIC, 2005). Marine organisms in particular have few physical defence mechanisms and therefore protect themselves by chemical means. As such, many organisms produce venoms, antifouling agents and other biochemical agents that may be utilised for commercial and biomedical applications (Volkman, 1999). Their discovery may result in better vaccines, faster diagnosis of diseases, better quality foods and more environmentally friendly products. Sea sponges and other invertebrates, as well as marine algae, have been some of the most common sources of extracts used in pharmaceuticals. Heat loving microbes from hydrothermal vents may be suitable for use in novel biotechnological processes including oil, coal and waste-gas desulphurization as well as in the treatment of industrial effluents. Other industries utilizing marine genetic resources include the food, aquaculture, agriculture and nutritional supplement industries (UNU-IAS 2007).

Australia is one of twelve megadiverse countries in the world, therefore prospects for biodiscovery are high (Quinn *et al*, 2002). Both the land and the sea surrounding the country provide possibilities for biodiscovery; however the sea provides much greater potential resources than land due to the larger diversity of life forms (Quinn *et al*, 2002). This is particularly important as Australia has a large Exclusive Economic Zone of 11 million square kilometres and one of the world's largest coral reef systems which support many endemic species (Volkman, 1999). The Australian Exclusive Economic Zone comprises 60 marine bioregions, each with their own unique biota, physical and chemical features (Quinn *et al*, 2002). Approximately, 30,000 species from 28 marine phyla inhabit the bioregions of the Australian Exclusive Economic Zone (ABRS, 2001). Therefore scope for marine biodiscovery in Australia is large due to the richness of genetic marine diversity. The genetic diversity and vastness of Australia's Exclusive Economic Zone has generated great interest and promise for new scientific knowledge and wealth through biodiscovery.

Recently discovered compound from Australian marine organisms are listed in Table 9-1.



Table 9-1 Potential therapeutic compounds from Australian marine species

Compound	Source of compound (organism)	Medical condition
Lamellarin a 20 sulfate	Tunicate	HIV
Dithiocyanates	Sponge	Nematode infection
Conotoxins	Snail	Pain

Source: Adapted from Kijos and Swaangwong (2004).

Compounds from some Australian marine species have become commercial such as the ziconitide from the cone shell.

Conus Magnus

More recently, the chronic pain treatment called Prialt (ziconitide) has been released on to the market. It is derived from peptides isolated from the cone shell Conus Magnus (Olivera, 2000). More than 100 patents and patent applications with "conotoxin" in the title have recently been listed on the database esp@cenet (UNU 2007)



Source: Nature, 2005.

9.1.2 Regional activity

A recent report by UNU-IAS and UNESCO (2007) explains that patents reflect the intellectual and/or industrial property of discoveries, which confer to their holders exclusive rights on the exploitation of the patented invention. Approximately 135 patents relevant to marine genetic resources have been identified, which were filed in the period comprised between 1973 and present. These have been categorised and constitute of Pharmacology; 32%, Agriculture; 1.7%, food; 5.7%, cosmetics; 1.2%, chemistry; 53.5% and other; 5.7% (UNU-IAS and UNESCO, 2007). The numbers of patents have increased at a rapid rate each year from 1973, particularly from the mid 1990's to present. At the time that this report was compiled, information on compounds sourced from organisms specifically from the East Marine Planning Region was not available.

Access to Commonwealth waters of the East Marine Planning Region for the purposes of biodiscovery is regulated by EPBC Regulation Part 8A and a permit to undertake the activity is required. In coastal waters off Queensland, marine biodiscovery falls under access and benefit sharing legislation – the *Biodiscovery Act 2004* - which extends its scope as far as 3 nautical miles.

A number of biotechnology companies, universities and government agencies from New South Wales and Queensland are interested in the collection of marine species from State and Commonwealth waters including the East Marine Planning Region. These include but are not limited to:

- The Australian Institute of Marine Science;
- CSIRO Molecular Science;
- Queensland Institute of Medical Research;
- University of Wollongong;
- University of Queensland;
- Griffith University;
- University of New South Wales; and
- James Cook University.

