



FINFISH AQUACULTURE WASTE CONTROL REGULATION

INTENTIONS PAPER

SUMMARY OF PUBLIC COMMENTS

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Finfish Aquaculture Waste Control Regulation Intentions Paper – Summary of Public Comments

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1. Introduction

The Ministry of Environment (“the ministry”) is presently reviewing the Finfish Aquaculture Waste Control Regulation (FAWCR) of the *Environmental Management Act* (EMA) – with the goal of amending the regulation. This review is part of a process of continual improvement of the standards regulating the industry and is intended to draw on understanding of current finfish aquaculture industry practices and scientific knowledge gained in the past several years concerning wastes associated with the industry.

This report provides a summary of stakeholder and First Nations comments received as part of the consultation process for revising the regulation

1.1 Background to the consultation process

In early 2005 the ministry established a technical committee, including representatives from the ministry, as well as the Ministry of Agriculture and Lands, Department of Fisheries and Oceans and the finfish aquaculture industry, to review the existing regulation and provide comment on potential issues and aspects of the regulation that would benefit from amendment. Drawing on recommendations of the technical committee, the ministry identified a number of aspects of the regulation for potential amendment and initiated scientific studies of several issues. Following the studies, the ministry developed potential amendments to the regulation that were then reviewed by an independent peer review panel comprised of individuals with expertise in the field of aquaculture. In June and July 2007, the ministry hosted a series of community meetings (in Nanaimo, Prince Rupert, Campbell River, Tofino, Alert Bay and Port McNeill) to provide information and solicit early comments on potential changes to the regulation, as well as other waste management issues of concern.

An intentions paper was posted for public review and comment on the ministry’s website (www.env.gov.bc.ca/epd/codes/index.htm) October through November of 2008. The intentions paper provided a summary of ministry and government goals, background information regarding the regulation of finfish aquaculture wastes, proposed revisions to the regulation, and information on the development of best management practices and assuring compliance. The paper also described the avenues for providing comment on the proposed revisions.

1.2 Purpose and format of the *Summary of Public Comments* document

This document has been prepared for the Ministry of Environment by C. Rankin & Associates, contracted by the ministry to independently receive, compile and review comment on the ministry’s intentions for review of the regulation. The summary does not reflect the ministry’s position on any issue. It provides a synopsis of the responses that are being considered by the ministry in preparing the regulation – without specific attribution, except to the extent required to provide context for the comments. This summary does not include all detailed comments,

rather it attempts to capture the tenor and content of comments through summarization and specific excerpts from representative submissions.

The complete set of responses received through the consultation process has been compiled and passed to the ministry for detailed review and consideration. All comments and references submitted through this process, through independent submissions and through direct consultations with stakeholders, will be reviewed and carefully considered by the ministry in revising the regulation.

The summary of responses is arranged by topic as presented in the intentions paper. Direct excerpts from submissions are included in quotation marks (“ ”). Square brackets ([]) indicate inferred or contextual terms.

1.3 Description of responses received

Nine responses to the intentions paper were received (by e-mail, fax and attached file), and have been reviewed for this summary of stakeholder comments. More than half of the responses were made on behalf of non-government public interest (environmental) organizations. Other respondents included representatives of First Nations entities and aquaculture industry associations, as well as individuals.

1.4 Responses received from First Nations entities

Two responses were received from First Nations entities – one from a Treaty Group noting that the group is “not a First Nation” [and that while] we appreciate your opportunity to comment, [our group has] ...NO ability to discharge your duty of consultation to our member First Nations”. The second response expressed the First Nations’ opposition “to marine-based finfish farming” with an additional explanation regarding rationale and a statement that “we only support land-based fish farming in closed containment systems” (for full text of the response, see text under response form question 11.2 below).

Ministry Intentions

1. Focus for the Proposed Amendments

The ministry’s focus for the proposed revisions to the regulation is “near field” effects of organic enrichment on the ocean bottom (i.e., those in close proximity to farm sites). Proposed amendments to the regulation address the sampling and monitoring of hard and soft bottom seabed substrates with updated protocols, harmonization of regulatory requirements with those of other applicable ministries and federal agencies, certification provisions and policy for data providers, and encouraging effective utilization of appropriate Best Management Practices to address other objectives (such as mortality disposal, wildlife attract and harmful materials).

