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Technical Review of Impacts Matrices

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ABBREVIATIONS

AS/NZS	Australian Standards/New Zealand Standards
Hazid	Hazard Identification
IRCE	IRC Environment
m	metre
NOO	National Oceans Office
PCB's	polychlorinated biphenyls
SE	South East

EXECUTIVE SUMMARY

This report presents IRC Environment's (IRCE) independent technical review of the two matrices (Ocean Environs Vs. Disturbance and Activity Vs. Disturbance) for the National Oceans Office. This review included an assessment of the construction of the matrices, assessment of consistency within the matrices, a literature search and targeted discussions with experts, and the identification of 'missing information'.

Section 1 of the report provides a brief background, explaining the requirement for an independent technical review of the two matrices, which have been developed to summarise the range of potential impacts on the natural system within the South-east Marine Region. Section 2 outlines the methodology used during this review. Section 3 provides a summary of the results of the independent technical review and documents the recommended changes to the construct of the matrices, based on the assessment of over 1200 individual cells. Finally, the results of the literature search and updated copies of the two matrices, incorporating most of the recommended changes, are provided.

1. INTRODUCTION

The Government's commitment to an integrated ecosystem-based approach to planning and management of all ocean uses is at the core of *Australia's Oceans Policy* (launched in December 1998). Regional marine planning is one of the tools by which this ecosystem-based approach will be delivered. The first Regional Marine Plan is being developed for the South-east region of Australia's marine jurisdiction. This region comprises waters off Victoria, Tasmania (including waters off Macquarie Island) southern New South Wales to Kangaroo Island off South Australia.

Two matrices have been developed that summarise the range of potential impacts on the natural system within the South-east Marine Region. Veronica Sakell, National Oceans Office (Oceans Office) Director, invited IRC Environment (IRCE) to conduct an independent technical review of these two matrices.

The deliverables on this project are:

- 1) An expert independent technical review of the two matrices to determine that each cell has been categorised correctly. This includes:
 - A review of the construct of the matrices;
 - Confirmation that the cells are supported by appropriate published literature to substantiate categorisation;
 - Identification of any 'missing information'; and
 - Assessment of consistency within the matrices.
- 2) Provision of additional references/sources to support recommended changes to the matrices, or to further support the existing classifications within the matrices.
- 3) A detailed report (15 – 30 pages in length) summarising the process and outcomes of the independent expert technical review of the matrices.

The review will provide several benefits to National Oceans Office including:

- Assurance that impacts have been identified and are clearly described, such that an assessment of risk can be made. The National Oceans Office would then be able to make informed decisions regarding the management of activities and associated impacts in the south-east region, as well as provide input into the South-east Regional Marine Plan; and
- Providing a degree of confidence to third parties interested in National Oceans Office activities that an appropriate process has been conducted with respect to the development of the matrices.

1. METHODS

A risk assessment approach was adopted by the Oceans Office for analysing the information about impacts on the marine system, based on the 'Australian and New Zealand Standard for Risk Management' (AS/NZS 4360:1995). One of the advantages of this approach is that it can be repeated for each Region, ensuring a consistent approach across all regions.

The first step in the risk assessment is the initial 'identification of impacts' stage. As such, it needs to be comprehensive, "using a well-structured systematic approach, because a potential risk not identified at this stage is excluded from further analysis" (AS/NZS 4360:1995, clause 4.2.1). The scope of this process was limited to human activity, action or process which has an affect, either positive or negative, on the natural system in the South-east Marine Region. It does not include affects upon human values such as aesthetics or loss of wilderness experience.

Categories

The environmental risk management guide (HB 203:2000) suggests three steps on how to identify sources of risk and potential environmental impacts: Identify sources of risk; Describe the surrounding environment; and Identify potential environmental impacts. The Oceans Office has identified and developed categories corresponding to these three steps under the heading: Activities; Ocean Environs and Disturbance respectively (see below).

The lists of categories corresponding to the three steps of identifying risk were independently assessed and reviewed for adequacy and consistency, to determine if they covered the full range of sources of risk, environments and potential impacts respectively, applicable to the South-east Marine region. Specifically, the adequacy of the Activities categories to completely encapsulate all anthropogenic activities; the Ocean Environs categories to completely encapsulate all ecosystem types; and the Disturbance categories to completely encapsulate all anthropogenic effects that occur in the South-east Marine Region were assessed.

