Food Authority

NSW GOVERNMENT

Shellfish wet storage system requirements:

Primary production and wholesale operations

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Introduction

Shellfish wet storage process

Shellfish wet storage is defined in the Australian Shellfish Quality Assurance Program (ASQAP) Manual as: “the temporary post-harvest storage of shellfish in containers or floats in tanks containing natural or synthetic seawater. Wet storage may be used to remove sand from, or to add salt to shellfish or to prolong quality attributes of the shellfish.”

Shellfish wet storage permits the submersion of harvested shellfish into tanks containing flowing saltwater which meets specific requirements outlined further in this manual.

The aim of wet storage is not to reduce food safety risk factors but rather is a means of extending shelf life of a perishable product (in this case bivalve shellfish) beyond that which normally would occur in the absence of the wet storage process. The process of submerging shellfish in water to reduce food safety risk factors is termed “depuration” and is a vital food safety reduction step necessary to render shellfish harvested from areas of known and/or potential pollution, safe and ready to eat. Both processes of wet storage and depuration are separate individual processes that are not synonymous. Depuration requirements are not covered in this document. For more information on depuration requirements please refer to the NSW Shellfish Industry Manual.

Wet storage of shellfish is a temporary holding process and does not constitute on-land aquaculture as shellfish are not receiving supplementary food throughout the wet storage process.

Wholesale shellfish wet storage has not been previously practised significantly throughout NSW; however, interest in the process is increasing rapidly due to the potential benefits during pollution events and long-term rainfall where shellfish harvest areas are closed for extended periods (see foodauthority.nsw.gov.au/industry/shellfish/status for current harvest area statuses). This increased interest has become a driver for innovation with several wet storage system designs being commercially created, which necessitates the need for a consistent approval process.

There are two main methods currently in use for shellfish wet storage, which are explained below.

1. All in / all out (quick dip method)

The all in / all out method is where a batch of shellfish are placed into a wet storage system as a single lot. Shellfish commence filtering and respiring. After a period of immersion shellfish are removed as a single lot from the system with a short extension of shelf life as a result. There is no minimum or maximum timeframe specified for this process. This process may be repeated; however, as the wet storage process causes shellfish to consume energy the shelf-life extension will diminish with every wet storage cycle. Businesses are encouraged to not exceed two wet storage cycles as shelf-life extension is compromised and shellfish mortalities may occur. Many existing shellfish depuration plants may be suitable for this method of shellfish wet storage following approval from the NSW Food Authority.

2. Extended wet storage using chilled water

The extended wet storage method utilises chilled water, typically between 8-14°C, which places shellfish in a stasis like state, reduces shellfish metabolic activity and respiration and assists in controlling temperature-dependent pathogens like *Vibrio* spp. and spoilage bacteria. Shellfish immersed in chilled water can be stored like this for multiple weeks and retrieved on an as needs basis to meet market demand. While further science and studies into shellfish wet storage residency time is required, anecdotal evidence suggests shellfish can be stored using chilled water for up to eight weeks if a wet storage system is appropriately designed and water quality is maintained. Businesses need to determine appropriate wet storage timeframes specific to their system and the species being stored.

Extended shellfish wet storage in recirculating systems require specialist and appropriately designed systems. In addition to disinfection units, the wet storage system may include chillers to control water temperature, filter systems and protein fractionators to address water quality concerns.

Aim of document

The aim of this document is to provide a clear and consistent approach to the shellfish wet storage approval process from a regulatory, manufacturer and buyer perspective, by outlining the requirements of shellfish wet storage.

This document is not an approval process and does not aim to provide approval if the recommendations in the document are adhered to. Approval to operate a wholesale shellfish wet storage system requires specific licensing with the NSW Food Authority and approval to operate, which is provided by the NSW Shellfish Program.

Biosecurity requirements

Use of wet storage systems have the potential to present biosecurity risk to the environment, economy and seafood industry of NSW if not correctly managed. Formal management measures built on a risk-based approach have been formalised and enforced in a General Biosecurity Direction under the NSW *Biosecurity Act 2015*. The measures have been developed collaboratively by a DPIRD and shellfish aquaculture industry working group. The proposed biosecurity measures differentiate shellfish wet storage systems into two separate classes based on risk, with tailored management measures for each class:

Class 1 High Risk

Stock from any source, including multiple estuaries, prohibited biosecurity movements, interstate or stock held with an unknown biosecurity risk.

Class 2 Low Risk

Stock from local origin (single estuary) or following existing permitted movements from within NSW.

On implementation the class of the system will be noted on the wet storage licence. All systems are subject to random inspections/audits as determined by NSW DPIRD Biosecurity and Food Safety Compliance team.

Export requirements

If shellfish held in the wet storage system are intended to be exported, the facility must be export registered with the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF). Further information can be found on the DAFF website: agriculture.gov.au/biosecurity-trade/export/controlled-goods/fish/registered-establishment.

