



Brussels, 18.5.2016
SWD(2016) 178 final

COMMISSION STAFF WORKING DOCUMENT

On the application of the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) in relation to aquaculture

Contents

Introduction.....	2
Background and policy context.....	2
Purpose of the document.....	3
Limitations of the document.....	3
EU Policy and legal framework.....	4
The WFD and aquaculture.....	8
The MSFD and aquaculture.....	10
SEA and EIA Directives.....	13
The MSP Directive.....	14
Alien species regulations.....	14
Potential impacts of aquaculture - Regulatory and industry good practices and suggestions.....	15
1) Benthic impacts and nutrients.....	15
Regulatory good practices and suggestions.....	16
Industry good practice and suggestions.....	17
2) Disease and parasites.....	18
Regulatory good practice and suggestions.....	18
Industry good practice and suggestions.....	19
3) Chemical discharges from aquaculture.....	21
Regulatory good practice and suggestions.....	25
Industry good practice and suggestions.....	26
4) Escapees and Alien species.....	27
Regulatory good practice and suggestions.....	28
Industry good practice and suggestions.....	29
5) Physical impacts, disturbance and predator control.....	30
Horizontal issues.....	32
Way forward.....	34

Introduction

Background and policy context

In 2013 the Commission issued a Communication on strategic guidelines for the sustainable development of EU aquaculture, with the aim of helping Member States and stakeholders overcome the challenges facing the sector¹. In the Communication, the Commission announced that it would prepare a guidance document addressing the requirements of the Water Framework Directive (WFD)² and the Marine Strategy Framework Directive (MSFD)³ in relation to aquaculture. The guidance should assist Member States and industry in the implementation of these EU laws and facilitate the development of sustainable aquaculture. This document is built on the outcome of a series of 6 stakeholder workshops, including 4 regional meetings conducted during 2014. The relationship between aquaculture and the Directives, and specific examples as researched and expressed during the workshops were compiled by a contractor and are published⁴ as a comprehensive background to this document.

In addition, since 2009, the Commission has committed to enhance the information available to national competent authorities and to the industry to ensure a coherent and effective implementation of the WFD and of the MSFD from both perspectives, allowing aquaculture activities⁵ to develop in accordance with the objectives of the Directives.

The Commission previously issued guidance that facilitates the knowledge and implementation of EU legislation underpinning Natura 2000 (Birds Directive⁶ and Habitats Directive⁷) in relation to

¹ COM(2013) 229 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Strategic Guidelines for the sustainable development of EU aquaculture

² Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. OJ L 327, 22.12.2000, p. 1–73

³ Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). OJ L 164, 25.6.2008, p. 19–40

⁴ Jeffery *et al.*, 2014. Background information for sustainable aquaculture development, addressing environmental protection in particular. Part 1: Main report & References p. 138, Part 2: Annexes & supporting documents p. 179

⁵ COM (2009)162 final. Communication from the Commission to the European Parliament and the Council. Building a sustainable future for aquaculture. A new impetus for the Strategy for the Sustainable Development of European Aquaculture

⁶ Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. OJ L 20, 26.1.2010, p. 7–25

⁷ Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. OJ L 206, 22.7.1992, p. 7–50

aquaculture activities.⁸ In addition, a large number of guidance documents and policy papers have been produced in the past decade in the context of the WFD Common Implementation Strategy (CIS)⁹, which address many implementation issues which are relevant for aquaculture. This document builds to large extent on that CIS work.

Purpose of the document

The overall aim of this document is to offer practical guidance which will facilitate the implementation of the Water Framework Directive and Marine Strategy Framework Directive in the context of the development of sustainable aquaculture. More specifically:

- to provide regulatory good practice and suggestions to national authorities about the requirements of the Directives in relation to aquaculture, to facilitate their implementation;
- to provide industry good practice and suggestions to aquaculture producers on what is expected of them and what they can expect from the implementation of the Directives;
- to provide information about the sustainability of EU aquaculture production and its compliance with relevant EU environmental legislation.

Limitations of the document

This document is intended to be bound by, and faithful to, the text of the WFD and the MSFD and to the wider principles underpinning EU policy on the environment and on aquaculture. Other potentially relevant EU environmental legislation (e.g., the Environmental Impact Assessment (EIA)¹⁰ and Strategic Environmental Assessment (SEA)¹¹ Directives, Regulation on invasive alien species¹², Veterinary Medicines Directive¹³) are not discussed in detail, whereas guidance on the implementation of EU legislation underpinning Natura 2000 (Birds and Habitats Directives) in relation to aquaculture activities has previously been issued. Broader sustainability issues, such as the dependence on wild fish as a feed source for carnivorous fish and potential cumulative impacts of

⁸ <http://ec.europa.eu/environment/nature/natura2000/management/docs/Aqua-N2000%20guide.pdf>

⁹ http://ec.europa.eu/environment/water/water-framework/objectives/implementation_en.htm

¹⁰ Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment. OJ L 26, 28.1.2012, p. 1–21 as amended by Directive 2014/52/EU

¹¹ Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment. OJ L 197, 21.7.2001, p. 30–37

¹² Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. OJ L 317, 4.11.2014, p. 35–55

¹³ Directive 2001/82/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to veterinary medicinal products. OJ L 311, 28.11.2001, p. 1

substantial increase of aquaculture production in European Union on aspects not covered by WFD and MSFD, are out of the scope of this document.

The document is not legislative in character, it does not make new rules but rather provides further guidance on the application of those that already exist. It builds on the input and feedback from a wide range of experts and stakeholders that have been involved through meetings and workshops, without binding them in any way to this content. As such, it reflects only the views of the Commission services and is not of a legally binding nature. It rests with the EU Court of Justice to provide definitive interpretation of a Directive.

Finally, the document recognises that the principle of subsidiarity is enshrined in the two Directives and that it is for Member States to determine the procedures and means necessary to implement the requirements of the Directives. The good practice procedures described in this document are not prescriptive in their intent; rather they aim to offer useful advice, ideas and suggestions based on extensive discussions with public administrations, aquaculture industry representatives, NGOs and other stakeholders.

EU Policy and legal framework

The WFD aims to improve and protect the chemical and ecological status of surface waters and the chemical and quantitative status of groundwater bodies throughout a river basin catchment. This extends from rivers, lakes and ground-waters through to transitional (including estuaries) and coastal waters. For ecological status, coastal waters extend to one nautical mile out to sea. Chemical status, however, applies also to territorial waters extending out to 12 nautical miles. Article 4 of the WFD requires Member States to prevent deterioration of the ecological and chemical status of surface waters, and to restore polluted surface waters and the ecological conditions necessary to achieve good status in all surface waters by 2015¹⁴. Article 4 also requires Member States to take all the necessary measures to progressively reduce pollution from priority substances and to cease or phase out the emissions, discharges and losses of priority hazardous substances.

The WFD includes five classes for the ecological status classification: high, good, moderate, poor and bad. Classification of final ecological status is determined for each water body for a range of biological quality elements, supported by hydromorphological and physico-chemical quality elements. The physico-chemical elements include temperature and nutrient and oxygenation

¹⁴ Later deadlines of 2021 and 2027 apply to good chemical status in relation to some priority substances.

conditions, as well as river basin specific pollutants – pollutants other than priority substances identified by individual Member States as being discharged in significant quantities into waterbodies. Annex VIII of the WFD contains a non-exclusive list of the main pollutants that should be considered by Member States as possible river basin specific pollutants. The hydromorphological elements include the variations of the water flow, the structure of the intertidal zone and the variations in depth and morphology of the water body. The ecological status of a water body is determined by the quality element showing the lowest status, i.e. a ‘one out – all out’ approach. The chemical status is assessed against environmental quality standards (EQS) set at EU level (in the Environmental Quality Standards Directive 2008/105/EC¹⁵ as amended by Directive 2013/39/EU¹⁶ (EQSD)) for selected priority substances. Chemical status is good if the concentration of no priority substance exceeds the relevant EQS. Derogations as regards good chemical and/or ecological status can be accepted in certain circumstances if a number of strict conditions are met. The application of such exemptions allows for development of new projects and water uses which are legitimate and provide significant socioeconomic benefits.

A watch list mechanism has been established in accordance with the EQSD to provide high-quality monitoring information on the concentrations of potentially polluting substances in the aquatic environment to support the identification of future priority substances, in line with Article 16(2) of the WFD. Work¹⁷ on the first watch list (Commission Implementing Decision (EU) 2015/495) supported its adoption by the Commission in March 2015¹⁸.

