CODEX ALIMENTARIUS COMMISSION

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World Health Organization

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Agenda Item 6 **CRD04**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON FOOD HYGIENE

Fifty-fourth Session

Nairobi, Kenya

11 - 15 March 2024

REPORT OF THE PHYSICAL WORKING GROUP ON THE DRAFT GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD PRODUCTION (ANNEX II ON FISHERY PRODUCTS AND ANNEX III ON MILK AND MILK PRODUCTS)

(Prepared by the European Union, Chile and the International Dairy Federation)

Background

1. A physical working group (PWG) was held on 10 March 2024 in Nairobi, Kenya immediately prior to CCFH54, chaired by the European Union and co-chaired by Chile and the International Dairy Federation to discuss the proposed draft Guidelines for the safe use and reuse of water in food production: Annex II on fish and fishery products and Annex III on milk and milk products.

General

2. The Chair began the session by presenting the outcome of the electronic working group (EWG) and the response to some general questions posed in the report of the group (EWG) (CX/FH 24/54/7).

3. The PWG supported the following changes as proposed by the EWG:

- a change to the title of Annex II to "Fish and fishery products" and the title of Annex III to "Milk and Milk products", to align with existing standards and with the different Annexes of these guidelines.
- a separate Annex IV on technologies, as it was considered to be horizontally applicable to the guidelines as a whole.
- to propose a restricted revision of the General Section and Annex I (fresh produce) of CXC 100-2023 with the purpose to make a cross reference to Annex IV for consideration by the plenary.

Annexes

4. The Chairs presented a revised version of the Annexes II (fish and fishery products) and III (milk and milk products), which had been amended based on comments provided in CX/FH 24/54/7Add.1 and various CRDs. Many editorial changes were made to the Annexes as well as several substantial changes. The PWG reviewed the Annexes, considered the proposed revisions and made additional changes as appropriate.

Annex II: Fish and Fishery products

5. The following issues were discussed at the PWG:

- New structure of Annex II for improved clarity and to align with the structure of Annexes I and III. The PWG did not oppose this change.
- A new paragraph 34: the purpose of this paragraph was to provide clarification on the decisions trees (DTs), subsequently presented in the annex. In this paragraph, changes in the text were made to clarify what low and high-risk level meant, and that the DT on aquaculture was relevant to both freshwater and marine aquaculture.
- The DTs in Figures 2 to 5: the chairs presented revised versions of the DTs to facilitate an improved understanding of these tools. Several comments were made on the wording of the text in certain boxes of the DTs, on the way to visually indicate the relative level of risk, on the questions related to storage at

4°C, on the relative level of risk indicated under certain scenarios and on the link between the arrow indicating an increasing level of risk and the outcome "water considered as fit for purpose".

6. The chairs made proposals to address these comments, but the PWG considered these changes were still insufficiently to enhance the clarity of the DTs. It was finally proposed and accepted to delete figures 3 and 5 and replace the existing text in points 8.1.2 and 8.1.4, to reflect the key content of the deleted DTs. The chairs agreed to propose such text to the plenary.

Annex III: Milk and Milk Products

7. Based on comments received, the chairs proposed to:

- move paragraphs 34 to 65 of Annex III to Annex IV, as it was relevant to the to the guidelines as a whole and not just Annex III.
- Make amendments to Annex IV to make clear which recommendations were for reuse of water and which ones to all uses of water.
- Amend the title of Annex IV to "*Specific recommendations on water fit-for-purpose assessment, water safety management and technologies for the use and reuse of water*".
- Propose additional examples of use of water as food ingredients in paragraph 20 of Annex III.

8. The PWG agreed to propose these changes to Annexes III and IV to the plenary, including further elaboration of Annex IV in a new EWG.

9. Additional discussion on Annex III included the following points:

- moving some definitions, no longer relevant of the remaining content of Annex III, to Annex IV.
- the addition of a second bullet point under 'potable water' in paragraph 20, which was added to reflect practices to use a minimum amount of water to recuperate the product in the pipeline; this is before the first rinsing is done, which is covered in the following bullet point.
- the paragraphs which would be moved to the Annex IV and replaced by references to sections 8 and 9 of the General Section of these guidelines and to the Annex IV (under development), noting. that comments received on these paragraphs should be taken into account when annex VI is further developed within an EWG.
- section 10 containing examples of fit-for-fitness water applications in dairy plants.

10. The PWG agreed that a revised version of annex III including these changes as well as changes consequent to comments received ahead of the session, would be forwarded as part of the report for consideration by the plenary.

Recommendations for the plenary

11. The PWG agreed to make the following recommendations to the plenary:

- To consider the revised Annexes II and III (without specific recommendations on water fit-for-purpose assessment, water safety management and technologies for the use and reuse of water) for advancement in the Codex step procedure,
- to establish a new EWG to further develop the proposed Annex IV '*Specific recommendations on water fit-for-purpose assessment, water safety management and technologies for the use and reuse of water'* for consideration at CCFH55.

Annex II: Fish and Fishery Products

1. INTRODUCTION

1. The fisheries and aquaculture sector plays an important role in the economy of many countries and water is a key element in the production and processing of fish and fishery products.

~~2. Water used in the production and processing of fish and fishery products can be obtained from many sources, namely: potable water from a public or private water supply system, fresh surface water, groundwater sources, harvested rainwater, seawater and brackish water, desalinated water, recycled water from production or processing step within an establishment or reused water originating from agricultural activities (e.g. hydroponics), etc.~~

~~3. These waters can be subject to many detrimental effects from climate change, pollution associated with population growth and development, and higher demands for food production and other uses (JEMRA 2021).~~

~~4.~~2. Fish and fishery products are generally regarded as safe, healthy, and nutritious foods. However, these products have been associated with infections and intoxications caused~~mediated~~ by viruses (e.g~~principally~~ norovirus and h~~H~~epatitis A), bacteria (e.g~~principally~~ *Vibrio* spp. and *Salmonella* spp.), protozoans (e.g~~principally~~ *Giardia lamblia*~~.~~ a ~~A~~nd *Cryptosporidium parvum*), marine biotoxins and helminths (e.g.~~principally~~ *Anisakis* spp.). The causes of such hazards~~fishery products safety concerns~~ are diverse, ranging from naturally~~-y –~~ occurring microorganisms and parasites to contamination of primary production environments and/or poor hygiene practices during processing and consumption. Depending on the pathogen, they can remain infectious in sources of water for a considerable period of time and affect the suitability of a site to produce or harvest fish and fishery products[1].

~~5.~~3. Water has multiple applications in the fisheries and aquaculture sectors, and water quality could impact the safety of the final product. This annex provides guidance on ensuring that the quality of water used in aquaculture and in fish and fishery products during processing on~~at~~ vessels and throughout processing facilities is fit-for-purpose.

~~6.~~4. There are multiple opportunities for reusing water in these sectors, especially in processing activities. To avoid the ~~use of~~ excessive use~~amounts~~ of water in production and processing of fish and fishery products, there is ~~also~~ a need to implement more sustainable practices for the management and efficient use/reuse of water resources. The type of application for reused water will determine whether that water is fit -for -purpose and/or a specific treatment is required before it can be used. (JEMRA, 2021).

~~7.~~5. A Water ~~fit~~ fit-~~for~~ for-purpose assessment, which encompasses the use of an appropriate level of comprehensive risk assessment and further risk management approach to the entire water supply from the catchment or source to its final use, may be an effective means to ensure ~~fit~~ fit-~~for~~ for-purpose water.

2. PURPOSE AND SCOPE

6. The purpose and scope of this annex is to provide recommendations for the microbiologically safe sourcing, use and reuse of water in production and processing of fish and fishery products for human consumption by applying the principle of 'fit for purpose' and using a risk-based approach. This annex also provides examples of Decision Trees for determining fit-for-purpose use and reuse of water.

~~8.~~

3. USE

~~9.~~7. This Annex is complimentary to and should be used in conjunction with the General section of these Guidelines and the following Codex Alimentarius standards:

- *Code of Practice for Fish and Fishery Products* (CXC 52-2003),
- *General Principles of Food Hygiene*: (CXC 1-1969),
- *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007),
- *Principles and Guidelines for the Conduct of Microbiological Risk Assessment* (CXG 30-1999),
- *Standard for live and raw bivalve molluscs* (CXS 292-2008),
- *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997),

[1] FAO & WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products – Meeting report. Microbiological Risk Assessment Series, No. 41. Rome. https://doi.org/10.4060/cc4356en

• *Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites* (CXG88-2016)*, and*

• *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG79-2012)

4. DEFINITIONS

~~10.~~8. Refer to~~See~~ the Gg~~g~~eneral part of these *Guidelines for the Safe Use and Reuse of Water in Food Production*.

~~11.~~9. Refer to ~~See~~ the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) for the definitions of fish, depuration, shellfish, aquaculture, extensive farming, intensive farming, fish farming, glazing and growing areas.

Evisceration~~ (gutting)~~: The removal of ~~gills~~, viscera, and other internal organs.

Fish and Fishery products: Any species of fish, including crustaceans, molluscs, ~~(including live bivalve molluscs),~~ marine gastropods, echinoderm, tunicates, or part of them intended for human consumption.

Processing facilities: A facility (vessel or on land establishment) where harvested fish and fishery products are depurated, processed, graded, and packed for further transportation and consumption.

5. WATER SOURCE

10. Water used in the production and processing of fish and fishery products can be obtained from many sources, such as:

a) drinking (potable) water from a public/municipal water supply system; or

b) other types of water, usually from private or independent supplies (operator's own supply or other), including, but not limited to:

c) freshwater from surface and groundwater sources.

d) harvested rainwater.

e) seawater and brackish water.

f) desalinated water.

g) recycled/reused processing water within an establishment recovered from a processing step within the operation.

6. WATER USE

6.1 Water use for aquaculture production

~~12.~~11. In aquaculture systems, the source of water used, varies according to the species, geographical location, and water availability. Seawater is used in marine aquaculture while inland aquaculture uses mainly surface and groundwater sources.. Depending on the geographical region, seasonality, proximity to marine dumping, industrial or sewage outflow (e.g., wastewater, storm water, sewer overflow), agricultural run-off and temperature, seawater can hold indigenous~~indigenous potentially~~ pathogenic microorganisms~~bacteria~~, such as *Vibrio* spp., that may require monitoring and control.

~~13.~~12. Food Business Operators (FBOs) should consider the following in assessing and managing water which is intended for use at rearing or harvesting:

• The use and reuse of water should be subject to a risk-based approach covering the whole water system from the source or catchment area, treatment and storage, distribution and up to the point of use (from "source to tap"). In this context, sanitary surveys/profiling and a water ~~fit~~ fit-~~for~~ for-purpose assessment may be important to determine if water is fit ~~-~~for purpose and the likelihood of contamination in the production and processing systems.

~~14.~~13. Characterization of surface or groundwater quality in extraction~~abstraction~~ points should be extended upstream, when possible, to include the whole water catchment area.

~~• Elaboration and implementation of~~A water fit-for-purpose assessment considering the specific waterborne hazards (e.g. marine microbiological contaminants) that may impact the safety and quality of the fishery product(s). Depending on the fishing ground of origin ~~In case of catchment of fish~~, seasonal and climatic factors affecting source water quality in the immediate area should be included.

6.2 Water use onboard vessels

~~15.~~14. Many different types and sizes of fishing vessels are used throughout the world for harvesting based on the environment and the types of fish and fishery products caught or harvested. Water use on ~~in the~~ vessels may vary from onboard preservation purposes to evisceration and further processing of the fish and fishery products. Onboard preservation can be done by chilling or freezing the fish and fishery products. The most common means of chilling is using ice. Other means are chilled water, ice slurries (of both seawater and freshwater), and refrigerated seawater, including brine freezers. When considering sources of water, including for the manufacture of ice, chilling, or cleaning in onboard fishing vessels, brackish water or seawater will be the natural choice for the water source.

~~16.~~15. If seawater is used on fishing vessels, it should ~~must~~ only be taken, where possible, from offshore areas that are some distance away from known pollution sources (e.g. sewage outflow) to ensure that the water is of suitable quality. ~~There should be no~~ cross-contamination between the point at which seawater is taken from offshore sources and ~~-~~wastewater streams, bilge water and engine coolant outlets from the~~on a~~ fishing vessel should be avoided.

