APPENDIX I

SHIPPING AND OFFSHORE ACTIVITY DATA FOR AUSTRALIAN PORTS AND WATERS

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Contents

I.1 INTRODUCTION

I.1.1 Objective

This appendix summarises the information on shipping and offshore activities that is used in the project.

I.1.2 Activity Types

The following types of activities are covered in the study, and hence require data:

- Port traffic (trading ships)
- Shipping traffic in the EEZ
- Ship-to-ship transfers at sea
- Other commercial vessel activity (non-trading vessels)
- Offshore drilling
- Offshore oil and condensate production in Australian waters
- Offshore oil and condensate loading
- Offshore pipelines
- Maritime safety measures
- Oil pollution response measures (the National Plan)

These activity types are considered separately below.

I.1.3 Data Sources

Diverse sources have been used, as appropriate for each activity.

I.1.4 Time Period

The data refers to 2010 where possible, or the last complete year that is available from each source. It also identifies historical and predicted future changes, where these are significant.

I.2 PORT TRAFFIC DATA

I.2.1 Numbers and Trends of Port Calls

The total number of trading vessel arrivals at Australian ports in 2010 was 26,235 (AMSA 2011a).

The average historical growth rate in port calls has been 1.9% per year (based on BITRE 2010a for FY1999-00 and FY2008-09).

I.2.2 Ship Type Breakdown

Ship types have been grouped as follows:

- Oil tankers (since these have higher oil pollution potential).
- Chemical tankers (since these may be of interest to AMSA in future studies).
- Bulk carriers (since these are numerically dominant in Australia).
- General cargo ships (known as “general cargo/multi-purpose ship” in the AMSA data).
- Container ships.
- Other ships, including the AMSA categories:
    - combination carrier
    - gas carrier
    - heavy load carrier
    - livestock carrier
    - MODU or FPSO
    - NLS tanker
    - offshore service vessel
    - other types of ship
    - passenger ship
    - refrigerated cargo vessel
    - ro-ro cargo ship
    - ro-ro passenger ship
    - special purpose ship
    - tugboat
    - vehicle carrier
    - wood-chip carrier

Table I.2.1 gives the overall type breakdown.

Table I.2.1 Ship Type Breakdown in Australian Port Visits, 2010

SHIP TYPE	VISITS	%	AVERAGE dwt/GT
Oil tankers	1,723	7%	1.72
Chemical tankers	1,150	4%	1.63
Bulk carriers	10,624	40%	1.79
General cargo ships	2,512	10%	1.40
Container ships	3,963	15%	1.25
Other ships	6,263	24%	0.68
All ships	26,235	100%	1.40

I.2.3 Ship Size Breakdown

Table I.2.2 gives the ship size breakdown, using the following categories of deadweight tonnage (dwt):

- Less than 10,000 dwt
- 10,000 to 50,000 dwt
- Over 50,000 dwt

Where the deadweight of a ship is not known, the gross tonnage (GT) is converted into an estimate of deadweight using the average ratio of dwt/GT for the ship type, as shown in Table I.2.1. The table shows that bulk carriers are mainly large, while “other ships” (as defined above) are mainly small.

Table I.2.2 Ship Size Breakdown in Australian Port Visits, 2010

SHIP TYPE	<10k dwt	10-50k dwt	>50k dwt	ALL SIZES
Oil tankers	7%	45%	48%	100%
Chemical tankers	7%	80%	13%	100%
Bulk carriers	3%	29%	68%	100%
General cargo ships	29%	62%	9%	100%
Container ships	1%	60%	39%	100%
Other ships	54%	39%	7%	100%
All ships	18%	42%	40%	100%

I.2.4 Port Breakdown

The ships were handled by a total of 80 different ports, although this includes 8 offshore oil terminals. These are eliminated in the analysis, because offshore loading is modelled separately. This leaves a total of 26088 port visits in 2010.

Melbourne and Brisbane had the largest shares, with 12% and 9% of port calls respectively. This data is used to obtain the number of port visits, and the ship type and size breakdowns, for each port in the study. Table I.2.3 gives a summary breakdown by State.

Table I.2.3 State Breakdown in Australian Port Visits, 2010

STATE	VISITS	%
QLD	6489	25%
NSW	4785	18%
SA	1884	7%
VIC	4115	16%
TAS	842	3%
WA	6805	26%
NT	1061	4%
CH	107	0%
All ships	26088	100%

I.2.5 Quantity of Oil Shipped

The 1723 port calls by oil tankers totalled 114 million deadweight tonnage. Assuming that 50% of port visits were to load cargo and 50% were to discharge, and that all ships carried their full deadweight of cargo when loaded, this would imply a total of 57 million tonnes of oil products shipped.

The BITRE (2010a) data shows crude oil and refined petroleum products totalled 35 million tonnes imported and 15 million tonnes exported. Coastal traffic is not broken down into the same categories, but the broader category of “mineral fuels, lubricants & related materials” comprised 12.4 million tonnes. This totals approximately 62 million tonnes of oil shipped. It is therefore consistent with the estimate from the AMSA port arrival data.

I.2.6 Bunker Capacities

Typical capacities for bunker fuel on board ships are expressed as fractions of deadweight in Table I.2.4.

Table I.2.4 Ship Bunker Capacities (Fraction of deadweight)

SHIP TYPE	<10k dwt	10-50k dwt	>50k dwt
Oil tankers	6%	5%	4%
Chemical tankers	6%	5%	4%
Bulk carriers	5%	4%	3%
General cargo ships	7%	6%	5%
Container ships	12%	11%	10%
Other ships	15%	15%	15%

I.2.7 Movements in Restricted Water

The length of transit from port to the open sea has been estimated from the satellite photographs in Google Maps. A representative berth location was used for each port. Because AUSREP reporting begins within 2 hours of port departure, the approach length is limited to 2 hours x 8 knots x 1.85 km/nm = 30 km, in order to avoid double-counting of time in restricted water and at sea. After weighting by the number of port visits, this results in an average length of transit in restricted water of 10 km per movement. This is an average of 20 km in restricted water per port visit.