The Australian Institute of Marine Science (AIMS) based in Far North Queensland, is actively working in the field of marine biodiscovery, concentrating largely on the development of pharmaceuticals, healthcare products, agrichemicals and bioremediation agents (Arico & Salpin, 2005). Currently, AIMS are working on two bio-initiatives including the development of sensitive bioassays to evaluate the risk to marine organisms and communities posed by climatic change and environmental contaminants. It will also determine sub-lethal impacts of adverse water quality on marine organisms, as well as the synergistic effects of environmental stress on ecosystem health (Australian Institute of Marine Science, 2003).

The Queensland State government has been actively investing in biotechnology research, having helped establish two research centres at the University of Queensland and Griffith University in addition to biotechnological collaborations with foreign universities and the establishment of Queensland Biotechnology Strategic Plan 2005-2015: Biotechnology – Setting New Horizons. This plan arose from the Smart State Strategy and outlines measures to assist the industry in Queensland to reach its revenue projections.

Some of the research in progress includes (Environment Australia, 2001):

- AIMS research creating synthetic analogues of specialised amino acids found in organisms such as reef building corals, sponges and anemones that allow them to be protected against sunlight. The compounds are being tested for commercial viability.
- The University of New South Wales in cooperation with multinational companies is investigating the commercial application of natural compounds from marine algae that prevent bacteria biofilms from forming, potentially preventing or reducing infections in humans and solving industrial problems. Application may include the development of antifouling paint and contact lens cleaning solutions.
- A collaboration between AIMS and James Cook University to produce natural herbicides from marine compounds. These herbicides present potential applications for farmers worldwide.

• A significant breakthrough in the management of marine compounds is the development of the Queensland Compound Library, an online tool that collates molecules and natural product extracts.

In addition, a number of Australian marine research laboratories are developing relationships with major companies from Japan, the EU and the US. Canada has also shown significant interest in accessing Australian marine biodiversity.

9.1.3 Economic context

The economic contribution of marine biodiscovery and biotechnology of the East Marine Planning Region is difficult to quantify as the industry is in its growth stage and biodiscovery revenue is expressed as a whole of biotechnology activities. Australia's current biotechnology related revenue is derived from pharmaceuticals, agrochemicals and nutraceuticals industry which is worth approximately \$6 billion, which is small by international standards but it is growing rapidly. In 2004, the Queensland biotechnology industry employed over 5,200 people and generated revenues of approximately \$690 million (Thorburn *et al.*2006).

Given Australia's large and unexplored genetic diversity, there is scope for future economic revenue from marine compounds in the Region. Therefore investment in the industry is growing. The AIMS Marine Biotechnology Group estimates their approximate level of investment, based on 2003-04 figures, to be \$1.72 million in Bioactive Molecule Discovery, \$2.01 million in Bio-innovation, and \$3.18 million in Tropical Aquaculture (AIMS, 2003).

Globally, the investments in marine bioresearch and biodiscovery from industry sectors known to be patenting marine compounds is unknown. The UNU-IAS (2007) paper has reported the profits made by particular industries known to be linked with marine biodiscovery as an indication of the industry value, however, exact figures of such investments are unknown. Estimates put worldwide sales of marine biotechnology-related products at US\$ 100 billion for the year 2000. Profits from a compound derived from a sea sponge to treat herpes were estimated to be worth US\$ 50 million to US\$ 100 million annually, and estimates of the value of anti-cancer agents from marine organisms are up to US\$ 1 billion a year (UNU-IAS 2005).

Companies using products of marine origin include the cosmetics giant Estée Lauder, which uses Pseudopterosin, an anti-inflammatory extracted from a seafan, in skin lotions. Total profits by Estee Lauder for 2001-2002 were reported to exceed US\$258 million. Other examples of companies using marine sources for cosmetics include the French Phytomer, a specialist in marine cosmetics, and the US-based AGI Dermatics, which uses a blue-green algae extract in some of its products. Specific sales figures for marine-based products were not available, but successful new products might command similar sales figures to the perfume "Lovely" (\$60 million annually in 2006) and the Hawaiian Tropic skin care line (\$340 million annually in 2006) (UNU-IAS and UNESCO, 2007).

