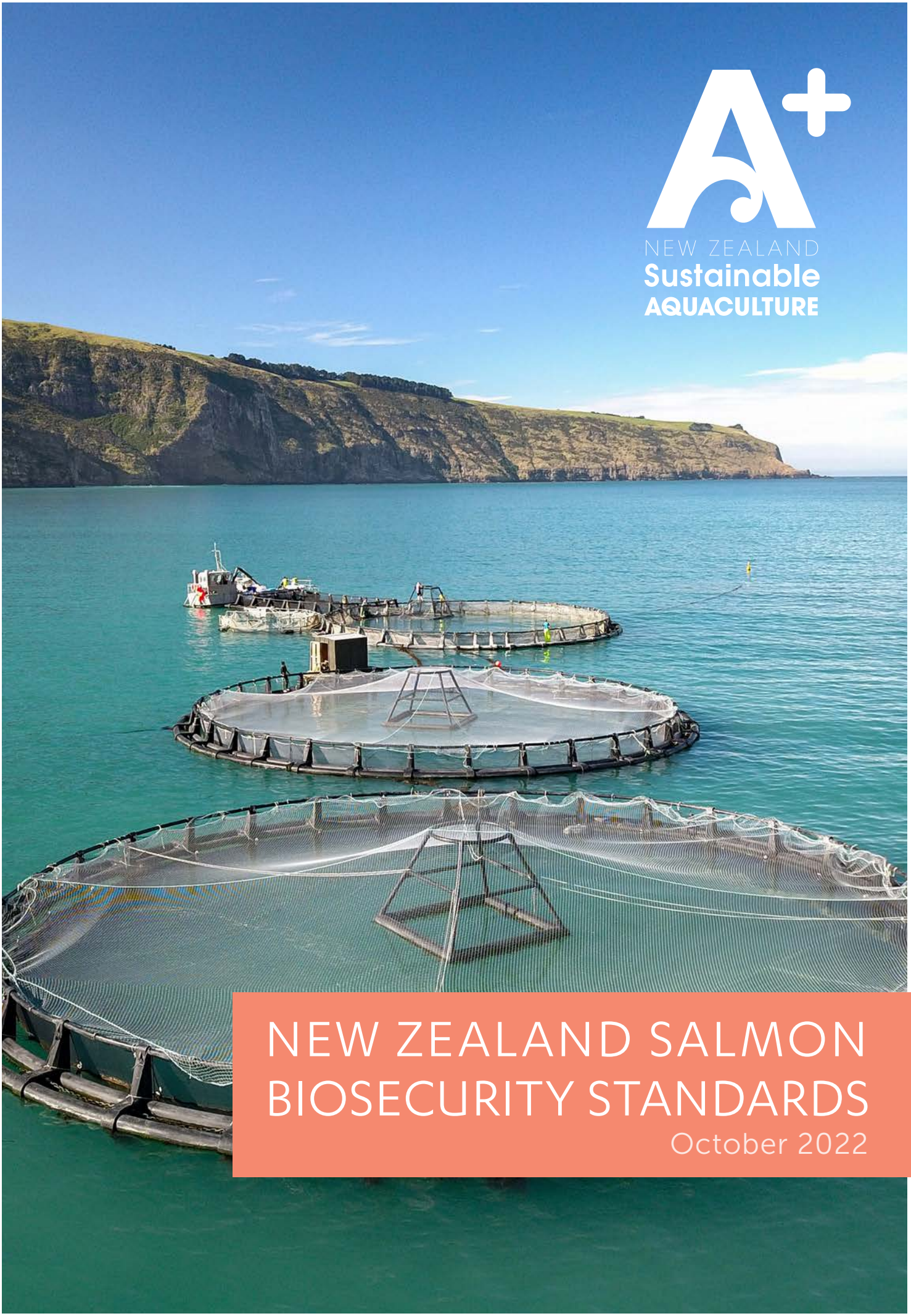


NEW ZEALAND
Sustainable
AQUACULTURE

NEW ZEALAND SALMON BIOSECURITY STANDARDS

October 2022

As members of the New Zealand Salmon Farmers Association we recognise that by managing biosecurity pathways within our control we can help to safeguard the industry and the environment in which we farm. We therefore agree to ensure appropriate measures are put in place to implement these Salmon Biosecurity Standards, as contained in this document, to their full effect.

Signed this 5th day of October 2022 by:

Duncan Bates for Akaroa Salmon

Brian Blanchard for Mount Cook Alpine Salmon

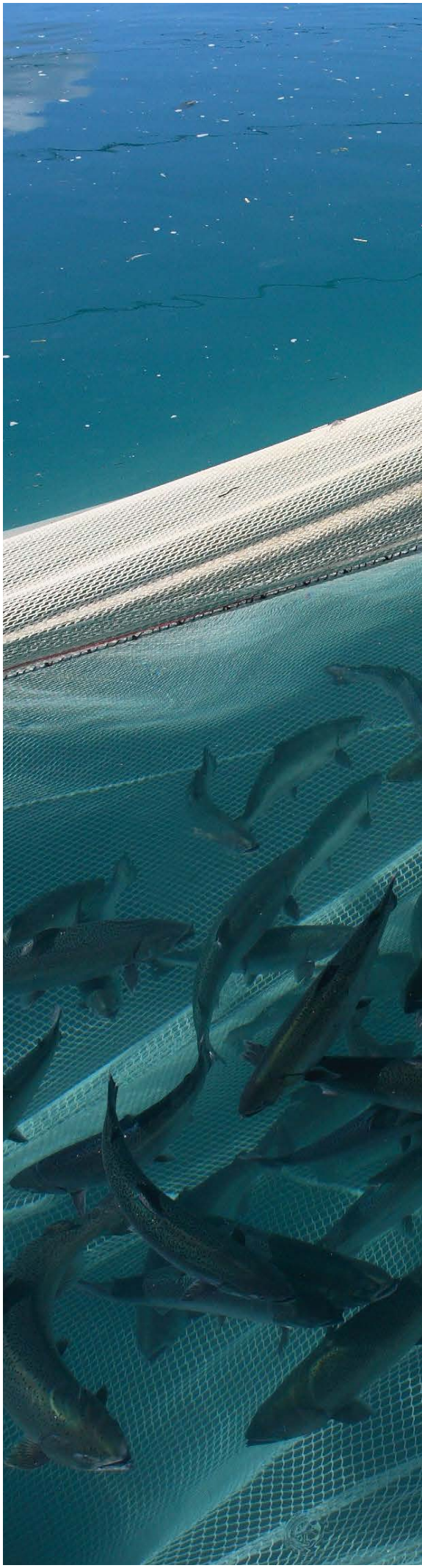
Richard Miller for Sanford Limited

Hylton Lewis for Salmon Smolt New Zealand

Karl French for High Country Salmon

Grant Rosewarne for The New Zealand King Salmon Co.

Mark Preece, Chairperson for the New Zealand Salmon Farmers Association



AQUACULTURE NEW ZEALAND
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Foreword

Biosecurity is a critical part of the New Zealand salmon industry.

Currently the industry benefits from regional separation of production zones, but the anticipated growth in open-ocean salmon farming within the next decade will require implementation of zone-based management to reduce biosecurity risk. In advance of this projected growth, the New Zealand salmon industry has agreed to form Operational Zones. The formation of industry Operational Zones is designed to provide larger scale protection of industry operations by introducing biosecurity controls on national pathways that are within the control of the industry. To coordinate biosecurity risk management and increase information sharing at a finer scale, it is expected that Management Areas will be formed within Operational Zones. Management Areas are likely to be in areas of higher risk, such as where multiple companies are farming within an Operational Zone, or where particular disease risk has been identified (e.g., a Controlled Area Notice is in place).

Objectives

Through the implementation of national biosecurity standards, the New Zealand salmon industry seeks to:

- Manage and reduce pathogen risk to the industry, both from internal and external sources that are within its control.
- Manage national industry risk pathways transparently and consistently, to assure all parties that appropriate measures are being carried out by everyone in industry.
- Provide assurance to regulators that site specific and agreed national standards are in place and maintained to safeguard the industry and the environment in which the industry operates; and
- Through biosecurity leadership, influence the external biosecurity environment to improve the overall aquatic biosecurity status of New Zealand.