I.2.8 Ship Visits in the Antarctic Territory

Ship visits to the Australian Antarctic Territory (AAT) are not covered in the AMSA port data above. The main shipping activities in the region are re-supply vessels servicing Australian research stations and foreign-flagged vessels servicing stations operated by other nations within the AAT, research vessels, fishing vessels and some limited ship-based tourism. Re-supply vessels will typically carry bulk fuel for transfer to stations for power generation, heating and for vehicle use, as well as their own bunker fuel. A typical Australian station will use about 600,000 litres of fuel per year and has storage capacity for about 1,000,000 litres. The Australian re-supply ice-breaker Aurora Australis has capacity for about 2,200,000 litres including both re-supply tanks and bunker fuel.

In order to represent risks from ship visits to the AAT, this study assumes that there are at most 20 visits per year from re-supply vessels. The average oil on board the vessels is taken as 2000 tonnes.

I.2.9 Ship-to-Ship Transfer

In the most recent year (2010) there were no ship-to-ship (STS) transfers of oil or condensate in Australian waters. However, AMSA have advised that approximately 4 STS operations are expected during 2011. In order to include STS in the risk estimates, this number is included in the current case.

STS operations would typically involve a 270,000 dwt VLCC being offloaded into three 90,000 dwt Aframax vessels, which are able to berth at Australian ports. Each operation would take approximately 45 hours, with the ships under way at 5 knots or less. A typical location would be 100 to 200 nm off the NSW coast, i.e. in calculation sub-region NSW-2-D (Caltex 2008).

The previous study (DNV 1999) identified 7 STS operations involving oil cargoes during October 1998 to October 1999. However, the annual number is sensitive to the price of oil, the production of Australian oil fields, and other market conditions.

Frequencies of future STS operations can therefore not be predicted with precision. This study assumes that by 2020 the number has increased to 12 per year. For simplicity, all are assumed to take place in the same sea area.

Offshore loading from production facilities into shuttle tankers are treated separately in Section I.5.3.

I.2.10 Future Growth

The overall future growth rate in port visits has been estimated as 2.0% per year (BITRE 2010b for FY2009-10 and FY2019/20).This source also estimates the number of port calls in Australian ports during FY2009-10 as 27,027, and so is consistent with the AMSA data above. An AMSA internal forecast based on the BITRE data used a growth rate of 2.2% per year, and hence estimated that traffic in 2020 will be 24% higher than in 2010. It applied this same growth rate to all ports.

Several ports have specific expansion plans. Table I.2.5 shows the growth in ship movements estimated by 2015 assuming these plans are implemented (AMSA 2011c). For convenience, new ports have been included under the nearest existing port. If it is assumed that growth continues at 2% per year in ports with no specific expansion plans, and after the

specific expansions currently planned, where these will be complete before 2020, this results in an overall national growth of 45% by 2015 and 79% by 2020. This is an average growth of 6% per year. Although much higher than previously assumed, this is adopted for the present study.

Table I.2.5 Estimated Growth by 2015 for Ports with Expansion Plans

PORT	2015 VISITS / 2010 VISITS	NOTES
Weipa, QLD	1.71	
Cape Flattery, QLD	1.67	
Cairns, QLD	1.65	
Mourilyan, QLD	2.42	
Lucinda, QLD	1.50	
Townsville, QLD	1.50	
Abbot Point, QLD	2.00	
Mackay, QLD	1.49	
Hay Point, QLD	2.00	
Port Alma, QLD	4.76	Includes Balaclava Island
Gladstone, QLD	1.39	
Newcastle, NSW	1.21	
Port Botany, NSW	1.12	
Port Kembla, NSW	1.14	
Port Adelaide, SA	1.29	
Port Pirie, SA	4.00	
Port Bonython, SA	2.99	Includes Port Augusta
Port Lincoln, SA	1.44	Includes Sheep Hill & Cowell
Thevenard, SA	1.10	
Esperance, WA	1.30	
Albany, WA	1.54	
Bunbury, WA	1.64	
Kwinana, WA	1.12	
Fremantle, WA	1.22	
Geraldton, WA	2.00	
Exmouth, WA	250.00	From a very low base
Onslow, WA	5.71	Includes Ashburton North
Barrow Island, WA	20.92	
Cape Preston, WA	2.65	
Dampier, WA	1.50	
Port Walcott, WA	1.98	Includes Mount Anketell
Port Hedland, WA	3.49	
Broome, WA	1.50	Includes James Price Point
Darwin, NT	1.39	

I.3 SHIPPING TRAFFIC DATA

I.3.1 Quantity and Trend of Shipping Traffic

The total exposure of trading vessels at sea in the Australian EEZ is estimated as 2.04 million ship-hours per year. This is based on AUSREP data for 2009, which includes a total of 371,557 reports. This has been analysed by DNV to sum the time intervals between successive reports from the same voyage. This method slightly under-estimates the total exposure because the first report may be up to 2 hours after leaving port, and the last report may be before leaving the AUSREP area. It excludes traffic in the AUSREP area that is outside the Australian EEZ.

The total distance travelled by trading vessels at sea in the Australian EEZ is estimated as 58 million ship-km per year. This is based on AUSREP data for 2009, which has been analysed by DNV to multiply the time intervals between successive reports from the same voyage by the reported ship speed and sum the results.

The average historical growth rate in traffic is estimated as 13% per year (based on analysis of AUSREP by AMSA 2010). This is also consistent with the difference between the current exposure of 58 million ship-km per year and the previous risk assessment (DNV 1999), which estimated a distance of 11.8 million vessel-miles per year (21.9 million vessel-km per year) in 1998. However, given the much smaller increase in port traffic, it is possible that some of this change is in fact from more comprehensive reporting to AUSREP rather than increased traffic.

The estimated future growth rate is therefore assumed to be 3.6% per year, as for port traffic.

