Area Management Agreement

for salmonid aquaculture in Macquarie Harbour

between

Huon Aquaculture Group Pty Ltd
Petuna Aquaculture Pty Ltd
Tassal Operations Pty Ltd

Schedule 1: Macquarie Harbour Fish Health Management Plan

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Macquarie Harbour Area Management Agreement: Fish Health Management Plan
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1 Introduction

As aquaculture production increases in Macquarie Harbour (MH), it has been recognised that a Fish Health Management Plan that is inclusive of all aquaculture operators in MH is required.

This Fish Health Management Plan (FHMP) outlines the fish health issues that relate to MH and mitigation measures that will be employed against them. Given the close proximity of all leases within MH, the health measures described in this FHMP have been developed as if just one company is growing fish in MH.

The objective of the FHMP is to ensure that the risk of introduction of new diseases into MH is minimised and to reduce the impact of new diseases (if they occur) and diseases currently present in MH, thereby ensuring that disease does not affect the long term sustainability of the farming of salmonids in this region. The FHMP will be an integral part of farming strategy and well understood by relevant staff within companies (e.g. company veterinarians, regional managers and technical staff).
2 Key diseases of concern

Key diseases of concern to salmonids being farmed in MH can be broadly categorised into two groups, including those which are:

1. Exotic to MH and which should be excluded; and
2. Currently in MH and which need to be dealt with on a day to day basis to minimise their potential impact(s).

Please refer to Appendix A for detailed information on diseases.

The Animal Health Act 1995 requires people to report any case or suspicion of a notifiable animal disease. These notifiable diseases are all serious. Notifiable diseases in Tasmania are broken down into two lists – List A and List B.

List A diseases are exotic – that is, we believe there are no cases in Tasmania. The law requires that any suspicion of a List A disease is reported immediately and that the owner of the suspect animals isolates them immediately, pending further investigation of the signs.

List B diseases are endemic – that is, they are known to occur in Tasmania or on the Australian mainland and some form of monitoring or control is required. The law requires that any suspicion of a List B disease is reported immediately. There is no legal requirement to isolate the suspect animals pending a further investigation of the signs, but owners are strongly urged to take all reasonable steps to prevent any spread of those List B diseases that are contagious.

In addition to the List A and List B diseases, there are two further categories of notifiable disease that must be reported\(^1\):

1. Any suspect case of a new disease must be reported immediately.
2. Any disease that is causing deaths or production losses and which is not readily diagnosed is deemed to be an unknown disease. Any unknown disease must also be reported immediately and the suspect animals isolated pending further investigation of the signs.

2.1 Diseases of concern which are exotic to Macquarie Harbour

2.1.1 Viral diseases (exotic to Australia and notifiable)

- Infectious haematopoietic necrosis (IHN) (List A Disease);
- Infectious pancreatic necrosis (IPN) (List A Disease);
- Infectious salmon anaemia (ISA) (List A Disease);
- Pancreas disease (PD).

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2.1.2 Viral diseases (exotic to Tasmania and notifiable)
   
   • Epizootic haematopoietic necrosis (EHN) (List A Disease).

2.1.3 Bacterial diseases (exotic to Australia and notifiable)
   
   • Bacterial kidney disease (IHN) (*Renibacterium salmoninarum*) (List A Disease);
   • Enteric redmouth disease (ERM) (*Yersinia ruckeri* – Hagerman strain) (List A Disease);
   • Furunculosis (*Aeromonas salmonicida* subsp. *salmonicida*) (List A Disease);
   • Piscirickettsiosis (*Piscirickettsia salmonis*) (List A Disease).

2.1.4 Other diseases/pathogens exotic to Australia
   
   • Gyrodactylosis (*Gyrodactylus salaris*);
   • Sea lice (*Lepeophtheirus salmonis*) (List A Disease);
   • Whirling disease (*Myxobolus cerebralis*) (List A Disease).

2.2 Diseases of concern that are present in Tasmania but not in Macquarie Harbour
   
   • Tasmanian Salmonid Rickettsiosis (Tas-SR) – SE strain (List B Disease).

2.3 Diseases of concern which are known to be present in Macquarie Harbour

2.3.1 Viral diseases
   
   • Tasmanian aquabirnavirus (TAB) (List B Disease);
   • Aquareovirus.

2.3.2 Bacterial diseases
   
   • Marine Aeromonad Disease of Salmonids (MAS – *Aeromonas salmonicida* biovar *acheron*) (List B Disease);
   • Yersiniosis (*Yersinia ruckeri*, serotype O1b, biotype 1 and 2);
   • Vibriosis (*Vibrio anguillarum*);
   • Noccardiosis (*Nocardia* spp.).

2.3.3 Other diseases known to be present in Macquarie Harbour
   
   • Ichthyophonous (*Ichthyophonus hoferi*).
### 3 Potential pathways of disease introduction into Macquarie Harbour

Figure 1 describes the key steps by which disease can develop through the introduction of a disease agent from a region outside MH to farmed fish growing in MH.

Figure 1: Key steps in establishment of disease

Specific pathways by which exotic or new diseases could be introduced into MH include:

1. Live fish movements, including the water in which they are transported;
2. Infected fish products, including bait;
3. Contaminated equipment translocation, including transport trucks and boats;
4. Personnel movements;
5. From wild fish in MH (acknowledging that wild fish may already be carrying diseases that have not yet been identified);
6. Contaminated tackle carried by recreational anglers/wild fishers.

Once viable disease agents have entered and established infection in MH, it will be very difficult to prevent spread of that agent within MH and limit the impact of disease. Hence all measures must be taken to minimise the risk of introduction of disease agents into MH, as described in Section 4.

Disease agents can live and propagate within live fish. The potential for viable disease agents to enter MH in sufficient numbers to establish infection is highest when transferring live fish. Hence over time the number of viable disease agent(s) being carried with these fish will remain the same or potentially increase, particularly if fish are stressed during transport.

Once a disease agent is outside the fish (e.g. present on equipment or personnel or in the water) the viability of the disease agent(s) will, in general, lessen with time.

The potential for a disease agent to survive outside of a fish depends on the environment it is located within. For example, disease agents are more likely to survive in a moist environment such as water or biofouling on nets than on the exposed surface of equipment.

In general, the more often a potential pathway occurs, the more likely a disease agent will be introduced into MH. Therefore, the potential risk of a disease agent(s) entering MH and infecting MH fish is a function of two factors:

- how frequently the movement occurs; and
• the likelihood of the disease agent remaining viable during the movement.

This is shown in Figure 2.

![Overall risk of disease entry = Potential for viable disease agent to be moved through specific pathway \times Frequency of pathway occurring](image)

**Figure 2: Risk of disease entry is dependent on what is being moved and how often it is moved**

Hence movements of live fish, which occur frequently, are likely to present the greatest risk of transferring a disease or diseases into MH from elsewhere.

While the potential to carry viable disease agent(s) with equipment and personnel is less than live fish, the frequent movements of equipment and personnel means that this pathway still poses a significant risk of disease introduction.

Disease agents may also be carried by wild fish or other aquatic organisms (e.g. shellfish, plankton) that either reside in, or move in and out of MH. Minimising contact between farmed fish and wild fish or other aquatic organisms in MH is more difficult. However, there are several measures that can be implemented to reduce this risk, e.g.

- Transfer of disease from wild fish to farmed fish is less likely if farmed fish are healthy and maintained in optimal conditions;
- Conversely, holding stressed or poor quality farmed fish on a site increases the risk of disease transfer from wild fish;
- Farmed fish that are well fed are less likely to predate on wild fish, shrimps or other aquatic organisms - feeding on wild prey is potentially a direct pathway for introducing a new disease to farmed fish.

The use of bait and tackle by recreational fishers in MH is also a potential pathway to be aware of, particularly where bait or tackle is brought in from overseas. A risk assessment would be required to determine the relative risk of this pathway.

