ALBERTA WATER COUNCIL



MARCH 2016

Recommendations to Improve Aquatic Invasive Species Management in Alberta

About the Alberta Water Council

The Alberta Water Council is a multi-stakeholder partnership with members from governments, industry, and non-government organizations. All members have a stake in water. The Alberta Water Council is one of three types of partnerships established under the *Water for Life* strategy; the others are Watershed Planning and Advisory Councils and Watershed Stewardship Groups.

The Alberta Water Council regularly reviews the implementation progress of the *Water for Life* strategy and champions the achievement of the strategy's goals. The Alberta Water Council also advises the Government of Alberta, stakeholders, and the public on effective water management practices, solutions to water issues, and priorities for water research. However, the Government of Alberta remains accountable for the implementation of the *Water for Life* strategy and continues to administer water and watershed management activities throughout the province.

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Contents

Figures

Acronyms

AEMERA	Alberta Environmental Monitoring, Evaluation and Reporting Agency
AIS	Aquatic invasive species
AF	(Alberta) Agriculture and Forestry
ALMS	Alberta Lake Management Society
AWC	Alberta Water Council
EDRR	Early detection rapid response
EP	(Alberta) Environment and Parks
GoA	Government of Alberta
HESL	Hutchinson Environmental Sciences Ltd.
WfL	Water for Life (strategy)

Executive Summary and Recommendations

The Alberta Water Council established the Aquatic Invasive Species (AIS) Project Team to identify gaps and opportunities to improve awareness, communication and coordination of activities by stakeholders in Alberta that are working to prevent and manage threats of AIS. The team documented the state of AIS prevention and management in Alberta and in six other jurisdictions to inform its work.

This initiative was undertaken in parallel with work by the Government of Alberta to develop a provincial AIS management system. The approach to the provincial AIS system aligns with other jurisdictions, and includes many of the following elements: prevention, early detection rapid response, public awareness, stakeholder engagement, risk assessment, long-term management, monitoring, policy and legislation, inspections, and enforcement. The Alberta Water Council (AWC) presents its advice and recommendations in line with these major elements of AIS prevention and management systems. To remain within the project terms of reference and avoid confounding the policy work occurring within the Government of Alberta, the AWC highlights gaps that were identified in areas that would be considered policy without offering recommendations.

Prevention, Public Awareness, and Stakeholder Communication and Collaboration

Recommendation 1

The Government of Alberta continue working with governments and national, regional and local partners to enhance the effectiveness of the provincial AIS program, focusing particularly on

- prevention;
- increasing public awareness of AIS and their potential impacts, targeting high-risk audiences; and
- supporting AIS-related stakeholder communication and coordination networks.

Significant progress should be evident over the course of 2016 and 2017.

Long-Term Management

Recommendation 2

The Government of Alberta collaborate with and support industry, non-government organizations, academia and other orders of government to develop and disseminate effective AIS tracking and control options for long-term management by the end of 2018.

Recommendation 3

The Government of Alberta work with its partners to communicate success stories of AIS management.

Develop a Monitoring Plan

Recommendation 4

The Government of Alberta work with AEMERA to develop and begin implementing a provincial AIS monitoring plan for fish, invertebrates and aquatic plants, with assistance from stakeholders, including citizen scientists, by spring 2017.

Inspections

Recommendation 5

The Government of Alberta maintain the mandatory watercraft inspections element of the AIS program and also begin inspecting other vectors of potential introduction by 2017. This should include working with stakeholders where inspections are planned to raise the profile of the issue and increase buy-in from the public.

Supporting Enforcement

Recommendation 6

The Government of Alberta have a protocol in place by the spring of 2017 to ensure that fishery officers and fishery guardians are educated and trained on their authority to enforce AIS legislation.

Recommendation 7

The Government of Alberta share information on enforcement activities and potential penalties with stakeholders and the public to raise the profile of the AIS issue.

1.0 Introduction

Over the past 30 years, aquatic invasive species (AIS) have become a prominent concern and focus in managing North America's freshwaters. Invasive species are one of the most serious environmental threats of the 21st century.[1] Many of these species, including plants, mussels, fish, amphibians, snails, and others, pose a significant threat to Alberta's water management facilities, water supply infrastructure, and aquatic ecosystems. This threat involves direct and indirect economic costs to the agriculture sector, industry, and municipalities. It affects aquatic ecosystem integrity and has social and economic impacts on recreation and tourism activities; for example, it is estimated that an infestation of invasive mussels (e.g., quagga or zebra) would create about $75 million in annual losses if they were to establish themselves in Alberta's lakes and rivers.[2] Alberta currently has five aquatic invasive species: flowering rush, purple loosestrife, yellow flag iris, Himalayan balsam, and Prussian carp. Unlike many other jurisdictions that have been forced to allocate substantial resources to repel or manage AIS invasions, the most harmful AIS (e.g., zebra and quagga mussels, Asian carp, and Eurasian watermilfoil) have not yet become established in Alberta waters. This allows for proactive management of the issue.

Flowering rush

For more information, see: www.abinvasives.ca/factsheets/140520-fs-floweringrush-1.pdf?iframe=true&width=800&height=600

Photo credit: Tanya Rushcall, Agriculture and Forestry

The *Water for Life* (WfL) strategy is the over-arching strategy for managing Alberta's water resources. It emphasizes the dependence of our communities and economic well-being on clean, sustainable water supplies and healthy aquatic ecosystems. The strategy's goals are:

- safe, secure drinking water
- healthy aquatic ecosystems
- reliable, quality water supplies for a sustainable economy

1 Statement of Michael Soukup, Associate Director for Natural Resource Stewardship and Science, National Park Service, Department of the Interior, before the Subcommittee on National Parks, U.S. Senate Committee on Energy and Natural Resources, August 9, 2005; "Invasive Species: Scientists Demand Action on Invasive Species," Union of Concerned Scientists, Cambridge Massachusetts, January 18, 2006 (last revised), online at www.ucsusa.org/invasive_species/call-to-action-on-invasive-species.html as of July 17, 2006; Invasive Species Management, Program Plan: 2003-2007, NASA, Office of Earth Science, Applications Program, June 6, 2003.

2 Neupane, A. *An Estimate of Annual Economic Cost of Invasive Dreissenid Mussels to Alberta*. November 2013. Alberta Environment and Sustainable Resource Development.

The strategy lists three key directions in support of achieving the goals:

- knowledge and research
- partnerships
- water conservation[3]

The Alberta Water Council's (AWC) main purposes are to steward the implementation of the WfL strategy and provide advice on water management issues to its stakeholders. Preventing AIS from becoming established in Alberta and managing existing AIS threats supports all three goals of WfL.

1. 1 Purpose of the Aquatic Invasive Species Project Team

In 2013, the Government of Alberta (GoA) proposed that the AWC support the development of a provincial approach to prevent new infestations of AIS and manage existing ones. Such a project would make recommendations on how to improve awareness, communication and coordination of activities by stakeholders who may be involved in a provincial AIS management system. This work would occur in parallel with program development and policy work within the GoA to address emerging AIS threats.

3 More information on the *Water for Life* strategy and Action Plan is available at www.waterforlife.alberta.ca

Purple loosestrife

For more information, see: www.abinvasives.ca/factsheets/140609-fs-purpleloosestrife.pdf?iframe=true&width=800&height=600

Photo credit: Nicole Kimmel, Agriculture and Forestry

Yellow flag iris

For more information, see: www.abinvasives.ca/factsheets/140619-fs-yellowflagiris.pdf?iframe=true&width=800&height=600

Photo credit: Nicole Kimmel, Agriculture and Forestry

The AWC approved terms of reference for a project team to undertake the following tasks:

1. Document the prevention and management approaches in Alberta to determine the current state of AIS;
2. Document the current AIS prevention and management approaches of other jurisdictions;
3. Determine the need for a common definition for AIS; and
4. Evaluate barriers to, and opportunities for, improving AIS prevention and management within Alberta, and propose recommendations to improve awareness, communication and coordination of activities to respond to AIS threats.[4]

This work aligned with the WfL strategy's management principle to "manage Alberta's water infrastructure for long-term sustainability."[5] It also supports the strategy's goals of healthy aquatic ecosystems[6] and ensuring reliable, quality water supplies for a sustainable economy.[7] This report summarizes the AWC's work and findings.

4 Complete terms of reference and a list of team members and acknowledgements appear in Appendices A and B respectively.

5 Government of Alberta. 2008. *Water for Life: A renewal; p. 7.*

6 Government of Alberta. 2008. *Water for Life: A renewal; p. 10.*

7 Government of Alberta. 2008. *Water for Life: A renewal; p. 11.*

Prussian carp

For more information, see: www.abinvasives.ca/factsheets/150722-fs-prussian-carp-1.pdf?iframe=true&width=800&height=600

Photo credit: Thinkstock Photos - DOBphoto

Himalayan balsam

For more information, see: www.abinvasives.ca/factsheets/150722-fs-himalayanbalsam-4.pdf?iframe=true&width=800&height=600

Photo credit: Nicole Kimmel, Agriculture and Forestry

2.0 What are Aquatic Invasive Species?

Various formal definitions for AIS exist, but Alberta does not have an official definition. In the US, the National Invasive Species Management Plan defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health."[8] Definitions from a number of other jurisdictions, including ones reviewed in support of this work, have the following common elements:[9,10,11,12,13,14]

- The species is not native to the jurisdiction or regions of the jurisdiction;
- The reproduction and spread of the species threatens the health of existing native species, ecosystems, or natural resources; and
- There is the potential for negative impacts to human health.

One component of this project was to determine whether a formal definition for AIS was needed to inform the rest of the work. It was decided not to define AIS in Alberta because current policy work by the GoA is expected to develop a formal definition. Another factor is that, for years the GoA has been stocking fish species in support of recreational fishing in many water bodies, and those species could be considered invasive, depending on the definition adopted. Thus, it was decided not to consider species that were intentionally introduced as a result of a policy decision. However, fish stocking programs that introduce non-native, potentially invasive species to certain water bodies may increase the risk of unintentional spread to other water bodies.

The common elements of definitions, as stated above, were determined to be sufficient for the purposes of this work.

8 National Invasive Species Council, United States Department of Agriculture. August 2008. *2008–2012 National Invasive Species Management Plan.* Online at www.invasivespeciesinfo.gov/council/mp2008.pdf. Accessed March 2015.

9 *Aquatic Invasive Species.* Fisheries and Oceans Canada. July 2014. Online at www.dfo-mpo.gc.ca/science/enviro/ais-eae/index-eng.htm. Accessed November 2014.

10 *An Invasive Alien Species Strategy for Canada.* Environment Canada. September 2004. publications.gc.ca/collections/collection_2014/ec/CW66-394-2004-eng.pdf. Accessed November 2014.