I.3.2 Ship Type Breakdown

Ship types have been grouped as follows:

- Oil tankers, including the AUSREP categories:
  - asphalt tanker
  - bitumen tanker
  - bunker tanker
  - crude oil tanker
  - floating storage offtake
  - FPSO
  - products tanker
  - tanker

- Chemical tankers, including the AUSREP categories:
  - chemical tanker
  - chemical/oil tanker

- Bulk carriers, including the AUSREP categories:
  - bulk carrier ore strengthened
  - bulk cement carrier
  - bulk wood chip carrier
  - bulker
  - bulker open hatch

  - ore carrier
  - ore/bulk/oil carrier

- General cargo ships, including the AUSREP categories:
  - deck cargo ship
  - general cargo ship
  - multi-purpose ship

- Container ships.

- Other ships, including the AUSREP categories:
  - anchor handling/tug
  - anchor handling/tug/supply
  - anti-pollution vessel
  - barge
  - buoy tender
  - cable repair ship
  - cable ship
  - crewboat
  - cruise ship
  - cutter suction dredger
  - diving support vessel
  - drillship
  - fisheries research
  - fisheries training
  - fishing vessel
  - heavy lift ship
  - hopper barge
  - hopper suction dredger
  - livestock carrier
  - LNG carrier
  - logistics vessel
  - LPG carrier
  - maintenance/utility vessel
  - multi-hull passenger ferry
  - multi-hull passenger/vehicle ferry
  - naval vessel
  - oceanographic vessel
  - offshore construction vessel
  - offshore maintenance/utility vessel
  - offshore support vessel
  - oil well stimulation vessel
  - passenger vessel
  - passenger/cargo ship
  - passenger/train/vehicle ferry
  - passenger/vehicle ferry
  - patrol vessel
  - pipe carrier/platform supply
  - pipe laybarge
  - pipelay vessel
  - pleasure craft
  - pleasure craft - motor

- pleasure craft - sail
- pusher tug
- reefer
- refrigerated fish carrier
- research vessel
- rock laying ship
- ro-lo
- ro-ro
- ro-ro barge
- ro-ro/heavylift
- sail training vessel
- seismic survey vessel
- semi-sub heavy lift vessel
- semi-submersible mobile offshore
- suction dredger
- supply vessel
- support ship
- training vessel
- transshipment vessel
- tug
- tug & barge combination
- unknown
- vehicle carrier
- whaling vessel

Table I.3.1 gives the overall ship type breakdown in the AUSREP data. The percentages are based on a sample of 65,000 reports, and multiplied by the total estimated exposure. The results are similar to those for port visits, as expected.

Table I.3.1 Ship Type Breakdown in AUSREP Data, 2009

SHIP TYPE	EXPOSURE (million ship-hours)	%	AVERAGE SPEED
Oil tankers	0.21	9%	12.3
Chemical tankers	0.09	4%	12.5
Bulk carriers	1.05	45%	12.3
General cargo ships	0.17	7%	11.9
Container ships	0.29	12%	16.6
Other ships	0.53	22%	9.5
All ships	2.34	100%	12.1

I.3.3 Ship Size Breakdown

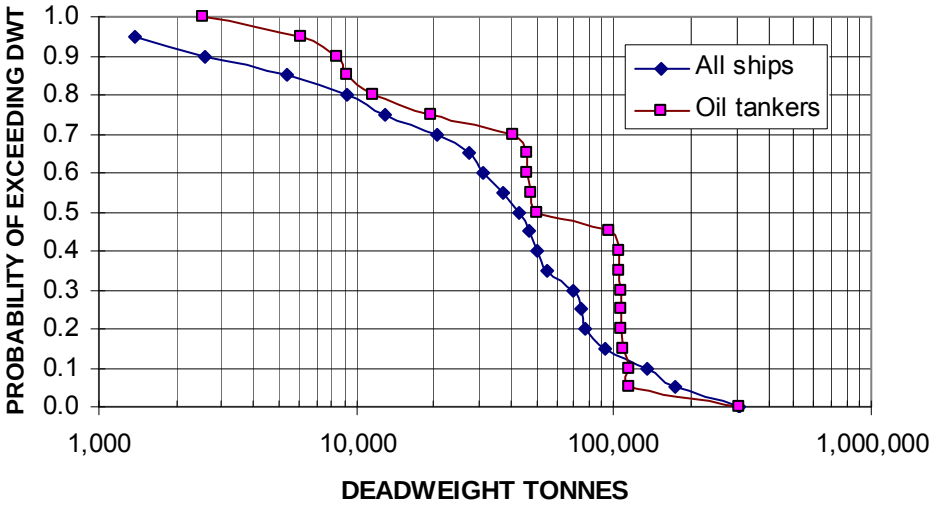
Table I.3.2 gives the ship size breakdown. Where the deadweight of a ship is not known, the gross tonnage (GT) is converted into an estimate of deadweight as in Section I.2.3. The table shows that bulk carriers are mainly large, while “other ships” (as defined above) are mainly small. Compared to Table I.2.2, this table takes account of the time at sea, but in practice it is not significantly different, given that it is based on an entirely different dataset.

Table I.3.2 Ship Size Breakdown in AUSREP Data, 2009

SHIP TYPE	<10k dwt	10-50k dwt	>50k dwt	ALL SIZES
Oil tankers	19%	30%	51%	100%
Chemical tankers	8%	82%	10%	100%
Bulk carriers	0%	31%	68%	100%
General cargo ships	37%	58%	5%	100%
Container ships	3%	68%	29%	100%
Other ships	71%	23%	6%	100%
All ships	21%	38%	41%	100%

Figure I.3.1 shows the size distribution of the AUSREP reports. Oil tankers are generally larger and clustered around standard sizes of 50,000 and 100,000dwt, whereas other ships are more smoothly distributed. In terms of gross tonnage, oil tankers are very similar to other ships.

Figure I.3.1 Ship Size Distributions in AUSREP Data



I.3.4 Pilotage Data

Figure I.3.2 shows the main shipping routes in the Great Barrier Reef and Torres Strait (AMSA 2001). The numbers of voyages piloted under the compulsory pilotage requirements (see above) during 2009 were:

- Great Barrier Reef Hydrographer's Passage - 1642 voyages, including 9 oil tankers.
- Great Barrier Reef Inner Route - 2139 voyages, including 78 oil tankers.
- Torres Strait Great North East Channel - 972 voyages, including 346 oil tankers.