Process and document life

- Objectives for the A+ Sustainable Aquaculture Salmon Biosecurity Standards were agreed to by the farming members of the New Zealand Salmon Farmers Association (NZSFA).
- The objectives of this document were then translated into specific biosecurity standards and approved by the Salmon Biosecurity Working Group of the NZSFA in 2019. The standards have been reviewed and updated by the NZSFA working group in 2022.
- The agreed standards are implemented through the development of company specific Biosecurity and Fish Health Management Plans. This includes a requirement for these plans to be operative and regularly reviewed.
- Salmon farmers self-report against these Biosecurity Standards as part of their membership of the A+ Sustainable Management Framework and may be assessed against the standards by an external assessor appointed by Aquaculture New Zealand (AQNZ).
- These standards will be reviewed every two years by the Salmon Biosecurity Working Group and updated as required but may be amended at any time with the agreement of the NZSFA and AQNZ.
- AQNZ maintain the standards as they exist within the A+ programme.

Notifiable Organisms relevant to Salmonid Aquaculture

Notifiable diseases are those compulsorily reportable to the Competent Authority (Ministry for Primary Industries (MPI)) 0800 80 99 66 hotline. They represent internationally significant pathogens with potential for serious production or trade related impacts.

Those farming salmonids in New Zealand must ensure there are measures in place to educate staff on the appearance of, effects of, and reporting mechanisms for the following legislated notifiable diseases:

SCIENTIFIC NAME	COMMON NAME
Aeromonas salmonicida	Furunculosis
Aphanomyces invadans	Epizootic ulcerative syndrome
Epizootic haematopoietic necrosis virus	Epizootic haematopoietic necrosis
Gyrodactylus salaris	Gyrodactylosis
Infectious haematopoietic necrosis virus	Infectious haematopoietic necrosis
Infectious pancreatic necrosis virus (exotic strains)	Infectious pancreatic necrosis
Infectious salmon anaemia virus	Infectious salmon anaemia
Koi herpesvirus	Koi herpes virus disease
Myxobolus cerebralis	Whirling disease
Oncorhynchus masou virus	Oncorhynchus masou virus disease
Piscirickettsia salmonis	Salmonid rickettsial septicaemia
Rickettsia spp. affecting farmed salmon	Rickettsia-like organism affecting farmed salmon
Red sea bream iridovirus	Red sea bream iridovirus disease
Renibacterium salmoninarum	Bacterial kidney disease
Spring viraemia of carp virus	Spring viraemia of carp
Viral haemorrhagic septicaemia virus	Viral haemorrhagic septicaemia
Yersinia ruckeri (exotic strains)	Enteric red mouth disease

(Pathogens highlighted in light blue are not relevant to salmonids)

In addition, some salmonid pathogens may be listed in the unwanted organisms register (searchable at https://www1.maf.govt.nz/uor/searchframe.htm). In the event of a suspected new incursion, all parties should be aware of the need to check organism identifications against the unwanted organism register and report suspected presence of unwanted organisms when detected. Unwanted organisms which are marine pests are also reportable to MPI (See Section D/2/h.)

If there is any doubt as to the status of an identified organism, salmonid farmers can check with Aquaculture New Zealand and/or MPI directly.

There are other reporting requirements in the event of mortalities of unexpected scale or unknown cause. These are detailed in Section D/3/d.

Standards

Biosecurity standards have been set to address biosecurity risk from national to farm levels. This document defines standards related to the following general areas:

- National standards and zoning.
- Operational Zone standards
- Management Areas;
- Facility standards;
- Broodstock & breeding standards;
- Smolt movement standards;
- Harvest standards;
- Waste management standards;
- Communications requirements;
- Response standards – including trigger levels for biosecurity investigation and communication; and
- Decontamination standards.

A. National Zoning

Salmonids are grown in both freshwaterand seawater areas of New Zealand. The NZ Salmon aquaculture industry has seawater pens in the Marlborough Sounds, Akaroa Harbour, and Stewart Island. Freshwater grow-out farms are in the hydroelectric canals of the Mackenzie Basin. Freshwater broodstock farms and hatcheries are scattered across New Zealand and include Golden Bay, Canterbury, and Otago.

The industry recognises the importance of separation between farming areas and between types of operation as much as is practical to reduce biosecurity risk.

Industry zone-based management will, therefore, be actioned at a national scale to reduce biosecurity risk.

Industry Operational Zones have been formed (Figure 1). These Operational Zones are separated geographically and consider the hydrodynamics of the water bodies they encompass, and the essential aspects of farming operations. Each Operational Zone will designate at least one Biosecurity Coordinator. The Biosecurity Coordinator will be the first point of industry contact within each Operational Zone. It is anticipated that Biosecurity Coordinators will be included in the Biosecurity Standards Working Group.

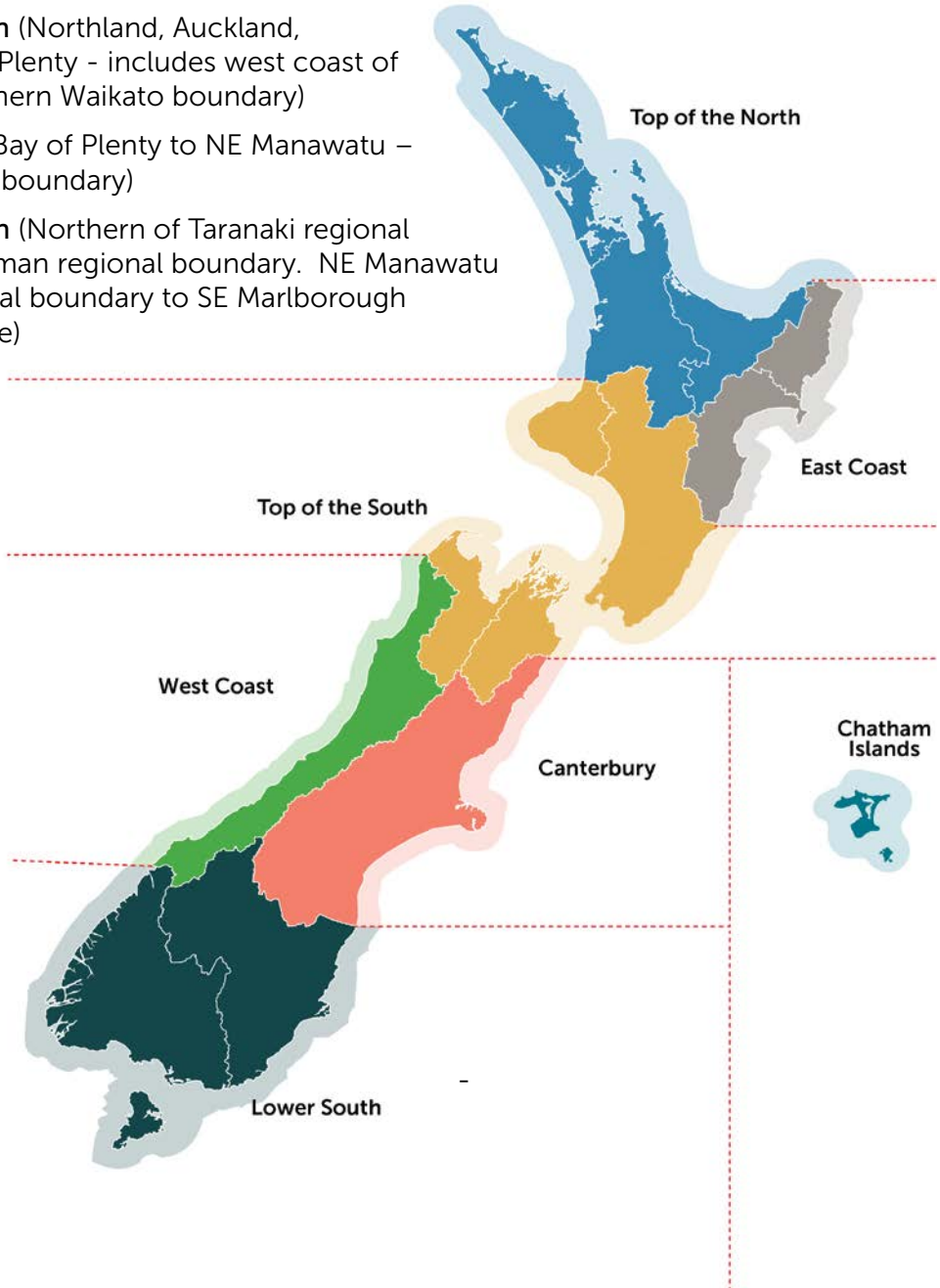
Freshwater and research facilities (broodstock sites, hatchery sites, and nursery sites) are included in their adjacent Operational Zone, due to the link with the water body (unless discharged water is sufficiently treated to remove risk of pathogen and disease, in which case they will be considered separate facilities).

Where appropriate, Management Areas may be formed within Operational Zones. Management Areas can be formed based on the following criteria:

1. Regional and national statutory biosecurity requirements (e.g., Regional Pest Management Plans, Controlled Area Notices which may include policies and rules related to the management and control of marine biosecurity risks).
2. Agreement between companies (e.g., a Management Area Agreement), where multiple growers farm in a shared waterbody and / or share facilities.
3. Individual company or research facilities (e.g., hatchery or farm).