9.1.4 Impacts on the environment

There is limited information available regarding the environmental impacts of marine biodiscovery. Hunt & Vincent (2006) identified the following environmental concerns:

- The use of destructive or non-selective collection methods (such as trawls or grabs) may not control samples sizes or avoid non target species. However, this practice should only be deployed where careful methods such as scuba collecting are unfeasible. Additionally, collection methods can be regulated by collection protocols such as those provided under the Australian Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999*.
- The possible introduction of pathogens or exotic species by collectors. A Commonwealth inquiry conducted into Biodiscovery in Australia however, found the risk of introduction was negligible (Voumard, 2000).
- The possible over collection of target organisms for clinical workup could significantly reduce local populations and genetic diversity especially for rare or range restricted organisms. The low natural concentrations of some compounds used for biotechnology compounds, could result in an unfeasible large-scale exploitation of wild harvests. For example, Hunt & Vincent (2006) reported rare organisms such as the New Zealand deep-water sponge *Lissodendoryx* sp. required 1 tonne of the organism to produce 300g of the pharmaceutical compound. However, it is often difficult to ascertain the degree of impact resulting from large scale collections of specific organisms because often the local abundance and population life history parameters are unknown (Hunt & Vincent, 2006).

Collection is regulated in Commonwealth waters through the EPBC Act 1999 and legal collection is assessed for sustainability.

9.1.5 Future uses

Measures undertaken by the Queensland Biotechnology Strategic Plan 2005-2015 outlines aims to significantly develop the biotechnology industry, to employ over 16,000 staff and create revenue projections of \$4 billion by 2025 (Department of State Development and Innovation, 2005). Currently, over 22% of national public sector research funding is invested in research and development in biotechnology in Qld (Department of State Development and Innovation, 2005). However, these funding measures will not necessarily lead to further development of marine Biodiscovery in the East Marine Planning Region. Due to the nature of this industry, interest in the marine resources of the East Marine Planning Region are likely to come from anywhere in the world.

9.1.6 Information Gaps

There is limited information regarding the extent of marine biodiscovery in the East Marine Planning Region, this is in part to be due to the importance of intellectual property rights in the pharmaceutical and biotechnological industries. Hunt & Vincent (2006) found that most bioproduct collection data is protected by confidentiality agreements between bioprospectors and the source country.

In addition, a large expanse of the Australian Exclusive Economic Zone has not yet been investigated. A lack of reliable data on the distribution and abundance of many marine organisms makes assessing the sustainability of the biodiscovery industry difficult to determine. Further research needs to be conducted into the locations, methodologies and impacts of marine Biodiscovery.

Furthermore, collection is regulated in Commonwealth waters through the EPBC Regulations. Legal collection is assessed for sustainability and the industry has no interest in dependency on small populations, for economic as well as ecological reasons – rare and threatened biological resources are simply not worth investigating if they cannot be suistainably harvested in the long term. However, important breakthroughs have been made in bio-synthesis in recent years, as well as significant work being done by the likes of AIMS in aquaculture of sponges to produce valuable biochemicals. These subsidiary industries increase the economic benefits of marine bioprospecting.

The UNU-IAS and UNESCO (2007) suggests that there needs to clearly identify and define the scope of biodiscovery, as well as develop criteria and guidelines to assist governments in ascertaining the nature and implications of marine scientific research.

9.2 Renewable energy

9.2.1 Background

Australia primarily relies upon non-renewable energy such as fossil fuels to provide power to the population. Unsustainable consumption of fossil fuels including oil, gas and coal has reduced the availability of hydrocarbons required for power generation. Consequently government and industry are investing in renewable energies that are a sustainable source of power and will be available for future generations. Renewable energies such as wind, solar, wave, tidal, biomass and hydroenergy have also become increasingly popular due to concerns about greenhouse gas emissions.

Wave and tidal energy are particularly valuable sources of renewable energy along the vast Australian coastline due to natural coastal processes. Wave energy can be readily harvested to produce power which can be connected to the grid system for household consumption.

