Date: December 19th 2017

From: Marci Riel (Manitoba Metis Federation)

To: Candida Cianci, Environmental Assessment Specialist
Canadian Nuclear Safety Commission

By email: cnsc.ea-ee.ccsn@canada.ca

Subject line: Manitoba Metis Federation: Review of Draft EIS_Decommissioning_Whiteshell

CEAA Reference number: 80124

Comments:

Good afternoon Candida,

Attached is the Manitoba Metis Federation's report on the technical review of the draft Environmental Impact Statement for the proposed In Situ Decommissioning of the Whiteshell Nuclear Reactor #1 Project. If you have any questions, please contact me directly. Thank you.

Regards,

Marci Riel

Marci Riel
Director, Energy and Infrastructure
Manitoba Metis Federation

Whiteshell Reactor Decommissioning Project Technical Review

Technical Review of the Draft Environmental Impact Statement

Prepared for:

Manitoba Métis Federation

Scott Mackay, MSc, RPP, MCIP
(226) 706 – 8888 ext. 102
scott.mackay@sharedvaluesolutions.com

62 Baker Street
Guelph, ON, Canada
N1H 4G1

Shared Value Solutions

1.0 Introduction

The Decommissioning of the Whiteshell Reactor No 1 is undergoing a Federal Environmental Assessment (EA). The EA is being administered by the Canadian Nuclear Safety Commission (CNSC), the Responsible Authority under the Canadian Environmental Assessment Act. The EA process is intended to assess how a proposed project may cause changes to the biophysical and socio-economic environment and whether those effects are adverse and significant. It includes an assessment of potential impacts to Indigenous people. Shared Value Solutions (SVS) has been retained by the Manitoba Métis Federation (MMF) to undertake a technical review of the Whiteshell Reactor No 1 Decommissioning Project (the Project) to support the Manitoba Métis Community (MMC) in this process. The objectives of our review are outlined below:

- Provide a plain language explanation of the scope and nature of the Whiteshell Project
- Clearly identify where the MMC's rights and interests overlap with and may be impacted by the Whiteshell Project
- Identify environmental and technical issues with the Draft EIS, and provide recommendations on where and how MMC's rights and interests may need to be better accommodated through revisions and additions to the Final EIS and Project plan
- Identify issues and challenges with the Project that will require ongoing engagement and consultation with MMF on behalf of the MMC

1.1 Project Description

The Whiteshell Reactor No 1 (WR-1) is located at the Whiteshell Laboratories (WL) site in southeastern Manitoba, near Pinawa. WR-1 was constructed in the early 1960s by Atomic Energy of Canada Limited (AECL) and reached full operation in 1965. WR-1 is a 60 MW thermal nuclear reactor that was historically used as a research reactor to explore the feasibility of using an organic-cooled reactor, and to carry out a variety of engineering and scientific experiments (e.g. alternative fuel sources, fuel channels and reactor coolants). WR-1 was permanently shut down in 1985 and in the early 1990s, the reactor was defueled and underwent preliminary decommissioning.

The Project Proponent, Canadian Nuclear Laboratories (CNL), is a private-sector company, contracted by AECL (a crown corporation) to decommission the WL site, including WR-1. The decommissioning approach previously approved for WR-1 (Licence No NRTEDL-W5-8.04/2018) included the removal and remediation of all activated and contaminated components of WR-1 and associated facilities, including the reactor core. At this time, however, there is no approved long-term nuclear waste disposal facility in Canada, and therefore, the Proponent is proposing to demolish the WR-1 building and decommission the nuclear waste in situ ("ISD" – In Situ Decommissioning). This will involve the demolition and removal of above-ground buildings and facilities (two stories). The below-ground structures and facilities,

including the reactor and radiological hazards, will be permanently disposed of on-site. These will be protected with an engineered cover that is intended to prevent intrusion of soil and groundwater and allow the radioactive contaminants to decay to safe levels. All other previously approved decommissioning activities are assumed to be unchanged.

Upon completion of the decommissioning program, the Whiteshell site will be under 300 years of Institutional Control, with active monitoring occurring for the first 100 years. Table 1.2-1 shows the proposed decommissioning phases and schedule (CNL, 2017).

Table 1.2-1: WR-1 Decommissioning Project Phases and Schedule

Phase	Activity	Duration
Closure	Preparation for In Situ Decommissioning	2019 to 2021
	Grouting of Below-grade Systems and Structures	2021
	Removal of Above-grade Structures	2021 to 2022
	Installation of Engineered Cover	2022 to 2023
	Final Site Restoration	2023
	Preparation for Institutional Control	2024
Post-closure	Institutional Control (Active)	2024 to 2124
	Institutional Control (Passive)	2024 to 2324
	Post-Institutional Control (Passive)	Beyond 2324

1.2 Regulatory Process

The Whiteshell Project is subject to a Federal environmental assessment (EA) by Responsible Authority, as a "designated project" under Section 35 (Regulations Designating Physical Activities) of CEAA, 2012 for "the construction, operation and decommissioning of a new nuclear fission or fusion reactor." For this decommissioning project, the Responsible Authority is the Canadian Nuclear Safety Commission (CNSC).

The Environmental Impact Statement (EIS) is CNL's submission to the CNSC, which, if approved, will subsequently result in the CNSC issuing its own summary report on the Project and EA process as a basis for a regulatory decision regarding the decommissioning program. If it is determined that there are no significant adverse residual effects as a result of the Project, the CNSC will issue a decision to support the Project. If it is determined that there are significant residual effects from the Project, then the CNSC will issue a recommendation to the Minister of Natural Resources including the findings of their review. The final decision regarding whether such Project effects are justified under the circumstances, and subsequently, if the Project should be approved, rejected or approved with conditions, will by made by the Minister and Governor-in-Council (Cabinet).

Other federal and provincial permits, licenses, and authorizations that may be required include:

- permits from Environment Canada for on-site petroleum storage tanks; and
- waste generator registration under the *Dangerous Goods Handling and Transportation Act* from Manitoba Conservation and Water Stewardship.

All EA and permit processes for the Whiteshell Project involve Crown conduct that has the potential to trigger the Crown's duty to consult and, where appropriate, accommodate the Manitoba Métis Community. CEAA 2012 also has specific requirements under Section 5 (c) of the Act for assessing the effects of changes to the biophysical environment on Aboriginal peoples—including the MMC—which may be caused by a project, including:

- effects on current use of lands and resources for traditional purposes;
- effects on health or socio-economic conditions; and
- effects on archaeological or cultural heritage.

As such, the review of the Draft EIS was conducted through the lens of potential impacts to MMC's rights and interests.

2.0 Manitoba Métis Community

2.1 History and Identity

The Métis Nation—as a distinct Indigenous People—evolved out of relations between European men and First Nations women who were brought together as a result of the early fur trade in the Northwest. In the eighteenth century, both the Hudson Bay Company and the Northwest Company created a series of trading posts that stretched across the upper Great Lakes, through the western plains, and into the northern boreal forest. These posts and fur trade activities brought European and Indigenous peoples into contact. Inevitably, unions between European men—explorers, fur traders, and pioneers—and Indigenous women were consummated. The children of these families developed their own collective identity and political community so that "[w]ithin a few generations the descendants of these unions developed a culture distinct from their European and Indian forebears" and the Métis Nation was born—a new people, indigenous to the western territories *(Alberta (Aboriginal Affairs and Northern Development) v. Cunningham*, [2011] 2 SCR 670 at para. 5; *R. v. Goodon*, 2008 MBPC 59 at para. 25; *Manitoba Métis Federation Inc. v. Canada (Attorney General)*, [2013] 1 SCR 623 at para. 2).

The Métis led a mixed way of life. "In early times, the Métis were mostly nomadic. Later, they established permanent settlements centered on hunting, trading and agriculture" (*Alberta v. Cunningham*, at para. 5). The Métis were employed by both of the fur trades major players, the Hudson's Bay and Northwest companies. By the early 19th century, they had become a major component of both firms' workforces. At the same time, however, the Métis became extensively involved in the buffalo hunt. As a people, their economy was diverse; combining as it did, living off the land in the Aboriginal fashion with wage labour (*MMF Inc. v. Canada*, at para. 29).

It was on the Red River, in reaction to a new wave of European immigration, that the Métis Nation first came into its own. Since the early 1800s, the Manitoba Métis Community—as a part of the larger Métis Nation—has asserted itself as a distinct Indigenous collective with rights and interests in its Homeland. The Manitoba Métis Community shares a language (Michif), national symbols (Infinity flags), culture (*i.e.*, music, dance, dress, crafts), as well as a special relationship with its territory that is centered in Manitoba and extends beyond the present day provincial boundaries.

The Manitoba Métis Community has been recognized by the courts as being a distinctive community, with rights that are protected in section 35 of the *Constitution Act, 1982*. In *Goodon*, the Manitoba courts held that:

> The Métis community of Western Canada has its own distinctive identity […] the Métis created a large inter-related community that included numerous settlements located in present-day southwestern Manitoba, into Saskatchewan and including the northern Midwest United States. This area was one community […] The Métis community today in Manitoba is a well-organized and vibrant community (paras. 46-47; 52).

This proud independent Métis population constituted a historic rights-bearing community in present day Manitoba and beyond, which encompassed "all of the area within the present boundaries of southern Manitoba from the present day City of Winnipeg and extending south to the United States" (*R. v. Goodon*, at para. 48).

The heart of the historic rights-bearing Métis community in southern Manitoba was the Red River Settlement, however, the Manitoba Métis also developed other settlements and relied on various locations along strategic fur trade routes. During the early part of the 19th Century, these included various posts of varying size and scale spanning the Northwest Company and the Hudson Bay Company collection and distribution networks.

More specifically, in relation to the emergence of the Métis – as a distinct Aboriginal group in Manitoba – the Supreme Court of Canada wrote the following in the *MMF Inc. v. Canada* case:

> [21] The story begins with the Aboriginal peoples who inhabited what is now the province of Manitoba – the Cree and other less populous nations. In the late 17th century, European adventurers and explorers passed through. The lands were claimed nominally by England which granted the Hudson's Bay Company, a company of fur traders operation of out London, control over a vast territory called Rupert's Land, which included modern Manitoba. Aboriginal peoples continued to occupy the territory. In addition to the original First Nations, a new Aboriginal group, the Métis, arose – people descended from early unions between European adventurers and traders, and Aboriginal women. In the early days, the descendants of English-speaking parents were referred to as half-breeds, while those with French roots were called Métis.

> [22] A large – by the standards of the time – settlement developed at the forks of the Red and Assiniboine Rivers on land granted to Lord Selkirk by the Hudson's Bay Company in 1811. By 1869, the settlement consisted of 12,000 people, under the governance of Hudson's Bay Company.
>
> [23] In 1869, the Red River Settlement was a vibrant community, with a free enterprise system and established judicial and civic institutions, centred on the retail stores, hotels, trading undertakings and saloons of what is now downtown Winnipeg. The Métis were the dominant demographic group in the Settlement, comprising around 85 percent of the population [approximately 10,000 Métis], and held leadership positions in business, church and government.

The fur trade was vital to the ethnogenesis of the Métis, and was active in Manitoba from at least the late 1770s whereby numerous posts and outposts were established along cart trails and waterways throughout the province. These trails and waterways were crucial transportation networks for the fur trade (Jones 2014; Figure 1), and were the foundation of the Manitoba Métis Community's extensive use of the lands and waters throughout the province. In the early 20th Century, the Manitoba Métis Community continued to significantly participate in the commercial fisheries as well as trapping activities, which is well documented in provincial government records.

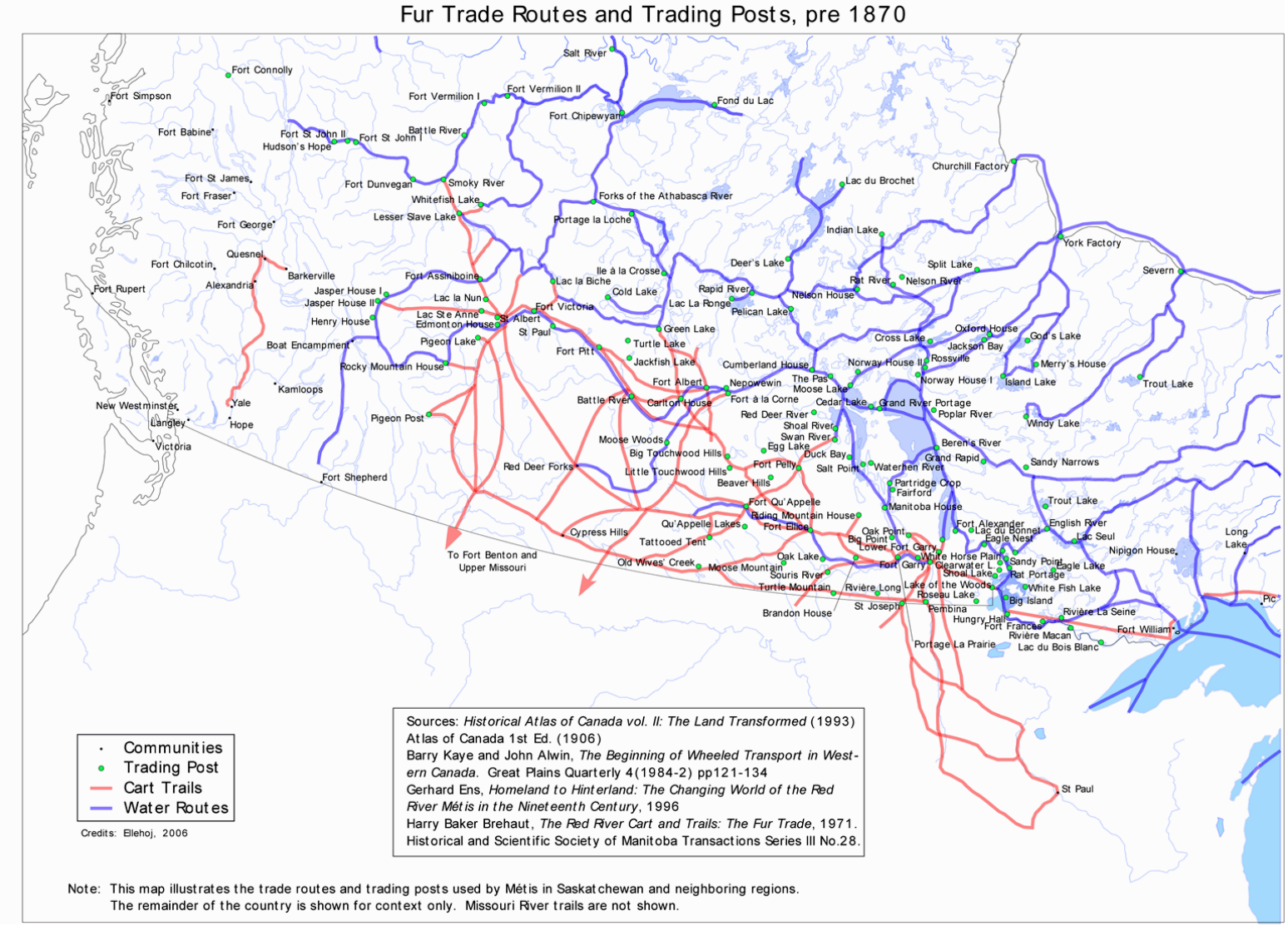

Figure 1. The Fur Trade Network: Routes and Posts Prior to 1870

2.2 Manitoba Métis Federation

The Manitoba Métis Federation (MMF) is the democratically elected government of the Métis Nation's Manitoba Métis Community (MMC), and is duly authorized by the members of the MMC for the purposes of dealing with Manitoba Métis rights, claims, and interests, including conducting consultations and negotiating accommodations (as per MMF Resolution No. 8, see Section 2.3). While the MMF was initially formed in 1967, its origins lie in the 18th century with the birth of the Manitoba Métis Community and in the legal and political structures that developed with it. Since the birth of the Métis people in the Red River Valley in the early 1800s, the Manitoba Métis Community—as a part of the larger Métis Nation—has asserted and exercised its inherent right of self-government. Over the last 50 years, the MMF has represented the MMC at the provincial and national levels.

During this same period, the MMF has built a sophisticated, democratic and effective Métis governance structure that represents the Manitoba Métis Community at the local, regional and provincial levels throughout Manitoba. The MMF was created to be the self-government representative of the MMC—as reflected in the Preamble of the MMF's Bylaws, which are agreed to by its members as a part of registering with the MMF:

> WHEREAS, the Manitoba Métis Federation Inc. has been created to be the democratic and self-governing representative body of the Manitoba Métis Community.

In addition, the purpose: "to provide responsible and accountable governance on behalf of the Manitoba Métis Community using the constitutional authorities delegated by its members" is embedded within the MMF's objectives, as set out in the MMF Bylaws. These objectives mandate the MMF to advance the cultural, legal, constitutional, social, economic, and political rights and interests of the MMC. The objectives of the MMF, as set out in the MMF Bylaws, are as follows:

i. To promote and instill pride in the history and culture of the Métis people.

ii. To educate members with respect to their legal, political, social and other rights.

iii. To promote the participation and representation of the Métis people in key political and economic bodies and organizations.

iv. To promote the political, legal, social and economic interests and rights of its members.

v. To provide responsible and accountable governance on behalf of the Manitoba Métis community using the constitutional authorities delegated by its members

The Federation is organized and operated based on centralized democratic principles, some key aspects of which are described below.

President: The President is the Chief Executive Officer, leader and spokesperson of the Federation. The President is elected in a province-wide ballot-box election every four years and is responsible for overseeing the day-to-day operations of the Federation.

Board of Directors: The MMF Board of Directors, or “MMF Cabinet” leads, manages and guides the policies, objectives and strategic direction of the Federation and its subsidiaries. All 23 members are democratically elected by the membership.

Regions: The MMF is organized into seven regional associations or "Regions" throughout the province (Figure 2): The Southeast Region, the Winnipeg Region, the Southwest Region, the Interlake Region, the Northwest Region, the Pas Region, and the Thompson Region. Each region is administered by a vice-president and two executive officers, all of whom sit on the MMF’s Cabinet. Each Region has a separate office which delivers programs and services to their specific geographic area.

Locals: Within each Region are various area-specific "Locals" which are administered by a chairperson, a vice-chairperson and a secretary-treasurer. Locals must have at least nine members and meet at least four times a year to remain active. There are approximately 140 MMF Locals across Manitoba.