Operational Zones (Figure 1)

1. **The Top of the North** (Northland, Auckland, Waikato, and Bay of Plenty - includes west coast of North Island to southern Waikato boundary)
2. **East Coast** (Eastern Bay of Plenty to NE Manawatu – Whanganui regional boundary)
3. **The Top of the South** (Northern of Taranaki regional boundary to SW Tasman regional boundary. NE Manawatu – Whanganui regional boundary to SE Marlborough boundary at Clarence)
4. **West Coast** (includes the West Coast of the South Island SW Tasman to NW Southland regional boundary)
5. **Canterbury** (SE Marlborough boundary at Clarence to NE Otago regional boundary)
6. **Chatham Islands**
7. **Lower South** (NE Otago Regional boundary to NW Southland boundary includes Stewart Island Big Glory Bay)



There are specific biosecurity requirements for moving between the Operational Zones, which vary depending on the risk of each item, but which cover animals, equipment, feed, water, people, and personal protective equipment (PPE). These requirements are specified in the following sections.

The industry also recognises that there are other growers of salmonids in New Zealand whose operations may benefit from, be at risk from, or pose risk to other salmonid operations. The salmon farming industry encourages other organisations growing salmonids to adopt similar standards and develop and implement Biosecurity and Fish Health Management Plans, and are happy to assist in the process.

B. National Standards

The following overall national standards apply to all salmonid farming operations in New Zealand:

1. All parties will participate in any fish health or fish biosecurity programmes as required by the MPI and/or relevant territorial authorities, understanding that such measures are regulatory requirements. There may be consent conditions, urgent response or readiness measures, or initiatives developed in partnership with the industry through the Government Industry Agreement on Biosecurity.
2. Any treatments administered to fish must be:
   a. exempt from regulatory controls, OR
   b. strictly applied according to label conditions where such products are licensed for direct use by animal owners, OR
   c. authorised by a veterinarian, OR
   d. administered under a suitable Approved Operating Plan (AOP) approved under the Agricultural Compounds and Veterinary Medicines Act 1997 (ACVM Act), AND
   e. at all times where necessary, must be in accordance with the requirements of the New Zealand Veterinary Council and all regulatory instruments managing therapeutant use and residue management (e.g., ACVM Act, Food Notice: Maximum Residue Levels for Agricultural Compounds 2017, Animal Products Notice: Contaminant Specifications 2016, or such regulatory instruments as amending or replacing those).
3. All parties must comply with any 'directions' and movement restrictions put in place by the Ministry for Primary Industries under the Biosecurity Act 1993.
4. All plans developed to ensure compliance with these Biosecurity Standards must be readily available to relevant staff within each company and to the regulator upon request.
5. Fish must only be fed commercially manufactured pelleted feed manufactured by a recognised and appropriately licensed fish feed company, and where imported, meeting the requirements of the Import Health Standard (IHS) for fish feed [fisfooic. all; found at https://mpi.govt. nz/ document-vault/1778].

C. Operational Zone Standards

Operational Zone standards specify controls around movements and biosecurity requirements for movement between Operational Zones. Specific requirements are:

1. No movement of fish is permitted between Operational Zones except where routinely necessary for production reasons and approved by the company fish health expert).
2. Movement of smolt from freshwater facilities between Operational Zones (seawater and freshwater) may occur at any time as long as smolt movement requirements have been met (see **"Smolt Movement Standards"**).
3. Movement of harvest fish from Operational Zones to processing facilities may occur at any time as long as harvest standards have been met (see **"Harvest Standards"**).
4. Processing facilities will comply with relevant components of the "Harvest Standards", "Waste Management Standards", and "Facility Standards" to manage risks associated with movements of personnel, equipment, and vehicles between Operational Zones for processing.
5. Eggs may be moved between freshwater zones provided **"Broodstock and Breeding Standards"** are met.
6. Broodstock may be moved between Operational Zones provided "Broodstock and Breeding Standards" are met.
7. Nets used in Operational Zones should not be used in other Operational Zones. On farms, use new nets and ropes in preference, but if deemed necessary, use of used nets must comply with the "Decontamination Standards".
8. Absorbent and/or permeable items (e.g., wet suits used by divers, or waders by freshwater staff) should not move between Operational Zones unless they comply with the "Decontamination Standards".
9. Non-absorbent and non-permeable equipment can be moved between Operational Zones provided decontamination procedures have been followed as per Risk Specific Measures [6]b and [6]c below (see also **"Decontamination Standards"**). The equipment should be labelled to indicate that decontamination has been completed.
10. Other equipment and vessels should not routinely move between Operational Zones. Movements of well-boats between Operational Zones should comply with the 'special provisions' in the "Decontamination Standards". Additional risk specific measures for equipment and vessels moving between Operational Zones are detailed in Section E [6]. Any equipment moved between Operational Zones and stored on land should be separated and clearly labelled.
11. Where movements are necessary that do not meet the above standards, a risk assessment must be carried out by a suitably qualified fish health expert. Where this occurs, the circumstances and risk management measures taken should be made available to the Standards owner (Salmon Biosecurity Working Group) and be considered at the next review of the Biosecurity Standards.

D. Management Areas

Management areas are smaller discrete areas within each Operational Zone. Management of biosecurity risks arising from movements between Management Areas are managed by compliance with Facility Standards (next section).

Where more than one farming company operates within the same Management Area (and they are epidemiologically linked), a Management Area Agreement should be considered.

A Management Area Agreement could include:

- An agreement between the operating companies on how they will:
  - » Share common space.
  - » Work together to reduce biosecurity risk and maximise fish health.
  - » Communicate with each other and external parties.

Management Areas may also be guided by regional and national statutory biosecurity requirements (e.g., Regional Pest Management Plans, Controlled Area Notices under the Biosecurity Act 1993), which may include policies and rules related to the management and control of marine biosecurity risks associated with all aquaculture activities (e.g., vessel and equipment movements).

In reviewing these standards, the following Management Areas have been recommended:

- **Seawater Management Areas**
  - Pelorus
  - Queen Charlotte / Tory Channel
  - Tasman Bay
  - Akaroa Harbour
  - Foveaux Strait / Stewart Island
  - Big Glory Bay
  - Otago
- **Freshwater Management Areas**
  - Mackenzie Basin
  - Takaka broodstock site
  - Waiau hatchery
  - McLeans Island hatchery, Christchurch
  - Silverstream & Winchmore hatcheries
  - Tentburn hatchery
  - Waitaki hatchery
  - Kaitangata hatchery
- **Research Management Areas**
  - Cawthron Aquaculture Park (Nelson)
  - NMIT (Nelson Campus)
  - Plant and Food Research (Nelson)
  - Skretting Aquaculture Research Centre (Okiwi Bay)
  - NIWA Northland Marine Research Centre (Ruakaka)
- **Primary Processing Management Areas**
  - Nelson
  - Christchurch
  - 2 x Twizel
  - Timaru
  - Bluff

E. Facility Standards

Facility standards apply to discrete salmon rearing facilities including broodstock, hatchery and grow-out farms, and shared common resources such as ports and processing facilities. Companies may have standard policies and procedures at all facilities or may customise by facility where minimum requirements are met on all facilities.

Every facility must a Biosecurity Management Plan that outlines how it will meet specified minimum standards in the following areas:

1. Training and induction of staff in biosecurity and fish health
2. Monitoring fish health and pathogen status
3. Investigation and response to biosecurity challenges
4. Communicating biosecurity issues
5. Contingency plans
6. Risk specific biosecurity measures
7. Stock record requirements for traceability of stock.

Specific minimum standards to be met in these areas are as follows:

1. Training and induction of all staff in biosecurity and fish health

a. Appropriate staff should be identified and have technical responsibility and accountability for biosecurity and fish health at the facility. These individuals should be known to all staff and receive specialised training over and above that required for all staff (e.g., disease sampling for histopathology, bacteriology, molecular and virology testing, etc.), including how to carry out basic necropsy, classify mortality, and sampling for disease investigation.

b. All staff should understand the theory of biosecurity, risk pathways and mitigation measures possible and the specific procedures (e.g., SOPs) in place at the facility to ensure maintenance of biosecurity standards, including:

   i. Normal healthy stock – their appearance and behaviour.

   ii. Unhealthy stock – clinical signs of abnormal health and abnormal behaviours.

   iii. Importance of regular mortality removal and inspection.

   iv. The appearance of unwanted aquatic pests, how to sample unknown pest organisms, who to contact, and where to send samples.

   v. The importance of surveillance for aquatic pests and fish diseases to the industry, the environment, and for market access.

   vi. Environmental parameters to measure and record (DO, water temperature, phytoplankton), why they are important, and what to do when they deviate from accepted ranges.

   vii. Stock records to maintain for traceability purposes in the event of a biosecurity event.

   viii. The main identified risks to salmon farming in New Zealand (in terms of pathogens) and their potential impact on the industry and the environment.

   ix. How biosecurity is regulated in New Zealand and the role of the Government Industry Agreement on Biosecurity of which AQNZ is a signatory.