The Water Framework Directive repealed Council Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters¹⁹ and Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life²⁰. These Directives aimed to protect or restore water bodies in order to support shellfish life and growth, and to protect waters against pollution, including fresh waters capable of supporting fish life, respectively.

The repeal of the Shellfish Waters Directive has raised some concerns among shellfish producers regarding the protection of shellfish waters. Member States are required to ensure, through the proper implementation of the WFD, at least the same level of protection against pollution of shellfish

¹⁵ OJ L 348, 24.12.2008, p. 84–97

¹⁶ OJ L 226, 24.8.2013, p. 1–17

¹⁷ Carvalho *et al.*, Development of the first Watch List under the Environmental Quality Standards Directive, JRC Technical Report EUR 27142 EN, 2015

¹⁸ OJ L78, 24.3.2015, p.40-42

¹⁹ OJ L 281, 10.11.1979, p.47. Directive repealed by Directive 2006/113/EC

²⁰ OJ L 222, 14.08.1978, p.1. Directive repealed by Directive 2006/44/EC

waters under the Shellfish Directive. In particular, Member States are required to establish a register of protected areas including shellfish protected areas. In these areas, Member States are expected to design a specific monitoring programme, set additional objectives and implement specific measures, in order to ensure at least the same level of protection as guaranteed by the repealed Directives. The River Basin Management Plans should include shellfish waters as protected areas as well as the specific objectives arising from standards in the Shellfish Directive. This ensures continuity of legal requirements for the protection of these areas.

As regards the objectives in Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters, they are fully integrated into the WFD objective of good ecological status, by the use of supporting physico-chemical quality elements and the inclusion of fish as a biological quality element. Therefore, proper implementation of WFD should afford the same level of protection.

The river basin management plans (RBMPs) are the key tools for the implementation of the WFD. Member States must produce RBMPs covering all River Basin Districts (RBD) in the EU (Articles 11 and 13). The planning process should include an economic analysis of all the water uses in each RBD, as well as determining the pressures and impacts on the water environment. The second RBMPs should be adopted by December 2015 and will cover the planning period 2015-2021. During the first cycle of RBMPs (2009-2015) aquaculture has been identified as exerting the following pressures on water bodies: use of water resources; point source of pollution; localised reductions in benthic biodiversity; significant dredging of water bodies and physical modification of land; changes in flow regimes; introduction of alien species²¹. On the other hand, sustainable aquaculture relies on sufficient quantities of clean water. In order to protect waters used for aquaculture, additional objectives beyond good ecological and chemical status should be established for aquaculture protected areas that require for example specific microbiological standards. Consequently, specific measures should also be defined in the Programmes of Measures accompanying the RBMPs to achieve those additional objectives. In a number of RBMPs additional objectives and measures have been clearly described for the protection of shellfish areas into the RBMPs, to ensure at least the same level of protection to shellfish waters (which the WFD classifies as protected areas) as did the previous Shellfish Waters Directive, which was repealed in 2013. In other cases, the additional objectives and measures have not been specifically included in the RBMPs. Member States should

²¹ Even though these pressures may not be relevant for all fish production technologies, such as extensive aquaculture.

make sure that the specific objectives and measures required in protected areas for aquaculture purposes are integrated in the next RBMPs due by December 2015. In any case, most Member States have decided to maintain in force the national transposition of the Shellfish Directive as to ensure the same level of protection to waters used for the production of shellfish.

The Court of Justice of the EU has recently handed down a judgment on the obligations laid down by WFD concerning enhancement and prevention of deterioration of individual projects (Weser case C-461/13²²). It addressed a number of seminal issues, namely the binding character of environmental objectives of the Directive (which apply to the authorisation of individual projects, including aquaculture, in case projects may deteriorate the status of water bodies or prevent the achievement of good status) and the meaning of deterioration of the water status (which is to be assessed at quality element level).

The MSFD aims to achieve good environmental status (GES-MSFD) in marine waters by 2020. Its scope of application extends to coastal waters on aspects of environmental status which are not already addressed by the WFD or other Community legislation, as well as the full extent of Member States territorial waters over which they have or exercise jurisdictional rights (MSFD, Article 3.1). To help achieve GES-MSFD, eleven descriptors of the state of the environment have been defined: biodiversity, non-indigenous species, commercial fish, food webs, eutrophication, sea-floor integrity, hydrographical conditions, contaminants, contaminants in fish and seafood, litter, and underwater energy such as noise. A detailed set of criteria and associated indicators for assessing good environmental status, in relation to the above-mentioned eleven descriptors have also been developed to help interpretation²³. The criteria build on existing obligations and developments within the EU legislation, covering further relevant elements of the marine environment, not yet addressed by existing policies. Good environmental status (MSFD) is not exactly equivalent to good ecological/chemical status (WFD). The criteria associated with the Directives differ due to the geographical scale to which the Directives apply. As the ultimate objective of the Directives is the protection of the environment, they are designed to have similar criteria insofar as possible. Chemical quality, the effects of nutrient enrichment, and aspects of ecological quality and hydro morphological quality in both Directives are closely related.

²² <http://curia.europa.eu/juris/document/document.jsf?jsessionid=9ea7d2dc30ddf90283e2da9b4ff7976ccf851d306c91.e34KaxiLc3qMb40Rch0SaxuRaxb0?text=&docid=165446&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=807910>. A press release is contained at: <http://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf>.

²³ 2010/477/EU: Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters. OJ L 232, 2.9.2010, p. 14–24

The main differences between the WFD and the MSFD are that the scope of good (environmental) status within the latter is broader, covering a wider range of biodiversity components and pressures; and that assessment scales for the MSFD are larger, requiring assessment of environmental status at the scale of the relevant sub-regions (e.g. Greater North Sea, Celtic Seas) or subdivisions of these rather than at WFD individual water body scales. The boundaries for MSFD and WFD assessments overlap in coastal waters. In these areas, the MSFD is intended only to apply to those aspects of good environmental status which are not covered by the WFD (e.g. noise, litter, aspects of biodiversity).

The WFD and the MSFD do not contain explicit obligations for aquaculture. The aquaculture industry has to comply with the requirements of the national legislation that implements those Directives in each Member State. Annex II, section 1.4 of the WFD requires Member States to collect and maintain information on the type and magnitude of significant anthropogenic pressures on surface waters in each River Basin District. Member States should identify significant point source and diffuse source pollution, in particular substances listed in Annex VIII, from urban, industrial, agricultural and other installations and activities for the purposes of each River Basin Management Plan. Discharges from aquaculture can be regarded as point-source inputs and thus monitoring information is likely to be required as a precursor to effective management. In addition, as the aquaculture industry relies on good quality water, management measures which introduce and maintain best practices for the protection of the environment are also essential to the functioning of the industry.

The EIA and SEA Directives are cross-cutting and cover a wide scope of environmental issues, including aquaculture related plans, programmes or projects. They set procedures aiming at implementation of certain plans, programmes and projects with due account taken of their likely significant environmental effect, before their adoption. Both directives ensure that environmental concerns are taken into account in the decision making through access to information, public participation and consultation.

The WFD and aquaculture

On the one hand, aquaculture activities can potentially exert pressures and impacts upon aquatic ecosystems, for example through increased nutrient load, from concentrations of faecal matter and uneaten feed, from dispersal of cleaning agents and medicines. On the other hand, aquaculture can itself be subject to pressures and impacts from other activities taking place in the aquatic ecosystem, for example pollution incidents, waste water treatment facilities upstream, and hydropeaking/flow variations due to flow regulation in the river e.g. from dams. It is important to remember that

aquaculture producers require high quality waters, and are often the first in a river basin to detect problems with water quality, pathogens or introduced species in the aquatic environment. If properly managed, certain aquaculture practices such as extensive exploitation can have positive effects on the natural environment, such as retention of water in the landscape, flood control and protection of biodiversity (e.g. providing habitats for amphibians or birds). Integrated multi-trophic aquaculture systems (IMTA) can reduce eutrophication by converting byproducts and uneaten feed from fed organisms into harvestable crops. Aquaculture relies on, but does not consume, significant quantities of high quality water.

Pressures and impacts of different aquaculture systems depend on multiple factors, including farm location, type of cultured organism, methods used, and the sensitivity or vulnerability of the environment to possible pressures. They include:

- Infrastructure (containment, abstraction, discharge, harvesting) can impact hydro-morphological quality elements (hydrology/typology- flow rates, wave exposure, habitat);
- Dissolved and particulate nutrients (as excretory products and uneaten fish food) can cause de-oxygenation of the water column and smothering of the seabed, impacting on the physico-chemical quality elements; they can also contribute to local eutrophication, with impacts on biological quality elements;
- Biological quality elements can also be affected by interbreeding with wild stocks, pathogen infections (e.g. sea lice), escapees and the introduction of non-native species;
- Contamination, e.g. by compounds (e.g. disinfectants, veterinary medicinal products, trace metals) can impact on physico-chemical quality elements and on biological elements.

