

# **NSW Land Based Sustainable Aquaculture Strategy**

**December 2009**

**A NSW Government Initiative**

# NSW Land Based Sustainable Aquaculture Strategy

A NSW Government initiative of Department of Premier's and Cabinet, Department of Planning; Industry & Investment NSW; Department of Environment, Climate Change and Water; Land and Property Management Authority; Department of Local Government and NSW Food Authority to encourage sustainable land based aquaculture.

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## Executive Summary

Aquaculture is one of the fastest-growing industries in the world. Already 50% of seafood consumed worldwide is produced through aquaculture. According to the United Nations' Food and Agriculture Organization it is estimated that at least an additional 40 million tonnes of aquatic food will be required by 2030 to maintain the current per capita consumption.

New South Wales is poised to capture a significant proportion of this projected growth. A growing number of viable aquaculture investment opportunities are being generated by the drive to satisfy increasing domestic and export demand, and by the competitive advantages (both natural and man-made) which this State offers.

New South Wales has large areas suitable for the development of land based aquaculture with access to high quality surface water, ground water, estuarine and marine waters. The State's transport and energy infrastructure are well developed with the capacity to service growth in the aquaculture sector.

Aquaculture industry participants and the NSW Government's regulatory agencies are very conscious of the need to ensure that the development of the aquaculture industry in New South Wales proceeds in a manner that does not jeopardise its ecological sustainability. Industry and government continue to invest heavily in research, technology and management practices to provide for the sustainable growth of this sensitive industry. Both recognise the environmental benefits arising from aquaculture, as well as the environmental conditions aquaculture needs to ensure the continuing high quality of its products.

The NSW Land Based Sustainable Aquaculture Strategy (NSW LBSAS) is made up of two interlinked sections – a best management section and an integrated approvals section so that projects can be established and operated to meet sustainability objectives.

The best management section provides the basis for the Aquaculture Industry Development Plan (AIDP) for land based aquaculture in NSW under the provisions of the *Fisheries Management Act 1994*. The AIDP identifies best management for business planning, species selection, site selection and design, planning and operation of the facility and includes the performance requirements for relevant environmental regulations.

Based on best practice in the AIDP a 'project profile analysis' has been established to provide an up-front preliminary assessment of the likely level of risk to the environment from aquaculture proposals. The project profile analysis provides the basis for streamlining approvals. Low risk proposals will require a statement of environmental effects to analyse potential environmental impact. Only those developments that are identified as high risk in the project profile analysis will require an Environmental Impact Statement (EIS). The project profile analysis is given effect under *State Environmental Planning Policy No 62 – Sustainable Aquaculture*.

The NSW LBSAS recognises the importance of the role of Industry & Investment NSW (I&I NSW) in extension and compliance. In addition to I&I NSW Officers being available to provide current information from research programs and advice on best practice in aquaculture management, they will be in the front line in ensuring best practice is followed.

The NSW LBSAS is designed to provide information to investors, government agencies and the community and to ensure that aquaculture enterprises in New South Wales are established and operated in a sustainable manner.

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## DEFINITIONS

Following definitions apply as used in this Strategy:

| TERM  | DEFINITION   |
|---|--|
| <b>Acid Sulfate Soils (ASS)</b>                     | Acidic soil material resulting from the oxidation of iron sulfides. 'Acid Sulfate Soils' means actual acid sulfate soils and/or potential acid sulfate soils. 'Actual Acid Sulfate Soils' are soils containing highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in sulfides, primarily iron sulfide. This oxidation produces hydrogen ions in excess of the sediment's capacity to neutralise the acidity resulting in soils of pH of 4 or less |
| <b>Australian Height Datum (AHD)</b>                | A common national place of level corresponding approximately to mean sea level.  |
| <b>Aquaculture</b>                                  | The cultivation of aquatic animals or marine vegetation for the purpose of harvesting the animals or marine vegetation, or their progeny for sale, or the keeping of animals or marine vegetation in a confined area for a commercial purposes.  |
| <b>Aquifer</b>                                      | A layer of rock or soil which holds water in sufficient quantity to provide a source of water that can be tapped by a bore.  |
| <b>Average recurrent interval (ARI) flood event</b> | It represents a flood that has a particular probability of occurring in any one year. A 1 in 100 ARI flood is a best estimate of a flood which has on average, 1 chance in 100 of occurring in any one year. It is important to acknowledge that the 100 year ARI event may occur more than once in a 100 year period as the definition of the event is that it occurs once, on average, in 100 years.   |
| <b>Biochemical Oxygen Demand (BOD)</b>              | The quantity of oxygen used in the biochemical breakdown of organic matter in the effluent expressed in milligrams per litre or ppm.   |
| <b>Broodstock</b>                                   | A parent fish.   |
| <b>Catchment Area</b>                               | A drainage area, eg. for a reservoir, river or river reach.  |
| <b>Closed system</b>                                | An aquaculture facility where there is no direct discharge of water to a waterway.   |
| <b>Discharge Water/effluent</b>                     | Treated water discharged from ponds, hatcheries etc that may be reused in the ponds or for irrigation or may be discharged to waterways.   |
| <b>Dissolved Oxygen (DO)</b>                        | The amount of oxygen dissolved in water expressed in milligrams per litre or ppm. In ponds it is a measure of the stability of the water environment. The colder the water, the greater the amount of oxygen that can dissolve in it. In freshwater, oxygen is soluble up to 14.6 mg/L at 0°C, and up to 8.4 mg/L at 25°C. Fish and other aquatic organisms generally require more than 2 mg/L of DO to survive.   |
| <b>Endangered Species</b>                           | The species is likely to become extinct in nature if threats continue, or its numbers are reduced to a critical level, or its habitat is reduced.  |
| <b>Endemic Species</b>                              | A species confined in occurrence to a local region.  |
| <b>Environmental Impact</b>                         | The potential biophysical, social and/or economic effects of a project on the community or the natural environment   |
| <b>Environmental Impact Statement (EIS)</b>         | A detailed assessment on the potential effects of a Class 3 project (See Chapter 9). It should be prepared by an appropriately qualified person and must stand up to rigorous community and agency review. The EIS must address all matters requested by the consent authority.  |
| <b>Estuarine</b>                                    | Estuary means any part of a river whose level is periodically or intermittently affected by coastal tides or any lake or other partially enclosed body of water that is periodically or intermittently open to the sea or anything declared by the regulations under the <a href="#">Water Management Act 2000</a> to be an estuary.   |
| <b>Estuarine waters</b>                             | Saline waters sourced from an estuary as defined under the <a href="#">Water Management Act 2000</a> .   |
| <b>Fish</b>   | Means any marine, estuarine or freshwater fish or other aquatic animals life at any stage of their life history (whether dead or alive). Fish includes oysters and other aquatic molluscs, crustaceans, echinoderms and beachworms and other aquatic polychaetes. It also includes any part of a fish but does not include whales, mammals, reptiles, birds, amphibians or other things excluded from the definition by regulations.   |
| <b>Flood planning area</b>                          | Area below the flood planning level (FPL). Many Councils use the 100 year flood event plus a 0.5 m freeboard as the basis for defining the FPL and therefore the flood planning area. (see <a href="#">floodplain development manual</a> )   |
| <b>Food conversion ratio</b>                        | Food conversion ratio (FCR) is the ratio of dry weight of food to the wet weight gain of the fish. The lower the ratio, the more efficiently food has been converted.  |
| <b>Groundwater</b>                                  | Underground waters (aquifers).   |
| <b>Growout</b>                                      | Stage and/or unit where the cultivation of aquatic animals is undertaken from initial seeding of young fry or juveniles up to harvesting of marketable sizes.  |
| <b>Health Certificate</b>                           | A certificate issued by a competent authority attesting to the health status of a shipment of aquatic animals and/or their production facility.  |
| <b>Indigenous Species</b>                           | A species native to a particular region or country.  |

| TERM  | DEFINITION  |
|---|---|
| <b>Intensive Aquaculture</b>                    | Aquaculture undertaken by providing supplementary food for the fish or marine vegetation that are being cultivated (whether or not naturally occurring food is consumed or available for consumption by the fish or marine vegetation).   |
| <b>Introduced Species</b>                       | A species introduced into an area where it does not naturally occur.  |
| <b>Landform Element</b>                         | Part of the landform characterised by a distinctive slope, shape, size, form and type of geomorphologic processes (eg. alluvial) active on it.  |
| <b>Open system</b>                              | An aquaculture facility which discharges on average between 15 to 100% per day of its culture water directly to a waterway. This system is sometimes referred to as a flow through system.  |
| <b>Pathogen</b>                                 | An infectious agent capable of causing disease.   |
| <b>Permeability</b>                             | The ease with which water can penetrate or force its way through rocks, gravel and soils. Coarse sand and gravel permit rapid flow and are rated as highly permeable materials. Microscopic pores in clay impede flows; such soils are considered impermeable or of low permeability for dike and dam constructions.  |
| <b>pH</b>                                       | A measure of acidity or alkalinity of a substance.  |
| <b>PMF or Probable Maximum Flood</b>            | The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study. (see <a href="#">floodplain development manual</a> ) |
| <b>Project Profile Analysis</b>                 | A matrix of environmental and operational factors for ranking the level of environmental design and operational factors and the level of environmental risk in relation to the siting, establishment and operation of an aquaculture development in relation to those factors (See chapter 9).  |
| <b>Pond Aquaculture</b>                         | Type of aquaculture undertaken predominantly in ponds or dams (including any part of the aquaculture undertaken in tanks such as during the hatchery or depuration phases), but not including natural water-based aquaculture.  |
| <b>Quarantine</b>                               | The holding of aquatic animals or plants in an isolation facility.  |
| <b>Reconditioned Water</b>                      | Water from culture units that has been treated by physical, biological and chemical processes to remove waste products.   |
| <b>Recycled Water</b>                           | Wastewater from ponds, tanks or hatcheries that has been treated and re-used for culture.   |
| <b>Saline groundwater</b>                       | Saline water sourced from a bore or inland saline interception scheme.  |
| <b>Salinity</b>                                 | The measure of salt concentration of water in ponds, tanks or hatchery expressed in part per thousand or ppt.   |
| <b>Semi closed system</b>                       | An aquaculture facility which discharges on average less than 15% per day of its culture water directly to a waterway.  |
| <b>SEPP</b>                                     | State Environmental Planning Policy as an instrument pertaining to issues of State Environmental Planning significance made under section 39 of the <i>Environmental Planning and Assessment Act 1979</i> .   |
| <b>Statement of Environmental Effects (SEE)</b> | A detailed assessment of the potential effects of a Class 1 or 2 project.   |
| <b>Stocking Densities</b>                       | Number of animals per square metre of effective pond area.  |
| <b>Suspended Solids</b>                         | The mass of particulate matter (organic and inorganic) that is suspended in the water.  |
| <b>Tank Aquaculture</b>                         | Type of intensive aquaculture that utilises recirculating water technology in tanks (eg. hatcheries and tank aquaculture of barramundi, and abalone).   |
| <b>Vulnerable Species</b>                       | A species that will become endangered unless mitigating action is taken against its threats.  |
| <b>Wastewater</b>                               | Untreated water discharged from ponds, tanks, hatcheries, etc.  |
| <b>Waterway</b>                                 | Generally refers to creek, river, wetland, waterbody or groundwater.  |

## ACRONYMS

|                     |  |
|---------------------|--|
| <b>AHD</b>          | Australian Height Datum  |
| <b>AIDP</b>         | Aquaculture Industry Development Plan  |
| <b>ANZECC</b>       | Australian and New Zealand Environment and Conservation Council  |
| <b>ASS</b>          | Acid Sulfate Soils   |
| <b>BCA</b>          | Building Code of Australia   |
| <b>BOD</b>          | Biological Oxygen Demand   |
| <b>CMA</b>          | Catchment Management Authority   |
| <b>DA</b>           | Development Application  |
| <b>DECCW</b>        | Department of Environment, Climate Change and Water  |
| <b>DGR's</b>        | Director General requirements (Department of Planning)   |
| <b>DLG</b>          | Department of Local Government   |
| <b>DLWC</b>         | Former Department of Land and Water Conservation   |
| <b>DO</b>           | Dissolved Oxygen   |
| <b>DoP</b>          | Department of Planning   |
| <b>EA</b>           | Environmental assessment   |
| <b>EC</b>           | Electrical Conductivity  |
| <b>EIS</b>          | Environmental Impact Statement   |
| <b>EP&amp;A Act</b> | <i>Environmental Planning and Assessment Act 1979</i>  |
| <b>FCR</b>          | Food conversion ratio  |
| <b>GIS</b>          | Geographical Information System  |
| <b>HACCP</b>        | Hazard Analysis Critical Control Point   |
| <b>I&amp;I NSW</b>  | Industry & Investment NSW (incorporating former Department of Primary Industries and the Department of State and Regional Development) |
| <b>IDA</b>          | Integrated Development Assessment  |
| <b>LEP</b>          | Local Environment Plan   |
| <b>LPMA</b>         | Land and Property Management Authority (formerly Department of Lands)  |
| <b>MHWN</b>         | Mean High Water Neap   |
| <b>MLWN</b>         | Mean Low Water Neap  |
| <b>NOW</b>          | NSW Office of Water  |
| <b>PCA</b>          | Principal certifying authority   |
| <b>pH</b>           | Acidity or basicity of water; Amount of Hydrogen-ion concentration   |
| <b>PMF</b>          | Probable Maximum Flood   |
| <b>POEO Act</b>     | <i>Protection of the Environment Operations Act 1997</i>   |
| <b>PVP</b>          | Property Vegetation Plan   |
| <b>RAMSAR</b>       | Convention on Wetlands of International Importance (Ramsar Convention)   |
| <b>REP</b>          | Regional Environmental Plan  |
| <b>RTA</b>          | Road Transport Authority   |
| <b>SEE</b>          | State Environmental Effects  |
| <b>SEPP</b>         | State Environmental Planning Policy  |
| <b>SIS</b>          | Species Impact Statement   |
| <b>VENM</b>         | Virgin Excavated Natural Material  |
| <b>WQO's</b>        | Water quality objectives   |

## Acknowledgment

The NSW Aquaculture Strategy Steering Group developed the NSW Land Based Sustainable Aquaculture Strategy (NSW LBSAS) as an extension of the NSW State Government's Aquaculture Initiative. The steering group would like to thank all those who contributed to the development of the NSW LBSAS by making submissions. The steering group will continue to liaise with all stakeholders in implementing the NSW LBSAS and reviewing it from time to time.

The following have contributed through the State Aquaculture Strategy Steering Group to the development of the NSW LBSAS.

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# 1. The NSW Land Based Sustainable Aquaculture Strategy

## 1.1 Introduction

The NSW Land Based Sustainable Aquaculture Strategy (NSW LBSAS) provides information on best practice for land based aquaculture and establishes a streamlined approvals process for land based aquaculture in NSW. The information is provided in two sections:

- Section 1: Aquaculture Industry Development Plan under the *Fisheries Management Act 1994*.
- Section 2: Assessment and approvals under the *Environmental Planning and Assessment Act 1979*.

The detailed sections of the NSW LBSAS will assist you in analysing a proposed project and assist in completing the project profile analysis tables found in [Chapter 9](#) along with any environmental assessments required.

In addition, NSW government agencies are available and willing to assist proponents with information and advice. Key web links for additional information are contained in Appendix 2.

**Aquaculture within public waterways is not dealt with in the NSW LBSAS. However, land based aquaculture may access water from public waterways including rivers, estuaries and the ocean.**

## 1.2 What is land based aquaculture?

Aquaculture means the breeding, growing, keeping and harvesting of fish or marine vegetation with a view to sale or commercial purpose. The NSW LBSAS uses the definition of aquaculture given in the *Fisheries Management Act 1994*.

The NSW LBSAS covers the following types of land based aquaculture which may be used to produce fish for food, fish stocking and the ornamental trade, namely:

- Pond aquaculture systems using estuarine, marine, saline groundwater or fresh water for growing species.
- Tank aquaculture systems using estuarine, marine, saline groundwater or fresh water for growing species.

## 1.3 Critical success factors

Some critical factors to consider and resolve when deciding whether an aquaculture venture may be feasible include:

- **Water** – access to abundant good quality water;
- **Land** – predominantly freehold land that is zoned appropriately (Crown land may be used for pipelines or other services) and free of constraints to the proposed development;
- **Stock** – reliable access (numbers and time of year) to juveniles of your selected fish species;
- **Feed** – access to quality feed that ensures the physiological requirements of your selected fish species;
- **Markets** – access to established markets or the ability to establish new markets;
- **Finance** – initial finance required for total capital expenditure plus 2 years operating expenses;
- **Profitability** – development of a sound business plan.

## 1.4 Strategy purpose and vision

The purpose of the NSW LBSAS is to detail best practice guidelines which promote ecologically sustainable development (ESD) of the land based aquaculture industry in NSW. It aims to simplify the approvals process giving greater certainty to investors and the community.

The vision for the land based aquaculture industry in NSW is for a thriving, economically and environmentally sustainable industry.

## 1.5 Ecological sustainable development

ESD is not just about the environment, but also about the viability of businesses and the broader community's well being. The principles of ecologically sustainable development were adopted by all Australian governments in the National Strategy on ESD (1992) which states that we should be:

*'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.'*

ESD has become a major objective of all NSW natural resource management, environment protection and planning legislation. A key object of the *Fisheries Management Act 1994*, is to promote ecologically sustainable development and this is being met in part through the development of statewide sustainable aquaculture strategies. ESD is now accepted as the foundation for aquaculture management in NSW.

The relevant definition for ESD in NSW is given in the *Protection of the Environment Administration Act 1991*, (s.6), which states:

Ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

- (a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
  - (ii) an assessment of the risk-weighted consequences of various options,
- (b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,
  - (c) conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,
  - (d) improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services, such as:
    - (i) polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
    - (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
    - (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

**The principles of ESD are integrated into NSW LBSAS by:**

- Identifying areas where land based aquaculture is a permitted land use and ecologically sustainable through implementing measures that will lead to the protection of the environment in those areas;
- Describing best operational and management practices based on ESD principles.

**For the land based aquaculture industry, adopting ESD principles will:**

- Provide a pathway to address issues affecting the industry's long-term survival;
- Put in place a systematic and recognised means of establishing the industry's resource management credentials with regulatory agencies, seafood consumers and the community;
- Support the industry's position as a legitimate user of water resources and crown land (eg. pipelines);
- Result in improved development outcomes that provide greater certainty and a simplified assessment and decision making process.

**For individual farmers the potential benefits are to:**

- Safeguard business profitability through maintaining access to existing markets, accessing new 'green' markets and reducing the cost of production;
- Gain the support of the local community and reduce the risk of conflict with neighbours;
- Understand obligations to comply with environmental and planning legislation so that the risk of breaches can be minimised;
- Have ongoing continual improvement that will help the business keep pace with developments in environmental legislation and community expectations.

**For the broader community the potential benefits are:**

- Improved environmental outcomes that address cumulative issues and provide effective indicators of sustainability;
- Increased certainty in the nature and operation of the industry;
- Increased confidence in the environmental performance of the industry;
- Improved employment outcomes with an improvement in industry viability;
- Improved outcomes for regional NSW with a coordinated approach to providing sustainable land based aquaculture investment opportunities.

## 1.6 Implementation and legislation

The implementation of NSW LBSAS requires effective collaboration between government, industry and the community. The NSW LBSAS brings together the interests of economic development, land use planning and sustainable natural resource management to form a partnership that can lead to sustainable land based aquaculture and generate employment in regional NSW.

I&I NSW is the key agency responsible for delivery of the on-the-ground outcomes of the NSW LBSAS. Local government and State agencies share responsibility for development assessment processes.

Section one of the NSW LBSAS establishes details for an Aquaculture Industry Development Plan under s.143 of the *Fisheries Management Act 1994* with section two providing revised planning provisions for the NSW land based aquaculture industry to be gazetted under State Environmental Planning Policy 62 – [Sustainable Aquaculture](#).

## 1.7 Performance indicators and review

The *Fisheries Management Act 1994*, requires performance indicators to be established within an AIDP to determine if the objectives set out in the plan are being achieved. The plan must also specify at what point a review is required if these performance indicators are not being met.

I&I NSW will report annually on the performance indicators. This report shall consider the need to update or review the NSW LBSAS generally or in relation to particular culture systems or particular aspects of environmental performance. New species, improved land based farming practices and management responses to emerging issues will also be considered. The NSW LBSAS will be reviewed in five years, or earlier if triggered by the performance indicators given in Table 1.

**Table 1. Triggers for review of the NSW Land Based Sustainable Aquaculture Strategy.**

| Indicator   | Measure   | Trigger for review  |
|---|---|---|
| 1. Number of new or expanded aquaculture permits per annum  | Reflect effectiveness of objective to encourage aquaculture industry development.                   | Less than 5 aquaculture permits per annum   |
| 2. Percentage of aquaculture farms providing Industry & Investment NSW with 'acceptable' compliance reports per annum | Reflect effectiveness of the industries acceptance of responsibility for environmental performance. | Less than 90% per annum   |
| 3. Surface area of estuary pond farms per estuary compared with area suitable for estuarine pond farms in estuary     | Potential cumulative water quality issues   | Greater than 10% of area suitable for estuarine pond farms in an estuary developed. |
| 4. Percentage of designated development proposals or Part 3A.   | Reflect the effectiveness of objective to encourage lower risk projects                             | Greater than 30% of aquaculture projects being designated development or Part 3A.   |
| 5. Number of years since review (if not triggered for other reasons)  | Potential to become out of date with advice no longer reflecting the most sustainable approach.     | Greater than 5 years since gazettal or last review.                                 |

## 1.8 Developing and implementing the NSW LBSAS

The initial ideas for the NSW LBSAS were developed through a working group of government agency representatives. The working group consolidated the regional North Coast and the Hunter & Central Coast Sustainable Aquaculture Strategies along with some preliminary work undertaken to develop strategies for the South East and Riverina – Murray regions to provide for an overarching Statewide sustainable aquaculture strategy.

The aim was to develop innovative ways to overcome 'red tape' associated with approvals for aquaculture development. Following this initial process, input was sought from both industry and community stakeholders.

The major stakeholders in the NSW LBSAS are:

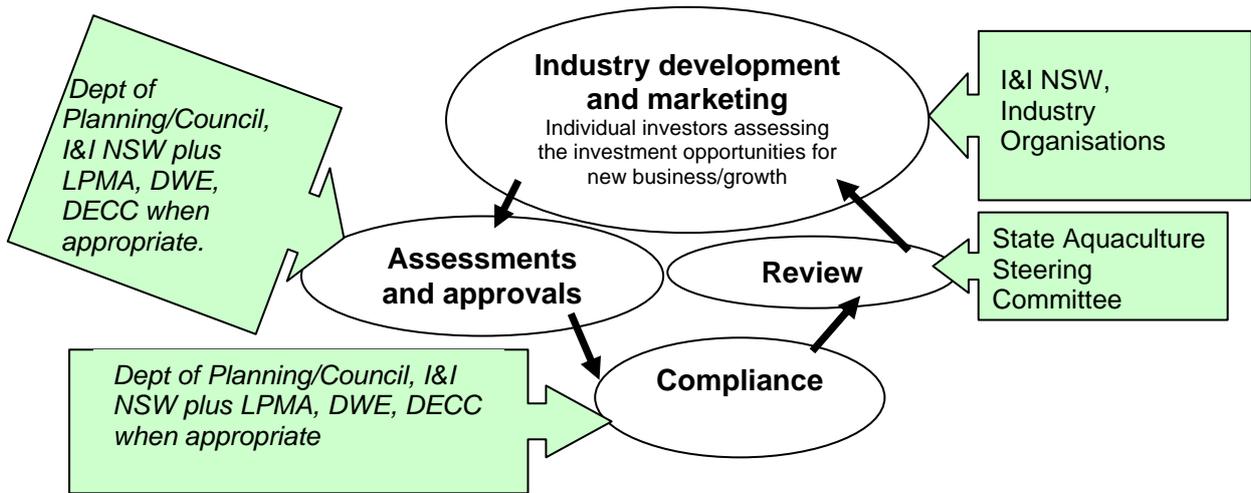
- the private sector – aquaculturalists and other business people investing in aquaculture;
- State and local government – I&I NSW is the major State Government participant, delivering on the ground outcomes in four action areas (see Figure 1). Local Council or Department of Planning for development consent and integrated approvals (see Figure 1);
- the NSW Aquaculture Steering Group – providing technical assistance regarding legislative requirements, performance standards and monitoring protocols;
- general Community.

The partnerships between government, industry and the community are essential to:

- maximise efficiencies and competitive advantages for new and expanding aquaculture projects;
- avoid duplication of effort by applicants and agencies;
- streamline assessment and approval processes provided that environmental requirements and criteria are met;
- provide incentives to adopt best practice guidelines in aquaculture;
- strategically consider projects by assessing the environmental impacts both at the individual project level and cumulatively in a catchment.

Implementation of the NSW LBSAS falls into four distinct areas as shown in Figure 1.

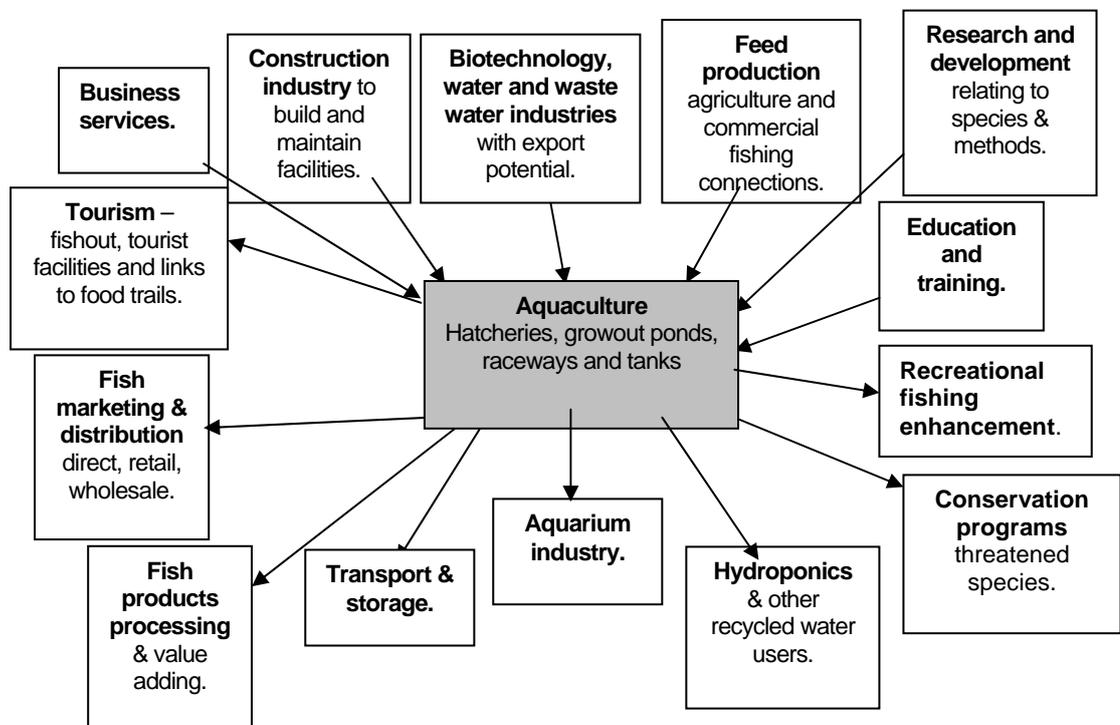
Figure 1. NSW LBSAS implementation – the four key areas and key government agencies.



### 1.9 Investment and employment

Aquaculture is estimated to employ up to one full time person per 2 hectares of ponds (plus casual labour during busy periods). In addition, it is an industry with significant flow-on value and employment benefits for regional communities, as well as export potential. If aquaculture is integrated into the local tourism industry, such as has happened on the [Eyre Peninsula](#) in SA, the flow on employment value of the industry is greatly increased. Figure 2 summarises the multiple employment and investment opportunities that aquaculture has the potential to generate.

Figure 2. Summary of the multiple employment and investment opportunities.



## 2. The Aquaculture Industry Development Plan

### What is the AIDP?

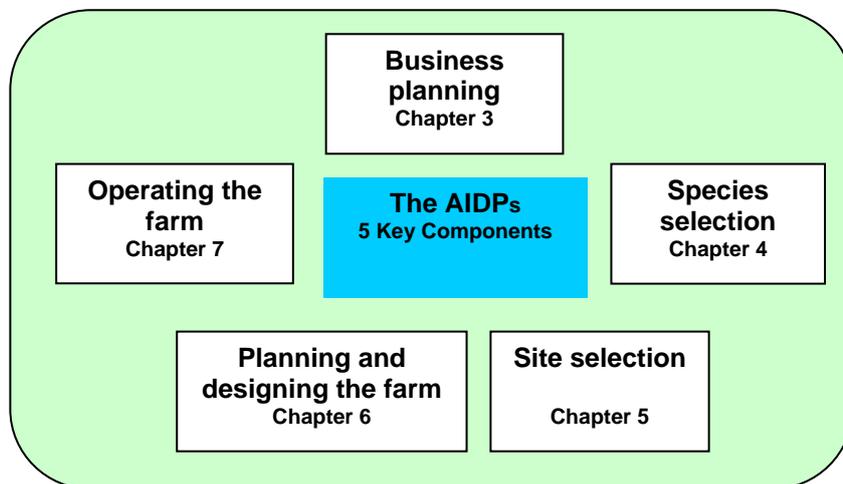
The Aquaculture Industry Development Plan (AIDP) is one of the two components of the NSW LBSAS. It provides a best practice approach to environmental management that aims to attract investment and employment in economically and environmentally sustainable land based aquaculture by:

- reinforcing within the aquaculture industry environmentally sustainable practices and a duty of care for the environment in which the industry is located;
- ensuring environmental factors are considered during site selection for new aquaculture enterprises;
- ensuring environmental factors are considered during the planning, design and operation of all aquaculture enterprises;
- providing the technical basis for the efficient and effective regulation of the industry with up-front certainty to applicants, the community and decision makers as to the appropriate environmental performance of aquaculture businesses.

Current industry operators and new investors are expected to meet the environmental performance objectives. Further, there is an expectation of continuous improvement in environmental performance. In practice this means the encouragement of approaches which provide outcomes above those outlined in the AIDP (best practice at the time of developing this publication).

Figure 3 summarises the five key components of the AIDP. The numbering of key component in Figure 3 cross references it to the relevant chapters of the AIDP (section one) in the NSW LBSAS.

**Figure 3. Key components of the AIDP for developing an aquaculture venture.**



### 3. Business Planning

Remember the old saying: *'most people do not plan to fail, they simply fail to plan'*.

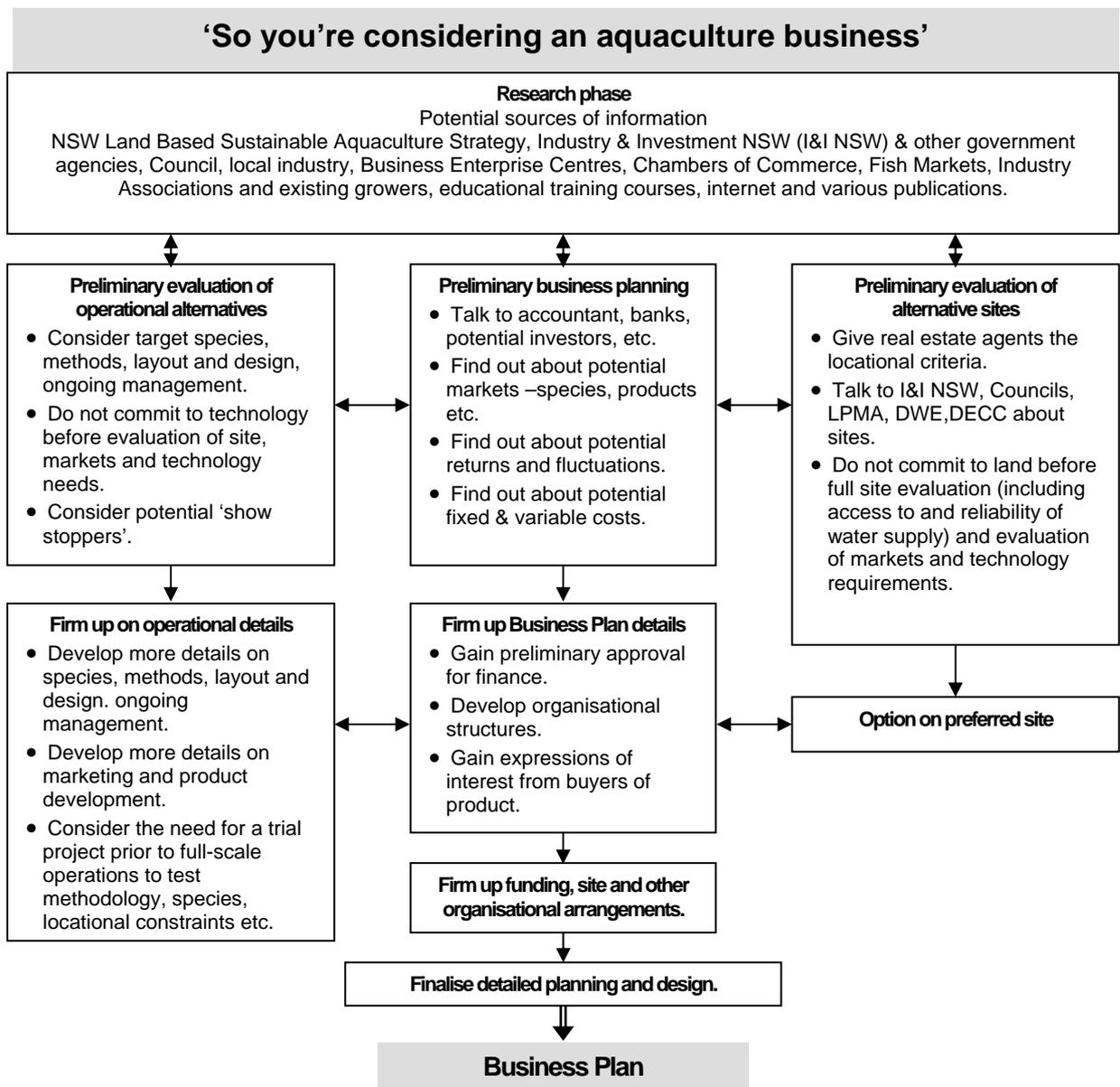
#### 3.1 Introduction

The success of an aquaculture venture will primarily be determined by its ability to operate as a profitable business. Large purpose built facilities will normally start by identifying a market, then selecting a species, a site and suitable culture technology in that order.

However, if you already own a site or have previous experience with a particular species or method you will probably be inclined to build on these existing assets. In this case, you must still come back to considering the market for your product as an essential part of deciding if the venture is viable.

No two businesses are exactly the same and therefore a **business plan** specifically addressing your production and marketing issues needs to be one of the first things to be developed. The business plan acts as a blueprint for the future operation and growth of the business. Figure 4 summarises the process of preparing a business plan

Figure 4. Business and project planning.



The [business plan](#) will need to demonstrate solid reasoning behind your aquaculture business and the justification for financial support. Its importance cannot be over-stated as potential investors or financial institutions will use it to evaluate the business and many will be unfamiliar with aquaculture.

Business plans can take various formats, depending on the type and source of funding sought. Before you start writing your [business plan](#) it is useful to do some background preparation. In addition to the information contained within this document additional information can be found using the following web link, [www.smallbiz.nsw.gov.au](http://www.smallbiz.nsw.gov.au). Also, project management software packages are available that enable you to store, document, report and monitor your business.

A Commercial Farm Development Plan (CFDP) is required under the [Fisheries Management Act 1994](#) as part of the application for an aquaculture permit. The requirements of the CFDP will be predominantly addressed by the business plan developed for your aquaculture farm. Therefore, the business plan can either be used to complete the CFDP or if it addresses all of the matters within the CFDP, it can be submitted as your CFDP.

### 3.2 The business and its structure

Sole proprietorship is a common organisational structure for NSW aquaculture enterprises. Factors affecting structure choice may include access to resources, management issues, long term plans, interrelationships, liability and taxation issues.

You should seek advice from a business planner, accountant and/or legal advisor about the options and potential of different [business structures](#) and how they may affect an aquaculture business at different phases of development.

### 3.3 Marketing feasibility

The aim of commercial aquaculture is to maintain a profitable business. Therefore, the business requires the production of sufficient quantities of marketable product and the ability to receive a market price greater than the production costs.

All too often, a decision is made to farm a species based on production factors with little consideration given to market acceptance and price. A [marketing plan](#) is a core part of the business plan, and helps determine the marketing strategy. Developing the [marketing plan](#) is often the hardest part of an aquaculture business plan. Getting it right can fundamentally influence the businesses profitability.

#### ***Help is at hand***

Potential sources for business information and consumer data include: [Regional Development Boards](#), [Department of State and Regional Development](#), [NSW Business Advisory Service](#), [Business Enterprise Centres](#), Chambers of Commerce or the [Yellow Pages](#).

The Sydney Fish Market is a key source of information on market trends and opportunities.

#### ***A tip!***

Farmer networks can help ensure that a consistent and reliable supply of quality product is supplied to meet market specifications and requirements. This will help increase demand and smooth out periods of glut and short supply, thereby leading to more reliable prices for the farmed products. Industry groups are better placed to develop quality assurance programs and promote markets for new aquaculture products than individual producers. (See [NSW Aquaculture Directory](#))

### The domestic market

The main areas of the domestic seafood market are:

- **Live seafood market.** Generally returns higher prices than chilled product; has the added value of freshness but can have a degree of risk/costs associated with harvest, holding and transport;
- **High volume markets for fresh seafood.** Chilled product, including cooked, fresh chilled, filleted, head on gilled and gutted, frozen, vacuum packed or smoked. There is a risk that this higher volume market will return lower prices and in some cases insufficient to cover production costs;
- **Restaurants and seafood retailers.** Direct sale in live and/or slaughtered form;
- **Recreational markets.** eg. tourism (Fishouts), aquarium trade and fishing bait.

### Export markets

Wild fisheries are expected to plateau or decline over coming years and aquaculture product has the potential to fulfill shortfalls in supply. Australia is well placed to meet these shortfalls however, establishing export markets requires comprehensive research and marketing.

### Factors affecting market value and price

The price can vary between market sectors and geographic locations. There can be significant differences in price between local markets and the Sydney, Brisbane and Melbourne markets, and between wholesalers, retailers (supermarkets and fishmongers), restaurants and the take-away-food sector.

It is essential to be well informed regarding the cost implications in getting your product to market and the likely differentials in returns. The lowest acceptable price once both fixed and variable costs have been factored in should be equal to the cost per kilogram (including profit) to produce the product.

### Positioning

In some cases, product can be 'positioned' to maximise returns by creating or utilising boutique markets. This may be achieved as individual or regional producers under the banner of aquaculture associations or cooperatives. The implementation of quality assurance protocols helps maintain a quality product through emphasis on careful handling, cleaning, processing, packaging, reliable transport and quality service.

### Promotion

Product promotion is essential and one of the best forms of promotion is the product's reputation supported by a quality assurance protocol. Individual business promotion may dovetail with the promotion of the State, region or the industry as a whole. Promotion through regular appearances at regional or promotional events, markets and direct contact with customers is effective, particularly as it provides opportunity for customer feedback.

### Quality assurance

A quality assurance program is necessary to ensure consistent quality of product. All products should meet the National Food Standards and will be required to meet [NSW Food Authority](#) requirements. (See also Australian Seafood Industry Quality Assurance Project by [Seafood Services Australia](#)).

### Packaging and presentation

Packaging and presentation must be considered, especially in the retail market. The use of well designed innovative packaging can add value and increase returns, especially for speciality products.

### **Market acceptance**

Market acceptance is critical. You must do your own research as market acceptance can change for a wide range of reasons.

### **Distribution**

Market location including the distance to market and the logistics of supplying the products is another major practical business planning issue. You will need to determine available delivery options (eg. using agents, distribution companies or own staff) and costs in reaching your markets.

Direct deliveries to speciality markets often have the greatest potential for the highest return per kilogram. However, the full cost in terms of staff time (lost from production activities), equipment, vehicle costs, packaging, ice, plastic bags, boxes, labels, etc should be considered.

### **Tourism**

Tourism may have potential for additional returns, but must warrant the added expense. It is important that the full cost of a tourism component to the business (eg. customer amenities, insurance, sales display area, equipment and additional staff costs) and costs associated with disruption to the daily operations of the farm. Tourism projects may include fishouts or guided tours (see [Planning and Design](#) Chapter).