The prevention of spread of disease agents out of MH to other regions is also important but will not be dealt with in this FHMP which relates specifically to disease within MH.
4 Fish health and biosecurity measures - General

4.1 Introduction

This Section is an overview of general measures considered critical to an effective Fish Health Management Plan. More detailed description of specific measures is presented in Section 5.

4.2 General fish health and biosecurity measures

4.2.1 Written fish health and biosecurity protocols which are adhered to

Development and review of written Fish Health and Biosecurity Protocols promote a well thought through and comprehensive approach to fish health and biosecurity. They serve several functions:

- Enable broad participation in ensuring effective measures are in place;
- Provide an effective education resource for training staff;
- Provide a clear reference on which internal or external auditing can be based. It is essential to ensure agreed measures are adhered to.

Protocols must aim to:

- Avoid the introduction of new or exotic diseases into Macquarie Harbour farm stock;
- and
- Minimise the spread and impact of diseases already present in Macquarie Harbour;
- and
- Avoid the spread of diseases present in MH to other regions.

4.2.2 Disease monitoring – Early detection mechanism

General health monitoring on a regular basis is an essential part of effective fish health management to ensure that important or unusual conditions are detected as quickly as possible. Early recognition of a potential health issue increases the likelihood that mitigating actions will prevent the spread and/or reduce the impact of a disease.

Early recognition also allows for timely investigation and research into the condition to determine its significance and possible control mechanisms.

Regular stock inspections are best incorporated into other farm activities such as mortality collection, weight checks and harvests. However, staff should be in the habit of assessing fish behaviour and appearance during all farm activities.

Mortality numbers must be closely monitored as an increase in mortality is an early warning of a potential health problem. Fresh mortalities or preferably moribund (sick) fish provide the best subjects for specific disease investigation. Reduced feeding may also indicate a fish health issue.
At the time of mortality collection divers should, to the best of their ability, record the possible cause of death of the fish. Divers should record if they see lesions (e.g. abscesses on the skin), other unusual signs in dead fish or unusual fish behaviour within the population. At times of significant increased mortality and/or unusual signs or behaviour, it is essential that company technical staff and/or veterinarian accompany the dive team to investigate any such increase or unusual signs and to collect samples for laboratory submission, if this is deemed necessary.

The key aim of these investigations and general health monitoring is to ensure each company detects any problem in its fish as early as possible and is quickly able to confirm whether or not an infectious disease is involved. Regular monitoring also improves the capability in each company’s staff to identify problems.

Besides general health monitoring, it is important to routinely conduct targeted monitoring that specifically checks for the presence (or not) of specific diseases. General and targeted disease monitoring is also linked to the Tasmanian Fish Health Surveillance Program (TFHSP) which is a joint program between the Tasmanian Salmonid Industry and Tasmanian Government.

Key objectives of the TFHSP are:

- Demonstration of freedom from those salmonid diseases considered exotic to Tasmania, but not necessarily Australia, in order to provide support for maintaining state border biosecurity regulations;
- Monitoring of significant endemic diseases and their causative agents in order to maintain regional biosecurity within Tasmania; and
- Investigation of significant or unusual disease events in a rapid and efficient manner.

As part of the TFHSP, the Fish Health Unit (DPIPWE) provides each farm on a monthly basis with a bacteriology sampling kit containing agar plates, microscope slides and sterile loops to facilitate timely and routine bacteriological sampling.

### 4.2.3 Staff training and awareness

The ability of staff to recognise diseased fish is essential in the early detection of a disease. Staff awareness of biosecurity issues and protocols is critical in minimising the spread and impact of diseases. To ensure staff competency, regular general health monitoring (as outlined above) and continuing education is required. Such education includes both in-house and external training, continued reinforcement of the importance of fish health and biosecurity issues by management, and ongoing feedback about fish health and biosecurity matters as they arise.

Technical staff need to be aware of how to assess fish for the presence of disease and be familiar with:

- External and internal fish appearance and anatomy;
- Normal and unusual fish behaviour;
- Basic understanding of fish physiology (what each organ does);
- How to perform a post-mortem on a fish; and
- How to collect basic samples for bacteriological and histological assessment.

4.2.4 Fish health and laboratory services

Effective disease investigation and response relies on experienced personnel. It is essential that each Company has access to a Fish Veterinarian experienced in the diagnosis and control of aquatic animal diseases.

Disease monitoring and investigation is also reliant on an experienced and well resourced laboratory service. Without such a service the capability to identify and respond to new and emerging disease issues is compromised.

The Fish Health Unit (DPIPWE) in Launceston provides an excellent primary diagnostic facility for the Tasmanian salmonid industry, including: microbiological, histological, molecular biological and other services. The FHU is well supported by the Australian Animal Health Laboratory (CSIRO) in Geelong which provides mostly virological testing. On occasions where significant or notifiable infectious disease occurs, events may be referred to DPIPWE Animal Health Branch for investigation. In such cases, the government veterinary officer will work with the company veterinarian to investigate the issue.

4.2.5 Communication and reporting strategies

Efficient and effective communication, both internally and externally, are critical to the function of the FHMP.

The FHMP will be reviewed annually; however changes to elements of the Plan can be made at any stage upon agreement between the companies farming in MH.

Notification protocols will be agreed such that each company’s designated veterinarian is routinely notified in a timely manner of significant issues, e.g. signs of infectious disease, antibiotic treatment and other important issues (as outlined in Section 5).

4.2.6 Contingency planning

In the event that a serious new disease emerges in MH, it is essential to have an agreed “Contingency Plan” in place that clearly outlines what processes and procedures will be undertaken to manage such an event.

A disease outbreak emergency exists when a population of aquatic animals is recognised as having undergone a severe mortality event or significantly decreased productivity and the responsible authority within the State (the Tasmanian Chief Veterinary Officer – CVO) believes that the cause may be an infectious agent. The CVO may also consider latent events as emergencies, for example where the presence of an infectious agent is confirmed but without any signs of disease.

Each State and Territory in Australia has operational responsibility for the surveillance, monitoring, control and eradication of aquatic animal diseases within its borders. In Tasmania DPIPWE is the lead agency for management of animal disease emergency response. Such events are normally administered according to the State Special Emergency Plan: Biosecurity Emergencies, and under the direction of the Tasmanian CVO in
consultation with industry.

The Australian CVO is also responsible for Australia’s international obligations, including reporting to the Office International des Epizooties (OIE; or World Organisation for Animal Health).

Disease agents and hosts that may be involved in an emergency situation can be diverse. In many cases, little may be known of an agent and a control strategy may need to be developed very quickly, using first principles and the immediately available knowledge.

There are 3 broad options to consider in the event that a serious disease emerges in MH.

- **Eradication** – The scale of eradication may vary, but in a worst case scenario may be harbour-wide (i.e. eradicate all farmed fish from the entire production area of MH).

- **Containment, Control and Zoning** – These measures aim to exclude an exotic disease from defined geographic areas and unaffected populations (e.g. by quarantine) and contain the disease to areas with known infection.

- **Control and mitigation of Disease** – These measures aim to manage the frequency and severity of disease episodes in infected populations and keeping them within acceptable levels.

Events will need to be assessed on a case by case basis, however, it is imperative that decisions and actions are implemented quickly.

**4.2.7 Record keeping and review**

Data gathered monthly from the FHMP will be collated and reviewed by the Macquarie Harbour Area Management Agreement (AMA) Management Officer, with a report produced which will be provided to the company veterinarians and the AMA Management Group. Reports circulated to all companies and regulators would not identify individual company data which would only be circulated back to the relevant company. The specific data to be collected will be agreed by the designated company veterinarians.

In order to facilitate further analysis of fish health trends, investigation of fish health issues, traceability and review it is essential that extensive and clear recording is undertaken on all aspects of the Fish Health and Biosecurity Protocols.
5  Fish health and biosecurity measures – Specific
Best Practice Recommendations, Conditions and Compliance Conditions

5.1  Introduction
The objective of this Section is to present details of specific measures that are considered important to maintaining good fish health and biosecurity within MH production. Each measure is categorized as one of the following (See definitions in Section 5.2):

i. Compliance Conditions;

ii. Conditions; or

iii. Best Practice Recommendations.