~~17.~~16. It is essential that the seawater used is free from microbiological hazards that could pose risks to human health and the following recommendations should be considered:

- When seawater or refrigerated seawater is used for on board product preservation, the potential hazards (e.g. faecal pollution or contamination with indi~~endo~~genous marine flora) conveyed via the water should be considered in the further processing steps when not possible to treat water prior to use.

- ~~seawater known to have with high salinity and free from particulate material will increase seawater quality prior to treatment, since the level of presence of naturally occurring marine microorganism are associated with temperature and salinity as well as sediments~~.

- Water used in direct contact with fishery products during processing and preservation activities (such as washing whole fish and rinsing the fish cavity after beheading, evisceration, skinning, and trimming) should be fit for purpose and ~~don´~~should not further contaminate ~~add contamination to~~ the fish or fishery product.

~~.~~6.3 Water use at land-based processing facilities~~.~~

~~FISHERY PRODUCTS PROCESSING PLANT~~

~~18.~~17. Water is used in fishery products facilities for a variety of applications~~, including, washing fishery products, cleaning process areas, cooling, and other processing purposes such as brining, cooking and glazing~~. The characteristics of the process activity (e.g. direct contact with food) and the intended use of the fishery product (e.g. raw consumption or not) should be considered for the quality of water used. Water ~~used as ingredient or water~~ that comes into direct contact with fishery products or food contact surfaces should be fit for purpose. Water used as ingredient should be of potable quality.

~~19.~~18. The use of clean ~~non-potable~~ water is allowed during handling and processing, as long as its use does not add contamination, compromise the safety of the product(s). ~~or further processing stages can eliminate the hazard posed by the non-potable water.~~

~~20.~~19. Water use and reuse should be tailored to the particular conditions of the specific fish processing operation it is applied to, considering the operation's potential reusable water sources, the various applications of the reused water, available recovery and treatment technologies, and the capabilities of the operator.

~~21.~~20. In the fishery products ~~production and~~ processing facilities~~industry~~, some common examples of where water is used are:

- For washing whole fish and rinsing the fish cavity after beheading, evisceration, skinning, and trimming
- for purification, depuration, conditioning[2] or reimmersion, in the case of live bivalve molluscs.
- as an ingredient,
- to transport/convey fishery products,
- to wash, cool down and cook fishery products,
- to clean and sanitize facilities, utensils, containers, and/or equipment,
- to make ice,
- other processing purposes such as brining fish, glazing of frozen fishery products to maintain quality during frozen storage,

[2] Bivalve Molluscs Conditioning: Placing live bivalve molluscs in tanks, floats, or natural sites to remove sand, mud or slime and improve product acceptability (CXC 52-2003).

- for personal hygiene purposes,
- for non-food contact purposes.

~~22.~~21. If potable water is not available, or its use is not possible in the ~~production and~~ processing facility~~environment~~, a thorough identification of the risks linked to the water source is required and ~~minimum~~ quality requirements and criteria should be established using a~~based on~~ risk-based approach.

22. In any ~~production or~~ processing facility, care must be taken to avoid contamination of the potable water system with non-potable water from other sources. Non-potable water systems should be identified (for example, with labels or colour codes) and should not connect with or allow reflux into potable water systems. Contamination may occur for example, due to cross connections, backflows or back siphonage in the water plumbing systems because of~~and can result from~~ improper installations, or additions/modifications to the existing plumbing.

23. Before any processing~~-~~ stage at a fish and fishery products facility, water source of the water coming into direct or indirect contact with material or product, should be identified ~~must be sourced~~ and, where necessary, tested and treated so that it complies with appropriate standards and be fit-for-purpose.

~~24. The decision on whether to use fresh or seawater in land-based processing plants, will depend on several factors, such as the type of water available, the availability of a regular water supply, the location of the ice plant, etc.~~

~~25.~~24. Coastal sources, used for abstraction of seawater in land-based processing plants, cannot be guaranteed to be free from pathogens from the marine biota or from faecal contamination, and cannot be classified as fit-for-purpose sources for processing without the appropriate monitoring and control measures. ~~Seawater from offshore sources (geographically away from inland or inland pollution) is generally considered safe. However, depending on the geographical region and temperature, seawater can hold indigenous potentially pathogenic bacteria, such as *Vibrio* spp., that may require control~~.

~~**7. GENERAL RECOMMENDATIONS**~~

25. Where disinfection forms part of the water processing facility treatment or any other water treatment, the effectiveness should be validated.

~~26.~~

7~~8~~. WATER INTENDED FOR REUSE

~~27.~~26. Treated wastewater or recycled from fish processing or ~~water originating~~ from agricultural activities (e.g. hydroponics) may be reused, as long as the microbiological quality of the ~~waste~~ reused water is fit-for-purpose~~safe~~ and thoroughly controlled.

~~28.~~27. Water reuse can be made more efficient by targeting the water quality requirements to specific processes. Matching water quality requirements with the type of water to be use, requires an analysis of the hazards and the possible establishment of critical control points (CCPs) and an evaluation of the potential for contamination of the food products. Reuse of water in the processing facility should be integrated into existing Food Hygiene Systems ~~HACCP programs~~ alongside the development of frameworks for water reuse in food~~/production and~~ processing.

~~29.~~28. There are also multiple ways of reusing water in aquaculture, for example, integrated multi-trophic aquaculture systems, where multiple aquatic species from different trophic levels are farmed in an integrated fashion (e.g. finfish and seaweed)~~ with benefits such as improved efficiency and reduced waste~~. Another example is the aquaponic system[3], which integrates recirculating aquaculture and hydroponics into a single production system as is shown in Figure 14. These ways of reusing water should be considered for implementation of water fit-for-purpose assessment.

[3] More information on Aquaponic System could be found in FAO & WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products – Meeting report. Microbiological Risk Assessment Series, No. 41. Rome.
https://doi.org/10.4060/cc4356en

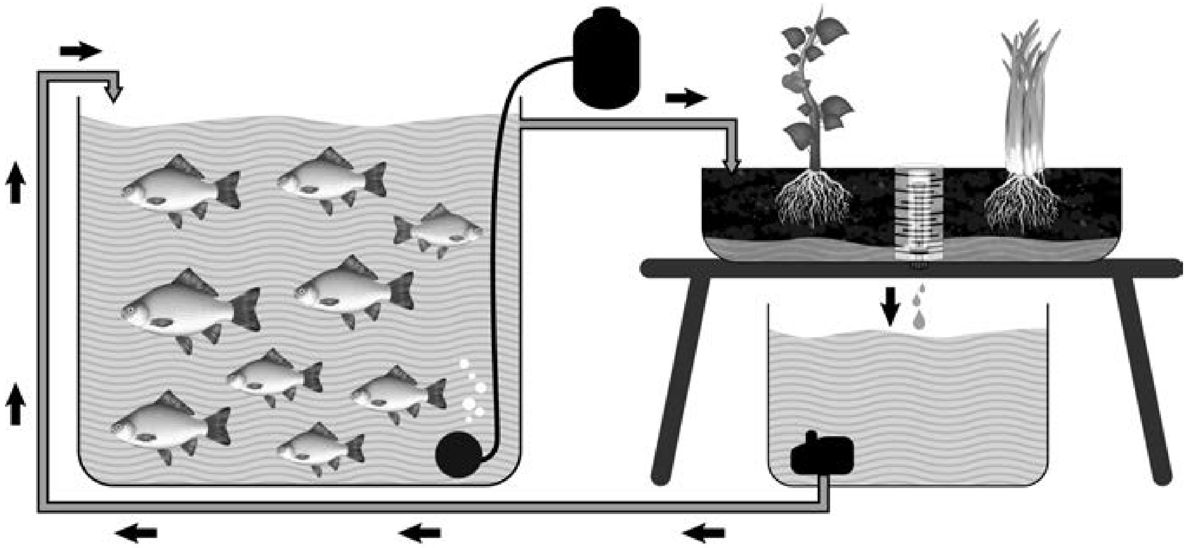


Figure 14: Schematic of a simple aquaponic unit[4]

8~~9~~. WATER USE OR REUSE ~~FIT~~ FIT-~~FOR~~ FOR-PURPOSE ASSESSMENT

~~30.~~29. Refer to section 7 of the general section and Annex IV[5] of this Guidelines

~~31.~~30. Any scenario aiming to implement water use or reuse in fish and fishery product processing should consider...~~Any water reuse scenario considered for implementation, should consider the following in assessing and managing microorganisms in water~~:

- ensuring the safety of water using a risk-based approach covering the whole water system from the source to the point of use ~~use~~, the end use of the food product (e.g. whether the food is eaten raw), and management options such as treatment options and their efficacy and the application of multi-barrier approach for risk mitigation~~;~~

- ~~elaboration and implementation of fit fit-for for-purpose assessment and management procedures and implement efficient monitoring plans; and~~

31. ensuring ~~fit~~ fit-~~for~~ for-purpose assessment considers the specific waterborne microbiological hazards (e.g. marine microbial contaminants) that may impact the safety and quality of the fish and fishery product(s) and other aspects that may affect the source water quality (e.g. groundwater quality in extraction points and upstream, seasonal and climatic factors)~~.~~ In evaluating risk of microbiological hazards in water, their risk should be based on local circumstances (e.g. based on epidemiological data), particularly where the water is used.

~~32.~~ Some of the most relevant biohazards and their relative risk which may be considered under a water ~~fit~~ fit-~~for~~ for-purpose assessment are listed in Table 1.

8.1. **Considerations and Examples of Decision Trees (DTs)** ~~to~~ on how to understand the level of risk of pathogens presence in water use and **identify possible critical control points (CCPs)~~-~~with regards to water quality for fish and fishery products, potentially eaten raw or undercooked**[6].

~~33.~~32. Recommendations on best hygiene practice related to the use and reuse of water in the Code of Practice for Fish and Fishery Products (CXC 52-2003) are considered sufficient to control the microbiological risk from such water when ~~in case~~ fish is eaten cooked. DTs may help to determine~~estimate~~ the need for the consideration of ~~possible~~ control measures to mitigate the risks, ~~CCPs~~ related to the use and reuse of water when the fish and fishery products are potentially eaten raw or undercooked.

33. Consideration of control measures ~~The possible CCPs~~ should aim at controlling (e.g. freezing as control measures for parasites) of the pathogens most significant for the fish production. These pathogens should be identified by a case-by-case assessment (e.g. based on epidemiological data). In case of marine or estuarine fish, *Vibrio parahaemolyticus* (Vp) is often of most concern but this highly depends on the

[4] Source: FAO. 2014. Small-scale aquaponic food production. Integrated fish and plant farming. FAO Fisheries and Aquaculture Technical Paper No. 589. Rome, FAO. https://www.fao.org/3/i4021e/i4021e.pdf

[5] Under development

[6] Based on Microbiological Risk Assessment Series 33. Safety and Quality of Water Used in Food Production and Processing Meeting Report. https://www.fao.org/publications/card/en/c/CA6062EN/

geographical origin/area where the seawater is collected. In case of freshwater and estuarine aquaculture, faecal (enteric) pathogens mostly represent the primary public health risk[7].

34. The DTs below provide examples on how to understand the level of ~~f~~risk of pathogens presence in water use in;

- aquaculture, (figure 2)
- ~~post-harvest handling and processing of freshwater fish,(figure 3)~~
- on-board handling/processing of marine or estuarine fish (figure 34) ~~and~~
- on-shore handling/processing of marine or estuarine fish (figure 5),

using a number of questions to be answered with yes or no. Each figure with an arrow pointing to the high or low risk represent levels of risk, not the absolute risks.