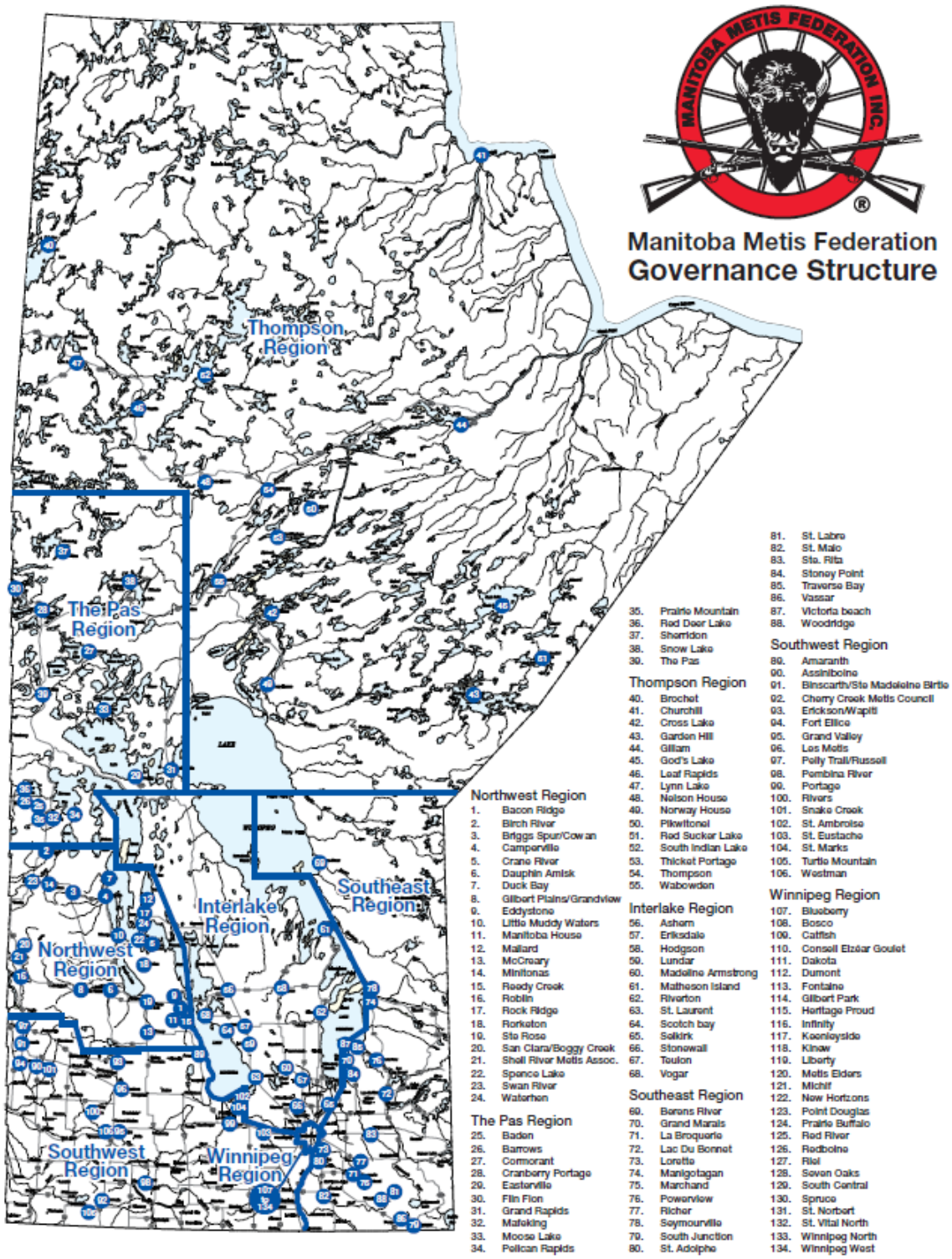

Figure 2. Manitoba Métis Federation (MMF) Regions

2.3 MMF Resolution No. 8

Among its many responsibilities, the MMF is authorized to protect the Aboriginal rights, claims and interests of the MMC, including as related to harvesting resources, traditional culture, and economic development.

In 2007, the MMF Annual General Assembly unanimously adopted Resolution No. 8 in order to set out the framework for engagement, consultation and accommodation to be followed by federal and provincial governments, industry, and others when making decisions and developing plans and projects that may impact the MMC. Under MMF Resolution No. 8, direction has been provided by the MMC for the MMF Home Office to take the lead and be the main contact on all consultations affecting the MMC. Resolution No. 8 reads, in part that:

> …this assembly continue[s] to give the direction to the Provincial Home Office to take the lead and be the main contact on all consultations affecting the Métis community and to work closely with the Regions and Locals to ensure governments and industry abide by environmental and constitutional obligations to the Métis…

The MMF Home Office works closely with the Regions and Locals to ensure the rights, interests and perspective of the MMC are effectively represented in matters related to consultation and accommodation.

Resolution No. 8 has five phases:

Phase 1: Notice and Response;

Phase 2: Funding and Capacity;

Phase 3: Engagement or Consultation;

Phase 4: Partnership and Accommodation; and,

Phase 5: Implementation.

Each phase is an integral part of the Resolution No. 8 framework, and proceeds logically through the stages of consultation.

2.4 Manitoba Métis Community Rights and Interests

The Manitoba Métis Community possesses Aboriginal rights, including, pre-existing Aboriginal collective rights and interests in lands protected by section 35 of the *Constitution Act, 1982*, throughout the territory where the Project is proposed. Indeed, Manitoba courts recognized these pre-existing, collectively-held Métis rights in *R. v. Goodon* (at paras. 58; 72):

> I conclude that there remains a contemporary community in southwest Manitoba that continues many of the traditional practices and customs of the Métis people.
>
> I have determined that the rights-bearing community is an area of southwestern Manitoba that includes the City of Winnipeg south to the U.S. border and west to the Saskatchewan border.

As affirmed by the Supreme Court of Canada, such rights are "recognize[d] as part of the special aboriginal relationship to the land" (*R. v. Powley,* 2003 SCC 43, at para. 50) and are grounded on a "communal Aboriginal interest in the land that is integral to the nature of the Métis distinctive community and their relationship to the land" (*MMF Inc. v. Canada*, at para. 5). Importantly, courts have also recognized that Métis harvesting rights may not be limited to Unoccupied Crown Lands (*R. v. Kelley*, 2007 ABQB 41, para. 65).

The Crown, as represented by the Manitoba government, has recognized some aspects of the Manitoba Métis Community's rights through a negotiated agreement: the *MMF-Manitoba Harvesting Agreement (2012)*. This Agreement was signed at the MMF's 44th Annual General Assembly and "recognizes that collectively-held Métis Harvesting Rights, within the meaning of s. 35 of the *Constitution Act, 1982*, exist within the [Recognized Métis Harvesting Zone], and that these rights may be exercised by Métis Rights Holders consistent with Métis customs, practices and traditions…" (*MMF-Manitoba Harvesting Agreement*, section 1). In particular, the *MMF-Manitoba Harvesting Agreement* recognizes that Métis rights include "hunting, trapping, fishing and gathering for food and domestic use, including for social and ceremonial purposes and for greater certainty, Métis harvesting includes the harvest of timber for domestic purposes" throughout an area spanning approximately 800,000 km² (the "Métis Recognized Harvesting Area") (*MMF-Manitoba Harvesting Agreement*, section 2; Figure 3 below). The MMF further asserts rights and interests beyond this area, which require consultation and accommodation as well.

Beyond those rights already established through litigation and recognized by agreements, the Manitoba Métis Community claims commercial and trade related rights. Courts have noted that Métis claims to commercial rights remain outstanding (*R. v. Kelley* at para. 65). These claims are strong and well-founded in the historical record and the customs, practices and traditions of the MMC, and it is incumbent on the Crown and proponents to take them seriously.

The Manitoba Métis Community has its roots in the western fur trade (*R. v. Blais*, 2003 SCC 44 at para. 9 [*Blais*]; *R. v. Goodon* at para. 25). The Métis in Manitoba are descendants of early unions between Aboriginal women and European traders (*MMF Inc. v. Canada* at para. 21). As a distinct Métis culture

developed, the Métis took up trade as a key aspect of their way of life (*R. v. Powley* at para. 10). Many Métis became independent traders, acting as middlemen between First Nations and Europeans (*R. v. Goodon* at para. 30). Others ensured their subsistence and prosperity by trading resources they themselves hunted and gathered (*R. v. Goodon* at para. 31, 33, & 71). By the mid-19th century, the Métis in Manitoba had developed the collective feeling that "the soil, the trade and the Government of the country [were] their birth rights." (*R. v. Goodon* at para. 69(f)). Commerce and trade is and always has been integral to the distinctive culture of the Manitoba Métis Community. Today, the Manitoba Métis have an Aboriginal, constitutionally protected right to continue this trading tradition in modern ways to ensure that their distinct community will not only survive but also flourish.

Unlike First Nations in Manitoba, whose commercial rights were converted and modified by treaties and the *Natural Resources Transfer Agreement* ("*NRTA")* (*R. v. Horseman*, [1990] 1 SCR 901), the Métis' pre-existing customs, practices, and traditions—including as they relate to commerce and trade—were not affected by the *NRTA* (*R. v. Blais*) and continue to exist and be protected as Aboriginal rights. First Nations' treaty rights in Manitoba are, for example, inherently limited by the Crown's power to take up lands (*Mikisew Cree First Nation v Canada* (*Minister of Canadian Heritage*), [2005] 3 SCR 388 at para 56). Métis rights, in contrast, are not tempered by the "taking up" clauses found in historic treaties with First Nations. Métis rights must be respected as they are, distinct from First Nations' rights and unmodified by legislation or agreements.

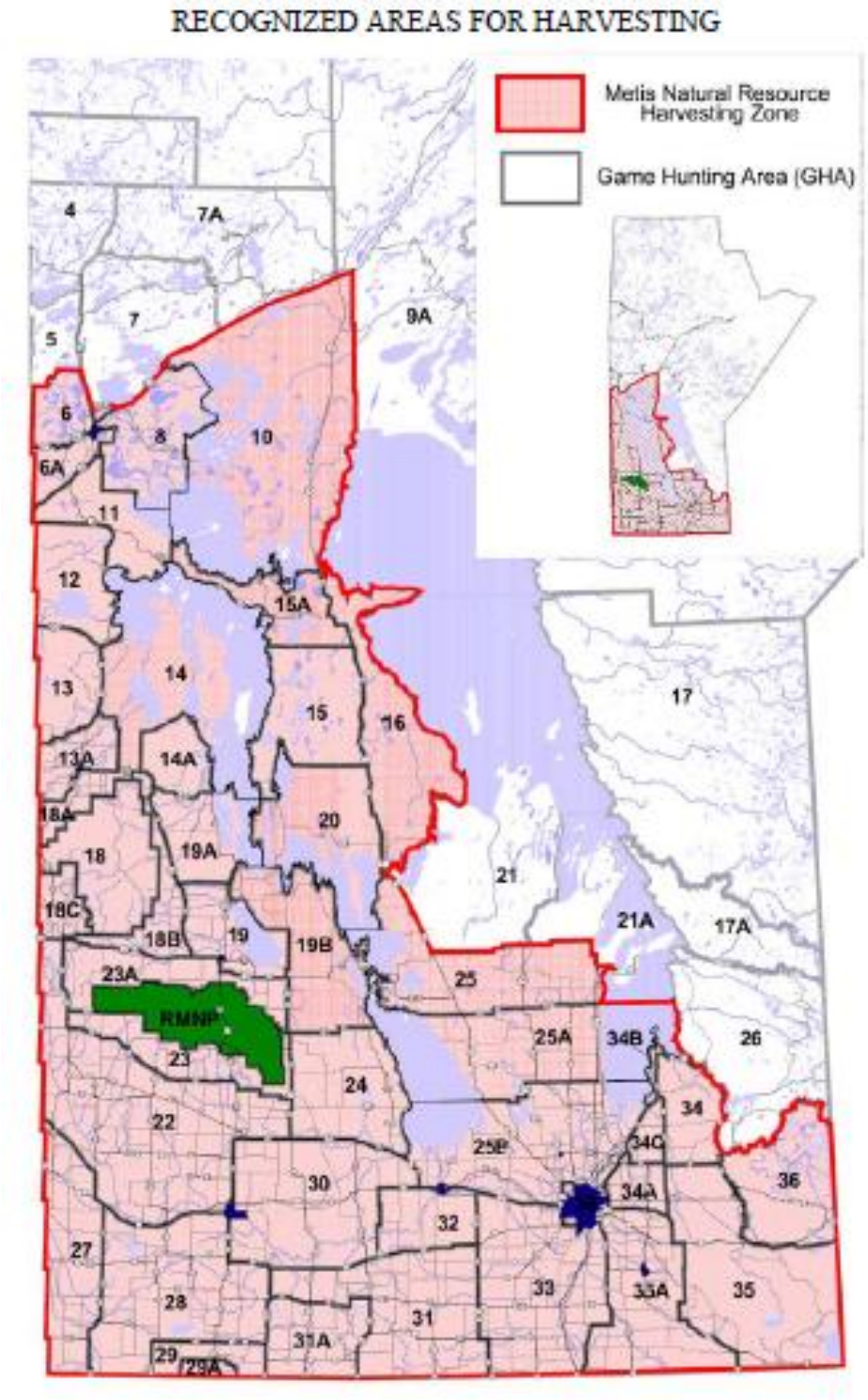

Figure 3. MMF-Manitoba Harvesting Agreement Recognized Manitoba Métis Harvesting Zones

2.5 Potential Impacts of the Whiteshell Project on the Manitoba Métis Community

The proposed Whiteshell Project site falls within the Southeast Region on lands to which MMC asserts and exercises its Aboriginal rights. The site is within the Traditional Territory of the MMC and as such potential risks (such as leaks of radioactive contaminants) associated with the Whiteshell Project would occur within the Traditional Territory of the MMC, and have the potential to affect the exercise of the MMC's constitutionally protected Aboriginal rights. Potential environmental and ecological risks furthermore have the potential to impact and engage the ongoing stewardship rights and obligations of the MMC. The Project site is in proximity to several MMF Locals, including: Lac Du Bonnet, Powerview, Ste Rita, and Traverse Bay, and MMF members live and harvest in the vicinity of the Project.

The MMC has and will continue to exercise its inherent and Aboriginal rights around and downstream of the Project area without limitation. The MMC also continues to significantly rely on the land as a part of their economy; businesses that rely on renewable resources include commercial fishing, outdoor adventure, wild rice gathering, blueberry production and blueberry picking, and bee keeping, among others. Commercial fishing may be one of the biggest Métis employers in Manitoba.

In addition, the Manitoba Métis are highly active land users, and continue to gather for ceremonies and cultural events on the land as well as staying overnight on the land at various occupancy sites across the province of Manitoba. More specifically, the Manitoba Métis consistently harvest large mammals, birds, and plants for food and medicinal purposes. In addition, the Manitoba Métis have water-based land use such as the use of waters for navigation purposes and fishing to provide subsistence for individuals, families, and community members.

Based on land use and occupancy data held by the MMF, it is well-known that the Project site is within a region where the MMC has a longstanding and well-established record of historic use and occupancy and ongoing current use. Drawing on this data, and based on the MMC's constitutionally protected rights, and the requirements of CEAA, 2012, SVS has considered the following potential issues and concerns, related to the rights and interests of MMC in our review of the Whiteshell Project EIS:

- Potential negative impacts to the current use of lands and resources for traditional purposes, including impacts to the exercise of Métis rights by MMC citizens, must be avoided, mitigated, or accommodated.
- Potential negative impacts to the health of MMC citizens—including, but not limited to those conditions reliant on the current use of lands and resources for traditional purposes—must be avoided, mitigated, or accommodated.
- Potential negative impacts to collective MMC informal, and formal, socio-cultural and economic systems associated with the trade and sharing of resources or products from traditional land-use must be avoided, mitigated, or accommodated.

- Potential negative impacts to MMC individuals commercial and subsistence harvesting rights and activities associated with traditional land-use must be avoided, mitigated, accommodated or compensated.
- MMC citizens must be able to equitably participate in the economic benefits and opportunities associated with the construction, operations, and maintenance of the Project.
- Through ongoing consultation and specific roles and/or employment, the MMF must be able to participate in the environmental monitoring and management of the Project in all stages.

3.0 Methodology and Scope

SVS reviewed the 'Environmental Impact Statement - In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site – Revision 1' (the "EIS") on behalf of the MMF. The review completed by SVS considers the entire area of the Project and any potential effects, including cumulative effects. SVS has completed the review by analyzing the connections between proposed activities and potential risks and impacts to the MMC. In our review, we have

i) assessed adequacy of baseline information and data, Valued Environmental Components ("VECs"), effects assessment, mitigation, management, and monitoring plans;
ii) assessed adequacy of information provided in the EIS; and
iii) evaluated the use of local knowledge, traditional knowledge and land use incorporated in the EIS.

Using the results of the review, we have provided specific recommendations to address the identified issues and concerns, which we believe are representative of MMC's values, rights and interests (Section 3.0). Our recommendations include best practice mitigations, management and monitoring plans for respective subject areas, as well as recommendations for emergency response planning. These issues and recommendations reflect potential impacts from the Project on the MMC's rights and interests, and are meant to inform the MMF of the priority issues identified by SVS for resolution/accommodation. The review was completed by focusing on the following categories of concern that are of priority to the MMC:

Section 4.1 Potential effects on the aquatic environment

Section 4.2 Potential effects on wildlife, vegetation and wetlands

Section 4.3 Potential effects to human and ecological health

4.0 Review Findings

Findings of our review of the EIS with respect to the aquatic environment, terrestrial environment, and human and ecological health are presented in the subsections 4.1 to 4.3 below.

4.1 Aquatic Environment

4.1.1 Summary of EIS Content

A review of the Whiteshell EIS focusing on the Aquatic environment was completed. This includes an evaluation of the surface water quality and quantity, freshwater fish and invertebrates. Specifically, the sections reviewed for this evaluation were:

- Section 3.5 Project Description
- Section 4.3 Aboriginal Engagement
- Section 6.3 Geological and Hydrogeological Environment
- Section 6.4 Surface Water Environment
- Section 6.5 Aquatic Environment
- Section 7.0 Malfunctions and Accidents
- Section 8.0 Summary and Cumulative Effects
- Section 10.0 Assessment of Effects of the Environment on the Project
- Section 11.0 Summary of Monitoring and Follow-up Programs
- APPENDIX 6.4.2-1 Surface Water Quality Data

The Whiteshell Laboratories (WL) Nuclear Reactor 1 operated from 1965–1985, at which time the site was placed into a state of permanent shut down. Preliminary decommissioning of the site occurred during the 1990s when removal of nuclear fuel, coolant and moderators occurred. Removing these materials reduced the amount of radioactive materials on-site and lowered the associated risk. Since this time, the site has been inactive and radioactive materials have been undergoing natural decay.

The WR-1 Reactor and other WL facilities have produced a range of radiological and non-radiological contaminants during construction, operation and preliminary decommissioning. Now that the site is moving towards the next phase in decommissioning the Proponent plans to limit the risks from previous activities to the extent possible while mitigating or minimizing new liabilities that arise.

The WL site slopes towards the Winnipeg River. Groundwater on the site flows towards the river and is discharged through an underground seep to the west of the site. Surface water runoff is also directed towards the Winnipeg River. Surface water in the vicinity of the Project site is managed through a series of swales and ditches that direct it to the Winnipeg River. During operation of WR-1 Reactor, effluent and storm water from the WL site was treated at the Active Liquid Waste Treatment Centre and then released to the Winnipeg River through an outfall pipe located 8m offshore. Each of these represent potential vectors for the movement of contaminants into the aquatic environment (the Winnipeg River).

It is known that at least 61 species of fish inhabit the Winnipeg River (Stewart and Watkinson 2004). This includes many fishes from the minnow (Cyprinidae) and darter (Percidae) families; important game fish such as northern pike, walleye, several suckers (e.g. white sucker, redhorse), smallmouth bass, and lake whitefish; and two species at risk (“SAR”), the carmine shiner and lake sturgeon. Despite the known

occurrence of these species, no targeted baseline study has been completed. The Proponent has taken the conservative approach by assuming that all species known within the Winnipeg River are present within the RSA.

To-date there have been only minor issues related to water or sediment quality associated with the operation of the CNL facility. Monitoring in the aquatic environment has been conducted by the Proponent associated with their existing license for the CNL facility (NRTEDL-W5-8.04/2018), and as part of the current EA process. Sediment and water quality monitoring has occurred in the Winnipeg River 10 km upstream of the WL site near Pinawa, near the effluent outfall and the groundwater seeps, and downstream in Lake du Bonnet (Figure 4 & Figure 5). Results of aquatic monitoring has found that most contaminant concentrations (radionuclides and non-radiological contaminants) in water and sediment are below applicable guidelines (e.g. Canadian Drinking Water Quality Guideline, CCME Water Quality, CCME Sediment Quality). However, there are some notable exceptions that have occurred. For example, levels of Cs-137 in sediment above Nuclear Substance and Radiation Devices Regulations NSRDR guidelines have been observed, the highest of which was 2,610 Bq/Kg in 2000 at station K03 (the NSRDR Clearance Level for Cs-137 is 100 Bq/Kg). Average background water quality levels of some contaminants are also above CCME guidelines including chromium, copper, lead and phosphorus.

