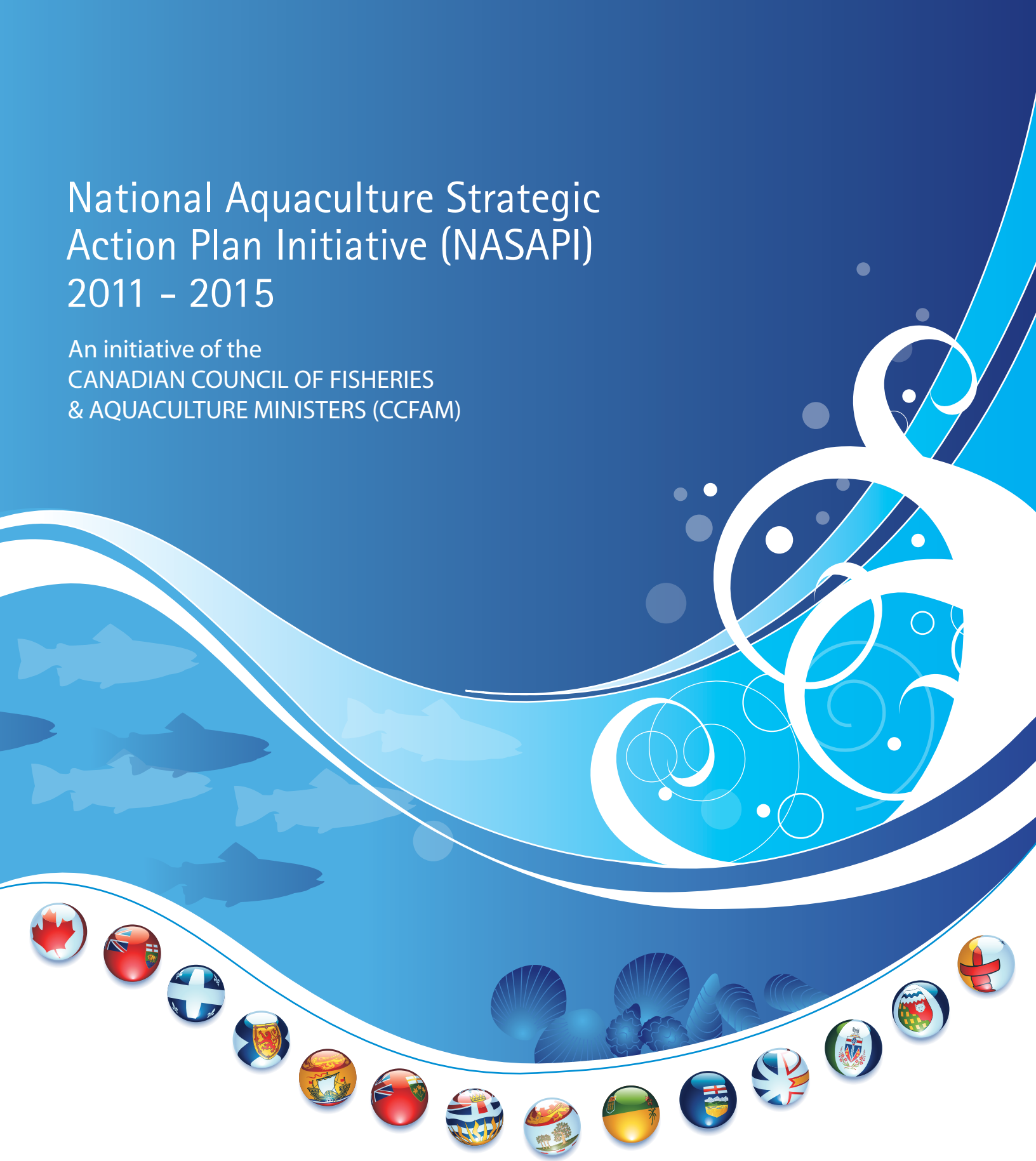
National Aquaculture Strategic Action Plan Initiative (NASAPI) 2011 - 2015

An initiative of the
CANADIAN COUNCIL OF FISHERIES
& AQUACULTURE MINISTERS (CCFAM)



Freshwater Sector Strategic Action Plan

Canada

NATIONAL AQUACULTURE STRATEGIC ACTION PLAN INITIATIVE

FRESHWATER SECTOR STRATEGIC ACTION PLAN

2011–2015

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INTRODUCTION

The National Aquaculture Strategic Action Plan Initiative (NASAPI) is a collaborative exercise led by the Canadian Council of Fisheries and Aquaculture Ministers (CCFAM) to enhance and advance economically, environmentally and socially sustainable aquaculture development in all regions of the country. For additional information regarding the initiative, refer to the overarching NASAPI document (http://www.dfo-mpo.gc.ca/aquaculture/aquaculture-eng.htm). The initiative includes five strategic actions plans that pertain to the five regionally distinct aquaculture sectors in Canada: East Coast marine finfish, East Coast shellfish, national freshwater, West Coast marine finfish and West Coast shellfish. Although the action items outlined herein are specific to the freshwater aquaculture sector, implementation of this action plan should remain consistent with the vision, objectives and guiding principles of the initiative's overarching document.

The strategic action plans outline areas where efforts are required to improve public governance of aquaculture and private operations (although not all of the action items within the plans necessarily apply to all provinces and territories). Effective, well-communicated governance enhances public confidence in government oversight of industry activities, leading to an improved social licence—and in turn, to increased investor confidence in aquaculture, which will stimulate responsible and sustainable growth that creates economic prosperity.