2. Monitoring fish health and biosecurity status

a. Fish are inspected at least daily, weather permitting, for abnormal behaviour, clinical signs of disease, moribund fish and mortalities.

b. Where possible, moribund fish are removed from pens and are assessed for clinical signs of disease. Samples should be taken for diagnostic purposes when appropriate.

c. Mortalities are removed from the pens frequently enough to permit examination of a proportion for putative cause of mortality (i.e., mortalities should not remain in the pens to the point where they decompose). Numbers and causes of mortalities should be recorded.

d. For the purposes of assessing fish health, records of the following will be useful. Records should include, but should not be limited to:

   i. Daily water quality assessments before feeding. Ideally, point water temperatures and dissolved oxygen levels will be measured and recorded in at least one pen or raceway (but more samples may be necessary where a farm has known variation in temperature or oxygen distribution across pens, tanks, or raceways).

   ii. On sea farms, a daily visual check of water colour, particularly during warmer water temperatures. A weekly water sample assessed for ichthyotoxic phytoplankton, with records of appropriate actions taken in response to findings.

   iii. Records of feed type feed intake, fish behaviour, and farm management interactions with each pen, tank, or raceway (e.g., net washing, grading, pumping, etc).

e. A diagnostic testing programme for pre-emptive surveillance should be developed in association with the facility veterinarian and in accordance with the minimum requirements that follow. The minimum requirements shall be:

   A. For members of the Australian Export Surveillance Scheme:

      1. Kidney samples for aerobic bacterial culture (annually from each year class).

      2. Kidney and spleen samples for cell culture virology (annually from each year class).

   B. For non-members: as determined by the facility veterinarian.

f. All staff should monitor farm structures during routine management and maintenance activities for the presence of unwanted aquatic pests. New pest identifications must be reported to MPI. Where practicable, known unwanted aquatic pests should be removed from a facility in such a way that the pests are killed, to prevent proliferation. If collected, unwanted pests should be disposed of securely on land.

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3. Investigation and response to biosecurity challenges

a. Each facility should develop and maintain a record of normal mortality levels and background health status.

b. In the event of elevation of mortality above normal levels, the farm should be reviewed by personnel with responsibility for biosecurity and fish health to determine if there is a clear reason for the elevated mortality, and the causes addressed. This may include referral to the farm veterinarian and diagnostic sampling under their direction.

c. A *'potential biosecurity event'* is considered to have occurred where:

   i. mortality rates exceed 0.1% per day in a consistently increasing trend over 4 days, and/or 0.5% per week, and a cause is not immediately apparent, or

   ii. a new clinical presentation is noted.

d. In the case of a potential biosecurity event, the facility must make strenuous efforts to identify the cause, utilising the facility veterinarian and other external expertise as required.

Diagnostic testing is expected to cover at least histopathology, bacteriology, and virology (plus any other organism under targeted surveillance by the industry e.g., NZRLO, SOMV). Communication should be carried out as specified in [4]b below.

e. All parties must remain cognisant of their obligations under the Biosecurity Act 1993 to report syndromes of unknown cause or which may be new to New Zealand, presence, or suspicion of notifiable organisms; unwanted organisms, or potentially new to New Zealand organisms. Such notification should be made to the **MPI hotline 0800 80 99 66**

f. **Where a response to a *potential biosecurity event* is mounted, it is expected that affected farmers will be part of any Technical Advisory Group.**

4. Communicating biosecurity issues

a. Broad level communications will be carried out through annual A+ reporting. Annually, each farming member shall provide a brief review of fish health to AQNZ. AQNZ will hold such information confidentially and will collate and circulate a summary to growers to facilitate identification of emerging issues.

b. Early communication will be carried out within the following timeframes when a ***potential biosecurity event*** has occurred:

i. In order to minimise damages, the fish health professional of other salmonid farming parties with epidemiological links will be notified of a potential biosecurity event as soon as practicable.

ii. Across industry within one week.

iii. To non-signatories involved in salmonids, only in the event of a notifiable or unwanted organism.

5. Contingency plans

a. Each company must draw up a contingency plan that clearly shows the communication requirements within the farming company and the path to escalate in the event of an emergency for immediate priority action.

b. Facilities must draw up plans to be able to cull, emergency harvest, or remove large numbers of mortalities or fish from sites to processing facilities, or landfill in a biosecure manner. This should include identification of suitable vessels, equipment, waterproof containers, vehicles, routes, and disposal points. For example, approval for mort pits should be sought before an emergency arises.

c. Voluntary movement restrictions – in the event of a ***potential biosecurity event***, from its initiation to its resolution, no stock or equipment movements will occur from the affected Operational Zone to other Operational Zones, excepting stock which may be harvested and moved to a processing facility. Within an Operational Zone, no stock will be moved from the affected facility except for harvest. Equipment may only be moved after suitable decontamination measures have been taken (See **"Decontamination standards"**). Once the cause is known, and if appropriate risk mitigation measures known to be effective can be put in place, then stock movements may re-commence before the event is fully resolved.

6. Risk specific biosecurity measures:

a. PERSONNEL & PPE (INCLUDING DIVE TEAMS)

Appropriate entry/exit decontamination procedures must be in place for all people and associated gear entering a facility.

i. Staff

- Upon arrival at a facility, staff must disclose if they have attended another aquaculture facility in the previous 72 hours and undertake any additional disinfection procedures advised by company site managers.
- **Upon entering a facility, all staff must undertake appropriate disinfection procedures (e.g., disinfectant foot baths) and wear only approved PPE.**
- **Onshore personnel (those staff that are based onshore but visit multiple facilities) must receive safety and biosecurity inductions and specialised training.**
- Prior to leaving a facility, all staff must undertake normal disinfection procedures including disinfection of PPE.
- Personal clothing soiled with fish material (e.g., scales, blood, faeces, viscera) or feed must not be transferred to another facility unless it is disinfected or laundered.

ii. Visitors (including contractors)

- Appropriate signage should direct visitors to the correct reception point and to disinfect vehicles and footwear as required.
- Visitors must be asked if they have visited any other aquaculture sites in the previous 72 hours. If they have, the site manager must assess the risk and determine appropriate control measures. These may include denial of entry or changing of clothing to site issued coveralls.
- Visitors must sign-in to a logbook when entering any facility for traceability.
- Visitors must receive safety and biosecurity inductions, and where appropriate wash hands and arms with detergent, and should use only PPE approved by the company being visited.
- All visitors must be escorted and supervised by company representatives.
- Contractors must be supervised by company personnel.
- Prior to departure visitors must follow an appropriate decontamination process, which could include a foot bath, and washing of hands and arms with detergent.

iii. Dive teams and gear

- Dive gear may be transferred between facilities of equivalent health status or from higher to lower health status, but it must be cleaned, soaked in freshwater, and ideally disinfected before being moved.
- Additional risk mitigation measures must be implemented for dive gear movements with elevated risk (e.g., contract dive teams moving between Operational Zones, or coming from a facility with a lower health status). These movements must comply with the 'Decontamination Standards'.
- Dive teams should use mort bags for recovery and transfer of mortalities to secure bins on the boat deck or pen

structures ready for secure storage or removal from the farm. Where practical, dive teams should remove mortalities from younger year class stocks before moving to older year class stocks. Mort bags should be disinfected after each use.

- In the case of a *potential biosecurity event*, dive gear must not be moved between facilities until the issue is resolved.