The numbers of piloted voyages in the Great Barrier Reef have grown by 12% per year for the Hydrographer's Passage and 0.2% per year for the Inner Route, since 2000. Because compulsory pilotage was introduced for the Torres Strait in 2006, no such comparison is possible there. It is believed that all these vessels are included in the AUSREP data.

Figure I.3.2 Shipping Routes in the Great Barrier Reef and Torres Strait

I.3.5 Ship Movements in the Antarctic Territory

Ship movements in the Australian Antarctic Territory (AAT) EEZ include re-supply vessels servicing Australian research stations and foreign-flagged vessels servicing stations operated by other nations within the AAT, research vessels, fishing vessels and some limited ship-based tourism. Movements and vessel types are given by AUSREP. Although the western part of the EEZ (region AAT-1) is outside the AUSREP region, it has similar ship density to the central part (region AAT-2), and so reporting is assumed to be comprehensive and the AUSREP data is used directly in the model.

I.3.6 Double Hulls

Virtually all oil tankers are now of double-hull design. Most single-hull oil tankers were phased out of operation by the end of 2010. A very small proportion are permitted to remain in operation if they are less than 25 years old, pass condition assessments and are approved by the national administration. None of these now visit Australia. This change, which took place since 1990, is partly reflected in the tanker oil spill frequencies estimated in Appendix IV. A further reduction in the spill probability has been adopted to take account of the absence of single hull tankers in Australian ports and waters.

I.4 OTHER VESSEL DATA

I.4.1 Types of Other Vessels

The AUSREP and port data above focus mainly on large trading ships. The following types of vessel are also within the scope of the study but are not fully covered above:

- Coastal passenger vessels.
- Fishing vessels. Some report to AUSREP, but most of the smaller vessels do not.
- Harbour vessels, including tugs, dredgers, barges etc. Some report to AUSREP, but harbour vessels do not.
- Naval vessels. Some report to AUSREP, but most naval vessels do not.
- Recreational vessels. A few report to AUSREP, but most do not.

Sources of data for these vessels are presented below.

I.4.2 Small Commercial Vessels

There are many small commercial vessels (SCVs) that are within the scope of the study but are not included in the port and AUSREP data above. An analysis of commercial vessels in 2008 (AMSA 2009) recorded over 28,000 commercial vessels operating in state and territory jurisdictions in Australia. This study has collected data recorded by the individual state maritime authorities, totalling 16,100 vessels, registered in 2011. The difference is believed to result from vessels that are not registered with the state authorities, which are too small to give a pollution risk that would be relevant to the present study.

Commercial vessels are classified as:

- Class 1 – passenger vessels, i.e. vessels carrying more than 12 passengers.
- Class 2 – trading vessels, e.g. tugs, barges, dredgers and other vessels carrying no more than 12 passengers.
- Class 3 – fishing vessels.
- Class 4 – hire and drive vessels, e.g. cruisers, houseboats and powered dinghies.

They are also classified by their area of operation as follows:

A. Unlimited area of operation.
B. Offshore operations up to 200nm from the coast.
C. Restricted offshore operations up to 30nm from D waters or the mainland coast.
D. Operations within specified partially smooth waters.
E. Operations within specified smooth waters (generally inland waters).

F. Other/unknown.

Table I.4.1 shows the breakdown by type of all commercial vessels in the data supplied by the state authorities.

Table I.4.1 Type Breakdown in Commercial Vessel Data

VESSEL TYPE	VESSELS	%
Class 1 (passenger)	3633	23%
Class 2 (trading vessels e.g. tugs, barges)	7175	44%
Class 3 (fishing vessels)	4679	29%
Class 4 (hire & drive)	634	4%
Total	16121	100%

For the present study, the following are excluded:

- Vessels certified for unlimited area of operations (Area A), which are likely to be included as trading vessels in the data in Sections I.2 and I.3.
- Vessels certified for inland waters (Area E), which are outside the scope of this study.
- Vessels where the area of operations is unknown (Area F), which are mainly houseboats, pontoons, dinghies and sail boats.

Table I.4.2 shows the breakdown by type of vessels selected by eliminating vessels certified for Areas A, E and F from the above data. They cover the types of small commercial vessels relevant for the present study.

Table I.4.2 Type Breakdown in Small Commercial Vessel Data

VESSEL TYPE	VESSELS	%
Class 1 (passenger)	1200	10.5%
Class 2 (trading vessels e.g. tugs, barges)	5667	49.4%
Class 3 (fishing vessels)	4547	39.7%
Class 4 (hire & drive)	48	0.4%
Total	11462	100.0%

Table I.4.3 gives a breakdown of SCVs by State. In order to distribute these into the calculation sub-regions used in this study, it is assumed that they are distributed around the coast of each State in proportion to the distribution of port visits from trading ships in that State (Section I.2).

Table I.4.3 State Breakdown in Small Commercial Vessel Data

STATE	VESSELS	%
Queensland	3581	31%
New South Wales	2144	19%
Victoria	741	6%
Tasmania	1040	9%
South Australia	1447	13%
Western Australia	2038	18%
Northern Territory	471	4%
Total	11462	100%

Table I.4.4 gives the permitted areas of operation of SCVs. These correspond roughly to the three offshore distances used for calculation sub-regions in the present study.

Table I.4.4 Areas of Operation in Small Commercial Vessel Data

AREA OF OPERATION	VESSELS	%
Area B (offshore <200nm)	2382	21%
Area C (restricted <30nm)	6456	56%
Area D (partially smooth/unknown waters)	2624	23%
Total	11462	100%

The following assumptions are made, in order to obtain a distribution of SCV activity by distance from shore:

- SCVs are assumed to spend approximately 80% of their time in port and 20% at sea.
- The 23% of SCVs permitted to operate in Area D are assumed to spend all their 20% of time at sea in the near-shore region.
- The 56% of SCVs permitted to operate in Area C are assumed to split their time at sea equally between the near-shore and intermediate regions.
- The 21% of SCVs permitted to operate in Area B are assumed to split their time at sea equally between the near-shore, intermediate and deep-sea regions.

