REPORT

RISK ASSESSMENT OF EMERGENCY TOWING AND SALVAGE CAPABILITIES

AMSA/DOTARS

REPORT NO MS/314/2004/145
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DET NORSKE VERITAS

REPORT

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Summary:

The objective of the study is to provide DOTARS and AMSA with an independent assessment of whether the current towing and salvage capacity along the coastline is sufficient to sustain the level of environmental risk of the 2000 baseline. If assessed as not being sufficient, the study will identify the cost of any additional capacity required to bring the risk down to the 2000 level and quantify the costs of the necessary additional efforts the next 5 years.

The work has been carried out in five tasks:

- Task 1 – Trends in Shipping Incidents in Australian Waters
- Task 2 – Identify Trends in Availability of Emergency Resources
- Task 3 – Environmental risk model for the Australian Coastline
- Task 4 – Identification of capacity gaps and risk control options to minimise gaps
- Task 5 – Cost analysis and effect of risk control options

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Report title:
Risk Assessment of Emergency Towing and Salvage Capabilities

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1 EXECUTIVE SUMMARY

Based on the updating of DNV's 2000 risk assessment, the following main conclusions can be made regarding the environmental risk, i.e. risk of oil and chemical spills from ship activities, along the Australian coastline:

- Overall environmental risk is 7% lower today than five years ago, and is likely to further reduce over the next five years. The main reason for the reduced risk is the general global reduction in accident frequency, due to e.g. implementation of more robust port state control regimes, improved ship design, higher crew competence, implementation of ISM, etc.
- Ports (including approaching port) represent 75% of the total risk;
- The number of shipping incidents and volume of oil spills in Australian waters has fallen steadily over the last 15 years;
- The minor changes that have been for emergency towing and salvage capacities in Australia the last five years have had no significant influence on the risk level;
- Both towing and salvage capabilities exist in all high risk areas.

From a risk point of view the effect of an increased emergency response capacity is small. The cost-effectiveness of subsidising private contractors to introduce dedicated emergency towing and salvage vessels is expected to be low. The current coverage, regulated by market forces, does not lead to any increase in risk level compared to the situation five years ago. The coverage may of course decrease when future demands for the service providers change, but the indications given by most stakeholders in the industry are promising. The capability could decrease if service providers reallocate vessels overseas, but the view across the whole industry is that any capacity gaps will be filled by market forces.

For certain accident types, towing vessels are effective measures. However, due to the small proportion of ship accidents that can be prevented by means of tugs (i.e. drift groundings), representing less than one incident per year since 1990, the impact on the total risk level is low. Improved salvage coverage would mitigate consequences of all types of accidents requiring assistance, but the actual benefit in terms of reduced risk of pollution is limited. In comparison to towing, salvage is normally a longer term exercise that allows the sourcing of vessels and equipment from further away, with the possible use of local harbour towing vessels for interim stabilisation.

Interviews with the stakeholders reveal consensus that the current emergency response coverage is adequate, and that tugs based in Australian waters would be released as soon as they were needed for an emergency situation. It was generally expected that resources deployed in Australian waters would meet the future demands of the ports and the offshore industry, and that towing and salvage capable vessels would be involved in these sectors. No companies, authorities and other shipping industry peak bodies consulted are aware of a situation where the response has been delayed or was not adequate.

2 BACKGROUND

To protect the marine environment from pollution as a result of shipping incidents, the Australian authorities want to ensure that there is the necessary emergency towing and salvage capacity available along the Australian coastline. The Australian Transport Council is currently considering whether there is a public policy need to ensure the availability of a minimum level of capacity.

DNV has been commissioned by The Department of Transport and Regional Services (DOTARS) and the Australian Maritime Safety Authorities (AMSA) to undertake a risk assessment and cost assessment for Australia's emergency towing and salvage capacity.

The study intends to evaluate how the environmental risk in Australian waters has changed compared with the situation five years ago, how the emergency towing and salvage capacity has changed in the same period, and to assess how the emergency towing and salvage capacity influence the risk level. This capacity involves preventative emergency towage capacity and the ability to respond to the recovery of a ship that has already become a casualty (salvage) and may also involve actions to prevent pollution of the marine environment as a result of a casualty.

This study is based on DNV's report on Risk Assessment of Pollution from Oil and Chemical risk in Australian Ports and Waters (2000) [DNV 2000 study], ref. /1/, and K. Dwyer & Associates Pty Ltd's report on National Salvage Capacity (2002) [K. Dwyer report], ref. /2/.

3 OBJECTIVE AND SCOPE OF WORK

The objective of the study is to provide DOTARS and AMSA with an independent assessment of whether the current emergency towing and salvage capacity along the coastline is sufficient to meet the environmental risk level of the 2000 baseline. If assessed not sufficient, the study will identify the cost of any additional capacity required to bring the risk down to the 2000 level and quantify the costs of the necessary additional efforts for the next 5 years.

The work has been carried out in five tasks. Ref. /1/ and ref. /2/ have been used as extensively as possible. The tasks are described in the following.

- **Task 1 – Trends in Shipping Incidents in Australian Waters**

  The incident trend for ships in Australian waters is investigated in order to identify incident locations and the importance of the emergency towing and salvage capacities. The project also indicates the types and location of incidents where emergency towing and salvage capacity would materially assist in preventing a casualty resulting in pollution.

- **Task 2 – Identify Trends in Availability of Emergency Resources**

  The project has mapped the current available emergency towing and salvage capable vessels for the Australian coastline over the last five years. A five year projection is also made to estimate the future adequacy of emergency resources, taking into consideration the number and capabilities of vessels that are available for emergency towing and their effectiveness in the next five years.

- **Task 3 – Environmental risk model for the Australian Coastline**

  The input to the environmental risk model from the DNV 2000 study has been re-investigated to identify needs for updating to 2004 level. The important input parameters has been changed and the new model has been run to provide data for any changes in risk and the ability to evaluate the effect of new measures.

- **Task 4 – Identification of capacity gaps and risk control options to minimise gaps**

  Task 1 and 3 enables an understanding of the high risk areas along the Australian coastline, whilst Task 2 provides a mapping of the emergency towing and salvage capacities. Where (if) gaps between risk and capacities are found for the next five years, risk control options will be identified in an attempt to bring the risk to the risk baseline (i.e. risk level in DNV 2000 study).

- **Task 5 – Cost analysis and effect of risk control options**

  Where (if) gaps between risk and capacities are found for the next five years, the proposed measures on emergency resources will be evaluated and their annual cost and effect on the risk level will be indicated.

4 APPROACH

The project has basically covered three aspects:

1. trends for the environmental risk,
2. trends for tug availability,
3. identification and reduction of potential gaps

Item 1 is mainly based on the risk model in the DNV 2000 report, in addition to new input from AMSA and the industry, as well as various accident data sources and databases. Item 2 is based on input from the industry obtained by telephone conversations and questionnaires, as well as the K Dwyer report. The mapping of risk versus emergency resources sought to identify potential gaps and risk control options to bring the risk down to the baseline.

The project has built upon the previous studies as much as possible.

4.1 General

Environmental risk is in this study defined as accidental spills of oil and chemicals to sea from ship activities.

4.1.1 Review of DNV 2000 risk model

The environmental risk assessment for the Australian coast has been based on the DNV 2000 study. This project included a total risk assessment of oil and chemical spills in Australian ports and waters as a part of the review of the National Plan to combat pollution of the sea by oil and other noxious and hazardous substances.

The results of the risk assessment include numerical data and maps identifying the total frequency and risk of spills due to all sources considered, for each of the three industry sectors oil, ports and ship at sea. The most important input parameters to the model have been updated, and the model run again.

4.1.2 Baseline for Risk Evaluations

For the purpose of this study, the environmental risk level in 2000, as described in the DNV 2000 report, has been used as a baseline to measure all risk changes. All increases in risk compared to 2000 are addressed and linked to emergency towing and salvage capabilities.

4.1.3 Study Areas

As for the DNV 2000 study, the Australian coast has been divided into 31 regions, each approximately of the same coastal length, see Figure 4-1. The outer boundary of the study area is defined by the Australian Exclusive Economic Zone. The major ports are also indicated in Figure 4-1.