Cost recovery for water services for aquaculture activities

Article 9 of the WFD requires Member States to take account of the principle of recovery of the costs of water services, including environmental and resource costs, and to ensure that water-pricing policies provide adequate incentives for the efficient use of water. The economic analysis to be performed as part of the RBMP should assess each water service and water use, its negative impacts on the aquatic environment and related cost-recovery from the provision of water services including environmental and resource costs, taking into account the polluter pays principle.

However, in designing their water pricing policies, the Directive also allows Member States to take the social, environmental and economic effects of water services cost-recovery, as well as the geographic and climatic conditions of the regions affected into consideration. Member States are

also allowed to exclude certain activities from the cost recovery requirement provided that these do not compromise the achievement of the WFD objectives. Available information shows that charging policy for water abstraction, use and discharge for aquaculture varies considerably across Member States, ranging from no charging to charges that, according to the industry, can make an operation economically non-viable. The Commission will continue to ask Member States to justify the exclusion of certain activities from cost recovery when these represent a significant pressure on the aquatic environment which needs to be addressed if the objective of good status or potential is to be achieved. The focus will be on whether Member States have provided in their RBMPs a justification fulfilling all conditions of article 9.4 of the WFD.

Finally, it should be taken into account that aquaculture does not consume significant quantities of water, as most of the water is returned to the rivers. The quality of the returned water varies widely and it depends on the type of aquaculture and local conditions. Water quality can often be equal to or sometimes even better than when abstracted. It is also important to consider that some systems, such as large extensive ponds, can also help to manage the effects of drought or flood within a river catchment, where they act as reservoirs or buffers in reducing extremes of flows.

The MSFD and aquaculture

The main potential environmental impacts of aquaculture relevant to the MSFD come from the introduction of non-indigenous species (NIS), nutrients, organic matter, contaminants including pesticides and litter, the disturbance to wildlife, and the possibility for escape of farmed fish. The magnitude of these impacts from aquaculture in comparison with impacts from other sources (e.g. agricultural runoff) has not been assessed until now and it is difficult to gauge the proportionate scale of these impacts in relation to the overall impacts on the environment from other anthropogenic activities together with CFP. The role of the MSFD is becoming increasingly important to ensure that aquaculture activities provide long-term environmental sustainability. At the same time the "Blue Growth"²⁴ communication foresees the expansion of aquaculture activities including i.a. through the farming of new species or moving further offshore.

Different aquaculture systems may impact the MSFD Descriptors in different ways (Table 1). However, such effects are dependent on factors such as the hydrological conditions at each aquaculture facility, the type of species being cultured, the production method and management

²⁴ COM(2012) 494 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. Blue growth. Opportunities for marine and maritime sustainable growth.

practices. In broad terms, potential environmental impacts include habitat loss and degradation including changes to the biological communities, contamination, nutrient and organic matter enrichment, and species disturbance, displacement and mortality. These may have implications for the following MSFD descriptors: biodiversity (D1), non-indigenous species (D2), commercial fish and shellfish (D3), foodwebs (D4), eutrophication (D5), seafloor integrity (D6), hydrographic conditions (D7), contaminants (D8), fish and seafood contaminants (D9), marine litter (D10) and energy including underwater noise (D11).

Table 1: Potential interactions between aquaculture, the environment, and MSFD descriptors based on Member States initial impact statements.

Descriptor	Degree of interaction	Evidence & mitigation
1. Biodiversity	Small	If unmanaged, escapees, diseases and parasites may have localised effects on biodiversity. These should be addressed through the implementation of the EIA, SEA and Habitats Directives. Siting is a critical factor in reducing the potential impacts on biodiversity.
2. Non-indigenous species	Large	Aquaculture provides a potential route for introduction of NIS; introduction of alien species in aquaculture is regulated by Regulation 708/2007 requiring a specific authorisation for any introduction of alien species.
3. Commercial fish & shellfish	Small	If unmanaged escapees (gene flow), diseases and parasites may have localised effects on wild commercial fish and shellfish.
4. Foodwebs	Small	If unmanaged escapees (gene flow), diseases and parasites may have localised effects on foodwebs. Siting is a critical factor in reducing the potential impacts on foodwebs.
5. Eutrophication	Small	Some impact at local scale, but generally unlikely to occur at sufficient scale at present to have significant impact except in enclosed seas like the Baltic that already have significant nutrient inputs. In such cases, Member States may consider the application of nutrient-neutral schemes or other approaches that remove nutrients from the sea.
6. Sea-floor integrity	Small	Some impact at local scale due to siltation or scour, but unlikely to occur at sufficient scale at present to have significant impact. This can be mitigated by moving cages, by fallowing areas or by relocation to more energetic sea areas (areas with a greater circulation).
7. Hydrographical conditions	Small	Some impact at local scale due to formation of small scale features including eddies, but unlikely to occur at sufficient scale at present to have significant impact unless large scale facilities.
8. Contaminants	Small	Some impact at local scale due to contamination by hazardous substances and microbial pathogens, but unlikely to occur at sufficient scale at present to have significant impact. Mitigation comes from the regulatory limits set within food safety legislation. However, these regulatory limits, which are set to protect the health of consumers, are not specifically designed to protect the environment. Therefore, additional action may be necessary to ensure

		adequate environmental protection.
9. Fish & seafood contaminants	Small	Impacts are assessed using regulatory limits set within food safety legislation.
10. Marine litter	Small	Aquaculture may be a source of marine litter alongside urban discharges and fisheries.
11. Underwater energy (e.g. noise)	Small	Some impact at local scale close to cages, but unlikely to occur at sufficient scale at present to have significant impact. Little information available on potential mitigation.

The key issues in relation to MSFD are the spatial scale at which the environmental impacts from aquaculture are likely to occur and their cumulative impacts considered together with the impacts from other anthropogenic pressures. These need to be considered in relation to the specified quality elements for assessment under the different MSFD descriptors and at the spatial scales defined for the MSFD assessments.

Assessments of whether GES has been achieved under MSFD are typically expected to be for relatively large sea areas (e.g. at a (sub-)regional scale, or subdivisions of these). This contrasts with the scale of aquaculture facilities, with many of the impacts of aquaculture being at a local scale. Individual aquaculture facilities may therefore contribute a relatively small footprint of impact within an MSFD assessment area; however, multiple facilities combined with the impacts from other activities in the area could mean there is, overall, a significant problem in achieving GES for a given descriptor/quality element. This could be particularly the case when the quality element is confined to areas where aquaculture facilities are placed (e.g. inshore species or shallow-water habitats).

Thus, while impacts and mitigation of aquaculture are generally assessed as part of the marine licensing process or under the WFD in coastal areas²⁵ on an individual facility basis, it is important to consider these, as with the licensing of any activity, within the overall context of cumulative effects from all activities.

Despite the current scale of aquaculture operations and the local impacts, it is possible that aquaculture, alongside all other sectors, will need to reduce impacts in order to reach GES under MSFD.

There are two other ways that aquaculture is potentially relevant in the implementation of the MSFD:

²⁵ Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 7. Monitoring under the Water Framework Directive. 153 pp. 2000.

- The MSFD is beneficial for aquaculture production. A reduction in contaminants, nutrient enrichment and litter in the marine environment will lead to improved water quality for aquaculture and reduce events of contamination in the fish produced and problems of litter effecting fish and equipment.
- Sustainable aquaculture contributes to delivering GES under MSFD. Greater production from aquaculture results in reduced pressure on wild fish stocks provided it is based on an ecologically sustainable feed source. The natural filtration feeding of shellfish also leads to improvements in water clarity, as demonstrated by mussel farms in the Baltic.

SEA and EIA Directives

Planning and development of aquaculture plans, programmes or projects fall under the SEA and EIA directives. They allow environmental concerns to be taken into account at an early stage in the planning process, thus avoiding or minimising negative impacts.

Certain aquaculture projects are listed in Annex II, point 1 (f) of the EIA Directive, and as such they are subject to 'screening', i.e. determination of their significant environmental effect on the basis of thresholds or criteria, or examining those projects on a case-by-case basis. When performing the screening procedure, the Member States should take account of the relevant selection criteria set out in Annex III of the EIA Directive. The developers of aquaculture projects, which are made subject to an assessment, should supply a certain minimum amount of information concerning the projects and its effects, pursuant to Annex IV of the EIA Directive.

