COMPREHENSIVE MAL RESPONSE TO BC AUDIT

April 5 2006

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Differences between BC and Other Jurisdictions in Wild Salmon Stocks and Their Need for Protection

The 5th paragraph in the Introduction to the Report recognizes the limits of relying on audit criteria that do not account for unique situations, but ignores those limitations in comparing BC with other jurisdictions. We offer the following information on jurisdictional differences and in particular, how differences can be applied to make a critical comparison more informative.

- There are fundamental differences between BC and other jurisdictions that farm salmon that both determine the options possible in protecting wild salmon and their necessity.
- These differences are due to the variety of salmonid species found in BC and other locales and variations in their life histories, geography and environment, production practices, and differences in parasites and pathogens.
- The differences that are noted between the jurisdictions make it questionable as to whether the Williamsburg Resolution should be used in BC in evaluating its success in protecting wild salmon stocks.

Variations in Life History and Population Numbers

- In northern Atlantic jurisdictions in which Atlantic salmon are farmed, there are four naturally occurring anadromous (sea-going) salmonid species – Atlantic salmon (Salmo salar), brown trout (Salmo trutta), arctic char (Salvelinus alpinus) and brook trout (Salvelinus fontinalis).
- Each of these fish species has a life history pattern in which, once the eggs hatch from the gravel in which they are laid, the juveniles spend more than one year in freshwater prior to migrating to sea (ranging generally between 2 and 6 years, depending on environmental conditions of the river they are located in and the species of fish concerned).
- This life history pattern requires that the streams that support such fish must be relatively large and stable, since pre-smolts (juvenile salmon prior to adaptation to a saltwater existence) cannot survive in streams that dry intermittently or are so small that the fish cannot find appropriate rearing habitat. Many streams leading to saltwater in the north Atlantic are too small to support populations of all, or in some cases any, salmonids.
- The life history strategy of all of these salmonids also dictates that smolt outputs are low – most of the mortality in a generation occurs before the fish reach saltwater. The life history strategy also means that adult runs are comparably small. For example, in eastern North America, prior to run declines over the past few decades, historic runs of Atlantic salmon were in aggregate approximately 1.5 million salmon and grilse (precocious spawners) per year, while in Europe during the same time period, the aggregate of historic runs was approximately 6.0 million fish per year (Monte Burke, 2001, http://magazine.audubon.org/features0111/on_the_brink.html).

- Declines over the past few decades due to habitat alteration and reductions in ocean survivals have reduced numbers of some species, notably Atlantic salmon, by approximately 75% in eastern North America and 50% in Europe to 400,000 and 3.0 million fish per year respectively. Small run numbers in European and eastern North American salmon mean that relatively small events or impacts can significantly affect population size.
- In BC, there are nine different species of native anadromous salmonids – chinook (Oncorhyncus tshawytscha), coho (Oncorhyncus kisutch), sockeye (Oncorhyncus nerka), chum (Oncorhyncus keta), pink (Oncorhyncus gorbuscha), steelhead trout (Oncorhyncus mykiss), cutthroat trout (Oncorhyncus clarki), Dolly Varden char (Salvelinus malma), and bull trout (Salvelinus confluentus).
- These fish utilize a variety of life history strategies and stream types to maintain their populations. The trout and char utilize similar life history strategies to those of European salmonids with respect to utilization of freshwater for prolonged periods of time and produce relatively few smolts of a large size. Cutthroat and char juveniles primarily move between brackish water areas and spend only brief periods in the marine environment. As a result, they are less likely to be significantly affected by marine parasites such as sea lice than are other salmonids.
- The fish commonly referred to as Pacific salmon either have short freshwater residency periods (pink and chum salmon fry migrate to sea immediately following emergence from the gravel in which the eggs were laid, chinook salmon generally migrate to sea after either 6 months or one year in freshwater, and coho migrate to sea after one year in freshwater) or rely on lakes for rearing (sockeye and some coho populations). Large numbers of juveniles are produced, and support large populations of adults.
- The smaller sizes of Pacific salmon juveniles enable most small coastal streams to support runs of anadromous salmonids. Even intermittent streams are capable of supporting pink and chum runs, as the water courses carry water during the period of time required to support these fish.
- As a consequence, Pacific salmon are far more numerous than are Atlantic salmon, and far more streams are significant producers than in the north Atlantic area.
- Due to the large size of many runs, the large number of total runs of salmon and the plasticity of their life histories, they can withstand greater impacts and recover more rapidly than Atlantic salmon.
- Some individual runs of pink and sockeye salmon in BC are as great in number as the entire wild production of Atlantic salmon in the north Atlantic region.

Differences in Migratory Routes

- Another factor that makes protection of salmon stocks different in the north Atlantic area than in BC is that salmon-bearing rivers and streams in Europe and the UK tend to empty into inlets or fjords that empty into open oceanic waters.
- The morphology of many of the inlets and fjords restricts the salmonid migratory route to a single pathway. As a result, if an inlet contains a critical salmon bearing river or rivers, designation of that inlet as non-compatible with salmon farming may ensure that smolts moving through the inlet do not encounter salmon farms.
- In Norway, 37 salmon rivers and 21 fjords were designated as exclusion zones in which aquaculture was not permitted. However, in eight of these fjords where farms were already established, no new farms would be permitted, but existing farms would be allowed to continue to operate and expand their operations. (WWF-Norway Report 2, 2005, www.wwf.no/core/pdf/wwf_escaped_farmed_fish_2005.pdf)
- BC's siting guidelines require sites to be at least 1 km from the mouth of a salmonid-bearing stream determined as significant in consultation with DFO and the province. This also means that if two such rivers are 1.9 km apart, the buffering will not allow a salmon farm between them, thus protecting them both.
- While it is true that BC's siting buffer was not determined strictly as a matter of scientific investigation, neither were such siting buffers based on science in any other jurisdiction. Like BC, no other jurisdiction has undertaken scientific studies to consider the impacts on wild salmon in the vicinity of net pens.
- BC Ministry of Agriculture Food and Fisheries (now Ministry of Agriculture and Lands) pledged in 2002 to review the salmon stream siting buffer. To say, as it does in the Report, that the standard is inadequate by implication is a supposition that is not supported by any evidence. The Ministry review concluded that lacking any evidence of negative impact, 1 km was adequate to protect streams.
- In BC, many rivers and streams empty into waters that flow around islands and through archipelagos for a long distance prior to meeting open oceanic waters. Migratory routes vary as a result, depending on environmental and weather conditions, available feed, and the fish species migrating.
- This is confirmed by recent DFO research that challenges the idea that juvenile salmon follow distinct "migration corridors" (summary below).

Paper on Abundance and distribution of juvenile salmon and other fish caught in the Broughton Archipelago, Knight Inlet and Muchalat Inlet, B.C. in 2003. **Dr. Brent Hargreaves, Doug Herriott, Vic Palermo. (Full Report will be available on DFO web site in early June 2006).**

Re: Species Abundance

- This PSARC paper provides analyses of the catches, abundances (CPUE), and size of juvenile pink and chum salmon (and stickleback) for the Broughton and Knight Inlet.
- Generally, juvenile pink and chum were caught throughout the Broughton and Knight Inlet in all time periods, and frequently these two species were found together.
- The abundances of pink and chum remained low throughout the study area during March, gradually increasing during April.
- Peak abundances of pink and chum salmon occurred in Knight Inlet in mid-to-late April, about two to three weeks earlier than in the Broughton.
- The average size of pink and chum remained low (30 - 40mm fork length range) during March, then increased steadily to 70-80 mm by mid-June.

Re: Migration Route

- One hypothesis put forward in 2002 was that juvenile pink salmon migrate through the Broughton area using a specific corridor.
- In 2003, all commercial salmon farms along this route were fallowed (ceased production).
- Results from the research show juvenile pink and chum salmon were widely distributed throughout the Broughton and Knight Inlet – this did not support the theory of a "main migration corridor" in the Broughton.
- These results represent only one year and the conclusion may be different in other years when the abundances of pink or chum are substantially higher or lower. Also, determining the migration routes and timing for juvenile pink and chum was not the primary objective for the 2003 study, and the sampling program was not optimal for resolving these questions.

Differences in Production

- In 2004, it is estimated that Norway produced 537,000 metric tonnes of farmed salmon, while BC produced 61,800 metric tonnes of salmon, most of which was Atlantic salmon.
- In Norway, there are approximately 800 salmon aquaculture licences, each of which operates 3 sites. The general production strategy is that one site is fallow at any one time, while one is carrying sub-yearling fish and the remaining site carries pre-harvest fish.

- Over a two year cycle, each farm produces approximately 1800 MT of fish. Prior to harvest, there may be up to 400 million fish in culture in net cages in Norwegian waters.
- This represents more than a 100 fold increase over the number of wild adult Atlantic salmon produced in the entire north Atlantic region.
- In BC, most farms produce approximately 2500 metric tonnes of fish over a two year cycle. Atlantic salmon comprised approximately 76% of overall production in 2003 and has increased its representation in the intervening years. Chinook salmon comprised approximately 22% of production at that time, and have been significantly reduced in overall production in the interim.

Escapes and their Potential Effects

- As a result of the overall number of fish produced, the number of sites and operational practices, Reported Norwegian escapes of Atlantic salmon number approximately 0.5 million per year.
- BC, at about 11% of the total production of Norway, Reported an average of 23,942 (Atlantic and Pacific salmon) per year over the past 7 years.
- In spite of the distance between farms and rivers in Norway where exclusion zones were applied, percentages of farmed fish returning to monitoring sites in fjords ranged up to 81%, and in rivers ranged as high as 57% ((WWF-Norway Report 2, 2005, www.wwf.no/core/pdf/wwf_escaped_farmed_fish_2005.pdf). Furthermore, as noted in the New Farm (May 12, 2005 (http://www.newfarm.org/international/news/2005/050105/050605/no_fish.shtml), the Norwegian government monitors 30 rivers annually, and the results from 2003, show that eight of these have more than 20 percent farmed fish.
- WWF's Report shows that the up-river migration of escaped farmed salmon late in the spawning season physically displaces the eggs of the wild salmon that have already spawned.
- The high number of escaped salmon has led to an increase in interbreeding between the two (wild and farmed) varieties, which WWF says dilutes the gene pool and threatens the survival rate of offspring.
- In BC, the Atlantic Salmon Watch Program and the West Coast Vancouver Island Chinook Survey have routinely surveyed Vancouver Island Rivers for Atlantic salmon. In 2001, First Nations members were trained and participated in 117 surveys of 55 separate rivers. Over 389,000 salmonids were counted during the surveys, only two of which were Atlantic salmon. Other surveys in areas where Atlantic salmon were likely to be found after escape events have also demonstrated that few Atlantic salmon find their way to freshwater in BC.

- Following one year (1999) in which 133 adult Atlantic salmon were sighted in the Salmon River on Vancouver Island, subsequent surveys in two successive years failed to find offspring resulting from these adults. Even where spawning was successful (Tsitika, 1998) few offspring (24-40) resulted. They represented only a very small fraction of the biomass of juvenile salmonids produced by the river, and were unlikely to have any measurable negative impacts on wild salmonid juveniles in the river.
- Production of chinook is less than 22% of overall production. Escapes may be proportional to those of Atlantic salmon, indicating that up to 5,500 may be lost per year. To date, there have been no observations of these fish in freshwater.
- There is no evidence that these naturally spawned fish have survived as there have been no repeat observations of naturally spawned Atlantic salmon in these rivers over the past three years.

Disease Issues

- In Europe, there are significant concerns regarding the potential spread of Infectious Haematopoietic Necrosis virus (IHN) and other OIE Reportable diseases from farmed to wild stocks. As Atlantic salmon are highly susceptible to this foreign disease, concerns about limiting its spread are justified.
- In BC, IHN is also a major concern, albeit one focusing on transmission of the disease to farmed stocks. Current scientific evidence indicates IHN is not transmissible to wild salmon in a marine environment. However, it does appear in sockeye salmon when they enter freshwater, and up to 95% of a spawning population can test positive for the virus as they become senescent. Even with such strong expression of the virus, most adult fish survive to spawn. As a consequence, issues around IHN in BC do not conform to the Williamsburg Resolution as they would in Europe.
- Veterinarians who have observed the effects of sea lice (Lepeophtheirus salmonis) in salmon farms in Europe and BC have noted that the parasite seems to have less pathological effects in BC – that is, it damages the fish at the farms less than in Europe, and often does little or no damage in BC, whereas in Europe, damage to mucus layers, scales and cartilage can be extreme. This is reflected in the reduced number of SLICE treatments required in BC to keep the parasite under control.

Summary Table: Factors that should be taken into Account in Comparing BC to European Salmon Farming

Factor	BC Situation	European Situation
Number of Species	9 species of anadromous salmonids	4 species of anadromous salmonids
Life History Strategies	Highly variable, some migrate almost immediately to ocean, some smolt in 3 months- 1 year, most have large adult populations	Most produce large smolts in low numbers, overall populations of salmon are small
River Utilization	Some species will be found in any stream with suitable habitat, flow is not necessarily a factor	Streams must be larger and run year-round due to larger smolt sizes
Geography	Multiple channels leading to open water, no one migration route	Fjords and inlets that lead directly to open ocean, single migration routes available
Production	61,800 metric tonnes, 2500 metric tonnes/farm every two years	537,000 metric tonnes, 800 metric tonnes/farm every year
Escapes	Averaged 0.19% of production, approximately 23,942 over past 7 years, based on mandatory Reporting	Averages 0.1% of production, approximately 450,000 fish, based on mandatory Reporting
Significance of ecological interaction with wild fish	Very low	Variable, but may be high
Significance of genetic interaction with wild fish	Nonexistent for Atlantic salmon, likely low for Chinook due to low numbers	Variable, but can be high
IHN Concerns	Disease moves to farms from wild fish, does not transmit to wild fish	Disease could move to and from farms, could infect wild fish with devastating effects
Sea Lice	Do not seriously affect farmed fish, require 1.5 treatments per cycle	May adversely affect farmed fish, require up to 5 treatments per production cycle.

