THE NATIONAL ESD FRAMEWORK

the 'How To' Guide for Aquaculture

Version 1.1

June 2004

Ecologically Sustainable Development

Catching Sustainabilty

Australian Government

Fisheries Research and Development Corporation

Department of Fisheries

CSIRO

The University Of Queensland

AUSTRALIA

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This 'How To' Guide for ESD analysis and reporting on aquaculture is part of an on-going process to develop a framework for ESD across all fisheries and aquaculture sectors within Australia. This is the first edition for this sector and changes are expected to be made at regular intervals.

The material may be copied for use in completing assessments and reports as long as appropriate acknowledgement of the source is given.

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1.0 EXECUTIVE SUMMARY

1.1 Background

Aquaculture is one of the fastest growing industries in Australia having grown in value by over 13% for the past 10 years[1]. It is currently valued at $743 million[2] with an industry vision to achieve $2.5 billion in sales by 2010.

The industry is made up a large number of different sectors that produce over 40 species, but the five main sectors - oysters, prawns, tuna, salmon and pearls account for over 85% of the GVP. These operations are located from tropical to temperate regions and utilise production techniques that involve the use of land based, estuarine and fully marine systems.

It has been recognised that there are a number of potential impediments to achieve continued growth of this industry. These include the need for increased investment, an expansion in markets and ensuring environmental sustainability. One of the most important, however, is meeting the growing expectations of the community that all aquaculture sectors can clearly demonstrate that they are operating within the principles of Ecologically Sustainable Development (ESD).

The agencies responsible for the management of aquaculture in Australia and the relevant aquaculture industries are committed to incorporating ESD into their management processes. A direct outcome of this commitment has been the development of an ESD Framework for Aquaculture which is being generated by the FRDC subprogram in conjunction with the Aquaculture Committee of the Australian Fisheries Managers Forum (AFMF) in conjunction with the National Aquaculture Council (NAC).

The first stage in the development of this framework is the completion of a *How To Guide* that documents the methods needed to enable the initial analyses of any aquaculture sector against the principles of ESD.

1.2 What is ESD?

Ecologically Sustainable Development (ESD) is:

"*Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased" (COAG, 1992)*.

It includes three key objectives:

- *To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;*
- *To provide for equity within and between generations; and*
- *To protect biological diversity and maintain essential ecological processes and life-support systems.*

To achieve these objectives will require the integration of short and long-term economic, social and environmental effects in all decision-making. Thus, to be consistent with ESD principles, *"resources not only need to be used sustainably, but how they are used, who benefits and when, along with the impacts of their use, all need to be evaluated"* (Fletcher, 2002).

The desired outcomes using such a process are likely to evolve through time as society's needs and values alter. Therefore ESD should be seen as a means – not as an endpoint.

[1] *Source - Aquaculture Industry Action Agenda.*

[2] *Source - 2002/03 Australian Fisheries Statistics – ABARE, Canberra.*

1.3 How does the ESD framework fit with Aquaculture?

Until recently, there were no methods available to implement ESD in a full and practical manner.[3]. During the past four years, work within the FRDC subprogram on ESD Reporting and Assessment has been underway to develop a series of National ESD frameworks to enable all Australian fisheries and aquaculture sectors to demonstrate that they are operating utilising ESD principles.

The ESD framework for aquaculture has similarities to the ESD framework that was previously developed for wild capture fisheries. Thus, both of them help to identify the relevant environmental, social/economic and governance issues, they assist with determining the appropriate level of management response using risk assessment techniques, and they provide a reporting structure to document outcomes. There are, however, a number of important differences between these systems.

The major difference between the two frameworks is in the structure of the environmental components. For aquaculture, they are structured into three different spatial levels - (1) Whole of industry issues, (2) Catchment/Regional issues and (3) Within facility issues. This hierarchical approach is designed to show the linkages between what is required at the operator level and the outcomes wanted by government/community at the regional and whole of industry scales.

This guide can be used to facilitate the development of reports/assessments at the whole of industry level, at a regional level, or as the basis for an EMS (environmental management system) at the facility level (see Section 7 for more details on EMS). Thus, it can be used at whatever level is appropriate depending upon the questions being asked and who is asking them.

Given that most aquaculture operations are assessed/approved at an individual venture level and a large number of government agencies are usually involved in the assessment of aquaculture, the ESD framework for aquaculture can also function as a set of guidelines for coordinating processes and ensuring due diligence, not just as a method for the generation of a single report on an industry.

Finally, this ESD Framework has not been developed to add more steps to the process of approvals for aquaculture leases/licences. Instead, it is designed to help minimise overlaps, redundancies and omissions[4] in the current procedures to improve the efficiency and effectiveness of the outcomes for both industry participants and the wider community.

1.4 What are the major components of ESD for Aquaculture?

To enable ESD to be implemented in a practical manner, it has been divided into eight major components, grouped within three main categories – contributions to ecological wellbeing, contributions to human wellbeing and ability to achieve. Each of these is split into a number of components relevant to aquaculture.

Contributions to Ecological Wellbeing

1. ***Impacts on the General Environment (Whole of industry)***
   Are there issues that need to be dealt with at the whole of industry level?
2. ***Impacts within Catchment/Region***
   This deals with the cumulative impacts that may occur from multiple facilities in the one region/catchment
3. ***Impacts within Facility***
   What issues need to be addressed within each facility?

[3] *Although in many instances the management of fisheries and aquaculture covered many of the principles now incorporated under ESD.*

[4] *If significant omissions are found, this may result in the need for additional regulations.*

Contribution to Human Wellbeing

4. ***Indigenous Wellbeing***
   How does the industry sector affect indigenous communities in the area where the industry operates?
5. ***Community Wellbeing***
   Are there local (including the industry itself) or regional communities that are dependent on the industry and/or are they supportive or negative about its operation?
6. ***National Wellbeing***
   How does the industry/sector contribute to national issues such as employment rates, supply of fish, economic returns, reductions in trade deficit etc?

Ability to Achieve

7. ***Governance***
   Are the management processes and arrangements for the industry appropriate and efficient to enable the other elements to achieve an adequate level of performance?
8. ***Impacts of the Environment***
   Are there issues that may reduce or improve performance of the industry/sector that are outside of the direct control of the management agency/industry?

1.5 How does the ESD Framework operate?

There are five key elements used in the process to complete an ESD report for an aquaculture sector:

(1) identifying the issues relevant to the industry/sector/individual;

(2) prioritising these issues;

(3) completing suitably detailed reports/management strategies for each issue (dependent upon their priority, complexity and the scope of the requirements – ie whole of industry, a region or even just a single operator);

(4) compile summary background material on the industry (where relevant), the major species affected and the environments that the industry operates within. This enables the reader to put the material presented within any report into an appropriate context.

(5) using the generated material to assist individuals or industry (e.g. for use in generating EMS's, COPs) or by agencies as the basis for demonstrating they are achieving appropriate outcomes for government (e.g. Reports to Parliament).

1.6 How are the specific issues identified?

The first step in the ESD framework is to identify the relevant issues for the industry through the use and modification of a set of "*generic component trees*".

There is one *generic component tree* for each of the eight components of ESD (see section 3). Each of these trees was developed in consultation with the Aquaculture Committee, the NAC and the ESD Reference group to cover the suite of issues that are relevant to aquaculture.

These generic component trees are used as a starting point, tailoring them to suit individual industry circumstances, expanding some sub-components and collapsing or removing others, depending upon the farming methods, areas of operations and the species involved.

The number of component trees used to identify issues will depend upon the assessment being completed.

For example, government agencies responsible for aquaculture management may concentrate on the use of the "whole of industry", "regional/catchment level", and "community wellbeing" trees for planning purposes. Similarly, an individual license holder may only need to use the "within facility" component tree to identify the issues relevant to the management of their operations.

The best application of this system is, nonetheless, when all elements have been examined in a coordinated manner and the linkages amongst the levels are understood and recognised within the management processes of both the government agencies and the industry participants.

1.7 How are the issues prioritised?

Tailoring the component trees to any specific industry sector can often result in a large number of issues being identified, the importance of which often varies greatly. In nearly all cases, it is necessary to prioritise amongst these issues so that the level of management actions and the level of detail for any reports generated are aligned with the importance of the issue.

To determine the relative priority of each issue, risk assessment methodology (see Section 4) has been adapted to assist this process. The outcome of these risk assessment evaluations must include the justifications for the levels chosen. This enables third parties to review the logic and assumptions behind any decisions. It also facilitates future amendments if alternative information becomes available.

1.8 How can performance/management reports be completed?

Two levels of reporting are suggested, depending on the level of management response required:

(1) Where specific management is not undertaken, reports only need to justify this conclusion.

(2) Where specific management actions are needed, a report that details all elements of the management system is required (see Section 5). These performance reports should contain a series of headings, which includes identifying: operational objectives (what are you trying to achieve?), indicators (what will you measure to determine performance?), performance measures (how will you know if you are being successful?), and the management responses taken (what actions are/will be taken to achieve acceptable performance?).

    Most importantly for aquaculture, it needs to include a heading for articulating which specific management agency is responsible for the particular issue (there is often more than one interested agency and it needs to be determined who will be the determining authority for each issue).

    Once completed, these reports form an integrated management system for each issue.

As stated above, it is not expected that this process will always result in the generation of a single, comprehensive ESD report that covers all levels. Rather, we anticipate that government agencies may routinely only collate the ecological material for the whole of industry and catchment levels. Individual leaseholders would probably only generate facility level reports, although these data may be needed to complete the higher level reports.

Similarly, who, and to what extent the social, economic and governance issue reports would need to be completed will vary amongst jurisdictions and industry sectors and the expected audience/purpose.

1.9 How does ESD fit in with EMSs and similar processes?

A major difference between an EMS and ESD is that the ESD framework is designed to encompass *all* aspects and issues that may affect the natural resources of the entire industry being assessed. However, an EMS may be developed to only address a single issue for a single facility. Moreover, ESD encompasses social and economic concerns whereas an EMS usually only includes environmental issues.

A certified EMS (eg ISO 14000) requires third party auditing but this only covers the processes, not the outcomes. Consequently, if there are no regulatory standards available for use as the targets within an EMS, these systems cannot guarantee that appropriate ecological outcomes will be generated.

The outputs from the ESD process, however, involve identifying the objectives and determining the levels/targets for acceptable performance using input from all relevant stakeholders. These could be used as the basis of an EMS developed by individuals to achieve acceptable performance for their facility. Consequently, the two systems are complementary not competing.

2.0 INTRODUCTION

2.1 Background

Aquaculture is one of the fastest growing industries in Australia having grown in value by over 13% for the past 10 years (Dadswell, 2001). It is currently valued at $743 million (ABARE, 2003) with an industry vision to achieve $2.5 billion in sales by 2010.

The industry is made up a large number of different sectors that produce over 40 species, but the five main sectors - oysters, prawns, tuna, salmon and pearls account for over 85% of the GVP. The wide variety of aquaculture activities are located around many parts of Australia, from tropical to temperate regions. Moreover, they utilise an array of production techniques that involve the use of land based, estuarine and fully marine systems.

It has been recognised that there are a number of potential impediments to achieve continued growth of this industry, including increased investment, expanding markets and ensuring environmental sustainability. One of the most important of these, however, is to meet the growing expectations of the community that all sectors of the seafood industry (including the aquaculture sectors) can clearly demonstrate that they are operating within the principles of Ecologically Sustainable Development. To assist with this, an ESD framework for the aquaculture sector is needed.

The ESD Framework for Aquaculture has been developed as part of the activities within the Fisheries Research and Development Corporation (FRDC) subprogram for ESD Reporting and Assessment. The agencies responsible for the management of aquaculture in Australia and the relevant aquaculture sectors are committed to incorporating ESD into their management processes. The first step in this process is the documentation of the methods needed to enable the initial analyses of any aquaculture sector against the principles of ESD through the completion of a *How To Guide*.

This *How To Guide* has been completed in collaboration with the Aquaculture Committee of the Australian Fisheries Managers Forum (AFMF), the ESD Working group of the Marine and Coastal Committee of the NRMSC and the National Aquaculture Council (NAC). The current version of the *How To Guide* has been refined following consultation with relevant government agencies (including many fisheries/aquaculture agencies and environmental agencies across all jurisdictions), industry (e.g. NAC) and other stakeholders (e.g. ESD Reference Group) through a series of workshops held in late 2002 and early 2003. The *How To Guide* has also been tested using a number of "Case Studies" completed in Qld, WA, SA and Victoria during 2000–2003 (see appendix 4 for a full list).

The *How To Guide* begins with a brief outline of what is ESD[5] and covers in detail each of the main steps involved in using the ESD framework for the initial assessment of any aquaculture sector/ industry.

2.2 What is Ecologically Sustainable Development (ESD)?

The concept of "*sustainable development*" emerged during the 1970s and 1980s, following concerns about the impacts that unrestrained economic growth and development were having on the environment. It was recognised that we need to ensure that: *"development…meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).*

[5] *for more detailed descriptions on ESD see Fletcher (2002) or the ESD subprogram website www.aqua-esd.com or www.fisheries-esd.com.*

The term "Ecologically Sustainable Development" (ESD) was adopted in Australia to emphasise the importance of the environment to long-term survival and to ensure that there was a balanced approach in dealing with environmental, social and economic issues. The National Strategy on ESD (NSESD, COAG, 1992), which was agreed to by all Australian governments, includes three key objectives:

- *To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;*
- *To provide for equity within and between generations; and*
- *To protect biological diversity and maintain essential ecological processes and life-support systems.*

ESD has often been wrongly assumed to address only environmental issues, however the management of natural resources should be about more than just setting minimum biological limits. It requires improving the quality of human life from the utilisation of these resources while only having an acceptable level of impact on the environment. Importantly, the NSESD specifies that the guiding principles and core objectives need to be considered as a package; no objective or principle should predominate over the others. Thus, to be consistent with ESD principles,

> *"resources not only need to be used sustainably, but how they are used, who benefits and when, along with the impacts of their use, all need to be evaluated"* (Fletcher, 2002).

Moreover, society's goals and values often influence what are considered to be the acceptable levels of change, sometimes these are well above any biologically-based limit and as these attitudes develop and evolve, the acceptable levels often change over time.

2.3 How does the ESD framework fit with Aquaculture?

ESD covers a very broad range of issues, so that it could be argued that everything fits within these principles. Consequently, there is a need to clearly define how ESD can work within the context of aquaculture management.

Until recently, there were few methods available to implement ESD in a practical manner. During the past four years work within the FRDC subprogram has been underway to develop a series of ESD frameworks to enable all Australian fisheries and aquaculture sectors to demonstrate that they are operating in accordance with these principles. These frameworks differ from previous attempts, which were often too prescriptive, and indicator focused (Fletcher, 2002). The systems developed through the current initiative use a process that systematically identifies issues, develops operational objectives and then works out what indicators need to be measured. The first ESD framework to be initiated dealt with wild capture fisheries (largely due to the pressures generated by their need to meet the Australian Governments' Environmental Protection and Biodiversity Conservation Act regulations) with the first phase (the development of a reporting framework) completed almost three years ago (Fletcher, *et al.*, 2002)[6].

The ESD framework for aquaculture has some similarities to the wild capture framework. It has been designed to help identify what are the relevant environmental, social/economic and governance issues for the aquaculture sector being examined (see Fig. 1), determine what level of management response is required for each of these issues through the use of a risk assessment module, and finally provide a reporting structure to document these outcomes (if needed).

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[6] The second phase of this work has also been completed with the publishing of the first edition of an ESD Assessment Manual for Wild Capture Fisheries (Fletcher et al., 2003).

Despite the structural similarities with the wild capture framework, there are a number of important differences that needed to be made for aquaculture. First, the environmental components needed to be structured to reflect the different issues facing aquaculture. These issues are separated into three different spatial levels –

(1) General/Whole of industry issues,

(2) Catchment/Regional issues and

(3) Within facility issues.

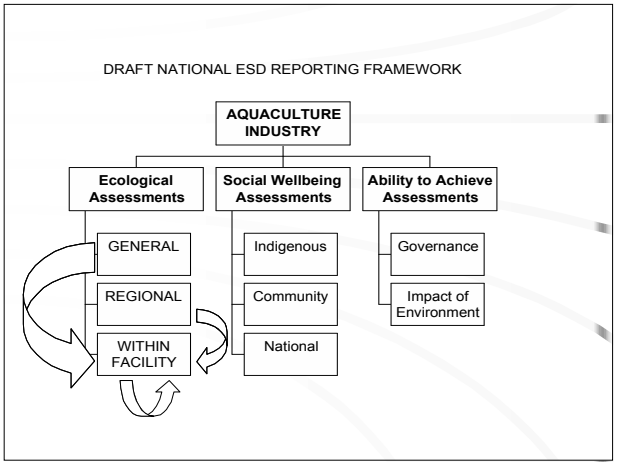

Figure 1. The eight components of ESD for Aquaculture showing the relationships between the three environmental components.

The hierarchical nature of the trees used in the aquaculture framework is designed to show that there needs to be clear linkages between what is required at the operator level with the outcomes that are wanted by the government/community at both the regional and whole of industry levels.

Currently, for most aquaculture sectors, there are few identifiable linkages between the monitoring requirements and restrictions imposed at the operator level and the outcomes wanted at either the whole of industry or even at the regional level. Moreover, there are only a few cases where these higher-level objectives and performance levels have been identified or agreed. Therefore, identifying these linkages and ensuring that there are appropriate objectives, performance measures and indicators at all relevant levels is probably the greatest benefit that will be derived from using this framework.

The hierarchical nature of the aquaculture framework is designed to clearly show the linkages between what is required at the operator level and the outcomes wanted at both the regional and whole of industry levels.

Another major difference is that for wild capture fisheries, the legislative responsibility for nearly all of the environmental and economic components of ESD falls within the scope of the fisheries management agency and assessments are usually done at the "whole of industry" level. By contrast, many government agencies (sometimes more than five) are often involved in the assessment of aquaculture and a large number of regulations and approvals processes are already in place. Consequently, the aquaculture framework can also be used as a set of guidelines for coordinating processes (i.e. ensuring that due diligence has been followed) not just as a method for the generation of reports for an industry.

The aquaculture framework can also function as a set of guidelines for coordinating processes not just as a method for generating reports on outcomes for an industry.

There is a high degree of flexibility in how this *Guide* can be used. Thus, it can be used at whatever level is appropriate depending upon the questions being asked and who is asking them with the number of component trees used to identify issues being dependent upon the assessment being completed. For example, government agencies responsible for aquaculture management/regulation may, for planning purposes, concentrate on the use of the "whole of industry", "regional/catchment level", and "community wellbeing" trees for planning purposes. Alternatively, an individual license holder may, however, only need to use the "within facility" component tree to identify the issues relevant to the management of their own operations.

Irrespective of the level chosen, completing this process will provide an excellent planning tool, helping to identify what needs to be carried out in the future, what current programs assist with these needs, and which of these programs need to be improved or even deleted.

It should be stressed however, that the best application of this framework will arise when all elements have been examined in a coordinated fashion by government, industry and other stakeholders with the linkages amongst the levels recognised within the management processes of both the government agencies and the industry participants.

The best application of this framework will arise when all elements have been examined… with the linkages amongst the levels recognised within the management processes.

Importantly, the ESD framework is not designed to add more steps to the process of approvals for aquaculture facilities. Unlike wild capture fisheries, there has been a long history of application and approval processes in place to regulate aquaculture activities. Instead of adding to this "burden", the ESD framework for Aquaculture is designed to help determine how the existing regulations and requirements fit together to, hopefully ensure that there are minimal overlaps in regulations, redundancies and omissions. This should increase the level of confidence for all stakeholder groups (including industry) that the processes used to manage this process are comprehensive, relevant, effective and, most importantly, efficient.

2.4 How does the ESD Framework Operate?

There are five key elements used in the process to complete an ESD report for an aquaculture sector (shown in Figure 2) - these include:

(1) identifying the issues relevant to the industry/sector;

(2) prioritising these issues;

(3) completing suitably detailed reports/management strategies for each issue (dependent upon their risk level and complexity);

(4) compile summary background material on the industry, the major species affected and the environments that the industry operates within (where relevant). This enables the reader to put the material presented within the report into an appropriate context.

(5) using the generated material to assist individuals or industry (e.g. for use in generating EMS's, COPs) or agencies (e.g. Reports to Parliament) to demonstrate appropriate outcomes are being obtained.

A number of tools have been developed to assist completing some of these elements. A feature of these tools is the high level of involvement and input from each of the major stakeholder groups.

Given the similarities of issues (particularly in the basic description of Risk Analysis and the social and economic elements), some sections of this *Guide* have been based on the *Wild Capture Guide* (Fletcher et al, 2002). Nonetheless, in most cases even these have required some modifications to ensure that they are relevant to the issues facing aquaculture.