Additional control measures for dive teams should include:

- The dive boat deck will be cleaned with detergent and disinfected prior to moving to a different farm that is not epidemiologically linked.
- Boat decks and equipment will be thoroughly cleaned with detergent and disinfectant at the end of each workday.
- All dive equipment will be thoroughly cleaned, disinfected, and dried at the end of each workday.
- Mort bags will be thoroughly cleaned and disinfected at the end of each workday

Recommended cleaning and disinfection process for dive gear

2. Obvious organic material should be removed by rinsing divers, equipment, and decks throughout diving operations. Deck hoses and pressure sprayers may be used for this purpose.
3. At the end of diving, all equipment should be thoroughly washed in fresh water to remove salt water.
4. All equipment should be washed in a cleaning solution to remove remaining traces of organic matter. If on-site showers are available, thoroughly rinsing wetsuits while showering is acceptable practice and has the advantage of using warm water to clean the suit. Divers must ensure that all areas of the suit are cleaned, including the internal surface. Other equipment is best washed in large plastic bins. At this stage, any non-alkaline detergent is satisfactory, provided that it is safe for staff and equipment and appropriate for the cleaning task.
5. All equipment should be dipped in a bath of disinfectant solution for the prescribed time. Suggested disinfectants include:
   - povidone-iodine solutions at 100 mg/L available iodine for 10 minutes (avoid acidified iodophors);
   - chloramine-T solution at 2% by weight for 10 minutes; or
   - monosulfate solutions (Virkon-S®) at 0.5% by weight for 10 minutes.
   - Alternatively, gear may be heat treated using hot water maintained at more than 55°C for at least 5 minutes.
6. Equipment should then be plunged in fresh water and dried in a well-ventilated area.

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b. VEHICLES AND VESSELS

The movement of vehicles, vessels and their associated equipment between facilities requires risk assessment and, where appropriate, disinfection treatments as a precautionary measure to prevent the spread of infectious disease agents.

Details of approved decontamination treatments are presented in **"Decontamination standards"** for reference.

i. Vehicles

Vehicles used to move smolt from hatcheries to marine facilities or transfer harvest fish to processing facilities are subject to the requirements of the relevant sections below - refer to **"Smolt movement standards"** and **"Harvest standards"**. The following control measures should be required for third-party vehicles (e.g., delivery trucks, contractor vehicles, feed delivery trucks, veterinary vehicles):

- Third-party deliveries which only access the visitor parking or delivery area without entering production

areas will undertake disinfection if required by the company site manager.

- If required by the site manager, all surfaces of transport vehicles will be decontaminated. Refer to **"Decontamination standards"** for details of suitable decontamination methods.

ii. **Vessels**

Within an Operational Zone, the following control measures should be required for company and contractor vessels:

- The decks and equipment of work vessels should be hosed off and sprayed with disinfectant weekly. The disinfectant should be left to dry.
- Refer to **"Decontamination standards"** for details of suitable decontamination methods and special requirements for well-boats.

The following control measures should be required for vessels (including contractor and third-party vessels), which are to be moved between Operational Zones (unless both facilities are entirely operated by one company in which case the company fish health personnel have discretion on these requirement):

- Vessels should be cleaned with detergent and then disinfected on the deck surface and down to the water line.
- Mooring lines on vessels contaminated with organic material should be replaced or pressure washed and soaked in disinfectant.
- Non-essential equipment should not be transferred between zones.
- Bilge water should be disposed of before leaving one Operational Zone and entering another.
- Ballast water should be exchanged between Operational Zones.
- Other companies operating in the respective Operational Zone should be notified of vessel movement between Operational Zones.
- Details of required decontamination actions for contractor and third-party vessels should be recorded.
- Refer to **"Decontamination standards"** for special decontamination requirements for well-boats.

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c. FISH HANDLING EQUIPMENT

i. **Pens and nets**

Pens and nets should be cleaned and disinfection prior to movement to another facility in the same Operational Zone.

Pens and nets brought to onshore maintenance and treatment yards must be segregated from new or previously disinfected pens, nets, and other production equipment; particularly if they originate from other companies.

Any non-absorbent material salvaged from pens which is removed from the site or imported from elsewhere must be cleaned and disinfected prior to transport between Operational Zones.

Refer to **"Decontamination standards"** for details.

ii. **Ancillary equipment**

Any equipment used in operations (e.g., grading equipment, harvest bins and barges) must be cleaned and disinfected prior to transfer to another Operational Zone.

Refer to **"Decontamination standards"** for details.

d. MORTALITY DISPOSAL

i. **Under normal operations**

When possible, moribund, or injured fish should be caught and removed from pens and humanely euthanised[1]. No live fish should be left in air.

Under no circumstances should fish be bled directly into fresh or marine waters.

During normal operations, mortalities should be transported to an approved rendering or disposal location.

During normal operations, mortalities must not be disposed of into the aquatic environment, or used for any other purpose (e.g., bait) unless appropriately handled and treated using a method proven to inactivate pathogens.

Mortalities must be contained in secure bins with sealed covers for transport to reprocessing or disposal facilities.

Additional biosecurity control measures for mortality disposal should include:

- No discharges will be permitted from mort bins to the road.
- All mort bins will be sealed to prevent discharge and to prevent scavenging by wildlife.
- All personnel undertaking mort removal activities will wear appropriate PPE and use dedicated equipment which is decontaminated after use.
- Trucks used to transport mort bins will be disinfected after delivery and before returning to any farm site.
- Once emptied, mort bins will be detergent washed then disinfected - refer to **"Decontamination standards"** before being returned to any farm site.

ii. **Mortality disposal under exceptional circumstances**

Refer Section 5(b) - Contingency plans.

NB: Some regional plans allow for disposal of fish at sea under exceptional circumstances.

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7. Stock record requirements for traceability of stock.

a. ALL FACILITIES MUST KEEP, AS A MINIMUM, RECORDS OF:

i. stock entry to site

ii. stock movement on site by pen, tank, pond or raceway

iii. stock departure from site, including destination

iv. mortality rates and classification by culture unit (pen, tank, pond or raceway)

1 see A+ New Zealand Farmed Salmon Welfare Standards 2021 https://www.aquaculture.org.nz/resources/general

F. Broodstock & Breeding Standards

Measures to achieve the following must be applied:

1. Facilities must operate a risk management programme to reduce potential for vertical and horizontal transmission of pathogens from parent to offspring generations:
   i. Egg disinfection should be carried out during the water-hardening step.
   ii. No equipment should be moved from broodstock sites to hatcheries.
   iii. Containers of eggs should be disinfected externally before leaving the broodstock site.
   iv. Broodstock onsite should be monitored routinely for health. Broodstock mortalities should be sampled for health screening as agreed with the facility veterinarian. Post-spawn broodstock should also be randomly sampled for health screening to build up and maintain health status for the broodstock site, with knowledge of any enzootic pathogens.
2. Movement of broodstock gametes, or ova is permitted, providing the following guidelines are followed:
   a. Only healthy broodstock, gametes, and ova are to be moved. Broodstock must be segregated as far as possible from other populations of farmed fish (i.e., held separately from the rest of the production population) and actively monitored for disease for four weeks prior to transfer. If evidence of disease is noted in broodstock, gametes, or ova, this must be investigated using diagnostic sampling and no transfer activities carried out until the cause of disease is determined and resolved.
   b. Broodstock exhibiting evidence of disease must not be transferred to a hatchery or used for ova or gamete production.
   c. Stress to broodstock must be minimised to decrease susceptibility to disease.
   d. All personnel undertaking broodstock transfer activities, or production of ova or gametes must wear broodstock specific PPE.
3. Trucks are to be disinfected prior to loading broodstock. Gametes and ova must be transported in clean containers with the external surface disinfected after leaving site and before entry to a freshwater facility.Water from one facility should not be allowed to enter the waterways of another facility during broodstock transfer.

G. Smolt Movement Standards

1. Smolt production facilities must have a programme monitoring the health of the eggs, fry, fingerlings, parr, and smolt on the facility. This should encompass:
   a. Daily health observation and recording
   b. Surveillance of the overall health status of the site as per Section [D]2(g)
   c. Investigation is carried out under direction of an appropriate veterinarian in cases of unusual clinical signs, elevated mortality, or poor performance, etc.
   d. At this stage, there are no specific requirements for routine vaccination.

   In addition:
   e. No smolt movement should occur unless fish are visibly clinically healthy at time of transfer.