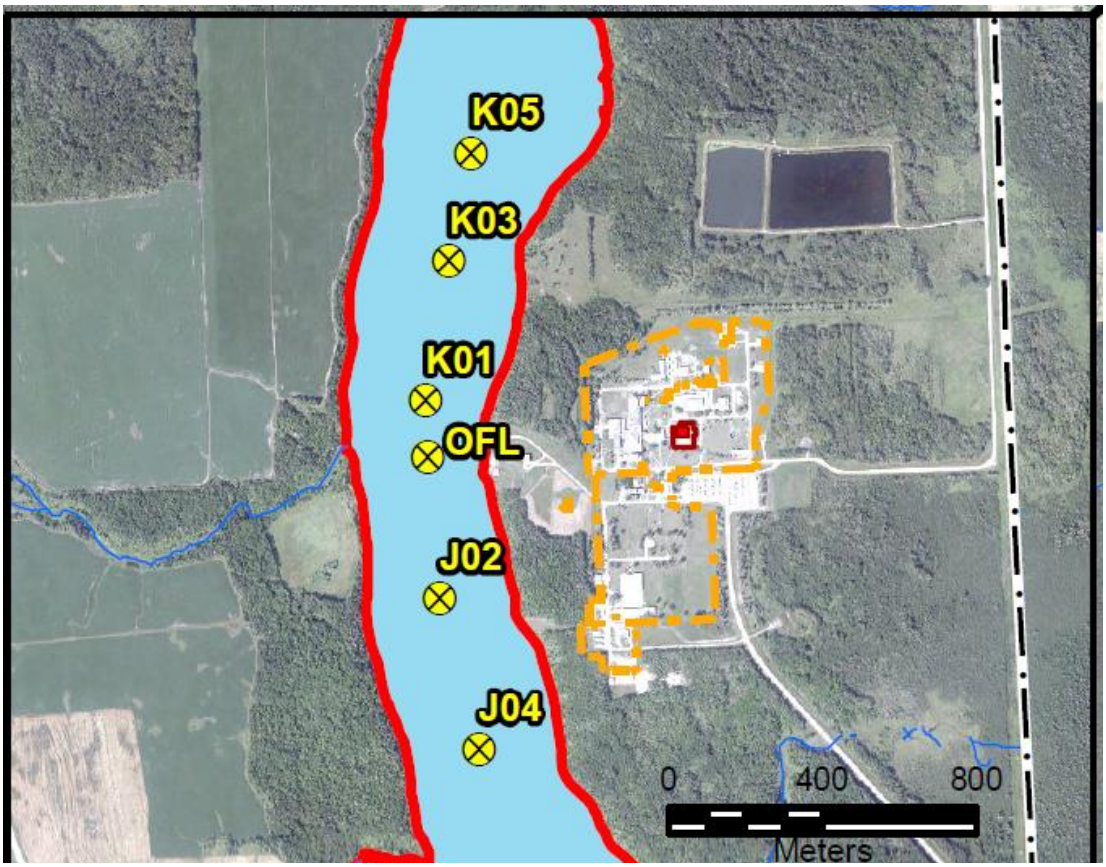

Figure 4. Annual water and sediment sampling locations on the Winnipeg River (modified from Figure 6.4.2-3)

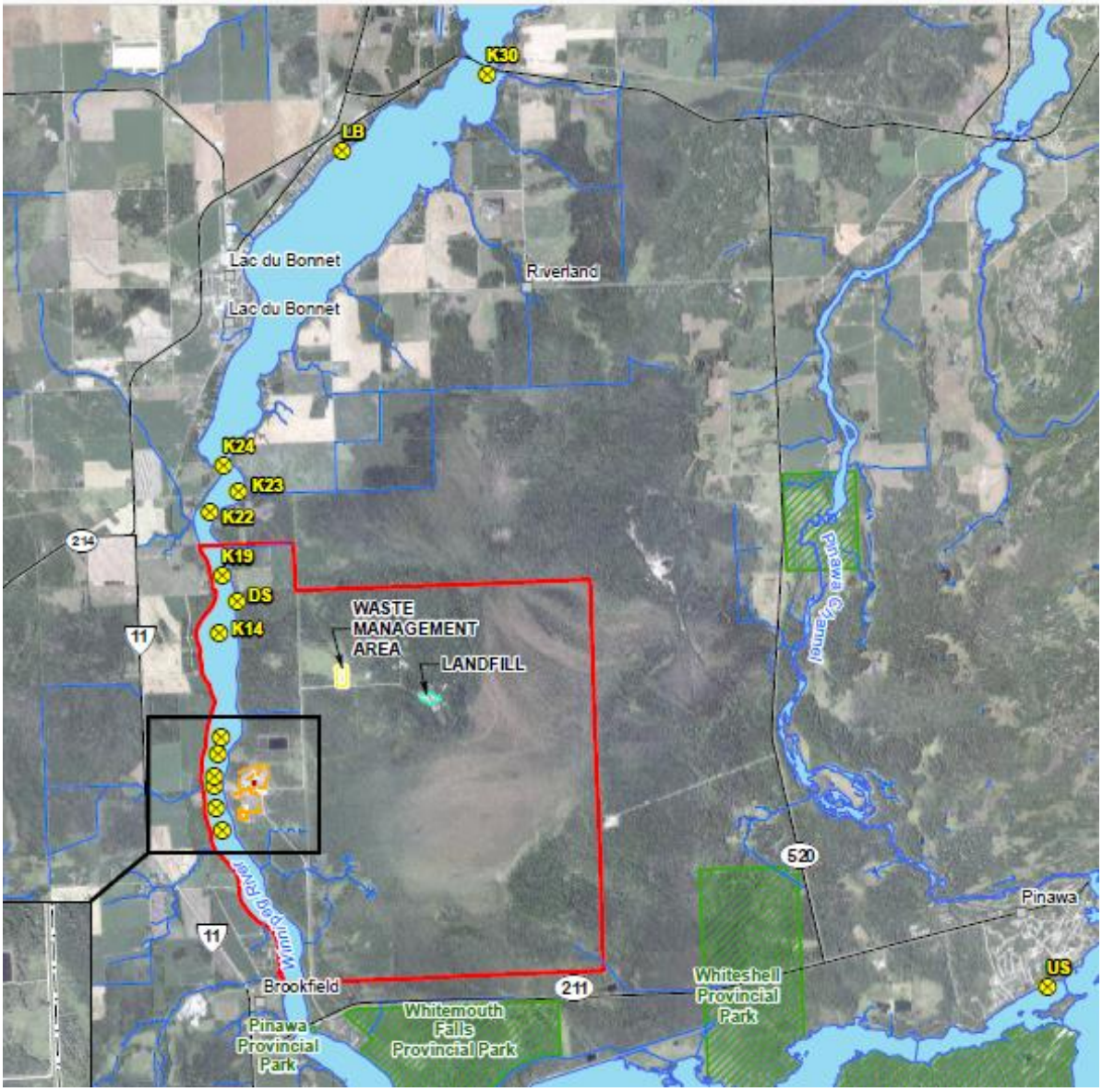

Figure 5. Regional water and sediment quality monitoring stations on the Winnipeg River (modified from Figure 6.4.2-3)

4.1.2 Evaluation and Recommendations

The MMC has an interest in, rights and traditional stewardship responsibilities associated with fish and fishing, including access to fish for harvesting purposes, the maintenance of aquatic resources overall and the ecosystems that support them, and the quality/safety of the fish for consumption as part of a traditional diet. Adverse impacts on the aquatic environment from the Project could negatively impact the rights and interests of the MMC. Moreover, changes to fish health could have negative

consequences on human health for individuals of the MMC that consume fish as part of a traditional diet. The primary risks to the aquatic environment from the Project are related to:

- The alteration of fish habitat.
- The alteration of water quality from deposition of deleterious substances, runoff, erosion and sedimentation, spills, and groundwater seepage.
- Contamination of aquatic wildlife (e.g. benthic invertebrates and fish) through releases of radiological and non-radiological contaminants.
- Cumulative impacts associated with other developments including effects of water level controls associated with hydro electricity, other linear developments such as hydroelectric lines and pipelines, other industrial activities such as forestry, and future developments.

Based on these (and other) risks associated with the Project, several issues and concerns were noted. Recommendations for addressing and/or mitigating these issues are also provided.

Issue 1 – In evaluating options for the decommissioning of the WR-1 Reactor the Proponent has evaluated four (4) alternatives. Of these, ISD represents the highest risk to local aquatic systems because contaminated materials will reside permanently within the local environment. Permanent storage of radioactive contaminated material must be monitored indefinitely. Once the containment system fails, decaying radioactive material will have a direct pathway for contamination of groundwater. Over time, this contamination will likely migrate to surface water (e.g. through seepage to the Winnipeg River <500m), posing risks to aquatic wildlife and humans who consume these organisms. For example, based on predictions of mass loadings to the Winnipeg River, it is expected that Carbon-14 and Tritium are expected to be particularly high, with maximum groundwater concentrations (at point of discharge) of 147 Bq/L and 3,760 Bq/L respectively. The latter of which is expected to occur within 68 years during post-closure. Due to the risks associated with contaminated groundwater, a robust monitoring program must be in place.

The Proponent is planning to conduct surface water monitoring and surficial sediment monitoring to test for contaminants during closure and post-closure (EIS, 2017, pp 6-203). However, it is unclear at what intervals this monitoring will occur. Moreover, the locations for water quality monitoring follow-up program are not sufficient. The nearest downstream surface monitoring location to the groundwater seep is 2 km downstream from the site boundary (monitoring station DS, Figure 6.4.2-3). This is unlikely to detect any contamination except from extreme events, nor to show any gradient or distribution of contamination.

Recommendation 1a – The Proponent must clarify the location, frequency and timing at which surface water and sediment sampling will occur. This data must be presented in text and in the form of a map (similar to Figure 6.4.2-3) with locations of all proposed follow-up monitoring locations clearly marked. This must be accompanied by a description of the frequency of monitoring proposed for these stations.

Recommendation 1b – The nearest downstream surface water and sediment sampling station in the Winnipeg River is too far for monitoring contamination of groundwater seepage. Additional surface water monitoring stations must be planned closer to the location of groundwater emissions. At minimum, we suggest these occur at the effluent outflow, the groundwater seep, 25m, 100m and 500m downstream on the Winnipeg River.

Recommendation 1c – Water quality in trenches/ditches from the Waste Management Area must be monitored actively during closure and post-closure. The Proponent must provide additional details on locations and frequency of monitoring associated with the Waste Management Area. There should be clear adaptive management and contingency plans for responding to degrading water quality in these features such as capture and additional treatment.

Issue 2 – The Proponent has identified "No Linkage Pathway" to residual effects from runoff during closure (EIS, 2017, pp 6-186). However, there is an issue with this evaluation because there could be large loads of contaminated material and dust during active closure. These could be from building demolition, excess piping or other contaminated materials. If there is a significant precipitation or snowmelt while this material is present, it could result in a slug of contaminated runoff to the Winnipeg River. The Proponent has assumed that this would not occur because best practices would be in place. This includes, water management, containment barriers, and water testing.

Recommendation 2 – The Proponent must prepare an Environmental Protection Plan (EPP) outlining in detail the mitigation strategies and actions that will be taken to prevent contaminated runoff from the site to receiving waters during closure. The EPP must be provided to the MMF so that there is an opportunity for review. Failing this, it will be necessary to incorporate potential effects of increased contamination to the Winnipeg River because of runoff, into the EA process.

Issue 3 – Beginning during post-closure and continuing for a up to 500,000 years, groundwater contaminated from contact with the below grade building materials and WR-1 reactor will leach steadily into the Winnipeg River. Radionuclides released can result in harm to aquatic wildlife. In the Goldsim® (Version 11.1) mass balance and transport model for groundwater, only radionuclides with half lives longer than 1 day were modelled. This excludes a large number of potentially damaging radionuclides which, if present in large quantities could contribute to radiological effects on aquatic wildlife in the Winnipeg River. Moreover, certain radionuclides with short half lives may decay into daughter radionuclides with longer half lives that continue to emit radiation. For example, I^{135} with a half life of 6.5 hours can decay through β− decay into Xe^{135} and Cs^{135}, the latter of which has a half life of 2.3 million years. Thus, by excluding short lived radionuclides from the modelling, the Proponent is potentially ignoring important sources of radioactive contamination and underestimating the potential risk to the aquatic environment.

Recommendation 3 – The mass balance and transport model for groundwater must include all radionuclides, including those with half lives shorter than a day.

Issue 4 – In their evaluation of the potential effects of surface water contamination (dispersion modelling), the Proponent only evaluated of concentrations of radionuclide and non-radionuclide contaminants at the Nearfield (50m downstream) and Farm A (approximately 3,100m downstream) locations. As a result, they were able to assume complete mixing of contaminants and utilize large dilution rates. For example, the dilution rate used for evaluation of contaminants for the nearfield site was 300,000:1. However, at the point where contaminated groundwater is being released into the Winnipeg River, the dilution will be much less. This will result in higher concentrations of contaminants in the water column (than shown in Table 6.4.2-12 and 6.4.2-13) and in sediment (shown in Table 6.4.2-14 and 6.4.2-15) (EIS, 2017). This is of concern for all contaminants, but particularly for highly toxic contaminants for which concentrations in groundwater are above applicable guidelines such as cadmium and lead. These contaminants released through the groundwater seep may have locally high concentrations that could bioaccumulate in fish and benthic invertebrates causing harmful effects. Moreover, the accumulation of these contaminants in fish tissues represents a potential pathway for human consumption, including affecting MMC citizens who rely on fishing and harvesting aquatic resources for subsistence and as part of a traditional diet and lifestyle.

Recommendation 4a – By evaluating the concentrations of contaminants at the Nearfield location rather than in the immediate vicinity of the groundwater release, the Proponent is underestimating the potential effects of this Project. To evaluate these effects the Proponent must produce a dispersion model to predict the concentrations of contaminants between the point of groundwater release into the Winnipeg River and the Nearfield location (between 0 and 50m). These higher concentrations should be used to calculate contaminant concentrations in sediment within the mixing zone for groundwater seepage. This updated and more localized information would enable the Proponent to evaluate the potential effects within the immediate area of effect near the seep and whether any contaminants are above regulatory guidelines for either surface water or sediment.

Recommendation 4b – If concentrations of contaminants (radiological and non-radiological) are found to be higher than what has been predicted at the Nearfield and Farm A locations, the Proponent must update the Human Health and Ecological Risk Assessment to evaluate the potential impacts of these higher concentrations.

Issue 5 – As part of the existing license for the CNL facility (NRTEDL-W5-8.04/2018), the Proponent engages in monitoring of fish tissue at upstream and downstream locations from the Project site. However, the Proponent is not planning to monitor fish tissues for contaminants during closure and post-closure (EIS, 2017, pp 6-231). Many individuals from the MMC fish regularly along the Winnipeg River for game species such as walleye, lake whitefish, smallmouth bass, and northern pike. The risk of health effects from consuming these contaminants is thus a serious concern for these fishermen and their families.

Recommendation 5 – Due to the importance of fishing and fish consumption to the MMC, it is critical that monitoring of fish tissue occur and be designed accordingly so that the predictions of low contamination can be verified. The Proponent must engage in monitoring of fish tissues during closure

and post-closure (institutional control) and have adaptive management plans in place to address unanticipated levels of contaminants in edible portions of fish in exposure areas. We recommend that the sampling locations currently used for monitoring associated with the existing license be maintained. Monitoring should occur every year during closure and at least every 10-years during post-closure.

4.2 Wildlife, Vegetation and Wetlands

4.2.1 Summary of EIS Content

The following review and comments on the terrestrial environment are based primarily on Section 6.6 of the EIS Report. Additional resources used for support as a background information include:

- Section 2.0 Purpose of the Project and Alternatives to the Project
- Section 3.5 Project Description
- Section 4.3 Aboriginal Engagement
- Section 6.7 Human and Ecological Health
- Section 6.8 Land and Resource Use
- Section 7.0 Malfunctions and Accidents
- Section 8.0 Summary and Cumulative Effects
- Section 10.0 Assessment of Effects of the Environment on the Project
- Section 11.0 Summary of Monitoring and Follow-up Programs
- Appendices

The Project's Regional Study Area (RSA) is located within the larger Boreal Shield Ecozone, Lake of the Woods Ecoregion, and Stead Ecodistrict (Smith et al. 2001). In general, this ecoregion has a large number of forest types characterized by tall, closed stands of jack pine (*Pinus banksiana*), trembling aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), white spruce (*Picea glauca*), eastern white cedar (*Thuja occidentalis*), black ash (*Fraxinus nigra*), and American elm (*Ulmus americana*) (Smith et al. 2001). Wildlife are diverse and characteristic of the region, including: gray wolf (*Canis lupus*), American black bear (*Ursus americanus*), moose (*Alces americanus*), White-tailed deer (Odocoileus virginianus), snowshoe hare (*Lepus americanus*), hooded merganser (*Lophodytes cuculata*), turkey vulture (*Cathartes aura*), and ruffed grouse (*Bonasa umbellus*) (Smith et al. 2001). The surrounding area consists of cleared lands with areas of peat bog. Whiteshell Provincial Park, the largest provincial park in Manitoba, is located on the east side of the RSA; Pinawa and Whitemouth Falls Provincial Parks are both immediately south of the RSA.

The spatial extent of the study area for the terrestrial environment was subdivided into the following three categories:

- **Site Study Area (SSA)**: the SSA is the Project footprint, which accounts for the direct physical disturbance and alteration of potential wildlife habitat caused by demolition and reclamation of the WR-1 Building (0.07 ha).
- **Local Study Area (LSA)**: was selected in consideration of the Project footprint, and the spatial extent of potential direct effects of the Project on the terrestrial environment. The LSA includes the fenced area of the WL main campus, which includes the SSA. This spatial area was chosen as it represents an area under the highest anthropogenic activity levels that is distinct from, and also separated from, the surrounding area by a physical barrier (i.e., a six-foot high chain-link fence). Ground-based VC species (i.e., snapping turtle) have restricted access to, or from, the LSA, although movement of aerial VC species (i.e., birds, bats) is less constrained by the presence of the fence. The spatial extent of Project-related physical disturbances to wildlife VCs (through noise) is also highest within this defined area. The approximate size of the LSA is 29 ha.
- **Regional Study Area (RSA)**: is defined as the area within which the maximum geographical extent of potential indirect effects of the Project may interact with the effects of other existing or reasonable foreseeable projects. The RSA is the 3,710 ha portion of the WL property on the east side of the Winnipeg River (Figure 6). This federally-owned property is not fenced around the perimeter, which means there is no physical barrier restricting access to or from the area by ground-based wildlife from the north, east, or south. The Winnipeg River itself represents a partial barrier to (primarily ground-based) wildlife access from the west. The RSA is relevant to the evaluation of effects on wildlife VCs because it is under distinct management and ownership relative to the surrounding landscape. The entire area is under ownership by CNL, and because there are nuclear facilities within the area, it is managed differently from the surrounding landscape (i.e., with respect to active fire suppression and prevention). There is a relatively high degree of diversity in terrestrial habitat within the RSA (Figure 6). The RSA is primarily under treed cover (83% of total area), consisting of a mixture of wetlands and forests of broadleaf, mixed and coniferous stand types. A large area (1,946 ha, or 52% of the total area) contains a complex of bog, fen and swamp wetlands spanning the center and east portions of the RSA, from north to south. Black spruce dominates large portions of this wetland habitat and it is reported that stands may be over 100 years old (AECL 2001). Black spruce dominated bog wetlands have understories of tamarack (*Larix* sp.), willow sp. (*Salix* sp.), blueberry (*Vaccinium* sp.), common Labrador tea (*Rhododendron groenlandicum*), horsetail sp. (*Equisetum* sp.) and mosses.

