2022

# Aquaculture Biosecurity Manual

## Producer Guide

Produced by
**The Ontario Animal Health Network**
**www.oahn.ca**

# About the Biosecurity Manual

This manual applies to all commercial and non-commercial aquaculture including, farmers, research facilities and hobbyists. Plans will vary depending on the type, location, design and size of your farm, in addition to the species and life stages farmed. It is vital that your biosecurity plan is as individualized as your farm.

Developing a biosecurity plan will help you to assess the biosecurity risks relevant to your operation. It is recommended to seek professional biosecurity advice to help you with this process.

Be aware of your country's regulatory bodies and follow any laws that are in place. These laws are there to protect your industry, the interests of other water users, and the aquatic environment.

This manual is designed to provide the information required to reduce risk on farm and to help achieve aquaculture certifications.

## Important Symbols

- Ask your vet
- Environmental Impact
- Social, cultural and economic impact
- Animal Welfare
- Consider annual budget

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# 1. Introduction

## 1.1 Aquaculture industry in Canada

Global fish production peaked at about 171 million tonnes in 2016, with aquaculture representing 47 percent of the total and 53 percent of non-food uses (FAO, 2018).

Aquatic animal production has many similarities with terrestrial farm production and poor animal health has a direct impact on welfare and fish performance. Poor disease outbreak management and environmental stressors will lead to economic losses due to mortality and morbidity.

Like land animals, aquatic animal production needs professional and technical health expertise. To help reach the farm's economic goals, 3 main actions are required to maintain a healthy fish population: prevention, knowledge about disease free status and action plans to contain diseases. Figure 1 provides a breakdown of the hierarchy used to best maintain proper fish health management on farm.


Figure 1: Fish Health Principles

In fish, the best-known path to prevent the introduction of a new disease and minimize the spreading of an outgoing outbreak is through the implementation of a biosecurity plan. Biosecurity in aquaculture consists of practices that minimize the risk of introducing an infectious disease and spreading it to the animals at a facility. It also considers the risk that diseased animals or infectious agents will leave a facility and spread to other sites and susceptible species.

Canada's aquaculture industry is an important employer and economic driver in many coastal, rural, and Indigenous communities. Canadian aquaculture occurs in all provinces and the Yukon Territory, farming more than a dozen species of fish and shellfish. The largest and most prominent aquaculture sectors in Canada are Atlantic salmon, mussels, trout, oysters, and clams. Most of the facilities are located on the east and west coasts but freshwater trout operations are found in almost every province.

The Canadian Food Inspection Agency (CFIA) conducts, in collaboration with other groups, surveillance for aquatic animal diseases in all provinces and territories. Canada has a National Aquatic Animal Health Program (NAAHP) which aims to keep exotic diseases out of Canada. Additionally, they aim to keep existing diseases confined to areas and not to allow their spread through the movement of fish or fish products.

The CFIA provides the overall lead for the NAAHP, while Fisheries and Oceans Canada (DFO) delivers diagnostic testing, research, and development, providing scientific advice to support the program. DFO is meeting its responsibility for the delivery of NAAHP through its National Aquatic Animal Health Laboratory System (NAAHLS).

In Ontario, aquaculture is regulated and licensed by the Ministry of Natural Resources and Forestry (MNRF). As a regulator, MNRF may require the implementation of emergency action plan if elevated mortality is detected on farm.

All diseases from farmed fish are potentially covered by the Animal Health Act as hazards, through the Animal and Welfare Branch run by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) as laid out in the regulation "Reporting of Hazards and Findings".

## 1.2 Purpose of this manual

The objective of this manual is to reinforce the main concepts of biosecurity in the Ontario aquaculture industry so that they are permanently applied on farm. Preventive biosecurity is more cost effective than trying to solve a problem once it has occurred. The best way to start is to understand the risks associated with your farm and industry, and to undertake proper biosecurity practices to manage and minimize them. Plans will vary depending on the type, location, design and size of your farm, and the species and life stages farmed. It is always recommended to seek professional biosecurity advice to help assess the risks associated with your farming operations and in the development and implementation of your biosecurity plan.

## 1.3 The team

The biosecurity manager is responsible for producing and maintaining a biosecurity plan, as well as demonstrating its effectiveness through the use of good record keeping. Additional responsibilities include ensuring staff are trained in biosecurity issues and visitors are aware of measures that apply to them. To set up a biosecurity plan, managers should identify professionals with specialized knowledge of fish health, welfare, and biology (e.g., fish veterinarian, fish biologist, aquaculture engineer). Biosecurity will be successful only if managers, staff, and visitors understand and follow the necessary practices. Employees and visitors who do not follow established protocols will increase the risk of disease.

## 1.4 Fish health management

It is highly recommended to develop a fish health plan with the assistance of a veterinarian with experience in fish diseases. Along with this biosecurity plan, both documents should be connected and refer to each other. To complement the biosecurity plan, farms should have a veterinary health plan (VHP) or fish health manual (FHM), which includes preventive measures, treatments, and contingencies. The VHP should always be updated at the same time as the biosecurity plan.

# Biosecurity Plan Steps

**2.1: COORDINATION**

Step 1: Consider the need, purpose, and regulatory requirements for your biosecurity plan.

**2.2: PREVENTION**

Step 2: Describe site locations, features, and layout of the facilities.

Step 3: Identify potential risks for each area of the aquaculture production.

Step 4: List potential priorities in biosecurity (animal welfare: infectious hazard).

Step 5: Identify the major routes of disease transmission in your facility (source of hazards).

Step 6: Rate the risk. How likely does that pathogen enters, spread within, and exit the farm through the already identified routes of transmission?

Step 7: Think about consequences when an infectious disease enters the system.

Step 8: Rate consequences and estimate your farm risks.

Step 9: Evaluate your farm risks. What can be done to reduce either the likelihood or the consequences of it occurring?

Step 10: Risk management options. What can be done to manage all the risks I identified?

Step 11: Implement the biosecurity plan measures on your farm.

Step 12: Risk communication.

**2.3: CONTAINMENT**

Step 13: Set up a plan for early detection of diseases.

Step 14: Set up an emergency plan in case of outbreaks (endemic vs. exotic pathogens).

Step 15: Disease control.

**2.4: SOP'S AND TRAINING**

Step 16: Create and modify protocols to agree with the new biosecurity plan.

Step 17: Train staff, contractors, and visitors about different biosecurity requirements.

**2.5: MONITORING AND AUDITING**

Step 18: Document how biosecurity plan guidelines will be addressed on your farm.

Step 19: Implement a review cycle for your biosecurity plan (self-auditing).

Step 20: Have a successful farming operation.

# 2. Biosecurity Plan

## 2.1 Coordination

### 2.1.1 Fish Health and Regulatory Frameworks of Aquaculture

Biosecurity requires teamwork when the goal is to stop the spread of disease. In terms of standardization and collaboration against infectious threats, World Organization for Animal Health (WOAH) member countries make available to other member countries whatever information is necessary to minimize the spread of significant pathogenic agents for aquatic animals. This helps to achieve better worldwide control of these diseases which benefits the entire Canadian aquaculture industry.