Disturbance categories

As a means of summarising the range of individual impacts that can effect the natural system, twelve broad 'disturbance categories' were identified in consultation with the Impacts Working Group:

- *Chemical change* – a change, natural and/or induced, in the concentration and/or properties of compounds naturally occurring in the ocean. Changes to salinity, nutrients, and dissolved oxygen fall into this category;
- *Contaminants* – the input of substances that are not normally found in the marine environment for example heavy metals, polychlorinated biphenyls (PCB's) and litter;
- *Temperature* – changes to the natural temperature ranges in the marine environment;

- *Mechanical* – removal or change in structural (biological and physical) components of the ecosystem including the building of fish barriers such as dams;
- *Nuclear radiation* – the introduction into the marine environment of radioactive isotopes;
- *Electromagnetic radiation* – the introduction of radiation consisting of electromagnetic waves;
- *Noise* – an increase, beyond the natural range, in the level and/or amount of sound in the marine environment;
- *Biological interactions* – removal of, or damage to, organisms including discarding of bycatch;
- *Introduced pathogens* – disease-producing organisms introduced to the marine environment either from terrestrial sources or from marine sources;
- *Introduced marine species* – species which occur outside of the natural or historical ranges;
- *Turbidity/Light* – change in the extent to which light penetrates the water column; and
- *Artificial light* – a source of light in the marine environment that is man made.

Ocean Environs categories

This analysis describes where the different types of disturbances occur across the ecosystem, divided into 11 ocean environs and subcategories related to fauna and flora:

- Bays and estuaries;
- Inshore (0 –20m water depth);
- Inner shelf (benthic and demersal) (20-60m);
- Middle shelf (benthic and demersal) (60 - 150m);
- Outer shelf (benthic and demersal) (150 – 200m);
- Slope;
- Pelagic Inner shelf;
- Pelagic Shelf;
- Pelagic Offshore;
- Seamount; and
- Multiple ocean environs.

Activity categories

This analysis describes which activities or uses of the Region cause the types of disturbances under 13 broad categories of activities, most with subcategories:

- Aquaculture;
- Defence;
- Emerging
- Harvesting;
- Human changes to the coastal zone;
- Indigenous customary use;

- Land based sources of pollution;
- Ocean dumping;
- Petroleum;
- Recreational activities;
- Shipping;
- Submarine cables; and
- Tourism.

Matrices

Each of the disturbance categories was assessed in terms of the ocean environs (general ecosystem types) where they could occur and in terms of activities that could cause them, and presented as matrices. Four criteria were developed by Oceans Office as a way of determining whether or not the disturbance was known to occur in the ocean environs within the Region and which activities cause these types of disturbance in the Region. The criteria for each matrix were:

Matrix 1: Ocean Environs vs. Disturbance

- *Known*: The disturbance is known to have an effect on this part of the ecosystem in the Region;
- *Possible*: Possibly causes a disturbance, but there is no example in the Region;
- *Unknown*: It is unknown if the disturbance has an effect on this part of the ecosystem in the Region;
- *Known not to occur*: The activity is known not to affect this part of the ecosystem in the Region.

Matrix 2: Activity vs. Disturbance

- *Known*: The activity is known to cause this type of disturbance in the Region.
- *Possible*: Possibly causes a disturbance, but there is no example in the Region.
- *Unknown*: It is unknown if the activity causes this type of disturbance in the Region.
- *Known not to occur*: The activity is known not to cause this type of disturbance in the Region.

An expert independent technical review of the two matrices by IRCE staff was undertaken to determine that each cell has been categorised correctly according to the four criteria. This initial review was based on the results of the 'Impact Assessment Report' and in-house expertise. More time was devoted to the assessment of the Activity vs. Disturbance matrix as it was believed that the type of activity would, in large part, determine which ocean environs were subject to a particular disturbance.

Literature searches and review

The Oceans Office provided two electronic databases of literature relevant to impacts occurring in the South-east Marine Region. Three literature databases were searched for additional information that would enable confirmation that cells were correctly classified or provide support for recommend changes to the classifications. These databases were:

1. IRCE literature database containing over 6000 records dealing mostly with Australian marine issues.
2. The Australian Agriculture and Natural Resources Online databases. These databases were particularly useful for searching government technical reports that are not documented in the other databases.
3. The Biological Abstracts database (1993-2001), a world-wide database of published scientific journal articles. This database was searched for references to work conducted in Australia, specifically the SE region.

A total of seventy-eight additional references were gathered and the results of these literature searches are provided electronically in the format requested (see attached files called 'NOO additions'). The results of these literature searches were incorporated into the technical review of the two matrices and changes made to the categorisation as appropriate.