The Performance-Based Adaptive Management Approach

General Comment. In general, the Report does not recognize the performance-based adaptive management approach upon which much of the regulatory framework in BC is based. Consistent with a "smart" regulatory approach, BC has adopted performance-based standards, monitoring, auditing and adaptive management over a more traditional prescriptive approach. This is a fundamental problem with application of the criteria used to evaluate the prescriptive models of other jurisdictions in that simple existence of a regulation may result in a good score, but there is no evaluation of the effectiveness of that regulation.

- Aquaculture regulation in British Columbia is built on a performance-based and adaptive management approach. This approach flows from the recommendations of the Salmon Aquaculture Review, which concluded that:

  "Where the risk of environmental impacts from an economically important activity is low but the consequences of damage may be significant, the public interest may best be served by dealing with risk by being precautionary and invoking a series of measures, including: preventative management, adaptive management, and performance-based standards. In the case of salmon farming, this means reducing risk by setting high standards for farm operations based on the best available knowledge, and rigorously enforcing the implementation of those standards. And it means being prepared to alter management practices over time to take account of increased understanding of risk and different means of reducing it. This means that industry will be required to adapt to evolving management schemes"
- The Province applies adaptive management as a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. BC incorporates ongoing redefinition and modification throughout the policy-making process together with ongoing stakeholder involvement.
- In establishing performance-based standards, BC states goals and objectives to be achieved and describes methods that can be used to demonstrate whether or not these goals and objectives have been met. This is contrasted to a more traditional prescriptive method which typically establishes a limit without setting goals and objectives. BC's performance-based standards focus on a desired final state or activity rather than requirements for the processes to produce it. The advantage of a performance-based standard is that it promotes innovative approaches and solutions for complying with clearly stated goals and objectives.
- A good example of both is the *Finfish Aquaculture Waste Control Regulation* which replaced a prescriptive regulation that placed a limit on the amount of feed that could be used by an individual farm but did not establish any standards for environmental conditions.

Finfish Aquaculture Waste Control Regulation

- The regulation represents a comprehensive regulatory regime and protective framework for finfish aquaculture. This framework is designed to ensure both the sustainability of the tenure for farming and of ocean floor organisms surrounding the farm.
- Measures designed to ensure this include pre-operational and operational monitoring requirements, establishment of chemical and biological standards, and the requirement for best management plans for each site. These information requirements include; resource and resource use mapping, physical, chemical and biological sampling and analysis and detailed site current measurements.
- During operations a sediment chemical standard of 6000 micromoles (μm) of free sulphide must not be exceeded 30 meters from the net-cages and biological diversity and abundance at the edge of the farm tenure must be the same as control stations. Prior to restocking a site, free sulphide levels must not exceed 1300 μm at 30 m. from the net-cages. Specific chemical conditions and biological monitoring requirements must be met if these chemical levels are exceeded during a production cycle.
- Finally, a Best Management Practices Plan (BMP) must be developed and adhered to which details how the farm will be managed to achieve the waste standards, deal with mortalities or materials spills and how negative interactions with wildlife will be managed. Operators must implement practices consistent with these objectives:
    1. compliance with requirements in sections 5/6 and the standards
    2. continual reduction of the discharge or potential discharge of the number and quantity of wastes and pollutants;
    3. management of potentially harmful materials including therapeutants, therapeutic additives, anaesthetics, disinfectants, pesticides, wood preservatives, antifouling agents, bloodwater and net-cleaning wastes and wastewater to preclude spillage to the environment, and capacity to respond appropriately in the event of a spill;
    4. continual improvement in the feed conversion ratio for feed fed to finfish;
    5. prevention of the spillage of feed into the environment outside the containment structures;
    6. prevention of the attraction and access of wildlife to feed, foodstuffs and mortalities;
    7. prevention of access to containment structures by wildlife;
    8. collection of mortalities and their disposal in a timely fashion only as authorized under the Environmental Management Act using equipment and locations that:
        - preclude spillage to the environment, and
        - minimize odours during storage and transportation;
    9. management in accordance with a fish kill contingency plan.

- The BMP must contain a description of specific management practices and standard operating procedures used to achieve the objectives and these must be approved by the responsible government authority.
- Similar approaches are taken in Fish Health, with the requirements for a Fish Health Management Plan.

CEAA role in siting/cumulative impacts

Re: Criterion 1. The Report notes scientists have called for a 20 mile separation between farms and salmon rivers. We feel it would be useful to have a reference for this, along with concerns this distance is intended to address. Also, the role of the Canadian Environmental Assessment Act (CEAA) in siting is not sufficiently recognized. We offer the following information for consideration.

Re: Criterion 2. Cumulative effects analysis is a component of the current CEAA screening analysis and is required by law. Please review the information below with regard to this issue.

- DFO is the federal authority responsible for ensuring all aquaculture site proposals undergo environmental assessments as per the *Canadian Environmental Assessment Act* (CEAA).
- DFO conducts CEAA reviews of aquaculture site proposals when any one of the following triggers occur (Note: a single assessment is conducted when both triggers occur):
    1. HADD Authorizations, Section 35.2, Fisheries Act: DFO may issue authorizations under S.35.2 for the acceptable *Harmful Alteration, Disruption, or Destruction* (HADD) of fish habitat relating to aquaculture activity. HADDs are only authorized where the effects of the proposed operation can be adequately mitigated. The issuance of a HADD authorization automatically triggers a DFO CEAA screening.
    2. NWPA Permit: In accordance with the provisions of the *Navigable Waters Protection Act*, the Coast Guard reviews aquaculture site application to ensure that the public's right of navigation is protected from interference. If no interference is determined an NWPA permit is issued, which in turn triggers a DFO CEAA screening.
- The majority of aquaculture projects undergo what are known as “screenings” under CEAA. Screenings involve a systematic approach to documenting the environmental effects of a project and determining the need to minimize or mitigate these effects, modify the project plan, or recommend further assessment through mediation of a panel review.
- CEAA screenings vary in time, length, and depth of analysis based on the circumstances, the surrounding environment, and likely environmental effects.
    - CEAA defines “environment” as “the components of the Earth, and includes land, water and air, including all layers of the atmosphere, all organic and inorganic matter and living organisms, and the interacting natural systems that include the above-noted components.”
    - CEAA defines “environmental effect” as “any change that the project may cause in the environment …”

- When conducting CEAA screenings of a project DFO considers both specific environmental impacts and cumulative environmental effects (ie: effects that result from the project in combination with other current, past, or future projects/activities).

Cumulative Effects

- Systematic analyses of cumulative effects involve consideration of the individual putative effects and associated risks of single activities combined over all activities in an area.
- For salmon farming, putative effects can range from increasing the numbers of infective stages of sea lice to impacts on benthic habitats, each of which varies in the amount of scientific research and the degree of proven causal relationships. For some effects the impacts and risk are proven, whereas other remain the subject of considerable debate and therefore require additional research.
- DFO applies a formal framework and methodology when assessing cumulative effects of salmon farming operations. Risk analyses are based on reviews of current available scientific evidence on each putative effect. Research on farmed - wild salmon interactions is multi-faceted and ongoing; the knowledge base is increasing and new information is integrated in the cumulative assessment via an adaptive management approach. Potential mitigation factors are considered for each risk and the residual risk is analyzed and considered for its cumulative effect. In this context, when DFO considers "cumulative environmental effects" of a project the following specific guidelines are adhered to:
    - What other projects and activities should be considered in an assessment of cumulative environmental effects?
        - Existing and planned projects.
    - What environmental effects should be considered as cumulative?
        - Effects of a project are reviewed in light of the environmental effects of other projects/activities that may have affected or will affect the same aspect(s) of the environment.
        - Only those effects of other projects/activities that are cumulative with the environmental effects of the project under review are included in the assessment (ie: if an aquaculture project is likely to adversely impact local water quality, and local water quality is also impacted by a nearby processing plant, then this is cumulative and should be considered in the assessment).
        - If the environmental effects of other projects/activities are not likely to act in combination, then they are not included in the assessment (ie: if bird habitat is not affected by a proposed aquaculture project but is affected by an existing project, then this effect is not cumulative as a result of the project under review and would not be considered in the assessment).
    - How can cumulative environmental effects be assessed when limited information is available? All project and site-specific

information is included in assessments, and can include any available elements, such as:

- Quantitative data, based upon relevant modeling or other tools, if they exist (ie: considerations of: carrying capacity, tolerance levels, assimilative capacity of the natural system; existing guidelines, objectives, regional/area mgt plans appropriate to the situation).
- Qualitative analysis (ie: based on available information, scientific understanding, professional judgement, probability and risk analysis, worst/best case scenarios).
- Consideration of severity of the effects, as well as their geographic extent, frequency, duration; reversibility. Also, the fragility of ecological area.
- Implementation of mitigation (the adaptive management approach includes a monitoring program, research relevant to the site/area, analysis of data to determine adequacy of mitigation measures, and, if required, changes to the project).

- The following is an excerpt from a recent screening document which explains the typical process (highlighted in grey):

A screening level Environmental Assessment requires consideration of the factors stated in Section 16(1) of CEAA:

- *(a) The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;*
- *(b) The significance of the effects referred to in paragraph (a);*
- *(c) Comments from the public that are received in accordance with this Act and the regulations;*
- *(d) Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project: and*
- *(e) Any other matter relevant to the screening, such as the need for the project and alternatives to the project, that the responsible authority or, except in the case of a screening, the Minister after consulting with the responsible authority, may require to be considered.*

The scope of the environmental effects examined in the EA is included in the following sections titled Environmental Description and Effects and Cumulative Environmental Effects. The potential environmental effects of the proposed project are considered within spatial and temporal boundaries that encompass the periods and areas during and within which the project may potentially interact with, and have an effect on, components of the environment. These boundaries may vary with each environmental component, and reflect factors such as:

- *The construction, operation, and maintenance phases of the project;*
- *The natural cycles of a population or ecological component;*
- *The timing of sensitive life cycle phases in relation to the scheduling of proposed activities;*
- *The time required for an effect to become evident;*
- *The time required for a population or ecological component to recover from an effect and return to a pre-effect condition;*
- *The area directly affected by the proposed project; and*
- *The area within which a population or ecological component functions and within which a project effect may be felt.*

Under CEAA, all environmental assessments are to include a consideration of "any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out" (Section 16(1) of CEAA). The primary objective of a cumulative effects assessment (CEA) is to determine the potential contribution of the proposed project to existing and reasonably foreseeable cumulative effects from all activities in the area (not just salmon farming). All other salmon farms and other human activities (typically industrial activities) with similar putative effects are considered in the assessment.

The potential residual effects that may result from the proposed installation, construction, operation, maintenance and decommissioning of the aquaculture project include:

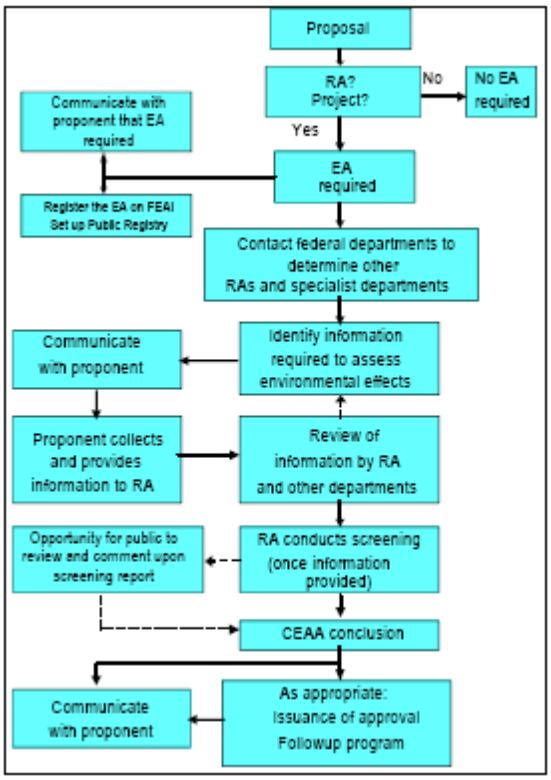
- *Potential introduction and/or transmission of disease and/or parasites from farm fish could impact wild populations.*
- *Escaped farm fish may have genetic effects from farm salmon inbreeding with wild salmon of the same species, and/or population and ecological effects from farm fish competing with wild salmon for resources.*
- *Release of toxic and biological waste into the environment resulting from use of anti-foulants and net cleaning could impact fish and fish habitat through water quality change, waste deposition, toxic substance release.*
- *Excess fish food and fish faecal materials may accumulate on benthic substrates in the vicinity of the facility, altering the ecosystem and productive capacity of the area.*
- *Use of therapeutants (e.g. sea lice treatments) and antibiotics may have direct toxic or immunological impacts on non-target organisms (e.g. crustaceans), affect the surrounding environment, and/or potentially result in a human food safety risk.*
- *Use of night lighting to enhance fish growth can reportedly attract wild fish to the net pens, increasing chances of disease transfer and causing small wild fish to be consumed. May also attract predators. If night lighting is not used during sensitive periods (i.e. during periods of juvenile salmon migration, during times of expected herring spawn, egg hatching and juvenile herring presence), the residual effect scoring would be reduced.*
- *Mortality of animals that are attracted to the fish farm and become nuisance predator of farm fish, and become subject to lethal control measures. Scoring has assumed that lethal control may occur once non-lethal methods have proven ineffective; if lethal control not required then residual effects scoring would be reduced "*