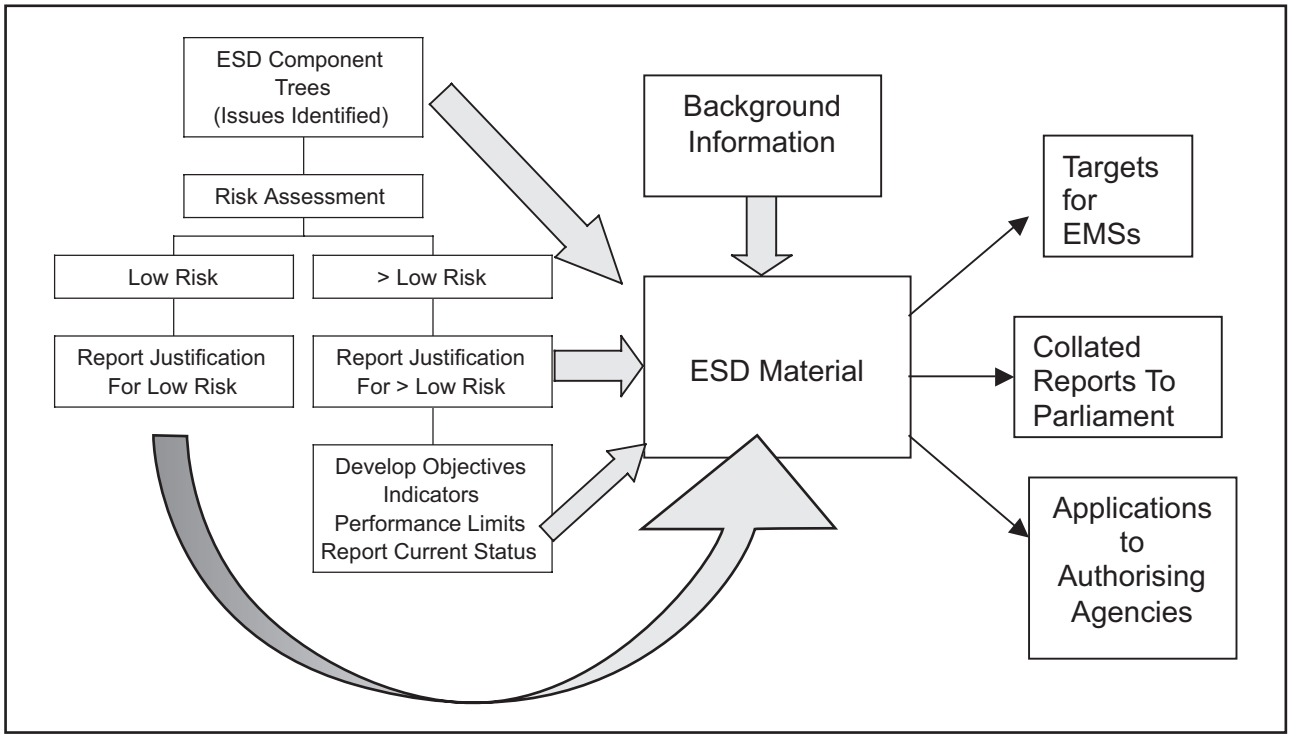

Figure 2. Summary of the National ESD Reporting Framework Processes for Aquaculture.

3.0 IDENTIFYING ISSUES

3.1 Background

One of the most important steps in the ESD process is determining the issues that need to be examined - if you haven't identified an issue, you can't deal with it. Furthermore, to be managed effectively, issues need to be identified at a level that will allow the development of sensible operational objectives and indicators – if you can't measure the performance of something, you can't manage it effectively. Finally, to assist in the efficiency of dealing with issues, they should be grouped appropriately to illustrate their affinities and relationships.

The identification of issues is the first step for all management and assessment processes and frameworks, this includes Environmental Management Systems (EMS) and Environmental Risk Assessments. However, most of these systems do not specify the way this identification process should occur, often relying on rather haphazard techniques such as 'brain storming' to produce the list of issues (which are sometimes referred to as hazards). The following section outlines a more structured, and therefore robust, approach to this process that includes the use of a set of components, which are organised into component trees.

3.2 National ESD Components for Aquaculture

The National ESD reference group originally divided ESD into eight major components, grouped within three main categories relevant to fisheries – contributions to environmental wellbeing, contributions to human wellbeing and ability to achieve. Each of these is further split into a number of high-level objectives from which the rest of the structure can be developed. This system has now been adapted for the aquaculture sector, which is outlined below[7].

Contributions to Ecological Wellbeing

1. ***Impacts on the General Environment (Whole of industry)*** To manage the impacts of aquaculture such that only acceptable impacts occur to functional ecological relationships, habitat and processes.
   (Are there issues that need to be dealt with at the whole of industry level?)

2. ***Impacts within Catchment/Region*** The total impact of all aquaculture facilities in each catchment/ region should be kept within the agreed limits[8]), given the assimilative capacity of the catchment/ region and recognition of impacts already occurring.
   (This deals with the cumulative impacts that may occur from multiple facilities in the one region/ catchment)

3. ***Impacts within Facility*** Individual operations should maintain their impacts within the acceptable levels that take into account background levels and specific catchment issues/limits and whole of industry objectives**.**
   (What needs to be addressed within each facility?)

[7] *The full set of aquaculture component trees can be downloaded as a WORD file from the ESD subprogram website www.aqua-esd.com. They are created in MS Organisational Chart V 2 which can be edited on most computers that have MS Office.*

[8] *it is recognised that these agreed limits are often not currently available – their development is expected to be the major outcome of this ESD process.*

Contribution to Human Wellbeing

4. ***Indigenous Community Wellbeing*** To satisfy traditional (customary) fishing needs, cultural /economic development and sustainability of indigenous communities.
   (How does the industry sector affect indigenous communities in the area where the industry operates?)

5. ***Community Wellbeing*** To contribute to community and regional wellbeing, lifestyle and cultural needs.
   (Are there local or regional communities that are dependent on the industry and/or are they supportive or negative about its operation?)

6. ***National Wellbeing*** To contribute to national wellbeing, lifestyle and cultural needs.
   (How does the industry/sector contribute to national issues such as employment rates, supply of fish, economic returns, reductions in trade deficit etc?)

Ability to Achieve

7. ***Governance*** To (a) ensure that ESD principles are underpinned by legal, institutional, economic and policy frameworks capable of responding and taking appropriate peremptory and remedial actions; and (b) allocate resource access to maximise/optimise community benefits.
   (Are the management processes and arrangements for the industry appropriate and efficient to enable the other elements to achieve an adequate level of performance?)

8. ***Impacts of the Environment*** To recognise that there can be impacts of the environment on an aquaculture industry from both natural and non –industry-based human induced sources and incorporate these within management responses.
   (Are there issues that may reduce or improve performance of the industry/sector that are outside of the direct control of the management agency/industry?)

3.3 Use of the generic component trees

The objectives for each of the eight major components of ESD described above are, in virtually all cases, at too high a level to develop sensible operational objectives. Consequently, each of these components needs to be 'deconstructed' into more specific sub-components for which ultimately operational objectives can be developed.

The method adopted to facilitate this flexibility (and visibility) is the BRS component tree approach. This design is very flexible and has already been shown to be applicable to completing reports for a number of sectors and industries (Whitworth et al., 2000; Chesson, 2004).

The system uses one *generic component tree* for each of the eight components of ESD stated above. Each of these trees was initially developed by the ESD Reference group and subsequently refined by discussions with the Aquaculture Committee of the AFMF and the NAC to ensure that they covered the suite of issues relevant to aquaculture sectors around the country. Finally, they have been further refined following testing in a series of case studies completed in Qld, WA, SA and Victoria. (see appendix 4 for a full list)

These generic component trees are used as a starting point, with each being tailored to an industry to suit its individual circumstances. Depending upon the aquaculture sector being examined, the production methods used, the areas of operation and the species involved, some sub-components are expanded into more detail, others are collapsed or removed entirely, see diagram below for an example of how the components are added or removed.

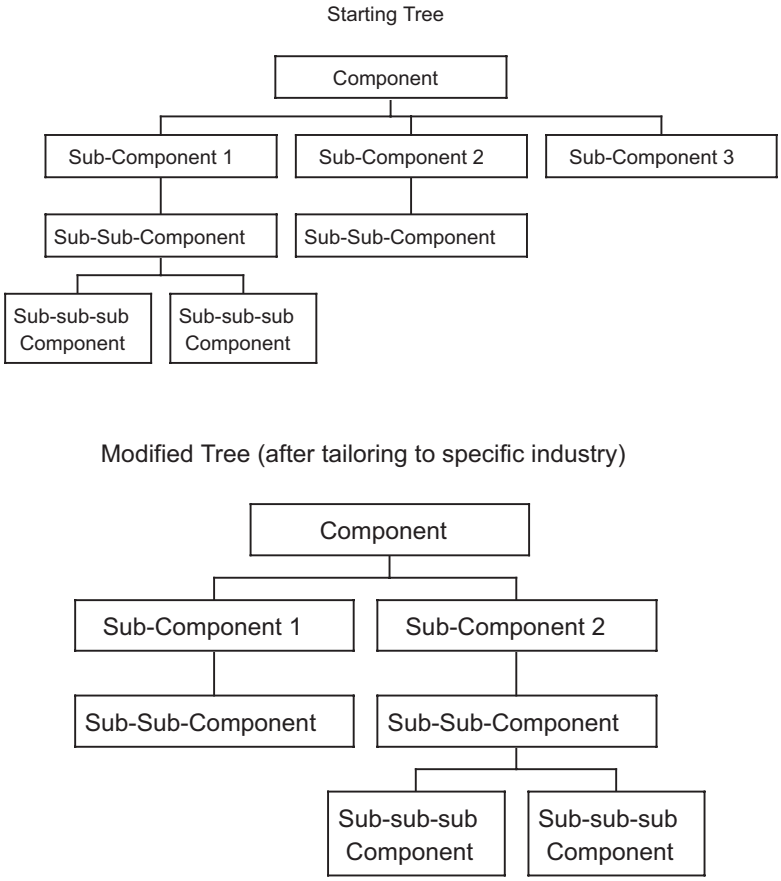

Figure 3. Description of the use of component trees to identify issues**.**

There are a number of benefits in using a system of generic component trees:

- The assessments of all sectors can be completed in a consistent manner.
- The system requires the explicit determination of whether an issue is relevant for an industry. It requires the specification of which potential sub-components present on the generic component trees are NOT issues as much as it assists determining what are issues. This should result in less issues being omitted purely because no one thought of them at the time when issues were being identified.

3.3.1 Impacts on the General Environment (Whole of Industry)

General Description

The issues/topics covered in this generic component tree are relevant to and, more importantly the management outcomes need to be set at, the level of the whole of industry (see Fig. 4). This covers issues that have a wider scope than an individual facility, or even a single catchment or region or where identical protocols need to be implemented for all operators.

The three areas covered by this tree include the potential impact the entire industry may have on:

(i) the wildstock of the cultured species;

(ii) issues affecting the husbandry of the cultured species (in closed life cycle conditions) and;

(iii) other species that could be affected in all areas.

To determine if an issue should be dealt with at this level or at the catchment/regional level, it may be helpful to assess whether or not the same basic management approach (or monitoring outcome) would be taken in all regions. For circumstances where the industry currently operates only within a single catchment/region, assess if the issue would be similar if the same type of industry started in another area.

For example, assessing the potential impacts on wild stock populations from aquaculture activities, such as determining the sustainable level of total broodstock collection, should, in most cases, be dealt with at an industry wide level.

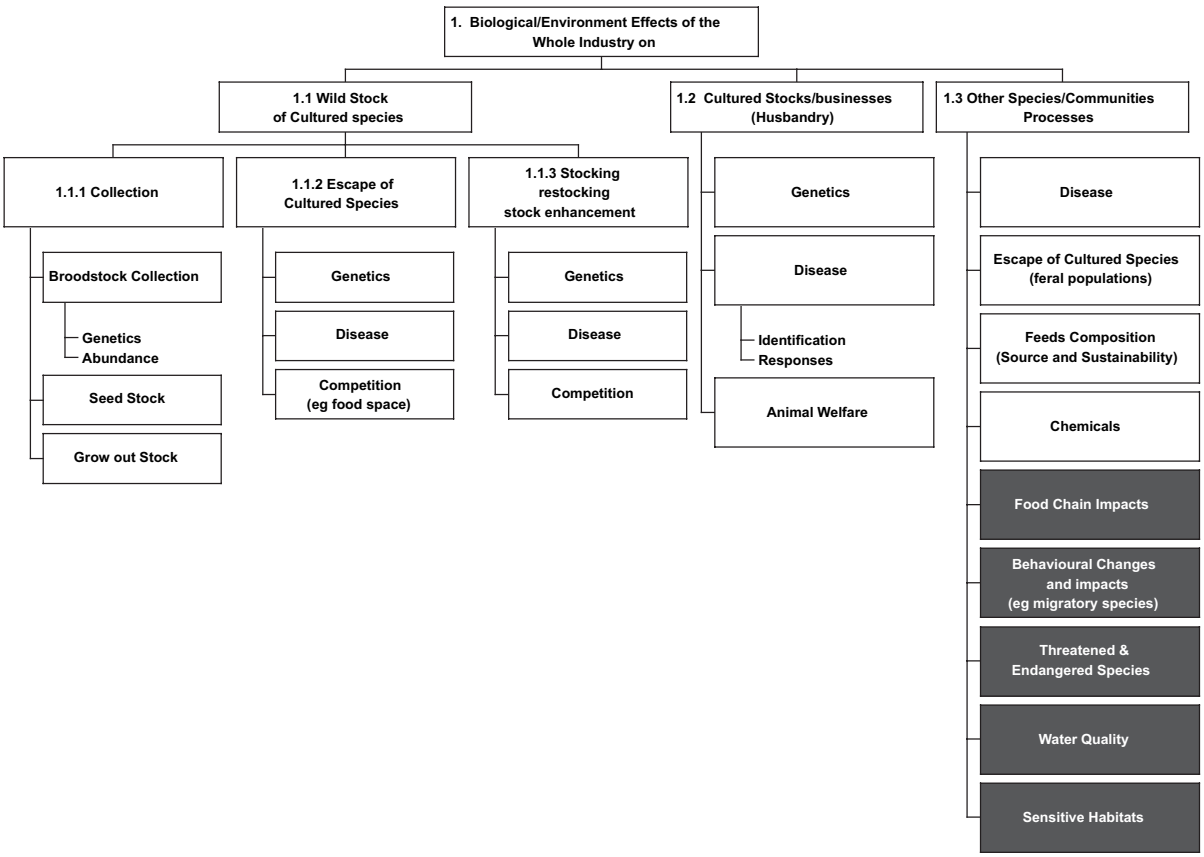

Figure 4. Generic Component Tree for Whole of Industry Aquaculture Issues. *Note - issues in dark boxes are usually dealt with at the regional/catchment level but, in some circumstances, there may be a need for a whole of industry approach. Also note that the topics listed under some of the boxes (e.g genetics and abundance under Broodstock Collection) are elements that need to be considered in the assessment of the issue, but they are not usually addressed by themselves.*

3.3.1.1 Wildstock

Collection

This set of issues covers where industry, or someone else specifically on behalf of industry, collects material from the wild for use in the aquaculture facilities.

Broodstock Collection

Are management protocols in place (or needed) to ensure that the collection of the broodstock animals does not unduly affect the spawning stock size and /or the genetic composition of the wild population?

This is likely to be of most relevance if a relatively rare or endangered species is being cultivated by the industry (e.g. Eastern Cod in NSW).

Seed Stock

If the industry relies on seed stock, are there protocols in place (or needed) to ensure seed stock are not over harvested such that they affect the wild stocks (e.g. spat collected on sticks for oyster production), or unduly affect other fisheries that rely on these species (e.g. puerulus collected for lobster production)?

Grow out Stock

If the industry relies on collecting stock for grow out, are protocols in place (or needed) to ensure stocks are not over harvested or unduly affect other fisheries reliant on these species?

It is likely that many of these issues will already be managed by an appropriate wild capture fishery management plan, in which case they just need to be identified and documented. Where this is not covered by a set of fisheries management arrangements, justification for why this isn't necessary needs to be developed.

Escape of Cultured Species

This set of issues covers the potential impacts that may occur to the natural stock of the species being cultivated from the accidental[9] escape of adults, juveniles or progeny from the cultured stock. The main question is whether there can be escapes or not? If this is impossible (such as using closed systems on land), then no further detail is needed. If this is not impossible then the following three issues may need to be assessed.

Genetics

Are industry wide protocols needed to avoid or minimise the risk of genetic impacts on the wild stock population from the escape of any cultured individuals?

Disease

Are protocols needed at the whole of industry level to minimise the risk of disease transmission to the wild stock from the escape of cultured individuals?

Competition (food/shelter)

Would the escape of cultured animals cause problems to the wild stock due to increased competition for resources (this could be food, shelter, space etc)?

Stocking

This set of issues covers the potential impacts that may occur to the natural stock of the species being cultivated from the planned release into the natural environment of adults, juveniles or progeny as part of a stocking or restocking program.

Genetics

If restocking of the cultured species is an objective, have protocols been used to ensure this does not significantly impact upon the genetic structure of the remnant wild stock population?

[9] *This does not include deliberate release as part of a restocking program, this is covered in the section on stocking below.*

Disease

Will the release of cultured individuals increase the risk of disease introduction to the remnant stock?

Competition

Will the stocking of individuals put the remnant wild stock at a competitive disadvantage by displacement?

3.3.1.2 Cultured Species

This branch covers issues that may affect the status of the stocks being cultured within the facilities which could require industry wide protocols.

Genetics

Are protocols necessary to ensure the genetic composition of captive broodstock is maintained at appropriate levels? For example is there a need for industry wide agreement on GMOs, selective breeding etc.?

Disease

Are disease monitoring, surveillance and risk minimisation programs applied across the whole of industry? This may include programs to ensure the identification of any new diseases and any industry wide response plans to deal with a severe disease event?

Animal Welfare

There may be a need to assess whether the industry requires a protocol for dealing with the animal welfare issues associated with holding animals – particularly when farming vertebrates.

3.3.1.3 Other Species/Communities/Processes

Disease

Could diseases from the cultured species be passed on to other fauna in the region, either through passage of pathogens through water, intermediary hosts or from escapees?

Formation of feral populations

If the species/population being cultured is not native to the country or even the region (i.e. outside their natural range), could they establish feral populations if they escaped?

Feeds Composition (Source and Sustainability)

Does the industry use feeds? If so, is the source of these feeds sustainable?

Chemicals

Are there chemicals being used in the industry that require whole of industry approaches to their use?

Food chain impacts

If escapes occur, could these cause significant shifts in the food chain for large regions of the coast (this may also need to be answered at the regional level)?

Behavioural changes and impacts (e.g. migratory species)

Is this type of industry (e.g. structures used to house farmed individuals) likely to cause "large-scale" changes to behaviour of other species? Is a whole of industry approach sensible (i.e. same types of impact likely to occur everywhere) or is a regional approach more appropriate?

Threatened/Endangered/Protected Species

Is this type of industry likely to cause impacts on these categories of species? Are whole of industry approaches sensible (ie same types of impact likely to occur everywhere) or is a regional approach more appropriate?

Water Quality

Are there common standards for all of industry to use with regards to water quality? (e.g. to avoid poisoning customers who purchase the products grown).

Sensitive Habitats

Are there certain habitats that all of industry should avoid using &/or all of industry need to use a common approach to operate within? These issues are usually dealt with at a regional level but there may be circumstances where the entire industry deals with the issue in a similar fashion (e.g. – total avoidance of seagrass beds).

3.3.2 Impact of the Industry on the Catchment/Region (Cumulative Impacts)

General Description

This generic component tree (Fig. 5) covers issues that may need to be considered when assessing the combined impact of all aquaculture facilities operating (or planned to be operating) within a defined region/catchment/area. The main purpose of this tree is to try and assist in the examination of the potential cumulative impact of all these facilities in relation to regional circumstances such as geography and other industries already operating. For example, if there are already objectives, or levels that have been established that all industry within a region (not just aquaculture industry) needs to comply with (e.g. – total amount of water extraction), this is the place to address these issues. Thus this tree could be valuable for use by regional planning authorities.

3.3.2.1 Water Use (quality/quantity)

This branch covers the potential impacts that all facilities within a catchment/region might have on water quality within that area. This includes impacts both on the incoming waterbody (such as from water extraction) and to any receiving waterbody (e.g. waste water release).