Any wet storage systems within existing export approved packing facilities must have mechanisms in place to prevent wet stored shellfish from entering the export chain unless the wet storage system is approved by DAFF.

Approval process

The approval to operate a wholesale shellfish wet storage system is multifaceted and lies within the remit of the NSW Food Authority. Operation of a shellfish wet storage system is prohibited until a formal licence has been issued to cover this activity from the NSW Food Authority.

Businesses are encouraged to contact the NSW Food Authority - Shellfish Program at food.nswsp@dpird.nsw.gov.au or (02) 6552 3000 - option 2 prior to purchase or constructing a wet storage system. It is often easier and financially beneficial to discuss options at this design stage to

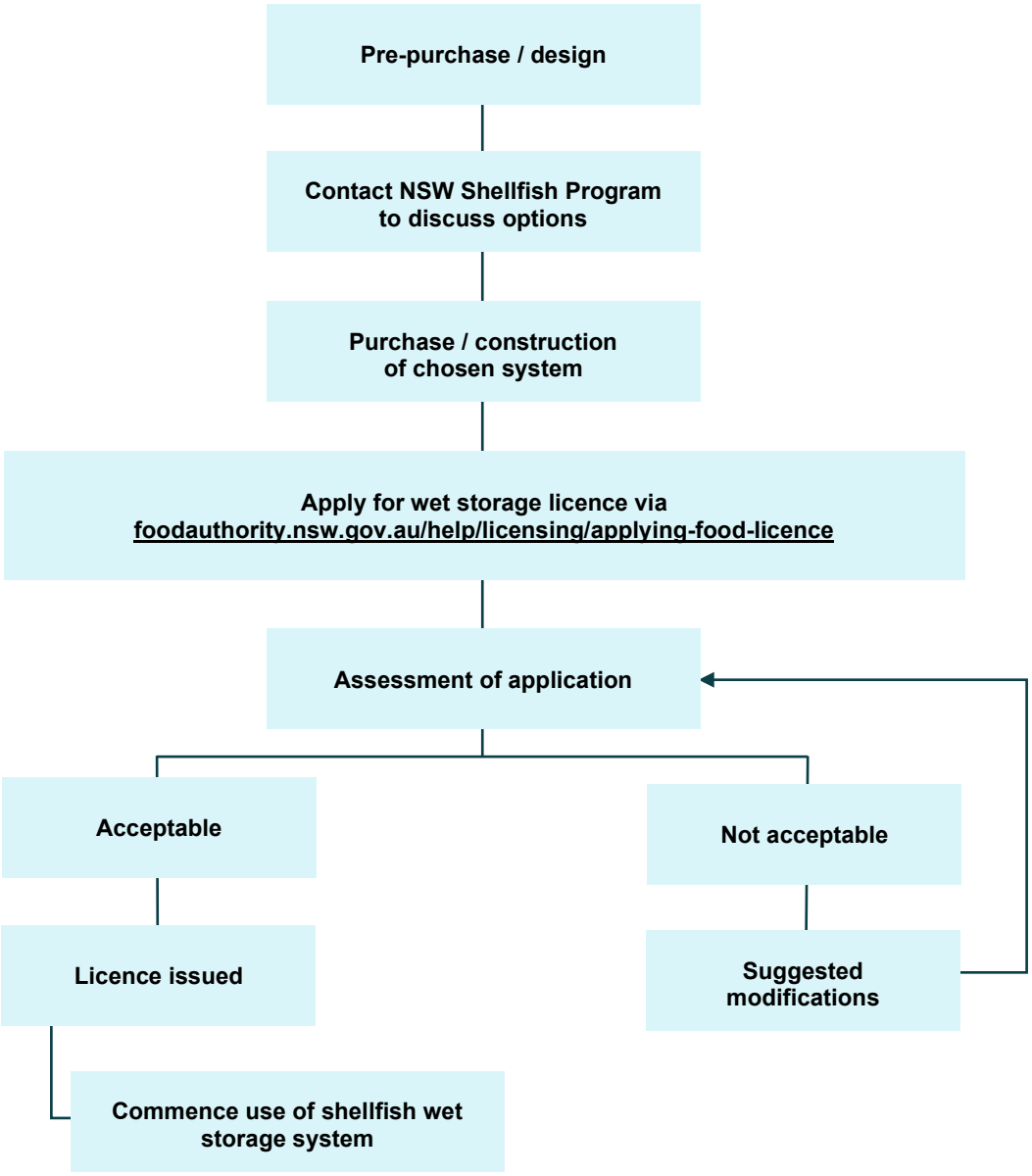
make allowances and modifications to wet storage system design which will likely meet regulations than it is to purchase or construct a system that may not meet requirements.

Once a business is satisfied the system design meets intended purpose the business can apply for a Seafood Business Licence to cover the operation of a wet storage system (see foodauthority.nsw.gov.au/help/licensing/applying-food-licence for more information and to apply). NSW Food Authority licensing staff can be contacted at admin.bfs@dpird.nsw.gov.au or by calling 02 6552 3000 - option 1. Note that a $50 application fee applies to all wet storage licensing applications.