11 *Aquatic Invasive Species.* Alberta Environment and Sustainable Resource Development. Online at esrd.alberta.ca/recreation-public-use/invasive-species/default.aspx. Accessed November 2014.

12 *Invaders.* Ontario Federation of Anglers and Hunters. Online at www.invadingspecies.com/invaders/. Accessed March 2015.

13 *Idaho Invasive Species List.* State of Idaho Agriculture. 2005–2006. Online at www.agri.state.id.us/Categories/Environment/InvasiveSpeciesCouncil/InvSppList.php. Accessed March 2015.

14 *2014 Minnesota Statutes, 84D.01 "Definitions".* Office of the Revisor of Statutes. 2014. Online at www.revisor.leg.state.mn.us/statutes/?id=84D.01. Accessed March 2015.

Fish stocking in Alberta

Sport fishing is an activity enjoyed by over 300,000 anglers per year in Alberta. Fish stocking in Alberta remains a very important aspect of the overall fish management program in the province. Stocking of non-native trout supports about one-quarter of all fishing effort in Alberta and, in some areas, stocked trout fisheries are the most popular and productive still-water fisheries available. Over 50% of Alberta anglers fish at recreational stocked ponds and rainbow trout are the third-most caught species in Alberta. A large portion (> 95%) of Alberta's fish stocking program is dedicated to the maintenance and growth of these recreational stocked fisheries.

Alberta Environment and Parks seeks to provide a variety of enhanced sport fishing opportunities while protecting and conserving native fish species and biodiversity. Alberta water bodies have varied and complex physical, chemical and biological characteristics, which must be considered when determining the best strategies for sustainable native and non-native fish management. It is important that the ecological, genetic, disease, economic, and social benefits and risks to stocked and surrounding aquatic ecosystems are evaluated and considered. Alberta stocks nearly three million trout annually into approximately 250 water bodies for recreational purposes. Most are stocked in closed systems, but in waters where the accidental release or escape of stocked species may have an impact on wild trout populations, triploid (sterile) trout are used.

Golden trout have been stocked in Alberta lakes

Photo credit: Jay White

2.1 How are AIS introduced to an area and subsequently spread?

Bringing AIS to a new region, intentionally or otherwise, is known as the "primary introduction." Trade and transport activities are the most common source of primary introductions of AIS to North America. Examples include releasing ballast water from cargo ships on international trade routes; tourist travel; and imports for the ornamental plant, aquarium and pet industries, live fish retailers, bait shops, and aquaculture. For example, zebra and quagga mussels were introduced to the Great Lakes region as a result of trade and transport; a release of larval mussels during the ballast exchange of a commercial cargo ship travelling from the north shore of the Black Sea to Lake St Clair has been deduced as the likely vector of introduction to North America.[15]

Once introduced to a region, AIS can spread rapidly from one jurisdiction or water body to another, a process known as "secondary spread." Examples include the overland transport of watercraft and other conveyances[16] from infested areas, intentional releases (e.g., anglers introducing bait, cultural and ceremonial releases, and dumping of aquariums and aquarium species) and accidental introduction, such as fouled equipment or water coming from AIS-infested areas. In the case of the initial zebra mussel infestation in Lake St Clair, the subsequent rapid dispersal of zebra mussels throughout the Great Lakes and major river systems was due to the passive drifting of the larval stage (veligers), and its ability to attach to boats navigating these lakes and rivers (which would be considered secondary spread).[17] Within five years, previously robust walleye populations in the Great Lakes were decimated, and other native species were also negatively affected.[18]

15 McMahon, R.F. 1996. *The physiological ecology of the zebra mussel,* Dreissena polymorpha, *in North America and Europe. American Zoologist 36:339-363.*

16 "Conveyance" is defined in the *Fisheries (Alberta) Act* and "means a vehicle, being a device in, on or by which an individual or thing may be transported or drawn, and includes (i) a trailer and any combination of such vehicles, (ii) an aircraft that is not in flight, (iii) an item or watercraft, a dock or wharf, (iv) a railway car, and (v) a shipment or proposed shipment existing in any other circumstances; and also includes any container or equipment in or on any such conveyance." Source: Government of Alberta. *Fisheries (Alberta) Act*. RSA 2000 Chapter F-16. Current as of March 2015. Online at www.qp.alberta.ca/documents/Acts/F16.pdf. Accessed September 2015.

17 United States Geological Survey. *Nonindigenous Aquatic Species, Zebra Mussel fact sheet*. Online at nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5. Accessed September 2015.

18 The Columbia Basin Fish & Wildlife News Bulletin. *Pacific Northwest 'Only Place on Continent' Unaffected by Mussel Invasion; Preventative Strategy Urged*. May 2013. Online at www.cbbulletin.com/426624.aspx. Accessed September 2015.

To learn more about AIS issues and introductions, see the following websites:

Alberta Environment and Parks: esrd.alberta.ca/recreation-public-use/invasive-species/

My Wild Alberta: www.mywildalberta.com/Fishing/SafetyProcedures/AquaticInvasiveSpecies.aspx

Alberta Invasive Species Council: www.abinvasives.ca/

Crown Managers Partnership: www.crownmanagers.org/aquatic-invasive-species/

Pacific States Marine Fisheries Commission: www.westernais.org

100th Meridian Initiative: www.100thmeridian.org/

2.2 What threats do aquatic invasive species pose and why is it important to address this issue?

Aquatic invasive species pose a multitude of threats; they can alter existing aquatic ecosystem functions; impair water treatment and industrial infrastructure; potentially harm human health; and affect ecological tourism and fisheries, recreational watercraft and waterfront properties.[19]

In Canada, some native fish species have become threatened and certain fisheries have already been devastated by the introduction of AIS.[20] Forty-two percent of threatened and endangered species in the US are considered to be significantly affected by invasive species competition or predation.[21] Zebra mussels in the Seneca River, a major US tributary to Lake Ontario, have caused dramatic changes to the river's water quality, including reduced phytoplankton concentration, increased nutrient availability, and depleted oxygen saturation.[22]

19 Neupane, A. *An Estimate of Annual Economic Cost of Invasive Dreissenid Mussels to Alberta.* Alberta Environment and Sustainable Resource Development. November 2013.

20 Department of Fisheries and Oceans. *A Canadian Action Plan to Address the Threat of Aquatic Invasive Species*. 2004. Online at www.dfo-mpo.gc.ca/science/environmental-environnement/ais-eae/plan/plan-eng.htm#challenges. Accessed May 2015.

21 *Ibid.*

22 Effler *et al*. 1996. *Impact of zebra mussel invasion on water quality.* Water Environment Research. Vol. 68, No. 2. Pages 205-214. Online at www.jstor.org/stable/25044708. Accessed September 2015.

Operations of municipal water treatment plants and irrigation systems have also been negatively affected. The US Department of Agriculture estimates that $500 million is spent on mitigation and control of invasive freshwater mussels, which includes treating drinking water facilities, in the Great Lakes region alone.[23] Growing international trade and travel, combined with climate change, are predicted to increase the likelihood of AIS introduction and survival in Alberta's freshwater ecosystems.[24]

In 2003, the costs of control and eradication of AIS in the US were estimated to exceed $9 billion annually. This estimate includes expenditures of $5.4 billion on fish, $1 billion on invasive mussels, $1 billion on Asian clams and more than $500 million on aquatic plants.[25] The economic impact of a zebra or quagga mussel infestation in Idaho alone was estimated to exceed $94 million annually.[26] In British Columbia, these invasive mussels could cause economic impacts to hydropower, municipal water supplies and recreational boating of at least $28 million annually.[27] Ontario spends between $75 million and $91 million annually as a result of zebra mussel infestations.[28]

Zebra mussels' selective filter feeding has caused increases in toxic blooms of blue-green algae in Lake Huron and Lake Erie.[29] Human contact with blue-green algae can cause skin irritation and dermatitis, and ingestion of some toxic species can cause gastro-intestinal disorders, liver damage, paralysis and death.[30]

23 National Invasive Species Information Center. 2012. US Department of Agriculture. Online at www.invasivespeciesinfo.gov/index.shtml. Accessed September 2015.

24 Hutchinson Environmental Sciences Ltd. *2014. Current Prevention and Management Approaches for Aquatic Invasive Species in Jurisdictions outside Alberta*. Page 1. Online at awchome.ca/Projects/CurrentProjects/AquaticInvasiveSpecies/tabid/167/Default.aspx. Accessed May 2015.

25 Pimentel, D. 2003. *Economic and Ecological Costs Associated with Aquatic Invasive Species. In: Wakefield & Faults (Eds) Aquatic Invaders of the Delaware Estuary*. Malvern, PA.

26 Idaho Aquatic Nuisance Species Taskforce 2009. 2009. *Estimated Potential Economic Impact of Zebra and Quagga Mussel Introduction into Idaho*. Online at www.aquaticnuisance.org/wordpress/wp-content/uploads/2009/01/Estimated-Economic-Impact-of-Mussel-Introduction-to-Idaho-Final.pdf. Accessed September 2015.

27 Robinson, D. *et al. Preliminary Damage Estimates for Selected Invasive Fauna in B.C.* 2013. Online at www.for.gov.bc.ca/hra/invasive-species/Publications/BC_Invasives_Final_Report.pdf. Accessed September 2015.

28 Marbek. 2010. *Assessing the Economic Value of Protecting the Great Lakes: Invasive Species Prevention and Management*. Page iii. Online at www.aquaticnuisance.org/wordpress/wp-content/uploads/2010/06/Assessing_the_Economic_Value_of_Protecting_the_Great_Lakes_Invasive_Species_Prevention_and_Mitigation_MARBEK_2010_.pdf. Accessed October 2015.

29 Vanderploeg, H. *et al.* 2001. *Zebra mussel* (Dreissena polymorpha) *selective filtration promoted toxic* Microcystis *blooms in Saginaw Bay (Lake Huron) and Lake Erie*. Canadian Journal of Fisheries and Aquatic Sciences. 58**:** 1208-1221.

30 Zurawell, R.W. 2015. *Toxic Cyanobacteria. In: J. Bartram (Ed) Routledge Handbook of Water and Health.*

AIS Impacts on Irrigation and Hydropower Generation Infrastructure

The establishment of invasive zebra and quagga mussels in Alberta would be highly challenging for water management infrastructure, particularly for irrigation and hydropower generators.

Alberta has 13 irrigation districts, and the irrigation infrastructure includes more than 50 reservoirs and about 8000 kilometres of irrigation canals and pipelines. Several irrigation reservoirs also serve as popular destinations for recreational boaters and anglers, and thus are at a high risk of invasive mussel introduction. Invasive mussels would clog pipelines, foul water control and screening structures, and spread within irrigation canals which would reduce the ability of the irrigation districts to efficiently and effectively convey water throughout their irrigation systems. Irrigation water users would be affected including agricultural and industrial users, and many communities. Given the interconnectedness of watercourses in the South Saskatchewan River Basin, mussels would be transported throughout the basin, and the impact would be felt throughout Alberta's irrigated area. The costs to manage the mussels would be millions of dollars each year in perpetuity and would likely be at the expense of all water users.