8.1.1 Example of DT to determine the risk of faecal pathogens in aquaculture (Adapted from Figure 4 of MRA33)

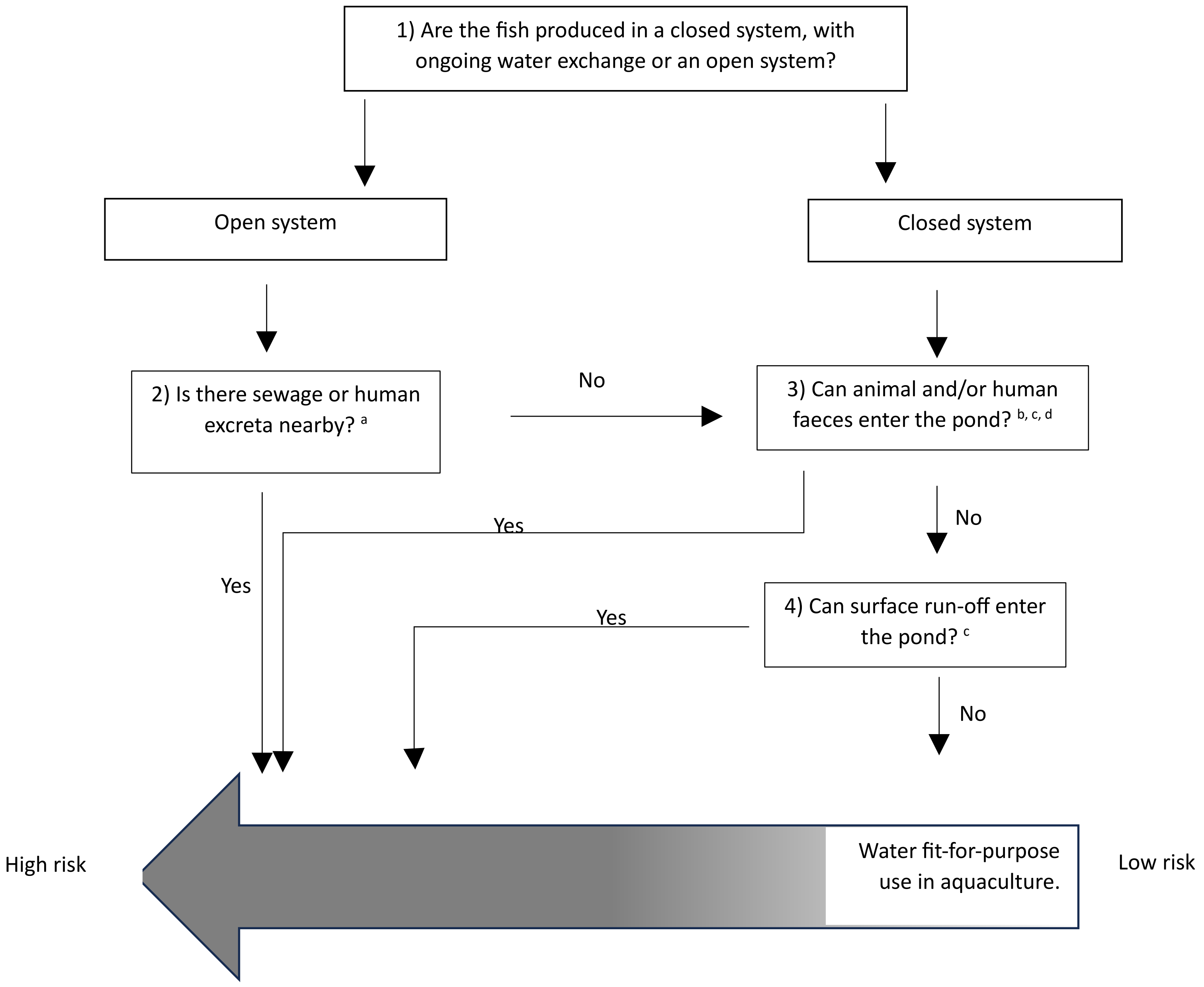
35. In case of production of fish in freshwater aquaculture, the DT in Figure 2 can be used to determine hazardous events (e.g. unacceptable presence of faecal pathogens) due to the use of water.

36. When one or several risk factors have been identified by the DT, the possible presence of faecal pathogens should be considered as a risk ~~CCP~~ until control measures have been introduced and validated. Detailed information on the possible control measures can be found in the FAO/WHO documents referred to by footnotes at different steps or in relevant national guides.

37. Seasonality may ~~refers to an~~ enhanced risk in case of periods with higher temperatures or rain events increasing the risk of surface run-off water entering the freshwater aquaculture.~~pond~~.

[7] Table 2 of MRA33 provides a list of some fish associated pathogens. However, the list of enteric pathogens is long and may include others such as *Escherichia coli, Salmonella, Klebsiella, etc.* to be assessed on a case-by-case basis.

Figure 2: Example of DT to determine the risk of faecal pathogens in aquaculture (*Adapted from Figure 4 of MRA33*)



a: WHO Sanitation Safety Plan Manual

b: Section 6 of the Codex Code of Practice for fish and Fishery products on aquaculture products

c: WHO Water Safety Plan. WHO/Europa 2014

d: WHO Safe Use of Wastewater, Excreta and Grey Water. Vol 3. Aquaculture

8.1.2 Considerations for post-harvest handling and processing of freshwater fish which will potentially be eaten raw or undercooked.

38. Keeping the fish at a low temperature (e.g. 4°C) is one of the most important measures related to fish preservation and microbial pathogen die-off after harvest.

39. Consideration to the possible presence of faecal pathogens due to the use non-potable water when descaling, evisceration and washing fish cavity. The risk on the use of non-potable water at this step should also be applied for contact surfaces (knives, cutting boards).

40. Consideration to Seawater pathogens (e.g. Vp) when cross-contamination can occur at this stage between freshwater and seawater products.

[**Figure 2: Example of a DT for post-harvest handling and processing of freshwater fish, including crustacean, which will potentially be eaten raw or undercooked** *(Adapted from Figure 5 of MRA33)*]

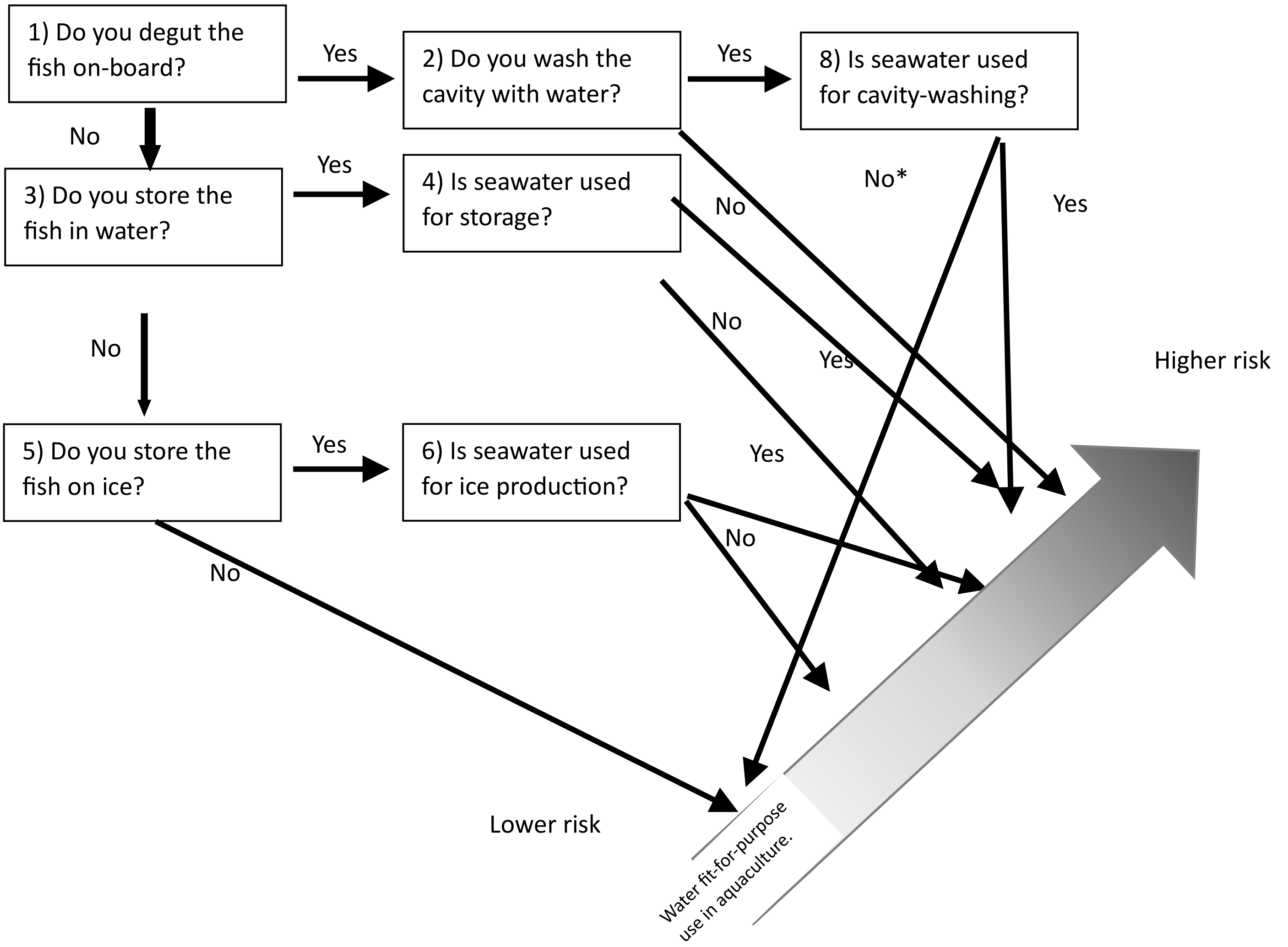
8.1.3 Example of decision Tree (DT) in case of on-board handling and processing of marine or estuarine fish potentially eaten raw or undercooked.

41. In case of on-board handling and processing of marine or estuarine fish, the DT in Figure 4~~3~~ can be used to determine~~magnitude~~ hazardous events (e.g. unacceptable levels of/ presence of pathogens~~Vp~~) due to the use of seawater. In addition, keeping the fish at a low temperature (e.g. 4°C) is one of the most important measures related to fish preservation and microbial pathogen die-off after harvest.

42. The ~~magnitude~~ risk of hazardous events depends on the on-board activities such as degutting, cavity-washing and the storage conditions. When one or several risk factors have been identified by the DT, the possible presence of pathogens such as Vp should be considered as a risk ~~CCP~~ until the handling and processing have been reviewed to control the risk and this revision has been validated.

~~41.~~43. As more activities are done using seawater the level of risk will increase. The risk may~~can~~ be ~~further~~ reduced if seawater can be used from areas that are known to be less contaminated or, when the possibility exists, to use potable water on-board.

Figure 2: Example of DT to determine the risk of pathogens such as Vp, in on-board marine or estuarine handling and processing of fish (*Adapted from Figure 6 of MRA33*)



8.1.4 Consideration ~~Example of DT~~ to determine ~~magnitude~~ the risk of pathogens such as Vp, in onshore marine or estuarine handling and processing of fish

~~42.~~44. The ~~magnitude~~ risk of contamination with Vp increase when the the on-shore activities are done with non potable water such as degutting, cavity-washing and the storage

~~Figure 4b5: Example of DT to magnitude the risk of pathogens such as Vp, in onshore marine or estuarine handling and processing of fish (*Adapted from Figure 7 of MRA33*)~~

10. WATER SAFETY MANAGEMENT

~~43.~~45. Refer to section 8 of the general section and Annex IV(see footnote 5) of this Guidelines

~~44.~~46. Elaboration and implementation of management procedures, for instance the design of a management plan that should be site specific, consider relevant hazards and hazardous events and the outcomes of the fit-for-purpose assessment of the water system. Efficient and appropriate preventive measures should be implemented, and possible corrective measures should be anticipated when required based on the outcome of the monitoring.

~~45.~~47. Multi-barrier approach (e.g. protecting the water source from faecal contamination, washing with portable water, controlling temperature and time, and avoiding cross-contamination) is possible with regard to water safety management. The management procedures should include strict segregation measures for preventing cross-connections between the safe supply ~~of water~~ of potable water ~~quality~~ and any unsafe or questionable supply of water of non-potable quality or sewer disposal system.

~~46.~~48. When reusing water, the need for water treatments (e.g. biological, chemical, physical, irradiation) should be considered to ensure that the water from the reuse system is safe, including conditions related to distribution, storage and intended use where relevant.

~~47.~~49. Implement safety plans with operational monitoring of the water used in the production and processing of fish and fishery products to provide insight into water safety management process performance and associated water safety and quality issues, enabling rapid remedial action in the event of nonconformity. When~~re~~ nonconformity with water safety has been detected,~~appropriate~~, ~~the plan should be supplemented with~~ microbiological control of the finished fish and fishery products should be considered.

10.1 Treatments for ~~fit~~ fit-~~for~~ for-purpose water

~~48.~~50. Treatment options will have to be designed on a case-by-case basis and consider both the hazards from microorganism contamination (e.g. faecal pollution) as well as those from the indigenous~~endo~~genous marine flora (e.g. pathogenic *Vibrio* spp. and *C. botulinum*).