As a member of the World Trade Organization (WTO), Canada has an aquatic animal health program that meets the WOAH standards. The CFIA has developed a list of reportable and notifiable pathogens affecting aquatic animals for Canada within the *Health of Animals Act* and its regulations. Some of the listed aquatic pathogens are common throughout Canada while others only occur regionally or are considered foreign animal diseases (FADs) to Canada. For either case, NAAHP is the surveillance program used within Canada.

At the national level, Canada has established a National Code on Introductions and Transfers of Aquatic Organisms. A national code helps to ensure that proposed introductions or transfers of aquatic species are evaluated fairly, equitably, and consistently by all parties, using established scientific criteria. It also helps to clarify the mandates, responsibilities and working relationships of the regulatory body.

This is also supported by the NAAHP which aims to keep exotic diseases out of Canada and ensure diseases confined to certain areas do not spread through the movement of fish or fish products. The DFO delivers diagnostic testing, research, and development, and provides scientific advice to support this program through the NAAHLS.

In Ontario, the legislative and regulatory systems affecting aquaculture are complex and dynamic. The principal regulating agencies are: DFO, CFIA, OMAFRA, MNRF, the Ontario Ministry of the Environment, Conservation and Parks (MECP) and local municipalities. The MNRF is responsible for the licensing of aquaculture farms. However, depending on the type of operation or farming activity, numerous other Acts administered by various federal, provincial, municipal agencies or conservation authorities may be involved.

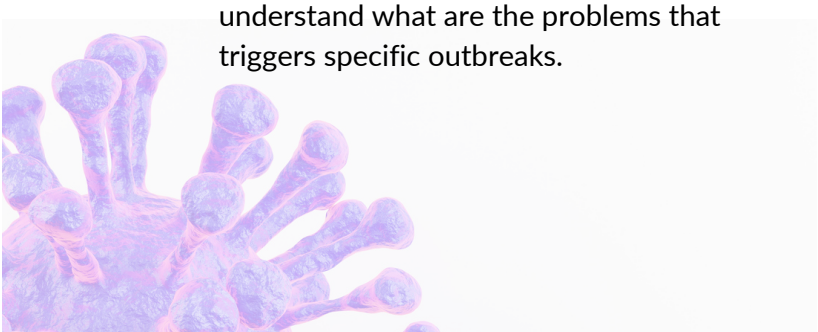
The *Animal Health Act (2009)* and its Regulations are intended to protect animals, their health and welfare in Ontario. It gives the province authority for providing the control of immediately notifiable diseases and hazards that may affect terrestrial and aquatic animals as well as those that are zoonotic in nature. Immediately notifiable diseases and hazards are reportable to the Office of the Chief Veterinarian of Ontario by either veterinarians or a laboratory.

### 2.1.2 National Surveillance for Aquatic Animal Diseases in Canada

The CFIA monitors for aquatic animal diseases and functions as the focal point for the collection, analysis, and dissemination of surveillance data at different levels consistent with international standards set by the WOAH. Samples collected under the surveillance program are tested by the National Aquatic Animal Health Laboratory System using testing protocols validated using international standards set by the WOAH. Results of surveillance activities are shared through quarterly and annual reports. This information gives the baseline for health certification and domestic disease control measures, giving access to domestic and international markets and providing the necessary information for international reporting purposes.

### 2.1.3 Endemic Disease Monitoring

There is no such thing as a microbe-free productive environment, yet there should be a balance between endemic microorganisms present in any aquaculture system. Maintaining biosecurity measures helps to keep this balance where the concentration of potentially pathogenic endemic organisms is low. Unfavourable environmental changes and stress attributed to poor animal welfare can promote the increase of these pathogenic microorganisms, breaking the balance that maintains fish health. Recording details of disease outbreaks caused by endemic pathogens is important for any biosecurity plan since this information could be used to understand what are the problems that triggers specific outbreaks.



It is important as a community to share as many experiences with diseases as possible through publicly accessible data to help reduce endemic pathogens in an area, region, or country. A better knowledge of diseases and pathogens could support future containment plans.

For updated information on reportable and immediately notifiable aquatic animal diseases in Canada please visit the CFIA website.

## Step 1: Consider the practical needs, purpose, and regulatory requirements for your biosecurity plan

### 2.1.4 Internal Regular Disease Monitoring

Most of the diseases observed annually are not notifiable. However, to set up a biosecurity plan, one of the steps is to keep records of endemic diseases.

*Ask your vet the best way to set up a monitoring system that helps you understand the common diseases in your farm.*

Make a list of internal outbreaks of diseases that cause economic losses in your farm. What proportion of your annual losses are due to endemic diseases? What is the impact of these diseases? A biosecurity plan can be based on specific problems. For example, a group of endemic pathogens that you have already experienced and/or exotic diseases that you don't want in your farm.

## 2.2 Prevention

The main goal of a biosecurity plan is to prevent the entrance of any pathogen to the farm facilities; thus, the first component of this process is prevention, which includes risk assessment and monitoring. Before discussing risk analysis and assessment, it's important to take into consideration the location, features and layout of the facility.

### Step 2: Describe site location, features and layout of the facilities

**2.2.1 Site Location, Layout, and Features**

The design of a farm will determine how biosecurity can be managed and will be vital to identifying major access and exit routes for disease. When developing a biosecurity plan, you should include a map of the farm that identifies all the major facilities and significant natural features of the site, as well as a diagram depicting each building and system entry and exit points, major flow patterns (fish movement, visitor and employee movement), and life stages of aquatic animals in each system.