For hydropower generators, significant steps have been taken to ensure that critical infrastructure (e.g., spillway gates) is inspected regularly for the presence of any invasive species. AIS can seriously hinder the proper operation of this infrastructure at critical times.

Zebra mussels completely encrust any substrate, including water intake pipes, in infested water bodies.

Photo credit: Kate Wilson, Environment and Parks

Efforts to eradicate flowering rush

Flowering rush is found in Alberta in many water bodies. One of the densest infestations, estimated to extend for approximately 13 km, is in the Western Irrigation District Headworks Canal and Chestermere Lake. In 2011, the canal was drained to allow for weed control. Dredging was used as a control measure. Alberta Environment and Parks and Alberta Transportation dredged a 250-metre stretch of the canal near Chestermere Lake, but limited re-growth occurred along armored areas of the canal. In 2012, the flowers and buds were cut and removed, followed by more dredging. An aggressive approach was adopted whereby the canal bottom was removed rather than scraping the sides. Dredged soil was stored in piles along the right-of-way parallel to the canal, which prevented flow back into the canal. Further dredging in support of eradication continued into 2014; to date, nearly $680,000 has been spent on dredging the Headworks Canal. Chestermere Lake was surveyed in August 2013 and 307 visible plants were observed within six metres of the shore. The lake may require draining and dredging. It is estimated that this additional work could cost $50 million.

(Source, Calgary and Area Governmental Weed Committee, minutes from Sept. 24, 2014)

Flowering rush forms thick stands and invades open water

Photo credit: ThinkStock Photo – RuudMorijn

3.0 Documenting AIS Management in Alberta and Other Jurisdictions

An important component of this project was documenting the current state of AIS prevention and management in Alberta and other jurisdictions. This provides a baseline of information for the province that will assist with setting program priorities and evaluating progress. Reviewing AIS programs and policies in other jurisdictions enables consideration of approaches that have worked well elsewhere and how they might apply to Alberta. The jurisdictional review provides valuable insight and information to support the successful development and implementation of a new AIS program now underway in Alberta.

This section describes the current AIS program in Alberta and the process used to document the AIS management activities of Alberta stakeholders, as well as those of the five states and one province in North America that were selected for the jurisdictional review (Ontario, Minnesota, Texas, Colorado, Utah and Idaho). These jurisdictions have implemented successful programs to prevent the introduction and spread of AIS within their borders.

3.1 Alberta's AIS Program

Alberta Environment and Parks (EP) has partnered with other GoA ministries, non-government organizations, municipalities and industry stakeholders to develop and implement a program to prevent the introduction and spread of AIS in Alberta's aquatic ecosystems. This program began as a prototype in 2012–2013 focused on quagga mussels, zebra mussels and Eurasian watermilfoil in the Crown of the Continent Ecosystem in southwestern Alberta. EP sought input and participation from various organizations, including the Alberta Irrigation Projects Association, Alberta Invasive Species Council, Watershed Planning and Advisory Councils, Watershed Stewardship Groups, Alberta Summer Villages Association, Alberta Lake Management Society, agricultural producers, agricultural fieldmen and industry representatives. The program expanded in 2013–2014 to be province-wide, focusing on all aquatic invasive plants, invertebrates, and fish of concern.

The provincial program is led by EP's Fish and Wildlife Policy Branch in partnership with other EP branches including Operations Infrastructure, Alberta Support and Emergency Response Team, Education and Outreach, and Parks. Other partners include Alberta Agriculture and Forestry (AF), Alberta Justice and Solicitor General, as well as the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA). The structure of the provincial AIS program is illustrated in Figure 1, which shows the five specific program elements on which cross-ministry teams are focused.

Figure 1: Structure of provincial AIS program

1. Education and Outreach: The education and outreach team works with stakeholders to raise awareness of the threats of AIS to Albertans by developing and disseminating informational materials and developing campaigns such as the *Clean, Drain and Dry Your Boat* (2014) and the *Don't Let it Loose* (2015–2016) campaigns.
2. Watercraft Inspections: Mandatory inspections of watercraft on key highways entering the province target the highest risk vector of AIS introduction. Watercraft inspections have been conducted in Alberta since 2013, but have increased substantially with amendments to legislation in 2015 that made inspections mandatory for passing watercraft. A similar approach has contributed to the successful prevention of zebra and quagga mussel invasions in several western states in the US.
3. Monitoring: Prior to 2013, Alberta had no comprehensive AIS monitoring program. AEMERA now performs ambient environmental monitoring, including some non-fish AIS (e.g., zebra mussels, quagga mussels, and spiny water flea) as part of its surface water quality monitoring program. Further details about AEMERA are included in Section 4.7. Since 2013, other agencies have also undertaken various monitoring initiatives:

- EP and Alberta Lake Management Society monitor for invasive mussels and initiated a pilot project on monitoring for aquatic invasive plants through 2014–2015.
- AF has monitored many of the high-risk irrigation reservoirs for invasive zebra and quagga mussels.
- EP monitors for fish based on regional priority and works with AF to monitor aquaculture operations.

4. Response and Control: A hotline (1-855-336-BOAT) was established for the public and other jurisdictions to report AIS sightings, and the GoA has protocols in place to respond to reports of mussel-fouled boats. Current response efforts also include developing an invasive mussel rapid response plan (if they are detected in a water body), tracking and control of existing AIS such as flowering rush and Prussian carp, and exploring the registration of pesticides to address AIS infestations across Canada. Response to AIS threats is a vital component of any AIS program. As the lead agency responsible for responding and coordinating the provincial AIS response, EP will continue to strengthen this component with the goal of eradicating threats.
5. Policy and Legislation: The *Fisheries (Alberta) Act* is the primary piece of legislation that addresses AIS. Interim measures to address significant gaps in enforcement were adopted in 2013, and on March 30, 2015 the *Fisheries (Alberta) Act* was amended to better address the threat of AIS in general. Modifications to the *Act* include:
   - Providing for mandatory inspections of watercraft and other AIS conveyances;
   - Enhanced protective measures for other (non-watercraft) potential sources of AIS (e.g., aquarium and pet trade, horticulture, aquaculture, live fish markets, bait shops);
   - Specified quarantine authorities if AIS are detected in a water body;
   - Enhanced authority provided to fishery officers, fishery guardians and watercraft inspectors to mitigate the risk of AIS introductions; and
   - Creation of a schedule of prohibited aquatic invasive plants, invertebrates and fish. The schedule (Appendix C) lists species that are prohibited for importation and possession, including sale and transportation, with some exemptions for research and education purposes.

The amended *Fisheries (Alberta) Act* also provides for the ability to regulate AIS matters as needed in the future through Ministerial Orders or regulations.

3.2 Documenting the AIS Activities of Stakeholders in Alberta

A wide variety of Alberta stakeholders who are or could be involved in a provincial AIS management system were surveyed to gather information about the state of AIS management in Alberta. A number of provincial and federal government employees from ministries and agencies that have a role in AIS management were also interviewed. The findings from the survey and interviews are reflected in Section 4.

Interviews with key stakeholders were conducted to supplement the information gathered through the survey. Interviews were conducted exclusively with individuals representing an agency or organization that has regulatory or enforcement authority regarding AIS or invasive species in general. This information was then used to identify gaps and opportunities for improving awareness, communication, and coordination of AIS prevention and management activities in Alberta. Other areas such as the challenges and limitations encountered with respect to enforcement and regulation were also explored through the interview process.

The findings reflect the diverse perspectives of participating stakeholders and are not intended to be statements of consensus or to represent all stakeholders. Rather, the information presents a broad perspective on what interviewees considered possible and desirable to address the gaps and challenges in preventing and managing AIS, and the opportunities to improve awareness, communication, and coordination of AIS management activities in Alberta. Many of the interviews were conducted in the early stages of the project, and some of the suggestions may already be in the process of being implemented or incorporated into the provincial AIS program.

3.2.1 Survey and Interview Methodology

Survey Methodology

An electronic survey was distributed to all AWC sectors and other relevant stakeholders by email and was available to the general public via social media (e.g., Facebook, Twitter, LinkedIn) and various water related e-newsletters.

The survey contained 61 questions. It included general questions about the level of awareness of AIS threats, which area of Alberta the respondent lived or operated in, and what kind of organization they represented, if any. Most of the survey focused on specific facets of AIS management, including

- risk assessment
- prevention methods
- stakeholder communication

- education and awareness programs
- monitoring programs
- AIS response plans
- perceived barriers to success.

The team received 247 responses from individuals and organizations across the province. Responses were received from all major watersheds and from a great diversity of interests.[31]

Interview Methodology

The interview process was developed to glean information from stakeholders who have responsibilities in the regulatory or enforcement aspects of AIS management. A number of specific topics and questions were used to guide an open conversation between the interviewing team and the interviewee. Interviews were designed to elicit various perspectives and focused specifically on what interviewees felt were gaps, barriers, limitations, and opportunities that could be addressed to improve the state of AIS management in Alberta. Interviewees were chosen because of their knowledge, experience, and engagement in various aspects of AIS prevention and management, and based on their expertise and ability to articulate their organization's regulatory or enforcement roles. Interviews were conducted with ten individuals from agencies that included EP Fisheries and Wildlife Enforcement Branch, EP Fish and Wildlife Policy Branch, the AF Pest Surveillance Branch, the Justice and Solicitor General's Commercial Vehicle Enforcement Branch, Alberta Association of Agricultural Fieldmen, the Canadian Border Services Agency, Parks Canada (Banff National Park), and the Department of Fisheries and Oceans Canada. Interviews were done in person in Edmonton, Calgary, Red Deer, and Banff while telephone interviews were done with those from other areas.

31 Survey responses were provided by: Watershed Planning and Advisory Councils, Watershed Stewardship Groups, municipalities, water and wastewater treatment facilities, power generators, irrigators, Summer Village Associations, Government of Alberta ministries such as Environment and Parks and Agriculture and Forestry, the Alberta Association of Agricultural Fieldmen, academics, environmental consultants, recreational users (anglers, sailors), and numerous non-governmental organizations such as Alberta Lake Management Society, Alberta Conservation Association, Trout Unlimited Canada, Ducks Unlimited Canada, as well as Albertans that did not associate themselves with any particular organization.

3.3 Review of AIS Prevention and Management in other Jurisdictions

Hutchinson Environmental Sciences Ltd. (HESL) was engaged to review AIS management approaches in other jurisdictions. The review included two components: a literature review of existing AIS prevention and management programs and strategies in chosen jurisdictions (Ontario, Idaho, Minnesota, Texas, Utah, and Colorado), and interviews with staff who administer the programs. The jurisdictions reviewed were chosen by the AIS Project Team because of their similarities with Alberta such as: presence of several freshwater lakes, reservoirs, and navigable waters; they are subject to periods of water scarcity; and they have existing successful programs or strategies to prevent and manage AIS within their jurisdiction.