Nutrients

This sub-branch is one of the main areas of contention for aquaculture facilities. Therefore it has been broken down into two main subcomponents, these being:

(1) Nutrient Input by Industry

If production by facilities in the region results in the release of nutrients (either through outflow pipes or from diffusion/losses from cages), a maximum/total amount allowable (e.g. total dissolved solids per day/week/year) for the whole region may need to be set.

This level may need to be related to background levels. So one of the questions that may need attention in addressing this issue is what are the background levels of nutrients in this area within

both the incoming and receiving waters? If there is already a problem due to pre-existing industries then it is possible that no or little further additions may be tolerated. Similarly, if the incoming water is very low in nutrients, this may also affect what output levels will be allowed. These need to be identified.

In addition to total nutrient inputs, is there a specific issue related to where in the catchment/region these inputs should, or should not, be occurring (e.g. not next to sensitive habitats)?

Consequently, the assessment of risk from nutrient inputs on the region may be affected by how much is added, how much was already being added, where it is added and how concentrated this addition will be at any one point.

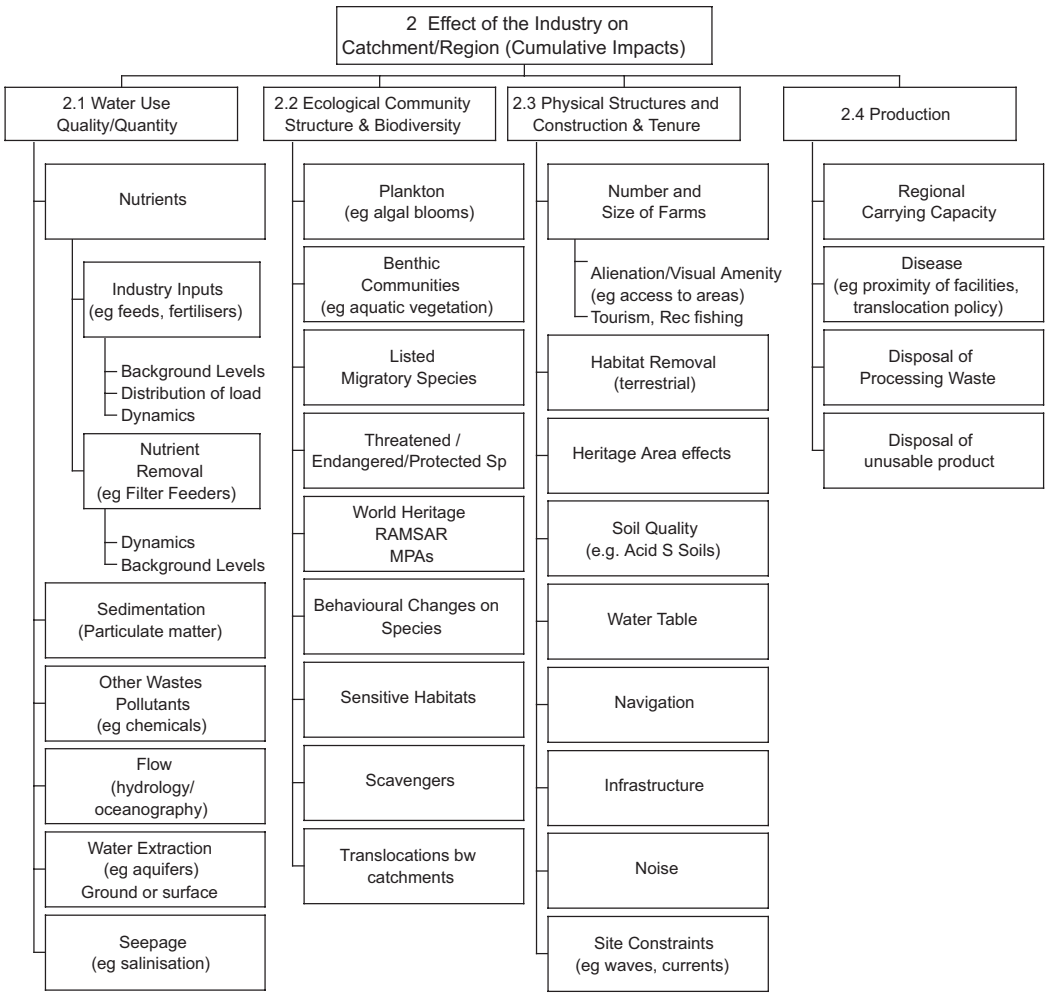

Figure 5. The generic component tree for the cumulative impacts that may operate at the catchment or regional level. *Note: the topics listed below some of the boxes indicate elements that may need to be considered in assessing these components, usually they could not be assessed as components by themselves*.

(2) Nutrient Removal (Filter feeders)

If the aquaculture industry is cultivating filter feeders such as oysters, it is possible that their stocking density may affect the nutrients available in the surrounding water by reducing the concentration of plankton. The potential for impact of all facilities within the catchment may need to be assessed.

Sedimentation

Can the collective amount of material released/escaping/dropping from the structures, including biological material or sediments from erosion, cause a problem for the catchment from sedimentation?

Other Wastes/ pollutants (e.g. chemicals)

Are there issues associated with the release or use of chemicals that need to be managed at the entire catchment/region scale?

Flow

Could the collective impact of the facilities affect the flow of water within the embayment? (e.g. too many cages too close together could impede water flushing rates).

Water Extraction

If fresh water is used by the industry, does an upper limit for all removals from aquifers, rivers, etc need to be set for the region?

Seepage

If the facilities are using land based ponds, could seepage of the water (e.g. saltwater) affect the surrounding water table, soil, etc.? If so, what levels/rates are un/acceptable?

3.3.2.2 Ecological Community Structure

This branch addresses the potential impacts (both direct and indirect) from the operation of all the facilities on the ecosystems within the catchment/region. In many cases, this could be the ecological manifestation of the effects identified in the previous branch.

Plankton

If the facilities increase the nutrient load could this lead to an increased frequency/intensity/ composition of plankton blooms (algal, zooplankton or both)? Is there a need to monitor this region for toxic species?

Benthic Communities

Could all the activities result in catchment wide changes to the benthic communities (including aquatic vegetation) such as from total levels of sedimentation (ie smothering benthic organisms), or from shading or turbidity (decreases in light intensity), or from increased nutrients and algae smothering seagrass?

Listed Migratory Species

Are there listed migratory species that frequent this area? If so, what protocols need to be employed by all facilities within the area? Could the facilities impact on these species in a detectable and ecologically significant manner? (e.g Is development a referable action under *EPBC 1999*)?

Threatened/Endangered/Protected species

Do any of these species interact with any facilities in the region? If they do, should protocols be employed by all facilities within the area to minimise these interactions or the effect of these interactions? (e.g. Is development a referable action under *EPBC 1999*)?

World Heritage RAMSAR/MPAs

Are any of these types of zones present in the area? If there are, what special arrangements etc are needed to meet their requirements? (e.g. Is development a referable action under *EPBC 1999*)?

Behavioural Changes to Species

Could the facilities in the area significantly alter the behaviour of individual animals – either attracting them or repelling them from the entire area such that it will cause them an ecologically significant problem (this may need to be assessed again at the individual facility level)?

Scavengers

Will the facilities result in a significant increase in the regional density or overall abundance of scavengers?

Translocation between Catchments

Are there any translocation policies or protocols that need to be considered by all facilities in the region who may be importing or exporting live product/seed stock/larvae, cages, etc into or out of the region?

3.3.2.3 Physical Structures, Construction & Tenure

This branch covers issues associated with the physical structures that are usually associated with aquaculture facilities and what impacts, collectively, these may cause.

Number & Size of Farms[10]

Are there any limitations/expectations/concerns regarding the total number of farms, the maximum size of any one farm or the total area occupied by all farms/leases within the region? This may relate to concerns about the total amount of area lost via alienation for other activities (either recreational activities such as boating - or other commercial activities – e.g. commercial fishing) or from the impact on visual amenity such as from having "too many" floats cages etc present from the development of this industry? This may require limits on the total area lost, or the number/type of structures used, the level of access still possible?

Habitat Removal

How much terrestrial vegetation can acceptably be removed/affected by the construction/operation of all the facilities within the catchment? Again this may need to be assessed in combination with all types of industry and the general planning objectives within the region. Will these affect sensitive habitats?

Heritage Value

Are there areas of heritage value that may be affected by the construction of any facilities – old buildings, historical sites, places of indigenous significance?

Soil Quality

Are there issues associated with the quality of the soils in the area (such as acid sulphate soils)? Have they been mapped appropriately and are protocols needed to ensure they are not disturbed by the construction of any facilities in this region; or what areas need to be avoided?

[10] *Alienation of area is often considered a social issue, but many jurisdictions include it as an environmental impact so it is covered here. The main issue is that it only needs to be covered once.*

Water Table

What overall restrictions (if any) are there for the water table? Will it impact on what and where constructions can occur and what can be extracted or discharged?

Navigation

Will the structures constructed for all facilities pose a navigation hazard or benefit for the region? Are there any requirements for all facilities to comply with in this region?

Infrastructure

What constraints will there be from the current infrastructure (eg are there enough roads, power, wharves, moorings etc)? What benefits/impacts will there be if there is a need to construct any of these items?

Site Constraints (eg waves – currents etc)

Does the region have particular constraints (eg for water based facilities - wave height, strength etc.; for land based facilities - soil qualities etc) that make it more or less suitable for the facilities proposed? This is where any planning authority decisions on zoning could be incorporated, particularly where these spell out which areas are not available for such activities.

3.3.2.4 Production

This branch covers the issues that may assist production of the cultured species at optimal levels for the catchment by minimising the collective impacts of the individual operations.

Regional Carrying Capacity

Is a maximum level of stocking for all individuals (particularly for filter feeders) within the catchment/ region needed – e.g. to avoid any stunting of growth, increased disease risk etc?

Disease (proximity of facilities, translocation etc)

What protocols (if any) are needed within the region to minimise the risk of disease transmission either in terms of where sites are located and their proximity to each other, the movement of stock within the region and the introduction of stock from outside the region. (Refer to whole of Industry protocols).

Processing Waste

Does the processing of product occur in the water, and if so what is the impact of this?

Disposal of Unmarketable product

Could the need to dispose of significant quantities of unmarketable product (from disease or other cause) be handled within the area (i.e. are there suitable waste disposal facilities)?

3.3.3 Impacts of Individual Facilities on Environmental Wellbeing

General Description

These are the potential topics that may relate to what an operator (& any consent authority) needs to consider for assessing the issues related to a specific facility. This includes both the construction phase/site selection aspects and the issues associated with the operation of the facility once it is in production.

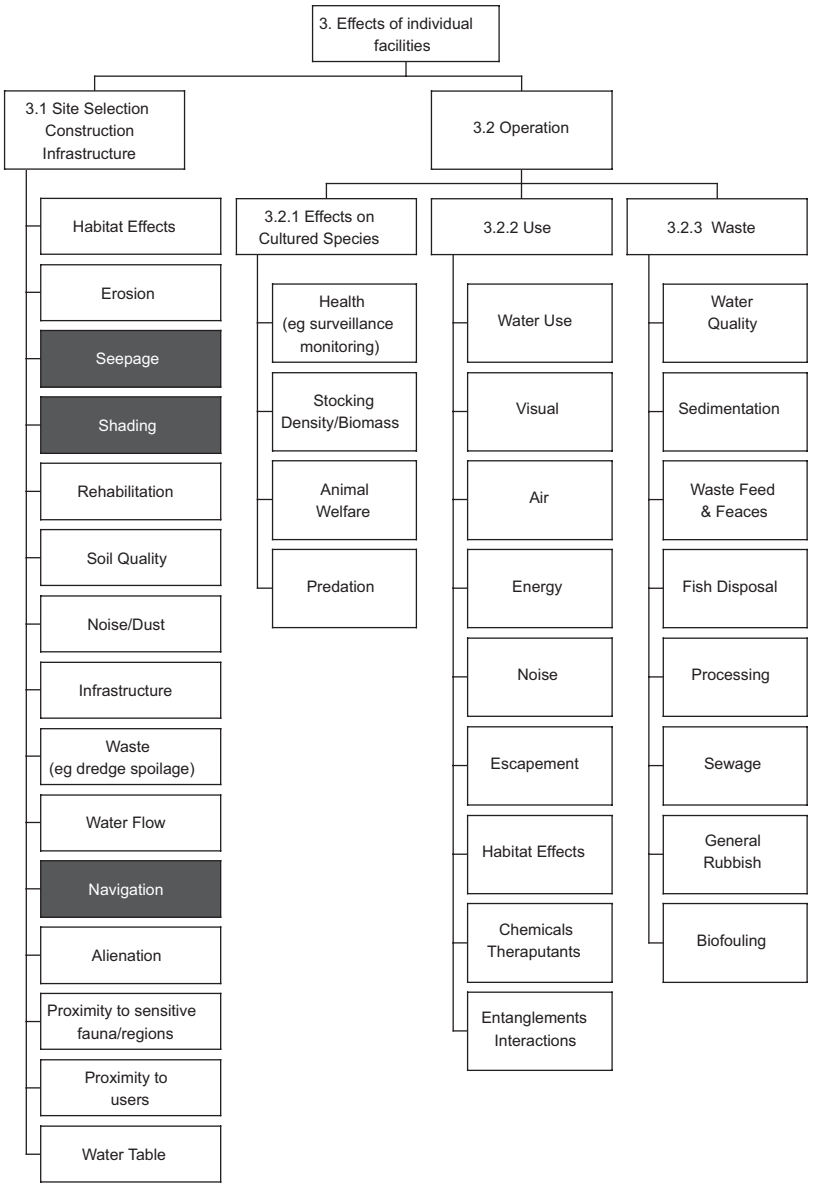

Figure 6. Generic component tree for impacts to ecological wellbeing within facilities. *Note, the dark boxes may need to be assessed both in terms of the initial construction and also ongoing impacts.*

Where relevant, we have identified which topics are possibly affected by objectives/levels developed at higher-level trees (catchment and/or whole of industry). This transparent linkage is designed to facilitate the setting of suitable objectives and performance targets/limits at each level to ensure that what is imposed at the operator level is sensible and appropriate (and presumably justifiable).

3.3.3.1 Site Selection and Construction

This branch is designed to cover the issues related to the initial building, construction and development of an aquaculture facility, – i.e. before the facility becomes operational. It can also be used as a checklist for proponents (and assessors) in their submission for approvals when they are trying to determine whether a potential site is suitable to put their facility.

Habitat Effects

What habitat will have to be removed or affected by the construction; development; expansion of the facilities? This includes the digging of any ponds, the construction of cages and also the building of other required infrastructure – roads, offices, labs, workshops etc. Does the proposed level of

removal for the facility fit within the total amount allowed to be affected for the catchment/region? (i.e. refer to catchment/region tree).

Erosion

Will construction cause any short or long-term erosion problems for the area?

Seepage

Will the type of construction allow seepage of materials, e.g. saltwater from ponds, into neighboring areas? (this may be an ongoing issue).

Shading

Will the construction of the facilities result in the shading of some areas (e.g. seagrass from cages/ racks etc)? (this may be an ongoing issue).

Rehabilitation

Do processes have to be planned to rehabilitate the site if production is ended?

Soil Quality

Is the area prone to acid sulphate soils or other such problems? If it is, are processes needed to ensure that this does not get activated when construction occurs?

Noise/Dust

Will construction of the facility result in an unacceptable increase in noise and dust to surrounding areas?

Infrastructure

Is the necessary infrastructure e.g. roads, electricity, etc available in the area where the proposed site is located?

Waste

Will waste be produced from construction? If so, what disposal mechanisms have been planned to deal with this waste (e.g. soil, dredge spoilage) from the construction of the facilities?

Water Flow

Will the construction of this facility interrupt water flow within the region? (this may need reference to the whole of catchment level assessment).

Navigation

Will the structures pose a navigational hazard or benefit? (this may need reference to the whole of catchment level assessment and could be an ongoing issue).

Alienation

Will the construction of the facilities alienate other groups (e.g. indigenous, recreational and commercial fishers, boating) from using an area that they previously had access to?

Proximity to sensitive fauna/habitat

Is the proposed facility close to an area where there are sensitive fauna, habitat or other regions of particular value?

Proximity to users

How close is the facility to markets?

Water Table

Will the construction of the facility have an impact on the water table (other than associated with soil quality issues dealt with above)- may need to refer to whole of catchment issues?

3.3.3.2 Operation

This set of three sub-branches is designed to identify the issues that may occur, or be needed, during the operation of the facility once it is in production.

Effects on Cultured Species

This sub-branch covers issues related to the impacts on the stocks being cultivated that may need to be addressed within each facility.

Health

Is a health surveillance monitoring system needed? (this may need to refer to whole of industry/ catchment protocols).

Stocking Density

Is there a sensible limit to the stocking density (or biomass levels) of individuals within the facility to minimise impacts on growth/survival etc? (this may need reference to any catchment level protocols).

Animal Welfare

Is there any relevant animal welfare legislation that needs to be incorporated into the husbandry techniques used within the facility? (this may need to refer to whole of industry requirements).

Predation

Are predators (e.g. birds, seals, sharks) a problem around this facility? If these predators are protected species this may result in different actions being necessary. (this may need to refer to any catchment and/or whole of industry codes of conduct or limitations).

Use

This sub-branch covers issues associated with the use of resources whilst the facility is operational.

Water Use

Does the facility need to use water (e.g. fresh water/river water/ground water) that is in limited supply? (this may need to refer to any catchment level limits).

Visual

Does the facility need to meet any visual impact limitations?
(this may need to refer to any catchment level limits/restrictions).

Air

Does the operation produce greenhouse gases, other air pollutants, smells?

Energy

What is the energy consumption for the facility and what is the energy efficiency rating?

Noise

Does the operation of the facility include noisy machinery (e.g. pumps) or devices (e.g. bird scares)? Would such activities affect neighbours or sensitive fauna?

Escapement

Is escapement of individuals an issue? (this may require reference to any whole of industry protocols).

Habitat Effects

Will operation of the facility continue to impact on habitat (eg trampling around leases, smothering of habitat, impacts on sensitive habitat)? (May need to refer to whole of catchment objectives).

Chemicals/Theraputants

Are these used? If so what protocols are needed? (May need to refer to any whole of industry protocols).

Entanglements/interactions

Could the structures result in entanglement of whales or other large/protected species? (This may need to refer to catchment or whole of industry protocols).

Waste

This sub-branch refers to issues that arise from any waste products generated by the facility.

Water quality

Is the quality of the water used by the facility acceptable for release into the environment, freshwater or marine.? (The required levels should be related to whole of industry levels).

Sedimentation

Does the operation result in the sedimentation of habitat or physical environment (e.g. under a cage, near an outfall)? If yes, refer to appropriate levels for the catchment.

Nutrients/Waste Feed/Faeces

Does the quality of wastewater released from pipes/overflows or the water that passes from cages/rafts include increased/decreased levels of nutrients, waste feed or faeces? Are these within agreed limits of the lease regulations and are these compatible with the total levels allowed for the catchment?

Fish/Product disposal

For any deaths of the cultured species, are there adequate facilities for their disposal (e.g. local dumps)?

Processing

Is there any processing of product (particularly filleting etc) done on the facility? Is there any disposal of this waste on site?

Sewage

Does the facility have appropriate sewage treatment?

General Rubbish

Are there protocols for the management of general rubbish within the facility?

Biofouling

Is biofouling removed from structures used in the facility? If so, what happens to this material when it is cleaned off?

3.3.4 Indigenous Community Wellbeing

General Description

This 'Indigenous Community Wellbeing' tree is the starting point to cover the contribution of the industry being examined with regard to the relevant indigenous communities that may be affected - either positively or negatively - by the operations of the industry. Thus, the more the industry interacts with - or has interacted with - indigenous communities, the more issues are likely to be identified. For many coastal facilities, particularly in areas where indigenous communities are present, numerous issues could be identified.

Figure 7. The Generic Component Tree for Indigenous Wellbeing.

Components

In terms of the major components of contributions (which to repeat, can be positive or negative), an industry may affect the wellbeing of indigenous communities by providing (or removing) employment opportunities, infrastructure and economic benefits. It could also affect the community's ability to complete cultural activities such as traditional fishing (either by direct exclusion or indirectly by a lowering of stock numbers) or access to areas for ceremonies, etc.

Our understanding of this section is less well developed than that which deals with the environmental component trees. This is a function partly of the type of case studies that were completed (none had significant indigenous issues). In addition, the techniques used to generate the case study component trees (i.e. small workshops of interest group representatives) were probably not appropriate to gather this information effectively. As a result, it was concluded that a different approach was needed to involve indigenous stakeholders. This has yet to be developed but will require expertise from this field to be involved.