The SEA Directive applies for plans and programmes which are prepared for a number of sectors, and which set the framework for future development consent of projects listed in Annexes I and II of the EIA Directive, as well as all plans and programmes which require appropriate assessment under the Habitats Directive. To this end, aquaculture plans and programmes fall under the scope of the SEA Directive. Where SEA is required for a respective plan or programme, an environmental report should be prepared containing relevant information, identifying, describing and evaluating the likely significant environmental effects of implementing the plan or programme, and reasonable alternatives.

In order to ensure transparent decision making, the SEA and EIA Directives provide that environmental authorities and the public are consulted during the assessment of those plans, programmes and projects. Member States should set appropriate time frames, allowing sufficient

time for consultations, including expression of opinion, as well as ensure that when a plan or programme is adopted and when the project is authorised, the relevant authorities and the public are informed and relevant information is made available to them.

The MSP Directive

The recently-agreed Directive on Maritime Spatial Planning (MSP)²⁶ aims to promote sustainable development and use of marine resources, including for aquaculture, through the establishment of maritime spatial plans in each Member State by 2021.

In situations where there may be competition for space maritime spatial plans should be used to reduce conflicts between sectors and create synergies between different activities, encourage investment by instilling predictability, transparency and clearer rules, increase coordination between administrations in each country via the use of a single instrument to balance the development of a range of maritime activities, increase cross-border cooperation and protect the environment through the early identification of impacts arising from the multiple use of space. The development of spatial planning for aquaculture is very valuable approach that can integrate the requirements of the WFD and MSFD.

Alien species regulations

The Regulation on the use of alien and locally absent species in aquaculture²⁷ addresses the movement of alien species for aquaculture purposes. Operators must conduct prior risk assessments and obtain permits to introduce or transfer any alien or locally absent aquatic species. The Regulation specifies the information to be provided by the operator and the criteria to be used by the Competent Authorities for granting a permit.

The newly adopted EU Regulation on the prevention and management of the introduction and spread of invasive alien species²⁸ addresses threats posed by those invasive alien species whose potential adverse effects require concerted action at the EU level. The Regulation foresees the adoption of a list of invasive alien species of Union concern, which can be tackled through actions

²⁶ Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. OJ L 257, 28.8.2014, p. 135–145

²⁷ Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture. OJ L 168, 28.6.2007, p. 1–17

²⁸ Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. OJ L 317, 4.11.2014, p. 35–55

which: 1) restrict their introduction and limit their spread; 2) establish effective early warning and rapid reaction mechanisms; and 3) manage invasive alien species that are already present and widespread in the EU. The list will be regularly updated and it may also include species relevant to aquaculture.

Potential impacts of aquaculture - Regulatory and industry good practices and suggestions

Aquaculture is a hugely diverse industry, and it should be emphasised that environmental impacts cannot be generalised across the sector. As for any other sector, in order to ensure a high level of protection of the environment, precautionary actions need to be taken for aquaculture projects which are likely to have significant adverse effects on the environment. The EIA and SEA procedures are important tools for integration and adoption of certain plans, programmes and projects which are likely to have significant effects on the environment because they ensure that such effects are taken into account during their preparation and before their adoption. Impacts vary with species, farming methods and management techniques, precise location and local environmental conditions and wildlife. They can be prevented, minimised or mitigated by the adoption of appropriate environmental safeguards, including regulatory, control and monitoring procedures. In addition, the aquaculture industry has a vital interest in a clean environment and therefore has evolved to lessen potential pressures. Possible environmental effects of aquaculture include:

- 1) Benthic impacts and nutrients
- 2) Disease and parasites
- 3) Chemical discharges
- 4) Escapees and alien species
- 5) Physical impacts, disturbance and predator control

1) Benthic impacts and nutrients

Most types of finfish aquaculture contribute to increasing the nutrient load in the water through uneaten feed, excretions, etc. The effects of nutrient enrichment on benthic communities have been extensively documented in field-based studies. In many regions, numerical models have been applied, to predict nutrient concentrations and impacts on benthic communities based on nutrient loading and/or hydrodynamics, or to help with site selection. While excessive nutrient enrichment

can be problematic, alternative uses for nutrient enriched water may be beneficial to other sectors, as fertiliser for agriculture for example.

Regulatory good practices and suggestions

There are different ways licence procedures mitigate the impacts of organic enrichment and nutrient input, such as:

- limit site biomass and production levels to a maximum level (e.g. set a cap on feed input; set a maximum biomass limit for a site based upon predictive models of assimilative capacity of the receiving environment);
- limit and control discharges²⁹;
- limit the use of fertilisers to what the ponds require and therefore reduce consumption and avoid discharges;
- control stocking levels, where the loading of nutrients in aquaculture effluent is dependent on stock biomass (and feeding rate), and the level of emissions is related to the total farmed population on the site.

Additional good practices and suggestions for regulators include:

1. Improved clarity on which parameters or data the industry should provide to show baseline loads;
2. Improved monitoring to quantify nutrient loads from different sources, including aquaculture;
3. Use of mitigation tools or practices (e.g. for effluent water quality) in the assessment of consents/licences;
4. Adequate flexibility in the regulatory framework to facilitate measures such as the following of sites;
5. Use of modelling approaches to the location of new farms.
6. Consider the use of nutrient enriched water (post filtering and settling as necessary) for biogas production or crop irrigation, encouraging better overall water management and integration between aquaculture and adjacent agricultural land use;
7. Collaboration at inter-departmental and inter-agency level, to achieve a common understanding about the existing situation and measures already in place, and to establish programmes that will allow for well-informed and responsible aquaculture operations;

²⁹ Limiting and controlling discharges requires regular monitoring of the nutrients discharged at the farm; this can imply extra costs. On the other hand, limiting biomass and production levels does not require additional monitoring costs, but it does not promote innovation such as more efficient feeding systems or use of closed containment systems.

8. Further consideration of the potential of a mass balance management approach for nitrogen and phosphorous in any previously impacted locations, e.g. Baltic and Black Sea;
9. Further discussion of nutrient trading schemes (including co-location), provided that local impacts are also adequately addressed.

Industry good practice and suggestions

Good industry practices and suggestions for mitigation against the impacts of organic enrichment and nutrient input include:

1. Use of efficient feeding systems to ensure that uneaten (waste) feed is minimised, e.g. by using camera systems or other mechanisms to monitor the feeding response. Camera systems are often used in conjunction with automatic feeders in the salmon farming industry;
2. Use of good quality feed types that are highly digestible by the cultured organism and minimise the release of nutrients in the faeces and water. Where appropriate the use of binders that keep solids together for effective collection and settlement;
3. Site management , such as fallowing (timing, impacts, area), treatments, exclusion zones, where a break in the production cycle allows for recovery of the seabed;
4. Monitoring to ensure that measured limits for nutrients and any EQS are within those determined by the licence conditions;
5. Reduction in release of nutrients into the receiving environment through, e.g. the use of closed containment or partial recirculation where dissolved nutrients and solid waste is removed from the effluent; land based/sediment traps, settlement ponds, and modern clean up technology such as drum filters; the use of constructed wetlands (where space allows) to clean and process dissolved nutrients;
6. Controlling use of fertilisers to minimise the introduction of nutrients directly into the river catchment;
7. The development of integrated multi-trophic aquaculture (IMTA) systems. The concept of IMTA is that farms combine fed aquaculture (e.g. finfish, shrimp) with species that extract the nutrient (e.g. seaweed) and suspended solids (e.g. shellfish) to create balanced systems for environment remediation (bio-mitigation).
8. Promotion of the use of blue catch crops (e.g. farming of mussels, algae and ascidia) associated with aquaculture as a compensation measure in order to remove nutrients from the sea;
9. Using partial or full recirculating aquaculture systems (RAS) in the production cycle as appropriate;

10. Developing and implementing innovative technological solutions such as closed system cages³⁰, once they are fully tested.

2) Disease and parasites

Disease and parasites are relevant to the WFD and MSFD because of the potential impacts of pathogens and parasites on wild stocks (affecting biodiversity and thus ecological status) and because of the release of chemicals and medicines which may be used for disease control into the local environment during and after treatments. The latter aspect is addressed in the next chapter.

