Risk Assessment
of the
NSW Seafood Industry

Prepared for

NSW Fisheries

by

Foodlink Management Services

October, 98

Contents:

Foodlink Management Services gratefully acknowledge the assistance offered by the following in the preparation and editing of this report:

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1. NON TECHNICAL SUMMARY

1998/359 Risk assessment for the NSW seafood industry

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OBJECTIVES:

1. To conduct a risk assessment of the health risks by the NSW seafood industry using accepted risk classification models and to identify those areas posing significant and/or immediate threats to human health and to prioritise the areas requiring food safety planning. To conduct a risk assessment of the health risks by the NSW seafood industry using accepted risk classification models and to identify those areas posing significant and/or immediate threats to human health and to prioritise the areas requiring food safety planning.
2. To review available information and identify any deficiencies in effectiveness and efficiency of current food safety measures for the seafood industry, and any risks not addressed by the current systems.
3. To estimate likely costs to government and industry of implementation of food safety plans over a five year period to address the identified risks.

NON TECHNICAL SUMMARY:

The purpose of this project was:

- to undertake a food safety risk assessment of the seafood industry in New South Wales;
- to identify the gaps between current and required practice; and
- to identify and prioritise the areas of concern and deficiency in terms of food safety measures; and estimate the likely costs of implementation of food safety plans over a four year period.

Seafood, unlike most other foods, can pose serious food poisoning risks simply as a result of their biology and/or the way in which they are consumed. This problem is further exacerbated by the fact that animals posing a risk do not show any signs that can easily distinguish them from 'safe" food. This has resulted in a widespread lack of appreciation of the dangers posed by seafood amongst those that catch and distribute the products.

The notion amongst those in the industry is that if the product is "fresh" - meaning recently caught- it is safe to eat, with the corollary being that catchers and distributors take little action to ensure that food is safe to eat, other than to keep the product cold to touch. The lack of data on outbreaks of food poisoning attributed to seafood, except in cases related to shellfish, may have further contributed to the complacent attitude amongst seafood operators to food safety. However the risks posed by seafood are real, and apart from oysters and pipis, little is being done to ensure that only safe products are offered for sale. Even enterprises that export under AQIS requirements may sell product onto the domestic market that is not necessarily handled under their export quality program. The following summarises the risk posed by seafood:

Ranking of Risk	Description of Risk	Existing Hazard Reduction Measures
Critical: **ingestion is most likely to cause illness**	Seafood species that accumulate biotoxins and/or harmful bacteria and/or viruses that are not destroyed by further processing.	SQAP Pipi biotoxin food safety plans
Major: **ingestion is likely to cause illness**	Fish containing histamine. Contaminated cooked seafood intended to be eaten without further cooking.	One or two quality management systems, AQIS
Minor: **ingestion may cause illness**	Cooked or raw seafood that contains a high bacterial load as a result of time/temperature abuse. No cooking or cooking time insufficient, to kill all bacteria. Heavy metal & other pollutant residues.	One or two quality management systems, AQIS

Our study has shown that most operators in the seafood industry are unable to describe the hazards posed by the seafood that they handle and sell and unwittingly subject most to considerable time/temperature abuse. There is ineffective product identification through the distribution channels and thus the industry has limited ability, if any, for effective product recall in the event of a food poisoning outbreak.

There is sufficient evidence (based on survey and interviews with managers and staff within the NSW seafood industry, and with senior personnel from peak industry organisations) to indicate a significant gap between existing industry practice and what is required to control hazards.

Recommendations are made based on these findings, and suggest a "whole of industry" approach to minimise implementation cost, and maintain consistency from catchers to wholesalers. We recommend that comprehensive research is carried out to quantify the hazards and effective control measures for the NSW seafood industry. This research is essential to provide the industry with a scientific basis for the preparation of their HACCP programs, and to ensure that industry can equip itself to provide safe seafood.

Research is also needed to develop a program of product identification and traceability from the catcher to the final point of sale. Hand-in-hand with research we recommend the development of training programs for seafood operators in the application of effective control measures within their operations to ensure the supply of safe seafood.

The estimate of implementation costs is based on a phased program of a) research to provide scientific data on hazards and control measures, b) development of industry guidelines and specific training packages; c) a pilot program to test the efficacy of industry guidelines, and d) facilitated introduction across the industry.

This report concludes that there is an imperative for a structured, practical approach to implementing food safety programs across the catching/harvesting, distribution, and wholesale/retail sectors. This will only happen if Safe Food Production NSW ("Safe Food") ensures that consultation and negotiation is effective across the entire industry.

2. CONTEXT

2.1 Introduction

In NSW there are approximately 380 registered commercial fishing businesses (ABS), employing around 1800 fishermen, utilising some 3000 licensed fishing vessels. There are 20 fishermen's co-operatives in coastal towns operating as the point of first sale for fresh caught seafood, and in some cases as processors. There are around 35 wholesalers, and 2 independent processors. There are an estimated 449 identified seafood retailers (where sale of fresh seafood comprises at least 50% of their business), and more than 120 supermarket seafood outlets.

NSW supplies 11% (by weight) of the national catch, worth around $113 million per year. However NSW consumes a much greater share of the national seafood product. 60% of seafood consumed in NSW is imported from either overseas or interstate.

The demand for seafood is high, and is likely to increase over the medium to long term. Australian consumers eat around 12 kgs per year, 75% of which is taken as fresh or frozen product or as product eaten outside the home (ASIC facts sheet). With red meats and poultry increasingly perceived by many consumers as "high risk" foods, seafood is considered a healthy alternative and is promoted as such. 36% of consumers actively seek seafood in preference to red meat or poultry.

The tourism industry actively promotes the availability of fresh seafood as one reason to visit Australia. With visitor numbers expected to swell up to and beyond the Olympic Games in 2000, the outlook for the NSW seafood industry is promising.

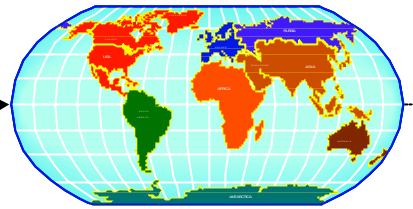
2.2 Distribution Channels for Seafood Sold in NSW

There are four primary sources of seafood sold in NSW. These are:

- NSW wild catch;
- NSW aquaculture;
- Imported from other states;
- Imported from overseas

Commercial fisheries in NSW are diverse in terms of area, method, and species. Most fishery categories are fully exploited, and NSW Fisheries plays a key role in managing the resources for viability and sustainability.

The following diagram indicates the complexity of the NSW distribution channels. Statistics on the catch are from NSW Fisheries 1995/96, imported product from ABS, and Sydney auction from Sydney Fish Market (97/98). Other movements can only be extrapolated or assumed.



3,200 MT

38,800 MT
(including point of landing
for other states)

Ocean:
20,647 MT

Estuarine:
5,833 MT

Inland:
322 MT

Aquaculture:
693 MT
(direct to
market)

TOTAL:
27,500 MT

(380 MT)

Processors

Supermarkets

NSW Fishermen's
Co-operatives

13,200 MT

Sydney Fish
Market

16,200 MT

Wholesalers/
retailers

~72,000 MT
consumed

(2,700 MT)

11,100 MT
(including local sales)

~20,000 MT
from interstate

2.2

Current information from the Australian Bureau of Statistics Business Register Counts can be found in Appendix 1.

The Sydney Fish Market (SFM) occupies a unique position within the NSW industry. Approximately 16 million kgs of seafood is sold at auction annually, 80% of which is sourced from within the state. Between 50-60% of the NSW catch passes through the Sydney market, making it a major conduit in the distribution channel for NSW seafood.

2.3 The Scope of this Study

The primary objective of this project is to undertake a food safety risk assessment and gap audit of the seafood industry in New South Wales; to identify and prioritise the areas of concern and deficiency in terms of food safety measures; and estimate the likely costs of implementation of food safety plans over a four year period.

The types of businesses involved in the through-chain include fishermen, fishermen's co-operatives, seafood processors, aquaculture operators, wholesalers, and retailers.

The impact of road and air transport is also considered in this study.

The requirements of this project are:

Identify food safety concerns across the producer, processor, wholesaler, and retailer sectors of the NSW seafood industry;

Identify high, medium, and low priority risks to food safety;

Identify food safety risks not satisfactorily addressed by current practices.

Identify the gaps between current practices and those required to meet the national food hygiene legislation.

Estimate the likely costs of implementation of food safety plans throughout the NSW industry over the next five years.

The NSW oyster industry is excluded from this study.

2.4 Food-borne Illness from Seafood

In Australia and world wide, the incidence of food borne illness is increasing. Recent estimates suggest there could be 2.1 million cases of food related illness per year in Australia, which costs the community an estimated $1 billion. [1]

Accurate measures of the level of food-borne illness in Australia are currently not possible. *'The current food-borne illness surveillance system is not implemented consistently between States and Territories, nor does it systematically link with other measures of food-borne illness or food safety'* [2]

The situation is only marginally better in other western countries. Statistics on food-borne illness are affected by lack of reporting of all bar the more serious cases. According to the World Health Statistics Quarterly (Vol 50, N1/2, WHO, 1997), surveys indicate that food-borne diseases may be 300-350 times more frequent than the reported cases tend to indicate. The cases that are reported are generally related to specific outbreaks.

Nevertheless, there is sufficient evidence from home and abroad to indicate that seafood is a significant contributor to food-borne illness:

+ In Sydney in 1997, an outbreak of *Hepatitis A* was linked to imported frozen prawns. [3]

+ An investigation by the Brisbane North Environmental Health Service in 1995 indicated that as few as one or two Spanish mackerel caused 7 incidents of ciguatera poisoning affecting 15 people. The fish steaks implicated were purchased from the same Brisbane retail store over a two-day period in July of that year. [3]

+ Large outbreaks of *Vibrio parahaemolyticus* occur regularly in Japan, especially during the winter months. [4]

+ In the last ten years, two separate outbreaks of botulism have occurred in the USA, involving commercially canned salmon. Also, smoked fish, both hot and cold-smoke, have caused outbreaks of *type E* botulism. [4]

+ From 1979 to 1990, there were 434 suspected incidents of scombrotoxic fish poisoning, involving 943 people, in the UK. 164 incidents were confirmed by histamine analysis (levels greater than 5mg per 100g of flesh). Fish involved included raw and canned tuna, smoked, canned, and soused mackerel, canned sardines, pilchards, herring, anchovies, and salmon. [5]

+ A comparative study of food-borne outbreaks in the republic of Korea and Japan between 1971 and 1990 revealed considerable differences in morbidity and mortality as well as in agents involved. Most incidents occurred in the workplace and in the home in the republic of Korea, whereas they were more frequent in restaurants and hotels in Japan. Seafood was often implicated in both countries.

1 '*Regulatory Impact Statement, Proposed Nationally Uniform Hygiene Standards'*, ANZFA, 1998

2 *'Food, a Growth Industry – the Report of the Food Regulation Review'*, Food Regulation Review Committee, August 1998.

3 *"Food Safety and Hygiene",* Food Science Australia Information Service, (September 1996)

4 *'"The Bad Bug Book" – Foodborne Pathogenic Microorganisms and Natural Toxins Handbook",* US Food & Drug Administration – Center for Food Safety and Applied Nutrition; (internet available) last update April 1998

5 *'Hygiene for Management; A text for food hygiene courses'*, Richard a Srenger, Highfield Publications, UK, eighth edition 1998

2.5 The Proposed New Food Regulatory Requirements in Australia [6]

The Australia New Zealand Food Authority (ANZFA) is developing a series of food hygiene standards to ensure production of safe food. The proposed new standards represent a fundamental shift in the way regulatory authorities administer food safety. There will be an emphasis on the industry and individual food businesses for the safety of the foods they produce. The practices applied by the food industry will be based on minimum but appropriate regulations developed by ANZFA. These regulations will be based on Hazard Analysis and Critical Control Point (HACCP) principles and will require a consistent, through-chain approach.

The proposed reforms comprise a package of new standards in the Food Standards Code, and will apply to all agrifood businesses currently covered by the Food Standards Code. However the standards cannot be enforced until State and Territory Food Acts have been amended. The four new standards are:

- Standard 3.1.1 - Interpretation and Application
- Standard 3.2.1 - Food Safety Programs and General Requirements.
- Standard 3.2.2 - Food Hygiene Practices.
- Standard 3.2.3 - Food Premises and Equipment.