3.3.5 Community Wellbeing (Social and Economic Impacts)

General Description

The 'Community Wellbeing' tree covers the potential social and economic impacts of the industry on the wellbeing of the local or regional communities associated with that industry. This includes the aquaculture community itself, the small local towns that may be directly and highly dependent upon the industry for their existence, and the communities that are only indirectly affected by the industry. For some industries, depending upon their size and location, there may not be a need to assess regional communities separately.

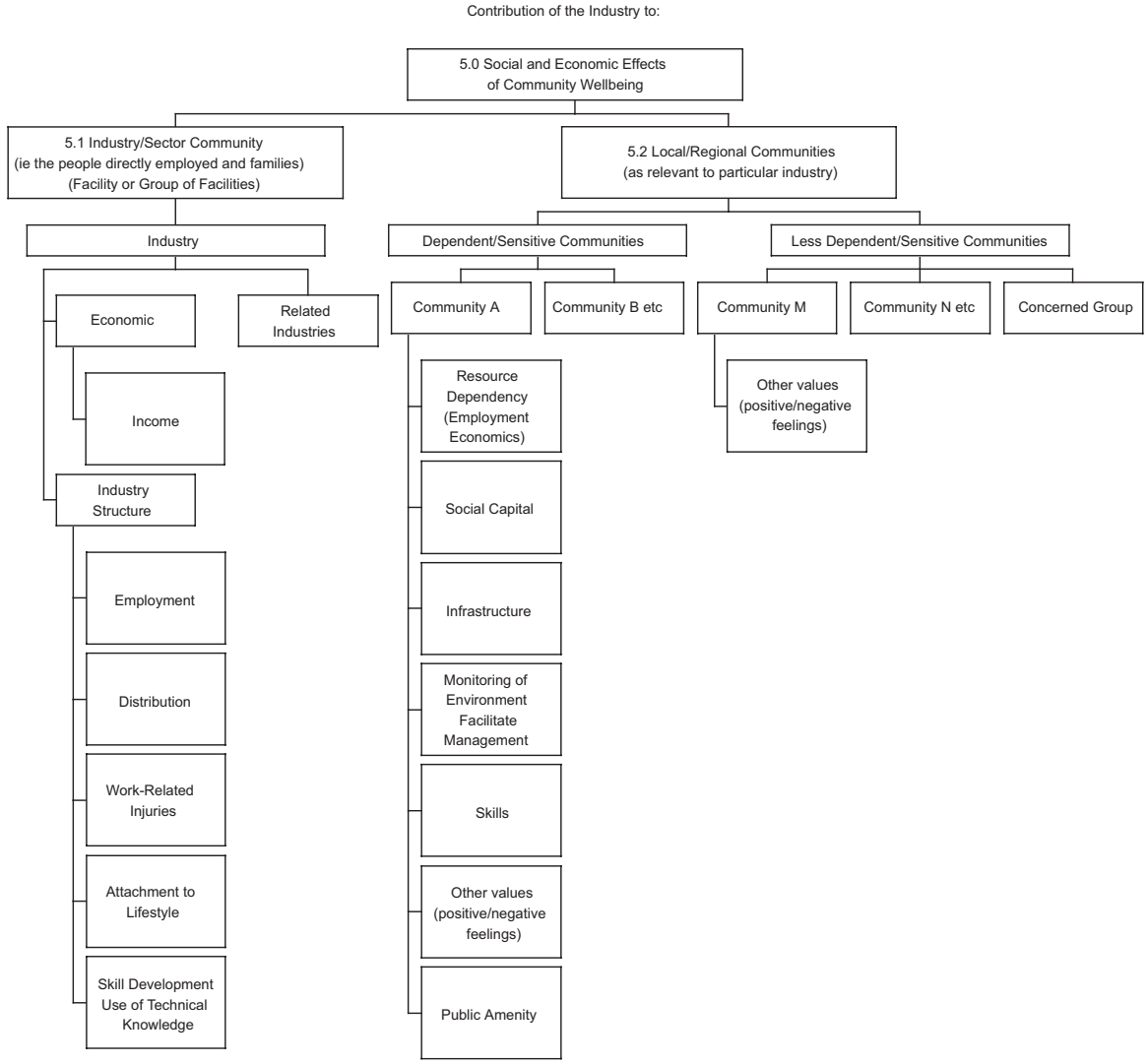

Figure 8. The Generic Component Tree for Community Wellbeing.

The community wellbeing component tree covers both the financial benefits/costs to communities of having the industry continue to operate in the area, along with the social impacts of the industry, including the general attitudes of the community towards the industry. There has been a growing recognition of the importance of different industries to rural communities that extends beyond the financial.

While the importance of local industries to income and employment opportunities is obvious, other impacts could include attracting or maintaining services and contributions to social capital. It should be noted that community attitudes may be *the* major driver of the decision for an industry to continue or not.

It may also be somewhat difficult in some circumstances to identify and isolate for this component tree the issues associated with a single industry from those issues associated with other aquaculture industries in the area - at least not without carrying out a significant data collection effort.

The community wellbeing component tree is broken into two main branches, one dealing with the industry community (those directly employed in the industry and their families) the other dealing with the local communities affected by the industry.

3.3.5.1 *Industry Community*

The 'Industry Community' branch can include contributions to wellbeing through a range of factors directly associated with the industry. The components identified during case studies included income, employment, industry structure, links to locally-based processing, contribution to lifestyle, family involvement in the industry, and occupational health and safety.

For some of these components, data may exist (for example, on reported occupational health and safety incidents) but for others it would need to be collected.

3.3.5.2 *Community Wellbeing*

This section could be made more concise and directed toward the aquaculture industry. It loses the reader its general descriptive nature.

The approach generally taken is to break the local communities impacted on by the industry into two categories. In the first category are those communities which may be highly dependent on the industry resource and which may be sensitive to change, while the second group covers those communities which are less dependent on the resource and/or which are less sensitive to change.

Most of the data required to assess this group of issues needs to be collected, as there is usually no existing data set for most industries. Separating the local communities into these two categories allows a focus on the communities most likely to suffer as the result of a change to an industry.

'Resource dependency' means, as the term suggests, how dependent a community is on the industry resource. The dependency of a community on a resource, in this case an industry, can be assessed in the traditional way of looking at the income and employment it generates.

If, say, 65 per cent of the total employment in a community is in aquaculture, the community is 'highly dependent' on the industry resource. In contrast, if say less than five per cent of the total employment in a community comes from aquaculture then it would seem to be 'less dependent' on the industry. That being said, it should be noted that it is likely that an industry resource may contribute more to community employment than just those jobs directly related to aquaculture. For example, the industry resource may contribute jobs related to fish processing, retailing, provision of boat fuel and parts, accountancy, groceries for industry members and their families, school teaching for their children and so on. These are the multiplier effects of the industry. Each dollar earned through aquaculture production that is spent in the community generates employment and income for other community members.

As well as the direct and indirect employment/income/expenditure links between an industry and local communities, access to services for a community may also depend to some degree on an industry. Some government services are allocated on the basis of the number of a target group in a given area - for example, the number of schoolteachers provided to public schools depends on the number of children in the school.

Private sector services like banks, shops, doctors, pharmacies, etc, will only be present where there is enough demand to support their business. If the population of a town declines or people start

shopping in other towns in the area, these services are likely to close down or move to larger regional centres.

So, in brief, the dependency of a community on an industry could be considered in terms of:

- direct employment and income for the industry as a proportion of the total in the community;
- indirect employment and income generated by expenditure made by those involved in the industry; and
- the role the industry and its dependents play in qualifying a community for a government service and in attracting and retaining commercial services.

The term 'community sensitivity' is used to describe how well a community might be able to handle change. More attention is being paid by government and business these days as to how resilient or robust communities are.

One way of thinking about the impact of a significant change in an industry or a community is to assume that the community will adjust or cope with the change. For example, let us imagine recreational and commercial fishing are banned in a region. This is likely to lead to a range of community impacts - some people will lose their jobs and some businesses will go broke. However, over a period of time, the people who lost their jobs will probably get new ones and the investment in the now defunct businesses will be put to some other profitable use - the community will adjust.

Even though some people might leave the area to look for new work or business opportunities, the assumption is that these human and financial resources will be put to different uses than they were previously. This has obviously occurred in the past in Australia - there are far fewer people employed as blacksmiths now than there used to be and far more employed as mechanics. However, this adjustment process may take time, be painful for those involved and may lead to a long-term decline for a whole region.

Governments are now paying more attention to trying to improve the adjustment process after a significant decline or loss of an industry has occurred, so that the social pain involved is reduced and new opportunities for regions and communities are provided. This was a feature of the Regional Forests Agreement process and is being examined in the context of the National Salinity and Water Quality Action Plan and Regional Marine Planning (see Coakes, 1999 for overview).

Some communities are inherently more vulnerable to change than others. While some communities cope with adjustment pressure well, others find it more difficult. It appears that communities which have high levels of unemployment, low levels of education, low levels of skilled work and high levels of welfare dependency are less able to absorb and adapt to change than communities where this is not the case.

Assistance to cope with change can be targeted at those communities most in need. In the fisheries context, this assistance should be targeted principally at those communities that are quite dependent on aquaculture and are the most sensitive to change. Communities where aquaculture is relatively unimportant compared to the other activities that support the community, or who are strong and adaptable communities, are likely to be able to adjust to industry impacts without outside assistance.

Communities that are highly dependent on aquaculture and are vulnerable will not only be the ones that most feel the effects of a change in the industry, but who are also likely to have trouble absorbing the negative impacts of that change.

Of course, this does not mean that management decisions can be made in a way that prevents any community impacts. The value of understanding the community impacts of management actions is that:

- where a management decision is likely to have a severe negative social impact, the relevant government agencies can be informed so that they can target employment, business development etc assistance to the area;
- where there are two or more management options which are equally beneficial in ecological and economic terms, understanding the social impacts would allow managers to choose the option which causes the least community impact.
- an informed understanding of the social impacts of a decision will take some of the emotion and assertion out of the debate - as occurred in the Regional Forests Agreement process when Social Impact Assessment was introduced into the process. A social science model was developed by the Bureau of Rural Sciences for the Regional Forests Agreement process and details of the model are obtainable from the former.

Social Capital

'Social capital' is a concept that is being used more frequently in western countries. There are a range of ways of looking at it - and much disagreement amongst sociologists about what it means and how it should be measured. It is most frequently used to describe the 'glue' that holds communities together. It can also be likened to the concept of the ecosystem function, everyone knows that it is important and has an idea of what it is, but it is difficult to define.

In language that is more academic, social capital can be defined as the norms and networks that enable collective action. It is an important concept because it is clear that understanding the economics and infrastructure - human and physical - of a community isn't enough to understand why some communities do well and others go into decline, even though they seem to be very similar.

Communities with high levels of social capital are better able to respond to and deal with adverse change. For example, if there is a significant reduction in access to an industry resource, the community with good social capital is likely to be able to pull together to find ways to rebuild. However, the community with low social capital may not be able to find ways to overcome the reduced employment and income resulting from an industry closure.

Some of the elements that are seen as occurring in communities with high levels of social capital are

- high levels of trust amongst community members;
- good networks within the community;
- good networks from the community to outside;
- reciprocity - or a preparedness to help each other;
- high numbers of voluntary organisations;
- high levels of participation in voluntary organisations;
- these voluntary organisations are effective and 'get things done'; and
- effective government institutions that help rather than hinder community collective action

There are a number of methods for measuring community social capital that have been developed. The Commonwealth and State health departments are currently developing a measure that, if successful, could be added to the Australian Bureau of Statistics surveys.

At present the only existing data relating to social capital would be to look in the 'Yellow Pages' and in local government directories for details of voluntary organisations. This would provide information

on the number of organisations in a community, but would say nothing about participation rates or their effectiveness – or about any of the other aspects of social capital mentioned above.

Infrastructure

Industry-related infrastructure was identified in some case studies as a component of the contribution of an industry to community wellbeing. For example, a harbour and associated infrastructure that exists primarily to service commercial aquaculture provides benefits to other users.

Alternatively, if an industry requires the construction of a significant level of infrastructure in order to develop (e.g. roads, power supply etc), then government may have to decide if the investment needed to complete this infrastructure is worth it.

Other values (positive and negative feelings)

Positive and negative community attitudes were raised in a number of case studies. The perceptions of the local community about the industry and its impact on that community were seen as important.

Negative perceptions (whether accurate or false) were seen as presenting a danger to the industry and potentially able to influence political decisions about who could access the industry resource and under what conditions. These negative attitudes might include a preference to reduce aquaculture to increase either recreational fishing or conservation; feelings that the industry contributes to visual or actual pollution. These could vary greatly depending upon who was being asked – thus there may be differences in attitudes between people in the area where the facilities will be built to those who are nearby but not directly impacted.

Positive attitudes could include seeing the industry as part of:

- the identity of the community;
- feeling that industry employees contribute to the social fabric and support local community activities; and
- valuing the employment aquaculture bring to a town and the opportunities aquaculture gives for local young people to stay in their home town.

Generally, attitude data on local perceptions of the local industry is not available and would need to be collected.

It should be pointed out that a handbook is currently being developed as part ofa another FRDC project by BRS. This will describe how to complete Social Impact Assessments, including most of the categories outlined above, especially focusing on how to use current data sources.

3.3.6 National Social and Economic Wellbeing

General

This tree (Fig. 9) covers the broader, non-regional, social and economic costs/benefits associated with an industry.

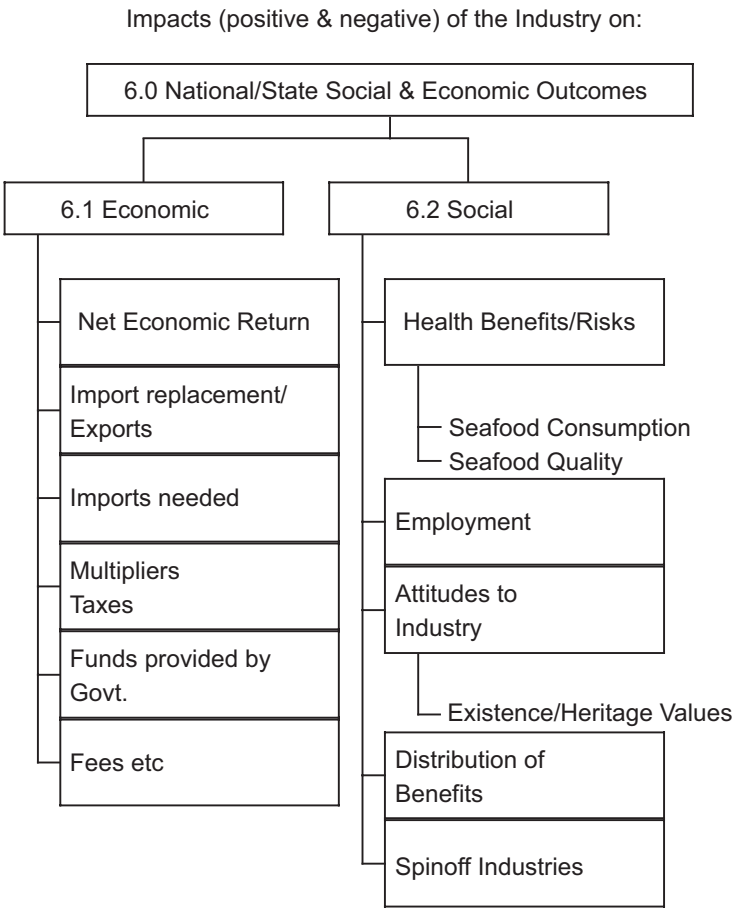

Figure 9. The Generic Component Tree for National Wellbeing.

3.3.6.1 Economic

At a national level, the economic value of the industry may be important – this covers issues such as the Net Rate of Return but not financial turnover and employment as these are strictly social issues. Whether the levels of employment generated by the industry; and the level of either export replacement or export earnings which contributes to our balance of payments and therefore 'allows' the community to buy in overseas goods fits on the economic or the social branch depends upon who is asked.

3.3.6.2 Social Issues

The social issues that may be important at a national level may include components such as the provision of seafood for the community - which has food and health benefits.

General attitudes towards aquaculture were seen as important in all the cases studies completed so far. The perception of community concern about aquaculture and their impacts is seen as having a significant potential to influence government decisions over access to industry resources.

A recently completed FRDC project that involved a national survey of community perceptions of, and attitudes to, commercial, recreational and traditional fishing and aquaculture found a relatively high level of support for aquaculture at the national level.

3.3.7 Governance

General Description

The Governance tree covers all the legislative, administrative and bureaucratic processes that need to be completed to enable the issues in the previous six trees to be dealt with effectively. These issues may cover a number of levels of government, the industry and in most circumstances now, even Non-Governmental Organisations (NGOs) and other groups.

The government branch of the Governance tree is usually split into government agencies with direct responsibility and those that may influence decisions indirectly (eg local and Commonwealth governments). The government agencies with direct responsibility include the management agency which tackles the majority of aquaculture issues, and other state government agencies which may have responsibility for some specific issues. An issue that should be covered by the management agency includes determining an overarching measure of the effectiveness of the management arrangements – in other words, is aquaculture producing adequate outcomes for the community?

Given the very different legal structures used to manage aquaculture amongst jurisdictions, this component tree is likely to need significant changes for each location.

3.3.7.1 Government Coordination

This branch includes the issues that need to be completed by the main management agency (which are usually either the Fisheries agency or a stand alone Aquaculture agency) such as the development of management plans associated with the industry, whether there is adequate compliance with the regulations and other arrangements in the plan (and is this measured); and whether there are appropriate levels of resources to manage the industry effectively (and is this measured)?

The main issues for aquaculture, however, are those related to inter-government cooperation and coordination. As stated above there are normally five or more separate government agencies involved in the approvals and monitoring of aquaculture facilities/leases. Consequently, if there is not a sensible mechanism to ensure that these groups operate effectively there is a substantial chance that either long delays will occur and/or inappropriate approvals/denials for facilities will be made.

The performance or policies of the Australian Government can often impact on an industry's ability to meet objectives and these issues may also need identification. Some examples of these include the setting of taxation, monetary and financial policies in a national context (e.g. the federal National Competition Policy).

Local government is often involved in land-based facilities with respect to the approvals for licenses and the provision of infrastructure.

3.3.7.2 Industry

At the industry level, the types of issues that may need to be reported include the structure and operation of any industry association, and the presence of any relevant codes of conduct/environmental management systems. There may also be the need to report on the existence and performance of any Occupational Health and Safety programs.

3.3.7.3 Other

Finally, the issues associated with any relevant NGOs (e.g. World Wildlife Fund, Conservation Council) or other group (e.g. recreational associations) that have significant input into the operation of the industry may need to be identified.

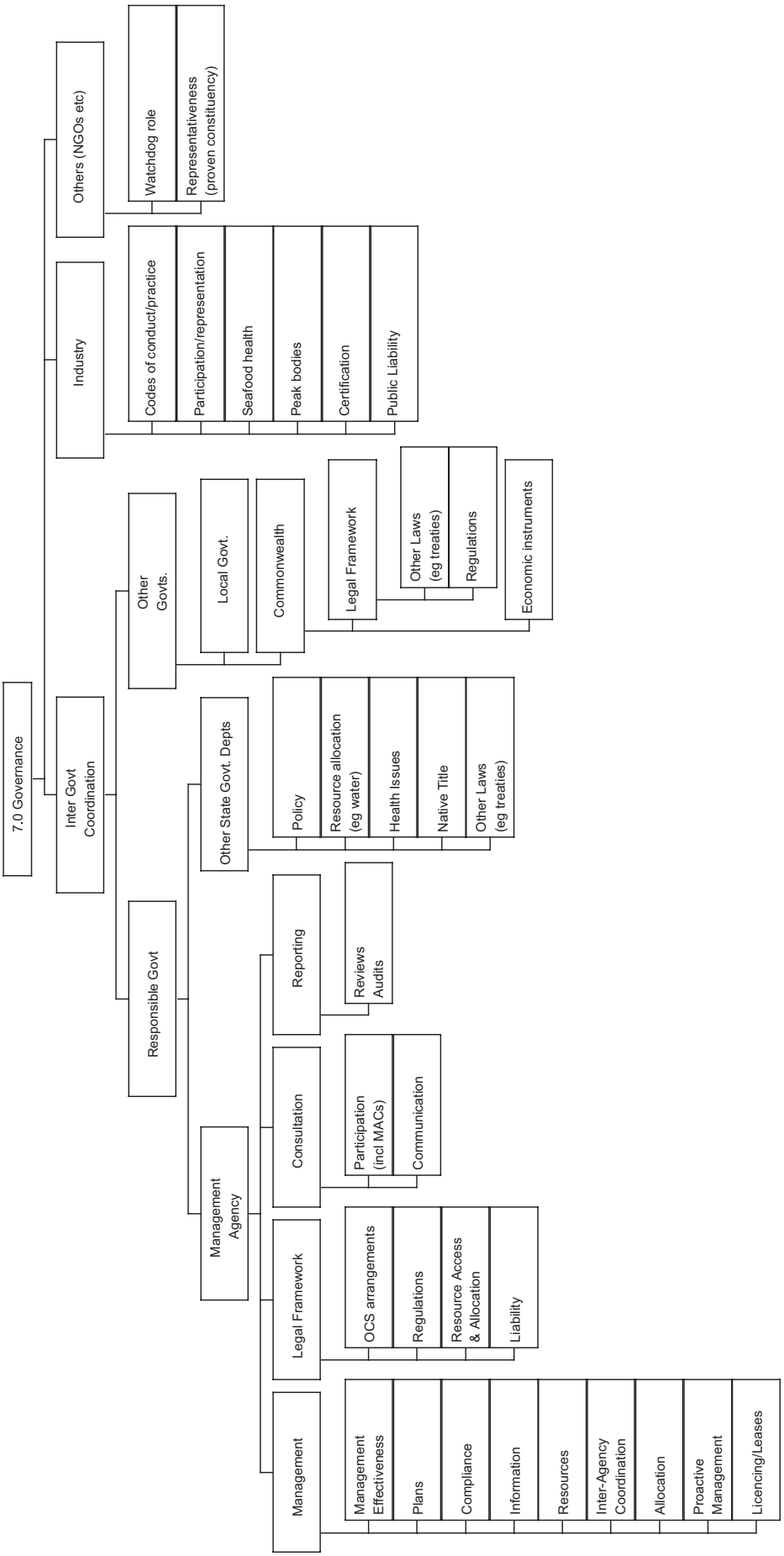

Figure 10. The Generic Component Tree For Governance.