## **3.4 Production feasibility**

Once the business planning has determined that there is a potential market for the product, a full production [feasibility assessment](#) is undertaken. Preliminary research on this topic should be undertaken as any barriers in production could have implications for the long term viability of the business. The production feasibility assessment should consider all fixed and variable costs, including:

- the site's suitability (see the [Site Selection](#) chapter);
- the species to be produced (caution should be exercised in trialling new species, species with difficult production phases or no species specific commercially available feed);
- production methods;
- feed costs and food conversion ratio (FCR);
- infrastructure requirements (caution should be exercised in respect of expensive technical rearing and husbandry equipment);
- staff – the availability of suitably experienced and skilled staff or advisers and/or access to appropriate training and instruction so that the enterprise can run smoothly;
- management – including the ability of management to make decisions and take actions for the reliable production of product;
- quality controls.

In the production feasibility analysis, slight changes in cost of feed, juveniles, power, labour and health management should be considered to test the sensitivity of the production viability.

## **3.5 Financial feasibility**

A cash flow projection (statement) is required within the business plan to help predict possible cash deficits as well as profitability. It is critical for those enterprises where there will be a single harvest per year while the production and marketing expenses will be spread over the year.

It should also include timing of capital investments and managing of borrowings, particularly if future expansion is proposed in the business plan. A cash flow projection plan should include monthly budgets for preferably 3 years or until the operation is likely to be 'in the black'. In many operations, expenditure occurs in spurts, with higher costs experienced during stocking and harvesting when additional labour may be required. You need to distinguish between:

- **Fixed costs** – those that do not change as production volume changes (eg. full time employee salaries, overheads, insurance and depreciation on ponds/tanks, plant and equipment);
- **Variable costs** – those that change with production levels (eg. costs of juveniles, feed, chemicals, water, electricity and casual labour).

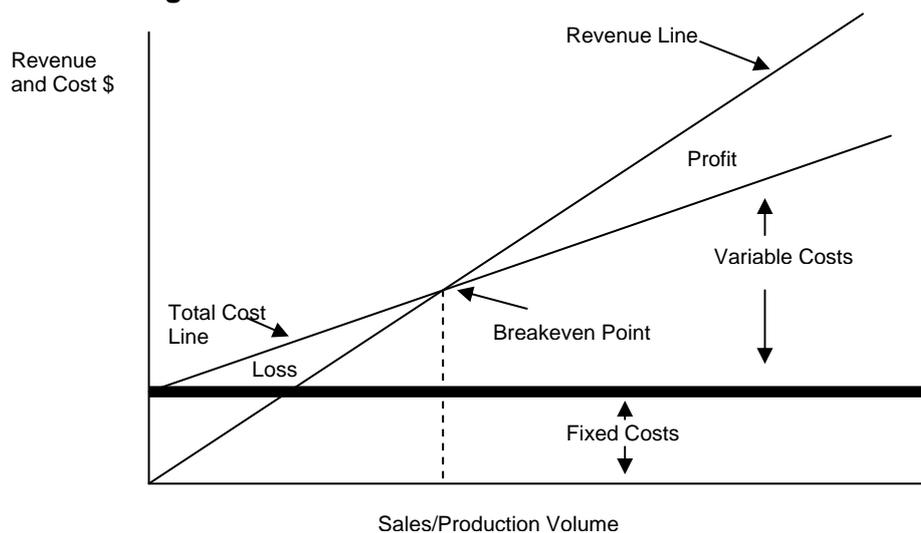
On the revenue side, there can be difficulties in making predictions because of price variability and harvest quantities. Therefore, it is essential that you consider variations in:

- sale price for various products in various markets;
- costs, including feed, water, juveniles, power and transport.

A risk analysis should also consider the short and longer term viability of the business if various scenarios occur. These may include:

- disease outbreaks and subsequent mortalities;
- constraints on water supply because of droughts or regulations;
- major or extreme flood events;
- variable interest rates;
- shortages in the availability of juveniles;
- domestic or overseas market constraints.

**Figure 5. Considering fixed and variable costs.**



### Insurance

A comprehensive business plan greatly assists in acquiring insurances particularly stock insurance. Some policies are compulsory and others are essential to mitigate potential risks to the business. Examples of insurances that should be considered include:

- workers compensation;
- sickness and accident;
- key person;
- product liability;
- public liability;
- loss of profits;
- fire;
- burglary;
- machinery breakdown.

Under insurance as well as lack of insurance could endanger your business and it should be reviewed on a regular basis. Aside from those required by law, a good starting point is to assess the extent to which the business is at risk from potential hazards. You should discuss your

insurance requirements with an insurance broker, insurance company, accountant or legal advisor prior to commencing business.

### 3.6 Planning for continued success

Business planning doesn't stop once a business has been established – a business plan should be a living document. It needs to be checked from time to time (to ensure the marketing, production and financial strategies remain internally consistent and supportive of each other) and whenever there are major events or changes.

It is good practice to have a regular cycle of review, covering issues including:

- **Past performance** – assessing the production yields and cost, quality and any other defined performance variables; and marketing and financial performance measures. It is then possible to compare actual with planned performance and make any necessary adjustments to the strategies;
- **Strengths and weaknesses analysis** – including a comparative analysis of your business's performance (as best you can) compared with other growers. This 'benchmarking' review of your performance against others (quantity as well as quality and costs of production) will give some indication as to how the farm is performing;
- **Opportunities and threats analysis** – you need to be aware of changes in markets and the potential for competition from within the region as well as interstate and overseas. Other changes in value adding, harvest size, transport, technology, cultivation species, species management, interest rates, etc. may offer opportunities as well as threats;
- **Adjusting the plan as necessary** – you may need to make changes to your business plan as threats and/or opportunities arise.

### Avoiding business failure

Aquaculture like any business has potential pitfalls that may hamper the development of a strong business. Some pitfalls include:

- for family operations, the death of the key person (who understood how to operate the farm) or marital/divorce problems or attempting to support too many family members, especially during start up times;
- natural disasters (flood, drought, extreme heat or cold, etc.);
- speculation without proper research of as yet undeveloped technologies;
- poor business plan with unrealistic returns;
- under capitalisation;
- poor production management;
- failure to realise that aquaculture is a farming business and that animals have specific physiological requirements which often requires attention 24/7;
- poor marketing;
- poor monitoring or record keeping of the production, financial and/or marketing aspects;
- appropriate/adequate information not used for decision making;
- lack of 'business' experience or skills;
- not planning for expenses such as professional fees and taxes.
- lack of reliable/experienced workers and managers.

### 3.7 Further information

There are many resources available to assist with preparing a business plan. The Internet is a useful source of information on aquaculture management and business planning in general. The following are some useful web links.

#### **Australian Government Business Entry Point**

[www.business.gov.au](http://www.business.gov.au)

**Industry & Investment NSW**

[www.dpi.nsw.gov.au/fisheries/aquaculture](http://www.dpi.nsw.gov.au/fisheries/aquaculture)  
 NSW Aquaculture Directory  
 NSW Aquaculture Production Reports  
[www.business.nsw.gov.au/](http://www.business.nsw.gov.au/)  
[www.smallbiz.nsw.gov.au/](http://www.smallbiz.nsw.gov.au/)

**Sydney Fish Market**

[www.sydneyfishmarket.com.au](http://www.sydneyfishmarket.com.au)

**NSW Food Authority**

[www.foodauthority.nsw.gov.au](http://www.foodauthority.nsw.gov.au)

**Seafood Services Australia**

[www.seafood.net.au](http://www.seafood.net.au)

**Seafood CRC**

The [Seafood CRC](#)'s mission is to assist end-users of its research to profitably deliver safe, high-quality, nutritious Australian seafood products to premium markets, domestically and overseas.

**National Aquaculture Council**

The National Aquaculture Council (NAC) is the peak body representing the aquaculture industry across Australia. The NAC has established a website called the [Australian Aquaculture Portal](#) which has been developed in an attempt to centralise the growing body of information, research and business opportunities in the Australian aquaculture industry. The [Australian Aquaculture Portal](#) contains a number of useful links to Federal, State and Territory government agencies and aquaculture associations.

**Local Council**

Contact the economic development manager with your local [Council](#) for advice on site selection and planning issues.

**Local tourist authority**

Your local tourist authority may be able to provide advice on the tourism potential of a site, particularly a fishout or public sale outlet and how it may be linked with other regional tourism facilities.

**Local Business Enterprise Centre (BECs)**

BECs are able to assist with business start up and business planning issues.

[www.beca.org.au](http://www.beca.org.au)

**Professional and trade sources**

Equipment suppliers can also be a useful source of information on the latest technology. Professional associations also have helpful general information on planning and operating a successful aquaculture enterprise.

**Universities & TAFEs**

There are a number of Universities and TAFEs that run aquaculture courses in NSW and other states. See the NSW Aquaculture trade directory.

**NSW aquaculture associations**

Industry associations can be a useful source information on the aquaculture industry in Australia. The I&I NSW website contains a [trade directory](#) which provides contact details for aquaculture associations, suppliers of aquaculture products and aquaculturalists.

## 4. Species Selection

### 4.1 Introduction

Aquaculture businesses and the species they culture are not restricted to the production of protein for human consumption. They can include production for conservation or recreational stockings, aquarium trade, production of pharmaceuticals or specialist health products, jewellery and feeds for other cultured/farmed organisms.

The decision to culture a specific species is determined by many factors, including:

- Is the species permitted for your intended aquaculture production method and location?
- Is there a ready supply of juvenile stock from hatcheries or will you need to breed the species yourself?
- Market analysis (eg. acceptability of product at a price that ensures a viable business);
- The biological feasibility of culturing the species (degree of control over the life cycle, spawning, egg incubation, larval and juvenile rearing or availability, growout and feed conversion, sensitivity to crowding, disease and handling); feed sources, availability and suitability to meet the physiological requirements of the species;
- Do you go for one or more species? (and if more than one, which species are most compatible);
- Site specific attributes (eg. size required to be profitable, degree of flood liability and associated development limits or controls, climate, water quality and quantity) – see [Site Selection](#) chapter;
- Management issues, including disease management – see [Operating the Farm](#) chapter.

Generally a species that is already successfully cultured is selected however, this should not deter investigating a new species provided careful planning is undertaken including:

- Preliminary screening – collection of information of the ecology/biology of the species and any legal constraints (see 4.2 below) and some investigation of market assessment;
- Pilot study – focusing on the general physiological/environmental requirements of the species; reproduction, growth, nutrition, survival, growout trials and the economic feasibility;
- Commercial trial – construction of full size culture units, spawning runs, information on costs/profits and handling of large volumes;
- Full production – increase in number of culture units and hatchery output, suitable site has been selected and capital organised, further market development.

### 4.2 Translocation policy and species selection

Translocation is the introduction of animals or plants to an area to which they are not endemic and includes genetically distinct populations of endemic species. Industry & Investment NSW aims to protect indigenous (native) species from non-indigenous species and this may limit your choice of species or how you farm.

All proposals for land based aquaculture must be assessed according to the National Translocation Policy Guidelines. The guidelines set out a risk assessment process for considering translocation issues.

Translocation of non-indigenous species can be approved in some catchments (eg. trout stocking for recreational fishing). However, some freshwater species that are capable of breeding in certain NSW regions that are not endemic have been assessed as high risk and have been determined as high security species. There are stricter requirements in terms of site selection, design and operational parameters for high security species. (See [Site Selection](#), [Planning and Design](#) and [Operating the Farm](#) Chapters).

Translocation issues may vary as new knowledge on a species is obtained or as new species enter culture. Therefore, it is imperative that when you consider a species to be cultured, you consult with [I&I NSW](#) to ascertain if it has any specific translocation issues.

Table 2 summarises the key translocation principles that apply to aquaculture in NSW.

**Table 2. Key Translocation Principles for Aquaculture in NSW.**

|  |
|--|
| <ol style="list-style-type: none"> <li>1. Non-endemic marine species to NSW cannot be translocated into estuarine or marine semi closed or open systems.</li> <li>2. Non-endemic species to NSW may be required to meet prescribed health testing protocols for stock to be translocated from interstate.</li> <li>3. Non-endemic species to NSW with high security status are generally permitted only in tank aquaculture. Stock imported from outside of NSW must be certified disease free in accordance with any current I&amp;I NSW disease testing protocols which may also cover discharge water treatment and disposal.</li> <li>4. Non-endemic species to a region with a high security status are only permitted if site selection, design and operational components meet the relevant AIDP performance criteria.</li> <li>5. Other non-endemic species to a region such as Silver, Golden perch and Yabbies are permitted in freshwater pond aquaculture that meet the relevant AIDP performance criteria.</li> </ol> |
|--|

I&I NSW has evaluated the risk of culturing a number of species in Table 3. Any new species proposed for culture will require to undergo an evaluation of its associated risks. Under this risk management approach a species may be prohibited for culture if any associated risks can not be adequately addressed.

Table 3 summarises, species by species, the translocation issues, culture methods and specific constraints – it must be read in conjunction with Table 2 to determine possible species for cultivation in NSW. I&I NSW may consider variation of permissible culture methods providing an appropriate risk management strategy is developed.

**Table 3. Species culture methods and constraints.**

| Species  | Disease/<br>Pathogen<br>security status  | Risk of survival<br>&<br>establishment<br>following<br>escape | Permissible culture methods <sup>1</sup> |  |  |                              | Specific operational and site constraints |
|--|--|---|--|--|--|------------------------------|---|
|  |  |   | Tank                                     | Ponds below the PMF level in the eastern drainage or below the 1:100 ARI flood level in the western drainage. <sup>2</sup> | Ponds above the PMF level in the eastern drainage or above 1:100 ARI flood level in the western drainage. <sup>2</sup> | Open system (Flow – through) |   |
| Any hybrid fish, any species not listed in this table or a variation of culture method listed in this table. | Assessment must be done on a case by case basis according to the National Policy on the Translocation of Live Aquatic Organisms. |   |  |  |  |                              |   |

<sup>1</sup> For any **culture methods** not listed in this table an assessment must be done on a case by case basis according to the National Policy on the translocation of live aquatic organisms.

<sup>2</sup> Highest historical flood level may be considered where 1:100 ARI flood event is not readily available in the western drainage.

| Species   | Disease/<br>Pathogen<br>security status              | Risk of survival<br>&<br>establishment<br>following<br>escape                           | Permissible culture<br>methods <sup>1</sup> |   |  |                                       | Specific<br>operational and<br>site constraints       |
|---|--|---|---|---|--|---------------------------------------|---|
|   |  |   | Tank  | Ponds<br>below the<br>PMF level<br>in the<br>eastern<br>drainage<br>or below<br>the 1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Ponds<br>above<br>the PMF<br>level in<br>the<br>eastern<br>drainage<br>or above<br>1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Open<br>system<br>(Flow –<br>through) |   |
| <b>Freshwater aquarium species</b>  |  |   |   |   |  |                                       |   |
| Exotic freshwater<br>aquarium species listed<br>on Schedule 6 of the<br>EPBC Act. | High   | High  | Yes   | No  | Yes  | No                                    |   |
| Flat – headed gudgeon<br>( <i>Philypnodon grandiceps</i> )                        | Natives:Low within<br>endemic area – high<br>outside | Natives:Low within<br>endemic area – high<br>outside/<br>domesticated<br>natives: High  | Yes   | Yes   | Yes  | No                                    |   |
| Climbing galaxias<br>( <i>Galaxias brevipinnis</i> )                              | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Common jollytail<br>( <i>Galaxias maculatus</i> )                                 | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Eastern dwarf galaxias<br>( <i>Gallaxiella pusilla</i> )                          | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Empire gudgeon<br>( <i>Hypseleotris compressa</i> )                               | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Firetail gudgeon<br>( <i>Hypseleotris galii</i> )                                 | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Goldfish<br>( <i>Carassius auratus</i> )  | High   | High  | Yes   | No  | Yes  | No                                    | Prohibited in<br>catchments free of<br>Carp/Goldfish. |
| Koi carp<br>( <i>Cyprinus carpio</i> )  | High   | High  | Yes   | No  | Yes  | No                                    | Prohibited in<br>catchments free of<br>Carp           |
| Cox’s gudgeon<br>( <i>Gobiomorphus coxii</i> )                                    | Natives:Low within<br>endemic area – high<br>outside | Natives: Low within<br>endemic area – high<br>outside/<br>domesticated<br>natives: High | Yes   | Yes   | Yes  | No                                    |   |
| Purple spotted gudgeon<br>( <i>Mogurnda adspersa</i> )                            | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Murray cray<br>( <i>Euastacus armatus</i> )                                       | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Pacific blue eye<br>( <i>Pseudomugil signifer</i> )                               | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Rainbow fish<br>( <i>Melanotaenia sp.</i> )                                       | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Striped gudgeon<br>( <i>Gobiomorphus australis</i> )                              | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Sydney crayfish<br>( <i>Euastacus spinifer</i> )                                  | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Western carp gudgeon<br>( <i>Hypseleotris klunzingeri</i> )                       | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Bullrout<br>( <i>Notesthes robusta</i> )  | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| Floodplain mussel<br>( <i>Velesunio ambiguus</i> )                                | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| River blackfish<br>( <i>Gadopsis marmoratus</i> )                                 | As above   | As above  | Yes   | Yes   | Yes  | No                                    |   |
| <b>Marine aquarium species</b>  |  |   |   |   |  |                                       |   |
| Barramundi cod<br>( <i>Cromileptes altivelis</i> )                                | High   | Low   | Yes   | No  | No   | No                                    |   |

| Species                                   | Disease/<br>Pathogen<br>security status | Risk of survival<br>&<br>establishment<br>following<br>escape | Permissible culture<br>methods <sup>1</sup> |   |  |                                       | Specific<br>operational and<br>site constraints   |
|---|---|---|---|---|--|---------------------------------------|---|
|   |   |   | Tank  | Ponds<br>below the<br>PMF level<br>in the<br>eastern<br>drainage<br>or below<br>the 1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Ponds<br>above<br>the PMF<br>level in<br>the<br>eastern<br>drainage<br>or above<br>1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Open<br>system<br>(Flow –<br>through) |   |
| Seahorse<br>(Hippocampus kuda)            | Low in east high in<br>West             | As above  | Yes   | No  | No   | No                                    |   |
| Seahorse<br>(Hippocampus procerus)        | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Seahorse<br>(Hippocampus<br>trimaculatus) | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Seahorse<br>(Hippocampus tristis)         | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Seahorse<br>(Hippocampus whitei)          | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Wrasse<br>(Labroides bicolor)             | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Wrasse<br>(Labroides dimidiatus)          | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| Wrasse<br>(Labroides pectoralus)          | As above                                | As above  | Yes   | No  | No   | No                                    |   |
| <b>Species non endemic to NSW</b>         |   |   |   |   |  |                                       |   |
| Atlantic salmon<br>(Salmo salar)          | High                                    | Low within present<br>distribution or High<br>elsewhere       | Yes   | Yes   | Yes  | Yes                                   |   |
| Brook trout<br>(Salvelinus fontinalis)    | High                                    | As above  | Yes   | Yes   | Yes  | Yes                                   |   |
| Brown trout<br>(Salmo trutta)             | High                                    | As above  | Yes   | Yes   | Yes  | Yes                                   |   |
| Carp<br>(Cyprinus carpio)                 | High eastern / Low<br>western           | High  | Yes   | Yes   | Yes  | No                                    | Prohibited in<br>catchments free of<br>Carp   |
| Rainbow trout<br>(Oncorhynchus mykiss)    | High                                    | Low within present<br>distribution or High<br>elsewhere       | Yes   | Yes   | Yes  | Yes                                   |   |
| Redfin<br>(Perca fluviatilis)             | High                                    | High  | Yes   | Yes   | Yes  | No                                    | Prohibited in<br>catchments free of<br>Redfin   |
| Barramundi<br>(Lates calcarifer)          | High                                    | Low   | Yes   | No  | No   | No                                    | Farms are to be<br>above the PMF in the<br>eastern drainage or<br>above 1:100 ARI flood<br>event level in western<br>drainage or above<br>level of highest<br>historic flood level. No<br>discharge of any<br>waters to natural<br>water bodies<br>permitted. |
| Marron<br>(Cherax tenuimanus)             | High                                    | High  | Yes   | No  | Yes  | No                                    | Special fencing may<br>be required  |
| Redclaw<br>(Cherax quadricarinatus)       | High                                    | High  | Yes   | No  | Yes  | No                                    | Special fencing may<br>be required  |
| Sleepy cod<br>(Oxyeleotris lineolatus)    | High                                    | High  | Yes   | No  | No   | No                                    |   |
| Brine shrimp<br>(Artemia sp.)             | High                                    | High  | Yes   | Yes   | Yes  | No                                    |   |

## NSW Land Based Sustainable Aquaculture Strategy

| Species   | Disease/<br>Pathogen<br>security status                     | Risk of survival<br>&<br>establishment<br>following<br>escape                                  | Permissible culture<br>methods <sup>1</sup> |   |  |                                       | Specific<br>operational and<br>site constraints                             |
|---|---|--|---|---|--|---------------------------------------|---|
|   |   |  | Tank  | Ponds<br>below the<br>PMF level<br>in the<br>eastern<br>drainage<br>or below<br>the 1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sub>2</sub> | Ponds<br>above<br>the PMF<br>level in<br>the<br>eastern<br>drainage<br>or above<br>1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sub>2</sub> | Open<br>system<br>(Flow –<br>through) |   |
| <b>Freshwater species</b>                                   |   |  |   |   |  |                                       |   |
| Australian bass<br>(Macquaria<br>novemaculeata)             | High in Western<br>drainage Low in<br>Eastern Drainage      | High in Western<br>drainage Low in<br>Eastern Drainage   | Yes   | Yes   | Yes  | No                                    | Eastern drainage sites  |
| Eel tailed catfish –<br>eastern form<br>(Tandanus tandanus) | High in Western<br>drainage Low in<br>Eastern Drainage      | High   | Yes   | Yes   | Yes  | no                                    | Stock to be sourced<br>from approved genetic<br>broodfish                   |
| Eel tailed catfish –<br>western form<br>(Tandanus tandanus) | High in Eastern<br>drainage Low in<br>Western Drainage      | High   | Yes   | Yes   | Yes  | No                                    | Stock to be sourced<br>from approved genetic<br>broodfish                   |
| Eel-long finned<br>(Anguilla reinhardtii)                   | High in Western<br>drainage Low in<br>Eastern Drainage      | High in Western<br>drainage Low in<br>Eastern Drainage   | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required of ponds.                                |
| Eel-short finned<br>(Anguilla australis)                    | High in Western<br>drainage Low in<br>Eastern Drainage      | High in Western<br>drainage Low in<br>Eastern Drainage   | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required of ponds.                                |
| Freshwater mullet<br>(Myxus petardi)                        | High in Western<br>drainage Low in<br>Eastern Drainage      | High in Western<br>drainage & South of<br>Shoalhaven - Low in<br>remaining Eastern<br>Drainage | Yes   | Yes   | Yes  | No                                    |   |
| Cusped crayfish<br>(Cherax cuspidatus)                      | High outside natural<br>range / low within<br>natural range | Low North Coast /<br>High otherwise  | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required outside<br>natural range                 |
| Rotund crayfish<br>(Cherax rotundus)                        | High outside natural<br>range / low within<br>natural range | High outside natural<br>range / low within<br>natural range                                    | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required outside<br>natural range                 |
| Strong crayfish<br>(Euastacus valentulus)                   | High outside natural<br>range / low within<br>natural range | High outside natural<br>range / low within<br>natural range                                    | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required outside<br>natural range                 |
| Freshwater prawn<br>(Macrobrachium sp.)                     | High outside natural<br>range / low within<br>natural range | High   | Yes   | Yes   | Yes  | Yes                                   | Broodstock must be<br>sourced from local<br>catchment                       |
| Freshwater shrimp<br>(Atyidae sp.)                          | High outside natural<br>range / low within<br>natural range | High   | Yes   | Yes   | Yes  | Yes                                   | Broodstock must be<br>sourced from local<br>catchment                       |
| Mussels (freshwater)<br>(Vesunio entate e)                  | High outside natural<br>range / low within<br>natural range | High outside natural<br>range / low within<br>natural range                                    | Yes   | Yes   | Yes  | Yes                                   | Broodstock must be<br>sourced from local<br>catchment                       |
| Barcoo grunter<br>(Scortum barcoo)                          | High  | High   | Yes   | No  | No   | No                                    |   |
| Bony bream<br>(Nematalosa erebi)                            | High in Eastern<br>drainage Low in<br>Western Drainage      | High in Eastern<br>drainage Low in<br>Western Drainage   | Yes   | Yes   | Yes  | No                                    |   |
| Golden perch<br>(Macquaria ambigua)                         | High in Eastern<br>drainage Low in<br>Western Drainage      | high (high genetic<br>variation)   | Yes   | Yes   | Yes  | No                                    |   |
| Murray cod<br>(Maccullochella peelii)                       | High in Eastern<br>drainage Low in<br>Western Drainage      | High in Eastern<br>drainage Low in<br>Western Drainage   | Yes   | No in<br>Eastern<br>Drainage  | Yes  | No                                    | Prohibited in ponds<br>within Richmond and<br>Clarence River<br>catchments. |
| Silver perch<br>(Bidyanus bidyanus)                         | High in Eastern<br>drainage Low in<br>Western Drainage      | High in Eastern<br>drainage Low in<br>Western Drainage   | Yes   | Yes   | Yes  | No                                    |   |

| Species  | Disease/<br>Pathogen<br>security status                | Risk of survival<br>&<br>establishment<br>following<br>escape | Permissible culture<br>methods <sup>1</sup> |   |  |                                       | Specific<br>operational and<br>site constraints |
|--|--|---|---|---|--|---------------------------------------|---|
|  |  |   | Tank  | Ponds<br>below the<br>PMF level<br>in the<br>eastern<br>drainage<br>or below<br>the 1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Ponds<br>above<br>the PMF<br>level in<br>the<br>eastern<br>drainage<br>or above<br>1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Open<br>system<br>(Flow –<br>through) |   |
| Spangled perch<br>(Leiopotherapon unicolor)    | High in Eastern<br>drainage Low in<br>Western Drainage | High in Eastern<br>drainage Low in<br>Western Drainage        | Yes   | Yes   | Yes  | No                                    |   |
| Welchs grunter<br>(Bidyanus welchi)            | High   | High  | Yes   | No  | No   | No                                    |   |
| Yabby<br>(Cherax destructor)                   | High in Eastern<br>drainage Low in<br>Western Drainage | High in Eastern<br>drainage Low in<br>Western Drainage        | Yes   | Yes   | Yes  | No                                    | Special fencing may<br>be required in East      |
| <b>Marine / estuary species</b>                |  |   |   |   |  |                                       |   |
| Balmain bugs<br>(Ibacus peronii)               | High in Western<br>drainage Low in<br>Eastern Drainage | low   | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Banana prawn<br>(Fenneropenaeus<br>merguensis) | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Banded coral shrimp<br>(Stenopus hispidus)     | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Beachworm<br>(Australonuphis<br>parateres)     | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Beachworm<br>(Australonuphis teres)            | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Beachworm<br>(Hirsutonuphis<br>mariahirsuta)   | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Black tiger prawn<br>(Penaeus monodon)         | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Blacklip abalone<br>(Haliotis rubra)           | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Bloodworms<br>(Marphysa sanguinea)             | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Blue mussel<br>(Mytilus gallo provincialis)    | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Brown tiger prawn<br>(Penaeus esculentus)      | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Cobia<br>(Rachycetron canadum)                 | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Coral trout<br>(Plectropomus leopardus)        | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Dusky flathead<br>(Platycephalus fuscus)       | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Eastern king prawn<br>(Melicertus plebejus)    | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Eastern lobster<br>(Jasus verreauxi)           | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Estuarine clam<br>(Katelaysia rhytiphora)      | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Estuarine clam<br>(Tapes dorsatus)             | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Estuary cod<br>(Epinephelus coioides)          | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Estuary perch<br>(Macquaria colonorum)         | As Above   | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage              |
| Fingermark bream<br>(Lutjanus johni)           | As Above   | As Above  | Yes   | No  | No   | No                                    | Open system in<br>eastern drainage              |

## NSW Land Based Sustainable Aquaculture Strategy

| Species   | Disease/<br>Pathogen<br>security status | Risk of survival<br>&<br>establishment<br>following<br>escape | Permissible culture<br>methods <sup>1</sup> |   |  |                                       | Specific<br>operational and<br>site constraints              |
|---|---|---|---|---|--|---------------------------------------|--|
|   |   |   | Tank  | Ponds<br>below the<br>PMF level<br>in the<br>eastern<br>drainage<br>or below<br>the 1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Ponds<br>above<br>the PMF<br>level in<br>the<br>eastern<br>drainage<br>or above<br>1:100<br>ARI flood<br>level in<br>the<br>western<br>drainage.<br><sup>2</sup> | Open<br>system<br>(Flow –<br>through) |  |
| Flat (mud) oysters<br>( <i>Ostrea angasi</i> )            | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Flowery cod<br>( <i>Epinephelus<br/>fuscoguttatus</i> )   | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Greasyback prawn<br>( <i>Metapenaeus bennettiae</i> )     | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Greenback flounder<br>( <i>Rhombosolea tapirina</i> )     | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Kingfish<br>( <i>Seriola lalandi</i> )                    | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Kuruma prawn<br>( <i>Marsupenaeus<br/>japonicus</i> )     | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Mahi mahi<br>( <i>Coryphaena hippurus</i> )               | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Mangrove Jack<br>( <i>Lutjanus<br/>argentimaculatus</i> ) | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Mud crab<br>( <i>Scylla serrata</i> )                     | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Mullet<br>( <i>Mugil cephalus</i> )                       | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Mulloway<br>( <i>Argyrosomus japonicus</i> )              | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Offshore greasyback<br>prawn<br>( <i>M. ensis</i> )       | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Pacific oysters<br>( <i>Crassostrea gigas</i> )           | As Above                                | As Above  | Yes   | Yes   | Yes  | No                                    | Noxious species in all<br>estuaries except Port<br>Stephens. |
| Queensland groper<br>( <i>Epinephelus lanceolatus</i> )   | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Red emperor<br>( <i>Lutjanus sebae</i> )                  | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Sand whiting<br>( <i>Sillago ciliata</i> )                | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| School prawn<br>( <i>Metapenaeus macleayi</i> )           | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Silver bream<br>( <i>Acanthopagrus australis</i> )        | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Silver trevally<br>( <i>Pseudocaranx dentex</i> )         | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Snapper<br>( <i>Pagrus auratus</i> )                      | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Southern bream<br>( <i>Acanthopagrus butcheri</i> )       | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Sydney rock oysters<br>( <i>Saccostrea glomerata</i> )    | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Tubeworms<br>( <i>Diopatra aciculata</i> )                | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Tubeworms<br>( <i>Diopatra dentata</i> )                  | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |
| Yellow eye mullet<br>( <i>Aldrichetta forsteri</i> )      | As Above                                | As Above  | Yes   | Yes   | Yes  | Yes                                   | Open system in<br>eastern drainage                           |

It should be noted that silver perch are not permitted in extensive aquaculture and eels are not permitted under a Class E aquaculture permit.

### 4.3 A single species or polyculture

Monoculture, or the culture of a single species at any given time, is the most common form of aquaculture in NSW. 'Polyculture' is the growing of more than one species together in the same culture facility which can help maximise productivity. Polyculture can provide for greater economical use of water, feed and energy.

The integration of aquaculture with an agricultural use (eg. hydroponics, rice, trees) can be a valuable sideline to an aquaculture business. It can greatly increase the economical use of water and energy.

### 4.4 Temperature

Water temperature is one of the most critical environmental factors affecting the growth and health of aquatic species. Each species has a preferred water temperature at which biological functions, including growth, are optimal.

Table 4 summarises the optimal growing temperatures for several species. It is important to consider climate (temperatures) when selecting a site for species grown outdoors as minimum and/or maximum temperatures may be lethal (See [Site Selection](#) chapter).

**Table 4. Temperature range for breeding and growout.**

| Species             | Ideal temperature |                    |
|---------------------|-------------------|--------------------|
|                     | Hatcheries        | Growout facilities |
| Prawn – Black tiger | 28 – 32°C         | 25 – 32°C          |
| Prawns – Kuruma     | 25 – 30°C         | 20 – 28°C          |
| Prawns – School     | -                 | 21 – 27°C          |
| Crustacea – Redclaw | 27 – 30°C         | 27 – 32°C          |
| Crustacea – Yabbies | 15 – 20°C         | 23 – 25°C          |
| Barramundi          | 27 – 30°C         | 26 – 30°C          |
| Eels                | -                 | 23 – 28°C          |
| Kingfish            | 21 – 24°C         | 15 – 25°C          |
| Mahi-Mahi           | 25 – 30°C         | 25 – 30°C          |
| Mulloway            | 21 – 26°C         | 14 – 30°C          |
| Murray Cod          | 19 – 21°C         | 23 – 26°C          |
| Silver Perch        | 20 – 25°C         | 23 – 28°C          |
| Snapper             | 21 – 24°C         | 17 – 30°C          |
| Trout Brown         | *6 – 10°C         | 4 – 19°C           |
| Trout Rainbow       | *9 – 14°C         | 10 – 22°C          |

*\*for spawning and egg production*

### 4.5 Feed

Intensive and semi-intensive aquaculture generally requires a high degree of management, high stocking levels and the feeding of formulated diets. Higher production rates can be achieved when using formulated feeds specific to the selected species. However, not all species readily accept pellets (eg. Australian bass and golden perch) and some species are difficult to wean during early hatchery stages. Consequently, there has been limited progress in the culture of some of these species.

Dietary requirements vary significantly between species and need a good balance of protein, energy, minerals and vitamins to meet the physiological requirements of the selected species.

Often due to the lack of specific dietary research, feeds targeting other species are utilised. However, there is some danger in taking this approach often resulting in poor growth, fatty animals or poor resistance to disease and husbandry issues.

Feed costs often constitute 40 to 55% of total production costs, therefore it is essential to use species that convert food efficiently and use efficient feeding practices. Species that have high meat to total body weight ratio are desirable because of their more efficient conversion of feed into edible flesh.

If you plan to market your product for human consumption, you need to obtain a vendor declaration or written statement from the feed manufacturer stating that the feed is suitable for feeding to food producing animals.

### 4.6 Hatchery and Seed stock

#### ***A caution***

Aquaculture ventures incorporating a hatchery wishing to produce fingerlings for stocking NSW waters will need to be accredited under the NSW Hatchery Quality Assurance Scheme.

A critical issue for any aquaculture venture is the reliable availability of seed stock (juveniles). Some aquaculture growout ventures incorporate juvenile production into their business whereas others are reliant on sourcing stock from other farms and hatcheries. Generally, hatcheries require specialised infrastructure and technical expertise beyond that required for growout operations. However, having control over hatchery operations offers clear advantages to the growout farm including selection and reliability of stock. Some species are only available once per year whereas others may be more frequently available due to manipulative breeding techniques within the hatchery. It is important that a new ventures carefully research the availability of seedstock to make sure the hatchery is capable of producing the quantities of seedstock to satisfy the farm's projected production plan.

Some important aspects a hatchery needs to consider when managing broodstock and seed stock are:

- maintenance of genetic diversity and avoidance of inbreeding;
- production of disease-free stock;
- seed stock are not contaminated with other species;
- maintaining a bio-secure site.

Broodstock can be collected from the wild in NSW under the authority of a I&I NSW permit, grown and maintained in a hatchery or purchased from a commercial supplier. Ventures wishing to undertake hatchery operations should be familiar with the NSW Hatchery Quality Assurance Scheme ([HQAS](#)) and the rules and regulations relating to broodstock collection and species.

## 5. Site Selection

### 5.1 Introduction

Selection of an appropriate aquaculture site is paramount to the success of the venture. Appropriate site selection can avoid the need for environmental mitigation measures and costly ongoing management, operational and monitoring procedures. Whether the land is already owned or the property is to be purchased, the following should be considered:

1. **Aquaculture must be a permissible land use and compatible with nearby land uses.** The site must not be affected by near-by agricultural pesticide use or be constrained by potential adverse affects on adjacent residents.
2. **Site specific investigations should indicate that the site is fundamentally suitable for an aquaculture operation.** Consider the supply of water (quality & quantity); soils suitable for pond construction; a climate suitable for the culture species; enough land to manage waste water or means of disposal via municipal infrastructure; proximity to power; suitable land slope for construction, minimisation of pumping costs and managing waste; proximity to markets, service providers, supplies and manpower (all can impact adversely on operational costs).

A site-specific investigation and evaluation, commensurate with the size and complexity of the proposal is required. The evaluation will consider all relevant legislation, plans and government policies (eg. in relation to river and estuary flows regimes, water allocation, floodplain management, vegetation management, zoning, heritage strategies, potential land use conflicts, acid sulfate soils, biodiversity protection, etc). In general, the selection of a site should be based on a thorough knowledge of local and regional hydrology, geology, topography, ecology and climate. Although environmental factors are critical when assessing sites other factors such as land and construction costs need to also be considered.

The project profile analysis chapter of this document provides a systematic and rigorous ‘sieve’ approach to site selection. Government agencies will use this approach when formally assessing a proposed aquaculture venture.

Firstly assessing a project or location against the project profile analysis model will help determine whether your proposal meets minimum mandatory performance criteria. If it does, then the process, in conjunction with the information in this strategy, will help assess how the proposal will be classified from low risk to higher risk.

**Information in this strategy provides detail to be considered when undertaking a project profile analysis.**

### 5.2 Estuarine aquaculture sites

Assessment of estuarine aquaculture sites should refer to the [NSW Government's sea level rise planning benchmarks](#), relevant coastal zone management plans and address issues related to inundation, water quality, drainage and acid sulfate soils (ASS) which could impact on the long-term viability of aquaculture on the sites.

To provide assistance in identifying potential sites for saline pond aquaculture within estuarine areas of NSW, maps have been prepared for 12 northern NSW estuaries (see appendix 1). These areas are:

1. Tweed River Estuary
2. Brunswick River Estuary
3. Richmond River Estuary
4. Clarence River Estuary
5. Bellingen and Kalang River Estuaries

6. Nambucca River Estuary
7. Macleay River Estuary
8. Hasting River Estuary
9. Camden Haven River Estuary
10. Manning. River Estuary
11. Port Stephens including Myall and Karauh rivers.
12. Hunter including Hunter, Patterson and Williams Rivers.

These maps have been developed using GIS information and identify potential locations based on attributes including:

- elevation above Australian Height Datum;
- spatial salinity for the estuary and bathometry assessment;
- acid sulfate soil profile;
- land use zoning;
- conservation exclusion zones.

Although maps have only been prepared for the above estuarine areas, saline pond aquaculture is potentially suitable within other NSW estuaries provided the site meets the minimum locational performance criteria.

It should be noted that the 12 estuarine aquaculture maps were compiled based on data available at the time of production and only represent areas that may have potential for aquaculture. Detailed site assessment as outlined in this chapter is still required and current LEP and other mapping information may need further investigation.

Because of the extent of locational possibilities for freshwater tank, raceways and ponds, a detailed mapping approach to identify potential freshwater aquaculture sites has not been undertaken.

## 5.3 Water considerations

### Overview

The following is an overview of the issues that need to be considered when determining whether a proposed site would have a reliable water supply of the necessary quality and quantity for the success of an aquaculture business. **This is not an exhaustive list but a guide only.**

Water budgets for any aquaculture venture must be carefully considered. Water budgets should be calculated based on volumes required to fill tanks, pipes, ponds and storages, seepage, evaporation and operational procedures.

### Water supply quantity

#### **PREFERRED LOCATION**

**A site with abundant, permanent and affordable supply of good quality water with no access restrictions.**

An abundant, all-seasons supply of good quality water is essential for land based aquaculture. The quantity of water required will be dependant on the size of the farm, type of farm infrastructure (pond or tank), water budget of the site (rainfall and evaporation), discharge classification (closed, semi closed or open systems) and species requirements. Water sources may include estuaries, rivers, ocean or bay, irrigation channels, bores, saline interception schemes, municipal supplies and over land catchment. All waters should be tested for compatibility with the selected species early in the planning process. Pumping costs can be high and should be minimised with options for gravity flow, low head or relatively short suction and delivery lines. These issues must be considered when evaluating a site and assessing layout options.

Potential impacts of climate change need to be factored into any water quantity and Quality investigations. The NSW Office of Water ([NOW](#)) may assist early in the planning process to ascertain [water management](#) issues affecting water availability including water harvesting or extraction from a water source. Local government approval may also be required for the construction of any water storages.