The aim of the new standards is to offer a flexible, non-prescriptive approach that will allow businesses to determine how they can best meet the requirements of the standards. The standards achieve this through five broad provisions.

a) Food Business Notification

The owner/s of food businesses will be required to notify relevant State and Territory agencies of their existence so that standards can be enforced and food poisoning outbreaks identified and contained as soon as possible.

b) Food Produced by a Food Business must be Safe

'Safe' in relation to a food, means the food will not cause harm to the person consuming it when it is prepared and/or eaten according to its intended use.

c) Training Competencies for Food Handlers and Supervisors

Each food business will have to ensure that food handlers and supervisors have the necessary skills and competencies in food hygiene matters.

d) Food Recalls

The responsibility for providing for the recall of unsafe food rests with the food business.

e) Food Safety Programs

All food businesses will be required to implement a written food safety program. These food safety programs will involve the:

- Systematic identification and analysis of the potential food safety hazards in all operations of the food business.
- Identification of where each hazard can be controlled and the means of control.
- Provision for the systematic supervision and monitoring of the controls.
- Provision of appropriate corrective action when a process is found not to be under control.
- Regular program verification.

Food safety programs will be independently audited to ensure their adequacy and compliance with the requirements for food safety programs.

2.7 Implementation of the New Regulations

ANZFA has proposed the following implementation process:

Compliance with Standard 3.1.1 Interpretation and Application will be compulsory within at least 12 months after the date of gazettal.

Standard 3.2.1 Food Safety Programs and General Requirements will take effect 12 months after gazettal. Compliance with this standard will be strongly encouraged but will be optional from its commencement date for a proposed 6 year period. Those food businesses that choose not to opt for compliance with Standard 3.2.1 will continue to be required to comply with existing food hygiene regulations in addition to Standards 3.1.1, 3.2.2, and 3.2.3.

Standards 3.2.2 and 3.2.3 for *Food Hygiene Practices* and *Food Premises and Equipment* were released for public comment in March 1998 and should be finalised by the end of 1998. Compliance with Standards 3.2.2 and 3.2.3 will be compulsory from the date of gazettal.

[6] '*Development of National Food Hygiene Standards. Proposal P145 Explanatory Notes to Draft Standards 4.1 and 4.2*'. (July 1997), Australia New Zealand Food Authority, Canberra and Food Hygiene Reforms Fact Sheet, ANZFA (March 1998).

2.8 'Safe Food Production NSW'

A bill has been drafted by the office of the Minister for Agriculture in NSW, and is currently distributed for comment throughout NSW producer groups. It proposes to dissolve the NSW Dairy Corporation and NSW Meat Authority, and establish a body called Safe Food Production NSW '*with functions related to ensuring the safe handling of primary produce and seafood during the production, processing and transportation stages'*. [7]

However, the proposed Bill does not apply to '*the handling of primary produce on retail premises or in or from retail vehicles'*. [7]

It is proposed to incorporate NSW Dairy Corporation into the new agency early next year, and the NSW Meat Authority in the year 2000. The inclusion of other food groups is likely to occur some time after.

Although Safe Food Production NSW is assigned to the Agriculture portfolio, it is also expected to work closely with NSW Fisheries and NSW Health. The latter agency has responsibility for the Food Act 1989, and will be responsible for administering the ANZFA food hygiene regulations once approved by the Health Ministers, and included in the Food Standards Code.

NSW Health is currently preparing a green paper on the introduction of the national food hygiene standards for public comment.

The likely scenario for the short term is therefore that NSW Fisheries will retain responsibility for seafood safety in the harvesting and transport sectors, until that
role is absorbed into Safe Food Production NSW. NSW Health will retain responsibility for administering the national food hygiene standard in the wholesale/retail sectors, after gazettal in NSW.

[7] *'Food Production Bill 1998 – Exposure Draft'* issued by the office of the Minister for Agriculture (NSW), September 1998.

3. RISK ASSESSMENT METHODOLOGY

The objective of this section is to develop a risk classification framework that is consistent with that proposed by ANZFA ("Prioritisation classification systems for food businesses", ANZFA, September 1998), and can be used specifically to classify seafood businesses according to food safety risk.

Risk Assessment involves classifying and prioritising food industries or businesses according to the food safety risks inherent in their operations. It is synonymous with the hazard analysis step required in the Hazard Analysis and Critical Control Point (HACCP) system. The Codex Alimentarius Commission's HACCP Guide defines hazard analysis as:

"The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety and therefore should be addressed in the HACCP plans" [1]

It requires the identification of biological, chemical or physical food safety hazards, and the application of agreed criteria to determine the likelihood of each hazard occurring and the severity of those hazards if they do occur.

Whereas ' hazard analysis' is used by a business to determine the hazards that need to be controlled, 'risk assessment' uses the same process to determine the significance of hazards in terms of regulatory or other intervention. However, the relationship means that the risk assessment can become the basis of generic industry HACCP plans at a later stage.

3.1 Draft Priority Risk Classification System for a Food Business

In their report to ANZFA [8], Dr P Desmarchelier and his project team reviewed six existing risk classification systems in use both in UK and Australia, and held workshops with food industry and health representatives in Sydney, Melbourne and Brisbane

Based on this work, they identified four major risk classification headings:

- ✓ Food type and intended use
- ✓ Handling
- ✓ Customer base
- ✓ Confidence in management system

The categories within each classification are discussed on the next page, together with comments on the appropriateness of the framework for classifying risk within the NSW Seafood Industry

[8] "A Risk Classification System for Food Businesses – A Report to the Australia New Zealand Food Authority", Desmarchelier, P; Vanderlinde, P; and Janssen, E; 29th July, 1998.

Draft Priority (Risk) Classification System for a Food Business

from: *"A Risk Classification System for Food Businesses – A Report to the Australia New Zealand Food Authority"*, Desmarchelier, P; Vanderlinde, P; and Janssen, E; 29th July, 1998.

Food type and intended use	Handling	Customer base	Confidence in management system
1. Potentially hazardous foods which would not be heat treated before consumption.	1. Handling high risk foods not subjected to a kill step. Temperature control is the only hurdle	1. Targeting vulnerable groups eg infants, hospitals or institutions.	1. Little confidence – varying record of compliance or little appreciation of the hazards. No safety system in place, no technical advice available (or not used)
2. Potentially hazardous foods which normally would be heat treated immediately prior to consumption.	2. Handling high risk foods subjected to a kill step ie thermal processing, cook chill)	2. Substantial. > 1,000 national or international customers	2. Some confidence – satisfactory level of compliance. Limited access to technical advice. May have satisfactory food safety systems in place but only some appreciation of hazards.
3. Pre-packaged potentially hazardous foods.	3. Handling low risk foods not subjected to a kill step.	3. Intermediate. 100 to 1000 ie state wide.	3. Moderate confidence – reasonable record of compliance. Technical advice available. Has an appreciation of hazards. Operates using satisfactory procedures and systems.
4. Post-processing storage of foods not conducive to bacterial growth.	4. Handling low risk foods subjected to a kill step	4. Few. 20 – 100, ie local trade	4. Highly confident – good record of compliance or validated safety systems. (HACCP or similar) in place. Access to technical information within the organisation. Subject to in-house inspection.
5. Foods not conducive to bacterial growth.		5. Very few. <20/day	

Comments on appropriateness of framework for classifying risk within the NSW Seafood Industry

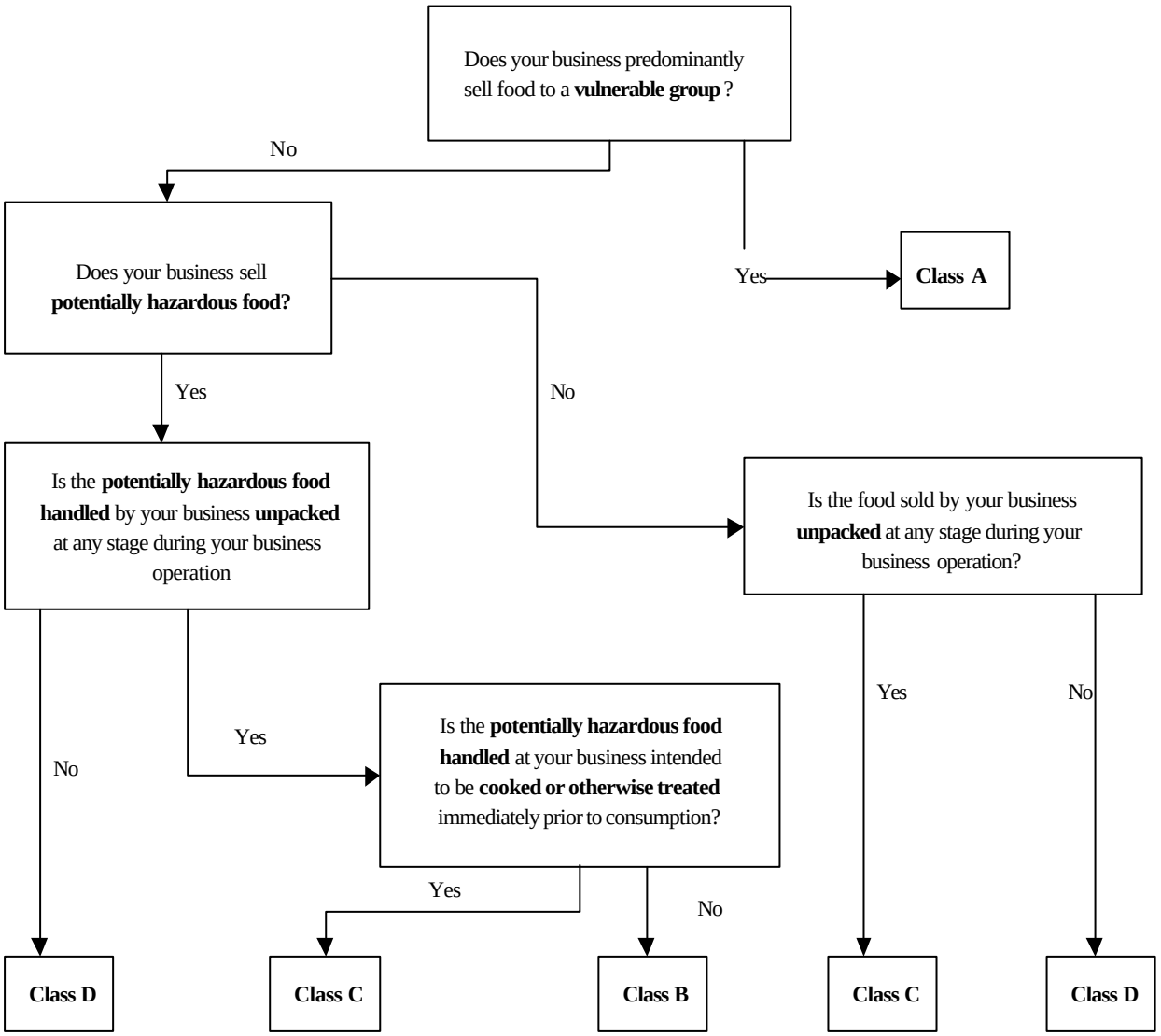
Most seafood products are 'potentially hazardous', Further differentiation is required into the severity of hazards.	Further differentiation required between 'handling' (not designed to reduce micro level) and 'processing' (designed to reduce micro level)	Quantity and vulnerability of customers should not be used. The industry must assume that every customer is both important and vulnerable.	In this instance, some consideration can be given to the level of confidence in industry sectors.

3.1

3.1 Food Safety Victoria Risk Assessment System

In Victoria, the state government has taken the lead in implementing the national food hygiene standard (whilst other states await it's inclusion in the Food Standards Code). The Victorian Food Act 1984 has been modified to include a requirement for food premises to have a food safety program in place by December 1998.

In line with ANZFA's intent to phase implementation according to risk, the Victorian Government Gazette, 20 August, 1998, issued a list of exemptions by class (through to December 2000) based on the following classification criteria [9]:



Whereby:

'potentially hazardous food'	Includes any perishable food which consists in part or whole of: • milk or milk products, • eggs, • meat, • poultry, • **fish, including opened shellfish,** • cereals • processed fruit and vegetables, • other ingredients capable of supporting rapid growth or progressive growth of infectious or toxigenic micro-organisms.
'handle'	In relation to food, includes the preparation, packing, storing, serving, supplying, and conveying of that food.
'cooked or otherwise treated immediately prior to consumption'	Means food that is sold in a state where it has been appropriately washed, treated, or cooked, (or is intended to be cooked) so that any infectious or toxigenic micro-organisms that might be in or on the food have been minimised or eliminated.
'requirement of a food safety program'	Means: hazard analysis hazard control procedures training plan food recall procedures (all relate to section 19D of the Victorian Food Act 1984)

This model also is designed for a particular purpose – to provide phased implementation of the amended Victorian Food Act. It's relevance and appropriateness in assessing the risk within the seafood industry group is limited.