H. Harvest Standards

1. Where harvest is carried out on site, all bloodwater must be contained and dispatched to the relevant processing facility along with the harvest fish, and/or disposed of into authorised collection points. Bloodwater must not be disposed of at the farm site.
2. To control the potential introduction and spread of disease agents through harvested fish and equipment at land-based facilities (e.g., processing, research), the following control measures should be put in place:
    a. Surveillance will be undertaken at processing facilities to monitor harvested fish for quality and signs of disease. Quality data includes observation of lesions and general reporting of abnormal condition in harvested fish.
    b. All harvest bins will securely contain fluids to ensure no spillage. If necessary, bin liners will be used.
    c. Harvest bins will be decanted on-site into a bunded area to collect blood water in wastewater treatment systems.
    d. Smolt hauling vehicles must be decontaminated between deliveries. Decontamination is to be carried out to the **"Decontamination standards" and the special requirements for smolt transport vehicles in that section**.
    e. Records of decontamination are to accompany the smolt hauling vehicles.
    f. Stress on smolt during movement should be minimised.
    g. Smolt should be grouped on the receiving farm by year class to simplify separation of year class activities, with the aspirational goal of single year-class grow-out farms, if farming space permits.
    h. Harvest bins will be washed with detergent or disinfected with an approved disinfectant - refer to **"Decontamination standards"**. If necessary, bin liners will be inserted into disinfected bins.
    i. Harvest bins arriving from different facilities will be colour-coded or otherwise marked for identification and segregated in separate washdown and disinfection areas.
    j. All personnel entering or leaving the bunded unloading and washdown area will use a disinfectant footbath.
3. For transport vehicles that deliver harvest bins or fish in tanks from marine farms, the following control measures should apply:
    a. It is recommended that all trucks are disinfected at a designated location or enter the processing facility through a mat disinfection station.
    b. Tankers will have 'clean-in-place' (CIP) systems that will be activated after the tank is emptied of product. The purpose of CIP systems is to clean the internal surfaces of the tanker.
    c. Tankers will enter a wash station to clean the wheels and external truck surfaces.
    d. Drivers will use a disinfectant foot bath and wash hands with detergent at the point of arrival. Drivers will again use a disinfectant foot bath prior to re-entering their vehicle to leave the site.
    e. Details of required decontamination actions will be recorded
4. At all facilities, pest control should be managed through additional barriers. The design and implementation of these barriers will be developed by each company, but should include:
    a. Rodent bait stations around the transfer point from trucks to the facilities and within the facilities to prevent the spread of infectious agents.
    b. Preventive measures to keep birds away from fish and wastewater during bin decanting operations.
    c. Securing of lids on harvest bins if personnel are not present so that wildlife cannot gain access to fish.

I. Waste Management Standards

Waste management standards apply mainly at processing facilities but should be applied to other land-based facilities where appropriate.

1. Wastewater should not be discharged to the marine environment without a resource consent and should include treatment to inactivate pathogens harmful to farmed fish. This is either by an inactivation process (e.g., UV, chlorine etc.) or by discharge to the municipal wastewater treatment system.

The following control measures (a-d) must be applied for wastewater management in processing facilities:

a. All bin tipping, bin washing, and truck washing will be undertaken in a bunded area where water is collected in a wastewater treatment system.

b. Bunded areas will be washed down with detergent using a high-pressure hose after all bins have been off-loaded from trucks.

c. Bunded areas and the corresponding wastewater holding tank will have sufficient storage capacity to ensure there is no overflow during storm events.

d. All other wastewater from processing facilities will be directed to the wastewater treatment system, or will be directed to a municipal wastewater treatment plant under a 'trade waste agreement' and in accordance with government requirements.

2. Solid organic waste from processing facilities should be diverted to an approved landfill, rendering, composting or biodigestion site. This waste must not be placed into the aquatic environment (freshwater, or coastal marine environments) unless treated in a manner that will inactivate any potential pathogens.

3. Organic waste should not be directed to bait or burley manufacture unless the requirement to inactivate any pathogens can be achieved.

4. Risks from inorganic waste should be assessed and managed according to the risk profile.

J. Decontamination Standards

This section specifies minimum decontamination standards required.

Decontamination is used as the preferred term, rather than disinfection, as proper and effective decontamination is a combination of cleaning and disinfection.

These decontamination standards apply to all farm sites, equipment, harvest equipment and smolt hauling vehicles.

PRODUCT NAME (ACTIVE INGREDIENT)	USE	DOSAGE	APPLICATION METHOD
Virkon (potassium monopersulfate and sodium chloride)	Disinfection of pre-cleaned surfaces (e.g. culture tanks, walls, floors, tables)	1:100 (freshwater only)	Wipe or spray at 300mL/m^2
	Disinfection of equipment (e.g. hand-held meters, refractometer, secchi disk, algae nets, aeration systems, weigh scales)	1:100 (freshwater only)	Wipe or spray at 300mL/m^2; or immerse in solution for 10 min, rinse clean with fresh water and air dry
	Foot baths and vehicle tyre baths	1:100 (freshwater only)	Fill baths with solution and replenish every 4 days or when moderately fouled
	General disinfection of farm equipment (eg boats, feed hoppers, feeding equipment)	1:200 (freshwater only)	Spray 300mL/m^2 and air dry
Quaternary ammonium compounds – can be used where freshwater is not available but lack efficacy for some pathogens	Disinfection of equipment	2 ppm (fresh or saltwater)	Immerse in solution for 15 min, rinse clean with fresh or saltwater and air dry.
	Foot baths and vehicle tyre baths	10 ppm (fresh or saltwater)	Fill baths with solution and replenish every 4 days or when moderately fouled

If neither Virkon nor quaternary ammonium compounds are available, or facilities wish to use other compounds (e.g. hypochlorite), then the table in Annex 1 should be followed.

Special requirements for smolt hauling vehicles:

1. All water should be drained from transport tanks. Any fish, faecal matter, or other soil should be cleaned from tanks by flushing with clean water. All pipes and associated pumps should also be inspected and flushed to ensure that carcasses or organic material trapped within are removed.
2. Equipment such as gas diffusers, electrical monitoring equipment, and other delicate or porous items should be removed for individual cleaning, disinfection, or replacement.
3. The complete exterior of the truck and/or transport containers should be thoroughly washed, beginning at the top and working down to the wheels. The underneath of the truck and tanks should also be washed.
4. The interior of transport containers should be washed preferably using high pressure water systems and mechanical scrubbing. Cleaning should start from the top of the internal surface and move downward.
5. Surfaces should be thoroughly rinsed if detergents have been used. All surfaces should then be allowed to drain.
6. Internal surfaces of tanks should be disinfected using wet heat (on suitable surfaces) or chemical disinfectants. Suitable chemical disinfectants include hypochlorite solutions, chlorine dioxide solutions, chloramine-T or iodophors as per the requirements in the table above.

Special requirements for well-boats[1]:

The use of well-boats in farming operations presents a transmission risk where pathogens are present. The greatest risks arise not from the vessels themselves, but from the live fish they carry and from any pathogens which may be present in these fish. Thus, if a pathogen is present, the 'Probability of Establishment' and risk of spread will increase significantly where there is any contact between:

- fish that have been brought to a farm and those that are already there; or
- fish at a farm and potentially contaminated sea water; or
- equipment on the boat, or pipes linking the boat to the farm, which have been used to handle one batch of fish and are not properly cleaned and disinfected before being used to handle another batch of fish.

Cleaning and disinfection procedure for well-boats and well-boat equipment are a critical control points in risk management. Guidelines on a three-stage cleaning and disinfection regime for well-boats are provided in Table 1. They are based on a regime focused on the degree of risk that may be encountered under different circumstances. To be fully effective they must be robustly established and must take account of the potential points on each vessel that may harbour contamination. These may vary in detail between vessels and therefore, each vessel requires a robust and 'customised' cleaning and disinfection plan that must be strictly adhered to. Where contractor well-boats are used, farmers should seek written assurance from well-boat operators that they have an up-to-date cleaning and disinfection plan that is being followed routinely.

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1 This section has been modified from the Scottish Finfish Aquaculture – Code of Practice, Annex 5 "Minimising Risks In Wellboat Operations" https://www.salmonscotland.co.uk/

Table 1. Three-stage cleaning and disinfection regime for well-boat operations

OPERATION	STAGE 1	STAGE 2	STAGE 3
Arriving in NZ waters	X	X	X
Leaving a site suspected or confirmed infected with a notifiable disease	X	X	X
Leaving a Controlled Area1 for a new Operational Zone of greater health status	X	X	X
Operating between sites of equal status within a single Management Area	X		
Operating on shuttle runs between sites of equal status	X		
Leaving operations in one Management Area to start in a different Management Area within the same Operational Zone	X	X	
Before and after operating at a broodstock site	X	X	
Routine anti-fouling (following company inspection)	X	X	X

Notes:

1. A Controlled Area is an area established for control of notifiable diseases under the Biosecurity Act 1993, and is subject to a Controlled Area Notice (e.g., NZ-RLO CAN, *Bonamia ostreae* CAN).
2. Subject to MPI Biosecurity NZ approval, Stage 2 disinfection may be acceptable in the case of a vessel leaving a Controlled Area, or site of a *potential biosecurity event*, if a self-polishing type of anti-foulant paint is used on the hull, and the hull is foulant free.

Three stage cleaning and disinfection regime

Stage 1: (Daily hygiene procedure when working with fish) Brush/clean solids from all surfaces. All pipe work, including vacuum pumps, must be cleared of fish or fish waste. Pressure clean (with detergent) areas which have been in contact with fish and water with which fish have had contact:

- deck;
- wells;
- protective clothing;
- fish pumps and piping;
- all other relevant on-board equipment Hot water cleaning may give optimum performance but check manufacturers' instructions and/or recommendations on specific items of equipment or clothing.