The team worked with HESL to develop a detailed questionnaire that covered the major themes common to most AIS management systems. The questionnaire was sent to ten individuals from the six jurisdictions. The individuals included invasive species biologists, AIS coordinators, and a director of a freshwater research centre.

The results summarized the AIS prevention and management programs of the six jurisdictions, identified knowledge and policy gaps, and noted barriers to the success of the program. The HESL report, as well as other information about this initiative, is available at: awchome.ca/Projects/CurrentProjects/AquaticInvasiveSpecies/tabid/167/Default.aspx.

4.0 Improving Awareness, Communication and Coordination of Stakeholder Activities in Support of a Provincial AIS Management System

The purpose of this project was to identify gaps and opportunities for improving awareness, communication and coordination of activities by stakeholders in Alberta that are working to prevent and manage the threats of AIS. Research and discussions identified that many jurisdictions' approaches to AIS prevention and management include the following elements:

- prevention
- public awareness
- stakeholder engagement
- risk assessment
- early detection rapid response
- long-term management
- monitoring
- policy and legislation
- compliance and enforcement
- inspections

Nearly all of these elements include components of awareness, communication among stakeholders, and coordination of activities. Based on the expert knowledge of the team members, findings of the survey, interviews and jurisdictional review report, the AWC presents its advice and recommendations in line with these major elements of AIS prevention and management systems in this section. To remain within the terms of reference and avoid confounding the GoA's ongoing policy work, this section also highlights gaps that were identified in areas that would be considered policy without offering recommendations.

"Clean, Drain and Dry Your Boat" poster

Photo credit: Environment and Parks

4.1 Prevention

Prevention is one of the most important aspects of an effective AIS management system since AIS are generally very difficult to eradicate once introduced. A successful strategy will ideally target the early stages of the invasion process, with the aim of preventing invaders from being transported to and entering areas beyond their native range.[32] Prevention includes first identifying the highest risk sources of introductions and taking actions that help prevent the possibility of introduction. Many jurisdictions in Canada and the US have taken a proactive approach to preventing AIS infestations by educating the people who are most likely to spread invasive species into unaffected areas. Programs such as "Clean, Drain and Dry Your Boat" have successfully prevented the spread of zebra and quagga mussels and other species to five states of the Pacific Northwest (Washington, Oregon, Idaho, Montana and Wyoming), as well as British Columbia and Alberta. Prevention is also the most cost-effective approach to invasive species management because management efficiency decreases and costs increase as invasion advances.[33]

32 Hutchinson Environmental Sciences Ltd. *Current Prevention and Management Approaches for Aquatic Invasive Species in Jurisdictions outside Alberta.* 2014. Page 5. Available online at awchome.ca/Projects/CurrentProjects/AquaticInvasiveSpecies/tabid/167/Default.aspx. Accessed May 2015.

33 *Ibid.*

4.1.1 Prevention in Alberta

Of the Albertans surveyed, 89% of respondents indicated that it was "very important" or "somewhat important" to prevent AIS from becoming established in Alberta. The most commonly reported motivations for preventing AIS from becoming established were their impacts on fisheries and biodiversity, followed by impacts on infrastructure or boating access.

Many respondents are undertaking some form of activity to prevent AIS from being introduced into Alberta water bodies. The most reported activities included cleaning of equipment (e.g., watercraft, sampling equipment, pumps and hoses), especially if moving from one water body to another, and inspecting for mussels or watermilfoil when removing the watercraft from the water. Others reported looking for common plant AIS such as yellow flag iris, flowering rush, purple loosestrife or Himalayan balsam. Many respondents who said they were not undertaking any prevention activities would like to, but reported not having the funding, resources or knowledge to do so. Some survey respondents and interviewees reported that there is a lack of regulations that identify roles and responsibilities required to manage an effective AIS prevention system. Others noted that taking action to prevent AIS from becoming established is not part of their mandate, and thus they were not able to directly undertake activities that would contribute to preventing the spread or establishment of AIS.

4.1.2 Findings from the Jurisdictional Review

All jurisdictions reviewed have an official strategic plan or prevention program in place to address invasive species. These plans all rely on public education, outreach coordination and detection to help prevent, control, or minimize the impacts of AIS. The most commonly identified barriers to an effective prevention and management system were insufficient funding and personnel to help with all aspects of a prevention and management program, with community engagement, monitoring and surveillance being paramount considerations.[34]

4.1.3 Recommendation — Prevention

Because the AWC's advice on the topics of prevention (Section 4.1), public awareness (Section 4.2) and stakeholder engagement (Section 4.3) is sufficiently similar, it is presented as a single recommendation (Recommendation 1 in Section 4.3).

34 *Ibid.*

4.2 Public Awareness

Public awareness of AIS threats and impacts is an essential part of any AIS management program. Improved general awareness is one way to increase the number of people who are looking for AIS and can be counted on to respond to an early detection. Approaches to increasing public awareness can vary widely, from a formal strategic plan to informal discussions with potential stakeholders. Generally, educating the public about AIS threats helps raise awareness and provides the tools needed to participate in a solution. In the case of high profile AIS such as quagga and zebra mussels, increasing public awareness can also enhance support for prevention measures such as watercraft inspections and outreach campaigns.

4.2.1 Public Awareness in Alberta

Education and outreach is a large part of Alberta's AIS program. In 2013, the "Clean, Drain and Dry Your Boat" campaign was developed. This messaging is used across western Canada to prevent AIS introductions by watercraft travelling from one area to another. The campaign emphasizes the importance of personal actions to curb the spread of AIS, and urges boaters to take these three simple steps every time they remove their watercraft from the water. The messaging targets the highest risk boaters — that is, those travelling across jurisdictions — as they come into contact with signs, inspection stations, radio and other media. Alberta is using boat launch signs, billboards, posters, radio and TV spots, websites, social media, and other outreach materials in its "Clean, Drain and Dry Your Boat" campaign. Materials such as chamois, floating key chains, waterproof wallets, stickers, and beverage cozies with the "Clean, Drain and Dry Your Boat" logo are handed out to boaters at inspection stations to serve as a reminder and as appreciation for complying with the inspection.

Many survey respondents revealed an awareness of AIS threats that are already established in Alberta (e.g., flowering rush, purple loosestrife, and Prussian carp) and others that have not yet arrived in Alberta (e.g., Asian carp, zebra and quagga mussels, Eurasian watermilfoil).

4.2.2 Findings of the Jurisdictional Review

Most of the jurisdictions reviewed have some form of public awareness and education plan, which is often formalized in their invasive species strategic plan. Activities can be organized informally or through formal education programming. Ontario has developed curriculum modules for Grades 4–6 and the University of Minnesota offers an interdisciplinary graduate training program on invasive species risk analysis.[35] Public awareness and educational initiatives are typically coordinated by government agencies, partners and education specialists. The target audiences of the educational initiatives vary widely; many jurisdictions specifically target the audiences that are most likely to spread AIS (anglers, boaters, gardeners and aquarium owners), while others focus on the general public.

4.2.3 Recommendation — Raise public awareness of AIS

Because the AWC's advice on the topics of prevention (Section 4.1), public awareness (Section 4.2) and stakeholder engagement (Section 4.3) is sufficiently similar, it is presented as a single recommendation (Recommendation 1 in Section 4.3).

4.3 Stakeholder Engagement

A successful, sustainable and comprehensive AIS program requires ongoing support, cooperation and coordination from all affected stakeholders. Ensuring that susceptible industries, non-government organizations and individuals are engaged provides an avenue to coordinate actions and keep lines of communication open to raise awareness of existing and emerging AIS threats. All orders of government (municipal, provincial, federal) that have jurisdiction and various levels of authority within a watershed where AIS must be managed will benefit from stakeholder engagement.

35 *Ibid. Page 27.*

4.3.1 Stakeholder Engagement in Alberta

Many diverse Alberta stakeholders, including governments and non-government organizations, are involved in invasive species management. Provincial government ministries including EP and Justice and Solicitor General have responsibilities that apply directly to AIS, while AF manages most terrestrial invasive species. AF has also been working with the irrigation districts and other irrigation stakeholders with specific concerns about the risk of mussel infestation in the irrigation infrastructure. Departments of the federal government such as the Canadian Border Services Agency and the Canadian Food Inspection Agency also have a role in preventing AIS from entering the country at border crossings.

At the provincial level, the GoA has engaged many stakeholders in the development of its AIS program. Examples include multi-stakeholder participation in the Crown of the Continent Ecosystem, the Alberta AIS prototype in 2012–2013, and the inclusion of many stakeholders in the development of the provincial AIS program through "task teams" associated with each program area.

Participation from external stakeholders is a key factor in the creation and development of the provincial AIS program and in enhancing public awareness and support for prevention measures. While many of the stakeholders who completed the survey have joined in the fight to prevent AIS from establishing in Alberta, other relevant groups may not yet be engaged and could add valuable support to a provincial AIS management system. The Alberta Invasive Species Council focuses on educating the public about the threats of AIS and encourages the planting of native species through campaigns such as "Grow Me Instead."[36] The irrigation industry has taken out ads and assisted with program development to support prevention efforts. The Alberta Association of Municipal Districts and Counties, the Alberta Urban Municipalities Association, the Alberta Summer Villages Association, and the Agricultural Service Board Provincial Committee all passed formal resolutions urging EP to take stronger action and pass legislation to make inspections mandatory and ensure a sustainable program; these resolutions provided support at a critical time and likely assisted with the timely passing of the amendments to the *Fisheries (Alberta) Act* in 2015.

36 Alberta Invasive Species Council. 2015. *Grow Me Instead.* Available online at www.abinvasives.ca/images/uploadsfile/150303%20AISC%20GMI%20PlantWise%20Brochure_Final%2003_03_2015_web.pdf. Accessed October 2015.

At the local level, survey respondents in Alberta indicated that some communication to share information about new AIS threats and managing existing ones is already happening. There is, however, an opportunity for improved and perhaps more formalized communication processes to be established.

There are various approaches to engaging stakeholders. Many jurisdictions have organizations in place to facilitate stakeholder engagement and communication. These groups typically comprise a wide cross section of stakeholders, representing various levels or departments of government, industry, academia, non-government organizations and the general public. Alberta has such an organization, which recently expanded its mandate to focus on all invasive species. The Alberta Invasive Species Council's objectives are:

- Make Albertans aware of the impact that invasive species have on the environment, economy, and society through communication, education and awareness.
- Be recognized as Alberta's voice on invasive species by acting as a key resource organization.
- Foster partnerships between agencies with a mutual interest in invasive species management through communication and cooperation.