[9] *"Food Premises Declaration",* Victorian Government Gazette, 20 August 1998

3.3 Seafood Risk Assessment Methodology

Seafood is, by ANZFA's definition, a "potentially hazardous food" (unless rendered safe by processing or packaging):

Potentially Hazardous Food	Food that supports the proliferation of microorganisms (ie food that contains meat, fish, poultry, or dairy products, and certain vegetable products, that have a pH and a_w that will allow growth)

Source: "Prioritisation classification systems for food businesses", ANZFA, September 1998

Within the scope of this project, however, the concern is more hazard identification and prioritisation according to the nature and severity of the health outcome, and the extent to which control can be exercised by the business, or must be applied outside the business eg by an industry organisation or statutory authority.

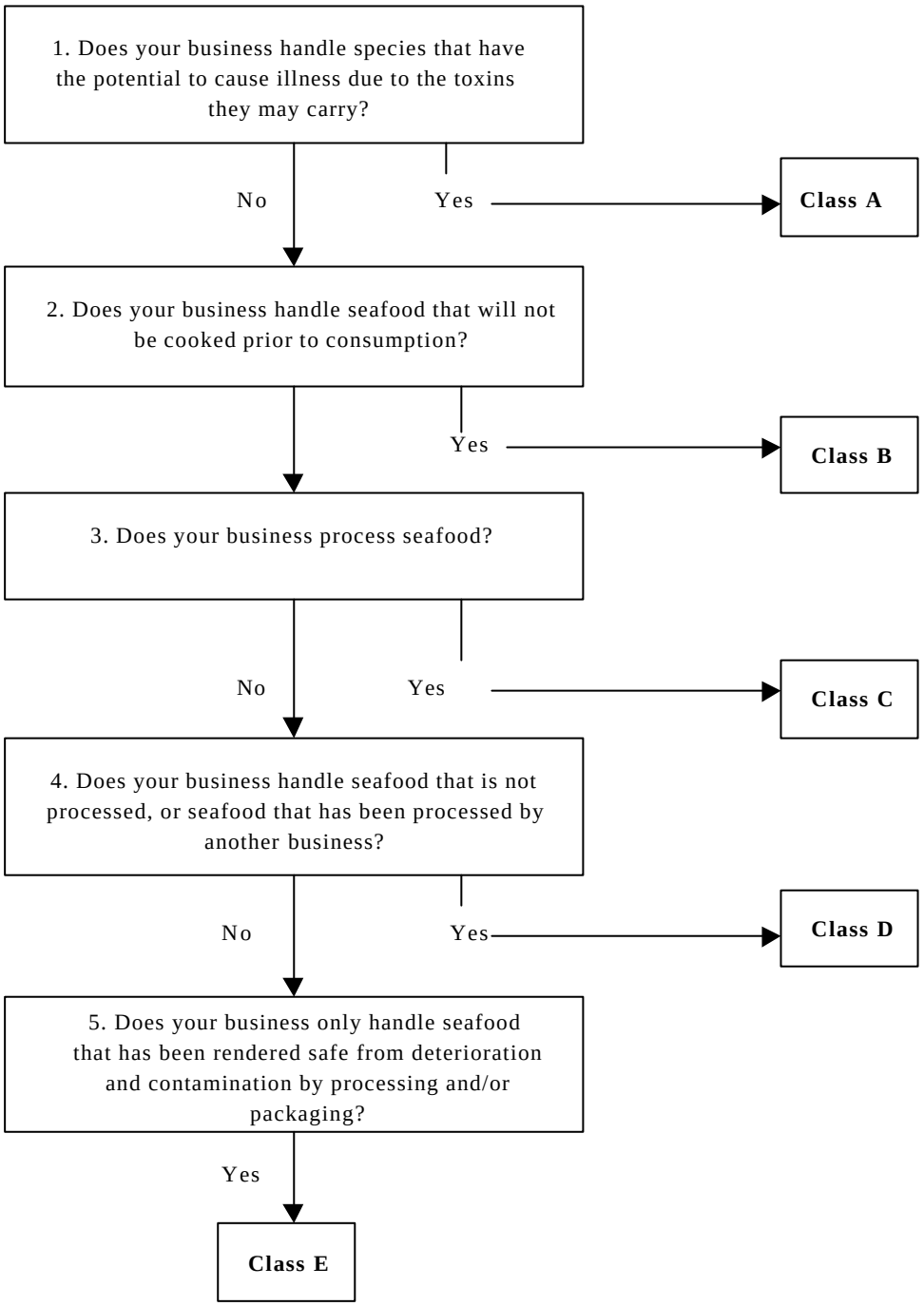
There needs to be further differentiation of "potentially hazardous food" therefor, to achieve this.

The following risk assessment model is consistent with the ANZFA and Victorian templates, but is specific to the needs of seafood businesses. It enables further prioritisation of the risk, and identification of the management systems necessary to achieve control.

Within the context of this model, the following meanings apply:

Business	A commercial business either partially or entirely involved in the harvesting, storage, transport, processing, or sale of seafood.
Handle	To convey, deliver, display, harvest, serve, store, transport, or treat, seafood. 'Handling' is not designed to improve the microbiological stability of the product.
Process	To cook, freeze, preserve, package seafood in a manner designed to improve the microbiological stability of the product.
Rendered safe	Packaged in a manner that will not permit further microbiological growth if treated in the prescribed manner.

Seafood Risk Assessment Decision Tree



The ANZFA discussion paper names four factors that should be considered before determining the potential hazards: [10]

- Type of food and intended use;
- Principle activity of the business;
- Method of processing;
- Customer base.

With the exception of the fourth one 'Customer Base', this matrix attempts to address these factors, and categorise businesses according to risk to public health:

Class	*Category*	*Examples*
A	The business handles species that have the potential to cause serious illness because of the toxins they may carry.	Species carrying environmental contaminants, or toxins capable of causing health risk.
B	The business handles seafood that will not be cooked or processed prior to consumption	Sashimi grade, raw oysters
C	The business processes seafood	Gutting, filleting, cooking, etc
D	The business handles only seafood that is not processed, or has been processed by another business	Seafood that is stored and displayed only.
E	The business only handles seafood that has been rendered safe by processing and/or packaging.	Shelf-stable product such as canned or bottled product.

Application of this model within seafood industry sectors will vary depending on the nature of the business. However, in general, the following categories apply:

Fishermen	Class A	If they catch product that may contain toxins
	Class C	If they cook prawns on board
	Class D	If they harvest seafood

Fishermen's Co-ops	Class A	If they handle product that may contain toxins
	Class B	If they handle product that will be consumed raw
	Class C	If they process seafood

Processors	Class C	If all they do is process seafood

Merchants	Class A	If they handle product that may contain toxins
Merchants	Class B	If they handle product that will be consumed raw
	Class C	If they process (gut, fillet, cook) seafood
	Class D	If they only handle seafood

Transport	Class D	They only handle seafood

SFM	Class D	They only handle seafood

Aquaculture	Class A	Potential for misuse of aquaculture drugs

This must be considered within the context that all seafood is "potentially hazardous food".

[10] "Prioritisation classification systems for food businesses", ANZFA, September 1998

4. HAZARD IDENTIFICATION

This section identifies, classifies, and justifies, the potential hazards associated with the NSW seafood industry.

The following habitat, species, and handling related hazards can be broadly sorted according to the Seafood Risk Classification. Hazards assigned to lower classes also apply to higher ones, eg class A businesses must consider hazards 1-15; class B – hazards 4-15, etc.

This list of hazards is not exhaustive, and it is the responsibility of all seafood businesses to identify and control **all** food safety hazards associated with their business.

4.1 Class A

The business handles species that have the potential to cause serious illness because of the toxins they may carry.

Potential hazards	*Species/products involved*	*Control measures required*
1. Environmental chemical contaminants Environmental chemical contaminants and pesticides pose a potential human health hazard for fish. Fish are harvested from waters that are exposed to varying amounts of industrial chemicals. These contaminants may accumulate in fish at levels that can cause illness over long-term exposure. [11]	Fish and molluscan shellfish harvested from inland waters, estuaries, and near-shore coastal waters around urban areas.	• Screening programs to monitor levels in local fish from different areas for early detection of increasing environmental pollution. • Water sampling to test the environment for hazardous contaminants • Similar programs on imported product from known problem areas. • Traceability programs to ensure fish is not harvested from closed harvest areas.

[11] "Compendium of Fish, Fishery Product Processes, Hazards and Controls" by Robert J. Price of the University of California, Davis, Ca., updated Sep 1998

Potential hazards	*Species/products involved*	*Control measures required*
2. Natural Toxins		

Paralytic shellfish poisoning (PSP), diarrhetic shellfish poisoning, (DSP), amnesic shellfish poisoning (ASP), neurotic shellfish poisoning (NSP), and ciguatera fish poisoning (CFP) are caused by contamination of seafood with natural toxins from the harvest area.	Spanish mackerel, barracuda, coral trout Bivalve molluscs (all other poisoning syndromes)	• Control and classification of harvest areas • Purchasing product from approved suppliers in approved growing areas • Prohibit sale of involved species from harvest areas that are known to be hazardous
3. Aquaculture Drugs Unregulated drug use in aquacultured fish holding ponds poses a potential human health hazard. These substances may be carcinogenic, allergenic, and/or may cause antiobiotic resistance in humans.	All aquacultured fish	• Clear understanding of prescribed limits by aquaculture operators • Strict control over dosing and treatments • Monitoring of levels in aquacultured product

4.2 Class B

The business handles seafood that will not be cooked or processed prior to consumption.

4. Scombrotoxin (Histamine) formation Scombroid poisoning results from a build up of histamine as a result of time/temperature abuse, ie, when the product is held under warm conditions.	Tuna, mackerel	• Awareness of the potential for histamine build-up, and the species involved. • Adequate refrigeration and control over all processing steps to maintain cool temperatures.

Potential hazards	***Species/products involved***	***Control measures required***
5. Pathogens from Harvest Area Bacterial and viral pathogens may exist in molluscan shellfish which are consumed raw. Shellfish filter and	Molluscan shellfish	• Screening programs to monitor levels in local fish from different areas for early detection of increasing

concentrate pathogens that may exist in harvest waters. Pathogens may also exist in other fish types depending on the harvest area. The degree of risk will depend on the expected consumption of the product, and the pathogenicity of the bacteria and viruses.	All species harvested in estuarine or near-coastal waters after heavy run-off	environmental pollution • Monitoring environmental pollution levels • Similar programs on imported product from known problem areas • Effective and prompt refrigeration, and good handling practices
6. Parasites Parasites consumed in uncooked or only partially cooked, unfrozen seafood can present a human health hazard. These include nematodes or roundworms, cestodes or tapeworms, and trematodes or flukes,	Aquacultured species, Salmon, Barramundi, Flounder, Grouper, Herring, Trevally, Mackerel, Mullet, Plaice Ocean perch	• Cooking (or pasteurising) of raw fish • Freezing to below –20°C for seven days or more

4.3

Class C

The business processes seafood.