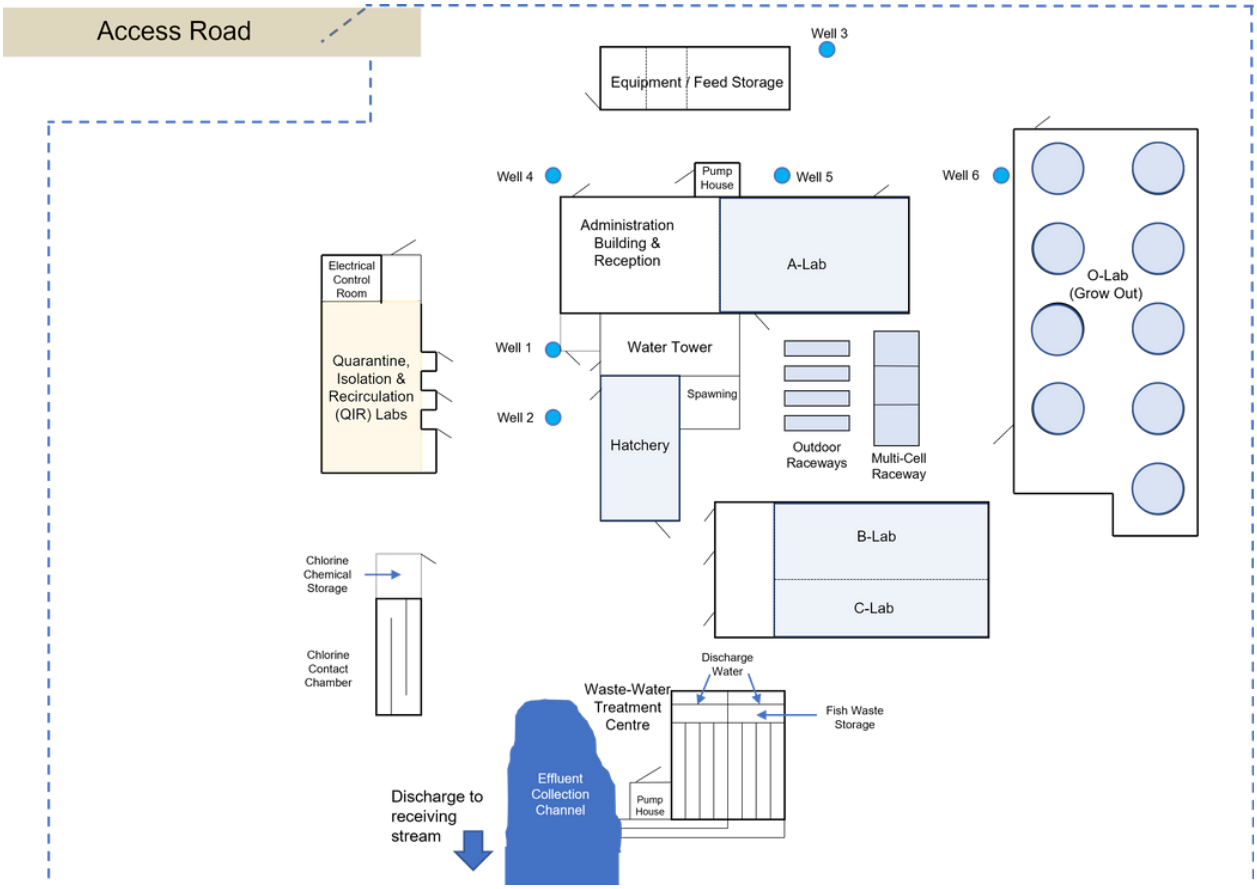



Figure 2: Example of farm layout including major site features

### 2.2.2 Starting the Risk Assessment

Now that you are familiar with the regulations, have considered what diseases are important in your production system and have described the facility layout, we can continue with the next step, risk assessment. Risk assessment is defined as the examination of the level of biosecurity risk associated with the entry, emergence, establishment, spread of diseases and the identification of options, to limit the level of biosecurity risk. The process of risk assessment includes hazard identification, risk analysis, risk management and risk communication.

## Step 3: Identify risks for each area of aquaculture production

### 2.2.3 Hazard Identification

The first component of a risk assessment is the process of identifying which hazards could potentially produce adverse consequences. A complete risk assessment of your aquaculture facility should include hazards identified in Figure 3. These include: risk to personnel, risk to food safety, risk to fish welfare, risk to the environment, and risk to material assets. It is recommended that the different risks of infectious hazards are identified through different process points of an aquaculture facility. Table 1 outlines potential risks and hazards related to animal welfare in aquaculture biosecurity.


Figure 3: Five dimensions of risk in an aquaculture establishment

## Step 4: Enlist potential risks and hazards related to biosecurity (animal welfare)

| Risks for animal welfare | Description of different type of risk affecting animal welfare | Source of hazards |
|---|---|---|
| **Infectious** | - Introduction of exotic diseases<br>- Outbreak of endemic diseases<br>- Spread of exotic and endemic diseases | Animals (Stock wildlife, pests, domestic animals)<br>Water<br>Feed<br>People<br>Equipment and vehicles |
| **Nutritional** | - Mycotoxin<br>- Low absorption of nutrients (feed quality, genetics, husbandry) | Feed storage<br>Feed quality<br>Fish genetics<br>Poor Husbandry |
| **Husbandry** | - Poor water quality<br>- System malfunction (ozone, UV, Oxygen/Redox alarms, etc.)<br>Poor systems design | High densities<br>Poor hygiene<br>Change of currents<br>Mechanical or systematic error |
| **Environmental** | - Hazards that are unavoidable due to nature | Algal blooms<br>Storms<br>Ice<br>Conifer Pollen |

Table 1: Risks in fish welfare dimension and sources of hazards.

## Step 5: Identify the major routes of disease transmission in your facility (source of hazards)

**1. Animals**

Aquatic animals entering the farm can present a significant disease risk, particularly if they are of unknown health status. Aquatic animal vectors of disease can include brood stock, eggs, and animal products (specifically those harvested at other sites). Aquatic animals entering via the water supply (e.g., copepods, molluscs, and fish), wild animals such as birds, pest animals such as rodents, mink, herons, stray dogs/cats, and other scavengers can represent risk of disease transmission into the farm. Waste products such as dead animals may also present a disease risk. These products should be handled and disposed of as required.

**2. Water**

A farm's water supply is an important asset that has a major influence on animal health. In semi-open systems such as sea cages, there can be little control on water as a route of disease transmission, however, the nature of water currents and positioning of farms can pose risk to biosecurity. For land-based facilities, disease transmission risks will depend on the nature of the water source, presence of host animals in that water source and the proximity of other farms that may discharge into the water source. Waste products such as processing water, processing waste and cleaning effluent can be vectors for transmission of disease onto a farm. Appropriate infrastructure and procedures are required to manage the disease risks associated with wastewater products.

**3. Feed**

Manufactured feeds such as extruded pellets generally present a low risk of disease transmission due to deactivation of pathogens in the manufacturing process, however, live, fresh, or frozen feeds can present significant risks. The level of risk will depend on the pathogens of concern, the origin of the feeds and the level of processing; for example, freezing may kill parasites but may not kill viruses. Additionally, improperly stored feed can become contaminated by rodents or insects, or poor handling by employees.

**4. People**

People can include staff, contractors, visitors, and unauthorized trespassers. They can present a significant risk of disease introduction, particularly where they visit other farms or environments containing diseases of concern, introducing pathogens via contaminated skin, clothing and footwear. For example, a veterinarian or visitor could bring *Lactococcus* sp. bacteria from a dairy facility to a fish facility. Or staff could transmit *Lactococcus* sp. bacteria from one fish farm to another.

**5. Equipment, Vehicles and Vessels**

Equipment that has been in contact with aquatic animals can provide a risk of disease transmission onto the farm. Equipment can include anything brought onto the farm and used for harvest, grading, diving, and feeding. The level of risk will depend on the history of use. For example, equipment used at other farms or processors will have a much higher risk compared to new equipment. Vehicles such as cars, trucks and tractors can bring pathogens onto the farm. As with equipment, the level of risk will depend on the history of use. Vessels present a source of introduction of disease, particularly when they have been used at other farms or have been in close contact with animals (e.g., well boats or fishing vessels).