3.3.8 Impacts of the Environment on the Industry

General Description

The Impacts of the Environment on the Industry tree (Fig. 11) has been designed to capture the major issues that are, or may at some time, impact upon the performance of the industry, but which are beyond the scope of the relevant legislation of the main management agencies. Even though they are not controllable directly, these issues still need to be taken into consideration when developing management arrangements because they are likely to affect what is possible, which may affect the granting of leases.

There are two major types of issues in this tree. The first are the impacts that arise from natural changes to the environment, a good example of this is potential impact of seawater temperature on fish survival in cages.

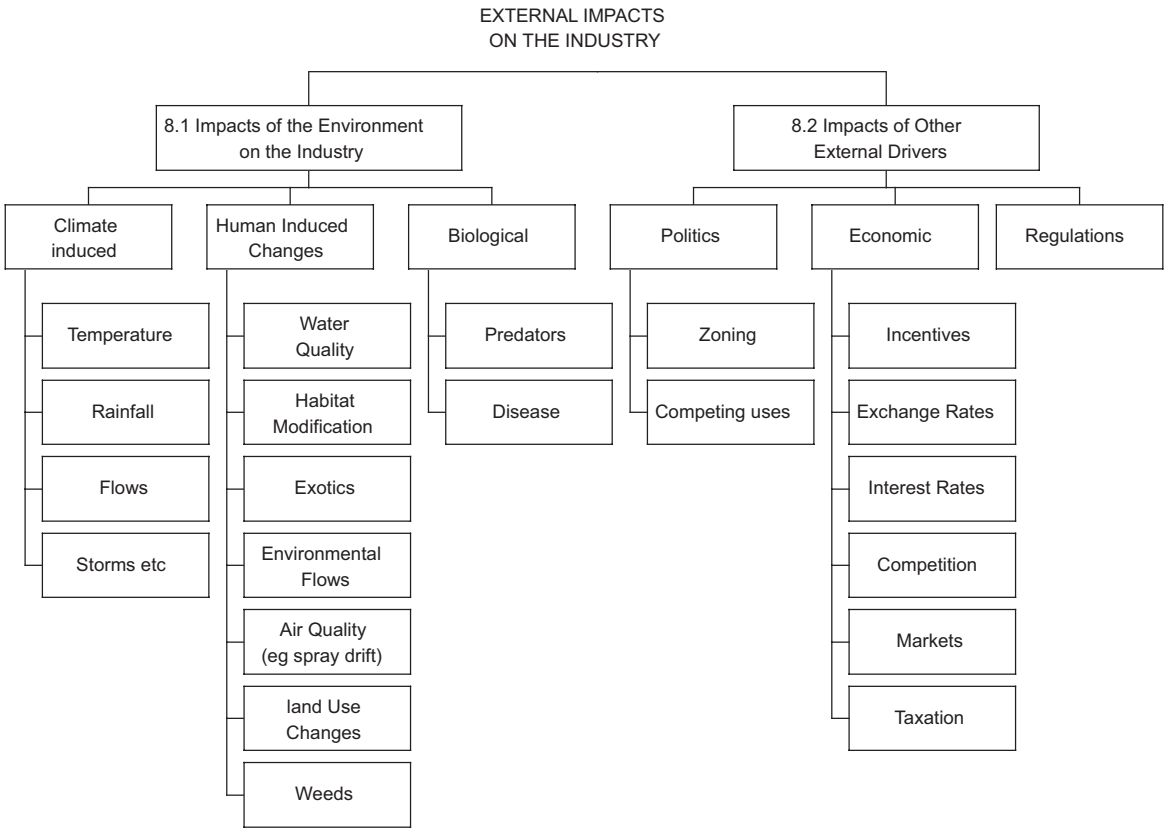

Figure 11. The Generic Component Tree for Impacts of the Environment on the Industry.

The other branch covers the anthropogenic impacts from non-fishing activities on the performance of an industry. These can include impacts on water quality such as those occurring from increased sediment loads or water pollution from land-based activities.

Other types of impacts may come from the introduction of exotic species that may swamp or eat native species, clog equipment etc. In freshwater areas, the use and removal of water from the streams by agricultural activities is probably a potential issue for the culture of many of the native species in these environments.

4.0 HOW TO PRIORITISE ISSUES

The process of identifying the relevant issues for a industry/sector - by the modification of the eight generic component trees - can often result in a large number of potential topics being identified. The importance of each of these may vary from the relatively insignificant to the vitally important.

If an issue is relatively insignificant, it is unlikely to require specific management arrangements and monitoring programs. However, those issues that are important may need strong management intervention if unacceptable outcomes are to be avoided.

Given the variation of levels in the importance of issues, and the scarcity of resources to address all of them at equal levels, there will generally be a requirement to prioritise the identified issues, so that management actions and monitoring systems are only implemented where appropriate.

To assist in prioritising the issues, the use of Risk Analysis methodology as a tool to help the decision-making process has been adopted. This involves using the Risk Assessment component of Risk Analysis to provide a disciplined and consistent approach for the calculation of the relative level of 'risk' associated with each issue.

This relative level of risk can be used as a way of determining the appropriate level of management response and reporting at all three levels (whole of industry, catchment and individual facility).

4.1 Risk Analysis in the Aquaculture Context

What is Risk?

"Risk is the chance of something happening that will have an impact on objectives (AS/NZS 4360- 1999)*"*.

For a management agency/department, 'risk' is associated with the chance of something affecting the agency/department's performance against the objectives in their relevant legislation. In contrast, for the aquaculture industry, the term 'risks' generally relates to the potential impacts on their long-term profitability, while for the general community, 'risk' could relate to a possible impact on their enjoyment[11] of the marine/coastal environment.

The aim for each of these groups should be to ensure that the 'risk' of an unacceptable impact is kept to an acceptable level[12].

The calculation of a risk in the context of an industry may be determined within a specified time frame (e.g. the life of the management plan, the generation time of the cultured species, the term of the current government) or 'for the foreseeable future'.

The management of risk is a sensible approach to take within the aquaculture context because of the large number of potential issues and the impossibility of gaining a perfect understanding for any of these. While not all elements of aquaculture management will be able to use quantitative simulation modelling to predict the probabilities of performance given a set of proposed management arrangements, there is still value in utilising these principles across all relevant issues. The methods outlined below, developed to support the ESD reporting framework, use a formal risk assessment process that is consistent with the Australian Standard AS/NZS 4360:1999 Risk Management and the companion paper on Environmental Risk Management – Principles and Process (HB 203:2000).

[11] *This enjoyment could include non-extractive and non-direct uses.*

[12] *In some cases there may be the opportunity to measure the 'risk' of having a beneficial outcome, particularly for social and economic issues.*

The most important thing to remember is that until you determine your objectives you cannot assess risk. Depending upon your objectives the occurrence or non-occurrence of the same event can either be positive or negative (e.g no rainfall may be major problem for a farmer needing to plant crops for the season but getting this rain would be catastrophic for someone organizing an outdoor function).

4.2 The Risk Assessment Process

4.2.1 General

What is Risk Analysis?

"*Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur."* AS/NZS 4360 – 1999

As stated above, the major objective for using a risk assessment technique is to assist in separation of the minor acceptable risks from the major unacceptable risks. This assessment requires the determination of two factors for each issue – the potential consequence arising from the activity on a sub-component, and the likelihood that this consequence will occur[13].

The combination of the level of consequence and the likelihood of this consequence is used to produce an estimated level of risk associated with the particular hazardous event/issue in question.

Determining the levels of consequence and likelihood should involve an assessment of the factors that may affect these criteria, but this should be done in the context of what existing control measures - management arrangements - are already in place. For example, in determining the risks from nutrient increases resulting from some form of fish farming you would need to take into account the current management regime (such as whether there are any restrictions on leases, farm size, proximity, stocking rates, allowable output levels etc.) in assigning the appropriate likelihood and consequence values.

You should come up with very different risk values depending upon whether the current management arrangements are, or are not, included in the assessment (if not, either you either don't need management or your current management is having little effect). However, as the whole point of this exercise is to see whether current management is acceptable or not, the assessment *must* include the arrangements that are currently being used.

Consequence

The process of risk assessment begins by assessing the possible consequence level of an issue. The criteria used to assign a level of consequence can be:

- *Qualitative* – using a descriptive scale to describe the magnitude of potential consequences.
- *Semi-quantitative* – in these cases the qualitative scales are given values. However, these numbers may not be an accurate reflection of the actual magnitude of the consequence.
- *Quantitative* – uses numerical values alone to assign the level.

In a qualitative system, the number of consequence levels used generally varies between four and six. The lowest level of consequence is usually assigned a value of zero or one, which should indicate a negligible consequence.

[13] *Consequence and likelihood are sometimes described as impact and probability.*

At the other end of the spectrum is the highest category, which should be a catastrophic/irreversible consequence, with the score being related to the number of categories. The assessment of the potential consequence of a hazard should be based upon the judgment of individuals or a group that collectively have sufficient expertise in the areas examined to provide credible assessments.

Likelihood

The likelihood of the consequence occurring is then assigned to one of a number of levels. Most systems use between four and six categories, varying from 'remote' to 'likely'.

In doing so, the participants should consider the likelihood of the 'hazardous' *event* (i.e. the consequence) actually occurring, - *not* the likelihood of the activity occurring. For example, in determining the likelihood of having a fatal car accident, you do not use the likelihood of driving a car. Instead, it is the likelihood that whilst driving a car you will have a fatal accident - i.e. likelihood is a *conditional probability.*

As with the consequence tables, the likelihood tables can use qualitative categories through to quantitative probabilities, depending upon the level of analysis needed and the level of data available.

Risk

The overall risk level for each hazard is generally calculated as the mathematical product of the consequence and likelihood levels (Risk = Consequence x Likelihood). From this product, which is called the *Risk Value*, each issue can be assigned a *Risk Ranking,* depending upon where a risk value falls within one of a number of predetermined categories.

In this *Guide*, five levels of risk have been suggested: 'Extreme', 'High', 'Moderate', 'Low' and 'Negligible'[14].

The cut-off values between the Risk Rating levels, and the management actions that flow from the different rankings, may be: "*based on operational, technical, financial, legal, social, humanitarian or other criteria" (AS/NZS 4360)*. In particular, you need to ensure that the outputs of the risk analysis correspond to the types of risks present and the outcomes that would be expected to occur.

4.2.2 Scope of Assessments

Unlike the wild capture fishery assessments, there can be three scales of assessments, at the whole of industry, the regional and the individual facility level.

For the first level you need to take a relatively high level approach, based on asking what is the risk to each issue in this tree of 'having an industry'. At the next level, the question is what is the risk of the industry to the region, with the last level being the risk associated with an individual facility.

4.3 Consequence and Likelihood Tables

With the Risk Assessment methodology recommended in this *Guide* largely being used as a first stage filtering process, mostly qualitative criteria[15] have been developed for the consequence and likelihood tables. In addition, it was recognised that more than one type of consequence table would be needed because the variety of issues - and the possible outcomes - differ both amongst the different component trees and, in some cases, within the same component tree.

[14] *A table with just three levels of risk ratings has also been included in Appendix 3 if this is seen as more practical to use.*

[15] *It is envisaged that this may develop into a semi-quantitative procedure over the coming years as we determine what numbers relate to the qualitative categories identified.*

Thus, a series of Consequence Tables, each with six levels of impact ranging from negligible to catastrophic, has been generated so far. A General Table has been developed which can be used to assess all issues. This is described in detail below. There are also four more specific tables that have been generated to cover some areas in a more consistent manner:

1. Protected Species (a category under both State and Commonwealth environmental Acts);
2. Habitat issues,
3. Ecosystem/trophic level effects; and
4. Social Political issues

4.3.1 General

The general consequence table was developed as the basic template for all assessments of consequence. The levels in this table are generic in nature and therefore when using this table for assessing an issue it would be necessary to adapt these levels to fit the circumstances. For example if this table is used to assess the risk of disease outbreaks on wild stock from an aquaculture facility(ies) the possible consequence levels should relate to the impacts on the wild stock and range from not detectable (as the negligible level) up to causing extinction (as the catastrophic level). Thus, the pilchard kills that occurred some years ago would be rated as having caused a severe impact to these stocks.

Table 1. The General Consequence Table for use in ecological risk assessments related to aquaculture.

Level	General
Negligible (0)	Very insignificant impacts. Unlikely to be even measurable at the scale of the stock/ ecosystem/community against natural background variability.
Minor (1)	Possibly detectable but minimal impact on structure/function or dynamics.
Moderate (2)	Maximum appropriate/acceptable level of impact (e.g. full assimilation rate for nutrients)
Severe (3)	This level will result in wider and longer term impacts now occurring (e.g. increased plankton blooms)
Major (4)	Very serious impacts now occurring with relatively long time frame likely to be needed to restore to an acceptable level
Catastrophic (5)	Widespread and permanent/irreversible damage or loss will occur – unlikely to ever be fixed (e.g. causing extinctions)

4.3.2 Likelihood Table

The Likelihood Table that was developed also has qualitative criteria that range from 'remote' to 'likely'. Only one of these has been necessary so far (see Table 2)

Table 2. Likelihood Definitions.

Level	Descriptor
Likely (6)	It is expected to occur
Occasional (5)	May occur
Possible (4)	Some evidence to suggest this is possible here
Unlikely (3)	Uncommon, but has been known to occur elsewhere
Rare (2)	May occur in exceptional circumstances
Remote (1)	Never heard of, but not impossible

Table 3. Risk Matrix – numbers in cells indicate risk value, the colours/shades indicate risk rankings (see Table 4 for details)

		Consequence					
		Negligible	Minor	Moderate	Severe	Major	Catastrophic
Likelihood		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

4.3.3 *Risk Rating Table*

The matrix shown in Table 3 shows the resultant risk values, based upon the arithmetical calculation of the Consequence x Likelihood (0-30). These risk values have been separated into five risk ranking categories (See Table 4 for separation points) from 'negligible' risk to 'extreme' risk.

It is suggested that only issues of sufficient risk or priority (i.e. 'moderate', 'high' or 'extreme' risk) or those that require management actions to achieve a low risk score, need to have full performance reports completed. This should identify all those issues that require specific management actions.

Alternatively, some groups have preferred to only use three categories (Low, Moderate, High – See Appendix 3 for details) to minimise the level of confusion for participants at risk assessment meetings.

Output from the Risk Assessment

The actual risk assessment is not just the scores generated during the assessment process but needs to include the appropriate level of documentation/justification for the categories selected.

For the negligible and low risk issues whilst full performance reports are not needed, a necessary element of the ESD framework is to document the rationale for classifying issues in these categories. These should form part of the ESD report so that stakeholders can see why these issues were accorded these low ratings (and potentially supply additional or alternative information to affect subsequent assessments). This also facilitate any reviews of these risks at future intervals because it makes it simpler to determine if there have been any changes either in status or assumptions used to generate the outcomes obtained if these have been recorded explicitly.

Table 4. Suggested Risk Rankings and Outcomes – 5 category version[16]

Risk Rankings	Risk Values	Likely Management Response	Likely Reporting Requirements
Negligible	0	Nil	Short Justification Only
Low	1-6	No Specific Action needed to achieve Acceptable Performance	Full Justification needed
Moderate	7-12	Specific Management Needed to Maintain Acceptable Performance	Full Performance Report
High	13-18	Possible increases to management activities needed	Full Performance Report
Extreme	> 19	Likely additional management activities needed	Full Performance Report

The level of justification required should be appropriate for 'low' compared to 'negligible' risk issues. It should be noted that if a full performance report is not needed, this by definition means that there are no specific management actions being taken.

If you need to take management actions, then you need to develop a performance report to assess the performance of this management. However, if you are not going to directly manage something, then having performance reporting is probably not a priority.

Finally, for issues that were rated as either having a 'high' or (especially) an 'extreme' risk, it is likely that extra management measures in addition to those already being applied may be necessary, or it may indicated that further information is needed to more accurately quantify the risks. These suggested outcomes are summarised in Table 4 and Appendix 3. The decision of whether to use the three or five category version would depend on factors such as the number of issues being addressed and the experience of the group in competing risk assessments

4.4 Details of Consequence Tables

4.4.1 Background

The four detailed Consequence Tables were designed to assist in the process of rating issues. The criteria within each level of the tables are usually qualitative, based on the general table presented above, although in one instance (the Habitat Table), suggestions are presented about what quantitative levels may be relevant to the qualitative levels – but these are only suggestions.

To realistically assess the ecological impacts (not the social impacts, e.g. community attitudes to an activity), as stated above, the assessments must be completed at the level of the relevant local population (unit stock), habitats, and ecosystems within the local bioregion - not at the level of an individual or 'patch'.

The consequences must also be scaled appropriately - from virtually 'nil' through to 'widespread' and 'irreversible'.

[16] *See Appendix 3 for the three category version.*

The temptation to shift the assessment across into social issues, such as the impacts of the killing of one cetacean, beyond any true environmentally-based assessment of ecosystem impact, needs to be recognised and allocated to the appropriate section. Such social/political and other non-ecological issues are likely to be just as important to assess as ecological impacts and may alter what happens to the priority of an issue, but it is important to distinguish whether something is a social/moral rating or whether it is an environmentally-based rating.

The suggested Consequence Tables that have been developed for use in the risk assessment do not mimic exactly the eight categories for ESD. This situation has occurred for a number of practical reasons.

The 'Protected Species' (not threatened species) table was generated because the public's expectation for many of the species in this category requires that a 'higher' level of protection is expected for them than for other species. It is recognised that there may be some inconsistency in this approach, but it is matter of trying to categorise species in a manner that is as 'realistic' as possible.

Ecosystem issues generally fall into two categories - those that may affect the habitat in a rather direct fashion and those that may impact on the ecosystem function in a more indirect manner. Hence two tables were developed.

For, both of these tables, the use of IMCRA-style definitions or other scientifically determined scales (e.g. for World Heritage Area listings) may be useful.

No tables have been generated for the broader environmental impacts (such as impacts on air quality and water quality). Many of these types of issues are already subject to other legislation/standards and over time these will be added to later versions of the *Guide*.

For the social and economic components, at the moment the only Consequence Table generated covers the political outcomes, and this has largely been included only to demonstrate that the concept can be used within these areas. Methods to determine the relative levels of social dependence and sensitivity to change are available from the Bureau of Rural Sciences (using ABS statistics) and these values can be used to identify which towns/communities/regions may be at significant risk following changes to management arrangements.

The following sections will explain each of the tables in detail. This will include suggestions on how the assessments could be completed/utilised.

4.4.2 Protected Species

Table 5. Suggested consequence levels for the impact on Protected species.