Each region is divided into three main zones:

- Near shore, 0-12 nautical miles (nm)
- Intermediate, 12-50nm
- Deep sea, 50nm to AEEZ boundary, typically 200nm

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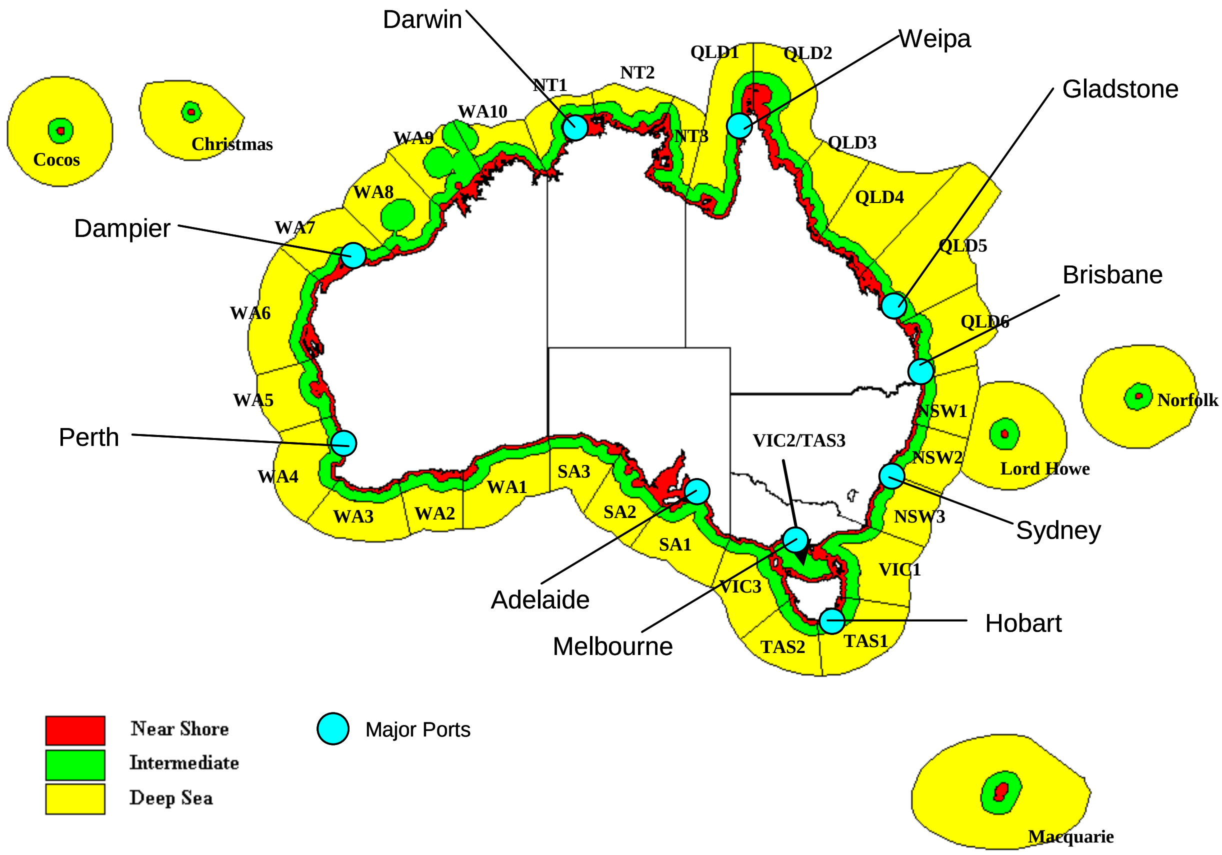

Figure 4-1 Study Areas

Each region, including its ports, is given a unique name consisting of the state prefix (as defined in Table 4-1) and a number. A unique reference for each sub region is obtained from the regional identifier plus N, I or D for near shore, intermediate or deep sea respectively.

Table 4-1 State prefixes used for defining region names

State	Prefix
Queensland	QLD
New South Wales	NSW
Victoria	VIC
South Australia	SA
Western Australia	WA
Northern Territory	NT
Tasmania	TAS
Norfolk Island	NOR
Lord Howe Island	LHW
Macquarie	MAC
Christmas Island	CH
Cocos Keeling Island	COC

This breakdown has been used both when assessing the risk and incident trends, as well as the mapping of the emergency towing and salvage capabilities..

4.2 TASK 1: Incident Trends from Historical Data

The approach for this task is mainly based on gathering, comparing and analysing historical accident information related to Australian waters. The main tasks carried out were:

- Gather information related to incidents along Australian coastline
- Identify areas along the Australian coastline which are highly exposed to incidents. The robustness of the results will be examined through comparison with the different information sources
- Analyse the importance of towing and salvage as preventive measures

4.2.1 Data Gathering

Data on incidents in Australian waters are gathered as part of the process of identifying the accident trends.

Since 1970, pollution incidents in Australia which are reported have been compiled and utilised for statistical purposes, ref. /3/. This database has information on the vessel name, pollution type, spill size, occurrence site and location.

To ensure robustness of the results, different data sources have been compared. Information on incidents in Australian waters from Lloyd's Register and Fairplay (LRFP) database, ref. /4/, has therefore been analysed. The LRFP database is the most extensive world-wide maritime accident database. However, only the more severe incidents are reported in this database. Smaller incidents which do not result in spillages or casualties are not included in LRFP.

Oil spills reports and inquiry reports from the AMSA website, have also been analysed, as well as information on the reported salvage incidents in Australian waters since 1990.

A substantial amount of data has also been gathered in the DNV 2000 report. These data have been used as extensively as possible for this task.

4.2.2 Incident Patterns and Importance of Towing and Salvage Vessels

The incident data described in the above have been analysed and used to identify patterns of maritime pollution incidents in Australian waters. The analysis is done both in terms of incident locations, ship types and spills sizes.

A coarse assessment has been done in order to give an indication of the importance of towing vessel capacity, identifying the proportion of incidents where a towing vessel could have prevented the accident from happening.

The reported salvage cases have also been analysed to identify which towing and salvage vessels have been used, locations, etc.

4.3 TASK 2: Mapping of Emergency Resources

4.3.1 Data Gathering

The objective of Task 2 is to identify trends in the availability of emergency towing and salvage resources around the Australian coastline. The intention is to characterise the capacity at the present time (2004), five years ago (1999) and in five years time (2009). The sources included:

- Information provided by DOTARS and AMSA – including a one-day briefing and the K. Dwyer Review of the National Salvage Capacity;
- Information sourced directly from stakeholders via telephone interviews which were conducted according to the requirements of a questionnaire;
- Information from earlier studies and sourced directly from technical libraries and/or the internet.

This process sought information from local and international operators and responsible parties (e.g. state regulators) about those characteristics which combine to determine the quality of response that might be mounted from a particular location, specifically:

- Location(s) under consideration – information was sought regarding local wind and sea conditions, the nature of the physical geography (with respect to maritime operations), the availability of anchorages, the room available for manoeuvre, remoteness and other considerations the stakeholder felt deserved a mention;
- Number of towing and salvage vessels at the location(s) – Vessel specific data was collected from each stakeholder (where they had direct responsibility for towing and salvage vessels) in order to characterise e.g. the capability in terms of normal operating role, bollard pull, speed, etc. As far as practicable this information was gathered for each vessel in the fleet under consideration;
- Stakeholder's view of the adequacy of the local/wider situation five years ago, what it is like in the present day and what they anticipated would be the trend over next five years. This element included the specific question "Are you aware of an instance where support has not been available?"

The complete fleet list summarising what was received from all of the respondents is included as Appendix A. The statements about 10 year trends and other general comments from the respondents are included as Appendix B.

4.3.2 Data Processing

The data collected during the first phase of Task 2 has been entered into spreadsheets, detailing the ports in each sector (or the closest port), the amount of traffic in that sector (based upon stakeholder interviews and shipping density plots), the relative wind strength in that sector as well as characterising factors for sea conditions, remoteness, cyclone threats etc.

The tug capacity within each geographical sector was then mapped, based on the number of vessels in the given sector including those that have an ocean going capability, any specialist equipment maintained in the sector (e.g. fire fighting, towage, salvage), the bollard pull, speed, crew numbers etc.

4.3.3 Data Output

The output from Task 2 is the following:

- Questionnaires, most important output is included in Appendix A and Appendix B
- Emergency Response (by State) and Salvage (National) diagrams which are based upon the information collected, but include assumptions regarding vessel speed, ability to make headway in all conditions etc., ref. Appendix C

4.4 TASK 3: Updating of Risk Model

DNV has carefully re-investigated the risk model to see whether there have been any changes that would affect the current study. For the purpose of the current project, the risk model is a tool to identify areas with higher risk and to evaluate the effect of risk control options. To provide "hard" numbers to base the conclusions upon, the risk model has been updated so that the new risk results can be documented.

There are a lot of input parameters to the risk model; however, some parameters are not expected to have changed since 2000, e.g. weather conditions, and were therefore not revisited. The parameters that have been re-investigated and updated in the new model are:

- Traffic data for the commercial fleet – trade patterns, ship types, ship sizes, hull designs (DH/SH), etc.
- Generic failure frequencies
- Current availability of emergency towing vessels
- Current availability of salvage vessels
- Pilotage
- Vessel Traffic Service (VTS)
- Other regulatory control measures

Data provided from AMSA as well as data and input from the industry has been used in the study. DNV has received spreadsheets with both traffic data and an indication of changes over recent years in terms of the number of calls, ship types, tonnage, etc. for ports. This has ensured a good quantitative input to the project. Upon DNV's request, AMSA has also provided more qualitative input on the current ship movements compared to 2000 level and expected future changes for ports, terminals and oil field activities.

Regarding the current status for pilotage, VTS and other regulatory control measures in Australian waters, AMSA has provided the necessary information.

Australian waters have too few incidents to provide any statistically significant incident frequencies. Therefore, it is necessary to base the risk model on world-wide, generic statistics, with adjustments to make it suitable for Australian conditions. In other projects, DNV has developed accident frequencies for different ship types. Changes in world-wide accident frequencies in the last five years have been an important input to modify the frequency input in the risk model.