Responsibility for the implementation of the strategic action plans lies principally with the bilateral Federal–Provincial Aquaculture MOU Management Committees. For those actions that are national in scope, the CCFAM Strategic Management Committee will assume a lead role in implementation. The following principles will guide the implementation process:

- Each government partner shall remain accountable to its jurisdiction.
- Using a collaborative decision-making process, the Federal–Provincial/Territorial Bilateral Aquaculture MOU Management Committees will prioritize actions, agree upon time frames and coordinate implementation efforts.
- Implementation will occur in accordance with the resources available within each jurisdiction where agreed upon - i.e., the process is intended to help direct resources toward areas of need and priority within each province/territory.
- Performance measurement will facilitate implementation by helping to keep the plan(s) current and by identifying constraints.

GOVERNANCE

Within the federal government, the Department of Fisheries and Oceans (DFO) is the lead agency for aquaculture development. As such, part of DFO's mandate is to create the conditions necessary to support a vibrant and innovative aquaculture sector. Several other federal departments and agencies are involved in the management of aquaculture in Canada. Most notably, these include the Canadian Food Inspection Agency, Environment Canada, Health Canada and Transport Canada. The provinces and territories also play substantive roles in the development and management of aquaculture.

Environmental Management

In freshwater finfish aquaculture, environmental management consists of two distinct classes of activities, both of which fall largely under provincial jurisdiction: those in land-based systems and those in open water (cage culture). For both classes, the requirement to uphold environmental protection is enforced primarily through provincial/territorial statutes and policies. Environmental protection is also regulated by federal authorities.

The NASAPI presents an opportunity for governments to introduce increased consistency and certainty to these processes by applying harmonized environmental standards, monitoring and reporting. This is expected to improve environmental management within the sector, leading to increased public confidence in both industry operations and government oversight of them.

Action Items—Environmental Management			
Potential Contributors	**Actions**	**Suggested Timeframe[1]**	**Status**
EM–1. Develop a consolidated environmental management framework governing freshwater cage aquaculture			
DFO, Provinces/Territories, Environment Canada, Industry & Other Stakeholders	- Identify and share insight regarding valued ecosystem components, ecosystem use and dynamics, cumulative impacts, etc. - Identify and recognize any established federal and provincial/territorial standards, benchmarks and monitoring protocols for biological performance & environmental management; where these are absent or inconsistent, establish them - Review management processes based on consistent use of appropriate science-based predictive management tools (e.g., FW-DEPOMOD, feed management) - Outline an adaptive management approach to decision-making - Improve participatory decision-making and	Year 3 Year 3 Year 3 Year 3 Year 3	Ongoing Ongoing Ongoing

[1] Within the tables, a time frame has been suggested for completion of all action items within the strategic objective. Inevitably, some action items will be completed on a faster schedule than others, even within the same strategic objective. The final time frames will be reviewed and agreed upon by each of the MOU Management Committees.

	communication mechanisms appropriate to each province/territory and sector - Incorporate service standards into environmental review processes	Year 3	
EM–2. Establish fish habitat protocols for freshwater cage aquaculture consistent with the application of the *Fisheries Act* to be applied equitably across the country			
DFO, Provinces/Territories, Industry	- Review fish habitat protocols in consultation with stakeholders - Identify mechanisms to allow reviewed and approved aquaculture applications to advance without contravening s.35 of the *Fisheries Act* while ensuring that proper measures are in place to conserve and protect fish and fish habitat	Year 1 Year 2	Ongoing
EM–3. Support R&D pertaining to environmental effects and management in all freshwater aquaculture			
DFO/Provinces/Territories, Industry	- Prioritize R&D requirements for improved environmental management in aquaculture	Year 1	
EM–4. Streamline and harmonize the site application and review process for all freshwater aquaculture			
DFO, Provinces/Territories, Industry	- Establish a process to develop a class-type environmental assessment for site applications and environmental reviews with appropriate service standards - Implement the class-type assessment protocol	Year 2 Year 5	

Introductions and Transfers of Aquatic Organisms

In 2003, Canada's provincial, territorial and federal governments jointly introduced *The National Code on Introductions and Transfers of Aquatic Organisms*, which establishes an objective decision-making framework regarding intentional introductions and transfers of live aquatic organisms in Canadian watersheds. The Introductions & Transfers (I&T) Code prescribes a consistent process for assessing and managing the potential risks associated with introducing and transferring aquatic organisms, thereby enabling governments to maximize the benefits associated with such introductions or transfers while avoiding harm to natural aquatic ecosystems, deleterious genetic impacts on feral fish populations, and risks to aquatic animal health from the spread of pathogens and/or parasites. (Note, however, that the I&T assessment process does not include diseases that are regulated under the NAAHP.).

The I&T Code is designed to protect aquatic ecosystems while encouraging the responsible use of aquatic resources for the benefit of Canadians. It is administered by a combination of federal and provincial agencies under the *Fisheries Act*; the Fisheries (General) Regulations authorize DFO to issue I&T licences in all provinces and territories except Québec (in freshwater), Ontario and the Prairies, where provincial regulations apply. The NASAPI presents an opportunity to introduce comprehensive policy and management guidelines to improve consistency and predictability for the aquaculture sector, particularly when routine transfers are involved.

Action Items—Introductions & Transfers			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
IT–1. Review and update the I&T management framework (pending implementation of the NAAHP) as appropriate			
DFO, Provinces/Territories, CFIA, Industry	– Delineate roles and responsibilities, including delegation of administrative authorities where necessary – Establish a national electronic I&T database to facilitate information sharing regarding risk assessments & decisions – Review federal & provincial/territorial I&T information requirements, application procedures and service standards to facilitate consistency – Incorporate routine I&T matters related to fish transfers, habitat, fish health, genetics, etc., as conditions of licence where applicable – Outline a protocol for "medium risk" factors (as defined in the code), taking into account additional factors such as other potential vectors for the transfer of unwanted pathogens or organisms, socio-economic implications, mitigation measures, etc.	Year 1 Year 2 Year 2 Year 2 Year 2	

Navigable Waters Protection Act

Most suspension (floating) aquaculture structures require approval under the *Navigable Water Protection Act* (NWPA) because they have the potential to interfere with navigation. The requirement for an NWPA approval may also trigger a federal environmental assessment under the *Canadian Environmental Assessment Act* if the project is considered likely to cause substantial navigational interference.