### 2.2.3.2 Risk Analysis

**Three Levels of Risk:**

There are three different types of risk in an aquaculture establishment: entry-level, internal level and exit-level. Table 2 outlines the sources of hazards and routes of disease transmission from these sources. It is important to consider potential risks at each level in order to create a biosecurity plan that is unique to your farm and can mitigate the introduction and spread of disease at any given point in time.

| Types of risks | Source of hazard | Routes of transmission |
|---|---|---|
| Entry-level | Animals | e.g., import of wild brood stock, import of eggs, import of juveniles<br>e.g., Vectors, intermediary hosts |
| | Water | e.g., intake water |
| | Feed/algae | e.g., purchase of algal paste or starter cultures, live feed from external suppliers |
| | People | e.g., entry to the hatchery by staff, contractors, and visitors |
| | Equipment | e.g., admission of gear from outside the hatchery |
| Internal level | Animals | e.g., movement of broodstock, larvae or spat between production areas |
| | Feed/algae | e.g., algal cultures |
| | People | e.g., movement of staff between different production areas |
| | Equipment | e.g., sharing of gear between production areas |
| Exit-level | Animals | e.g., discard of mortalities, fish escapees<br>e.g., Vectors, intermediary hosts |
| | Water | e.g., discard of water, outlet water |
| | People | e.g., exit of the hatchery by visitors, contractors, and staff |
| | Equipment | e.g., disposal of wastes |

Table 2: Overview of potential disease/pest transmission routes in an aquaculture facility

## Step 6: Rate the risk. How likely is it that the pathogen enters, spreads within, and exits the farm through the already identified routes of diseases?

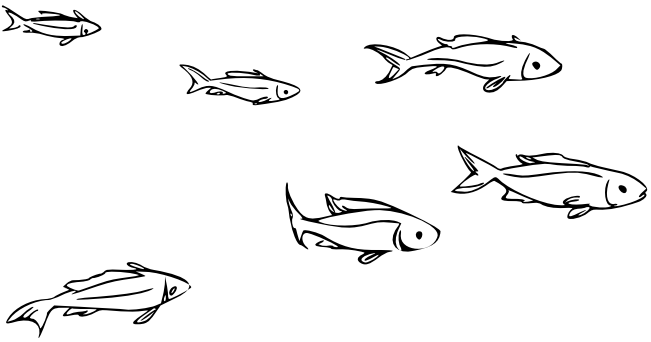
Rating the risk is the process of evaluating the likelihood that a defined hazard will be introduced and spread, causing biological and economic consequences through a qualitative rating. This is achieved through an assessment of the release, exposure and consequence.

**Release Assessment:**
Identify the transmission routes, evaluating and projecting the likelihood that a defined hazard will be introduced or released, consequently causing biological and economic repercussions.

**Exposure Assessment:**
Determine the likelihood that a transferred hazard will be able to establish and spread in its new environment. In many cases, different farm stages will have different risk levels on health status. For example, broodstock and hatcheries may have the highest risk; nursery areas may have a slightly lower risk and grow out populations may have the lowest risk in health status within the farm. Consideration should be given to the risks of disease transmission between areas of different health status.

| Rating | Descriptor |
|---|---|
| Remote (1) | Maybe not known to occur here but does occur rarely in Canada or Ontario (occurs less than once in 20 years) |
| Unlikely (2) | May occur here, but only in exceptional circumstances (occurs more than once in 20 years) |
| Possible (3) | Evidence suggesting this does infrequently occur (more than once every 3 years) |
| Likely (4) | It is likely, but not certain, to occur here – occurs more than once in 2 years (>50%) |
| Certain (5) | It is certain to occur (occurs every year) |

Table 3: Assessment of disease release and exposure likelihood



**Consequence Assessment:**
Quantify the potential biological damage that the established hazard may cause. For each hazard there is at least one consequence that occurs although the occurrence of more than one is possible. Consequences may be expressed qualitatively or quantitatively and must identify the intensity or degree of impact, the geographical extent of impact and the permanence or duration of impact. Consequences fall into five broad categories shown in Table 4.

| Rating | Descriptor |
|---|---|
| Insignificant (1) | Impact not detectable or minimal |
| Minor (2) | Impact on farm productivity limited to some production units or short term only |
| Moderate (3) | Widespread impact on farm productivity due to increased mortality or decreased performance |
| Major (4) | Considerable impact on farm production resulting in serious supply constraints and financial impact |
| Catastrophic (5) | Complete depopulation of the farm and barriers to resumption of production |

Table 4: Assessment of disease consequence

## Step 7: Think about consequences when an infectious disease enters the system

It is also important to consider the impact of the infectious disease on human life. The table below represents the impact of infectious disease on environmental, social, political, cultural, economic and animal welfare aspects. For each impact on human life add a point to your consequence rating.

| | Impact | Description |
|---|---|---|
|  | Environmental +1 | Include loss of biodiversity, loss of habitats, disease in target and non-target species, and alterations to trophic interactions |
|  | Social and political +1 | Altered employment rates, altered tourism, significant change to artisanal resources, international economic sanctions, and loss of international trade |
| | Cultural +1 | Alteration to aesthetics, connection to the aquatic environment and religious beliefs |
| | Economic +1 | Loss of domestic and international trade, loss of current and potential resource(s), loss of consumer confidence, loss of production and loss of business viability. Poor food quality, disease, predation, escapes |
|  | Animal welfare +1 | Loss of a healthy stock, poor feed conversion (economic losses), loss of consumer confidence |

Table 5: Impact of infectious disease on human life

## Step 8: Rate consequences and estimate your farm risks

**Risk Estimation:**

Risk is estimated as a product of likelihood and consequence, resulting in risk ratings of 1–25. Risk ratings can be determined by applying estimates of likelihood, where 1 is remote and 5 is certain (ratings in Table 3) and consequence, where 1 is insignificant and 5 is catastrophic (ratings in Table 4) to a risk matrix. Risks are highest when both likelihood and consequences are high. However, risks may be low even if the consequence is catastrophic, but the likelihood is remote; or even if likelihood is certain but the consequence is insignificant. Table 6 outlines various examples of risk estimation at each level in an aquaculture facility.