Potential hazards	*Species/products involved*	*Control measures required*
7. Introduced pathogens Poor refrigeration, processing, or handling practices can encourage the growth of existing, harvest originated pathogens. However, the same practices can introduce new pathogens, and allow them to grow to unacceptable levels. The growth of parasites and some pathogenic organisms is arrested by cooking. However recommended core temperatures must be reached for a minimum time to achieve the required kill. Some seafood (eg prawns) may be inadequately cooked and chilled, or chilled in contaminated cooling water, before transit to their market area. They may also be cross contaminated in the process	All species Prawns	• Identification of potential hazards at all steps in the process • Implementation of control measures to eliminate or minimise all potential hazards (HACCP) • Product traceability • Staff hygiene training and enforcement
8. Introduced Chemicals Cleaning compounds or other chemicals may be introduced to seafood products through the processing step.	All species	• Control of processing and cleaning chemicals
9. Cross contamination between cooked/uncooked product The potential for cross-contamination of cooked product by uncooked product arises where they are stored or displayed together.	Product cooked on-site	• Strict separation of cooked from uncooked product

4.4 Class D

The business handles only seafood that is not processed, or has been processed by another business

Potential hazards	*Species/products involved*	*Control measures required*
10. Contaminated ice Ice is the primary form of refrigeration of fresh seafood on board commercial vessels, in transit, and on display in retail outlets. The ice itself must be potable to avoid contamination. Ice may also cause cross-contamination between products.	All species	• Ensure ice is from an approved source • Handle ice only in clean containers and in a clean, hygienic manner • Use ice only once and discard
11. Temperature rise during Distribution Transport of seafood in an uncontrolled environment will expose the product to high temperatures for an unknown period, and thus risk growth of pathogenic organisms.	All species	• Use only refrigerated and insulated transport • Adherence to cold chain temperature requirements
12. Physical hazards Physical hazards are foreign objects not normally associated with the product that can cause injury.	All species	• Good handling and personal practices • Staff training in food hygiene • Keep seafood covered and protected at all times
13. Surface contamination Otherwise clean product may become contaminated through contact with other product, contaminated surfaces, or contaminated tools or equipment.	All species	• Cleaning procedures for all surfaces and equipment • Process design that prevents or minimises cross-contamination

Potential hazards	*Species/products involved*	*Control measures required*
14. Contamination caused by poor packaging		

NSW caught seafood is transported between Co-ops, Sydney auction, and merchants in plastic tubs that are subject to misuse, contamination, or cross-contamination. Interstate product sold through Sydney market is 'opened' prior to auction and subject to handling, and foreign objects.	All species	• Codes of practice for product protection and packaging • Hygiene awareness training for all seafood handlers
15. Pathogen growth through poor time/temperature control Pathogen control in seafood is a function of temperature and time. Analysis shows that decomposition and bacterial growth continues even at refrigerated temperatures. Lack of understanding of temperature requirements, prolonged product life, or extended periods at ambient temperature can increase the levels of pathogenic organisms	All species	• Awareness and compliance with the cold chain guidelines • Awareness of product history, especially catch date, product traceability, and purchase only from approved suppliers

4.5 Class E

The product can be considered safe as long as it is not subject to physical or temperature abuse, is stored as per the processors instructions, and is not sold outside it's recommended shelf-life.

4.6 Notes on Potential Hazards

4.6.1 Environmental Chemical Contaminants

Bivalve molluscs are considered more susceptible to contamination by environmental chemicals than other species. However many finfish can also accumulate significant levels of these contaminants over time.

Harvest areas will generally change slowly with the impact of urbanisation or changing land use, but estuarine, inland, or immediate coastal waters may experience contamination pockets in periods of rapid run-off.

Environmental contamination is unlikely to cause acute illness. (unlike contamination by environmental pathogens). [12] However, this hazard is more commonly associated with long-term exposure to relatively small levels of contaminants.

Chemical contaminants include pesticides or herbicides, or heavy metal contamination eg mercury, cadmium, zinc, and lead.

Detection cannot be expected at the 'business' level. Harvest areas or product from suspect harvest areas must be monitored over time to determine trends in environmental contaminants.

The United States Food and Drug Administration publishes tolerances for environmental chemical contaminants in seafood. They are contained in Appendix 2 of this report.

There is new data available in the US on the health effects of methyl mercury from consumption of fish. Currently the FDA action level is 1.0ppm, but it will be re-evaulated it on the basis of further study.

4.6.2 Environmental Toxins

Paralytic shellfish poisoning (PSP) diarrhitic shellfish poisoning (DSP), and ciguatera Poisoning (CFP) are included under this heading.

PSP and DSP may result from the consumption of mussels and other bivalves that have fed on poisonous plankton (various species of dinoflagellates). The aquatic biotoxins causing PSP and DSP may withstand cooking. Symptoms for PSP include a tingling or numbness of the mouth almost immediately, and this spreads to the neck, arms, and legs within four to six hours. Death, when it occurs, is usually caused by respiratory paralysis within two to twelve hours. DSP symptoms include nausea, vomiting, abdominal pain, diarrhoea and chills with an onset time of 30 minutes to 12 hours.

[12] *'Hygiene for Management; A text for food hygiene courses',* Richard a Srenger, Highfield Publications, UK, eighth edition 1998

Ciguatoxin enters the food chain through fish eating the toxic dinoflagellate *Gambierdiscus toxicus* which is associated with dead coral reefs and marine algae. Carniverous fish accumulate toxins when consuming the smaller herbivorous fish. Species of fish involved include the moray eel, red bass, and coral trout, Spanish mackerel, reef cod, grouper, and suregeonfish. Fish affected look, smell, and taste normal. The head, gonads, liver, and roe, are usually the most toxic part of the fish. The toxin is unaffected by freezing, cooking, or gastric juices.

The onset period is usually one to six hours, and symptoms include malaise, disturbed vision, alternating feelings of hot and cold, respiratory paralysis, numbness or burning of the mouth, throat and tongue, weakness, abdominal pain, vomiting, and diarrhoea. Occasional deaths are recorded.

4.6.3 Scombrotoxic Fish Poisoning

Scombrotoxic fish poisoning [12,13] is caused by toxins which accumulate in the body of some fish, mainly Scombridae family, during storage, especially above 4^{o}C. The onset period is between ten minutes and three hours. Symptoms last up to eight hours and include headache, nausea, vomiting, abdominal pain, a rash on the face and neck, a burning or peppery sensation in the mouth, sweating and diarrhoea.

Scombrotoxic poisoning is most closely linked to the conversion of histidine, an amino acid found in some species, to histamine by the action of spoilage bacteria such as *proteus spp*., *hafnia spp*., and *klebsiella spp*. However, there is also evidence that other chemicals, such as biogenic amines, may play a role in the illness (US FDA, 1998).

Histamine is normally found at levels exceeding 200 ppm in fish responsible for illness (US.FDA) and these levels may be reached before the fish appears spoiled. However, there are reports from UK (MAFF.UK) of fish responsible for illness having "levels in excess of 50ppm".

Problems can also arise in canning fish as, once formed, the toxin is very heat resistant, and will not be destroyed during processing.

Refrigerated storage of fish below 4^{0}C should prevent toxin formation.

[12] *'Hygiene for Management; A text for food hygiene courses',* (Eighth Edition), Richard a Srenger, Highfield Publications, UK,

[13] *"The Bad Bug Book" – Foodborne pathogenic Microorganisms and natural Toxins Handbook",* US Food & Drug Administration – Center for Food Safety and Applied Nutrition; (internet available) last updates April 1998

The Australia New Zealand Food Authority (ANZFA) proposes to include a standard for histamine in fish and fish products, based on the Codex standard, into the Food Standards Code. The Codex Alimentarius standard indicates the following levels as indicators of a) Decomposition, and b) Hygiene and handling:

Indicator	*Standard*	*Species*
Decomposition	10mg/100g sample unit	*Scrombridae, Scrombrescocidae, Pomatomidae, Coryphaenedae* families
Hygiene and handling	20mg/100g sample unit	*Scrombridae, Clupeidae, Scrombrescocidae, Pomatomidae, Coryphaenedae* families

Source: "Proposal P183: Fish and Fish Products, Explanatory Notes", ANZFA, 16/9/98

4.6.4 Pathogens from Harvest Area

Bacterial pathogens such as *Vibrio parahaemolyticus, Vibrio cholerae,* and *Vibrio vulnificus* may be present in low numbers at the time that shellfish are harvested, and control is maintained by rapid cooling and maintenance of low temperatures.

Vibrio parahaemolyticus may cause diarrhoea, abdominal cramps, nausea, vomiting, headache, fever, and/or chills. Onset can be 4-96 hours, and the median duration of the illness is 2.5 days.

Clostridium botulinum has also been associated with seafood products, including tuna, lobster, and even processed (smoked and salted) fish. Although the frequency may be very low, the severity is very high because of it's high mortality rate if not treated immediately and properly. It is one of the most toxic substances known to man. The estimated lethal dose for humans is 1ng/kg body weight. 60% is the highest death rate recorded.

It is found in soil, freshwater and marine sediments, rotting carcasses, shellfish, and the intestines of meat animals and fish.

Enteric viruses such as Hepatitis A and Norwalk virus, can originate in contaminated waters, but may be controlled by subsequent refrigeration and handling practices.

Fecal coliform counts can be used as an indication of the extent of sewage pollution of coastal waters. E.coli can be transferred to seafood by either contamination of harvest waters, or by subsequent poor handling practices. E.coli causes abdominal cramping, watery or bloody dairrhoea, fever, nausea, or vomiting.

Lysteria moncytogenes is widespread in the environment, and can also be found in estaurine, inland, and coastal waters through natural run-off. It causes diarrhoea, discoloured urine, vomiting, headache, backache, fever, convulsions (flu-like symptoms).

It also has a relatively high mortality rate of 30%

In Australia the number of cases of listeriosis reported is 40 to 45 a year. Annual incidence is 3 people per 1,000,000.

4.6.5 Parasites

Tapeworm, *Diphyllobothrium latum*, may not cause serious illness, but it can cause a pernicious-anemia like illness, and may cause chronic abdominal complaints. Fish tapeworms are usually ingested by eating raw fish, especially salmon used in sushi.

Trimming and gutting are effective methods for reducing the number of parasites. However, they do not completely eliminate the hazard. This can only be achieved by cooking or freezing.

4.6.6 Introduced Pathogens

Apart from *Vibrio parahaemolyticus* and *Clostridium botulinum*, most pathogenic bacteria are introduced into fish by poor handling. As fish spoil rapidly, they should be stored under hygienic conditions on ice, in refrigerators or freezers, as soon as possible after removal from the water. Achieving and maintaining a core temperature under 4^{o}C slows the growth rate of pathogens.

Bacterial pathogens that may be introduced include:

Salmonella	Poor handling and temperature control
Escherichia coli	May occur through environmental contamination, poor handling or processing practices. The most important group causing food poisoning is the enterhaemorrhagic strains.
Bacillus cereus	Caused by food being held without refrigeration after cooking.
Staphylococcus aureus	Poor personal hygiene practices

Cooking is an effective method of eliminating pathogens, or reducing them to an acceptable level only if the cooking process is designed to achieve the minimum temperature/time requirement to eliminate vegetative cells of potential pathogens.

Likewise, the cooling process must be designed to the reintroduction of pathogens through poor temperature control or dirty contact surfaces. On some prawn trawlers, water used to cool prawns after cooking is often suspected of re-contaminating the product.

4.6.7 Transport & Distribution

Recommended temperatures for storage and transport of seafood are

Fresh or wet seafood	0-4 ^{o}C
Frozen seafood	-18 ^{o}C or less

Source: SeaQual Pack 1

Standard 3.2.2 Food Hygiene Practices of the ANZFA food hygiene standards states:

"A food business must, when receiving potentially hazardous food, take all practical measures to ensure that the potentially hazardous food is 5^0C or below, or 60^0C or above".

(Division 2, section 3.3)

"A food business must, when transporting potentially hazardous food, transport it under temperature control" (under 5^0C)

(Division 3, section 8)

"Potentially hazardous food that will not undergo or is not undergoing a pathogen-eliminating step to render it microbiologically safe must not be sold if it has been held for a cumulative period of four hours or more at a temperature of 5^0C or above, or 60^0C or below".

(Division 3, section 10)

4.6.7 Physical Hazards

Physical hazards are unlikely to cause food poisoning outbreaks, but can and do cause injury to individual consumers. These foreign objects may include:

Glass	from windows, watches, etc
Metal	saw blade teeth, washers, nuts, bolts, shavings, blades
Plastic	from tubs
Wooden splinters	from pallet boards, etc
Jewelry	rings, ear-rings, watches

Other foreign objects may not cause personal harm, but create a negative consumer reaction regarding the care and hygiene practices of the industry:

band-aids	cigarette butts	dirt
oil or grease	other food	tags

4.6.8 Cross-contamination

The crate wash process at Sydney Fish Market maintains a temperature of the washing machine units of over 70^0C, with a chlorine solution in the final rinse of 200 parts per million.

Nevertheless, control of crates, and the contents of crate throughout the distribution system, and on the auction floor, raises the possibility of contamination due to lack of covering, or contamination in dirty crates.

4.6.9 Poor temperature/time control

Some seafood businesses may unknowingly exceed the cold chain time/temperature requirements because of lack of awareness of the prior history of the product.