5.2  Definitions
Within the FHMP, the definition of each category is as follows:

i. **Compliance Conditions** are mandatory due to Legislative or Regulatory requirements;

ii. **Conditions** are Best Practice Measures that are considered to be mandatory under the FHMP;

iii. **Best Practice Recommendations** are provided as a guide to the best way of maintaining fish health outcomes. While these measures are not mandatory under the FHMP, they are strongly recommended.

Best practice is a method, process or activity that is believed to be more effective at delivering a particular outcome than any other technique, method, process, etc., when applied to a particular condition or circumstance.

5.3  Fish health and biosecurity measures - Specific

5.3.1  Overall measures
Overall Measures (unless otherwise specified) apply to both hatcheries supplying fish to MH and grow-out sites within MH.

**COMPLIANCE CONDITIONS**

- All leaseholders must participate in any fish health or fish biosecurity programs as directed by the CVO or Director of Marine Resources;

- Any treatment administered to fish must be prescribed by a Veterinarian;

- All companies must comply with their responsibilities for reporting disease under the *Animal Health Act 1995* (www.dpipwe.tas.gov.au);

- All farms must comply with any movement restrictions put in place by the Chief Veterinary Officer (CVO). MH is currently declared as a restricted area in accordance with section 35(1) of the *Tasmanian Animal Health Act 1995*. 

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All treatments must be administered consistent with conditions outlined within the Tasmanian “Code of Practice for the Use of Agricultural and Veterinary Chemicals” and with the Tasmanian Veterinary Surgeon Board guidelines for standards of veterinary practice.

Prior to any stock on a marine lease being treated with therapeutants, the licence holder must advise the Director of Marine Farming, and a copy of any medication authority specific to stock treatment that has been issued. The licence holder must comply with requirements to undertake any reasonable residue testing prescribed by the Director.

**CONDITIONS**

All sites must:

- Have access to a designated Fish Health Veterinarian experienced in the diagnosis and control of aquatic animal diseases;
- Have a documented Biosecurity Plan in place which clearly identifies methods and procedures to prevent the introduction, internal spread or exit of new or unknown diseases. The Biosecurity Plan will be based on the template developed by the company veterinarians and will be based on best practice;
  - Each Biosecurity Plan must be reviewed and agreed to by the designated Veterinarian and signed off by each Farming Company.
- Have in place and utilise an early warning mechanism to ensure prompt recognition and investigation of any significant increased acute or chronic mortality and/or unusual signs of disease. This must include routine and timely notification of their designated Veterinarian so that an appropriate course of action can be instigated as required;
  - The designated Veterinarian for one company must notify all other designated Veterinarians promptly if there is any suspicion of a new or exotic disease; as well as outbreaks of endemic disease (e.g. MAS)
- Must regularly inspect fish during routine farm activities such as mort collection and weight checks;
- All Fish Health Management, Biosecurity and Environmental Management Plans must be readily available to the designated Veterinarian and Regulatory Authorities upon request;
- All visitors, suppliers and contractors must sign in and be briefed on relevant biosecurity issues before entering the site;
- Recreational fishing must not occur within marine leases. If a hatchery allows controlled fishing to occur (e.g. catch out), there must be a strict biosecurity protocol in place for such activity. This protocol would be included in the Biosecurity Plan for that hatchery.
Fish must only be fed with pelleted feed manufactured by a licensed fish feed company (e.g. Skretting, Ridleys, Biomar). It is acknowledged that from time to time it may be desirable to feed non-pelleted feed (e.g. the feeding of cooked mussels to stimulate feeding of smolt) to optimise health. In such rare occasions, the non-pelleted feed must be treated in such a manner as to ensure that no disease agents could remain viable within the feed.

**BEST PRACTICE RECOMMENDATIONS**

All sites should:

- Have a designated Fish Health Technician who is responsible for day to day biosecurity and fish health monitoring. This person is the key contact person with the designated Veterinarian. Note – the Fish Health Technician can be responsible for more than one site;
- Undertake regular training (at least annually) either by In-House or Fish Health Unit trainers to ensure appropriate level of expertise in Fish Health Technicians and a high level of awareness within staff generally of critical biosecurity issues;
- Provide appropriate protective clothing and boots to all visitors, suppliers and contractors before entering the site;
- Promote maintenance of healthy stock through appropriate nutrition, feeding regimes, stock husbandry and equipment/pen maintenance to minimise fish susceptibility to disease;
- Sample moribund fish for bacteriological and histological assessment at the FHU at least on a monthly basis.

**5.3.2 Measures to avoid introduction of new and/or exotic diseases exotic into Macquarie Harbour farm stock and into hatcheries supplying Macquarie Harbour**

**COMPLIANCE CONDITIONS**

- All sites must be aware of any movement restrictions currently in-place within Tasmania and comply with all conditions, including the agreed Tasmanian broodstock movement protocol.
- All fish to be transferred to MH must be vaccinated against those diseases known to exist in MH for which a proven effective commercial vaccine is available. This includes, but is not necessarily limited to the following vaccines: Yersinivac-B (salmon), Anguillavac-C (trout) and Anguimonas (salmon)

**CONDITIONS**

- No fish should be transferred from a hatchery to MH during a period when there is an unexplained increase in mortality and/or unusual signs of disease in fish within
the hatchery until such time that the mortality reason is identified and confirmed not to be a disease of concern;

- All companies must have a clearly documented cleaning and disinfection protocol to minimise the risk of disease transfer on equipment, vehicles and personnel when moving fish from the hatchery to MH and when returning from MH to the hatchery. Records must be kept to show compliance with such procedures.
- Fish vaccination must occur in a manner consistent with product guidelines to maximise vaccine efficacy.
- Representative fish from hatchery populations due to be transferred must be assessed by a designated veterinarian as close as possible (< 4 weeks) to the transfer date to confirm that they are healthy and showing no evidence of clinical disease. A veterinary certificate of stock health (Appendix B) is then issued which is valid for a period of a month. If there is any change in the health status of fish between the pre-transfer assessment and the time of transfer the hatchery must notify the designated Veterinarian.

**BEST PRACTICE RECOMMENDATIONS**

- Ingestion of wild prey/non-pelleted food should be minimised through appropriate feeding regimes that satiate fish;
- Only fish of good quality should be transferred to MH;
- All vehicles transferring fish from hatcheries to MH should have a written Transport protocol detailing the method used to transfer these fish. This should include how water quality will be maintained during transfer. Records should be kept of every transfer.

**5.3.3 Measures to limit spread and impact of diseases in Macquarie Harbour**

**COMPLIANCE CONDITIONS**

- Any pens of fish due to be harvested within a 3 month period and with a 7 day mortality above 0.2% that has occurred for 2 consecutive weeks or more must be reported as soon as possible to an inspector appointed under the *Animal Health Act 1995*;
- Mortality exceeding 0.25% for 3 consecutive days in any pen will be reported as soon as possible to the Marine Farming Branch and the other designated company veterinarians;
- All fish mortalities arising in connection with the marine farming operations must be disposed of according to the relevant Act and local council conditions;
- Blood water from harvested fish must be fully contained and not released into the marine environment unless authorised by the Chief Veterinary Officer;
- Harvested fish must be transported in fully secured containers that do not leak or spill;
• Any plastic liners and/or other disposable items used with harvest transport containers must be disposed of via deep burial, incineration or other method approved in writing by an inspector appointed under the Animal Health Act 1995 and comply with appropriate local government regulations.

**Conditions**

• Dive Teams must have a written Biosecurity Protocol (consistent between companies) which is adhered to when undertaking inspections, mortality dives or other dive activities on farms. This Protocol must include details on such areas as wash down and disinfection of the dive vessel, dive equipment and divers between quarantine areas, year classes, species or control zones. Dive Teams must maintain adequate records to verify that the Biosecurity Protocol has been adhered to for each dive.