The NASAPI has identified an opportunity for Transport Canada to introduce a more standardized approach for site reviews and navigational marking requirements for aquaculture works. Renewed site review and operational guidelines will improve consistency and interpretation amongst regional reviewers and level the playing field for producers. Efforts should also be made to extend the approval period beyond five years, with longer approvals and simplified renewal procedures for compliant operators.

Action Items—Navigable Waters			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
NWPA–1. Review and renew national policies and guidelines for freshwater cage aquaculture site applications under the NWPA			
DFO, Transport Canada, Industry, Provinces/Territories	– Review and update Transport Canada's Application and Site Marking Requirements for Aquaculture Projects in Canada to meet federal, provincial/territorial and industry needs □ specifically address needs regarding freshwater cage aquaculture □ strive toward development of a streamlined review process □ consistently apply navigational site marking requirements across Canada	Year 1	Ongoing
	– Conduct a review of all current Transport Canada aquaculture approvals to determine the level of compliance, and take measures to make all sites compliant	Year 1	Ongoing
	– For sites where aquaculture gear is submerged during winter, develop protocols/technologies to minimize potential navigational risk and impact prior to ice-over and before the gear has been raised after ice-out	Year 2	
	– Identify policy and/or procedural means by which Transport Canada can allow for 'works' to be realigned and/or modified within the boundaries of the leased area to facilitate improved site management without contravention of the NWPA	Year 2	Ongoing
	– Identify means to lengthen the duration of NWPA approvals and to simplify the approvals process for compliant operators	Year 3	

On-Site Inspection

Federal and provincial/territorial legislation and regulations make it necessary for government officers to conduct site inspections from time to time to ensure that legal requirements are being upheld. The NASAPI presents an opportunity to introduce clear and comprehensive guidelines that could consolidate and streamline federal–provincial/territorial inspection requirements. A renewed and consistent inspection and reporting protocol would increase operator compliance and enhance public confidence in governments' abilities to oversee the sector.

Action Items—On-Site Inspections			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
SIE–1. For each class of aquaculture operations, review site inspection requirements and protocols to improve operational efficiency as appropriate for the scope and scale of the sector			
Provinces/Territories, DFO, EC, TC, CFIA	– Outline a uniform site inspection and reporting protocol for all federal/provincial/territorial regulatory requirements	Year 2	
SIE–2. Foster the development of a class of government "aquaculture officers" to conduct inspection activities as appropriate for the scope and scale of the sector			
Provinces/Territories, DFO, EC, TC, CFIA	– Train enforcement officers to work specifically in the aquaculture sector (full- or part-time as required in the area)	Year 3	

Other Regulatory and Governance Issues

Other regulatory and governance issues exist within the aquaculture sector, as outlined in the following chart. Among these, the rights and obligations of aquaculturists under the existing legislative and regulatory regime should be better defined with respect to property rights, public rights of access to waters near aquaculture sites, First Nations and aboriginal rights, etc. The NASAPI presents an opportunity to address and resolve these matters as well.

Action Items—Other Regulatory & Governance Issues			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
ORI–1. Identify the rights, privileges and obligations of aquaculturists operating in public waters			
DFO, Provinces/Territories, Industry	– Conduct a comprehensive review of aquaculture rights, privileges and obligations vis-à-vis fisheries, riparian rights, agriculture, right-to-farm, etc., including: □ control mechanisms □ lease, tenure & licence rights □ property rights (transferability, exclusivity, duration, flexibility, security) □ economic externalities □ remediation of retired and/or fallow sites	Year 1	
ORI–4. Enable multiple species to be listed on a single lease			
Provinces/Territories, DFO, CFIA, EC, Industry	– Review licensing protocols to enable more comprehensive management of leases, including: □ provisions for the culture and harvest of multiple species on a single lease □ the establishment of protocols (SOPs) for each species to be managed	Year 2	

SOCIAL LICENCE AND REPORTING

Public Engagement and Communications

This action plan outlines means to improve private operations and public governance within the sector to advance the environmental and social sustainability, as well as the international competitiveness, of Canadian aquaculture. Assuming these action items are implemented effectively, the industry's social licence should improve - but only if First Nations, aboriginal groups, community interests and the general public are aware of the progress within the sector. Therefore, timely and transparent communications as well as active community engagement are necessary to disseminate information about the economic, social and environmental sustainability of Canadian aquaculture. As part of the NASAPI, DFO, in collaboration with Statistics Canada and the provinces/territories, will compile an annual progress report entitled *Aquaculture Sustainability Reporting Initiative*, which will objectively present the economic, environmental and social sustainability of Canadian aquaculture.

Considering the broad array of user groups and the overlay of public and private interests in the aquatic environment, a broad policy perspective and public support are essential for effective aquaculture development planning. To be effective, planning initiatives must reflect an ecological perspective to spatial boundaries on a watershed basis, taking into consideration the interests of all users. The NASAPI presents an opportunity to develop and implement a cooperative planning approach to identify areas within Canada's coastal zone where aquaculture development can be optimized. Governments can play a variety of catalytic roles, including policy development, providing financial contributions to stimulate progress, and contributing to the science base required for aquatic resource mapping.