Communication with experts

The Oceans Office had previously contacted experts to review the construct of the two matrices. The Internet was searched for additional Victorian and Tasmanian experts, positioned in government agencies and universities, to briefly review the construct of the matrices in areas corresponding to their area of expertise, though some overlap with the previously contacted experts was unavoidable. Victorian and Tasmanian experts were targeted because of their familiarity with the SE Region. The experts were E-mailed and asked to quickly review the construct of the portion of the two matrices corresponding to their area of expertise (see list below) and provide objective evidence, preferably in the form of a journal publication citation, internal/ technical report or as a stated expert opinion. These opinions were considered and changes to the construct of the matrices incorporated where necessary.

No experts were sought in the area of Indigenous Customary Use as substantial consultation had been under taken by the Oceans Office in this area. Also, no additional experts were sought in the area of Petroleum as IRCE has considerable expertise with the Petroleum Industry. Finally, no experts were found that could adequately review the areas of Defence, Nuclear and Electromagnetic radiation.

Name	Organisation	Area of expertise
Geoff Gooley	Natural Resources and Environment, Vic.	Aquaculture
Colin Buxton	University of Tasmania, Tas	Aquaculture
Ian Knuckey	Natural Resources and Environment, Vic.	Harvesting
Sandy Morison	Natural Resources and Environment, Vic.	Harvesting
Katrina Maguire	AFMA, Canberra	Harvesting
Greg Parry	Natural Resources and Environment, Vic.	Human change, Shipping, Introduced species
Craig Johnson	University of Tasmania, Tas	Human change, Shipping, Introduced species
Gus Fabris	Natural Resources and Environment, Vic.	Land-based pollution, chemical change, contaminants
Andy Longmore	Natural Resources and Environment, Vic.	Land-based pollution, chemical change, contaminants
Alistair Birtles	James Cook Uni., QLD.	Tourism

2. RESULTS AND DISCUSSION

The Disturbances, Ocean Environ and Activities categories were reviewed for comprehensiveness and consistency. Some of the suggested changes were aimed purely at simplifying and shortening the range of categories and sub-categories to avoid unnecessary overlap where possible and to reduce the size of the matrices. However, overlap between categories is to be expected as a single source of risk or activity may have multiple impacts, multiple sources of risk may have the same impact and multiple sources may have multiple impacts (HB 203:2000).

Following this review of the categories, the construct of the two matrices (Matrix 1: Ocean Environs vs. Disturbance, Matrix 2: Activity vs. Disturbance) were reviewed to assess that each cell had been correctly categorised according to the four criteria established for each matrix. All suggested changes, with justifications, have been stated below in this report. However, the Oceans Office did not accept for specific stated purposes some of the suggestions made by IRCE. IRCE has only incorporated the changes to the construct of the two matrices that the Oceans Office has agreed to. The final construct of the two matrices specifically reflects the position of the Oceans Office following the changes suggested by IRCE.

Disturbance categories

The 12 broad disturbance categories were assessed to cover the full range of potential disturbances that occur in the SE Region. However, three minor suggestions are made which are concerned only with the precise definition of some categories. This is aimed at

ensuring that all disturbances are thoroughly covered whilst attempting to group similar biological processes together:

- The 'Introduced Pathogens' category considered both exotic pathogens and the increased abundance of indigenous pathogens. The introduction process for exotic pathogens would be best dealt with in the 'Introduced Species' category, as the vectors for introduction of all exotic species are similar. The 'Introduced Pathogens' category was renamed 'Pathogens' to specifically concentrate on issues associated with the enhanced abundance or 'blooms' of pathogens, not the introduction of exotic pathogens.
- The separation between the 'Mechanical' and 'Noise' categories is not clear which results in overlap, particularly concerning issues involving the use of explosives. A suggestion may be to make the 'Mechanical' category primarily concerned with mechanical damage caused by direct contact e.g. from fishing gear. The 'Noise' category could be broadened to include disturbances associated with sudden pressure changes caused by anthropogenic activities. In the marine environment, noise travels principally as a pressure wave. Conversely, the 'Noise' category could be incorporated into the 'Mechanical' category, reflecting the mechanical nature (pressure wave) of noise. The Oceans Office did not accept this change, as they argued that the physical damage that mechanical and noise disturbance can make is substantially different, and the literature for each of these two types of disturbances is also very distinct.
- The issues to do with sedimentation have been included under the 'Turbidity/Light' category. Whilst sedimentation can be the result of increased turbidity, the impacts differ. Turbidity is the reduction in light whilst sedimentation is a mechanical impact. To resolve this, the 'Turbidity/Light' category was broadened to include sedimentation and renamed 'Turbidity/ Sedimentation'.