During this application period the NSW Shellfish Program will assess the wet storage system *in-situ* and in operation with findings of the system either acceptable, or not acceptable, or will suggest modifications to meet requirements. Once modifications have occurred the system can be re-assessed.

Once a business has received a wet storage licence permission from the NSW Food Authority, use of the shellfish wet storage system is permitted in accordance with any conditions of licence.

Figure 1: The wet storage system approval process.



Wet storage system assessment

Shellfish source

As wet storage is a process step intended to increase shelf life of a food which is ready to eat, thorough consideration must be given to shellfish being sourced from areas where a quality assurance program is in effect. Shellfish intended to be wet stored must only be sourced from areas in the open status that are classified as “Approved, Approved Remote, Conditionally Approved or Off-shore” or from areas in the open status that are classified as “Restricted or Conditionally Restricted” after being subject to effective depuration[1] according to ASQAP.

[1] ASQAP 8.3.4

Shellfish from different harvest areas and/or different batches must not be co-mingled together during wet storage[2]. If more than one batch of shellfish is being held in a wet storage system at the same time the identity of each batch must be maintained[3].

Shellfish are not to be mixed with other non-bivalve shellfish in the same tank. Where multiple tank systems use a common water source the water must be effectively disinfected prior to the entering tanks containing shellfish[4]. It is imperative in multi-species wet storage systems that tanks containing shellfish are first inline to receive water after being disinfected to prevent potential contamination from other species being wet stored.

Any dead, damaged or compromised shellfish must be discarded prior to being placed in a wet storage system[5].

Required	• Shellfish must be sourced from harvest areas in the open status classified as either Approved, Approved Remote, Conditionally Approved, Off-Shore, Restricted (following depuration) or Conditionally Restricted (following depuration). • Shellfish must not be co-mingled. • Shellfish batch identity must be maintained. • Shellfish must not be mixed in the same tank as other non-bivalve shellfish. • Any dead, damaged or compromised shellfish must be discarded prior to wet storage.
Best practice	• In multi-species systems bivalve shellfish tanks are first inline after the disinfection step. • Any dead stock must be removed from the system.
Biosecurity considerations	• Unexplained mortality of stock in systems must be reported to NSW DPIRD (via EAD Hotline 1800 675 888; or by contacting a local Fisheries Officer or Authorised Officer). • Shellfish sourced from local (single origin) estuary or following existing biosecurity requirements for movements within NSW will be classified as Class 2 Low Risk. All others will be considered Class 1 High Risk. • Class 1 High Risk — Stock is not to be returned to any NSW waters. • Class 2 Low Risk: — If not sold to market, shellfish may be returned to the estuary of origin, or any estuary permitted by existing shellfish shipment and biosecurity regulations.

[2] ASQAP 8.3.8; Food Standards Code 4.2.1

[3] ASQAP 8.3.9

[4] ASQAP 8.3.10

[5] ASQAP 8.3.7

Water requirements

Source water

Wet storage systems vary considerably in design, functionality, and operation, and may not be near a suitable water source. While many systems are housed in existing shellfish business sheds adjacent to suitable water sources, some systems are portable. Others are large scale semi-industrial, which require dedicated buildings to house them often in commercial business districts well away from accessible water sources. The water used for wet storage is a critical factor in ensuring shellfish remain uncontaminated and safe for human consumption. Not all water is suitable for the purposes of shellfish wet storage and careful consideration must be given to obtaining water for use in a shellfish wet storage system. As wet stored shellfish are considered ready to eat the product must, at all times, be protected from physical, chemical, biological and thermal conditions that may compromise the shellfish quality or survival during wet storage. Factors such as temperature, salinity, turbidity and dissolved oxygen need to be carefully considered[6].

Consideration is to be given to source water that optimises shellfish safety. Source water from a water body likely to compromise shellfish safety must be avoided, for example highly urbanised waterways, adjacent to sewage outfalls, adjacent to heavy industry, adjacent to busy boat ramps or jetties, or following heavy rainfall[8]. Sourcing water on an incoming tide is preferable as water quality is generally higher during this time.

There are a few options available for sourcing water for shellfish wet storage, as outlined below.

Water from “Approved” areas and in the open status[7]

Water may be pumped and/or collected from an existing shellfish harvest area formally classified as “Approved” or “Conditionally Approved” by the NSW Shellfish Program when it is in the open status. Water sourced from these areas can be used in a flow through wet storage system. A flow through system draws water from an “Approved” or “Conditionally Approved” shellfish harvest area, which is in the open status, and circulates this water through a tank holding shellfish prior to discharge back into the estuary at the other end. No further disinfection of the water is required.

This water may also be used in a re-circulating system with continual disinfection.