~~49.~~51. There are several treatment technologies that can provide~~recover~~ water of a quality that makes it fit-for-purpose or that can eliminate or inactivate microorganisms or reduce them to acceptable levels for use/reuse water. These treatment technologies include~~ing~~, but are not limited to, heating (e.g. pasteurization or boiling); use of a chemical disinfectant such as chlorine, chlorine dioxide, ozone; and/or physical treatments such as membrane filtration and irradiation (e.g. UV light). Guidance on resistance to chlorination by different microbiological hazards is provided in Table 1.

52. Appropriate parameters of treatments applied ~~to~~to water or reuse water, intended to be used as a food ingredient or in a manner that will contact fish and fishery products, should be monitored to ensure such water will be potable or fit for purpose respectively. The efficacy of such treatments should be periodically verified through appropriate microbiological testing of the treated water.

53. For more information on water treatment technologies refer to Annex IV(see footnote 5) of this guidance.

10.2 ~~Water~~Monitoring the microbiological quality ~~monitoring~~of water

~~50.~~54. Water monitoring is a core element of food safety management systems and is essential to ensure water quality and safety and to define fit-for-purpose water in the Fishery sector. ~~Irrespective of the source,~~ W~~w~~ater used in the production and processing of fish and fishery products must be frequently monitored to ensure that it is of the fit-for-purpose quality.~~safe~~.

~~51.~~55. Monitoring practices should be risk-based, covering the whole water system, from ~~the~~ source to ~~the~~ point of use, and consider any ~~including considering~~ the historical data in determining ~~to determine~~ the frequency of monitoring.

~~52.~~56. ~~Fit Fit-for for-purpose assessment should include an operation-specific assessment to determine which indicator(s) (e.g. microbiological parameters) are appropriate to be used. Geographical region and temperature of seawater should be considered as they may impact the level of potentially pathogenic bacteria, viruses, and parasites~~.

~~53.~~57. No single m~~icrobiological~~ indicator microorganism[8] is suitable in all circumstances. ~~Microbiological~~ I~~i~~ndicators microorganism have disadvantages that must be understood when using test results to assess the microbiological quality of water, when possible, testing for multiple groups of indicators should be more appropriate. Consideration should be given that on a sample-by-sample basis, there is rarely a direct correlation between indicator microorganisms such as coliform bacteria and indigenous marine pathogenic bacteria such as *Vibrio* spp. enteric protozoans, or viruses. The observed low correlations between microbiological indicators and pathogens, in different types of water used for food production and processing and the occasional failure of indicators to predict pathogen occurrence, should be considered~~given~~. However, testing for pathogens alone is also discouraged because this testing does not afford the degree of health protection given by testing for traditional non-pathogenic indicators.

~~54.~~58. Fit-for-purpose assessment should include a~~A~~n operation-specific assessment to determine which indicator(s) are appropriate to ~~could~~ be used to control the water source or the reconditioning treatment for

[8] Indicator microorganism: microorganisms used as an indicator of quality, process efficacy, or the hygienic status of food, water, or the environment, commonly used to suggest conditions that would allow the potential presence or proliferation of pathogens. Examples of indicator microorganisms include mesophilic aerobic bacteria, coliforms or faecal coliforms, *E. coli* and Enterobacteriaceae.

water reuse should be more appropriate to conduct to control these hazards and reduce the risk of human exposure to pathogens~~.~~. Geographical region and temperature of seawater should be considered as they may impact the level of potentially pathogenic bacteria, viruses, and parasites.

59. When monitoring water quality in a harvest region or area, surface or ~~groundwater~~ groundwater possible contamination risks from the immediate area of the catchment and seasonal and climatic factors should be assessed ~~quality should be characterized at abstraction points~~. In addition, upstream extension should also be considered, when possible, to include the whole water catchment area.

~~55.~~60. The selection of an analytical method for water testing should take into consideration the information and management needs of the monitoring program, the analytes and the laboratory and human resources available, among others. The selection of parameters should be prioritized according to the outcomes of a ~~fit~~ fit-~~for~~ for-purpose assessment of the water system and its historical data.

Table 1. Risk Ranking on the most significant waterborne microbiological hazards of relevance to fish and fishery products[9].

Microbiological HAZARD	RESISTANCE TO CHLORINE	RISK RANKING
Aeromonas hydrophila	Moderate	++
Bacillus cereus	High	++
Campylobacter jejuni/C. coli	Low	+++
Clostridium botulinum	Low	+++
Escherichia coli, pathogenic	Low	+++
Listeria monocytogenes	Low	+++
Pseudomonas aeruginosa	Low	+
Nontuberculosis mycobacteria	Low	+
Salmonella enterica, all serovars	Low	+++
Salmonella, typhoid	Low	+++
Shigella spp.	Low	+++
Vibrio cholerae	Low	+++
Vibrio parahaemolyticus	Low	+++
Vibrio vulnificus	Low	+++
Vibrio, other species	Low	+
Yersinia enterocolitica	Low	++
Viruses		
Enteroviruses	Moderate	+++
Hepatitis A virus (HAV)	Moderate	+++
Hepatitis E virus (HEV)	Moderate	+++
Norovirus and sapovirus	Moderate	+++
Rotavirus	Moderate	+++
Protozoans		
Acanthamoeba spp.	High	+
Cryptosporidium parvum	High	++
Cyclospora cayetanensis	High	++
Entamoeba histolytica	High	+++
Giardia lamblia	High	+++
Toxoplasma gondii	High	+++
Helminths		
Anisakis spp.	N.R.	+++
Dracunulus medinensis	Moderate	+++
Schistosoma spp.	Moderate	+++
Diphyllobothrium latum	N.R.	++

N.R. = Not relevant.
Note~~s~~: The risk ranking in the table refers to the risk for consumers of fishery products and is based on the perceived frequency and consequence of disease: (+) low risk to consumers; (++) common cause of foodborne disease, but of variable importance for fishery products; and (+++) cause of disease by fishery products and of potentially high risk to consumers. The hazards listed are assumed to represent all regions globally and include those hazards relevant to all

[9] Adapted from FAO & WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products – Meeting report. Microbiological Risk Assessment Series, No. 41. Rome. https://doi.org/10.4060/cc4356en

types of water, including fresh-, brackish- and seawater. The selection of hazards when evaluating risk should be based on local circumstances, particularly where the water is used.

Annex III: ~~Production of~~ Milk and Milk products

1. INTRODUCTION

1. Milk and milk products are an important and often essential source of food in many parts of the world and are a significantly traded food. Water is used for a wide range of activities in dairy operations, and the sector consumes a substantial volume of water for production processes, cleaning and disinfection. Other activities such as chilling and steam production may also have a high demand for water. At primary production, the availability of water fit -for- drinking for the animals may have a direct impact on animal health, as well as the amount, quality and safety of the milk being produced.

2. Milk naturally consists of 80 to 85% of water which may become available for use during certain processes (e.g. concentration and drying of milk products). Reuse of such water, being reclaimed water provides an additional source of water within dairy manufacturing plants. The reuse of reclaimed water from milk and other ~~dairy~~ milk products, and of recycled water in dairy manufacturing plants provides opportunities to significantly reduce the need for water from external sources. It can be an important tool for food business operators (FBOs) to address water scarcity and reduce the stress of water availability in certain parts of the world and/or under certain environmental circumstances.

3. If water used in the production of milk and milk products is not fit for its intended purpose, it may be a source of microbiological hazards such as *Listeria monocytogenes, Campylobacter* spp.*, Bacillus cereus, Staphylococcus aureus, Salmonella* spp. and Shiga-toxin producing *Escherichia coli*. and protozoa from cross-contamination. The use of non-~~fit~~ fit-~~for~~ for-purpose water in dairy operations may also contribute to the distribution and multiplication of such pathogens.

4. Guidelines on the fit-for-purpose use and reuse of water are essential to ensure the manufacturing of milk and milk products that are safe for consumption.

2. PURPOSE AND SCOPE

5. ~~These guidelines~~This annex provides recommendations for the microbiologically safe use and reuse of water from the dairy farm to the dairy manufacturing/processing plant. ~~These guidelines are~~It is intended for FBOs and competent authorities, as appropriate, to provide for practical and applicable use and reuse of water in the dairy sector by applying the principle of fit for purpose using a risk-based approach. ~~These guidelines~~This annex also provides examples of fit-for-purpose use and reuse of water. The scope of ~~these guidelines~~ the annex strongly focuses on the reuse of water since this provides a significant opportunity to limit the need for external water sources.

3. USE

6. ~~These guidelines~~This annex should be used in conjunction with the General Section of these guidelines and the following Codex Alimentarius guidance:

- Code of Hygienic Practice for Milk and Milk Products (CXC 57-2004),
- General Principles of Food Hygiene (CXC 1-1969),
- Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM) (CXG 63-2007),
- Principles and Guidelines for the Conduct of Microbiological Risk Assessment (CXG 30-1999),
- Guidelines for the Validation of Food Safety Control Measures (CXG 69 – 2008),
- Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods (CXG 21-1997),
- Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites (CXG88-2016), and
- Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food (CXG79-2012).

4. DEFINITIONS

~~**Cleaning-In-Place (CIP) systems:** water-based cleaning and disinfecting systems used to clean and disinfect product flow pipes and equipment without disassembly (*from MRA40*).~~

Condensate: water recovered by condensing water vapor, for instance water vapor recovered from the drying of dairy materials/products.

Dairy effluents: water from cleaning and disinfection, or other operations involving water, during the manufacture of milk products, including both for-food-contact applications and no~~t-for~~n--food-contact applications, and which contains identifiable substances. ~~Dairy effluents do not include black[1] and grey[2] waters *(from MRA40).*~~

~~**Indicator microorganisms[3]:** microorganisms used as an indicator of quality, process efficacy, or the hygienic status of food, water, or the environment, commonly used to suggest conditions that would allow the potential presence or proliferation of pathogens. Examples of indicator microorganisms include mesophilic aerobic bacteria, coliforms or fecal coliforms, *E. coli* and Enterobacteriaceae (from the *Guidelines for the control of Shiga toxin-producing E. coli (STEC) in raw beef, fresh leafy vegetables, raw milk and raw milk cheeses, and sprouts*).~~

Permeate: the fluid derived from milk or other milk products obtained after removing milk constituents by membrane filtration, Micro-filtration (MF) (Ultra-filtration (UF), ~~Micro~~Nano-filtration (~~MF~~NF), Reverse Osmosis (RO~~),~~) and/or Reverse Osmosis & Polishing (ROP~~),~~). ~~and/or Nano-Filtration (NF))~~ ~~(*from MRA40*).~~

Retentate: the product obtained by concentrating milk constituents using membrane filtration (UF /MF/ RO / Reverse Osmosis and Polishing water (ROP)/ NF) technology for milk or milk products.

Stagnant Water: water that occurs as the result of setting, pooling or otherwise accumulating, allowing for the accumulation of organic matter and growth of unwanted microorganisms~~,~~ including yeasts and molds. Usually found on floors and other areas that do not allow water to drain to floor drains.

~~**Water reuse scenario**: the combination of reusable water source and reuse water application, including specifics such as recovery, reconditioning, storage and distribution (logistics and technologies) *(from MRA40).*~~

5. PRIMARY PRODUCTION AND TRANSPORT FROM THE FARM

7. An adequate supply of water ~~of a suitable quality (~~fit-for-purpose~~)~~ should be available for use in the various operations, including further processing on dairy farms.

8. Water used as drinking water for animals should be fit for purpose and free from feed or faecal material to the extent of possible. Drinking troughs (or other vessels) should be regularly inspected and cleaned when dirty.

~~9. Fit-for-purpose water, preferably potable water, should be used when washing of the udder is recommended (e.g. when dirty), especially in the production of milk for raw milk products.~~

9. Water intended for drinking by animals should be analyzed periodically to determine microbiological quality (e.g. based on coliforms, or turbidity/colour limits that can be done at low cost, such as with a Secchi disk modified for relatively shallow water troughs~~or aerobic total counts~~). The frequency of testing should depend on the risk associated with the water source~~and~~ , results from previous testing, applied treatment and intended use of the milk.. The risk associated with the water source generally increases from municipality water, deep well water, hygienically collected rainwater, ground water to surface water.

10. When washing of the udder is recommended (e.g. when dirty), fit for purpose water should be used. In the production of milk for raw milk products, potable water should be used. Attention should be given to proper washing and drying.

~~10.~~11. Stagnant water near drinking troughs or~~r~~ in milking and storage facilities should be avoided.