Regulatory good practice and suggestions

Control of diseases within EU aquaculture is regulated under the Aquatic Animal Health Directive³¹. Additionally, the following regulatory good practices and suggestions are identified:

1. Locate proposed open net-pen farms away from the entrances to rivers or narrow channels (to minimise interactions with migratory wild fish species);
2. Implement zonal or area management plans that will reduce potential negative interactions between wild and farmed fish species, including as part of river basin management plans. An additional advantage of such schemes is they are likely to reduce the overall disease burden on sites, thereby also increasing productivity of businesses. Such area management plans can include:
 - Specifying the maximum biomass of fish or shellfish that can be cultured in a particular area;
 - Where practicable, implementing all-in-all-out production by synchronising year class production of any species within the managed area. Harvesting all the fish within a managed area within a defined period of time makes it easier to implement fallowing periods between rearing cycles;
 - Coordinating fallowing periods between producers to ensure effective disease breaks between production cycles within a managed area;
 - Coordinating treatment schedules for farms within a managed area to ensure treatments are used in as effective way as possible;

³⁰ These are freshwater and marine pens through which water cannot pass, thereby closing the farmed fish and limiting effluents and discharges from the open environment. A full description is available in the background document (Jeffery et al., 2014, chapter 9.3)

³¹ Council Directive 2006/88/EC of 24 October 2006 on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals. OJ L 328, 24.11.2006, p. 14–56.

3. Consider the cumulative impacts of aquaculture and other operations within a managed water body.

Industry good practice and suggestions

1. The application of the principles of integrated pest management, as implemented in agronomy, for the control of fish and shellfish pathogens, where the optimum strategy that includes use of medicines, site management activities such as fallowing may be determined and implemented. Use of medicines in accordance with the terms of their marketing authorisation (as indicated in the package leaflet or summary of product characteristics) unless prescribed differently by a veterinarian (off-label use), and in a manner that promotes optimal treatment efficiency. Optimal treatment efficiency often includes a reduced requirement for numbers of treatments, and hence total quantity of medicine released.
2. Use of treatment strategies that result in minimal or no additional chemical impacts, particularly in areas where water bodies and associated benthic fauna are assessed to be of moderate or lower status.
 - a. Investigate and, where feasible and safe, implement biological control methods as an alternative to chemical treatments (e.g. the use of cleaner fish for sea lice control)
 - b. Production systems with appropriate conditions for aquaculture (environment, nutrition, hygiene) should be encouraged. Chemotherapeutics should not be used instead of implementing good farming practices, animal husbandry and management.
 - c. Use vaccination-based methods where possible. Priority should be given to vaccination-based control methods that have minimal environmental impact.
 - d. Develop and implement effective biosecurity processes (plans) to minimise the spread of disease agents within and between farms and into the wider environment. Rear animals using systems and methods that are near physiological and behavioural optima in order to minimise stress, as stress is considered to be an important factor predisposing cultured animals to disease.
 - e. Careful consideration of controlling factors such as stocking density, rearing temperature, dissolved oxygen level, turbidity, dissolved ammonia and nitrites etc.
 - f. Where economically viable, consider using closed rearing systems (e.g. RAS) to minimise pathogen exchange with wild fish and shellfish and the release of chemical treatments into the environment.

- g. Reducing the use of antimicrobials and occurrence of antimicrobial resistance should be promoted e.g. by following relevant guidelines (such as Commission Guidelines for the prudent use of antimicrobials in veterinary medicine³²).
3. Aquaculture producers have a duty of care to ensure that the eggs, seed and juveniles they import onto their premises are free of diseases that may be transmitted to wild fish and shellfish species.
4. Selective breeding to increase disease resistance.
5. Implementation of effective biosecurity processes and use of effective and environmentally safe treatment methods should form part of the Codes of Good Practice (CoP) adopted by producers. To ensure adherence to CoP, quality control processes, including audits, may be considered.
6. With concern over increasing resistance to some veterinary medicines used in sea lice treatments, continue research and development into other emerging non-chemical methods of lice control such as treatment by heat, freshwater, laser or by cage depth and design. Recent research and development into the use of cages with built in snorkels has showed promising results for the significant reduction of lice numbers which are prevalent in the surface layers.
7. Industry good practices and suggestions n°1-4 from Chapter 3 "Chemical discharges" also apply here.

Specific example: sea lice

Probably the most high profile example of pathogen exchange between wild and farmed fish populations is the transfer of sea lice between wild and farmed Atlantic salmon. Sea lice can affect the growth, fecundity, and survival of their hosts because their feeding may cause skin lesions leading to osmotic problems and secondary infections. If untreated, they can reach a level that is highly detrimental to the host fish. Both wild and farmed salmonids can act as hosts to sea lice, and the possible interaction and transmission of the parasite between farmed and wild fish is causing much concern. The abundance of hosts available in farms can result in large sea lice production. Wild anadromous fish in areas with salmon farms may experience severe sea lice infestations, in some cases resulting in their premature return to freshwater or mortality at sea. To control sea lice, aquaculture operations typically use a range of antiparasitic medicines, and these may pose some environmental risks if not applied carefully.

There is debate about the significance of the impact on wild fish populations of sea lice from farmed fish. However, to counter the potential threat posed by sea lice to wild fish species, regulators and producers in the main Atlantic salmon farming regions of Northern Europe have developed methods

³² Commission Notice. Guidelines for the prudent use of antimicrobials in veterinary medicine (2015/C 299/04) http://ec.europa.eu/health/antimicrobial_resistance/docs/2015_prudent_use_guidelines_en.pdf

to control their proliferation and minimise chances of transfer. These include development of area management plans that regulate how the industry operates in particular zones, and development of improved treatment programmes. In Norway the authorities can impose cuts on the production in certain facilities if need be.

The recommendation for sea lice as stated by the North Atlantic Salmon Conservation Organization (NASCO) is for 100% of farms to have effective sea lice management such that there is no increase in sea lice loads or lice-induced mortality of wild salmonids attributable to the farms.

3) Chemical discharges from aquaculture

As with agriculture production systems where diseases affect the animals, farmed fish and shellfish are also affected by disease. A number of chemicals are used as medicines, biocides, antifoulants and feed additives to improve the survival, performance and quality of farmed fish and shellfish, particularly in intensive rearing systems. Medicines reduce losses during production, improve the welfare and quality of farmed fish, and can reduce the spread of disease from farmed fish to wild fish (and vice-versa). Access to effective, cost-efficient medicines is a high priority for the aquaculture industry and wild fish interests alike. On the other hand, the use of veterinary pharmaceuticals and other chemicals poses a potential threat to the environment, particularly the areas immediately around or under the farms. Unless their use on farms is carefully managed, their discharge into the aquatic environment can pose a risk. This risk includes direct toxic effects (on benthic micro and meiofauna, algae, plankton and other aquatic organisms) and more subtle effects including potential modification of bacterial communities (and the promotion of antibiotic resistant organisms) as a result of discharge of antibiotics into the environment.

The release of chemicals into the aquatic environment is regulated across Europe under a range of EU and national regulations. Under the WFD and the Priority Substances or Environmental Quality Standards Directive³³, (EQSD), EQS have been established for 45 priority substances and 8 other chemical pollutants of high concern across the EU. The EQSD applies to surface waters, i.e. inland waters, transitional waters (estuaries and inlets) and coastal waters: chemical status is assessed out to 12 nautical miles. The EQSD includes biota standards for several substances including mercury

³³ Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council. OJ L 348, 24.12.2008, p. 84–97, as amended by Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy. OJ L 226, 24.8.2013, p. 1–17

(Hg), hexachlorobenzene (HCB) and hexachlorobutadiene (HCBd). Member States are also required to take the necessary measures to progressively reduce pollution from priority substances and suppress emissions, discharges and losses of priority hazardous substances. In addition, Member States should also set EQS for pollutants of national concern (river basin specific pollutants).

Achievement of the WFD objective of good chemical status (and good ecological status) is supported by other EU legislation including the Industrial Emissions Directive³⁴, the Urban Waste Water Treatment Directive³⁵, the REACH legislation^{36,37}, the Biocidal Products Regulation³⁸, the Veterinary Medicines Directive³⁹, the Plant Protection Products Regulation⁴⁰ and the Sustainable Use of Pesticides Directive⁴¹.