• Dive gear used on farms in MH must not be taken out of MH;

• Dive gear used within one company’s sites must not be used on another company’s sites without undergoing cleaning and disinfection as detailed in the Diver Biosecurity Protocol;

• Morts must not be released into the environment, fed to wildlife or used as bait;

• Morts removed from pens must go directly into a secure mort container. Morts must not be left lying on the deck of a boat or hanging at the edge of pens;

• Morts collected each day must be disposed of within 24 hours of collection into an approved mortality pit or storage facility according to relevant Acts and Bylaws;

• Any company treating fish must notify all other farms in MH;

• If a disease is caused by a bacterium that can be cultured at FHU, then the FHU should also conduct antibiotic testing on the bacterium to indicate which antibiotics the bacterium is sensitive to (and hence may potentially be able to use as a treatment).

• All farms must have a written protocol which details how transport containers are to be cleaned and disinfected before being returned to areas used for farming. A record must be kept showing that this protocol has been followed.

• All farms must have a written harvesting protocol.

• Harvest bins and other transport containers used in MH, must not be used in other regions and vice versa unless an appropriate disinfection process is approved by an inspector under the Animal Health Act 1995; and

• The leases of different companies must be separated by a minimum distance of 1 km.

**Best Practice Recommendations**

• Naïve or younger stock should be dived first during normal diving duties or as a separate dive by a separate diver.
Any pen of fish in which there is an increase in mortality and/or unusual signs of disease and/or confirmed infectious disease should be dived last during normal diving duties or as a separate dive by a separate diver. It is acknowledged that by the time a pen of fish shows unusual signs of disease the disease may have been present for a number of days in that pen.

- If there is increased mortality and/or unusual signs of disease and/or confirmed infectious disease then a wash down and disinfection of the dive vessel, dive gear and diver should occur before leaving the pen.

- Morts should be removed from pens as regularly as possible (at least twice weekly). The regularity of removal should increase during periods of increased mortality (preferably daily).

- Separate mort bags should be used for fish of differing year classes, species or quarantine areas;

- Mort bags should be cleaned and disinfected between every pen dived;

- All sites should have a written cleaning and disinfection protocol that ensures that there is minimal risk of infectious disease agents remaining viable on cranes, hooks, mort off-loading areas and any other equipment involved in the collection of morts or coming in contact with morts.

- Treatment of an infectious disease should be based on the diagnosis of the designated veterinarian with confirmation of treatable pathogen by the Fish Health Unit laboratory.

- Leases should be fallowed for a minimum of 3 months. Longer fallowing may be advisable if significant losses caused by infectious disease have occurred.

- Companies should have the necessary equipment to monitor critical water quality parameters such as temperature, salinity and dissolved oxygen. These parameters should be monitored on a regular basis.

- Nets should be kept sufficiently clean to allow good water exchange;

- Different salmonid species should not be farmed on the same lease.
Appendix A – Diseases of concern for fish being farmed in Macquarie Harbour

VIRAL DISEASES EXOTIC TO TASMANIA AND NOTIFIABLE

- **Epizootic haematopoietic necrosis (EHN)** - is caused by epizootic haematopoietic necrosis virus (EHNV), a systemic iridovirus (ranavirus).

  This disease is present in Victoria but has never been detected in Tasmania.

  Signs of disease include distended abdomen, darkened skin colour, petechial (pinpoint) haemorrhages at base of fins and haemorrhaging of the gills. Internally, the kidneys and spleens are swollen.

  EHN is usually seen in Australia as large kills of small redfin perch, but mortality also occurs among older perch. Clinical outbreaks are associated with poor water quality, and water temperature between 11°C and 17°C in rainbow trout and above 12°C in redfin perch. Kills occur over a short period (several weeks) in summer, and then the disease may disappear from an area for years. Low mortalities over a period of months have been reported in young farmed rainbow trout. Infectivity is less severe in rainbow trout, mainly affecting fingerlings <125 mm long. Low-grade mortalities with covert EHNV infection can also occur in grower fish. Therefore, care must be taken when moving redfin perch and rainbow trout from the known geographical range of EHNV to areas where it is exotic, unless freedom can be adequately documented. Low prevalence of antibodies in naturally infected trout suggests a very low prevalence of carrier status in farmed trout.

  Fish known to be susceptible to EHN:
  - rainbow trout* (*Oncorhynchus mykiss*)
  - redfin perch* (*Perca fluviatilis*)
  - Macquarie perch (*Macquaria australasica*)
  - mosquito fish (*Gambusia affinis*)
  - mountain galaxias (*Galaxias olidus*)
  - silver perch (*Bidyanus bidyanus*).
  * naturally susceptible (other species have been shown to be experimentally susceptible)

- **Infectious haematopoietic necrosis (IHN)** - is caused by infectious haematopoietic necrosis virus (IHNV), a rhabdovirus related to viral haemorrhagic septicaemia virus.

  Signs of disease include fry of rainbow trout and salmon show numerous yolk
sac haemorrhages, darkening of the skin, haemorrhages on the abdomen and around pupil of eye, occasionally exophthalmus (pop eye) and ascites (swollen abdomen from accumulated fluid), possible long, white discharge from anus and bleeding at base of fins.

IHN is typically found in young farmed trout and Atlantic salmon in the fingerling stage or in the final spawning period of their lifecycle. Mass mortalities can occur, typically with 100% of population infected and mortality greater than 90%. High mortality also occurs in wild Pacific salmon infected with IHNV, and survivors can be the source of infection of farmed stock. Susceptibility to overt infection varies between individuals of the same species and appears to be largely age dependent, with younger individuals being more susceptible. Fish that survive IHN are presumed to be carriers of the virus. Transmission is generally via water, with the virus entering fish through the gills and skin. The virus enters the water in faeces, urine, spawning fluids and external mucus, and through contaminated transport water and blood-sucking parasites of infected fish. Fish-eating birds can also transfer virus to new areas. Outbreaks are most likely to occur around spawning, with increased levels of virus excreted to water with spawning fluids. IHN is a cold-water disease. Outbreaks rarely occur in water above 15°C and require a neutral pH of around 7. It is believed the migration of IHNV from northern America to Asia and Europe has been through the importation of infected fish and eggs, indicating some degree of vertical transmission.

Fish known to be susceptible to infectious haematopoietic necrosis virus:
- Amago salmon (Oncorhynchus rhodurus)
- Atlantic salmon (Salmo salar)
- Brook trout (Salvelinus fontinalis)
- Brown trout (Salmo trutta)
- Chinook salmon (Oncorhynchus tshawytscha)
- Chum salmon (Oncorhynchus keta)
- Coho salmon (Oncorhynchus kisutch)
- Cutthroat trout (Salmo clarki)
- Masou salmon (Oncorhynchus masou)
- Pacific salmon (Oncorhynchus spp)
- Pink salmon (Oncorhynchus gorbuscha)
- Rainbow trout (Oncorhynchus mykiss)
- Sockeye salmon (Oncorhynchus nerka)

**Infectious pancreatic necrosis (IPN)** – is caused by a birnavirus. Signs of disease include fish lie still on bottom, fish swim with a spiralling, corkscrew motion, white faecal casts, swollen belly, darkening body colour and exophthalmus (pop eye).

IPN is highly contagious. Transmission of the virus to uninfected fish is via water. The virus enters fish through the gills and by ingestion. IPN is also vertically transmitted via eggs. The virus enters the water in faeces, urine, spawning fluids.
and external mucus, and through contaminated transport water, contaminated eggs and blood-sucking parasites of infected fish. Fish-eating birds can also be a source of the virus to the environment. Outbreaks are most likely to occur around spawning, with increased levels of virus excreted to water with spawning fluids. Cumulative mortality can vary from 10% to 90%. IPN affects post-smolt Atlantic salmon eight weeks after transfer from freshwater to seawater. The disease can cause high mortalities in young trout. The virus is both freshwater and marine tolerant. Fish that survive IPN are presumed to be carriers of the virus. The virus is not host-specific, having been found to affect fish of at least 20 different families. Pathogenicity depends on virus strain, species and age of host, and the environment. The virus is quite stable, enabling it to persist in a range of environmental conditions, and resists destruction by disinfection.