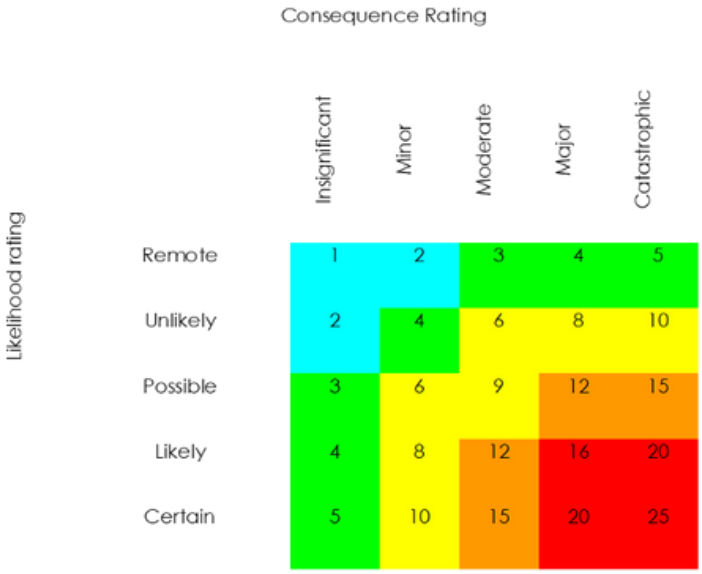



Figure 4: Risk Estimation Matrix

## Step 9: Evaluate your farm risks. What can be done to reduce either the likelihood or the consequences of it occurring?

### 2.2.3.3 Risk Management

### A. Evaluating Risk

Risk management involves identifying measures to reduce the identified risks to an acceptable level. To address any specific additional risks identified for your facility, consider each of these measures as part of a standard approach. Evaluate risks and establish measures to reduce risks to acceptable levels. Low risks may not require specific mitigation measures but may warrant some level of ongoing monitoring to identify if the risk profile changes over time. Medium, high, and extreme risks should be considered unacceptable.

| Risk level | Explanation and management response |
|---|---|
| 1-2 Negligible | Acceptable level of risk. No action required |
| 3-5 Low | Acceptable level of risk. On-going monitoring may be required |
| 6-10 Medium | Unacceptable level of risk. Active management is required to reduce the level of risk |
| 12-15 High | Unacceptable level of risk. Intervention is required to mitigate the level of risk |
| 16-25 Extreme | Unacceptable level of risk. Urgent intervention is required to mitigate the level of risk |

Table 6: Evaluating Risk

| Type of risk (hazard) | Source of hazard | Routes of transmission | Likelihood | Consequence | Risk |
|---|---|---|---|---|---|
| Entry-level | Animals | e.g., import of wild brood stock, import of eggs, import of juveniles | 5 | 4 | 20 |
| | Water | e.g., intake water | 3 | 4 | 12 |
| | Feed/algae | e.g., purchase of algal paste or starter cultures, live feed from external suppliers | 2 | 4 | 8 |
| | People | e.g., entry to the hatchery by staff, contractors, and visitors | 1 | 4 | 4 |
| | Equipment | e.g., admission of gear from outside the hatchery | 1 | 4 | 4 |
| Internal level | Animals | e.g., movement of brood stock, larvae or spat between production areas | 3 | 2 | 6 |
| | Feed/algae | e.g., algal cultures | 1 | 2 | 3 |
| | People | e.g., movement of staff between different production areas | 4 | 3 | 12 |
| | Equipment | e.g., sharing of gear between production areas | 4 | 3 | 12 |
| Exit-level | Animals | e.g., discard of mortalities, fish escapes<br><br>e.g., Vectors, intermediary hosts | 5 | 5 | 25 |
| | Water | e.g., discard of water, outlet water | 3 | 5 | 15 |
| | People | e.g., exit of the hatchery by visitors, contractors, and staff | 2 | 2 | 4 |
| | Equipment | e.g., disposal of wastes | 3 | 1 | 3 |

Table 7: Risk Evaluation for Transmissible Diseases

## Step 10: Risk management options. What can be done to manage all the risks I identified?

**B. Risk Management Options**

There may be numerous risk management options available to reduce risks to an acceptable level. The preferred option should be chosen based on its practicality, effectiveness, and cost. Risk management options may reduce likelihood, consequence, or both. For example, vaccination would have no influence on the likelihood of the entry of a pathogen but may reduce the consequences significantly. The risk management should include physical (e.g., infrastructure and equipment), procedural (e.g., production practices and training) or other supporting measures (e.g., signage).

**Animals**

The most significant risk for bringing disease onto a farm is through broodstock, especially if you do not know the health status of the fish. Manage on-farm stock introductions and movements carefully to minimize this risk. See Table 8 below for management measures.

| Risk category | Risk management measures |
|---|---|
| Extreme | Obtain health status information and appropriate permits for broodstock before it enters the hatchery. Ensure the health status of any introduced stock is equal to or better than that of stock already present. Permanently quarantine stock if you cannot achieve this. |
| | Keep broodstock in isolation in separate water from all other farm stock and in separate production units/dedicated quarantine facilities with appropriate biosecurity measure. |
| | Import eggs and consider having your own brood stock. |
| | Inspect broodstock on introduction to the hatchery, including laboratory test. |
| | Dispose of mortalities or unwanted stock in an appropriate manner* that is approved by the relevant jurisdictional authority. Ensure dead or unwanted stock is not returned to the environment or accessible to scavengers (for example, birds). |
| | Investigate health problems (suspected diseases) with assistance from aquatic animal health professionals. |
| | Ensure staff responsible for managing husbandry are trained in, and aware of, their role and responsibility in reporting signs of disease and high mortality. |
| | In accordance with jurisdictional requirements, immediately inform relevant authorities of any significant, unexplained mortality event or suspected reportable disease. |
| Medium | Inspect health, mortality, and behaviour daily. Record this information. |
| | Keep stock stress to a minimum by ensuring appropriate water quality, hygiene, stocking density, nutrition, and handling. |
| | Remove mortalities daily. |
| | Ensure domestic animals (for example, cats and dogs) do not have access to production areas at any time. |
| | Have a professional pest control plan and bait pests as necessary (if you observe live rodents, droppings, or nests). |
| | Keep all building entrances closed when not in use and to prevent pests and/or wildlife accessing the building. |

Table 8: Risk management options for stock animal movement

**Water**

Site water supply can pose a significant risk of disease transfer depending on if the source water carries pathogens. This is particularly important if there are host animals in the water source, or if it is close to water discharge from other aquatic enterprises or processors. See Table 9 for a summary of risk management measures.

| Risk category | Risk management measures |
|---|---|
| High | Treat incoming water appropriately (for example, screening, ageing, filtration, ultra-violet light, ozone) to minimise the risk of disease/pest entry. |
| | Treat discharge water from dedicated quarantine facilities appropriately to minimise the risk of disease/pest establishment in the marine environment. |
| | Ensure water intake and outflow avoid cross contamination. |
| | Install screens on discharge pipes. |
| | Dispose of other waste appropriately (for example, used water filters). |
| | Direct high-risk wastewater down drains away from foot traffic. |
| | Design water flow within the hatchery to prevent disease spread between biosecurity zones. |
| | Ensure contact with untreated water (for example, inspecting or maintaining water treatment equipment) occurs at the end of the day. |
| | Regularly service and maintain water treatment infrastructure and keep a record. |
| | Adequately monitor water treatment to ensure it remains effective. |
| | Ensure potable water is available for cleaning and disinfection procedures. |