Action Items—Public Engagement & Communications			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
SL–1. Establish a transparent information sharing system to facilitate aquaculture reporting			
DFO, Provinces/Territories, Industry	– Define information requirements and establish a standardized system for compiling, reporting and disseminating operational and compliance information that is respectful of the proprietary nature of some industry data – Incorporate information sharing protocols into the federal–provincial/territorial aquaculture MOUs – Where appropriate, and within the scope of the *Privacy Act* and other pertinent regulations, incorporate information sharing requirements as a condition for securing an aquaculture licence □ Identify the key issues related to the scope, timing and cost of the information requirements – Implement the Sustainability Reporting Initiative; i.e. compile information and publish an annual, fact-based, objective report on the social, economic and environmental sustainability of the aquaculture sector that will: □ report transparently on sustainability	Year 1 Year 1 Year 1 Year 1 Year 1	Ongoing

	□ demonstrate and reflect the performance & transparency of government and industry		
SL–2. Research and prepare regional aquatic resource maps to optimize aquaculture development in public waters in a manner that is respectful of the interests of other resource user groups			
DFO, EC, Provinces/Territories, Research Organizations, Industry	– Outline mechanisms to include local interests in informed dialogue, collaboration & communication □ outline procedures for evaluating and communicating objective information about the social, economic and biological costs and benefits of aquaculture development to support informed decision-making – Develop a resource-use geographical information system (mapping) tool to facilitate the identification of suitable areas for aquaculture development in public waters □ incorporate traditional ecological knowledge amongst the parameters used to evaluate areas for aquaculture development □ establish objectives for sector development on a regional (watershed) basis □ utilize existing databases and knowledge repositories, where they exist – Where Integrated Coastal Zone Management initiatives are underway, assure that regional aquaculture interests are appropriately represented	Year 1 Year 2 Year 3 Year 4	Ongoing Ongoing in some areas
SL-3 – Continue to advance industry-led communications strategies to effectively disseminate objective information about aquaculture technologies and practices			
Industry	– Industry associations to develop and/or maintain proactive communications	Year 1	On-going

FIRST NATIONS AND OTHER ABORIGINAL GROUPS

Sustainable aquaculture development has proved beneficial to several First Nations communities. Aquaculture presents an opportunity to supplement limited harvest volumes from the food fishery, address nutrition and human health issues by providing a source of wholesome foods, and improve the social situation. Today, First Nations and aboriginal communities are engaged in aquaculture development throughout Canada. Several First Nations, such as Kitasoo/Xiaxias on the central coast of British Columbia, Aundeck Omni Kaning on Manitoulin Island, Ontario, Mi'kmaq in Nova Scotia, and Miawpukek in Newfoundland, have elected to become directly engaged in aquaculture production to generate employment and prosperity in their communities.

In contrast, some other First Nations have been more reluctant to become involved in aquaculture as they are uncertain about the effects of aquaculture development or do not have the capacity to evaluate and implement opportunities in aquaculture. Still other communities are opposed to aquaculture development within their traditional territories. Nevertheless, First Nations and other aboriginal communities have access to some of the best sites for aquaculture development in Canada, and many have an undeniable need for sustainable economic development opportunities. Furthermore, the current participation of aboriginal communities in

aquaculture is not commensurate with the opportunities available. Aboriginal aquaculture development is often precluded by insufficient awareness of potential opportunities, misinformation regarding the environmental effects of aquaculture, the lack of capacity to develop opportunities, and difficulty with accessing capital.

The NASAPI presents an opportunity to further engage First Nations and aboriginal communities in aquaculture development by making it easier to evaluate opportunities in the sector.

Action Items - Aboriginal Engagement in Aquaculture			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
AEA-1 - Explore mechanisms and strategies for engaging aboriginal peoples in the implementation of NASAPI and generate awareness of opportunities for expanded engagement in aquaculture development amongst First Nations and other aboriginal groups			
DFO First Nations, Other Aboriginal Groups, INAC, Provinces / Territories, Industry	- Encourage and support aboriginal engagement in aquaculture development through: □ technological and managerial expertise □ market information and analyses □ food quality and safety initiatives □ access to capital □ partnership development □ training, mentoring and internship □ aboriginal communication and self-support networks for aquaculture □ incorporation of local historical aboriginal knowledge along with conventional scientific knowledge in decision-making processes □ selection and training of Aboriginal peoples to become DFO Fishery Officers to monitor, report and enforce aquaculture activities within aboriginal territories	Year 4	
AEA–2. Help develop the capacity of First Nations and aboriginal communities to provide meaningful input into the aquaculture site review and assessment process			
DFO, First Nations, Other Aboriginal Groups	- Provide resources to support capacity development within regional/watershed management groups with appropriate training and expertise	Year 3	

PRODUCTIVITY AND COMPETITIVENESS

Fish Health

Fish health and animal welfare are pivotal concerns for the aquaculture industry. Poor health and disease increase the cost of production, decrease revenue (because of higher mortality rates, reduced growth, and inferior product quality), and compromise public confidence. In some regions of Canada, the capacity to deliver effective fish health management programs is compromised by the small size of the aquaculture sector. Consequently, the capacity to diagnose disease events and administer appropriate treatment and/or management measures can be inadequate. In some regions, this has weakened controls governing potential vectors for pathogen transfer and compromised research into diseases of commercial relevance.

Under the leadership of the CFIA, in partnership with DFO and with the support of the CCFAM, the National Aquatic Animal Health Program (NAAHP) has been launched to better manage serious infectious diseases among aquatic animals in order to protect Canadian aquatic animal resources and to facilitate trade of aquatic animals along with their products and by-products, both nationally and internationally. Amendments to the Health of Animals Regulations and the Reportable Diseases Regulations, and to proposed and existing regulations under the *Fisheries Act,* are intended to streamline the regulatory management of fish diseases. The NAAHP has the mandate to prevent the introduction and spread of serious pathogens associated with live animals, products, by-products and other elements through (i) mandatory notification of disease; (ii) emergency disease response; (iii) import controls; (iv) zonation; and (v) national movement permits. The NAAHP also facilitates trade internationally through an export certification program for aquatic animal health, and will do so nationally through a voluntary Facility Recognition Program. Support activities for the NAAHP include surveillance, risk assessment, diagnostic laboratory services and regulatory research.