The most important results from the risk model are included in this report.

4.5 TASK 4: Identification of Risk Gaps and of Risk Control Options

This task consisted of two activities:

- Comparison of risk level for all regions between 2000 and 2004
- Comparison of risk where gaps are identified and the emergency resources within this area

As concluded in section 5, there was no increase in the environmental risk when comparing the 2000 model with the 2004 model. If using the 2000 risk level as a baseline, no risk reducing measures are therefore necessary.

4.6 TASK 5: Cost and Effect Assessment of Risk Control Options

Task 5 has not been included in the present report at as there was no increase in the risk profile compared to the 2000 baseline, and therefore out of scope for this report.

5 RESULTS

5.1 TASK 1: Historical Incident Trends in Australian Waters

The review of historical data was undertaken to serve as a reality check and to give a focus to the risk assessment. All the findings are based on data from 1990-2003/4.

5.1.1 Locations

There are about 2,500 reported pollution incidents in Australian waters recorded since 1970, ref. /3/. Taking into consideration the improvements in technologies, regulations and policies, and for the relevance in this study, only records since 1990 have been used. About 1,000 spill cases have been reported for this period, which includes both confirmed and unconfirmed reports. In addition to reported oil spills from ships, this number also includes spills to have originated from land based sources (e.g. storm water drains or road run-off after heavy rains) and reported substances that resemble oil, such as coral spawn or marine algae. It should be emphasized that while the oil spill amounts vary in the range of a few litres up to 17,700 tons, the vast majority of the cases are small.

Figure 5-1 shows the distribution of reported incidents around the coast of Australia, in addition to the distribution for the various Australian states in percentages.

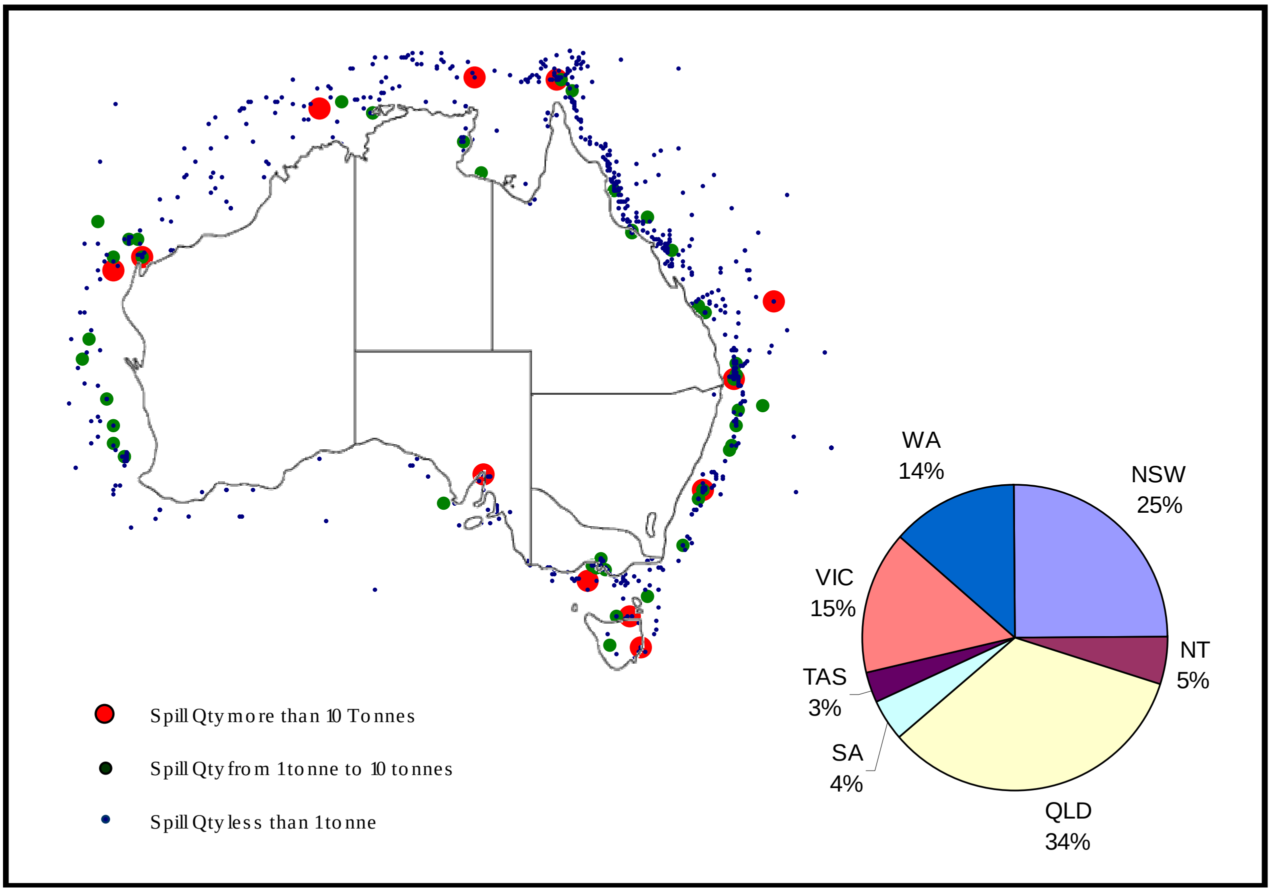

Figure 5-1 Distribution of reported incidents in Australia (ref. /3/)

It should be noted that this data set is to some extent subject to the high profile and environmental sensitivity of the Great Barrier Reef, and this area is therefore likely to have less underreporting on the smaller spills than other parts of Australia.

From these distributions, it can be observed that the areas on the east coast of Australia have a relatively high frequent occurrence of incidents, accounting for about 60% of the spill cases in Australian waters. This corresponds well with the high traffic density in these waters. The oil spill amounts are dominated by the single spill of 17,700 tons off Western Australia. There have only been 60 cases where the spill has exceeded 1 ton.

A check was made with LRFP data, ref. /4/, for incidents in Australian waters, and the distribution of incidents around the Australian coastline is similar to the results of data provided by AMSA.

5.1.2 Analysis of Incident Type

A further analysis was made of the type of incidents that occurred. The AMSA database does not include a parameter describing the incident type. As it would have been very time consuming and difficult to identify each incident type by investigating the free text, the LRFP was instead used for this purpose.

Using information from 1990–2003, the distribution of serious accident has been derived. Serious accidents in this instance are defined as “Breakdown resulting in the ship being towed or requiring assistance from ashore and repairs before the ship can continue trading” This type of accident also includes total losses of ship. This database also covers incidents not resulting in pollution. The results are presented in Figure 5-2.

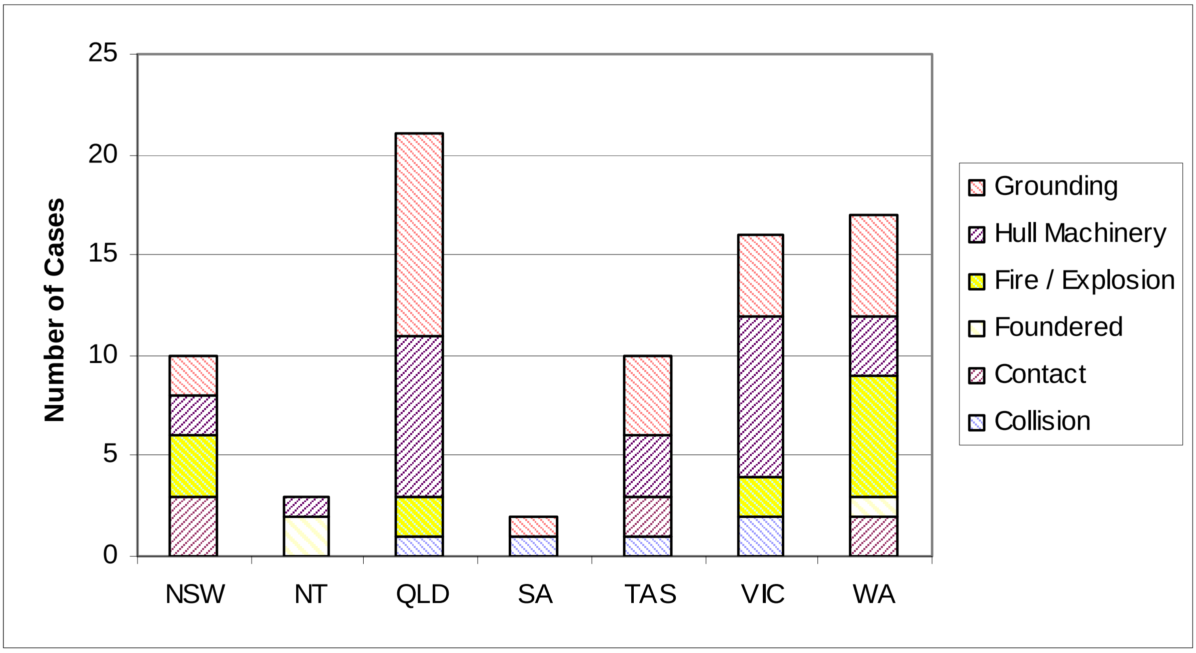

Figure 5-2 Accident types in Australian waters (ref. /4/)

In Figure 5-2, it is apparent that Grounding and Hull & Machinery are the main incident types within the identified areas in section 5.1.1. The latter type includes hull/machinery damage without leading to any of the other incident types. Hull/machinery incidents do not normally impact on the environment, but represent rather a business interruption for the operator.