Table 9: Risk management options for water

**Feed**

Feed can pose a risk to potential disease transfer as it can be a medium for bacterial growth or carry other pathogens when managed improperly. It is imperative that feed is stored in clean, dry, temperature-controlled areas to minimize the risk of disease transfer.

| Risk Category | Risk Management Measures |
|---|---|
| Medium | Inspect health, mortality, and behaviour daily. Record this information. |
| | Keep stock stress to a minimum by ensuring appropriate water quality, hygiene, stocking density, nutrition, and handling |
| | Remove mortalities daily. |

Table 10: Risk management options for feed

**People**

The risk of people introducing disease to your farm is far greater if they have recently visited other farms, or environments potentially containing diseases of concern such as fish processing plants. Contaminated skin, clothing and footwear can all potentially spread disease.

| Risk category | Risk management measures |
|---|---|
| Low | To always ensure effective disinfection, locate footbaths (or provide the opportunity to change into zone-specific boots) and hand sanitation stations at the hatchery entrance/exit and between biosecurity zones. Ensure boots worn in production areas are not worn or taken outside their designated production area. Keep footbaths clean and refill disinfectant solution frequently. |
| | Ensure staff attend work in laundered, clean clothes each day. |
| | Only permit designated staff to routinely enter farm quarantine areas. |
| | Ensure workflow is unidirectional (from low- to high-risk zones) when staff need to access multiple zones during a day. Make sure you have an appropriate procedure when this is not possible. |
| High | Do not permit staff to visit other aquaculture sites or seafood processors before entering the hatchery (unless they have been appropriately decontaminated). |

Table 11: Risk management options for staff

| Risk category | Risk management measures |
|---|---|
| High | All visitors must complete a biosecurity declaration on arrival to ensure you assess their risk to hatchery's biosecurity. Consider refusing entry to high- risk visitors. |
| | Limit movement of people into and through the hatchery, restrict visitor access to quarantine zones. |
| Low | Visitors must sign-in on arrival (by completing the hatchery visitor log) and undergo a hatchery biosecurity induction. |
| | Appropriately disinfect all visitors on production area entry and exit using footbaths (or provide the opportunity to change into zone-specific boots) and hand sanitation stations. |
| | Clearly display hatchery entry requirements to visitors at the sign-in point. |
| | Ensure contractors conduct routine maintenance work within quarantine area(s), where possible, between batches and before final disinfection. |
| | The site manager must approve all visitors and visits must be unidirectional from lowest to highest risk areas. |
| | Always accompany visitors when on site. |
| | Use approved contractors for routine services. |

Table 12: Risk management options for visitors

**Equipment, Vehicles and Vessels**

Depending on their history of use, contaminated equipment, vehicles, or vessels can carry and spread disease agents. Equipment and vehicles pose the greatest risk of disease transfer if used for off-site aquaculture purposes or in association with stock or broodstock. See Table 13 for a summary of risk management measures.

| Risk category | Risk management measures |
|---|---|
| High | Do not permit equipment, vehicles or vessels that have been in contact with off-site oysters or water used to hold off-site oysters to enter the hatchery. In exceptional circumstances, make sure you can appropriately clean and disinfect such equipment, vehicles, or vessels, or those of unknown origin or status, before using on the hatchery. |
| | Use specific equipment, clearly labelled, per zone. |
| | Do not remove equipment from its dedicated zone and use elsewhere in the hatchery. |
| | If moving equipment between zones or species (for example, an expensive item), ensure you clean and disinfect it appropriately. |
| Low | Keep equipment properly maintained and appropriately decontaminated as required. Ensure maintenance records are maintained and up to date. |
| | Park visitor vehicles in a dedicated parking area. |
| | Ensure the hatchery has a dedicated delivery and loading area. |
| | Regularly clean all hatchery areas and keep free of rubbish and clutter. |
| | Clean contractor tools before entry and ensure they are free of dust/ organic matter. |
| | Disinfect and dry all equipment and surfaces between runs. |

Table 13: Risk management options for equipment, vehicles and vessels

## Step 11: Implement actions and changes

**C. Risk mitigation implementation**

Implementation is the process of following through the risk management decision and ensuring that the risk management measures are in place. The performance of the management action can be monitored and improved if it fails to meet expected goals. The mitigation actions should be associated with the parts of the biosecurity plan: actions to prevent, actions to contain the hazard and actions to control or eradicate.

Consider the time frame of necessary changes. If the implementation of the biosecurity plan requires extensive changes, they may need to be phased in over a reasonable period. This would allow time for staff consultation and training on the most suitable approaches, and for any new equipment to be deployed or existing equipment or facilities to be modified. If implementation must be phased in over time, it would be logical to focus first on biosecurity measures that mitigate the highest biosecurity risks.

## Step 12: Risk Communication

**2.2.3.4 Risk Communication**

Risk communication should be frequently reported to provide a formal document of the outcome of the risk analysis process. This requires a continuous, open, and transparent process where all stakeholders are consulted and results, assumptions, uncertainty, and management measures are communicated. Scientific peer review of the risk analysis is an essential component of risk communication for obtaining a critique aimed at ensuring that the data information methods and assumptions are the best available.

Public input in different risk assessment stages (data collection, analysis methods and assumptions) helps establish credibility, as customers including slaughter plants, markets and feed trucks may have animal welfare and environmental impact concerns. Communicate with all the interested parties the progress of the risk assessment. This should be done throughout the whole process and not only at the end.

# 2.3 Containment

**2.3.1 Early Detection**

Objective: Minimize the biosecurity risk to a farm by implementing appropriate monitoring and surveillance practices.

Make sure you have a plan for the data you will collect before you start collecting it - what will you collect, how will you analyse your health data and who will do the analysis? *Ask your veterinarian or aquatic health professional for guidance.*

**2.3.1.1. Monitoring testing (surveillance)**

Knowing the potential contributors of infectious diseases in a specific animal population to allow early recognition of an outbreak is key. Any aquatic health plan or any policy development would not be possible without quality health data. Disease control, quarantine, and health certification can be achieved by conducting animal surveillance.

Surveillance for early detection of exotic disease is an important element of any biosecurity strategy. It would identify potential disease introduction routes and avoid spread of the pathogen through contingency plans (compartmentalization). On the other hand, surveillance programs could also be used for establishing endemic pathogen base lines within the farm and recognize early disease patterns that could allow management to act quickly and reduce the impact of well-known seasonal diseases.

For example, with *Paramoeba perurans*, a well-known gill pathogen in marine salmonid farms, a quantitative PCR is used for detection to allow farmers to know when concentrations are increasing. This early detection facilitates the contingency plan specific for this pathogen and treatment in early stages before significant gill damage occurs.