Vaccination against infectious diseases plays a key role in assuring the sustainability of the aquaculture industry. Vaccines help to reduce the use of antibiotics, and may indirectly help reduce the incidence of disease transmission between wild and farmed fish. Continued efforts are required to improve the quality of vaccines, and of vaccine administration methods, in order to increase the effectiveness of vaccination and facilitate the low-cost mass vaccination of farmed fish.

Clearly, fish health protection and management is a complex undertaking. The NASAPI presents an opportunity for industry and governments to cooperate more effectively to implement proposed changes to the federal and provincial fish health management regimens.

Action Items—Fish Health			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
FH–1. Evaluate the scope of health services available to industry in each province/territory, including the costs associated with these services			
Provinces/Territories, CFIA, DFO	– Within each province/territory, compile an inventory of fish health services available to the sector, the time required to effect diagnosis and treatment, the implied costs, and the extent of substantive limitations. Identify opportunities to improve fish health management □ as part of this review, agencies involved in fish health management will evaluate their capacity to deliver their mandated roles and responsibilities	Year 2	
FH–2. Prepare a regional or provincial/territorial fish health management strategy to coordinate fish health management procedures throughout the sector and provide a living compendium of the principal fish health issues in the sector			
DFO, Provinces/Territories, CFIA, HC, Industry	– Publish guidelines for aquaculture drug and pesticide submission requirements – Prepare a discussion document on bacterial kidney disease (BKD) consistent with the objectives of the National Fish Health Working Group – Prepare biosecurity and fish health management plans for all industry sub-sectors (where they do not presently exist) in a manner consistent with and complementary to NAAHP – Review therapeutant residue levels and withdrawal times for other production species (e.g., sturgeon, walleye) – Develop a national fish health database in coordination with similar existing provincial/territorial plans	Year 1 Year 1 Year 3 Year 3 Year 4	
FH–3. Propose regulations under the *Fisheries Act* to enable the administration of drugs and pest control products in aquaculture for fish pathogen and pest treatment within the conservation & protection mandate of the Act			
DFO, EC, PMRA, VDD, CFIA	– Outline a regulatory process by which drugs and pest control products can be used for fish health management without contravening s. 32 or s.36 of the *Fisheries Act* while ensuring that proper measures are in place to conserve and protect fish and fish habitat	Year 1	Ongoing
FH–4. Outline a minor-use program for aquaculture to enable access to therapeutic agents and pesticides approved in other jurisdictions or for other animal purposes			
HC, VDD, PMRA, CFIA, DFO, Provinces/Territories, Industry	– Review international examples of minor use programs for small livestock sectors and develop an appropriate program for the Canadian aquaculture sector	Year 2	

FH–5. Continue to develop and implement aquatic animal health measures through the NAAHP			
CFIA, DFO, Provinces/ Territories, Industry	– Build relations with aquaculture clients, processors and other stakeholder representatives to ensure existing and new information on the NAAHP is distributed effectively □ develop a mechanism for clients to request that information sessions be held to ensure clear understanding of the program and its processes	Year 1	Ongoing
	– Implement mandatory reporting	Year 1	Ongoing
	– Discuss and develop aquatic animal health emergency response plans, including MOUs or other agreements, with provinces/territories and other affected partners and stakeholders	Year 1	
	– Implement import controls	Year 2	
	– Develop and implement zonation and movement permitting based on the health status of Eradication Areas or parts thereof.	Year 2	

Aquatic Invasive Species

Aquatic invasive species are defined as "fish, animal, and plant species that have been introduced into a new aquatic ecosystem and are having harmful consequences for the natural resources in the native aquatic ecosystem and/or the human use of the resource"[2] and which have not become naturalized. Identified vectors for transferring invasive species in aquatic environments include attachment to ship/boat hulls, transfer through ballast water, the use of live bait, aquarium/water garden trade, live food fish, and the movement of fisheries and aquaculture gear and products.[3]

Once an invasive species has become established in an area, it becomes essential to develop innovative technologies and practices to effectively manage it. The NASAPI presents an opportunity to enhance measures to manage aquatic invasive species, which continue to be a nuisance to aquaculture operations and impose additional operating costs.

Action Items—Aquatic Invasive Species			
Potential Contributors	**Actions**	**Target Complete**	**Status**
AIS–1. Outline a regulation under the *Fisheries Act* to enable the administration of products and procedures for the prevention and management of aquatic invasive species in aquaculture			
DFO, HC, EC, CFIA, Provinces/Territories, Industry	– Outline a regulatory process by which pesticides, drugs, chemicals, anaesthetics and disinfectants can be used to manage nuisance and invasive species without contravening s. 32 or s.36 of the *Fisheries Act*; at the same time, ensure proper measures are in place to conserve and protect fish	Year 3	

[2] Canadian Council of Fisheries and Aquaculture Ministers (CCFAM) Aquatic Invasive Species Task Group (2004). *A Canadian Action Plan to Address the Threat of Aquatic Invasive Species, 26 p.*

[3] Ramsay, A., J. Davidson, T. Landry and G. Arsenault (2008). *Process of invasiveness among exotic tunicates in Prince Edward Island, Canada.* J. Biological Invasions 10:1311–1316.

	and fish habitat		
AIS–2. Enhance research, communications and biosecurity related to aquatic invasive species			
Provinces/Territories, DFO, EC, Industry, Universities, Research Organizations	– Establish a freshwater advisory group to identify research priorities and develop comprehensive protocols for the proactive management of aquatic invasive species – Foster education amongst commercial and recreational users of the aquatic resource base regarding means to avoid the inadvertent transfer of invasive species – Invest in research to better understand and control vectors for transfer of invasive species	Year 1 Year 1 Year 3	Ongoing
AIS–3. Adopt an approach for management of aquatic invasive species that have not become naturalized			
Provinces/Territories, DFO, EC, Industry, Universities	– Promote investment in pest management technologies and practices – Outline protocols for effective pest management in freshwater aquaculture operations	Year 1 Year 3	Ongoing Ongoing

Emerging Technologies

Measures to improve sustainability and prosperity in aquaculture are driven largely by the application of innovative technologies. Looking toward the future development and expansion of aquaculture, there are several areas that warrant additional investment in innovation. The NASAPI presents an opportunity to address the following needs within the freshwater aquaculture sector.