Stage 2: Complete Stage 1 then steam clean and disinfect all surfaces, including hull down to the water line.

Stage 3: Complete Stage 1 and Stage 2 plus (where possible) slip the vessel and clean and disinfect the hull below the water line. While travelling to the slip, the vessel must be routed to minimise contact with fish farms.

Well-boat operators should complete and sign a check list of cleaning, which indicate that cleaning and disinfection procedures have been conducted according to the appropriate schedule(s). Well-boat operators and farmers should receive a signed copy of the documentation, which should be retained at the farm site for auditing purposes.

Well-boat operating procedures

In minimising the risks of well-boat operations there are important risk control points that should be included in standard operating procedures.

1. All well-boat operations should be subject to general or specific risk management assessment which should consider:
   - Operations in which fish are removed from a site by well-boat are of lower risk than those that involve delivery of fish to, or return of fish to, an already occupied net pen.
   - Deliveries or pick-ups of fish within a single management area limit between area risk exposure.
   - Deliveries or pick-ups should be made to farms of similar health status or, alternatively, to the farm with highest health status first. It follows that farming companies should systematically allocate a status grading to each farm within an area so well-boat operations can be optimised, and risk minimised.
2. 'Bus stop' deliveries/collections are recognised to present a risk of disease transmission and should be subject to a documented risk assessment and agreement with all other operators within the same Management Area. Where a well-boat has delivered fish to or collected fish from a site already containing fish, it should not then proceed directly to another farm without appropriate procedures to manage the risk.
3. Well-boats must travel closed (i.e., with no water exchange) when located within 5km of any finfish farm site.
4. Ballast water must not be discharged within 5km or one tidal excursion (whichever is greater) of a farm site. This means that ballasting and pump cleaning need to be part of a vessel's passage plan and are sequential operations.
5. Procedures at farms should be designed to minimise risk of disease spread. For example:
   - Access by farm personnel to the well-boat and by the well-boat personnel to the farm and farm equipment should be restricted.
   - Equipment should not be shared between well-boat and farm operations.
6. Compliance with the above procedures should be audited by the receiving farm site management using the well-boat movement records, the disinfection logs, and the corresponding fish movement records as a basis for their assessment of risk.

NZ King Salmon farms in Tory Channel, Marlborough

Annex 1: Disinfectant uses and doses

Disinfectant application and recommended doses (DAFF 2008).

DISINFECTING AGENT	APPLICATION	PATHOGENS	RECOMMENDED DOSE	COMMENTS
Hypochlorite solutions **(sodium hypochlorite or calcium hypochlorite)**	Treatment of clean, hard surfaces	All pathogens	Minimum 30 mg/L available chlorine	Use as a general disinfecting solution
	Treatment of water (assuming low organic loading)	All pathogens	Minimum 30 mg/L available chlorine Maintain a minimum of 5 mg/L of residual chlorine	Hold for a minimum of 24 hours to inactivate Test chlorine level before discharge or neutralise with thiosulfate Less active in the presence of high levels of organic matter Re-dose if necessary
	Treatment of net pens	All pathogens	Initial dose of 1000 mg/L available chlorine Maintain a minimum of 5 mg/L of residual chlorine	Thoroughly mix to ensure even distribution Immerse for a minimum of 6 hours
	Dip treatment of absorbent material such as dip nets, clothing, ropes or absorbent surfaces	All pathogens	Solution of > 200 mg/L available chlorine	Allow time to completely saturate plus a further 2 minutes (minimum) Rinse items in fresh water or neutralise with thiosulfate
	Treatment of tanks, floors and walls in culture facilities	All pathogens	Spray with a solution > 1500 mg/L available chlorine	Leave solution for 2 hours, then rinse to free any remaining soils Tanks should be filled with freshwater and dosed with 200 mg/L available chlorine Leave for 24 hours in the case of whirling disease
Chloramine-T	Treatment of water	Bacteria, viruses, fungi	20 mg/L of chloramine-T (or as per manufacturer's instructions)	Hold for a minimum of 24 hours Test chlorine level before discharge or neutralise with thiosulfate Concentrations and doses vary between products
	Treatment of previously cleaned hard surfaces	Bacteria, viruses, fungi	20 mg/L of chloramine-T (or as per manufacturer's instructions)	Hold for a minimum of 24 hours Test chlorine level before discharge or neutralise with thiosulfate Concentrations and doses vary between products
	Footbaths	Bacteria, viruses, fungi	50 g/L of chloramine-T (or as per manufacturer's instructions)	Concentrations and doses vary between products
	Treatment of hard surfaces	All pathogens	1% solution for > 60 minutes (or as per manufacturer's instructions)	Concentrations and doses vary between products

DISINFECTING AGENT	APPLICATION	PATHOGENS	RECOMMENDED DOSE	COMMENTS
Peracetic acid	Treatment of porous surfaces	All pathogens	2% solution for > 60 minutes (or as per manufacturer's instructions)	Concentrations and doses vary between products
	Treatment of waste slurries (high organic matter)	All pathogens	40 L concentrate solution/1000 L	Contact time > 1 hour May cause excessive foaming and tank overflow in presence of high levels of protein
Monosulfate compounds	Treatment of hard surfaces	All pathogens	10 g/L (or as per manufacturer's instructions)	Application rate of 400 mL/m^2 for > 10 minutes Concentrations and doses vary between products
	Treatment of porous surfaces	All pathogens	20 g/L (or as per manufacturer's instructions)	Application rate of 400 mL/m^2 for > 10 minutes Concentrations and doses vary between products
	Footbaths	All pathogens	50 g/L (or as per manufacturer's instructions)	Remove all organic matter on footwear before immersion Immersion time > 1 minute Replace solution daily in areas of heavy use; every 4 days in areas of light use Concentrations and doses vary between products
Chlorine dioxide	Treatment of water	All pathogens	As per manufacturer's instructions	Can produce volatile fumes when first activated
	Treatment of hard surfaces	All pathogens	As per manufacturer's instructions	Can produce volatile fumes when first activated
Iodophors	Treatment of hard surfaces	Bacteria, viruses, fungi	> 200 mg/L available iodine	Apply to surface 1-2 minutes
	Spray disinfection of equipment	Bacteria, viruses, fungi	> 100 mg/L available iodine	Apply to previously cleaned and dried equipment.
	Footbaths	Bacteria, viruses, fungi	> 200 mg/L available iodine	Clean boots before disinfection Replace daily in high-use areas, or when solution has lost colour
	Use as a hand or skin wash, or on angling or other delicate equipment	Bacteria, viruses, fungi	> 200 mg/L available iodine	Povidone-iodine solution only, do not use acidified iodine solutions
	Treatment of water	Bacteria, viruses, fungi	30 mg/L available iodine, left for 12 hours	Treat with thiosulfate before release
Calcium oxide	Earthen-based ponds	All pathogens	0.5 kg/m^2 for 1 month	Repeat dose on at least two occasions in wet areas or in event of flooding

DISINFECTING AGENT	APPLICATION	PATHOGENS	RECOMMENDED DOSE	COMMENTS
Sodium hydroxide	Treatment of concrete or cracked surfaces of appropriate materials	All pathogens	Applied as a mixture with CaOH and Teepol	NaOH generally sold as pellets Repeat dose on at least two occasions in wet areas or in event of flooding May also be used as a 0.2% solution as a cleaning agent for equipment Teepol (wetting agent) enhances penetration through soil and into concrete
	Treatment of appropriate surfaces where high organic loading may be a problem	Viral pathogens on suitable Surfaces	Applied as a solution of 20 g/L NaOH for > 10 minutes	
	Treatment of wastewater	All pathogens	At a rate to achieve pH > 12 for 24 hours	
	Treatment of waste slurries (high organic matter)	All pathogens	50% (wt/vol) solution at a rate of 30 L/1000 L of slurry	Dose should achieve a pH of > 12 Treat for >4 days
Calcium hydroxide	Treatment of waste slurries (high organic matter)	All pathogens	40% (wt/vol) solution at a rate of 60 L/1000 L of slurry	Dose should achieve a pH of > 12 Treat for > 4 days
Glutaraldehyde	Treatment of small items or those subject to corrosion	All pathogens	2% (wt/vol) for 30 minutes	Available as concentrate solution
Formalin solution	Treatment of hard or porous surfaces	All pathogens	8% (vol/vol) for 30 minutes	Available as 40% solution Dilute 1:12 for use Use only in well-ventilated areas
	Foot baths	All pathogens	8% (vol/vol) for 30 minutes	Available as 40% solution Dilute 1:12 for use Use only in well-ventilated areas
	Treatment of waste slurries (high organic matter)	All pathogens	40 L formalin solution/1000 L (40%)	Must be distributed evenly
	Treatment of pipelines or sewage channels (in situ)	All pathogens	300 mL of commercial grade formalin solution/10 L of water	Completely fill pipeline with disinfecting solution and leave for 24 hours
Quaternary ammonium compounds	Use on skin or delicate items	Some bacteria, some viruses	1 mg/L for > 1 minute	Limited range of efficacy
	Use on hard surfaces	Some bacteria, some viruses	2 mg/L for > 15 minutes	Limited range of efficacy