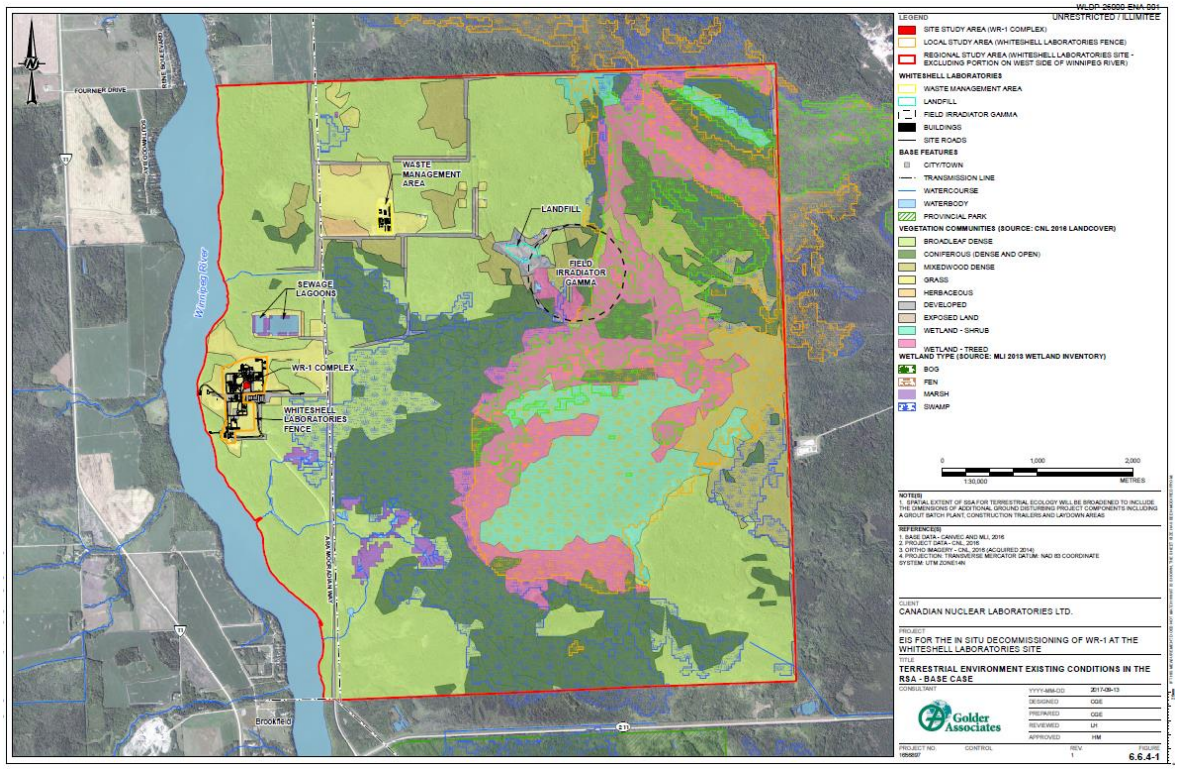

Figure 6: Terrestrial habitat classifications in the Regional Study Area.

Baseline conditions were characterized in the Proponents' application by means of incidental observations and desktop analysis.

4.2.2 Evaluation and Recommendations

The MMC have historic and ongoing land use and Aboriginal rights associated with the terrestrial environment in the EA study areas. The MMC value access to habitats for harvesting (including of timber for domestic purposes), and the quality and availability of medicinal plants and country foods for consumption as part of their traditional culture and diet. Adverse impacts on vegetation and wildlife from the Project have the potential to negatively impact the rights and interests of the MMC. These potential impacts have not been considered in the EIS and as such, some elements of the Project continue to remain issues that have not been addressed and are therefore unresolved with respect to potential impacts on the MMC.

Issue 1 – Baseline terrestrial data for the WL property was gathered through incidental observations by staff and through targeted surveys for Species at Risk (SAR) in 2015 (Section 6.6.4.2/6-245). Desktop review was also completed to identify potential SAR within the RSA, however TEK or harvesting rights, practices and needs of MMC land users were not considered.

Recommendation 1a – Conduct multi-season (spring/summer/fall/winter), baseline terrestrial surveys to provide a less biased and more comprehensive measure of site characteristics and an accurate

representation of the ecological components potentially affected by the Project. This would provide a more comprehensive assessment of potential impacts to native vegetative species and species of traditional importance to the MMC.

Recommendation 1b – Engage the MMF to identify and consider the MMCs extensive TEK, harvesting rights, current exercise of rights and ongoing needs and interests, during or in addition to the base-line surveys recommended in Recommendation 1a. There needs to be recognition of and accommodation measures provided for the Métis who live within the vicinity of and/or harvest within the Project assessment areas as part of determining the significance of net effects as a result of the Project.

Issue 2 – 'Traditional, cultural and heritage importance to Aboriginal peoples' was said to be considered in the selection of valued components (EIS, 2017; pp 2-11), yet no Traditional Knowledge or land use by the MMC has been included in the EIS. The MMC has longstanding use of the lands and waters in the vicinity of the Project that continue to be of ongoing importance to the MMC in exercising their constitutionally protected harvesting and other rights. These rights have the potential to be impacted by the decommissioning activities and yet have not yet been considered by the Proponent, nor have accommodation or mitigation measures been discussed with the MMF.

Recommendation 2 – A Traditional Knowledge and Land Use study with the MMF must be undertaken to determine and understand Métis-specific land use and interests in the Project study area. Further discussions of accommodation and / or mitigation measures with the MMF may be needed.

Issue 3 – Wildlife VECs focus on SAR, as per regulatory requirements, with no inclusion of wildlife species and habitats of traditional and cultural importance to the MMC. The MMF has expressed interest in Indigenous values and rights, as identified in *the Summary of Key Interests and Concerns for the Manitoba Métis Federation* (EIS, 2017; Table 4.3.2-8/ pp 4-15) with regards to Valued Components (VCs) for the Project.

The Proponent has determined that the "Project is not expected to have a substantial effect on an individual's land and resource use experience or on harvested species with because of mitigation and management practices put in place for the Project" (EIS, 2017; pp 6-381), however without conducting a full effects assessment with applicable mitigation measures for traditionally valued species of the MMC specifically, we do not believe the Proponent can make this determination with respect to effects on the MMC.

Recommendation 3 – Complete a thorough effects assessment on species of traditional importance to the MMC identified in a Project specific Traditional Knowledge, Land Use and Occupancy Study (TKLUOS). Include monitoring and follow-up programs for potential effects to culturally important terrestrial species, including objectives and any monitoring measures (i.e., thresholds) that will be implemented to verify the predictions of effects and evaluate the effectiveness of proposed mitigation measures.

Issue 4 – The complete removal of the facility (Alternative 2) would improve the perceived suitability of the site for future socio-economic MMC interests because long-lived radioactive material will no longer be present within the former WR-1 Building footprint. In addition, the complete removal *may* allow this portion of the site to be released for unrestricted use which would allow safe use of the land for traditional land use activities and interests by the MMC such as hunting, berry picking, and medicinal plant gathering (EIS, 2017; pp 2-18). There are concerns that the Proponent is choosing ISD due to estimated Project cost differences (in excess of $100 Million difference) rather than selecting a decommissioning alternative that is ecologically preferred or least impactful on the rights of Indigenous communities or best aligned with the long-term use and sustainability of the area for the MMC.

Recommendation 4 – Further meaningful consultation and engagement with the MMC must occur, to identify their interest and preference in the complete removal of the facility, as outlined in the Comprehensive Study Report (CSR) and as identified in Alternative 2 of the EIS. This consultation and engagement should occur through the MMF and in accordance with MMF Resolution No. 8.

Issue 5 – The surrounding grounds that were disturbed during demolition and decommissioning activities will be graded and restored with a grass seed mixture, but information on the approach and/or seed mix has not been provided (EIS, 2017; pp 3-34 & pp 6-266).

Recommendation 5 – The MMF requests that native seed mixes be used for reclamation in the Project area. The incorporation of native floral and grass seed mixes in re-vegetation efforts would further enhance habitat/forage for wildlife, particularly for pollinators.

Issue 6 – During reclamation, the Proponent has stated that the Project site and final vegetation cover will be graded to promote drainage from the site to the Winnipeg River (EIS, 2017; pp 3-34). An engineered cover will be installed over the former footprint of the WR-1 Building to minimize water infiltration and migration of contaminants to underlying aquifers (EIS, 2017; pp 3-33).

Recommendation 6 – The engineered cover will not provide a barrier for release of contamination explicitly, but rather will be installed to limit additional water infiltration into the system and protect the barriers that are in place by resisting intrusion into the sub-surface structure. It is therefore recommended that for the same reason, this impermeable barrier should be installed around the entire grouted below-grade facility.

Issue 7 – Changes in radiation and radioactivity levels during post-closure phases were predicted for wildlife VCs living on or near the WL site (EIS, 2017; pp 6-234). However, because species of traditional importance (i.e., commonly harvested by the MMC such as moose, deer, waterfowl, etc.) to the MMC were not specifically identified or considered as part of the post-closure plan, there are ongoing concerns regarding potential effects and exposure to animals in the long-term, and in particular that some specific species of importance to the MMC may not have been identified or considered.

Recommendation 7 – Re-run the effects assessment of radioactive exposure to wildlife species of traditional importance to the MMC, as per the TKLUOS recommended in Recommendation 2.

Issue 8 – The Proponent has identified that wildlife collisions with vehicles will be monitored, for which adaptive management measures will be considered, however no thresholds have been provided (EIS, 2017; Table 6.6.5-1/pp 6-234).

Recommendation 8 – Please provide adaptive management thresholds at which additional wildlife collision mitigation measures will be applied.

Issue 9 – It is not clear what the Project schedule is for construction/decommissioning activity (EIS, 2017; Table 3.1-1/pp 3-2). Loud decommissioning activity (i.e., jack hammering to remove deeply imbedded contaminants in concrete; EIS, 2017; pp 6-264) is expected. Consequently, there are considerable concerns over the potential disturbance and displacement of sensitive SAR species and to wildlife of traditional interest and importance to the MMC.

Recommendation 9a – Identify what consideration, if any, will be given to limit construction activity during sensitive timing periods for SAR, migratory birds and wildlife species of traditional importance to the MMC, such as during ungulate calving periods. It is recommended that a plan be developed to limit construction activity during sensitive timing periods as to minimize the potential for disturbance and displacement of species and wildlife in the Project area.

Recommendation 9b – Provide clear communication and notification (minimum of 21 days) of the finalized construction scheduling to MMF for distribution to their membership, with follow-up communication on a weekly basis for any scheduling changes. There is concern that Manitoba Métis harvesters may have their harvesting rights and activities impacted when they travel to the Project area to hunt, and then find that the area they are travelling to is subject to construction activity which has disturbed or displaced the wildlife they are planning to hunt or harvest.

Issue 10 – The Proponent has identified that bat surveys will be conducted in the year prior to initiation of Project decommissioning, during the 'appropriate season', and over multiple visits if necessary (EIS, 2017, pp 6-264 – 265, & pp 6-276). Additional measures could be implemented to mitigate effects of disturbance and mortality to SAR bat species which are not considered in the EIS.

Recommendation 10a – Please identify the exact timeframe and frequency at which bat monitoring surveys will be completed. Please note that the seasonal and daily pattern of bat activity and the use of different types of roosts at different times of the year will impact the appropriateness of survey methodologies. The optimum time for dusk surveys at buildings, particularly during early summer is for two hours after the first bats emerge as this will cover the emergence period as well as the first return to the roost for some species. The time of first emergence varies between species, with noctules leaving around sunset and others leaving about 1 hour after sunset. Bats using underground structure at the site during the summer may not emerge until later, upwards of 4 hours after dark. Towards dawn, many bats swarm outside their roosts and surveys beginning about 90 minutes before sunrise and continuing until 15 minutes after sunrise ('sunrise surveys') is recommended (Mitchell-Jones, 2004).

During this time, it is recommended that continuous automated bio-acoustic detectors linked to data-loggers be used, so as to minimize missing the presence of SAR bats in the Project area.

Recommendation 10b – The location and installation of the replacement roosts (bat boxes) should be chosen to maximise the chances of the bats finding and adopting it. Care should be taken to install boxes close to existing flight lines and have an entrance close to appropriate/preferred habitat types. Many bat species prefer to fly in dark areas straight into vegetation, so external lighting on the site close to boxes should be avoided.

Recommendation 10c – If SAR bat species are identified during pre-decommissioning surveys, demolition of the facility should stop until individuals have left the area, roosts/nests are no longer active and/or adoption of habitat off-sets (bat boxes) have been confirmed.

Issue 11 – Chemical and radiological contaminant release will be monitored as part of follow-up monitoring during the closure phase to verify effects predictions and to provide information for use in adaptive management measures to address unforeseen effects. Adaptive management approaches have been proposed, yet thresholds at which implementation of these approaches have not been provided in the EIS (EIS, 2017;Table 6.6.5-1/pp 6-265).

Recommendation 11 – Please provide adaptive management measures and thresholds being considered for follow-up monitoring.

Issue 12 – There are ongoing concerns with airborne contaminants that could deposit to soil, and water, where they could affect vegetation and wildlife/wildlife habitat of interest and importance to the MMC (EIS, 2017; pp 6-273). What Emergency response protocols are in place to notify the MMC in the event that monitoring values exceed radiation benchmark values and applicable environmental guidelines?

Recommendation 12 – An Emergency Response Plan must be developed in consultation with the MMF, to notify its members in the event of radioactive leaks and airborne monitoring exceedances.

Issue 13 – General Comment.

Recommendation 13 – Provide opportunities to the MMC to build capacity and knowledge in decommissioning activities and reclamation of Project components. Opportunities to build MMC capacity and knowledge in efforts that are of importance to the Manitoba Métis, such as participation in seeding, planting and monitoring in follow-up programs should be explored with the MMF.

4.3 Human Health and Ecological Risk Assessment

4.3.1 Summary of EIS Content

The human health and ecological risk assessment portions of the EIS were reviewed with the perspective of MMC traditional land uses, whereby Métis individuals exercising their harvesting rights in the Project

area may be exposed to greater risks from radioactivity released from the decommissioned reactor. This includes Métis practices of harvesting and reliance upon the consumption of land mammals, birds and plants, as well as fish and aquatic plants from the Winnipeg River. The land surrounding the WR-1 reactor and contaminated area such as the Low Level Waste Management Area may be opened to the public or for commercial use, and may allow expanded land use, such as for hunting and harvesting activities. Terrestrial exposure pathways during the post-closure phase of decommissioning are unlikely but increased land use could increase fishing in the Winnipeg River, which may have an impact on members of the MMC exercising their rights in this area. Radionuclides transport and exposure models must consider pathways that demonstrate that Métis rights, including hunting and harvesting, will be protected, and that there will be no adverse impacts on the health and wellbeing of the MMC members pursuing a more traditional lifestyle, including subsistence reliance on the plants and animals in the Project area.

One of the issues with the EIS is that the Proponent assumes that conditions of resource and land use and the environment will be the same in 2324 as in 2024. This may or may not be the case. The proposed ISD will require maintenance and monitoring for at least 100 years, and possibly 300 years (it isn't clear how "active" and "passive" institutional control differ), which places a burden on future generations and may restrict some land uses, such as for example, harvesting fish from the Winnipeg River.

The EIS identifies three alternative scenarios for the decommissioning the reactor, all of which provide some aspects of delay of the decommissioning or removal of the most radioactive components of the reactor. ISD is clearly the Proponents' preferred option (and details of the HHERA are only provided for that option), and the alternative options are only provided in very general terms. Due to the uncertainty in land use and social and environmental conditions in 300 years, the most conservative option is to consolidate radioactive components from across the nation in a single facility that can be monitored indefinitely. This would reduce the burden on future generations as much as possible by concentrating the radioactive components and limiting the area over which risk may result and monitoring would be required.

It is important to note that it is very difficult, and untested, to estimate environmental and social conditions 300 years in the future when the cover of the WR-1 would erode and the grout may start releasing nuclides to groundwater and, ultimately, the Winnipeg River. Models of radionuclide physical decay and transport can estimate the inventory of contaminants in the future (up to 500,000 years in the EIS) but the receiving environment and land use patterns may be significantly changed, particularly in light of climate change. The models used to predict radionuclide and non-radionuclide releases are deterministic and do not include a range of scenarios, such as a broad range of MMC harvester diets, land use and living patterns, TEK and environmental conditions. These factors would need to be considered, particularly as they relate to members of the MMC that have the potential to face disproportionately higher impacts based on pursuing a traditional lifestyle, including through exercising their hunting and harvesting rights and relying on a traditional subsistence diet.

4.3.2 Evaluation and Recommendations

The following review and comments on the potential impacts to human and ecological health due to the proposed Project are based on Section 6.7 of the EIS Report and the Environmental Risk Assessment (EcoMetrix, 2017). Additional information reviewed includes:

- Section 2.0 Purpose of the Project and Alternatives to the Project
- Section 3.5 Project Description
- Section 4.3 Aboriginal Engagement
- Section 6.7 Human and Ecological Health
- Section 6.8 Land and Resource Use
- Section 7.0 Malfunctions and Accidents
- Section 8.0 Summary and Cumulative Effects
- Section 10.0 Assessment of Effects of the Environment on the Project
- Section 11.0 Summary of Monitoring and Follow-up Programs

Issue 1- The safety case for the WR-1 decommissioning relies to a large extent on the conclusions of the 2001 Comprehensive Study Report for the WL site. Two areas with elevated radioactivity were expected to remain on the WL site: the contaminated Winnipeg River sediments and the Low-Level Waste Management Area (LLWM Area). The conclusions from that study were based on the assumption that all high-level waste would be removed from the site and sent to a national disposal site within a number of years. As no facility has been selected or developed, leaving the high-level waste would change the conditions for the Comprehensive Study for the WL site, which should be re-examined as it forms the basis for the long-term plan for the site.

Recommendation 1 – Although the WR-1 decommissioning is a separate component of the Comprehensive Study, exposure models should be assessed in terms of the other sources of radioactivity on the site (LLWM area, Winnipeg sediment, sewage lagoon and other sources of radioactive and noon-radioactive contaminants).

Issue 2 – The Comprehensive Study Report ("CSR") names the CNSC and Fisheries & Oceans Canada as Responsible Authorities (RA), although in the Appendices to the CSR, CNSC is named as the only RA. Given the importance of the aquatic transport pathway in the Post-Closure period, and the potential for contamination of the Winnipeg River and the reliance of MMC harvesters on fish and aquatic resources, the RA for the Project requires clarification and consistency.

Recommendation 2 – Please clarify if Fisheries and Oceans Canada is a Responsible Authority for the WR-1 Decommissioning.

Issue 3 – The Proponent states that **"**ISD is a *permanent, passive decommissioning end state* [and] CNL is proposing a revised approach to the WR-1 decommissioning that includes partial dismantling and demolition, along with *passive, permanent disposal* of the below-grade portions of the facility (the Project)" (EIS, 2017; pp 1-1, emphasis added).

The WR-1 decommissioning is not a "permanent disposal" of the high-level waste in the reactor. It is a long-term storage in which the radioactivity is not isolated from the biosphere but will be released to the environment through time. Conditions of the high-level waste disposal program by the CNSC in the 1990s stipulated that the waste must be isolated from the biosphere and should not be a burden on future generations.