An Environmental risk assessment must accompany an application to obtain a Marketing Authorisation (MA) for a veterinary medicine. In accordance with Directive 2001/82/EC as amended, any relevant scientific guidelines and/or scientific advice should be taken into account as part of the risk assessment. These measures ensure that the environmental impacts of the medicine will be minimal when used as directed as per label. Furthermore, as a public health measure, EU law requires that animals, including aquaculture products to be marketed as food must not contain residues of pharmacologically active substances above an established Maximum Residue Limit (MRL) in accordance with Commission Regulation (EU) No 37/2010. There are residue monitoring programs

³⁴ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). OJ L 334, 17.12.2010, p. 17–119

³⁵ Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. OJ L 135, 30.5.1991, p. 40–52

³⁶ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. OJ L 396, 30.12.2006, p. 1–849

³⁷ Directive 2006/121/EC of the European Parliament and of the Council of 18 December 2006 amending Council Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances in order to adapt it to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and establishing a European Chemicals Agency. OJ L 396, 30.12.2006, p. 850–856

³⁸ Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products Text with EEA relevance. OJ L 167, 27.6.2012, p. 1–123

³⁹ Directive 2001/82/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to veterinary medicinal products. OJ L 311, 28.11.2001, p. 1

⁴⁰ Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC. OJ L 309, 24.11.2009, p. 1–50

⁴¹ Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. OJ L 309, 24.11.2009, p. 71–86

⁴²(both statutory and Member State specific non-statutory) in place to ensure that levels of allowed pharmacologically active substances and certain contaminants in aquaculture products in the EU are below maximum permitted limits and also free from detectable levels of prohibited substances⁴³ and of those with no established MRLs. The Marketing Authorisation process for veterinary medicines and the official controls on the distribution and use of veterinary medicines have the effect of greatly limiting the range of chemicals that can be used in aquaculture, providing some environmental protection. However, caution is required during the "off-label" use of a medicinal product authorised for terrestrial animals to treat aquatic species, as the impact to the aquatic environment is unlikely to have been considered as part of the authorisation process.

Of the priority substances for which EQS have been set only the antiparasiticide cypermethrin and the antifoulant cybutryne are of direct relevance to aquaculture operations. These substances were added to the list in 2013, meaning the respective EQSs have to be met by 2027. In addition to this, certain Member States have identified as river basin specific pollutants substances that are relevant for aquaculture (Table 2). These include certain heavy metal (copper and zinc) compounds used as antifoulants, as well as chemicals that have been used as antiparasiticides (such as the sealice treatments diflubenzuron, cypermethrin and azamethiphos), formaldehyde (still widely used to control a range of diseases in aquaculture) and EDTA (Ethylenediaminetetraacetic acid, used to improve water quality by reducing heavy metal concentrations or remove organic substances in the water). Ammonia is listed in Annex VIII of the WFD and can also be considered as part of ecological status under the support quality element 'nutrient conditions'. Therefore, specific quality standards are usually in place in most Member States and it is relevant for aquaculture because it is a compound excreted by aquatic organisms and therefore it is discharged into the aquatic environment from aquaculture operations.

As well as datasets of pollutant transfers from aquaculture operators maintained by national administrators or the regulators, information on discharge from intensive aquaculture operations can be found at the European Pollutant Release and Transfer Register⁴⁴.

Table 2. List of substances used in aquaculture that are identified as priority substances in the EQS Directive, or identified as river basin specific pollutants in at least one Member State

⁴² Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. OJ L 125, 23.5.1996, p.10

⁴³ As provided in Table 2 of the Annex to Commission Regulation (EU) No 37/2010 and in Directive 96/22/EEC

⁴⁴ <http://prtr.ec.europa.eu/IndustrialActivity.aspx>

Chemical	Priority substance under WFD (European EQS set)	WFD Annex VIII	National EQS set (at least in one Member State)	Aquaculture uses
Zn	No	Yes – point 7	Yes	
Cu	No	Yes – point 7	Yes	Antifouling
Diflubenzuron	No	Yes – point 9	Yes	Seallice treatment
Cypermethrin	Yes - PSD		Yes ⁴⁵	Seallice treatment
Formaldehyde	No	Yes – point 9	Yes	Antiparasiticide and antifungal treatment
Azamethiphos	No	Yes – point 9	Yes	Seallice treatment
Cybutryne	Yes	Yes – point 9		Antifouling
EDTA	No		Yes	Improve water quality

Under the WFD, levels of priority substances in surface waters are allowed to exceed their EQS (as established by the EQS Directive) in designated mixing zones adjacent to points of discharge, as long as the rest of the water body still complies with the EQS. The reasoning applies in a similar manner to river basin specific pollutants (nationally-set EQSs). The designation of mixing zones involves defining a boundary beyond which the EQS should not be exceeded; the size of the mixing zone must be restricted to the proximity of the point of discharge and proportionate⁴⁶.

As well as these overarching controls, the release of chemicals from aquaculture operations is typically tightly regulated nationally, with most Member States specifying what chemicals can be used as part of aquaculture operations and their maximum permitted discharge levels, irrespective of whether they are considered as river basin specific pollutants under the WFD.

Discharge of chemicals into the aquatic environment from aquaculture operations is also of relevance to the MSFD, as they may affect the environmental status of the marine regions they are discharged into. Of particular relevance here would be GES-MSFD Descriptor 8 (Contaminants) and Descriptor 9 (Contaminants in seafood). In general, the good practices and suggestions that help ensure compliance with WFD obligations will also apply to MSFD obligations.

Regulatory Example: Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR)

These national regulations explicitly cater for the unique requirements of aquaculture. The Scottish Environmental Protection Agency (SEPA) set limits on the biomass of fish that can be held in the

⁴⁵ Cypermethrin was identified as a river basin specific pollutant in certain MSs before its inclusion in the priority substances list in 2013. This explains why national EQSs had been set for this substance. National EQS will now have to be replaced by the EQS set by the EQS Directive.

⁴⁶Article 4 of Directive (2008/105/EC).

cages (and thus indirectly the amount of food) and the amounts of certain medicines that can be administered and discharged. In setting these limits, SEPA aims to ensure that fish farms operate within the capacity of the environment.

SEPA separate their assessments into 'near field effects' (i.e. in areas immediately adjacent to an operating or potential aquaculture site) and 'far field effects'. Essentially, some 'near field' impacts are tolerated if these are not widespread and do not affect the wider aquatic environment. The main aim is to maintain a functioning community of seabed animals to process waste and limit the area impacted by the use of veterinary medicines. The assessment uses local tidal and bathymetric data in computer models to predict impacts, with the aim of setting relevant, site-specific conditions that ensure environmental protection. The approach embeds the principle of a mixing zone – Allowable Zone of Effects (AZE) or the footprint around the farm. Within the AZE, some exceeding of environmental standards is accepted, but at the AZE boundary, standards must be met to prevent adverse 'far field effects' to the surrounding water body.

The Scottish Government through SEPA and other agencies have also produced clear guidance documents for aquaculture producers that detail how an operator can apply for a licence as well as a website⁴⁷ where data on Scottish fish farms can be searched by anybody with an interest. This includes information on where the farms are located, maximum permitted biomass, treatments permitted and used, and results of environmental monitoring in and around the sites.

Regulatory good practice and suggestions

1. If maximum limits are set for the biomass of fish that can be held on a site and/or for production levels (see regulatory good practices on nutrient enrichment), these can indirectly result in a limitation to the amount of veterinary medicines administered and discharged.
2. Proceed with licensing of aquaculture producers only after it is demonstrated that the chemical impacts of the proposed activity will not adversely affect the ecological status (benthic fauna, phytoplankton) and the chemical status of the area. For open cage farms in the marine environment, give particular consideration to the use of modelling approaches to assess likely chemical treatments spread, dilution rates, turnover time and their resultant impact.
3. During the licensing application process, take the scale of any impacts into account. In particular, 'near' and 'far' effects may need to be differentiated. As for any other anthropogenic activity, it is necessary to balance the possible environmental effects of an

⁴⁷ <http://aquaculture.scotland.gov.uk/default.aspx>

activity against its possible benefits (economic, societal etc.). The WFD provides mechanisms to balance these effects and they should be used according to the criteria and conditions therein (e.g. mixing zones in EQS Directive, exemptions in the WFD).

4. Consider the application of the principle of allowable zones of mixing, whereby the concentrations of priority substances and the eight other pollutants in the EQS Directive, and by analogy those of the river basin specific pollutants, are permitted to exceed the EQS close to the discharge from an aquaculture activity but not to exceed those levels beyond a designated boundary. Principles and criteria in the EQS Directive and Mixing Zones Guidance⁴⁸ should be respected.
5. Transparency is important to ensure data on what chemical treatments farms are allowed and their potential environmental effects are made available to all stakeholders. In this regard, consider publishing data on publicly accessible and readily searchable websites.
6. Stimulate the development of technology and practices with lesser environmental impacts as alternatives to chemical treatments
7. Strengthen contacts between relevant environment agencies and medicine regulators in evaluating medicinal products for veterinary use, both at the national and EU level.