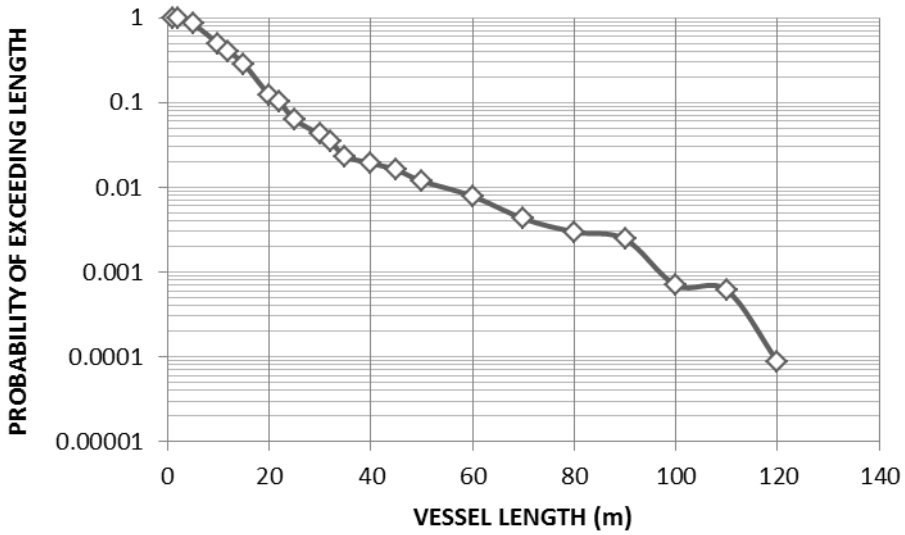
Table I.4.5 shows the overall breakdown SCV activity by distance offshore. This is of course very uncertain, and sensitive to the assumptions above.

Table I.4.5 Distribution of Activity for Small Commercial Vessels

AREA OF OPERATION	VESSEL YEARS	%
Near-shore (<12nm)	10,499	91.6%
Intermediate (12-50nm)	802	7.0%
Deep-sea (50-200nm)	160	1.4%
Total	11,462	100%

The size distribution of the SCVs is shown in Figure I.4.1. The median length is 10m, and only 1% exceed 50m.

Figure I.4.1 Size Distribution for Small Commercial Vessels



No information is available on displacement and bunker capacity. Based on an analysis of a small sample of vessels, the displacement (Δ in tonnes) is assumed to be:

$$\Delta = 0.021L^3$$

The oil fuel is assumed to be 15% of the displacement. For the median vessel size of L=10m, this gives a displacement of 21 tonnes and a fuel capacity of 3 tonnes. For vessels of this size, the fuel is assumed to be diesel oil.

I.4.3 Naval Vessels

The Royal Australian Navy consists of 62 vessels of various types. No suitable vessel activity data has been obtained that could be used in the present study. Naval vessels comprise a small addition to the population of commercial vessels, so detailed data collection is not justified. They are therefore neglected in the present study.

I.4.4 Recreational Vessels

Australia has over 800,000 recreational boats (Dickson 2009). Of these, 65% are less than 4.5m in length. No suitable activity data has been obtained for recreational vessels. They may be a significant addition to the population of small commercial vessels, but the spill quantities are mainly small, so detailed data collection is not justified. They are therefore neglected in the present study.

I.5 OFFSHORE ACTIVITY DATA

I.5.1 Drilling

The number of wells drilled offshore in Australia was reported by Geoscience Australia (2008). The drilling activity in 2007 (the most recent reported year) was:

- 29 new-field exploration wells
- 31 extension/appraisal wells
- 35 development wells

This totals 95 offshore wells of all types.

During the last decade, offshore drilling activity in Australia has fluctuated, with development drilling activity trending up (approximately 3% annual growth) while exploration drilling has no overall trend (DRET 2011). Therefore the current level of drilling is assumed to provide a reasonable estimate of average future drilling.

APPEA (2010a) lists all Australian wells quarterly. It includes 199 wells with some activity in 2009, but after eliminating wells spudded in 2008 and wells that appear in more than one quarter, there were 114 separate new wells in 2009. Table I.5.1 shows the breakdown by basin and well type.

Table I.5.1 Offshore Well Drilling in Australia in 2009

BASIN	EXPLORATION	APPRAISAL	DEVELOPMENT	TOTAL
Bass	2	1		3
Bonaparte	7		8	15
Browse	6	6		12
Carnarvon	29	11	21	61
Gippsland		1	15	16
Otway	1			1
Timor Sea	4	1	1	6
Grand Total	49	20	45	114

The locations of the basins are shown in Figures I.5.1 and I.5.2 (from Geosciences Australia http://www.ga.gov.au/oceans/rpg_OffNorthWestA.jsp). The Timor Sea region in Table I.5.1 is in fact part of the Bonaparte Basin.