~~11.~~12. Water fit for purpose should be available in areas designated for milking of dairy animals and milk storage, as well for use when rinsing, cleaning and disinfecting milking equipment, storage containers, vessels and tanks. It should be available at the dairy manufacturing plants, and elsewhere as required for the cleaning of transport facility equipment and tanks. Rinsing equipment, storage containers, vessels and tanks with water fit for purpose, should also be carried out after the use of chemical compounds and biocides for disinfection, when necessary.

~~[1] Source-separated wastewater from toilets, containing faeces, urine and flushing water (and eventually anal cleansing water in washing communities) (*definition from the "WHO guidelines for the safe use of wastewater, excreta and greywater"*)~~

~~[2] Water from the kitchen, bath and/or laundry, which generally does not contain significant concentrations of excreta (*definition from the "WHO guidelines for the safe use of wastewater, excreta and greywater")*~~

~~[3] Including utility microorganisms which are microorganisms occurring in food and food environments, originating from sources in which they are naturally present (e.g. water sources, raw materials or ingredients for foods) or from sources associated with food handling/processing (e.g. packaging material, the production environment, and utensils/utility equipment used in the operation) (from MRA40).~~

~~12.~~13. New water sources used for rinsing, cleaning and disinfecting the product contact surfaces of milking ~~processing~~ equipment, tanks, vessels and facilities for milk transport from dairy farms, should be checked visually for clarity and odour as well as tested for microbiological quality where appropriate before first use, and then regularly thereafter in a similar way as in dairy manufacturing plants. Records of analyses should be ~~kept~~ maintained and ~~made~~ should be readily available to competent authorities ~~at their request~~when requested.

~~13.~~14. When economically feasible at dairy farms or during transport, reusable water sourcing and reconditioning (as necessary) could add value for the milk production operations ~~wishing~~ seeking to reduce overall consumption of externally sourced water, by collecting, recovering and reconditioning water used for rinsing and cleaning, e.g. the animal housing facility, milk storage area, floors, walls and ceilings, and for rinsing, cleaning and disinfecting milking equipment, on-farm milk storage containers, vessels and tanks. ~~e.g. by collecting, recovering and reconditioning water used for rinsing and cleaning milking equipment and for cleaning on-farm milk storage containers, vessels and tanks.~~ When reusing and reconditioning water, the guidance provided below for dairy manufacturing plants should be followed.

~~14. When~~ As simple examples of reuse, raw milk is heat treated and concentrated using membrane filtration at the dairy farm, the water from the concentration process may be used ~~for~~ as drinking water for animals ~~drinking~~, cleaning the milking and animal housing facility, as well as milking equipment, provided it is fit for purpose. Properly treated sewage water or other water collected from the farm (e.g. from rinsing, cleaning and sanitizing, or from possible production of whey or wash of cheeses at the farm) could be used, for example, to irrigate grazing pastures or to clean the milking and animal housing facility.~~Recycled sewage water or other water collected from the farm (e.g. from rinsing, cleaning and sanitizing, or from possible production of whey or wash of cheeses at the farm) can be used, for example, to irrigate grazing pastures or to clean non-food contact surfaces that cannot cause contamination.~~

15.

6. DAIRY MANUFACTURING PLANT

~~15.~~16. Within a dairy manufacturing plant, water may be used as an ingredient, for rinsing, cleaning and disinfecting production equipment, for heating and cooling of raw milk, ingredients and finished milk products, as boiler feed water for the production of hot water and steam, and for facility (floors, walls, piping, etc.) cleaning, among other purposes. The availability and volume of fit-for-purpose water ~~fit~~ required for ~~purpose~~ dairy manufacturing plants, may be limited by geography, climate and competing demands. Also, the dairy industry is continuing to evolve, utilizing facilities with large processing capacities and subsequently, larger water requirements. This large, concentrated demand for water in a small geographic location can stress the availability of water for necessary purposes, such as drinking, irrigation, etc. Water reuse is an important strategy for reducing water consumption from external sources.

6.1 GENERAL RECOMMENDATIONS

~~16.~~17. Differentiation should be made between ~~for food contact applications of~~ - water that is used in food or on surfaces that come into contact with food ~~with direct or indirect contact with food materials~~ (e.g. ingredient water, water used to ~~wash~~rinse, clean, or disinfect food contact surfaces of processing equipment and transport vehicles), and ~~non-food contact applications of~~ water that will not come into contact with food, either directly or indirectly (e.g. boiler feed for technical steam, ~~boiler feed,~~ water needed to extinguish fires, or to wash the exterior of vehicles ~~(other than food and food ingredient transport vehicles)~~, for cooling towers, to water lawns, to clean ~~external~~ exterior surfaces or to flush toilets).

~~17.~~18. Measures should be taken to avoid or remove stagnant water, condensation or steam from dairy manufacturing plants by the design, operation and maintenance of the plant as quickly and frequently as possible. Ventilation should be adequate to reduce/eliminate steam and condensation accumulation.

~~18.~~19. Measures should be taken to capture in a sanitary manner, treat and reclaim water from various sources as quickly as possible after its first use or when it originates from milk, whey or other ~~dairy~~ milk products within a dairy manufacturing plant.

~~19.~~20. As a general recommendation, but subject to adaptation based on testing and evaluation, the following water could be considered as fit for purpose ~~(See also Table 2)~~:

- ~~Potable~~ potable water and reclaimed water from milk meeting potable water requirements can be used for any purpose in dairy manufacturing, including:
    - as a food ingredient; examples are:~~;~~

- low fat dairy spreads,
- rehydration of dairy powders and other dry ingredients,
- addition to concentrated dairy products before drying or filtration,
- direct steam injection for pasteurization in cheesemaking or fermented milks,

  - to flush dairy materials out of the pipeline at the end of a production run and before the first rinse of the cleaning process;
  - for any direct or indirect contact with milk products, including for the first rinsing, cleaning, disinfection and final ~~rinse~~ rinsing of food-contact surfaces of processing equipment;

- ~~Recycled~~ recycled water from the final rinsing of food-contact surfaces of processing equipment, tanks, vessels, ~~and~~ utensils and milking equipment, or from other sources subject to reconditioning~~, if necessary, can be used~~:
  - ~~For~~ for the first or intermediate rinse during the cleaning and disinfecting of food-contact surfaces of processing equipment, tanks, vessels and utensils (with the possible addition of an acceptable level of biocides);
  - for cleaning non-food-contact surfaces (for example walls, floors);
  - ~~For~~ for food-contact applications or for the final rinse, if the reuse water is subjected to a microbiocidal (e.g. thermal, UV treatment, filtration, chlorination, ozonation).~~or other process~~, sufficient to reduce microbiological risk to an acceptable level~~ (e.g. thermal, UV treatment, filtration, chlorination, ozonation)~~.

- Other water may be used for boiler feed purposes, as cooling water/ice or for washing of other surfaces, if not in direct or indirect contact with food.

~~20.~~21. The dairy plant should have ~~an external~~sufficient water supply providing enough water of potable water quality and the water handling systems within the plant should maintain water quality to the point of ~~first~~ use.~~ It is the responsibility of the FBO to manage any microbiological contamination of the water supply on its premises~~. Sampling of water for microbiological testing is relevant upon any suspicion of contamination of the supply water on the premises. It is the responsibility of the FBO to manage any microbiological contamination of the water supply on its premises including informing competent authorities should the food be potentially affected.

~~21.~~22. Any external supply of ~~other~~ non-potable water to the dairy plant e.g. for the production of steam, firefighting and cooling, is acceptable provided that the water handling system is dedicated for these purposes and is clearly marked.

23. If the FBO has identified contamination in the water supply, it should conduct an investigation and assess whether such contamination was a sporadic occurrence or represents a persistent problem that may require more extensive corrective actions. When a source of contamination is not evident, the FBO should contact relevant authorities, in most cases the municipality, to determine whether there is a general contamination of the water supply or whether the contamination originates at the plant and implement appropriate corrective actions to mitigate the cause of the contamination.

23(bis)~~ ~~Disinfection to reduce microbiological hazards in any water source must never compromise the safety of any milk or milk products.

6.2 WATER INTENDED FOR REUSE

~~22.~~24. At dairy manufacturing plants, the technology to safely reuse water and dairy effluents to meet ~~fit~~ fit-~~for~~ for-purpose applications does exist, making this a viable option for dairy manufacturing plants to reduce their externally sourced water consumption (see Annex IV[4]). Attention ~~must~~ should be given to address any health risks associated with using reuse water in food production.

~~23.~~25. The application for which water may be reused is dependent upon its source and how it is collected, stored and treated. Evaluating these elements will establish if the water is fit for the intended purpose. Water that potentially can be sourced for reuse include:

[4] Under development

- ~~water (~~reclaimed water~~) that originated~~ from milk, dairy ingredients or was part of a milk product (e.g. in milk powder or cheese manufacturing),
- water that has come into a dairy operation in the form of potable water and is recirculated until it is no longer suitable as potable water,
- water that is being recirculated for heating or cooling purposes,
- water that has been used for cleaning processing equipment,
- water that has been used to clean facility floors, walls, ceilings, the outside of piping and processing equipment, etc., and
- water that is part of a dairy operation's effluent.

~~24.~~26. Based on the fit-for-purpose assessment such reuse water can be used for different purposes, subject to appropriate treatment when ~~appropriate~~applicable:

- as an ingredient;
- any direct or indirect contact with milk products and the product contact surfaces of dairy processing or milking equipment;
- the cleaning, disinfection and rinsing of product contact surfaces of processing equipment, tanks, vessels, pipelines, valves, utensils and equipment; water fit for purpose ~~of~~ for rinsing before cleaning and disinfection (first rinsing) might not be fit for purpose ~~of~~ for rinsing after cleaning and disinfection;
- cleaning non-product contact surfaces (e.g. walls, floors, etc.);
- boiler water feed; and
- heating or cooling of raw materials, ingredients and finished product.

Further, there might be laws and regulations addressing water reuse established by competent authorities that need to be followed.

~~25.~~27. ~~Technical~~ External technical expertise~~, outside the dairy manufacturing plant,~~ might be needed for the design of safe water reuse systems in dairy operations.

7 TECHNOLOGIES FOR RECOVERY AND TREATMENT OF WATER ~~FOR REUSE~~

7.1 General recommendations

27bis Membrane filtration, and other technologies of hygienic design, may be applied to reclaimed, recycled or recirculated water (other than potable water) in order to make the water fit for purpose. Refer to Annex IV[5].~~See Annex IV, including its definitions.~~

7.2 Specific recommendations for ~~use of~~ reverse osmosis in the use and reuse of water in dairy production

~~26.~~28. RO water recovered from permeates,~~ of~~ for example whey or water mixtures resulting from equipment and pipeline flushes, typically has very low microbial counts. When the performance efficiency of RO has been subjected to a hazard analysis and validated, and is verified to be consistent, RO water may be used for the following purposes based on a risk assessment or within approximately 24 hours after generation, without additional microbiocidal treatment[6] for example:

- ingredient in milk products, e.g. reconstitution of dry ingredients and dairy powders, scalding of cheese curds and grains;
- production of ice and steam, including steam for direct injection;
- washing of cheese curd to remove the casein/whey protein and to directly cool cheeses;
- cleaning, disinfection and rinsing in between cleaning steps;
- final cleaning, disinfection and rinsing of product contact surfaces for all processing lines used for heat-treated products;

[5] Under development

[6] Recommendation from MRA40.

- cleaning of membrane filtration systems or washing of reusable packaging boxes and product moulds;
- diafiltration, i.e. process applied in combination with another membrane filtration method, where water is added to the membrane filtration retentate to flush out constituents to reduce product viscosity and to make the purification of lactose and minerals more efficient;
- ~~Preparation~~ preparation and dilution of brine used for brining cheese. The microbiological control of reuse water for diluting brine can be done as part of the normal verification process for the microbial quality of the brine.

~~27.~~29. In dairy production, RO water of which the microbiological quality is uncertain (~~e.g.~~for example in case of no microbiological testing, ~~indicating~~ indication of poor quality or no validation of the testing) and that will not be used within approximately 24 hours or based on a fit-for-purpose assessment, should be subjected to an effective microbiocidal treatment.

7.3 Specific recommendations for the recovery of reclaimed water from milk by condensation of vapours evaporated during concentration of milk and milk products

~~28.~~30. Condensate water is water recovered by condensing water vapor from the drying and evaporation processes used to remove water in the manufacturing of certain milk products, such as milk powders.