The US FDA publishes a time/temperature guide for controlling pathogen growth and toxin formation in seafood:

Hazard	*Product temperature*	*Maximum cumulative exposure time*
Escherichia coli	7-10°C 11-21°C above 21°C	14 days 6 hrs 3 hrs
Vibrio parahaemoliticus	5-10°C 11-21°C above 21°C	21 days 6 hrs 2 hrs
Listeria monocytogenes	0.4-10°C 11-21°C above 21°C	2 days 12 hrs 3 hrs

Source: US FDA Center for Food Safety and Applied Nutrition

5.The Effectiveness of Food Safety Controls

This section reviews current practices within the NSW seafood industry, and the extent to which they effectively control potential food safety hazards.

The ANZFA discussion paper[14], under *"Level of compliance and confidence in the food safety system"*, identifies three levels of confidence:

1	Highly confident	Complies with statutory obligations and an industry code, and/or has accredited food safety system in place. eg businesses with HACCP or SQF 2000 or equivalent system, with in-house advice available. A member of a recognised industry/authority group.
2	Confident	Complies with statutory obligations and/or has an approved safety program. eg Appreciation of the hazards and controls appropriate to their business.
3	Not confident	Does not apply with statutory obligations and/or no knowledge of food safety principles

In applying this scale generally across the NSW seafood industry, the conclusion is reached that the level of food safety controls range between (2) and (3), with a lean towards (3).

It must be emphasised that there is no direct evidence of any substantial level of seafood poisoning in NSW. However, the industry must also take a 'zero tolerance' approach. The Wallis lakes oyster incident, and similar occurrences in other industries, are abject lessons in the commercial impact a seafood poisoning outbreak can have, not only on the immediate businesses, but on the entire industry from the market floor to seafood restaurants.

This study only overviews the industry, but concludes that, while no immediate risk is apparent, industry controls at present are not sufficient to prevent or eliminate industry hazards, and as such, there is a potential public health risk.

The evidence collected was based on survey and interviews with managers and staff within the NSW seafood industry, and with senior personnel from industry organisations. The sample size was too small to be statistically significant, or to quantify the gap. Nevertheless, there is sufficient evidence to indicate a significant variation and gap between existing industry practice and that required to eliminate hazards or reduce them to a significant level.

The following table indicates where each group within the industry appears to be in terms of the hazards they can control.

[14] "Prioritisation (risk) Classification Systems for Food Businesses", ANZFA, September 1998

5.1 Levels of compliance

Class	*Hazard*	*"Industry"*	*Fishers*	*SFM/ Co-ops*	*Processors*	*Merchants*	*Transport*
A	Environmental chemical contaminants	3	3	2-3	N/A	3	N/A
	Natural toxins	2	3	2-3	N/A	3	N/A
B	Scombrotoxin	N/A	3	2-3	N/A	3	N/A
	Harvest pathogens	3	3	2-3	N/A	3	N/A
	Parasites	N/A	3	2-3	N/A	3	N/A
C	Introduced pathogens	N/A	3	2-3	2	2-3	3
	Introduced chemicals	N/A	N/A	2-3	2	2-3	N/A
	Cross-contamination	N/A	3	2-3	1-2	2-3	3
D	Contaminated ice	N/A	3	2	1-2	2	3
	Temperature rise during distribution	3	3	3	1-2	3	3
	Physical hazards	N/A	3	3	1-2	3	3
	Surface contamination	N/A	3	2-3	1-2	2-3	3
	Poor packaging	N/A	3	2-3	1-2	2-3	3
	Poor time/temperature control	N/A	3	2-3	1-2	2-3	3

Where 1, 2, 3 represent the levels of "confidence" indicated on the previous page.

5.2 The "Industry"

This term has been used to capture the hazards that may be outside the control of individual seafood businesses but should be addressed by the "industry", ie the agencies that regulate and bodies that represent the seafood supply chain. Identification of these agencies is not discussed here. However there is a noticeable lack of cohesion between the industry regulators and industry associations, and the businesses they represent.

If seafood is contaminated at source, and will not be subject to a further processing step that will eliminate that hazard, there may be little that a seafood business can do to detect or control that hazard. There are therefore key issues for the "industry" to consider regarding source:

5.2.1 Wild Catch

There is little regular monitoring of environmental toxin levels in seafood caught in NSW. NSW Health Department was monitoring organochlorides and heavy metals up to five years ago but discontinued the practice apparently due to low or undetectable levels.

Some quarters of industry have questioned the reliability of the NSW Health data set, and suggested the need for a regular monitoring system agreed by all parties. A proposal was prepared for the Australian Government Analytical Laboratories (AGAL) some time ago, but didn't raise sufficient interest.

CSIRO scientists are conducting research using advanced biomarker techniques to trace hydrocarbon and faecal pollution in coastal ecosystems near Hobart, and are designing a large-scale integrated study of the ecosystem of Adelaide's coastal waters for the South Australian EPA. However, these (and others) are one-off specific purpose research projects. CSIRO know of no on-going monitoring planned of environmental toxins.

Plankton blooms of harmful algae have occurred in recent years in Tasmania, Victoria, and New Zealand, and there has been a global increase in notification of plankton blooms and biotoxin related incidents. In 1993 blooms of harmful algae were discovered in marine and estuarine waters in NSW, and a toxin capable of causing Paralytic Shellfish Poisoning was discovered in wild oysters in Sydney Harbour.

As a result of these outbreaks, a NSW Marine Algal Biotoxin Taskforce[15] was established, charged with the responsibility to develop a strategic, co-ordinated approach to the management of Marine Algal Biotoxin events in NSW. There is little evidence of awareness of this task force within the industry.

(Appendix 3 contains ocean landings and estuarine catch by site)

[15] *"Marine Algal Biotoxin issues in NSW",* report of the Joint Government/Industry Committee, 1998

5.2.1

Imported from other states

The sale of much of Australia's seafood is largely deregulated. Unless designated for export, seafood product can be moved freely around the country without regulatory control or inspection.

It is estimated that approximately 20,000 MT of seafood sold in NSW, originates from other states.

Whilst there is no evidence to justify concern about the safety of Australian seafood, there is no national uniformity in the regulatory and industry controls that are exercised across the nation. The reports from each state indicate that the industry nationally is only just coming to terms with the requirements of the national food hygiene standards, and each state is currently engaged in initiatives to improve their own situation.

There are many food safety programs that have been recently completed, or are underway. However, they are ad hoc. Surveys conducted in at least two states indicate around 60% of businesses have never heard of the national food hygiene legislation. The industry in other states, as in NSW is polarised. On one side are the conscientious businesses that proactively implement food safety programs; on the other the businesses who don't know and don't care.

Although labeled identification is required on product from interstate this is no guarantee of effective control at source. Buyers must enforce vendor assurance requirements on interstate suppliers. But equally, the industry has a responsibility to ensure national alignment of industry standards. The implementation of a National Docketing System, currently being negotiated by the States, will assist in this regard.

5.2.2 Imported from overseas

NSW imports around 38,800 MTs of seafood per annum. Of that, it is likely that much of it enters Australia through Sydney but is destined for other parts.

The table in Appendix 4 shows the source of origin for four separate customs codes of seafood product landed in NSW. These are:

- Fish: fresh or chilled
- Fish fillets, and other fish meat: fresh, chilled, or frozen
- Crustaceans: live, fresh, chilled, frozen, dried, salted, or in brine.
- Molluscs: live, fresh, chilled, frozen, dried, salted, or in brine

All seafood imported into this country (except from New Zealand) is subject to import inspection by the Australian Quarantine Inspection Service (AQIS). AQIS sample all incoming loads and issue phytosanitary certificates.

By far the majority of seafood imported into NSW is from New Zealand, which is considered a "safe" country. Much of the other product is frozen fish fillet sourced from factory ships in South America or Southern Africa, for use in the frozen portion control packs of Birds Eye, and I & J.

Nevertheless, it is of concern to see susceptible product imported from Indonesia, China, Thailand, and India. There is little evidence of formal food safety systems amongst importers and brokers.

5.3 Fisheremen & Co-ops

5.3.1 Fishermen's Co-op Survey

The responses to a survey form sent to all NSW Fishermen's' Co-operatives can be found in Appendix 5. 23 responses were received, including three catchers, and one transporter.

Generally with this type of survey, responses are skewed by the fact that many that oppose the content, or simply do not know, will not respond. That was reflected in this survey by the fact that some started but failed to complete.

Notwithstanding this, views were polarised on the value of food safety systems. Some were very critical in their views, others were positive, and demonstrated knowledge of the hazards and their controls.

Thirteen of the 23 respondents were either business owners or managers. The balance of respondents was staff within the Co-operatives.

Responses showed that:

- Only 8 out of 23 know of the pending food hygiene legislation;
- Most know of the requirements for hygiene within their business;
- Only 4 have training programs for staff, although 15 indicated they have uniform and personal hygiene programs in place;
- Almost all had separate washing facilities for staff;
- Almost all use ice made from potable water, although strangely 2 indicated otherwise;
- Most believe that their premises meet the pending food hygiene legislation, although 4 were honest enough to tick "not sure";
- All agree that equipment and utensils are cleaned before use;
- Only half check the arrival condition and temperature of their seafood;
- All know the source of their product;
- There was some variation in understanding of chilled and frozen temperatures and duration at that temperature;
- Notably, there was a difference indicated between storage temperature and display temperature;
- Only 3 keep temperature logs of chilled and frozen product;
- The majority have a pest control program in place;
- Very few have a formalised food safety plan in place, although Clarence River indicated they are about to start;
- Only one Co-op has a HACCP plan in place;
- A majority consider that the implementation of a food safety program is a net benefit, although views were split.

There was a strong contrast in attitudes across the group, but an indication that some, if not most, favour the implementation of food safety programs, for commercial as well as regulatory reasons, and seek assistance and knowledge in doing so.

However, at this stage, whilst the potential is there, only two have food safety programs in place and one of these systems is very top-driven, and is expected to lapse following the resignation of the manager.

Clarence River is very positive in their approach, and expects to start implementing HACCP within four weeks.

5.3.2 Fishermen

There were only 3 catcher responses included with the Co-op surveys, however, this was not unexpected. Fishermen are less likely to respond to written surveys than others are.

From other reports, 'food safety' is not generally seen as the responsibility of fishermen, and practices are often lacking. Problems are experienced with:

- Boats often not carrying ice;
- Methods of storage – fish may be dumped and carried on deck;
- Tainting of product from diesel (quality issue);
- Time to port without adequate temperature control;
- Potential for physical contamination

On the positive side, where industry codes have been introduced into the Australian fishing fleet that are well directed, practical, and implemented by industry peers, there has been good response (eg APPA Code of Practice promoted by the Queensland fishing industry for sea-caught prawn fishing operators).

5.4 Processors

Only one major NSW processor was considered within the scope of this survey. A manufacturer of retail and food service, quick-frozen, portion control packs, this processor imports largely block frozen fillet.

The processor exercises control over the incoming material and internal processes, meets all statutory requirements, and is in the process of implementing a HACCP system on all company products.

The principal risk would seem to be maintaining temperature and load lines within retail cabinets.

Processors are not considered a high priority risk.

5.5 Merchants

5.5.1 Wholesaler / retailer survey

A similar survey to that conducted with the Fishermen's' Cooperatives was also conducted with merchants attending the Sydney auction. Over two auction days, approximately 100 survey forms were distributed, and 21 were returned (Appendix 6).

Several attempts to hold merchant workshops to elaborate on the issues raised in the survey were aborted. Merchants declined because of frustration over perceived lack of outcomes and/or feedback from previous food safety meetings.

Whilst the merchants were not as vocal in their responses as the fishermen were, they were equally as polarised. Some were obviously cynical in their attitude to the survey, but many were positive, and recognised the commercial benefits of food safety programs to the industry. Some started the survey, but gave up when the questions became specific.

Of the 21 respondents, 19 were business owners, and thus in the key position to influence how the business is run.

Responses were similar to those of the Co-operative group:

- 10 out of 21 know of the pending food hygiene legislation;
- 11 out of the 21 felt they know where the major food safety risks are in their business.
- Only 5 have training programs for staff, although 17 indicated they had uniform and personal hygiene programs in place;
- Almost all had separate washing facilities for staff;
- Most have facilities to separate cooked from uncooked product, although 2 responded otherwise.
- Almost all use ice made from potable water, although 1 indicated otherwise;
- Most believe that their premises meet the pending food hygiene legislation, although 4 were honest enough to tick "not sure";
- All agree that equipment and utensils are cleaned before use;
- 60% check the arrival condition and temperature of their seafood;

- 80% know the source of their product as expected;
- There is some variation in understanding of chilled and frozen temperatures and duration at that temperature;
- The storage temperature and shelf life of cooked product was generally not known, or guessed at;
- Only 4 keep temperature logs of chilled and frozen product;
- The majority have a pest control program in place;
- 31% have a formalised food safety plan in place, and 4 indicated a certified Quality Assurance system;
- Only one merchant has a HACCP plan in place;
- A majority considers that the implementation of a food safety program is a net benefit, although views were split.