### NSW Water Quality Objectives

Water quality must be of a standard that satisfies all the physiological requirements of the targeted species. Guidelines exist for acceptable parameters for some species. Sub-optimal or poor water quality can increase the running costs of operations significantly through poor growth, disease, loss of stock, equipment deterioration and expenditure on remediation.

The NSW Government is committed to ensuring the long-term health of NSW waterways, with improved water quality and flow regimes its prime objectives. The intent is to achieve a better balance in the sharing of water between users and the environment, and reduce the stress on rivers and aquifer systems.

For each of the State's catchments, the State government has endorsed the community's environmental values for water known as 'Water Quality Objectives' (WQOs). Booklets outlining the WQOs for catchments are available by telephoning the Pollution Line on 131 555 or you can access the documents on the DECCW website at [www.environment.nsw.gov.au/publications/epa/](http://www.environment.nsw.gov.au/publications/epa/).

The NSW WQOs are consistent with the agreed national framework for assessing water quality set out in the [ANZECC 2000 Guidelines](#). These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values. The WQOs provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values.

Water quality and flow objectives are required for the protection of aquatic ecosystems; visual amenity; recreation, aquatic food, commercial shellfish production; maintaining wetland and floodplain inundation; managing groundwater for ecosystems; minimising the effects of weirs and other structures; maintaining or rehabilitating estuarine processes and habitats; and maintain natural flow variability. Particular water quality issues include:

- Nutrients and other contaminants in stormwater and sewage outflows and the release of highly acidic waters from ASS areas into estuaries;
- Dredging and drainage works within the flood planning area that could disturb ASS.

The NSW Shellfish Program administered by the [NSW Food Authority](#) regularly monitors estuarine water quality to support commercial shellfish production.

### Water supply quality for aquaculture

#### PREFERRED LOCATION

A site having consistent high water quality and unlikely to adversely affect water quality for other users.

Access to reliable potable (drinking) water or mains water for processing, pre-market conditioning and employee uses.

Avoid sites downstream of land uses that are likely to adversely affect water quality (eg. downstream of sewage treatment works discharge, town storm-water overflows, industrial centres, proximity to agricultural chemical uses or recreational boating including marinas).

In evaluating the suitability of the quality of a water supply, factors that need to be considered include:

- the water is free of organic, agricultural or industrial pollution (pesticides, heavy metals);
- the water is free of suspended particles (check particulates - composition (organic and inorganic), size, concentration, likely seasonal variation);
- the waters physical and chemical properties (pH, salinity and tidal amplitudes, temperature, dissolved oxygen, ammonia, nitrite and nitrates, alkalinity and hardness, hydrogen sulphides, chlorine, turbidity, carbon dioxide, etc);
- the water is free of pathogens, trash fish and other undesirable aquatic organisms.

It is desirable that the source of water for aquaculture meets the relevant criteria set down in the [ANZECC Water Quality Guidelines](#) including protection of aquatic ecosystems and aquaculture and human consumption of aquatic foods. The guidelines suggest levels of physio-chemical parameters that would be required to maintain a viable natural aquatic community and provide guidance relating to levels of organic contaminants that may cause tainting of the products.

If the water supply does not meet the criteria set out in the [ANZECC Guidelines](#), you need to assess the potential effect this would have on the selected species at all stages of the life cycle (eg. an animal may tolerate waters having a pH of 6.0, however, eggs and larvae may not survive).

In some waterways, the water quality may meet the criteria for protection of the aquatic communities, but not meet the guidelines for human health or food safety requirements. See [ANZECC Guidelines](#) and consult [NSW Food Authority](#).

### Water licensing

A [water licence](#) or activity approval is required to install a pump, construct a levee, divert the river flow, undertake works within 40 metres of a river, install a bore or piezometer or to harvest more than 10% of catchment overland flows across a site.

### Measuring water extraction

Under the water licence provisions for water extraction, [NOW](#) may, as conditions of licences or approvals, require the quantity of water to be recorded and reported, annually or more regularly, if required using approved measuring equipment. Information required will include hours pumped, monthly extraction rate and use of water. NOW may limit the extraction from a river from time to time to ensure adequate flows remain for other water users and the environment.

### Estuarine or marine water supply

#### Tidal exchange

Ideally you need a satisfactory estuarine water supply on a site adjacent to waterways. The estuarine aquaculture maps (see Appendix 1) identify sites that potentially have water quality satisfactory for an estuarine water supply source.

Detailed investigations will be required to determine if there is good tidal exchange and circulation, and if the water quality is able to consistently recover quickly following rain events.

Avoid sites with significant freshwater ingress and variable salinity, high suspended solids, low pH (acid sulfate), high organic loading and other poor water quality characteristics.

#### Tidal amplitude

##### **PREFERRED LOCATION**

A site adjoining an estuary with a tidal amplitude of greater than 600 millimetres.

Ideally you need water intake sites in an area of good water ventilation. An indirect measure of ventilation is tidal amplitude. Tidal amplitude is defined as:

MHWN - MLWN where MWHN = Mean High Water Neap, and MLWN = Mean Low Water Neap.

Generally, tidal amplitude will diminish further up river systems and where restriction to tidal movement occurs such as narrow and/or shallow channels and sand bars. Tidal gauge data is available from the [Manly Hydraulic Laboratories](#) in Sydney. You may need the assistance of a coastal engineer to calculate tidal amplitude where there are no tidal gauges.

Avoid areas that may be adversely and significantly impacted by adjoining floodgates and land runoff.

### Access

#### PREFERRED LOCATION

A site where no deepening is required of the estuary for a pumping station, or existing infrastructure exists to carry inlet and outlet pipes for estuarine or marine waters.

Carefully consider if potential inlet sites will require a change to the estuary channel (eg. require a sump or deepening or other disturbance of the bed of the estuary). If mangroves, seagrass or foreshore vegetation is likely to be disturbed, a permit may also be required under the [Fisheries Management Act 1994](#).

Where it is proposed to undertake work (excavation, fill or anything that could affect the flow or quantity of water) in, on or within 40 metres of an estuary, a controlled activity approval will be required pursuant to the [Water Management Act 2000](#).

Establishment of pipelines across ocean beaches to access marine waters requires detailed investigations as storms may result in catastrophic failure of the pipeline. You will need to consult with [LPMA](#) to obtain approval for the pipeline.

Note also that pipelines that cross SEPP 14 wetlands will trigger the requirement for an environmental impact statement and if a RAMSAR wetland is involved, a Commonwealth approval under the [Environmental Protection and Biodiversity Conservation Act](#) may be required.

### Saline ground water supply

#### PREFERRED LOCATION

Adjacent to a saline ground water interception scheme.

Access to saline ground water may be from either a saline ground water interception scheme or bore. Care needs to be undertaken in managing the saline ground water within the aquaculture facility to ensure that freshwater aquifers are not impacted. You will need to consult with [NOW](#).

All saline ground water bores must be of an approved diameter, lined and capped to the standards required and licensed by NOW.

### Freshwater supply

#### Access licence or extraction rights

#### PREFERRED LOCATION

A site with an approved access licence or available rights for water extraction.

Water for freshwater fish farms can be drawn from sources such as streams, on-site dams, underground bore water or town supply providing the relevant permit/entitlement can be obtained. For advice on [water extraction](#) rights consult the [NOW](#).

#### Water Access restrictions

#### PREFERRED LOCATION

A site with no water access restrictions based on flows under normal conditions.

Detailed investigations will be required to evaluate the reliability of water quantity and quality during drought periods, periods of high demand (multi-users), floods and 'fresh' river flows. Sites having the potential to experience periods of restricted water access should consider on-site storage or alternative sources (bores/wells) and have the capacity to support continued operation during these events.

### **Pumping station**

#### **PREFERRED LOCATION**

A site requiring no deepening of the river for intake line and for easy management during floods.

Ideally you need a river site having sufficient depth under all flows and readily accessible to remove infrastructure for maintenance and during rising waters and floods. The existing profile of the channel or bank must not be disturbed more than is necessary to install the pumping facility. The intake should be as protected as possible from debris and excessive flows.

Any location where the bank or the bed of the river would require substantial disturbance (especially of aquatic or foreshore vegetation) should be avoided. The construction of a pump station may require a controlled activities approval under the [Water Management Act 2000](#). Where a licence or permit issued for the commercial use of water, an exemption from controlled activity approvals exist, refer to clause 39A of the [Water Management \(General\) Regulation 2004](#).

### **Be aware!**

#### **Surface water access rules**

NSW Office of Water ([NOW](#)) should be contacted to ascertain the current [water access](#) licensing rules applying to basic landholder rights, on farm dams, extraction from watercourses and any surface water licence embargoes that may apply to a selected site.

#### **Groundwater access**

All ground water bores must be of an approved diameter, lined and capped to the standards required and licensed by NOW.

You will need to consult with [NOW](#) on the principles and issues to be considered relating to groundwater, for example:

- groundwater quality, quantity and vulnerability;
- threats and protecting the resource;
- conservation of water resources.

### **Be aware!**

#### **Groundwater access rules**

Under Section 112 of the [Water Act 1912](#), anyone using a bore or well **must have** a groundwater licence. There are a number of alluvial aquifers in NSW that are embargoed, and therefore no new water licences will be approved. However, applications can be made to transfer allocations from existing licences.

Any proposed use of groundwater in areas possessing [ASS](#) will need considerable environmental assessment to ensure that such extraction will not lower groundwater tables to levels leading to the formation of acidic ground water. NOW will generally require a full assessment of any works in areas mapped as having either vulnerable groundwater, or significant potential for ASS. See Table 5.

A licence or approval is required **prior** to the construction of any bore and all applications for licences are subject to assessment by NOW.

**Table 5. Assessment regime for groundwater.**

| Situation   | Site selection assessment required   |
|---|--|
| In areas where groundwater is not vulnerable because of the depth, overlying geology and where there are no obvious sources of contaminants and no ASS are present (as indicated in DECCW ASS Risk Maps). | <b>No assessment</b> is necessary.   |
| In areas which have groundwater of 'low' value which may be vulnerable and where there are no obvious sources of contaminants.  | <b>A professional opinion</b> is required as to the nature of the groundwater resource and the risk the development places on the resource.  |
| In areas where there <i>may be</i> a potential risk to groundwater or the environment.  | <b>A desk study</b> is required showing the nature of groundwater resource, pollution risk, effect of any barriers to pollution flow, either natural or engineered. Calculations need to show the level of environmental risks based on existing knowledge of the site.  |
| In areas where the desk study indicate that there <u>are</u> potential risks to the environment.  | <b>Limited site studies</b> are required with soil and water testing to establish a baseline and to confirm the characteristics of the resource and the likely effectiveness of barriers or other possible measures (natural or engineered) to protect the resource.   |
| In areas where there <u>are significant</u> risks to the quality of groundwater as indicated by the desk study or the limited site studies.   | <b>Extensive site studies</b> are required with soil and water testing and modelling of the groundwater flows and quality to predict the likely effectiveness of the barriers and other design and planning options to prevent degradation of the resource. There may be some situations where the groundwater quality cannot be protected and the siting may not be feasible. |

Sites that have underlying high quality fresh potable groundwater within 3 metres of the surface will require detailed investigations. The quality of the underlying groundwater should not be put at risk by the aquaculture activity, in particular where saline ponds are over fresh water aquifers. Any risk to groundwater used for potable water supplies may result in a proposed aquaculture development being refused.

#### **Multiple use of recycled freshwater pond/tank or processing water**

There are significant economic and environmental benefits to multiple water use. Multiple uses include hydroponics, horticulture or irrigated agriculture. Any irrigation schemes associated with aquaculture should be considered as a value adding process utilising the discharged water.

#### **Pond siting**

##### **PREFERRED LOCATION**

A pond aquaculture site not located in areas of high groundwater (within 3 metres of the surface), or areas highly vulnerable to groundwater contamination, which are used for stock, domestic or town water supplies.

If your area is one where there are **ASS**, you need to consider the cost of minimising the generation and runoff of acid into the ponds or neighbouring environment.

Sites with high groundwater are high risk for pond construction and management. It can be difficult to build the ponds and prevent seepage. It also may not be possible to adequately drain and dry out ponds built in such areas, something which is necessary for efficient pond management.

#### **Flood liability**

##### **PREFERRED LOCATION**

A site that is not within the flood planning area and/or a design that will not impede the flow of flood waters or affect catchment stormwater drainage. A site where the development is compatible with the relevant Council or DECCW floodplain management plan, where available.

Freshwater aquaculture ponds should be constructed above the probable maximum flood (PMF) level in the eastern drainage and constructed so not inundated by the discharge of a 1:100 ARI (average recurrent interval) flood event in the western drainage. In the western drainage if data is not readily available regarding the 1:100 ARI flood event a proponent may wish to consider the highest historic flood level. An aquaculture site within a flood planning area is likely to be severely impacted by floodwater and should therefore be avoided.

Ponds using estuarine or marine waters should be constructed above the 1:100 ARI flood event, although a case-by-case evaluation may be considered.

It is preferable that there is no major stormwater drainage across the site. If unavoidable, there should be sufficient space to manage the flows so as not to affect neighbouring properties or ecosystems.

### Waterway protection

#### PREFERRED LOCATION

A site that allows for all infrastructure (except pipelines) to be at least 50 metres from the riparian zone.

Separation between the facility and any natural waterbodies is necessary to avoid disturbance of riparian vegetation and to allow for natural hydrological processes (such as bank erosion) without putting ponds or buildings at risk.

Disturbed buffer areas should be revegetated to prevent erosion and minimise flow into the waterbody. There should be a vegetated buffer zone of at least 20 to 40 metres between any effluent irrigated areas and the high bank of any adjoining watercourse.

#### **Tip!**

A buffer area of more than 40 metres would avoid the need for a controlled activities approval under the [Water Management Act 2000](#). In addition, Aboriginal sites commonly occur adjacent to waterways, and a set back may reduce the likelihood of disturbance to [Aboriginal sites](#).

### Water temperature at a site

Water temperature is a key limiting factor in [species selection](#) and when selecting a site this must be considered. Information on freshwater temperatures is available for some [river systems](#) however it should be noted that water temperature within culture facilities is often much higher. Information on estuarine and seawater temperatures can be found using the following web link for a number of NSW coastal locations [www.metoc.gov.au/products/data.html](http://www.metoc.gov.au/products/data.html).

## 5.4 Elevation and topography

#### PREFERRED LOCATION

Ponds using estuarine or marine waters on a site with an elevation above 1 metre Australian Height Datum (AHD) and a slope of less than 2%.

A site for freshwater ponds that has a slope of less than 5%.

Key elevation and topographic considerations include:

- coastal land below 1 metre AHD is likely to have significant ASS issues. Ponds constructed on these sites are likely to have problems with draining and drying and ASS. Tidal and flooding inundation is likely to occur on land below 1 metre AHD. These sites are also at greater risk from sea level rise;
- land above 2 metres AHD is less likely to contain ASS;
- the slope of the land will influence the shape of the ponds, drainage system and construction cost.

Topography is an important issue for high security species with translocation concerns. It is also an important factor if pond discharge water is to be used onsite for irrigated crops. I&I NSW [Agnote DPI-493](#), “*Landform and soil requirements for biosolids and effluent reuse*” (I&I NSW 2004) contains further information on landform assessment and requirements for effluent reuse.

## 5.5 Soil and soil contamination

### PREFERRED LOCATION

A site that:

- has clay loam or a soil/sand mix with low erosion potential;
- has no soil contamination from previous land uses;
- has no ASS; or ASS landform Process Class A with [Landform Element class b, l, t, p, y or w](#);
- is suitable for freshwater recycle systems/irrigated agriculture.

The soil characteristics of a site can influence construction costs and the long term maintenance and management costs. With high security species, particularly those with translocation concerns, the assessment of suitability of the soil for pond or dam construction is essential.

Key soil considerations include:

- sites which have clay or clay loam soil characteristics suitable for pond construction (stable and nil seepage). A soil survey is recommended covering the pond construction site and at the estimated pond excavation depth to determine if there are likely to be any gravel or sand layers, rock strata and other soils characteristics that may interfere with water holding qualities and thus add to the construction costs. Soil specialists at the Land and Property Management Authority and/or DECCW may have soil survey information or maps of particular sites. If saline water is used the risk of seepage is high even in clay soils as the saline water can cause the clays to flocculate and increase permeability;
- for sites with highly dispersive or flocculative soils, additional erosion controls and other measures (dam liners) to prevent dam wall failure through ‘tunnelling’ may need to be factored into the costs;
- land previously used for crops, should be tested for accumulated pesticide residues such as organophosphate, carbamates and synthetic pyrethroids. Current pesticide and herbicide use on adjoining lands and within the catchment need to be investigated to ensure minimal impact on site;
- in estuarine areas, high-risk acid sulfate soils (ASS) should be avoided. ASS can impact on aquaculture operation through poor water quality, acid runoff and costly remediation. Sulfidic muds also have poor load bearing characteristics resulting in pond wall instability and leakages. Soil survey work will be required to identify the depth to the ASS and any likely ‘hot spot’ areas, particularly as ASS may not be evenly distributed across a site. Reference should be made to the [ASS Manual](#) for sampling and assessment regimes;
- with some soils the preloading of the site prior to construction may need to be considered to ensure stability. However, consideration of the effects of compaction on groundwater levels and the potential for discharge of acid is required.

### Tip!

ASS risks maps (available from DECCW) are a useful tool for ruling out unsuitable aquaculture sites. Sites on ASS should be evaluated using methods in the [ASS Manual](#).

### Irrigation Soils

The characteristics of the receiving [soils for irrigation](#) need to be thoroughly investigated to ensure they are suitable to receive such waters into the future without creating environmental or management issues.

**Tip!**

If irrigation is proposed using recycled water or processing wastewater, the suitability of the soil for pasture, crops or tree plantations must be considered. Factors such as fertility, permeability and slope should be considered when assessing methods of irrigation and crop types. All relevant soil characteristics should be fully established when designing an irrigation system. NSW DPI [Agnote DPI-493](#), *Landform and soil requirements for biosolids and effluent reuse* (NSW DPI 2004) and the DECCW [Environmental Guidelines: Use of Effluent by Irrigation](#) contains further information on landform assessment and requirements for effluent reuse.

## 5.6 Local climate and air quality

Key climate and air quality considerations include:

- **Growing cycle** – Water temperature significantly affects the metabolism and growth of aquatic animals. The longer the temperature is below the optimum range, the longer the growout cycle. It is therefore important to consider climate when evaluating a site. (See [Water temperature](#));
- **Design and construction issues** – Climate and weather conditions should be considered when planning construction timetables, use of solar energy, positioning of ponds (water fetch, wave action, erosion), runoff, catchment and flood management facilities or flood control works;
- **Effect on environmental performance** – Noise and odour impacts are likely to be more of an issue in areas that experience local temperature inversions;
- **Effect on irrigation water use** – Temperature, humidity, rainfall, sunlight and wind patterns will affect plant growth and evapotranspiration levels. These factors will dictate the effectiveness of an irrigation area to utilise discharged water.

## 5.7 Ecological factors

### PREFERRED LOCATION

The site should have:

- no impact on threatened species, populations or ecological communities or their habitats or critical habitat listed under the [Threatened Species Conservation Act 1995](#) or the [Fisheries Management Act 1994](#);
- no disturbance of native vegetation (including trees, shrubs, grasses, etc).

Key ecological considerations include:

- If terrestrial or aquatic threatened species, populations or ecological communities or their habitats occur on the site or in the area of impact, a test of significance (Section 5A of the [Environmental Planning and Assessment Act 1979](#)) must be undertaken (see Figure 6) and referred to the consent authority before a development application (DA) is lodged. The authority may determine that a Species Impact Statement is required under the [Threatened Species Conservation Act 1995](#) and, in the case of any threatened aquatic species, under the [Fisheries Management Act 1994](#). The Department of Environment, Climate Change and Water maintains a [register of critical habitat](#).
- Areas of native vegetation and habitat should be retained wherever possible to maintain or improve biodiversity values of a site. The site layout should be designed to minimise the destruction or disturbance of native terrestrial and aquatic vegetation;
- The clearing of native trees, shrubs or grasses will usually require an approval under the [Native Vegetation Act 2003](#). Native vegetation may be permitted to be cleared under routine agricultural management activities ([RAMAs](#)). If the vegetation is removed within 40 metres of the bank of a waterway or wetland, a controlled activity approval could also be required under the [Water Management Act 2000](#). If mangroves, seagrass or foreshore vegetation is to be disturbed by the inlet and outlet pipes or drains, an approval may be required under the [Fisheries Management Act 1994](#) (both Acts list threatened species, population and ecological communities and protected habitats) and [Water Management Act 2000](#);

- [Vegetation Management](#) under the [Native Vegetation Act 2003](#) is administered by DECCW and has developed a land management system which includes Property Vegetation Plans (PVPs). PVPs are developed in consultation with the Local Catchment Management Authorities (CMAs).
- If impacts on native vegetation can not be avoided or mitigated then [offsets](#) should be established.
- If abutting an estuarine area, consideration should be given to the likely risks to any nearby oyster aquaculture particularly [Priority Oyster Aquaculture Areas](#) or important fish nurseries or habitat;

**Tip!**

To determine the appropriate level of assessment for an aquaculture proposal, a test of significance and a project profile analysis can be referred to the consent authority for consideration.

**Figure 6. The factors to consider in a test of significance.**

The [Environmental Planning and Assessment Act 1979](#) requires the following factors to be considered when assessing whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitat:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
  - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
  - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
- (d) in relation to the habitat of a threatened species, population or ecological community:
  - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
  - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
  - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
- (g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

**Tip!**

[DECCW](#) maintains a GIS database of information on the flora and fauna of NSW - [Atlas Listing of Fauna and Flora Records in NSW](#) (Contact: Data Licensing Officer (02) 9585 6684). This may provide an early warning of the occurrence of threatened wildlife species on or near the site. [Councils](#) may also have lists of species, populations and ecological communities in their areas and other useful data.

You should contact [I&I NSW](#) to see if any threatened species, populations or ecological communities have been recorded for a particular estuary or river.

## Conservation sites

Good site selection avoids sites that may impact on areas of high conservation value. Various pieces of legislation protect these sites and are require additional assessment and additional approvals if they are potentially impacted. Conservation sites include:

- **Coastal rainforest** especially [SEPP 26](#) – Littoral Rainforest;
- **Wetlands** especially [SEPP 14](#) – Coastal Wetlands, wetlands listed in the [Directory of Important Wetlands in Australia](#) should also be considered;
- **RAMSAR wetlands**. Please note that a project does not need to be in or adjacent to a RAMSAR wetland to have an impact eg. development in a catchment of RAMSAR wetland could significantly alter water quality and quantity in the RAMSAR wetland;
- **Habitat of migratory species** protected under [CAMBA](#) and [JAMBA](#) international agreements;
- **Critical habitat** declared under Part 3 of the [Threatened Species Conservation Act 1995](#);
- **DECCW protected areas** which include all lands managed by the DECCW and protected under the [National Parks and Wildlife Act 1974](#) such as National Parks, Nature Reserves, Historic Sites, Aboriginal areas, Karst conservation areas, State recreation areas and regional parks;
- **Wilderness Areas** declared under the [Wilderness Act 1987](#);
- **World Heritage Area**. Please note that a project does not need to be in or adjacent to a [World Heritage Area](#) to have an impact eg. development in a catchment of World Heritage area could significantly alter water quality and quantity in the World Heritage area;
- **Marine parks**: The zoning of [Marine Parks](#) permits aquaculture where it can be demonstrated that the activity is environmentally sustainable and does not impact adversely on the marine park environment or its flora and fauna (see zoning plan for each park);
- **Aquatic reserves**: These [Reserves](#) provide protection for important sensitive fish habitat as well as providing unspoilt natural sites for recreation, education and research;
- **Areas** identified as high conservation value in regional strategies and regional conservation plans.

## Aquatic ecology

You need to consider the risks of the site's operation to native aquatic species within the catchment. Risks may include escape of stock, spread of disease (discharge water or flood breaches), water use or erosion. These issues are considered in the [species selection](#) chapter, however they are also listed here as a site selection factor as the preferred species may have locational constraints.

## Predators

The impact of bird or other predators needs to be assessed as their activity can impact significantly on farm operational costs.

### **Tip!**

Avoid sites near where predator aquatic birds congregate as the long term costs, either through loss of fish or in mitigation measures, can be very significant (See [Planning and Design](#) chapter for more details).

## 5.8 Native title

### **Tip!**

Proposals sited on Crown lands subject to a Commonwealth Native Title Claim/NSW Aboriginal Land cannot proceed until the claims are resolved.

Key native title considerations include:

- Native title claims are not quickly resolved. Most vacant State Crown land is subject to a claim under [NSW Land Rights Act 1993](#). LPMA can provide information on those areas that are presently under [claim](#).
- Aquaculture proposals that need to cross Crown land (subject to either of these claims) to gain access to water supply should be avoided unless agreements can be made with the claimants.

## 5.9 Heritage

Land previously cleared and used for agriculture is less likely to contain heritage items (Aboriginal or non-Aboriginal). However, if heritage issues are suspected of occurring on the site (built and non-built) the following 2-step process should be considered at the site selection stage.

**Step 1:** Research and collate information from the following sources:

- i) consult relevant heritage or historical research on the area;
- ii) consult with the local Council, the Aboriginal community ([DECCW](#) can provide relevant contacts) and local historical societies;
- iii) inspect existing heritage registers, databases or lists including:
  - in LEPs and REPs for relevant heritage issues,
  - in heritage studies prepared by a local Council,
  - on [State Heritage Register](#) for items protected under the Heritage Act or subject to Interim Heritage Orders or s.136 Orders,
  - on the [National Trust Register](#),
  - on DECCW Aboriginal Heritage Information Management System ([AHIMS](#)),
  - in [Shipwrecks Atlas](#) (if affecting an estuary or its banks or accessing marine waters),
  - on the [National Heritage List](#) (Australian Heritage Commission).

**Step 2:** Survey the area to identify any items of potential heritage significance:

- The *Aboriginal Cultural Heritage Standards and Guideline Kit* provides guidance on methodology for surveying, identifying and assessing the importance of Aboriginal sites;
- The *NSW Heritage Manual 1996* provides guidance on methodology for surveying, identifying and assessing the importance of non-Aboriginals sites.

### **Tip!**

The Heritage Office maintains a computerised [State Heritage Inventory](#) with listings of items protected under the [Heritage Act 1977](#) and LEPs or REPs.

## Aboriginal heritage

### **PREFERRED LOCATION**

The site does not contain or impact on any recorded Aboriginal sites, places or values of significance to the Aboriginal community and/or Aboriginal sites, places or values.

Aboriginal sites or items have been recorded across the landscape in the State. Other cultural values may also be associated with this landscape, such as traditional uses of an area (eg. a ceremonial area, a historic event or place, and/or contemporary values such as access to wild resources). Areas that are adjacent to creeklines and waterways often have a high potential to contain Aboriginal sites. Steps to identify potential Aboriginal sites include searching the DECCW Aboriginal Heritage Information Management System ([AHIMS](#)) and the State Heritage Inventory, and early consultation with the local Aboriginal community and/or Local Aboriginal Land Council (LALC) is advisable. There is a fee for each search of the [AHIMS](#) contact: (02) 9585 6513 or 9585 6345. All search requests should clearly identify the site and state the

reason for the request, ie. to accompany an aquaculture development application in accordance with the NSW LBSAS. The results of the search and accompanying advice will be sent to the applicant. In determining the assessment required, DECCW considers a range of factors including:

- the results of the DECCW Aboriginal Heritage Information Management System search;
- reference to general archaeological models relating to Aboriginal site locations within a given area;
- the views of the local Aboriginal community.

### **Tip!**

It is wise to consult the relevant Aboriginal communities early in the site selection and evaluation process to determine if there are any major constraints on the site relating to Aboriginal heritage issues.

When lodging a request with DECCW [AHIMS](#), applicants should send a letter of notification to the Aboriginal groups in the area ([DECCW](#) can advise of the relevant groups). This letter should include a copy of the relevant 1:25,000 topographic map clearly illustrating the area of the proposal and a brief description of works proposed. It should request notification of the presence of any Aboriginal sites on the property and further discussions with the group should Aboriginal sites be present which require active management.

Under the Integrated Development Approvals (IDA) process DECCW can require up to an additional 46 days to consult with Aboriginal communities, organisations or LALC after the development application has been lodged prior to issuing general terms of approval, if it is considered by DECCW that an Aboriginal place or object is likely to be disturbed or destroyed.

A survey may be required, by an appropriately qualified and experienced person in consultation with the relevant Aboriginal community group/s. The significance of any [places or values](#) that are recorded should be assessed, and appropriate management options developed. Places of high significance should be conserved in-situ wherever possible.

## **Non-Aboriginal heritage**

### **PREFERRED LOCATION**

The site does not contain any heritage items identified in a Local Environment Plan (LEP) and if present the project will not affect the significance of these items.

You should check the LEP, REP, State Heritage register, National Heritage list and the National Trust register for any [historic or cultural items](#) on the site already listed for protection.

You may need to engage an appropriately qualified and experienced heritage expert to undertake an investigation of the site. If in doubt, contact Council officers and/or the [NSW Heritage Office](#) regarding the appropriate provisions for the identification, assessment and conservation of heritage items.

## **5.10 Amenity issues**

Conflicts can arise if there is a perception that the amenity of residents or recreational users is likely to be impacted by an aquaculture business. Site evaluation must consider the compatibility of the aquaculture business with surrounding existing or future land and water uses. Concerns raised may include:

- risks to any heritage significance of the adjacent properties, buildings or sites;
- the amenity of the area being compromised due to noise, air or water emissions, and stock loss;
- the visibility of sheds, ponds and other plant on the site could affect the visual quality of the landscape of the area.

If there is potential for conflicts, consideration should be given to acquiring additional land to provide adequate on-site separation to mitigate noise or odour generating activities including pumps, aerators, plant and waste storage areas. The level of odour, dust or noise beyond the site boundary must be kept to acceptable levels. Landscaping can act as a visual barrier or vegetation buffers from nearby houses. This will help maintain good relationships with neighbours.

## 5.11 Strategic land use issues

### PREFERRED LOCATION

The site is compatible with neighbouring land uses.

Early discussions with the local Council are required to understand the future strategic land use of the area. Sites in 'stable' agricultural areas (or industrial areas for tank production) are preferable. Areas in transition from agriculture to rural residential or residential carry long term risks which may require future costly mitigation measures or even pressure the aquaculture enterprise to relocate.

Sites for pond aquaculture will generally have an agricultural land use or for tank culture an agricultural or industrial land use. Evaluations need to consider:

- If the land is prime agricultural land, the practicality and cost of returning the land to agriculture if aquaculture should fail;
- If the site is on prime agricultural land (eg. class 1, 2 or 3), marrying the aquaculture project with agricultural production that could utilise discharge water (eg. hydroponics, horticulture, orchards, vineyards or fodder) may be considered;
- Residual agricultural chemicals eg. pesticides, fungicides, nemocides or herbicides on the site or adjacent land. Soil analysis should be undertaken early in the site evaluation process. Sites with significant soil contamination should be avoided;
- The potential for chemical contamination from chemical sprays used on surrounding land should be considered. The site should be assessed for prevailing winds, neighbouring spray regimes and buffer zones.

## 5.12 Potential cumulative impacts

Cumulative impacts can arise from the clustering of similar industries in a catchment. Table 6 identifies most common cumulative impacts.

**Table 6. Potential contributing industries/activities to cumulative impacts.**

| Potential cumulative impact                   | Examples of contributing industries/activities to cumulative impacts                                    |
|---|---|
| Water quality - sedimentation                 | Urban development, agriculture, storm water, forestry, estuarine aquaculture and road works.            |
| Surface water quality - nutrients             | Urban development, agriculture, sewage treatment & stormwater, manufacturing and estuarine aquaculture. |
| Sub-surface water quality                     | Agriculture, manufacturing, aquaculture, sewage treatment and the disturbance of ASS.                   |
| Water supply usage                            | Urban development, agriculture, aquaculture and manufacturing industry.                                 |
| Disturbance of ASS                            | Urban development, agriculture, estuarine aquaculture, road works and manufacturing industry.           |
| Aquatic diseases                              | Aquaculture, fishery activities and stress from poor water quality especially ASS discharge.            |
| Land clearing – loss of vegetation & habitats | Urban development, agriculture, forestry, aquaculture and road works.                                   |
| Noise & odour                                 | Urban development, agriculture, aquaculture and sewage treatment.                                       |

### 5.13 Size of the site

A site needs to be large enough for current production needs plus any future expansion or buffers. Depending on the project type, there should be adequate area for the following:

- Growing facilities - ponds and/or tanks;
- Spawning and/or hatchery facilities/laboratory complex;
- Cold storage and packing and possibly processing sheds;
- Water storage tanks/dams;
- Pond/tank water recycling and reuse facilities including storage dams;
- Waste management facilities - mortalities, sludges, processing waste water, sewage, etc;
- Management and staff facilities;
- Roadways, loading docks and carparks;
- Tourist facilities if relevant.

### 5.14 Energy

The site should permit the facility to be designed to minimise energy use and maximise opportunities for the use of alternative energy sources. The layout and design of the facility on the site needs to critically consider energy issues including alternative energy sources (solar or wind) to reduce operation and production costs.

Water pumping is expensive. Where possible the site should provide for the use of gravity for water recirculation.

Initiate early discussions with the appropriate power transmission authority about power supply (3 phase), capacity and access. Also you should contact the Industry & Investment NSW ([I&I NSW](#)) and the [Australian Greenhouse Office](#) (in Canberra) about energy saving in business design and management.

### 5.15 Availability of services and other practical matters

#### PREFERRED LOCATION

The site has access and services available or can be readily connected.

Practical factors for consideration include:

- Access to power (3 phase);
- Vehicle access (safe truck entry and exit) and transport networks;
- Proximity to markets; efficient transport options to Sydney, Canberra or Melbourne;
- Distance and availability of stock, feeds, plumbing and other supplies;
- Availability of suitable manpower to operate the farm;
- Ability to secure the site against poaching and sabotage;
- Proximity to processors;
- Availability of services for staff (eg schools, health services, etc.).

### 5.16 Access and location for tourists

If an aquaculture facility is to be developed as a tourist attraction then site aspects such as ease of access, prominent location and integration with other tourist facilities or routes should be considered. Businesses incorporating tourism may need to consider insurance, construction aspects such as coach or car with caravan access, public amenities and safety.

## 6. Planning and Designing the Farm

### 6.1 Good planning and design are key elements

Land based aquaculture accounts for over 95% of world aquaculture fish production. Earthen ponds are used in many regions of the world and are practical, reliable and viable. The use of intensive tank recirculation systems is increasing as new technology improves the reliability, performance and viability of these systems. The success of both culturing methods is dependant upon the selection of good sites and the implementation of good design features.

It cannot be over emphasised that planning and design are critical steps when building a new facility or expanding an existing aquaculture farm. Construction is one of the major capital investments of aquaculture. Sound planning and design can minimise the costs associated with construction, operation and management of an aquaculture development and any associated environmental protection measures.

### 6.2 General site layout and design issues

Once a site is identified, the next step is the physical site planning and design. Advice and assistance from professionals such as aquaculturists, water and soil chemists, engineers, irrigation and agricultural scientists, accountants and relevant Government departments should be sought and used. It is advised that similar aquaculture facilities are visited to discuss operational procedures and view farm design features.

A detailed survey of the site will determine the most efficient location of facilities, minimising construction costs and providing for efficient running of the operation. A plan detailing the farm's most efficient layout of water supply, reticulation and drainage lines, power access, buildings and roads, predation control, visual barriers, etc. should be drawn up and specifications documented. Make a checklist and consult with [I&I NSW](#) as to available information sources and what approvals may be required given the risk profile (see [Site Selection](#) and [Project Profile Analysis](#) chapters).

### 6.3 Water supply dams

If an aquaculture project is located on a large property, water catchment could be significant and could provide a primary or supplementary source of water. The implications of [harvestable rights](#) should be considered with the option to 'capture' and use 10% of the average yearly regional runoff from the property without needing a licence.

Projects accessing water via estuaries or rivers may experience periods of poor water quality during low or high river flows. Off-river storage during periods of high quality water may be an optional design feature and should be discussed with [NOW](#).

Guidance on the location, design and construction of dams may be provided by Land and Property Management Authority (Soil Conservation Services). Factors to be considered include:

- the location of the dam in relation to local water flows;
- the dam construction features – wall design, heights, method of construction, etc;
- volume of water and extent of the land inundated when the dam is at capacity;
- the relative height and dimensions of the by-wash to control the dam's capacity or the provisions to ensure that inundation of land does not exceed the specified extent;
- provision to provide for passing flows.

[NOW](#) approval is required if dam design or location is to be altered. Aquaculture projects, particularly pond aquaculture, should not rely on small dams (and limited catchments) as their major water supply.

## 6.4 Accommodating operational facilities

Buildings are essential components of an aquaculture facility and their design and location should be planned so that space, labour and equipment are used efficiently and economically within the site. The layout should meet the relevant local Council development control plan or other development controls.

## 6.5 Road access

Road access should provide for safe entry and exit from the site. The design needs to consider the traffic flow in the road adjacent to the site and the likely level of vehicle movements particularly during peak flows. Public roads having high flows may require design features in accordance with the [RTA](#) road design guidelines. Adequate off street parking spaces should be provided for trucks and cars (particularly if tourist or fishout facilities are part of the aquaculture project). Car parking layout should take into consideration the provisions of AS 2890.1-1993.

## 6.6 Crown lands and road reserves

A licence is required for any structure that is built on Crown land or crosses it or is attached to the estuary bottom (eg. Pipeline for water access). Under the [Crown Lands Act 1989](#), the bed of all estuaries below the high tide mark is Crown Land. The extent of the estuary varies depending on the river system. Some river beds are also Crown land but they may also be private property.

You may need to undertake a [title search](#) to determine the status of estuary and riverbanks and to determine the exact land status of the proposed development site.

There are numerous unconstructed 'unopened' Council controlled roads (administered by [Council](#)) or Crown roads (administered by [LPMA](#)) for which a reserve has been created under the [Roads Act 1993](#). Some of these roads have been incorporated into the management of abutting freehold properties for a number of years. Before any aquaculture works are built on these roads they should be formally closed if not required for access.

### Setback from any natural waterbody

#### PREFERRED DESIGN

Culture or effluent pond/dam/buildings which are at least a distance of 50 metres from any riparian areas.

The setback distance provides protection for riparian vegetation and allows for natural hydrological processes such as bank erosion without putting infrastructure at risk. There should be sufficient buffer (may be greater than 50 metres depending on the size, location and morphology of the stream or subject to any PVP) so that if any pond water should overtop or be accidentally released, it will not drain directly into the natural waterbody. The buffer areas should be vegetated to prevent erosion and minimise flow into the waterbody.

In addition, a vegetated buffer zone of not less than 20 metres should be maintained between any irrigated areas and any adjoining watercourse. It should be maintained to protect any existing native plant species.

#### **Tip!**

A setback of more than 40 metres would avoid the need for a permit from [NOW](#) under the [Water Management Act 2000](#) and reduce the likelihood of disturbance to Aboriginal sites.

## 6.7 Disturbance of native vegetation

### PREFERRED DESIGN

No native vegetation/habitat to be disturbed.  
No riparian vegetation, mangroves or aquatic habitat to be disturbed.

The site layout for the ponds, dams, buildings, water intake, outlet and water reticulation system and operational facilities should be designed to minimise the destruction or disturbance of native terrestrial and/or aquatic vegetation or the habitat of native fauna.

Any disturbance of native vegetation (terrestrial or aquatic communities) must be undertaken in accordance with any relevant approvals (eg. under the [Threatened Species Conservation Act 1995](#), [Native Vegetation Act 2003](#), [Fisheries Management Act 1994](#)). Native vegetation located near construction activities (which are not to be disturbed) should be marked or temporarily fenced (or equivalent) to ensure that accidental damage does not occur. In particular, threatened or protected species for which disturbance has not been approved, should be marked to avoid accidental disturbance. Wherever possible, native vegetation including grasses should be used in the rehabilitation or stabilisation of disturbed areas.

The clearing of native trees, shrubs or grasses will usually require an approval by the relevant Catchment Management Authority, DECCW and/or local Council under the [Native Vegetation Act 2003](#). Reference should be made to any regional vegetation plan or Catchment Action Plan prepared for the catchment. Also if vegetation is removed within 40 metres of the bank of a waterway or wetland, a controlled activity approval could also be required under the [Water Management Act 2000](#).

Any channels, drains, pipes or pumping equipment should be installed to minimise disturbance of foreshore or aquatic vegetation communities (in particular mangrove communities). If mangroves, seagrass or foreshore vegetation is to be disturbed by the inlet and outlet pipes or drains, an approval may be required under the [Fisheries Management Act 1994](#) and [Water Management Act 2000](#).