- Any residual effects are considered during the assessment process have a relative risk attached to them. This assessment is incorporated into a Risk Management Framework which is used to compare the sensitivity of the fish habitat with the scale of the effect to determine management approaches. If scale of the negative effect is high and cannot be mitigated by redesign or relocation the project is rejected.
- Direct effects of the project on valued ecosystem components and indirect effects of the project on valued social components are assessed and a determination as to whether they are likely to lead to significant adverse cumulative effects. Since the siting of the farms seeks to avoid impact on sensitive habitats what is left is impact to less productive habitat which, if there is a harmful alteration, must be authorized and compensated for.
- The following actions may be taken by DFO following conclusion of a CEAA screening (see next page):

Conclusion of CEAA Screening	Action
The project is not likely to cause significant adverse environmental effects.	DFO can consider whether to issue the NWPA approval or *Fisheries Act* authorization, as appropriate. The RA is required to ensure the implementation of the mitigation measures which were identified in reaching this conclusion, as well as any follow-up program, deemed necessary.
The project is likely to cause significant adverse environmental effects that cannot be justified in the circumstances.	DFO cannot issue the NWPA approval or *Fisheries Act* authorisation.
It is uncertain whether the project is likely to cause significant adverse environmental effects.	DFO refers the project to the federal Minister of Environment for mediation or assessment by a review panel.
The project is likely to cause significant adverse environmental effects that may be justified in the circumstances.	DFO refers the project to the federal Minister of Environment for mediation or assessment by a review panel.
Public concerns warrant a reference to a mediator or a review panel.	DFO refers the project to the federal Minister of Environment for mediation or assessment by a review panel.

- Application of the federal CEAA screening process is extremely rigorous, and the average costs to proponents for data collection/analysis can exceed $100,000 last over 4 years.
- For an overview of DFO's approach to a CEAA review, please see the next page.
- Also, please see the following Appendices at the end of this document:
    1. Cumulative Effects Guidelines (Appendix 1).
    2. Example Cumulative Effects Assessment Background, Petrel Point (Appendix 2).

CEAA Screening Process



Abbreviations:

- RA (Responsible Authority).
- EA (Environmental Assessment)
- FEAI (Federal Environmental Assessment Index)

Summary of Coastal Planning in BC

Re: Criterion 1. There is no reference in the Report to provincial coastal planning processes that identify areas not suitable for aquaculture development. We would like to offer the following information to address this oversight.

- An important component of aquaculture siting is the broad-based coastal planning process that guides development in BC's coastal regions through the consideration of environmental, cultural and stakeholder interests.
- The Province of British Columbia along with federal and local authorities is responsible for the management of over 29,500 km of shoreline and seabed in BC's inshore and near-shore waters.
- The Integrated Land Management Bureau (ILMB) is responsible for design and delivery of coastal planning, and for coordinating policy related to coastal and marine issues. This occurs in conjunction with other provincial agencies.
- Coastal Plans focus on the provincial jurisdiction of the foreshore areas and address economic development and diversification, environmental threats, land and resource conflicts, First Nations issues, and support informed decision making for coastal areas.
- Coastal zone planning occurs at two distinct levels:
    A. Strategic level coastal plans (eg. 1:250,00 scale) designed to identify broad goals, objectives, and strategies for coastal and marine resources.
    B. Local level coastal plans (eg. 1:50,000 to 1:5,000 scale), which fall into three general types:
        1. Coastal plans designed to identify a range of land tenure opportunities to guide decision makers.
        2. Issue resolution plans, designed to resolve specific conflicts & issues relating to coastal land uses/activities.
        3. Special management plans provide more detailed direction for managing specific uses or distinct areas.
- The coastal plan identifies potential sites for recreation and tourism, shellfish and finfish aquaculture as well as structures associated with upland development, including docks, wharves and other infrastructure. All key interest groups, including First Nations, industry, environmental and recreation organizations, participated in the development process.
- This helps all levels of government work together to share data and build a co-operative approach to outstanding concerns regarding habitat management.

Oceans & Coastal Strategy Policy Framework

- The Province of BC is also presently developing an *Oceans & Coastal Strategy Policy Framework*. The Ministry of the Environment is the lead provincial agency for the Framework.
- The underlying purpose of the Framework is to manage the ocean and its resources in a manner that balances varied interests, obligations, and uses, and to ensure the full balance of provincial interests are reflected in federal oceans policy.
- Eight supporting principles are guiding the development of the Framework:
    1. Sustainable Management (of coastal and ocean resources).
    2. Science & Information (government decisions based on sound science, information, and planning).
    3. Shared Jurisdiction (an integrated approach to shared jurisdiction).
    4. Collaborative Approach (between the federal and provincial government to coordinate respective goals).
    5. Provincial & First Nations Interests (management consistent with provincial ownership/jurisdiction over coastal /ocean resources and with obligations to meet First Nations' rights).
    6. Adaptive Management (to ensure management approaches achieve the intent of sustainable use).
    7. Consultation (decisions informed by dialogue with affected parties).
    8. Partnerships (with the private sector, governments, educational institutions to expand oceans research and industry in coastal BC).

Fish Health Management Plans - Compliance and Enforcement

Re: Criterion 3. The Report's analysis of the fish health regime in BC contains conclusions that we would like to address: (1) it does not recognize that provincial aquaculture licences are required under the BC Fisheries Act, and; (2) the three fish husbandry practices the Report focuses on are covered by Fish Health Management Plans (FHMP), and FHMPs are linked to the regulations governing licensing (without a FHMP one can not be licensed). The Report also makes other inaccurate assertions about elements of the fish health program. Please review the information provided below.

- The BC Environmental Assessment Office's 1997 Salmon Aquaculture Review identified the need for "enforceable standards for managing farmed salmon health… that should apply to all intensive fish culture operations".
- In 1999, the Province of British Columbia accepted this recommendation, developed a new Salmon Aquaculture Policy, and committed to address concerns through the implementation of a new regulatory and management framework. Included in the policy is the goal to improve fish health.
- To assist in this objective, government requires all private companies and public fish culture facilities to develop and maintain an up-to-date Fish Health Management Plan (FHMP) specific to their facility. Under S.13(5) of BC's Fisheries Act, a person must not carry on the business of aquaculture in British Columbia unless the person holds a licence. The requirement to have and comply with an FHMP is established and made enforceable as a condition of the aquaculture licence which reads:

  "The licence holder must maintain and follow an up-to-date Fish Health Management Plan (FHMP). This plan must be reviewed annually by the holder and any updates to the FHMP must be submitted to the Ministry of Agriculture and Lands for approval prior to implementing those amendments."
- Monitoring compliance with the FHMP is the responsibility of the provincial Fish Health Veterinarian (FHV). The FHV has two avenues to assess compliance with the FHMP. Firstly, Fish Health Bio-technicians can identify suspect non-compliance during their regular visits to finfish facilities and Report their observations to the FHV for follow-up. Fish Health Technicians visit a minimum of 25% of the salmon farm sites during each calendar quarter or 30 farm sites per quarter for a total of 120 site visits per year for Fish Health Audits. As a result there is an opportunity for all sites to be visited at least once per year. Secondly, all companies are required to Report all mortalities and reasons for those mortalities quarterly. The FHV can identify suspect non-compliance with the FHMP through regular review of data obtained through the fish health disease Reporting system compared to the audit information. Any irregularities in this data can be pursued by the FHV and action taken as required. As a condition of the FHMP, the companies must make all records available for audit by the FHV.

- Fish Health Management Plans have been in place in the Aquaculture Industry since 2003. They have undergone formal evaluation by a fish health veterinarian in 2004 and 2006.
- Once the FHV has become convinced that non-compliance with the FHMP exists, the FHV can then bring this issue to the attention of the licensee, ensure that steps are taken to address the issue of non-compliance. In the event that the issue is not addressed on a voluntary basis, the FHV will refer an ongoing breach of the FHMP to the Fisheries Inspectors within the Fisheries and Aquaculture Licensing and Compliance Branch, to be pursued as a breach of the Term and Condition of the Aquaculture Licence. Administrative actions that may be taken include revocation, suspension or refusal to renew a licence. Upon conviction, a breach of a term and condition of the aquaculture licence may also carry a maximum penalty of $2,000 (Fisheries Act Chapter 149, Section 25 (4)) per day that the offence occurs. Non-compliance with the requirement to hold a valid licence, which includes the requirement to have an approved FHMP, can carry fines of up to $10,000 per day the offence occurs.

Disease Reporting Requirements in Federal Regulations.

Re: Criterion 5. It is important to note that federal regulations require the Reporting of specific fish diseases. Please review the following information.

- The federal Fish Health Protection Regulations (FHPR) are administered under the (federal) Fisheries Act.
- The FHPR aim to minimize the introduction, spread, and occurrence of infectious fish diseases through the inspection of production sources of fish stocks, and by controlling the movement of infected stocks.
- The FHPR covers live and dead cultured fish, eggs of cultured and wild fish, and products of dead cultured fish coming into Canada or moving across provincial boundaries. All such activity is prohibited unless a permit is issued by a Local Fish Health Officers who administer the FHPR in their respective provinces or regions.
- The FHPR apply to all salmonids.
- The FHPR lists the following diseases:
  - *DISEASES & AGENTS FOUND IN LIVE FISH OR THEIR SOURCE:*

    Any filterable replicating agent capable of causing cytopathic effects in the cell lines of fish specified by the Minister including, but not limited to:
    - Viral Hemorrhagic Septicemia;
    - Infectious Hematopoietic Necrosis (IHNV);
    - Infectious Pancreatic Necrosis (IPNV);
    - Whirling Disease (Myxobolus cerebralis);
    - Ceratomyxosis (Ceratomyxa shasta);
    - Furunculosis (Aeromonas salmonicida);
    - Enteric Redmouth Disease (Yersinia ruckeri).
  - *DISEASES & AGENTS FOUND IN DEAD FISH OR THEIR SOURCE:*
    - Viral Hemorrhagic Septicemia
    - Whirling Disease (Myxobolus cerebralis)
  - *DISEASES & AGENTS FOUND IN LIVE FISH OR THEIR SOURCE:*
    - Myxobacterial infections
    - Motile Aeromonad Septicemia (Motile Aeromonas sp)
    - Pseudomonad Septicemia (Pseudomonas spp)
    - Vibriosis (Vibrio spp)
    - Bacterial Kidney Disease (Renibacterium salmoninarum)
- Under the FHPR, specific diseases must be scanned for when bringing fish or fish eggs into any province from any other province or country.
- The Fish Pathology Program at the Pacific Biological Station undertakes the inspection of facilities and certification of fish under the FHPR. Before a

facility is certified, four inspections must occur over a 2-year period and the facility must be found free of pathogens.

- BC salmon farmers require a suitable genetic base and occasionally request to import eggs from new stocks. The permitting process under the FHPR ensures the appropriate safeguards are in place, including:
    - importation of eggs only (live fish are not permitted);
    - surface-disinfection of eggs prior to shipping;
    - certification of the exporting facility under the FHPR and inspection by a Canadian Fish Health Officer;
    - rearing of eggs and fry in a DFO-approved quarantine facility until the fish are at least 3g. During this time monthly health monitoring must be done to test for infectious agents.
- Please see: *Fish Health Protection Regulations: Manual of Compliance* at the following web address:

  www.dfo-mpo.gc.ca/science/aquaculture/aah/manual_of_compliance_e.htm

Report's Analysis of the Fish Health Regime in BC

The Report's analysis of BC's fish health regime does not recognize that all aquaculture facilities in BC must have a Fish Health Management Plan (FHMP) that is approved by the provincial fish health veterinarian. This is enforceable as a condition of the aquaculture licence. Please review the following information.

- Page 12 of the Report states:

  > "An inquiry with the Office of Fish Health Veterinarian revealed that stocking densities, fallowing and year-class separation are not part of that office's responsibility either."

- The Fish Health Veterinarian claims this is not what she said. She agreed that BC does not have a regulation related to these issues, but explained that they are covered by the FHMP. A lengthy discussion about why and whether or not regulating density is appropriate ensued. She emphasized that the number of species and various conditions under which they are held in addition to the variety of oceanographic and other factors that influence these issues makes it extremely difficult to make a "one size fits all" approach work.

- Page 12 of the Report states:

  > "Each salmon aquaculture site is required to have a Fish Health Management Plan, which is supposed to identify risk factors in regard to fish health and "minimize their effect on fish health and their role in predisposing fish to disease." However, the 2003 "Required Elements" document on these factors does not make reference to any of the three fish husbandry issues."

- The document clearly states that its purpose is to outline "what" should be done, not "how" it should be done. The appropriate document to reference in this instance is the Template and or the Manual of Practices. Both documents include consideration of, and go much further than, the three aspects of fish health upon which the Report focuses. See below for examples.