Industry good practice and suggestions

1. When multiple chemical alternatives are available, base substance selection not only on efficacy data but also on available information regarding environmental persistence, potential effects on non-target organisms, propensity to stimulate microbial resistance and rate of residue elimination.
2. Where animals are reared in the open water, consider using contained treatment processes where practicable (e.g. well boat treatments). Care should then be taken to ensure the treated water is disposed or inactivated safely prior to discharge.
3. Aquaculture producers are expected not to discharge into natural bodies any effluent containing chemical residues at concentrations likely to cause biological effects and to privilege the reduction of concentrations, preferably by residue removal or increased residence time, and/or by dilution with other effluent waste streams within the farm.
4. When chemical treatments are required, coordinate application between producers to limit the scale of any environmental impacts.

⁴⁸ <https://circabc.europa.eu/w/browse/24e6ac00-9f10-4d01-a3d2-4afbfc5b37f>

5. Industry good practices and suggestions from Chapter 2 "Disease and parasites" (except n°3), are also relevant for this chapter, because they aim at reducing the amount and toxicity of medicines discharged in the environment.
6. Favour alternative cleaning techniques over the use of antifoulants and chemical-based cleaning products where possible:
 - a) For net-pen aquaculture in the marine environment, as an alternative to the use of potentially toxic antifoulants, consider washing and drying nets at regular intervals.
 - b) The use of water jet operated underwater net cleaning devices is also an alternative to using antifoulants on netting.

4) Escapees and Alien species

There is a clear interest, shared among all stakeholders – aquaculture industry, regulators, civil society – in minimising escape of any stock or species, whether indigenous or not, and in reducing potential interactions with wild fish stocks.

From the point of view of the ecosystem, the potential effects of escapees from aquaculture are well documented, studied and modelled although conclusions are often disputed. Escapees of non-indigenous species may alter the structure and functions of marine ecosystems by habitat modification and competition for food and space with indigenous organisms. This has the effect of reducing their abundance, biomass and spatial distribution. Farmed indigenous species are often selectively bred for many generations and may therefore differ genetically to wild populations; this raises concerns for the fitness and productivity of wild populations if interbreeding with escapees occurs. However, escapees are equally undesirable for the aquaculture industry as they represent a financial loss⁴⁹.

In the context of the WFD, invasive alien species – although not explicitly covered – should be considered as a '*potential anthropogenic impact*' on biological elements listed in Annex V. Unlike the WFD, Descriptor 2 of the MSFD requires that '*non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem*'. The criteria for GES under Commission Decision 2010/477/EU for Descriptor 2 include:

- Abundance and state characterisation of non-indigenous species, in particular invasive species;
- Environmental impact of invasive non-indigenous species.

⁴⁹ The EU PREVENT ESCAPE project estimated escapees lost European aquaculture as much as €47.5 million p.a. at point of first sale, and produced a set of recommendations and guidelines to reduce both environmental impacts and financial losses.

A problem related to non-indigenous species is that once an aquatic organism has been introduced and becomes established in a new environment, it is often nearly impossible (or at least financially not feasible) to eradicate. At that stage, policy measures can practically only focus on containment and control. Consequently, defining an area as "bad" status, depending on the presence of invasive species, could mean that there is no possibility for remediation to "good" status.

The regulation of alien species within the aquaculture industry is well developed in comparison to other sectors. Regulation (EC) No 708/2007 requires Member States to appoint a Competent Authority to operate a permit system for the introduction of alien, and translocation of locally absent, aquaculture organisms. This Regulation recognises two types of stock movement:

1. Routine movements: where there is a low risk of transferring non-target organisms;
2. Non-routine movements: where an environmental risk assessment has been carried out and risk was found to be low, or where appropriate mitigation can be applied.

Certain alien species with a long history of aquaculture within the EU and which do not have any major adverse ecological impacts are not subject to the main obligations of the Regulations, but Member States can still put controls in place if they consider it appropriate. These species are listed in Annex IV of the Regulation. In addition, movements to closed aquaculture facilities pose less risk and are exempt from the permitting system.

The new Regulation on the prevention and management of the introduction and spread of invasive alien species has been adopted on 29/09/2014 and entered into force in January 2015⁵⁰. This Regulation is not specific to aquaculture and covers a wider remit, including all IAS, activities and sectors. The Regulation foresees the establishment of a list of IAS of Union concern, which will not be allowed to be introduced, kept, bred, placed on the market or released into the environment in the EU. The species listed in Annex IV to Regulation (EC) No 708/2007 are excluded from the scope of the new IAS Regulation when used for aquaculture purposes.

Regulatory good practice and suggestions

1. Carry out inspections of premises to ensure that they meet conditions of the licence / permit with regard to containment of stock;

⁵⁰ Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. OJ L 317, 4.11.2014, p. 35–55

2. Adopt technical standards and specifications for pen design, mooring systems and nets, and ensure compliance with these standards under the licence conditions for open net-pen aquaculture units. Technical standards for aquaculture systems – such as the ones developed in Norway and Scotland – can help manage the risk of escapes from aquaculture systems and any subsequent potential impact on biodiversity;
3. Ensure coordination between respective competent authorities for the implementation of Regulation (EC) 708/2007 and Regulation (EU) 1143/2014;
4. Consider locating proposed open cage sites away from areas with any potential wild fish interactions, e.g. entrances to rivers or narrow channels;
5. Within the spirit of openness and accountability, publish transparent, easy to access data on escapees and establish reporting systems for escapees;
6. Provide economic incentives to trace escapees;
7. Consider catch actions in rivers with escapees.

Industry good practice and suggestions

1. Develop or follow existing codes of good practice or recommendations that address operational procedures at aquaculture units;
2. Risk assess, document and train staff in high risk handling procedures such as transfer, grading and harvest;
3. Ensure that aquaculture seed stocks destined for human consumption come from domesticated hatcheries wherever possible and are not released into the environment (i.e. for mitigation restocking);
4. Fish for mitigation stocking should be reared from sustainably caught wild brood-stock and that these are kept separate from domesticated stocks;
5. Use best available technology for the production of sterile fish where possible. Take up new technology when licensed and available;
6. Ensure that land-based flow-through systems have adequate screening for the size of the fish and that it is maintained regularly;
7. Develop contingency plans for the recovery of escapees and implement routine preventive maintenance for containment units;
8. Gene banks of wild species should be encouraged where possible.

A combination of good licensing, Regulation (EC) No 708/2007 on alien species and the use of best available technology combined with best practices and codes of conduct will contribute to reducing

environmental impacts from escapees and achieving the targets set in the WFD and MSFD. The development of guidelines, sectorial codes of conduct and other awareness-raising and educational campaigns will also be useful in this context.

5) Physical impacts, disturbance and predator control

Physical impacts on prevailing hydrographic conditions, flow rates, morphology, and sedimentation, as well as temporary or permanent disturbances in environmental conditions and ecosystems deriving from aquaculture activities may affect the WFD hydromorphological elements, while predator control may affect the biological elements, with possible impacts on the WFD Good Ecological Status. The MSFD descriptors of sea- biodiversity (D1), non-indigenous species (D2), foodwebs (D4), sea-floor integrity (D6), and hydrographical conditions (D7), are most likely to be impacted by changes in physical impacts, disturbance and predator control for aquaculture.

Physical impacts, disturbance

Marine aquaculture facilities such as net-pens (finfish) and longlines (shellfish, macroalgae) can have physical impacts since they may be anchored on the seabed, and could physically damage the seabed habitat. Proper siting and design of aquaculture infrastructures can mitigate these impacts by avoiding locating on sensitive habitats and considering the best technical solution for each type of area (e.g. adapting mooring structures to the conditions of the seabed substrate). Large enclosures could also affect current circulation and water clarity. Risks can be managed, if necessary, by limiting the sizes of complexes and relocating them regularly.

In freshwater systems, the main physical impacts relate to changes in river flow, river continuity, and morphological conditions. Water abstraction is seen as one of the key challenges facing Europe, so it is important that resource-efficient methods are used to mitigate those impacts. These will need to be addressed on a case-by-case basis generally through good farm design, but the potential for approval of new sites is very dependent on the individual location and the RBMP for that system.

The only way to completely remove the physical impacts of aquaculture is to use land-based recirculation systems which do not provide a barrier to water movement or change sedimentation. However, these are expensive to set-up and maintain and are unlikely to provide substantial increases in volume of seafood production. An example of reducing physical impacts is the Danish model farm approach with partial-recirculation.