Response Form Question 1.1: Do you have any general comments or suggestions regarding the ministry’s focus for the proposed amendments?

Several respondents commented that they first wished to “restate some of the criticisms put forward by the environmental community when the Finfish Aquaculture Waste Control Regulation was first introduced in 2002” – notably “the use of a singular measure (sulphide levels) for impact... [is] not a true measure of biological harm or remediation; ...[the lack of a definition of] biodiversity standards for fine sediment sites”; “impact to the benthos directly beneath a salmon farm...; [the need to address] pesticides, antibiotics [and] other therapeutants; ...[unclear] compliance mechanisms; [and dealing with] disease organisms that are found in fish waste during significant disease outbreaks”. Respondents expressing these concerns felt that “these issues should have been dealt with during the current review [of the regulation]”. Other comments from these respondents included: “any proposed amendments...should focus on more intensive sampling protocols and a more rigorous experimental design in order to detect the possible effects farm waste is having on the environment”; “we would like to see penalties for farms that are out of compliance...clearly outlined”; and “it is our view that the Intentions Paper is vague on necessary specifics in several cases and there is little evidence provided to support many of the proposed changes – these factors combine to make it difficult to ascertain whether or not the proposed changes will meet the intended outcomes”.

In contrast, one respondent commented that: “[our organization] would like to acknowledge the Ministry of Environment’s efforts to continually improve industry regulatory standards – we commend you for following the performance-based collaborative approach as recommended by the Salmon Aquaculture Review...the structure of the Steering Committee and Finfish Aquaculture Waste Management Technical Subcommittee enabled federal and provincial agencies and industry to work collaboratively – this efficient model was integral to the successful development of the new proposed hard bottom standards...In general [our members] support the proposed amendments. We can envision the long term benefits of these changes which will ultimately improve business certainty, public support and environmental sustainability. However, it is important to note that the industry will face a period of operational challenges as it adjusts to the proposed regulatory regime. Implementation of the amendments will present significant hurdles for the industry; namely, increased monitoring costs, oversubscription of qualified professionals, changes in production (timing and tonnage) and the potential decrease in operational flexibility”.

2. Issues Not Included in the Proposed Amendment

Response Form Question 2.1: Do you have any suggestions for the ministry when considering issues and priorities to be addressed in future reviews and revisions to the Finfish Aquaculture Waste Control Regulation?

Several respondents commented that “many of the...issues identified [by the ministry] as ‘not included’ have been previously identified by the environmental community [for] inclusion [in the regulation]”. Respondents also commonly referred to Canadian and international [scientific] literature on “benthic impacts caused by fish farms” when specifying important issues that should be addressed in the regulation, notably “far-field effects”, “improved monitoring” and “cumulative effects”.

Specific suggestions for considerations to be addressed in the regulation included:

- “Including water quality monitoring of finfish farm wastes...around aquaculture sites [and] alongside reference sites”;
- “Regulating the mandatory inclusion of a ‘tracer’ in all finfish feed...[to] assist with determining the fate of finfish wastes in...far-field and cumulative effects”;
- “More rigorous and comprehensive monitoring...to assess the true impacts of this industry in the marine benthic environment”; and
- [Implementing a regulatory] “system that allows discretionary use of a variety of sampling scales...for B.C. coastal habitats and ecosystems...[rather than using ‘Performance Based Standards’ to conserve the productive capacity of bottom fish habitat]”.

3. Development of Initial Hard Ocean Bottom Standards

The ministry is proposing compliance parameters and a compliance range for monitoring and enforcement of hard ocean bottom standards.

Response Form Question 3.1: Do you have any comments or suggestions regarding the proposed compliance parameters and standards for hard ocean bottom fish farm sites?

Several respondents “disagreed” with the statement in the intentions paper that “the regulation does not presently include regulatory standards for hard ocean bottom fish farm sites” – commenting that “there is a mechanism in place in the regulation that would allow a standard to be set” and pointing to continued use of “Schedule B...Part 1 of the current regulation...[as a] monitoring protocol...that would enable regulators to determine if that standard is being met”.