Figure I.5.1 Basins Offshore Northwest Australia

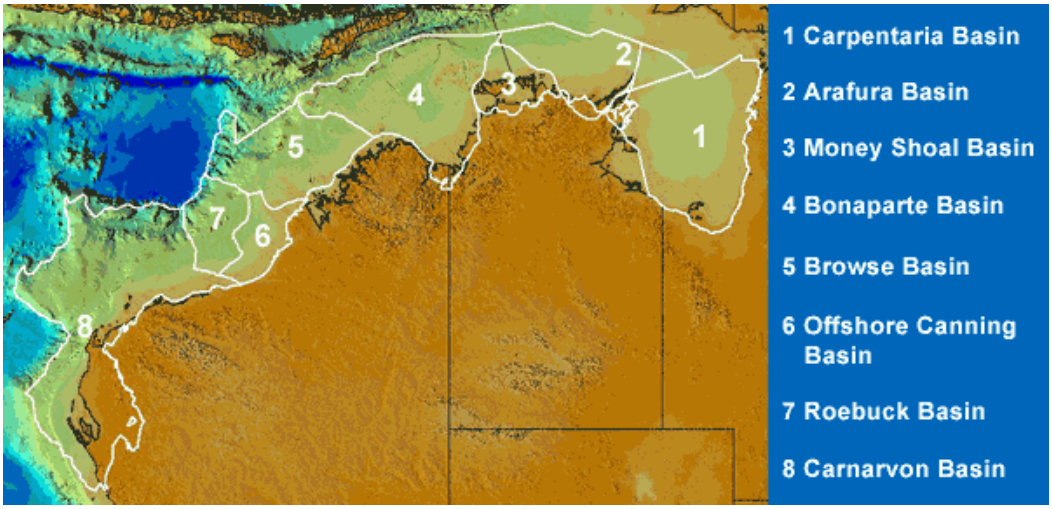
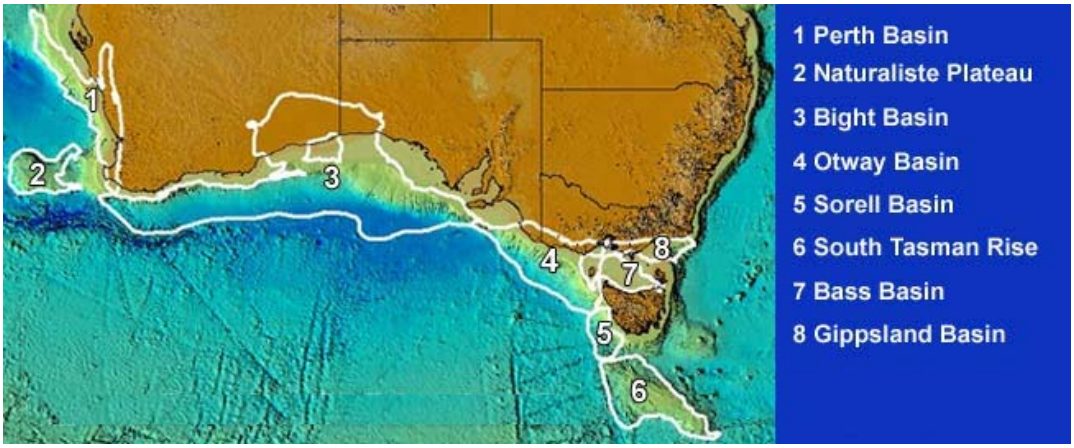


Figure I.5.2 Basins Offshore Southern Australia



I.5.2 Oil and Condensate Production

Australian offshore production during 2009-10 totalled 26.1 billion litres (26 million m^3 or 449,000 bbl/day) (DRET 2010). This was broken down as 17.2 billion litres of oil and 8.9 billion litres of condensate.

The forecast changes in production to 2020 (50%ile values) average a 2% per year reduction (Geoscience Australia 2008). The most recent projection for crude oil and condensate production is a slow decline by 2% per year to 2029/30 (ABARE 2010). The total conceals a much more rapid reduction for crude oil and an increase for condensate. By 2020, crude oil is predicted to have reduced by 89% while condensate is predicted to have increased by 73%, compared to 2010 production (ABARE 2010). The total oil and condensate production is predicted to decline by 35%. This includes onshore fields as well as offshore, but the results are assumed to apply to offshore production in the absence of a specific breakdown.

APPEA (2010b) lists most Australian production facilities in 2009. After eliminating onshore facilities, and including the complete production of the Timor Sea fields, it gives a total of

25.4 billion litres (160.0 million bbl/year), broken down as 13.7 billion litres of oil and 11.8 billion litres of condensate. Combined with information from Geoscience Australia (2010), it shows 77 separate facilities in production in 2009. Table I.5.2 shows the breakdown by basin and fluid type.

Table I.5.2 Offshore Production in Australia in 2009 (billion litres per year)

BASIN	OIL	CONDENSATE	TOTAL
Bass	0.00	0.11	0.11
Bonaparte	1.07	3.20	4.27
Carnarvon	8.78	7.36	16.14
Gippsland	3.60	0.99	4.59
Otway	0.00	0.10	0.10
Perth	0.23	0.00	0.23
Total	13.68	11.76	25.44

Information on offshore facilities, wells, risers and pipelines that was included in the previous risk assessment (DNV 1999), has been updated using information supplied by AMSA and published by the offshore operators. Facilities that were abandoned or out of service in 2009, or which do not produce oil or condensate, have been excluded. The total number of oil/condensate facilities in service is now estimated to be:

- 72 production installations
- 410 production wells
- 139 production risers
- 1135 pipeline km

I.5.3 Offshore Loading

The total quantity of oil and condensate loaded from Australian facilities (including the full production of the Bayu/Undan field) was 9.4 million tonnes in 2009. Based on an average off-take tanker size of 100,000dwt (50,000dwt for Wandoo) and a minimum of 1 loading per year at each field, the total number of offshore tanker loadings is estimated as 106 per year.

I.5.4 Refinery Production

The crude oil input to Australian refineries in 2009-10 was 37.7 billion litres, consisting of 6.4 million litres (17%) from indigenous production and 31.3 million litres of imports (DRET 2010)

DRET (2010) also gives the imports and exports of various petroleum products. Combining imports and exports, eliminating liquefied gases, and converting from litres to tonnes using representative densities for each product, the distribution of products is as shown in Table I.5.3.

Table I.5.3 Petroleum Product Types Shipped to/from Australia in 2009-10

PRODUCT	MILLION LITRES	MILLION TONNES	% MASS
Crude oil	45,334	36.3	70%
Gasoline	4,142	3.1	6%
Aviation fuel	2,240	1.8	4%
Diesel oil	8,867	8.0	15%
Fuel oil	1,906	1.7	3%
Lubricating oil	814	0.7	1%
Bitumen	295	0.3	1%
Total	63,598	51.8	100%

The fuel oil in the table is mainly marine bunker cargoes exported. In addition, 260 million litres (0.2 million tonnes) of fuel oil are exported in ships' bunker tanks (DRET 2010). Sales figures show that 1008 million litres (0.9 million tonnes) of fuel oil and marine diesel fuel are sold in Australia (DRET 2010), which probably includes the exports in ships' bunker tanks as well as domestic consumption.