- Page 15 of the Report states:

  > "That industry-led initiative involved fish farm reporting to their own database, and there was no legal requirement to report to MAFF."

- In fact, the industry actually started to report to MAFF at the exact same time: a legal requirement to do so was not necessary. All the reports on fish health have been on the Ministry web site since 2001.

- Page 15 of the Report states:

  > "But operators had a choice of contributing to the aggregate data on mortalities each quarter to the industry's own fish health database for providing more detailed data on its sampling and test

findings to the BCMAFF Fish Health Veterinarian on a quarterly basis."

- This is misleading. The choice available is to either send the data to their database or send to the Fish Health Veterinarian; either way, it was required for the Fish Health Vet to see it. Also this does not recognize the fact that the Ministry audits individual site data and has direct access to on farm data as required.
- Page 15 and 16 of the Report states:

  "The sampling and testing for disease was still not standardized across the industry. The "Manual of Fish Health Practices" issued in August 2004 only called for samples to be "taken in a manner that represents the population held at the facility." And that sampling of fish in contact with a disease should be sampled "as advised by a qualified fish health professional."

- In fact, all testing is completed according to Office International Epizootic (OIE) standards. The design for sampling was completed by an epidemiologist for the detection of diseases at a prevalence of 2% in any given population. The specific testing requirements again are dependant on the disease. It was explained to the author that the Ministry uses bacteriology on two types of agar plus virology on standardized five tissues from every animal examined run for the same tests using Polymerase Chain Reaction (PCVR) testing and histology on each fish through a board certified fish pathologist.
- Page 16 of the Report states:

  "There are no mandatory steps regarding depopulation of cages or sites upon clinical verification of any disease found on the site."

- This is true, but it does not recognize that there are options other than depopulation, even for terrestrial animal diseases. In cases where there is no threat to wild stocks and no threat to human health depopulation for control may not be the preferred option.
- Page 28 of the Report states:

  "Since the beginning of 2001, the B.C. salmon aquaculture industry has experienced two major health problems: an epizootic of Infectious Haematopoietic Necrosis (IHN) Virus Infection and an infestation by sea lice."

- Contrary to the implication in the Report, sea lice did not suddenly become a problem for Atlantic salmon farmers in BC. In fact, sea lice are not and have never been a health "problem" for the aquaculture industry. This is why there was no official monitoring program before 2001, when concerns about wild fish prompted the government to act cautiously and put the program in place. Treatments did and still do occur for sea lice, particularly in the fall and winter. However there is a notable difference in clinical impact from sea lice on

Atlantics in the Pacific Ocean and Atlantic Ocean, as well as lower levels of treatment (frequency and numbers).

- Page 29 of the Report states:

  "However, no specific actions, in terms of harvesting the fish on sites which had cases of IHNV regarding harvesting or depopulation were taken until December 2001."

- The reason for this is because the risk posed to wild stocks in the marine environment from IHN on farms is minimal and because all control is based on containment to prevent transmission between farms.

- Page 29 of the Report states:

  "Even worse, although every site in the area had contracted the IHNV by April 2003, there was no complete depopulation of all the sites until early 2004."

- Why is this "even worse"? According to fish health professionals, the risk to wild stocks is so low that depopulating is unnecessary.

- Page 29 of the Report attributes the following to Sonja Saksida:

  "It also poses risks to adults and juvenile salmon migrating past fish farms where the epizootic was in process. Furthermore, returning adult salmon could transmit the disease to their offspring."

- Sonja Saksida does not agree that this is what she said. She agrees that she said that keeping exposed fish on the farms was a significant contributing factor to the spread of IHN to other farm fish, but did not say *anything* about the risk to wild salmon and that it is incorrect to say that she did.

- Garth Traxler is a leading authority on IHNV. He comments that "there is little or no evidence that migrating adult or juvenile salmon moving past a salmon farm with IHN are at risk of contracting the disease." He agrees that returning adult salmon *could* pass the disease to their offspring; however, the source of IHNV in returning adults is not likely salmon farms but rather previous exposure or the freshwater environment.

- The requirement to hold an aquaculture licence is found in s.13(5) of the Fisheries Act, RSBC 1996 C. 149:
  - a person must not carry on the business of aquaculture at any location or facility in British Columbia or its coastal waters unless the person holds a licence issued for that purpose under this Part and has paid the fee prescribed by the Lieutenant Governor in Council.
- Compliance with terms and conditions of an aquaculture licence is mandatory and enforceable. S.25(2) of the Fisheries Act establishes that
  - A person who contravenes a provision of this Part, a regulation made under this Part or a condition of a licence issued under this Part commits an offence.

- FHMPs are linked to the legislation governing licensing; without a Provincial veterinarian approved FHMP that addresses the fish husbandry practices of concern upon which the Report focuses, one can not be legally licensed to conduct aquaculture.
- Contrary to the Report, the three fish husbandry practices upon which the Report focuses: fallowing, year class separation and rearing densities are covered by FHMPs as follows:

1. Fallowing:

- The Manual of Health Practices (Manual) found at http://www.agf.gov.bc.ca/fisheries/health/FHMP_Manual.pdf is a guide to be used by culturists in writing and by regulators in assessing FHMPs.
- The Manual describes an accepted set of fish health management practices that will meet the required elements. The Manual is not all-inclusive as there are other ways to meet the required elements, consistent with a performance-based adaptive management philosophy.
- Regulators must use professional judgment and expert advice to determine if the specific methods proposed by culture facilities adequately address the required elements.
- The Manual contains the following with respect to fallowing:

2.2.1.1 Fish Groups and Segregation

  - Fish populations should be grouped in a manner that avoids cross-contamination with disease causing agents.
  - Single-year classes for saltwater sites and fallowing of holding units are encouraged.

- In general, fallowing for the purpose of pathogen reduction is ineffective due to the large numbers of wild fish in British Columbia that carry endemic pathogens and sea lice. This is a significant difference in comparison with other jurisdictions.
- However, fallowing is an effective tool in breaking the cycling of pathogens within and between farms, hence more prescriptive requirements are put in place in the event of disease on a farm that is more likely to be transmitted to other farms.
- This is reflected in the document “IHNV Isolation and Control Procedures for IHNV Positive Farm Sites” at http://www.agf.gov.bc.ca/fisheries/health/IHNV_Isolation_Control_Procedures.pdf which contains the following:
  - Sites that have experienced an outbreak of IHNV should remain fallow for a minimum of three months post the date of removal of the last infected fish from last affected site prior to re-stocking fish into the site. For IHNv positive zones where multiple sites are affected a coordinated fallow period and restocking program should be established.

- Once the site or an IHNv positive zone has been re-stocked, fish should be monitored for the presence of the virus up to three months post the last day of stocking.

2. Year Class Separation:

- The "Template for Development of Facility – Specific Fish Health Management Plans" (Template) at www.agf.gov.bc.ca/fisheries/health/FHMP_Template.pdf is to be used by operators to ensure that their operations meet all aspects of the "Required Elements of a Fish Health Management Plan for Public and Commercial Fish Culture Facilities in British Columbia" at http://www.agf.gov.bc.ca/fisheries/health/fhmp_Required_Elements_June-03.pdf
- The Template, in the Net-pen Sites section 2.2.1 on page 8 states:
  - Where possible, sites will contain single year classes of stock to prevent transmission of disease between year classes.
- The Template section 3.2.1 on Hatchery Sites at page 27 establishes:
  - Hatchery operations typically have overlapping year classes on site, e.g., early incubation, fry rearing and possibly broodstock. Rearing units will be kept separate to prevent transmission of disease between year classes.
- The Manual in s. 3.2.1.1 Fish Groups and Segregation on page 25 states:
  - Fish populations should be grouped in a manner that avoids cross-contamination with disease causing agents.
  - If a facility has multiple year-classes, facility design and management should strive to cause a functional separation of year classes by keeping them in different holding units, where possible. Management operations should account for differences in disease or infection status of year-classes and be performed to reduce the risk of cross contamination.
  - Whenever physically possible, new arrivals of fish should be held separately from existing stocks regardless of their source or disease history. Where possible a physical separation of holding units, different equipment, and designated personnel.
  - The separation period for new arrivals should extend to cover the incubation period of diseases of particular concern for the specific fish transfer.
  - The mortality rate of new arrivals should be evaluated at least bi-weekly for this period of isolation. Samples of sick and dead fish should be checked weekly in the absence of signs of illness and on a daily basis in the presence of elevated mortality rates or signs of disease.

- When fish are moved between Transplant Zones (as defined by the Federal-Provincial Introduction and Transfers Committee) or are imported from another country or province, restrictions imposed by the Federal-Provincial Introduction and Transfers Committee and the Federal Fish Health Protection Regulations must be followed.

- The Manual, in Net-pen Sites section 2.2.1.1 Fish Groups and Segregation (page 5), establishes:
  - Where possible sites will contain single year classes of stock to prevent transmission of disease between year classes.

3. Maximum Stocking Densities:

- The Template, Sections 2.2.3 and 3.2.3 on Normal Fish Behaviour states:
  - Fish will be routinely monitored for signs of health and disease. All staff should be familiar with normal fish behaviour. Key behaviours that indicate healthy fish include but are not limited to:
    - Physical – changes from normal i.e. scale loss, parasites, external injury
    - Behavioural - swimming and schooling behaviour, increased respiration
    - Feeding – normally aggressive feed response when feed is presented
  - Fish will be kept at reasonable densities. Changes in behaviour and physical condition will be reported to site management. Early detection is key to good disease management.

- The Manual, in sections 2.4 and 3.4 on Monitoring Water Quality states:
  - Water quality management requires the consideration of fish density, feeding rate, volume, and source supply.
- Animal rearing density is site specific and is adaptively managed in a performance-based manner. It is not possible to place an absolute number on an acceptable maximum or minimum density limit because such a limit will be determined by site-specific parameters.
- Based on evaluation of management plans and actual production figures, our knowledge is that rearing densities range from 15-18 kg/m^3 for Atlantic salmon and 12-14 kg/m^3 for Chinook salmon. These figures are for the most part no higher than densities experienced in other countries.
- Other assertions contained in the Report about elements of the fish health program are addressed as follows:
- **Criterion 4** challenges the adequacy of monitoring and enforcement of best practices in fish husbandry without recognizing the following:
  - Ministry of Agriculture and Lands Fish Health Technicians monitor best practices in fish husbandry during on site visits conducted under the Fish Health Audit and Surveillance Program.
  - Fish Health Management Plans are reviewed and approved by the Provincial Fish Health Veterinarian. This evaluation process includes assessment of stocking densities and year class separation.
  - Fisheries Inspectors from the Fisheries and Aquaculture Licensing and Compliance Branch of the Ministry of Agriculture and Lands inspect every active salmon farm in the province a minimum of once per year, and more frequently at some farms when necessary. There are several primary inspection categories according to which each site is evaluated.
    - The Aquaculture Regulation requires that holders keep accurate and complete inventory records of stock on hand and requires that these records be maintained for each net cage on the system. These records must show the inventory introduced to the farm site and documentation should include date of entry, species, hatchery source, size, strain and age of fish. Reconciliation for fish transferred in or out, escapes and mortality must be included in these Reports.
    - The objective of this requirement is for the farm operator and government inspectors to know at any given time what the stock levels are for each net cage on the farm. These records enable the operator to accurately Report incidents of escapes and allow inspectors to audit compliance with escape reporting requirements.
    - Ministry of Agriculture and Lands) *Finfish Aquaculture Site Inspection Checklist* includes a review of whether multiple year classes are on site and their separation.

- **Criterion 5** examines the adequacy of practices and procedures for early detection of an outbreak of any disease or parasitic infection likely to affect wild salmon and rapid response to such an outbreak. The analysis does not recognize the following:
    - The Fisheries Act and Aquaculture Regulation establish record-keeping requirements for prescribed information in BC, including fish inventory records with specific information including number of fish stocked, and causes of mortalities.
    - The Fish Health Program also requires certain records to be kept (see below). There is a legal requirement to make records available upon the request of an Aquaculture Inspector, an Inspector of Fisheries or a Conservation Officer.
    - Companies submit data to the Fish Health Database on a monthly basis and sites are audited on a regular basis.
    - The Report quotes the Sierra Legal Defence fund petition to the Auditor General. The petition contains several errors, for example it concludes:
        - In summary, since neither provincial nor federal legislation lists aquatic diseases as Reportable, there is no Canadian legislation requiring salmon farmers to Report outbreaks of fish diseases.
- In fact, Canada is a signatory to the OIE (World Organization for Animal Health) and as such when OIE listed pathogens are found by veterinarians they have an obligation to Report these diseases to the Provincial and Federal authorities.
- With respect to the reference in the Report to “standardizing protocols,” it should be noted that no country does this, but there are standard approaches to specific diseases. In BC, a sampling Standard of Practice is required to be submitted in each company’s FHMP. Companies are required to demonstrate access to fish health expertise and knowledge of sampling or sample shipment methods.
- Sampling protocols are not prescribed, but this is not unusual practice. For example, the British Columbia Veterinary Medical Association does not prescribe protocols requiring all practitioners to neuter dogs in exactly the same way; similarly, medical doctors are not required to culture throat samples, for example, in a specific way. Licensing bodies for health professionals ensure that veterinarians and their technicians have the necessary skills and knowledge to meet expected standards of practice.
- Sections of the Manual that establish requirements for sampling include s. 2.7 Monitoring Fish Health, at page 15:

2.7 Monitoring Fish Health (Refer to section 2.7 of the Template Fish Health Management Plan).

- Fish and fish behaviour should be observed daily to examine for signs of illness.
- Samples of freshly dead fish should be examined if available at a facility as a minimum on a twice-monthly basis. The numbers of fish to be sampled, frequency of sampling and agents to be examined for will vary with the size of the facility and past medical history. Sample protocols can be developed in consultation with fish health staff and qualified fish health professionals.
- The planned release of enhanced, cultured fish (produced by governments or by private groups on their behalf) to the wild should be judged to not result in undue harm to wild fish or public health. This judgment should be based upon a review of the disease and mortality records, recommendations by a qualified fish health professional, the results of any recommended pre-release disease screening and guidance from regulatory agencies.
- Modifying factors such as the biological/ecological constraints to release for a specific group of fish, the known disease status of wild stocks likely to encounter the released fish and likely progression of the disease or infection of concern should also be considered.