Some interviewees who have responsibilities for preventing AIS from entering Alberta indicated that there is insufficient integration among the stakeholders in Alberta, including a lack of formal linkages between municipalities, the federal government, and the GoA, which is primarily responsible for managing AIS. Some survey respondents indicated that the lack of formal linkages has led to confusion regarding roles and responsibilities for preventing and managing AIS. Others expressed concern that if the public is not regularly reminded of the threat of AIS, they may not be interested in the issue despite the potential impacts to the environment and economy.

4.3.2 Findings of the Jurisdictional Review

All six jurisdictions that were reviewed incorporated stakeholder engagement in their AIS management system. While Idaho and Minnesota have formal communication plans, the remaining jurisdictions relied on informal communications to share information as needed. Other jurisdictions have relied on informal and formal partnerships, often formed from the bottom-up instead of by regulation. However, reaching all potential stakeholders requires a large investment of time and staff resources, which are often not available. Other barriers identified were that stakeholders may not fully understand the magnitude of the AIS problem and may resist changing their behaviour. Stakeholders often have other priorities which may make them slow to respond to AIS initiatives.

4.3.3 Recommendation — Prevention, Public Awareness, and Stakeholder Communication and Coordination Networks

The AWC stresses the need for integrated, coordinated action to improve prevention, public awareness, and stakeholder communication and collaboration. Because its recommendations in these three areas have similarities and all contribute to the project mandate, advice is consolidated into a single recommendation.

Recommendation 1: The Government of Alberta continue working with governments and national, regional and local partners to enhance the effectiveness of the provincial AIS program, focusing particularly on:

- prevention;
- increasing public awareness of AIS and their potential impacts, targeting high-risk audiences; and
- supporting AIS-related stakeholder communication and coordination networks.

Measurable progress will be evident over the course of 2016 and 2017.

4.4 Risk Assessment

In the context of AIS prevention and management, risk assessment is a process where risks are identified, evaluated and estimated to determine the potential impacts if AIS were to become established in water bodies. Understanding the risks can help determine whether to invest time and resources towards preventing the introduction and establishment of AIS. Many groups, particularly the public, are not aware that Alberta's water bodies are threatened or what the potential impact of an AIS infestation could be.

4.4.1 Risk Assessment in Alberta

According to responses from the stakeholder survey, approximately 20% of respondents indicated that they or their organization had performed a risk assessment for AIS. Many of these risk assessments were reported to have been undertaken by groups such as government departments or municipalities that have a mandate to manage AIS. Respondents from the power generation and irrigation sectors also reported undertaking risk assessments. Generally, the results of the risk assessments were shared with EP and the local municipal government.

4.4.2 Findings from the Jurisdictional Review

Assessing risks from existing and potential AIS is a key component of AIS management in almost all reviewed jurisdictions. Most risk assessments consider probabilities of arrival, establishment, and secondary spread, as well as economic, social and environmental impacts. The results of risk assessments conducted within and outside jurisdictions are essential for prioritizing species and funding their management. Risk assessments are also used to develop regulations, prioritize pathway management and help identify locations for monitoring, inspections and public awareness campaigns (e.g., signage).

The main barriers to undertaking risk assessments are the availability of resources (i.e., funding, time and qualified personnel) and the lack of a consistent, robust methodology that applies to the species in question. Risk assessments need to receive priority in resource allocation and training programs to develop the expertise to conduct such assessments.

4.4.3 Identified Gaps in Risk Assessment

While the research provided insight into the importance of risk assessments in an AIS prevention and management system, the AWC was of the view that making recommendations in this area was outside its mandate. Instead, the following two gaps were identified:

- **Municipalities, industry and others would benefit from guidance on how to perform an AIS risk assessment. The GoA might have a role in providing the expertise and required information, but municipalities and industry are likely better informed about the specific risks and potential impact of AIS infestations to their operations than anyone else.**
- **Alberta stakeholders need a protocol for developing scientifically credible species-specific risk assessments.**

4.5 Early Detection Rapid Response

It is inevitable that some invasive species will be introduced to new areas despite prevention efforts. Early detection rapid response (EDRR) plans are an important AIS management tool to attempt to eradicate new infestations. Once an invasion is detected, a successful response depends on readiness to act and having immediate access to the resources and funding needed for action.[37] Steps in an EDRR plan may include identifying the threat and extent of the infestation, determining AIS impacts and feasibility of management, evaluating treatment options, implementing treatment, and monitoring and evaluating the response.

4.5.1 EDRR in Alberta

One-quarter of the survey respondents said they have a response plan, which often includes notifying EP via the 24/7 AIS hotline (1-855-336-BOAT). For some species, an eradication process can be followed once the presence and identity of the AIS are confirmed. A number of gaps with respect to responding to early detection were identified. For example, agricultural fieldmen are engaged by rural municipalities to eliminate invasive species in cropland adjacent to water, but their jurisdiction is limited to the terrestrial environment. And few if any control options are available for most AIS; this issue is evident throughout Canada where for example, very few pesticides are registered for aquatic use. Also, in cases of new infestations of AIS, there are limited emergency and special use allowances for chemical control.

37 *Ibid. Page 6.*

Further, there is currently no formal response protocol or requirement to ensure newly found AIS are reported to the proper authorities, and this can delay a timely response. Two-thirds of respondents who do not have a response plan in place would like to develop one, but most reported not having the resources or the knowledge required to create an effective response plan.

Early Detection Rapid Response in Alberta

In 2015, black bullhead (*Ameiurus melas*), a highly invasive non-native fish, was detected in a small constructed pond near Fort McMurray just months after the species was listed as prohibited in the *Fisheries (Alberta) Act*. An angler reported the species and a rapid response team of EP staff was quickly assembled to contain the species and address the issue. The pond was closed immediately, a press release was issued, and signs were erected around the pond noting that an aquatic invasive species was present and access to the pond was restricted. The Rapid Response Team assessed control options and developed an eradication plan. Within a couple of months, a plan was in place and a fish toxicant expert from the US was consulted who assisted with project implementation. The pond was surrounded by public lands that were closed for the treatment period. The pond was treated in the late summer of 2015 and monitoring to date has not detected any of the target species. The pond will be restocked with hatchery trout in the spring. Provincial and federal policies and legislation guided the process and were adhered to at all times. The Rapid Response Team comprised emergency response professionals, policy specialists, and operational staff. The project provided an excellent case study in aquatic invasive species early detection rapid response and will be a model for future responses.

4.5.2 Findings from the Jurisdictional Review

Each of the jurisdictions reviewed has a network of external stakeholders who are made aware of confirmed AIS detection and take part in the communication and coordination of actions to respond quickly to a new infestation. Ultimately, EDRR is most likely to succeed if there is a lead agency to oversee the process, ensuring cooperation and coordination among stakeholders.[38] In most cases, a government agency leads the rapid response effort and coordinates with external stakeholders. Key barriers to effective EDRR systems are inadequate funding and personnel, limited authority in water bodies, no designated lead agency, and the lack of available control options (biological, mechanical or chemical).

38 *Ibid. Page 7.*

4.5.3 Identified Gap in EDRR

The AWC notes that Alberta lacks a rapid response plan for a number of AIS threats. The jurisdictions reviewed all have rapid response protocols in place, which are mainly led and coordinated by a single government agency, depend on effective communication with stakeholders, and have the resources and authority to quickly address early detection events.[39] EDRR is a vital component to a successful AIS program, and work is underway within the GoA to develop a response plan to zebra and quagga mussels. To remain within the scope of the project terms of reference, the AWC identifies as a gap the lack of a provincial rapid response plan for numerous other AIS threats including Asian carp and Eurasian watermilfoil.

4.6 Long-Term Management

Prevention should always be the focus of AIS management, but if EDRR efforts are deemed unsuccessful in eradicating newly-introduced AIS, a long-term management approach is needed. Long-term management typically includes trying to contain and reduce the size of the infestation, curbing the rate of spread, tracking the population through monitoring, and exploring all control options including mechanical, chemical and biological measures. If an AIS population cannot be contained, focus shifts to mitigating the threat to vulnerable assets (e.g., water management structures, irrigation pipelines and other intakes, dams). Figure 2 depicts how the goal of managing AIS evolves as an infestation spreads, from eradication to long-term management and protection of at-risk assets.

39 *Ibid. Page 47.*

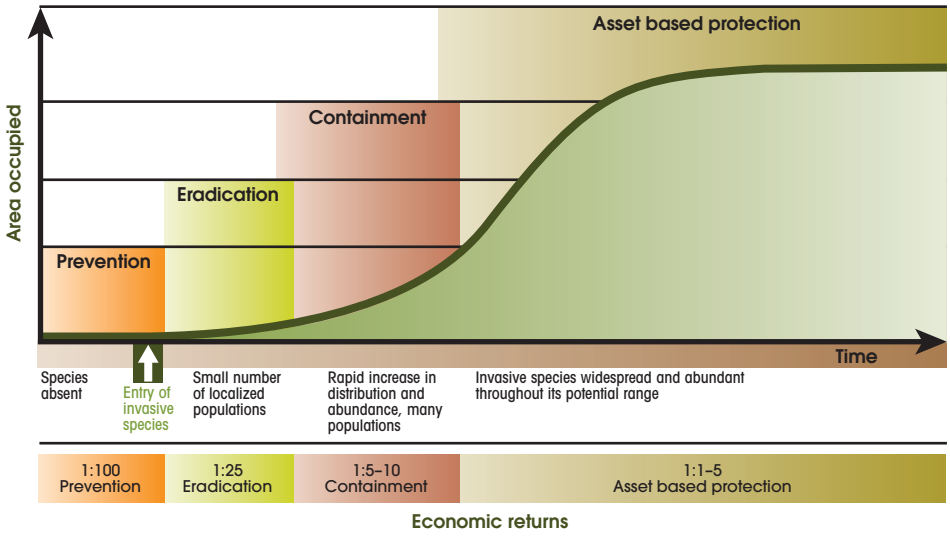

Figure 2. Generalized invasion curve showing actions appropriate to each stage
Government investment in management of invasive species occurs at all stages of invasion – from preventing early entry to managing widespread species. Prevention provides a higher return on investment than eradication, eradication is better than containment, and containment is better that managing the impacts of widespread invasive species.

Source: Department of Primary Industries. Invasive Plants and Animals Policy Framework. 2010. Melbourne, Australia. p. 14.