Level	Ecological
Negligible (0)	Almost none are impacted.
Minor (1)	Some are impacted but there is no impact on stock
Moderate (2)	Levels of impact are at the maximum acceptable level
Severe (3)	Same as target species
Major (4)	Same as target species
Catastrophic (5)	Same as target species

Scale of Assessment

Assessed at the level of a locally reproducing population – unit stock (if known)

General

This table was generated because the criteria for assessing the impact on the species on the protected list appear to be more stringent than merely using ecological criteria. Thus, there appears to be a level of social/moral add-on attached to these species and therefore the criteria are different than species not on the list.

4.4.3 Habitat Issues

Table 6. Suggested consequence levels for the impacts on habitats. (Three levels – standard, fragile, critical).

Level	Ecological (HABITAT)
Negligible (0)	Insignificant impacts to habitat or populations of species making up the habitat – probably not measurable levels of impact. Activity only occurs in very small areas of the habitat, or if larger area is used, the impact on the habitats from the activity is unlikely to be measurable against background variability (*Suggestion- these could be activities that affect < 1% of original area of habitat or if operating on a larger area, have virtually no direct impact)*
Minor (1)	Measurable impacts on habitat(s) but these are very localised compared to total habitat area. *(Suggestion – these impacts could be < 5%; < 3%; <2%) of the original area of habitat)*
Moderate (2)	There are likely to be more widespread impacts on the habitat but the levels are still considerable acceptable given the % of area affected, the types of impact occurring and the recovery capacity of the habitat *(Suggestion – for impact on non-fragile habitats this may be up to 50% [similar to population dynamics theory] - but for more fragile habitats, to stay in this category the percentage area affected may need to be smaller, e.g. 20% and for critical habitats less than 5%)*
Severe (3)	The level of impact on habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function. *(Suggestion - Where the activity makes a significant impact in the area affected and the area > 25 - 50% [based on recovery rates] of habitat is being removed; whilst for critical habitats this would be < 10%)*
Major (4)	Substantially too much of the habitat is being affected, which may endanger its long-term survival and result in severe changes to ecosystem function. *(Suggestion this may equate to 70 - 90% of the habitat being affected or removed by the activity; for more fragile habitats this would be > 30% and for critical habitats 10-20%)*

Catastrophic (5)	Effectively the entire habitat is in danger of being affected in a major way/ removed. *(Suggestion: this is likely to be in range of > 90% of the original habitat area being affected for fragile areas this would be > 50% and for critical habitats > 30%).*

Scale of Assessment

Habitat (attached species – e.g. seagrass/coral) should be assessed at the regional habitat level, defined as the entire habitat equivalent to that occupied by the exploited stock. The real extent against which impacts should be judged is not the current distribution, but what is considered the best estimate of the original extent of the habitat.

General

There should be some inverse relationship between the relative level of potential impact on a habitat from an activity and the relative extent of the habitat over which the activity can be allowed to occur. For example, the real extent which involves dredging or digging ponds, would be which would be classed as one of the most destructive forms of aquaculture , would be much smaller than that for less destructive methods such as longline methods of production.

Determining what is an acceptable level of loss or disruption to a habitat may involve examining the impacts on the dynamics of the habitat species, but also the indirect impacts of the species reliant on the habitat. Obviously, some habitats are more fragile than others, which will affect the levels of disturbance they can withstand sustainably. Furthermore, some habitats form important functions such as juvenile fish habitats and this may need to be included in the determination of the levels of acceptable disturbance for each region/activity. Thus the table above has three categories of habitat – standard, fragile and critical to cover these differences. The determination of what category a habitat belongs to should be determined *a priori*.

4.4.4 Ecosystem Issues

Table 7. Suggested consequence levels for the impact of aquaculture on the general ecosystem/trophic levels.

Level	Ecological (ECOSYSTEM)
Negligible (0)	General - Insignificant impacts to habitat or populations, Unlikely to be measurable against background variability Ecosystem: Interactions may be occurring but it is unlikely that there would be any change outside of natural variation
Minor (1)	Ecosystem: None of the affected species play a keystone role – only minor changes in relative abundance of other constituents.
Moderate (2)	Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components).
Severe (3)	Ecosystem: Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Recovery measured in years.

Major (4)	Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major components of the region) Recovery period measured in years to decades.
Catastrophic (5)	Ecosystem: Total collapse of ecosystem processes. Long-term recovery period may be greater than decades.

Scale of Assessment

The indirect impacts due to flow-on effects of food chain interactions should be assessed at the regional/bioregional level – this is equivalent to the "species"/unit stock scale. Thus, this assessment should not be completed just for the area where the industry/sector operates, unless this is the entire extent of this community/bioregion.

General

The changes to the ecosystem from the addition or removal of nutrients on the food chain may be difficult to predict. There are however, a number of situations where ecosystems have been seriously impacted by aquaculture facilities through poor management practices to provide a guide as to the severity of some impacts.

The important element to ensure is addressed is that the scale of the impact is understood and to recognise that it is not possible to have no effect. The main trick is to determine what level of change is acceptable.

4.4.5 *Social/Political Consequences*

Table 8. Possible consequence levels for impacts of aquaculture management at a political level.

Level	SOCIAL - POLITICAL
Negligible (0)	No impact - would not have any flow-on impacts to the local community. No agency staff would need to make a statement.
Minor (1)	May have minor negative impact on the community (for example, small number of job losses, small loss of amenity) but these impacts would be easily absorbed.
Moderate (2)	Some increase in unemployment and decrease in overall income to which the community will adjust over time. Some community concern about the loss of amenity, which may translate to some political action or other forms of protest.
Severe (3)	Significant reductions in employment and income associated with the fishery. Significant employment and income flow-on effects to other community businesses, as reduced income and increased unemployment in fishing works its way through the local economy. Significant levels of community concern over the future of the community, which may translate to political action or protest.

Major (4)	High level of community impacts which the community could not successfully adapt to without external assistance. Significant level of protest and political lobbying likely. Large-scale employment and income losses in the seafood sector of the local economy. Significant flow-on effects in terms of increasing unemployment and income reductions as a consequence of changes to the fishery. Decline in population and expenditure-based services (e.g. schools, supermarkets, bank). Population declines as families leave the region looking for work.
Catastrophic (5)	Large-scale impacts well beyond the capacity of the community to absorb and adjust to. Likely to lead to large-scale rapid decline in community income and increase in unemployment in areas directly and indirectly related to fishing. May lead to large-scale and rapid reduction in population as families leave the region. Likely to lead to high levels of political action, protest and conflict. Significant reduction in access to private and public sector services, as businesses become unviable and target populations needed to attract government and commercial services decline below threshold levels. Total change in the nature of the community from e.g. from rural to industrial.

Scale of Assessment

In this case, the affected community would include those towns that derive a significant proportion of employment and or income from the industry, either directly or indirectly.

General

An understanding of the social impacts of management decisions does not assume either that aquaculture management decisions will be made to minimise social impacts at the expense of ecological considerations - or that the management agencies are responsible for intervening to minimise the social impacts of their actions.

At best, if a management agency is aware that a management action will have severe - or worse - social impacts on a local community, they should bring this to the attention of relevant state, local or Australian Government agencies. For example, the decision to deregulate the dairy industry was taken and implemented by the relevant agriculture departments. At the time, an assessment of potential social impacts was undertaken and identified those rural communities least likely to be able to absorb any negative impacts.

As a result, assistance was provided in the form of employment and small business programs by the Commonwealth agency with responsibility for small business. The original decision was not affected and the agriculture agencies were not expected to respond to the community impacts, as this was outside their area of responsibility

5.0 PERFORMANCE/ MANAGEMENT REPORTS

5.1 General Overview

For each of the lowest level or terminal sub-components/issues identified as greater than a low risk/ priority, a detailed assessment report or management plan can be generated. The set of standard headings for these ESD reports are listed below in Table 9.

The main question for aquaculture is who would complete these reports? Unlike wild capture fisheries, the issues at the whole of industry and catchment levels are usually not managed by one agency, but are shared amongst five or more different departments/agencies. Moreover, the issues at the individual operator level are likely to be only reported by a single operator. Nonetheless, any identified issue that required management should go through the following process to ensure that it is being managed appropriately. Furthermore, a major part of the ESD process should be the determination/clarification of who is the managing authority for an issue.

The level to which any reporting would be collated would vary depending upon the circumstances and there may (or may not) be a need to generate a single comprehensive report covering all levels. Consequently it is expected that any ongoing collated reports would generally only cover the whole of industry and catchment level issues (but the inputs for some elements may need to come from reports provided at the individual facility level). To what extent the socio economic and governance issue reports would need to be completed will vary amongst jurisdictions and industry sectors.

Table 9. The list of ESD report headings for Aquaculture.

1. Rationale for Inclusion and Identification of Management Authority
2. Operational Objective (plus justification)
3. Indicator
4. Performance Measure/Limit (plus justification)
5. Data Requirements/Availability
6. Evaluation
7. Robustness
8. Fisheries Management Response
    - Current
    - Future
    - Actions if Performance Limit exceeded
9. Comments and Action
10. External Drivers

After determining why an issue needs to be covered and who requires this (i.e. which management authority is in charge of this), the next step to completing the reports is to specify an operational objective for each sub-component.

To be effective, the objective that is chosen needs to have a direct and practical interpretation in the context of the management of the industry/facility and/or the surrounding environment. Most importantly, performance against the objective needs to measurable and auditable. The objective should also be consistent with, and clearly linked, to any higher-level objectives that appear in the relevant legislation, policy statements or management plans (i.e. provide the justification for selecting this objective compared to any other possible objective).

The indicator is the measure that is to be used to track performance with respect to an operational objective. The performance measures provide the means to enable interpretation of the indicator

and can be expressed in relationship to one or more reference points (e.g. average light levels should remain as close as possible to the target X but go no lower than limit point Y – see Figure 12 for an example). It could simply be assessed in terms of a trend (e.g. increasing is desirable, stable is OK, decreasing is undesirable).

The operational objective, indicator and performance measure are a package. All three are needed before any one of them is useful. Indicators by themselves (as used in some reporting schemes) are of little value because without an objective and performance limit, you cannot interpret performance.

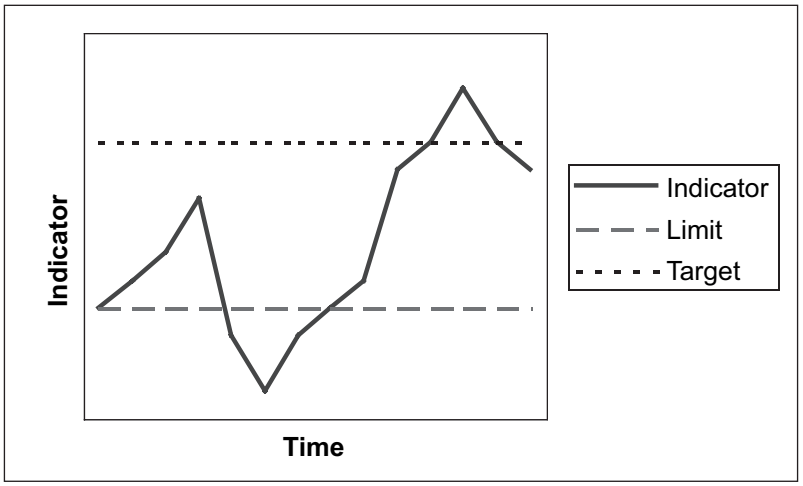

Figure 12. A summary of the relationships between the indicator and limit and target reference points that can be used for measuring performance. The measurement of performance can be 'binary' – acceptable or unacceptable - or it can be some function dependent on the distance the indicator is from the limits/targets (see also Sainsbury et al. 1998).

In addition to stating the operational objective, indicator and performance measure, there are headings for:

- data quality and availability;
- robustness of the indicators/performance measures;
- what the management responses are; and
- whether there are there any 'external'[17] drivers.

The inclusion of 'management response', particularly when it is discussed in relation to the data available, makes the explicit link between the operational objective, the measurement and reporting of performance and the action to be taken to maintain or improve that performance. This is an important distinction, and advantage of this National ESD framework, compared to other systems (Chesson *et al*., 2000).

Summary of Performance Reports:

Can you justify that the management actions you currently have in place are appropriate, given the level of risk and current knowledge of the issue?

[17] *external to the industry and its legislative basis (see more below).*

It is envisaged that this reporting scheme for aquaculture industries will evolve over time, as experience and understanding of the issues increases. This evolution is unlikely to end quickly, given that the standards and policies used to report on financial performance of companies are still being modified - despite having been in use for over half a century - to make them more relevant and effective. The development of effective aquaculture 'accounting methods' is unlikely to be less elusive.

5.2 Description of Headings

5.2.1 Rationale for Inclusion and Identification of Management Authority

This provides an overview of why this issue needs to be addressed. In most cases it should summarise the outcomes of the risk assessment process outlined in the previous section – including both the risk assessment scores and the justification for these scores. This section should also specify who is the management or determining authority responsible for the granting of approvals and for ensuring adequate performance for this issue. Thus if the issue being examined is related to nutrient outflow, the likely authorities would be the relevant "EPA", whereas if it related to whales or dolphins the main authority would be the local &/or federal "Parks" agency. In cases where more than one agency is involved, this should be recorded with a description of how the relationship amongst the relevant agencies will operate.

Having this documented is imperative because this is the group that must be involved in determining what the next three elements (objectives, indicators and performance measures) need to be.

5.2.2 Operational Objective

Each of the sub-components/issues requires an agreed operational objective. This must be an outcome-based objective, not a process or data gathering objective, i.e. "What, specific to this issue for this industry at this level, do you wish to achieve?"

It is not how you will achieve it, nor what you will need to achieve it, and, most importantly, performance against this objective must be measurable.

Generation of the objective:

- This could involve the recording of an existing objective listed in current lease requirements/ management plan/arrangements.
- It may involve turning an implicit objective into an explicit objective (i.e. there has already been an objective developed, but it has just never been recorded formally before).
- The report may include a proposed objective that requires later ratification by the relevant Agency/ Minister.
- The report may contain a series of alternative objectives for consideration and consensus at a later stage.

Irrespective of which method is used to generate the objective, the justification for choosing this objective must be recorded. This justification should also provide specific information as to how it relates to any relevant higher-level objective, such as those present in the relevant legislation/act.

It is important to emphasise that the justification required is for the selection of the objective, it is *not* where you describe what management arrangements will be used to achieve the objective (these should be detailed below in 'Management Responses'). The justification should change, depending upon what objective is chosen - which may vary due to the type of issue or the specific circumstances. The justification should signal what type of performance measure should be used (i.e. limit, target).

5.2.3 Indicator

For each operational objective, an indicator or indicators needs to be identified. This can be a direct measurement of performance (e.g. total kg of dissolved solids in outflow water to measure if outflow targets are being met) or a surrogate (e.g. production levels as a surrogate for measuring economic benefit to local communities).

Initially, it was thought that having more than one indicator would not be helpful because they would need to be combined somehow to form an assessment of current performance. However, a composite of indicators can be used to provide a greater degree of confidence in the result, particularly where none of these by themselves is considered particularly robust.

It should be recognised that in some cases the collection of more than one indicator could suggest that different aspects are being addressed, hence you may need more operational objectives – one for each indicator. There is no definitive limit to the number of sub-components and hence operational objectives that can be developed.

Ultimately, it is not appropriate to enforce the collection of data that are not used as an indicator for the assessment of an objective. Similarly, if more than one indicator is collected, the protocols for determining how they will be integrated into the decision process must also be developed.

5.2.4 Performance Measure

How do you determine if performance is acceptable or not? Having some type of performance measure is necessary to define how you will interpret the indicator to enable a determination on whether performance against the objective is acceptable (see Figure 13 for example).

The performance measure can take a number of forms which includes:

Specific value measures

- Limit reference points – the values which management avoids reaching (either exceeding or falling below, depending upon the issue); and
- Target reference points – the values which management should be directed to attaining

A range of values

- A range of values within which performance is considered acceptable, outside of which performance would not be considered acceptable.

A trend in values

- A positive trend could be good, but a negative trend would be bad (or the reverse – depending upon the issue and indicator).

Adequacy of Performance

1. *Binary Method*

Performance is either acceptable or not acceptable.

2. *Continuous method*

The adequacy of performance can be measured more precisely by using the distance the indicator is from either some target or limit reference point - the closer to the target or the further from the limit, the better is the performance. For trend indicators, the actual slope of the trend line, rather than if it is just positive or negative could be used.

Some monitoring schemes use non-linear functions to enable an even more precise measurement of performance. Again, the system used to gauge performance can be as complicated or as simple as you need to make it - you merely need to justify what you are using and why this scheme was chosen (see below).

Development of the performance measure may involve:

- Recording a performance measure that is already in use from the current management plan/ arrangement/lease condition.
- Turning an implicit performance measure into an explicit one (i.e. a limit, target, trend that is already being used to assess performance, but had not been written down).
- Agreeing to a proposed performance measure for later ratification.
- Listing a series of potential measures for later consultation (if possible recording the justification for the proposals made).

Justification for Performance Measure Chosen

It is vitally important that the justification for choosing the level/limit/trend function for assessing the performance measure against the objective is recorded. This ultimately is the most important decision for the management of any issue and therefore the reasons for choosing this level, including all assumptions used (e.g. based on previous studies, historical trends, results from similar industries elsewhere, preferably scientific references etc.) all needs to be articulated clearly.

5.2.5 Data Requirements and Availability for Indicator

What data do you need to measure the indicator? This is where you should explain the types of data that are needed to generate the indicator – i.e. what monitoring schemes are in place or need to be put in place.

In many cases, this may require more than one sampling regime to generate all the information used to generate the indicator – particularly for more complicated measures involving simulations of population biomass.

You also need to ask:

- What data are currently available and how accurate are the data that will be used?
- What data will be available in the future?

This is often best depicted using a table/matrix see below:

Data Required	Availability
Description of Indicator/Supporting Data	Time period for which data are available or when data will become available

5.2.6 Evaluation

If data are available, how well is the industry/facility performing against the objective? Usually graphs such as that depicted in Figure 13 are useful – showing both the indicator and how it relates to the performance measure.

This should be accompanied by a description of the information and an explicit statement (somewhere near the front of the section) as to whether the assessment of the current performance is acceptable or not. It should also have a textual description and interpretation of the information provided.

5.2.7 Robustness

What is the robustness of the current indicator/performance limit/evaluation? This could involve both a textual description and possibly choosing a summary level (e.g. High/Medium/Low – see Table 10 for examples of possible categories).

This is where you discuss how well the indicator and the performance measure are at measuring the performance against the operational objective. Thus, if your objective relates to levels of employment and your indicator is employment numbers, then this indicator would normally be considered robust.

However, if your objective relates to the acceptable level of ecosystem change, but the only indicator available is total lease area, then this is likely to be less robust.

Furthermore, you may have very good measures of the indicator, such as estimates of total solids released from outflow pipes, but the performance measures may be less robust. Thus, you may not have a precise understanding of what is, or is not, an acceptable level of released solids before this will cause an impact. Consequently, the robustness of the indicator and the performance measure may need to be determined separately.

Finally, you need to provide an overarching assessment of whether the combination of current indicator, performance measures and management strategy are suitable to meet the objective. Thus, it is not necessary to always have a highly robust indicator and performance measure if you can show that the management strategy is suitably precautionary.

Table 10. Possible Robustness Classifications.

Level	Description
HIGH	The indicator is a direct measure of the objective and there is a clear understanding of the acceptable limits, or if an indirect measure is used, this is known to closely reflect changes in the issue of interest.
MEDIUM	The indicator and performance measures are suspected to be reasonably accurate in assessing performance against the objective, or the known error is in the conservative direction.
LOW	The degree to which the indicator and/or the performance measure can be used to assess against the objective is largely unknown, or known to be low. Often this will involve surrogate indicators.

5.2.8 Management response

This is the section where you describe what actions you are taking or going to take to achieve the operational objective. What is the total package of management arrangements (current, future, triggered) that have been developed? The types of responses should particularly note the level of information available and the reliability of the evaluation.

Current

What are the current management arrangements that are in place to maintain or improve performance and help you achieve the objective?

This is where all the current management arrangements can be listed. If these have been presented in detail in any background information, then a list of 'dot points' (brief statements) about them and a reference to the more detailed section should be sufficient. Somewhere (either in the background information or here) there should be an explanation as to how each of the arrangements will impact on performance.

Future

What, if any, are the proposed (i.e. extra or different) management arrangements/options including any possible changes to current arrangements that have been identified and proposed to be implemented? These are *in addition* to the current arrangements - you should not simply state that the current arrangements will be used in the future.

These changes should also probably make some reference to the current level of the indicator (i.e. current performance); the degree of information available; and the reliability of the evaluation (i.e. why is there to be a change in the management?).

If the Performance Measure/Limit is "exceeded"?