~~29.~~31. Due to the presence of organic material (different sources of milk products and technologies result in different qualities of organic material in this reclaimed water) which may support the growth of microorganisms, treatment of such condensate (e.g. by UV treatment, thermal treatment, microbiocidal treatment, biological filters, MF, UF, ~~MF,~~ NF or RO filtration) may be required before this condensate water is reused for some applications, such as a food ingredient or for food-contact application. Untreated condensate water may be directly used for non-food-contact applications.

~~30.~~32. Reuse water from dairy processing operations is known to contain microorganisms that can form biofilms on stainless steel surfaces~~;~~ , as well as pathogenic bacteria.~~, including pathogenic strains of *Escherichia coli*.~~ It is therefore important that reuse water has an appropriate disinfection treatment when required, that achieves the guideline values for the verification of microbial quality appropriate to the intended use. ~~The choice of disinfection treatment should also consider whether a residual disinfectant will persist throughout the maximum storage time of the reuse water, and, if not, then an additional treatment may be needed.~~ Chemical disinfection of water will inevitably generate disinfection ~~by-products~~residues ~~whether it is externally sourced water or reuse water~~. The optimal choice of disinfectant will vary between different dairy manufacturing sites, depending upon their individual milk product range and method of recovering water for reuse, which will affect the organic loading. ~~Unusual depletion of the disinfectant can arise from spikes in organic loading which need to be investigated rather than simply increasing the disinfectant dose. It is of paramount importance that effective disinfection against microbiological hazards must never be compromised in attempting to meet guidelines for disinfectant by-products.~~

8 WATER ~~REUSE~~ FIT-FOR-PURPOSE ASSESSMENT

33. Refer to Section ~~1~~ 7 of the General Section and Annex IV[7] of these guidelines.

9 WATER SAFETY MANAGEMENT

~~31.~~34. Refer to Section 8 of the General Section and Annex IV[8] of these guidelines.

~~32. A thorough hazards analysis of water should be conducted for each step of water usage from externally sourcing of water, to recovery, reconditioning and application of reuse water, in order to identify the presence and levels of known and potential microbiological hazards. It is important to assess the types of hazards and levels at each step which may be present due to the technologies/methods applied from recovery to application. The factors that should be considered are:~~

- ~~the microbiological hazards present in the original water sources from which the reuse water supplies originate (reusable water sources), and which are introduced into the water system, and hazards associated with other parts of the operation (e.g. factory environment, storage and distribution system) that could contaminate either the source or a reuse water supply;~~

[7] Under development
[8] Under development

- ~~the nutrients that may be present in a reuse water supply after recovery and reconditioning, which may support the growth of spoilage organisms (thereby limiting shelf-life) or pathogens;~~

- ~~reuse water application;~~

- ~~the impact of physical and chemical substances on the effectiveness of controls (e.g. turbidity or high loads of organic matters that may affect treatment efficiency);~~

- ~~whether reuse water that has been recycled or recirculated multiple times in a specific process operation which could lead to biofilm formation or significant increase of spore levels;~~

- ~~whether any particular measure for the preservation or control of microbiological growth is required over the established shelf-life of the reuse water supply;~~

- ~~the availability of a back-up fit-for-purpose water supply, such as an external potable water source, that can be used in case the reuse water treatment system is not effective or not functioning properly;~~

- ~~assessment of the current cleaning and disinfection regime put in place.~~

~~33. In some cases, there may not be a need for a fit-for-purpose assessment when reusing water e.g.:~~

- ~~the reuse water will strictly be used for non-food-contact applications;~~

- ~~the reuse water is free of microbiological hazards, for example through the use of validated heat treatments before, during or after recovery and reconditioning;~~

- ~~when competent authorities have established criteria for the water to be reused to meet various fit-for-purpose requirements and the water meets these requirements.~~

~~WATER SAFETY MANAGEMENT~~

~~34. Based on the outcome of the fit-for-purpose assessment of the water, risk associated with the reuse of water should be managed by measures to be implemented within a food hygiene system and supplemented by monitoring, record keeping and verification activities to ensure that the system is operating as expected.~~

~~35. Figure 1 provides an overview of the aspects that the FBO should consider when establishing measures for a water reuse scenario that is specific to its operation and is validated at full-scale.~~

~~**Figure 1: Steps for implementing measures in a water reuse scenario into full scale operation** (Source: adapted from *MRA40, Figure 4)*~~

~~**Prerequisite programmes (PRPs)** (*copied from MRA40, some adaptation of terminology to be consistent with the terminology in this guidance*)~~

~~36. It is essential that proper PRPs are in place. All PRPs should be supported by procedures and specifications that will minimize hazard entry, spread and increase. In the context of water reuse in a dairy manufacturing operation and for hazard control, PRPs should include in general:~~

- ~~measures that ensure the maintenance of good hygienic conditions, such as the ability to conduct Cleaning-In-Place (CIP) and manual cleaning to remove/reduce potential hazards;~~

- ~~provisions to have a potable water supply available at the point(s) of water use to serve as back-up;~~

- ~~measures to be taken prior to switching to the back-up system in the event of an issue (e.g. full wash down flush of the facility and water holding tanks to avoid contamination from water that is not fit for purpose);~~

- ~~proper construction and maintenance to ensure the reliability of equipment in terms of operational performance and hazard control, e.g. specified requirements for RO processes, UV treatment systems and heat treatment/pasteurization processes, as well as calibration of monitoring equipment;~~

- ~~measures to prevent/reduce the spread and/or increase of hazards occurring and/or their levels, for instance, by eliminating dead-ends or pockets in the water distribution system;~~

- ~~measures to reduce the likelihood of cross-contamination and inadvertent reuse of water for food-contact applications, which can introduce potential hazards, e.g. by using identifiable pipelines, regular maintenance and inspection of the entire water distribution to detect leaks and other malfunctions; frequent monitoring of the collection, storage, treatment system (filtration, chemical and UV light) and end-use or application points.~~

~~37. Floor plan, design and construction of dairy manufacturing plants:~~

~~• Systems for water distribution and recovery and recirculation for both sourcing water as well as reused and recirculation water should be superimposed on the dairy plant floor plan, drawn to scale with pipelines, valves, hoses, tanks and silo sizes. If possible, flow rates within the water system should be identified either on the plans or via a separate schedule.~~

~~• All tanks, piping for the storage, treatments, and distribution system for (reuse) water in the plants and facilities, should be designed for CIP and be able to withstand heat or cold exposure as needed, as well as extreme pH values.~~

~~• As needed and when not circulating or recirculating, the water system should self-drain.~~

~~38. Water distribution system (piping):~~

~~• All waterline discharge points and water taps should be secured against the backflow from potential contaminants caused by submerged inlets, for example in case of loss of pressure.~~

~~• All water pipelines should be clearly marked with a word or code identifying the type of water (source, potable, recycled, untreated reused, treated reused, etc.) as well as the direction of flow. Clear separation and identification between systems for the storage and distribution of water intended for-food-contact application and other water should be ensured. Different colours or marks should be used for water of different quality and intended use.~~

~~• Facility design should ensure pipes, pipelines, tanks and taps used for potable water cannot be interchanged with or contaminated by similar equipment used for water of other qualities.~~

~~• Piping, buffer tanks and storage tanks should be installed such that no inadvertent mixing of water of lower quality can take place via backflows, improper valving and leaks in the pipes. If water of different qualities is mixed intentionally, the mixed water should always be categorized as that of the lower quality water used in the mixing.~~

~~• Pipes and tanks should be made from materials fit for food use and adequately manufactured (i.e. smooth surface, proper welding, etc.).~~

~~Tubes, pipes, tanks, etc., used for milk and milk products may also be used for handling reused water. If this multiple use of the same pipes and tanks is done, it is recommended they be clearly labelled to indicate this.~~

~~• Dead ends (piping lengths of twice the diameter of the piping or greater from the fluid flow point to the end of the pipe or valve) should be avoided to minimize piping locations where water may become stagnant (e.g. taps).~~

~~• All necessary measures should be taken to reduce or ideally eliminate condensation from forming on the outside of pipes and other equipment and to avoid fluctuations in the temperature of water inside the system. This may include things like insulating pipes where temperatures inside the pipes or equipment vary from the temperatures on the outside of pipes or other equipment. Pipelines that are no longer used should be removed.~~

~~39. Maintenance:~~

~~• FBOs should conduct regular inspection and good maintenance of the entire water system and associated components to check for and repair any leaks or damages (e.g. leaky gaskets, cross-connections, corrosion) that may lead to entry of microorganisms and contaminate the water supply.~~

~~• Ensure the tightness of the RO membranes to avoid microbiological hazards bypassing the membranes. The “flux” and “life” of the membranes should be monitored and documented to identify when replacement should occur (based on the recommendations by the manufacturer) to ensure their effectiveness and proper performance.~~

~~• Special attention should be made to check the tightness of gaskets for pipelines and valves connected to piping.~~

~~• Maintenance incidents and problems related to the water system should trigger timely corrective action.~~

~~40. Cleaning:~~

~~• Facilities for the recovery, treatment, storage and distribution of water (including pipe ends where the water flow leads to the product) should be cleaned thoroughly to remove/reduce possible microbiological hazards and done at a frequency that prevents the build-up of biofilm.~~

~~• All equipment making up the facility's water system should be emptied when not in use and cleaned regularly based on a hazards evaluation. Historical experience and specific knowledge about the potential problem areas and shortcomings of the facility's water system e.g. stagnant water in pipes/the distribution system should be taken into account.~~

~~• CIP equipment used for dairy manufacturing plants should conform to applicable regulations, industry best practices, manufacturer's specifications. The specifics (time and temperature) of a CIP regime should be fit for purpose and depends on different variables. These include microflora characteristics, quality of reclaimed water from milk, extent and type of fouling.~~

~~• If an automated CIP system is out of operation for more than a certain period of time (to be determined by hazard analysis), it should be evaluated prior to use. If not assessed, cleaning should be conducted prior to use if the CIP system has been out of operation for approximately 24 hours or longer.~~

~~• During cleaning, all pipe and tank parts should be able to withstand cleaning and disinfection procedures in place, such as temperatures and chemicals. It is recommended to heat pipe and tank parts to at least 60 °C for at least 30 minutes. If the equipment can withstand it, 80 °C for at least 10 minutes is preferred.~~

~~41. Storage of water:~~

~~• Potable water and reuse water intended for-food-contact application can normally be stored without temperature control (e.g. 15-20 °C in temperate and subtropical conditions) for a limited period (e.g. up to two days) if the nutrient levels that can support microbial growth is limited (can be approximated by measuring turbidity).~~

~~• Shelf-life can be extended if water is refrigerated (e.g. < 7 °C, measured at the top of the tank where the water is warmest) or hot (e.g. minimum 60 °C, measured at the bottom of the tank where the water is coldest). Storage of reuse water at other temperatures can be acceptable if combined with an ongoing microbiocidal treatment, e.g. by continuous recirculation through an UV treatment system, ozonation, chlorination or by a heat treatment.~~

~~• Water stored hot or cold should be thoroughly and frequently stirred to ensure the maintenance of proper storage temperature conditions throughout the tank.~~

~~• The maximum storage time of any water should be established and validated based on monitoring and testing the potable or reuse water with regard to key microorganisms (such as total bacteria count, coliform or Enterobacteriaceae counts, Pseudomonas counts), turbidity, pH, and titratable acidity, as well as organoleptic indicators (primarily smell and appearance).~~

~~Establishment of control measures~~

~~42. Control measures for the fit for purpose reuse of water should be developed based on a water reuse fit-for-purpose assessment utilizing a hazard analysis to ensure the safe use and reuse of water within dairy plants. The measures should include the consideration of the applied prerequisite programs and the available treatment technologies.~~

~~43. A flow diagram should specify the key process steps where reuse water is introduced to the food and steps where used reuse water is removed from the food processing line, as the basis for the hazard analysis.~~

~~44. All water uses should be included in the water safety management. If the reuse water is intended for food contact (direct and indirect), the results of the hazard analysis of the reuse water should be included as input to the hazard analysis for the milk products that will be impacted.~~

~~45. Figure 2 provides an overview of input from an assessment to develop control measures for the fit for purpose reuse of water.~~

~~**Figure 2: Potential fit for purpose assessment questions that provide insights and inputs into the development of control measures for the safe reuse of water** (*Source; adapted from MRA40, Figure 1*)~~