As well as commenting on the proposed zone of compliance (included under responses to question 3.2 below), several respondents expressed concern regarding the choice of parameters for monitoring hard bottom fish farm sites. One respondent, for example, commented that “[our organization] would like to see [instead] the use of a broader species diversity and relative abundance” while another felt that “the use of 10% for *Beggiatoa* and polychaete complexes at hard bottom sites is troublesome [as, for example] it is not known if other compounds (e.g., Slice, antibiotics, metals, pesticides) may impede growth of these species”.

One respondent “commended” the ministry for the “performance-based collaborative approach” used to develop the proposed hard bottom standards, noting that the “structure of the Steering Committee and Finfish Aquaculture Waste Management Technical Subcommittee enabled federal and provincial agencies and industry to work collaboratively”.

Response Form Question 3.2: Do you have any comments or suggestions regarding the proposed zone of compliance for hard ocean bottom sites?

Responses to this question echoed or overlapped with comments made with regard to question 3.1 above. Many respondents who commented pointed to monitoring reports and scientific studies that show “that the local extent of altered benthic community structure and biomass is limited to less than 50 m from finfish operations” and that the proposed compliance zone “is too far from the net pen array and a compliance zone set at this distance will not capture truly in-compliant [sic] effects from farms at hard bottom (and soft bottom) sites”.

Specific comments and recommendations included:

- “MOE should fund and carry out research on chemical effects such as Slice and mandate”;
- “We suggest multiple compliance zones much nearer to the net pen array which are based on peer reviewed science on the likely distance at which measurable effects from farming are seen and will likely be measured...we recommend taking visual samples at multiple points (every 25m) along each transect as compliance zones and identifying at least higher taxonomic groups (i.e., family) – these data could be used to generate diversity indices and relative abundance of organisms at each point along each transect at each specific farm...we feel that it is important to have an idea of the impacts of finfish operations have on local diversity”;
- “[Our organization] would like a more intensive sampling protocol initiated”; and
- “We can appreciate that the zone of compliance for net-pen arrays over hard bottom is initially set to mirror the ecological threshold for net-pen arrays over soft bottoms however, the compliance parameters are different for the two types of substrates...we suggest that the zone of compliance for hard bottoms initially be set closer to the edge of the net pen array (60 m) until it is scientifically established that the compliance parameters indicate an equal level of habitat degradation as the compliance parameters for soft bottom sites”.

4. Establishing an Ecological Threshold Approach for Soft Ocean Bottom Sites

The ministry is proposing a science-based ecological threshold approach – utilizing the relationship between the biological community and associated total free sulphides ($S^=$) and a set distance from the net pen array – as the basis for compliance.

Response Form Question 4.1: Do you have any comments or suggestions regarding the proposed ecological threshold approach to monitor compliance for soft ocean bottom fish farm sites?

Most respondents who commented on this question “agreed with” or “supported” using a science-based ecological threshold approach as the basis for compliance. Several respondents were concerned “however, [that] the proposed amendment does not stipulate that compliance points must be within the zone of deposition that is unique to each tenure, and therefore falls short of a true science-based approach”. To address this concern, respondents commonly recommended that “all sampling points...be independently validated (by DFO, MOE, or other qualified biologists) that they are within the depositional area/zone of the farm”.

Additional comments included:

- “What is needed is a combination of a chemical indicator like sulphide, and a faunal diversity/abundance indicator with some critical taxa criteria – the Scottish use this approach now, along with ecosystem deposition modeling and bay area management”; and
- “We trust [that the ministry] intends to continue with the established [collaborative] process [used to identify and study issues associated with amending the regulation] – the focus on science-based adaptive management ensures that the industry is managed according to its measured environmental effects through a precautionary performance-based approach”.

Response Form Question 4.2: Do you have any comments or suggestions regarding the proposed compliance parameter (total free sulphides, compliance concentration (700 $\mu\text{M S}^-$) or compliance location of 125 m from the edge of the net pen array for soft ocean bottom fish farm sites?