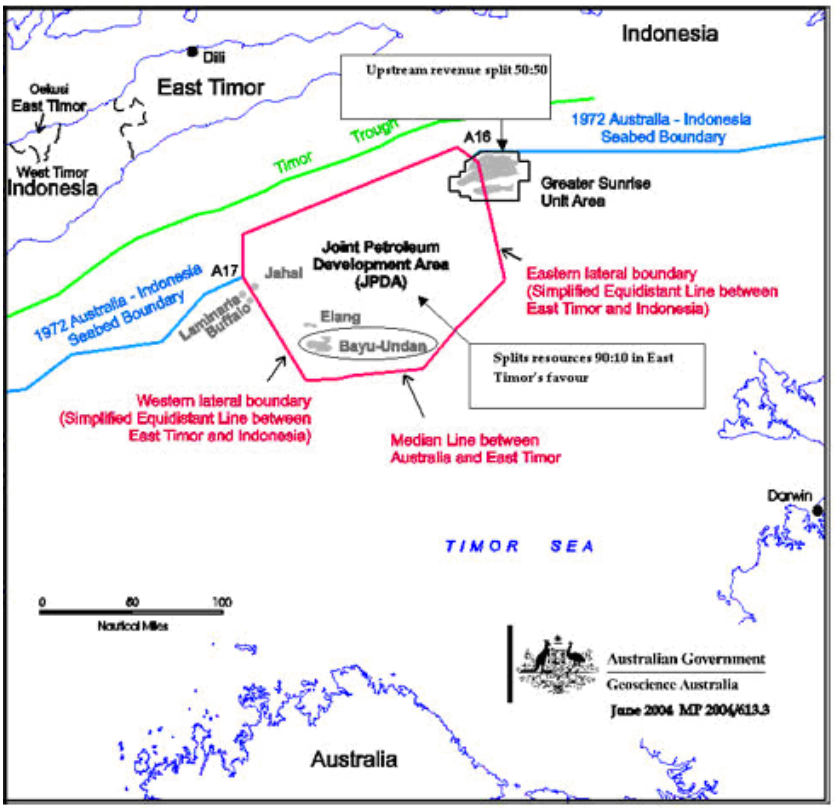
Bunker fuel consumption for a typical 50,000 dwt ship would be approximately 20 tonnes per day at sea (0.83 tonnes per hour) (DNV 2001). Based on the total exposure from powered ships in the AUSREP area in 2009 of 4.7 million vessel-hours per year, the oil consumption within the Australian EEZ is estimated as 4.7 x 0.83 = 3.9 million tonnes.

I.5.5 Production in Neighbouring Countries

The Kutubu development in Papua New Guinea is an onshore oil field that exports oil via a 265km pipeline to a marine loading terminal in the Gulf of Papua. The Kutubu crude oil is a light, sweet 45 degree API oil (SG = 0.8, 7.8 bbl/tonne). Production peaked in 1993 at 130,000 bpd. In 2010, production was 6.1 mmbbl (i.e. an average of 17,000 bpd) (based on OilSearch 2010). The marine terminal is an SPM located 40 km off the southern coast of Papua New Guinea (latitude 08°06'00" longitude 144°33'49"E). It can accept tankers up to 150,000 dwt, but a typical load is 90,000 tonnes. This implies an average of 9 tanker loadings per year.

Offshore developments between Australia and East Timor take place within the Joint Petroleum Development Area (JPDA), which establishes a temporary division of revenues (90% East Timor, 10% Australia). The area is shown in Figure I.5.3. At present, Bayu-Undan is the only operating field in this area, and is included in the data in Section I.5.2. A second field, Kitan, is expected to begin production during 2011.

Figure I.5.3 Timor Sea Boundaries



I.6 MARITIME SAFETY MEASURES

I.6.1 Relevant Measures

Maritime safety measures that significantly affect oil spill risks include:

- Traffic separation schemes
- Vessel Traffic Services areas
- Compulsory pilotage areas
- Emergency Towage Vessels

The availability of these measures in the Australian EEZ is summarised as follows.

I.6.2 Traffic Separation Schemes

There are two traffic separation schemes (TSS) in the Bass Strait with separate eastbound and westbound lanes, intended to protect the offshore installations in the area. They are:

- Bass Strait – sub-region VIC-1-I
- South of Wilson's Promontory – sub-region VIC-1-N

I.6.3 Vessel Traffic Services

The Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS) was established in 2004 to enhance navigational safety. It incorporated the earlier REEFREP reporting system, which was introduced in 1997. Reporting requirements apply to oil, chemical or liquefied gas tankers, and all other vessels over 50m length except Defence Force vessels. The REEFVTS area is shown in Figure I.6.1. An extension of the southern boundary from 22°S to 35°S is planned (Figure I.6.2).

Through the integrated use of AIS, Radar, Automated Position Reporting via Inmarsat-C, VHF reports and detailed route plans provided by vessels, REEFVTS compiles a timely and accurate traffic image of shipping throughout the region. It generates ship encounter predictions and disseminates them to ships via Inmarsat-C messaging or VHF voice communications. Where information available to REEFVTS may assist in onboard decision making, the VTS operator may contact the ship to provide this information. This may include instances where a ship may be standing into shallow water or deviating from a recommended route.