4.6.1 Long-term Management in Alberta

Alberta has five known AIS, and all are under long-term management. Three are riparian plant species (purple loosestrife, pale yellow iris, and Himalayan balsam), one is a submerged/emergent aquatic plant (flowering rush), and the other is a fish (Prussian carp). Purple loosestrife[40] and flowering rush[41] have been on the landscape in Alberta for decades, while pale yellow iris and Himalayan balsam have arrived more recently. All of the known AIS plant species are listed as prohibited noxious weeds in the *Weed Control Act* and listed as prohibited species in the *Fisheries (Alberta) Act*; they cannot be imported or possessed (including sale and transport). Watershed stewardship groups and non-government organizations in Alberta raise public awareness of these threats and encourage Albertans to help eradicate them.[42, 43]

40 *Control of Purple Loosestrife in Alberta*. September 2011. Agriculture and Forestry. Available online www.1.agric.gov.ab.ca/$department/deptdocs.nsf/all/prm2593. Accessed June 2015.

41 Scotter, G.W. 1991. *Flowering Rush, Butomus umbellatus, a New Record for Alberta.* The Canadian Field-Naturalist. 105(3):387-389. Online at www.biodiversitylibrary.org/item/106992#page/403/mode/1up. Accessed June 2015.

42 Pigeon Lake Watershed Association. *Noxious weeds.* Online at www.plwa.ca/pages/stewardship-education/noxious-weeds. Accessed March 2015.

43 Alberta Invasive Species Council. Online at www.abinvasives.ca/resources. Accessed May 2015.

Several gaps in long-term management of AIS in Alberta have been identified:

- There is no widely accessible program that supports long-term management of AIS, including predictable funding and building taxonomic capacity to identify AIS.
- Mechanical, biological and chemical control options and ongoing management options are lacking.
- Success stories are not well communicated, which can lead to erosion of commitment to long-term management.
- The *Weed Control Act* requires that prohibited noxious species be eradicated; however, accepting that some species need long-term management due to a lack of control options does not meet the intent of the *Act*.

Managing purple loosestrife

Purple loosestrife is a highly invasive AIS that can have a severe negative impact on riverbank and wetland environments. It was observed in Rocky View County in 1990 and, in 1992, Alberta listed purple loosestrife as a prohibited noxious weed. Municipalities including Rocky View County, the City of Calgary, County of Wheatland, and Municipal District of Foothills, have been working together since 1998 to document the extent of purple loosestrife along the Bow River from Calgary to Carseland. The municipalities have successfully reduced the amount of purple loosestrife found along the Bow River from a high of more than 100,000 plants in 1999, down to about 100 plants in 2011, a reduction of more than 99%.

Source: Rocky View County media release Sept. 10, 2012. Online at www.rockyview.ca/NewsEvents/News/tabid/145/Article/817/Rocky-View-County-works-with-other-municipalities-to-reduce-invasive-aquatic-we.aspx. Accessed May 2015.

Purple loosestrife

Photo credit: Nicole Kimmel, Agriculture and Forestry

4.6.2 Findings from the Jurisdictional Review

In all jurisdictions reviewed, long-term management is part of their AIS programs. In all US jurisdictions, long-term management includes containment of an infestation, while Minnesota and Oregon also include eradication as part of their long-term management efforts. Common considerations for implementing long-term management measures include the scale of infestation, the likelihood of success, ecological and economic benefits, and cost. Containment measures often include partitioning off part of a water body (lake, river) or watershed, whereas Texas specifically implements containment to within its state boundaries if local containment is impossible.

All jurisdictions confirmed that mechanical, chemical and biological control methods are among their long-term management tools. Common mechanical options included removal by divers, harvesting fences (specific to carp), and draw downs. Chemical options are often used, but are subject to approvals from the Environmental Protection Agency and the Food and Drug Administration in the United States. In Canada, the Pest Management Regulatory Agency registers pesticides, and the use of pesticides is also subject to provincial regulation.[44] The major challenges to long-term management include lack of funding, lack of chemical management tools and trained personnel, and the public's perception and acceptance of control measures.

4.6.3 Recommendations — Long-Term Management

Recommendation 2: The Government of Alberta collaborate with and support industry, non-government organizations, academia and other orders of government to develop and disseminate effective AIS tracking and control options for long-term management by the end of 2018.

Recommendation 3: The Government of Alberta work with its partners to communicate success stories of AIS management.

44 Health Canada. Archived June 2013. *Fact Sheet on the Pest Management Regulatory Agency.* Online at www.hc-sc.gc.ca/cps-spc/alt_formats/pdf/pubs/pest/_fact-fiche/sheet_PMRA-fiche_ARLA-eng.pdf. Accessed September 2015.

4.7 Monitoring

Regular monitoring of water bodies is vital for early detection of AIS and to determine if control measures are effective or if existing infestations are spreading. Visual inspections and testing of water samples are some of the techniques used to ascertain whether AIS have been introduced or become established. Monitoring activities are typically led by a government agency, and depend in part on support from citizen science programs. Citizen scientists are usually members of the general public who have an interest in contributing to preventing or managing AIS threats without necessarily having personal risk if an infestation were to occur.

4.7.1 Monitoring in Alberta

Prior to 2013, no government-led AIS monitoring was happening in Alberta although a number of other stakeholders were monitoring their local water bodies informally and voluntarily. During the AIS prototype in the Crown of the Continent Ecosystem, formal monitoring for invasive mussels was initiated using provincial surface water quality monitoring staff. Two types of monitoring are used for invasive mussels in Alberta — plankton tows for veligers (larval phase of mussels), and artificial substrates (PVC pipes that are hung from docks and other submerged infrastructure to check for attached adult mussels). In 2013, 55 water bodies were monitored for invasive mussels and in 2014, 73 water bodies were monitored with no indication that mussels were present.

Since the creation of the provincial AIS program, a new arms-length monitoring organization, the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) has been established. Part of AEMERA's mandate is to provide timely and objective monitoring, evaluation and reporting of information on water and biodiversity to better inform the understanding of the public, policy makers, regulators, planners, researchers, communities, and industry.

AEMERA coordinates ambient environmental monitoring of Alberta's lakes, streams and rivers including chemical, physical and biological measures. In addition, the Agency is responsible for developing monitoring methods, standards and protocols and will provide training to partners and stakeholders. AEMERA coordinates monitoring of non-fish AIS as part of its surface water quality monitoring activities.

AEMERA monitors for invasive mussels in lakes across the province. This work has been augmented by partners such as AF, which monitors selected irrigation reservoirs in southern Alberta, the Alberta Lake Management Society (ALMS), and provincial parks staff. In addition, a joint aquatic plant monitoring pilot by AEMERA and ALMS was initiated in 2014 to (a)

incorporate aquatic invasive plant surveys into the *LakeWatch* citizen science program, and (b) conduct littoral plant surveys on a handful of recreational lakes.

Roughly 20% of survey respondents or a group they are affiliated with monitor for AIS. The most commonly monitored AIS — purple loosestrife and flowering rush — have been in Alberta since the 1990s. Some respondents reported monitoring for any species that are listed as "noxious" or "prohibited noxious" in the *Weed Control Act* regulations. Others indicated that they are monitoring for species that pose significant threats to Alberta water bodies that are not necessarily listed in the regulations of the *Weed Control Act* or the *Fisheries (Alberta) Act* schedule of prohibited species.

Some of the interviewees suggested that more resources should be allocated to design and implement monitoring programs to ensure early detection rapid response is possible to mitigate the potential damage of AIS invasions.

Identified gaps for AIS monitoring in Alberta include:

- A lack of comprehensive multi-taxa monitoring; current efforts are focused on zebra and quagga mussels, but additional emphasis needs to be put on monitoring for aquatic invasive plants, invertebrates and fish
- Lack of a formal sustainable funding model for provincial AIS monitoring

4.7.2 Findings of the Jurisdictional Review

All reviewed jurisdictions undertake monitoring as part of their AIS strategy. In the US, state departments lead and coordinate monitoring efforts with the support of stakeholders. In Ontario, AIS monitoring is integrated with existing government aquatic monitoring and citizen science programs that have objectives other than AIS detection.

Monitoring frequency, locations and rationale in programs directed specifically at AIS vary by jurisdiction. Some jurisdictions decide where to monitor based on the perceived risk of invasion, while others use randomized sampling or respond to reported sightings.

The most common barrier to monitoring noted in the jurisdictional review was a lack of funding and personnel, although a lack of public awareness and the inability of the public to identify AIS were also noted. Some jurisdictions are trying to address the issues of public awareness with programs aimed at increasing public involvement and expertise. Representatives from several jurisdictions thought that more collaboration with partners, such as invasive species councils, lake associations and conservation groups, would benefit early detection efforts.

4.7.3 Recommendation — Develop a Monitoring Plan

Recommendation 4: The Government of Alberta work with AEMERA to develop and begin implementing a provincial AIS monitoring plan for fish, invertebrates and aquatic plants, with assistance from stakeholders, including citizen scientists, by spring 2017.

4.8 Policy and Legislation

Another critical component of an effective AIS system is the policy and legislation that enables government and stakeholders to prevent threats and manage existing invasions. Legislation, policies and regulations provide authority and establish roles and responsibilities for the individuals responsible for delivering the various aspects of an AIS prevention and management system. Strong policy and legislation need to be the foundation of a successful multi-faceted AIS program.

4.8.1 Policy and Legislation in Alberta

Invasive species management in Alberta is regulated under various pieces of provincial legislation: the *Weed Control Act,* the *Fisheries (Alberta) Act,* and the *Agricultural Pests Management Act.* The *Weed Control Act* and *Fisheries (Alberta) Act* are the most relevant pieces of provincial legislation to AIS management. The regulations associated with the *Weed Control Act* provide lists of "noxious"[45] species and "prohibited noxious"[46] species which require action by the landowner should those species be found. Eurasian watermilfoil, flowering rush, Himalayan balsam, pale yellow iris and purple loosestrife are listed as "prohibited noxious" weeds in the *Weed Control Act*.

In general, the regulations of the *Weed Control Act* apply to invasive plants, and the schedule of prohibited species in the *Fisheries (Alberta) Act* restrict the importation and possession of 52 species, including aquatic invasive plants, invertebrates and fish.[47] The list of 52 restricted species is included in this report for easy reference in Appendix C. Prior to the passage of amendments in March 2015, the *Fisheries (Alberta) Act* restricted the possession of only three species: two lamprey species (*Lampetra sp.* and *Ichthyomyzon sp.)* and zebra mussels (*Dreissina polymorpha).*[48]

45 Part 1 of the Alberta *Weed Control Act* states that "A person shall control a noxious weed that is on land the person owns or occupies."

46 Part 1 of the Alberta *Weed Control Act* states that "A person shall destroy a prohibited noxious weed that is on land the person owns or occupies."

47 *Fisheries (Alberta) Act*, amended March 30, 2015. Online at www.qp.alberta.ca/documents/Acts/F16.pdf. Accessed September 2015.

48 General Fisheries (Alberta) Regulation. Section 42, Restricted possession. www.qp.alberta.ca/documents/Regs/1997_203.pdf. Accessed January 2015.