Water from “Restricted” areas and in the open status[8]

Water may be pumped and/or collected from an existing shellfish harvest area formally classified as “Restricted” or “Conditionally Restricted” by the NSW Shellfish Program when it is in the open status but must be disinfected prior to entering the wet storage system. If the disinfection system is plumbed in-line prior to entering a tank holding shellfish, then a flow through system using water from an open “Restricted” area may be permitted pending testing[9] to prove efficacy of the disinfection system.

This water may also be used in a re-circulating system with continual disinfection if it can be disinfected prior to entering a wet storage system.

Water from non-classified shellfish growing areas or classified harvest areas in the closed status[4]

Water may be collected from outside established shellfish growing areas or shellfish growing areas in the closed status pending tests to prove the source water is suitable for shellfish wet storage. Testing of the source water is required prior to entry into a shellfish wet storage system and must not exceed 70cfu/100ml for faecal coliforms prior to disinfection[10] and may be subject to additional testing[9]. If the

[6] ASQAP 8.3.6

[7] ASQAP 8.3.13; Food Standards Code 4.2.1; NSW Shellfish Industry Manual 5.1

[8] Food Standards Code 4.2.1

[9] ASQAP 8.3.14

[10] NSW Shellfish Industry Manual Part 6 Table 3

chosen disinfection treatment is via ultra-violet light the turbidity of the source water must not exceed 20 nephelometric turbidity units[11]. Consideration is to be given to salinity of the source water as different shellfish species have preferred salinity ranges for survivability. Source water must not interfere with the safety and suitability of the shellfish[8].

Artificial or reconstituted seawater

The use of artificial or reconstituted seawater may be used pending a written statement from the supplier of artificial seawater mixes stating suitability for use in food production which must be made available on request; and the salt mix is reconstituted with potable water. It is important to note that aquarium level artificial seawater mixes may contain additives that will not meet the standards required to be used for food production.

Containers used in the collection of water destined for shellfish wet storage must be non-toxic, non-corrosive food grade that have never stored or transported chemicals and/or materials which would likely render food unsafe for immediate consumption.

Required	• Water sourced from: — an “Approved” or “Conditionally Approved” shellfish harvest area in the open status; or — a “Restricted” or “Conditionally Restricted” shellfish harvest area in the open status (with continual disinfection) and disinfected prior to entering the wet storage system; or — outside formally classified shellfish growing areas or shellfish growing areas in the closed status (with continual disinfection) • Must not exceed 70cfu/100ml. • Must not exceed 20ntu turbidity if UV disinfection is used. • Artificial or reconstituted seawater must be accompanied with a statement from the manufacturer confirming use in food production. • Containers used in transport of water must be food grade.
Best practice	• Salinity is commensurate with shellfish species preferred range. • Seawater is best collected at high tide.
Biosecurity requirements	• Each system must have separate water flow, with water from Class 2 systems to remain separate from Class 1 systems at all times.

Storing water

Storage tanks are used to store water and act as settling tanks to reduce turbidity prior to water entering a wet storage facility. Storage tanks also allow the ability to continue wet storage using stored water during times when source water locations are either closed for taking water or are not conducive to drawing water for wet storage purposes. It is preferred that water being filled into storage tanks is disinfected to ensure water quality is maintained whilst being stored. Disinfecting water prior to being stored may also extend its shelf life. Stored water should be monitored regularly for odour and discolouration. If stored water is cloudy or has an odour it should be discarded and not used.

Storage tank outflow pipes should be raised off the floor of the tank to avoid sediment being piped into a wet storage system which may increase turbidity, introduce particulate matter and reduce disinfection efficacy.

[11] ASQAP 8.3.15

It is preferable to have a drain hole located lower than the outlet pipe to enable built up sediment to be flushed out of the storage tank.

Best practice	• Water is disinfected prior to being stored. • Outlet pipe is raised off the floor of the storage tank. • A drain hole is lower than the outflow pipe to allow thorough cleaning.

Ongoing testing of water

Water used for shellfish wet storage is permitted to be re-circulated and re-used pending a sufficient water disinfection method is continuously in use. Water re-circulated for greater than one calendar month is required to be tested for faecal coliforms from a sample taken from the inlet to the tank and must return a result of not detected in 100ml. Water must be discarded if this level is not achieved.

Required	• Water must be sampled monthly for faecal coliforms if continuously re-circulated and must return a result of not detected in 100ml.

Disposal of water

Disposal of water post wet storage is generally regarded as no concern to food safety, however significant biosecurity concerns may be applicable depending on the species and source location of shellfish stored within wet storage tanks. Biosecurity concerns surround shellfish species sourced from known QX or Pacific Oyster Mortality Syndrome (POMS) declared areas or from interstate and contact with NSW DPIRD Aquatic Biosecurity is required if shellfish are sourced from these areas.

Similarly, disposal of salt water into a sewerage system is often prohibited by many local councils or water authorities and contact should be made with these regulatory bodies to seek approval to dispose of wastewater into sewer.