Specific comments received in response to this question included:

- “Sulphide levels of this magnitude are seldom, if ever, seen at these distances from active fish farms, so it is doubtful that this threshold will ever be reached”;
- “We suggest lowering the compliance parameter (700 micromols of free sulphide) and shortening compliance location (125 m) in order to better protect the marine environment”;
- “The inclusion of a expanded metals testing protocol is a positive step, however, the current incompliance values for Copper (108 $\mu\text{g/g}$) and Zinc (271 $\mu\text{g/g}$) are far above the values deemed to protect marine habitat listed under the Contaminated Sites Regulation”; and
- “We propose that, at a minimum, the current standard of 1300 $\mu\text{M S}^-$ at 30 m from the net pen array be maintained as the compliance point and standard and should that value be exceeded, the farm should not be re-stocked and should be fallowed until the sulfide levels at the 30 m compliance point decline to the proposed ecological threshold level of 700 $\mu\text{M S}^-$ ”.

A. Establishment of fixed 30 m compliance stations

Response Form Question 4.3: Do you have any comments or suggestions regarding the proposed means of establishing 30 m compliance stations?

Limited and divergent responses were received regarding this question. One respondent noted that “we agree with the proposed means of establishing the 30 m compliance station” while another commented that “we are extremely concerned with how the 30 m and 125 m compliance locations will be selected by the fish farm companies”. The respondent who expressed concern recommended that “farm owner/operators should be required to locate and map the true zone of deposition so that subsequent sampling will actually capture the waste build-up footprint on the sea floor and this should be independently audited by the regulator – once the zone of

deposition has been identified then the appropriate fixed sampling points should be established to ensure they capture the actual zone of impact”.

B. Determination of present 0 m and 30 m compliance stations based on ecological threshold

Response Form Question 4.4: Do you have any comments or suggestions regarding the proposed sampling parameters for the 0 m compliance stations?

The limited comments received in response to this question included: “we believe that a true measure of biological degradation and biological remediation need to be assessed with more than just a singular measure of free sulphides”; and “they should continue to include some kind of faunal change indicator”.

Response Form Question 4.5: Do you have any comments or suggestions regarding the proposed compliance monitoring provisions for the 30 m compliance stations?

One respondent echoed the comment that measures of biological degradation and remediation need to involve more than one parameter. Another expressed “support [for] the proposal to have the current requirement to only analyze benthic sediments for zinc and copper changed to require a full-suite metal scan” and included detailed recommendations for what such a scan should involve. The respondent also reiterated recommendations that “a non-toxic, inert, easily detectable tracer compound [be added] to feed” and that “consequences for non-compliance (i.e., a fallowing requirement until the standard is met) [should] be specified in the regulation”.

C. Review of sulphide standards and triggers in relation to an ecological threshold approach

Response Form Question 4.6: Do you have any comments or suggestions regarding the proposed sulphide standards and triggers?

The limited number of respondents who commented on this question supported the ministry’s intention to lower the sulphide standards and triggers – while noting potential challenges with the ministry’s proposed approach or recommending lowering the standards and triggers even further “to ensure more rapid remediation rates and recovery times”.

D. Sampling protocols for large net pen arrays oriented perpendicular to major current flows

Response Form Question 4.7: Do you have any comments or suggestions regarding the proposed sampling protocols for large net pen arrays oriented perpendicular to major current flows?

Most respondents who addressed this question requested further clarification of the ministry's intended sampling requirements prior to making comment. Respondents who provided specific comment expressed concern that "modeling may not represent actual conditions" and that "sampling locations [should be] based on the true extent of the farm's footprint". One respondent noted that "we would prefer that the actual footprint of the farm be determined visually (through ROV sampling) and through sediment sampling using tracer elements as key indicators to distinguish actual fish farm waste from natural benthic sediments [and]...transects and fixed sampling point, compliance points and the relevant compliance standards [then] established based on this footprint".

5. Updating Schedules A and B of the Regulation and Protocols for Marine Environmental Monitoring

Response Form Question 5.1: Do you have any comments or suggestions regarding schedules of the regulation or Protocols for Marine Environmental Monitoring, their utility and/or the revision process?