Action Items—Emerging Technologies			
Potential Contributors	**Targeted Outcomes**	**Suggested Timeframe**	**Status**
ET–1a. Improve the quality and traits of broodstocks for rainbow trout aquaculture			
Industry, Research organizations, DFO, Provinces/Territories	– Develop and implement a domestic rainbow trout broodstock program for selection of genetic traits identified by producers that will enhance productivity and sustainability in the sector	Year 3	Ongoing
ET-2 - Quantify the environmental footprint, (e.g. carbon footprint, water quality impacts, sediments, chemicals, antibiotics, pesticides, nutrient loading, escapes, disease, etc.) of aquaculture subsectors and identify areas where investment into green technologies is most pertinent			
DFO, Provinces/Territories, Industry, Universities, Research Organizations, EC	– Review opportunities to adopt green technologies to improve waste management, energy use, water consumption, pest control, recycling in aquaculture – Outline a comprehensive approach / methodology that would encompass all aspects of aquaculture environmental impacts for closed containment, RAS, open net cages, other technologies, etc.	Year 1 Year 2	Ongoing

ET–3. Invest in research and development to advance commercial closed-containment aquaculture (CCA) systems and recirculating aquaculture systems (RAS)			
DFO, Provinces/Territories, Industry, NRC, Universities, Research Organizations	– Research available technologies for closed-containment[4] aquaculture and identify opportunities for commercial-scale evaluation – Identify principal areas of risk associated with RAS[5] and appropriate mitigation strategies, including environmental and business risk management – Promote benchmarking associated with land-based aquaculture systems	Year 1 Year 1 Year 3	Ongoing
ET–4. Invest in research and development to advance cage aquaculture in high-energy/off-shore areas			
DFO, Provinces/Territories, Industry, NRC, Universities, Research Organizations	– Support development of new technologies and equipment for cage aquaculture in high-energy/off-shore areas □ identify opportunities for commercial-scale evaluation □ promote domestic use and export opportunities – Establish a pilot program to review of all aspects of off-shore aquaculture development, including site access, policy and regulatory requirements, technology transfer, proof-of-concept/validation, etc.	Year 3	Ongoing

Aquatic Feeds

A nutritionally complete and balanced diet that meets the needs of fish for growth and health is essential to produce a wholesome, quality product. Moreover, feed is the ultimate source of faeces and other metabolic waste by-products in fish culture operations. Thus, feed and feeding strategy have a determining influence on the environmental effects of an aquaculture operation. Additionally, since feed typically accounts for 40 to 60 per cent of the cost of growing fish, feeding strategy is also a significant factor in the financial viability of an aquaculture venture.

Being piscivorous species, salmon and trout require fish meals and oils in their diets for optimal performance. The aquatic feed sector is working to develop more efficient and effective diets using a larger component of agriculture-based inputs as part of a continuous improvement initiative to reduce the overall cost of feeds and to mitigate public concerns regarding 'feeding fish to fish.' Similarly, the industry is also developing diets tailored specifically for recirculation and cage-culture operations. The federal *Feeds Act* mandates specified ranges for several nutrients used in aquatic diets. Diets having nutrient formulations outside of these ranges face a cumbersome registration process, which is not conducive to the development of improved diets for current production species or for development of diets for emerging species. In some

[4] Closed containment is a term used to describe a range of technologies that attempt to restrict and control interactions between farmed fish and the external aquatic environment, with the goal of minimizing impacts and creating greater control over aquaculture production factors.

[5] Recirculating aquaculture systems utilize intensive filtration processes to enable more than 90 per cent of total process water to be continually reused within the system.

cases, the minimum nutrient level (e.g., phosphorus) is higher than the current minimum nutrient requirements of the species, which can make the diets less environmentally friendly.

The NASAPI presents an opportunity to advance technologies, management strategies and regulations that could improve the sustainability of aquaculture operations through better feeds and feeding practices.

Action Items—Aquatic Feeds			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
AF–1. Support R&D to improve the quality and availability of aquafeeds in Canada			
Industry, DFO, Universities, Research Organizations	- Continue to evaluate the availability of alternative feed ingredients sourced from wild fisheries and aquaculture (e.g., processing by-product, by-catch, etc.) to enhance the value of these resources, improve utilization, and foster a more sustainable aquafeed sector	Year 1	Ongoing
	- Continue research on diets for alternative finfish species that are not yet widely produced (e.g., sturgeon, walleye)	Year 3	Ongoing
	- Support research to foster the use of plant products in aquaculture diets as a replacement for fish meals and oils	Year 3	Ongoing
	- Improve the sustainability of aquafeed ingredients through: □ advanced processing technologies □ nutrigenomics □ improved aquafeed formulation □ innovative ingredient production processes	Year 5	Ongoing
AF–2. Develop predictive models for environmental performance based on feed formulation and utilization			
Universities, Research Org'ns, DFO, NRC, Provinces/Territories, Industry	- Support R&D to validate the prediction of environmental impacts from aquaculture operations based on feed use and hydrological conditions to establish credible environmental performance targets for feeds	Year 3	Ongoing
AF–3. Develop a proposal for a 'modernized aquafeeds regulatory framework'			
Industry/ANAC	- Coordinate a regulatory review study aimed at ensuring that issues pertinent to the Canadian aquafeed sector are adequately communicated and addressed in the exercise being undertaken by the Animal Nutrition Association of Canada (ANAC) for submission to CFIA	Year 1	Ongoing
	- Canadian aquafeed sector to develop an ongoing process to identify regulatory issues and communicate these formally to government on an annual basis (e.g., phosphorus constraints)	Year 1	Ongoing

Alternative Species Development

An industry is loosely defined as a group of companies producing more or less the same product using more or less the same processes and generating a profit. While not all ventures may be successful, collectively, the sector is generally profitable. By this measure, there are only a handful of industrial aquaculture sectors in Canada: salmon, trout, oysters, mussels and clams. On the other hand, there are many alternative species that are purported to have commercial potential. Successful commercialization of these alternative species for which the foundational research is complete requires a focused effort to overcome the last remaining challenges so that their production becomes commonplace.