- When determining if there are changes in fish health, fish health staff should:
  - Review recent patterns of death and morbidity.
  - Conduct an on-site visit to:
    - Observe fish behaviour.
    - Review general hygiene, management and other possible fish health risks.
  - Conduct gross post-mortem examination to describe the presence and type of pathological processes.
  - Conduct sampling and/or additional testing of fish as required. Samples should be taken in a manner that represents the population held at the facility.
  - Contact information for fish health expertise should be readily available for all staff in the event of an occurrence of disease.
  - If experiencing increased mortality rates monitoring efforts should be increased & additional sampling to determine cause of event may be required.

- If fish are affected by a disease, groups of fish in contact with affected groups or otherwise linked to affected groups should be monitored for changes in mortality rates or morbidity. Additional sampling should occur as advised by a qualified fish health professional.
- Fish Health Program record keeping requirements from the Manual include the following:

2.8 Fish Health Records

- Operators should keep a chronological record of observations or other information that may indicate illness in a fish population including:
  - Increased morbidity levels.
  - Daily feed consumption, growth rate, and feeding behaviour.
  - Disease findings or Reports of carcass quality made at slaughter.
  - External lesions on live fish including signs of ecto-parasites.

2.8.1 Reporting to BC Fish Health Database

- Companies who choose not to Report to the BC Fish Health Database must provide the following records to BCMAFF Fish Health Veterinarian for review:
  - Inventory records (including source, number, location and lot of fish at the site).
  - Fish movement records.
  - Mortality records including mortality cause.
  - Water quality records.
  - Medicated feed records.
  - Therapeutant treatment records.
  - Records of mitigative actions (other than therapeutants) taken to prevent or mitigate disease, e.g. taking fish off feed due to a plankton bloom.
  - A record of all laboratory diagnostic procedures and their results should be kept for each group of fish. Included in these records should be:
    - The date of sampling and test findings Reported.
    - The group(s) sampled and those from which the findings were made.
    - The number of fish examined and tested.
    - Who did the testing and what tests were used.
    - Why the fish were examined (disease screening, population health screening, routine health check, response to increased disease, outbreak investigation, other).

- Records will have to be provided on a quarterly basis (twentieth day of the last month of each quarter – March 20, June 20, Sept 20 and Dec 20) for all sites in operation.

- Fish Health Program record keeping requirements from the Template include the following on page 17:

  2.8 Fish Health Records

  - Fish health records include but are not limited to:
    - Inventory records (includes source, number, location and lot of fish at the site)
    - Fish movement records
    - Mortality records including mortality cause
    - Lab work
    - Diagnostic sampling records
    - Water quality records
    - Medicated feed records
    - Therapeutant treatment records (see also 2.12 (below))
    - Records of mitigative actions (other than therapeutants) taken to prevent or mitigate disease, e.g. taking fish off feed due to a plankton bloom
    - Records of Reporting to Provincial or Federal authorities, in accordance with existing regulation
  - Many of these records are computerized and form part of the integrated operator record keeping system. The operator will provide adequate system training and documentation to authorized site personnel including data entry and Reports, e.g. ENPRO for DFO and HIMAN for FFSBC. Backups will be maintained.
  - Paper records not entered into a computerized system will be easily accessible and protected from damage, e.g. kept in binders in the site office.
  - Records will be kept for the duration of time the fish are on site. The operator will keep archived records at a suitable location in head office or securely stored off site.
  - Aquaculture facility records will be available for inspection upon request by BC MAFF as per regulation.
  - Records will be reviewed on a routine basis by the operator's Veterinarian and/or Fish Health Management to look for patterns in fish health and disease.

2.8 Reporting to BC Fish Health Database

- The operator will Report required fish health data, including mortality cause and fish health event information to the BCSFA Fish Health Database on a monthly basis. The Database Reports aggregated information quarterly to BCMAFF.
- The following saltwater/brackish categories should be used for Reporting:
  - Environmental
  - Fresh “silvers”
  - Handling/transport
  - Mature
  - Old
  - Poor performers
  - Predators
- Aquaculture companies will keep records of data submission for audit by BC MAFF.

Appendix 1 - Cumulative Effects Guidelines

INTERIM GUIDE TO CONSIDERATION OF CUMULATIVE ENVIRONMENTAL EFFECTS UNDER CEAA RELATIVE TO AQUACULTURE PROJECTS

OPERATIONAL POLICY GUIDANCE

Fisheries and Oceans Canada

January 18, 2002

Copies of this publication are available from the following Fisheries and Oceans Canada locations:

Headquarters,
Office of Sustainable Aquaculture *or* Habitat Management Program (HMP)
200 Kent Street
Ottawa, Ontario
K1A 0E6

Regional Offices
The Regional Aquaculture Coordinators *or* HMP Offices as listed below:

Pacific Region
400, 555 West Hastings Street
Vancouver, British Columbia
6B 5G3

Québec Region
104 rue Dalhousie
Québec, Québec
G1K 7Y7

Maritimes Region
176 Portland Street
P.O. Box 1035
Dartmouth, Nova Scotia
B2Y 4T3

Central and Arctic Region
501 University Crescent
Winnipeg, Manitoba
R3T 2N6

Gulf Region
343 Université Avenue
P.O. Box 5030
Moncton, New Brunswick
E1C 9B6

Newfoundland Region
Box 5667
St. John's, Newfoundland
A1C 5X1

On the Internet at:

This guide will be reviewed and updated on a regular basis to reflect recent research findings, changes in aquaculture technologies and practices, and new legislative and policy initiatives.

Feedback on the content and format are welcome. Please send any comments to:

Office of Sustainable Aquaculture
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario
K1A 0E6

Table of Contents

INTRODUCTION

The following **Operational Policy Guidance** is provided to guide DFO regional staff in the consideration of cumulative environmental effects relative to aquaculture projects under the *Canadian Environmental Assessment Act* (CEAA) to clarify:

- What other projects and activities should be considered in an assessment of cumulative environmental effects?

- What environmental effects should be considered as cumulative?

- How can cumulative environmental effects be assessed when limited information is available?

This guidance applies in situations where DFO is asked to provide federal support in the form of a regulatory decision as identified on the *Law List Regulations*.

BACKGROUND

Fisheries and Oceans Canada (DFO) becomes a responsible authority (RA) and is required to ensure that an environmental assessment of an aquaculture project is conducted under the *Canadian Environmental Assessment Act* (CEAA) when DFO proposes to issue one or more of the following[1]:

- a paragraph 5(1)(a) or subsection 6(4) approval under the *Navigable Waters Protection Act* (NWPA);

- a subsection 35(2) *Fisheries Act* authorization.

Section 2 of CEAA defines "environmental effect" as including:

> "any change that the project may cause in the environment, including any effect of any such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, and any change to the project that may be caused by the environment, whether any such change occurs within or outside Canada."

Environment is defined by CEAA as:

> "the components of the Earth, and includes land, water and air, including all layers of the atmosphere, all organic and inorganic matter and living organisms, and the interacting natural systems that include the above-noted components."

The environmental assessment for an aquaculture project will usually be in the form of a screening. Section 16 of CEAA indicates that every screening of a project must include a consideration of the environmental effects of the project, including a consideration of "any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out".

[1] The above assumes that a determination has been made that the aquaculture proposal in question is a "project" under CEAA.

ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS

It has been acknowledged by many that there are difficulties in assessing cumulative environmental effects for many projects and activities. Key questions arise, such as:

- What other projects and activities should be considered?
- What environmental effects should be considered as cumulative?
- How can cumulative environmental effects be assessed when limited information is available?

This last issue can be problematic because most environmental assessment processes (such as CEAA) apply to individual projects rather than to a region or area (and the projects and activities within). Assessing the cumulative environmental effects associated with aquaculture projects is no exception.

The following direction is provided to DFO assessors to assist the minister answering the above questions in order to carry out the assessment of cumulative environmental effects as required under CEAA. How the assessor addresses each of these questions in conducting the cumulative effects assessment should be explained in the CEAA screening Report, including the rationale for including or not including certain projects/activities or environmental effects, the information considered, assumptions made and conclusions reached.

What other projects and activities should be considered in an assessment of cumulative environmental effects?

Cumulative environmental effects are environmental effects that result from the project under review, in combination with other projects or activities. Thus, an assessor must determine what other projects and activities to consider.

Under CEAA, there must be a consideration of cumulative environmental effects of other projects and activities that have been (existing) or “will be carried out”, i.e., that are "certain" or “reasonably foreseeable". This implies that, at a minimum, projects or activities that have already been approved, but not yet carried out, must be considered. It would also be prudent to consider projects or activities that are in a government approvals process.

What environmental effects should be considered as cumulative?

During an environmental assessment, potential environmental effects relative to the project under review and mitigation measures to minimize/reduce these effects are identified in order to assess whether the project is likely to cause significant adverse environmental effects. Consideration of cumulative environmental effects in an assessment is an exercise by which the environmental effects of a project are reviewed in

light of the environmental effects of other projects and activities that may have affected or will affect the same aspect(s) of the environment.

Only those environmental effects of other projects and activities that are cumulative with the environmental effects of the project under review should be included in the cumulative effects assessment. For example, if a finfish aquaculture project is likely to cause adverse effects to local water quality, and local water quality is also affected by an nearby processing plant, then this effect is cumulative and should be considered in the assessment.

If the environmental effects of other projects or activities are not likely to act in combination, then it is not necessary to include them in the assessment. For example, if migratory bird habitat is not affected by a proposed aquaculture project but is affected by an existing project, then this effect is not cumulative as a result of the project under review and would not be considered in the assessment.

How can cumulative environmental effects be assessed when limited information is available?

Fisheries and Oceans Canada (DFO) is developing various scientific tools, as well as working with industry and provincial agencies, to understand the environmental issues associated with aquaculture better and to facilitate the assessment of cumulative environmental effects. Monitoring results associated with provincial licencing and federal monitoring requirements are providing additional information. However, not all of these tools are currently available and direction is required on how to proceed in the absence of some information.

Based upon the project- and site-specific information provided by the proponent for an individual project, as well as any available information relative to other projects or activities in the area or region, an assessment of cumulative environmental effects can be undertaken.

Such an assessment should include the following:

- Quantitative assessment, based upon relevant modeling or other tools, if they exist. Where possible, consider the carrying capacity, tolerance level or assimilative capacity of the natural system(s) and/or comparison with existing environmental standards, guidelines and objectives and regional or area management plans appropriate to the situation.

- Qualitative analysis, based upon available information, scientific understanding and professional judgement. Include an analysis of risk and probability. An analysis of worst case and best case scenarios can also be useful.

- Consideration of the following:
  - severity of the effects;
  - the geographic extent of such effects;
  - the duration and frequency of such effects;
  - the degree to which such effects are reversible; and
  - fragility of ecological area.
- Implementation of mitigation.

Regardless of the method(s) of assessment of cumulative environmental effects, an assessor should provide clear indication in the CEAA screening Report of the information considered, the quantitative and/or qualitative assessment, any assumptions made and conclusions reached.

An adaptive management approach should be adopted to ensure that results of any relevant monitoring or studies are analysed and that adjustments are made to the project and/or its operation to maintain the adverse effects on the environment below the significance threshold..

The adaptive management approach should include:

- the follow-up (monitoring) program required by DFO under section 35 of the *Fisheries Act* relative to potential impacts to fish habitat (details of this program will be addressed through an agreement between DFO and the proponent);
- any required follow-up (monitoring) program specific to the project relative to other potential environmental effects;
- results of ongoing scientific research or studies relative to the geographic area or results which are extrapolable to the area; and
- analysis of these data to identify the need for additional mitigation and/or changes to the project or its operation.

The results of any follow-up program and research and studies will contribute to the ongoing analysis of cumulative environmental effects of aquaculture by DFO, industry and provincial agencies.

To ensure the implementation of any follow-up program, a proponent will be required to implement aspects of a monitoring program specific to the project. At this time, the project proponent will only be required to Report on aspects of the effects of his own project on the environment, including conducting scheduled monitoring, Reporting the findings, and in addition, implementing identified mitigation measures should cumulative

environmental effects associated with the project be identified that are unexpected or more extensive than expected. In addition, security for costs may be required should the proponent fail to comply with the terms and conditions for the implementation of the follow-up program and required mitigation measures.

Such a follow-up program *should* be incorporated as a condition of the project proceeding in several ways:

- as a condition of a DFO authorization (e.g., subsection35(2) *Fisheries Act* authorization), should one be required; or

- a Monitoring Agreement between DFO and the proponent (which may extend beyond monitoring of cumulative environmental effects); or

- other federal tools available that would enable DFO to ensure that the follow-up program is implemented.