Ocean Environs categories

The 11 broad ocean environs categories and other minor categories were assessed to cover the full range of marine habitats occurring in the South-east Marine Region. However, there was overlap between some of the categories. To minimise the duplication of 'positive' results in the matrices, more precise definitions for some categories were warranted. During the assessment of the Ocean Environs vs. Disturbance matrix, the following definitions of the ocean environ categories were used:

- The Shelf environments were assumed to be primarily concerned with the benthic/demersal habitats whilst the pelagic environments represent the overlying waters.
- The Pelagic Nekton excludes Cetaceans, Pinnipeds and Seabirds (Penguins), which are dealt with separately.

Activity categories

Whilst the 13 broad activity categories were assessed to cover the full range of activities that affect the marine environment in the SE Region, it is recommended that a separate category be established to investigate disturbances caused by greenhouse issues and global warming. Issues associated with the air emissions from industrial and urban discharges, along with air emissions from shipping and petroleum, which may result in sea-level change and changes in weather intensity, are currently not dealt with satisfactorily as they span across many activities. The direct impact of air emissions (fallout of chemicals) on the marine environment are otherwise likely to be minimal. However, the National Oceans Office did not wish to include greenhouse gas or global warming issues, as they felt that these issues were the result of increase in contaminants in the environment, and that a number of activities contributed to these issues. The Office felt that these global issues could not be dealt with in a South-east regional marine planning context, but by assessing the disturbances caused by individual activities.

The list of activities was long and the level of detail in the 13 broad categories of activities was not consistent. Some omissions were detected and some clarifications and suggestions for simplifying and reducing the number of sub-categories were made. These include:

Aquaculture

- Disposal of waste should include faeces/waste products generated by stock. This was not apparent in the "Impact Assessment Report". A new category was created called 'Disposal of cultured species wastes' to deal with this issue.
- Translocation of pens needs to be expanded to include translocation of stock. For example, the translocation of mussel 'droppers' between Port Phillip and Westernport is a known vector for the introduction of exotic species. This was done and the category renamed 'Translocation of pens/stock'.
- Sourcing feed and sourcing stock (from the wild) are adequately dealt with in the 'Harvesting' category and could be removed from "Aquaculture" to avoid duplication. However, the Oceans Office argues that the source stock is likely to come from a hatchery, therefore this activity will have different down stream effects.

Defence

The 'Defence' category includes a radio/radar transmissions sub-category yet the 'Shipping' category does not. Radio/radar transmissions are not unique to the Defence Forces and, as such, were moved into the generic 'Shipping category'. The 'Defence' category should be for activities unique to the Defence industry.

Emerging

The National Oceans Advisory Group requested that 'Research' be included as an activity under the main heading for 'Emerging'. For all disturbance categories, except 'Introduced

Species', the cells were classified as possible or known reflecting the wide range of research that is undertaken.

Harvesting

The discard of fish should be expanded to include the discard of non-fish species. This was done and the category was renamed 'Bycatch'.

Indigenous customary use

The sub-categories commercial harvest, aquaculture and ecotourism could be dealt with under the major categories of Harvesting, Aquaculture and Tourism respectively, to avoid duplication. The disturbance cause by these activities, and the ocean environs they affect, are going to be a sub-set of the disturbances caused by the same non-indigenous activity. The summary report "Southern Seas: Indigenous perspectives" acknowledges that commercial harvest issues for Indigenous customary use are not well understood in South-east Marine Region. However, this change was not implemented as the Indigenous Working Group felt that Indigenous peoples managed these activities differently.

Land based

The categories domestic waste (grey water) and sewage could be combined, reflecting that grey water generally ends up in the sewage system. However, this change was not implemented as the Oceans Office believe that it is possible that not all grey water is treated through the sewage system.

Petroleum

The 'Petroleum' category has several deficiencies and needs improvement. Specific problems which need to be addressed include:

- No sub-category for pipeline physical presence despite having a sub-category for physical presence under "Submarine Cables".
- The subsea installation subcategory should be broadened to include other installations that occur above the water including production facilities. This subcategory could be renamed 'Construction'.
- Seismic is only one form of acoustic survey undertaken by the petroleum industry so this subcategory should be expanded to include other geotechnical surveys.
- The 'Shipping' category includes garbage, sewage and grey water discharges which are also generated by the petroleum industry. However, these sub-categories have not been included under the 'Petroleum' category.
- The 'Petroleum' category could be simplified, as outlined in Table 1. Drilling activities can occur throughout the life of a petroleum lease and would be best dealt with as a broad category, avoiding unnecessary overlap.