9.2.2 Regional activity

Use of renewable energy in the East Marine Planning Region is restricted to the coastal environment within state waters. Investigations into the viability of renewable energy are underway with Australia's first trial wave energy system being installed on the breakwall of Port Kembla near Wollongong, New South Wales in December 2006. Installation of the wave energy generator developed by Energetech Australia Pty Ltd (now Oceanlinx Limited) was undertaken to determine if the harvesting of wave energy was a feasible option for energy production. The Port Kembla Wave Energy Plant has been highly successful with connection to the main power system forecast for the near future. Several intensive trails have produced promising results with continual deployment of the turbine system expected to produce 1GWh of electricity each year (Port Kembla Port Corporation, 2006).

9.2.3 Economic context

The economic contribution of renewable energy in the East Marine Planning Region is nil at this stage, however advances in wave energy systems and the potential development and installation of offshore wind farms may contribute to the economics of the East Marine Planning Region.

9.2.4 Impacts on the environment

Environmental impacts associated with renewable energy projects such as the wave energy harvesting off Port Kembla are not widely documented as the project is in its preliminary stages.

9.2.5 Future uses

The wave energy harvesting program off Port Kembla has not yet been linked to the grid to provide power to the local area of Wollongong (Port Kembla Port Corporation, 2006). However, the project trials has been highly successful and it is likely that the system will be used to provide energy to the local community (Port Kembla Port Corporation, 2006).

9.3 Aquaculture

9.3.1 Background

There is constant and increasing pressure on the wild fisheries of the East Marine Planning Region, with a majority of commercial species being classified as fully or over exploited. With this pressure comes the realization that commercial fishing alone cannot provide for the increased demand for seafood worldwide.

Australia currently ranks around 55th in seafood production, despite having the third largest fishing zone in the world. Australia's fisheries resources are not as productive or as abundant when compared with many other parts of the world. With the ever-increasing population, demand for seafood is outstripping supply. Aquaculture has been heralded as a sustainable method of commercial production of fish, molluscs crustaceans and marine plants.



Aquaculture is a rapidly developing industry in Australia and worldwide, representing approximately 30% of total Australian fisheries production. Aquaculture worldwide has a growth rate of 11% per year and is worth an estimated \$US56.5 billion dollars (NSW DPI 2005). At present however, aquaculture is largely restricted to the coastal state waters although there is vast potential for expansion of aquaculture activities in the East Marine Planning Region.

Aquaculture in NSW

NSW aquaculture has always been dominated by Sydney Rock Oyster farming, worth approximately \$38 million annually. Black mussels, marine fish, prawns and scallops are all seen as important species to NSW, with research currently being conducted into the optimal methods for production by NSW Fisheries.

Marine fish aquaculture in NSW has been hampered by a lack of suitable sites for marine fish farming along the coast, a lack of a consistent supply of juvenile fish and the expenses related to production. There is currently one marine fish commercial production farm in Botany Bay, Sydney which utilizes floating mesh cages with others planned within the region.

Land based aquaculture makes up only one quarter of the value of NSW aquaculture, with approximately \$4 million in prawns produced annually.

Aquaculture in NSW is predicted to increase to \$100 million by 2010 (NSW DPI 2004)

Aquaculture in QLD

Aquaculture in Queensland saw a 4% increase for the 2005-2006 period, with total value estimated at \$70.5 million, comprising 28% of Queensland's fisheries resource (QLD DPI&F 2007). This has been combined with a 12% reduction in the wild-catch fishery over the same period.

Aquaculture research in Queensland is currently focusing on (QLD DPI&F 2007):

- crab aquaculture (mud and blue swimmer);
- scallop ranching;
- prawn broodstock domestication;
- rock lobster aquaculture; and
- inland prawn farming.

9.3.2 Regional activity

Aquaculture in the East Marine Planning Region is primarily restricted to coastal waters within state jurisdictions. The major aquaculture industries in the East Marine Planning Region include the farming of scallops, prawns, edible oysters and silver perch. In terms of value, the majority of aquaculture production in the East Marine Planning Region lies with inland aquaculture, however

there is a large amount of research being conducted into expanding the marine component of this resource.