Specific comments made in response to this question included:

- "We support the use of schedules of the regulation for the revision process and suggest that priority be given to the inclusion of far field and cumulative effects from open net-pen fin-fish farms and the inclusion of water quality standards as soon as possible"; and
- "We want to ensure that that the current minimum monitoring requirements specified in Schedules A and B will remain and be improved upon rather than relaxed, reduced or removed – we also believe that the statistical analyses section of the Protocols for Marine Environmental Monitoring be retained and improved upon".

6. Effective Regulation that Ensures Environmental Protection While Allowing Industry Increased Production Efficiency

A. Use of transfer/harvest pens

Response Form Question 6.1: Do you have any comments or suggestions regarding the proposed revisions addressing use of transfer/harvest pens?

Several respondents expressed “opposition to any amendments that are intended to increase open net cage production efficiency and the associated increase in chemical and organic waste production and resultant habitat degradation”. These respondents felt that “regulations should promote improved performance through reduction in biological impacts on the environment until there is a viable alternative (i.e., closed system farms)”.

One respondent expressed support for the proposed intentions, commenting that “in general, [our members] support the proposed amendments – we can envision the long term benefits of these changes which will ultimately improve business certainty, public support and environmental sustainability – however, it is important to note that the industry will face a period of operational challenges as it adjusts to the proposed regulatory regime”.

Specific recommendations made by respondents included:

- “The maximum day period associated with transfer/harvest pens should be lowered to 30 days from 90 days...transfer/harvest pens, with or without fish, should be required to be kept within registered tenure areas at all times – waste monitoring and compliance zones should be established under transfer pens”;
- “Change ‘could’ to ‘will’ in the statement ‘Use of transfer/harvesting pens beyond 30 days could trigger a requirement for an amendment to the fish farm registration (under the regulation) to acknowledge the structures as *permanent*’ “; and
- “Introduce regulations that promote waste and chemical reductions in inputs over time”.

B. Restocking of an alternate net pen array

Response Form Question 6.2: Do you have any comments or suggestions regarding the proposed provisions for restocking of an alternate net pen array?

Respondents who commented specifically on this question felt that “this change is completely unacceptable...as it provides an opportunity for continuous production on a tenure that contains degraded habitat that is not in compliance with FAWCR guidelines”. Instead, respondents suggested that “any amendment should lead to improved environmental performance and not increase habitat degradation – any tenure that becomes non-compliant should be required to fallow, regardless of the net pen array location and its corresponding compliance zone”.

C. Requirements for routine peak biomass monitoring

Response Form Question 6.3: Do you have any comments or suggestions regarding the proposed requirements for routine biomass monitoring?

Similar to responses received for question 6.2 above, respondents who commented specifically on this question felt that the proposed requirements should not be adopted. Respondents commonly recommended that “the regulation should continue to require compliance

monitoring prior to restocking, regardless of site production and compliance history” with the comment that “any reduction in the requirements for peak biomass monitoring will not improve compliance, or support good stewardship”.

7. Harmonization of Regulatory Requirements with Other Applicable Ministries and Federal Agencies

Response Form Question 7.1: Do you have any comments or suggestions regarding harmonization of regulatory requirements?

Respondents who commented specifically on this question commonly felt that “waste control regulations should not be concerned with reducing costs for industry nor the work-load for regulators but rather the protection of the environment”. Respondents suggested either keeping “the status quo” or increasing ministry capacity in order to effectively monitor and enforce regulations.

One respondent commented that “[our organization] aspires to work with the ministry to increase operational flexibility, increase harmonization of Federal and Provincial agencies and include the interests of First Nations through enhanced participation – as always, it is our goal to be the world leader in the environmentally sustainable aquaculture”.

8. Certification Provisions and Policy for Data Providers

Response Form Question 8.1: Do you have any comments or suggestions regarding the proposed provisions and policy for certification of data providers?