Best practice	• Contact NSW DPIRD Aquatic Biosecurity and/or local council or water authority to seek approval to dispose of wet storage wastewater.
Biosecurity requirements	• All systems must have the ability to isolate wastewater in the event of a system failure or stock issue. • Class 1 High Risk system wastewater must be either discharged to a municipal sewerage or wastewater treatment facility, or directly transported to a sewerage or wastewater treatment facility, or held in a wastewater tank and treated prior to release from the facility, by first: — removing all organic waste and disposing to landfill, followed by — treatment with chlorine at a minimum rate of either: • 200ppm available chlorine for 2 hours; or • 30ppm available chlorine for 24hrs, followed by — neutralisation of chlorine prior to discharge, via either: • application of sodium thiosulfate, or • vigorous aeration for 24 hours. You must obtain appropriate approvals before discharging wastewater.

Design and plans

Wet storage systems vary considerably in design and as discussed in the approval process section above, it is commonplace for manufacturers, buyers and operators to seek approval prior to purchase or construction. A formal approval to operate a wet storage system cannot be granted prior to a full system assessment; however, thorough discussion with the NSW Food Authority – Shellfish Program on intended purchase of off the shelf systems or designs of bespoke systems can oftentimes alleviate any post installation modifications required to meet final approvals.

Best practice	• Contact NSW Shellfish Program prior to purchase of an off the shelf system or at the design phase of a bespoke system.

Building requirements

General building requirements

Wet storage systems are required to have effective barriers to prevent entry of birds, animals and pests[12]. It is preferable to have wet storage systems situated inside a lockable building which may assist in limiting microbiological concerns, prevent unauthorised access and aid in temperature control. Where this is not possible, and systems are not inside a building, they must have covers, lids or other effective barriers to prevent entry of birds, animals, and adequate security to prevent unauthorised access[13].

Buildings containing wet storage systems must have adequate ventilation to allow surfaces to dry[14] and have adequate draining of surrounding grounds[15].

Wet storage systems should be stable and are not to be moved throughout the wet storage process so as to prevent resuspending waste material, pseudo-faeces and bacteria leading to potential contamination of shellfish.

The area surrounding a wet storage system must be, to the extent practicable, free from conditions that would provide harbourage of pests[16] and have adequate pest control measures in place to ensure pests are not present in the building[17].

Wet storage tanks must not be used for any other purpose unless approved by the NSW Food Authority (for example, depuration), including the storage of equipment not used in the wet storage process. It is vital that wet storage tanks are kept free from contamination likely to impact shellfish.

Required	• Effective barriers to prevent entry of birds, animals and pests. • Adequate security to prevent unauthorised access whilst in operation. • Adequate ventilation to allow surfaces to dry. • Free from conditions likely to harbour pests. • Adequate pest control measures.
Best practice	• Inside a secure building.
Biosecurity requirements	• All systems must be enclosed. • Class 1 High Risk systems:

[12] ASQAP 8.3.2

[13] NSW Shellfish Industry Manual 8.15 a)

[14] NSW Shellfish Industry Manual 8.12 f)

[15] NSW Shellfish Industry Manual 8.12 i)

[16] NSW Shellfish Industry Manual 8.12 k)

[17] NSW Shellfish Industry Manual 8.12 j)

	— must be installed within an enclosed facility, to prevent interaction with the environment, predatory animals or tampering by unauthorised personnel. — located away from NSW waters in a dedicated lockable land-based enclosed facility, so that no unauthorised personnel can access the system, untreated wastewater associated with the system cannot reach a waterway, any other stock or equipment. — personnel and facility hygiene required: 'Biosecurity Area' signage at entrance, footbaths or shed boots at entry/exit points, personnel PPE (gloves and sanitiser). • Class 2 Low Risk systems: — if installed outside, these systems must be covered with lids to isolate any exposed production systems.

Toilets and hand washing facilities

All wet storage facilities must have access to adequate toilets and hand wash facilities[18]. If toilets are located within the building, they must be physically separated by walls or barriers from the wet storage system. If toilets are nearby, demonstrated evidence is required to show access. Hand washing facilities must be easily accessible with soap and running water provided.

Required	• Must have access to an adequate toilet. • Hand washing facilities must be easily accessible and have soap and running water. • Toilets must be physically separated from wet storage system area.
Best practice	• Soap dispenser and disposable paper towel.

Lighting

In order to allow safe operation and use of a wet storage facility and to visibly observe shellfish, adequate lighting must be supplied. Natural light should not be the only source of light available. Adequate artificial light is required for use during the night or at low light periods. When using artificial light, all light fixtures must be covered to prevent accidental breakage and potential contamination of the shellfish[19]. It is preferable that lighting fixtures are not positioned directly over the wet storage system but rather in areas where it will not contaminate shellfish if accidental breakage occurs. Modern LED light fixtures are encouraged as breakage and glass contamination is less likely to occur compared to incandescent or fluorescent light bulbs.

Required	• Sufficient artificial light to visibly notice shellfish open and filtering. • Covers on all light fixtures.
Best practice	• Light units are not placed directly over the wet storage system. • Use of LED lights.