The assessor is also encouraged to work with provincial authorities in determining the extent to which follow-up program requirements could be reflected in the provincial aquaculture licence.

In addition to the results of the monitoring program(s) conducted by the proponent, other available and applicable information will be used in applying the adaptive management approach arising from:

- regional/area or bay-wide studies;

- results of ongoing scientific research relative to the geographic area or results which are extrapolable to the area; and

- other relevant available information pertinent to cumulative environmental effects.

It should be acknowledged that the assessment of cumulative environmental effects can be facilitated by several means, including:

- individual aquaculture proponents coordinating their monitoring programs individually or collectively, possibly through a recognized body;

- a regional/area of bay-wide review of aquaculture development to address cumulative environmental effects - such a review need not be constrained to individual projects and their effects, would not be limited by lease boundaries and could consider cooperative or complementary approaches to development and minimize environmental effects within the region; and

- the establishment of an integrated monitoring program (by DFO, industry, provinces, and other federal departments) which encompasses aquaculture projects, other

projects and activities within geographic and temporal boundaries of the cumulative effects assessment.

Note: The Habitat Management Program is reviewing the assessment requirements with respect to cumulative environmental effects under CEAA. This review will inform DFO in this important issue and may result in adjustments to this guidance document.

ADDITIONAL INFORMATION

Additional information on the assessment of cumulative environmental effects under CEAA is provided in guidance material provided by the Canadian Environmental Assessment Agency:

- Reference Guide: Addressing Cumulative Environmental Effects at http://www.ceaa.gc.ca/0011/0001/0008/guide1_e.htm;

- Operational Policy Statement (March 1999) - Addressing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act* at http://www.ceaa.gc.ca/0011/0002/cea_ops_e.htm; and;

- in the Responsible Authority's Guide.

Appendix 2 – Cumulative Effects Assessment (Example)

Cumulative Effects Assessment – Example

Referral Application: Pan Fish Canada Ltd. - Petrel Point

General Area: Principe Channel

BC Land File:	**6407366**
NWDS File:	**8200-02-8872.1**
HRTS:	**02-HPAC-PA1-000-000135**
FEAI:	**37331**

1.0 BACKGROUND

1. Referral Salmon Farm Site: Petrel Point – initial subject of this CEA; one additional approved application (Anger Anchorage) has been included in analysis.

2. Other Salmon Farm sites in Area:

Anger Anchorage - approved

Strouts Point – under review; this site is located at the north end of Petrel Channel, approximately 30 km from the proposed Petrel Point site, and is outside the spatial boundary of this assessment and unlikely to contribute to cumulative environmental effects. For this reason, Strouts Point is not included in this cumulative effects assessment.

3. Site separation distances

a) ***Tenure boundaries***

Petrel-Anger Anchorage 3.6 km

2. Previous CEAA Screenings

Anger Anchorage

(CEA considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

Summary of previous CEA results (for VEC concerns identified as low or higher in the Petrel Point EA):

	Anger Anchorage
Disease	***Intermediate***
Benthic habitat –Solids deposition	***Low***
-Chemicals	***Low***
Feral Atlantics	***Low***
Marine mammals	***Intermediate***

2.0 CEA Summary

Additional CEA, are summarized below using the results for Anger as start-points. CEA analyses of individual issues are appended.

	Previous CEA (Anger Anchorage):	**Current CEA (Petrel Point)**
VEC Concern	**Anger+Petrel**	**Petrel + Anger**
Disease	***Intermediate***	***Low***
Benthic habitat	***Low***	***Low***
Feral Atlantics	***Low***	***Low***
Marine mammals	***Intermediate***	***Low***

1. The assessment indicates that proposed salmon farm site at **Petrel Point** is *not likely* to contribute significantly to cumulative effects on VECs in the Petrel – Principe channel area.

Petrel Point will contribute to risks of pathogen transfer from farmed fish to wild fish, though probability of disease outbreaks in wild fish resulting from such pathogen transfer is low, based on available information and proposed mitigation measures. Similarly, Petrel point may contribute to effects on marine mammals, especially pinnipeds. The Petrel Point site also potentially would add to cumulative effects on other VECs but these would be localized, not permanent, and reversible (localized effects would exist as long as netcages are in place).

Results from the previous CEA have been adjusted for the Petrel Point case. In the **Anger Anchorage** assessment table, the **Intermediate** determinations were ***not based on a prediction that significant effects will occur***. They were based on a moderate level of uncertainty related to cumulative risks of pathogen-transmission at that time. With the current level of effectiveness of Fish Health Management and density of farm sites in the areas, this determination for ***Petrel Point*** is ***Low***.

Appendix: CEAA Work Sheets

A. Disease

Cumulative Effects Work Sheet

CEA Issue: SEA LICE
VEC: Wild Fish Populations

1. CONSIDERATIONS

a) Main Concern: Cumulative effects of sea lice transmission from proposed salmon farms to wild salmon and other fish species in or migrating along Petrel and Principe channels

b) Possible cumulative sources: Existing or reasonably foreseeable salmon farms

[1 farm has been recently approved; 1 has been applied for and is awaiting approval: each site will be designed for 2400 to 2500 harvest tonnage, or approximately 650,000 to 750,000 smolts]

c) Assessment Scope:

Geographical Scope: Part of taxonomic range of potentially affected fish species – fish using or migrating along Petrel Channel, Ogden Channel and Principe Channel

Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals) + population recovery time if effects occur

d) Choice of Analytical Tools:

A. Natural System Limits	
Carrying Capacity	Insufficient information
Tolerance Level	Insufficient information
Assimilative Capacity	Insufficient information
B. Comparison with existing information	
Environmental standards, guidelines and objectives	Not available for sea lice on wild fish populations
Regional or area management plans	Not available for sea lice, though province has now been divided into Fish Health Zones to enable tracking of fish health at culture facilities. Have guidance for managing fish populations

C. Qualitative analyses	
Based upon: ***1. available information,*** ***2. scientific understanding and*** ***3. professional judgement***	**1. Substantial information available from Europe but not conclusive, cause-effect relations still debated. Growing body of information from Broughton Arch. in BC.** **2. Scientific understanding of cause-effect relations is weak but improving, though methods to prevent/manage problems on farm sites appears to be relatively strong** **3. Professional judgement – supported by available information, management measures outlined in Fish Health Management Plans, and fallowing plans**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Yes***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Avoidance – siting criterion: At least 1 km from the mouth of a salmonid-bearing stream determined as significant in consultation with DFO and the province.

Fish Health Management Plans (based on government template and approval) at individual sites

Area-wide Mitigation

At present only one company (Pan Fish) appears likely to be in operation in the Principe-Ogden area (based on existing and foreseeable site applications) – SB indicates that area health management by one company is effective for controlling disease.

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Intermediate***

Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Intermediate***

(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Current CEA (Petrel Point):
VEC Concern	**Petrel + Anger**

Disease	***Low***

NOTES

1. ***Risks –*** Risk of sea lice numbers cumulatively (among all sites in operation) reaching sufficient numbers so that high rates of pathogen transmission to wild fish occurs, causing serious loss of wild fish. Risk increases as the number of salmon farm sites increases.

   Probability – For a measurable reduction in the size of a wild fish population to occur, sea lice numbers would have to be very large at one or more farms (i.e., either left untreated or not treatable), and likely in close proximity, to ensure large numbers of lice are available for transfer to wild fish at the same time that large numbers of vulnerable fish pass close enough to the lice-reservoir to be exposed. Probability of this occurring at individual sites is very ***low*** based on Fish Health Management Plan monitoring and treatment protocols that will be used. Probability of this occurring cumulatively within the area where all sites will be in operation is also ***low***.

2. ***Worst Case/ Best Case***

Worst Case: Failure of disease mitigation/ treatment/management at multiple sites; chronic and intense lice outbreaks on farms cause large reduction of wild fish population. Probability of this occurring is very low.

Best Case: Sea lice outbreaks cause no measurable change in wild fish populations

Expected Conditions:

The expected scenario is that fish health measures will be effective in maintaining low levels of sea lice at all farm locations, with a low body-burden at those locations serving as a small but chronic reservoir. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of disease management at multiple sites (Probability of Occurrence: Low)**		**Disease Management as Planned**	
		Rating		***Rating***
Magnitude:	Potential to cause measurable reduction in population of susceptible species (e.g., chinook and coho appear to have relatively low susceptibility; pink and chum appear to have relatively high susceptibility); sea lice occur naturally in wild fish populations.	*Moderate*	Measurable reduction in population of susceptible species (e.g., chinook and coho appear to have relatively low susceptibility; pink and chum appear to have relatively high susceptibility) is not expected.	*Low*
Geographic Extent:	Information on migratory patterns of salmonids in Muchalat Inlet is weak. Assume that wild fish that receive lice from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems.	*Regional*	Information on migratory patterns of salmonids in Muchalat Inlet is weak. Assume that wild fish that receive lice from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems..	*No detectable extent*
Duration/Frequency:	Worst case conditions are not likely to occur; if they occur, likely it would be only one occasion for the life of the project. Biological effect could persist for one or more generations. Apart from assumed worst case conditions, potential chronic sea lice loading from reservoir effect would potentially affect migrating fish annually, but on each occasion is not expected to cause a measurable reduction in fish population size	*Duration: Long-term.* *Frequency: Rare*	Lice as a source of exposure potentially will exist year round, but biological exposure of more vulnerable smaller-size wild fish will be for shorter periods during migration each year, but on each occasion is not expected to cause a measurable reduction in fish population size. Assume infrequent mortality of small numbers of wild fish, insufficient to cause a measurable reduction in fish population.	*Duration: Short-term.* *Frequency: Rare*
Reversibility:	It is not likely that all members of a wild population	*Full recovery*	Effects on population sizes are not expected to be	*Full recovery*

	would be affected and that numbers of fish succumbing to sea-lice infections would cause extinction of a population. Recovery of a heavily-infected population could take several generations (Duration)		measurable (magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration).	
Fragility:	Some populations of salmonids in the Principe Channel – Ogden Channel area might have been reduced by other factors.	*Moderate*	Some populations of salmonids in the Principe Channel – Ogden Channel area have been reduced by other factors.	*Moderate*

Sea lice that originate in salmon farms proposed for Petrel Point are *not likely* to have significant cumulative adverse effects on migratory salmonids in the Inlet. Uncertainty exists with respect to the migratory patterns of salmonids along the inlet. Precautionary assessments have been made for farm sites that have been proposed in this area.

3. In the Anger Anchorage assessment table, the ***Intermediate*** determination ***was not based on a prediction that significant effects will occur.*** It was based on a moderate level of uncertainty related to cumulative risks of pathogen-transmission at that time. With the current level of effectiveness of Fish Health Management and density of farm sites in the areas, this determination for **Petrel Point** is ***Low***.

4. Possible additional mitigation/adaptive management

Site cluster: additional sites that may be proposed to the west and north of Petrel Point and Anger Anchorage

- Undertake studies during operation of Petrel Point and Anger Anchorage to confirm that there will be no cumulative effects of farm-origin sea lice on wild fish populations, in or migrating through the Petrel Channel - Principe Channel area, prior to initiation of production at new sites that area.

Area-wide studies to support adaptive management

- Effectiveness of proposed Fish Health Management Plan protocols for preventing/controlling sea lice outbreaks on farms during several farm production cycles (the Fish Health Management Plan will be subject to annual review and revision)
- Migratory patterns of wild juvenile salmonids, particularly in proximity to netcage locations

Cumulative Effects Work Sheet

CEA Issue: IHN
VEC: Wild Fish Populations

1. CONSIDERATIONS

a) Main Concern: Cumulative effects of pathogen transmission from proposed salmon farms to wild salmon and other fish species in or migrating along Petrel and Principe channels

b) Possible cumulative sources: Existing or foreseeable salmon farms

[1 farm has been recently approved; 1 has been applied for and is awaiting approval: each site will be designed for 2400 to 2500 harvest tonnage, or approximately 650,000 to 750,000 smolts; additional sites may be applied for in the Principe Channel to Ogden Channel area.]

c) Assessment Scope:

Geographical Scope: Part of taxonomic range of potentially affected species fish species – fish using or migrating along Petrel and Principe channels

Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals) + population recovery time if effects occur

d) Choice of Analytical Tools:

A. Natural System Limits	
Carrying Capacity	Insufficient information
Tolerance Level	Insufficient information
Assimilative Capacity	Insufficient information
B. Comparison with existing information	
Environmental standards, guidelines and objectives	Not available for IHN on wild fish populations
Regional or area management plans	Not available for IHN, though province has now been divided into Fish Health Zones to enable tracking of fish health at culture facilities Have guidance for managing fish populations

C. Qualitative analyses	
Based upon: ***5. available information,*** ***6. scientific understanding and*** ***7. professional judgement***	**1. Substantial information available but not conclusive, cause-effect relations still debated** **2. Scientific understanding of cause-effect relations is improving, though methods to prevent/manage problems on farm sites appears to be relatively strong** **3. Professional judgement – management measures exist such that IHN can be monitored and treated at individual farms sufficiently to minimize reservoir size for possible transfer to wild fish. Fallowing and farm-spacing can reduce residual IHN to low or negligible levels fish post-harvest**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Yes***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Avoidance – siting criterion: At least 1 km from the mouth of a salmonid-bearing stream determined as significant in consultation with DFO and the province.