The WR-1 decommissioning as described in the EIS will not isolate the waste from the biosphere and requires monitoring of the site until 2324. This places a commitment on future generations and a possibility of exposure of released radionuclides to the public, particularly to those that harvest fish in the river and may harvest aquatic plants, including wild rice. As already identified throughout this review, the MMC has rights in the Project vicinity that include practices of harvesting fish and other aquatic resources from (among other locations) the Winnipeg River. The ISD plan for the Project has the potential to create additional impacts on the MMC and future harvesters, which are possibly greater than a disposal or decommissioning plan that does not involve in-situ options for decommissioning.

While the ISD plan meets one of the CNL Integrated Waste Strategy Objectives by providing a disposition route for the WR-1 Reactor components and systems (EIS, 2017; pp 2-1), it does not meet the objectives of "limiting nuclear legacy obligations for future generations" but requires monitoring and maintenance of the site for at least 100 years, and possibly as long as 300 years. This long-term monitoring requires ongoing resources and may lead to significant resource costs to correct any deficiencies. The alternative of moving the radioactive material to a final disposal site should be seriously considered.

Recommendation 3a – The CNSC should provide guidance on whether the long-term storage of high level waste in this form is acceptable, given the knowledge that radioactivity will be released to the Winnipeg River in the future.

Recommendation 3b – Alternatives to ISD, such as moving the radioactive material to a final disposition site should be considered as viable options for the WR-1 Reactor decommissioning. The CNSC should make recommendations to reconsider the alternatives to in situ storage of WR-1 Reactor and examine the possibility of removing and storing the highly radioactive components with other high-level waste from other sites. This would significantly reduce monitoring and maintenance costs.

Issue 4 – The EIS identifies that "Although the installation of the engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation" (EIS, 2017). The data used to justify this statement only cover a few years of when the Proponent has managed the site. It is unclear whether these assumptions will withstand the passage of time, particularly over 300 years given climate change and possible land-use changes in the area. It is unlikely that the surrounding environment and the land use will remain the same. The flow of the Winnipeg River may change with drier or wetter climate, and changes in the dams on the river. This uncertainty will also affect the Project description and other aspects of the Project over time as they are described, assessed and form conclusions in the EIS.

Recommendation 4a – The EIS should be revised to explicitly include acknowledgement that the uncertainty of the estimates increases over time. It is not possible to make conclusions on environmental and climatic conditions 300 years in the future with any certainty and the EIS should identify this limitation.

Recommendation 4b - The CNSC should consider this uncertainty in the conditions that it imposes on the decommissioning plan for the Project, including by imposing conditions or requiring options that include the removal of highly radioactive material to a permanent disposal site.

Issue 5 –The summary of the EIS does not discuss the other sources of radioactivity already stored on the site. The CSR indicates that, after decommissioning, there will be two sources of radioactivity that remain on the site: the Low Level Waste Management Area and the contamination in the Winnipeg River Sediment. There is no mention of these radiation sources or their influence on the risks from the WR-1 decommissioning. These existing sources of radioactivity present the potential for additional radioactive material and effects that requires consideration as it may result in additional cumulative effects on the environment and specifically the MMC members that rely on the natural environment for the exercise of their rights and subsistence.

The EIS further identifies that the "decommissioning approach for the WL site as described in the Comprehensive Study Report (CSR) was to remove all facilities entirely from the WL site with the exception of low level waste trenches in the Waste Management Area, which may be managed through on-site in situ disposal (AECL 2001). Over a 10-year period, multiple buildings and facilities at the WL site have been decommissioned and the occupied space has been remediated, in an effort to meet this objective" (EIS, 2017; pp 2-2). The Winnipeg River sediment is not mentioned here although it was identified in the CSR as remaining after site closure. It is also not clear what the long-term plans are for the irradiated fuel remaining on-site.

Recommendation 5 – Although the EIS is written specifically for the WR-1, it must be reviewed in the context of the larger site and other sources of contamination. At the very least, it is recommended that the description of the site and exposure models should include all sources of contamination and their management plans including identifying the long-term plans for the irradiated fuel currently on-site and the Winnipeg River sediment

Issue 6 – The EIS identifies that "AECL has asked CNL to perform the work, and in keeping with international best practices (IAEA 2004, 2006), the decommissioning timeframe has been accelerated with the goal of completing decommissioning of the WL site by 2024" (EIS, 2017; pp 1-7).

It appears that this timeframe is the key component for the plan to decommission the WR-1. The timeframe may not allow for a consideration of other alternative decommissioning or disposal options that have less potential for contamination effects on the local environment, and correspondingly less potential impacts to the MMC and other members of the public. ISD is the only alternative identified by the Proponent which will allow the decommissioning of the site by 2024.

Recommendation 6 – The CNSC, AECL and CNL should consider extending the timeframe for site decommissioning if it provides the best solution to WR-1 decommissioning.

Issue 7 – The Proponent is proposing ISD of the WR-1 to achieve the closure of the WL site by 2024. The EIS considered, among other factors, worker safety when undertaking ISD. This review does not dispute that worker safety is of importance, however the EIS has not presented evidence of the dose rates to workers currently in the building when performing maintenance or monitoring, or what the doses to workers were when removing the fuel from the WR-1 Reactor or transporting the fuel to its current location, and what the doses will be when transporting the fuel off-site (or where the fuel will be moved to). This information is required to make informed decisions about the preferred options for the WR-1 Reactor. If this information is available in supporting documents, it should be summarised in the EIS.

Other alternatives, such as leaving the reactor in place until a permanent national depository is available, should be re-considered, and affects of these options on worker safety should be identified and considered. The MMF has expressed an interest in having MMC citizens build capacity and knowledge in the decommissioning activities, over the lifecycle of the Project. As such the potential effects of various options for decommissioning on the workers safety is of interest and concern to the MMF.

Recommendation 7 – Consider and provide information about the effects on workers of alternative decommissioning options that do not involve ISD.

Issue 8 – The EIS outlines a consideration of cost estimates of the preferred method (ISD) and alternatives (EIS, 2017; Table 2.6.3.1). The preferred option of ISD has been identified by the Proponent as the cheapest and quickest method to decommission the WR-1 Reactor, but there is no explanation of individual costs. For example, monitoring of Alternative #1 is stated to be $1, but $7 for Alternative #3, however it is unclear what the units are. Alternative #3 has no surveillance after 2024 and no further details are provided. Presumably monitoring will continue on the site after 2024 as part of the site license and because of the legacy contamination in the lagoon, low level waste management area, cesium ditch, etc. however it is not clear whether the cost estimates include this ongoing monitoring. Also, if it has not already been undertaken, the cost estimates should be audited and validated by an independent source.

Recommendation 8a – More complete costing details need to be provided, including identifying individual costs and whether ongoing monitoring has been included. In addition, there needs to be greater transparency about allocated costs. Also, estimates of how costs are allocated 100 to 300 years in the future should be described, along with an explanation of how future costs are being estimated for the next 100 years.

Recommendation 8b- The cost estimates should be audited and validated by an independent source.

Issue 9 – The rationale for ISD relies on maintenance and monitoring of the installation for 300 years and states that “control” will last “indefinitely” (EIS, 2017; section 3.1.2). It is not clear how the

Proponent is prepared to make this commitment for the post-closure after 2124 or, in particular, after 2324. Environmental regulations change with each government, and it is possible that future governments may choose to not allocate funding to maintaining and monitoring the WL site. There is no way to guarantee future commitment of resources.

Recommendation 9 – Additional clarity is required for the post-closure phase activities and plan, in particular how long-term performance monitoring and maintenance activities are expected to be carried out. The EIS should further consider and acknowledge that the uncertainty in being able to guarantee the sufficiency of these planned activities increases over time given the potential for changes in priorities, funding, and environmental requirements. The CNSC should consider this uncertainty when identifying conditions to apply to the Project.

Issue 10 – The EIS identifies that "Project-specific effects can be quantified (e.g., incremental changes to ground and surface water quality, air quality, and fish and wildlife habitat). Because the socio-economic status of different communities, subpopulations and individuals may vary, a socio-economic effect may have positive aspects and negative aspects. An effect on a biophysical discipline is typically constrained to being negative or positive" (EIS, 2017; pp 6-2).

This introductory text is meant to provide support to later conclusions in the EIS, but it overstates the levels of confidence in the analysis. For example: "Project-specific effects…fish and wildlife habitat" are identified however the subsequent analysis does not quantify effects to fish and wildlife habitat. In fact, there are no formal surveys of fish and wildlife habitat for the WL site described in the EIS, and no methods for estimating effects to habitat, either in 2024 or in the future. This presents problems for later conclusions in the EIS, such as, for example, related to the protection of fish and fish habitat (EIS, 2017; Table 6.1.2.1); while identified as an issue to be assessed and considered in the EIS, the subsequent analysis does not specifically address changes to fish habitat in the Winnipeg River. It estimates the radiation dose to fish in the river (and the concentration of non-radioactive chemicals) and concluded that doses will not cause effects in adult fish. Later in the report (EIS, 2017; pp 6-215) it is stated that "Fish habitat is generally similar throughout the RSA" however it provides no evidence for this conclusion. A consideration of the evidence from the scouring (near the plant site) and depositional zones (further downstream) in several places in the river could be considered as it relates to supporting or refuting this conclusion.

Recommendation 10a – The EIS needs to be reviewed, particularly the text in the Assessment section (Section 6) for conclusions that overstate its accuracy or imply that the analysis will be rigorous and predict impacts with any accuracy or precision. For example, no surveys of fish or wildlife distribution have been conducted for the EIS so the text should not imply or include conclusions based on survey's that have not been undertaken; Log books by staff are not accurate indicators of wildlife presence, abundance, or distribution at the site; etc.

Recommendation 10b – To the extent that the conclusions identified in section 6 require surveys or assessment activities that have not be undertaken regarding the Project site and/or effects, these formal

surveys, assessments etc. should be undertaken by experienced personnel. Risk assessment models for the WL site should use site specific surveys of species distribution for both the aquatic and terrestrial environments to provide some conceptual support for the models. The ecological risk assessment uses data from other studies and anecdotal reports to estimate exposure and does to VCs. These surveys or assessment activities should, as much as possible, be at locations specific to the Project site and not drawn from other locations that may or may not provide comparable data (for example, pp 6-216 Fish Community data is drawn from other locations in the Winnipeg River and it is unclear if the fish population at the Project site are similar or comparable to the location of this data source).

Issue 11 – Section 1.5 (EIS, 2017) is intended to leave the impression that the risk assessment methods used here are rigorous and that the conclusions on exposure and effects are fully justified. However, most of the text glosses over the fact that conclusions are made without justification, a rationale or supported by data specific to the WL site. For example, phrases like "either because there was no linkage initially or because environmental design features or mitigation will remove the pathway, are not advanced for further assessment" or "pathways determined to have no linkage to a VC or those that are considered secondary are not expected to result in environmentally significant effects on the assessment endpoint of VCs" (EIS, 2017; section 6.1.5) result in pathways being removed without sufficient justification. Statements and conclusions must be based on evidence if they are to be relied on to support conclusions that there will be no, or limited, impacts on factors of importance to the MMC, its rights, interests or health and well-being.

Recommendation 11 – The EIS needs to be reviewed and revised so that statements of professional judgement are based on and linked to evidence that is put into the EIS.

Issue 12 – The EIS identifies that "From 1976 to 1982, downstream fish flesh concentrations of Cs-137 were greater than upstream concentrations for all fish species. However, the estimated dose from fish consumption (<0.005 mSv/a) remained far below (0.01%) the occupational dose limit, so the fish remained safe to eat (AECL 1983). Concentrations in water decreased subsequent to improvements to effluent treatment at the ALWTC in 1982, similar to levels observed between 1962 and 1972 (AECL 1983)" (EIS, 2017; section 6.5.4.2.3). This is a significant observation which connects releases of Cs-137 from the plant to fish consumed by fishers. The data presented in Table 6.5.4.1 were collected from 2010 to 2015 and do not include the data prior to 2010 even though AECL has been monitoring fish since 1976. Presumably these data are available and would provide additional details regarding the concentrations of contaminants in fish over longer periods of time. Such information would be relevant to the consideration of the long-term effects of contamination on fish populations, over the 300 years of the Project decommissioning, and the potential adverse effects on members of the MMC who harvest and consume fish as part of a traditional diet.

The total incremental dose due to fish ingestion was identified as 1.14 x 10-4 mSv/a for adults (EIS, 2017; section 6.5.4.2.3) Additional information for this assessment is required, including, sample sizes, species consumed, amount of fish consumed, and the other nuclides assessed. This information is vital

for estimating exposure in MMC citizens, and others harvesting fish as radionuclides are released from WR-1.

Recommendation 12 – Please provide and include a summary of the details of the historic concentrations in fish and the amount of fish consumed in the risk assessment models in the EIS. Monitoring of fish species has been conducted since the early 1970s but only the later data have been used for the assessment. The exposure models should use site specific data on species caught and amounts consumed, not generic values from the CSA.

Issue 13 – The EIS identifies that "CNL's current environmental monitoring program includes collecting water samples at one location upstream and three locations at varying distances downstream of the WL site. Surficial sediment is also collected at two locations upstream, at the outfall, and nine locations downstream. In addition, CNL has committed to collecting cores in depositional areas in 2026, 2046, and 2066 at Sylvia Lake and upstream and downstream of the waterbody Lac du Bonnet" (EIS, 2017; pp 6-205). It is unclear if the collection of samples as described is adequate to detect changes in water chemistry if the WL-1 Reactor releases radionuclide and non-rad components more quickly than predicted. Past monitoring programs may be considered to justify or refute the conclusion that the collecting sampling plan and timelines are sufficient to guard against the risks involved. Collecting cores every 20 years is unlikely to detect changes in water chemistry or deposition of contaminants and won't allow for quick adaptive actions to correct releases.

Recommendation 13 – The Proponent should consider data from past monitoring programs to justify a sampling schedule that will allow detection of any releases. Where indicated by these past monitoring programs, a sampling plan collecting cores more frequently than every 20 years should be implemented.

Issue 14 – The EIS uses the benchmark dose to non-human species from UNSCEAR and CSA (EIS, 2017; pp 6-221), however there have been more quantitative assessments completed. Environment Canada and the AECB used more conservative benchmark values for the Priority Substances List assessment for the protection of the environment around nuclear facilities (EC 2001). Specifically, the Radiation Benchmarks used in section 6.3.2 are very selective in the literature that it uses to rationalize the UNSCEAR 1996 values, which are seriously outdated. EcoMetrix 2017, in Table 7-2 - Assessment endpoints, measurement endpoints, etc. includes a line of evidence for the radiological dose of growth, survival and reproduction that is not supported by the UNSCEAR benchmark. More conservative benchmarks are more protective and are considerably more quantitative.

A more quantitative approach by the European Community (cited by Ecometrix) combined a detailed literature review, species sensitivity analysis and an added safety factor of 5, consistent with the assessment of other contaminants, to provide a chronic incremental screening dose of 10 µGy/h for the protection of all ecosystems (protective of 95% of species) using the ERICA approach (Brown et al. 2008, Garnier-LaPlace and Gilbin 2006, Garnier-LaPlace et al. 2006). It was recognised that this dose rate could also allow some cytogenetic effects in sensitive vertebrate species (Sazykina 2005, Sazykina et al. 2009).

Recommendation 14 - Given the uncertainties in predicting background and incremental doses in the future, the use of a more conservative benchmark should be used.

Issue 15 – The EIS and Ecometrix report indicate that land use plans and institutional control is clearly defined and will continue during Post-Institutional period (300+ years) and will be designated for other uses after 300 years (EIS, 2017 pp 6-225; EcoMetrix section 5). The EIS also acknowledges that the government might not maintain control over the site in which case monitoring programs might not continue and that people may "be present on-site and make some use of local resource" (EIS, 2017; pp 6-305). Given this uncertainty**,** predicting social, political and environment conditions 300 years into the future is very problematic. In terms of exposure modelling and access to the site, it seems to be more conservative to adopt a model that allows for no controls and unrestricted access to the site. The long-term plan or "end use" for the WL site is also unclear, and where possible should be clearly identified in the EIS as this "end use" state will be of importance to the MMF and ultimately affect what traditional uses and activities can be carried out there by MMC citizens.

Recommendation 15a – The EIS should be revised to include, as a possibility, an institutional control model with no controls and unrestricted access to the site, to take into account the uncertainty of the end state of the WL site.

Recommendation 15b – If possible, the long-term plan or "end use" of the WL site should be clearly identified, including a timeline leading up to this end use state. Limitations on the MMC use of the lands and resources resulting from this anticipated "end use" state should be clearly identified.

Issue 16 – The EIS identifies the harvesting practices of First Nations proximate to the Project site, and the potential effects on the harvesting and other rights of First Nations. For example, Table 6.7.1.1, identifies how **"**Sagkeeng FN harvest wild rice and medicinal plants in the area." As is identified throughout this review, the MMC has constitutionally protected rights and interests, and exercise those rights and interests in the vicinity of the Project area. Much like First Nations, these rights and interests and the health and wellbeing of the MMC stands to be impacted by the Project activities and resulting accumulation of contaminants in the environment and resources relied on by the MMC. Métis may have similar concerns and wish to harvest wild rice from depositional areas of the Winnipeg River downstream of WL site, which needs to be taken into account by the Proponent and included in the EIS.

Recommendation 16 – Work with the MMF to identify and consider the rights, interests and activities of the MMC that may be impacted by the Project. These need to be included in the EIS, along with a consideration of how these harvesting activities and practices may be impacted by the presence of contaminants and consequently affect the health and well-being of the MMC. Accommodation and mitigation options may be required.

Issue 17 – The EIS states that the "Results of the Comprehensive Study Report (AECL 2001) indicated that no public health threats were predicted from the decommissioning and reclamation activities for the WL site. Releases are well within regulatory limits for the protection of human health and regular

monitoring provides that any aberrations are detected immediately (AECL 2001)" (EIS, 2017; pp 6-288). It further identifies that the "Results of the Comprehensive Study Report ["CSR"] indicated no residual effects on public health are expected as a result of the closure of the WL site" (EIS, 2017; pp 6-294).

This is a misrepresentation of the results of the CSR. The CSR determined that there would only be the LLWM area and the Winnipeg River sediment as two remaining sources of radioactivity on the site. All high-level waste was to be removed to a national disposal site that would isolate the waste from the biosphere. Because of those assumptions, there would be no long-term impact on public health at WL site. Those assumptions have now been changed with the long-term ISD storage of WR-1 Reactor.

Recommendation 17 – The 2001 conclusions were based on the removal of high level radioactive concerns on the WL site to a national site. This WR-1 Reactor decommissioning was not part of the 2001 Comprehensive Study. The in situ WR-1 Reactor decommissioning should be analyzed in terms of the sources of radiation on the site (LLWM, the Winnipeg River sediment, lagoon, etc.). Also, the CSR should be re-visited with updated data.

Issue 18 – The EIS acknowledges that "Harvesters represent traditional users of the area who may be exposed through harvesting of country foods" (EIS, 2017; pp 2-697). The EIS (pp 6-297) and Ecometrix Report (section 5.2.2) make a series of assumptions about land-use location, duration, and frequency of harvesting activities. The time spent by traditional harvesters at the WL site in the exposure model is very restrictive. The HHRA for the harvester assumes land use practices in 2324 to be similar to those in 2024 but they may be completely different. It should be possible to conduct several land use practices using the transport models to determine if time of residency in the area and a more traditional diet will affect exposure.

The EIS further states that "Recreational users such as swimmers, anglers, and boaters that occasionally carry out recreational activities along the Winnipeg River at locations close to the WL site, as compared to the most critical group locations (Farm A and Farm F), are not directly considered for the assessment because these activities are not representative of population groups in the area" (EIS, 2017; pp 6-297). Given the potential for the change in land-use over time, these recreational activities should be considered as part of the assessment. As the Project-site and surrounding area become available for these uses, there is the potential for the recreational use of the area by the MMC to increase.