#### 2.3.1.2 Mortality Counting and Classification

Long-term mortality rates can be used as an indicator of past welfare performance and short-term mortality rates as an indicator of current welfare. By plotting these observations over time to create a mortality curve, farmers are able to identify early signs of infectious disease and can make operational changes to prevent future outbreaks. While useful, mortality curves require additional information to aid in disease prevention. Categorizing causes of death will enable action to be taken to prevent operational problems for the future and identify any early sign of infectious diseases.

Necropsy, also known as secondary mortality classification (SMC) is performed in the following situations 1. When there is an unusual number of daily mortalities 2. The finding of mortality counts/classification (PMC) is unusual (new lesions found in several of the mortalities) 3. Health checks (HC) 4. Disease diagnosis.

#### 2.3.1.3 Health checks

A full health check including necropsy (secondary mortality classification-SMC) and wet mounts techniques should be performed periodically on clinically healthy animals as part of a population monitoring strategy.

Sampling for PCR surveillance, daily PMC and periodic health checks should be performed by trained and experienced staff. Contact a veterinarian or aquatic health professional to receive training. All noted techniques should be part of an Animal Health Manual with its own SOPs for routine health analysis and suspected disease events.

#### 2.3.1.4 Disease Diagnosis

At the onset of a disease outbreak, groups of clinically healthy and moribund fish should be necropsied and sampled for laboratory analysis to get a final diagnosis. The identification of the cause of disease will lead to informed control options and specific actions. Broad and nonspecific actions (e.g., mass treatment with antibiotic without establishing a bacterial agent is involved) leads to treatment failures, mounting costs, and potential resistance or withdrawal issues down the road. Maintain access to qualified veterinary or aquatic health professionals who can provide advice and examine stock at short notice and what samples to take. Remember freshly killed or live fish yield better diagnostic samples.

### Step 13: Set up protocols and activities that allow you to detect pathogens as early as possible.

Monitoring testing (surveillance), PMC and HC will improve your early disease detection. Appropriate veterinary professional support is needed for disease diagnosis (DD).

#### 2.3.2 Emergency Plan

Effective contingency plans ensure that all resources required for the control of a potential disease emergency have been defined and are available to the users so that these resources can be activated and deployed promptly. Planning and rapid action can significantly reduce the social and economic impact of aquatic animal disease, as well as control or reduce its spread.
The components of an emergency plan should be detailed with more precision as data is accumulated and the risk analysis is completed.

## Step 14: Set up an emergency plan to act fast!

### 2.3.2.1 Disease Outbreak Alert

Listed diseases vs endemic diseases will require different management approaches. Regardless, both situations require an alert response as follows:

1. Give the alert. Everyone in the farm should be aware there is a problem.
2. Activate SOP's to aquatic animal health personnel in the field for collecting, packaging, and transporting samples to designated laboratories.
3. If you suspect a reportable disease, report to CFIA and/or OMAFRA as appropriate. Confirm diagnosis at a CFIA/DFO reference laboratory. It may be required to notify MNRF if the mortality rate is high enough to trigger a regulatory requirement.
4. Instructions for staff to start a specific emergency plan or SOP.

### 2.3.2.2 Emergency actions

Some highly contagious diseases which are currently not present in the country require stringent measures to immediately eradicate them as soon as they occur. Depopulation of an area or the entire farm with good cleaning and disinfection practices should be considered in some scenarios where eradication is the goal. In cases where such diseases are not promptly eradicated and become endemic, a long-term compulsory eradication program will be required if eradication becomes a goal.

**Monitoring:**

Surveillance methods for assessing success/failure of control efforts should be established. Depending on the pathogen, it might be appropriate to implement a program of surveillance for the presence/distribution within the farm of the disease in question. Is the pathogen present in biofilm or filters? Is the pathogen susceptible to desiccation? Would they be present after tank disinfection? What components of the system must be disinfected? Monitoring using PCR and bacteriology could give tools to improve specific actions of cleaning and disinfection within the farm. Quantitative PCR could also give us an idea of the acceptable levels for endemic potential pathogens.

**Recording data:**

Besides the routine record of water quality parameters, any disease outbreak event needs to be recorded. Farm area affected, number of cages, clinical signs, daily and accumulated mortality, dates, time of important events that you think might be associated with the problem (e.g., power interruption, significant rainfall, heat events). Talk to technicians and record any information they might give you about the situation. For the veterinarian, any information is useful.

**Mitigation strategies:**

1. **Movement restriction (compartmentalization):**

It is appropriate to put in place restrictions such as a prohibition of movements to and from affected areas of the farm. This would include equipment and animals, but also the movement of people to the problematic area should be reduced.

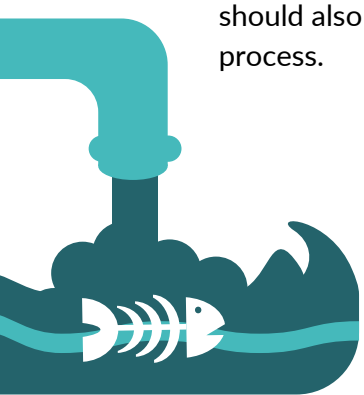
### 2. Stress management:

The primary function of the farmer is to attempt to maintain a system whereby the various components which can act as stressors are at the lowest possible level which are compatible with economic success. This has significant implications for growth and feed conversion as well as vulnerability to infection. Since stress is a predisposing factor that could lead or aggravate a disease process, pros and cons should always be evaluated before any management on diseased fish population. The basic rule is to reduce any unnecessary handling in a sick population, unless strictly necessary. Other palliative actions like stopping the feeding process and oxygen support should be considered.

### 3. Mortality management:

Even after death, diseased or contaminated animals can pose a threat to animal and human health unless they are properly disposed of. Often dead fish release more pathogens into the environment when they rot, so outbreaks can be made worse by leaving dead animals in systems. High pathogen levels may also spillover into wildlife (e.g., in net pens) which could then serve as reservoirs to spill back to the domestic fish.

In Ontario, on-farm disposal is governed by the Nutrient Management Act. During a fish health emergency, depending upon the incident local, provincial, and federal regulations may dictate the method of carcass disposal to be used (commonly burial, composting or rendering). Veterinarians should also be involved in the decision-making process.



### 4. Medication;

Several veterinary medicines used in aquaculture have been shown to have potential harmful effects on human health (e.g., chloramphenicol, malachite green, gentian violet, nitrofurans, fluoroquinolones and quinolones), leading to bans on their use in aquaculture, reducing the already limited arsenal of drugs that are available for disease treatment. The administration of drugs and chemicals indirectly, into the culture water, influences the speed and extent of exposure of non-target organisms such as other vertebrates, algae, invertebrates, and bacteria, in contrast to the direct administration of drugs and chemicals in a land-based setting. Before using chemical treatments to control any disease, each of the outbreaks should be analyzed independently by a veterinarian.