[18] NSW Shellfish Industry Manual 8.12 g)

[19] NSW Shellfish Industry Manual 8.15 e)

Product and chemical separation

In order to prevent co-mingling of shellfish, an adequate area for separating product intended to be wet stored is required[20]. It is preferable to have a solid barrier to separate product such as walls or partitions.

Storage of items that may potentially be a source of contamination must be adequate. This includes chemicals, pest control measures, poisons or any item with the potential to contaminate shellfish either within or outside the wet storage system. It is preferable if potentially hazardous items are separated with impervious physical barriers in order to prevent contamination of shellfish.

Required	• Adequate area for separating product. • Adequate storage of items that may potentially be a source of contamination.
Best practice	• Separate room or physical barrier for separating product. • Separate room for storing items that may potentially be a source of contamination.
Biosecurity requirements	• Where a Class 2 system is to be held in a facility with Class 1 system, it must be isolated from the Class 1 system, with separate water flows for each system and use dedicated or suitably decontaminated equipment.

6.4.5. Floors, walls and ceilings

Buildings containing wet storage systems must be of a construction that allows for easy cleaning of floors, walls and ceilings (where present) and have floors that are constructed so that there is no ponding of water[21]. Floors should slope towards drainage points to prevent water ponding and the potential for shellfish to be placed within this pooled water. It is preferable for the walls, floors and ceilings to be lightly coloured to ensure they are visibly clean.

Required	• Floors, walls and ceilings to be easily cleanable. • Floors to slope toward drainage points.
Best practice	• Lightly coloured to ensure cleanliness.

[20] NSW Shellfish Industry Manual 8.15 b)

[21] NSW Shellfish Industry Manual 8.12

Wet storage system construction

Water disinfection

Water disinfection is paramount to ensuring water used in the wet storage process maintains a high-level sanitary status for all recirculating systems. Recirculated water used in wet storage must be continuously disinfected or otherwise treated so that water does not affect the safety and suitability of the shellfish[8]. Regardless of the water disinfection method used it must not exceed the maximum flow rate stated by the manufacturer. Prior to approval of any disinfection method the animal and human health risks for toxic by-products from the disinfection process must be considered[22].

Ultraviolet (UV) light is the most common method of water disinfection used in wet storage facilities due to availability, size, ease of use and serviceable parts. The size of the UV light must be commensurate to the size of the wet storage system to ensure recirculated water is thoroughly disinfected.

Some UV light units in the aquarium market are not appropriate for use in food production and consideration is to be given when choosing an appropriate UV light. UV-C or germicidal wavelength UV lights are suitable, and certification can be provided by the manufacturer that the unit can effectively remove at least 99.9% (3-log reduction) *of E.coli* in water in a single pass.

UV light lamp life is to be strictly adhered to through manufacturer's recommendations or when the UV output is 80% of the original lamp rating (note: testing of UV lamp intensity requires specialised equipment and safety requirements). If unsure about the UV lamp intensity it is best to replace the lamp. Old UV lamps of unknown age are not to be used. Old lamps can be characterised by having stains on the glass or quartz tube (yellow, pink, brown or red stains); cracked, melted, burnt or loose end caps; and blackened sections of the tube. If a UV tube is noticed to exhibit any of these characteristics, then the lamp is to be replaced immediately.

An alternative method of water disinfection is ozone treatment; however, this method of water disinfection is less common due to high capital and running costs and potentially toxic elements being created in the process.

Required	• Recirculated water used in wet storage must be continuously disinfected or otherwise treated so that it is safe and does not interfere with shellfish survival, quality, or activity. • Flow rate throughout a wet storage system must not exceed the chosen water disinfection method efficacy. • Animal and human health risk for toxic by-products of any disinfection process is considered. • UV light, if used, is capable of 99.9% (3 log reduction) kill of E.coli. • UV light, if used, is UV-C or germicidal wavelength.
Best practice	• UV light lamps, if used, are replaced at manufacturer's recommendations or when UV output is 80% of the lamp rating.

Shellfish holding tanks and bins

Wet storage tanks and bins used to hold shellfish can be constructed of numerous building materials. Common materials used include, but are not limited to, food grade plastics, fibreglass, masonry bricks which have been covered in a food grade epoxy resin and high-density polyethylene. Any tank or bin holding shellfish must be food grade, non-toxic and corrosion resistant[23]. Porous material, such as masonry bricks and wood, must be fully enclosed in a food grade material to make it impervious. The

[22] ASQAP 8.3.18

[23] ASQAP 8.3.3

internal surfaces should be smooth faced, free from irregularities and open joints and preferably rounded at the junction of the sides and base to allow easy cleaning.

To allow ease of cleaning all tanks or bins must be self draining[22].