Recommendation 18a – Land use studies should be conducted to determine if time of residency in the area and a more traditional diet will affect exposure.

Recommendation 18b – Recreational users and the potential increase in the recreational land use of the area should be considered in the land use studies undertaken.

Issue 19 – Table 5-20 of the Ecometrix Report identifies that the dominant contributor to the total dose is carbon-14 through the ingestion of terrestrial plants and animals, and fish, except for the 3-month-old drinking formula, which has tritium as the dominant contributor to dose. Why is the dose not calculated for the nursing infant of the harvester?

The hazard quotients derived for constituents of potential concern were below the protective benchmark for all receptors, with the exception of a toddler harvester during post-closure, which slightly exceeded the benchmark. For the toddler harvester, the total ingestion HQ slightly exceeded 0.2 for lead (HQ = 0.24) (EIS, 2017; pp 6-314). The EIS further identified that "with the exception of a toddler harvester during post-closure, which slightly exceeded the benchmark. If only the Project contribution is considered, the HQs are reduced even further and hazard quotients are well below for all receptors (the Project contribution to the total is 0.0021% for cadmium and 0.00002% for lead)" (EIS, 2017; pp 6-314).

This gap in the modelling scenario is significant as there does not appear to be a pathway for the nursing infant for the harvester scenario. A rationale for this was not located, nor was a description of the infant diet for the harvester. It is assumed that the "harvester" is represented by a family with adults, a toddler and a breastfeeding infant, however this assumption needs to be confirmed and clearly identified in the EIS. Given the reliance of the MMC on harvesting activities, and the importance of protecting and preserving the harvesting rights and activities of the MMC for future generations of Métis harvesters, the data related to pathways for contaminates between adults and nursing infants is significant in terms of potential long-term health effects on members of the MMC.

Recommendation 19 – Further information is needed, including the diet for the infant harvester, and the identification of the family grouping considered, the pathway for the nursing harvester, etc.

Issue 20 – The Ecometrix Report and the EIS both often use the term 'conservative' when describing uncertainty without explanation or evidence. For example, page 7.1.6 of the Ecometrix Report: "The EcoRA problem formulation is conservative in its assumptions to accommodate uncertainties and meet the objective of protecting ecological health during the post-closure period" and "There is uncertainty in the radiological and non-radiological release rates to the surface water environment; however, the estimates are expected to be conservative." Also In a previous section of the Ecometrix Report, entitled Uncertainty in Exposure Assessment, sentences such as "This is considered appropriate" and "Dose coefficients were obtained from reputable sources" are not convincing and cannot be reviewed. Page 6-344 of the EIS states that: "Although uncertainties in the assessment exist, conservatism has been included in the modelling so that residual effects are not greater than predicted. Overall, residual effects are considered to be not significant for all ecological health VCs during the closure and post-closure phases. Monitoring and follow-up programs include implementation of CNL's existing Environmental Monitoring Program. These activities will verify effects predictions for ecological health."

There needs to be some support for these types of categorical statements. Evaluating conservatism needs to be expressed relative to another set of conditions. Here it is stated, without support. For the statement on page 6-344, there is no support for the observation of "residual effects are not greater than predicted" without some reference.

Recommendation 20 – The EIS needs to be reviewed for consistency in the use of the term "conservative" when describing uncertainty of various aspects of the Project. Evaluating conservatism needs to be expressed relative to another set of conditions.

5.0 Summary and Recommendations

We have conducted a focused review of the Whiteshell EIS based on our understanding of MMC rights and interests, and potential Project interactions with the environment that may lead to effects on MMC rights and interests, as described in Section 2.0 of this report, and the health and well-being of the MMC members. In our review, we have provided 38 specific comments on the Whiteshell Project, and related recommendations to address them in the areas of the aquatic environment, terrestrial environment, and human and ecological health. These comments have focused on all aspects of the EA process including baseline studies and scoping, alternatives assessment, the effects assessment, mitigation measures, significance determination, and follow-up monitoring. In general, we have found inadequacies with respect to baseline studies, failure to appropriately consider the land use, rights and interests of the MMC, missing information and incomplete effects assessment, mitigation of effects on wildlife, and inadequate monitoring and follow-up.

The EIS has not identified—and therefore has not considered—the impacts to the rights, claims and interests of the MMC. As identified throughout this review, the MMC has rights and interests which intersect with the Project area and vicinity and have the potential to be adversely impacted by the Project activities, including the potential for ongoing contamination of the lands and waters. As the health of the land, waters, and resources are impacted, so too is the health of the MMC that relies on those resources for sustenance. The rights and interests of the MMC are distinct from the rights and interests of First Nations and must be specifically considered and identified, through engagement with the MMF. Mitigation, minimization, and accommodation measures for any impacts should be identified, considered, and implemented in coordination with the MMF.

In our review we noted some serious problems with the stated conservatism of the EIS. In many instances professional judgement was used to determine effects without adequate support from scientific literature or an accompanying rationale. Likewise, decisions that the Proponent has taken in predicting effects of the Project may underestimate the potential contamination and result in greater impacts. For example, as described in Issue 3 from Section 3.1.2, the exclusion of radionuclides with half lives shorter than 1 day in the mass balance and transport model for groundwater is not conservative and likely to result in low predictions of contamination. These unconservative selections and resulting low predictions for contamination have resulting consequences on the rigour of the monitoring plans proposed by the Proponent, and whether the monitoring is sufficient to guard against and adequately identify and assess potential contamination.

The lack of conservatism employed for the effects assessment can be compounded by the land use practices of members of the MMC that may increase their exposure to contaminants. There are many individuals within the MMC who are active land users and are likely to be exposed to a higher concentration of environmental contaminants than what has been evaluated in the EIS. For example, land users who regularly consume fish from the Winnipeg River will receive multiple exposures to contamination. The combination of underestimated contamination and higher exposure is a serious

concern for members of the MMC, and presents possible disproportionately higher impacts on members of the MMC that must be considered and assessed.

By opting to go with the ISD alternative for decommissioning of the WR-1 Reactor, the Proponent is placing a considerable risk on future land users of the area. The WR-1 decommissioning is not a "permanent disposal" of the high-level waste in the reactor. It is a long-term storage in which the radioactivity is not isolated from the biosphere but will be released to the environment through time. The WR-1 decommissioning as described in the EIS will not isolate the waste from the biosphere and requires monitoring of the site until 2324. This places a commitment on future generations and a possibility of exposure of released radionuclides to the public and the MMC. The alternative of moving the radioactive material to a final disposal site should be seriously considered.

To address the issues noted herein and move forward discussions about the Project, we provide the following high-level recommendations for the CNL and the CNSC:

- Continue to engage with the MMF to identify and evaluate current land-use and potential future land use impacts associated with the Project on the rights and interests of the MMC. Métis Knowledge of land-use activities must also be used to inform the risk assessment of potential exposure pathways.
- Provide responses to the issues described in this report (summarized in Appendix B) by outlining specific information, actions and/or accommodations that will be undertaken by the CNL.
- The CNSC must to provide guidance on whether the long-term storage of high level waste in this form is acceptable, given the knowledge that radioactivity will be released to the Winnipeg River in the future. CNL has the expertise to move the material to another site safely.

6.0 References

Brown, J.E., B. Alfonso, R. Avila, N.A. Beresford, D. Copplestone, G. Pröhl and A. Ulanovsky. 2008. The ERICA tool. Journal of Environmental Radioactivity 99: 1371-1383.

CNL, 2017. *Environmental Impact Statement In Situ Decommissioning of WR-1 at the Whiteshell Laboratories Site*. Prepared for Canadian Nuclear Laboratories, September 13, 2017.

Cunningham (2011). Supreme Court Canada, Alberta (Aboriginal Affairs and Northern Development) v.Cunningham, 2011 SCC 37. Retrieved from http:/scc-csc.lexum.com/sc-csc/item/7952/index.do

EcoMetrix (EcoMetrix Incorporated). 2017. Whiteshell WR-1 Environmental Risk Assessment. WLDP-26000-REPT-006. Prepared for Canadian Nuclear Laboratories. August 2017.

EC (Environment Canada). 1997. Environmental Assessments of the Priority Substances under the Canadian Environmental Protection Act. Guidance manual, version 1.0. EPS 2/CC/3E. Chemicals Evaluation Division, Commercial Chemicals Evaluation Branch, Environment Canada.

ERICA, 2006. Derivation of predicted no effect dose rate values for ecosystems (and their sub-organisational levels) exposed to radioactive substances. Deliverable D5. In: Garnier-Laplace, J., Gilbin, R. (Eds.), European Commission, 6th Framework Contract no. FI6R-CT-2003-508847.

Garnier-Laplace, J., C. Della-Vedova, R, Gilbin, D. Copplestone, J. Hingston and P. Ciffroy. 2006. First derivation of predicted-no-effect values for freshwater and terrestrial ecosystems exposed to radioactive substances. Environmental Science and Technology 40, 6498–650

Garnier-Laplace, J. and R. Gilbin, (Eds.), 2006. Derivation of Predicted-No-Effect-Dose-Rate values for ecosystems (and their sub-organisational levels) exposed to radioactive substances. Report D5 to the ERICA project (EC Contract number F16R-CT-2003-508847). Swedish Radiation Protection Authority, p. 88.

Government of Manitoba (2012). Workforce: Average Hourly Wages – All industries (Hourly Wages, Including Overtime). Retrieved from: http://www.mmf.mb.ca/departments_portfolios_and_affiliates_details.php?id=11&type=message

Jones, G (2014) Historical Research Report on Métis Presence in the Nelson-Hayes River System. Prepared for Manitoba Métis Federation. Pp. 25

Manitoba Métis Federation Inc. v. Canada (Attorney General), 2013 SCC 14, [2013] 1 S.C.R. 623

Sazykina, T.G., 2005. A system of dose–effects relationships for the northern wildlife: radiation protection criteria. Radioprotection 40 (Suppl. 1), S889–S892.

Sazykina, T.G., A.I. Kryshev and K.D. Sanina. 2009. Non-parametric estimation of thresholds for radiation effects in vertebrate species under chronic low-LET exposures. Radiation and Environmental Biophysics 48:391-404.

Shared Value Solutions Ltd. (2014) Manitoba Métis Federation Traditional Land Use and Occupancy Study. Prepared for Manitoba Métis Federation.

Shared Value Solutions Ltd. (2015) Manitoba Métis Federation Traditional Land Use and Occupancy Study. Prepared for Manitoba Métis Federation.

Sprague, D. N., & Frye, R. P. (1983). The genealogy of the first Métis nation: The development and dispersal of the Red River Settlement, 1820-1900. Pemmican Pubns.

Stewart, K.W. and D.A. Watkinson. 2004. The freshwater fishes of Manitoba. Winnipeg MB: University of Manitoba Press. 276 p.

Appendix A – Review Team CVs

Scott Mackay, M.Sc., RPP, MCIP

Managing Partner, Shared Value Solutions Ltd.

Overview

Scott is a senior consultant and is the CEO and CFO of Shared Value Solutions Ltd. As a Registered Professional Planner, and with 19 years of diverse professional experience, he has established a strong environment and natural resource planning and management practice serving governments, Aboriginal communities, and progressive private sector clients.

Scott is adept at engaging and advising multi-disciplinary technical and engineering teams, communities, and government decision-makers about complex environmental issues, and decisions about how to respond to or address them. These issues have included cleanup of the Great Lakes, climate change and water management along significant waterways, management of nuclear waste, assisting First Nations communities to plan for the improvement of community infrastructure, and sustainable and equitable development of infrastructure and resources in the North.

As a consultant, Scott has recently led a literature review for the Canadian Environmental Assessment Agency on the consideration of Aboriginal Traditional Knowledge in Federal EAs, conducted and led numerous traditional land-use and occupancy studies and environmental peer reviews related to mining and infrastructure development in Northern Ontario and Manitoba on behalf of Aboriginal communities, provided environmental assessment advice to the Ontario Ministry of Transportation on the project implications of the Magnetawan First Nation traditional land-use study for the Highway 69 Four-Laning project, and advised Public Works and Government Services Canada and Parks Canada on socioeconomic and environmental considerations of changes to their water management infrastructure on the French River and Trent-Severn waterways in Ontario. Scott is also a sessional instructor of a fourth year undergraduate course in Environmental Impact Assessment in the Department of Geography, University of Guelph.

Contact

scott.mackay
@sharedvaluesolutions.com
(226) 706 8888 ext. 102

62 Baker Street
Guelph, ON
N1H 4G1

Professional History

2012 – Present
Managing Partner
Shared Value Solutions Ltd.

2012
Senior Consultant
Consultation and Communications
AECOM

2009 – 2011
Consultation and Communications
Specialist
AECOM

2008 – 2009
Project Manager/Researcher
University of Guelph

Shared Value Solutions

Scott Mackay, M.Sc., RPP, MCIP

Specialties

Environmental planning and impact assessment | Indigenous community consultation and the Duty to Consult | environmental peer reviews | traditional knowledge and land-use studies | community engagement | natural resources management | watershed management

Selected Experience

Magnetawan First Nation, Environmental Management Plan for Land Code
2016 - Present
Project director and client liaison for the development of a community-based Environmental Management Plan for reserve lands subject to transfer back to First Nations ownership under the First Nations Land Management Act. Includes community engagement and collaborative planning work, creation of a new environmental assessment law, formulating environmental management systems and plans related to community infrastructure and development on lands and waters within the community reserve, and environmental event response plans.

Mushkegowuk Tribal Council, Mushkegowuk All-Season Road Feasibility Study- Community Well-Being Baseline and Impact Assessment
2015 - Present
Working as a subconsultant to an engineering consultant (Morrison Hershfield)- Project director and client liaison leading a multi-phase community well-being (CWB) baseline study and impact assessment for an all-season road connecting indigenous communities on the west side of the James Bay coast to the provincial (Ontario) highway network. Our work is part of a feasibility study and preliminary work for a future EA process. Inlcudes early engagement and consultation, community focus groups to develop Valued Ecosystem Components and indicators for the EA process, benchmarking and case study analysis to develop a list of potential impacts for the EA process, and development of CWB criteria and evaluation frameworks for a route alternatives evaluation process, Assisting the prime engineering consultant and client by providing strategic advice and communicating and liaising with Tribal Council leadership and senior staff.

Manitoba Métis Federation (MMF), Environmental Reviews and Impact Assessments for Major Projects
2014-present
Led environmental, socio-economic, and cultural reviews of the EAs and Environmental Protection Plans (EPPs) for major project proposals (Manitoba East Side All-Season Road, Manitoba Hydro Bipole III transmission line, Enbridge Line 3 oil pipeline replacement and NEB process) including the development of Métis-specific effects assessment and mitigation frameworks and results based on traditional land-use studies. Worked with MMF representatives and their legal advisors to develop MMF negotiation strategy for bilateral agreements with proponents. Also represented MMF at meetings with proponents, and

2001 - 2007
Restoration Programs Officer
Environment Canada

1999 – 2000
Watershed Stewardship Coordinator
Nadina Community Futures
Fisheries and Oceans Canada

1997 – 1999
Project Leader
British Columbia Conservation Foundation

Education

M.Sc. Rural Planning and Development (OPPI-certified)
University of Guelph
2009

B.Sc. (HONS.), Environmental Science/Physical Geography
Trent University
1996

Years of Experience

15

Shared Value Solutions

made plain-language presentations of review findings and implications to Métis citizens at community meetings and to the MMF Board of Directors.

Canadian Environmental Assessment Agency, Aboriginal Traditional Knowledge in Environmental Assessment
2014 - Present
Project director and lead researcher for a literature review synthesizing knowledge about the gathering and consideration of Aboriginal traditional knowledge in environmental assessments in Canada and internationally, to inform training and operational policy development specific to CEAA 2012. Also involved conduct of a series of related workshops about the results of the review for Agency headquarters, legal, and regional staff.

Constance Lake First Nation, Pagwa Radar Site Preliminary Site Investigations 2014
Working under subcontract lead consultant Hutchinson Environmental Sciences. Project lead for community knowledge and land-use interviews and analysis, development of a community-based vision for site cleanup, and scan for funding sources for follow-on phases of work for the cleanup of an abandoned 1950s-era cold war radar site (Pinetree Line).

Constance Lake First Nation, Community-Based Water Management Action Plan
2013 – Present
Developing a community-based water management plan to assist the First Nation with managing their new well water supply for current needs and future community development goals, and developing strategies for the restoration of Constance Lake. Involves community meetings, youth workshops, and coordination and facilitation of a Community Liaison Committee.

Atikameksheng Anishnawbek First Nation, Consultation Protocol Development 2013
Developed a general proponent/Agency Consultation Protocol and organizational implementation strategy for the Protocol. Included community member, staff, and elected official interviews; a cross-Canada scan of example protocols and agreements from other communities, and consultations with Chief and Council and the community-at-large through meetings, workshops, and a community feast.

Taykwa Tagamou Nation, Regional Environmental Monitoring Board Development and Participation- Detour Lake Gold Mine
2012-Present
Senior environmental planner for ongoing consultation support and strategic advice to Chief and Council, and review of a recently permitted mining project's major post-EA permit applications, closure plan amendments, and environmental management systems; providing ongoing input on the formation and implementation of a new environmental management committee for the mine involving three First Nations (including client) and the proponent.

Shared Value Solutions

Alison Fraser, M.Sc.

Risk Assessment Specialist, Shared Value Solutions Ltd.

Overview

Alison Fraser is a risk assessment specialist with a strong background in human health and ecological risk assessment, as well as environmental toxicology. Alison has managed, reviewed and conducted environmental risk assessments for residential, parkland, commercial and industrial sites across Canada. She has a strong background in third party peer reviews of both human health and ecological risk assessments. She is a Qualified Person for Risk Assessment (QPRA) under Ontario Regulation 153/04.

Alison's passion is working to minimize the health risks associated with environmental contamination, by incorporating technically sound science and the needs of affected communities. Alison is a long-time member of the Society of Environmental Toxicology and Chemistry (SETAC) on both a regional and national level. In 2013, she was awarded the SETAC Presidential Citation for Exemplary Service.

Specialties

Project management | human health risk assessment | ecological risk assessment | environmental toxicology | environmental impact assessment and environmental site assessment

Selected Experience

Technical Review of a Phase 1 Environmental Site Assessment (ESA). Aroland First Nation.
2017 – present
Risk Assessment Specialist and Project Manager. A technical review of a Phase 1 ESA was conducted to identify any data gaps in the assessment results. This included community meetings to discuss the ESA and obtain feedback from community members, as well as a site visit.

Contact

alison.fraser
@sharedvaluesolutions.com
(226) 706 8888 ext. 117

62 Baker Street
Guelph, ON
N1H 4G1

Professional History

April 2016 – Present
Risk Assessment Specialist
Shared Value Solutions Ltd.

2002 – 2015
Risk Assessment Specialist/Associate
Dillon Consulting Ltd.

2001 – 2002
Junior Risk Assessor
Golder Associates Ltd.

1999 – 2001
Teaching Assistant (Biology)
Trent University

Shared Value Solutions

Alison Fraser, M.Sc.

Technical Review of a Proposed Transmission Line EA
2017 – present
Risk Assessment Specialist and Project Manager. Reviewed the EA, and associated supporting documentation, related to the development of a proposed transmission line that would traverse two Indigenous communities in Northern Ontario. Potential environmental risks were identified subsequent to the review, and community meetings were held to obtain community input and discuss the review results.

Technical Review of the East West Tie Transmission Line EA
2017 – present
Risk Assessment Specialist. Conducted a technical review of the project EA, with a focus on potential impacts to human health, on behalf of six Indigenous communities.

Magnetawan First Nation (MFN) Environmental Management Plan
2016 – present
Risk Assessment Specialist and Project Manager. Developed an Environmental Management Plan for MFN, intended to provide guidance on the management of lands, and potential environmental risks, under the community's land code.