As per the definition above, all the incidents in Figure 5-2 would require some sort of assistance from towing and salvage vessels.

5.1.3 Analysis of Vessel Type

The incident data has also been broken down to vessel types in order to find out which vessel types are the most likely to need assistance. Using the data provided by AMSA, the analysis of the vessel type involved in pollution incidents was made for the various states in Australia. The result is presented in Figure 5-3.

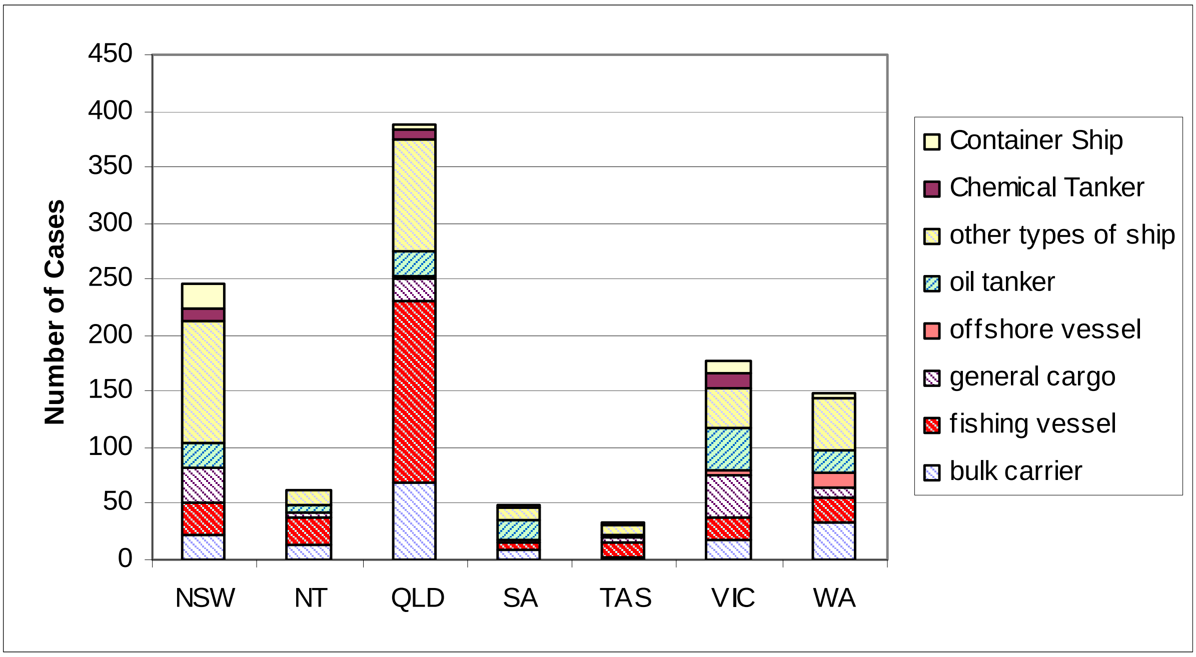

Figure 5-3 Vessel type involved in incidents in Australian waters (ref. /3/)

From the distribution it can be noted that Fishing vessels and Bulk carriers are the major contributors of reported pollution incidents in Queensland. The 'Other' category for Queensland is expected to include mostly recreational crafts. Although the numbers of reported incidents for such vessels are significant in several states, accidents with this type of vessels will not require salvage vessels with large capacities due to its smaller size. The same holds for fishing vessels which are also in general rather small vessels.

5.1.4 Oil pollution trend

About 1000 spill cases in Australian waters have been reported to AMSA from 1990 to 2003. It should be noted that the spill sizes from these accidents are on average relatively small. Based on the AMSA data, there are only 60 reported cases from 1990 to 2004 which resulted in spills above 1 ton, and 11 cases above 10 tons. The largest spill ever was the 17,700 tons spill off the coast of Dampier, Western Australia in 1991. The second largest was 700 tons outside Esperance on the south coast of Western Australia the same year.

There is a downward trend for major incidents resulting in pollution in Australian waters. This is demonstrated in Figure 5-4, which includes all incidents resulting in pollution above 1 ton. Some peaks can be seen, but these are mainly driven by single spill events.

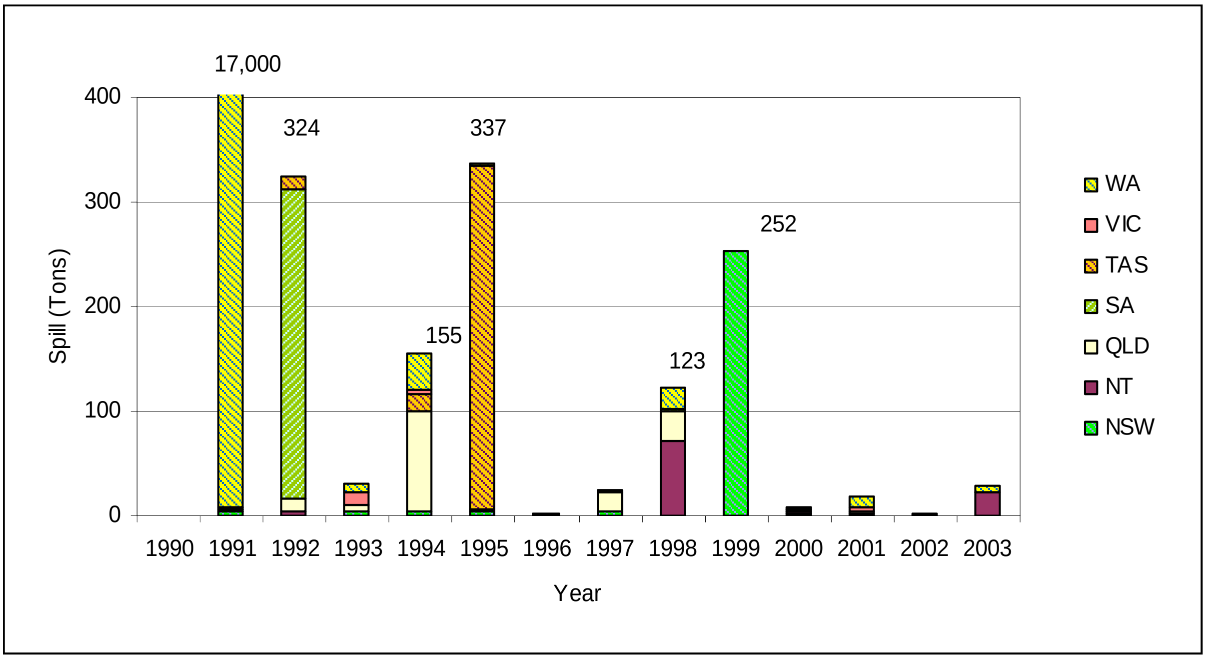

Figure 5-4 Evaluation of AMSA pollution data for Australian waters (ref. /3/)

5.1.5 Location of Emergency towing incidents

Figure 5-5 shows the location of Emergency Towing Incidents in Australian Waters 2000-2003.