There was a strong contrast in attitudes across the group, but an indication that some, if not most, favour the implementation of food safety programs, for commercial as well as regulatory reasons, and seek assistance and knowledge in doing so.

Although 31% of respondents indicated a "formal" food safety program, as a percentage of overall merchants, the number is very low. Only a handful of larger merchants who supply supermarket chains, have implemented, or are implementing, food safety systems. However, those that do, report a business benefit, improvement in staff attitude and awareness, and the need for simplicity in program documentation.

5.5.2 Practices observed in Sydney Seafood Retailers

During visits to the merchants at Sydney Fish Market and other suburban fish retailers, the following practices were observed:

- Cooked and uncooked product stored together
- In a suburban shopping centre, seafood display behind a window in full sun, with little to no ice remaining.
- Smoking in retail areas of fish shops (and on the auction floor of Sydney Fish Market.
- Filleted product on display without sneeze guards.
- Open, full product bins stored in pedestrian shopping aisles.
- Transport of product from Sydney Fish Market for delivery to shops and restaurants in unrefrigerated vehicles, including glass windowed MPVs.
- Offal on floor of fish shop.
- Seafood displayed in trays spilling over into other product trays. Trays packed together in display.

5.6 Transport

Transport is arguably the sector with least control exercised. A random check of temperatures recorded on arrival at Sydney Fish Market indicated temperatures of up to 12^{o}C were frequently experienced in product air-freighted to Sydney (in winter), and 5-7^{o}C occasionally seen in seafood transported by road. This is in direct contravention of accepted cold chain practice, and the requirements of proposed Standard 3.2.2 (refer section 4.6.7 – *Transport & Distribution*).

The issue is not only temperature, but time/temperature abuse resulting from misunderstanding and bad practice:

- Iced seafood products are often held at ambient temperature awaiting dispatch (eg Sydney airport).
- Product may be held in 'temperature controlled' rooms that are overloaded or not calibrated.

Bad handling and distribution practices also create the potential for product contamination and product damage.

Product distribution from the Sydney auction is equally as hazardous. After sitting on the auction floor (normally 20^{0}C) for up to six hours (albeit iced), product is often then transported to shops and restaurants in uninsulated vehicles.

5.7 Sydney Fish Market

The quantity of seafood that passed through the Sydney market in the last two years is:

Source:	*1997* *Kgs*		*1998* *Kgs*	
NSW	13,167,888	81%	12,293,971	80%
Interstate	2,719,244	17%	2,590,025	17%
Imported	386,108	2%	435,549	3%
TOTAL SALES	**16,273,240**		**15,319,545**	

Source: Sydney Fish Market

Sydney Fish Market is currently undertaking implementation of ISO 9002 with HACCP, in all parts of the operation including the auction floor. SFM management is aware not only of the needs of an increasingly competitive market, but of their own leadership role in the NSW seafood industry.

The challenge of exercising effective hazard control within the SFM auction system is considerable, and poses not only practical difficulties, but the need to change entrenched attitudes and behaviours. The responsiility for changing practices within the auction area rests with SFM, and that includes the regulation and education of buyers.

SFM are also conscious of the fact that there is no through-chain system. The system that SFM is introducing starts and stops on the auction floor. They can only seek to influence, and this may become more difficult in a deregulated market.
If the standards for seafood acceptance set by SFM are too high, fishermen will find a market elsewhere. Nevertheless, from October of this year, SFM senior management are visiting the Co-ops to explain Quality Assurance (including food safety) and product handling guidelines, and get feedback from fishermen.

Sydney Fish Market believe that the industry is looking for help in implementing food safety plans. However, before that the goals for the industry, ie the rules and critical limits that must be met, need to be defined.

6. General Recommendations

This section prioritises the areas of improvement required in the NSW seafood industry, and recommends possible strategies for improvement.

The main issue affecting all sectors of the industry is lack of understanding and practices that effectively control the time/temperature ratio. This, and handling practices, must be considered a priority issue ahead of the implementation of full hazard analysis and food safety plans.

Higher priority:

Industry Sectors:	*Key issues:*
Transport, Co-ops, SFM, Merchants	• Temperature/time control • Handling practices and staff training
Fishermen	• Temperature/time control • Handling practices and staff training

Medium Priority:

Merchants, Co-ops, SFM, Transport	• Recognition of all potential hazards and implementation of effective controls (full food safety programs
"Industry"	• Monitoring and control of environmental contaminants
Aquaculture	• Food safety programs in place that control
Merchants, Co-ops, SFM, Transport	• Product identification, traceability, and recall procedures

Lower Priority:

Processors	• Seem capable of implementing programs unaided
Others	• Establish food safety auditors, facilitators • Consumer awareness training

There are many areas for change within the NSW seafood industry. The following recommendations suggest taking an "all of industry" approach to ensure through chain compliance, rather than targeting the industry sector by sector. This will fail unless Safe Food Production NSW ("Safe Food") ensures that consultation and negotiation is effective across the entire industry.

Before Food Safety Programs can be cost effectively implemented into NSW seafood businesses, the following research and development must be undertaken:

6.1 Seafood Industry Guidelines

The US Food and Drugs Administration, through the Center for Food Safety and Applied Nutrition, has prepared a "*Fish and Fishery Products Hazards and Controls Guide*". This document, which is continually updated as new research becomes available, has become the basis for HACCP based food safety programs, training, and assistance, throughout the US.

A similar approach is required in Australia, based on Australian habitat and species. Whilst "Safe Food" may not be the appropriate agency to undertake this task, it should request as a priority that one of the national bodies ensure that this is achieved for the benefit of the Australian Seafood Industry.

Within the scope of this research, consideration may be given to further investigating the need, practicality, benefit and cost of monitoring NSW caught product sold through Sydney market for environmental chemicals.

There is no direct evidence at this time to suggest increased contamination levels. However, there is an increase in the incidence of algal blooms and marine biotoxins in all Australian waters, including NSW. International research has shown a link between the number of algal blooms and increased nutrient levels in marine waters associated with coastal pollution, particularly from sewage and some forms of industrial waste (Shumway 1990).

"Safe Food" must develop, or co-ordinate the development of, specific industry guidelines for Fishermen, Transporters, and Merchants that are "user friendly'" but assist them in meeting their regulatory and industry obligations. In "*Industry Guidelines for Australian Food Businesses"*, (October 1998), ANZFA clearly articulates the requirement and process by which industry bodies develop guidelines that are approved by ANZFA, and recognised by the Australian New Zealand Food Authority Advisory Committee (ANZFAAC) and the Ministerial Council.

6.2 Industry Training Programs

Training will be required at two levels:

- Instruction in documenting and implementing HACCP based food safety systems, for those involved in setting up business food safety programs (2-3 days);
- Basic food hygiene for all food handlers (generally one day or equivalent)

Training must be competency based, and aligned with the training competencies currently being developed by Seafood Training Australia. The involvement of "Safe Food", plus NSW Health, will ensure that any training packages developed meet the requirements of *Standard 3.2.1: Food Safety Programs and General Requirements* of the national food hygiene standard.

(Note: It is unlikely that Fishermen will co-operate with formal, one day training packages. Training for fishermen will need to be succinct, practical, flexible, and delivered by industry peers.)

6.3 Food Safety Facilitators/Auditors

The Quality Society of Australasia has the only certification and registration process in Australia for food safety facilitators and food safety auditors. Both registers require the demonstration of

competencies acquired through appropriate food safety (HACCP) training, work experience, and industry experience in an appropriate industry sector. Sector 4 covers 'Seafoods and Seafood Processing'.

Of the 200 plus certified auditors on the QSA register, only a handful are seafood auditors, and the experience of existing auditors is arguably in the quick frozen processing sector.

The food safety system facilitator register has only been in place since July this year and is understood to have few registered seafood industry facilitators.

"Safe Food" should actively encourage and assist experienced industry personnel to seek appropriate training to become either seafood industry food safety facilitators and/or auditors, that will then be available and qualified to assist with implementation of food safety programs, and audit them to the required standard.

The ANZFA requirements for auditing of food safety programs have not yet been published. However it is known that there is an industry sub-committee, under ANZFA, investigating the possibility of equivalence with industry based systems. Also, the Victorian model, which is most advanced, encourages the use of industry developed, contestable systems, audited by QSA registered auditors.

6.4 Product Identification and Traceability

Seafood product must be clearly identified and traceable at all parts of the supply chain. "Safe Food" must develop protocols for product identification and traceability for inclusion in the generic industry programs.

Product should be identified according to "*Marketing Names for Fish and Seafood in Australia",* prepared for the Standing Committee for Fisheries and Aquaculture, grade, place of origin (catch), and date of catch.

(Product 'imported' from interstate is currently subject to product identification requirements).

6.5

Product Recall

Product recall procedures must also be included in the industry programs, and implemented by seafood businesses. Guidelines to developing these procedures are available in *"Food Industry Recall Protocol",* ANZFA, 1997

On an industry level, "Safe Food" must also develop and implement an industry wide product recall (or emergency response) plan in the event of a major species or habitat contamination.

6.6 Financial Assistance for Food Safety Programs

Experience in other industry sectors shows that implementation programs are more successful when participating businesses are required to contribute to the program. The meat, dairy, and horticultural industries have all experienced greater 'buy-in' when programs are subsidised, but businesses also commit directly.

It is therefore recommended that the same practice be exercised in the NSW seafood industry. It is suggested that participating businesses contribute to the cost, and that the outcomes of initial or 'pilot' programs be used to sell the benefits of food safety to other NSW seafood businesses.

7. ESTIMATE OF DEVELOPMENT COSTS

This section explores the possible cost implications of bringing the NSW seafood industry into line with the proposed food hygiene regulations

The cost of implementing food safety plans varies with the size, needs, and complexity of the business. Reports of businesses (from other industry sectors) with from 10-20 staff vary from $5,000 - $60,000, and slightly larger businesses report up to $100,000.

Nevertheless, the cost to businesses can be minimised by:

- Establishing industry sector templates and guidelines for businesses to use;
- Providing targeted training based on industry sector guidelines, and business needs;
- Using industry peers as facilitators;
- Businesses working collectively in groups or networks;
- Ensuring implemented food safety plans meet all regulatory and commercial needs;
- Industry coordination of audit requirements to avoid high on-going audit costs.

The following table identifies the expected costs in implementing effective food safety programs in the NSW seafood industry. It considers the costs on an industry basis rather than 'per business'. Certain assumptions have been made regarding the rate of uptake per annum. The assumptions are explained in the notations beside each line item, and in the general notes following the table.

The table identifies only direct costs, and does not include internal business costs of development, maintenance, and review.

This report draws no conclusion as to the responsibility for these costs – whether government, industry, or individual businesses. However, recommendation 6.6 suggests that participating businesses should bear some of the implementation costs.

Business and employee numbers used in this table are as indicated in the ABS table shown in Appendix 1.

7.1 Cost Estimate

	Report Number	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Assumptions/Explanations*
Research:						
Secretariat	6.1, 6.14	$300,000	$300,000	$250,000	$150,000	3 x staff, plus on costs, reducing in Yr 4
(3 x staff plus on costs)		***$300,000***	***$300,000***	***$250,000***	***$150,000***	as 'Safe Food' assumes responsibility
Development Costs:						
Industry guidelines (all sectors)	6.2, 6.8	$50,000				Guidelines for Catchers and Merchants as per ANZFA
HACCP training package	6.3	$20,000				3 day seafood specific HACCP training
Food Hygiene Training Packages	6.3	$10,000				
Transport Code of Practice	6.6	$15,000				
Aquaculture Quality Program	6.10	$20,000				
Product Recall and Emergency Response	6.9	$15,000				
		$130,000	***$0***	***$0***	***$0***	

Note:

Development and training costs based on development of similar sector guidelines and training programs for other industry sectors.