Aroland First Nation Community Energy Plan
2016 - 2017
Risk Assessment Specialist. A Community Energy Plan (CEP) was completed for Aroland First Nation. The plan included the collection and analysis of energy use data from residential and community/commercial buildings on reserve lands. Using recent Hydro One bills, a financial assessment was also completed. The results of the assessment were used, in conjunction with a needs assessment, to develop the Aroland CEP.

Technical Review of the Energy East Pipeline ESA. Grand Council Treaty #3.
2016 - 2017
Risk Assessment Specialist. A review of potential risks to both human and ecological receptors was conducted on behalf of Grand Council Treaty #3, for the Energy East Pipeline Project. The review focused on the rights and interests of community members, and considered their strong reliance on the land for food, recreation and cultural practices.

Technical Review of the Energy East Pipeline Project ESA. Mi'gmawe'l Tplu'taqnn Incorporated (MTI).
2016 - 2017
Risk Assessment Specialist and Project Manager. Conducted a technical review of the pipeline project ESA for MTI communities. Potential risks to both human and ecological health were identified. Community meetings, and meetings with the proponent, were carried out to present and discuss the review results. The project also included the provision of NEB process support.

Education

M.Sc. Environmental Science
Trent University

B.Sc. Environmental Science (Honours)
University of Guelph

Years of Experience

15

Training and Certifications

Qualified Person for Risk Assessment under Ontario Regulation 153/04
2012 - Present

Soil Vapour Assessments
Laurentian SETAC Short Course
2015

Decision Making Over Project Life From Exploration to Site Closure and Important Statistical Decisions
Laurentian SETAC Short Course
2014

Multivariate Statistics
Laurentian SETAC Short Course
2011

Review of Environmental Risk Assessments
Laurentian SETAC Short Course
2011

Professional Affiliations

Cambridge Environmental Advisory Committee Member
2015 – Present

Society of Environmental Toxicology and Chemistry (North America)
2000 – Present

Shared Value Solutions

Technical Review of Greenstone Gold Mine Environmental Assessment on behalf of Aroland First Nation
2016-Present
Risk Assessment Specialist. Assisted in a technical review of the Greenstone Gold Mine Project on behalf of Aroland First Nation. The review focused on the potential risks to both human health and the environment, associated with the project.

Sisson Mine Project Draft Comprehensive Study Report and Environmental Assessment Review. Mi'gmawe'l Tplu'taqnn Incorporated (MTI).
2016
Risk Assessment Specialist. Conducted a review of the human health and ecological risk components of the EA on behalf of MTI. Data gaps and technical issues related to potentially unacceptable environmental risks were identified. Proposed mitigation measures to address risks were also evaluated in the review.

Site-Specific Human Health and Ecological Risk Assessment – RCMP Detachment Site, Nunavut. Public Works and Government Services Canada.
2014
Risk Assessor. Completed a human health and ecological risk assessment for an RCMP detachment site in Nunavut. Historical sampling conducted at the site, as well as sampling conducted as part of the supplemental site investigation, indicated the presence of petroleum hydrocarbons and metals in soil above applicable guidelines. A risk assessment was completed at the site, which included an assessment of background concentrations of metals in soil. A soil vapour assessment was also conducted. No unacceptable risks were found to occur, thus no risk management measures were required.

Site-Specific Human Health and Ecological Risk Assessment – RCMP Detachment Site, Northwest Territories. Public Works and Government Services Canada.
2013
Risk assessor. Completed a human health and ecological site-specific risk assessment at an RCMP detachment site in Northwest Territories, known to have PHC impacted soil and groundwater. A supplemental site investigation was conducted to further delineate groundwater impacts. A vapour assessment was conducted within the onsite building located in the area of PHC impacts, to quantify potential migration of vapours into indoor air. Potential risks to human and ecological receptors present on the site were quantified.

Risk Assessment – Frontenac Correctional Institution, Public Works and Government Services Canada.
2012 - 2013
Risk Assessment Specialist**.** A site specific human health risk assessment and screening level ecological risk assessment was conducted for the Frontenac Institution, a correctional institution in eastern Ontario, on behalf of Corrections Services Canada. The site was located adjacent to a wetland area, with several streams traversing the site.

Third-Party Peer Review of Risk Assessments, Ministry of Environment and Climate Change. 2011-2015

Society of Environmental Toxicology and Chemistry (Laurentian Chapter)
Member, VP, President and Committee Lead
2002 - Present

Shared Value Solutions

Risk Assessment Specialist and Project Manager. Conducted third-party peer reviews of Ontario Regulation 153/04 risk assessments on behalf of the MOECC. The risk assessments were for a variety of land uses including commercial, industrial, residential and parkland, with the intent to file a Record of Site Condition.

Risk Assessment/Risk Management, Commercial Property and Retail Store, Ontario.
2010 – 2015
Risk Assessment Specialist and Project Manager. A human health and ecological risk assessment was conducted for a site located above a known chlorinated solvent groundwater plume. The risk assessment identified the migration of chemical vapours from groundwater to indoor air as having the potential to cause adverse health effects to indoor employees. A subslab vapour depressurization system was designed and installed at the site to mitigate unacceptable risks. A Record of Site Condition was obtained for the site.

Human Health Risk Assessments – Light Stations, Public Works and Government Services.
2010 - 2011
Risk Assessment Specialist. A site specific human health and screening level ecological risk assessment was conducted for five sites that house light stations in Ontario, on behalf of the Department of Fisheries and Oceans. Supplemental site investigations, including soil, groundwater, and surface water sampling, were conducted on the sites to support the risk assessments. The results of the assessments were subsequently used to prioritize sites for potential future remediation.

Sediment Management Strategy, Sarnia Harbour, Transport Canada and Public Works and Government Services Canada.
2009 – 2011
Risk Assessment Specialist and Project Manager. A detailed sediment assessment was conducted for the Sarnia Harbour. The project included the assessment of potential risks to both human and ecological receptors exposed to sediments of the harbour. Both sediment and surface water sampling was carried out as part of the assessment. A preliminary quantitative risk assessment (PQRA) using the triad approach (chemical analyses, benthic community assessment and sediment toxicity testing) was completed for the harbour. The results of the assessment suggested no risks to human health or ecological receptors would be expected, however, additional sampling and analysis were recommended to address the previously identified data gaps. As a result, a second sampling event was conducted and the triad approach was once again applied. The results formed the basis of a detailed quantitative risk assessment (DQRA) conducted at the site. The results once again suggested no risks to human or ecological health.

Environmental Site Assessment and Risk Assessment – Lighthouse Sites, Public Works and Government Services Canada.
2009 - 2010
Risk Assessor. Environmental site assessments were conducted at six sites in Ontario that housed either lighthouses or day markers, on behalf of the Department of Fisheries and Oceans. Contaminants of concern identified at the

Shared Value Solutions

sites included metals and polycyclic aromatic hydrocarbons. The results of the site investigations formed the basis of both human health and ecological risk assessments for each site. The results of the assessments were subsequently used to prioritize sites for potential future remediation.

Environmental Assessment, Confidential Power Generating Company
2009
Risk Assessment Specialist. In support of the environmental assessment process in Ontario, screening level human health and ecological risk assessments were conducted for two sites that were planned for redevelopment in order to house new power generating facilities. The assessment included the quantitative modeling of deposition and subsequent exposure of both humans and ecological receptors to emissions from the power plants. No unacceptable risks were found.

Human Health and Ecological Risk Assessment, Wetland Property (Ontario)
2008 - 2015
Risk Assessment Specialist and Project Manager. A human health and ecological risk assessment was conducted for a site that contained a provincially significant wetland and historical landfill. The site contained elevated concentrations of metals and polycyclic aromatic hydrocarbons in soil, groundwater, surface water and sediment. Risk management measures implemented at the site included a restriction on the construction of buildings on the site and a prohibition on the use of the site for potable groundwater.

Quantitative Ecological Risk Assessment, Confidential Petroleum Sector Client
2006
Risk Assessor. A quantitative ecological risk assessment was carried out at a former bulk plant property in Eastern Canada due to the presence of benzene, toluene, ethylbenzene, and xylenes and petroleum hydrocarbons in soil and groundwater on the site. Potential risks to both the terrestrial habitat on-site and the aquatic habitat in the adjacent river were quantified.

Risk Assessment, Former Sodium Chlorate Manufacturing Facility.
2005 - 2010
Risk Assessor. A human health and ecological risk assessment was completed at an environmentally sensitive site due to the presence of organic chemicals and metals in the soil, groundwater and surface water. The site was considered to be part of a wider area of abatement under O. Reg. 153/04. As such, public consultation was carried out throughout the risk assessment process. A Record of Site Condition was obtained for the site.

Toxicological Reference Values Review, Health Canada.
2004
Risk Assessor. A comparative review of toxicological reference values (TRVs) was carried out on behalf of Heath Canada. This entailed compiling TRVs from numerous regulatory agencies. A screening process was then used to identify those chemicals

Shared Value Solutions

for which variation among TRVs was greatest. The rationale used in the derivation of the values was then evaluated to identify possible causes for the observed variation.

Keegan McGrath, M.E.S., B.Sc.

Environmental Consultant – Fisheries and Aquatics Biologist, Shared Value Solutions Ltd.

Overview

Keegan McGrath is an fisheries biologist with a background in fish behaviour and environmental science. He has extensive experience working in the field throughout Ontario, Nova Scotia, New Brunswick and Labrador. Keegan has engaged in population assessments, construction monitoring, wetland restoration, stream restoration, fish community monitoring and wildlife monitoring in a wide diversity of habitats. He has been involved in environmental assessments projects for metal mines, hydroelectric dams, transmission lines, highways and all-season roads, offshore drilling and wind turbines.

Keegan finished his B.Sc. Biology at Carleton University in 2009 where he studied aquatic behavioural ecology and landscape ecology. Then in 2014 he finished a Masters of Environmental Studies at Dalhousie where he investigated the environmental impacts of salmon aquaculture technologies. He has published articles in peer-reviewed journals on fish behaviour and aquaculture.

Keegan is passionate about conservation and resource management. He enjoys working on projects to protect the environment and maximize benefits for all parties.

Specialties

Aquatic biology | wildlife biology | behavioural ecology | Species at Risk | ecological field research | fish habitat assessment | stream assessment | habitat restoration | water quality | community research | community energy planning

Contact

keegan.mcgrath
@sharedvaluesolutions.com
(226) 706 8888 ext. 123

62 Baker Street
Guelph, ON
N1H 4G1

Professional History

February 2016 – Present
Environmental Consultant
Shared Value Solutions

September 2014 – October 2015
Environmental Coordinator
McCallum Environmental

May 2014 – September 2014
Project Coordinator
Shubenacadie Watershed
Environmental Protection Society

February 2013 – April 2014
Seafood and Aquaculture Analyst
Seafood Watch

Shared Value Solutions

Keegan McGrath, M.E.S., B.Sc.

Selected Project Experience

Mi'kmaq Confederacy of Prince Edward Island – Moderate Livelihood Study
2017
Collaborated with the Mi'kmaq Confederacy of Prince Edward Island (MCPEI) to undertake a study to develop an understanding of the concept of a 'Moderate Livelihood' as it relates to Indigenous rights and fisheries. Interviews with fisheries managers, Councilors, and Chiefs from Abigweit and Lenox Island First Nation were carried out. This research was supplemented with a review of existing literature.

Qikiqtarjuaq Fisheries Development Team
2017-Present
Provides technical and project support to the Qikiqtarjuaq Nativak Hunters and Trappers Association for the development of small scale in-shore fisheries. Collaborates with the Fisheries Development Team to coordinate project logistics and gain improved market access for fisheries products.

Miawpukek First Nation Offshore Drilling Environmental Support
2017 - Present
Provides technical and strategic support to Miawpukek First Nation related to offshore drilling. In collaboration with Miawpukek fisheries and natural resources staff, Keegan is working to evaluate effects on fisheries, species at risk and diadromous fishes (e.g. Atlantic salmon and American eel).

Anishinaabeg of Naongashiing Fisheries Offsetting and IBA Support
2017
Evaluated the potential impacts from the development of the New Gold mine on community rights and interests. Prepared options for fisheries offsetting and environmental stewardship in cooperation with community and legal representatives. These options were used to support IBA negotiations.

Sheshegwaning Aquaculture Permit Development
2017
Drafted the environmental conditions and monitoring requirements for operation of a rainbow trout aquaculture operation on behalf of Sheshegwaning First Nation. This included the design of baseline studies required for assessment of environmental conditions.

Lake Winnipeg East Side Road Environmental Assessment Technical Review and Community Engagement
2016 – 2017
Evaluated adequacy of the fisheries and aquatics studies, assessments and mitigation measures for the East Side Road Project on behalf of the Manitoba Metis Federation. This included conducting community engagement and information sessions throughout Manitoba to provide updates and hear concerns from the Manitoba Metis Community.

January 2012 – April 2014
Teaching Assistant
Dalhousie University

November 2010 – August 2011
Fisheries Technician
Fisheries and Oceans

Education

Masters of Environmental Studies
Dalhousie University

B.Sc. Biology
Carleton University

Years of Experience

6

Training and Certifications

Backpack Electrofishing Certification,
Canadian Rivers Institute
2015

Wetland Restoration and Water Management Course
2016

Royal Ontario Museum Freshwater Fish Identification Course
2017

Shared Value Solutions

Detour Gold Mine Regulatory Support and West Detour Technical Review
2016 - Present
Provided technical support for aquatics and hydrology issues related to permits and approvals for the operating Detour Gold Mine, north of Cochrane ON. Engaged in the technical review of the proposed West Detour Gold mine expansion that is in early phases of the Ontario Provincial Environmental Assessment process.

Taykwa Tagamou Nation (TTN) Walleye Enhancement Evaluation
2016
Assessed potential benefits of walleye enhancement alternatives for Takwata Lake. Alternatives evaluated included building a hatchery, engaging in a stocking program, completing fish habitat restoration and creating a fisheries management plan. Results were communicated to TTN to support fisheries management within their traditional territory.

Energy East Pipeline Project Fish and Fish Habitat Independent Review. Grand Council Treaty #3
2015 – 2016
Engaged with multi-disciplinary team of reviewers to evaluate adequacy of the ESA and identify impacts to Treaty #3 Aboriginal rights and interests; support Treaty #3 Grand Council in National Energy Board EA review process; community engagement and information sharing regarding the proposed project.

Greenstone Mine Project Environmental Assessment Technical Review. Aroland First Nation
2016
Evaluated the Fisheries and aquatics, identified impacts of concern and developed recommendations for addressing issues and interests.

Sisson Mine Project Draft Comprehensive Study Report (CSR). Mi'gmawe'l Tplu'taqnn Incorporated (MTI).
2016
Aquatics Reviewer. Evaluated the CSR, identified impacts of concern and developed recommendations for addressing Mi'kmaq community issues and interests related to fish and fish habitat.

Environmental Coordination, Construction Monitoring and Mitigation for the Muskrat Falls Hydro-electric Project Transmission Line
2014 - 2015
Worked with clients to provide environmental services including: wetland delineation/ wetland functional assessments; wildlife surveys (e.g. moose surveys, species-at-risk assessment, electrofishing etc.); environmental construction monitoring (Muskrat Falls Hydro Project); and regulatory compliance and permit approvals.

Shubenacadie Watershed Environmental Protection Society, Stream Restoration Project
2014

Shared Value Solutions

Laid out the strategic direction of the summer program and identified and prioritized stream restoration activities in the Shubie watershed. This included stream assessments, construction of in-stream structures, and water quality testing. Supervised two summer students, managed the project budget and coordinated successful public events.

Seafood Watch, Aquaculture Sustainability Assessment
2012 - 2013
Evaluated the sustainability of aquaculture systems based on scientific literature, government/industry reports and interviews with industry/academic professionals. Participated in a special review of energy use in aquaculture and published the report on farmed rainbow trout in the USA.

DFO, Lobster Population Ecology and Maturity
2011 - 2012
Tracked lobster population dynamics in coastal NS with the population ecology division. Conducted field sampling, laboratory research, report writing and database management. Worked with fisherman to implement tracking programs and field protocols to collect lobster maturity data. Coordinated licence renewals for lobster and urchin fisheries in LFA 29-40.

Research Biologist, Carleton University
2008 - 2009
As part of a research program with the behavioural ecology lab I collected fish (seining, angling, trolling, gillnetting); managed captive fish populations; observed behaviors; and installed/maintained lab equipment. I co-authored key aspects of this research which were published in the *Canadian Journal of Fisheries and Aquatic Sciences*.

Peer-Reviewed Publications

Keegan P. McGrath., Nathan L. Pelletier., Peter H. Tyedmers. (2015) Life cycle assessment of a novel closed-containment salmon aquaculture technology. *Environmental Science and Technology*, 49(9): 5628-5636

Keegan P. McGrath (2015). U.S. *Farmed (Net Pens) Rainbow Trout Seafood Watch Report*. Seafood Watch. Monterey Bay Aquarium. pp 44

Alexander D.M. Wilson, Thomas R. Binder, Keegan P. McGrath, Steven J. Cooke, Jean-Guy J. Godin. (2011) Capture technique and fish personality: angling targets timid bluegill sunfish, *Lepomis macrochirus*. *Canadian Journal of Fisheries and Aquatic Sciences*, 68(5): 749-757

Melissa Tonge, M.Sc.

Wildlife Ecologist, Shared Value Solutions Ltd.

Overview

Melissa Tonge is an ecologist with a strong background in wildlife sciences and terrestrial ecology. She has 15 years of experience in wildlife biology and GIS research, managing projects ranging from pollinators to polar bears. She has worked with federal and provincial governments, academic institutions, non-profit and private organizations.

Melissa has worked on projects that include assessment of biodiversity and wildlife habitat, analysis or environmental threats and impacts, mapping of sensitive areas, and determination of wildlife movement and ranges. In addition to research projects, she has worked on literature and regulatory reviews, recovery strategies, and technical reports. Melissa is most passionate about work that combines scientific and traditional knowledge to promote and enable ecological conservation.

Specialties

Wildlife and spatial landscape ecology | ecological field sampling | GIS modelling and mapping | literature reviews | outreach and communication initiatives | Species at Risk research and recovery efforts | recovery strategy development | jurisdictional review and public consultation | technical review and consultation.

Selected Experience

Land Management Technical Guides and Eco-regional Planting Guides for Pollinators, Pollinator Partnership & SVS
2016
Project Lead. Developing content and resources for Manitoulin-Lake Simcoe and Algonquin-Lake Nipissing planting guides. Research and development of technical land management guides for roadsides (highway, municipal) and corridors (hydro, pipeline, other easements) for the enhancement of native and managed pollinator populations.

Contact

melissa.tonge
@sharedvaluesolutions.com
(226) 706 8888 ext. 113

62 Baker Street
Guelph, ON
N1H 4G1

Professional History

2016 - Present
Wildlife Ecologist
Shared Value Solutions Ltd.

2015 - 2016
Pollination Research Associate
School of Environmental Sciences
University of Guelph

2009 – 2016
Forest and Climate Change Research Associate
School of Environmental Sciences
University of Guelph

Shared Value Solutions

Melissa Tonge, M.Sc.

Wildlife and Terrestrial Technical Reviews
2016
Assist in technical reviews of regulatory documents related to industrial projects such as mines, pipelines and roads.

Status and Trends of Pollinators in Ontario, University of Guelph & Ontario Ministry of Agriculture and Rural Affairs
2015 - 2016
Research Associate. Contributed to the development of a comprehensive report focusing on the status and trends, agricultural pollination and conservation programs and initiatives for pollinators in Ontario.