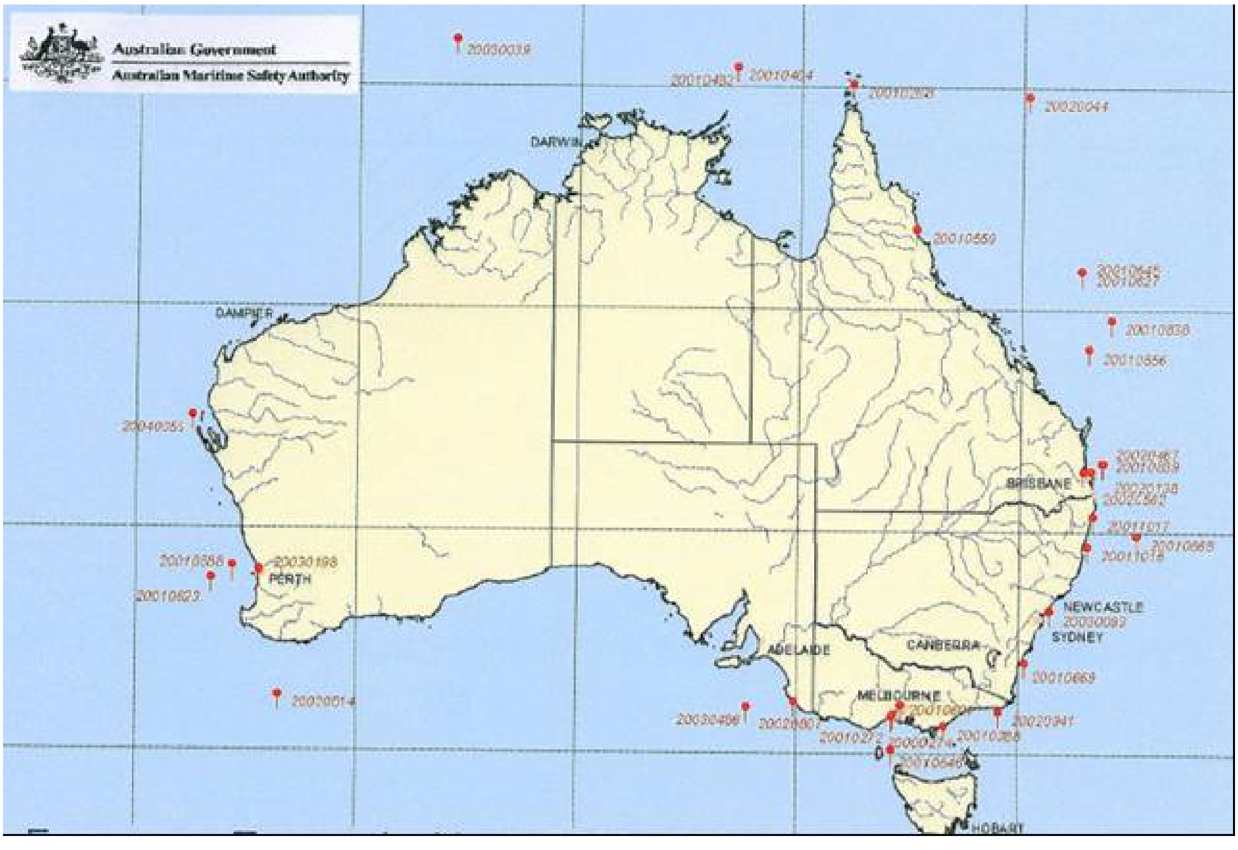

Figure 5-5 Emergency Towing Incidents, 2000-2003

Figure 5-5 illustrates that most incidents where the vessels have been assisted take place in the heavy traffic areas around the larger ports of Brisbane and Melbourne. Due to the heavy traffic, these are also the areas with the best towing and salvage vessel coverage. While not including anything on risk or number of incidents where towing has been necessary or could have assisted, the data should be coupled with the input that there is no awareness of situations where towing has been requested and tugs not released. Thus, the figure gives a rough indication on where tugs are most needed.

5.1.6 Importance of Emergency Towing and Salvage

In simple terms, salvage would have an effect on the mitigation of all types of incidents, whilst emergency towing only has an effect on preventing drift groundings.

To investigate the importance of emergency towing DNV has looked into the LRFP database. As earlier mentioned, the AMSA data does not include accident type in their reporting of cases, and has thus not been used for this purpose.

In total, 148 incidents in Australian waters have been reported to Lloyd's/Fairplay from 1990 to 2003 (see Figure 5-6). It is apparent that in about 50% (79 cases) of the incidents the vessels require some sort of assistance from ashore before they could continue their voyage. Of the 79 serious cases reported to LRFP, about 50% (36 cases) were a result of grounding. Further assessment revealed that about 27% (10 cases) of grounding cases are drift groundings, where adequate towing resources could have a positive impact to the accident scenario. This represents in average less than 1 incident per year over more than 10 years. This is also in line with other DNV risk models which show that about 20% of the grounding incidents are drift grounding and the rest powered grounding.

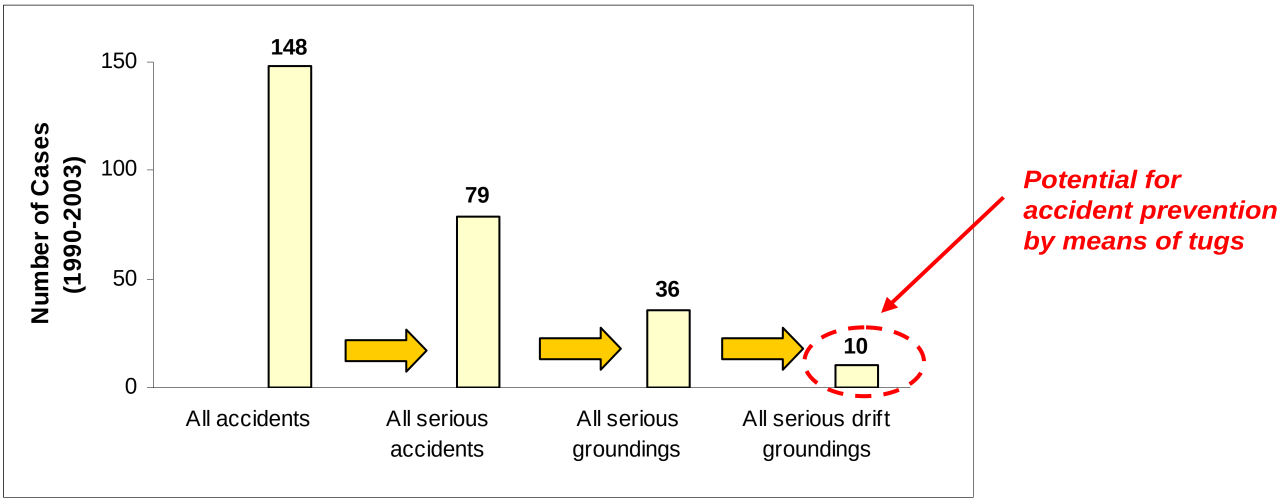

Figure 5-6 Evaluation of LRFP Accident statistics for Australian waters, 1990-2003

This approach gives an indication that there is only a small proportion of incidents where an emergency towing vessel could actually have a preventive effect. Even if a towing vessel is needed and available, it is far from certain that there would be enough time or that the weather conditions would allow a towing operation to be carried out.

Salvage operations, in any case, will be required for serious incidents. In comparison to towing, salvage is normally a longer term exercise that allows the sourcing of vessels and equipment from further away, with the possible use of harbour towing vessels for interim stabilisation. However, given a leaking vessel, the amount of oil prevented from reaching shore taken up by skimmers etc. is limited and very weather dependent.

5.1.7 Analysis of Salvage Cases

36 salvage cases have been reported to Australian authorities in the period 1990-2003, ref. /5/. The data set is not complete, as salvage incidents are not always reported to AMSA. It also excludes salvage incidents around Tasmania.

From the reported cases it is found that the average size of the ship requiring assistance is about 25,000 dwt. The cases are quite evenly distributed around the coast.

A more detailed analysis of some of the cases, ref. /6/, shows that in the case of groundings the time between grounding and a vessel being refloated has generally ranged between 5 and 14 days. The main reasons for these delays is that a considerable amount of preparatory work is usually required before an attempt to refloat a grounded ship can be made without risking additional damage to the ship, e.g. by lightening the ship by removing cargo and/or fuel and ballast or waiting for a suitable high tide.

It can also be seen that harbour towing vessels (in addition to the ocean going towing and salvage vessels) have a role in both preventing and mitigating incidents, e.g. for salvage activities like refloating of stranded ships. Hence, the availability of ocean going salvage vessels may be well supported by local harbour towing vessels. Harbour towing vessels could be deployed for initial response, and bigger capacity towing and salvage vessels made available when required.

The risk model shows that given good coverage of both towing and salvage vessels, the overall risk reducing effect is still less than 5% compared to having no emergency resources available at all. The mitigation effect from salvage can not be measured the same way, but is considered to be at least as important. The main reason for the low preventive effect is the limited portion of drifting grounding incidents. The areas with the major ports are shown in Table 5-1.

Table 5-1 Risk reducing effect of towing and salvage vessels

Area	Major port in Area	Effect on risk level*
QLD6	Brisbane	1.0 %
NSW2	Sydney	1.0 %
VIC2	Melbourne	1.0 %
WA4	Perth	2.4 %

* comparing no emergency resources with the current situation in the ports

It should be noted that within the ports themselves, the effect of towing vessels on risk levels is higher than indicated in Table 5-1.

5.2 TASK 2: Trends on Availability of Emergency towing and Salvage Vessels

5.2.1 Emergency towing versus salvage

In order to keep the line between emergency towing and salvage clear for the purpose of this project, the differences are highlighted in this section.

The general consensus amongst those interviewed in the course of this analysis was that Emergency Towing and Salvage are entirely separate activities.

Emergency Towing

Emergency towing is an activity that precedes salvage.

Emergency towing can be effected by passing ships, port-based vessels – including towing and salvage vessels, and vessels supporting offshore oil and gas activities. This obligation to assist is enshrined in tradition and international treaties such as SOLAS.

None of those interviewed were aware of an instance where emergency towing had been limited by a vessel not being made available to assist a distressed vessel. The level of assistance would be only limited by safety concerns for the vessel providing the assistance or her crew.

Salvage

Salvage is taken to generally occur after emergency towing even though a salvage capable vessel may conduct the emergency response activity.

Salvage capable vessels must be able to work with the specialist equipment used in such situations. This equipment might not be kept onboard (e.g. shore stores, air delivery). A salvage capable vessel must be able to tow the stricken vessel a considerable distance (depending on the incident, possibly as far as Singapore or Japan).

5.2.2 Response to questionnaires

Fourteen different service providers, shipping industry peak bodies and state authorities, in addition to AMSA, were consulted in the course of this work. Their response has enabled the project to compile an appreciation of the emergency resources capabilities in Australian waters.