Adequate clearance between the bottom of the tank or bin and containers holding shellfish must be maintained to ensure shellfish are not contaminated by waste material, pseudo-faeces or particulate matter which accumulates at the bottom of the tank[24]. It is common for tank style holding systems to have raised ridges that run the length of the tank built into the tank base to allow waste material to be swept away by water currents and to avoid deposited waste material and sediment being re-suspended into the water column and potential contamination of shellfish in the tank. It is recommended that tanks that do not have built in ridges employ some means of preventing containers holding shellfish sitting directly on the bottom of the tank. Small diameter PVC electrical conduit is commonly used for this purpose. When raising shellfish off the bottom of the tank the method used must not run the width of the tank as water flow hits the object and can re-suspend waste material. For bin style shellfish holding systems it is recommended that a sufficiently perforated false floor or other means or allowing waste material, pseudo-faeces and particulate matter to fall through to avoid potential contamination of shellfish.

Shellfish being wet stored must be held within containers which are designed and constructed so that they allow the free flow of water to all shellfish within the container[25]. Shellfish are not to be placed directly into a wet storage system without being contained.

No rust or exposed porous areas are to be visible on the inside of the tank. If rust exists outside the tank, it should be removed or painted to prevent it spreading or flaking into the tank.

It is preferable to have all tanks or bins lightly coloured to easily identify cleanliness.

Required	• Tank or bins fabricated from non-toxic, corrosion resistant food grade, non-porous materials. • Adequate clearance between tank or bin floor and containers holding shellfish. • Shellfish holding containers must allow free flow of water to all shellfish within the container. • No rust or exposed porous areas.
Best practice	• Lightly coloured to ensure cleanliness. • No open joints within the tank. • Junction between the wall and floor of the tank or bins is smooth.

Pipes and connections

All pipes and connections used in the wet storage process must be non-corrosive, nontoxic, food grade materials (plastic pipes stamped with AS 1477 are suitable) and are maintained in a condition that will not contaminate shellfish[26]. The most common pipes used are PVC pipes and connectors. Black agricultural pipe is not food grade and is therefore prohibited for use. Clear pipes are to be avoided as algal growth may occur on the inside of the pipe if exposed to sunlight. Pipes should be installed in such a way that they are able to self-drain. Dead end pipes that fill with water and become stagnant should be prevented.

[24] ASQAP 8.3.11

[25] ASQAP 8.3.12 & NSW Shellfish Industry Manual 8.15 d)

[26] NSW Shellfish Industry Manual 8.15 c)

Required	• All pipes and connections must be food grade material that is non-corrosive.
Best practice	• No pipes with dead ends which could harbour stagnant water. • Pipes are able to self-drain. • No use of clear pipes and hoses.

Pumps

Pumps used in the wet storage process must be saltwater resistant with the most commonly used pumps being those used in saltwater swimming pools. Working parts should be free from corrosive materials. Due to the harsh saltwater environment the life expectancy of pumps is generally low (2-3 years) and as such it is one of the more commonly replaced pieces of equipment in a wet storage facility. If a new pump is required, the flow rate should approximately match the old pump to ensure no major changes occur to the flow rate and hydraulics of a wet storage system.

Pumps used in wet storage systems must be large enough to ensure that water movement is constant and does not exceed the water disinfection unit capacity. It is preferable to have a flow rate which permits continual circulation with minimal turbulence to allow waste material, pseudo-faeces or particulate matter to settle out and prevent it from being re-suspended.

Required	• Pumps must be resistant to saltwater exposure. • Pumps must have sufficient flow rate to ensure constant water movement but not to exceed the water disinfection unit capacity.
Best practice	• Pump working parts should be free of corrosive materials. • New pumps to closely match the flow rate of the old pump. • Flow rate is continual with limited turbulence.

Spray bars

Spray bars may be installed to ensure water is entering the wet storage tank along its width to provide uniform flow.

Due to the often-forceful spray of water entering a wet storage system a zone of turbulence is often created. Shellfish are not to be placed within a turbulence zone and exposed to conditions unsatisfactory for shellfish filtration and suspension of sediment and waste material.

Where spray bars are not in use the means of water entering a wet storage tank should prevent the suspension of particulate matter throughout the tank.

Best practice	• Shellfish not placed directly within a turbulence zone.

Dissolved oxygen

Dissolved oxygen concerns are limited in a well-designed wet storage system. Where the “all in / all out” wet storage method is used, shellfish are not submerged long enough for dissolved oxygen in the water to be depleted to levels likely to compromise shellfish safety. Where the “extended wet storage” method is being used the water is chilled which reduces shellfish metabolic activity and dissolved oxygen consumption.

Some species of shellfish (mussels) have higher levels of dissolved oxygen demand which should be considered when wet storing these species. If wet storage utilising deep sided holding bins is practised the level of dissolved oxygen at the bottom of these bins requires consideration. If air stones are used to

increase dissolved oxygen levels the air stones should be suspended above the floor of the tank or bins to prevent suspension of waste material, pseudo-faeces and particulate matter.

Best practice	• Air stones to be suspended above the floor of the tank or bin.