Fish that are likely to be severely affected by IPNV:
- Atlantic salmon (*Salmo salar*)
- Brook trout (*Salvelinus fontinalis*)
- Brown trout (*Salmo trutta*)
- Danio zebrafish (*Danio rerio*)
- Rainbow trout (*Oncorhynchus mykiss*)
- Yellowtail (*Seriola lalandi*)

**Infectious salmon anaemia (ISA)** - is consistent with those of the Orthomyxoviridae family of viruses. Signs of disease include pale gills, ascites (swollen abdomen from accumulated fluid), bleeding eyes and fin rot are also common, ecchymotic (bruise-like) skin haemorrhages may be present. Internally, the liver and spleen are swollen and dark (early sign), pinpoint haemorrhages in fat, blood in intestines, haemorrhaging of the liver and pale heart.

ISA occurs in spring and early summer, at water temperatures from 3°C to above 15°C. Mortality varies up to 90%, and may occur over a prolonged period, not necessarily as acute outbreaks. Spread of the disease has occurred with the movement of live juvenile salmonids from fish farm to fish farm and with the discharge of organic waste from fish processing plants into the marine environment. Natural outbreaks seem to occur only in salmonids exposed to seawater. ISA has been the subject of extensive eradication campaigns in several countries, such as Scotland, which has since declared itself free from the disease. It appears that stress caused by treatment against salmon lice, cestodes or infectious diseases may predispose salmon to outbreaks of ISA two to three weeks later. The only species seen to show clinical signs of ISA is the Atlantic salmon (*Salmo salar*).

Species known to be naturally asymptomatic carriers:
- Brown trout* (*Salmo trutta*) - least susceptible
- Coho trout* (*Oncorhynchus kisutch*)
- Rainbow trout* (*Oncorhynchus mykiss*)
**Pancreas Disease**

The causative agent was isolated in 1995 and was shown to be an alphavirus, now known as Salmon Pancreas Disease Virus (SPDV).

Classically there is a sudden drop in feed intake, in some cases preceded by voracious feeding. A variable proportion of fish become lethargic and can be seen swimming around the edges and corners of the net pen. There may be a small increase in mortalities at this viraemic stage, but the most significant mortalities usually occur 3-6 weeks after the acute phase disease at temperatures of 12-14°C. An increase in yellow cast-like faeces is often associated with PD. Other clinical manifestations include sudden death in large fish, fish lying motionless on the bottom of the pen, unusual swimming behaviour (including circling and spiral swimming) and spitting out feed pellets. A variable percentage of fish become runts.

Histologically, during the acute phase there is acute pancreatic acinar cell necrosis, with a rapid disappearance of the majority of pancreatic exocrine tissue. A variable inflammatory reaction is observed at this stage in the peripancreatic fat. Acute necrosis of heart fibres occurs concurrently with the above pancreatic lesions. Cardiac muscle cells in the atrium and the compact and spongy layers of the ventricle can be affected. Affected cells become very eosinophilic and have shrunk nuclei. Skeletal muscle lesions are rarely seen at this stage. Approximately, 14 days post infection; there is significant loss of exocrine pancreas in the majority of fish, with concurrent and variable cardiac myopathy. Skeletal muscle lesions also appear around 14 days post infection.

The only species seen to show clinical signs of SPDV is the Atlantic salmon (*Salmo salar*).

**Viral Haemorrhagic Septicaemia** - is a rhabdovirus of the genus *Novirhabdovirus*.

Initial outbreak (acute) stage - slight darkening of body colour, exophthalmus (pop eye), bleeding around eyes, bleeding under skin around base of pectoral and pelvic fins, skin ulceration and pale gills with pinpoint haemorrhages.

Chronic stage - intense darkening of skin, exophthalmus (pop eye), gills grey-white (anaemic).

Behavioural (nervous) stage - most external signs of acute and chronic stages are gone.

Internal signs during the acute stage are swollen abdomen, marked by ascites (swollen abdomen from accumulated fluid) and pinpoint haemorrhages in the fatty tissue, intestine, liver, swim bladder and muscle. During the chronic stage, the interior of abdomen particularly pale and the liver is pale, with evidence of haemorrhages on surface. During the behavioural (nervous) stage, the internal signs...
are as for acute and chronic stages above.

Variant strains of the virus are responsible for disease in different parts of the globe, affecting hosts from different environments.

Rainbow trout appear to be less susceptible to infection from marine strains of the virus. Younger fish are generally more susceptible to disease.

Water temperature at outbreak is generally between 4°C and 14°C. From 1°C to 5°C, there is an extended course of disease with low daily but high accumulated mortality, whereas temperatures between 14°C to 18°C result in a short disease event with modest mortality.

Transmission is horizontal directly through the water, from virus shed with faeces, urine (predominantly) and sexual fluids of infected or carrier fish. The virus can also be spread in the faeces of birds that have consumed infected fish and on equipment that has been in contact with water from infected fish.

Heightened stress caused by overcrowding, extreme temperatures or overfeeding will greatly reduce an animal's resistance to infection.

Mortality can range from 10% to 80% depending on the stage of disease, water temperature, age of fish and other stressors (highest mortality rates occur in the initial acute stage, with lowest mortality rates in the nervous stage).

VHS is now thought to have existed in the marine environment before its apparent transfer to freshwater, where it became virulent in trout.

It has been suggested that the European freshwater isolates of VHS virus originated from fish in the northern Pacific and Atlantic oceans. The mechanism of transfer was possibly through the feeding of marine feed fish to cultured freshwater species (Hedrick et al 2003).

Fish known to be susceptible to VHS:

- Atlantic cod* (*Gadus morhua*)
- Atlantic salmon* (*Salmo salar*)
- blue whiting* (*Micromesistius poutassou*)
- brook trout* (*Salvelinus fontinalis*)
- brown trout* (*Salmo trutta*)
- chinook salmon* (*Oncorhynchus tshawytscha*)
- coho salmon* (*Oncorhynchus kisutch*)
- dab* (*Limanda limanda*)
- English sole* (*Pleuronectes vetulus*)
- European eel* (*Anguilla anguilla*)
- European flounder* (*Platichthys flesus*)
- four-bearded rockling* (*Rhinonemus cimbrius*)
grayling* (Thymallus thymallus)  
Greenland halibut* (Reinhardtius hippoglossoides)  
haddock* (Melanogrammus aeglefinus)  
herring* (Clupeidae)  
Japanese flounder, 'Hirame' strain* (Paralichthys olivaceus)  
lesser argentine* (Argentia sphyraena)  
North Pacific hake* (Merluccius productus) Norway pout* (Trisopterus esmarki)  
Pacific cod* (Gadus macrocephalus)  
Pacific herring* (Clupea pallasi)  
Pacific salmon* (Oncorhynchus spp)  
Pacific sandlance* (Polygymnus myriophylla)  
pike* (Esox lucius)  
pilchard* (Sardinops sagax)  
plaice* (Pleuronectes platessa)  
poor cod* (Trisopterus minutus)  
rainbow trout* (Oncorhynchus mykiss)  
rockling* (Gaidropsarus spp)  
sablefish* (Anoplopoma fimbria)  
shiner perch* (Cymatogaster aggregata)  
Spanish barbel* (Barbus graellsi)  
sprat* (Sprattus sprattus)  
turbot* (Psetta maxima)  
walleye pollock* (Theragra chalcogramma)  
whitefish* (Coregonus spp)  
whiting* (Merlangius merlangus)  
whiting* (Sillago ciliata)

**BACTERIAL DISEASES EXOTIC TO AUSTRALIA AND NOTIFIABLE**

**Bacterial kidney disease** (Renibacterium salmoninarum) - is recognised as a slowly progressive and frequently fatal infection of cultured and wild salmonids in both fresh and marine waters. Some affected fish show exophthalmus (pop eye), distended stomachs and skin lesions. Internally, gross signs of disease in an infected animal include creamy white granulomas in kidney and sometimes in liver and spleen, fluid in stomach cavity, haemorrhages on abdominal wall and in the viscera, diffuse white membranous layer on one or more internal organs, enlarged spleen and holes in muscle blocks.