Table 1 Suggested sub-categories within the Petroleum category

Surveys (Includes Seismic, Geotechnical and other surveys)	
Drilling (including exploration, appraisal and production drilling. Drilling occurs throughout the life of a petroleum lease.)	Establishment Discharges <ul style="list-style-type: none"> • drill fluids/cuttings • domestic (sewage/grey water-see Shipping) • cooling waters • oily waters Physical presence Lights
Construction/ Production	Establishment <ul style="list-style-type: none"> • facilities • pipelines and other structures Discharges <ul style="list-style-type: none"> • PFW and additives • domestic (sewage/grey water) • cooling waters • oily waters Physical presence <ul style="list-style-type: none"> • platform/FOSU • pipelines and other structures Lights Offloading
Decommissioning	
Other Routine Activities	Refuelling Oil spills that may (accidentally) result from routine activities

All these changes in the petroleum category were implemented.

Recreational activities

The harvesting or collection of live or dead species for recreational activities is similar to the commercial harvesting of species, except for the scale of the operations. Both can change the population structure of the target species and result in mechanical damage, depending on the techniques used. As such, issues associated with 'Aquarium Collection' and 'Collection of Species' were dealt with in the 'Harvesting' category, avoiding duplication.

Shipping

Two activities that cause a potential impact have not been included in what is otherwise a comprehensive list. These are:

- passage/steaming. For example, the passage of a ship may affect the movement of cetaceans.
- navigational markers. The physical presence and maintenance of navigational markers are likely to cause changes to the marine environment in the immediate vicinity.

Three suggestions are also made to simplify and improve the categorisation of activities.

- Grey water, sewage and garbage discharges are biological products that probably cause similar disturbances, mainly falling into the '*Chemical change*' disturbance category. As such, these three categories were combined into one category called 'Domestic discharges'. These discharges still need to be kept separate to cooling water and oily waste discharges category.
- Dredging channels could be included in the 'Human Changes Coastal Zones' category. The impacts caused by dredging are different from most other shipping impacts. Dredging impacts are more akin to the impacts caused by construction activities in the coastal zone. This change also avoids unnecessary duplication of the dredging sub-category.
- The sub-category 'Grounding/Sinking' was expanded to include accidents and collisions which do not result in a grounding or sinking, as these accidents still have the potential to cause a disturbance. This category was renamed 'Grounding/Collisions'.

Matrices

Environmental risk management differs from other risk management because of the complexity of the environment and the scientific uncertainty surrounding the identification of potential environmental impacts and the corresponding assessment of likelihood and consequence (HB 203:2000). This complexity makes the assignment of occurrence criteria for the two matrices difficult and somewhat subjective. In addition, environmental science, for many reasons that will not be discussed here, generally does not investigate anthropogenic activities that are not expected to disturb the environment. The result of this is that there are few studies to support the assignment of a disturbance to the '*Known not to occur*' criteria. As a result, the '*Known not to occur*' criterion was mainly applicable to activities that are incapable of causing particular disturbances. For example, recreational diving cannot cause a nuclear radiation disturbance.

The assessment of 'occurrence' criteria in the two matrices was further confounded because the principal form of supporting evidence, the draft 'Impact Assessment Report', was only concerned with disturbances that were '*Known to occur*'. Little or no justification was supplied for assignments to the other three criteria. Nor, in many cases, were there detailed justifications to support the assignment of a disturbance to the '*Known to occur*' criteria, especially as the 'Impact Assessment Report' was structured around a coarser, broad level of Ocean Environs and Activities categorisation. That is, there was no justification of the assignments made at the sub-category level. A less serious criticism was that it was difficult to determine whether the cited literature truly justified the assignments made because the specific detailed needed to confirm the classification was not directly cited. This lack of supporting evidence or justification will also effect the assignment of consequence and likelihood during the later stages of the risk assessment process.

Due to the lack of detailed supporting evidence, the analysis of the construction of the matrices and assignment to the criteria relied heavily on the expert opinion of the reviewers. This is not ideal, as it is important that the process for the assignment to the four 'occurrence' criteria is justifiable and defensible, principally by being repeatable whilst delivering similar results. However, the results of the literature search confirmed that for the cells where appropriate information was obtained, that these cells were correctly classified. Also, these literature search results did not provide support for many changes to the classifications, suggesting that review by experts is probably sufficient.