In addition to the schedule of prohibited species, the recently amended *Fisheries (Alberta) Act* also provides for mandatory inspections of watercraft and other AIS conveyances, authority to stop and determine the risk of travelling watercraft, quarantine measures in the case of AIS-fouled conveyances or infested water bodies, and the ability to address other AIS matters through provincial Ministerial Order or regulation. A signed provincial Ministerial Order articulates who, under the amended *Act*, is required to stop for an inspection if they are passing an inspection station that is open; the Order requires all watercraft to stop at any open inspection station, including those on highways or at boat launches.[49]

Many survey respondents and interviewees noted that stronger legislation is needed in Alberta to support practitioners in dealing with invasive species. It was consistently noted that the regulations in the *Fisheries (Alberta) Act* need to be expanded to reflect the known AIS threats Alberta faces. The GoA's cross-ministry team on policy and legislation reached a similar conclusion, and suggested amending the *Fisheries (Alberta) Act* accordingly.

The Federal *Fisheries Act* also affects AIS prevention and management in Alberta, as it authorizes the federal government to restrict listed species. Recently approved federal AIS regulations include prohibiting the importation, possession and transportation of zebra mussels, quagga mussels and four species of Asian carp (silver, black, bighead and grass).

Many high-risk watercraft enter Alberta from the US, and all vehicles must stop at the international border crossing point. Canadian Border Services Agency officers have the authority to inspect watercraft and other conveyances crossing the border for the presence of prohibited species. Prohibiting the importation or possession of such species adds a layer of defense that benefits all provinces' efforts to prevent and manage AIS introductions.[50] The federal AIS regulations are being implemented and EP participates on the National Aquatic Invasive Species Committee, a cross-Canada organization that drafted the regulations and will oversee their implementation.

49 Ministerial Order 30-2015 under section 32 of the *Fisheries (Alberta) Act*. Accessed May 2015.

50 "Changes to the Fisheries Act". Fisheries and Oceans Canada. Online at www.dfo-mpo.gc.ca/pnw-ppe/changes-changements/index-eng.html. Accessed January 2015.

4.8.2 Findings from the Jurisdictional Review

Four of the six jurisdictions reviewed by the team have stand-alone legislation focused on invasive species in general or AIS in particular. The other two jurisdictions have several pieces of legislation to cover the various aspects of AIS, similar to the approach used in Alberta.

A variety of approaches are used by these jurisdictions to apply prohibitions to AIS. Some prohibit possession while others restrict trade, transportation, import and export. Each jurisdiction has a process to classify species as invasive, and each requires eradication or management. Some jurisdictions have targeted vectors of transport, such as boat trailers and associated equipment, within their legislation to further strengthen their efforts.

Suggestions were gathered from the six jurisdictions for improving existing approaches to policy and legislation:

- Regulate more AIS (Ontario);
- Prohibit overland transport of aquatic vegetation (Idaho);
- Better coordinate activities between adjacent jurisdictions (Minnesota); and
- Increase authority to: inspect commercial vessels (Idaho), close infested water bodies (Oregon), and track individual boats (Utah).

The lack of political will and understanding of the AIS issue is often a key barrier to strengthening policy and legislation. Respondents from Minnesota suggested that it is critical to communicate success stories of AIS prevention and management to policy makers to garner support.

4.8.3 Identified Gaps in Policy and Legislation

Making recommendations on policy and legislation is beyond the scope of this project. At the time this report was drafted, the commentary suggested that there was a gap in the policy and legislation aspect of Alberta's AIS prevention and management system. The AWC was informed that policy work within EP would be considering how to address that gap, and the GoA has since amended the legislation to provide for a more robust AIS program.

4.9 Inspections

While some jurisdictions refer to inspections as "surveillance," Alberta uses the term "inspections" to differentiate them from environmental monitoring activities. For the most part, inspections refer to the physical examination of trailered watercraft — the most likely source of AIS introductions. Alberta implemented an inspection component to the AIS program in 2013 and has continued to expand this component. Many other jurisdictions, particularly in the western US, have been conducting inspections for a number of years. Watercraft inspections typically focus on quagga and zebra mussels, although they also prevent the spread of other AIS by removing plants, mud, standing water or other debris found on watercraft and ensuring the watercraft are clean, drained, and dry before they leave the inspection site.

4.9.1 Inspections in Alberta

When watercraft inspections began in Alberta in 2013, nearly 400 boats were inspected in southern Alberta. In 2013–2014, EP piloted the use of commercial weigh stations at four locations on major highways entering the province and in 2014 inspected more than 3,700 boats, many of which were considered high risk because they were coming from a jurisdiction that was known to be infested with mussels. In 2014, EP partnered with Working Dogs for Conservation in Montana to initiate a mussel sniffer dog pilot to augment the inspection program. In other jurisdictions, sniffer dogs have expedited the inspection process with great accuracy, and this is believed to be necessary in Alberta, especially at the busy international border. This was a very successful pilot and efforts are underway to establish the component as a permanent part of the program.

Inspections rely on sniffer dogs and portable decontamination stations in Alberta

Photos Credit: Cindy Sawchuk, Agriculture and Forestry

4.9.2 Findings from the Jurisdictional Review

All six jurisdictions examined in the review conduct watercraft inspections and four have made inspections mandatory. The main goals of their inspections are to prevent AIS from being introduced and to verify and enforce compliance with AIS regulations. Secondary goals include education and data collection for the purposes of risk assessment and future planning. Inspections in these jurisdictions commonly focus on major highways at state and provincial borders, live fish markets, bait shops, and online sources.

Inspections in these jurisdictions are commonly overseen by state or provincial departments in natural resources or wildlife sectors, and are performed by conservation officers, biologists, and seasonal technicians. The most common challenges to an effective inspection program were resources related to funding and staffing, and legal barriers.

Identified gaps in Alberta include:

- A lack of user-based funding (such as fines and fees), to build up and ensure adequate financial and human resources and coverage of mandatory and permanent watercraft inspections now and into the future.
- A need to expand inspections to include other potential AIS vectors besides watercraft (e.g., containers, equipment, live-bait vendors, aquarium and pet stores, and retail stores that sell live food fish).

4.9.3 Recommendation — Inspections

Recommendation 5: The Government of Alberta maintain the mandatory watercraft inspections element of the AIS program and also begin inspecting other vectors of potential introduction by 2017. This should include working with stakeholders where inspections are planned to raise the profile of the issue and increase buy-in from the public.

4.10 Enforcement

Enforcement is an essential part of any AIS program that is supported by legislated policies or regulations. The possibility of being caught and penalized for failing to comply is an incentive for most people to adopt the behaviours specified in the laws. Enforcement is a challenging aspect of any AIS management program, given that preventing an AIS introduction may not be given the same level of importance by authorities as other issues, and this is cited as a struggle in many jurisdictions. However, without legislated policies and regulations to prevent the spread of AIS, the focus can only be on education, which, by itself, is insufficient.

4.10.1 Enforcement in Alberta

Lack of compliance with AIS legislation and regulations in Alberta includes subjects not stopping for a mandatory watercraft inspection, failing to follow the order of a fishery officer or fishery guardian, refusing to provide information on the history or risk of the conveyance in question, importing or possessing prohibited species, and transporting or introducing live fish or AIS into water bodies. Failure to comply may result in a court appearance where subjects face penalties of up to $100,000 and a year in prison; corporations face fines of up to $500,000.

Regulations pertaining to the AIS listed in the *Weed Control Act* are enforced by municipal and provincial weed inspectors. This occurs mainly when prohibited noxious or noxious weeds are found on private lands.

4.10.2 Findings from the Jurisdictional Review

State or provincial departments, including the lead AIS agency and law enforcement officials, are responsible for enforcing applicable AIS regulations. In some jurisdictions, the penalty is a fine or warning, while other jurisdictions are more stringent, requiring impoundment and quarantine of watercraft that are suspected to be infested with AIS, or even incarceration. In jurisdictions where mandatory watercraft inspections are specifically included in applicable legislation and policies, fouled boats and trailers require decontamination, and can also be seized and quarantined and fines issued.

Tickets and violations are recorded in all US jurisdictions reviewed, and in some jurisdictions, such data are used to inform decisions on program effectiveness. The main challenges to enforcement were cited as funding and personnel. Further to challenges with personnel, the main issues were lack of education on the importance of enforcing regulations, and subsequent lack of enforcement.

A clearly identified gap in Alberta relates specifically to enforcement, but also to many other components of an AIS prevention and management program. This is the need to gather accurate data on all aspects of AIS management and enforcement so that the AIS program can be continually improved. Such data could include:

- the quantity, origin and destination of boat traffic;
- what live fish and plants that may be AIS are being imported and if they are available at retail stores (e.g., bait shops, pet stores); and
- incidences of risk vectors that are not well tracked (e.g., cultural releases).

4.10.3 Recommendations — Supporting Enforcement

Recommendation 6: The Government of Alberta have a protocol in place by the spring of 2017 to ensure that fishery officers and fishery guardians are educated and trained on their authority to enforce AIS legislation and policies.

Recommendation 7: The Government of Alberta share information on enforcement activities and potential penalties with stakeholders and the public to raise the profile of the AIS issue.

5.0 Conclusion

AIS pose significant threats that could adversely affect aquatic ecosystems, the economy, recreational opportunities and human health. Many groups and individuals in Alberta are aware of the threat and have been taking action to prevent or manage AIS, although until recently, a formal provincial-scale plan to address these threats was lacking. Albertans want to be involved in preventing AIS from entering the province and in managing existing threats, but seek leadership, expertise and support from the government to do so. Some jurisdictions that deal with established AIS have developed AIS management plans or strategies that rely largely on the support of stakeholders to prevent the spread of AIS to unaffected areas. Building on the experience of local stakeholders and of other jurisdictions, the AWC believes the recommendations in this report, when implemented, will support the development of a holistic AIS management approach in Alberta. The recommendations address identified opportunities to improve general awareness of the issue, communication among stakeholders and coordination of activities in support of preventing AIS from becoming established in Alberta and effectively managing those that are already present.

Appendix A — Terms of Reference

Aquatic Invasive Species Stakeholder and Jurisdictional Review

Project Team Terms of Reference

Approved by the Alberta Water Council on June 13, 2013. Timelines amended on March 19, 2015.

CONTEXT

In October 2012, the Council approved undertaking an initiative regarding aquatic invasive species based on a statement of opportunity titled *"Safeguarding Alberta's Water Supplies and Ecosystems from Aquatic Invasive Species"*, brought forward by the Government of Alberta. This initiative was started in March 2013.

Aquatic invasive species are becoming increasingly problematic across Canada and the United States, negatively impacting economic and social activities, and aquatic ecosystems. Some of the economic and social impacts include significant costs associated with maintaining affected water structures, and reduction or loss of recreational pursuits. Aquatic ecosystems are affected when invasive species out-compete native species for habitat and resources; they can also alter water chemistry, food webs and communities.