The causative bacterium is likely to live only within salmonids and not in the environment. Other non-salmonid species have shown infection but only when raised with highly infected salmonids. The bacterium is transmitted both horizontally (fish to fish via the water) and vertically (fish to egg through the generations). Advanced infection becomes apparent only after the first year of the
Fish’s life.

Fish known to be susceptible to bacterial kidney disease:
- Atlantic salmon (Salmo salar)
- bartail flathead (Platyccephalus indicus)
- brook trout (Salvelinus fontinalis)
- brown trout (Salmo trutta)
- chinook salmon (Oncorhynchus tshawytscha)
- rainbow trout (Oncorhynchus mykiss)

**Enteric redmouth disease** (Yersinia ruckeri – Hagerman strain) The causative agent of enteric red mouth disease is the bacterium Yersinia ruckeri. The several serotypes of the bacterium vary in the severity of disease they cause. *Yersinia ruckeri* serotype 01a, the ‘Hagerman strain’, is exotic to Australia. Rainbow trout are particularly susceptible to this serotype, while Atlantic salmon are relatively resistant.

Clinical signs of disease include dark colour, haemorrhages at base of paired fins and vent, reddening of corners of mouth, gums, palate and tongue (hence the name of the disease), reddening of gill cover and haemorrhaging in eyes. There may also be ascites (swollen abdomen from accumulated fluid).

Fish known to be susceptible to enteric red mouth disease:
- Atlantic salmon (Salmo salar)
- brown trout (Salmo trutta)
- common carp (Cyprinus carpio)
- goldfish (Carassius auratus)
- rainbow trout (Oncorhynchus mykiss)

**Furunculosis** (Aeromonas salmonicida subspp. salmonicida) is almost a worldwide disease. To date, there have been no reports of ‘typical’ furunculosis in salmonids in Australia. Signs of disease include lethargy, cessation of feeding, swimming just below surface, respiratory distress and random jumping from water immediately before an outbreak.

Clinical signs of disease in an infected animal include furuncles (or boils) causing deep abscesses, usually in adult salmon in the acute phase of infection, haemorrhages on skin, mouth and fin bases (mainly paired fins), darkening of body colour, exophthalmus (pop eye). Internally, gross signs of disease in an infected animal include haemorrhages in muscle and internal organs, enlarged spleen and focal necrosis of the liver, stomach filled with mucus, blood and sloughed epithelial cells, congested intestine and fusion of gill lamellae.
While classical furunculosis (as described above) occurs in both juvenile and adult salmon, peracute infections in juvenile salmon can result in death without the fish showing any clinical signs other than darkening of the skin.

- All salmonids are believed to be susceptible

**IN TASMANIA BUT NOT MACQUARIE HARBOUR**

**Tasmanian Salmonid Rickettsiosis (Tas-SR)** – A range of gross signs of disease may be present in salmonids infected with Tas-SR. Severely affected fish are dark, anorexic and lethargic. They often swim near the water surface or at the edges of the cages. Fish with milder infections may appear normal. Infections of the brain may cause erratic swimming behaviour. Skin lesions, appearing as small white patches that can progress to shallow ulcers, may also be present on some fish. The most consistent external sign seen during Tas-SR infections is pale gills indicating anaemia but this is not pathognomonic for the disease.

In common with many systemic, chronic inflammatory diseases of salmonids, the internal signs include a swollen and discoloured kidney and an enlarged spleen. Ascites in the peritoneal cavity and haemorrhages on the visceral fat, stomach, swim bladder and body musculature can also occur. Hallmark internal lesions of the disease are found in the liver, which may exhibit large, whitish or yellow, multifocal, coalescing, pyogranulomatous nodules. These lesions often rupture, resulting in shallow crater-like cavities in the liver.

Tamar and South East strains - The Tas-RLO, which was first detected in 2001, is a significant pathogen of sea-caged Atlantic salmon and is thought to be unique to Tasmania. The only other known rickettsial disease of salmonids is caused by *Piscirickettsia salmonis*, which is exotic to Australia, and is the cause of salmonid rickettsial septicemia (SRS) (AQUAVETPLAN Disease Strategy Manual-Piscirickettsiosis, DAFF, in-press). Although Tas-RLO is different from *P. salmonis*, the symptoms of Tas-SR and SRS are similar.

The Tas-RLO has now been detected in all marine salmonid production regions in Tasmania. Of note is that disease associated with the Tas-RLO occurs only in the south-east. There have been no reports of Tas-SR from either the Macquarie Harbour or Tamar River production regions and levels of detection of Tas-RLO in these regions continue to be low. Neither Tas-SR nor Tas-RLO has been detected in any freshwater facilities in Tasmania.

**OTHER DISEASES/PATHOGENS EXOTIC TO AUSTRALIA**

**Gyrodactylosis (Gyrodactylus salaris)** - the causative agent for gyrodactylosis is *Gyrodactylus salaris* (a small parasitic flatworm).

Clinical signs include rubbing against objects in response to skin irritation and flashing (darting and twisting of fish and erratic swimming), ulcers on infected fish, peeling of skin, fish appear pale, excess mucus on skin and frayed fins.
A few parasites cause no problem to healthy populations, but massive infestations lead to compromised resistance to viruses and bacteria. *Gyrodactylus salaris* may be present for years in farmed salmonids, especially rainbow trout, without the fish showing any clinical signs of disease. Identification of *G. salaris* is based on morphology and morphometry of hooks and bars in the opisthaptor (an attachment organ), or by DNA analysis. The whole surface of a fish, including gills and mouth cavity, must be examined under a dissecting microscope. The parasite can survive a few days at a salinity of 20 ppt, but cannot survive in seawater. The parasite can survive 5–6 days unattached to a host, but cannot survive drying out. Transmission is horizontal, direct from the water column. Parasites can breed prolifically. The parasite is readily spread through transport of infested fish.

Fish known to be susceptible to gyrodactylosis:
- Atlantic salmon* (*Salmo salar*)
- brown trout* (*Salmo trutta*)
- grayling* (*Thymallus thymallus*)
- rainbow trout* (*Oncorhynchus mykiss*)

**ÅSea lice** (*Lepeophtheirus salmonis*) is a species of copepod. It is an external parasite of salmon that lives off the mucous, skin and blood of the fish, and heavy infestations can be fatal. *Lepeophtheirus salmonis* are significant pathogens of Atlantic and Pacific salmon in the northern hemisphere. These parasites are common in the wild but are rarely reported in large numbers on individual fish. In culture, however, sea lice can rapidly multiply and seriously threaten commercial production. Initial infection with the copepod *L. salmonis* produces small white patches around the head, along the base of the dorsal fins and in the perianal areas. Progressive hyperplasia in these areas and the invasion of secondary pathogens is associated with severe ulceration, haemorrhage, oedema and exposure of the cranium and other areas of supporting tissue (Bruno and Poppe 1996).

*L. salmonis* is a parasite of salmonids, primarily infesting fish in the genera *Salmo*, *Salvelinus* and *Oncorhynchus*.