The details of the assessment of both matrices (over 1200 individual cells) are provided in an attached Excel spreadsheet (called 'assessment.xls'). The changes made to the original assignments of Disturbances, Ocean Environs and Activities to the four 'occurrence' criteria are summarised in Table 2 and 3. The identification of any 'missing information' is listed in Tables 4 and 5. This list of 'missing information' was derived following the assessment of the two matrices and primarily comprised any matrix cells, which have been assigned to the *Known*, *Possible* or *Known not to occur* categories (not *Unknown*), without some supporting evidence. Finally, the revised matrices, incorporating the suggested changes accepted by the Oceans Office, are presented in Tables 6 and 7 (see attached Excel spreadsheet called 'Impact matrices modified.xls').

Future Directions and Improvements

As highlighted earlier, the lack of detailed supporting evidence for the current classifications based on the 'Impact Assessment Report' meant that the assessment of the construction of the matrices and assignment to the criteria relied heavily on the expert opinion of the reviewers. This is not ideal as it is important that the process for the assignment to the four 'occurrence' criteria is objective, repeatable and technically defensible, principally by not being dependent on the subjective opinions of particular reviewers. It is strongly recommended that future scoping exercises for the other Regions are required to document specific examples to justify the assignment of Disturbances, Ocean Environs and Activities to the four 'occurrence' criteria, prior to the review being undertaken.

Whilst it is not necessary to describe every known example to determine the correct classification, this comprehensive information is needed for the subsequent parts of risk assessment process where the likelihood and consequence of disturbances are assessed to determine the overall risk. Due to this lack of justification for the assignment to the four 'occurrence' criteria, IRCE had difficulty in objectively reviewing the construct of the matrices and it took considerably longer than anticipated. It was necessary to take an approach that assumed that the assignments to the four 'occurrence' criteria were correct unless they could be proven otherwise. It is strongly recommended that future scoping exercises document specific examples to justify the assignment to the four 'occurrence' criteria, before an independent expert review is undertaken. The initial construct of the matrices could be conducted following a detailed literature review.

Table 2 Proposed changes: Ocean Environs Vs. Disturbance

Category	Sub-category	Initial classification	Final classification	Summary for reason for change
Chemical Change				
Pelagic inner-outer	Plankton/nekton	Known not	Known/Possible	Report documents effect on plankton, flow on trophic effects expected to affect nekton
Contaminants				
Mid-shelf	Flora	Possible	Known	Contaminants in petroleum discharges known to affect flora.
Pelagic inner-outer	Plankton/nekton	Known not	Known/Possible	Report documents effect on plankton, flow on trophic effects expected to affect nekton
Temperature				
Mid-shelf	Flora	Unknown	Possible	Report documents effects which extend to mid shelf
Pelagic inner-mid	Plankton	Possible	Known	Temperature of petroleum discharges known to effect plankton
Mechanical				
Multiple Oceans	Pinnipeds/Seabirds	Unknown	Possible	Collection of seals in fishing nets and seabirds on long lines
Electromagnetic				
Inner-Mid Shelf	Fauna	Unknown	Possible	Future construction of 'Bass link' cable extend into these ocean environs
Multiple Oceans	Cetaceans	Unknown	Possible	Report documents possible effects on cetaceans
Noise				
Outer-shelf	Fauna	Known	Possible	Report documents effects as possible
Pelagic inner-shelf	Nekton	Possible	Known	To be consistent with Pelagic Mid-outer shelf
Introduced Pathogens				
Multiple Oceans	Seabirds	Unknown	Possible	Report states that pathogens and diseases may be transferred from fish to seabirds
Introduced Species				
Inner shelf/ Pelagic inner	Flora	Possible-unknown	Known	Exotic dinoflagellates occur in waters and sediments of inner shelf (needs to be confirmed)
Turbidity				
Bays and Estuaries	Fauna	Possible	Known	Sedimentation known to affect fauna
Artificial Lights				
Bays and Estuaries/ Inshore	Flora	Possible	Unknown	Report questions how this is biologically possible
	Fauna	Possible	Known	Attracts squid
Inner-shelf	Flora	Known	Unknown	Question how this biologically possible
	Fauna	Unknown	Possible	Report mentions effects of petroleum facilities though this applies to pelagic fauna
Pelagic	Nekton	Unknown	Known	Artificial lights from fishing/petroleum known to attract squid
Multiple Oceans	Seabirds	Possible	Known	Report gives example of seabird disorientation