Aquaculture can have also an impact on seafloor integrity, related to physical disturbance from input of waste products and debris from the facility. These impacts can be controlled and mitigated by licensing procedures that identify an acceptable zone of impact and a further monitoring zone around the facility; in practice, the area of these zones will be no more than a few 100 m² reflecting the current size of net-pen and longline systems for finfish and shellfish cultivation.

Visual impact concerns relate mostly to how visible the facilities are from the shore, or what the landscape impacts are in the case of land installations. Studies and guidance on reducing visual impacts have been published in different Member States. Mitigation measures, should they be required, may relate to the size and colour of the cages, with a preference for black or blue cages, as well as reducing the size of above-water physical elements in order to reduce the seascape impact, but in all cases without prejudice to the regulations on the proper marking of the facilities for boaters. Mitigation measures may also include siting the cages far from the shore or using submersible cages.

Oyster farming may alter intertidal macrozoobenthic assemblages moderately, and off-bottom cultures may cause more disturbance than on-bottom cultures. Hydrodynamics and season interact with cultivation practices to affect dispersal and accumulation, and hence the extent of smothering and bio-deposition. The future establishment of oyster long-line production in sub-tidal areas may reduce stocking biomasses on intertidal grounds with positive effects on intertidal benthic communities. However, the potential negative effects of these new culture practices on the sub-tidal areas needs to be assessed.

Finally, it is important to consider impacts, not just in terms of departure from baseline, but also in relation to how they influence resilience, i.e. capacity of the system to withstand or recover from other shocks. Some anthropogenic disturbances, not necessarily resulting from aquaculture, are thought to have affected the resilience of aquatic environments.

Predators

Farmed fish and shellfish stocks will inevitably attract the attention of wild predators including fish (e.g. pike), mammals (e.g. otters, seals), and birds (e.g. cormorants, herons, eider ducks). Invertebrates (e.g. starfish, crabs) can also predate shellfish in the subtidal zone.

Predator control can be challenging since many predators are protected by Member States' and EU legislation, especially within designated sites of conservation interest. The form of protection

employed will depend on the location, the aquaculture system, the species and the life-stage being cultured. The system of control chosen should attempt to minimise the impact on biodiversity and the predators, and may take the form of exclusion from sites (e.g. seal nets, otter fences), deterrents (e.g. noise, fake predators), farm management strategies (e.g. removal of mortalities, lower stocking densities), siting (e.g. avoiding known predator aggregation sites) or as a final resort, reducing numbers through licensed control methods (e.g. shooting).

Avian predators

Avian predation, by cormorants in particular, is an important factor affecting pond-based finfish aquaculture production in certain regions. Mussel farms may attract birds, with eider ducks and scoters seeming to cause the most concern. Many of the techniques used to control cormorants can also be applied to ducks and other birds.

The EU Cormorant Platform provides information on cormorant numbers, management, and interactions with aquaculture⁵¹. This platform is based on outputs from the INTERCAFE project⁵² and it defines a number of different tools for managing the impacts of cormorants.

When considering options, it is important to recognise the protection of cormorants under the Birds Directive, the complexity of conflicts between cormorants and fisheries, and the efficacy of control measures. The Birds Directive sets out a derogation system to protect fishery and aquaculture interests. Member States can make full use of the derogation provisions to prevent serious cormorant damage to fisheries or aquaculture. The European Commission has published a guidance document to clarify the key concepts in relation to the implementation of the derogation system⁵³.

Horizontal issues

The development of simple guidance on the licensing aquaculture developments at national level would help regulators and industry assess whether plans for new or expanded aquaculture facilities will comply with obligations of the MSFD and WFD (building on existing WFD Common Implementation Strategy guidance documents⁵⁴).

In accordance with the case-law of the Court of Justice of the European Union, the Precautionary Principle has to be applied to the environmental legislation of the Union. This includes applying the

⁵¹ http://ec.europa.eu/environment/nature/cormorants/home_en.htm

⁵² <http://www.intercafeproject.net/>

⁵³ http://ec.europa.eu/environment/nature/pdf/guidance_cormorants.pdf

⁵⁴ http://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.htm

precautionary principle to aquaculture, also in line with EU guidance^{55,56}. The guidance that has been provided by the Commission, if followed correctly, should help clarify the requirements in the application of the Precautionary Principle to sustainable aquaculture development and address concerns raised about the sector's growth ambitions, especially for new developments such as offshore aquaculture.

In order to ensure a more effective implementation, a risk and evidence-based approach could be followed to determine monitoring requirements. Administrations could also facilitate compliance by the aquaculture industry by specifying more clearly which parameters or data should be provided for licensing and monitoring, as well as the quality and quantity of the information required. Data on both emission and uptake of nutrients is required, and improvements in monitoring would be needed to quantify and allocate proportional nutrient loads from different sources, identifying the contribution from aquaculture within an overall nutrient budget. The current Data Collection Framework (DCF)⁵⁷ under the CFP contains provisions requiring Member States to collect and transmit to end-users socio-economic data on marine aquaculture⁵⁸ but does not cover data on the environmental impact, or sustainability, of the aquaculture sector. Although scientific studies are available on the environmental impacts of different types of aquaculture, at the moment this type of data is not collected and readily available at the EU level. Such data is needed in order to better assess policy options to support a sustainable development of aquaculture.

Moreover, the adoption of regional technical standards across the whole aquaculture industry may help to mitigate environmental impacts across a range of aquaculture systems and species. The implementation of such standards can also help ensure a consistent approach across different administrations, increase legal certainty for operators, and ensure that systems and equipment are appropriate for the location and species farmed.

Planning is a key issue in relation to the strategic development of the marine aquaculture sector and has been raised as an opportunity to manage the environmental impacts of the industry in a manner that optimises the management of marine resources, providing the best possible mitigation of the environmental impacts. A strategic view is important to ensure that aquaculture develops in the

⁵⁵ COM/2000/0001 final. Communication from the Commission on the precautionary principle

⁵⁶ EEA (2001) Late lessons from early warnings: the precautionary principle 1896 – 2000. Environmental Issue Report No 22. 1–211.

⁵⁷ OJ L 60, 5.3.2008, p. 1–12.

⁵⁸ For aquaculture, the current DCF covers only marine species, including eels and salmon, farmed within the Member States and EU waters.

most suitable areas and that the sector can coexist with other activities. In particular, national administrations/regulators can use maritime spatial planning to provide strategic planning for marine aquaculture development and ensure linkages with other marine industries. The provision of AZAs can also complement an ecosystem approach to the management of the sustainable development of aquaculture. The adoption of geographic information systems (GIS) or other mapping systems and planning techniques can support a more strategic vision for the aquaculture industry's sustainable development.

In the case of both freshwater and marine aquaculture, it is recommended that the specific objectives and measures for protected areas for aquaculture production are fully integrated into in the second round of RBMPs to ensure parity with other industries and allow for considering the pressures and requirements of the industry in the context of the management of the whole river basin. Regulators need to ensure that the aims of reducing nutrient emissions and enabling industry development are balanced and one aim does not override the other. Aquaculture also merits recognition for its potential positive contributions towards achieving good ecological status.

Way forward

As the aquaculture sector expands further, it must continually consider its environmental sustainability as well as its economic and social sustainability. Broader sustainability issues such as the aquaculture feed sustainability or the cumulative impacts from substantial increase in aquaculture in a marine region need also to be addressed. These aspects are essential to the long-term viability of aquaculture as a food source. The environmental concerns of other stakeholders are recognised by the aquaculture industry, which has made good progress in improving its own environmental record in recent years. Similarly, the environmental concerns of the industry are recognised by other stakeholders, and steps have been taken to provide greater assurance of access to clean, litter free water to guarantee the safety and quality of the food produced. Research has shown that some environmental pressures have been mitigated in absolute terms and significant improvements in efficiency have also been noted. Technological and biological developments will enable further improvements, as long as ecological interactions can be managed appropriately. Scientific evidence must continue to play a central role in this industry, informing the evolution of best practice. Ongoing applied scientific research is needed to develop practical solutions to mitigating environmental impacts as they evolve. Member States and the industry are encouraged to implement the good practices and follow the suggestions provided in this document and illustrate

how environmental protection and sustainable aquaculture are compatible, complementary activities.

Finally, due to the localised environmental aspects of the aquaculture industry and the existence of national and region-specific laws, Member States are invited to share this document with relevant local authorities and take them as a basis to develop further guidance as necessary. This would help both the aquaculture industry and regional and local authorities implementing EU law in an efficient and effective way.