If vegetation is cleared or lopped, the material should be mulched and used onsite to minimise erosion and to encourage revegetation of disturbed areas using native endemic species as soon as possible.

## 6.8 Threatened species issues

### PREFERRED DESIGN

No impact on threatened species, populations or ecological communities or their habitats.

If terrestrial or aquatic threatened species, populations or ecological communities or their habitats occur on the site or in the area of impact, a test of significance (S5A of the [EP&A Act](#)) must be undertaken (see Figure 6). The test of significance sets out the factors to be considered in determining whether there is likely to be a significant impact. If there is likely to be significant impacts on threatened terrestrial species or marine mammal or reptile species, populations or ecological communities, or their habitats, a Species Impact Statement (SIS) must be prepared under the [Threatened Species Conservation Act 1995](#). The proponent must contact [DECCW](#) to obtain these requirements. DECCW maintains a register of [critical habitat](#). In addition if there is likely to be a significant impact on any threatened aquatic species, populations or communities or their habitats, a SIS will be required under the [Fisheries Management Act 1994](#).

A test of significance should be referred to the consent authority to decide if a SIS is required prior to lodging the development application (DA). To determine the appropriate level of assessment for an aquaculture proposal the test of significance (if necessary) could be referred to the consent authority at the same time as a project profile analysis.

## 6.9 Noise issues

The design and layout should mitigate the impacts of the aquaculture facility on neighbours and the broader community. Noisy activities (eg. truck loading areas or plant/equipment) should be located away from or with a barrier between the noisy activity and the receiver.

DECCW's Noise [Policies and information](#) provides details of the requirements or contact DECCW directly. Where noise could become a nuisance, options to reduce noise impacts may include:

- quieter, insulated plant/equipment;
- enclosing the noisy activities in a building;
- building of noise barriers; or
- adjusting work schedules.

### Construction noise

During construction the recommended maximum noise levels as outlined in [DECCW noise guidelines](#) should be adhered to. Where [recommended levels](#) cannot be adhered to discussions should be held with neighbours and the Council on how activities can be managed. Generally, a construction noise management protocol is required with the level of detail matching the level of noise nuisance. The protocol should include:

- compliance standards;
- community consultation;
- complaints handling monitoring/system and site contact person to follow up complaints;
- contingency measures where noise complaints are received;
- mitigation measures, with design and orientation of the proposed mitigation method demonstrating best practice;
- construction times;
- monitoring methods and program.

## 6.10 Heritage considerations

### PREFERRED DESIGN

No heritage items present on the site or disturbance or impact on items should be avoided.

As outlined in the site selection chapter an assessment should be undertaken of Aboriginal and non-Aboriginal heritage items and their significance established. The aquaculture project should be designed to ensure that there is no disturbance or impact on heritage items and their significance on the site.

If during construction, a previously unrecorded Aboriginal site (eg. midden or tools) is uncovered, work in the area should cease immediately and the regional office of [DECCW](#) contacted. Prior to further disturbance occurring to Aboriginal sites, an approval is required from [DECCW](#). Under s.140 of the [Heritage Act 1977](#), works involving the disturbance of other archaeological relics (land or under water) require [Heritage Council](#) approval.

## 6.11 Pond design

Ponds are constructed by excavating earth and reshaping it to create a purpose built pond that has the capacity to hold and exchange water. These structures may be constructed below or above ground level and may be lined with impervious soils or with a liner such as concrete, rubber, plastic or fibreglass in areas where seepage is a problem or to prevent erosion in open (flow through) systems.

Common pond features include batters, inlets and outlets, sloping bottoms, sumps or low points, power outlets, walkways and vehicle access roads. Ponds are typically 0.1 to 1.0 ha (1000 to 10,000 m<sup>2</sup>) in size, rectangular or square in shape, have a water inlet and outlet and have

power to drive aerators and pumps. Ponds may have a sump area (lowest point) made of concrete, fibreglass or plastic to facilitate harvest and final draining of the pond. Ponds may contain raceway devices that, although being tank like they are fully contained within the ponds, and therefore are considered pond aquaculture.

Existing dams on farms that are used for stock or domestic water supplies or as irrigation storage may be used for extensive aquaculture under a Class C or E aquaculture permit issued under the *Fisheries Management Act 1994*. These dams/ponds must meet the criteria as outlined in the [project profile analysis](#) chapter.

### Water and system type

The type of water used within the pond aquaculture facility also needs consideration in the design phase, as saline waters such as estuarine, marine and saline ground waters may cause soils to flocculate and therefore ponds may need to be specially lined.

Open pond (flowthrough) systems generally have large volumes of water flowing through them and therefore will require careful design to prevent erosion.

### Designing for climatic effects

A pond site that is open to the weather is advantageous because it allows some wind aeration of ponds. However, at exposed sites, ponds should be built having their long axis perpendicular to prevailing winds to reduce bank erosion and any predatory netting needs to be well constructed. In areas where there are likely to be temperature inversions, any noisy or odour generating activities could be amplified.

### Drainage and flooding controls

#### PREFERRED DESIGN

- Aquaculture development is not liable to flooding and is consistent with any [Council](#) or [DECCW Floodplain Management Plan](#) relevant to the site.
- The design will not adversely affect the passage of flood waters or have adverse impacts on other developments. The development will maintain environmental flows to flood dependant ecosystems.
- Design will not affect site stormwater drainage.
- No stormwater catchment drainage into excess water (effluent) storage pond/dam.

An analysis of any flooding implications should be undertaken and discussed with the relevant local Council. Any flood mitigation works must be constructed and installed so as not to obstruct the passage of floodwaters flowing in, to or from a river. These should be designed in consultation with the local [Council](#) and [DECCW](#). The plans for levees or other flood control works should:

- specify the location and nature of the works;
- specify the level of the crest of the works;
- be consistent with any relevant local [Council](#) or [DECCW Floodplain Management Plan](#);
- show analysis to indicate that flood behaviour will not result in adverse impacts on nearby land;
- meet the requirements of Part 8 of the [Water Act 1912](#) or the [Water Management Act 2000](#) for flood control works, where applicable.

The blockage of stormwater drainage passage across the site by ponds, drains, roads or other structures can result in management and maintenance problems as well as local flooding problems for neighbouring properties.

Ponds used to hold excess water (effluent) discharged from culture/growout ponds, tank or hatchery facilities must have no stormwater catchment draining into them. This is to prevent the

ponds filling during storm events and nutrient rich waters escaping into the environment uncontrolled.

### **Pond shape and size**

Aquaculture ponds should be designed for efficient filling, cleaning, draining and water circulation and for efficient management. The shape and size of a pond affects:

- the cost of construction;
- the level of production;
- the size of inlet and outlet pipes, water circulation, the amount of aeration and power outlets;
- the stocking density, harvesting and feeding methods;
- the water volume and farm water budget.

Management, topography and site characteristics will determine the pond size and shape. Square and rectangle ponds are the most efficient use of space. Rectangular ponds are generally easier to manage than square ponds as they offer good water circulation (provided they are not too narrow), they are relatively cheap to build and have practical feeding and harvesting advantages. Most earthen aquaculture ponds range from 1 to 2 metres in depth; this allows good light penetration, good aeration of the water and bottom muds and uniform temperature with little chance of stratification.

Ponds generally are designed to have a deep section (2 – 2.5 metres) and a shallow section (about 1 metre). Depths will vary but generally having a deep section provides a buffer against extremes of temperature, reduces evaporation during summer, facilitates harvesting and reduces the growth of macrophytes (large aquatic plants).

Pond size is determined by several factors; namely, the target level of production, land area and ease of management (water quality monitoring, harvesting, aeration, etc). Larger ponds tend to have lower cost per unit area to construct and maintain compared to smaller ponds. However, they have some disadvantages including: they are more difficult disease control; they require more aeration, power outlets and larger inlet and outlet pipes; and, they are more difficult to harvest and maintain stock inventories. Well managed smaller ponds (eg. less than 0.5 hectares) can maintain relatively higher production levels without these issues.

### **Pond banks and floor**

Earthen pond banks should be designed with optimal batter angles to prevent slump or erosion. It is important that they are wide enough to ensure strength, stability and vehicular access. The recommended dimensions of pond embankments are:

- crest approximately 3 metres in width;
- 2.5:1 on the inside and 2:1 on the outside for embankments less than 3 metres high;
- 2.5:1 for embankments greater than 3 metres but less than 6 metres;
- 3:1 for embankments greater than 6 metres (rare);
- have freeboard minimum of 0.5 metres (where wave action fetch is less than 100 metres);
- have a cut-off trench minimum 300 millimetres into good clay.

Ponds made of manufactured products such as plastic/rubber liners or reinforced embankments utilising concrete etc may have steeper gradients. However, care must be taken so that the steepness does not create access and maintenance issues.

Walkways to any drainage outlet structures (eg. penstocks and monks) enable efficient control of the boards, screens and valves, as well as being ideal sites for observing and feeding stock and monitoring water quality.

Acid sulfate soils ([ASS](#)) should not be used in pond bank construction. If no alternative is available, consult the [ASS Manual](#) to ensure that the long-term use of the ponds and surrounding environments is not jeopardised.

**Be aware!**

The construction on and disturbance of ASS would constitute a 'high risk' option, requiring a high level of assessment and approval.

Earthen pond banks, batters and backfill should be covered with stockpiled topsoil and planted with grasses to ensure stability and prevent erosion. In some circumstances (highly erodable soils, or with some water circulation/aeration systems), a pond bank liner should be used. Any embankment at the water inlet should be fortified to prevent erosion. Animals (cattle, horses and to a lesser extent sheep and goats) grazing the banks may lead to bank degradation, and increase turbidity and eutrophication.

**Pond water inlet****PREFERRED DESIGN**

Inlet pipes that allow the largest pond to be filled within 24 hours or less.

Water inlets, other than bore water, should be screened to prevent the entry of trash fish and other undesirable aquatic fauna. Where there is likely to be poor water quality or restricted access to water supply because of seasonal variations in flows, it is good practice for the farm to include a storage system of high quality water.

Each pond should have a separate water inlet and outlet of at least 150 mm in diameter depending on pond dimensions. Water supply reservoirs should be aerated and if topography permits piped by gravity to the individual ponds and buildings.

**Pond water outlets**

Ponds should be designed so that they can be drained individually, completely and rapidly. This will enable the removal of all stock, maintain inventories, dry out, de-silt and re-shape bottoms and walls.

The water outlet (eg. monk, tower, penstock, gate or standpipe) is the most important feature for regulating the water levels and draining the pond. Outlets vary in construction and costs and should be screened to allow water passage during water exchange and rainfall whilst retaining stock.

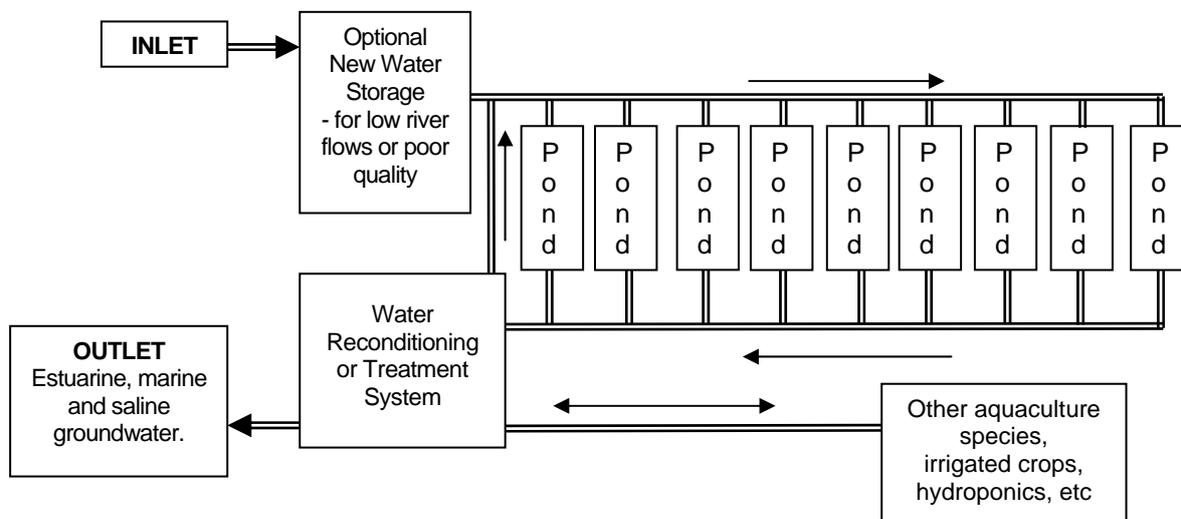
Ponds using a monk as an outlet are usually 300 mm to 800 mm in width. There must be adequate space between the rear board and back wall of the monk to avoid restricting the drainage capacity of the pipeline. The drainage pipeline traversing the embankment should have an incline between 0.5% and 1.5%. If fish are to be externally harvested through the outlet pipe, pipes should be a minimum 300 mm diameter, the receiving sump should be at least 30 cm in depth and large enough to hold most of the fish. External drain harvest is most successful when harvesting small fingerlings and fry (eg. hatchery operations).

**Circulation and drainage systems**

Ponds should be sited to allow for efficient water reticulation. Main features include water supply facilities, storage dams, culture/growing ponds, discharge ponds and drainage lines. Reticulation systems should be designed to allow:

- culture pond discharge water to be retained in reconditioning ponds (to reduce suspended solids and to allow for appropriate treatment if necessary); and
- ample capacity to recirculate the culture water on the farm or release/reuse the water in an appropriate manner (see Figure 7).

Figure 7. Water recirculation and reconditioning system.



Site planning should include drainage earthworks:

- to protect the farm and ponds from excessive runoff drainage from surrounding land during storms or flooding;
- to protect surrounding areas from run-off water from the farm.

For freshwater farms, site planning needs to provide for efficient use of reconditioned water following pond use. In some areas, it may be possible to provide discharge water to nearby irrigated agriculture, hydroponics or other water users. If the pipes cross a public road, permission will be required from the [RTA](#), the local Council or [Land and Property Management Authority](#). If on-site irrigation is proposed, the irrigation layout should consider land slope and relief, soil type, distance from natural creeks or drainage lines, location of pumping systems, irrigation reticulation systems and catch drains (if relevant). See [Site Selection](#) Chapter for further information on site and soil assessment for proposed irrigation areas.

For estuarine and marine farms, the discharge points need to be located to maximise the dispersal of the discharge water, minimise disturbance of marine vegetation or any oyster leases in the estuary and sited away from water intake points.

### Fencing ponds and/or the farm

Ponds culturing freshwater crayfish and eels may require perimeter fencing to prevent stock from escaping. Properly constructed fencing can also help exclude water rats and eels, which are both nuisance predators for yabby farmers.

## 6.12 Pond water reticulation system

### Water management as a resource

Reconditioning and recycling of culture pond discharge water should be part of standard environmental management practice for aquaculture farms. Any new or expanding existing farms should incorporate a reconditioning area and/or treatment systems so that water is reused within the aquaculture farm.

#### **Tip!**

For estuarine and marine farms, a water recirculation system should include appropriate reconditioning areas to strip nutrients and suspended solids before reticulation or discharge.

**Discharge to waterway**

It is I&I NSW policy that intensive freshwater aquaculture enterprises (except approved open (flow-through) systems) are not permitted to discharge water directly onto public or Crown roads, Crown land, neighbouring land (without landowner permission), rivers, creeks or natural wetlands or groundwater aquifers. This requirement does not apply to extensive aquaculture.

Open (flow through) systems and semi closed systems using estuarine, marine and saline ground waters may be permitted to discharge under a licence issued by DECCW. However, this will also require extensive consideration by NOW in terms of water extraction, embargoes and water quality impacts on the river system. See *Operating the Farm* chapter for further information on discharge considerations and requirements. Culture water sourced from a saline interception scheme should be discharged back to the same scheme.

**Discharge water reconditioning system****PREFERRED DESIGN**

Freshwater reconditioning storage capacity of greater than 2 times the size of the largest culture/growout pond (except open systems and extensive systems).

For open freshwater (for approved species) or estuarine, marine and saline ground water semi closed pond aquaculture, water treatment system to ensure discharge meets water quality objectives (WQOs) of receiving waters or licence requirements.

The capacity to recirculate water discharged from culture/growing ponds within a farm system relies on the pond discharge water being appropriately reconditioned.

Saline ground water discharged from a farm into a saline interception scheme may require treatment in accordance with any conditions applied by the scheme managers.

Open aquaculture farms may have filtering less than 1000 microns and a water treatment system to reduce impacts on water quality in receiving waters. They may require other design features in accordance with any conditions of a licence issued by DECCW regarding the management of the discharged water

If using sedimentation basins as a water treatment system, the two most important factors determining efficiency of are *retention time* and *pond geometry*. The four main features are an inlet zone (water is dispersed across the full width of the basin); settling zone; bottom zone (settled particles accumulate as sludge) and; outlet zone (waste water is drawn and/or discharged). Ideally, the length to width ratio of sedimentation basins should be at least 4:1 and preferably 8:1 with the long side set transversely to prevailing winds. This arrangement helps achieve uniform horizontal and vertical mixing throughout the depth and breadth of the basin and hence good deposition of suspended particles.

A reconditioning area or any channel systems should have the ability to be completely drained and maintained for de-silting and re-shaping.

**Use of reconditioned freshwater**

Efficient use of water is a management goal on aquaculture farms. You should consider establishing an integrated aquaculture/agriculture system with the reconditioned freshwater water used for hydroponics or agricultural crops, preferably substituting for raw water. It may be possible to pass on or on-sell to a neighbouring water user.

### **Use of reconditioned saline water (estuarine, marine or saline groundwater)**

In some saline water aquaculture systems overseas, the water is used by species such as fish, filter-feeding organisms, and seaweeds prior to the water passing through mangroves or wetlands into the natural system.

#### **PREFERRED DESIGN**

Disposal of saline groundwater via piping or channels lined with impervious liner to a saline groundwater interception and evaporation scheme, onsite evaporation facility or reinjection to a saline aquifer.

The use of saline groundwater will require the design of evaporation ponds if discharge water cannot be sent directly to a saline groundwater interception and evaporation scheme, or reinjected into an aquifer or discharged to the sea or an estuary.

### **Pre-market conditioning facilities**

Some species require pre-market conditioning (purging) in clean water for 3 to 14 days to improve the product taste. Some algae and bacteria produce off-flavours in pond and tank aquaculture systems. Taste testing the product will determine the presence of any off-flavours.

The design of pre-market conditioning systems should include:

- fibreglass or plastic tanks;
- clean water, free of algae and off flavour compounds (eg. underground bore or spring, rainwater or domestic (dechlorinated));
- the ability to exchange water and provide good aeration.

## **6.13 Predator management**

During the site selection process, you need to evaluate the extent of any predatory bird activity in the area. In addition to cormorants, nuisance predators may include water rats, night herons and pelicans.

### **Avian predators**

#### **PREFERRED DESIGN**

Netting of fingerling ponds and deterrent system for other ponds.

Pond aquaculture needs to be designed to minimise losses to predator birds. Ponds require daily checking, particularly at dawn when birds often visit. Methods could include:

- deterring the birds from gathering around the farm (eg. removal of dead roosting trees);
- deterring the birds from entering the water (eg. pond netting, deterrent wires, regular checking, activity around ponds).

### **Exclusion and partial exclusion netting**

Total exclusion netting is costly but may be a requirement at some sites. Netting design can be at the water surface level using props of wire or timber, waist level using perimeter fencing and cross-wires as support; or elevated (approx 4 metres) using a grid of poles and tension cables.

Other systems include nylon scare line set 300 millimetres apart and running in two directions across the pond.

### **Fright methods for avian predator control**

Fright devices (eg. gas guns) used to manage predator birds can have noise implications and should be avoided if residences are nearby. Discussions should be held with neighbours and the Council to determine if acceptable protocols can be developed for the use of noisy scare devices. The neighbours should be informed of the likely frequency of use, the times of the day and season to be used, the loudness and likely affect on the birds.

'Fright' methods (see Table 7) utilising gas guns or scarecrows tend to have limited or short term success and should not be considered as the first line of defence. Surveillance (often a person on a motor bike doing 'rounds') coupled with a number of fright mechanisms seems to offer the best solution.

**Table 7. Summary of some fright methods.**

|   |   |
|---|---|
| Birdscare, Bird Deter or recorded calls | Various commercial machines have been developed which generate distress calls of target species, which are turned on and off at random or in response to the presence of birds. Devices that emit more random noises, or respond to movement are likely to be more effective as birds do become familiar with the device. |
| Birdfrite                               | Cartridges are fired from shotguns or pistols that explode in the air. When fired at random and aimed at the flock it is likely to be more effective.   |
| Water bird effigies                     | Life size models of birds which can simulate a bird in distress in combination with birdscare calls can be effective for a time.  |
| Chemicals                               | The use of chemicals around the ponds is not recommended.   |
| Hawk kites & silhouettes or Scarecrow   | When the wind is favourable, the flying of simulated birds of prey can be effective. The approach is labour intensive and effective for a short time and like scarecrows need to be moved around to remain effective. Otherwise the birds become familiar with them.  |
| Dogs                                    | Some breeds of dogs can be trained to deter birds. Dogs which will also swim can be quite effective.  |
| Motor bikes or vehicles                 | Regular monitoring of ponds at dawn and dusk is the most effective deterrent but is labour intensive.   |
| Gas guns                                | Emit regular loud bangs; birds can become familiar with it.   |

Predator birds, particularly cormorants, can lead to significant fish losses. Research has shown uncontrolled bird predation can lead to complete loss of fish in unprotected ponds. The daily presence of any predators causes stock stress, disease, poor feeding and subsequently lower productivity.

### Summary of potential risks

#### **Great Cormorant**

The Great Cormorant (*Phalacrocorax carbo*) occurs in most areas of NSW, breeding along rivers and lakes in the Murray Darling and some coastal rivers of NSW. They congregate in significant numbers at breeding locations and can travel considerable distances in search of suitable feeding habitats. Estuaries can support cormorants year round, with the numbers boosted significantly during droughts.

Great Cormorants are sociable feeding birds, their diet being mainly freshwater fish supplemented by crustacean, salt-water fish, frogs and insects. They principally feed in daylight but have been observed feeding at night. They are capable of taking fish up to 1kg with a daily intake of a breeding bird of around 750 grams and can make significant impacts on the stock in a short period if unchecked.

**Risk:** Significant risk, visitation at dawn and dusk and ability to take large numbers of large fish.

#### **Little Black Cormorant**

The Little Black Cormorant's (*Phalacrocorax sulcirostris*) distribution is similar to the Great Cormorant. During summer and autumn they tend to congregate in colonies of up to 100 birds in breeding localities such as swamps, lakes and along rivers but tend to disperse during other times. Drought will increase the numbers in coastal areas. The Little Black Cormorant feeds socially taking fresh and salt water fish, crustacea and insects. They tend to take smaller slow swimming fish but because of their abundance in NSW, they have significant impacts on aquaculture farms.

**Risk:** Significant risk; unprotected fingerling ponds most vulnerable; can hunt in large numbers.

### **Pied Cormorant**

The Pied Cormorant (*Phalacrocorax varius*) occurs sporadically in NSW. They tend to breed in colonies during autumn and winter in estuarine areas. They feed principally on fish but also take crustacea and molluscs. Because of their size, they are capable of taking quite large fish but are less of a problem compared with the Great Cormorant.

**Risk:** Less of a risk because of their lower numbers.

### **Little Pied Cormorant**

The Little Pied Cormorant (*Phalacrocorax melanoleucos*) is widespread and most common of the cormorants along most of the rivers, lagoons and swamps of NSW. Colonies may include as many as 4000 birds. These Cormorants tend to be solitary feeders mainly on freshwater crustacea, invertebrates or small slow moving fish up to about 90 millimetres in size. Generally, they are not considered to be a risk for fish farms but can be a major concern for yabby farms. They mainly take slower moving trash fish.

**Risk:** Low risk due to solitary behaviour; can become a problem for crustacean farms.

### **Darter**

The Darter (*Anhinga melanogaster*) distribution is similar to other cormorants but is usually seen in low numbers but may form colonies of up to 100 birds. They can be nomadic with a sudden appearance at water bodies. Their main source of food is fish, small crustacea, molluscs and aquatic insects. Because of their size, it is expected that they will consume similar quantities of fish to the Great Cormorant. However, as they are solitary feeders, they are thought to pose less of a problem than the Great Cormorant.

**Risk:** Reasonable risk, can cause stress to stock and damage to cages.

### **Other potential problem birds**

Nankeen Night Heron (usually at night) and White Faced Herons can be problematic for crustacea, larvae and smaller fish.

### **Water rats**

Water rats can be a nuisance at some sites particularly east coast yabby farms. Water rats are very agile and are often capable of climbing low perimeter fencing.

### **Fish predators**

Poorly designed screening of inlet water can allow the entry of 'trash' fish (including eels) into ponds. Trash fish compete for feed and harbour disease; some species are capable of causing physical damage to stock. Filtering water at the intake, the reservoir and at the pond can eliminate this problem.

### **Poaching**

Poaching of aquaculture stock occurs irregularly particularly from perimeter ponds adjacent to public roads. Some sites may require gates and fencing to prevent access. Strategically placed movement detection lights may be an effective deterrent.

## **6.14 Construction of ponds and related facilities**

It is strongly recommended that you invest in professional construction of ponds to avoid, costly maintenance caused by pond wall erosion, slump, leakage or failure. Leaking ponds (seepage) result in unnecessary cost due to additional water pumping and repair work.

The most common pond type is the 'excavated' pond in which earth is removed and used for building the banks and can be constructed on flat or undulating land. 'Levee' ponds are

constructed on very flat land typically with imported material and are similar in structure to rice bays but have pond walls.

### Soil material

The pond walls and floor should be constructed and/or lined with material capable of retaining water with hydraulic conductivity (eg. less than  $10^{-9}$  metres/sec). Clay or clay/loam is preferable. In loamy soils, heavy compaction using rollers or bulldozers is required. Prior to construction, the proposed site should be surveyed for rock, gravel or sand layers at proposed pond depths. Ponds constructed in sandy or other porous soils may be made watertight by lining the bottom and sides with clay, using sealers or artificial liners. However, this is often expensive and the pond water quality, waste assimilation and ecosystem operate vastly different to earthen surfaces.

The construction of ponds in areas of high groundwater can be problematic as it may be difficult to build ponds that can be completely drained and dried at these sites. Ponds leaking saline water to groundwater pose contamination risks.

Seasonal conditions can affect construction and must be considered in the scheduling of work contracts. Wet weather can create difficulties with plant and equipment and add significantly to costs. Dry conditions will necessitate the application of water to maintain soil moisture during construction.

The main factors that contribute to pond failure are insufficient soil moisture, lack of compaction and the use of poor soil material.

### Erosion and sediment controls

Disturbed areas should be kept to a minimum to reduce erosion during construction activities including problems associated with soil stockpiles, rehabilitation works or truck movements.

Measures to reduce erosion during construction and intercept mobile sediment should include silt fences, sediment traps and the use of straw bales. At some sites, it may be necessary to bund the construction site and soil stockpiles to prevent overland flows from entering the construction area. Measures should include:

- integrating clearing and grading with layout design;
- limiting grading to areas involved in current construction activities;
- limiting the time during which unprotected graded areas are exposed to the wind and rain;
- subdividing drainage catchments into smaller units, at a size appropriate to the type of sediment control measure to be used;
- trapping sediment as close to the source as possible, with sediment traps or filters below all disturbed areas to intercept and detain sediment laden runoff and above all prevent sediment entering environmental sensitive areas such as streams;
- reducing runoff velocity by minimising the length of flow paths and constructing channels with gentle gradients, with rough linings to the steeper channels;
- intercepting and diverting clean runoff water from flowing onto all disturbed areas, including soil stockpiles;
- installing permanent stormwater drainage works as soon as possible;
- applying temporary vegetation or mulch to all disturbed areas, including soil stockpiles, where construction is only partially completed and which will remain exposed for a period of 14 days or more;
- progressively stabilising all disturbed areas either with permanent vegetation or mulch as each stage is completed.

### Rehabilitation of the pond walls and disturbed areas

At the commencement of pond construction, topsoil should be stripped and stored for later use on pond walls, batters or in the rehabilitation of other disturbed areas. As soon as possible, pond walls, batters, backfilling and disturbed areas should be rehabilitated preferably with local native vegetation. All cleared vegetation should be mulched and used to help stabilise disturbed areas. This material should not be placed where it could enter streams during heavy rains or impede drainage.

Any disturbance to coastal or riparian zones including the bed or banks of rivers, estuaries or drainage lines should be stabilised and restored using native vegetation.

### Contaminated soils

You may need to test previous agriculture sites for [chemical residues](#) (pesticide, herbicides, cattle dips). If present, it may be necessary to remove all the topsoil and not use it in the rehabilitation of the pond and batter walls. Leachate from contaminated soil into aquaculture ponds can cause water quality and long-term production problems.

### Acid sulfate soils

#### PREFERRED DESIGN

In a location where there is no ASS, or ASS Landform Class A with [Landform Element class b, l, t, p, y or w](#). (ASS Risk Maps can be obtained from DECCW).

The excavation or disturbance of ASS during construction of ponds, access roads or reticulation drains should be avoided. If the disturbance of [ASS](#) is unavoidable, then the construction must be undertaken in accordance with an approved environmental management plan that is consistent with the [ASS Manual](#). Soil survey work will be required to identify the depth to the ASS and any likely 'hot spot' areas. All excavated ASS material should be treated in accordance with the [ASS Manual](#).

Preloading of the site may be required, with hydrological analysis necessary to determine the effects of compaction on groundwater levels and the potential for discharge of acid.

#### ***Be aware!***

Some ASS clays have the consistency of a gel with up to 70% water content; they have low load bearing capacity resulting in lateral movement or subsidence under load.

## 6.15 Tanks and related facilities

Tank aquaculture may be in open (flow through), semi closed or closed systems. Semi closed and closed farms may also utilise what is referred to as a recirculating aquaculture system (RAS). The tanks may be constructed from materials such as fibreglass, plastic, concrete, glass or metal and are usually situated either wholly or partly above ground. The technologies used in a RAS enable water to be reconditioned and recycled through the farm. The high rates of recycling, together with high stocking levels require sophisticated equipment to polish the culture water for reuse. This equipment includes filtration such as a swirl separators, drum filters and settling tanks, oxygenation, ozonation or UV sterilisation units, pumps, de-gassing chambers and a bio-filter.

Tank aquaculture is generally undertaken in a purpose built farm, industrial or plastic covered shed to assist in controlling environmental factors. They typically have a concrete floor with an integrated drainage system. Tanks are successfully used to rear Murray cod, barramundi and ornamental fish.

The risk of loss in these systems increases proportionally with intensification due to the inherent dependence on life support technology. However, a closed tank aquaculture farm utilising RAS technologies is a secure facility providing protection to both the environment and the aquaculture farm.

### General provisions

The advantages of tank aquaculture include control over stock (including non endemic species), conservation of water, flexibility in site selection and extended growing seasons with temperature control. However, tank aquaculture often has higher capital and operational costs and requires skilled technicians to manage the system. RAS often have the following features:

- structurally sound sheds or buildings;
- stock culture tanks (may include troughs/raceways);
- water pumps and drainage system;
- recirculation system with mechanical filters to remove solids, biological filter system to remove nitrogenous wastes; degassing towers; UV or ozone; temperature control;
- laboratory and general workroom with tanks for holding, sorting, quarantining and treating fish;
- handling/ packaging room for preparing stock for packaging and dispatch;
- plant room(s) with backup generators;
- store rooms for chemicals, feed, equipment;
- office(s) and staff meeting room, toilet and washroom;
- solid waste management facilities (filters, dead fish, packaging, solid waste);
- reconditioned water-holding tanks and disposal provisions if there is no trade waste agreement with Council;
- vehicular access.

### The buildings/structures

The fundamental requirements for structures housing tank aquaculture are that they:

- use well-insulated material to maintain temperature;
- have a concrete floor with high insulating properties and drains;
- have cladding that is salt and water resistant;
- are structurally sound and meet the functional needs of the proposal;
- are cost effective to construct or convert and maintain;
- have sufficient room surrounding the building(s) to handle waste water.

It is preferable that tank drainage lines are not enclosed in the floor concrete as routine cleaning and airing of drainage lines is important. It also allows easy access to all plumbing fixtures and allows for later modifications to the design if necessary.

Tank aquaculture systems can generate high humidity within buildings. Low humidity areas for office and feed storage are required. Electrical service to the site should be sufficient to accommodate immediate and future needs.

## Recirculation aquaculture systems (RAS) components

### 1. Tanks

Generally, circular tanks allow for efficient water circulation and solids removal. However, rectangular tanks/troughs/raceways use floor space more efficiently. Fibreglass tanks have the advantage over concrete of reduced frictional loss, weight, manoeuvrability, wear, colour choice and costs.

### 2. Solids removal

The removal of settleable, suspended and fine solids is fundamental to the successful operation of RAS. Suspended solids and fine solids are the most difficult to remove. Equipment required

to achieve this process include drum screen, belt and bead filters, hydroclones, swirl separators and foam fractionators.

### 3. Biofiltration

The assimilation and breakdown of protein (feed) generates ammonia. The biofilter is a 'living' filtration unit designed to convert ammonia to nitrite and then to nitrate by nitrifying bacteria (eg. *Nitrobacter* sp and *Nitrosomonas* sp.) on high surface area media.

### 4. Water disinfection

The high bacterial load of RAS often necessitates the use of ozonation or UV sterilisation units.

### 5. Aeration

RAS require high stocking densities to operate profitably. High densities can adversely affect water quality and generally RAS require oxygen generators and/or carbon dioxide stripping devices to maintain water quality. Larger systems may incorporate automated pH control to prevent acid waters developing.

## Discharged water reconditioning system

### PREFERRED DESIGN

Freshwater closed tank aquaculture with tanks or ponds capable of storing greater than 2 times the volume of the largest culture/growout tank.

If storage ponds are used then they should comply with the design features outlined in the pond chapter above.

## Discharge water management

### PREFERRED DESIGN

Open (flow through) freshwater (for approved species) or estuarine, marine or saline ground water tank aquaculture with screening to avoid escapement of stock and a water treatment system.

Open (flow through) tank aquaculture farms or semi closed tank aquaculture farms using estuarine, marine or saline ground waters may require additional design features in accordance with any conditions of a licence issued by DECCW regarding the management of the discharged water.

In semi closed tank aquaculture, the volume of discharged water tends to be relatively small (5 to 15% of culture tank volume/day). Therefore, in some land use zones (eg. industrial estates) waste water may be disposed of through the municipal sewage system under a trade waste agreement with the local Council.

It is I&I NSW policy that freshwater tank aquaculture (except approved open (flow through) systems) are not permitted to discharge directly to natural waterbodies or wetlands. Discharged freshwater should be collected in a storage unit (tank or pond) prior to another use such as irrigated agriculture (see [Pond Water Reticulation System](#)). In land use zones where other uses may not be readily available (eg. industrial estate) freshwater may be discharged with approval to sewer.

## 6.16 Water inlets and outlets

### PREFERRED DESIGN

Existing infrastructure to carry inlet and outlet pipe for estuarine or marine water based farms (eg. wharf).

The location of marine inlet and outlet systems is critical from an engineering perspective, particularly in areas exposed to high energy waves and currents. Pipelines traversing sandy beaches must be designed to ensure they are not affected by coastal storms and erosion. Existing infrastructure (eg. piers) or use of existing bedrock for anchoring the pipeline is an other option.

In freshwater open (flow through) production systems, place the inlet and outlet points to prevent dramatic modification to stream levels and flows, taking account of the large volumes of water required.

### **Be aware!**

The use of freshwater for open systems will require extensive consideration by [NOW](#) and [DECCW](#) in terms of water extraction, embargoes and discharge water impacts on the river system (See [Operating the Farm](#) chapter for further information).

## **6.17 Hatcheries**

Hatcheries are facilities where seedstock (fry, spat, etc) is produced for use in aquaculture and stock enhancement of waterways (See [Species Selection](#) chapter). Hatchery facilities include specialised buildings having tanks, incubators, laboratories, live food rearing systems, offices, and earthen ponds. Hatcheries may be stand alone facilities or integrated with a growout aquaculture farm.

Hatcheries require a high degree of technical knowledge involving broodstock conditioning, egg incubation, larval rearing, live feed production and nursery management.

### **Hatchery water management systems**

With an integrated hatchery/aquaculture farm, it is recommended that the hatchery water reconditioning system be kept separate from the farm's system.

Generally, nutrient loading from hatcheries is relatively minor due to a small biomass, low levels of feed input and regular de-stocking to growout farms. However, freshwater hatcheries are still not permitted to discharge to natural waterways or wetlands except for approved open systems which would be evaluated and licenced by DECCW.

Estuarine, marine and saline ground waters based hatchery discharge will be considered on a case by case basis, however, systems should be designed to improve the quality of discharge water. A licence issued by DECCW may still be required to discharge waste water to waterways from these facilities.

### **Hatchery Quality Assurance Scheme (HQAS)**

I&I NSW has developed a Hatchery Quality Assurance Scheme ([HQAS](#)) that describes the key features of the design and operation of fish hatcheries. The program provides a framework for best practice. Consult the HQAS when developing an aquaculture project plan that includes a hatchery facility.

The [HQAS](#) accredits fish hatcheries for the production of Murray cod, golden perch, silver perch and Australian bass fingerlings for recreational fishing enhancement stocking programs. It is planned to expand the HQAS to cover marine species. The scheme is a component of the I&I NSW Fisheries Management Strategy for fish stocking and was developed by I&I NSW Aquaculture and Recreational Fishing Staff with industry consultation and input.

A major objective of stocking programs is to maintain genetic diversity and the HQAS is designed to ensure the genetic integrity and health of consignments as well as the absence of

non-target species. Hatcheries in NSW that produce fingerlings for stocking under the FMS, must be accredited under the scheme.

HQAS accreditation for aquaculture production is also available for Murray cod, silver perch, golden perch and Australian bass as a quality assurance measure for the production of fingerlings to supply the aquaculture industry.

### 6.18 Tourist destination

There is community interest in visiting aquaculture facilities and buying produce directly from the growers. Visits provide an opportunity for the industry to showcase the sustainability of the aquaculture industry and for the broader community to develop an increased understanding of aquaculture operations.

An aquaculture business can include visitor facilities having displays explaining life cycles, operational procedures, farm design or tanks holding live product. Tourism facilities should include toilet facilities, tables and car parking. It is advisable to contact local tourism authorities for assistance.

Fish maintained in an aquarium for public display, might require a permit under the [Exhibited Animals Protection Act 1986](#).

### 6.19 Fishout facility

A fishout is a business where anglers pay to fish in private ponds or tanks. The fishout may be associated with accommodation developments or located in close proximity to urban areas and in rural settings. Intensive fishouts are similar to an aquaculture culture/growout facility that has relatively high stocking levels and aeration to ensure high catch rates and to maintain good water quality and healthy stock. Extensive (no feeding) fishouts also offer quality recreational fishing experiences.

Fishouts should provide fishing tackle as anglers using their own tackle could introduce disease to the facility. Anglers visiting NSW fishouts do not require a NSW recreational fishing licence. Bag and size limits do not apply to fishouts but the operator must supply the angler with a 'record' of the fish taken (date, number, size, combined weight by species and location of fishout). This is to prove the fish was not been taken from the wild.

### 6.20 Waste management

#### **PREFERRED DESIGN**

Site design should provide for daily disposal of organic wastes (material held so not to generate odour or other issues) and the disposal method does not affect groundwater or the local amenity.

Design the aquaculture farm to minimise waste and maximise reuse and recycling of materials at every opportunity. This includes:

- pond and processing water;
- pond sludge and filter materials;
- processing wastes and dead fish;
- packaging material.

Adequate facilities should be included in the design for the safe and efficient management of all wastes, especially organic material. The short-term storage of waste on site or its permanent disposal can lead to odour and vermin issues that can evolve into amenity and health issues. Any proposal that includes the onsite disposal of waste, in particular organic waste, must consider the potential impacts on nearby residences or for contamination of surface or ground water.

## 7. Operating the Farm

### 7.1 Business management

#### Annual production goals, products, markets

A business plan is a living document that should be prepared and reviewed regularly as the business evolves (see [Business Planning](#) chapter) and when major events occur, change of species, technology, production rates or management is proposed. The enterprise's progress and operation should be checked against the plan.