Table 3 Proposed changes: Activity Vs. Disturbance

Category	Sub-category	Initial classification	Final classification	Summary for reason for change
Chemical Change				
Aquaculture	Disposal of wastes	Known not	Known	Stock faeces alter sediment chemistry
Indigenous customary use	Aquaculture	Possible	Known	Should match other "aquaculture" assessments. Change not implemented according to NOO.
	Ecotourism	Known not	Possible	Should match other "tourism" assessments. Change not implemented according to NOO.
Petroleum	Waste disposal/PFW	Known not	Known	These waste products increase abundance of chemicals/nutrients
Recreational	Boating	Known not	Possible	Report discusses sewage from boating activities
Shipping	Dredging channels	Possible	Known	Dredging/spoil change sediment chemical properties
Contaminants				
Human change	Dam/Weir construction	Known	Unknown	Difficult to think of an example to justify 'Known' status
Indigenous customary	Aquaculture	Possible	Known	Should match other "aquaculture" assessments. Change not implemented according to NOO.
	Harvesting	Known not	Known	Should match other "harvesting" assessments. Change not implemented according to NOO.
Petroleum	Seismic	Known not	Possible	Seismic arrays are filled with kerosene which will leak out when damaged
	Pipeline installation	Known not	Possible	Discharge of hydrotest fluids which contain corrosion/scale inhibitors
Shipping	Dredging channels	Possible	Known	Similar issues as "Human Change Coastal Zone"
Temperature				
Aquaculture	Disposal of waste	Known not	Possible	Waste eater from onshore farms often has elevated temperatures
Defence	Explosions/Live fire/Lasers	Known not	Possible ???	Do these activities result in temperature changes ???
Human change	Coastal construction	Known not	Possible	Altered depths will alter water temperature
Indigenous customary	Aquaculture	Known not	Possible	Should match other "aquaculture" assessments
Petroleum	Drilling	Known not	Possible	Rigs discharge cooling water
	Production	Known not	Possible	Flares heat surface water???
Shipping	Air emissions	Known	Unknown	Air emissions have no immediate effect on water temperature-excludes greenhouse effects
Mechanical				
Harvesting	Diving	Known	Possible	Listed as possible in report
Petroleum	Drilling	Known not	Known	Drilling discharges smoother benthos
Nuclear				
Shipping	Sinking	Known not	Possible	Sinking of nuclear powered US Navy ship in Region is possible
Electromagnetic				
Submarine Cable	Laying of cable	Possible	Known not	Electromagnetic radiation not an issue until cable is operational

Category	Sub-category	Initial classification	Final classification	Summary for reason for change
Noise				
Human Change	Dredging	Possible	Known	Should be consistent with dredging channels/shipping
	Coastal Construction	Known not	Possible	Expect coastal construction to generate noise that may possible have an effect eg pile driving
Shipping	Air emissions	Known	Known not	Air emissions do not cause noise, rather it is propellers/engines
Tourism	Interactions Wildlife	Known not	Known	Report lists that Human noise during interactions may possibly have effect
Introduced Pathogens				
Aquaculture	Translocation of pens	Unknown	Possible	Report suggests that it is possible
	Sourcing feed	Known not	Possible	Report suggests that it is possible
Land based	Urban discharge	Unknown	Known	Storm water drains are a source of <i>E.coli</i>
Introduced Species				
Aquaculture	Stock escape	Possible	Known	Pacific Oyster, Salmon
	Translocation of pens	Unknown	Known	Transfer of exotics from PPB to WPB via mussel 'droppers'
Harvesting/Recreational	Diving	Known not	Possible	Presence of cysts/small individuals in diving gear-see Recreational diving
Petroleum	Production	Unknown	Possible	Presence of facility is similar to presence of a rig
Turbidity/Light				
Aquaculture	Physical Location	Possible	Known	Structures reduce light reaching ocean floor
Emerging	Bioprospecting	Unknown	Possible	If conducted using fishing equipment (such as nets) can caused sediment disturbance/turbidity
Petroleum	PFW	Unknown	Possible	Discharge increases turbidity/reduces light penetration
	Decommissioning	Unknown	Known	Removal will disturb sediments. Removal includes well head abandonment and pipeline decommissioning, both have occurred in Bass Strait
Shipping	Ballast discharge	Unknown	Possible	Will increase turbidity if sediment that settles in ballast tanks is discharged
	Maintenance	Known not	Possible	Hull scrapings can cloud water-more an issue for smaller vessels not dry-docked
Chem. spills/Domestic wastes/Oily water		Known not	Possible	May increase turbidity
	Propeller action	Known not	Possible	Disturbs bottom causing increased turbidity
Artificial Light				
Aquaculture	Physical Location	Unknown	Possible	Navigational markers
Harvesting	Stock exploitation/Harvesting	Unknown	Known	Squid fishery
Human Change	Coastal construction	Unknown	Known	Lights attract fauna
Petroleum	Production	Possible	Known	Lights on facility similar to drilling rig