Current fiscal challenges warrant a rational process to advance the diversification of the industry on a regional basis. Therefore, targeting resources strategically on a select number of emerging species with the greatest potential for economic viability is a practical industry diversification strategy. The status of various species purported to be feasible for commercial aquaculture was assessed, leading to a prioritized list of species for further development. The goal of NASAPI is to advance commercial aquaculture development for these targeted species within a five-year horizon. The initiative does not preclude ongoing research into other potential species that are not yet sufficiently advanced for commercial-scale development. Specific action plans for the prioritized freshwater species follow.

Action Items—Alternative Species (Freshwater)			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
AS–3.[6] Foster the development of commercially viable arctic charr aquaculture			
Industry, Universities, Research Organizations, DFO, Regional Development Agencies, NRC, Provinces/Territories	– Prepare a comprehensive business case and developmental plan for arctic charr aquaculture that includes a review of the following factors: □ market opportunities □ investment opportunities and challenges □ technological needs/obstacles/critical constraints □ realistic five- and 10-year projections for sector development The development plan could include (but would not be limited to) the following: □ Establish a Canadian arctic charr broodstock (genetics) program focused on developing stocks/strains with predictable results (this may complement the national rainbow trout broodstock program): – consistent growth/reduced variability – slow maturation – high survival – temperature tolerance, etc.	Year 1	

[6] The numbering of some strategic objectives may not be in order. This is deliberate to maintain consistency with the other NASAPI sector reports, and to facilitate performance monitoring and management during implementation.

AS–4. Foster the development of commercially viable sturgeon aquaculture			
Industry, Universities, Research Organizations, DFO, Regional Development Agencies, NRC, Provinces/Territories	– Prepare a comprehensive business case and developmental plan for sturgeon aquaculture that includes a review of the following factors: □ market opportunities □ investment opportunities and challenges □ technological needs/obstacles/critical constraints □ realistic five- and 10-year projections for sector development The development plan could include (but would not be limited to) the following: □ Develop techniques to advance maturation □ Transfer technologies from other countries on non-invasive sexing and staging techniques □ Streamline efforts to provide CITES permits □ Develop feeds/strategies to improve first feeding and early rearing survival □ Develop finishing diets to optimize caviar quality □ Develop techniques to optimize caviar and flesh quality □ Develop vaccines for iridovirus and herpes virus and management techniques to minimize their impacts	Year 1	
AS–8. Foster the development of commercially viable walleye aquaculture			
Industry, Universities, Research Organizations, DFO, Regional Development Agencies, NRC, Provinces/Territories	– Prepare a comprehensive business case and developmental plan for walleye aquaculture that includes a review of the following factors: □ market opportunities □ investment opportunities and challenges □ technological needs/obstacles/critical constraints □ realistic 5-year and 10-year projections for sector development The development plan could include but not limited to the following: □ Elaborate techniques to optimize survival and sexual maturation of walleye brood stock □ Develop new diets for walleye brood stock to optimize the quality and survival of eggs and larvae	Year 1	

Risk Management and Access to Financing

Aquaculture is often still perceived as a high-risk industry. Many investors lack confidence in the industry, so debt and equity financing can be difficult and expensive to attract. This is particularly true for smaller producers such as those in the shellfish sector. Developing a more attractive investment climate for producers of all sizes is imperative, which is why it is important that both industry and governments define measures to quantify and reduce the risks inherent to aquaculture. For example, while many operations currently implement robust best management practices (BMPs) and standard operating procedures (SOPs) to mitigate risk, these practices

are not yet universal. Moreover, until these and other practices, such as benchmarking,[7] become routine in the sector, it will be difficult to secure more affordable insurance coverage. Consequently, producers are encumbered by high insurance premiums, inadequate insurance coverage, or no coverage at all.

Action Items—Risk Management & Access to Financing			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
FIN–1. Develop standardized operating procedures in freshwater aquaculture sectors			
Industry DFO/Provinces/Territories	- In sectors where BMPs/SOPs do exist, review the protocols and update as necessary - In sectors where they do not yet exist, develop risk management & mitigation strategies based on BMPs and accompanying SOPs for all aquaculture operations - Foster use of third-party audits to validate compliance with BMPs and SOPs - Review the potential to use BMPs and SOPs as tools to introduce elements of 'smart regulation' to the sector; perhaps through a pilot project	Year 1 Year 3 Year 4 Year 5	
FIN–2. Implement aquaculture benchmarking programs			
Industry, DFO, AAFC, Provinces/Territories	- Review the potential to develop and implement a benchmarking system that will promote continuous improvement in the productivity and sustainability of aquaculture operations □ establish a pilot project to demonstrate benchmarking □ for each sub-sector, outline the scope of potential opportunities for productivity improvement	Year 3	
FIN–3. Continue to invest in programming to overcome the challenges involved in financing scale-up and expansion projects in aquaculture			
Seafood Value-Chain Roundtable, Federal/Provincial–Territorial Governments, Financial Sector, Industry	- Assess the typical constraints to securing financing in the aquaculture sector □ identify the scope of available financial instruments □ identify principal gaps in financing, such as that needed to foster the transition from research to pilot-scale/commercial development; and develop a plan to implement solutions (e.g., increased duration and transferability of site tenure, acceptable collateral for loans, etc.) □ establish a program to help young people become engaged as owner-operators in the aquaculture sector	Year 1	Ongoing

[7] Benchmarking is the process of comparing the operational performance of one company against the overall average performance of companies in a sector. Based on defined metrics (e.g., feed conversion, cumulative mortality, size at harvest, environmental performance, energy consumption, etc.), the process enables managers to identify where their own operations fall below industry norms, thus establishing a strategic process that enables all participants to identify where they are less efficient and/or competitive. In this way, benchmarking facilitates planning and decision-making for continuous process and performance improvement in a sector.