Figure I.6.1 REEFVTS Area

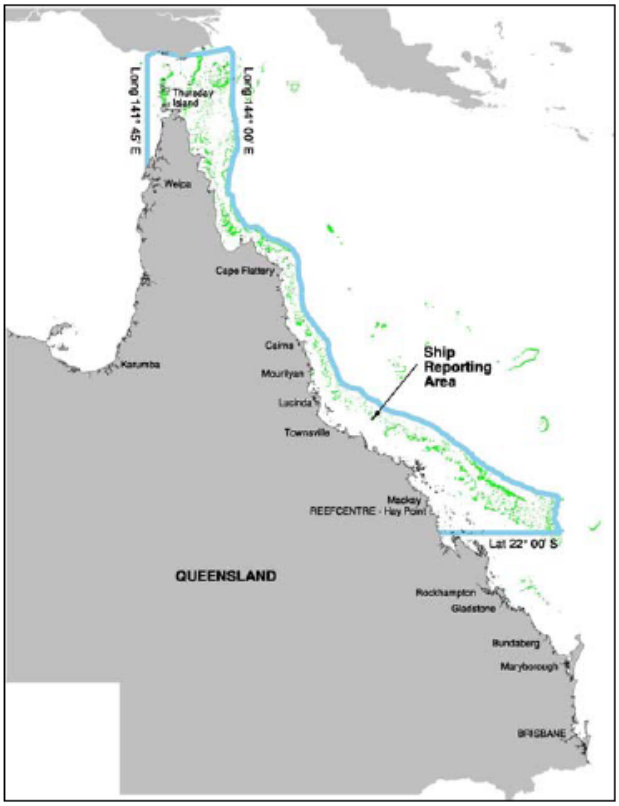
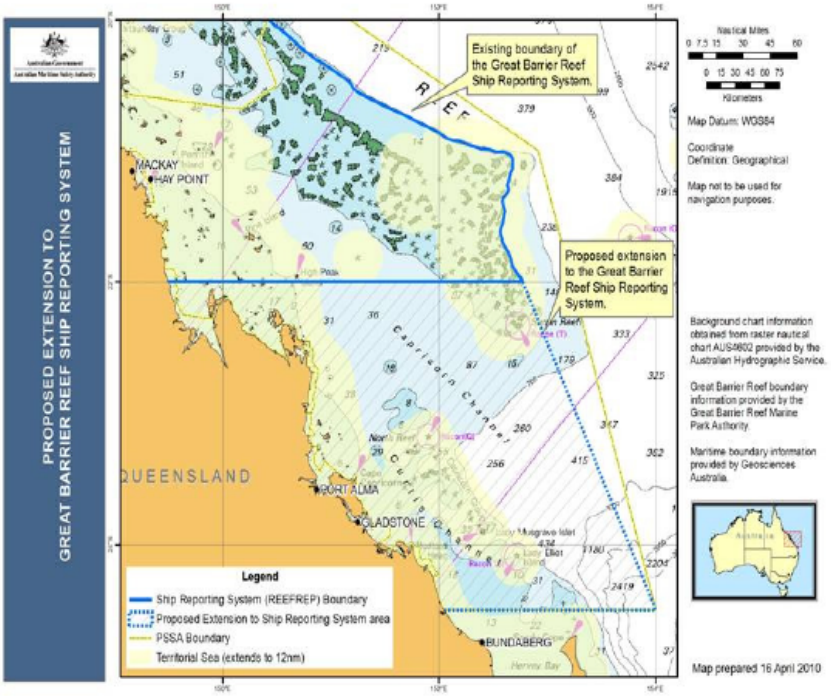


Figure I.6.2 Extension to REEFVTS Area



A radar-based VTS will be operational at Port Botany from 2011. VTS is likely to be adopted in several other ports, but in the absence of specific information, no other changes are modelled..

I.6.4 Compulsory Pilotage

Compulsory pilotage also applies in the Great Barrier Reef and Torres Strait (REEFVTS areas). All loaded oil, chemical or liquefied gas tankers, and all other vessels over 70m length, except Defence Force vessels, are required to use licensed pilots with specialist local knowledge.

I.6.5 Emergency Towage Vessels

Emergency Towage Vessels (ETVs) are located in strategic Australian coastal regions to provide an appropriate level of emergency towage capability to deal with a significant threat to Australia's marine environment. The emergency towage capability (ETC) consists of a three-tiered approach as follows (AMSA 2011b).

Level 1

AMSA has contracted Australian Maritime Systems (AMS) Limited, in conjunction with Swire Pacific Offshore, to supply and operate under AMSA's direction, a dedicated chartered ETV to provide emergency towage and first response capability in the Torres Strait and Great Barrier Reef area north of Cairns/Mourilyan.

The vessel, named Pacific Responder, has its home port in Cairns but spends the majority of its time at sea, available for emergency tasking by AMSA should a maritime incident occur. The vessel is also able to respond to other marine incidents, such as pollution of the sea and search and rescue action.

This vessel is engaged in maintenance of the aids to navigation network in its area of operation, and this part of its role is undertaken for approximately 100 days per year. However, the vessel's first response capability during a shipping incident, either actual or potential, will take precedence over its aids to navigation maintenance role.

The Pacific Responder has a maximum speed of 14 knots and a bollard pull of 80 tonnes.

Level 2

Emergency towage capability for the remaining areas around the Australian coastline is ensured by contracted suitable towage vessels with appropriately trained crews that normally undertake existing port or other operations. These vessels are contracted by AMSA to be available to be called upon in the event of an incident. Operators are paid by AMSA to ensure the availability of appropriate ocean-going vessels and the training of their crews for emergency towage operations.

AMSA currently has the following ETC contracts:

- RiverWijs-Dampier - ETC in North-West Western Australia. This is provided by four 65 tonne bollard pull tugs based at the Withnell Bay LNG export facility in Dampier.

- Svitzer ETC in 7 other strategic regions around Australia. For the purposes of this study, typical tug locations are taken to be:
    - Mackay, QLD
    - Brisbane, QLD
    - Sydney, NSW
    - Melbourne, VIC

- Port Adelaide, SA
- Fremantle, WA
- Darwin, NT

Information from tug operators (NSW Maritime 2011) indicates a typical transit speed through open waters of 8 knots. The time to mobilise is 4 hours. The time to transit the harbour is 30 minutes (in the case of Sydney), and the time to connect the tow is 30-60 minutes in good conditions.

Level 3

These will be suitable vessels that are in the relevant area at the time of the incident that are used as "vessels of opportunity". There is expected to be a range of vessels around the coast that would potentially be suitable for emergency towage work, such as offshore tender vessels, and these could be considered to undertake such a role if necessary to supplement, or substitute for, the Level 1 and 2 vessels according to the circumstances of each case.

Over the past 5 years there has been an increase in the number of harbour towage operators in Australian Ports. In particular:

- PB Towage is a growing tug and barge operator in Australasia. There are two divisions, PB Towage Australia with 17 tugs focussing on harbour towage around the coast and PB Sea-Tow with 11 tugs in the oil & gas and construction sector.

- SMIT Australia operates towage for the port of Gladstone, Queensland, with 5 new 70 tonne bollard pull tugs.

The availability and suitability of harbour tugs for emergency towage is uncertain, and so in this study only the tugs at Gladstone are explicitly represented.

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