Table 4 Missing Information: Ocean Environs Vs. Disturbance

Category	Sub-category	Classification	Comments
Chemical Change			
Slope	Fauna	Known not to occur	Probably correct though no supporting evidence so could be classified as <i>Unknown</i>
Seamount	Fauna	Known not to occur	Probably correct though no supporting evidence so could be classified as <i>Unknown</i>
Temperature			
Pelagic Offshore	Nekton	Known not to occur	Probably correct as can not think of a temperature changing activities that occurs in pelagic offshore
Mechanical			
Pelagic Offshore	Nekton	Known not to occur	Probably correct unless mid-water trawling occurs in pelagic offshore
Nuclear			
All categories	All categories	Possible	No supporting evidence so should be classified as <i>Unknown</i> (cf. Electromagnetic Radiation)
Pathogens			
inner-outer shelf	Flora & Fauna	Possible	Pathogens may have influence far from the coast though no supporting evidence
Introduced Species			
Pelagic Offshore	Nekton	Known not to occur	Probably correct, can not think of an introduced species in pelagic offshore that would have impact
Multiple Ocean	Cetaceans	Known not to occur	Possibly incorrect as may effect cetacean food supplies/water qualities
Turbidity/Light			
Multiple Ocean	Cetaceans	Known not to occur	Possibly incorrect as may effect cetacean food supplies/water qualities
Artificial Light			
Multiple Ocean	Pinnipeds	Possible	No supporting evidence

Table 5 Missing Information: Activity Vs. Disturbance

Category	Sub-category	Classification	Comments
Chemical Change			
Aquaculture	Translocation pens	Possible	No justification given and reason not obvious
	Maintenance	Possible	No justification given and reason not obvious
Recreational	Collection of spp	Possible	No justification given and reason not obvious
Shipping	Air emissions	Possible	No justification given and reason not obvious
Submarine cables	Laying cable	Possible	No justification given and reason not obvious
Tourism	Development	Possible	No justification given and reason not obvious
	Physical presence	Possible	No justification given and reason not obvious
Contaminants			
Emerging	Bioprospecting	Possible	No justification given and reason not obvious
Indigenous	Ecotourism	Possible	No justification given and reason not obvious
Mechanical			
Harvesting	Introduced fish bait	Possible	No justification given and reason not obvious
Land based	Sewage	Known	No justification given and reason not obvious
Shipping	Sewage	Possible	No justification given and reason not obvious
Nuclear Radiation			
Defence	NPW radiation	Possible	No justification given and reason not obvious-what is it????
Electromagnetic			
Shipping	Maintenance	Known not to occur	What about cathodic protection????
	Propeller action	Known not to occur	Does propeller generate electromagnetic currents????
Noise			
Recreational Act.	Collection of species	Known	No justification given and reason not obvious
Biological Interactions			
Defence	All	Possible	No justification given and reason not obvious
Pathogens			
Aquaculture	Disposal wastes	Known not to occur	Need to consider that this may enhance pathogen numbers
Land based	Industrial shipping	Known not to occur	Need to consider that this may alter pathogen numbers
Petroleum	Waste disposal	Known not to occur	Need to consider that this may enhance pathogen numbers
Shipping	Chemical/oil spill	Known not to occur	Need to consider that this may enhance pathogen numbers
	Sewage/grey waste	Possible	No justification given

Category	Sub-category	Classification	Comments
Introduced species			
Indigenous	Aquaculture/Ecotourism	Known not to occur	No justification given despite similar non-indigenous activities rated differently
Turbidity			
Aquaculture	Disposal of wastes	Known not to occur	Need to consider that this change may enhance turbidity
	Source stock/feed	Known not to occur	Need to consider that this change may enhance turbidity
Defence	explosions/Live fire	Known not to occur	Need to consider that this change may enhance turbidity
Artificial Light			
Indigenous	Aquaculture	Known not to occur	No justification given despite similar non-indigenous activities rated differently

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