**ÅWhirling disease** is caused by *Myxobolus cerebralis*, a parasitic protozoan that affects salmonids.

Signs of disease include convulsive movements, faster breathing and jerking backwards movements. At 3–8 weeks post-infection: many fish swim with a whirling motion (‘tail chasing’), erratic, nervous darting movements until exhausted and darkening of skin from the anus to the tail (‘blacktail’). At 5–6 months post-infection, signs include spinal curvature, skull deformation and shortened gill plates.
*Myxobolus cerebralis* has a complex lifecycle involving two hosts: fish (trout or salmon species) and its definitive host, the tiny bottom-dwelling tubifex mud worm (*Tubifex tubifex*). Infected fish develop *Myxobolus* spores (myxospores) that are very persistent and can survive in moist environments for many years. Worms ingest the myxospores, which develop in the worm’s intestine and multiply rapidly. The infected worms release a fragile waterborne spore stage of the parasite (triacontinomyxon stage), which must infect a fish within a few days or perish. When released by the worm, the spore infects a susceptible fish by attaching to the fish’s body. The parasite then migrates through the fish’s skin to the central nervous system, and ultimately into the cartilage. When an infected fish dies and decomposes, spores are released into the water, beginning the cycle again. Spores can also survive passing through the digestive tract of predators and can be transferred from place to place on muddy boots or other equipment.

Fish known to be susceptible to whirling disease:
- Atlantic salmon* (*Salmo salar*)
- brook trout* (*Salvelinus fontinalis*)
- brown trout* (*Salmo trutta*)
- chinook salmon* (*Oncorhynchus tshawytscha*)
- rainbow trout* (*Oncorhynchus mykiss*)

*Piscirickettsiosis* (*Piscirickettsia salmonis*) is caused by the bacterium *Piscirickettsia salmonis*, which has recently been classified within the gamma-proteobacteria, family Piscirickettsiaceae.

Clinical signs of disease include lethargy, circling, cessation of feeding, emaciation, swimming at the sides of net-pens. Externally, there may be multiple small white spots on skin, raised skin patches progressing to shallow ulcers on flanks and head, darkening of skin, ascites (swollen abdomen from accumulated fluid) and pale gills. Internally, there may be grey, swollen spleen and kidneys, mottled to spotted liver with large pale necrotic lesions and pinpoint haemorrhages of the stomach organs and flank muscle.

Fish known to be susceptible to piscirickettsiosis:
- Atlantic salmon* (*Salmo salar*)
- chinook salmon* (*Oncorhynchus tshawytscha*)
- coho salmon* (*Oncorhynchus kisutch*) - most susceptible to the bacterium
- pink salmon* (*Oncorhynchus gorbuscha*)
- rainbow trout* (*Oncorhynchus mykiss*)
- sakura salmon* (*Oncorhynchus masou*)

Piscirickettsiosis is only known to affect aquaculture stock and has not been recorded in fish from the wild.
DISEASES OF CONCERN WHICH ARE KNOWN TO BE PRESENT IN MACQUARIE HARBOUR

VIRAL DISEASES

**Tasmanian Aquabirnavirus (TAB)** – was first detected in rainbow trout within Macquarie Harbour sampled as part of TSHSP activities in 1998. Despite extensive testing of stock in other regions of Tasmania this virus has never been detected outside of Macquarie Harbour. Although infection with TAB is not normally associated with overt clinical disease, there is concern that establishment of the virus in hatcheries may cause disease in younger stock, and this, together with control of MAS, is the reason for maintenance of strict movement restrictions applied to stock in Macquarie Harbour.

TAB has subsequently been identified in Atlantic salmon in Macquarie Harbour.

**Aquareovirus** – Active surveillance activities detected a positive result for Aquareovirus in April 2009 from Atlantic salmon sampled within Macquarie Harbour. Although Aquareovirus has been detected in Macquarie Harbour on one previous occasion, this prior event was restricted to one cage and Aquareovirus did not appear to establish within the harbour population.

Aquareovirus has shown to be pathogenic under controlled laboratory experiments, but has not been associated with disease in the southeast of Tasmania where it is a common finding. There is concern that establishment of the virus in Macquarie Harbour may cause immunosuppression and compound other infectious diseases present within the region.

BACTERIAL DISEASES

**Marine Aeromonad Disease of Salmonids** is a disease of salmon caused by the bacterium *Aeromonas salmonicida* (biovar Acheron), an atypical form of *A. salmonicida* unique to Tasmania. This disease was first observed in late 1999 within a group of smolt transferred to a newly allocated lease within Macquarie Harbour. Signs of the disease include lethargy, loss of appetite, increased mortality, abnormal swimming and disorientation. Clinical signs of disease in an infected animal include white raised patches on the skin that progress to ragged-edged red ulcers, haemorrhages on skin and fin bases (usually the paired fins), fingernail-sized ulcers that might be anywhere on the fish, ulcers can extend through the stomach wall, leading to protrusion of intestines, ulcers most often on the upper side of the lateral line behind the head or at the base of the tail fin and pale gills with pinpoint haemorrhaging. Haemorrhaging can also be seen in the muscle and internal organs.

The disease affects Atlantic salmon and has only been reported on a small number of leases located within this region. Although the number of MAS cases increased
significantly in Atlantic salmon stock on these leases during subsequent summer periods, the development and introduction of the AnguiMonas (Intervet Schering Plough) vaccine has eliminated clinical outbreaks in recent years. Since mid-2007 there have been no positive findings of *A. salmonicida* (biovar Acheron) from within Macquarie Harbour or elsewhere in Tasmania.

**Â Yersiniosis** (*Yersinia ruckeri*, serotype O1b, biotype 1 and 2) - for freshwater Atlantic salmon, *Yersinia ruckeri* remains the most frequently occurring finding. The disease affects fish in hatcheries and in the early stages of marine production, arising from activation of covert infection. While open hatcheries are at most risk of exposure, *Yersinia ruckeri* has been isolated on several occasions from closed, recirculation facilities and demonstrates the ubiquitous nature of *Yersinia ruckeri* and its capacity to cause disease under intensive rearing conditions.

Infection with *Yersinia ruckeri* results in a bacterial septicaemia without disease specific signs but is most commonly detected due to exophthalmos and blood spots in the eye.

The strain of *Yersinia ruckeri* found in Tasmania is classified as serotype O1b, biotype 1 and has been the only strain known to occur since first isolated in 1987. In 2007 a second variant was detected at one site only, identified as serotype O1 (non-O1b) biotype 2; this is not the exotic Hagerman strain which causes enteric redmouth in rainbow trout. The biotype 2 strain however has not been detected again following its first isolation. The significance of the finding cannot be determined at this stage but consideration should be given to incorporating this variant into the existing vaccine if it were to emerge as a significant cause of disease in the future. Changes in vaccination strategy by hatcheries from extended bath to dip show promise to achieving improved protection in the early stages of hatchery production, which coupled with oral boosting shows promise as an effective control strategy for Yersiniosis.

- **Vibriosis** (*Vibrio anguillarum*) - Signs of vibriosis are similar to Marine Aeromonad Disease. Bacterial isolation is required to identify vibriosis. Following modifications to vaccination procedures for farms holding rainbow trout, beginning in 2004/05, there has been a rapid decline in reported cases involving *Vibrio anguillarum* serotype O1.

These changes have included the introduction of a second booster vaccination 6 weeks prior to sea transfer, introduction of injectable vaccination with Anguillvac-C and use of the bivalent AnguiMonas (Intervet Schering Plough) vaccine.
Up to 2006, *Vibrio anguillarum* was isolated repeatedly from Atlantic salmon and rainbow trout with clinical signs of disease but from 2007 there have been only very rare isolations of the organism. One study in 2008 looking at normal flora of rainbow trout in Macquarie Harbour established that vaccinated fish were carrying *V. anguillarum* O1 as normal gut flora; none of the fish examined had clinical signs of disease. Of note however is that with the continued success of the AnguiMonas and injectable Anguillvac-C vaccines, serotype variants as O3 and O12 of *Vibrio anguillarum* were detected on rare occasions. While the isolation of these two serotypes was associated with individual fish failure and not from a disease outbreak, it highlights the fact that other serotypes of *Vibrio anguillarum* occur in Macquarie Harbour with the potential to emerge as significant causes of disease in the future.