~~46. The control measures should be integrated into the food safety/ Hazard Analysis Critical Control Point (HACCP) plan as illustrated in Figure 3.~~

~~**Figure 3: Integration of control measures for the fit for purpose reuse of water into the food safety/HACCP system** (*Source: adapted from MRA40, Figure 2*).~~

~~47. A risk/hazard matrix such as in Diagram 2 of the General Principles of Food Hygiene (CXC 1-1969) or the Table 1 below can be used for the hazard analysis in order to link the hazardous event/step with the hazard and its risk characteristics, to better enable the selection of appropriate control measures. Specific examples can be found in the case studies in MRA40 (examples referred to below).~~

~~**Table 1: Example of risk/hazard matrix with an indication of the likely associated level of risk and possible control options** *(based on the risk matrixes provided in Annex 4 of MRA40).*~~

~~**Event**~~	~~**Hazard**~~	~~**Risk/hazard matrix**~~							~~**Control options**~~
~~E.g. cross-contamination, building of biofilm, carry-over from disinfection …~~	~~Pathogenic bacteria, chemical residue~~	~~Likelihood of hazard occurrence in the reuse water~~		~~Unlikely~~	~~Seldom~~	~~Sometimes~~	~~Frequent~~	~~Always~~	~~UV-treatment, limitation of recycling~~
		~~Risk to consumer in absence of control~~	~~Severe~~						
			~~Moderate~~						
			~~Minor~~						

~~Selection of measures to control identified hazards~~

~~48. Based on the identification of the hazards to be controlled, appropriate control measures should be selected. The need for possible critical control points (CCPs) within procedures based on the HACCP principles should be considered, e.g. at the reconditioning of the reuse water when the proper performance of the reconditioning process (such as temperature and time) is essential for acceptable hazard control and no other controls are in place after the reconditioning step.~~

~~49. When selecting appropriate control measures, the following factors, among others, should be taken into consideration:~~

- ~~the quality and safety of the original source water;~~
- ~~in plant treatment of incoming source water;~~
- ~~the age, characteristics and maintenance history of the facility's potable and reuse water systems;~~
- ~~the characteristics of the treated, reuse water matches the fit-for-purpose requirements including the needs for treatment and the quality of the fit-for-purpose water, such as whether the reuse water will be used for direct food-contact applications;~~
- ~~the microbiological profile of the recovered or reuse water;~~
- ~~the dynamics of the hazard such as:~~
  - ~~changes in the levels of relevant hazards at each step in the water supply system;~~
  - ~~the magnitude and frequency of such changes up to the application of the reuse water;~~
- ~~the risk of possible consumer exposure;~~
- ~~the effectiveness of individual or combined controls (in multi barrier approaches) in reducing or eliminating the targeted microorganisms (could include spores, vegetative cells, and different pathogens) in the water to be reused.~~

~~50. Control measures are typically applied at CCPs within a HACCP system. When non-reconditioned water is fit for purpose, and when the food is subjected to microbiocidal treatments at a later step, there are no CCPs related to the verification of reconditioning performance. However, it may be necessary to assess and control hazards pertaining to storage (e.g. time and temperature factors during holding) when it is part of the water reuse scenario and there still may be a need to have controls in-place to ensure that lower-risk hazards are controlled, minimized or eliminated.~~

~~51. To improve the microbiological quality of water, heating, chlorination, ozonation or UV treatment can be used.~~

~~Monitoring~~

~~52. The parameters of validated water reconditioning processes (such as total organic compounds (TOC), chemical oxygen demand (COD), biological oxygen demand (BOD), turbidity, pH or conductivity, based on the nature of the process) should be monitored, with occasional verification by microbiological testing.~~

~~53. The frequency of monitoring should consider the level of control specified for the reuse water scenario, event or step (e.g. is the reused water used for-food-contact application or not), and the identified risk for the consumer in case of deviation.~~

~~54. Monitoring data across subsequent reuse water batches being generated should be plotted for trending purposes to help benchmark information to be used in building confidence over the systems of reuse water. When the water reuse systems are consistently performing well, signals can be early detected when the operation or control measures may be trending towards failure, or when an out-of-control situation may develop. Trend analysis is a powerful operational management tool advocated both for water safety plans and food safety plans.~~

~~Corrective actions~~

~~55. In the event of a loss of control situation (i.e., in case the system overall or control measures during reuse water generation or use fail, resulting in a potentially unsafe water), several actions described below should be considered to ensure that the affected and future reuse water supply do not impact the safety of food products being processed:~~

- ~~identify the problem and analyze the root cause, correct the problem and establish corrective measures to prevent recurrence; amend the control measures, or other aspects of the reuse water generation system or the food safety management system, as appropriate;~~
- ~~conducting a risk-based evaluation of the hazards and possibly new corrective action steps or procedures may reduce the frequency of these incidents or eliminate them;~~
- ~~isolate reuse water that did not meet performance parameters and consider discarding or re-purposing it (i.e. to make a supply suitable for other fit-for-purpose applications);~~
- ~~invest in physical improvements to the water system to eliminate or reduce weak "links" where contamination has happened in the past or is suspected of happening in the future.~~
- ~~if the loss of water safety controls is associated with the reuse water supply, stop using this supply until the root cause of the loss of control can be determined and addressed in a permanent manner.~~
- ~~switch the use of reuse water to a lower level fit-for-use criteria, i.e. from for direct food-contact application to indirect food-contact application; consider an increase in monitoring frequency until confidence in the control has been regained with the understanding that monitoring frequency alone is not likely to be able to demonstrate with a high level of confidence that the water supply is under control again;~~
- ~~Identify any potentially impacted food products and take action as appropriate.~~

~~Validation~~

~~56. Validation of control measures used in the reuse water system should be carried out in accordance with the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008).~~

~~57. Specific validation is highly dependent on the plant-specific treatments and storage conditions and should be carried out on the reuse water shelf-life, i.e., how long the water may be used/stored or how many times can it be recycled while still suitable for its fit-for-purpose application. Validation will need to be re-done if any conditions or treatments are changed.~~

~~Verification and testing~~

~~58. Verification of the water safety management system should be carried out by:~~

- ~~reviewing and evaluating monitoring data and corrective actions;~~
- ~~conducting an audit on the water safety system;~~

- ~~conducting sampling and testing;~~
- ~~calibrating monitoring instruments.~~

~~59. Routine testing of reuse water for pathogens is not recommended, because the level of pathogens in reuse water, if present, are likely to be present at very low populations making detection by reasonable sampling plans improbable. It is more practical to test for suitable indicator microorganisms to verify process control and to identify potential out-of-control situations. Suitable indicator microorganisms generally occur in reuse water at levels that allow quantification. However, enhanced sampling and testing for pathogens would be warranted during validation of reconditioning processes or during an event where a loss of control may have resulted in reuse water becoming contaminated with pathogens. Such water should often be discarded.~~

~~60. Microbiological testing and analysis of indicator microorganisms such as total viable count or coliforms in water, have proven to be useful in many circumstances. However, the microflora relevant for verification of reuse water often is plant or operation specific. It is, therefore, essential to conduct an operation-specific study to determine which microbiological parameters/indicator organisms may be appropriate for use in evaluating a particular water reuse scenario.~~

~~61. The FBO should determine and document the acceptable microbial limits to be used as reference for verifying operational control, by establishing a maximum limit for each relevant hazard or indicator organism that is tolerable in the water supply system being generated for for-food-contact and not-for-food-contact applications.~~

~~62. Examples of microorganisms and their limits that can be considered for the monitoring of certain reuse water can be found in Section 6.3 of the FAO/WHO meeting report "Safety and quality of water use and reuse in the production and processing of dairy products" (MRA40)[9]. These are examples only and other limits or criteria could be applicable.~~

10 EXAMPLES OF FIT-FOR-PURPOSE ~~REUSE~~ WATER APPLICATIONS IN DAIRY PLANTS[10]

~~**Examples of water fit-for-purpose decision tools**~~

~~63. Table 2 provides an overview of fit-for-purpose considerations for different applications of reuse water and types of reuse water available. All three reuse water types (recirculating, reclaimed from milk and recycled) can be used for direct food contact application, providing there are no significant hazards present or that their levels are reconditioned to acceptable levels, when necessary. All three reuse water types may be suitable as sourced for indirect food applications as long as food contact is effectively controlled and avoided. When such control to avoid food contact is not possible or variable, the application should be considered as potential direct food application, meaning that significant hazards need to be absent or be consistently controlled to be within acceptable levels. From a microbiological basis, the four water types in the Table 2 are fit for purpose, for not-for-food-contact applications. For-food-contact applications, the reliable utilization of a reusable water supply, including recovery and any reconditioning, needs to be validated and verified within the overall food processing operation.~~

~~**Table 2: Overview of fit-for-purpose considerations for different applications and types of water** reuse (*from Table 2 of MRA40. Terminology adapted to be consistent with the rest of the guidance*)~~

~~PURPOSES~~	~~EXTERNAL POTABLE WATER~~	~~RECIRCULATED WATER~~	~~RECLAIMED WATER~~	~~RECYCLED WATER~~
		~~Closed loop (CIP)~~	~~Recovered from milk~~	~~Recovered from a processing step~~
~~Food Ingredient~~	~~Fit for purpose as sourced~~	~~No likely application~~	~~Fit for purpose if no significant hazards present either as recovered, or after reconditioning~~	~~Fit for purpose if no significant hazards present either as recovered, or after reconditioning~~
~~Direct food contact~~	~~Fit for purpose as sourced~~	~~Fit for purpose until undue levels of significant hazards are found; needs reconditioning to~~		

~~[9] https://www.fao.org/3/cc4081en/cc4081en.pdf~~
[10] Figures in this section were copied from MRA40.

		~~reuse~~		
~~Unintended food contact~~	~~Fit for purpose as sourced~~	~~Fit-for-purpose as recovered if no significant hazards are present, or food contact is avoided~~		
~~Not for food contact~~	~~Fit for purpose as sourced~~			

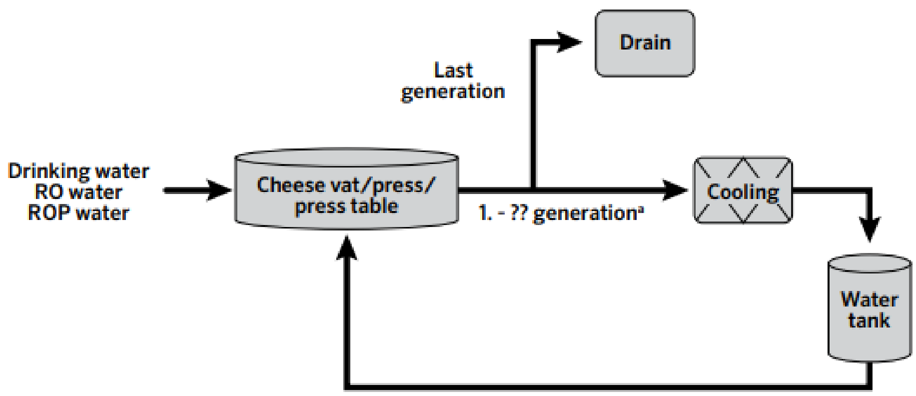
~~64.~~35. The examples below are for illustrative use only. Any reuse scenario should be based on a proper hazard analysis before implementation.

10.~~2~~1 Example of reuse of potable water by recirculation or recycling

~~65.~~36. After introducing potable water in a closed system, the water is recycled for a specific number of times. The number of acceptable cycles is based on the assessment of maximum levels of predefined parameters (e.g. microbiological criteria). The recycled water is then disposed of from the system~~,~~ or is treated with a microbiocidal treatment (e.g. heat, UV or chemical disinfectants) when the number of acceptable cycles has been reached.

~~66.~~37. As an example, during cheese production, reclaimed water is used for the following cooling step and then recycled in a closed system as illustrated in Figure 14. It is derived from a detailed example that can be found in case study 2 of Annex 4 of MRA40.

Figure 14: Scheme shows the recirculation of water used for cooling cheeses.