All respondents who commented on this question supported the “notion of certifying those individuals who generate compliance data for submission to the ministry”. Some respondents further recommended that “monitoring teams and data providers should be led by someone who is a registered professional biologist (RPBio) and is at arms length to industry”. One respondent, however, noted that notwithstanding “general support [for the stated intentions]...implementation of the amendments will present significant hurdles for the industry; namely, increased monitoring costs, oversubscription of qualified professionals, changes in production (timing and tonnage) and the potential decrease in operational flexibility”.

9. Best Management Practices

Response Form Question 9.1: What comments or suggestions do you have for the ministry regarding the present BMPs in FAWCR and the development of additional BMPs (e.g., existing information sources, organizations and/or agencies that could or should be involved)?

Respondents who commented on this question commonly suggested that “the proposed changes...appear to be inconsistent with the objectives of the current Best Management Practices Plan (section 8(1) (b)), which supports ‘continual reduction of the discharge and potential discharge of the number and quantity of wastes and pollutants’ ”. One respondent recommended that “a broader stakeholder group (other than just government and industry) [i.e., including environmental non-government organizations, First Nations and academics, be] involved in the development of ...BMPs”. The remaining respondents who commented recommended that “Best Management Practices documents [should be] produced by independent bodies that are at arms-length from industry and government”.

10. Assuring Compliance and Implementation

Response Form Question 10.1: What comments or suggestions do you have for the ministry regarding appropriate and effective means for assuring compliance?

Respondents who commented on this question suggested that “tough rules and enforcement” are needed to achieve compliance, with “no room for written advisories and warnings”. Several respondents suggested that “voluntary compliance [has] proven to be ineffective so far” with one respondent commenting that “assuring effective monitoring of industry compliance by whatever means necessary is essential for the protection of the environment and maintaining the public trust”.

Response Form Question 10.2: What advice or suggestions do you have for the ministry that might support effective application and administration of the regulation?

Specific comments received in response to this question included:

- “Do not waive peak bio-mass monitoring for ‘good performers’ ”;
- “Ministry policy for enforcement and response to non-compliance is unclear and has previously been applied in an *ad-hoc* manner that does not promote improved industry performance or protect the environment...if there is a ministry-wide policy for enforcement and response to non-compliance in place, then that policy should be articulated”;
- “All monitoring information gathered under the existing regulation and under the proposed new regulation must be made publicly available upon request, without delay and without hinderance”; and
- “Prior to any amendments being finalized, a joint government, industry workshop should be convened to determine the best way to move forward with any proposed amendments”.

11. Protection of Human Health and the Environment

Response Form Question 11.1: Are there any aspects of the regulation and management of waste discharges from finfish aquaculture that could significantly affect human health or the environment that are not, in your view, sufficiently addressed in the proposed revisions to the regulation?

Specific comments received in response to this question included:

- “Any amendments to the regulation should intensify sampling and monitoring protocols... the proposed...standards for hard ocean bottom sites are less substantive than what is outlined in the original regulation (Schedule B Operational Monitoring – Part 1 – Hard Bottom Surveys)...we would like to see Schedule B adhered to as well as the inclusion of diversity indices in the monitoring of hard bottom sites”;
- “We suggest better data management by ministry that includes verification of industry supplied data along with easier public access to data that relate to waste discharges by the finfish aquaculture industry”; and
- “Waste regulation does not define biodiversity standards for fine sediment sites, impact to the benthos directly beneath a salmon farm is ignored, regulation does not deal with pesticides, antibiotics or other therapeutants, mechanisms to ensure compliance are unclear, [and] regulation does not deal with disease organisms that are found in fish waste during significant disease outbreaks”.

Response Form Question 11.2: Do you have any other comments or suggestions for the ministry?

As noted in section 1.4 of this summary, one First Nation responded to the intentions paper and noted their “opposition to marine-based finfish farming”. This statement was supported by the following statement:

“Even though limited finfish farming has taken place in our Traditional Territory we are aware that fish farming poses a huge threat to the survival of wild salmon stocks, on which our livelihood and culture depend. The migration routes of salmon extend far outside our territory, and we know that salmon in our territory are often exposed to fish farms and their waste. Impacts from these farms could be felt across our Traditional Territories. In addition, fish farming has impacts on: water and sediment quality, predators, shellfish, human health, and access to resources. The high density of fish present on farms is an ideal environment for the development and spread of diseases to wild fish stocks. The organisms causing disease may develop resistance to antibiotics and be uncontrollable by the farms. By growing Atlantic salmon, the fish farm may also introduce exotic diseases or strains of disease into our traditional territories. These operations also pose the threat of escape of Atlantic salmon. Escaped Atlantic salmon have many potentially negative impacts on native salmon species. Atlantic salmon

have or could potentially affect native stocks by: interbreeding; digging up eggs; consuming smolts; and competing for food or spawning areas. Our native salmon stocks are in a state of crisis already; they do not need added threats to their survival. The cumulative production cycle impacts are unknown, and these impacts may start to show up after repeated production cycles, not only locally but through-out the entire areas of fish migration. We only support land-based fish farming in closed containment systems”.

Additional comments received from other respondents (and not included previously in this summary document) included:

- “We believe that, at the very least, the existing monitoring requirements...should...be retained without significant amendment save to improve on them and increase the scope of information that should be gathered at fish farm sites operating in B.C. water, especially considering that international and Canadian scientists have identified significant information gaps in the science and knowledge around the operations of fish farms and their impacts on the marine and freshwater environment – we feel that government and industry should move to fill and/or close these gaps, especially if it is to be a sustainable industry down the road”;
- “B.C. is already at the bottom of the list globally that classifies country’s standings on the regulatory environment standards on fish farms... where are the revised, updated waste regulations for land based fish farms?...please confirm...that the Government actually intends to develop, and implement an environmentally sound waste management plan, that considers public safety, and health”; and
- A detailed set of recommendations for the regulation and associated Protocols for Marine Environmental Monitoring (PMEM), including:
 1. “...Given there is great public and stakeholder concern and strong scientific evidence that farm waste degrades our ocean habitat, all survey and sampling data reported to the provincial Ministry of Environment related to waste from farms should be reported on the internet to allow the public to be well informed...”;
 2. “The new FAWCR should include monitoring of far-field impacts and the cumulative effects of farms, especially in high density areas such as the Broughton Archipelago...”;
 3. “Many precautionary sections of the current regulation are based on the principle of preventing significant statistical differences in certain measurements (such as abundance and diversity) between farm and reference sites. However, the inclusion of the requirement in section 6c of the FAWCR, whereby farm sulphide levels must not be significantly greater than 1300 uM **or** greater than reference site sulphide concentrations, allows farm sites with naturally low sulphide levels (e.g., such as 161 uM) to be restocked as long as they are below 1300 uM, even though their sulphide levels have been significantly elevated (e.g., by $1300 - 161 = 1139$ uM) and habitat has been degraded... the maximum level of sulphide allowed before restocking can occur...will likely be increased under the new regulation, allowing higher levels of degradation to legally occur under and around farms”;
 4. “Waste discharge should be transitioned out and become illegal along the same time-frame (three years) as the Special Committee on Sustainable Aquaculture recommendations. Industry should be required to monitor bottom habitat until it returns to normal

‘background’ conditions and should be fined if it does not recover and remediation costs should be incurred. In addition, the private prosecution of industry for the degradation and destruction of public resources should be allowed”; and

5. “The number of samples taken during monitoring (i.e., sample size) used by industry should be increased to ensure robust statistical results from comparisons between reference and farm site impacts...Precautionary statistical significance values (i.e., $\alpha = 0.1$) should be mandated by the PMEM and/or the FAWCR, and should not be decided by industry (i.e., ‘the investigator’) as is currently described under Section 7 Performing Statistical Analyses”.

Appendix A: Acronyms and Abbreviations

Acronym or Abbreviation	Definition
BMPs	Best Management Practices
DFO	Department of Fisheries and Oceans
e.g.	for example
EMA	Environmental Management Act
ENGO	environmental non-government organization
FAWCR	Finfish Aquaculture Waste Control Regulation
g	grams
i.e.	that is
MOE	Ministry of Environment
m	metre
PMEM	Protocols for Marine Environmental Monitoring
ROV	remotely operated vehicle
RPBio	Registered professional biologist
S=	free sulphide
ug	micrograms
uM	micromoles