9.3.3 Economic contribution

The economic contribution of aquaculture in the East Marine Planning Region is difficult to distinguish as both land-based and marine-based aquaculture occur in New South Wales and Queensland and as such are amalgamated in industry reports. **Table 9-2** presents the value of the aquaculture industry in New South Wales and Queensland for the periods 2003-04 to 2005-06. Queensland aquaculture production generally has a higher value than New South Wales production. This may be attributed to the size of the marine prawn production industry which presents the highest value aquaculture production overall. The value of prawn production was highest for the period 2003-04 with a value in excess of \$53 million.

Industry	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
Fish						
Salmon	5	-	-	-	-	-
Trout	1,552	1,784	1,742	-	-	-
Tuna	-	-	-	-	-	-
Silver perch	2,322	2,431	2,770	450	516	510
Barramundi	1,128	1,360	1,238	10,050	11,920	13,900
Others	516	1,184	720	300	259	320
Total	5,523	6,758	6,470	10,800	12,695	14,730
Crustaceans						
Prawn	4,432	4,464	3,387	53,330	45,900	46,500
Yabbie	354	362	214	-	-	-
Marron	-	-	-	-	-	-
Redclaw	-	2	-	1,240	1,280	1,270
Total	4,788	4,827	3,602	54,570	47,180	47,770
Mollusca						
Edible oysters	37,921	35,880	34,093	730	736	570
Pearl oysters	-	-	-	340	-	-
Mussells	261	215	207	-	-	-
Other	-	-	-	-	-	-
Total	38,182	36,101	34,300	1,070	736	570
Other NEI	1,154	686	655	2,200	3,889	3,050
Total	49,647	48,372	45,027	68,640	64,500	66,120

Table 9-2 value of aquaculture in New South Wales and Queensiand (value: \$0
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Data sourced from ABARE (2006).

9.3.4 Future uses

Aquaculture remains primarily a land-based activity in Queensland and New South Wales. Consequently values in **Table 9-2** are not truly representative of the value of aquaculture occurring in the East Marine Planning Region. Comprehensive research programs are currently being conducted with the view to expanding importance of marine species in aquaculture. Specific research programs include (NSW DPI 2005):

- Hatchery and breeding technologies for oysters and molluscs;
- Technologies and systems for finfish breeding and farming; and
- Fish feeds and feeding.

Research specific to developing commercial production of currently less productive marine species is being undertaken throughout the East Marine Planning Region in an effort to meet some of the increased demand for fresh seafood in Australia and world-wide.

9.4 Desalination plants

9.4.1 Background

Drought conditions affecting the mainland of Australia have placed enormous pressure on the nations' water resources. In order to manage this issue and meet the requirements of the Australian population the Australian government is investing in various water management strategies including water restrictions, water recycling and desalination plants.

9.4.2 Regional activity

Water resources on the mainland of Australia are declining as our current water storages reserves can no longer meet demands as a result of unpredictable drought conditions, with increasing populations in major centres placing more pressure on scarce water resources. Consequently, government organisations have researched alternative water sources with seawater being identified as one such option. Seawater may be treated through desalination which involves reverse osmosis to reduce the salinity of the water to a level that in acceptable for consumption. At this stage, desalinisation plants are planned for the major capital cities in the East Marine Planning Region including Sydney and the Gold Coast.

The Sydney desalination plant will use reverse osmosis technology to remove salts and other impurities from seawater to produce drinking water (Sydney Water 2007a). Sydney Water has listed 5 key environmental priorities including (Sydney Water 2007b):

- protect the marine and estuarine environment;
- protect terrestrial ecology in the conservation area;
- ensure no net greenhouse gas emissions;
- prevent clearing of native vegetation; and

prevent invasion of weed species into native plant communities.

9.4.3 **Economic context**

The economic contribution of desalination in the East Marine Planning Region is difficult to distinguish as these initiatives are predominantly in a pre-developmental stage. With an initial outlay of \$1.126 billion for the Gold Coast desalination plant, \$1.76 billion for the Sydney desalination plant and water bills expected to increase by \$100 a year, the economic contribution of desalination in the East Marine Planning Region is likely to be vast.