#### Personnel management and training

##### PREFERRED MANAGEMENT

Staff trained in water quality monitoring, disease management, husbandry practices and water management.

Experienced staff are essential in the operation of an aquaculture business. All new and existing staff must be aware of the need for the aquaculture enterprise to operate in an environmentally sustainable manner. They need specific training in disease and water quality management and correct husbandry procedures. Training should include:

- stock management, health and welfare;
- product quality control post harvest, quality assurance and food safety;
- pond/tank water management procedures;
- familiarisation with discharge permit, chemical approvals and licence conditions;
- commitment to waste prevention and energy conservation;
- contingency management procedures;
- the importance of monitoring and reporting.

Aquaculture courses exist at both tertiary and TAFE levels and training should include Occupational Health and Safety (including first aid, chemical use and machinery operation).

### 7.2 Species management

Only those species authorised by an Aquaculture Permit issued by I&I NSW can be cultured on the aquaculture farm. Also, certain species sourced from interstate are required to fulfil specific disease clearance protocols prior to stocking a farm.

Before fish are introduced to the culture environment, conditions should be favourable for survival and growth. Check water quality variables including temperature, salinity, pH, dissolved oxygen, ammonia, nitrite and alkalinity. Exclude potential predators. Stock containment practices must ensure that no farmed stock is released into the environment.

#### Stocking densities

Stocking density has a significant effect on the performance of aquatic animals. It influences behaviour, feeding patterns, incidence of disease, water quality and growth. Generally, stocking densities are much higher in tank aquaculture compared to pond aquaculture. To calculate an appropriate stocking density consider:

- Species;
- Culture system;
- Production strategies including life stages;
- Operator's skills and management systems.

#### Avoid stress

Aquatic animals are very prone to stress that may occur during handling (eg. grading, harvesting, transferring between ponds and under transport), heavy predation (eg. cormorants), during chemical treatments, poor water quality, malnourishment or overcrowding events. Stress will reduce growth, elevate FCR's cause disease, lessen marketability and impact on the success of

an aquaculture business. Good husbandry techniques to help stress prevention include:

- maintaining water quality;
- optimum stocking rates;
- quarantining of stock entering the farm and following handling;
- use of high quality feeds;
- regular monitoring of water quality and disease; prompt application of chemical treatments;
- implementation of disease preventative measures (eg. filtration, use of bore water, disinfection).

## Health management

### PREFERRED MANAGEMENT

Staff trained with appropriate equipment to monitor water quality and disease; quarantining facilities available.

Good aquaculture practices minimise stress and reduce disease risk in cultured animals. Initially, the purchase of certified pathogen free stock is advisable; new stock is a common pathway for disease transmission to farms. Quarantine and treat all new stock, including broodstock, prophylactically prior to stocking.

Most species are susceptible to disease under intensive and semi-intensive culture conditions. The interactions that cause disease outbreaks relate to three key components, namely:

- the presence of a disease agent;
- the host (the cultured organism);
- the environment (water, pond, tanks, feed, etc).

## Disease prevention

Many disease organisms already exist in the culture environment and it is when an adverse environmental change occurs (eg. stress, poor water quality, over-crowding, poor husbandry practices, etc) the disease manifests. Disease on farms has a significant impact on production with the loss of stock and productivity, costs for chemical treatments and disruption of farm processes and staff. Disease in hatcheries can be a particular problem as the incident can affect the hatchery itself (loss of income) and any growout farms or programs reliant upon the hatchery stock.

Disease specific prevention programs will minimise the risk of disease outbreaks occurring. Disease can enter a farm via new stock, water exchanges (especially surface waters), borrowed equipment and visiting vehicles, personnel or animals. It is often costly and difficult to rid a farm of disease therefore it is advisable to take all precautionary measures. Equipment and operator transfer between tanks/ponds is a common way of spreading infectious agents once on the farm. Nets, boots, etc should be sterilised using baths (chlorine/iodine) and sun dried.

## Disease management

Australia and NSW are fortunate in being free of the major diseases impacting on overseas aquaculture. Aquaculture permit conditions require I&I NSW to be promptly notified in the event of any disease/suspected disease or any significant deterioration in the wellbeing of stock (eg. greater than 5% mortality). I&I NSW may issue directions including quarantine of the premises in such an event. The permit holder is prohibited from releasing effluent (off farm) or selling fish having a [Declared Disease](#) (suspected or otherwise) under the [Fisheries Management Act 1994](#).

It is important to have a Health Management Plan (HMP) to help diagnose, treat and manage disease (the [HQAS](#) contains an example HMP). A disease monitoring protocol as part of the HMP should include routine monitoring of stock behaviour and feeding activity, monitoring of

water quality, disease and disease management. Priority should be given to ponds or tanks having:

- high biomass or high feeding rates particularly during summer months;
- episodes of poor or changed water quality;
- signs of moribund stock, mortalities or poor feeding responses;
- stock behaving abnormally (including stock that has not been sighted for a few days).

New ventures need to plan for [disease management](#). Approaches may include:

- protocols in place to [submit disease samples](#) to a diagnostic laboratory and a veterinarian;
- appropriate training of staff in disease recognition and treatment;
- clear quarantine procedures and processes of notification.

Most disease management can occur on-farm. The tools required to do this (water quality meters, dissection kit, microscope and [references](#)) are an essential component of any aquaculture operation.

### Some disease profiles

#### Freshwater crayfish

Thelohania ‘white tail disease’; protozoan, microsporidian; commensals, rotifers, platyhelminthes (*Temnocephala spp*). other protozoans, some records of nematodes, cestodes, polychaetes and arachnids found on Australian crayfish.

#### Freshwater native fishes

Ecto-parasitic protozoans common, myxosporeans, ect-commensals, gill flukes and copepods, fungal (*Saprolegniosis*) and less common, bacterial diseases

#### Trout

Temperature stress, bacterial diseases (*Streptococcus spp*); common parasites as for freshwater native fish, viral diseases, Epizootic Haematopoietic Necrosis Virus (EHNV).

#### Barramundi

As for freshwater native fish particularly ecto-parasitic diseases; barramundi restricted to tank (RAS) systems in NSW, bacterial diseases (*Streptococcus*, *Mycobacteriosis*) can be problematic, barramundi potential carrier of Barramundi nervous necrosis virus (BNNV), has potential to affect native endemic species.

#### Eels

As for freshwater native fish particularly ecto-parasitic disease; juvenile eels sourced from the wild, potential carriers of disease organisms, some evidence of susceptibility to fungal and bacterial infections.

The document “[Diagnosis, treatment & prevention of diseases of the Australian freshwater fish Silver perch](#)” on the I&I NSW website contains a number of useful disease diagnostic tools and management procedures that can be applied to other species.

### Therapeutants and chemicals

At times, it will be necessary to apply therapeutants to treat stock for diseases and parasites.

No aquaculture therapeutants should be used unless approved for use by the [Australian Pesticides and Veterinary Medicines Authority](#) (APVMA) or a veterinary script is obtained. They should be used in accordance with the manufacturer's instructions as outlined on labels or permits, veterinarian directions and relevant State and Federal legislation. Aquaculturalists should maintain accurate records regarding the use of chemicals as part of their HMP. Any

withholding periods stated on the labels/permits should be adhered to prior to sale for human consumption.

### **Aquatic predator management**

#### **PREFERRED MANAGEMENT**

Screening/filtering on intake of surfacewater, regular drying of storages, ponds and channels and exclusion netting or deterrent systems.

Predator management should be considered as part of the HMP as predators can cause stress and disease in stock. Screening of intake water and outlet structures, regular drying of ponds/storages and removal of mortalities is recommended. Predatory birds should be deterred by using netting, overhead wires, deterrent systems and staff patrols (See [Planning and Design](#) chapter).

### **Avian predator management**

#### **Licences to control native avian predators**

It is illegal to harm native animal species unless a licence to control predatory birds has been granted by the Department of Environment, Climate Change and Water (DECCW). [Licences](#) issued by DECCW under section 121 of the [National Parks & Wildlife Act 1974](#) are considered an extreme measure for managing bird predation. Also, Commonwealth approval may be required ('migratory species of interest' under the [EPBC Act](#)) to harm some bird species. (see [Integrated Approvals](#) chapter).

#### ***Be aware!***

Killing cormorants or other native birds or animals (eg water rats) is an offence. Aquaculturalists should not rely on DECCW continuing to issue [licences](#) to control predators.

If the birds are listed under the [Threatened Species Conservation Act 1995](#), applications for licences to harm these species will require a detailed level of assessment. As a general rule, DECCW is not likely to issue a licence to 'lethally harm' threatened species.

## **7.3 Feed management**

#### ***Be aware!***

That a system that delivers feed at optimum levels will promote maximum growth and feed conversion, prevent disease, maintain water quality and results in the lowest cost of production.

Feeds and feeding are usually a major component of total operating costs of aquaculture operations. Improvements in feeding strategies (ie. feeding frequency, feeding rates and delivery methods) can significantly improve farm profitability. The goal is to feed efficiently using a diet that will produce rapid growth, best food conversion efficiency for the least cost.

Feed is the major contributor to pond/tank water quality deterioration. To minimise feed waste managers should:

- Regularly sample stock for growth and biomass; grade stock, adjust rations and pellet sizes as the stock grows. Over feeding causes poor water quality and wastage; underfeeding will result in poor growth;
- Use high quality feeds meeting the species nutritional requirements (eg. for protein and essential amino acids, digestible energy, total fat and essential fatty acids, trace minerals and vitamins);
- Store feed in a rodent proof, low humidity, cool room;
- Suspend feeding when water quality or disease problems are suspected.

The rate of delivery of feed is as important as the ration amount to prevent wastage.

## 7.4 Harvest management

Incorrect harvest procedures can cause fish stress and injury that will adversely affect product quality, marketability and the subsequent selling price. Harvesting methods might include the use of nets, traps, trawls or the draining of ponds/tanks.

Harvest procedures should minimise stress, even if animals are to be slaughtered. It is important to maintain water quality during harvest procedures; use bottled oxygen when practicable. Design preharvest procedures to ensure:

- a planned approach is undertaken; avoid harvesting in poor water quality, following feeding, when animals are diseased and during the heat of the day;
- adhere to any therapeutic or chemical withholding periods and purge animals if required;
- ensure seafood is chilled internally (use a probe thermometer) and packed well with ice.

## 7.5 Comprehensive quality assurance systems

Establish a comprehensive Quality Assurance System to assure product quality. A number of accredited systems have been developed and these usually revolve around [hazard analysis critical control point](#) (HACCP pronounced ‘hass-up’) principles.

**Figure 8. The 7 steps to HACCP.**

1. Determine what the hazards may be. ‘Hazards’ for the produce at the farm including pre-harvest, harvest and post harvest issues.
2. Identify the *Critical Control Points*. These are the important areas or stages where things may go wrong, so they are critical to eliminating the hazards (eg. product exposure to high temperatures following harvest).
3. Set the ‘*critical limits*’ for each Critical Control Point. Again, these will vary from business to business, but an example could be a chiller temperature setting. Exceeding the critical limit will cause a problem problem may occur.
4. Monitor the *Critical Control Points* to record whether the targets are being met and any problems can then be traced.
5. Establish corrective *Actions*. These are the actions taken when monitoring shows there is a problem.
6. Verify that the HACCP system is working correctly. It is all very well having an effective system but it must be doing the job required. For example this step might involve microbiological testing.
7. Keep an accurate record so those responsible can track trends to improve management decisions. Record keeping must be thorough. Regulators also need records for compliance and auditing purposes. Producers who have their quality systems accredited need comprehensive auditable records. Independent third party auditing proves to customers that the stated procedures are being followed.

Hazards may be introduced into any stage of the handling and distribution of fish products. Prevention relies on:

- attention to the design and construction of the premises;
- equipment design;
- water quality controls;
- appropriate premarket conditioning protocols (if necessary for aesthetic or health reasons);
- pest/vector control programs;
- cleaning control programs;
- personnel hygiene and health awareness.

These practises are defined as good manufacturing practises and good handling practises. Of particular importance is the need to prevent cross contamination from raw to cooked product and the exclusive use of potable water and ice at all times. Automatic temperature controls are necessary for the maintenance of quality and in some cases is vital for ensuring food safety. Temperature control throughout the distribution chain, from harvest to retail, is an essential precaution.

## 7.6 NSW Food Authority issues

NSW Food Authority administers the [Food Act 2003](#). The [NSW Food Authority](#) is responsible for food safety arrangements from catch or harvest to plate. The NSW Food Authority is progressively developing [Food Safety Programs](#) for food industry sectors in NSW.

### Seafood businesses - NSW Food Authority licensing requirements

Seafood businesses in NSW are required to be licensed with the [NSW Food Authority](#). Seafood businesses are defined under section 147 of the [Food Regulation 2004](#).

There are heavy penalties for the operation of a seafood business without a NSW Food Authority licence with maximum fines of up to \$275,000. To apply for a license you should contact the NSW Food Authority licensing branch on (02) 6552 3000 or go to the website for a [licence application form](#).

### The Food Standards Code

All food sold in Australia is required to meet the requirements of the Food Standards Code (the Code). Food that does not meet the requirements of the Code may be seized and destroyed, in addition the manufacturer of the food maybe prosecuted for non-compliance with the Code. The Code can be obtained from the [Food Standards Australia New Zealand](#) website.

The NSW Food Authority has adopted [codes of practice](#) that regulate the design and construction of seafood premises in addition to the [food safety programs](#) mentioned above which regulate the processing and storage of seafood.

As a part of its licensing and approval process the NSW Food Authority assists businesses in the development of a Food Safety Program that complies with the Food Standards Code. Freezers, cool rooms, processing and packaging rooms must comply with certain design requirements in relation to floors, walls, ceilings, fittings and amenities. The NSW Food Authority can provide advice on the construction and fit out of these facilities to ensure compliance with the relevant standards. For further details call the [NSW Food Authority](#) information line on 1300 552 406 (local call Australia wide).

## 7.8. Farm preparation before stocking

### Tank and pond

Preparation of ponds or tanks for stocking is a step undertaken following total harvest of the culture unit or initial construction and start up. In the case of all in/all out production regimes, this usually follows a farm dryout, repair and maintenance phase.

A pond and tank preparation protocol should be developed with a timetable for activities such as maintenance, repair and reinstallation of all screens, aeration and filtration equipment, pumps and pond and tank structures. Pond preparation usually occurs at the completion of growout season or during cooler non-productive months.

### Dryout periods (ponds & tanks)

Generally, complete dryout of the entire farm is favoured for some species, as this practice has shown to reduce disease incidence and result in higher production. At the completion of the growout cycle, the culture unit should be dried completely. For ponds a drying period can be completed in about one month under favourable weather conditions. Following the drying of ponds, the bed is usually tilled (5 to 10 centimetres) to ensure the oxidation of residual organic matter. Excess silt can be removed and pond walls repaired if necessary. Where soils are acidic, agricultural lime may be added. Calcium hydroxide (Ca(OH)<sub>2</sub>) or calcium oxide (CaO) may be used to sterilise persistent damp patches.

**Establishing optimal plankton populations for larvae/fry rearing stages (ponds)**

Ponds with newly stocked larvae require microscopic animals (zooplankton) as a food source in order for them to survive. Zooplankton feeds upon phytoplankton (microscopic plants). The latter's growth is promoted by adding inorganic and organic fertilisers to the pond. This is often more an art than a science, individual farms having unique fertiliser regimes based on their climate, soil types and plankton response.

**Recirculating aquaculture systems (RAS)**

Pre-activation of the recirculation systems biofilter to stimulate the colonisation of nitrifying bacteria can be accomplished by seeding with appropriate bacteria or fish may be stocked with a gradual increase in feed (over 4 to 6 weeks). Biofilters usually take a period of months before being fully colonised and stable. Therefore, caution should be used when first stocking an RAS.

**7.9 Pond/tank water management**

Intensive aquaculture involves the addition of formulated feeds that result in elevated nutrient levels in the culture system and effluents. The degree of management of water quality will depend upon the type of culture that is undertaken.

Feed (protein) input can alter water quality by increasing turbidity (algae and suspended solids), ammonia, nitrite and nitrates. These processes can in turn, influence levels of DO, pH, alkalinity, carbon dioxide, hydrogen sulfides and other parameters.

Pond aquaculture usually employs a 'static' water rearing method where water is required for initial filling and then only to replace evaporation, seepage and water exchanges. The pond environment usually assimilates wastes generated from feed input. Water quality is more problematic under summer conditions due to high feed inputs and elevated temperatures.

In open culture units, the process of water exchange removes the metabolites.

Water quality management is more intensive in an RAS than pond aquaculture. RAS require sophisticated life-support equipment to maintain water quality. This includes swirl separators, biofilters, other filter units, pH buffering systems and de-gassing chambers. All tank facilities operate under partial water exchange to replace water lost through backwashing, cleaning and husbandry processes. Daily water exchange could range from 5% to 25% depending upon the system design and operation.

**Monitoring****PREFERRED MANAGEMENT**

Provide for regular monitoring of dissolved oxygen (DO), pH, temperature, ammonia, nitrite, nitrate and alkalinity.

Pond aquaculture should be monitored for water quality (DO, pH, temperature, TAN, ammonia) at least twice a week in summer. Tank aquaculture systems should be monitored for water quality daily (DO, ammonia, nitrite, nitrate, alkalinity, pH, salinity and temperature). Meters should be of high quality and calibrated regularly (once/week).

**7.10 Discharge of reconditioned waste water*****I&I NSW Policy!***

It is I&I NSW policy that intensive freshwater aquaculture farms are not permitted to directly discharge water to natural waterbodies or wetlands (exception for approved open (flow through) systems).

**Be aware!**

Aquaculture farms discharging water (fresh, estuarine, marine or saline ground waters) to natural waterways may require a licence issued by DECCW under the [Protection of the Environment Operations Act 1997](#). Discharge structures placed in, on or within 40 metres of a water source will require a controlled activity approval for their construction under the [Water Management Act 2000](#).

Land based aquaculture systems should endeavour to recirculate as much water as possible. The management of the ecological processes within the reconditioning areas or tanks can significantly improve discharge water quality prior to its return to the culture unit, reuse system or the environment (if permitted).

Aquaculture farms that are permitted to discharge water to natural waterbodies must manage this water to ensure it complies with the conditions of the aquaculture permit, the development consent and any licence issued by DECCW under the [Protection of the Environment Operations Act 1997](#) (POEO Act).

The DECCW licence conditions including load and concentration limits, and monitoring and reporting requirements will be determined on a case by case basis. These conditions will be developed with a view to maintaining the NSW Government [Water Quality and River Flow Interim Environmental Objectives](#) (WQOs) in the relevant catchment.

Where oyster leases or major fishing grounds are located nearby, there may be additional requirements for protection of water quality for safe consumption of aquatic foods. In the event of a disease issue, I&I NSW may order the farm water to be quarantined with no discharge being permitted from the premises.

Freshwater that can not be discharged to natural waterbodies or wetlands can be managed in the following ways:

- retained in a discharge pond and recycled in the aquaculture enterprise;
- discharged via town sewerage infrastructure (trade waste agreement);
- stored and utilised for agriculture, hydroponics or horticulture; or
- disposed of by irrigation or evaporation.

**Monitoring quantity and quality of discharge**

DECCW licences for aquaculture will usually be set for a number of parameters, including BOD, NFR, TP, TN, DO and pH. The licences may place limits on the daily discharge from the farm (eg. 10,000kL/day). The licence will set out how the discharge volume is to be monitored and calculated.

Monitoring of above parameters and an annual statement of compliance is required under the [POEO Act](#).

**Substituting raw water with discharge water**

As part of an integrated freshwater aquaculture farming enterprise, horticultural or agricultural crops may utilise discharge water instead of raw water. Other uses on an aquaculture farm may include irrigation of landscaping or gardens. In some locations, it may be possible to transfer discharge water to neighbouring properties for irrigation use. Provision must be made to store discharge water during rainy periods. Discharge ponds should be constructed with plenty of leeway and runoff from surrounding land must not be captured. Land for irrigation should not be within 50 metres of a natural waterbody.

When irrigating with discharge water, the following factors should be considered:

- soil characteristics (plant growth, permeability);

- avoiding sloping land unless drip irrigation;
- efficient application methods, metering/monitoring so not to over water;
- adequate erosion management provisions;
- avoiding land with salinity or potential salinity problems.

Under normal circumstances where water is used as a substitute for raw water, specific licence conditions for its use are not required.

### Sludge management

Ponds should be dried regularly and de-silted. Removed silt/sludge can be used on-farm depending on the nature of the material. Sludge from tank aquaculture may be de-watered disposed of via:

- disposal to landfill;
- sent to a commercial composter; or
- used in agriculture.

## 7.11 Managing other environmental issues

### Noise

On farm noise sources such as those associated with construction, equipment for feeding, pumping, aeration, harvesting, maintenance and construction need to be managed, particularly if located near residential areas. Sound may travel at night due to the effects of temperature inversion, air drainage and winds. Consequently, the responsibility is on the operator of the farm to ensure that noise impacts do not unreasonably affect neighbouring residents not only during the day but also evenings or weekends. DECCW can provide [information](#) on the assessment and management of noise issues.

With all plant and equipment, every effort should be made to reduce the noise levels at the source, for example with fitted silencers, insulation, vegetated bund walls or maintenance programs. For farms needing a licence under the [POEO Act](#), there is a requirement that all plant and equipment should be operated and maintained so as not to exceed the prescribed sound levels.

The use of noisy predator scare systems, sirens, PA systems, vehicle backing or other noisy devices that may be a noise nuisance should be minimised where possible.

### Odour

Odour emissions from aquaculture facilities can be associated with drying ponds, storage of feeds and management of any dead stock or fish processing wastes.

Minimising impacts of odours should be considered in the farm layout (eg. feed storage area, equipment, waste, cleaning and maintenance depots) and during operational procedures (pond/tank dry-out procedures). Solid waste should be stored, transported and disposed of so as not to cause an odour nuisance.

Sediment from ponds or sludge from tanks must be disposed of in a manner that will minimise odour or leachate problems. Do not disturb sediments in ponds until dry, when it can be either incorporated into the bed of the pond or removed. Sediment from tanks should be stored in a designated storage area (within appropriate bunding or sediment trap to prevent sediment runoff to adjoining areas/waterways) prior to:

- spreading as top soil in appropriate crop or pasture areas; or
- transport to a commercial composter or landfill.

### **Dust**

Dust can pose problems during construction stages and dry periods (see [Planning and Design](#) chapter). Appropriate surfacing of high volume traffic roads and vegetating wind exposed areas can minimise dust emissions. Until disturbed areas are stabilised, water and/or mulch should be used to control dust. It is recommended that neighbours be advised ahead of work schedules that are likely to generate dust.

### **Visual appearance**

Neat and tidy operations, vegetative screen plantings, earth mounds and aesthetically placed and coloured building should be adopted. In rural environments, landscaping should be used to soften the impact of 'industrial' shed complexes including planting of native species along boundaries.

### **Energy and greenhouse issues**

Energy efficiency initiatives can lead to benefits which extend beyond energy savings to include pollution prevention, process efficiencies and increased productivity. Farm operations should be designed to minimise energy usage (eg. gravity distribution of water) and use renewable energy technologies (solar or wind power) where possible.

In addition, consider energy conservation and cost reduction opportunities including:

- monitoring annual and quarterly energy expenditure;
- maintain equipment performance;
- use of 'off-peak' energy;
- identifying and rectifying actions or activities that waste energy or use energy inefficiently.

Aquaculture operators may also be able to minimise their greenhouse gas emissions by participation in programs run by State and Federal Governments.

### **Waste management**

Waste management protocols should be developed to reduce and recycle waste and to store and dispose of waste material responsibly.

The [POEO Act](#) establishes a classification system for wastes, which is documented in the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* ([Waste Guidelines – EPA 1999](#)). The obligations in respect of the management of wastes are based on their classification in accordance with the waste guidelines.

**Table 8. Waste categories likely to be generated by aquaculture farms.**

| Types of waste   | Implications  |
|--|---|
| <b>Non-liquid inert waste</b> <i>These types of waste are subject to minimal regulation</i>  |   |
| Virgin excavated natural material (VENM) eg. Clay, gravel, sand, soil or rock that has not been mixed with other waste. This category does not include chemical contaminated soils or ASS unless treated to meet criteria approved by DECCW. | If material is to be brought onto the site for the construction of ponds, it should be clearly established that the material is from an approved quarry or meets the VENM classification. In addition, if there is excess material to be removed from site following pond construction, ensure that it is not mixed with other materials or waste so it meets the VENM classification.<br><br>If ASS are to be removed from site, ensure that it is treated in accordance with the ASS Manual (ASSMAC) prior to removal from site to neutralise/remove the acid generating potential. |
| Building and demolition waste not mixed with other wastes or containing asbestos   | Preferably building waste should always be sorted into components (eg. Brick/concrete, glass, timber and metal) for reuse or recycling.   |
| Packing and office waste (paper, plastics, glass, metal and timber) not mixed with other wastes.   | Preferably these should be recycled. A major source of waste is the plastic or paper bags used to transport feed. Reductions in the use of feed as a result of efficient feeding management result in reduced waste generated or the supply of feed in bulk form.   |
| <b>Solid waste</b>   |   |
| Food waste.  | Should pursue options to recycle material (eg. fishmeal, compost). Otherwise dispose of to an approved landfill.  |
| Cleaned pesticide, biocide, herbicide or fungicide containers (cleaned in accordance to AVCARE protocols).   | Avcare Protocols require recycling of containers as a first option. For copies of the Avcare Container Management Strategy, contact: Avcare, Level 2, AMP Building, Hobart Place, Canberra, mail to Locked Bag 916, Canberra ACT 2601. Phone 02 6230 6399 Fax 02 6230 6355. Email: avcare@ozemail.com.au  |
| Pond/tank sludge that does not contain heavy metals or hazardous chemicals.  | The preferred use of the material is in compost mixes and/or incorporation into agricultural purposes. If these preferred uses are not available or inappropriate it is appropriate to send to an approved landfill site. Composting and agricultural use of sludge may not be appropriate for sludge from salt-water ponds/tanks.  |
| <b>Industrial waste</b>  |   |
| Asbestos waste from old buildings or industrial plant.   | Any asbestos should be managed in accordance with the requirements of Clause 29 of the <i>Protection of the Environment Operations (Waste) Regulation 1996</i> and disposed at a lawful waste management facility.  |
| <b>Hazardous liquid or non-liquid waste</b>  |   |
| Quarantine waste.  | This material must be stored, handled, transported and pre-treated in accordance with the requirements of the Australian Quarantine and Inspection Service (AQIS) prior to disposal at a disposal facility approved by AQIS. It should be noted that most landfills are not licensed for disposal of quarantine waste.  |
| Chemicals, pharmaceuticals and poisons.  | If chemicals are not to be use, inquiries should be made with distributors about the possibility of returning the material. Alternatively inquiries could be made as to whether other users are interested in taking the material. As a last option, the <i>Assessment, Classification and Management Guidelines</i> should be followed regarding the safe disposal of the material.  |
| <b>Liquid wastes other than hazardous above</b>  |   |
| Group A: Oils, solvents and solvent containing liquids.  | Arrangements should be made with a contractor to remove these materials from the site preferably for reuse or recycling.  |
| Group B: Liquid food waste or grease traps from food processing.   | Arrangements should be made with a contractor to remove these materials from the site preferably for reuse or recycling.  |
| Group C: Sewage – if on-site system.   | Where connection to a reticulated sewerage system is not an option, on-site sewage treatment should be in accordance with the Guideline - <i>On-Site Sewage Management for Single Households 1998</i> .   |

### **Environmental contingency planning**

A Contingency Plan should be established with specified management actions documented to deal with problems should they occur. Issues that should be dealt with in the plan include:

- water quality incidents;
- predators;
- chemical spills;
- flooding;
- dam/pond security;
- power failure or mechanical failure of key equipment (especially important for tank aquaculture systems).

The Contingency Plan should include protocols which all staff should be made aware of including:

- agreed indicators that suggest that there is likely to be a problem;
- a requirement to alert appropriate senior person in the company immediately;
- what actions will be taken should the conditions deteriorate;
- what actions should be taken in the event that problem results in environmental breaches occurring;
- what actions should be taken in the event that the problem results in a loss of stock;
- when the regulatory authority and others should be alerted.

Other issues that may need to be contained in the Contingency Plan include drought proof planning in relation to pond/tank and/or potable water supplies particularly where water supply may not be reliable.

### **Decommissioning an aquaculture facility**

The objective of the NSW LBSAS is to ensure that aquaculture enterprises are established and operated in a sustainable manner. As a result, emphasis has been placed on the need for careful site selection, design, operation and business management.

In the advent of an aquaculture enterprise ceasing operations, the site should be secured and not generate unacceptable off-site environmental impacts or create an unsafe environment (eg. electrical infrastructure, chemical storage, building security).

Decommissioning works may include:

- closure of water intake and outlet channels and removal of pipes/pumps from rivers/estuary;
- stabilisation of disturbed riparian zones;
- stabilisation of ponds/dams;
- perimeter fencing.

### **Good neighbour policy**

The establishment and maintenance of good public relations is essential for individual farms and reflects on the industry as a whole. Aquaculture, in part due to its novelty, attracts a large amount of community interest. It is important to recognise this interest and deal with it in a sensitive manner.

### **Tourism and the community**

Consumers are increasingly concerned with the environmental credentials of food production and aquaculture enterprises can benefit from demonstrating its environmental credentials. The public should be dealt with openly and honestly even when things go wrong. It may be useful to seek advice in preparing a Public Relations Management Plan for promoting products as well as for dealing with routine enquiries and complaints. Active and transparent management of community relationships can pay long term dividends.

Making provision for the public to visit the facility either as part of a tourist visitor centre or as an active program (Fishout) can help establish an open door approach to the broader community. This can help to promote aquaculture in the local economy as well as help promote the industry as a whole.

### **Complaints handling procedures**

Aquaculture farms may be required to establish complaint handling protocols under their conditions of consent. Local Councils should be informed of the procedures so that on receipt of any complaints they are able to redirect issues to the appropriate regulatory departments. The Complaints Handling Protocols may include:

- a contact number and a site contact person who manages complaints;
- a complaints register including a record of the complainant, the date/time, the nature of the complaint;
- proposed mitigation measures and follow up with the complainant;
- any contingency measures when repeated complaints are received including provisions for additional monitoring and amelioration measures;
- any compliance performance agreements with residents;
- any reporting procedures to relevant government agencies or Council.

It should be recorded if complaints originated from normal operational procedures, an 'incident' or occasional procedure:

- if from occasional procedures, discussions should be held with complainants regarding whether it was the timing or nature of the impact and how the impacts can be better managed. In many cases an agreement can be reached between parties regarding procedures, timetables, duration and intensity;
- if it resulted from normal operation procedures, these procedures should be reviewed in discussion with the relevant approval authorities.

## **7.12 Integrated compliance monitoring and reporting**

### **Monitoring**

An Environmental Monitoring Program, if required under a development consent, should be carefully designed and related to the key environmental indicators that demonstrate the sustainability of the aquaculture farm. The program requirements will be provided by the consent authority.

### **Record keeping**

Comprehensive record keeping is essential, not only as a requirement of licence and permit conditions, but as a fundamental tool in farm management and trouble shooting. A database for record keeping should be established for tracking both business and environmental performance.

From a business management point of view, data sets make analysis of expenditures, production levels, returns and environmental performance for sound future planning. In addition, the data is available for reporting to relevant government agencies on environmental performance. DECCW usually requires records to be held for a minimum of 3 years so if necessary, the details of longitudinal trends can be checked.

### **Reporting**

An annual report may be required under your development consent, aquaculture permit, environmental protection licence and any other approval. The report may include matters relating to stock management including translocation issues, disease management, sales and production.

DECCW may require more regular reporting (eg. monthly or quarterly) for farms that hold an environment protection licence under the [POEO Act](#) to discharge water to natural waterbodies.

### Incident reporting

Aquaculture operators are required to report incidents that are not authorised under an approval of the appropriate regulatory authority. Table 9 summarises some incidents and the response required.

**Table 9. Incident reporting.**

| <b>Incidents</b>  | <b>Authority</b>  | <b>When</b>                                |
|---|---|--|
| Disease outbreak or unusual stock behaviour   | I&I NSW   | As soon as practicable but within 24 hours |
| Incidents involving breaches of quarantine or translocation protocols   | I&I NSW   | Immediately and in not more than 24 hours  |
| Incidents causing or likely to cause environmental harm whether on or off the premises which are not authorised under the approval (eg. chemical spills, accidental release of untreated water) | DECCW pollution line if appropriate regulatory authority or Council | As soon as practicable but within 24 hours |
| Dam safety or flooding issues   | DECCW and local Council   | As soon as practicable                     |
| Incidents involving harm to birds or other native fauna which are not authorised under the approval   | DECCW   | Immediately and in not more than 24 hours  |
| Bushfires   | Fire authority and local Council                                    | Immediately                                |

## 8. Assessment and Approvals

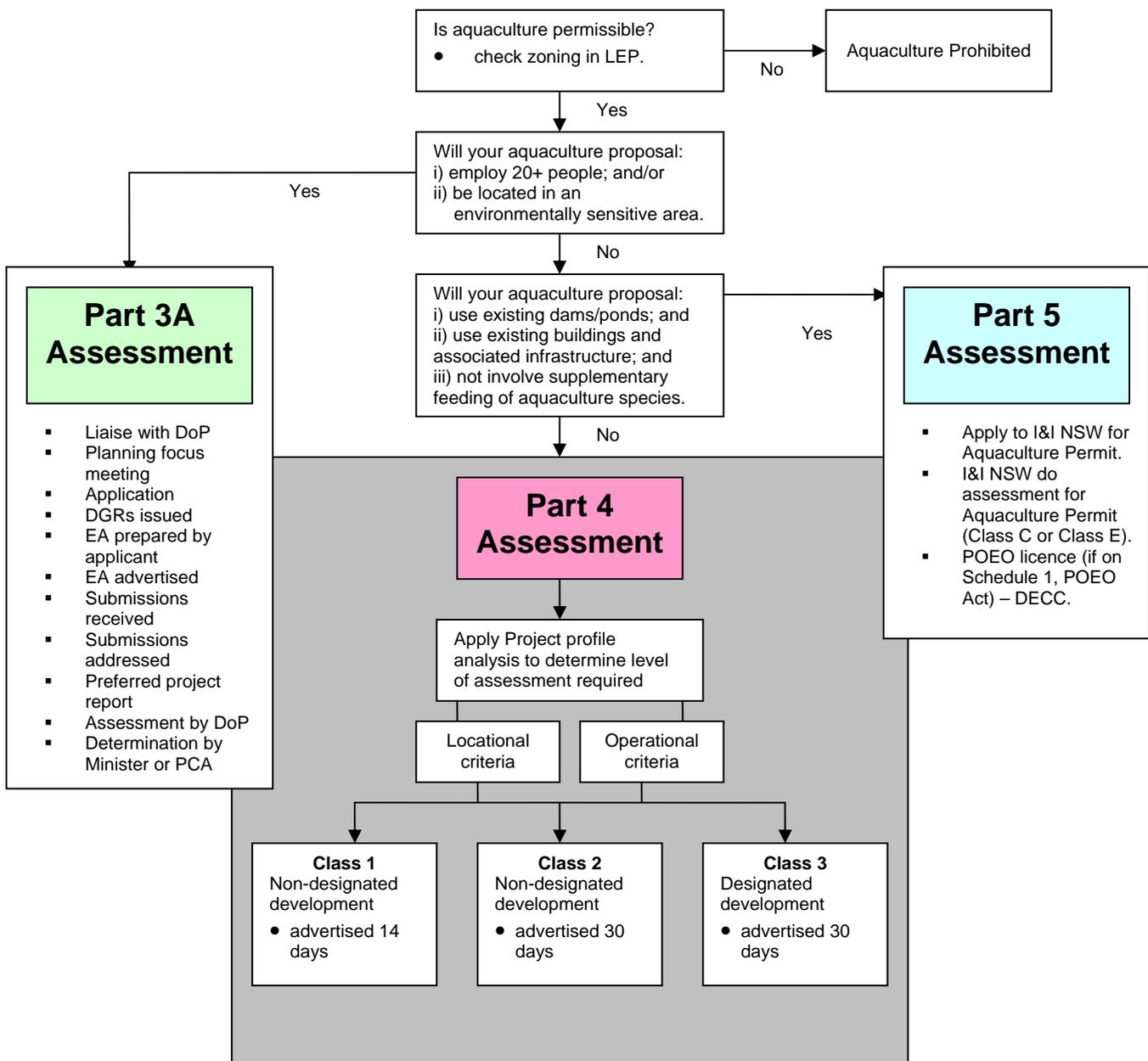
### 8.1 The Strategy’s assessment regime

The NSW LBSAS includes identification of appropriate aquaculture sites and a simplified approvals process. It is gazetted under *State Environmental Planning Policy (SEPP) – 62 Sustainable Aquaculture*. NSW LBSAS also contains an *Aquaculture Industry Development Plan (AIDP)* which is gazetted under the *Fisheries Management Act 1994*. The AIDP specifies best practice guidelines based on ESD principals.

#### Part 3A, Part 4 or Part 5 of the EP&A Act

The assessment regime for aquaculture projects in NSW is determined by the *Environmental Planning and Assessment Act 1979 (EP&A Act)*. Depending on the size and location of a land based aquaculture project, the assessment can be under Part 3A, Part 4 or Part 5 of the EP&A Act. Figure 9 summarises the pathways for different land based aquaculture projects.

**Figure 9. Assessment under the Environmental Planning and Assessment Act 1979.**



## 8.2 Part 3A – Major projects

After establishing whether the proposed aquaculture project is permissible you can determine whether your project is a major project. *State Environmental Planning Policy - Major Projects 2005* (MP SEPP) identifies major projects that are assessed under Part 3A of the EP&A Act by DoP and determined by the Minister for Planning. These projects are either large and/or located in an environmentally sensitive area. The types of aquaculture projects that fall under Part 3A assessment are listed under Schedule 1 of the MP SEPP.

| <b>State Environmental Planning Policy (Major Projects) 2005</b>  |
|---|
| <p><i>Schedule 1: Part 3A projects – classes of development</i></p> <p><i>Aquaculture</i></p> <p>(1) <i>Development that employs 20 or more people for the purposes of aquaculture.</i></p> <p>(2) <i>Development for the purpose of aquaculture located in environmentally sensitive areas of State significance.</i></p> <p>Environmentally sensitive areas of State significance include:</p> <p>(a) coastal waters of the State, or</p> <p>(b) land to which <i>State Environmental Planning Policy No 14—Coastal Wetlands</i> or <i>State Environmental Planning Policy No 26—Littoral Rainforests</i> applies, or</p> <p>(c) land reserved as an aquatic reserve under the <i>Fisheries Management Act 1994</i> or as a marine park under the <i>Marine Parks Act 1997</i>, or</p> <p>(d) land within a wetland of international significance declared under the Ramsar Convention on Wetlands or within a World heritage area declared under the World Heritage Convention, or</p> <p>(e) land identified in an environmental planning instrument as being of high Aboriginal cultural significance or high biodiversity significance, or</p> <p>(f) land reserved as a State conservation area under the <i>National Parks and Wildlife Act 1974</i>, or</p> <p>(g) land, places, buildings or structures listed on the State Heritage Register, or</p> <p>(h) land reserved or dedicated under the <i>Crown Lands Act 1989</i> for the preservation of flora, fauna, geological formations or for other environmental protection purposes, or</p> <p>(i) land identified as being critical habitat under the <i>Threatened Species Conservation Act 1995</i> or Part 7A of the <i>Fisheries Management Act 1994</i>.</p> |
| <p><i>*correct at time of printing – please check for updates on <a href="http://www.legislation.nsw.gov.au">www.legislation.nsw.gov.au</a></i></p>   |

If your project is a major project, your application should be submitted to DoP and they will advise you of the issues that your environmental assessment (EA) must cover. Under Part 3A, DoP prepares and makes publicly available the key issues that a proponent must address in an environmental assessment of the proposal. These are known as the Director-General's requirements (DGRs) for environmental assessment. State agencies such as I&I NSW, DECCW and other relevant authorities including local Councils, are consulted in developing these requirements to ensure all key issues are identified at the start of the process.

In preparing the environmental assessment, the proponent is also encouraged to consult with the community, relevant Councils and agencies. The environmental assessment is generally required to include a written statement of commitments outlining how the project's likely environmental impacts will be minimised or managed. If the project is approved, the proponent will be required to honour these commitments as part of the conditions of approval.

Once the proponent has prepared the environmental assessment, it is checked to ensure it addresses the DGRs and, if satisfactory, the department will arrange to exhibit the environmental assessment for public comment for a minimum of 30 days.