Several species of *Vibrionaceae* have been isolated consistently, mostly from fish in Macquarie Harbour but also from other marine farm sites. In nearly all cases, isolation has been from single fish rather than several within the same submission, a pattern suggesting individual fish failure rather than disease outbreak. The more frequently isolated species are *Vibrio scophthalmi* and *Vibrio ichthyoventeri*, both of which have been described as causes of disease in fish, principally turbot (*Scophthalmus maximus*) and Japanese flounder (*Paralichthys olivaceus*). There was also occasional isolation of *Photobacterium damselae* ssp. *damselae* and *Vibrio parahaemolyticus* from Atlantic salmon. These species are noteworthy in that they are zoonotic agents and have potential public health implications. As with the other *Vibrionaceae*, isolation was associated with individual fish failure rather than a disease outbreak.

- **Nocardiosis** (*Nocardia* spp.) - In 2003 a *Nocardia* species was isolated from a single Atlantic salmon in Macquarie Harbour. There were no more occurrences of *Nocardia* until 2006 when the species emerged as a cause of disease in a freshwater hatchery. Since 2006, the organism has been isolated each year and now from several hatcheries. It is thought to have spread through the transfer of juvenile fish between hatchery sites and highlights the biosecurity risks associated with such fish movements.

In salmonids, signs of nocardiosis can include darkening of the skin, lethargy and exophthalmus; on post-mortem, the kidney may be swollen due to the presence of granulomas. Nocardiosis is considered untreatable and refractory to antibiotic therapy. Hatcheries have reported varying levels of concern, but an outbreak in late summer at one hatchery was reported as serious.

**OTHER DISEASES**

- **Ichthyophonous** - During March 2006 a significant number of rainbow trout at the
time of harvest were noted with unusual lesions at two sites within Macquarie Harbour. Lesions noted included raised solid ‘lumps’ over the body of affected fish, red spotting over the ventral surface and liquefaction of kidney tissue. Elevated mortalities were also noted in two cages of rainbow trout at one site. It was determined that affected fish had widespread granulomatous-like lesions through a range of organs caused by the infective agent *Ichthyophonus hoferi*.

*Ichthyophonus hoferi*, was previously considered to be a mobile pathogenic fungi, but has subsequently been allocated to the DRIP group of organisms (*Dermocystidium*, rosette agent, *Ichthyophonus*, and *Psorospermium*) of the Mesomycetozoa that taxonomically are at the fungal- animal boundary of organisms. *Ichthyophonus* had previously been detected in Macquarie Harbour, but had not been seen for more than 8 years and then only as an incidental finding in isolated fish. The disease also caused significant problems at a hatchery facility during the early years of the Tasmanian salmonid industry.

Testing to determine prevalence of infection within Macquarie Harbour detected infection in 25% of mortalities from cages across farms in the region. Infection with *Ichthyophonus hoferi* was detected at all sites tested and was present in both rainbow trout and Atlantic salmon, although it’s prevalence was much higher in trout. The disease is reported to have continued to cause significant problems due to carcase quality downgrade at harvest in one farm growing rainbow trout.

- **Tasmanian Salmonid Rickettsiosis (Tas-SR)** - The Tas-RLO, which was first detected in 2001, is a significant pathogen of sea-caged Atlantic salmon and is thought to be unique to Tasmania. The only other known rickettsial disease of salmonids is caused by *Piscirickettsia salmonis*, which is exotic to Australia, and is the cause of salmonid rickettsial septicaemia (SRS) (AQUAVETPLAN Disease Strategy Manual- Piscirickettsiosis, DAFF, in-press). Although Tas-RLO is different from *P. salmonis*, the symptoms of Tas-SR and SRS are similar.

A range of gross signs of disease may be present in salmonids infected with Tas-SR. Severely affected fish are dark, anorexic and lethargic. They often swim near the water surface or at the edges of the cages. Fish with milder infections may appear normal. Infections of the brain may cause erratic swimming behaviour. Skin lesions, appearing as small white patches that can progress to shallow ulcers, may also be present on some fish. The most consistent external sign seen during Tas-SR infections is pale gills indicating anaemia but this is not pathognomonic for the disease.

In common with many systemic, chronic inflammatory diseases of salmonids, the internal signs include a swollen and discoloured kidney and an enlarged
spleen. Ascites in the peritoneal cavity and haemorrhages on the visceral fat, stomach, swim bladder and body musculature can also occur. Hallmark internal lesions of the disease are found in the liver, which may exhibit large, whitish or yellow, multifocal, coalescing, pyogranulomatous nodules. These lesions often rupture, resulting in shallow crater-like cavities in the liver.

The Tas-RLO has now been detected in all marine salmonid production regions in Tasmania. Of note is that disease associated with the Tas-RLO occurs only in the south-east. There have been no reports of Tas-SR from either the Macquarie Harbour or Tamar River production regions and levels of detection of Tas-RLO in these regions continue to be low. Neither Tas-SR nor Tas-RLO has been detected in any freshwater facilities in Tasmania.

(Note: The authors acknowledge the Report “Summary of Tasmanian Salmonid Disease Surveillance Activities 2004/05 to 2008/09, (DPIPWE 2010)” for much of the information provided on diseases of concern present in Tasmania.)
Appendix B – Draft Veterinary and Stock Health Certificates

VETERINARY HEALTH CERTIFICATE FOR SALMONIDS
DESTINED FOR MACQUARIE HARBOUR

This Veterinary Health Certificate is valid for one month from Date of Issue.

Certificate Number
Date of Issue
Certifying veterinarian

Hatchery Details
Address: ....................................................................................................................
....................................................................................................................

Phone No: .......... Fax No: .......... E-mail: ..........

Populations of fish covered by this certificate

Populations of fish specifically excluded under this certificate

Can be simply “nil” or specific populations of fish you may wish to sample on the day of visit and need to have a period of time (hopefully only a few days) for lab results to come back

Date of site visit to examine source farm and stock to be certified

Examinations performed
Visual inspection on day of visit
Sampling of fish as required
Other testing conducted
Relevant laboratory testing

Other examinations performed

Other information considered relevant to this certificate

e.g. Hatchery has biosecurity plan in place

Any other information considered relevant to support certificate

Declaration

I, the undersigned veterinarian, certify that at the time of the hatchery visit there was no evidence of infectious diseases of concern (as described in the Macquarie Harbour Fish Health Management Plan) in the stocks specified above based on the clinical examination of specified fish stocks at this hatchery, examination of mortality records conducted at the time of the hatchery visit, knowledge of the biosecurity protocols and procedures in place at the hatchery and testing of fish as summarised above.

The Certificate is immediately invalidated if there is a Fish Health Incident requiring investigation.

Signature: ........................................................... Name: ......................................................... Date: ...........................................................

Position: ...........................................................
STOCK HEALTH CERTIFICATE FOR SALMONIDS
DESTINED FOR MACQUARIE HARBOUR

This Stock Health Certificate is to be issued no earlier than 24 hours before time of transport.

Date and time of Issue

Veterinary Health Certificate covering this Stock Health Certificate
Number of valid vet health certificate

Authorised person certifying stock under this Certificate

Hatchery Details
Address: .................................................................................................................................
...................................................................................................................................................
Phone No: .......... Fax No: ........ E-mail: .................................................................

Populations of fish to be transported

Declaration
I, the undersigned authorized representative of Petuna/Tassal/HAC, certify that at the time of issue of this Stock Health Certificate there has been no evidence of infectious diseases of concern (as described in the Macquarie Harbour Fish Health Management Plan) during the period covered by the Veterinary Health Certificate in these populations destined to be transported to Macquarie Harbour based on my own knowledge of the populations and visual examination of the populations.

The Certificate is immediately invalidated if there is a Fish Health Incident requiring investigation prior to transportation of these populations.

Signature: ............................................................
Name: ............................................................ Date: ............................................................
Position: ............................................................