Fish Health Management Plans (based on government template and approval) at individual sites

Area-wide Mitigation

At present only one company (Pan Fish) appears likely to be in operation in the Principe Channel – Ogden Channel area (based on existing and foreseeable site applications) – SB indicates that area health management by one company is effective for

controlling disease. Response for a disease such as IHN will include use of implementation of treatment/management of all farms within a security ring of 3 km or 1 tidal flush (whichever is greater) in event of outbreak.

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Intermediate***
Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Intermediate***
(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Current CEA (Petrel Point):
VEC Concern	**Petrel + Anger**
Disease	***Low***

NOTES

1. ***Risks –*** the risk of pathogen numbers reaching sufficient numbers at fish farm sites so that high rates of pathogen transmission to wild fish occurs, causing serious loss of wild fish, increases as the number of salmon farm sites in production increases.

   Probability – For a measurable reduction in the size of a wild fish population to occur, pathogen numbers would have to be very large at one or more farms, and likely in close proximity, to ensure large numbers of pathogens are available for transfer to wild fish at the same time that large numbers of vulnerable fish pass close enough to the pathogen-reservoir to be exposed. Probability of this occurring at individual sites is very ***low*** based on Fish Health Management Plan monitoring

and treatment protocols that will be used. Probability of this occurring cumulatively within the area where all sites will be in operation is ***low***.

2. Worst Case/ Best Case

Worst Case: Failure of mitigation/disease treatment/management at multiple sites; intense IHN outbreaks on farms cause large reduction of wild fish population. Probability of a failure of management measures at multiple sites is assumed to be moderate; the probability of this occurring and together with a resultant large reduction of wild fish populations is low.

Best Case: IHN outbreaks cause no measurable change in wild fish populations

Expected conditions:

The expected scenario is that fish health measures will be effective in preventing or managing IHN outbreaks at all farm locations. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of disease management at multiple sites (Probability of Occurrence: Moderate)**		**Disease Management as Planned**	
		Rating		***Rating***
Magnitude:	Potential to cause measurable reduction in population of susceptible species. Pacific salmonids appear to have relatively low susceptibility; IHN occurs naturally in wild populations.	*Moderate*	Measurable reduction in population of susceptible species (e.g., Pacific salmonids appear to have relatively low susceptibility; IHN occurs naturally in wild populations) is not expected.	*Low*
Geographic Extent:	Information on migratory patterns of salmonids in the Principe Channel – Ogden Channel area is weak. Assume that wild fish that receive IHN pathogens from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems.	*Regional*	Information on migratory patterns of salmonids in Principe Channel – Ogden Channel is weak. Assume that wild fish that receive IHN pathogens from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems..	*No detectable extent*
Duration/Frequency:	Worst case conditions may occur on at least one occasion for the life of the project (farmed Atlantic salmon will be susceptible to infection from wild fish). Biological effect on wild fish if a farm-outbreak occurs is expected to be relatively low (magnitude) based on natural occurrence of IHN; if outbreak occurs, detection of reduced population	*Duration: Long-term.* *Frequency: Rare*	IHN outbreak on farms would have to occur at same time that vulnerable wild fish are in proximity of cages. Magnitude of effect is expected to be low, without a measurable reduction in size of affected population.	*Duration: Short-term.* *Frequency: Rare*

	size could persist for one or more generations.			
Reversibility:	It is not likely that all members of a wild population would be affected and that numbers of fish succumbing to IHN infections would cause extinction of a population. Recovery could take several generations (Duration)	*Full recovery*	Effects on population sizes are not expected to be measurable (magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration).	*Full recovery*
Fragility:	Some populations of salmonids in Principe Channel – ogden Channel area might have been reduced by other factors	*Moderate*	Some populations of salmonids in the Principe Channel – ogden Channel area might have been reduced by other factors.	*Moderate*

IHN pathogens that originate in salmon farms proposed for Petrel Point are *not likely* to have significant cumulative adverse effects on migratory salmonids in the Inlet. Uncertainty exists with respect to the migratory patterns of salmonids along the channels. Precautionary assessments have been made for farm sites that have been proposed.

3. In the Anger Anchorage assessment table, the ***Intermediate*** determination ***was not based on a prediction that significant effects will occur.*** It was based on a moderate level of uncertainty related to cumulative risks of pathogen-transmission at that time. With the current level of effectiveness of Fish Health Management and density of farm sites in the areas, this determination for **Petrel Point** is ***Low***.

4. Possible additional mitigation / adaptive management

Site cluster: additional sites that may be proposed to the west and north of Petrel Point and Anger Anchorage

- Undertake studies during operation of Petrel Point and Anger Anchorage to confirm that there will be no cumulative effects of farm-origin sea lice on wild fish populations, in or migrating through the Petrel Channel - Principe Channel area, prior to initiation of production at new sites that area.

Area-wide studies to support adaptive management

- Effectiveness of proposed Fish Health Management Plan protocols for preventing/controlling sea lice outbreaks on farms during several farm production cycles (the Fish Health Management Plan will be subject to annual review and revision)
- Migratory patterns of wild juvenile salmonids, particularly in proximity to netcage locations

B. Benthic Habitat

Cumulative Effects Work Sheet

CEA Issue: <u>Benthic Habitat Loss – Sediment Deposition</u>
VEC: <u>Wild Fish Populations</u>

1. CONSIDERATIONS

a) Main Concern: Effects of sediment deposition in benthic areas of multiple fish farms, potentially reducing production of fish in the area of southern Petrel Channel and Markale Passage

b) Possible cumulative sources: Benthic effects from existing or foreseeable salmon farms (Anger Anchorage and Petrel Point) and other human activity

[1 farm has been recently approved; 1 has been applied for and is awaiting approval: each site will be designed for 2400 to 2500 harvest tonnage, or approximately 650,000 to 750,000 smolts; additional sites may be applied for in the Principe Channel to Ogden Channel area.]

c) Assessment Scope:

Geographical Scope: Part of taxonomic range of potentially affected fish species – fish using or migrating along southern Petrel Channel and Anger Anchorage
Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals) + population recovery time if effects occur

d) Choice of Analytical Tools:

A. Natural System Limits	
Carrying Capacity	Information is available for benthos
Tolerance Level	Information is available for benthos
Assimilative Capacity	Information is available for benthos

B. Comparison with existing information	
Environmental standards, guidelines and objectives	Available for benthic quality but not for production of wild fish populations
Regional or area management plans	Available for some taxonomic groups. Have guidance for managing fish populations
C. Qualitative analyses	
Based upon: ***1. available information*** ***2. scientific understanding and*** ***3. professional judgement***	**1. Substantial information on salmon farm effects on benthic quality available from North America and Europe; information related to effects of habitat change on fish production varies among taxonomic groups.** **2. Scientific understanding of cause-effect relations related to benthic deposition is good. Scientific understanding of habitat production in marine areas varies among taxa.** **3. Professional judgement –measures exist to predict, mitigate and compensate for effects on benthic areas affected by deposition from fish farms. Fallowing and farm-spacing can reduce spatial effects to low or negligible levels post-harvest.**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Yes***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Siting criterion – 3 km distance between fish farms owned by different companies or 1km between netcages of the same company

Best Management Plans (based on government template and approval) at individual sites

Site Fallowing

DFO habitat compensation

Area-wide Mitigation

Site fallowing and production plans will be based on results of benthic monitoring, following provincial monitoring requirements.

DFO-industry habitat banking/compensation program (in development) will enable area-approach to habitat compensation

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Low***

Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Low***

(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Previous CEA:	**Current CEA (Petrel Point):**
VEC Concern	**Anger+Petrel**	**Petrel + Anger**
Benthic habitat	***Low***	*Low*

NOTES

1. ***Risks –*** Risk that the amount of benthic habitat affected will cumulatively increase as the number of salmon farms and other human activity potentially affecting benthic habitat increases. Risk that eventual amount of lost habitat will cause a measurable reduction in sizes of wild fish populations.

   Probability – With proposed compensation/management measures, probability of measurable reduction in wild fish population sizes appear to be ***low*** for site-specific effects and ***low*** for cumulative effects in the Petrel Channel to Markale Passage area.

2. ***Worst Case/ Best Case***

   Worst Case: Failure to adequately predict areas of affected deposition at multiple sites and/or failure of compensation results in reduction in population size of wild fish. Probability of measurable reduction in size of local fish populations is low.

   Best Case: Benthic effects cause no measurable change in wild fish populations, even without mitigation/compensation measures.

   Expected conditions:
   The expected scenario is that predictions of benthic solids-depositions and fish-habitat compensation measures will be effective in maintaining low effects on fish productivity at all farm locations. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of benthic habitat predictions/compensation at multiple sites (Probability of Occurrence: Low)**		**Benthic Habitat predictions/compensation as Planned (Probability of Occurrence: High)**	
		Rating		***Rating***
Magnitude:	Reduction in population size of susceptible species utilizing benthic habitat, sufficient to have detectable/measurable loss in fishery catch and/or species-of-concern population size.	*Moderate*	Measurable reduction in population of susceptible species is not expected.	*Low*
Geographic Extent:	Information on migratory patterns of fish species in Petrel Channel – Markale Passage is weak.	*Regional*	Information on migratory patterns of fish in Petrel Channel – Markale Passage is weak.	*Site*

	Assume that wild fish that use benthic habitat in farm depositional areas are from populations located along the inlet close to shore.		Assume that wild fish that use benthic habitat in farm depositional areas are from populations located along the inlet close to shore.	
Duration/Frequency:	Worst case conditions are not likely to occur for the life of the project because predictions/compensation will be subject to monitoring and adaptive management. Biological effect could persist for one or more generations, even after corrective action taken. Sites will be subject to fallowing between production cycles.	*Duration: Long-term.* *Frequency: Sporadic.*	Conditions are not likely to occur for the life of the project because predictions/compensation will be subject to monitoring and adaptive management. Sites will be subject to fallowing between production cycles.	*Duration: Short-term.* *Frequency: Sporadic.*
Reversibility:	Effects on population sizes are not expected to be large (Magnitude); and full recovery of a population is expected, though possibly longer than one generation (Duration).	*Full recovery*	Effects on population sizes are not expected to be measurable (Magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration).	*Full recovery*
Fragility:	Some populations of fish in the Petrel Channel – Markale Passage area may have been reduced by other factors, such as effects of the Gold River pulp mill.	*Moderate*	Some populations of fish in the Petrel Channel – Markale Passage area may have been reduced by other factors, such as effects of the Gold River pulp mill.	*Moderate*

Benthic solids-depositions from salmon farms proposed for Petrel Channel – Markale Passage are *not likely* to have significant cumulative adverse effects on fish populations utilizing benthic habitat in the inlet.

Cumulative Effects Work Sheet

CEA Issue: Benthic Habitat - Contaminants
VEC: Wild Fish Populations

2. CONSIDERATIONS

a) Main Concern: Cumulative use of metals (copper and zinc) and chemo-therapeutants causes reduced production of fish or increased risks for human consumption of fish in the area of southern Petrel Channel and Markale Passage

b) Possible cumulative sources: Potential contaminants from existing or foreseeable salmon farms and other human activity

[1 farm has been recently approved; 1 has been applied for and is awaiting approval: each site will be designed for 2400 to 2500 harvest tonnage, or approximately 650,000 to 750,000 smolts; additional sites may be applied for in the Principe Channel to Ogden Channel area.]

c) Assessment Scope:

Geographical Scope: Part of taxonomic range of potentially affected fish species – fish using or migrating along southern Petrel Channel and Anger Anchorage

Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals) + population recovery time if effects occur

d) Choice of Analytical Tools:

A. Natural System Limits	
Carrying Capacity	Information is available for some compounds
Tolerance Level	Information is available for some compounds
Assimilative Capacity	Information is available for some compounds
B. Comparison with existing information	
Environmental standards,	Available for benthic quality – some compounds

guidelines and objectives	
Regional or area management plans	Available for some taxonomic groups. Have guidance for managing fish populations
C. Qualitative analyses	
Based upon: ***3. available information*** ***4. scientific understanding and*** ***3. professional judgement***	**1. Substantial information on salmon farm effects on benthic quality available from North America and Europe; information related to effects of habitat change on fish production varies among taxonomic groups.** **2. Scientific understanding of cause-effect relations related to some chemicals is good. Scientific understanding of chemical-effects on in marine areas varies among taxa.** **3. Professional judgement –measures exist to predict, mitigate and compensate for effects on benthic areas affected by deposition from fish farms. Fallowing and farm-spacing can reduce spatial effects to low or negligible levels post-harvest.**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Yes***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Best Management Plans (based on government template and approval) at individual sites

Site Fallowing

DFO habitat compensation

Area-wide Mitigation
Site fallowing and production plans will be based on results of benthic monitoring, following provincial monitoring requirements.
DFO-industry habitat banking/compensation program (in development) will enable area-approach to habitat compensation

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Low***
Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Low***
(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Previous CEA:	**Current CEA (Petrel Point):**
VEC Concern	**Anger+Petrel**	**Petrel + Anger**

Benthic habitat	***Low***	***Low***

NOTES

2. ***Risks –*** Risk that amounts of chemical compounds in benthic habitat and non-target organisms will cumulatively increase as the number of salmon farms and other human activity increases. Risk that eventual amount of affected habitat or non-target organisms will cause a measurable reduction in sizes of wild fish populations or risks to human health.