Under Part 3A, the proponent can be required to respond in writing to issues raised in submissions and provide a preferred project report, which outlines any proposed changes to the project to minimise its environmental impact. If it is determined that the proposed changes significantly alter the nature of the project, the proponent may be required to make the preferred project report available to the public. All key project documents, including project declarations, applications and environmental assessments are made publicly available.

If approved, your aquaculture project will have a number of conditions that will be consistent with the best practice principles contained in the AIDP for land based aquaculture.

### **Application of AIDP to Part 3A projects**

The AIDP can be used by proponents to plan their aquaculture project, using the best practice principles to ensure that their project complies with ecological sustainable principles, and that their application is of a high standard to maximise their likelihood for approval.

While the PPA is not used to classify Part 3A aquaculture projects (as it is for Part 4 projects), the proposed aquaculture project would almost always be classified in a high risk category because of their scale and/or location in an environmentally sensitive area of state significance.

For information about assessment of major projects go to the Department of Planning website, [www.planning.nsw.gov.au/planningsystem/howda.asp](http://www.planning.nsw.gov.au/planningsystem/howda.asp).

### **Approvals needed under Part 3A**

If your project is assessed and determined under Part 3A then you only need separate approvals for *Protection of the Environment Operations Act 1997* matters (eg. water pollution licence), approvals for *Water Management Act 2000* matters and an aquaculture permit from I&I NSW. Part 3A removes the need for single-issue approvals under other Acts. It also replaces a separate threatened species assessment with an integrated assessment process.

You may also need an approval from the Commonwealth government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) if your project is likely to have an impact on matters of national environmental significance (eg. threatened species, migratory birds). For information about EPBC Act requirements go to: [www.environment.gov.au/epbc/](http://www.environment.gov.au/epbc/).

## **8.3 Part 4 projects**

New aquaculture projects, or alterations or additions to existing aquaculture farms (which do not fall under Part 3A of the EP&A Act), are usually assessed under Part 4 of the EP&A Act by local Councils. Again, the first thing you must consider is whether the project is permissible in the area of land you propose to carry out the project.

Land based aquaculture is permissible if it complies with minimum site locational (including zoning provisions) and operational criteria listed in the PPA. The Council (or consent authority) may impose additional requirements to these minimum requirements. The consent authority has to take into consideration the AIDP when making their determination.

Once the class of development and level of assessment required has been determined in consultation with the consent authority the proponent can use the AIDP to assist them prepare their application to ensure that their project meets the ecologically sustainable objectives set out in the AIDP. When the SEE/EIS has been submitted to the consent authority a determination can be made on the project.

### **Approvals/consents need under Part 4**

Under the integrated development assessment (IDA) provisions of the EP&A Act, aquaculture developments (whether designated or non-designated) are considered to be integrated

development as they will require one or more licences, permits or approvals as listed in Table 10.

**Table 10. Summary of Integrated Approvals under the EP&A Act.**

(Most approvals will only relate to the establishment phase of the project. Those marked with \* may be relevant throughout the life of the project.)

| Act   | Provision   | Integrated approvals applying to aquaculture  |
|---|---|---|
| <i>Fisheries Management Act 1994</i>                          | s 144*<br>s 201/205   | <ul style="list-style-type: none"> <li>• aquaculture permit.</li> <li>• permit to carry out dredging or reclamation work in any waters,</li> <li>• permit to cut, remove, damage or destroy marine vegetation on public water land or an aquaculture lease, or on the foreshore of any such land or lease.</li> </ul>   |
| <i>Heritage Act 1977</i>                                      | s 58  | <ul style="list-style-type: none"> <li>• approval in respect of the doing or carrying out of an act, matter or thing referred to in s 57(1).</li> </ul>   |
| <i>National Parks and Wildlife Act 1974</i>                   | s 90*   | <ul style="list-style-type: none"> <li>• consent to knowingly destroy, deface or damage or knowingly cause or permit the destruction or defacement of or damage to, a relic or Aboriginal place.</li> </ul>   |
| <i>Protection of the Environment Operations Act 1997</i>      | s 43 (a), 47 and 55*<br>s 43 (b), 48 and 55*<br><br>s 43 (d), 45, 55, 120* and 122* | <ul style="list-style-type: none"> <li>• Environment protection licence to authorise carrying out of scheduled development work at any premises.</li> <li>• Environment protection licence to authorise carrying out of scheduled activities at any premises (excluding any activity described as a 'waste activity' but including any activity described as a 'waste facility').</li> <li>• Environment protection licences to control carrying out of non-scheduled activities for the purposes of regulating water pollution resulting from the activity.</li> </ul>   |
| <i>Roads Act 1993</i>   | s 138   | <p>Consent to:</p> <ul style="list-style-type: none"> <li>• erect a structure or carry out a work in, on or over a public road, or</li> <li>• dig up or disturb the surface of a public road, or</li> <li>• remove or interfere with a structure, work or tree on a public road, or</li> <li>• pump water into a public road from any land adjoining the road, or</li> <li>• connect a road (whether public or private) to a classified road.</li> </ul>  |
| <i>Water Act 1912</i><br><i>Note: the Act is under review</i> | s 10*, 13, s 13A*<br><br>s 18F*<br><br>s 20B*, s 20CA*<br><br>s 113<br>Part 8       | <ul style="list-style-type: none"> <li>• Licence to construct and use a work, and to take and use water, if any, conserved or obtained by the work, and to dispose of the water for the use of occupiers of land.</li> <li>• Permit to construct and use a work, and to take and use water, if any, conserved or obtained by the work, and to dispose of the water for the use of occupiers of land for any purpose other than irrigation.</li> <li>• Authority to take water from a river or lake for the purposes of a joint water supply scheme.</li> <li>• Licence to commence sinking a bore or to enlarge, deepen or alter a bore.</li> <li>• Approval to construct a flood controlled work.</li> </ul> |
| <i>Water Management Act 2000</i>                              | s89<br><br>s90<br><br>s91   | <ul style="list-style-type: none"> <li>• Water use approval to use water for a particular purpose at a particular location.</li> <li>• Water management works approval to construct and use a specified water supply/drainage/flood work at a specified location.</li> <li>• Activity approval to carry out a controlled/aquifer interference activity at a specified location or in a specified area.</li> </ul>   |

For projects, which are integrated development, the consent authority (usually Council) must liaise with other approval authorities for an integrated consent. This process results in a streamlined approval process and a reduction in overlapping requirements from approval authorities. The process helps to ensure that the approval requirements are appropriate for the particular type of aquaculture proposal and reflect the level of risk.

It is therefore very important that you discuss with the consent authority (usually Council) what applications and assessment reports need to accompany a development application, as this information will be used to advise other agencies involved in the IDA process. The lack of, or poor information within your development application and/or assessment reports will result in a delayed approval process.

For Part 4 projects you may need a number of other approvals including:

- *Aquaculture Permit*. All aquaculture projects must hold a valid Aquaculture Permit from I&NSW;
- *Protection of the Environment Operations Act 1997* (POEO Act) licence. A land based aquaculture project will require a licence under the POEO Act if it is listed in Schedule 1 – Schedule of EPA-licensed activities;
- *Native Vegetation Act 2003*. The clearing of native vegetation will usually require approval.

You may need a licence under one or more of the following Acts:

- *National Parks and Wildlife Act 1974* (Aboriginal heritage or intending to destroy predator birds);
- *Water Act 1912* and *Water Management Act 2000* (water use, water access and excavations near rivers);
- *Exhibited Animals Protection Act 1986* (if intending to display live fish);
- EPBC Act (Commonwealth matters).

You may also need land owners consent from the Land and Property Management Authority if running water inlet/outlet pipelines over Crown land, prior to lodging a development application.

It should be noted that if a proposal is to be carried out in the vicinity of a marine park, under the *Marine Parks Act 1997*, the likely impact on the marine park must be considered and the Marine Parks Authority must be consulted as a permit may be required for certain developments eg. pipelines.

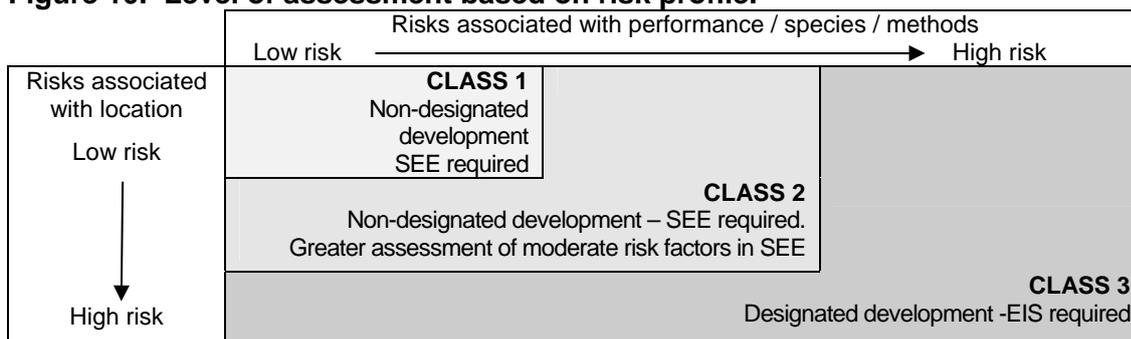
## 8.4 Classes of development

To determine the level of environmental assessment required in a land based aquaculture project, the PPA provides a matrix ranking of the level (or class) of environmental risk associated with the site locational and operational attributes of the aquaculture project. The criteria used in the PPA is consistent with the best practise principals in the AIDP. There are three classes of assessment possible when applying the PPA:

- Class 1 Non-designated development (low level risk)
  - if all risk levels in relation to each site locational and operational attribute are Level 1 (ie. lowest risk) in the PPA;
  - a statement of environmental effects (SEE) is required of the proponent;
  - this is an advertised development and required to be advertised for at least 14 days.
- Class 2 Non - designated development (medium level risk)
  - if all the risk levels in relation to each attribute are level 2 (medium risk) or level 1 and 2 in the PPA;
  - a statement of environmental effects (SEE) is required of the proponent and level 2 risk attributes should have a higher level of assessment;
  - this is also an advertised development but must be advertised for at least 30 days.
- Class 3 Designated development
  - if any risk level in relation to an attribute is Level 3 (high risk) in the PPA;
  - an Environmental Impact Statement (EIS) is required of the proponent;
  - designated development is to be advertised for at least 30 days.

These classes are summarised in Figure 10 and apply directly to Part 4 projects and are used to assist the assessment of Part 3A projects.

**Figure 10. Level of assessment based on risk profile.**



**Assessment provisions under the EP&A Regulation**

As Class 1 and 2 developments have been pre-assessed under the AIDP as less likely to significantly affect the environment, Schedule 3 of the EP&A regulation has been amended to remove the designation status from these classes of developments. However, Class 3 developments have been classified as designated development, even though that class may include development which would otherwise not be designated development under Schedule 3.

In addition, to streamlining the assessment process for Class 1 development because this class of development has been pre-assessed as being low risk, the EP&A regulation has been amended to reduce the exhibition period for this class of development to 14 days. Consent authorities and approval bodies will have 21 days to request additional information for this class of development.

**8.5 LEP zoning permissibility**

The LEP zoning table in the Project Profile Analysis chapter (see page 86) provides an overview of the zones in which pond and tank aquaculture is permissible. If aquaculture is permissible on the land then you will need to apply for consent from DoP or your local Council (depending on the scale and nature of the project).

**8.6 Development application**

The assessment guidelines and the relevant performance goals and best practice in the AIDP provide the information for the preparation of a SEE or EIS to accompany a development application. In addition, the applicant must consult:

- If an EIS is required, the Director-General, [Department of Planning](#) for any additional requirements.
- If an SIS is required, the Director-General of [DECCW](#) and/or [I&I NSW](#).

Whatever document is prepared, it should address relevant issues in sufficient detail so that the various approval authorities can quickly and efficiently make an informed decision about the environmental impacts of the proposal and whether it complies with the AIDP. If insufficient information is provided, approval authorities can ‘stop the assessment clock’ and the assessment of the proposal will be delayed.

If an EIS is required and/or the development is a Part 3A project a planning focus meeting may be convened with [Council](#) and other relevant Government agencies. The meeting is to determine if there are additional matters (to those in the assessment guidelines) which require the consideration of the applicant in the preparation of the EIS, EA or SEE.

**Lodging an application**

Care should be taken to ensure all relevant information is provided with the development application so that there are not delays as a result of additional information being requested including:

- the development application on the appropriate form with relevant supporting documentation;
- indication of all approvals required;
- the owners consent (if the applicant is not the owner. [Land and Property Management Authority](#) must sign if Crown Land is affected);
- the SIS/EIS if relevant;
- the relevant development application fee sent to the consent authority and assessment fee sent directly to each of the relevant approval authorities.

If the information in the application and accompanying documents is insufficient, the consent authority and the integrated approval bodies may request additional information from the applicant during the first 21 days of the development application being lodged. A request from an integrated approval body (through the consent authority) will ‘Stop the assessment clock’ (for the purposes of deemed refusal) until the requested information is received. When the applicant supplies the consent authority with the information, they will refer the information to the integrated approval bodies and ‘re-start’ the clock 2 days after the information is sent.

### Assessment

In making a determination, the consent authority is required to consider s79C of the [EP&A Act](#), which provides the following five generic heads of considerations:

- matters in environmental planning instruments (SEPPs, REPs and LEPs), including draft instruments, as well as development control plans and prescribed matters (the coastal policy and changes of building use);
- the impact of the development on the environment;
- the suitability of the site for the development;
- any submissions received;
- the public interest.

The consent authority has 40 days (if Class 1) and 60 days (if Class 2 or 3) from the day the development application was lodged to determine the application. This time includes the exhibition period. If the clock is stopped because of a request for additional information, the number of days the clock is stopped is added to the total number of days for a determination.

### Appeal provisions

An integrated DA may be deemed to be refused if a decision has not been made within 40 days (if Class 1) and 60 days (if Class 2 or 3) plus the number of days when the clock was stopped.

A deemed refusal simply allows the applicant to begin proceedings in the Land and Environment Court (LEC) and does not prevent the consent authority determining the application. The applicant may choose to continue working with the consent authority and other relevant approval authorities to find a solution to outstanding issues that may be holding up the approval process. The LEC may make determinations on development consents where an applicant has appealed against a refusal or in relation to conditions of consent or when a third party has appealed against the decision on the legality of the process.

With Class 3 development, an objector to the DA can appeal the decision of the consent authority in the LEC on the merits of the decision. Where integrated development consent is considered by the LEC, both the consent authority and the approval body will be bound by the decision of the LEC.

## 8.7 Part 5 Assessments

Extensive aquaculture systems can utilise existing water storages and established facilities to support pre-market conditioning and packaging of cultured product.

If your aquaculture project will be using existing:

- farm dams/ponds (need to ensure that any existing dam is appropriately licenced for its use);
- buildings and associated infrastructure;
- it will not involve supplementary feeding of the aquaculture species;
- your local Council considers you do not require to lodge a development application.

Then your proposal may not require development consent or approval under Part 3A or Part 4 of the EP&A Act. If this is the case then your project will be assessed under Part 5 of the EP&A Act by I&I NSW. Only a Class C or Class E aquaculture permit would be issued under a Part 5 assessment.

## 8.8 Native title and land claims issues

Typically, Native Title Claims under the Commonwealth [Native Title Act 1993](#) are over vacant Crown land and can take a long time to be resolved. Generally, claims under the NSW [Aboriginal Land Rights Act 1983](#) are granted unless an essential public use of the land can be proved.

Proposals made on Crown land under native title claim cannot proceed until the claim is resolved. Aquaculture applications that require works such as road or water pipeline access across Crown Land under native title claim should be avoided unless agreement can be made in writing with the claimant.

## 8.9 Threatened Species Conservation Act

Under s5A of the [EP&A Act](#), the consent authority must consider whether the granting of consent for an aquaculture proposal is likely to significantly affect terrestrial or aquatic threatened species, populations or ecological communities or their habitats (listed in the [Threatened Species Conservation Act 1995](#) and in the [Fisheries Management Act 1994](#)).

Applicants must provide the consent authority with adequate information to reach a conclusion as to whether threatened species, populations or ecological communities or their habitats are likely to be present on the development site and if so if the development is likely to significantly affect them. This is called the test of significance.

If there is likely to be a significant impact or if the proposal is on land that is, or is part of critical habitat, a Species Impact Statement (SIS) must be prepared in accordance with the requirements of the Director-General of DECCW (terrestrial plant and animal species and including marine mammals and reptiles) or Director-General of I&I NSW (marine vegetation and aquatic species not including marine mammals and reptiles). The SIS may be integrated into the SEE or EIS or exhibited separately. If a SIS is required and Council determines that a proposal is likely to proceed and will have a significant impact on threatened species, populations, ecological communities or their habitats, Council must seek the concurrence of the Director-General of DECCW/I&I NSW in making a decision. The Minister as consent authority must consult with the Minister for the Environment/Primary Industries in making a decision.

## 8.10 Construction and occupation certificate

### Construction certificate

Under s109 of the EP&A Act, a construction certificate must be issued by the consent authority or an accredited certifier prior to any building works commencing. The purpose of the construction certificate is to ensure that the building is safe for use taking into consideration structural and fire safety matters and compliance with the relevant provisions in the [Building Code of Australia \(BCA\)](#).

Once a construction certificate has been issued, it becomes part of the development consent. It is possible to issue construction certificates for various stages of the development.

### Before works begin

Before works begin, a principal certifying authority (PCA) must be appointed to ensure that the construction is in accordance with the DA approval. The PCA must undertake an audit of the building works by either carrying out specified inspections or by relying on other certifiers or professionals. The PCA may serve a notice to require a person to comply with the consent.

### Occupation certificate

Before a PCA can issue an occupation certificate, they must be satisfied that the specific works have been completed in accordance with the construction certificate and DA and that the building complies with the relevant provisions in the BCA.

## 8.11 Information sources

The level of information necessary for the development application should match the scale of the proposal, the potential associated environmental risks and the potential sensitivity of the location.

The information regarding the minimum performance criteria for your site is available in Council local environment plan (LEP), Council or DECCW floodplain management plans and associated studies, acid sulfate soils (ASS) risk maps and from key agencies.

### Industry & Investment NSW

Industry & Investment NSW (I&I NSW) has a range of aquaculture related information to assist investors or consultants including the estuarine aquaculture maps that identify land that is potentially suitable for estuarine pond aquaculture. Also aquatic habitat protection and aquatic threatened species information.

### Local Council

It is essential to consult with the local Council to determine the zoning of the land on which the proposal and any ancillary works (pipelines, roads) will be located. Also LEP maps can provide information on the location of road reserves or corridors identified for highway upgrades, wetlands mapped in SEPP 14 or SEPP 26 and land reserved for environmental protection.

Local Councils may also have floodplain management policies and floodplain management plans that may provide background on flood related issues and controls and which may provide advice on flooding in the vicinity of the site.

### NSW Office of Water (NOW)

NOW holds important information relating to:

- Activities carried out in or near a lake, river or estuary;
- Licence and approval requirements under the Water Management act 2000 and Water Act 1912;
- Harvestable rights for farm dams;
- Groundwater policies including the Groundwater policy, policy on groundwater dependant ecosystems and groundwater quality policy.
- the water availability in river catchment/sub-catchments and groundwater aquifers;
- the Water Sharing Plan process under the Water Management Act 2000.

### Land and Property Management Authority (LPMA) Information

LPMA can provide information on vacant Crown land and Crown land subject to native land claims. LPMA also holds topographical maps and air photos that may be important for an aquaculture proposal.

### DECCW Information

DECCW hold information on the important areas for conservation and protection. These include:

- DECCW [protected areas](#) - National & Regional parks, reserves, historic sites, State recreation areas;
- Recorded [Aboriginal sites](#) and places, relevant contacts for local Aboriginal communities;
- Areas subject to conservation or management agreements, [critical habitats](#);
- Areas where [threatened species](#), populations and ecological communities have been recorded;
- Recovery and threat abatement plans prepared under [Threatened Species Conservation Act 1995](#);
- acid sulfate soils risks;
- tidal characteristics of many [estuaries](#);
- [floodplain management plans](#).

## 9. Project Profile Analysis

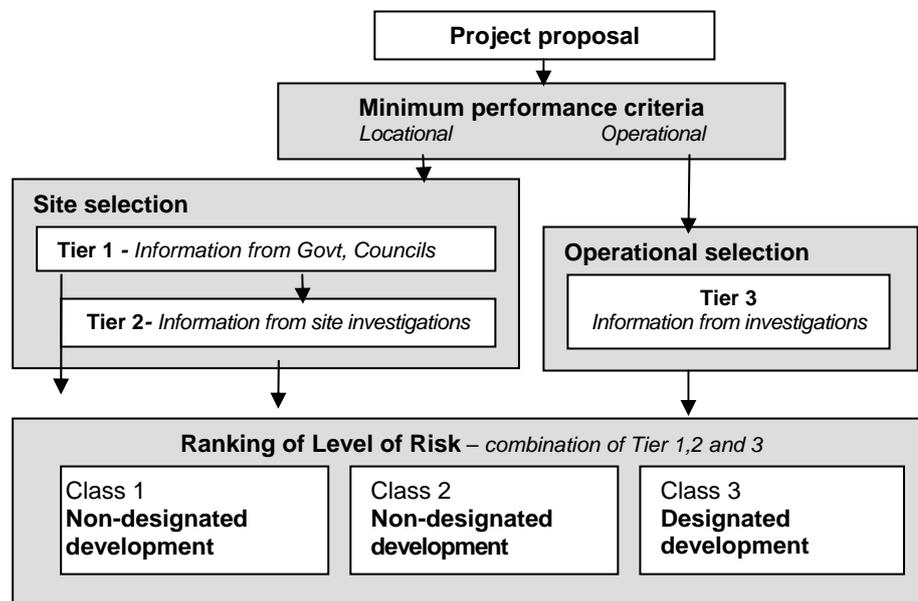
The Aquaculture Industry Development Plan (AIDP) sets out best practice for the establishment and operation of land based aquaculture projects. Based on this information, a project profile analysis has been developed to enable a preliminary evaluation of the risks associated with site selection, species, design and planning and operational criteria. These criteria allow the applicant and the consent authority to evaluate the likely risks associated with a project and establish the level of assessment to match the likely risks to the environment.

The project profile analysis provides three ‘sieves’ to evaluate options.

- The **minimum performance criteria** provides the first environmental sieve for selecting sites and project characteristics. These must be met in order for the project to proceed;
- The **site selection criteria** (Tier 1 and Tier 2) provide the next two environmental sieves to determine the acceptability of risks. Tier 1 information is available from Government or Council sources. Tier 2 information will need to be obtained from site investigation or studies;
- Following the selection of a site, **operational selection criteria** (Tier 3) provides the next ‘sieve’ to evaluate various options including species, layout and operation factors. The Tier 3 evaluation can serve as a cost effective tool to determine the relative risk associated with species, design and operational options and to assist in deciding if certain options should be excluded from further consideration.

These factors can be used to rank the likely risks associated with establishing an aquaculture facility in a particular location, eg. Level 1, 2 or 3 risk. Figure 11 provides an overview of the sieving process.

Figure 11. ‘Sieves’ in project profile analysis.



### 9.1 Minimum Site Performance and Operational Criteria

It is essential at the outset, that the minimum performance criteria for land based aquaculture in NSW is considered, as aquaculture projects that cannot meet these minimum performance criteria are not permissible. Information regarding the minimum performance criteria is readily available from Council, LPMA, DECCW or DoP.

### 9.2 Tier 1 Evaluation

For sites that meet the minimum locational performance criteria, the Tier 1 information should be sourced to determine the level of risk for the site for aquaculture. The Tier 1 criteria can be

sourced from information held by Council, I&I NSW, DECCW, LPMA, NOW or DoP. The ranking of Level 1, 2 or 3 for individual criteria will begin to provide a picture of the potential hurdles in developing a site and the likely level of environmental assessment and regulation that could apply. Whenever possible, higher risk sites should be avoided at Tier 1 evaluation.

### 9.3 Tier 2 Evaluation

For sites that are suitable after Tier 1 evaluation, the next layer of information should be sourced. Tier 2 investigations may involve significant expenditure with site investigations by technical experts, and in some cases, laboratory analysis may be required:

- to confirm the levels of ASS or soil contamination and develop management options;
- to determine soil suitability for dam construction;
- to identify threatened species, populations or ecological communities or their habitat;
- to identify any Aboriginal sites, areas of high potential to contain sites, areas of cultural sensitivity or other values of cultural significance to the Aboriginal community;
- to assess of potential water supply quality and security of supply.

It should be noted that the level of analysis at this stage needs to provide sufficient information for an informed decision to be made. Risk levels associated with the site along with the risk levels associated with operational constraints will decide the assessment regime of the project. The lower the risks, the lower the costs in assessment, mitigation and environmental supervision by authorities.

### 9.4 Tier 3 Operational evaluation

Following the selection of a site, and confirmation that the proposed design and planning parameters meet the minimum performance criteria, Tier 3 evaluation criteria provides the next 'sieve' to determine the relative level of risk associated with the aquaculture proposal.

The Tier 3 evaluation can serve as a cost effective device to determine if any of the proposed operational parameters are likely to lead to longer term costs associated with expensive mitigation measures. The ranking of Level 1, 2 and 3 operational criteria will begin to provide a picture of the potential hurdles and the likely level of environmental assessment and regulation that could apply; the lower the level of risk, the lower the level of assessment and regulation required.

### 9.5 Interpreting the rankings

The tables associated with Tier 1, 2 and 3 provide a ranking in relation to the criteria and the level of risk associated with the project characteristics. These rankings assist in evaluating individual sites and operational options as well as providing for a comparison between alternative options.

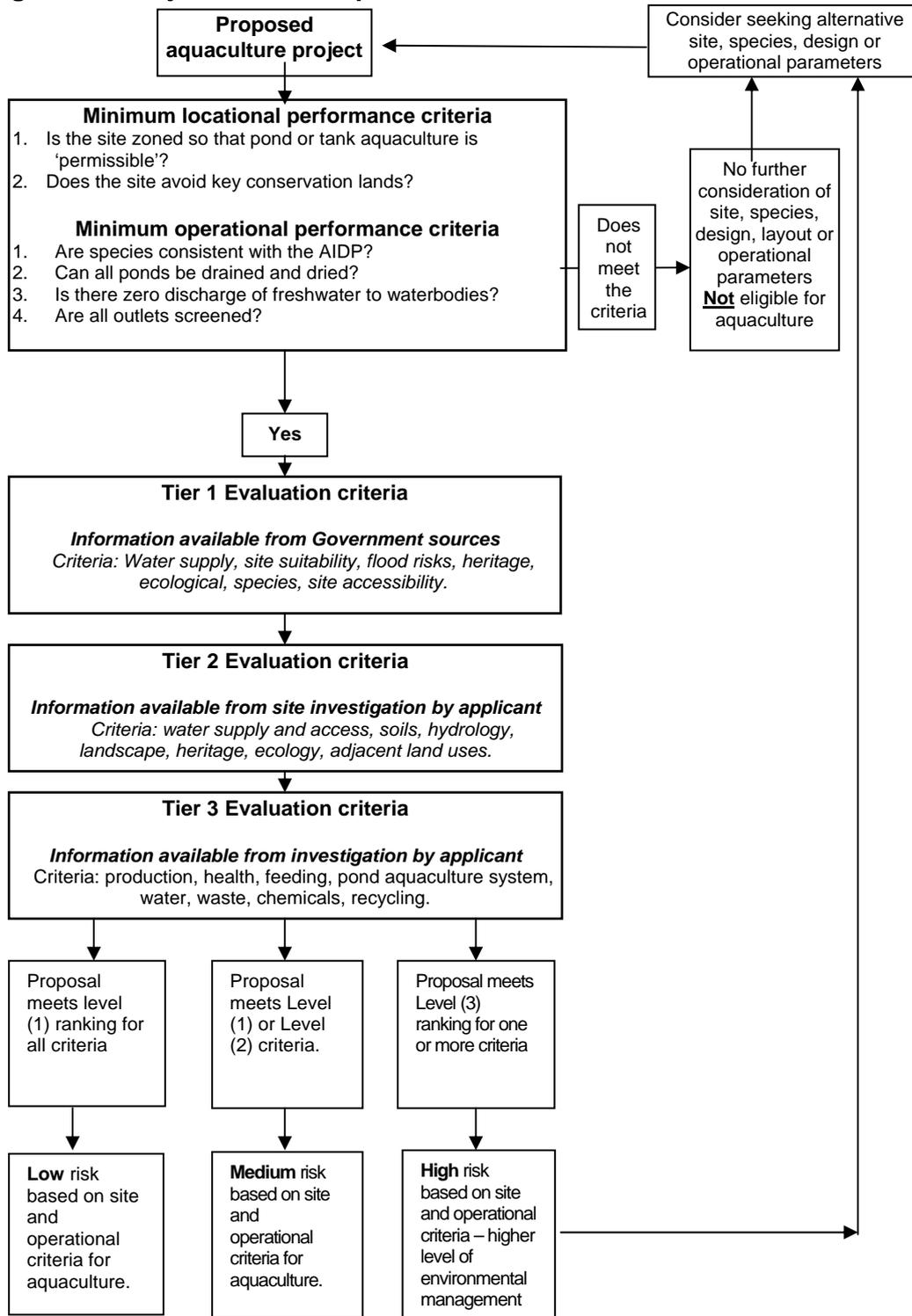
Table 11 provides an overview of how the rankings are interpreted to determine the class of development with Figure 12 providing an overview of the evaluation process.

**Table 11. Interpreting the Rankings.**

| Project profile analysis rankings  | Class of development | Development assessment     | Assessment document                                  |
|--|----------------------|----------------------------|--|
| Minimum performance criteria not met   | <b>Prohibited</b>    |                            |  |
| Minimum performance criteria met and all the rankings are level (1)                        | Class 1              | Non-designated development | SEE  |
| Minimum performance criteria met, any of the rankings are level (2) and none are level (3) | Class 2              | Non-designated development | SEE with greater assessment of moderate risk factors |
| Minimum performance criteria met and any of the rankings are level (3)                     | Class 3              | Designated development     | EIS  |

It must be reinforced that aquaculture projects undertaken in NSW, must meet the minimum locational and operational performance criteria.

Figure 12. Project evaluation process.



### 9.6 Who makes the decision

The consent authority (the local Council or the Minister for Planning) will decide whether the project meets the minimum performance criteria and the level of assessment (Class 1, 2 or 3) required, based on the project profile analysis and the development application.

Usually, the local Council will be the consent authority and as the development will also require an aquaculture permit from I&I NSW it is considered an 'integrated development' and falls within the provisions of Part 4 of the [EP&A Act](#). In some cases, where the project is determined to be a [major project](#) under Part 3A of the [EP&A Act](#), the Minister for Planning will be the consent authority. I&I NSW will usually be the consent authority under part 5 of the [EP&A Act](#) for extensive aquaculture (Class C & E aquaculture permits) proposals, where existing farm dams and buildings are being used.

### **9.7 Transitional provisions**

Where there is an existing aquaculture enterprise or a site of an abandoned aquaculture enterprise and there is a proposal to upgrade or re-establish an aquaculture operation on that site, the NSW LBSAS will apply.

For proposals that do not meet the minimum performance criteria, the applicant must formally seek and obtain agreement of the Minister for Planning to be exempted from the minimum performance criteria that would have otherwise made the proposal not permissible.

In making a decision for an exemption from the minimum performance criteria, the Minister shall take into consideration whether the proposal will lead to:

- improved environmental outcomes despite non or partial compliance with the site location minimum performance criteria;
- total compliance with the operational minimum performance criteria.

## 9.8 Project profile analysis - minimum performance criteria for ponds and tanks

The following are minimum performance criteria that proposals must meet to be permissible development within NSW.

| Locational criteria  | Minimum performance  |
|--|--|
| 1. LEP zones for ponds or tanks                              | Within permitted zones of LEP zoning table.  |
| 2. Conservation exclusion zones <sup>1</sup>                 | (1) Must not be carried out on land dedicated or reserved under the <i>National Parks and Wildlife Act 1974</i> :<br>(2) Must not be carried out on the following land, except to the extent necessary to gain access to water:<br>(a) land declared as critical habitat under the <i>Threatened Species Conservation Act 1995</i> ,<br>(b) vacant Crown land,<br>(c) land within a wetland of international significance declared under the Ramsar Convention on Wetlands.<br>(3) Must not be carried out on the following land, except for purposes of minimal infrastructure to support the extraction of water from, and discharge of water to, the land concerned:<br>(a) land declared as an aquatic reserve under the <i>Fisheries Management Act 1994</i> ,<br>(b) land declared as a marine park under the <i>Marine Parks Act 1997</i> . |
| Operational criteria   |  |
| 1. Species selection   | Species of fish or marine vegetation cultivated or kept must be consistent with the relevant Aquaculture Industry Development Plan.  |
| 2. Intensive pond aquaculture—pond design                    | Ponds must be capable of being drained or pumped and then completely dried.  |
| 3. Intensive pond and tank aquaculture freshwater discharges | No discharge of freshwater used to intensively cultivate or keep fish to natural waterbodies or wetlands is permitted, except freshwater discharge from open flow through systems  |
| 4. Outlets from ponds etc                                    | All outlets from culture ponds, tanks or other culture facilities must be screened to avoid the escape of fish.  |

<sup>1</sup> Nothing in subclause (2) or (3) affects any requirement under an Act relating to land specified in subclause (2) or (3) to obtain a licence or other authority under that Act for development of the land.

## LEP zoning table

| LEP ZONES                             | AQUACULTURE TYPE |                 |
|---------------------------------------|------------------|-----------------|
|                                       | Pond             | Tank            |
| <b>Rural</b>                          |                  |                 |
| RU1 Primary Production                | Permissible      | Permissible     |
| RU2 Rural Landscape                   | Permissible      | Permissible     |
| RU3 Forestry                          | Permissible      | Permissible     |
| RU4 Rural Small Holdings              | Permissible      | Permissible     |
| RU5 Village                           | Prohibited       | Permissible     |
| RU6 Transition                        | Prohibited       | Permissible     |
| <b>Residential</b>                    |                  |                 |
| R1 General Residential                | Permissible (1)  | Permissible (1) |
| R2 Low Density Residential            | Permissible (1)  | Permissible (1) |
| R3 Medium Density Residential         | Prohibited       | Permissible (1) |
| R4 High Density Residential           | Prohibited       | Prohibited      |
| R5 Large Lot Residential              | Permissible (1)  | Permissible (1) |
| <b>Business</b>                       |                  |                 |
| B1 Neighbourhood Centre               | Prohibited       | Permissible     |
| B2 Local Centre                       | Prohibited       | Permissible     |
| B3 Commercial Core                    | Prohibited       | Permissible     |
| B4 Mixed Use                          | Prohibited       | Permissible     |
| B5 Business Development               | Prohibited       | Permissible     |
| B6 Enterprise Corridor                | Prohibited       | Permissible     |
| B7 Business Park                      | Prohibited       | Permissible     |
| <b>Industrial</b>                     |                  |                 |
| IN1 General Industrial                | Prohibited       | Permissible     |
| IN2 Light Industrial                  | Prohibited       | Permissible     |
| IN3 Heavy Industrial                  | Prohibited       | Permissible     |
| IN4 Working Waterfront                | Permissible      | Permissible     |
| <b>Special Purpose Zones</b>          |                  |                 |
| SP1 Special Activities                | Permissible      | Permissible     |
| SP2 Infrastructure                    | Permissible      | Permissible     |
| SP3 Tourist                           | Permissible      | Permissible     |
| <b>Recreation</b>                     |                  |                 |
| RE1 Public Recreation                 | Permissible      | Permissible     |
| RE2 Private Recreation                | Permissible      | Permissible     |
| <b>Environment protection</b>         |                  |                 |
| E1 National Parks and Nature Reserves | Prohibited       | Prohibited      |
| E2 Environmental Conservation         | Prohibited       | Prohibited      |
| E3 Environmental Management           | Permissible (2)  | Permissible (1) |
| E4 Environmental Living               | Permissible (2)  | Permissible (1) |
| <b>Waterway</b>                       |                  |                 |
| W1 Natural Waterways                  | Permissible (3)  | Permissible (3) |
| W2 Recreational Waterways             | Permissible (3)  | Permissible (3) |
| W3 Working Waterways                  | Permissible (3)  | Permissible (3) |

**Note (1)** Permissible only if the development is for the purposes of small scale aquarium fish production.

**Note (2)** Permissible only if the development is for the purposes of extensive aquaculture.

**Note (3)** Permissible only if the development will utilise waterways to source water.

## 9.9 Project profile analysis - criteria for pond & tank aquaculture

### Tier 1 - Site evaluation

Information for Tier 1 evaluation criteria is available from government sources such as Councils, Land and Property Management Authority, Department of Planning and other relevant government agencies.

| SITE EVALUATION CRITERIA  | TIER 1 LEVEL OF ASSESSMENT   |  |   |
|---|--|--|---|
|   | Level 1  | Level 2  | Level 3   |
| <b>1. Water Supply Information</b>  |  |  |   |
| a) Saline ground water availability   | Saline water available from Saline Interception and Evaporation Scheme.  | Bore required to source saline waters.   |   |
| b) Fresh - Water availability   | <ul style="list-style-type: none"> <li>Existing licence approved for bore or river extraction, or</li> <li>Licence available.</li> </ul> | <ul style="list-style-type: none"> <li>New licence required for bore or river extraction, or</li> <li>Reliant upon on-farm dam and 10% of local run-off.</li> <li>Use of a mains water supply for growout, nursery or hatchery.</li> </ul> |   |
| c) Freshwater projects that plan to pump water from a river – Environmental flows   | No access restrictions based on flows in normal conditions   | Access permitted only during high flows in normal conditions   |   |
| <b>2. Acid Sulfate Soils</b>  |  |  |   |
| If site is less than 2 metres AHD based on survey data, ASS soil profile based on ASS Risk Maps <sup>2</sup>              | ASS Landform Process Class A with Landform Element Class b, l, t, p, y or w  | ASS Landform Process Classes A,W, B, E, L, S with other Landform Element than b, l, t, p, y or w   |   |
| <b>3. Heritage Issues</b>   |  |  |   |
| a) Heritage sites based on LEP or REP maps and State Heritage Inventory   | No listings on the proposed site   | Listings onsite  |   |
| b) Aboriginal heritage based on DECCW Aboriginal Heritage Information Management System and Local Aboriginal Land Council | No recorded sites or places and DECCW advises that no cultural or archaeological assessment is required                                  | Sites or places recorded on the land and/or DECCW advises that a cultural and/or archaeological assessment is required.  | Sites/places of regional or national significance present and likely to impact on sites/places. |
| <b>4. Native Title Issues</b>   |  |  |   |
| Status of native title interests  | Crown Land, previous determination<br>Native Title extinguished  | Crown Land Native Title interest needs to be determined  |   |
| <b>5. Flooding DECCW or Council information where available</b>   |  |  |   |
| a) Consistency with Council and/or DECCW Floodplain Management Plans  | Development is consistent with the outcomes of management plans and needs no controls  | Development of the site is consistent with the management plan but will be restricted or controlled  | Development of the site is inconsistent with the outcomes of management plans                   |
| b) Floodway Area  | Development is not proposed in a floodway  | Development is proposed in a floodway  |   |

<sup>2</sup> Sourced from the Acid Sulfate Soil (ASS) Risk Maps

**Tier 2 - Site evaluation**

Tier 2 requires the proponent to undertake a detailed site assessment including investigations by technical experts and in some cases, laboratory analysis. The information gained from this investigation can provide the basis for preliminary design and operation planning.

| SITE EVALUATION CRITERIA  | TIER 2 LEVEL OF ASSESSMENT  |  |   |
|---|---|--|---|
|   | Level 1   | Level 2  | Level 3   |
| <b>6. Water Supply Quality</b>  |   |  |   |
| a) Water quality risks from nearby land uses  | Growout water quality is consistently suitable for aquaculture and has low risk of contamination.   | Growout water quality is mostly suitable for aquaculture and has low risk of contamination.  | Growout water quality is not generally suitable for aquaculture and requires treatment OR has a high risk of contamination. |
| b) Potable water for processing etc.  | <ul style="list-style-type: none"> <li>Mains water; or</li> <li>Reliable supply of potable water onsite.</li> </ul>   | <ul style="list-style-type: none"> <li>Insecure supply of potable water requiring supplementation during dry periods; or</li> <li>No existing potable water supply on site.</li> </ul>                           |   |
| <b>7. Water Supply Access</b>   |   |  |   |
| a) Saline groundwater supply access   | Via piping from a saline groundwater interception and evaporation scheme  | Via saline groundwater bore on property  | Via compacted earthen channel from a saline groundwater interception and evaporation scheme.                                |
| b) Location of inlet/outlet pipe for estuarine or marine farms.   | <ul style="list-style-type: none"> <li>Existing infrastructure suitable to carry inlet/outlet pipe, or</li> <li>Sump/pit or any deepening of bed of estuary or waterway is not required.</li> </ul> | <ul style="list-style-type: none"> <li>Rock anchoring of inlet/outlet pipeline for marine water, or</li> <li>Requires a sump/pit in estuary or waterway, or</li> <li>Establishment across ocean beach</li> </ul> |   |
| c) Fresh water pump station site  | Does not require sump/pit or any deepening of bed of river.   | Requires a sump/pit in river   |   |
| <b>8. Stock Security</b>  |   |  |   |
| a) Proposed species consistent with Table 3 (species culture methods and constraints) in Species Selection chapter. | Pond or tank site above the PMF level in the eastern drainage or above 1:100 ARI flood level in the western drainage. <sup>3</sup>  | Pond or tank site below PMF level in the eastern drainage or below 1:100 ARI flood level in the western drainage but constructed so unlikely to be inundated and lose stock in a flood event. <sup>3</sup>       |   |
| <b>9. Hydrology Issues</b>  |   |  |   |
| a) Catchment Drainage including Stormwater  | <ul style="list-style-type: none"> <li>No catchment drainage across site, or</li> <li>Provision to manage across site flows not likely to affect surrounding area</li> </ul>                        | <ul style="list-style-type: none"> <li>Catchment drainage across site; or</li> <li>Alteration of the drainage of stormwater likely to affect surrounding properties</li> </ul>                                   | Flood management likely to alter the course of the river or drainage patterns.  |
| b) Excess water (effluent) storage pond/dam.  | No stormwater catchment drainage into excess water (effluent) storage pond/dam.   |  |   |
| <b>10. Mean site elevation</b>  |   |  |   |
| Mean elevation of the area occupied by ponds or tanks   | >1 metre AHD  | < 1 metre AHD  |   |
| <b>11. Ecology</b>  |   |  |   |
| a) Vegetation type on the actual development site (flora survey required)   | Cultivated land, improved pasture, or predominantly cleared and no need for consent to clear or disturb native vegetation under Native Vegetation Conservation Act or Water Management Act.         | Predominantly native vegetation – trees, shrubs, grasslands OR Clearing vegetation requires consent under Native Vegetation Conservation Act or Water Management Act.  | Proposal likely to impact on vegetation of ecological significance.   |

| SITE EVALUATION CRITERIA   | TIER 2 LEVEL OF ASSESSMENT   |  |  |
|--|--|--|--|
|  | Level 1  | Level 2  | Level 3  |
| b) Occurrence of threatened species, populations or ecological communities or their habitats (flora & fauna survey required) | No threatened species, populations or ecological communities or their habitats known or likely to occur – Test of significance not required  | Threatened species, populations or ecological communities or their habitats known or likely to occur<br>– Test of significance required  | Likely to significantly affect threatened species, populations or ecological communities or their habitats. <sup>4</sup>       |
| c) Likely impact on aquatic habitats and mangroves.  | No likely disturbance or impact  | Disturbance or impact on aquatic habitat or mangroves – approval or permit needed to disturb mangroves or seagrasses, reclamation or dredging works or impeding fish passages. |  |
| <b>12. Aboriginal Heritage</b>   |  |  |  |
| a) Consultation with Aboriginal community (Call DECCW for appropriate contacts)  | No values of cultural significance to the Aboriginal community identified.   | Values of cultural significance to the Aboriginal community identified. Agreement reached between Aboriginal community, DECCW and proponent on the management of these values. | Values of cultural significance and no agreement reached with Aboriginal community or DECCW on the management of these values. |
| b) Location of Aboriginal Sites  | No recorded Aboriginal site/place and DECCW advises that no cultural or archaeological assessment is required  | Recorded Aboriginal site/place and/or DECCW advises that a cultural and/or archaeological assessment is required   |  |
| c) Likely impact on Aboriginal heritage <sup>4</sup>   | No impact on Aboriginal sites/places or values of cultural significance to Aboriginal community  | Impact on Aboriginal sites/places or values of cultural significance to Aboriginal community   | Sites/places of regional or national significance present and likely to impact on sites/places.                                |
| <b>13. Provision of Riparian Buffer</b>  |  |  |  |
| Riparian buffer distance from the edge of the culture or effluent pond.  | > 50 metres  | < 50 metres  |  |
| <b>14. Excess Water Disposal</b>   |  |  |  |
| a) Management of excess freshwater from closed systems   | <ul style="list-style-type: none"> <li>Non-irrigation reuse scheme (eg. Hydroponics, reuse, discharge to sewer with a trade waste agreement); OR</li> <li>Irrigation re-use scheme and irrigation site has adequate area and soils have slight limitations<sup>5</sup>.</li> </ul> | Irrigation re-use scheme and irrigation site has inadequate area and/or soils have moderate or severe limitations <sup>5</sup>   |  |
| b) Management of excess saline groundwater   | Disposed to a saline groundwater interception and evaporation scheme, estuary or ocean via piping or channels lined with impervious liner.   | Disposal from a closed system to an on-site evaporation system or direct injection to a saline aquifer.  | Disposed to a saline groundwater interception and evaporation scheme, estuary or ocean via earthen channel.                    |
| <b>15. Adjacent Land Use</b>   |  |  |  |
| Potential for conflict with neighbours   | Neighbouring land zoning compatible eg. agriculture/industrial development.  | Neighbouring land zoned for residential or rural residential purposes or has been identified as suitable for this purpose in an LEP or REP.                                    |  |
| <b>16. Flooding Proponent Studies considering DECCW or Council information where available.</b>                              |  |  |  |
| Impacts of development on flooding   | Development not likely to adversely impact flood behaviour   | Development likely to adversely impact on flood behaviour  |  |

<sup>3</sup> Note: Highest historical flood level may be considered where 1:100 ARI flood level is not readily available in the western drainage

<sup>4</sup> Note: approval from DECCW is required.