Alberta has been relatively unaffected compared to other jurisdictions in North America. However, the province is increasingly at risk of aquatic invasive species establishing themselves via many pathways. Many groups are conducting on the ground work in specific areas of Alberta to prevent their establishment but such efforts are not consistent or coordinated across the province. This project is an opportunity to build on to existing work and develop recommendations that would improve coordination of the efforts of all the stakeholders involved in preventing and managing existing and emerging threats to our aquatic ecosystems.

STRATEGIC INTENT (GOAL)

The purpose of this project is to identify gaps and opportunities for improving awareness, communication and coordination of activities by stakeholders in Alberta that are working to prevent and manage the threats of aquatic invasive species. This work will include a review of other jurisdictions' prevention and management strategies; how their stakeholders are working together to achieve shared outcomes and how these strategies can be adapted or improved for Alberta.

OBJECTIVES

- Document the current prevention and management approaches to inform the team about the current state of aquatic invasive species in Alberta
- Document the current prevention and management approaches for aquatic invasive species in other jurisdictions
- Determine the need for a common definition for aquatic invasive species
- Evaluate barriers to and opportunities for improving aquatic invasive species prevention and management within Alberta
- Develop recommendations that could improve awareness, communication and coordination of activities to respond to threats from aquatic invasive species.

KEY TASKS

- Build a work plan and operate according to its tasks and timelines
- Design and conduct a survey of key stakeholders in Alberta to understand their current prevention and management approaches for aquatic invasive species. For example:
  - What are your threats? Do you have a monitoring system to detect threats? Do you have a response plan to threats and incidents? What barriers and opportunities do you see?
- Engage a consultant to conduct a review of prevention and management approaches from governments and their stakeholders for aquatic invasive species from selected jurisdictions that have similar characteristics to Alberta. The review should include aspects of: existing and emerging threats; monitoring and response plans; barriers and opportunities; legislation; governance structures; funding; education programs; definitions of aquatic invasive species; and potential economic impacts
- Evaluate barriers to and opportunities for improving aquatic invasive species prevention and management within Alberta
- Develop recommendations that could improve awareness, communication and coordination of activities to respond to threats from aquatic invasive species
- Prepare a report with recommendations
- Provide regular updates to the Council

TIMELINES and DELIVERABLES

The Project Team will provide the following deliverables to the Alberta Water Council:

- Present findings from survey..... March 2014
- Approve the definition of aquatic invasive species (if needed)..... March 2014
- Draft recommendations..... June 2015
- Final report with recommendations..... October 2015

MEMBERSHIP

The following sectors and groups have been identified as potentially having an interest in participating on the Project Team:

Irrigation, Power Generation, Oil and Gas, Mining, Large Urban Municipalities, Small Urban Municipalities, Rural Municipalities, the Alberta Lake Management Society, Fisheries Habitat Conservation, Wetlands Conservation, Watershed Planning and Advisory Councils, Watershed Stewardship Groups, Alberta Environment and Sustainable Resource Development, Alberta Agriculture and Rural Development, Alberta Tourism, Parks and Recreation, Alberta Innovates — Energy and Environment Solutions, Federal Government, Alberta Invasive Plants Council, Canadian Council on Invasive Species, Canadian Aquatic Invasive Species Network. Other groups may be identified as potential contributors or recipients of the information (or targeted with the survey) without necessarily being members of the Project Team.

The Project Team will meet regularly and will operate in a manner that is consistent with the rules, policies and procedures adopted by the Alberta Water Council, including the use of consensus to make decisions in a multi-stakeholder process.

All members of the Project Team will participate actively and will take on tasks such as proposing options/solutions, providing data and information, drafting documents, consulting with stakeholders and hosting meetings.

BUDGET

The estimated budget for this project is $75,000:

Core funding Costs (provided by Alberta Water Council)	
Stakeholder Support	$25,000
Hosting	$10,000
Communications support	$10,000
Project Funding Costs (provided by Alberta Water Council sectors)	
Report to assess management and prevention approaches in other jurisdictions	$30,000

Appendix B — Acknowledgements

The Alberta Water Council acknowledges the contributions of the following working group and project team members who volunteered their time and expertise on this project:

Dave Hayman	City of Calgary
Glenn Isaac	TransAlta Corporation
Mike Jenkins	City of Edmonton
Carolyn Kolebaba	Alberta Association of Municipal Districts and Counties
Daniel Laubhann	City of Edmonton
Brian Meagher	Trout Unlimited Canada
Ron McMullin	Alberta Irrigation Projects Association
Lesley Petersen	Trout Unlimited Canada
Nicole Seitz Vermeer	Alberta Agriculture and Forestry
Jon Sweetman	Alberta Innovates — Energy and Environment Solutions
Joan Tingley	ATCO Power
Jay White	Alberta Lake Management Society
Jon Willis	Alberta Environment and Parks
Kate Wilson	Alberta Environment and Parks
Ron Zurawell	Alberta Environmental Monitoring, Evaluation and Reporting Agency
Andre Asselin	Alberta Water Council
Anuja Ramgoolam	Alberta Water Council
Marie-Claire St-Jacques	Alberta Water Council

The following organizations generously provided invaluable financial support required to undertake the jurisdictional review:

- Alberta Agriculture and Forestry
- Alberta Environment and Parks
- Alberta Irrigation Projects Association
- Bow River Irrigation District
- City of Calgary
- City of Edmonton
- Taber Irrigation District
- TransAlta Corporation

The AWC thanks the 247 survey respondents who took their time to provide valuable information by completing the online survey. This work would not have been possible without your contributions.

The following interviewees provided valuable advice and perspectives that informed this report. The AWC thanks them for their time and expertise:

Interviewees for the state of AIS management in Alberta:

Steve Callaghan	Alberta Justice and Solicitor General
Tim Dietzler	Rocky View County
Jaquie Dumont	Alberta Justice and Solicitor General
Pat Dunford	Alberta Environment and Parks
Rachel Duval	Fisheries and Oceans Canada
Bill Hunt	Parks Canada
Nicole Kimmel	Alberta Agriculture and Forestry
Joelle Shelton	Canada Border Services Agency
Maureen Vadnais	Alberta Agriculture and Forestry
Jim Wagner	Alberta Environment and Parks

Interviewees for the jurisdictional review:

Rick Boatner	Department of Fish & Wildlife (Oregon)
Jeff Brinsmead	Ministry of Natural Resources (Ontario)
Justin Bush	Lady Bird Johnson Wildflower Center (Texas)
Dr. Earl Chilton	Parks and Wildlife Department (Texas)
Doug Jensen	Minnesota Sea Grant (Minnesota)
Francine Macdonald	Ministry of Natural Resources (Ontario)
Jordan Nielson	Division of Wildlife Resources (Utah)
Mark Sytsma	Center for Lakes & Reservoirs — Portland State University (Oregon)
Chip Welling	Department of Natural Resources (Minnesota)
Thomas E. Woolf	Department of Agriculture (Idaho)

Appendix C — Schedule of Species Restricted in the *Fisheries (Alberta) Act* and Conditions for Import and Possession Exemptions to Apply

This schedule is taken from page 36 the *Fisheries (Alberta) Act*, available here: www.qp.alberta.ca/documents/Acts/F16.pdf.

Common Name	Scientific Name	Conditions for import and possession exemptions to apply
Bowfin	*Amia calva*	Dead and eviscerated
Green sunfish	*Lepomis cyanellus*	Dead
Pumpkin seed	*Lepomis gibbosus*	Dead
Bluegill	*Lepomis macrochirus*	Dead
Snakehead (whole family)	*Channidae spp.*	Dead
Alewife	*Alosa pseudoharengus*	Dead and eviscerated
Oriental weather loach	*Misgurnus anguillicaudatus*	Dead
Red shiner	*Cyprinella lutrensis*	Dead
Utah chub	*Gila atraria*	Dead
Black carp	*Mylopharyngodon piceus*	Dead and eviscerated
Largescale silver carp	*Hypophthalmichthys harnandi*	Dead and eviscerated
Silver carp	*Hypophthalmichthys molitrix*	Dead and eviscerated
Bighead carp	*Hypophthalmichthys nobilis*	Dead and eviscerated
Orfe or ide	*Leuciscus idus*	Dead
Common rudd	*Scardinius erythrophthalmus*	Dead
Tench	*Tinca tinca*	Dead
Round goby	*Neogobius melanostomus*	Dead
Tubenose goby	*Proterorhinus marmoratus*	Dead
Black bullhead	*Ameiurus meias*	Dead
Yellow bullhead	*Ameiurus natalis*	Dead
Brown bullhead	*Ameiurus nebulosus*	Dead
White perch	*Morone americana*	Dead

Common Name	Scientific Name	Conditions for import and possession exemptions to apply
Ruffe	*Gymnocephalus cernuus*	Dead
Zander	*Sander lucioperca*	Dead
Western mosquitofish	*Gambusia affinis*	Dead
Flowering rush	*Butomus umbellatus*	No Exemptions
Eurasian watermilfoil	*Myriophyllum spicatum*	No Exemptions
Purple loosestrife	*Lythrum salicaria*	No Exemptions
Himalayan balsam	*Impatiens glandulifera*	No Exemptions
Yellow flag iris	*Iris pseudacorus*	No Exemptions
European frog-bit	*Hydrocharis morsus-ranae*	No Exemptions
Water soldier	*Stratiotes aloides*	No Exemptions
Yellow floating heart	*Nymphoides peltata*	No Exemptions
European water chestnut	*Trapa natans*	No Exemptions
Hydrilla	*Hydrilla verticillata*	No Exemptions
Phragmites	*Phragmites australis*	No Exemptions
Curly leaf pondweed	*Potamogeton crispus*	No Exemptions
Brazilian elodea	*Egeria densa*	No Exemptions
Fanwort	*Cobomba caroliniana*	No Exemptions
Variable-leaf watermilfoil	*Myriophyllum heterophyllum*	No Exemptions
Giant salvina	*Salvinia molesta*	No Exemptions
Zebra mussel	*Dreissena polymorpha*	No Exemptions
Quagga mussel	*Dreissena rostriformis bugensis*	No Exemptions
Golden mussel	*Limnoperna fortunei*	No Exemptions
Channeled applesnail	*Pomacea canaliculata*	Dead
Facet snail	*Bithynia tentaculata*	Dead
Asian tapeworm	*Bothriocephalus acheilognathi*	Dead
Spiny water flea	*Bythotrephes cederstroemi*	Dead
Fish hook water flea	*Cercopagis pengoi*	Dead
Asian clam	*Corbicula fluminea*	Dead
New Zealand mud snail	*Potamopyrgus antipodarum*	Dead
Chinese mystery snail	*Cipangopaludina chinesis*	Dead

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