We must also consider what will be done if the Performance Measure is "exceeded". What will be the management/industry/individual response if the performance targets/limits/trigger points etc indicate that performance is unacceptable? This may range from the instigation of a review that would determine the future actions that would occur, through to having explicit harvest strategies in which the management actions are totally pre-determined.

The degree to which the future actions can be predetermined will depend upon the fishery, the level of understanding of the dynamics, and the causes of changes to the indicator. In general, the more robust the indicator, the more likely it is that preset harvest strategies can be used. Where the indicator is not very robust then you would first need to ascertain why it has reached the performance limit before determining what management actions to take.

Issues for other agencies

Some issues may require informing other relevant government agencies such as interactions with seals or dolphins. For example, if some agreed level of interaction is breached for these types of species, the relevant environment-conservation agency may need to be informed.

For the social and economic issues, this could involve informing the social welfare agencies if there is to be a severe cutback in operations that are likely to result in loss of employment/income, etc., in a region.

External groups appear keen to have the management responses in such circumstances as automated as possible, largely due to the seeming inaction so often associated with previous examples of 'trigger points' having been reached. It is therefore incumbent upon the agencies concerned to ensure that the limits imposed are appropriate and do not get triggered every second year when there isn't a real problem.

5.2.9 Comments and Action

This section provides an overview of what future actions need to be done for this issue (e.g. begin new monitoring, alter management plan etc.), or what may need to be monitored more closely or looked at next time the issue is assessed.

5.2.10 External Driver Check List

This section is designed to articulate the factors that are known to potentially impact on performance against the objective being addressed, but which are outside of the legislative responsibility of the management agency listed in the first section.

Thus, issues such as climatologically-driven variations are acceptable as external drivers. However, the frequency of disease outbreaks may not be where these can be controlled by farming practices etc.

Impact of urban runoff may be a legitimate external factor for coastal aquaculture but the impacts from other aquaculture farms would not (as they should both be covered by the same agency).

6.0 ESD AND EMS: HOW DO THEY FIT TOGETHER?

6.1 Background

There has been a degree of concern about how the ESD framework, as outlined above, fits in with other initiatives such as Environmental Management Systems (EMSs), Codes of Practice (COP), Third Party Auditing, Accreditation and other related themes. Many of the terms and issues covered by these initiatives are similar which has lead to the confusion about whether applying the ESD Framework will result in overlaps, duplication or other problems. This section will attempt to clarify the situation by outlining the main elements of these systems and demonstrating that they are, in most circumstances complementary, not competing processes.

EMS, COP and Accreditation

Environmental Management Systems, or an 'EMS' as they are often termed, are systems designed to assist individuals or organisations manage the way they conduct their operations, generally to reduce their impact on the environment and hopefully improve their efficiency.

An EMS involves the development of a plan that specifies what issues will be covered, outlining the targets that are set, and details the management actions that will be taken to achieve the targets, along with how performance will be monitored and evaluated. Approaches to developing an EMS have varied greatly but more recently standardised approaches, such as the ISO 14000 standard, have been developed and are now widely used.

To gain ISO accreditation, an EMS must be reviewed by a certified[18] third party auditor[19]. Even if the initial audit is successful, to retain accreditation, the operation of the EMS by the proponent must be audited at regular intervals. An EMS does not have to be ISO accredited to be useful, they can be useful even if there is only internal auditing. This is because an EMS provides a system to improve environmental performance and this in turn should benefit the industry. In addition, an EMS provides a structure for reporting on environmental performance to stakeholders and NGOs. Having said this, the credibility of an EMS will be improved through 3rd party auditing and the aquaculture organisation will have to trade-off the cost of accreditation against the credibility benefits gained through independent auditing.

The ISO accreditation systems only audits the process, not the outcomes, and as a result if there is no regulatory standard available for use as the target within the EMS, these systems cannot guarantee that appropriate environmental outcomes will be generated.

The inclusion of the word 'Environmental' in an EMS is a bit misleading because the format/content of an EMS is not very different to any other type of auditable management system or risk based systems.

Codes of Practice (COP) usually have a lower level of complexity and are less comprehensive than an EMS. They are mainly used as ways for an industry to codify what it considers 'best practice' or their minimum acceptable methods/actions for an issue without the need for these to become part of any legislation/regulations. Common examples of COPs include actions to minimise the dumping of rubbish and best practice handling for live product. One of the main deficiencies of a COP is they usually do not include the monitoring of outcomes. A diagrammatic description of the relationship between these systems is presented in Figure 13.

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[18] *certified – to be an auditor for ISO and individual/company must be certified by ISO as being competent to undertake this task.*

[19] *third party – means a person/company not connected to the individual/company being audited nor to any management agency that may have an interest.*

The initiative to promote the use of EMS and other industry-managed processes has largely been led by the seafood industry as a "bottom up" approach to improve their performance and acceptability with the general public. The Seafood EMS chooser has been developed by Seafood Services Australia[20] to assist individuals; groups and industries within the wild capture fishery sector to determine what type (if any) of EMS may be suitable to meet their needs. A similar system could be developed for the aquaculture sector.

6.2 Comparison Between the Systems

The major difference between an EMS and ESD is that the ESD framework is designed to encompass *all* aspects and issues that may be affected by the industry being assessed. An EMS, however, may be developed to only address a single issue for a single facility. For example, one operator may develop an EMS to ensure that fish are handled appropriately to improve the quality of product reaching the market and therefore achieve a higher price.

In most circumstances, the ESD process (which needs to involve all relevant stakeholders not just industry) would be used to identify the issues, determine the level of risk at the industry level and if necessary develop the operational objectives and determine the levels/targets for acceptable performance. These outputs (especially the objectives, targets and limits) from the use of the ESD frameworks provide the essential inputs for the development of an EMS.

Once these outcomes and limits have been determined, an EMS could then be used by one or all individuals in the relevant industry to assist them in achieving an acceptable level of performance. This could include using a set of defined industry wide processes such as codes of practice or each individual operator can devise their own methods to achieve the levels required. Consequently, the two systems are complementary (see Figure 13 for details).

In many respects the use of EMS techniques are well suited to aquaculture because the individual operators have control on the activities within their facility. The "facility level" component of the ESD framework is there to ensure that actions in each facility will meet the industry and the regional/ catchment level objectives. Thus, the use of an EMS within each facility would be a very useful way for an operator to demonstrate that they are meeting (or bettering) the terms of their licence/lease conditions.

[20] *www.seafoodems.com.au*

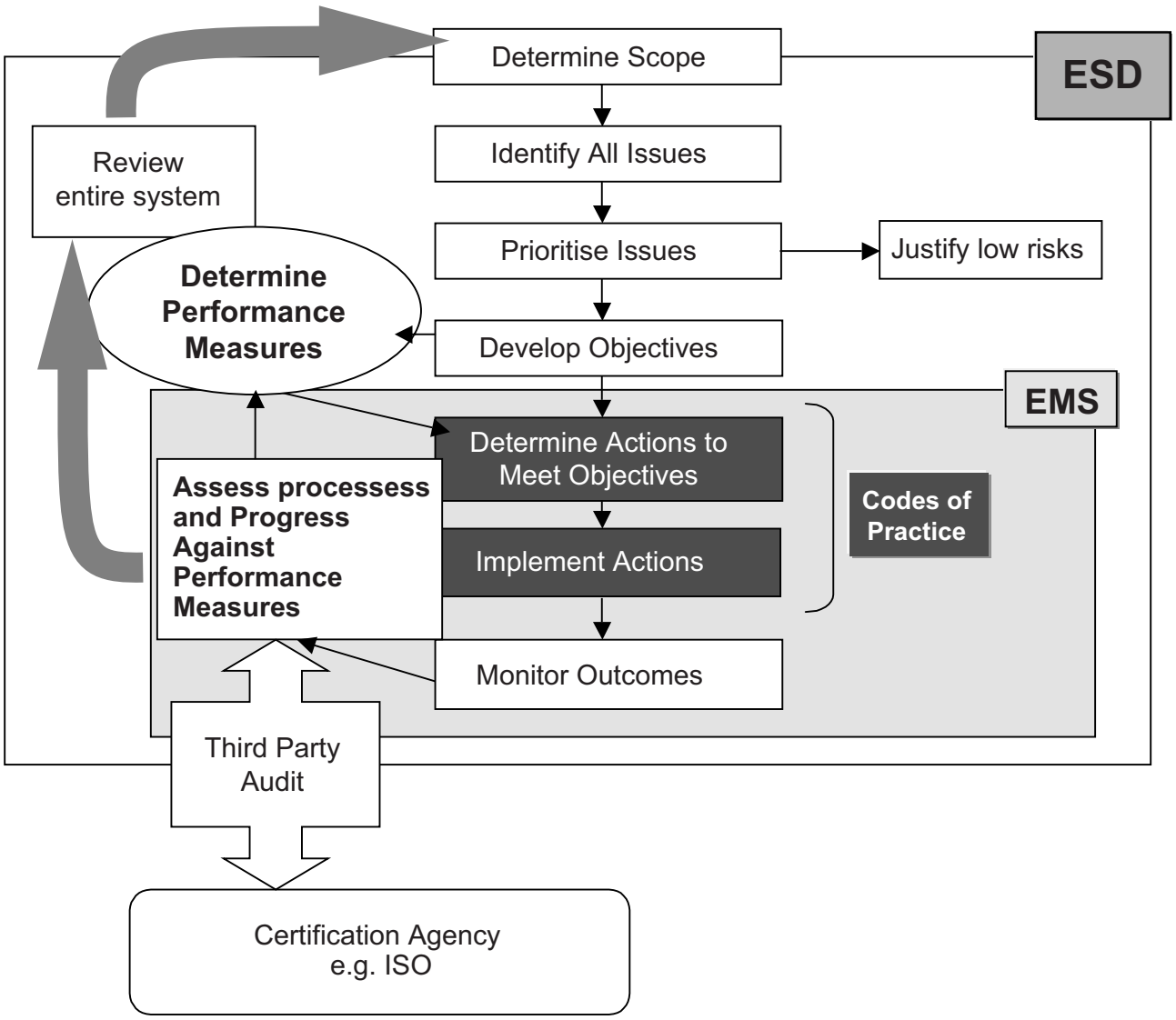

Figure 13. Diagram depicting how Environmental Management Systems, Codes of Practice and accreditation fit within the ESD Framework. The ESD elements outside the yellow area require input from the relevant management authorities and other stakeholder groups but are needed as inputs for the development of an EMS.

The elements within the light shaded area could be completed by industry operators (individually or collectively) as part of an EMS with the dark shaded sections possibly forming a Code of Practice that may or may not be part of an EMS.

The elements outside the box are those undertaken by third parties such as ISO certification.

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8.0 APPENDICES

Appendix 1: Outline of the ESD workshop process

How to tailor the Generic Component Trees to suit your Industry

The possible consultative methods that can be used to generate the modified component trees to suite a particular aquaculture sector includes:

1) A manager/scientist by themselves.
2) A small group of agency staff (i.e. both managers and scientists).
3) An Industry group
4) A working group of industry and agency staff.
5) A focused group containing representatives of all stakeholder groups (including industry, management agency, other government and non-government).
6) An open, public meeting.
7) Some combination of the above.

The most efficient process for generating the modified component trees is using a combination of methods 1 and 5. This is done by getting a manager or scientist to come up with an initial draft version of the component trees, which are then finalised through a workshop that includes representation from each of the main stakeholder groups.

In all cases, one person should be defined as the local workshop coordinator. This is the person who will be responsible for ensuring that all the appropriate people attend the meetings, receive the material in a timely fashion and ensure that the reports are written in a consistent manner.

Who Should Come to these Workshops?

The local participants at these workshops will include:

- the workshop coordinator, (most likely to be the relevant aquaculture manager or their Executive Officer),
- an experienced facilitator to drive the process to completion
- relevant stakeholders including representatives from the industry sector being assessed, aquaculture researchers, management and compliance staff,
- local EPA and Parks representatives,
- local conservation groups,
- relevant indigenous groups, recreational groups and possibly concerned citizens groups.

A strong level of local involvement is vital to ensure that the results of the workshop will be relevant (and acceptable) to local conditions/regulations/issues etc.

Instructions for Workshop Coordinators

Before a Workshop

Send out background material to each participant at least two weeks before the workshop is to take place. This background material should include:

- the outline of what the process is trying to achieve – initiate an ESD analysis for the ??? industry (i.e. send them a copy of the 'How to' *Guide* - or the web address where the guide is located).
- the draft component trees for the sector as generated as a starting point, along with the generic component trees, so everyone can see where they have come from.

The background material should also include an outline of the industry, a summary of the biology of the species involved, and notes on the environment where farming operations are occurring. This is needed to give context to the discussions.

Also:

(1) Arrange Venue and facilities

(2) Arrange for a high quality computer projector (1000 dpi resolution), electronic whiteboards etc.

(3) Develop attendee list (see above list of suggested attendee categories) and facilitate their attendance.

(4) Arrange for the collation of all relevant material - obtain copies of any relevant assessments, research data, management plans, regulations, codes of conduct etc.

(5) Organise a 15 minute talk on the industry (could be either the manager, ain industry representative or both)

Instructions for All Attendees

In the communications to the attendees let them know that they will be expected to contribute to the process by"

- Identifying the SPECIFIC issues relevant to this industry and compare these with the generic component trees and look for areas where additions or deletions will be necessary.
- Collating/ bringing/ distributing any relevant material for identified issues to assist with the risk assessment.

At the Workshop

Preliminary - An introductory talk is normally given to both clarify the scope of the workshop (which industry and what elements of ESD will be covered) and to cover the processes that will be used for those who did not read the material. There are always a large number of participants that don't read material provided. (A copy of the powerpoint presentation that has been given at the beginning of these workshops is located in Appendix 2 – a copy of this is on the National ESD website – www.aquaesd.com)

Modifying Trees - First, discuss the generic structure of the trees. These discussions will be more fruitful and efficient if each of the attendees has examined the component trees before the meeting and comes along with their suggestions as to what amendments will need to be made.

The group will need to modify these trees to meet specific issues for the industry by adding sub-components that are not covered adequately by the sub-components already, showing or deleting sub-components that are not relevant. If any of the generic sub-components are removed, you should provide written justification as to why they are not applicable to this fishery. For a sub-component to be removed this requires the issue to be not be significant, not just that there are no data available on it.

Someone should be using a computer with a projector and modify the trees during the discussions as the group agrees to any changes. The *ms organizational chart* software is relatively simple to use, but the person operating the computer should be familiar with this before the meeting.

The discussions to adapt each of the eight generic component trees should be restricted to no more than 45 minutes each and preferably less than 30 minutes. The facilitator should provide a five-minute introduction on each of the component trees, to assist in the efficiency of the discussions.

Remember, at this stage of the process, it is about issue identification, not prioritisation, so there should be virtually no discussion of how important an issue is. Even if the issue is not appropriate, this may be useful to document. In many cases, the articulation of what is *not* important is more valuable than what is. So, if someone raises something they think is an issue, deal with it.

Facilitation – Administration

In circumstances where there is likely to be a large degree of dissent on issues, particularly between fisheries agency/department staff and other stakeholders, it may be prudent - or more efficient - to use the services of an independent facilitator to manage proceedings. The alternative is to have the manager, or someone else from the agency/department, chair the proceedings.

However, a vital element in this is that the facilitator (be they independent or agency/department-based) needs to have a good understanding of the full ESD Reporting process and at least a passing understanding of the industry. Unless this is the case, it may be difficult to control proceedings and achieve a sensible outcome.

Someone – preferably not the facilitator but this is not mandatory- should be set up with a computer and computer-projector, so as to be able to assist the facilitator and display/amend the component trees, as the workshop progresses. Consequently, this 'assistant' can alter the trees when issues are identified or removed.

If this alteration can be done in 'real time', those involved in the workshop can see exactly what is happening, which helps the workshop to progress. Notes on why issues were removed should be kept, as this will need to be justified in the final report.

The use of a "parking space" whiteboard has been very useful on which issues that are not relevant to the current discussion but need to be addressed at some stage can be written down and not forgotten. The idea is that before the end of the workshop the group goes down this list to ensure that each of the points written has been attended to.

Tips and Guide to Use for Explaining the Concepts of Risk Assessment

It often takes a reasonable length of time for participants at any risk assessment workshop to become familiar with the process and what is required. It is useful, therefore, to run through a few examples that provide sufficient contrasts in consequence and likelihood to demonstrate how issues should be rated. A powerpoint presentation is located in Appendix 2 and can be downloaded from the ESD website www.aquaesd.com.

It is common for people to initially get confused in the assignment of issues to the correct categories within the consequence and likelihood tables. This confusion often arises because they try to directly rate the 'risk', not the two components of 'risk'. It is also hard to get across that risk is a conditional probability.

Figure A1 (see below) has been used at the beginning of a number of workshops to illustrate the difference between 'consequence', 'likelihood' and 'risk'.

Some practical examples are shown below.

Example 1 – The pilchard mortalities that occurred around Australia's south coast some years ago. These caused a severe 'consequence' (Consequence level 3) but this only occurred rarely (Likelihood level 3). This is illustrated by the dark shaded section in Figure 15 (cannot find in document) – most of the time the consequence will be 'nil', but when a disease event hits, the consequence increases to 'severe'. Hence the overall Risk Rating for this issue is 9 – which is a 'moderate' risk.

Example 2 – The impact of the prawn trawl fishery on the king prawn stocks in Shark Bay. With the current levels of effort and the dynamics of this species, the 'likelihood' is that every year (eg Likelihood level 6) there will be a 'moderate' consequence (Consequence level 2) on the stocks. This is illustrated by the medium shaded section of Figure 15 – every year the line will be in the same place. The Risk Rating for this would be 12 - which is also only a 'moderate' risk.

Example 3 – The impact on the bycatch of tropical species by a South Coast trawl fishery. As these individuals are unlikely to contribute to any spawning biomass of these species due to their location outside of the spawning range, the impacts of their capture will at most be negligible (Consequence level 0). Furthermore, as this will only occur in the years when a strong Leeuwin current sweeps them south, the likelihood (illustrated by the light shaded regions) will only be 'unlikely' (Likelihood level 3). This produces a Risk Rating of 0 – a 'negligible' risk.

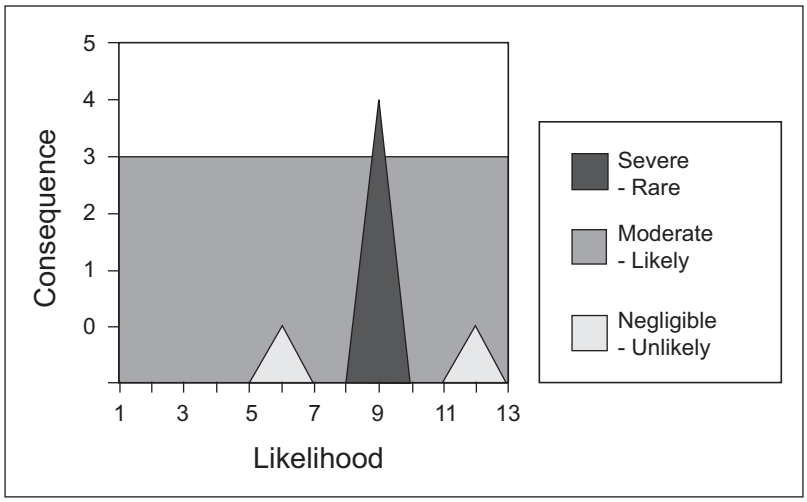


Figure A1. Pictorial representation of the differences between consequence and likelihood. The height (y axis) represents the relative level of consequence of an "incident", with the frequency of the incident shown on the x axis for each of three examples.

Suggested Agenda for Workshop Meetings

Day One (until morning tea)

Task 1: ***Provide an Overview of ESD (see Appendix 2 for presentation)***

- What is ESD?
- How does ESD fit into Aquaculture Management
- Describe the National ESD Reporting Framework
- How does it relate to other initiatives (EMS systems).
- Provide Descriptions of the industry to be assessed

Day One (morning tea until lunch)

Task 2: ***Develop component trees for this industry (do not attempt to complete the risk assessment at this stage)***

1. Discuss each of the draft component trees. These discussions will be more fruitful and efficient if each of the attendees has examined the component trees before the meeting and comes along with their suggestions as to what amendments will need to be made.
2. The group will need to modify the generic framework to meet specific issues for the industry by adding sub-components that are not covered adequately by the sub-components already showing and deleting sub-components that are not relevant. If any of the generic sub-components are removed, you should provide written justification as to why they are not applicable to this industry. For a sub-component to be removed this requires the issue to not be significant, not just that you have no data.
3. The discussions to adapt each of the 8 generic component trees should be restricted to no more than 30 minutes each.