<sup>5</sup> See Table 1 & Table 3 respectively in [Agnote DPI-493](#) Landform and soil requirements for biosolids and effluent reuse for more details.

**Tier 3 - Operational evaluation**

The proponent in Tier 3 is required to investigate operational criteria for species, design, layout and operation of the aquaculture proposal.

| OPERATIONAL CRITERIA  | TIER 3 LEVEL OF ASSESSMENT   |   |  |
|---|--|---|--|
|   | Level 1  | Level 2   | Level 3                                      |
| <b>17. Health Management</b>  |  |   |  |
| Identification and treatment of disease   | <ul style="list-style-type: none"> <li>On site trained staff with appropriate facilities, or</li> <li>Demonstrated arrangement with accredited laboratory or veterinary practice</li> </ul>  | No onsite provision for diagnosis of disease and no backup arrangements with an accredited laboratory or veterinary practice                      |  |
| <b>18. Feed Management</b>  |  |   |  |
| Feed storage  | Vermin proof facilities to store feed (eg. enclosed shed, cool, low humidity)  | Feed stored outdoors or so as not to minimise odour or other problems   |  |
| <b>19. Water Monitoring for Intensive Culture</b>   |  |   |  |
| a) Capacity to monitor water quality.   | Provisions of high quality water quality meters or test kits to monitor DO, Temperature, ammonia, salinity and pH  | No provisions for regular monitoring  |  |
| <b>20. Organic Waste Management (eg. mortalities, processing waste and other waste)</b>   |  |   |  |
| a) Temporary storage of organic waste   | <ul style="list-style-type: none"> <li>Daily disposal; or</li> <li>Held prior to disposal so no odour generated (eg. frozen or chilled)</li> </ul>   | Held in sealed or covered containers prior to intermittent disposal   | No specific arrangements                     |
| b) Disposal of organic waste on-site or off-site  | <ul style="list-style-type: none"> <li>Disposed at an approved off-site recycling or landfill facility; or</li> <li>Buried (with lime) or composted in an area which is &gt; 100m from a waterways and where the groundwater is &gt; 3m and the soil has low permeability</li> </ul> | Buried (with lime) or composted in an area which is < 100m from a waterways or where the groundwater is < 3m or the soil is not low permeability. | No specific arrangements                     |
| c) Disposal of stock in the event of a mass mortality, on-site or off-site  | Arrangements in place for disposal at an approved off-site recycling or landfill facility.   | Buried (with lime) or composed in an approved onsite disposal area.   | No specific arrangements                     |
| <b>21. Recirculating Water Management for Intensive Culture</b>   |  |   |  |
| Storage capacity for recycling water in semi closed and closed intensive culture systems.   | > 2 times the volume of largest growout pond or tank   | 1 - 2 times the volume of largest growout pond or tank  | < the volume of largest growout pond or tank |
| <b>22. Discharge Water Management for Open (flow through) freshwater (for approved species) or estuarine, marine or saline ground water Systems</b> |  |   |  |
| a) POEO Act Licence   | Not required   | POEO Act licence required.  |  |
| b) In stream water quality objectives.  | In stream water quality objectives met.  | In stream water quality objectives not met. Mitigation measures to meet WQOs required.  |  |
| c) Discharge water treatment.   | Discharge water screened to avoid escapement of stock and a water treatment system.  | Discharge water screened to avoid escapement of stock and no treatment.   |  |
| d) Daily Discharge limits for species approved for freshwater open systems eg. salmonids.   | < 60mg/l TSS<br>< 0.30mg/l Total N<br>< 0.05mg/l Total P   | > 60mg/l TSS<br>> 0.30mg/l Total N<br>> 0.05mg/l Total P  |  |
| e) Total Discharge load limits for species approved for freshwater open systems eg. salmonids.  | < 55kg N/tonne of fish produced<br>< 12kg P/tonne of fish produced   | > 55kg N/tonne of fish produced<br>> 12kg P/tonne of fish produced  |  |

## 9.10 Project profile analysis - additional criteria for pond aquaculture

### Tier 1 – Additional specific site evaluation criteria for pond aquaculture

| SITE EVALUATION CRITERIA FOR PONDS | TIER 1 LEVEL OF ASSESSMENT FOR PONDS |                 |         |
|------------------------------------|--------------------------------------|-----------------|---------|
|                                    | Level 1                              | Level 2         | Level 3 |
| <b>1. Water Supply Information</b> |                                      |                 |         |
| Estuarine - Tidal amplitude        | Greater than 600mm                   | Less than 600mm |         |

### Tier 2 - Additional specific site evaluation criteria for pond aquaculture

| SITE EVALUATION CRITERIA FOR PONDS  | TIER 2 LEVEL OF ASSESSMENT FOR PONDS   |  |         |
|---|--|--|---------|
|   | Level 1  | Level 2  | Level 3 |
| <b>2. Topography</b>  |  |  |         |
| a) Estuarine ponds – slope of land  | < 2% slope   | >2% slope  |         |
| b) Freshwater ponds – slope of land   | < 5% slope.  | >5% slope  |         |
| <b>3. Soils</b>   |  |  |         |
| a) Soil Characteristics – Suitability for pond/dam construction                   | Clay with mixture of soil/sand and low erosion potential and suitable for dam construction | Sandy/gravelly with erosion potential and/or limited water holding capacity – may need to import most pond clay for lining material or an artificial liner |         |
| b) Soil Contamination based on SEPP 55 criteria for the area occupied by any pond | Suitable for residential use or for animal occupation                                      | Exceed levels safe for animal or residential uses  |         |
| <b>4. Hydrology Issues</b>  |  |  |         |
| Potential to affect groundwater below any pond                                    | No underlying potable or high quality fresh groundwater within 3m of the surface           | Underlying groundwater within 3m of the surface.   |         |
| <b>5. Saline Groundwater Pond Design</b>  |  |  |         |
| a) Saline groundwater ponds including excess water storage ponds.                 | Artificial liner with compacted clay underneath and ground water monitoring bores.         | Compacted clay and groundwater monitoring bores.   |         |

### Tier 3 - Additional specific operational evaluation criteria for ponds

| OPERATIONAL CRITERIA FOR POND AQUACULTURE                               | TIER 3 LEVEL OF ASSESSMENT FOR PONDS  |  |         |
|---|---|--|---------|
|   | Level 1   | Level 2  | Level 3 |
| <b>6. Health Management for Intensive Culture</b>                       |   |  |         |
| a) Period of total farm dryout after every production cycle for prawns. | >6 weeks between crops  | <6 weeks between crops   |         |
| b) Predators management of fingerling or growout ponds                  | All fingerling ponds screened/netted, or other management systems not intending harm to predators in place for growout ponds. | Only 'scare' systems (Note: may trigger need for Test of significance if threatened bird species are affected) |         |
| <b>7. Pond Water Management for Intensive Culture</b>                   |   |  |         |
| a) Supply pipe or channel capacity                                      | Largest growout pond can be filled in < 1 day   | Largest pond can be filled in > 1 days   |         |
| b) Intensive Pond Outlet system   | No pumping required to drain a pond completely.   | Requires pumping from an internal or external sump to drain pond.  |         |

## 9.11 Project profile analysis - additional criteria for tank aquaculture

### Tier 1 - Additional specific site evaluation criteria for tanks

| SITE EVALUATION CRITERIA FOR TANKS | TIER 1 LEVEL OF ASSESSMENT FOR TANKS |         |         |
|------------------------------------|--------------------------------------|---------|---------|
|                                    | Level 1                              | Level 2 | Level 3 |
| <b>1. Water Supply information</b> |                                      |         |         |
| Estuarine – Tidal amplitude        | >300mm                               | < 300mm |         |

### Tier 3 - Additional specific operational evaluation criteria for tanks

| OPERATIONAL CRITERIA FOR TANK CULTURE           | TIER 3 LEVEL OF ASSESSMENT FOR TANKS  |   |         |
|---|---|---|---------|
|   | Level 1   | Level 2   | Level 3 |
| <b>2. Health Management</b>                     |   |   |         |
| Disinfection of tank aquaculture system         | Systems capable of disinfection and dry-out to break pathogen cycle   | Difficulty in total disinfection and dry-out of facility or no provisions     |         |
| <b>3. Culture Water Management</b>              |   |   |         |
| Semi closed and closed tank aquaculture systems | Recirculating aquaculture system with biofiltration, solids filtration (fine, suspended, settleable) oxygen, UV, or ozone, pH control | Recirculating aquaculture system having reduced or non-standard componentary. |         |

## 9.12 Project Profile Analysis - extensive pond aquaculture permissible without consent

Extensive pond aquaculture that is authorised under a Class C or E aquaculture permit that utilises existing on-farm water storages (dams or ponds) and buildings and meets all of the following criteria is permissible without consent.

| Locational Criteria                          | Minimum Performance   |
|--|---|
| 1. LEP zones                                 | Within rural zone RU1 (Primary Production), RU2 (Rural Landscape), RU3 (Forestry), RU4 (Rural Small Holdings), or RU6 (Transition).   |
| 2. Conservation exclusion zones <sup>6</sup> | (1) Must not be carried out on land dedicated or reserved under the <i>National Parks and Wildlife Act 1974</i> :<br>(2) Must not be carried out on the following land, except to the extent necessary to gain access to water: <ol style="list-style-type: none"> <li>land declared as critical habitat under the <i>Threatened Species Conservation Act 1995</i>, or</li> <li>vacant Crown land, or</li> <li>land within a wetland of international significance declared under the Ramsar Convention on Wetlands.</li> </ol> |
| 3. Flood liability                           | Must be designed or constructed on land so that it will not be inundated by the discharge of a 1:100 ARI (average recurrent interval) flood event.  |
| Operational Criteria                         |   |
| 1. Species selection                         | Species of fish or marine vegetation cultivated or kept must be consistent with the relevant Aquaculture Industry Development Plan.   |
| 2. Pond design                               | <ol style="list-style-type: none"> <li>Must not require the construction of new ponds, water storages, dams or buildings.</li> <li>Must not be located on permanent watercourses, creeks, billabongs or isolated outreaches of creeks or rivers.</li> <li>Must be capable of preventing the escape of stock into natural water bodies or wetlands.</li> </ol>   |
| 3. Culture Water                             | Must use freshwater.  |

<sup>6</sup> Nothing in in subclause (2) affects any requirement under an Act relating to land specified in subclause (2) to obtain a licence or other authority under that Act for development of the land.

## 10 Assessment Guidelines

These guidelines identify important factors to be considered when preparing a Statement of Environmental Effect (SEE) or an Environmental Impact Statement (EIS) to accompany a development application (DA) for a sustainable land based aquaculture proposal.

The SEE or EIS should predict the likely environmental impacts of the proposal (including construction and ongoing operation) and provide the basis for the project's on-going sustainable management. This information is important for the applicant in making business decisions and for the broader community to understand what is happening in their community and the approval bodies so they have adequate information to make a decision.

The preparation of a SEE or EIS should be preceded by effective consultation with relevant government agencies, Councils and neighbours. There should be early evaluation of alternatives, taking into consideration the factors in this guideline and in the relevant chapters in the NSW LBSAS. A high priority should be given to:

- considering environmental factors in site selection;
- evaluating alternative species, design, layout and management practices;
- ascertaining the suitability of the proposal in the intended location.

The analysis and justification for the the preferred site, species and technology should be consistent with ecological sustainability principles. The assessment process should focus on key environmental issues. Key matters for land based aquaculture facilities and related activities include:

- selection of an appropriate location and design layout to provide for sustainable management;
- water lifecycle management: source and availability of water and minimisation; management of wastewater;
- minimisation of adverse impacts on flora and fauna, in particular the risks associated with the species to be farmed and management of predators.

The SEE/EIS should outline commitments to the ongoing environmental management of the proposal, including monitoring.

The relevance of matters in this guideline to a particular land based aquaculture proposal will depend upon the proposed location, the species cultivated, intensity of production and the proposed cultural methods. The greater the potential environmental impacts, the more carefully the site, design and operational practices must be considered and assessed.

### 10.1 When is an EIS required?

If an aquaculture proposal is a Class 3 - designated development, an EIS must be prepared and submitted with the development application;

### 10.2 Factors to consider when assessing a proposal

The aim of an environmental impact assessment is to enable the approving authority, public, local Council, government authorities and the applicant to properly consider the potential environmental consequences of a proposal. It is important to provide sufficient information for:

- the applicant to make decisions about costs and benefits associated with the location, species, design and operation of the facilities;
- the broader community to understand the nature of the proposal being located in their area and to make an informed contribution to the assessment process;
- the approving authorities (Council and government agencies) to make a decision on whether to approve a proposal and if so, under what conditions.

The SEE or EIS should also provide the basis for sound ongoing environmental management.

It is the applicant's responsibility to identify and address, as fully as possible, the matters relevant to the specific proposal and to comply with the statutory requirements for EIS preparation. It should address relevant issues in sufficient detail so that the consent authority can make an informed judgement about the environmental impacts of the proposal. The following factors are important when preparing an EIS.

### 10.3 Early consideration of the strategic context

Strategic environmental issues need to be considered at the outset when selecting options for the proposal. These broader strategic issues have been considered in the development of the NSW LBSAS. It is not the role of the project SEE/EIS to undertake an environmental assessment of performance goals in the NSW LBSAS. Where the performance goals have been set out in the Aquaculture Industry Development Plan (AIDP), the SEE/EIS will only need to demonstrate compliance with those goals, not the justification of the goals. Information in the AIDP does NOT need to be repeated in the SEE/EIS.

### 10.4 Early assessment of options

The applicant should liaise closely with Industry & Investment NSW and Council at the early stages of a development proposal particularly in identifying and testing various options to meet the applicant's objectives for the proposal. When weighing up all feasible alternatives, the biophysical, economic and social costs and benefits throughout the whole life cycle of the proposal should be considered. Early adoption of ESD principles can reduce possible conflicts, and additional costs and delays at later stages of the approval process.

### 10.5 Identifying issues

There is no prescribed framework for a SEE however the general framework for a EIS can be used as a guide. The general framework for an EIS is prescribed in Schedule 2 of the *EP&A Regulation 2000*. If an EIS is required, the Director General of Planning must be consulted as to any specific matters to be addressed in an EIS. In issuing requirements, the Director General must consult integrated approval bodies in preparing the requirements. The requirements of these agencies will also be sent to the applicant at this time.

In addition to the specific requirements, the applicant has a broader responsibility to consider all potential environmental issues in relation to the proposal. As a precursor to identifying potential environmental issues, the applicant must outline:

- the important characteristics of the project;
- the proposed site;
- a preliminary assessment of the sensitivity of the site.

In addition to the issues outlined in this guideline, other sources of information that may assist in the identification of potential issues include:

- any relevant guidelines produced by NSW Government authorities, other States or overseas;
- EISs for similar projects, and any relevant Commission of Inquiry report, determination report and conditions of approval;
- Relevant research and reference material on similar proposals.

To help identify issues relating to a particular proposal in a location, informal consultation or a structured process with a high level of consultation with all stakeholders should be undertaken. The choice of the approach will depend on the scale and type of proposal and the sensitivity of the environment.

## 10.6 Prioritising issues

The relative importance placed on different issues identified in this guideline will vary from case to case, and is a function of the type and size of the proposal and the sensitivity of the surrounding environment. Issues should therefore be prioritised according to their importance in the decision-making process.

It is important that the budget for preparing the SEE/EIS, is allocated so that the necessary studies which are essential to predicting impacts and making decisions are undertaken and money is not wasted on unnecessary studies which may not be important to the decision making or the long term management of the site. It is critical that resources are focused on 'key' issues with the AIDP and the project profile analysis assisting in ranking the likely risks associated with most of the issues associated with land based aquaculture proposals.

The outcome of the identification and prioritisation process should result in:

- a) a list of all issues with a preliminary estimate of the relative significance of their impacts;
- b) identification of the key issues taking into consideration the project profile analysis;
- c) an estimate of the scope of the information required for these key issues;
- d) an explanation as to why other issues are not considered to be key.

The SEE/EIS should address the key issues as fully as practicable. However, the level of analysis should reflect the level of significance of the impacts and their importance for the proposal.

## 10.7 Impact analysis and prediction

Discussion of likely impacts should include predictions of the nature and extent of potential impacts and the effectiveness of mitigation strategies. This information is fundamental in deciding the potential ecological sustainability and hence the acceptability of a particular proposal.

### Baseline information

A certain amount of baseline information is required to determine the level of risk associated with the project based on the project profile analysis. A project considered high risk will require more detailed baseline information for predicting the likely level of impacts than a project considered to be low.

In some circumstances, there may be sufficient existing data available for assessment purposes without the need for additional data collection. Where existing data is used, its adequacy and appropriateness for assessment of the proposal's impacts should be reviewed and discussed.

In all cases, sampling programs and analysis procedures should reflect current scientific approaches for design, sampling methodology, data analysis and interpretation of results. Where baseline data is to be collected first-hand, careful consideration must be given to the design of the sampling program. The need for long term sampling to discern the variability of the environment should also be considered as early as possible to avoid time constraints. This could be an issue where discharges to natural waterways are proposed. Any assumptions and extrapolations used to draw conclusions from the data should be justified.

### Predicting the likely impacts and identifying mitigation

Impact prediction should consider magnitude, duration, extent, direct and indirect effects, beneficial and adverse effects and whether impacts are reversible or permanent. All predictions of impacts using predictive models should be justified in terms of appropriateness for the task, outlining its strengths and weaknesses, the likely success of mitigation strategies have and the element of uncertainty associated with them. The applicant should identify and, where possible, indicate the level of uncertainty associated with these predictions and mitigation measures. This

information is fundamental in developing appropriate management strategies and informs the applicant, community, government agencies and the decision-maker of the degree of risk associated with the proposal and the importance of that risk.

Whenever conclusions and recommendations have been based substantially on judgements instead of facts or objective analytical results, the basis of the judgements should be clearly identified. A staged development may be required in order to monitor and test predicted impacts.

### **Mitigation strategies**

Mitigation strategies must be considered both in relation to individual impacts and collectively for all impacts. This helps to avoid conflict between mitigation strategies and ensures that measures applied with respect to one (or more) potential impacts do not increase the magnitude or significance of other likely impacts. The mitigation strategy should include the environmental management principles that would be followed including:

1. a compilation of locational, layout, design or operational features in the EIS;
2. an outline of ongoing environmental management and monitoring plans.

Predictions made in the SEE/EIS should be monitored in an Environmental Management Plan (EMP). With projects posing potentially controversial environmental impacts, it may be appropriate to:

- consult with relevant government bodies, Council and the community;
- trial proposed mitigation measures in the EMP (obtaining necessary approvals);
- develop contingency measures to deal with impacts should mitigation measures not deliver the predicted outcomes;
- exhibit an annual environmental management report outlining the environmental performance of the proposal.

It is not expected that a detailed EMP be prepared at the development application stage. However the EIS/SEE should contain an outline of the content of an EMP addressing critical issues, structure and commitment to prepare an EMP if required.

## **10.8 Ecologically sustainable development**

Under the *EP&A Regulation 2000*, it is necessary to justify the proposal having regard to the principles of ecologically sustainable development (ESD). Ecological sustainability requires a combination of good planning and an effective and environmentally sound approach to design, operation and management. The applicant should have regard to the principles of ESD throughout the whole project life cycle especially in the use and reuse of resources, consideration of neighbours and minimising irreversible impact on the natural environment.

Continual reference should be made to the question 'Is this proposal ecologically sustainable?'

## **10.9 Consultation**

### **Purpose of pre-assessment consultation**

Early consultation with the local residents, other industry, Councils and government agencies is of great assistance in making a preliminary assessment of the potential viability and likely acceptability of the project at a particular site. It can also assist in ensuring that the SEE or EIS is focused on those matters that will add value to the decision-making process.

Effective consultation should enable an applicant to:

- clarify the objectives the proposal taking into consideration community concerns or issues;
- clarify the relationship of the proposal to relevant government policy directions or land use, economic, estuary or vegetation management plans which may constrain development on the site;

- identify feasible alternatives and their relative merits;
- identify environmental issues to:
  - \* prioritise and identify issues key to the decision-making process of the investors as well as to the consent and approval authorities;
  - \* identify the studies for key issues to provide adequate information for the decision-making process;
  - \* identify performance objectives or indicators for key issues;
  - \* when appropriate, identify experts (in government agencies or from other sources) who can assist in guiding and reviewing the assessment key issues;
- if appropriate, identify processes for continued community consultation.

In preparing the SEE or EIS, consultation with relevant parties should be undertaken early in the process and their comments taken into account in the SEE or EIS.

### **Planning focus meetings for major projects**

To facilitate consultation with relevant government agencies, it may be appropriate to hold a planning focus meeting (PFM). PFMs should be held for all major or potentially controversial proposals. The consent authority would usually be responsible for organising the PFM which would include government authorities which have an approval role, other agencies or independent technical experts.

### **Pre-lodgement Meetings for smaller projects**

For smaller projects, less formal meetings or discussions with relevant authorities, particularly the local Council, should be undertaken. Issues such as whether a proposal is consistent with the Council's strategic plan for the area and is permissible at the particular site should be clarified at the outset.

### **Formal consultation required for an EIS**

Under the provisions of the *EP&A Regulation 2000*, an applicant or proponent must formally consult the Director General of Planning regarding the content of an EIS. It is recommended that the PFM or preliminary discussions with Council occur before the proponent consults the Director General and that the minutes of the PFM or issues canvassed in the discussions be forwarded to Department of Planning when the Director General's requirements are requested.

### **Formal consultation required for a Species Impact Statement (SIS)**

If a proposal is on land that contains a 'critical habitat' or is likely to significantly affect threatened species, populations or ecological communities or their habitats, the Director General of the Department of Environment, Climate Change and Water should be consulted regarding the contents of a Species Impact Statement.

### **Community consultation**

The community likely to be affected, whether directly or indirectly, should be informed of the proposal and consulted early in the preparation of the EIS or SEE. The community can be a valuable source of information about a locality and by taking a 'partnership' approach with the local community, these factors can be identified early and appropriately considered. Consultation should aim to include affected individuals, community groups and groups with special interests such as local Aboriginal communities.

Consultation usually includes two phases:

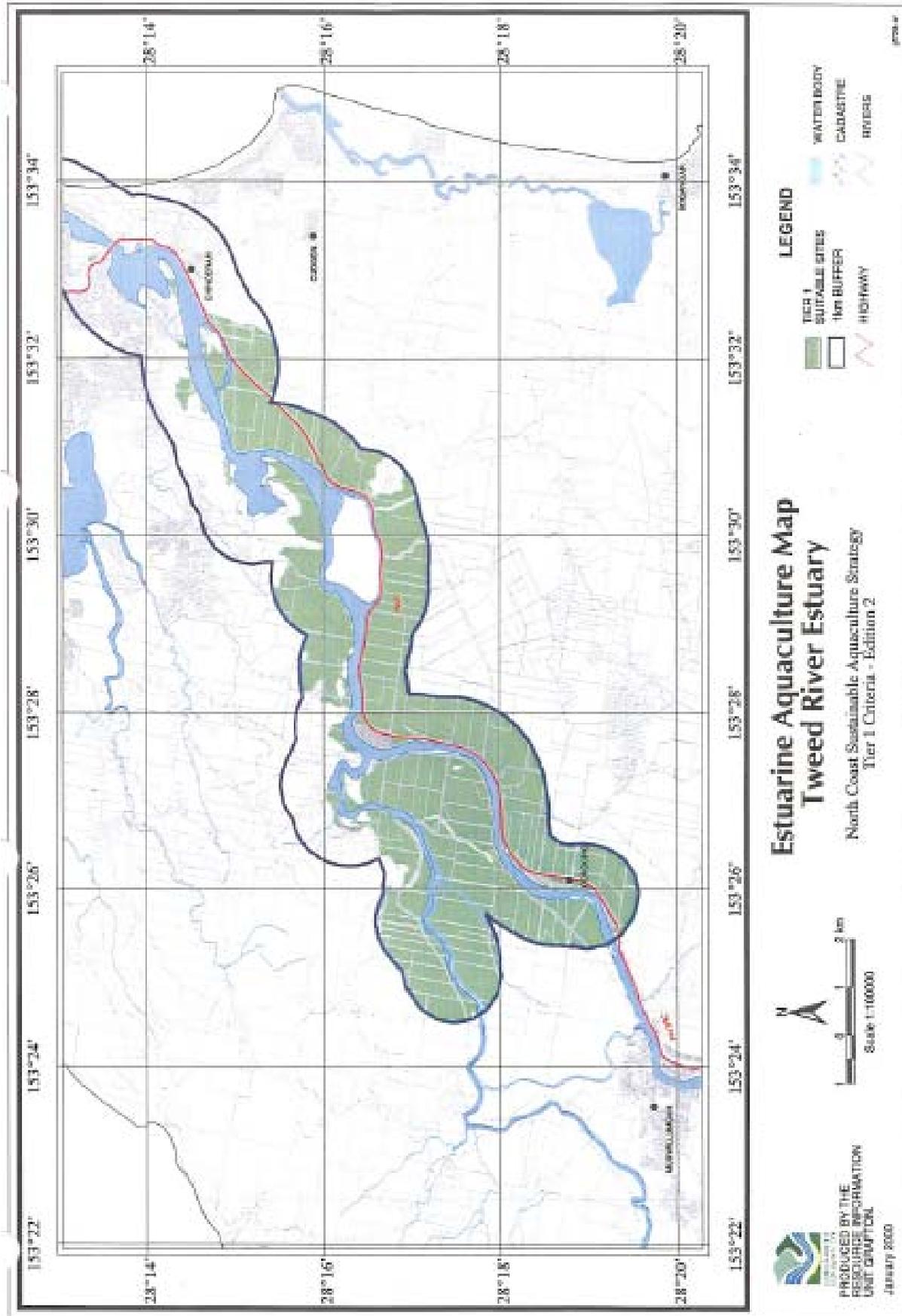
- Firstly, seeking to inform the community (public meetings, public displays or newsletters);
- Secondly, seeking to gain input on issues of community concern, to identify community values and to identify and evaluate alternatives (eg. focus meetings, 'issues' workshops and surveys).

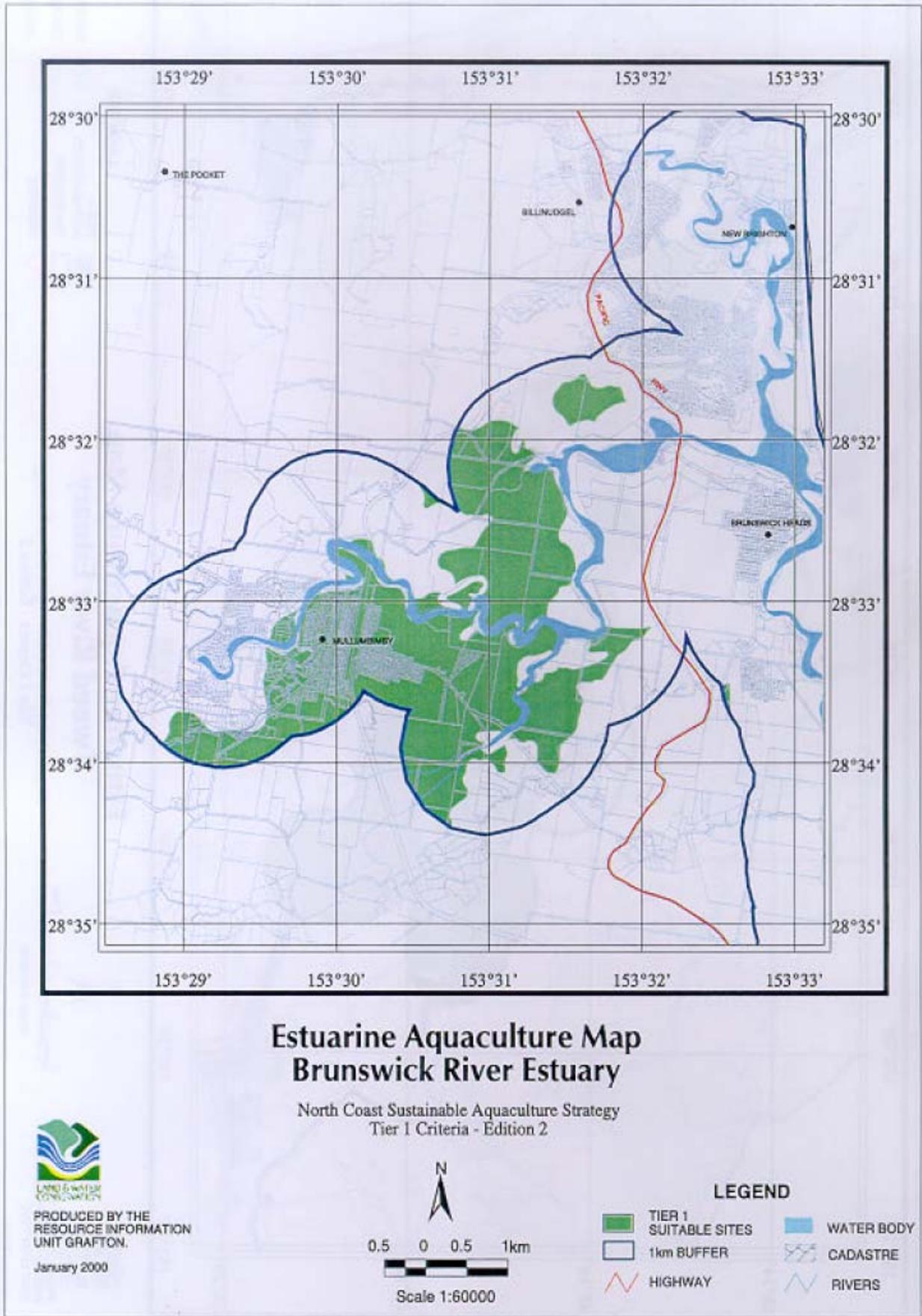
### 10.10 Who should be consulted on technical issues

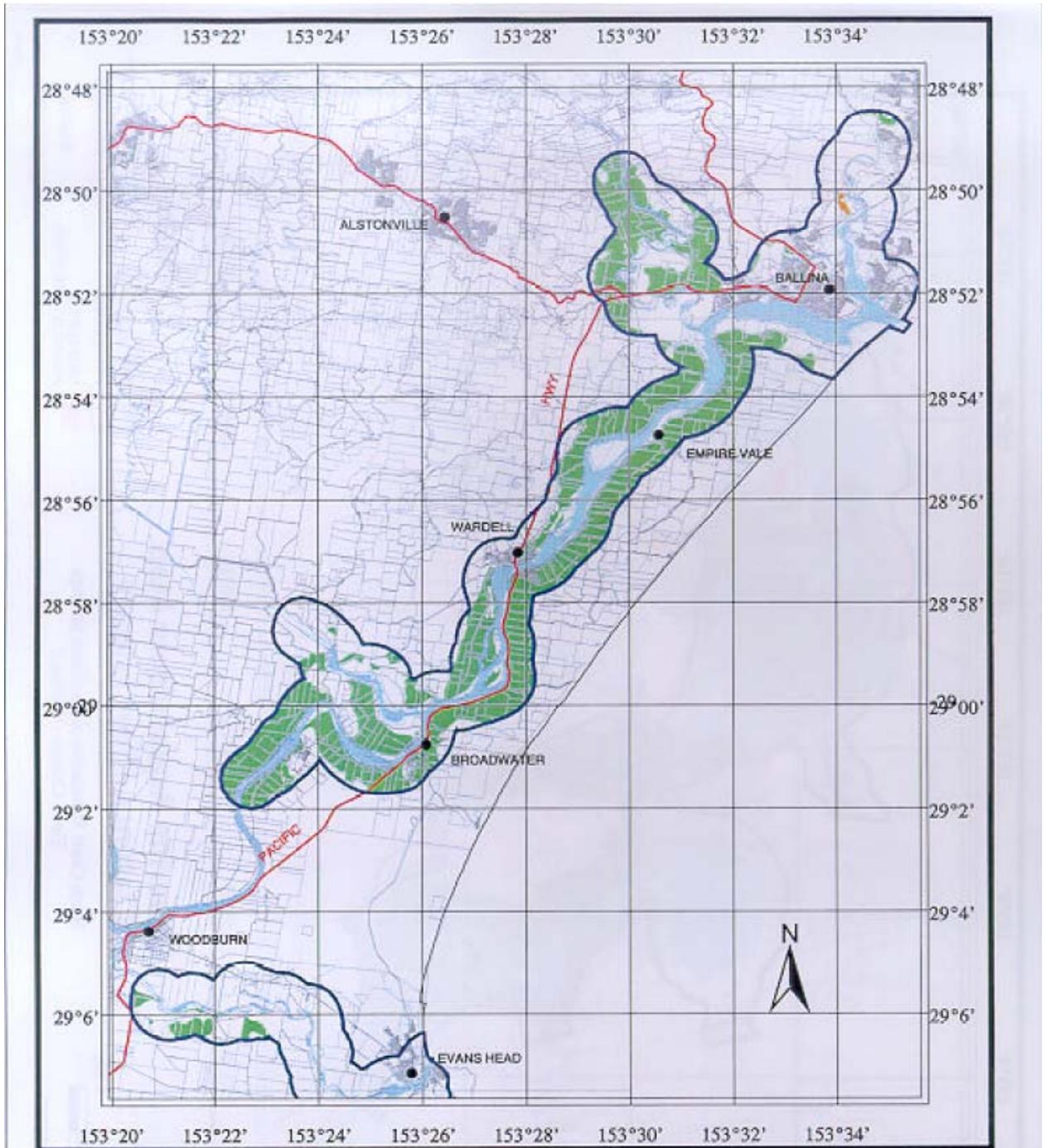
The consent authority ([Council](#) or [Department of Planning](#)) should be able to direct proponents to relevant State government agencies that may be able to assist on technical issues. These agencies may include:

- [Department of Water and Energy](#);
- [Industry & Investment NSW](#);
- [Land and Property Management Authority](#);
- [Department of Environment, Climate Change and Water](#);
- [NSW Food Authority](#);
- [Roads and Traffic Authority](#) or [State Rail Authority](#);
- [Department of Aboriginal Affairs](#);
- [Department of Bushfire Services](#).