(contd)	*Report Number*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Assumptions/Explanations*
Pilot Program:						
Industry facilitators (x2)	6.4	$60,000				2 facilitators full time for six months
Training of business facilitators	6.4	$12,000				12 businesses x 1 person x 5 days @ $200/day
In-house training (12 x 8 @ $150)	6.4	$14,400				Average employees per business is 8
Catcher training (300 @ $150)	6.4	$45,000				
Ongoing industry training:						
Catchers (industry facilitators)	6.3		$120,000	$120,000	$120,000	2 x industry facilitators full time
Merchants (3 day HACCP training)	6.3	$39,000	$39,000	$39,000	$39,000	6 x seafood HACCP training programs/year @ $6,500
Merchants (food handler training)	6.3		$274,000	$274,000	$274,000	1800 employees @ $150 per year
Transporters	6.6		$45,000	$45,000	$45,000	300 employees @ $150 per year
Aquaculture (3 day HACCP training)	6.10	$6,000	$6,000			2 x aquaculture HACCP training @ $6,000
Aquaculture (food handler training)	6.10		$45,000	$45,000	$45,000	300 employees @ $150 per year
		$176,400	***$484,000***	***$478,000***	***$478,000***	
Audit Costs (first audit only):						
Pilot Program		$12,000				12 businesses @ $1,000
Catchers			$60,000	$60,000	$60,000	100 businesses/year @ $600/audit
Merchants			$50,000	$50,000	$50,000	50 businesses/year @ $1,000
Transporters			$12,000	$12,000	$12,000	20 businesses/year @ $600
Aquaculture			$10,000	$10,000	$10,000	10 businesses/year @ $1000
		$12,000	***$132,000***	***$132,000***	***$132,000***	
Other:						
Training and registration of facilitators	6.7	$7,500	$7,500	$7,500	$7,500	5 per year @ $1,500 ea
Training and registration of auditors	6.7	$7,500	$7,500	$7,500	$7,500	5 per year @ $1,500 ea
		$15,000	***$15,000***	***$15,000***	***$15,000***	
Total		***$633,400***	***$931,000***	***$875,000***	***$775,000***	

7.2 Assumptions

7.2.1 Research Costs

The "Safe Food" seafood secretariat will require three people to co-ordinate development of Food Safety Guidelines for the NSW seafood industry.

7.2.2 Development Costs

The forecast allows for one-off development costs of all industry sector guidelines and training programs in year 1. It may be that some of this work can be done in conjunction with other state or national seafood industry bodies.

With much of the first year given over to development, the pilot program and some initial HACCP training will occupy the balance of the time.

However, the lessons gained from the pilot program will accelerate the training program in the second to fourth year.

Training in HACCP based on per participant rates charged by all private training providers recognised as HACCP trainers by Agwest Trade & Development for SQF 2000, and the Quality Society of Australasia.

Training in food safety based on per participant rates charged by the Chartered Institute of Environmental Health (UK)/Australian institute of Environmental Health one day food hygiene program.

The food handler training costs allow for all food handlers to be trained once per year.

An allowance is indicated for two industry facilitators to train fishermen. It is felt that fishermen are better trained in a flexible environment, by industry peers.

7.2.3 Audit Costs

At this time, estimates of audit costs are speculative. They assume the number of businesses ready for first audit each year, which cannot be forecast with any confidence.

Only first audits are included. Each business will be required to undertake an (minimum) annual audit.

The cost per audit is also likely to vary with the size and complexity of each business.

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APPENDIX 1: REGISTERED SEAFOOD BUSINESSES / SEAFOOD EMPLOYEES IN NSW

(Source ABS: Business Register Counts, 22 Sep, 1998)

	<5 employees		5 to 9 employees		10 to 19 employees		20 to 49 employees		50 to 99 employees		100 to 199 employees		**Total businesses**	
	NSW	Syd	NSW	Syd	NSW	Syd	NSW	Syd	NSW	Syd	NSW	Syd	**NSW**	**Syd**
Rock lobster fishing	*12*	*1*												
Prawn fishing	*76*	*5*	*6*											
Finfish trawling	*50*	*7*	*9*	*1*	*3*									
Line fishing	*30*	*4*	*1*				*1*	*1*						
Marine fishing n.e.c.	*130*	*16*	*10*		*2*	*2*								
Aquaculture	*259*	*49*	*38*	*9*	*8*	*2*	*2*		*1*					
Total harvesting	557	82	64	10	13	4	3	1	1	0	0	0	**638**	**97**
Sydney harvesting as %of NSW		15%		16%		31%		33%		0%				**15%**
Seafood processing	8	4	8	6	3	2					3	0	**22**	**12**
Sydney processing as % of NSW		50%		75%		67%						0%		**55%**
Fish wholesaling	142	100	44	25	20	12	12	6	3	2	1	1	**222**	**146**
Sydney wholesalers as % of NSW		70%		57%		60%		50%		67%		100%		**66%**
Fresh meat, fish, and poultry retailing	1439	793	415	229	97	59	7	3	1				**1959**	**1084**
Takeaway food retailing	3601	2196	1056	661	444	295	281	187	205	151	23	16	**5610**	**3506**
Sydney retailers/takeaways as % of NSW		59%		61%		65%		66%		73%		70%		**61%**

Seafood Employees in NSW

Business employing:	<5 employees	5 to 9 employees	10 to 19 employees	20 to 49 employees	50 to 99 employees	100 to 199 employees	**Total employees**
Rock lobster fishing	36	0	0	0	0	0	
Prawn fishing	228	42	0	0	0	0	
Finfish trawling	150	63	45	0	0	0	
Line fishing	90	7	0	35	0	0	
Marine fishing n.e.c.	390	70	30	0	0	0	
Aquaculture	777	266	120	70	75	0	
Total harvesting	1671	448	195	105	75	0	**2494**
% employees per business size	*67%*	*18%*	*8%*	*4%*	*3%*	*0%*	
Seafood processing	24	56	45	0	0	450	**575**
% employees per business size	*4%*	*10%*	*8%*	*0%*	*0%*	*78%*	
Fish wholesaling	426	308	300	420	225	150	**1829**
% employees per business size	*23%*	*17%*	*16%*	*23%*	*12%*	*8%*	

(Extrapolated from ABS: Business Register Counts)

Notes:

Fish wholesaling includes Co-ops, SFM, exporters, and other merchants.

Fresh meat, fish, and poultry retailing, and *take-away retailing* cannot be further divided to identify predominantly seafood retailers.

APPENDIX 2: US FDA TOLERANCES FOR ENVIRONMENTAL CONTAMINANTS IN SEAFOOD

Substance	*Level*	*Food Commodity*
Aldrin/Dieldrin	0.3ppm (edible portion)	All fish
Chlordane	0.3ppm (edible portion)	All fish
Chlordecone	0.3ppm (edible portion)	All fish
DDT, TDE, DDE	5.0ppm (edible portion)	All fish
Diquat	0.1ppm	All fish
Fluoridone	0.5ppm	Fin fish and crayfish
Polychlorinated biphenyls (PCBs)	2.0ppm	All fish
Simazine	12ppm	Fin fish
2,4-D	1.0ppm	All fish
Arsenic	76ppm 86ppm	Crusacea Bivalve molluscs
Cadmium	3ppm 4ppm	Crusacea Bivalve molluscs
Chromium	12ppm 13ppm	Crusacea Bivalve molluscs
Lead	1.5ppm 1.7ppm	Crusacea Bivalve molluscs
Nickel	70ppm 80ppm	Crusacea Bivalve molluscs

US FDA Guidance/Tolerances for Deleterious Substances
""Compendium of Fish, Fishery Product Processes, Hazards and Controls" by Robert J. Price of the University of California, Davis, Ca., updated Sep 1998

APPENDIX 3: NSW OCEAN / ESTUARINE PRODUCTION

Ocean Production (Kg)

Top 20 ports of landing

Port	Finfish	Molluscs	Prawns	Other Crustaceans	**All Species**
Eden	10,074,352	360,926	9,219	2,275	**10,446,772**
Uladulla	2,665,593	119,443	16,413	13,211	**2,814,660**
Bermagui	1,714,635	122,967	2,666	823	**1,841,091**
Wollongong	1,178,257	59,628	70,741	15,694	**1,324,320**
Newcastle	919,446	136,152	88,878	29,561	**1,174,037**
Sydney	870,810	98,223	142,136	19,028	**1,130,197**
Iluka	457,467	239,397	268,913	27,718	**993,495**
Port Stephens	777,199	86,188	74,664	12,088	**950,139**
Tuncurry	859,223	40,128	289	9,986	**909,626**
Coffs Harbour	470,825	171,850	123,187	24,416	**790,278**
Greenwell Point	679,568	6,839	7,686	1,783	**695,876**
Tweed Heads	429,664	18,962	94,783	138,283	**681,692**
Ballina	122,185	234,144	48,335	131,232	**535,896**
South West Rocks	364,600	73,803	23,168	6,157	**467,728**
Crowdy Head	372,870	26,171	24,203	13,008	**436,252**
Narooma	237,961	26,940	150	1,749	**266,800**
Terrigal	213,249	7,012	36	3,408	**223,705**
Batemans Bay	136,049	21,195	65,630	253	**223,127**
Brunswick Heads	76,891	14,566	38,635	47,660	**177,752**
Moroya	175,419	366		432	**176,217**
Total - top 20 ports	**22,796,263**	**1,864,900**	**1,099,732**	**498,765**	**26,259,660**
% of all ports	**95%**	**93%**	**94%**	**87%**	**95%**
Total all ports	**23,908,016**	**2,002,835**	**1,171,155**	**571,017**	**27,653,023**

Estuarine Production

Top 10 areas

	Finfish	**Molluscs**	**Prawns**	**Other Crustaceans**	**Total**
Clarence River	679,085	10	213,597	21,099	**913,791**
Wallis Lake	326,601	2,505	80,087	109,550	**518,743**
Hawkesbury River	315,667	28,240	116,116	14,981	**475,004**
Port Stephens	413,666	4,922	4,252	31,225	**454,065**
Tuggerah Lakes	326,301	229	74,095	1,468	**402,093**
Lake Macquarie	341,149	14,176	17,894	10,529	**383,748**
Botany Bay	257,600	17,905	23,737	2,925	**302,167**
Lake Illiwarra	171,281	64,357	25,027	4,370	**265,035**
Hunter River	201,434	120	44,478	5,009	**251,041**
Jervis Bay	192,744	8,149		2	**200,895**
Total - top 10	3,225,528	140,613	599,283	201,158	**4,166,582**
% of all estuaries	**68%**	**95%**	**71%**	**72%**	**70%**
Total estuaries	4,716,263	147,602	848,221	278,184	**5,990,270**

Source: NSW Fisheries 1992/93

APPENDIX 4: NSW IMPORTS BY COUNTRY

1997/98
(selected import codes)

	0302 Fish: fresh or chilled (excluding 0304)		*0304* Fish fillets, and other fish meat: fresh, chilled, or frozen		*0306* Crustaceans: live, fresh, chilled, frozen, dried, salted, or in brine.		*0307* Molluscs: live, fresh, chilled, frozen, dried, salted, or in brine	
	Kgs	%	Kgs	%	Kgs	%	Kgs	%
Argentina			12,000	0%				
Bangladesh	10	0%			2,412	0%		
Cambodia					37,710	1%	5,376	0%
Canada					7,588	0%	1,494	0%
Chile			3,312,232	19%	12	0%	11,621	0%
China	4,650	0%	267,918	1%	1,946	0%	330,999	6%
Cuba					51,490	1%		
Denmark			6,027	0%	9,728	0%		
Fiji	8,985	0%	440	0%	30	0%	1,923	0%
Gibraltar			15120	0%				
Hong Kong			15136	0%	7,527	0%	23,923	0%
India			39533	0%	199,935	4%	193,918	3%
Indonesia	45,153	2%	96220	1%	46,605	1%	7,254	0%
Japan	20	0%	7222	0%	74,296	1%	241,128	4%
Kenya			745880	4%				
Malaysia	14,122	1%	19801	0%	402,550	7%	234,797	4%
Mauritius							53	0%
Mexico					26,671	0%		
Myanmar			333510	2%	214,172	4%		
Namibia			513593	3%				
Netherlands	3,450	0%	22	0%			11,000	0%
New Caledonia					244,757	5%		
New Zealand	1,928,843	89%	8650262	48%	30,163	1%	1,412,522	24%
North Korea							16,745	0%
Norway			11200	0%	720	0%		
Peru							30,800	1%
Phillipines			112	0%	5,760	0%	4,038	0%
PNG	54,060	3%						
Portugal			2010	0%				
Russian Federation					733	0%		
Singapore	2,157	0%	56826	0%	93,461	2%	10,001	0%
Solomon Islands					3,561	0%	9	0%
South Africa	100	0%	2176712	12%				
South Korea			4630	0%	11,248	0%	23,243	0%
Sri Lanka					126	0%		
Taiwan	8,000	0%	58383	0%	79,004	1%	1,627,624	28%
Tanzania	7	0%	305132	2%				
Thailand			459208	3%	3,385,932	63%	1,364,724	23%
Tonga	60	0%						
Uganda			707175	4%				
USA	10	0%	1225	0%	117,569	2%	104,539	2%
Vanuatu					23	0%		
Vietnam	90,428	4%	50643	0%	282,639	5%	221,848	4%
(Australian re-imports)					34,191	1%	10	0%
Total	**2,160,055**		**17,868,172**		**5,372,559**		**5,879,589**	