The results from this task are based on the discussions held with the various stakeholders. Scrutiny of the questionnaire responses shows that the opinions they report reflect the views of the vast majority of parties contacted.

The telephone interviews caught the majority of respondents without them having prepared responses. This has afforded the opportunity to record a local view rather than a debated, more general one. There were several complex issues that became more straightforward when discussed with local operators. These generally supported and de-cluttered the debated view.

The issues listed below were not reconciled in the timeframe available in this assessment:

- One company (Singapore based) declined to contribute to the review
- Suitable bathymetric data across the study sectors was not located as the project did not assess it critical to the project; because where it is important (e.g. Inner Route, Great Barrier Reef) a good enough understanding exists.
- A comparison of responses with the fleet data in the Dwyer report revealed a few gaps – the K. Dwyer Report details a slightly larger fleet – but this does not affect the findings of the study.

5.2.3 Adequacy of Response

Appendix C includes the overview of emergency towing and salvage vessels in Australian waters. On the maps each port with a towing and/or salvage vessel is indicated with a circle, being an illustration of the area the vessel could cover in a certain period. One or more towing and salvage vessels in the same port will have the same coverage, so the number of vessels is not taken into account.

REPORT

The interviews conducted reveal that there is consensus that the overall current situation is adequate. However, also based on the public debate in Australia, there are divergent views on the future adequacy, with parts of the industry concerned about a possible degradation of capability due to market forces. There were an equal amount of optimists in the surveyed population whom saw market forces as a mechanism for developing a more robust network of ocean going vessels.

Towing and salvage vessels need to be available or be made available in order to respond to incidents. It was the unanimous opinion that towing and salvage vessels based in Australian waters would be released from other duties as soon as they were needed for an emergency situation. Nobody who was interviewed identified a situation where the response has been delayed or was not adequate. When questioned about the obligations of harbour or offshore support contracts, none of the interviewees considered that they would seriously impede an emergency operation. It is therefore the judgement of this review that any vessels that might assist in an emergency would be available should the need arise.

The mapping of emergency towing and salvage vessel can be found in Appendix C.

Emergency Towing

The general consensus was that any available towing and salvage vessels would assist a distressed ship up to the point at which it would be jeopardising itself.

The legal obligation of a passing vessel to assist any other vessel was clearly identified in the course of the interviews. There may be limitations with regard to the effectiveness of such assistance, but there will be a proportion of circumstances when it would prove invaluable. For instance, a ship encountering difficulties in a remote area, for instance in a remote section of the Inner Route on the Great Barrier Reef is likely to have another ship within four hours sailing, a location where it would never be commercially viable to sustain a towing or salvage vessel capable of multi-role emergency assistance.

For emergency situations within reasonable proximity to a port or collection of towing and salvage vessels, it was repeatedly pointed out that multiple vessels might be involved in a response and that these would be selected to best suit the requirement from those available.

Salvage Response

It was widely acknowledged that the primary dilemma with regard to basing salvage capable vessels at strategic locations is cost.

More than one operator, including those from Singapore, mentioned the ability to assemble specialists and specialist equipment using air transport in order to optimise response.

It was however observed that the response time for vessels from Singapore is not suitable for many of the situations when they might be required, due to the time it would take for them to arrive at the incident location. But there was also a general consensus that the Singapore vessels would not be needed due to the adequacy of vessels available from Australian waters.

Offshore Vessels

The view which emerged was that vessels engaged in offshore oil and gas work could provide a useful emergency response capability where they might be the closest potential aid to a distressed vessel. This view was held by the majority of those interviewed and not just those who work with such vessels.

The areas where this capability would be most valuable are offshore Western Australia (Dampier) and out of Darwin and the Gulf of Carpentaria which are remote and/or are ports with limited ocean going towing capabilities. Oil and gas activities in south eastern Australia can be said to be generally in decline and there are a greater number of shore-based vessels available so that the contribution from offshore vessels could be expected to be less significant. Incident reports shows that offshore vessels previously have played an important role in salvage cases.

The study's overview of emergency towing and salvage capacity is mainly based on towing and salvage vessels operated from the ports. Thus, it could be said to be conservative, as offshore vessels could have additional effect which is not accounted for. The overall effect on the risk level is however considered to be minor.

5.2.4 10 Year Trends

Commercial fleet

The assessment of ten year trends in the towing/salvage industry involved a question asking stakeholders to describe the change they had seen in the last five years with the current situation and where they anticipated things being in five years time.

There was a general opinion that the size of the commercial fleet supported by towing and salvage vessels in Australian waters has increased and that the quality of vessels has risen dramatically in the last five years. It is considered that the net effect of these trends is likely to fuel a reduction in the number of commercial salvage opportunities that arise in Australian waters.

Emergency towing and salvage vessels

The main trend in the operation of the towing / salvage fleet over the last five years has been the increasing influence of market forces. As ports have become increasingly commercially aware, they are more reluctant to pay for a vessel with a capability that is above their needs.

There are no dedicated salvage vessels in Australian waters. There is however a fleet of ocean going towing vessels with salvage capabilities. The number of the towing and salvage vessels which might be useful in a salvage operation has shown a minor reduction in a few places. Two salvage capable vessels have left Australian waters. These were however from the ports of Brisbane and Melbourne, where a capability of ocean going towing and salvage vessels remains.

It can be seen that there are new vessels in Darwin and off the north-west Australian coast near Dampier which are areas that were previously not serviced. The growth of activity within the offshore sector has resulted in salvage capable vessels in Australian waters that were not there five years ago.

All the new companies which have entered the market had a growth plan that would be dependent upon market forces (day to day market forces - not salvage market forces).

For towing and salvage vessels in general, there are several considerations that were judged to counterbalance the effect of increasingly commercialised ports:

- The larger commercial fleet requires larger, more capable towing and salvage vessels to assist it (a situation compounded by the fact that market forces extend to time at berth for bulk carriers etc. where increased productivity as a result of better towage can be significantly cost-effective);

- The towing and salvage vessel fleet has actually grown and new companies have entered the marketplace (all of whom anticipated growth in the coming five years);
- The internationalisation of the salvage business means that it is increasingly the realm of specialists (e.g. offshore companies capable of capturing business in Asia) and the super towing and salvage vessels that might be required in certain emergencies would never be viable for harbour work;
- The growth anticipated for Darwin as a result of the rail-link and oil & gas sector developments actually puts towing and salvage vessels in an area where the emergency response and salvage coverage was very limited five years ago. There is likely to be a corresponding growth of fleet in Dili, East Timor, which services some of the offshore production platforms in Australian Waters.

5.3 TASK 3: Updating of Risk Model

The important input parameters to the risk model have been updated to ensure up-to data risk results for Australian waters. The main focus is to see whether any areas have increased risk compared to the 2000 baseline.

5.3.1 Traffic

Traffic data were thoroughly investigated in the previous DNV study, estimating the exposure for different ship types and sizes along the coast. To meet the tight time frame of the project and at the same time safeguard the quality of the results, the current project has investigated changes in ship movements from 2000 level to 2004, rather than starting from scratch.

According to AMSA, there have been no significant changes in the traffic from 2000-2002, except for seasonal changes. These types of variations (with a large increase one year and a strong decline the next due to e.g. poor/good harvest) have been discarded in the study.

Ref. /7/ shows that there has been a steady, but small increase of both the total number of calls and tonnage from 2002 to 2004. There are also some ports with high volume that have experienced significant changes (> 10%). These ports have either increased the number of calls, tonnage or both (e.g. Adelaide, Hay Point, Port Hedland, Kwinana). It can also be seen that oil terminals have been shut down, e.g. Port Stanvac.

The risk model has been updated according to these changes in number of port calls.

5.3.2 Hull design

The proportion of double hull tankers in Australian waters is rapidly growing. The distribution between double hull and single hull in the tanker fleet trading in Australia is approximately 60%-40%, ref. /8/. This would have a positive impact on the risk level for the environment. The risk model has taken into account this trend.

5.3.3 Generic Incident Frequencies

Australian waters have an insufficient number of incidents to provide any statistical significant results on incident frequencies. It is necessary to base the risk model on world-wide generic statistics; however, with adjustments to make it suitable for Australian conditions. DNV has re-investigated the generic accident frequencies, which serve as input to the risk model, as DNV has newer data on this.

REPORT

According to world-wide statistics, the accident trend has declined in the past years due to e.g. implementation of more robust port state control regimes, improved ship design, higher crew competence, implementation of ISM, etc., see Figure 5-7 and Figure 5-8. A slight reduction in incident frequencies could therefore be expected from 2000 compared to 2004, meaning a lower risk.