# Appendix 1 Estuarine Aquaculture Maps







### Estuarine Aquaculture Map Richmond River Estuary

North Coast Sustainable Aquaculture Strategy  
Tier 1 Criteria - Edition 2



LAND & WATER  
CONSERVATION  
PRODUCED BY THE  
RESOURCE INFORMATION  
UNIT GRAFTON  
January 2000

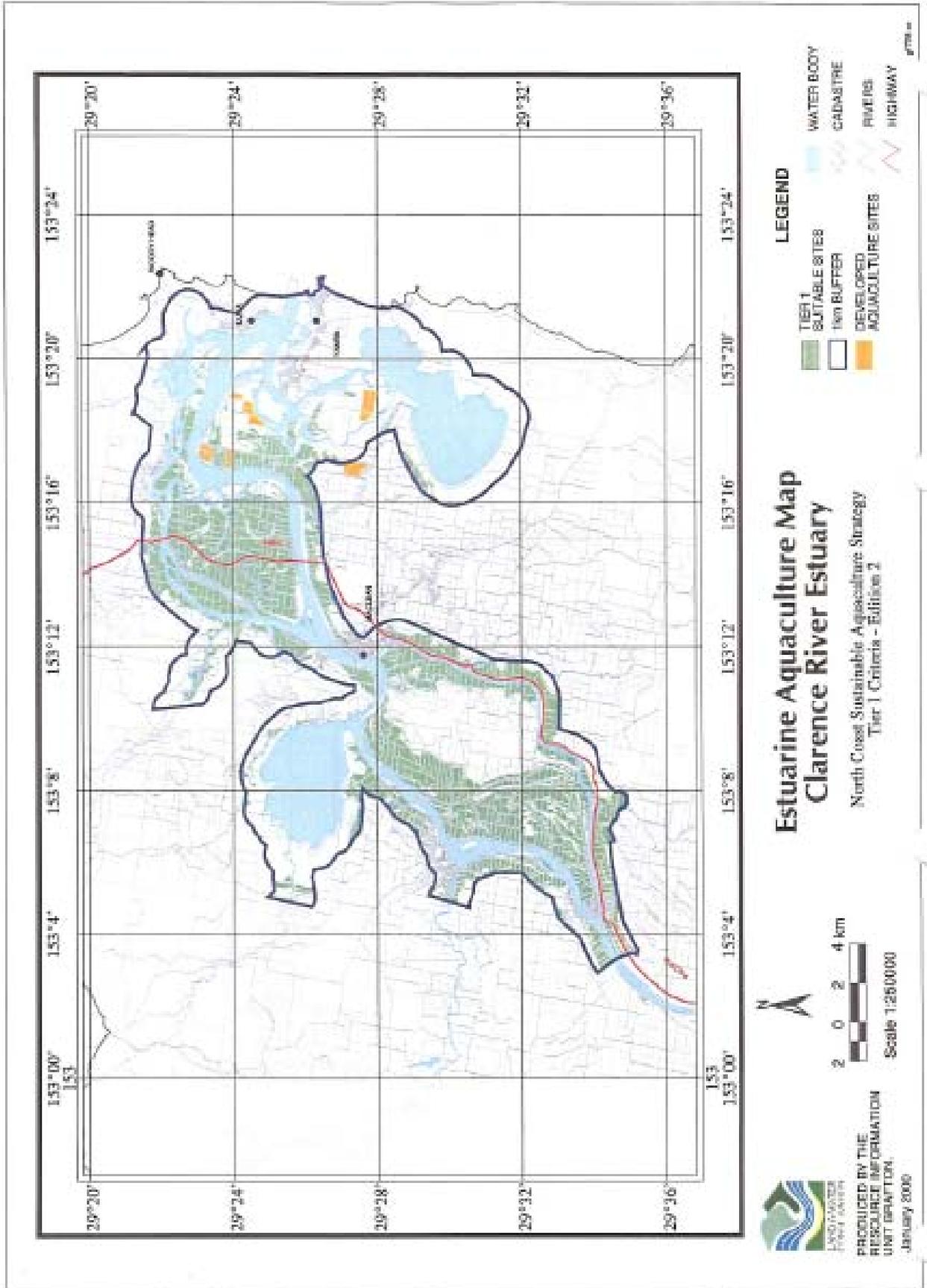


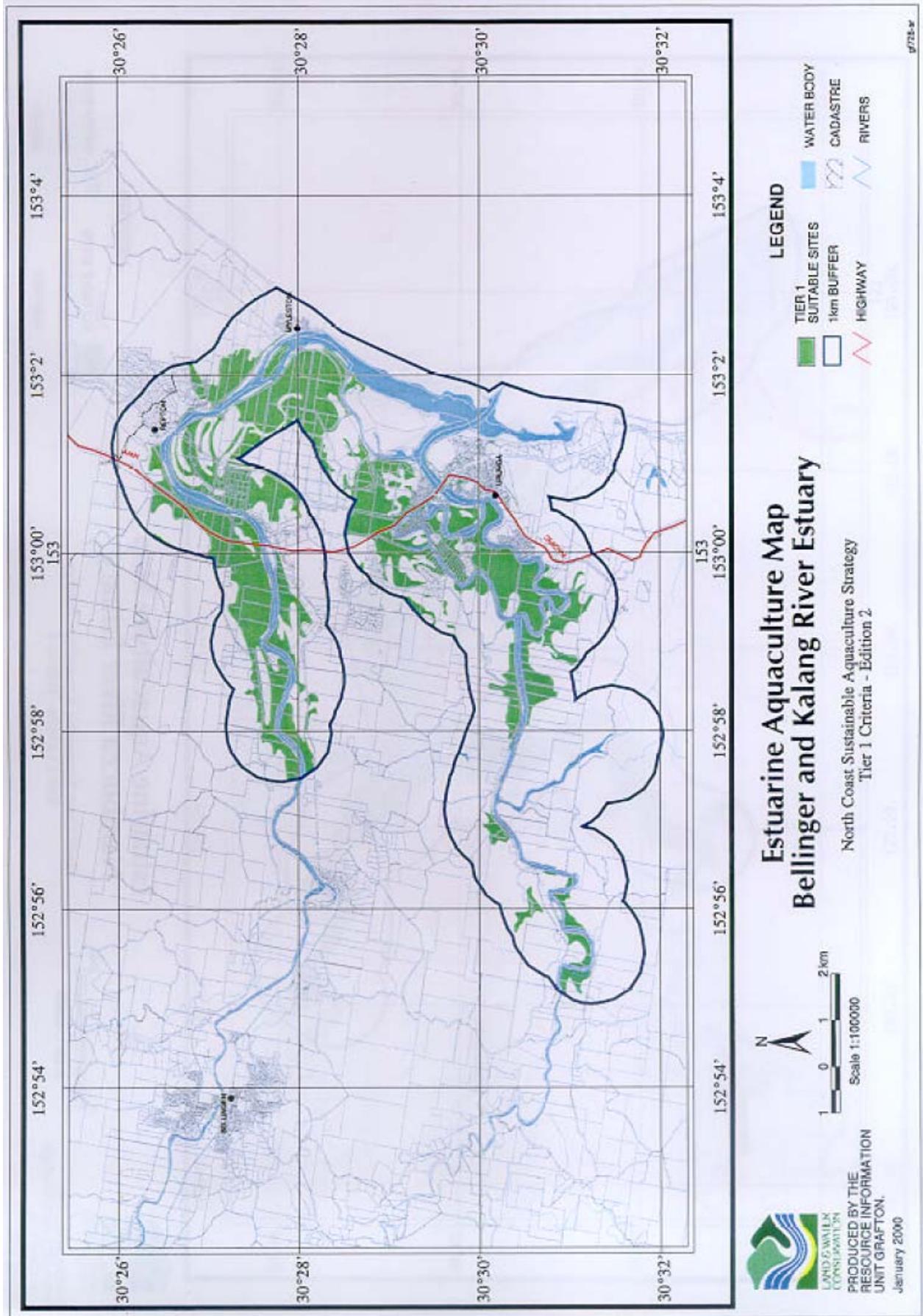
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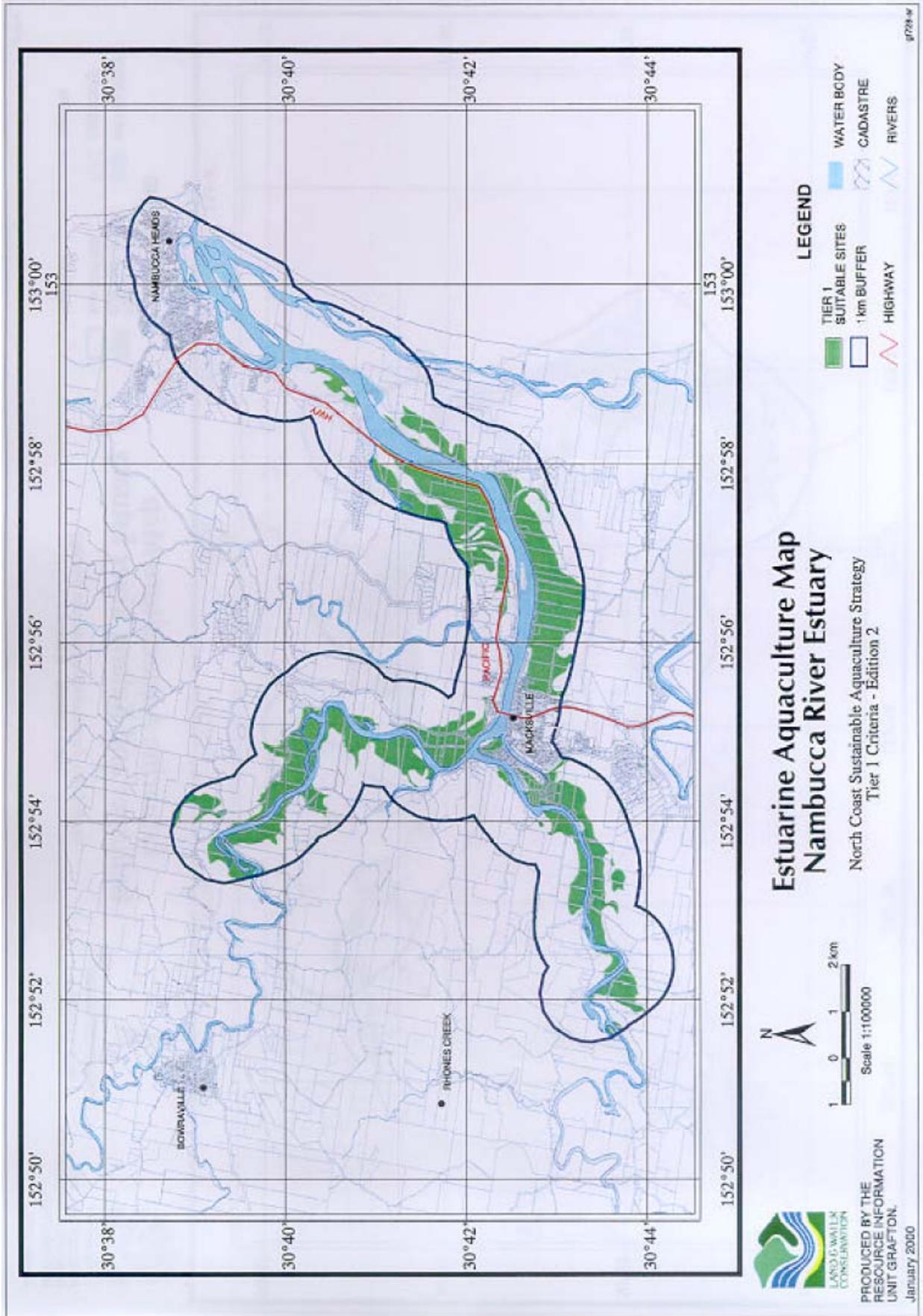
#### LEGEND

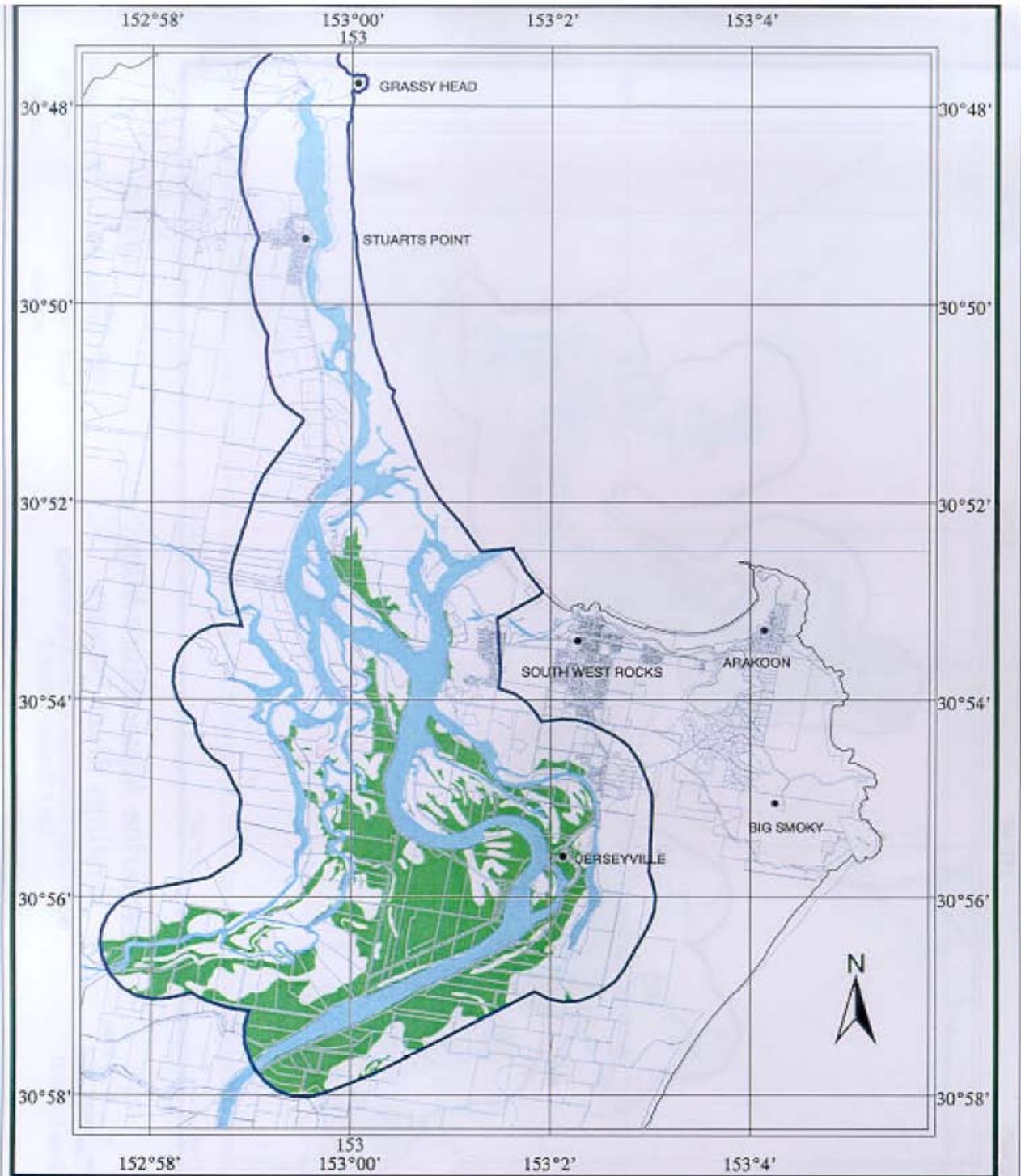
- |  |                             |  |            |
|--|-----------------------------|--|------------|
|  | TIER 1 SUITABLE SITES       |  | WATER BODY |
|  | 1km BUFFER                  |  | CADASTRE   |
|  | DEVELOPED AQUACULTURE SITES |  | RIVERS     |
|  |                             |  | HIGHWAY    |

07/28/00









### Estuarine Aquaculture Map Macleay River Estuary

North Coast Sustainable Aquaculture Strategy  
Tier 1 Criteria - Edition 2



LAND & WATER  
CONSERVATION  
PRODUCED BY THE  
RESOURCE INFORMATION  
UNIT GRAFTON.  
January 2000

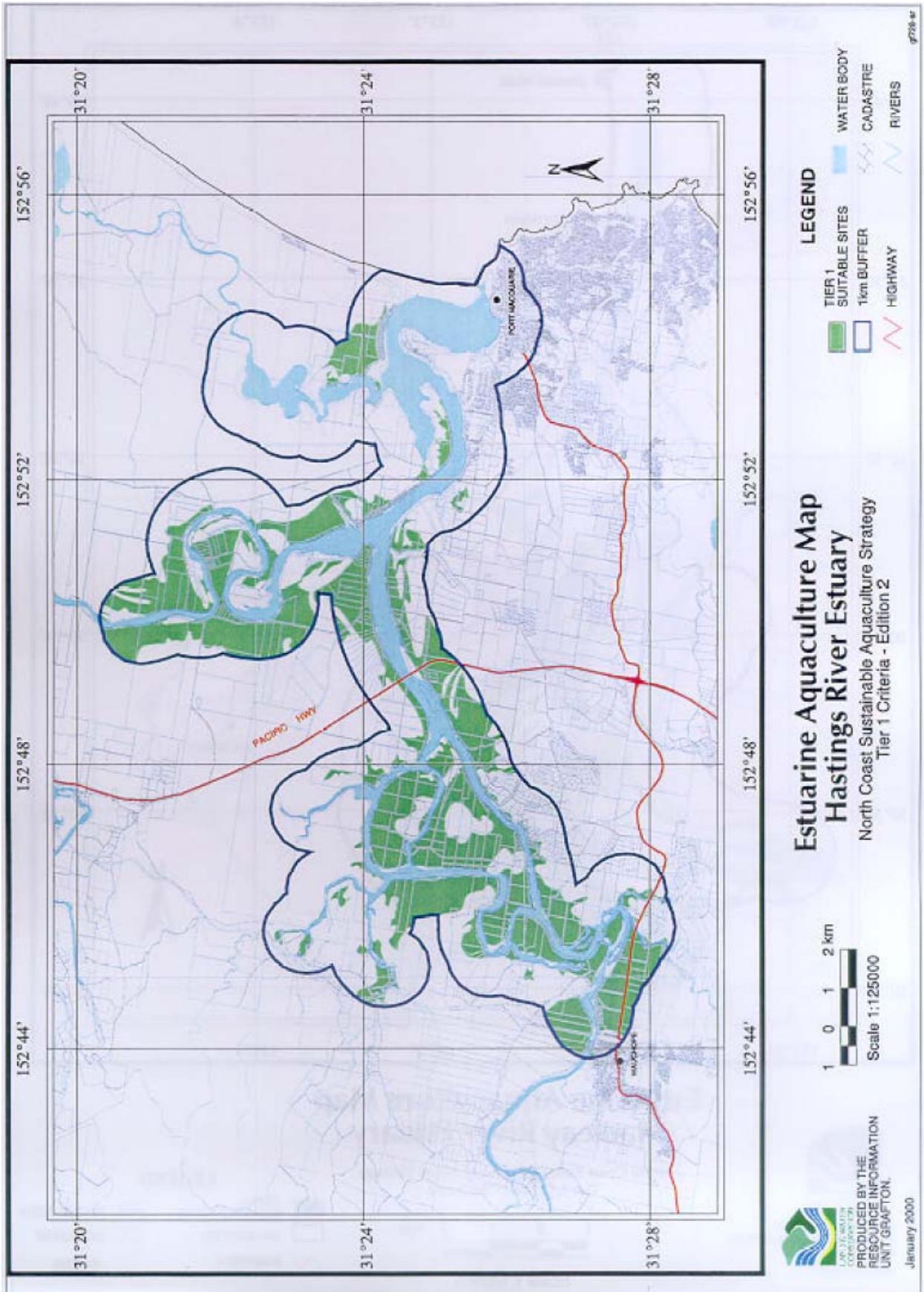


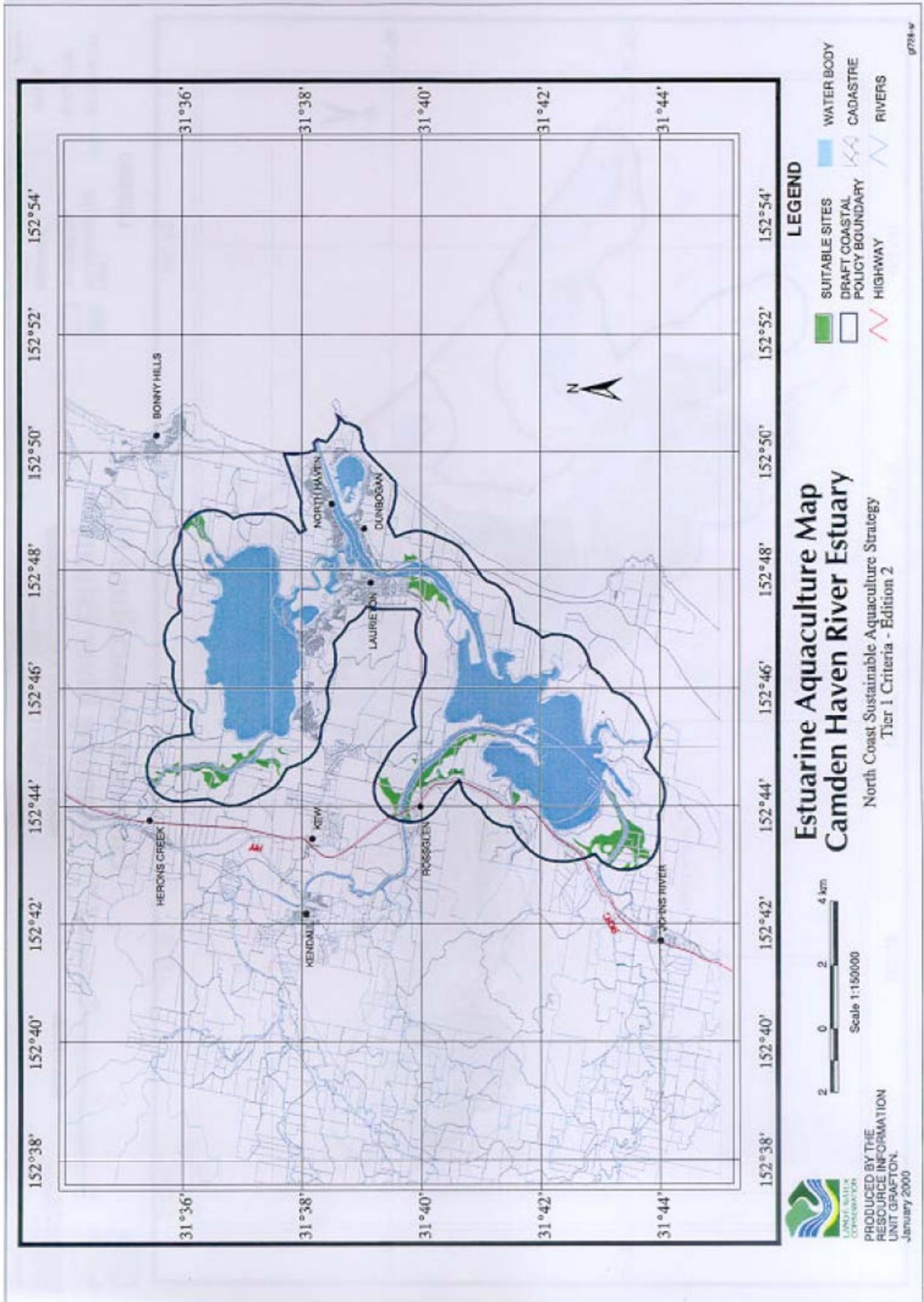
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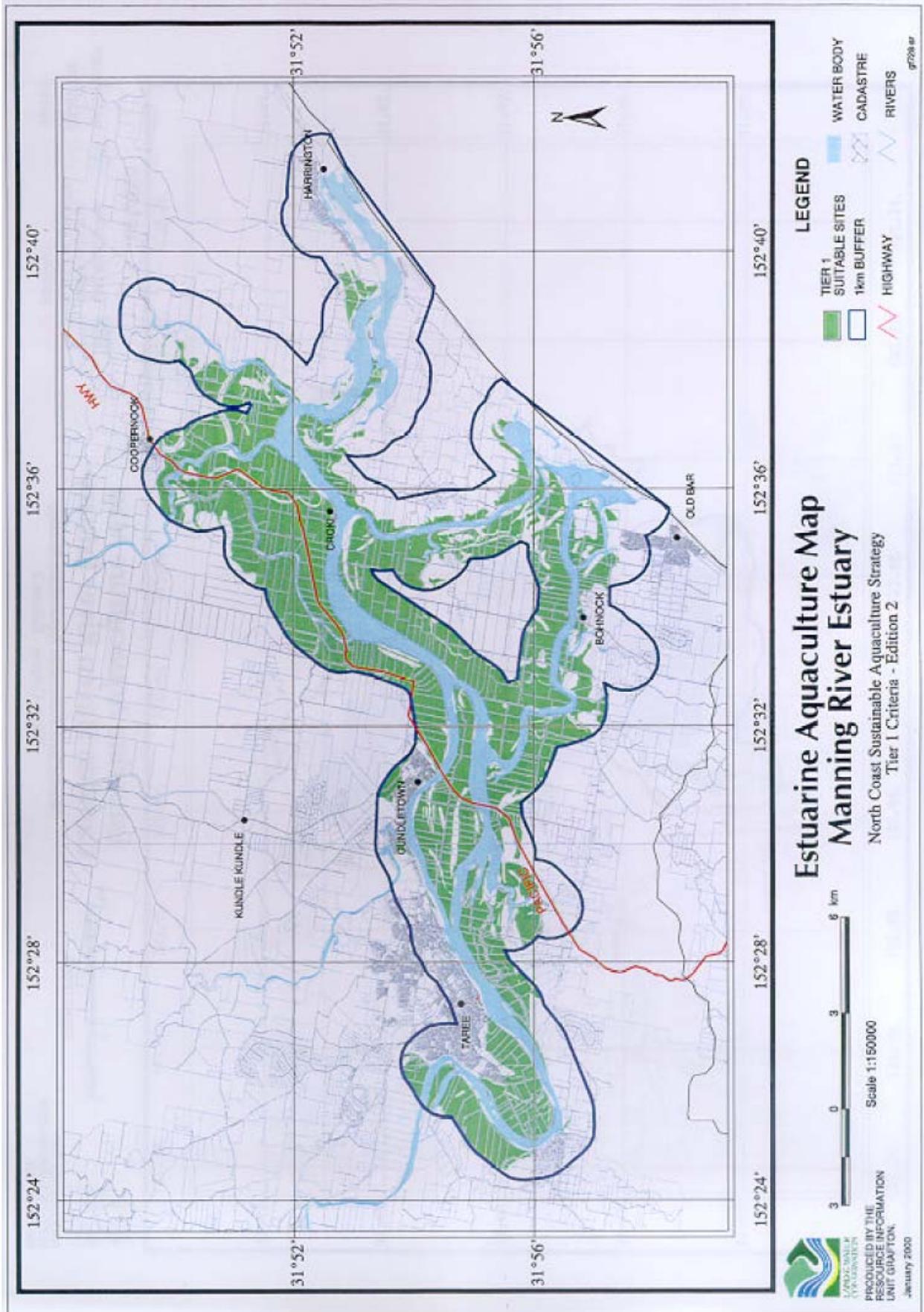
#### LEGEND

- |   |  |
|---|--|
|  TIER 1 SUITABLE SITES |  WATER BODY |
|  1km BUFFER            |  CADASTRE   |
|  HIGHWAY               |  RIVERS     |

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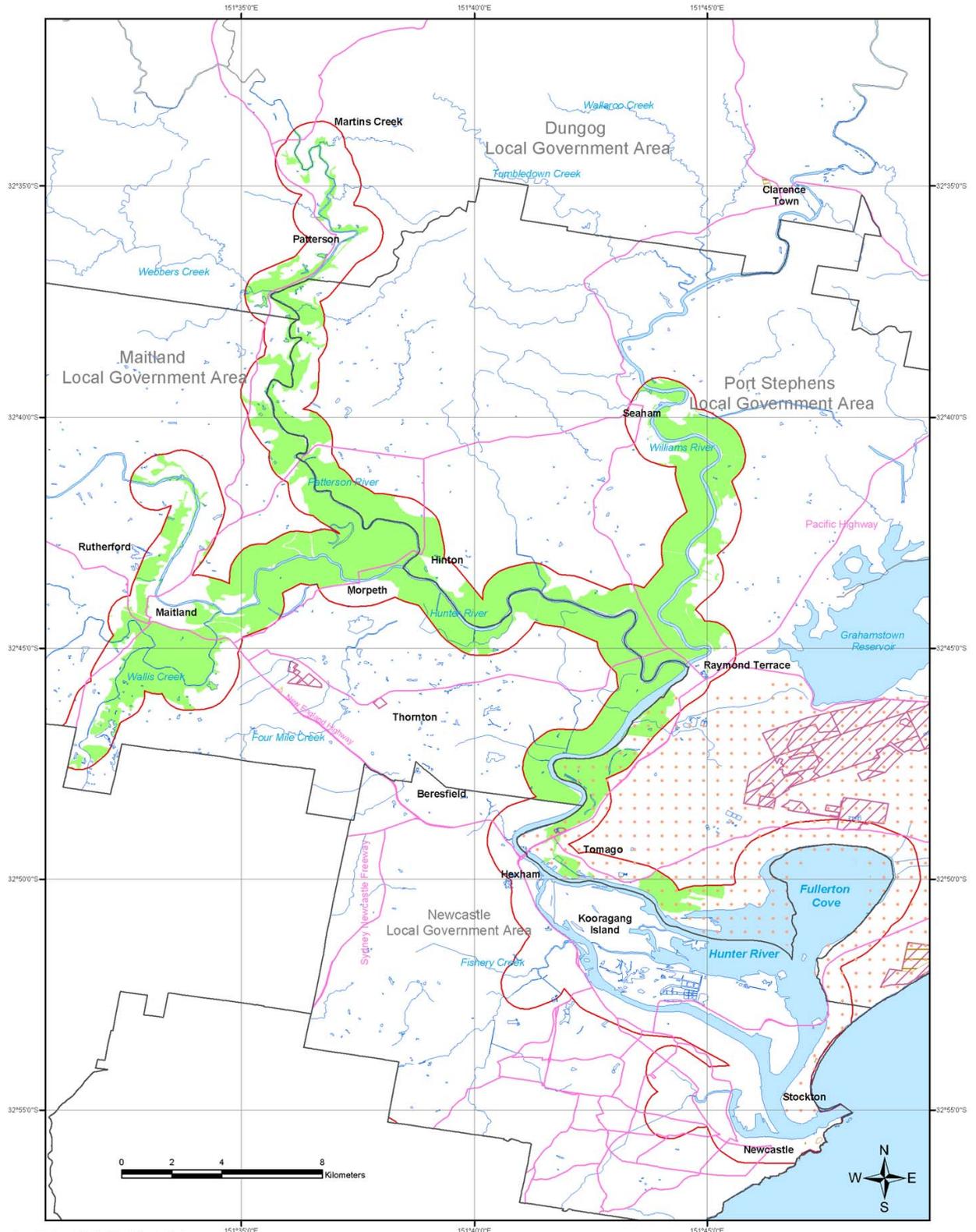






**Appendix 1 Estuarine Aquaculture Maps**





Source: data has been provided in 1999, 2000 and 2001 courtesy of Local Governments, councils, Department of Mineral Resources, Mine Subsidence Board, Department of Urban Affairs and Planning, National Parks and Wildlife Service, Environment Protection Authority, Department of Information Technology and Management and Department of Land and Water Conservation, Geospatial Data of Australia (GSDA).

All layers contained in this map have been prepared by the Hunter Region Resource Information Unit, Department of Land and Water Conservation, May 2001 prepared by GIS section, Aquaculture Management Branch, NSW Fisheries on 25 May 2003. PD



Tenure/Ownership/Status of all land shown on this map has not been validated. Before any works or planning decisions are undertaken, the status of each individual land parcel must be verified by the Department of Lands.

The State of New South Wales, the Department of Primary Industries, its employees, officers, agents or servants are not responsible for the result of any actions taken on the basis of the information contained on the map, or for any errors, omissions or inaccuracies that may occur on the map. The State of New South Wales and its employees, officers, agents or servants expressly disclaim all and any liability and responsibility to any person in respect of anything and the consequences of anything done or omitted to be done by any such person in reliance, whether wholly or partially, upon the information contained on the map.

**Estuarine Aquaculture Map 12**  
**Hunter River Estuary**  
 Edition 1, June 2004  
 Hunter and Central Coast Sustainable Aquaculture Strategy

- Potential Aquaculture Suitability**
- Minimum criteria sites
  - Local government area
  - Major road
  - Cadastre
  - 1 km buffer (Estuarine Area)
  - Drainage Line
  - Water Body
  - Groundwater Aquifer
  - Mining lease (minerals or coal)
  - Aboriginal land claim

## Appendix 2 Key Weblinks for Additional Information

### **Industry & Investment NSW**

#### **Primary Industries**

[www.dpi.nsw.gov.au](http://www.dpi.nsw.gov.au)

[www.dpi.nsw.gov.au/fisheries/aquaculture/](http://www.dpi.nsw.gov.au/fisheries/aquaculture/)

[www.dpi.nsw.gov.au/fisheries/aquaculture/contacts/aquaculture-industry-directory](http://www.dpi.nsw.gov.au/fisheries/aquaculture/contacts/aquaculture-industry-directory)

[www.dpi.nsw.gov.au/fisheries/aquaculture/publications/health/fish/info-sheet-silver-perch](http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/health/fish/info-sheet-silver-perch)

[www.dpi.nsw.gov.au/fisheries/aquaculture/publications/aquaculture-production-reports](http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/aquaculture-production-reports)

[www.dpi.nsw.gov.au/fisheries/aquaculture/publications/water-quality-management](http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/water-quality-management)

[www.dpi.nsw.gov.au/fisheries/aquaculture/publications/species-freshwater/collecting-finshish-broodstock#NSW-Hatchery-Quality-Assurance-Scheme](http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/species-freshwater/collecting-finshish-broodstock#NSW-Hatchery-Quality-Assurance-Scheme)

[www.dpi.nsw.gov.au/agriculture/farm/recycling-waste-mgt](http://www.dpi.nsw.gov.au/agriculture/farm/recycling-waste-mgt)

[www.industry.nsw.gov.au/energy](http://www.industry.nsw.gov.au/energy)

#### **State and Regional Development**

[www.business.nsw.gov.au/](http://www.business.nsw.gov.au/)

[www.smallbiz.nsw.gov.au](http://www.smallbiz.nsw.gov.au)

[www.businesscentre.com.au/](http://www.businesscentre.com.au/)

#### **Department of Planning**

[www.planning.nsw.gov.au/index.asp](http://www.planning.nsw.gov.au/index.asp)

[www.planning.nsw.gov.au/planningsystem/howda.asp](http://www.planning.nsw.gov.au/planningsystem/howda.asp)

[www.planning.nsw.gov.au/assessingdev/pdf/gu\\_plfocus\\_0134.pdf](http://www.planning.nsw.gov.au/assessingdev/pdf/gu_plfocus_0134.pdf)

#### **Land and Property Management Authority**

[www.lands.nsw.gov.au/crown\\_land/aboriginal\\_land](http://www.lands.nsw.gov.au/crown_land/aboriginal_land)

[www.lands.nsw.gov.au/contact\\_us](http://www.lands.nsw.gov.au/contact_us)

[www.lands.nsw.gov.au/land\\_titles](http://www.lands.nsw.gov.au/land_titles)

[www.lands.nsw.gov.au/survey\\_maps](http://www.lands.nsw.gov.au/survey_maps)

#### **NSW Office of Water**

[www.water.nsw.gov.au/](http://www.water.nsw.gov.au/)

[www.water.nsw.gov.au/Water-Licensing/default.aspx](http://www.water.nsw.gov.au/Water-Licensing/default.aspx)

[waterinfo.nsw.gov.au/drr/index.shtml](http://waterinfo.nsw.gov.au/drr/index.shtml)

#### **Department of Environment, Climate Change and Water**

[www.environment.nsw.gov.au/contact/](http://www.environment.nsw.gov.au/contact/)

[www.environment.nsw.gov.au/water/usinganzeccandwqos.htm](http://www.environment.nsw.gov.au/water/usinganzeccandwqos.htm)

[www.dnr.nsw.gov.au/floodplains/manual.shtml](http://www.dnr.nsw.gov.au/floodplains/manual.shtml)

[www.dnr.nsw.gov.au/soils/sulfate.shtml](http://www.dnr.nsw.gov.au/soils/sulfate.shtml)

[www.environment.nsw.gov.au/water/effluent.htm](http://www.environment.nsw.gov.au/water/effluent.htm)

[www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm](http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm)

[www.dnr.nsw.gov.au/vegetation/nv.shtml](http://www.dnr.nsw.gov.au/vegetation/nv.shtml)

[www.environment.nsw.gov.au/nswcultureheritage/AboriginalPeopleAndCulturalLife.htm](http://www.environment.nsw.gov.au/nswcultureheritage/AboriginalPeopleAndCulturalLife.htm)

[www.environment.nsw.gov.au/licences/AboriginalHeritageInformationManagementSystem.htm](http://www.environment.nsw.gov.au/licences/AboriginalHeritageInformationManagementSystem.htm)

[www.environment.nsw.gov.au/noise/index.htm](http://www.environment.nsw.gov.au/noise/index.htm)

[www.environment.nsw.gov.au/wildlifelicences/LandownersDevelopersLicences.htm](http://www.environment.nsw.gov.au/wildlifelicences/LandownersDevelopersLicences.htm)

[www.environment.nsw.gov.au/licensing/samplecalc.htm](http://www.environment.nsw.gov.au/licensing/samplecalc.htm)

[www.environment.nsw.gov.au/waste/envquidlns/index.htm](http://www.environment.nsw.gov.au/waste/envquidlns/index.htm)

[www.environment.nsw.gov.au/vegetation/noapproval.htm](http://www.environment.nsw.gov.au/vegetation/noapproval.htm)

[www.environment.nsw.gov.au/biocertification/offsets.htm](http://www.environment.nsw.gov.au/biocertification/offsets.htm)

**NSW Food Authority**

[www.foodauthority.nsw.gov.au](http://www.foodauthority.nsw.gov.au)

**Road and Traffic Authority**

[www.rta.nsw.gov.au/](http://www.rta.nsw.gov.au/)

**Department of Local Government**

[www.dlg.nsw.gov.au](http://www.dlg.nsw.gov.au)

**Other NSW State Agencies or Organisations.**

[www.legislation.nsw.gov.au/](http://www.legislation.nsw.gov.au/)

[www.mpa.nsw.gov.au/](http://www.mpa.nsw.gov.au/)

[www.mhl.nsw.gov.au](http://www.mhl.nsw.gov.au)

[www.cma.nsw.gov.au/](http://www.cma.nsw.gov.au/)

[www.heritage.nsw.gov.au/](http://www.heritage.nsw.gov.au/)

[www.nsw.nationaltrust.org.au/](http://www.nsw.nationaltrust.org.au/)

<http://maritime.heritage.nsw.gov.au/public/welcome.cfm>

[www.bpb.nsw.gov.au/index.shtml](http://www.bpb.nsw.gov.au/index.shtml)

[www.aib.org.au/buildingcodes/bca.htm](http://www.aib.org.au/buildingcodes/bca.htm)

[www.sydneyfishmarket.com.au](http://www.sydneyfishmarket.com.au)

**Other State/Federal Agencies or Organisations**

[www.dpi.qld.gov.au](http://www.dpi.qld.gov.au)

[www.dpi.vic.gov.au/](http://www.dpi.vic.gov.au/)

[www.foodstandards.gov.au/](http://www.foodstandards.gov.au/)

[www.environment.gov.au/epbc/](http://www.environment.gov.au/epbc/)

[www.environment.gov.au/water/quality/nwqms/](http://www.environment.gov.au/water/quality/nwqms/)

[www.environment.gov.au/water/publications/environmental/wetlands/database/](http://www.environment.gov.au/water/publications/environmental/wetlands/database/)

[www.environment.gov.au/biodiversity/migratory/index.html](http://www.environment.gov.au/biodiversity/migratory/index.html)

[www.environment.gov.au/heritage/index.html](http://www.environment.gov.au/heritage/index.html)

[www.nntt.gov.au/Pages/default.aspx](http://www.nntt.gov.au/Pages/default.aspx)

[www.greenhouse.gov.au/](http://www.greenhouse.gov.au/)

[www.metoc.gov.au/products/data.html](http://www.metoc.gov.au/products/data.html)

[www.seafood.net.au](http://www.seafood.net.au)

[www.seafoodcrc.com/](http://www.seafoodcrc.com/)

[www.australian-aquacultureportal.com/](http://www.australian-aquacultureportal.com/)

[www.natfish.tafensw.edu.au/](http://www.natfish.tafensw.edu.au/)

[www.seafoodtrail.com/](http://www.seafoodtrail.com/)