### 5. Cleaning and Disinfection

Cleaning and disinfection involve the use of physical and chemical agents to remove microorganisms usually on inanimate objects. In aquaculture, disinfectants can also include compounds used to destroy microorganisms living on the surface of fish eggs. These agents are used in aquatic animal rearing facilities as part of biosecurity protocols to control the spread of aquatic animal pathogens. They should therefore be considered part of biosecurity and increase their frequency during an animal health emergency response. It is important even if you are depopulating to remove all traces of an infectious agent.

If water from the facility is discharged any disinfectant used must be regulated under MECP. If there is use of ozone and/or UV to disinfect your aquaculture system, as part of emergency actions they should be checked in case of failure or have redundancies available.

Step 15. After a proper diagnosis, apply emergency actions depending on the type of pathogen detected (exotic vs endemic pathogen).

This is the only instance that antibiotics should be used, if necessary, along with other chemical treatments and management interventions. The antibiotic selection should be based on culture of pathogenic organisms and the situation must be always evaluated by a veterinarian for correct prescribing, including failure to respond as expected.

*If you or your staff see anything unusual, don't hesitate to call your veterinarian!*

**2.3.3.3 Indirect incidence: Natural disaster**

Because aquaculture is dependent on reliable resources of water, the possibility of major catastrophes during natural disasters should be considered. Farmers should prepare for natural disasters through:

1. Proper facility construction
2. Developing a disaster management plan
3. Having emergency backup equipment on site
4. Contacting power companies to get on a service priority list
5. Considering insurance options to provide some disaster relief

# 2.4 Documentation and Training

**2.4.1 Standard operating procedure (SOP's)**

New biosecurity processes may need to be described in a standard operating procedure (SOP) if they are complex, rarely performed, performed by multiple staff, or are critical to the maintenance of farm biosecurity. If a quality management system has been implemented on your farm, biosecurity SOPs should be incorporated within that quality system.A SOP aims to support consistent performance of a particular function by farm staff. For this reason, it must be clear, easy to follow and available to staff in areas where the function is performed.

**2.4.2 Suggested protocols to address major transmission routes**

1. Layout and workflow optimization of production areas within the facility (for example, hatchery, nursery and grow out)
2. Any features important for the species being farmed
3. Quarantine facilities within the farm
4. Typical stock movements through the facility (for example, from hatchery to nursery)
5. Escape prevention measures (for example, screens on discharge water)
6. Water supply, treatment, and discharge routes
7. Water pumps and valves
8. Water intake and discharge points
9. Site access points
10. Location of footbaths and disinfection areas
11. Personal Protective Equipment
12. Vehicle parking area
13. Reception points for visitors and contractors
14. Equipment and vehicle wash down areas
15. Equipment and vehicle storage areas
16. Marinas and boat ramps
17. Waste disposal areas

| SOP section | Explanation |
|---|---|
| Title | This should be clear and unambiguous (for example, emergency procedures for high mortality). |
| Objective | This should be clear and unambiguous (for example, describe procedures to be followed in the event of high, unexplained mortality on the farm). |
| Responsibilities | Describe who the SOP applies to and the roles they must perform. For example:<br>All staff: understand this procedure, be able to follow initial response actions, report to biosecurity manager.<br>Biosecurity manager: coordinate initial response, report to farm manager, liaise with farm veterinarian.<br>Farm manager: responsible for deciding on response actions, reporting to government authorities. |
| Procedure | Clearly describe the steps that should be taken as appropriate. For example:<br>1. Cease all activity including feeding, cleaning, or stock movement.<br>2. Check water quality parameters such as flow, DO, temperature.<br>3. Secure the area to prevent access by unnecessary personnel, and to prevent movement of equipment, or stock.<br>4. Assess the extent of the situation. How many tanks are affected? What is the proportion of sick or dead animals? Are there any obvious disease signs? |
| Precautions | Clearly describe any activities that must be avoided. For example:<br>1. Staff must not visit other production areas of the farm.<br>2. Equipment and animals must not leave the affected area. |
| Review date and further information | The SOP should include the date it came into effect, any supporting information and cross reference the relevant component of the farm biosecurity plan. |

Table 14: Standard operating procedure model

### 2.4.3 Record Keeping: Forms and Checklists

Your biosecurity plan will require that records are kept for different aspects of farm operation. The objective is to record all information necessary to trace and determine the origin of pest or disease in the event of an outbreak. Record management should collect only necessary information and be as simple and practical as possible.

- Maintain records to trace stock, and their associated health status, onto, within or from the farm.
- Maintain records for all aspects of the biosecurity plan (e.g., staff training, inspection and maintenance of farm infrastructure and equipment, visitor logs).

*All record keeping must comply with any relevant legislation*

### 2.4.3 Equipment

If new equipment is being put in place on the farm it should be labelled and farm staff should understand proper use and maintenance (for example, use of foot baths and procedures for refreshing disinfectant). In some cases, use and maintenance of new equipment may need to be supported by an SOP.

### 2.4.4 Signage

Your biosecurity plan may require that new signs be erected at access points, to label different production areas and to identify restricted areas.

Step 16: Create and modify protocols to agree with the new biosecurity plan.

### 2.4.5 Training

Staff training and consultation will be critical for effective implementation of your biosecurity plan. The facility must have a biosecurity manager, responsible for creating, maintaining, and reviewing the biosecurity plan, associated documents and activities including staff training. It is important that staff are trained before starting to work in the farm and understand their responsibilities under the farm biosecurity plan. Staff consultation in developing new procedures may improve practicality and efficiency but do not change practices simply because they are inconvenient (e.g., changing boots between buildings, required foot bath contact time).

A training record to ensure staff training is not overlooked is needed. It will also remind you to refresh training regularly (annually at a minimum), as well as after you update any procedures or associated documents. Training records can be also used to document additional role-specific training such as sample collection, packaging, and submission.
Provide all staff with a hatchery biosecurity induction and ongoing biosecurity training relevant to their role should occur. Document this and ensure it encompasses.

Step 17: Train staff, contractors, and visitors about protocols associated with the biosecurity plan.

## 2.5 Monitoring and Self Auditing

Monitoring and reviewing the biosecurity plan are the ongoing processes by which the risk management measures are continuously audited to ensure that they are achieving the intended results. The aspects of the review need to be considered: internal disease, pass events, scientific review, and updating of risk analyses. Fish health managers have the main responsibility, however the farm owner must consider the budget regarding staff, money, and time to achieve the plan.

Step 18: Document how biosecurity plan guidelines will be addressed on your farm.

The plan should also describe how the implemented biosecurity measures are going to be assessed, with respect to both implementation, and targeted goals.

Step 19: Implement a review cycle for your biosecurity plan (self-auditing).

Your farm biosecurity plan should include a schedule for routine review. Have audits conducted on-farm biosecurity plans and their implementation at regular prescribed intervals. To ensure that the risks are regularly re-assessed, and the measures are adjusted accordingly, the recommendation are two meetings a year (after 6 month and 12 month of implementation).

Step 20: Have a successful farming operation.

# For additional information or inquiries contact the Ontario Animal Health Network

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