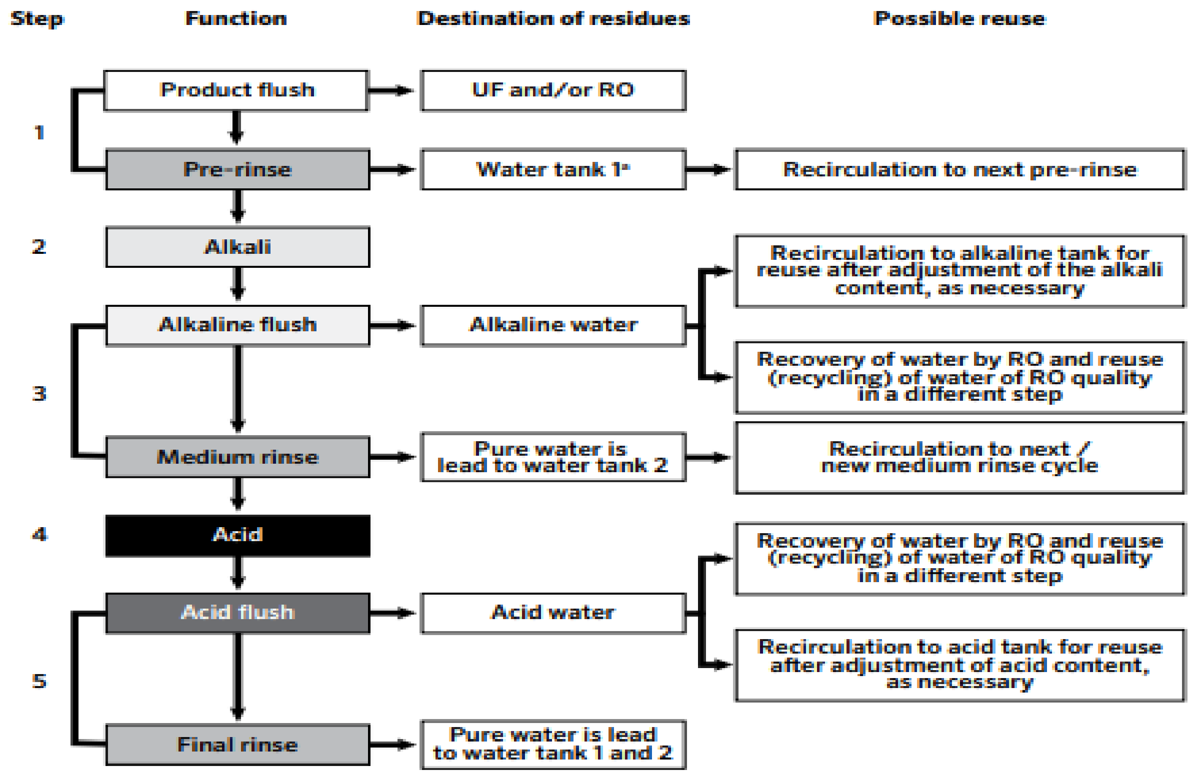
a) In this scenario, multiple runs of recirculation may apply. Recirculating externally sourced water for a new reuse, will produce a 2nd generation of water and recirculation of the 2nd generation would create the 3rd generation, etc. When the number of recirculations has reached its maximum (based on microbial testing) then the water is to be discarded as waste (last generation).

In case of recycling, the same principle should be applied, but before the water is ~~being~~ reused, a step of reconditioning/treatment should be applied as necessary.

10.2~~3~~ Example of recovery and reuse of water from CIP systems

~~67.~~38. CIP systems are used in dairy manufacturing plants to remove product residues from food-contact surfaces and to remove or reduce biofilm formation. A CIP system consists of a number of consecutive rinsing, ~~and~~ cleaning and disinfection steps using fit-for-purpose water at minimum designated temperatures, flow rates, pressures and concentration of chemicals in which the fit-for-purpose water needs to comply with different microbiological, physical and/or chemical parameters. On certain occasions, water used within a step can be recycled for the same step or an earlier step, e.g. potable water needed for the final rinsing step can be recycled for earlier rinsing. This is illustrated in Figure 25, which is derived from a detailed example of the use of a CIP system that can be found in case study 3 of Annex 4 of MRA40.

Figure 25: Sketch for reuse of water streams in a 5-step CIP system, including recovery of RO water from CIP fluids. Illustrates the flow of water streams and the associated options for recirculation or recycling the water from CIP fluids at different steps using UF, RO, ROP.



[a] When flushing of non-pasteurized product, the water should be pasteurized before reuse. Alternatively, it is led to the drain.

Source: Adapted from **Heggum, C. 2020.** Dairy Sector Guide - Recommendations of the Danish Agriculture & Food Council on implementation of food safety management systems in Danish dairy plants.

10.34 Example of recovery and reuse of water from food production/processing (reclaimed water)

~~68.~~39. Water present in milk or milk products can be recovered during processing (reclaimed water) and reused. Reclaimed water can be obtained from different processes which will determine its microbiological safety and its need for reconditioning. Examples are condensate from evaporation processes, casein wash water, milk whey and other ~~permeate, various~~ permeates with additional treatments and milk product rinse water.

~~69.~~40. This condensate from evaporation processes contains organic materials and chemical compounds such as milk solids and lactic acid, but it is generally very pure. Therefore, it can be used directly or ~~be~~ treated in a RO or ROP systems for reuse if it meets fit-for-purpose water criteria as a food ingredient or for cleaning and disinfection of food-contact material.

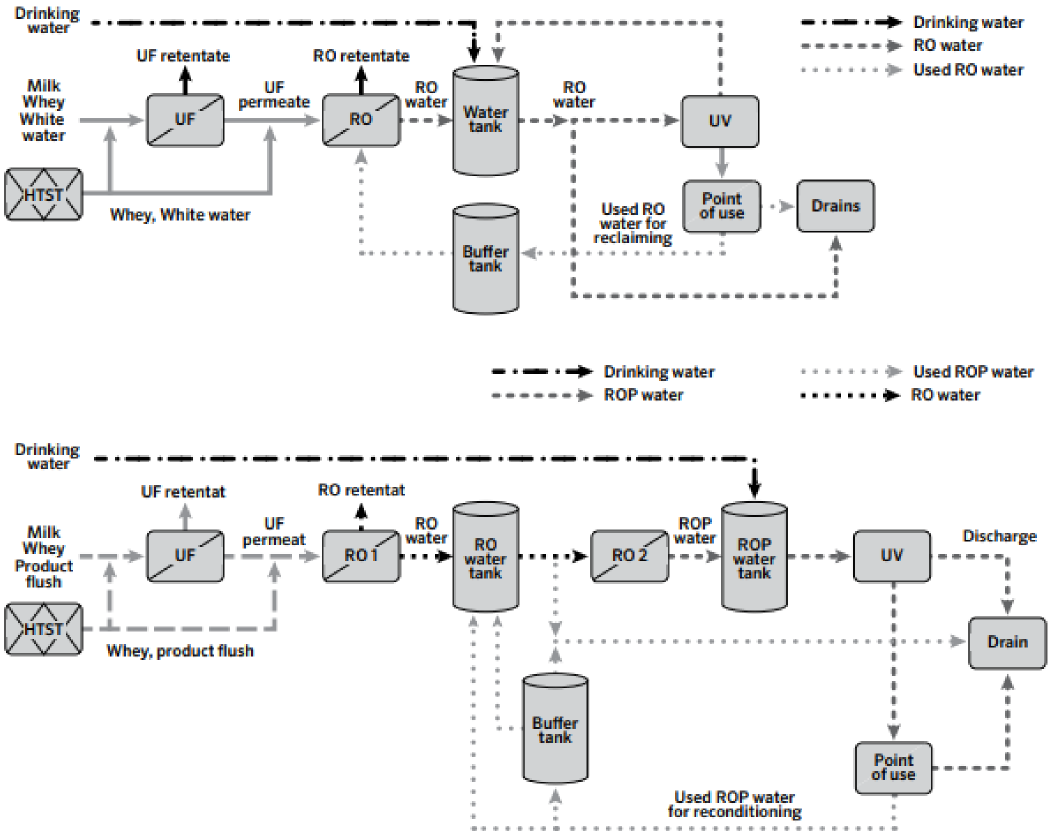
~~70.~~41. Casein wash water, ~~and~~ whey permeate, lactose permeate, milk permeate and some other types of permeates are a good source of reuse water but may support microbiological growth due to the presence of small amounts of milk solids such as milk proteins or lactose. Reusing water conditions should therefore be carefully assessed, monitored and verified. Treatment/purification steps such as UF, NF and RO and UF should be considered.

~~71.~~42. ~~Product~~ Milk product rinse water could be water recovered from the initial rinsing of pipes or tanks for milk and consists of a mixture of water and milk, milk-based food materials and deposits. Depending on the place of rinsing (e.g. equipment before or after pasteurization of the milk) and the presence/absence of biofilms, microbiological contamination might ~~be different~~vary. Treatment of recovered and stored rinse water to inhibit microbiological growth may need to be considered.

~~72.~~43. There should be sufficient documentation to identify the source and treatment (if any) of the reuse water (initial lot production) and subsequent use (which subsequent lots were exposed to this reuse water) in case a food safety investigation is needed.

Figure 36 provides an example of the recycling of water from whey using RO or ROP. It was derived from a detailed example that can be found in case study 4 of Annex 4, of MRA40.

Figure 36: Examples of two ~~water reuse~~ scenarios involving recycling of reusable water sources through RO/ROP and UV treatment(s). Top: describes the recovery of reclaimed water from milk, whey and product flushes using RO followed by UV treatment. Bottom: shows how the RO water is further purified by another RO process (a polisher), followed by UV treatment.



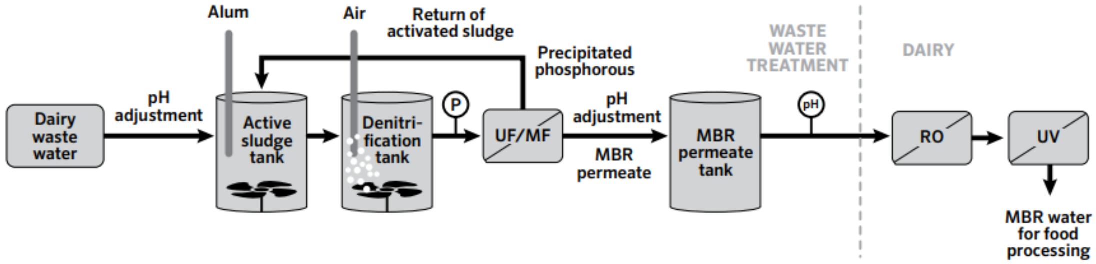
Source: Reproduced with permission from **Heggum, C.** 2020. Dairy Sector Guide - Recommendations of the Danish Agriculture & Food Council on implementation of food safety management systems in Danish dairy plants.

10.45 Example of recovery and reuse of dairy effluents

~~73.~~44. Effluents from dairy manufacturing plants such as dairy processing wastewater or sewage (wastewater from showers, bathrooms, toilets, wash stations etc.) that contain human pathogens, may be captured, treated and reused for certain applications when subjected to appropriate treatment and ~~fit~~ fit-~~for~~ for-purpose assessment and management measures are in place. These effluents may not only contain milk constituents supporting microbiological growth, but other hazardous substances.

~~74.~~45. Such wastewater should be collected and handled in a manner that prevents cross-contamination of the reuse water, and meets local, regional or national government requirements. Figure 47 provides an example of the recovery of water from dairy effluents using a Membrane Bioreactor and RO. It was derived from a detailed example that is provided in case study 5 of Annex 4 to MRA40.

Figure 47: Example of the recovery of water from dairy effluents using MBR and RO.



Source: Reproduced with permission from **Heggum, C.** 2020. Dairy Sector Guide - Recommendations of the Danish Agriculture & Food Council on implementation of food safety management systems in Danish dairy plants.

10.5~~6~~ Example of water recovery and reuse from non-food manufacturing operations

~~75.~~46. Water originating from external sources such as private wells may vary in chemical, microbiological and physical content, and may contain unidentified components. If the manufacturing facility has its own wells, the water may or may not be potable. This will need to be determined through a collection of data that includes microbiological sampling and testing as well as organoleptic evaluation (odour and appearance). I~~Consideration should also be given to i~~dentif~~ying~~ation of the pH, turbidity, nitrate level and hardness of such water may be helpful~~r~~. This will need to be determined through an appropriate evaluation. If the well water has come in contact with surface water, it will most likely have microbial contamination but can still be used if properly treated or for any qualifying fit-for-purpose use. A fit-for-purpose assessment and management measures are needed to identify likely hazards and controls to minimize or eliminate them. Treatment of the water, if needed, should be captured in the HACCP plan.

~~76.~~47. Case study 1 in Annex 4 to MRA40 illustrates the use of water from local wells at or near the dairy manufacturing plant.