Probability – With proposed compensation/management measures, probability of measurable reduction in wild fish population sizes or concentrations in non-target organisms causing risk to human health appear to be ***low*** for site-specific effects and ***low*** for cumulative effects in southern Petrel Channel and Markale Passage.

2. Worst Case/ Best Case

Worst Case: Failure to adequately predict concentrations of compounds in habitat or non-target organisms at multiple sites an/or failure of compensation results in reduction in population size of wild fish. Probability of measurable reduction in size of local fish populations or high chemical-concentrations in non-target organisms is low.

Best Case: Benthic effects cause no measurable change in wild fish populations or chemical-concentrations in non-target organisms, even without mitigation/compensation measures.

Expected conditions:

The expected scenario is that use of chemicals and therapeutants will be sufficiently low to prevent harmful concentrations occurring in benthic sediments or non-target organisms, such that neither fish productivity or human health will be affected by cumulative use. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of benthic habitat predictions/compensation at multiple sites (Probability of Occurrence: Low)**		**Benthic Habitat predictions/compensation as Planned**	
		Rating		***Rating***
Magnitude:	Reduction in population size of susceptible species utilizing benthic habitat, likely not sufficient to have detectable/measurable loss in fishery catch and/or species-of-concern population size; detectable concentrations in non-target organisms used for human consumption, likely insufficient to create risks to human health.	*Moderate*	Neither measurable reduction in population of susceptible species nor health risks associated with high concentrations in organisms used for human consumption are expected.	*Low*
Geographic Extent:	Information on migratory patterns of fish species in southern Petrel Channel and Markale Passage is weak. Assume that wild fish that use benthic habitat in farm depositional areas are from populations located along the inlet close to shore.	*Site*	Information on migratory patterns of fish in southern Petrel Channel and Markale Passage is weak. Assume that wild fish that use benthic habitat in farm depositional areas are from populations located along the inlet close to shore.	*Site*

Duration/Frequency:	Worst case conditions are not likely to occur for the life of the project because predictions/compensation will be subject to monitoring and adaptive management. Biological effects are not expected but would likely persist for less than one generation. Sites will be subject to fallowing between production cycles.	*Duration: Short-term.* *Frequency: Sporadic.*	Conditions are not likely to occur for the life of the project because predictions/compensation will be subject to monitoring and adaptive management. Sites will be subject to fallowing between production cycles.	*Duration: Short-term.* *Frequency: Rare.*
Reversibility:	Effects on population sizes are not expected to be large (Magnitude); and full recovery of a population is expected, though possibly longer than one generation (Duration).	*Full recovery*	Effects on population sizes are not expected to be measurable (Magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration).	*Full recovery*
Fragility:	Some populations of fish in the Muchalat Inlet area may have been reduced by other factors, such as effects of the Gold River pulp mill.	*Moderate*	Some populations of fish in the Muchalat Inlet area may have been reduced by other factors, such as effects of the Gold River pulp mill.	*Moderate*

Chemicals and therapeutants from salmon farms proposed for southern Petrel Channel and Markale Passage are *not likely* to have significant cumulative adverse effects on fish populations utilizing benthic habitat in the inlet or lead to concentrations in non-target organisms that will pose risks to human health.

C. Feral Atlantics

Cumulative Effects Work Sheet

CEA Issue: Feral Atlantic Salmon
VEC: Wild Salmonid Populations

1. CONSIDERATIONS

a) Main Concern: Cumulative escapes of Atlantic salmon cause a reduction in Pacific salmon populations in one or more streams

b) Possible cumulative sources: Existing or foreseeable salmon farms
[1 farm has been recently approved; 1 has been applied for and is awaiting approval: each site will be designed for 2400 to 2500 harvest tonnage, or approximately 650,000 to 750,000 smolts; additional sites may be applied for in the Principe Channel to Ogden Channel area.]

c) Assessment Scope:

Geographical Scope: Part of taxonomic range of potentially affected species – fish using North Coast streams, including Skeena River
Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals) + population recovery time if effects occur

d) Choice of Analytical Tools:

A.Natural System Limits	
Carrying Capacity	Insufficient information
Tolerance Level	Insufficient information
Assimilative Capacity	Insufficient information
B. Comparison with existing information	
Environmental standards, guidelines and objectives	Not available numbers of escaped Atlantic salmon mixed with wild fish populations
Regional or area management plans	Not available

C. Qualitative analyses	
Based upon: ***1. available information,*** ***2. scientific understanding and*** ***3. professional judgement***	**1. Substantial information available on attempted introduction of Atlantic salmon worldwide; some information on interactions between Atlantic salmon and Pacific salmon.** **2. Scientific understanding of Atlantic salmon – Pacific salmon interaction is sufficient to draw conclusions about potential effects.** **3. Professional judgement – supported by information on attempted introductions and Atlantic – Pacific introductions, and management measures that exist to minimize possible escapes of Atlantic salmon and to monitor in streams.**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Yes***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Best Management Practice Plans (based on government template and approval) at individual sites for fish escape prevention and response

Area-wide Mitigation

Atlantic Salmon Watch monitoring program.

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Low***
Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Low***
(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Previous CEA:	**Current CEA (Petrel Point):**
VEC Concern	**Anger+Petrel**	**Petrel + Anger**
Feral Atlantic Salmon	*Low*	*Low*

NOTES

1. ***Risks –*** Risk that cumulative numbers of escaping Atlantic salmon from all farm sites will be so great that numbers entering one or more streams are sufficiently large to reduce population sizes of wild fish as a result of ecologic, genetic, or disease factors.

   Probability – Available information strongly suggests that the probability of escaped Atlantic salmon from the farms proposed salmon farms in the North Coast area causing reduction in population sizes of native fish is ***low***. Periodic escapes of small numbers of Atlantic salmon are likely even with proposed prevention measures; probability of these escapes leading to measurable reduction in numbers of native species is ***low***.

2. Worst Case/ Best Case

Worst Case: Large-scale and repeated escapes of Atlantic salmon from the proposed number of fish farm sites lead to spawning populations of sufficient size to cause reduction in size of wild fish populations. Probability of this occurring is low.

Best Case: small numbers of Atlantic salmon periodically escape, causing no measurable change in wild fish populations, even without mitigation/compensation measures.

Expected conditions:

The expected scenario is that Atlantic salmon escape from the salmon farms will be minimized with the proposed escape prevention and response plans; small numbers of fish will undoubtedly escape and those that do will not have a detectable effects on ecologic, genetic and disease status of wild fish species. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of escape prevention and response measures at multiple sites (Probability of Occurrence: Low)**		**Atlantic salmon escape prevention and response as planned**	
		Rating		***Rating***
Magnitude:	Escaped Atlantic salmon may enter and utilize streams; a measurable, localized presence may be detected but is not expected to cause a measurable reduction in population size of wild salmonid species utilizing streams into which they migrate; measurable loss in fishery catch and/or species-of-concern population sizes are not expected.	*Moderate*	Escaped Atlantic salmon are not expected to cause a reduction in population size of wild salmonid species utilizing streams into which they migrate.	*Low*
Geographic Extent:	Locations and numbers of streams into which Atlantic salmon could migrate are not known, though likely they would seek those with habitat features most similar to those in their natural range, roughly comparable to Chinook, coho and steelhead.	*Local*	Locations and numbers of streams into which Atlantic salmon could migrate are not known, though likely they would seek those with habitat features most similar to those in their natural range, roughly comparable to Chinook, coho and steelhead. A measurable geographical-area of disruption is not expected.	*No detectable extent*
Duration/Frequency:	If they occur, effects on population sizes are not expected to be large (Magnitude); large-scale escapes would be episodic and not continuous.	*Duration: Short-term*	Effects on population sizes are not expected to be large (Magnitude); large-scale escapes would be episodic and not continuous. Small-scale biological effects are expected	*Duration: Short-term.*

	Small-scale biological effects would not likely persist for more than one generation.	*Frequency: Sporadic.*	to rarely occur.	*Frequency: Rare*
Reversibility:	Effects on population sizes are not expected to be large (Magnitude); and full recovery of a population is expected, though possibly longer than one generation (Duration).	*Full recovery*	Effects on population sizes are not expected to be measurable (Magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration).	*Full recovery*
Fragility:	Some populations of salmonids in North Coast streams may have been reduced by other factors, such as effects of logging.	*Moderate*	Some populations of salmonids in North Coast streams may have been reduced by other factors, such as effects of logging.	*Moderate*

Atlantic salmon that escape from proposed salmon farms along Petrel Channel are *not likely* to have significant cumulative adverse effects on wild salmonid populations in North Coast streams.

D. Marine Mammals

Cumulative Effects Work Sheet

CEA Issue: Marine Mammal Mortality
VEC: Marine Mammal Populations

1. CONSIDERATIONS

a) **Main Concern:** ***Mortality of individual marine mammals in the Principe Channel – Ogden Channel area increases as the number of salmon farms and other human activity increases***

b) **Possible cumulative sources:** ***Existing or foreseeable salmon farms and other human activity***

c) **Assessment Scope:**

Geographical Scope: the general area of Anger Anchorage and Petrel Point
Temporal scope: Life of Operation – tentatively length of lease (20 years; initial 5 year licence of occupation and possible subsequent renewals)

d) Choice of Analytical Tools:

A. Natural System Limits	
Carrying Capacity	Not applicable
Tolerance Level	Not applicable
Assimilative Capacity	Not applicable
B. Comparison with existing information	
Environmental standards, guidelines and objectives	Not available
Regional or area management plans	Not available
C. Qualitative analyses	
Based upon: 1.available information,	**1. Information is available in proponent management plans, based on information in government databases, discussions with local FN and proponent field observations.**

2.scientific understanding and 3.professional judgement	**2. Scientific understanding of interaction between marine mammals and salmon farms is available** **3. Professional judgement – supported by information on the known location or likely presence of items to avoid; measures to prevent damage can be taken.**
Qualitative analysis of: ***Risk and Probability*** ***Worst Case and Best Case Scenarios***	 Yes Yes
D. Consideration of:	
Severity	***Yes***
Geographic extent	***Yes***
Duration and frequency	***Yes***
Reversibility	***Yes***
Fragility of ecological area	***Not applicable***

2. ASSESSMENT

a) Mitigation Measures to be Applied

Site-Specific

Avoidance of areas used extensively by marine mammals.

Use of best management practices to minimize marine mammal interaction.

Area-wide Mitigation

None identified

b) Results of Previous/On-going Assessments

Individual sites

Anger Anchorage ***Low***

Petrel Point ***Low***

Cumulative Effects

Anger Anchorage ***Intermediate***

(assessment considered Petrel Point, though that site had not undergone individual analysis at that time and site approval/rejection status was not known)

c) Current Cumulative Assessment

	Previous CEA:	**Current CEA (Petrel Point):**
VEC Concern	**Anger+Petrel**	**Petrel + Anger**
Marine mammals	***Intermediate***	***Low***

NOTES

1. ***Risks –*** Risk of marine mammal mortality increases as the number of salmon farm sites and other human activities in the area increases, and this detectably affects marine mammal population levels.
   Probability – Probability of mortality reaching levels that will impair marine mammal populations is low, but is uncertain with increased numbers of farms in the area.

2. ***Worst Case/ Best Case***

   Worst Case: *Numbers of pinniped or other marine mammals that die as a result of interaction with salmon farms reaches levels that cause measurable, temporary reduction of populations in the Principe – Ogden area, but does not affect long-term viability. Probability of this occurring is low, but increases as the number of salmon farms, and/or other human activity in the area increases.*

   Best Case: *Small numbers of pinnipeds periodically die at proposed farms but not in numbers to affect health of populations.*

Expected Conditions:
The expected scenario is the salmon farms have avoided important marine mammal locations and small numbers of marine mammals will periodically die as a result of interaction with salmon farms. The significance of potential worst case and expected adverse effects are:

Significance of Potential Adverse Effects on VEC

Criteria	**Failure of mitigation leading to serious reductions in marine mammal population (Probability of Occurrence: Low)**		**Incidental mortalities of marine mammals**	
		Rating		***Rating***
Magnitude:	Numbers of pinniped or other marine mammals that die as a result of interaction with salmon farms reaches levels that cause impairment of populations	*Moderate*	Small numbers of pinnipeds periodically die at proposed farms but not in numbers to affect health of populations.	*Low*
Geographic Extent:	Population effects extend beyond site boundary and are measurable in the general Principe – Ogden area	*Regional*	Population reductions are not measurable within the geographic scope but short-term effect occurs in vicinity of site boundary.	*Local*
Duration/ Frequency:	Population level effects affect one generation or more but occur infrequently	*Duration: Long-term* *Frequency: Rare*	Population-level effects are not expected	*Duration: None.* *Frequency: Not at all*
Reversibility:	Population-level effects are reversible but may take may more than one generation	*Full recovery*	Large-scale population effects are not expected	*Full recovery*

The proposed salmon farms Petrel Point and Anger Anchorage are *not likely* to have significant cumulative adverse effects on marine mammal populations.

3. The intermediate determination for the Anger Anchorage site was based on precautionary valuations which should be confirmed during initial production at the proposed sites. With current predator avoidance measure and predator avoidance plans as well as facility sighting requirements, the CEA for ***Petrel Point*** is ***low***.

4. Possible additional mitigation/ adaptive management
Any lethal control requires a predator control licence from DFO. Conditions of the licence and all related Acts and Regulations must be followed. Further mitigation measures may be required.