Desalination Case Study – Gold Coast, Queensland Potential impacts to water quality include (GCD 2006):

Like many parts of Australia, south-east Oueensland has been suffering from extended drought periods. Two options were assessed to secure an emergency bulk water supply by the end of 2008: desalination and reclaimed potable drinking water (purified recycled water).

As with other areas in Australia, there has been community criticism regarding the reclamation of potable drinking water, with 81% of respondents in the Gold Coast community supporting the desalination option compared with 50% supporting reclaimed potable drinking water (Gold Coast City Council 2007).

Other countries such as Singapore have successfully adopted reclaimed potable drinking water into the main supply system after dealing with initial public criticism. Reclaimed potable drinking water costs Singapore approximately half what desalination would have (Reuters 2002).

The Gold Coast desalination plant is estimated to cost \$1.126 billion for installation of infrastructure including the plant, intake and outlet works and the construction of a distribution pipeline to integrate the project into the south-east

Queensland water grid (Gold Coast City Council 2006). The Gold Coast desalination plant will supply 125 million litres of desalinated water per day into the water grid.

Research into marine impacts was undertaken by scientists from Griffith University, the University of New South Wales and other industry experts.

- - Increased salinity;
 - Decrease dissolved oxygen; and
 - Increased heavy metals. -

The potential water quality impacts relate to impacts on marine ecology through potential (GCD 2006):

- Toxicity to benthic fauna from salinity;
- Suffocation of in-fauna, due to a decrease in dissolved oxygen;
- Changes to fauna abundance, diversity and community composition where tolerant species dominate sensitive species;
- Release of sediment-bound metals to the water column; and
- The stimulate plant growth through the release of nutrient laden water.

Conclusions of the study found that it is unlikely that there will be any significant impacts on fish or fisheries in the region from the intake of seawater and discharge of brine.



Source: Gold Coast Water (2007)

9.4.4 Impacts on the environment

Desalination plants draw in seawater through intakes at sea, and output seawater concentrate that is twice as salty and one to two degrees warmer than the water drawn into the plant (Sydney Water 2007a). The plants are designed with diffusers, which disperse salt content and temperature through the profile at the outlet to return the seawater to normal levels around 50-75 metres from the discharge point (Sydney Water 2007a). Elevated salinity is believed to effect some smaller marine organisms such as corals, sponges and sea anemones. The effects of desalination plants on iconic marine creatures such as the weedy seadragon and migratory whales will be monitored throughout the process.

Potential implications for works within transitional areas between commonwealth and state waters (the 3 nautical mile limit of coastal waters) were mitigated by limiting development of desalination infrastructure to near shore works. Other potential commonwealth approvals were avoided as there were no ecological issues (endangered species / communities etc) of commonwealth significance.

The intake and outlet tunnels associated with the desalination plant will be located in the Tasman Sea, approximately 300 - 400m offshore. Impacts associated with increased salinity, temperature and the operation of infrastructure were assessed (Sydney Water 2006a).

The impact the desalination plant may have on migratory whales was assessed with four potential impacts being identified (Sydney Water 2006b):

- The potential for whales to collide with intake and outlet structures;
- Entanglement in desalination infrastructure;
- Increased salinity within the outlet mixing area (the near field); and
- Increased bubbles and noise from the outlet.

These impacts were all determined to be not significant, although there were no studies to reference against for increased salinity. There will be some temporary effects on the whales as they pass the intake and outlet, but these impacts are expected to dissipate with increased distance from the infrastructure.

An impact on the East Marine Planning Region associated with the desalination plant and migratory whale populations is potential loss of ecotourism dollars. It is anticipated that fewer whales will be observed during the construction of the intake and outlet channels, as the whales are likely to avoid the disturbance and move further out to sea (Sydney Water 2006a). Scaling down or stopping construction works when whales approach have been suggested as mitigation measures to reduce the effect on the whale-watching industry.