Source: ABS

APPENDIX 5: FOOD SAFETY SURVEY: NSW FISHERMEN' COOPERATIVES

(23 complete or part responses)

1. What type of business are you from ? – **FISHERMEN'S CO-OPERATIVES Includes 3 catchers and 1 transporter)**

2. Are you the……

Business owner	4	Manager	9
Staff member	9	Agent representing the business	1

3. What size is the business?

Less than 6 employees	9	20-100 employees	7
6-20 employees	7	More than 100 employees	

	yes	*no*	*not sure*
4. Are you aware of pending changes to food hygiene legislation?	8	8	7
5. Do you know where the major risks to food safety are in your business?	13	5	5

6. What are they?

- Cross-contamination between cooked and uncooked product
- Contamination from unclean fish bins
- Temperature control
- Coolroom and fish processing room.
- Transport to market.
- Market floor awaiting auction.
- Having no ice on whole fish
- Freezers breaking down
- Coolrooms not working
- Keeping fresh fish away from cooked prawns.
- Temperature control
- Correct storage of product
- Correct sanitation of equipment
- Fish on deck (catcher)
- Fish in fish room
- Fish unloading in summer.
- Temperature control
- Correct storage of product
- Hygienic food handling
- Point of delivery
- Clean work area
- Temperature control
- Staff hygiene
- Hygiene of premises
- Chemical contamination
- Shelf-life
- Quality control on receival of goods.

- Work areas are clean
- Personal hygiene of workers.
- Bad hygiene
- Fish not kept at the right temperature.
- Unwashed hands.
- Hygiene of staff.
- Temperature control
- Hygiene of premises
- Cleanliness of containers, ie tubs
- Shelf-life of product.
- Spoilage
- Cross contamination
- Temperature control
- Storage facilities
- Handling procedures
- Pest/bacteria control
- Personal hygiene.
- Not keeping well-iced
- We are not aware of any risks
- Chopping boards
- Handling food
- Placing food in correct temperatures
- Cross-contamination
- Unclean surfaces
- Unclean utensils
- Personal hygiene, gloves
- Point of catching.
- Transportation in ice.
- Clean boxes.
- Packing with ice.
- Refrigeration
- Pest control
- Water contamination
- Hygiene
- Not keeping well-refrigerated
- Not keeping vessels and premises hygienically clean.
- No personal hygiene.

		yes	*no*	*not sure*
7.	**Do you have training programs in place for staff who are handling food product, and records of that training?**	4	15	4
8.	**Do you have uniform and personal hygiene policies in place for staff handling food products?**	15	7	1
9.	**Do you have hand washing facilities that are convenient for staff to use, and are not used for cleaning fish, containers, or utensils?**	15	1	
10.	**Do you have facilities to keep cooked fish separate from uncooked product?**	5	4	
11.	**Do you use ice made from clean drinking water?**	14	2	
12.	**Do your premises and facilities meet proposed food hygiene regulations?**	10	1	4
13	**Are all equipment, containers, and tools used for single products, and thoroughly cleaned before use.**	16		1
14.	**Do you check the temperature and condition of seafood received**	7	8	

into your business, whether fresh, chilled, or frozen?			
15. Do you know your suppliers and their source of supply?	13		1

16. What temperature do you keep chilled uncooked product at?			**17. How long can you store chilled uncooked product at this temperature?**		
0-4 °C	0-4 °C	0-5 °C	1-2 weeks	4 days	4 days
0-4 °C	0 °C	2 °C	3 days	Varies with	2-3 days
0-4 °C	2-3 °C	-3 °C	Fish trip	product	4-5 days
under 2 °C	0-4 °C	0-4 °C	4 days	4 days	5 days
	0 °C		6 days	4 days	

18. What temperature do you keep frozen product at?			**19. How long can you store frozen product at this temperature?**		
<-18 °C	-20 °C	-20 °C,	3 mnths	3 mnths	2 mnths
-18 to -20 °C	-32 °C	-16 °C	3-6 mnths	3 mnths	6 mnths
-22 °C	-18 °C	-20 to 22 °C	6 mnths	3-6 mnths	
				6 mnths	

20. How long can you keep filleted product on display?			**21. What temperature do you store filleted product on display**		
2-3 days	3 days	8 hrs	~2 °C	0-4 °C	2-4 °C
2-3 days	3 days	1 day	2-3 °C	0 °C	0-5 °C
6 days	2 days	3 days	2-3 °C	0-2 °C	2-4 °C
	5 days				

	yes	*no*	*not sure*
22. Do you keep temperature logs of chilled and frozen storage?	3	11	1
23. Do you have a pest control program in place?	11	3	1
24. Do you have a formalised food safety plan in place?	2	13	1
25. Do you have a certified Quality Assurance system in place?	1	15	1
26. Have you heard of the term HACCP before?	8	9	1
27. Do you have a HACCP plan for your business?	1	16	
28. Overall, do you consider the implementation of a food safety program to be a net benefit (yes) or additional cost (no).	11	6	1

29. What are the benefits?	30. What are the costs?
• If we can gain consumer confidence with a food safety program, it will lead to more business plus increased consumer confidence in the industry as a whole. • Assurance of product being sent to market is of best quality. • Best quality fish that we can catch. • Who knows? Position on the floor of Sydney fish Market appears more important than quality of fish. • There are no benefits. • Better hygiene and food handling practices. • Better product and more sales. Better product to the consumer. • Better quality product. • Improved product quality • Extended shelf-life • Customer satisfaction • Market penetration • Efficient recall procedures • Better product and customer satisfaction. • Gaining greater consumer condfidence, a much better product, longer shelf-life, therefore better prices. • Assurance of quality for consumers	• Implementation and running costs of a HACCP system (unknown at this stage) • Implementation and operating costs for HACCP (unknown). • More bureaucratic bullshit, costs, and regulations. Another chance to create empires at the cost of industry. This industry is hamstrung with rules, regulations, and bureaucrats. Who bloody needs more? • Short term – implementation and training. Long term – increased staff levels to monitor and audit. Internally, practices put in place. • Very little (Catcher) • Training and equipment • Setting up program, procedures, and action plans. • Damage to reputation, and unused product. • A slight cost to implement and control. • A lower return to fishermen if no consumer confidence.

APPENDIX 6: FOOD SAFETY SURVEY: MERCHANTS (THROUGH SYDNEY AUCTION)

1. What type of business are you from ? - RETAILERS/ WHOLESALERS (21 responses)

2. Are you the……

Business owner	19	Manager	
Staff member	1	Agent representing the business	1

3. What size is the business?

Less than 6 employees	12	20-100 employees	2
6-20 employees	7	More than 100 employees	

	yes	*no*	*not sure*
4. Are you aware of pending changes to food hygiene legislation?	10	6	5
5. Do you know where the major risks to food safety are in your business?	11	3	7

6. What are they?

- At times incorrect holding temp on display
- Coolroom racks require regalvanising
- Hygiene
- Temperature control
- Fish contamination
- Floors, offal, benches, cool room
- Age of product when purchased
- Blow flies, maggots
- Not keeping product at right temperature
- Cross contamination
- Temperature control, transport, cross contamination
- Not washing hands after nose picking
- Temperature control,
- Temperature control
- Cross contamination
- Product handling
- Not washing hands properly
- Smoking in work place
- Poor refrigeration equipment
- Not iceing product in display
- Not washing display counters and trays
- Maintaining strict control on product
- Handling product with disposable gloves
- Temperature control, cross contamination, paper trail for products, food handling

	yes	*no*	*not sure*
7. Do you have training programs in place for staff who are handling food product, and records of that training?	5	15	1
8. Do you have uniform and personal hygiene policies in place for staff handling food products?	17	3	1

		yes	*no*	*not sure*
9.	**Do you have hand washing facilities that are convenient for staff to use, and are not used for cleaning fish, containers, or utensils?**	19	1	0
10.	**Do you have facilities to keep cooked fish separate from uncooked product?**	15	2	0
11.	**Do you use ice made from clean drinking water?**	17	1	0
12.	**Do your premises and facilities meet proposed food hygiene regulations?**	12	2	4
13	**Are all equipment, containers, and tools used for single products, and thoroughly cleaned before use.**	16	0	2
14.	**Do you check the temperature and condition of seafood received into your business, whether fresh, chilled, or frozen?**	12	6	1
15.	**Do you know your suppliers and their source of supply?**	14	2	2

16. What temperature do you keep chilled uncooked product at?		
Very cold,	4 to 0 °C	0 to 3 °C,
0°C,	0 to 2 °C,	0 °C,
0 °C,	0 °C,	1 °C,
4 °C	<5 °C,	5 °C,
0 to 5 °C,	-2 to 2 °C,	-1 to 1 °C,
1 to 4 °C,	-1 to 4 °C,	0 to 5 °C ,
		0 °C

17. How long can you store chilled uncooked product at this temperature?		
Very long,	1 week,	0-4 days,
3-4 days,	4-5days,	3-5 days,
Varies with	4-5 days,	5 days,
species,	3-4 days,	3 days,
3 days.	3-4 days,	3 days,
4-5 days,		3 days
		3-5 days,

18. What temperature do you keep frozen product at?		
-20 °C,	-22 °C,	-18 °C,
-18 °C,	-18 °C,	-25 °C,
-20 °C,	-18 °C,	-20 °C,
-18 °C,	-18 °C,	-18 °C,
-24 °C,	-23 °C,	-22 °C,
-20 °C,	-17 °C,	-18 °C,

19. How long can you store frozen product at this temperature?		
3 mnth,	3-8 mnth,	4 mnths,
3 mnth,	3 mnths,	eternity,
3 mnths,	3 mnths,	6 mnths,
1-6 mnths,	2 mnths,	3 mnths
2-3 mnths	4 wks max,	
1 mnth,	6 mnths	

20. How long can you keep cooked product after cooking?		
1 day,	Not sure,	Not sure,
Not sure,	2 days	5 days

21. What temperature do you store cooked product at?		
0°C,	Not sure,	0°C,
0°C,	Not sure	0°C,
		0-5°C,

		yes	*no*	*not sure*
22.	**Do you keep temperature logs of chilled and frozen storage?**	4	14	1
23.	**Do you have a pest control program in place?**	14	3	1
24.	**Do you have a formalised food safety plan in place?**	6	11	2
25.	**Do you have a certified Quality Assurance system in place?**	4	15	0
26.	**Have you heard of the term HACCP before?**	6	13	0
27.	**Do you have a HACCP plan for your business?**	1	18	0
28.	**Overall, do you consider the implementation of a food safety program to be a net benefit (yes) or additional cost (no).**	11	3	4

29. What are the benefits?

- Safety to the consumer
- Confidence from the consumer
- Ease of identifying problems
- Better Quality Control
- Less waste
- Safety and health of customers
- Quality and safety
- Not just the safety and health aspect, but better systems for employees to follow, and better standards for our customers to see, and industry to follow
- Setting good standards across the industry, for the whole industry, and a lot safer product.
- Yes because the way you run a very clean place and a safe place where your customers feel comfortable and safe to come to your store and purchase their favourite seafood. That is one of the most important things in our business. Trust and security from the customer.
- Less rate of contamination
- Possible selling benefits
- Fresher, cleaner, incident free
- Customer confidence in your product
- Increased demand due to public confidence in the quality of the product

30. What are the costs?

- Courses to understand requirements
- Cost of drawing up and implementing plan
- Bringing shop up to standard
- Time and money
- To formally implement everything is time consuming.
- We run our business to very reasonable standards
- Basically I could tell you in $ and cents, but once everything is up and running properly, the cost of keeping everything maintained is not too expensive.
- $, time, and resources.
- Lack of information and guidance.
- Time
- Slows business down
- Hard to control
- May need to employ a person to control hygiene
- $12,000 start, and $2,500 every year. (20-100 wholesaler)
- Initial costs of training etc will be high and will take some time to recoup costs.