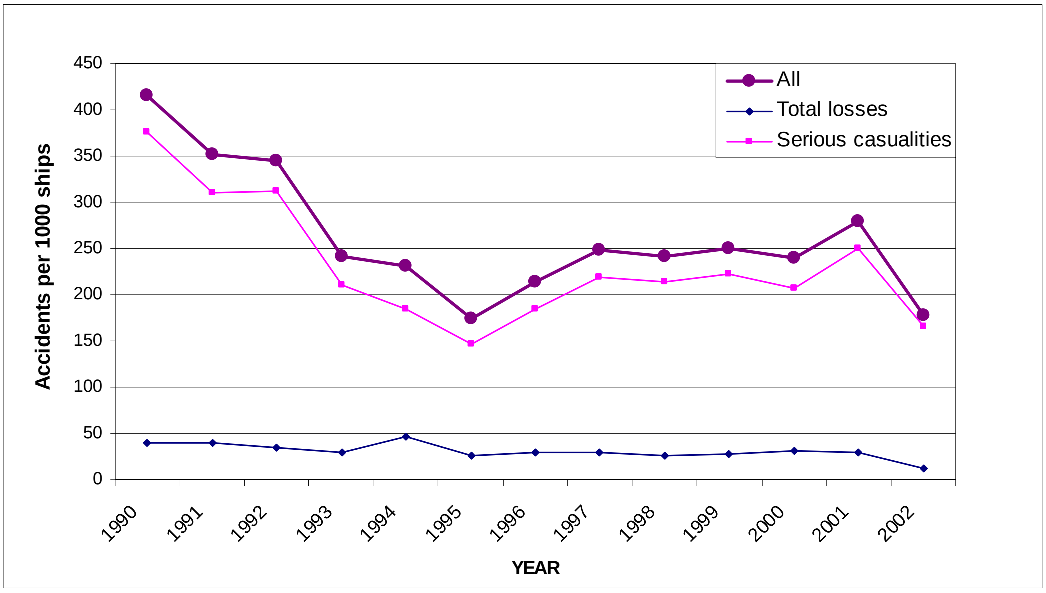

Figure 5-7 Accident trend for all ship types, serious accidents pr 1000 ships, 1990-2002

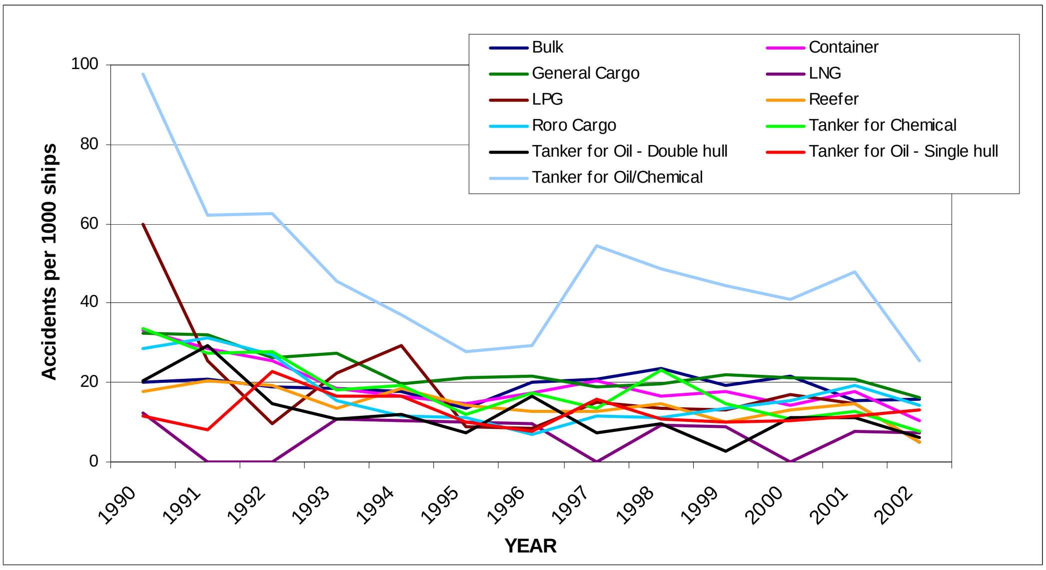

Figure 5-8 Accident trend broken down on ship types, serious acc. pr 1000 ships, 1990-2002

The risk model has been adjusted for this downwards trend. Each ship type has been evaluated for the relevant accident scenarios. Some of the numbers are not statistical significant, and DNV has used judgement to assess the change. The changes in frequency that were identified when comparing 2000 with 2004 data are shown in Table 5-2. The adjustment factors are used for all ship sizes.

Table 5-2 Changes in accident frequencies for the different ship types

Ship type	Collision	Grounding	Structural failure	Fire/Explosion
Tanker for oil	-10%	0%	0%	-10%
Chemical tanker	0%	0%	0%	0%
General cargo	-5%	-10%	0%	-10%
Bulk carrier	5%	-10%	-5%	0%
Ferry	0%	0%	0%	0%
Offshore	0%	0%	0%	0%

5.3.4 Current Emergency Towing and Salvage Resources

Emergency Towing

No major decrease of emergency towing resources from 2000 to 2004 has been identified, ref. section 5.2.4. On the contrary, it can be seen that there are towing resources today that did not exist a few years ago, e.g. due to the increased offshore activities on the North West coast of Australia, especially in Darwin and Dampier. This has a positive impact on the risk level.

It has also been taken into account that harbour towing vessels, in particular if there are more than one in a port, could be capable of keeping a distressed ship in position while waiting for a larger, more powerful towing vessel to arrive.

When comparing the coverage of towing vessels in the risk model as it was entered in 2000, the following locations have been given credit of available towing capabilities (in addition to what is already in the 2000 model):

- Harbour towing vessels in Weipa (QLD1)
- Harbour towing vessels in Cairns (QLD3)
- Ocean going towing vessels in Portland (VIC3)
- Ocean going towing vessels in Hobart (TAS 1)
- Ocean going towing vessels in Burnie, Port Latta, Devonport, Launceston, Bell Bay (TAS3)
- Harbour towing vessels in Albany (WA3)
- Harbour towing vessels in Geraldton (WA5)
- Increased capacity in Dampier due to offshore activities (WA7)
- Offshore towing vessels on the Bayu Undan gas field (WA10)
- Increased capacity in Darwin due to offshore activities (NT1)

Some of these towing vessels may not be new, but were not included in the previous report. The impact on this from a risk perspective is minor.

Salvage

Two salvage capable vessels have left Australian waters, one from Melbourne and one from Brisbane. However, these ports still have remaining capabilities. Except from this, no other changes in the salvage capacity have been identified. Hence, the salvage capabilities have been kept as it was in the 2000 model.

5.3.5 Pilotage and VTS

In the areas of the Great Barrier Reef and the Bass Strait, there are requirements for pilotage and/or Vessel Traffic Services (VTS) or when Traffic Separation Schemes (TSS) apply. Significant changes to such requirements in the last five years or proposed include the introduction of compulsory pilotage in the Whitsunday Islands from July 2001 and the upgrading of the REEFREP Ship Reporting System in the Great Barrier and Torres Strait to an IMO-approved Coastal Vessel Traffic Service.

For the ports, there have been requirements for pilotage put into force in the last few years. This will further reduce the risk. The pilotage has not been assessed in further detail, and no changes have therefore been made to the risk model. This is a conservative approach, as the risk may have been further reduced in some areas.

5.3.6 Other control measures

The Great Barrier Reef Marine Park's re-zoning of the Barrier Reef has come into force from July 2004 to provide the highest possible level of protection for one third of the entire Marine Park. An important aspect of this initiative was the retention of the existing key shipping routes while ensuring the risk of ship traffic moving outside of these routes would be reduced, and this could give a small positive impact on the risk of spills in these areas. These changes have not been included in the report, as the effect is considered to be minor from a holistic point of view.

5.3.7 Results

The model calculates a Risk Index for each sub-region, by combining the predicted frequency and average size of spills from all sources in each sub-region, with a simple environmental sensitivity factor which takes into account the vulnerability and importance of the main environmental resources in each sub-region. The Risk Index also takes into account the likelihood of spills dispersing from one sub-region to another, and the overall differences in environmental behaviour of spills of different types of material. These are simple relative scaling factors, hence the Risk Index is a measure of the relative risk level.

In Table 5-3 risk indices for all the study areas along the coastline is presented. The table shows that there has been an overall reduction of the total risk level in Australian waters of 7%. This is a result of a steady decrease in all regions, except SA1 where the increase in traffic to Adelaide is the main driver for the 9% increase in environmental risk. The risk in SA1 is still relatively low compared to other areas.

Ports (including approaching port) represent 75% of the total risk. In all areas where ports exist, these are the main risk contributors due to their heavy traffic. Thus, all areas with high risk have major ports. The main reason for the overall reduction in risk is the general reduction in incident frequency per vessel year, and the relative increase in double hull tanker tonnage. This has more than outweighed the relatively small traffic increase.

The areas with the most significant risk reductions are:

- 26% in QLD3 due to the general reduction in risk in the area
- 20% in SA2 mainly due to the shut down of the oil terminal in Port Stanvac
- 5% in QLD6 and 7% in NSW2 due to a general reduction in risk. Due to the high volumes in the ports of Brisbane and Sydney the risk reduction in terms of decreased risk index is rather significant for these two regions.