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Appendix A International freight by commodity



	Imports	Exports	Imports	Exports
Commodity	(\$'000s)	(\$'000s)	(Tonnes)	(Tonnes)
Non-alcoholic beverages nes	133,521	33,039	117,653	31,588
Spirits (potable), alcoholic bev nes	414,366	69,491	96,841	29,246
Tobacco & tobacco manuf	205,082	82,364	24,920	6,515
Wine & vermouth	242,957	2,756,150	52,269	1,704,835
Aluminium ores & conc; alumina	12,405	5,307,592	19,053	20,548,545
Copper ores & conc	16,517	3,403,942	5,774	1,717,375
Cork & wood	552,618	1,048,599	483,667	11,338,396
Cotton	83	1,137,442	42	656,729
Crude animal & veg mats nes	166,129	210,578	92,023	62,845
Crude minerals	120,544	510,350	1,505,924	15,276,037
Crude rubber (incl synthetic)	168,255	5,262	77,775	3,354
Fertilisers, crude	47,966	3,092	656,849	3,872
Hides, skins & furskins, raw	1,644	492,621	729	450,796
Iron ore & concentrates	218,515	12,831,373	4,895,668	255,910,284
Lead & zinc ores & conc	70,492	2,230,225	112,011	2,474,605
Mineral sands	10,217	226,968	22,229	933,154
Oil seeds & oleaginous fruits	46,185	413,859	92,549	1,124,460
Other metallif ores & metal scrap	52,786	3,310,099	131,575	6,986,334
Other textile fibres	102,570	42,232	58,335	43,186
Pulp & waste paper	228,667	145,729	354,745	940,805
Uranium & thorium ores & conc	-	545,846	-	10,908
Wool, sheep & lambs	38,700	2,246,415	8,679	440,897
Coal, coke & briquettes	23,321	24,353,384	206,872	232,921,795
Gases, natural & manuf nes	151,992	79	952,630	8
Liquefied natural gas	100	4,415,783	1,766	-
Liquefied petroleum gas (LPG)	198,271	1,002,648	319,035	1,519,672
Petroleum oil	13,292,483	6,098,607	21,654,158	9,179,114
Petroleum oils & refined prods	7,921,509	1,698,830	10,192,082	2,592,970
Oils & fats	407,545	316,033	291,605	485,774
Chemicals	4,876,848	2,755,485	5,782,385	1,218,184
Fertilisers, manuf	892,776	174,960	2,775,734	513,809
Organic chemicals	1,703,350	88,865	865,614	56,660
Plastics	2,226,426	458,477	897,147	230,272
Aluminium & aluminium alloys	636,873	5,233,964	157,099	1,734,854
Copper & copper alloys	315,914	2,601,056	44,322	385,259
Cork & wood manuf (exc furniture)	591,281	217,961	344,671	377,349
Iron & Steel	3,101,390	899,607	2,528,060	1,189,401
Lead & lead alloys	22,389	591,678	14,208	389,087
Leather, leather manurines	100,902	403,009	0,780	
Nickel & pickel allows	3,503,567	730,017 E7E 4E4	909,710	239,272
Non motallic minoral manuf nos	40,011	2/2,430	2,170	20,343
Other pep forrous motals pes	95 052	260 944	2,744,772	443,934
Paper, paperboard & articles	2 557 570	209,844	1 880 2/1	873 007
Pubber manuf nes	1 020 688	138 620	1,009,241	45 271
Textile varn fabrics & articles articl	2 020 276	314 250	365 828	41 560
Zinc & zinc allovs	14 231	1 005 595	4 540	390 843
Machinery	26 938 380	4 308 777	2 285 472	381 779
Road vehicles & transport equipt	21,731,644	4.542.229	1.736.398	432,113
Apparel & clothing access	3,193,059	103.526	237,467	8,110
Footwear	966.520	26,103	74.645	1,418
Misc manuf articles	9,502,475	1,556.294	1,882.838	215.560
Confidential	1,371,531	7,559,838	301,082	20,010,020
Misc	15,183	21,265	11,931	8,387
Total	120,502,889	128,495,076	71,470,046	624,480,

Source: Adapted from BTRE (2007c)