DISINFECTING AGENT	APPLICATION	PATHOGENS	RECOMMENDED DOSE	COMMENTS
Heat	Treatment of wastewater	Most pathogens Enveloped viruses and some bacteria may be resistant	60°C for 10 minutes 70°C for 6 minutes 75°C for 5 minutes 80°C for 4 minutes	
	Treatment of hard surfaces and equipment	Most pathogens Enveloped viruses and some bacteria may be resistant	Steam cleaning at 115-130°C for 5 minutes	Difficult to regulate, best used as an adjunct to other disinfection methods Especially suitable for treatment of transport tanks
Desiccation and light	Earthen tanks	Most pathogens	Dry for > 3 months at an average temperature of > 18°C	Drying period can be reduced if combined with an appropriate chemical disinfectant Use drying and sunlight as a general adjunct to all disinfection if possible
UV light	Treatment of wastewater	Viruses, bacteria, Fungi	> 25 mJ/cm^2	Requires pre-treatment with chemical precipitation or filtration
	Treatment of water	Myxosporidean species spores	> 35 mJ/cm^2	May requires pre-treatment with chemical precipitation or filtration
Ozone	Treatment of water	All pathogens	1 mg/L for > 1 minute	

Note: Levels recommended in this table come from a number of sources and have been provided here as a general guide. Since the disinfecting capability of disinfecting agents will vary depending on the conditions, concentrations and contact times given should be viewed as minimum acceptable levels for decontamination purposes.

Annex 2:

Efficacy of types of disinfectants against viruses, bacteria, fungi and spore-forming protozoa

DISINFECTING AGENT	VIRUS CATEGORY A	VIRUS CATEGORY B	VIRUS CATEGORY C	FUNGI	SPORE-FORMING PROTOZOA
Strong alkalis	++	+	++	++	+
Aldehydes	++	+	++	++	+
Peracetic acid	++	++	++	++	+
Chlorine	++	+	++	++	+/–[a]
Chlorine dioxide	++	++	++	++	+
Iodophors	++	+/–	++	++	+/–[a]
Ozone	++	+	++	+	+/–
Ultraviolet	+	+/–	+	+	?
QACs	+/–	–	–	+	–
Acids	+	–	+/–	–	–
Biguanides	+	–	–	–	–

QAC = quaternary ammonium compound

a. High concentrations required to be effective

DISINFECTING AGENT	GRAM-NEGATIVE	GRAM-POSITIVE	MYCOBACTERIA	RICKETTSIA-LIKE	BACTERIAL SPORES
Strong alkalis[a]	++	++	+	++	+
Aldehydes[b]	++	++	+	+	+
Peracetic acid	++	++	++	++	+
Chlorine dioxide	++	++	++	++	+
Chlorine	++	++	++	++	+
Iodophors[b]	++	++	++	++	+
Ozone	++	++	++	++	+
Ultraviolet	++	++	+	++	?
QACs	+/–	+	–	+	–
Acids[b]	+	+	+/–	+	+/–
Biguanides	+	+	–	+	–

QAC = quaternary ammonium compound

a. High concentrations required to be effective

b. Prolonged contact times required in some circumstances; in particular, for spores

Key:

++: Highly effective
+/–: Limited activity
?: Limited information
+: Effective
–: Not recommended

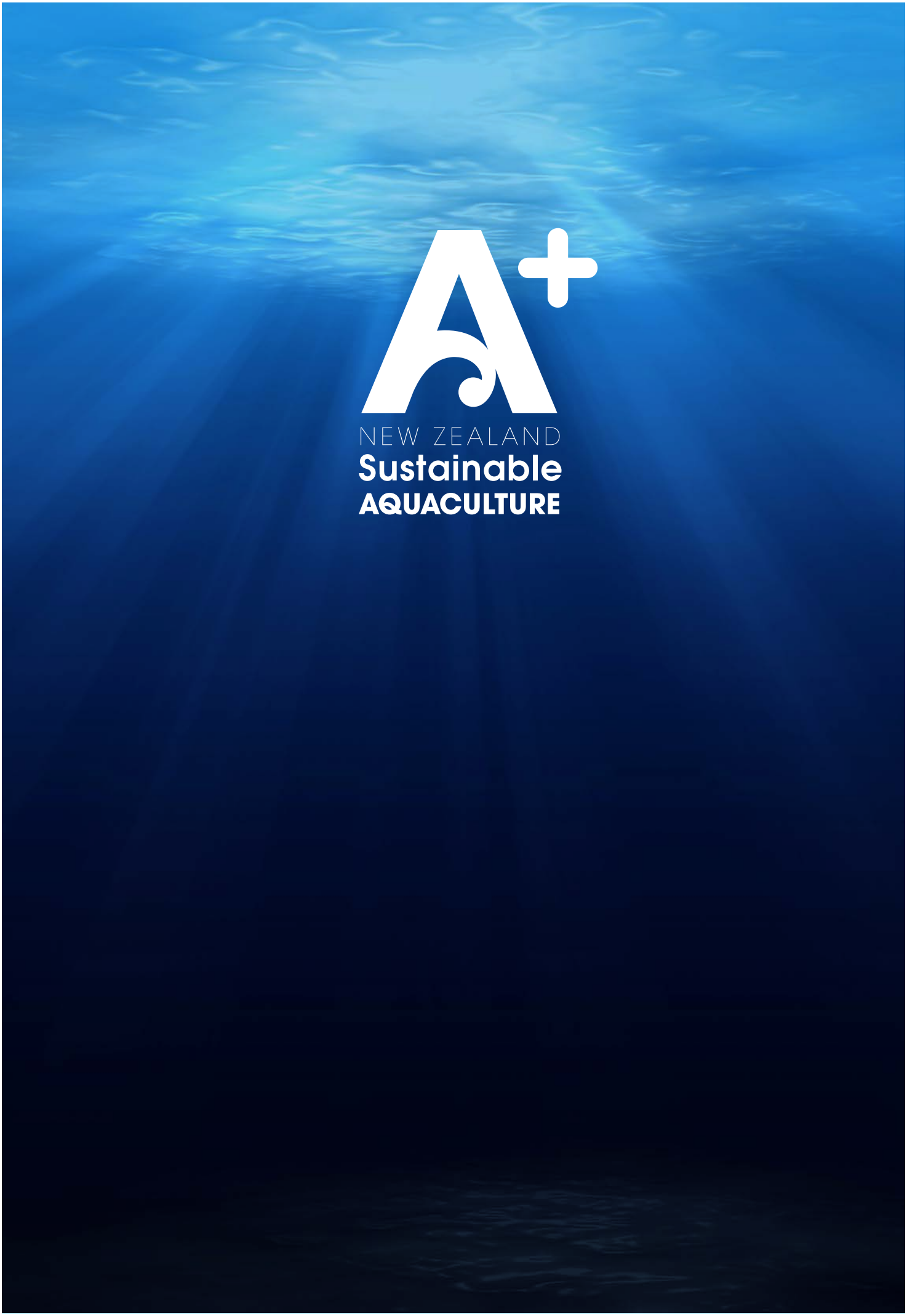
Example fish viruses and categories for disinfection

Epizootic haematopoietic necrosis	*Iridoviridae*	C
Infectious haematopoietic necrosis	*Rhabdoviridae*	A
Infectious pancreatic necrosis	*Birnaviridae*	C
Infectious salmon anaemia	*Orthomyxoviridae*	A
Iridoviral diseases of finfish	*Iridoviridae*	C
Oncorhynchus masou virus disease	*Herpesviridae*	A
Viral encephalopathy and retinopathy	*Betanodavirus*	B
Viral haemorrhagic septicaemia	*Rhabdoviridae*	A

Annex 3:

Email list for biosecurity communications

Akaroa Salmon	info@akaroasalmon.co.nz
High Country Salmon	sales@highcountrysalmon.co.nz
Mount Cook Alpine Salmon	aquaculture@alpinesalmon.nz
New Zealand King Salmon	contact@kingsalmon.co.nz
Sanford	info@sanford.co.nz
Salmon Smolt New Zealand	sean@salmonsmolt.co.nz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