Biological filters

Biological filters are permitted in a wet storage system due to the potential for extended wet storage operations where nitrogenous compounds can build up to levels likely to compromise shellfish safety. Any biological filter material must be external to the tank or in a separate section of the tank not containing shellfish; and must not allow water flow to return back into the section of tank holding shellfish. Water from any biological filters must pass through the disinfection unit prior to entering the section of tank containing shellfish. Any filter material used must be easily and routinely cleaned and/or backflushed to ensure biological processes are maintained.

Protein fractionators (skimmers) may be used to remove excess build-up of waste material. Waste material captured by the fractionation process must be discharged from the wet storage cycle and is not permitted to re-enter the wet storage tank.

Required	• Biological filters must be either external to the tank holding shellfish or separated from the section of tank holding shellfish by an impervious barrier which prevents backflow into the main tank. • Biological filters must be cleanable and/or back flushable. • Biological filters must be inline prior to the disinfection step. • Protein fractionators if used must prevent captured waste material from re-entering the tank and should be drained off to waste.
Best practice	• External sand/bead filters with the ability to backflush to waste.

Changes to wet storage systems

Approval of a wet storage system is granted as a holistic approval for the entire system at the time of approval. It is understood that the life expectancy of certain parts of a wet storage system vary, and replacement parts will be required on an ongoing basis. Replacement of parts for likeness is an important consideration to ensure continued uniformity throughout the system and the approval for which it was given. Pumps, UV light lamps, filter material and chilling units are parts that may require replacement in time. It is recommended that replacement parts are within the same parameters of the original part.

Any changes to an approved wet storage system either in design or parts which differ from the original must be approved by the NSW Food Authority[27].

Required	• Any changes to a wet storage system must be approved by the NSW Food Authority.
Best practice	• Replace parts for likeness with original part.

Cleaning / washing / flushing regime

Cleaning of a wet storage system should occur on a basis frequent enough to ensure the safety of product being wet stored is not compromised. This will vary between systems and the preferred wet storage method. Wet storage systems utilising the “all in / all out” method should preferably be cleaned between each wet storage cycle; whereas wet storage systems utilising the “extended wet storage”

[27] ASQAP 8.3.2

method may be cleaned on a less frequent basis with consideration given for systems using biological filtration units. It is recommended that cleaning a wet storage system is conducted when water is replaced.

Water disinfection units should be cleaned and serviced as frequently as necessary to ensure effective water treatment[28]. To achieve this, it is recommended that water disinfection units are cleaned on a six (6) monthly basis.

Required	• Water disinfection units should be cleaned and serviced as frequently as necessary to ensure effective water treatment.
Best practice	• Wet storage systems are cleaned when water is replaced. • Disinfection systems should be cleaned on a six (6) monthly basis.

Backflushing

Backflushing biological filtration units is an important step to prevent compaction of filter material and reduced efficacy. Biological material should be backflushed monthly to ensure the filtration media does not clog, which can reduce efficacy and flow rate throughout wet storage systems. When backflushing biological filters, the use of chemicals likely to remove beneficial bacterial populations is considered. Where possible backflushing should occur with water used in the wet storage process or if this is not possible then potable water is used.

Best practice	• Biological filters are backflushed on a monthly basis with either water from the wet storage process or potable water.

Washing shellfish

Shellfish intended for wet storage should be thoroughly washed of all mud, sediment, debris and foreign matter prior to entry into a wet storage system in order to maintain the water quality within a wet storage system. Shellfish must be thoroughly washed with water meeting ‘Approved’ area classification or water meeting ‘Restricted’ area classification following disinfection prior to use or potable water standards[29].

Required	• Shellfish are thoroughly washed with water meeting Approved area classification or water meeting Restricted area classification following disinfection prior to use or potable water standards.

Record keeping

The wet storage process allows multiple batches of shellfish to be stored within a wet storage system provided traceability is maintained. Wet storage system operators must keep complete and accurate records to enable a batch or lot of shellfish to be traced back to the source of harvest[30]. If more than one batch of shellfish are being held in a wet storage system at the same time the identity of each batch is maintained[31]. This may be achieved using individual trays, baskets or mesh bags holding shellfish for each individual batch.

Any testing conducted on a wet storage system or water source to determine suitability of water supply must be maintained for a minimum of two (2) years[32].

[28] ASQAP 8.3.17

[29] ASQAP 8.3.7

[30] ASQAP 8.3.5

[31] ASQAP 8.3.9

[32] ASQAP 8.3.16

Required	• Keep complete and accurate records to enable a batch of shellfish to be traced back to the shellfish source harvest area. • If more than one batch of shellfish are held in a wet storage system at the same time the identity of each batch is maintained. • Any tests conducted on a wet storage system or water source are maintained for a minimum of two (2) years.
Biosecurity requirements	• Records of all stock and numbers of stock in/out of the system must be kept. • Where stock is to be obtained from another estuary, a completed copy of the oyster shipment logbook must be completed and submitted to NSW DPIRD no less than 48 hours and no more than 2 weeks prior to movement into the system.