FIN–4. Continue to evaluate options for stock insurance			
Industry	– Initiate a comprehensive program to collect the data necessary to evaluate and quantify risks and evaluate insurance options – Compile background information to support insurance product development	Year 1 Year 1	Ongoing Ongoing

Marketing and Certification

Demand for fish and seafood in domestic and international markets is driven largely by consumer perception of product quality, food safety and value. Assurances of environmentally sustainable production, socially acceptable resource use, adherence to stringent food safety protocols, and farm-to-market traceability for all products are increasingly sought by consumers and seafood buyers looking for independent verification of attributes beyond what would be certified by governments. As a result, and as evidenced by the emergence of high-profile eco-labelling and quality assurance programs, responsible certification systems with third-party compliance audits are increasingly important in the fish and seafood sector. Currently, however, the Canadian aquaculture industry operates under a variety of certification and product traceability systems. In the not-too-distant future, it is conceivable that one or more international certification programs will emerge as the one(s) required by the marketplace.

For some Canadian aquaculture products, there has been insufficient effort directed toward generic market promotion. Producers and processors in some sectors are often unwilling to support such initiatives if they are not supported by all players. As a result, it has been difficult to increase demand and prices for aquaculture products. Additionally, some parts of the Canadian aquaculture sector are still largely focused on the production and sale of commodity products. Value-added products comprise only a small proportion of total output.

The NASAPI presents an opportunity for producers, with government support, to review emerging market certification programs. It is also believed that generic marketing efforts will help to improve prosperity and stability within the sector.

Action Items—Marketing & Certification			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
MC–1. Prepare industry to adopt international aquaculture certification programs			
Industry, DFO, Provinces–Territories, AAFC	– Identify appropriate certification standards for the freshwater aquaculture sector(s) – For each industry sector, conduct mock audits at several farms to identify some potential challenges that producers could encounter related to meeting the expected compliance criteria of certification programs	Year 1 Year 2	Ongoing Ongoing

[8] Canada's External Advisory Committee on Smart Regulation (*Regulating in the 21st Century: Global Changes and Implications for Regulation*, 2003) defines 'smart regulation' as regulation that maintains its traditional protective role but also enables innovation and productivity growth. The CCFAM views 'smart regulation' as an opportunity to align the regulatory requirements of both levels of government to address consumer and public confidence through a renewed, more effective and more efficient framework.

	- Support industry with certification training and other efforts to facilitate entry into appropriate certification programs - Ascertain that BMPs and SOPs meet the requirements of emerging international certification standards - Governments to evaluate the potential to utilize certification as a streamlining tool in support of 'smart regulation'[8]	Year 1 Year 3 Year 5	Ongoing
MC–2. Develop and implement generic marketing programs for aquaculture commodity products			
Industry DFO, Provinces/Territories, AAFC	- Review the potential to establish a pilot program for generic marketing supported by an industry check-off system □ after an initial three-year period, industry members will vote on continuation of the program	Year 5	

Labour and Skills Development

Aquaculture is often cited as offering the potential to attract or retain youth in coastal and rural communities by providing meaningful resource-based employment. This is the case in several areas of the country (e.g., Vancouver Island, southwest New Brunswick). In other areas, however, it is difficult for aquaculture operations to attract labour; the land-based trout farming sector is one example. To stay competitive, aquaculture requires a trained skilled and semi-skilled workforce.

The NASAPI presents an opportunity to re-examine the sector's labour needs as well as the training and skills development programs offered by community colleges and universities throughout the country.

Action Items—Labour & Skills Development			
Potential Contributors	**Actions**	**Suggested Timeframe**	**Status**
LSD–1. Outline human resource strategies and programs leading toward a well-trained and productive workforce			
Industry, Provinces/Territories, Academic Institutions, HRSDC	- Evaluate technical skill requirements in the national freshwater aquaculture sector; outline education, training and extension needs - Outline a labour market strategy to attract young people to aquaculture	Year 2 Year 2	

APPENDIX 1 — LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
ANAC	Animal Nutrition Association of Canada
ASI	Aquaculture-Specific Infrastructure
BKD	Bacterial Kidney Disease
BMP	Best Management Practice
CCFAM	Canadian Council of Fisheries and Aquaculture Ministers
CCFAM–SMC	CCFAM Strategic Management Committee
CFIA	Canada Food Inspection Agency
DFO	Department of Fisheries and Oceans
EC	Environment Canada
HC	Health Canada
NRSDC	Human Resources and Skills Development Canada
INAC	Indian and Northern Affairs Canada
I&T	Introduction and Transfer (of aquatic organisms)
MOU	Memorandum of Understanding
NAAHP	National Aquatic Animal Health Program
NASAPI	National Aquaculture Strategic Action Plan Initiative
NRC	National Research Council
NWPA	Navigable Waters Protection Act
PMRA	Pest Management Regulatory Agency (Health Canada)
R&D	Research and Development
RAS	Recirculating Aquaculture Systems
SOP	Standard Operating Procedure
TAC	Total Allowable Catch
TC	Transport Canada
VDD	Veterinary Drugs Directorate (Health Canada)