Day One (Lunch till late)

Task 3: ***Complete Risk Assessment for Identified Issues***

Outline the basics of Risk Assessment to provide the workshop participants with a better understanding of the concepts (use the PowerPoint presentation in Appendix 2).

Using the component trees developed earlier in the day, begin to step through each of the issues and determine risks associated with the operation of the industry. Pick an issue that there may be reasonable information about as the first issue assessed. Nonetheless, this first issue usually takes a long time to complete as the participants get used to the process. Try and get through at least one tree by the end of the first day.

Day two (Start – Morning Tea)

Task 3 (continued): ***Completion of Risk Assessment***

Try and finish the risk assessment for all the environmental issues by morning tea.

Day two (Morning Tea – Lunch)

Go through the non-environmental trees and use the risk assessment system to provide some insight into the level of priority/likely importance of the socio-economic and governance issues.

Day two (Lunch – Afternoon Tea)

Task 4: *Completion of Example Performance Reports*

It is important to provide at least a few example reports for a number of the component trees. This may involve developing a report where there is already an objective/indicator/measure available from a current management plan/lease arrangement. In many cases, however, it will first need to involve discussions with the stakeholder group present as to what these might be.

Wherever possible, it will be helpful to get agreement during the meeting about what should be in each of these headings. Any proposed objective and performance measure would, in most cases, require subsequent ratification. If, however, agreement cannot be reached during the meeting on a specific objective or performance level, then each of the propositions can be recorded (along with any justifications) and used as the basis for later consultation. This should not be seen as a failure, but as a means of identifying the specific issues that will require future attention.

It is expected that at best only brief notes would be made for the other headings (headings 4 – 10). These would need to be completed out of session.

Day two (Afternoon Tea)

It is best to finish by afternoon tea, because most participants will have already used up their energy/ patience etc by this time and in most cases some participants will have to leave to catch planes

The workshop coordinator, facilitator and manager need to meet and determine the plan to complete the unfinished elements (of which there will be plenty). It needs to be reiterated to the participants that this is the start of a process, not a completion.

Appendix 2: Power Point Presentations for Workshop

(also available from www.aquaesd.com)

ESD REPORTING
FOR AQUACULTURE

Initial Presentation and Overview
Dr Rick Fletcher

Ecological Sustainable Development
Catching Sustainability

Department of Fisheries
Government of Western Australia

FISHERIES RESEARCH & DEVELOPMENT CORPORATION

OUTLINE OF OVERVIEW

- Why have a Framework
- Overview of National ESD Framework
- Description of the draft Framework for Aquaculture
- First Task – identify issues
- Second Task – Analyse risk of each issue

National ESD Framework

- **Began in March 2000 (after Geelong ESD Conference)**
- **Project has used a stakeholder reference group to provide ongoing advice**
- **A "HOW TO GUIDE" was written to "operationalise" ESD for fisheries**
- **A draft guide now written for aquaculture**

What is ESD?

NSESD (1992)

"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"

Incorporates the 5 major issues of interest: Cultured Species, Ecosystem, Social, Economic and Governance

Why Not Just Environment??

- **Natural resource management needs more than just having minimum standards for affected populations**
- **The activity MUST produce some social or economic benefit or it is vandalism**
- **Depending upon societal values - acceptable impacts can be from "not to be harvested" (e.g. dolphins) to "fully exploit" (e.g. prawns).**
- **To effectively manage a fishery (and meet ESD Principles) requires integration of environmental, social and economic factors.**

Issues and Needs

- Fisheries Legislative Requirements (all have ESD in their Acts in some form)
- Other Government Requirements Various state-based and Local Govt. agencies want environment issues addressed (EPA, Councils etc).
- Market Leverage/Access Marine Stewardship Council
- Develop one reporting process that gathers the information to meets most of these needs
- But not the urgent need to respond to the EPBC requirements to enable exports past 2003 as in the Wildcapture Sector

Why Have a Framework?

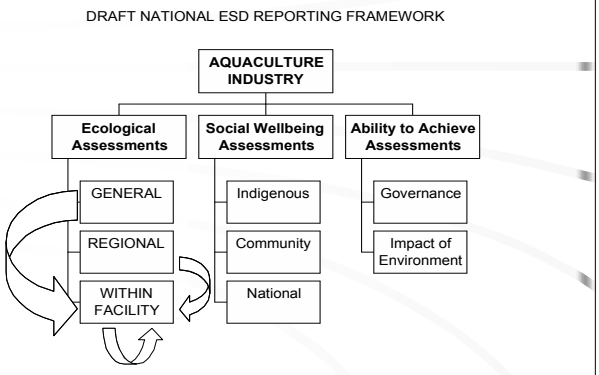
- **Having a framework is NOT an alternative for undertaking other necessary actions**
- **It puts all actions and issues into context**
- **Without a framework it is too easy to conduct unnecessary work and/or miss working on the real issues**
- **Helps determine what actions should be undertaken**
- **Should maximise their benefits**

ESD Measurement and Reporting

- **Many previous attempts have failed**
- **One size does not fit all**
- **Requires a process to systematically identify issues, develop operational objectives and then work out what indicators need to be measured.**
- **The objectives and acceptable range needs to be developed with all stakeholders**
- **Level of information presented needs to be appropriate to the issue**

What are the main differences with Aquaculture

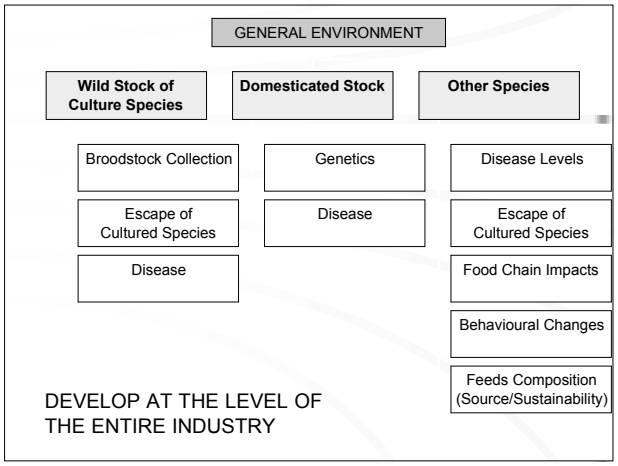
- **Requirements are often developed and imposed at operator level not the sector level**
- **Many industries are land based**
- **Many issues come from what is put in, not what is taken out**
- **Issues cut across many government agencies**
- **Need for a different Framework structure**

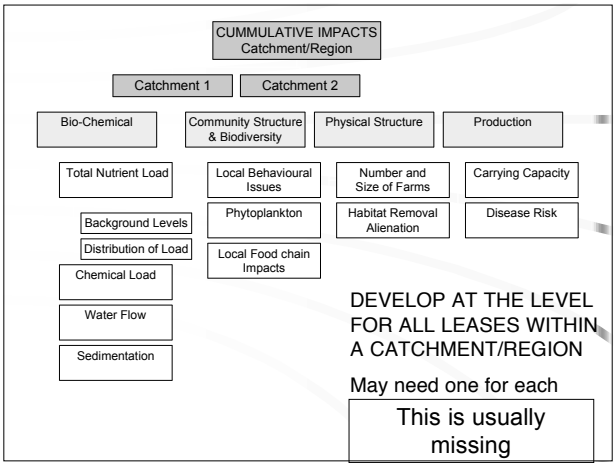


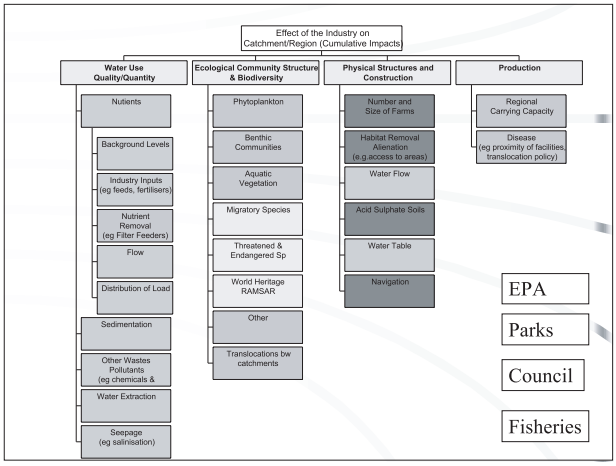
The hierarchical nature of the aquaculture ESD framework is designed to clearly show the linkages between what is imposed at the operator level and the outcomes wanted at both the regional and whole of industry levels.

How would it work for Aquaculture? Part 1:Identify Issues

- **Identify specific issues for each industry by adapting the set of generic component trees**
- **Generic trees are used as the starting point – consistency and minimize missing issues**
- **Adapt by removing irrelevant boxes, adding missing details**
- **Assists identifying the linkages among levels that need to be made**
- **Good visual way of showing issues**

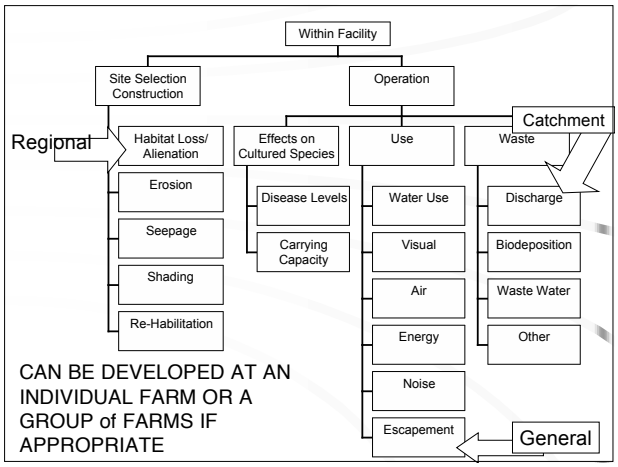






A large number of government agencies are often involved in the assessment of aquaculture

But the assessments and monitoring are usually focused at the level of an individual operator.



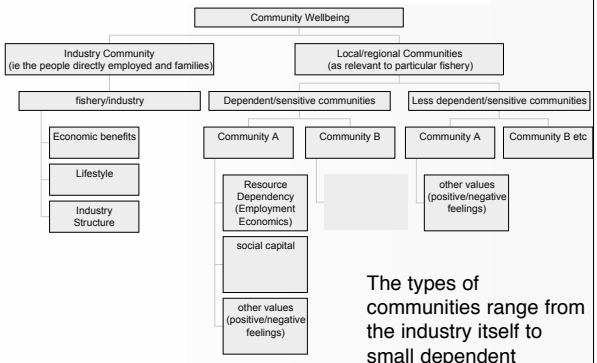
The monitoring levels and restrictions etc. imposed on each operator should, in most cases, be clearly linked to objectives at the regional and whole of industry levels.

Indigenous Issues

Indigenous Community Wellbeing

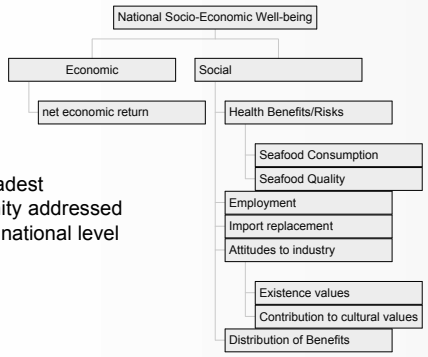
Economic Value | Employment | Social Capital | Cultural Values

COMMUNITY WELLBEING



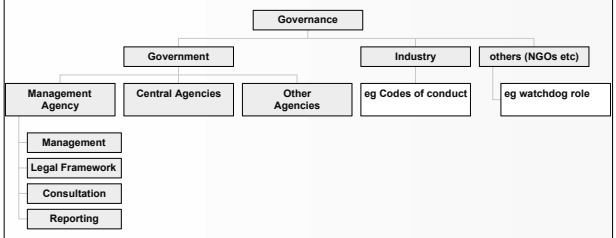
The types of communities range from the industry itself to small dependent communities to those that are not dependent

NATIONAL WELLBEING

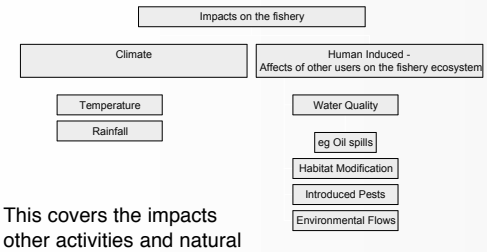


The broadest community addressed is at the national level

Governance



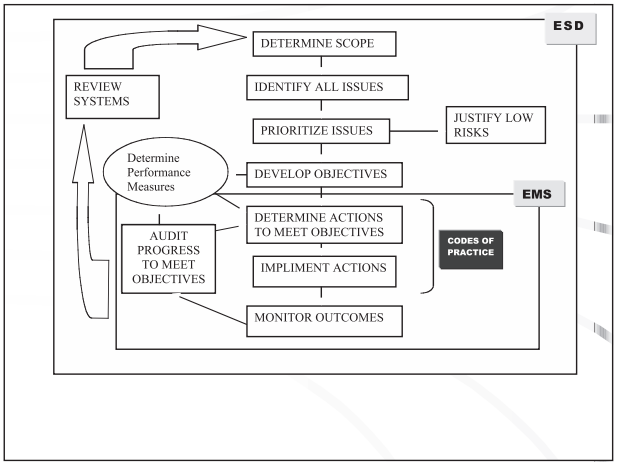
Impacts on the Industry



This covers the impacts other activities and natural climate variations have ON the industry

Comparison to EMS

- The ESD Framework allows REPORTING on the performance for ALL issues for an industry
- An EMS is a method of achieving or improving the level of performance from one to all issues of an individual facility to an entire industry
- Codes of Practice are a way of formalising a set techniques or principles used which may or may not need to be part of an EMS



Comparison to EMS

- ISO accreditation systems for an EMS only audits the process, not the outcomes
- Outputs from the completion of an ESD assessment/report provide the essential inputs for the development of an EMS (targets, performance levels)
- The use of an EMS could be used to demonstrate that an operator/sector are meeting the terms of their licence/lease conditions
- Thus, the systems are complimentary

How does the process work? Part 2:Prioritisation

- Often, many issues are identified, not all require direct management
- Conduct a Risk Assessment on each of the identified issues to determine appropriate level of response
- This process assists in the separation of the minor acceptable risks from the major unacceptable risks
- More Details to be Presented Later

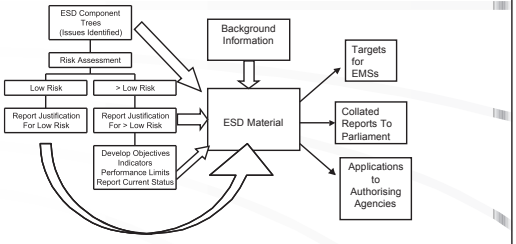
RISK ASSESSMENT

RISK	Description	Reporting	Likely Management
Negligible	not an issue	Justification	Nil
Low	acceptable - no specific control measures needed	Justification	None Specific
Minor	acceptable - with the current risk control measures in place (no new management required)	Performance	Continue Current Arrangements
Moderate	not desirable - Continue strong management actions ...OR...new or further risk control measures to be introduced in near future	Performance	Probable Increases to management
High	unacceptable - major changes required to management approach in immediate future	Performance	Substantial additional management needed

Reporting Categories

- Rationale & I.D. of Management Agency
- Operational Objectives *(+Justification)*
- Indicator
- Performance Measure *(+Justification)*
- Data Requirements
- Data Availability
- Evaluation
- Robustness of Assessment
- Management Responses *(Current, Future and if Trigger is reached)*
- Summary of Actions and Conclusions
- External Drivers

Summary of ESD Framework



General Comments

- **It's not "brain surgery" - specific adaptation of principles used in any good management system**
- **It focuses on generating operational objectives first, rather than looking for indicators.**
- **You don't have to cover all 8 elements of ESD in the first pass**
- **Need to see how and where all stakeholders (fishery agency, other govt. agencies and industry) fit into the scheme – not as simple as wild capture**

How does the National ESD Process Work? - Part 1

Identify specific issues for each fishery by adapting the set of generic component trees

Why use generic component trees?

- **Likely issues identified were developed into a generic tree for each component of ESD**
- **These generic trees are used as the starting point for all assessments**
- **Enhances consistency of approach**
- **Requires specification of what are NOT issues as much as determining what are issues.**
- **Minimises 'missing issues' at first pass**

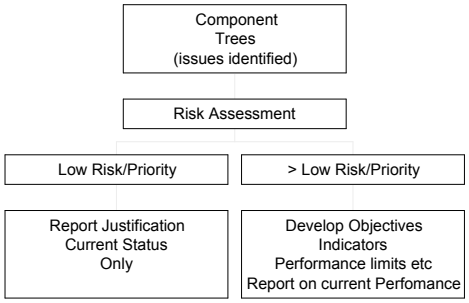
FIRST TASK FOR TODAY

- **AGREE ON THE COMPONENT TREE STRUCTURE FOR THIS SECTOR**
- **YOU CAN ADD ANY ISSUE YOU THINK HAS NOT BEEN INCLUDED**
- **WE WILL NOT DEBATE THEIR PRIORITY - THIS IS DONE IN THE NEXT STAGE**

How does the process work? Part 2

- Often many issues are identified, their importance varies and not all will require full reports and explicit management
- Conduct a Risk Assessment on each of the identified issues to determine appropriate level of response

RISK ASSESSMENT



RISK ASSESSMENT PROCESS STARTED TODAY

Reporting Process Part 3

Complete Suitably Detailed Reports on Each Issue

- Can you justify that your management actions (or in inactions) are appropriate given the level of risk and the current level of knowledge available?
- Is your current performance acceptable given the levels chosen?

DETAILS ON COMPONENT TREES

Appendix 3: Three category version of Risk Assessment Ratings Table

Table A3 -1. Alternative Risk Rankings and Outcomes – 3-category version.

Risk Rankings	Risk Values	Description	Likely Management Response	Likely Reporting Requirements
LOW	0 – 6	Risks are minimal without any specific management actions needed.	Nil	Short – Full Justification Only
MODERATE	7-12	Risks are broadly acceptable and are managed by current procedures.	Specific Management Needed	Full Performance Report
HIGH	> 12	Action is required	Additional Management activities needed	Full Performance Report

Appendix 4: Full list of Case Studies

Qld Prawn farming (October 2000)

(Contact Dr Rick Fletcher, WA Fisheries for details of outcome)

SA Bluefin Tuna Aquaculture (December 2001)

(Contact Stephen Madigan, SARDI for details of outcomes)

WA Black Pearls (mid 2002)

(Contact Rick Scoones, c/- Aquaculture Council of WA for more details)

SA Marine finfish Aquaculture (September 2003)

(Contact Simon Bryars, SARDI for more details)

Victorian Aquaculture Parks (October 2003)

(Contact Anthony Forster, Victorian Fisheries for more details)

Publications in the ESD Subprogram Series

1. Fletcher, W.J., Chesson, J., Fisher, M., Sainsbury, K.J., Hundloe, T., Smith, A.D.M. and Whitworth, B., 2002. *National ESD Reporting Framework for Australian Fisheries: The* 'How To' *Guide for Wild Capture Fisheries*. FRDC Project 2000/145, Canberra, Australia. 120pp.

2. Whitworth, B., Chesson, J., Fletcher, W.J., Sainsbury, K.J., Fisher, M., Hundloe, T., and Smith, A.D.M., 2002. *National ESD Reporting Framework for Australian Fisheries: Technical Support Document - Ecological Components of the 2000/2001 Case Studies*. FRDC Project 2000/145, Canberra, Australia. 98pp.

3. Fletcher, W.J., Chesson, J., Fisher, M., Sainsbury, K.J., Hundloe, T., Smith, A.D.M. and Whitworth, B., 2003. *National Application of Sustainability indicators for Australian fisheries*. Final Report: FRDC Project 2000/145. 48 pp.

4. Fletcher, W.J., Chesson, J., Sainsbury, K.J., Hundloe, T. and Fisher M., 2003. *National ESD Reporting Framework for Australian Fisheries: The ESD Assessment Manual for Wild Capture Fisheries.* FRDC Project 2002/086, Canberra, Australia 163 pp.

5. Fletcher, W.J., Chesson, J., Sainsbury, K.J., Fisher, M. and Hundloe, T., 2004. A flexible and practical framework for reporting on sustainable development for wild capture fisheries. Fisheries Research (in press).

6. Fletcher, W.J., Chesson, J., Fisher, M., Sainsbury, K.J. and Hundloe, T.J., 2004. *National ESD Reporting Framework: The 'How To' Guide for Aquaculture.* FRDC Project 2000/145.1, Canberra, Australia 88 pp.

Ecologically
Sustainable Development
Catching Sustainabilty

This report forms Publication No. 6 of the FRDC –
ESD Reporting and Assessment Subprogram

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