Table 5-3 Risk indices for all areas 2000 and 2004

	2000			2004			Change	
Area	**At sea**	**Port**	**Total index**	**At sea**	**Port**	**Total index**	**Total**	**%**
QLD1	470	1124	1594	345	1094	1439	-155	-10%
QLD2	1210	139	1349	1109	127	1237	-112	-8%
QLD3	3994	566	4560	2830	554	3385	-1175	-26%
QLD4	2436	7454	9889	2255	7256	9511	-378	-4%
QLD5	2036	5119	7155	1858	4800	6659	-497	-7%
QLD6	577	15596	16174	528	14802	15330	-844	-5%
NSW1	266	1	268	243	1	245	-23	-9%
NSW2	3702	9995	13697	3342	9462	12804	-893	-7%
NSW3	1936	666	2602	1750	641	2390	-212	-8%
VIC1	664	0	664	638	0	638	-26	-4%
VIC2	841	7417	8258	781	7293	8074	-184	-2%
VIC3	435	507	942	354	472	826	-116	-12%
TAS1	14	553	567	10	537	547	-20	-4%
TAS2	2	0	2	2	0	2	0	-8%
TAS3	185	5523	5708	127	5130	5258	-450	-8%
SA1	407	668	1075	434	734	1168	93	9%
SA2	2722	1488	4210	2509	847	3356	-854	-20%
SA3	28	0	28	26	0	26	-2	-6%
WA1	45	0	45	42	0	42	-2	-5%
WA2	172	0	172	157	0	157	-15	-8%
WA3	1028	592	1621	780	551	1332	-289	-18%
WA4	1429	14561	15989	1327	14319	15646	-344	-2%
WA5	98	296	394	80	275	355	-39	-10%
WA6	382	183	566	350	169	519	-46	-8%
WA7	2472	2852	5323	1885	2801	4685	-638	-12%
WA8	73	48	121	70	48	118	-3	-2%
WA9	37	2	40	36	2	38	-1	-4%
WA10	24	36	60	19	36	55	-5	-9%
NT1	78	411	489	55	406	461	-28	-6%
NT2	54	0	54	50	0	50	-5	-8%
NT3	536	254	790	483	247	730	-59	-8%
LWH	21	0	21	19	0	19	-2	-7%
MAC	3	0	3	3	0	3	0	-8%
NOR	1	0	1	1	0	1	0	-8%
CH	12	0	12	11	0	11	0	-4%
COC	18	0	18	17	0	17	-1	-5%
SUM	**28408**	**76053**	**104461**	**24528**	**72607**	**97134**	**-7327**	**-7%**

5.3.8 Risk Trends

The areas with the highest risk are mostly located on the east coast of Queensland. The main contributing factors for this region are the ports of Brisbane, Townsville and Gladstone, in addition to coastal shipping in the Great Barrier Reef. Also other major ports like Fremantle, Sydney, Newcastle and Melbourne give significant contributions to the risk. The situation is expected to be the same the next five years. Overall for Australia, the ports are representing 75% of the total risk.

Updating of the risk model has identified a steady reduction of the risk level from 2000 up to 2004. This is in line with world wide statistics, where the accident trend has steadily declined for the last 20 years due to efforts from both the shipping industry itself as well as from maritime authorities.

This tendency is likely to continue the next five years, i.e. the reduction in risk per vessel is likely to outweigh any small increase in vessel traffic. Only areas with significant increase in traffic are likely to expect an overall risk increase. One such area might be Darwin, both due to the increase of the offshore activities and due to the new railway from Darwin to Adelaide. The latter will increase the number of calls in Darwin, but on the other hand decrease the traffic to Adelaide.

5.4 TASK 4: Identification of Risk Gaps and Risk Control Options

5.4.1 Risk Comparison 2000 vs. 2004

Based on the findings in section 5.3, there has been no significant increase of the risk level in Australian waters from 2000 to 2004. DNV does therefore not find any areas along the coast that have any significant risk changes when using the 2000 study as a baseline for comparison. The trend for both emergency towing and salvage capabilities does not present any significant changes for the safety of the Australian marine environment.

5.4.2 Comparison of Risk and Emergency Resources

There have not been any significant increases in risk identified. The emergency towing capabilities have improved since 2000, whilst the salvage capabilities remain fairly constant. The mapping of risk and tug capabilities are shown in Table 5-4.

Table 5-4 Comparison of risk and emergency towing/salvage capabilities

Area	Risk index	Towing	Salvage
WA4	15646	x	x
QLD6	15330	x	x
NSW2	12804	x	x
QLD4	9511	x	x
VIC2	8074	x	x
QLD5	6659	x	x
TAS3	5258	x	-
WA7	4685	x	-
QLD3	3385	x	-
SA2	3356	x	x
NSW3	2390	x	x
QLD1	1439	x	-
WA3	1332	x	-
QLD2	1237	-	-
SA1	1168	-	-
VIC3	826	x	-
NT3	730	-	-
VIC1	638	-	-
TAS1	547	x	-
WA6	519	-	-
NT1	461	x	-
WA5	355	x	-
NSW1	245	-	-
WA2	157	-	-
WA8	118	-	-

Area	Risk index	Towing	Salvage
WA10	55	x	-
NT2	50	-	-
WA1	42	-	-
WA9	38	-	-
SA3	26	-	-
LWH	19	-	-
COC	17	-	-
CH	11	-	-
MAC	3	-	-
TAS2	2	-	-
NOR	1	-	-

The cross (x) indicates that there is coverage by towing and/or salvage vessels. The vessel specific capacity is defined in Appendix A. However, the towing and salvage vessels need to have a certain capacity to be considered as a useful tug for distressed vessels. As the towing and salvage vessels are stationed in ports along the coast it is evident that the coverage is best near shore and will decrease when moving further away.

Table 5-4 demonstrates that towing as well as salvage capabilities exist in all high risk areas. Some areas with relatively high risk (TAS3, WA7, QLD3) have no salvage capabilities based in those areas.

The Great Barrier Reef and Torres Strait is an area with significant focus when discussing risk in Australian waters, due to its environmental sensitivity. The risk for these areas (QLD 1-3) is moderate/high according to the risk model, and there are no salvage capabilities based there.

For the Torres Strait and the Inner Route, the fairway in most places is too narrow for an emergency towing vessel to have any effect on prevention of an accident of a drifting vessel. However, in some cases the relatively shallow waters make it possible for the distressed vessel to instead anchor to prevent a drifting grounding. On the Outer Route the ocean depth and exposure to weather and sea conditions make anchoring more difficult.

Salvage capabilities on the other hand would have an effect on all types of incidents due to the potential to mitigate the consequences of a distressed vessel. Depending on the incident, salvage operations could take days to plan and implement, offering considerable amount of time to deliver salvage resources from outside the affected area.

5.5 TASK 5: Cost and Effect Assessment of Risk Control Options

Task 5 has not been included in the present report at as there was no increase in the risk profile and therefore out of scope for the project.

6 CONCLUSIONS

Based on the updating of DNV's 2000 risk model, the environmental risk along the Australian coastline is 7% lower today than five years ago, and is likely to further reduce over the next five years. The main reason is the general reduction in the world-wide incident frequency and the increased portion of double hull tanker tonnage, which has more than outweighed the relatively small traffic increase.

There has been a minor reduction in salvage capabilities, and a small increase in emergency towing capabilities in Australia the last five years. These changes have no significant influence on the risk level.

The expectations for the future trend in towing and salvage capabilities is not uniform, but the indications given by most players in the industry are promising, especially for emergency towing.

For certain incident types, towing vessels are effective measures. However, due to the small proportion of ship incidents that can be prevented by means of towing vessels (i.e. drift groundings), the effect on the total risk level is low. Improved salvage coverage would mitigate consequences of all types of incidents requiring assistance, but the actual benefit in terms of reduced risk of pollution is limited.

In all areas where ports exist, these are the main risk contributors due to their heavy traffic. Thus, all areas with high risk have major ports.

The areas with the most significant risk reductions are:

- 26% in QLD3 due to the general reduction in risk in the area
- 20% in SA2 mainly due to the shut down of the oil terminal in Port Stanvac
- 5% in QLD6 and 7% in NSW2 due to a general reduction in risk. Due to the high volumes in the ports of Brisbane and Sydney the risk reduction in terms of decreased risk index is rather significant for these two regions.

The only area with an increase is SA1 where the increase in traffic to Adelaide is the main driver for the 9% increase in environmental risk. The risk in SA1 is still relatively low compared to other areas.

Towing as well as salvage capabilities exist in all high risk areas. Some areas with relatively high risk (TAS3, WA7, QLD3) have no salvage capabilities.

From a risk point of view the effect of an increased emergency response capacity is small. The cost-effectiveness of subsidising private contractors to introduce dedicated emergency towing and salvage vessels is likely to be low. The current coverage, regulated by market forces, has not led to any increase in risk level compared to the situation five years ago.

Interviews with the towing and salvage industry reveal consensus that the current coverage is adequate, and that towing and salvage vessels based in Australian waters would be released as soon as they were needed for an emergency situation. No companies, authorities and other stakeholders consulted are aware of a situation where the response has been delayed or was not adequate.

7 REFERENCES

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/7/ Traffic data for Australian ports 2002-2004, AMSA, received on e-mail 10th August 2004

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APPENDIX A

TOWING AND SALVAGE VESSEL DATA

APPENDIX B

STAKEHOLDER INPUT FROM QUESTIONNAIRES

APPENDIX C

EMERGENCY RESOURCES COVERAGE MAPS