Forest Ecology & Climate Change, University of Guelph
2009 - 2015
Research Associate. Collected ecological forest data, developed and reviewed funding proposals, edited scientific journal articles, conducted literature reviews, and produced cartographic maps using ArcGIS software

Polar Bear & Bogbean Buckmoth Recovery Strategies, Ministry of Natural Resources and Forestry
2010 - 2012
Author. Responsible for the development of the recovery strategy for Polar Bear and Bogbean buckmoth in accordance with the ESA 2007 for Ontario. Prepared as advice to the government, other jurisdictions and constituencies that may be involved in the recovery of both species. Provided habitat regulation recommendation to the Minister of Natural Resources. Collaborated with scientific and social-science researchers, conservation organizations, aboriginal communities and federal and provincial governments.

Black Bear Management, Pukaskwa National Park
2006 - 2007
Project Coordinator and Author. Identified issues and concerns surrounding bear management. Coordinated information exchange with bear management agencies, aboriginal and regional communities in order to reduce bear/human conflict situations. Provided recommendations for communicating and increasing awareness to park visitors and the general public of bear management issues.

Species at Risk Research, Bruce Peninsula & Fathom Five National Parks
2005 – 2006
Biologist. Developed research and application permits in compliance with the ESA and SARA. Monitored various terrestrial and aquatic Species at Risk (e.g., Massasauga rattlesnake, Queen snake, Eastern Milksnake, Eastern prairie fringed-orchid, Dwarf lake iris, Shortjaw cisco). [2005-2006].

2010 – 2012
Conservation Biologist
Nature Conservancy of Canada

February 2009 – August 2009
Ecologist
Ontario Ministry of Natural Resources

2006 – 2007
Ecosystem Scientist
Pukaskwa National Park

2005 – 2006
Species at Risk Biologist &
Awareness Orator
Bruce Peninsula/Fathom Five
National Parks, Parks Canada

2004 – 2005
Wildlife Health Care Technician
Canadian Cooperative Wildlife Health
Centre, Ontario Vet College
University of Guelph

January 2002 - August 2002
Ecological Integrity Monitoring
Program Technician
Bruce Peninsula/Fathom Five
National Park, Parks Canada

August 2001 – January 2002
Eastern Massasauga
Rattlesnake Researcher
Bruce Peninsula/Fathom Five
National Parks, Parks Canada

May 2000 – August 2000
Black Bear Field Technician
Ministry of Natural Resources

Education

M.Sc. Environment and Life Sciences
Trent University

B. Sc. Honours, Biology and
Environmental Science

Shared Value Solutions

Melissa Tonge, M.Sc.

Canadian Cooperative Wildlife Health, Ontario Veterinary College, University of Guelph.
2004 – 2005
Researcher. Collaborated with municipal and governmental health units, and local landowners to target and identify disease outbreaks in wildlife populations. Visited target areas in the field to collect blood and tissue samples. Performed necropsies and made gross diagnosis.

Ecological Integrity Monitoring, Bruce Peninsula & Fathom Five National Parks.
2002
Biologist. Collected data for the ecological integrity monitoring program including deer browse surveys, rare plant monitoring, frog monitoring, water quality analyses and population trends and hit rate visits to black bear bait stations. As member of national park dive team, dove to assess and monitor zebra mussel population trends on ship wrecks within Fathom Five National Marine park boundaries.

Massasauga Rattlesnake Research and Reptiles at Risk, Bruce Peninsula & Fathom Five National Parks
2001 – 2002
Biologist. Captured and handled threatened Eastern Massasauga Rattlesnakes in the field and laboratory to attain genetic and morphological data. Radio-tracked transmitted snakes to gather information on habitat use, gestation sites and thermal temperature regimes. Identified target audiences (landowners, park visitors, schools) and conducted outreach programs to increase awareness and understanding of reptiles at risk in the greater Georgian Bay area.

Black Bear Research, Ministry of Natural Resources and Forestry
2000
Trapped and tracked black bears within Bruce Peninsula National Park and Chapleau Crown Game Preserve to obtain information on habitat use and population dynamics of both populations.

Years of Experience

15

Training and Certifications

Beekeeping and Integrated Pest Management
2015

Chemical Immobilization of Wildlife
2001

Shared Value Solutions

Colin R. Macdonald, B.Sc, M.E.Sc, Ph.D.

Northern Environmental Consulting & Analysis (NECA), Inc.

Box 374, Pinawa, MB, Canada R0E 1L0
Phone (204) 753-2078; Fax (204) 753-2298
e-mail: northern@granite.mb.ca
website: www.northernenviro.com
Google Scholar Listing: http://scholar.google.ca/citations?user=Ogc2wGYAAAAJ
Total number of citations = 1361

Bus. No.: 84295 4208 RT0001

Summary

Dr. Colin Macdonald has over thirty years of experience in environmental research and study design, data analysis and ecological risk assessment. His primary area of expertise is in the movement of chemicals to fish and wildlife through aquatic and terrestrial food webs, and in the fields of ecological risk assessment and toxicology. Recent projects have involved radiological risk assessment to humans and the environment from uranium in groundwater and phosphate mining. His experience in study design, monitoring and statistical analysis has led to strategic program reviews and assessments to evaluate monitoring program performance and the ability of a monitoring program to meet its objectives. After opening Northern Environmental Consulting in 1998, his research expertise led to projects involving the collection and analysis of contaminants in wildlife and traditional foods near contaminated sites in the northern Canada.

Dr. Macdonald has worked extensively with private companies, federal departments (Environment Canada, Fisheries and Oceans, Aboriginal Affairs and Northern Development Canada (AANDC)), territorial agencies (Environment and Natural Resources, Nunavut Dept. of Health) and aboriginal organisations to design science-based field sampling programs and statistical analysis for ecological and human health assessment at northern contaminated sites and communities. He has contributed major sections of state of the environment reports for the GNWT (2005, 2010, 2015) and to reports for several NWT regional groups, such as the Protected Area Strategy. In 2004, he was commissioned by INAC to assess the effects of oil and gas development on terrestrial wildlife for the Arctic and Monitoring Assessment Program (AMAP - www.amap.no).

Dr. Macdonald has provided the design, sampling, analysis and interpretation of aquatic and terrestrial monitoring programs to AANDC's Contaminant and Remediation Directorate at several abandoned NWT mines, including the Colomac gold mine, Port Radium, Echo Bay Properties, Silver Bear Mines, Contact Lake, El Bonanza, and others. He has earned the qualification of Environmental Professional through Eco Canada and been a member of the Society of Environmental Toxicology and Chemistry (SETAC) for 25 years, the Arctic Institute of North America for 15 years, is a member of the American Chemical Society and is the author of over 60 journal papers and reports.

Colin R. Macdonald, Ph.D.

Northern Environmental Consulting & Analysis (NECA), Inc.
Box 374, Pinawa, Manitoba
Canada R0E 1L0
Phone (204) 753-2078
Fax (204) 753-2298
e-mail: northern@granite.mb.ca
website: www.northernenviro.com

Education

1976 University of Guelph (B.Sc. Honours Fisheries Biology)
1979 University of Western Ontario (Masters of Engineering Science)
1986 University of Guelph (Ph.D. Zoology)

Work Experience

1998-pres. Principal Consultant/analyst with Northern Environmental Consulting & Analysis, Inc.
1996-1998 Adjunct faculty, Science Department, University of Manitoba, Winnipeg, MB.
1991-1998 Research Scientist (Ecology/Environmental Toxicology), Whiteshell Laboratories, AECL, Pinawa, Manitoba.
1989-1991 Consultant/term biologist; National Wildlife Research Centre, Canadian Wildlife Service, Hull, Qc.
1986-1989 Post-doctoral fellow/adjunct professor, Environmental and Resource Studies, Trent University, Peterborough, Ont.

Professional Memberships and Experience

- Member of the Technical Review Panel for the Northern Contaminants Program for Aboriginal Affairs and Northern Development Canada (AANDC)
- Member of the American Chemical Society (ACS).
- Member of the Arctic Institute of North America.
- Member of the Society of Environmental Toxicology and Chemistry (SETAC) since 1989.
- Environmental Professional (Research and Development) designation through Eco Canada
- Author and co-author of over 60 scientific papers, reports, conference papers.

Primary Areas of Expertise

- Ecological risk assessment with radioactivity and stable elements
- Northern community science liaison
- Toxicology and environmental distribution of metals, organochlorine pesticides and radionuclides
- Statistical analysis and design of environmental surveys
- Coordination and delivery of collections for environmental quality surveys
- Report and publication preparation and program review

Recent Clients

- Environment and Natural Resources, Government of the Northwest Territories (Yellowknife, NT)
- Oil and Gas Branch, Aboriginal Affairs and Northern Development Canada (Ottawa)
- Department of Health (Nunavut)
- Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway
- Northern Contaminants Program, Aboriginal Affairs and Northern Development Canada (Ottawa)
- Contaminants and Remediation Directorate (CARD), Aboriginal Affairs and Northern Development Canada
- Subcontracting with Shared Value Solutions (Guelph), SENES/Arcadis Consultants (Richmond Hill, ON), AECOM (Winnipeg, Calgary), Dillon Consulting (Calgary), Intrinsik (Halifax) and Knight Piésold Limited (North Bay).

Project Experience

The following projects outline some specific examples of projects that Dr. Macdonald has completed during his career in environmental research (since 1982) and consulting (since 1998). Many of the projects overlap in the areas of monitoring and assessment in the terrestrial environment and evaluation of the spatial and temporal trends of chemicals of potential concern in the aquatic and terrestrial environments.

Program Performance Assessment and Review

Review of the Closure Program for Agrium Phosphate Operation in Ontario (2017)
Assisted the Taykwa Tagamou Nation (Kapuskasing First Nation) with their review of the environmental surveys of the Agrium Phosphate Operation showing elevated level of uranium in waste rock and tailings areas. Gamma surveys showed significant uranium levels in some areas of the waster rock pile due to uranium in the phosphate source material.

Review of the Final Environmental Impact Statement for the Kiggavik Uranium Mine on behalf of the Nunavut Department of Health and Department of the Environment (2014). Northern Environmental and Intrinsik Environmental Sciences were retained to review the human health and ecological risk assessment and cumulative effects relating to the dispersion of material from the Kiggavik mine through air and water during the proposed operation, and the human health and ecological risk assessment. Northern Environmental conducted a review of the radiological components of the EIS and the potential impacts to humans and non-human species. A follow-up report detailed what is known of radioactivity in barren-ground caribou in Canada's North.

Performance assessment of temporal trend monitoring data for the Northern Contaminants Program (NCP). Client: Aboriginal Affairs and Northern Development Canada (2014). This project evaluated the performance of the NCP to meet its objectives of detecting a 5% change in the concentrations of organochlorine pesticides in traditional food in the Canadian Arctic. The program objective is to eliminate man-made pesticides from traditional foods in northern Canada. This project examined the long-term monitoring programs for 5 representative compounds (DDE, αHCH, PCB153, PFOS and PBDE 47) in marine mammals, fish and birds in the Arctic. Power analysis was used to determine monitoring program performance relative to program goals.

High-level strategic review and gap analysis of research priorities for the Arctic Monitoring and Assessment Program. Client: Aboriginal Affairs and Northern Development Canada. Under the Arctic Council, AMAP is developing a work plan for 2013-2015 based on the last 10 years of assessments on contaminant distribution (e.g., mercury, organic pollutants, and radiation), effects to human health and the environment, and climate change in the Arctic. Dr. Macdonald provided recommendations to AMAP for consideration on future comprehensive assessments after a review of technical assessments since 2001.

Comprehensive review of climate change impacts in the Canadian Arctic Archipelago, including Baffin Island (2012). Client: Fisheries and Oceans Canada. A comprehensive review of changes to the physical, chemical and biological systems in the central Canadian Arctic with the changing climate was conducted by C. Macdonald for Fisheries and Oceans Canada The goal was to highlight observed changes and to demonstrate gaps of knowledge. Positive changes could improve fisheries and shipping. Areas of emphasis included changes to sea-ice, surface water chemistry and productivity, glacier and ice field melts, weather patterns, and the biological environment. Gaps in knowledge and areas of greatest uncertainty were identified.

The Environmental Effects of Oil and Gas Development in the Arctic. 2004-2007. Client: Oil and Gas Branch, AANDC. AMAP conducted an assessment of oil and gas activity in the Arctic in response to a request from the Arctic Council, which is comprised of Ministers from the 8 Arctic countries. The assessment provided advice to the Ministers regarding the extent of oil and gas development, the socioeconomic costs and benefits and the environmental effects of development. Dr. Macdonald was lo-lead author of the section of the report on environmental effects to the terrestrial ecosystem, the marine/freshwater systems and human health.

Phase 1 Assessments for the NWT's Protected Area Strategy. Client: Aboriginal Affairs and Northern Development Canada, Yellowknife. Phase 1 assessments were conducted on several areas that were selected for consideration of Protected Areas status. Data collection and initial assessments were conducted for the Łue Túé Sûlái Area of Interest (Five Fish Lakes near Jean Marie River) and Thaidene Nëné National Park Reserve near Lutsel K'e, NT. Northern Environmental also worked with the community of Kakisa to collect ecological data for a proposal to the Protected Area Strategy Program.

Assessment of environmental liabilities at a mine in northern Manitoba. 2011. Client: AECOM. Dr. Macdonald reviewed several years of monitoring data and provided an assessment of environmental liabilities at a major mine site in northern Manitoba prior to the potential development of new projects. The review included the critical evaluation of 50 years of monitoring and research studies at the site by government and industry and an assessment of the potential for long-term environmental issues after remediation. Continuing concerns included acid mine drainage and long-term contamination of surface waters.

Program review of aquatic and terrestrial assessment and monitoring programs at Colomac mine, NWT (2001, 2003, 2012). Client: AANDC. Macdonald designed and implemented programs to assess contamination in the aquatic and terrestrial receiving environments at Colomac, NT in relation to CCME guidelines and contaminated sites criteria. Aquatic programs were designed to test metals and hydrocarbons in traditional foods of the Tlicho near Colomac. In 2012, Northern Environmental reviewed the monitoring program results in terms of site-specific objectives after remediation, and identified areas that needed improvement.

Development of a statistical guide for the design of environmental assessment and effectiveness monitoring studies (2010). Client: Parks Canada Parks Canada required a statistically rigorous guide for the design of field studies to support program objectives of documenting ecological integrity and environmental assessments in national parks. The guide provided detailed advice on sampling protocols to allow the agency to detect changes in environmental conditions and to determine if management objectives were being met.

Impact/Risk Assessment

Tier 2 human health and ecological radiological risk assessment for a phosphate mine. A Tier 2 risk assessment was conducted for a phosphate mine in a developing country to identify potential risks due to elevated levels of uranium and other nuclides in phosphate ore and tailings. Risks were estimated for an agrarian lifestyle with vegetable crops and livestock. The ERICA assessment tool was used to estimate risk for a generic group of plants and wildlife from the U-238 decay chain series of nuclides (Ra-226, Pb-210, Po-210).

Contaminants in the Port Radium and Great Bear Lake environment (1998-2012). Client: AANDC. Radionuclides and metals in sediments, fish, water, and soil from Port Radium on Great Bear Lake were analysed to characterize contamination from the mine site. Dr. Macdonald worked with members of Déline First Nation in 1998 to collect water and sediments at the mine site, then worked with SENES consultants on a comprehensive site assessment prior to remediation and post-remediation monitoring. Dr. Macdonald sampled soils and plants and conducted fisheries surveys for evidence of contamination by radionuclides and stable elements. The projects also included several summary reports to the community of Déline on the levels of chemicals of concern in the Great

Bear Lake environment.

Ecological risk assessment of radioactivity at the Stark Lake mine. NWT. 2013. Client: AANDC. An ecological risk assessment was conducted on an abandoned mine site to the east of Lutsel K'e, NT. The mine consisted of waste rock with elevated gamma radiation, and surface waters with elevated uranium. The ecological risk assessment indicated significant risk to small mammals due to background radiation and elevated U-238 chain nuclides in vegetation adjacent to the waste rock.

Statistical and chemical analysis of environmental contaminants in northern large mammal populations (2012 - present). Client: Environmental and Natural Resources, GNWT. Clients include regional and headquarters Environment and Natural Resources biologists. The study consisted of the statistical analysis of metals, primarily cadmium and mercury, and radionuclides and stable isotopes (diet) in woodland caribou, moose, mountain goats, Dall's sheep in the DehCho region of the NWT. The project was initiated to explain high cadmium levels in some species which led to a food advisory by the GNWT. Outcome of the project has been a conference presentation and a manuscript for submission to a journal. Other projects included an analysis and plain language summary of metals, hydrocarbons and radionuclides in moose, woodland caribou and barren-ground cariou from the South Slave and Sahtu regions of the NWT.

Tier III risk assessment of human health and the environment at a small contaminated site in Manitoba. 2013. Client: Atomic Energy of Canada, Ltd (AECL). Monitoring programs indicated high levels of naturally-occurring uranium in surface soils due to the release of holding pond waters. This project evaluated the risk of adverse health effects in humans and non-human species from contact with the soil with elevated uranium. Risk to human health was assessed with Health Canada exposure models while exposure in non-human species (plants, birds, small and large mammals) were assessed using the ERICA model framework from the IAEA.

Detailed multi-element analysis of the elemental composition of tissues and faecal ash in a moose (*Alces alces*) exposed to tailings at the abandoned Colomac gold mine**, NWT. 2007. Client: Environmental and Natural Resources, GNWT.** The study involved the detailed analysis of a moose trapped in the tailings area of the Colomac mine. The data were used to support the ecological and human health risk assessment for the mine.

Research on the distribution and dosimetry of naturally-occurring radionuclides in caribou in the NWT and Nunavut (1992-ongoing). Client: Environmental and Natural Resources, GNWT. A research project was conducted in conjunction with GNWT's Environment and Natural Resources to determine the concentrations of naturally-occurring radionuclides (Ra-226, Pb-210, Po-210) and cesium-137 in caribou tissues. Activities involved analysis of muscle, liver and kidney for alpha and gamma-emitting nuclides, estimation of dose to the animals, and statistical analysis of trends. The research concluded with a paper published in Science of the Total Environment (1996) and several reports to the Northern Contaminants Program (1996-2013). An additional paper on the accumulation of cesium-137 in Canadian and Alaskan caribou herds since the 1960's was published through Health Canada.

Multielement analysis of barren ground caribou faecal pellets from Colomac mine and near diamond mines in NWT. 2004. Client: Environmental and Natural Resources, GNWT. A research project was conducted with Environment and Natural Resources scientists on the levels of individual elements in the faecal pellets of caribou near major industrial developments as a means of identifying contamination of foods sources.

Ingestion rates and radionuclide transfer in birds and mammals of the Canadian Shield. 1997. A review of ingestion rates for wildlife species was conducted to determine suitable parameters to model the uptake and exposure of major species like white-tailed deer and moose at mine sites. The data were used for ecological risk

assessments at mines on the Canadian Shield.

Contaminants in ecologically relevant samples at Contact Lake, Indore Hottah, North Inca, Silver Bear Mines, El Bonanza mines in the NWT (2001-2013). Client: AANDC. As part of Phase 1 and 2 assessments by SENES Consultants at these abandoned mines in the NWT, Dr. Macdonald designed and implemented soil/plant collection program to delineate spatial trends of contaminants at the respective mines to support human health and ecological risk assessments. Fisheries assessments were also conducted at several sites. Tasks involved sample collection, coordinating analysis for metal and radionuclide analysis, QA/QC, fish aging, statistical analysis and data interpretation mine and report submission.

Report of contaminants in traditional foods in Déline, NT. Client: Déline Renewable Resources Council. 2002/03 and 2011, 2012. Traditional foods were obtained from members of the community of Déline and analysed for radionuclides and stable elements. The data were used to determine if people in the community were exposed to higher levels of chemicals through the consumption of traditional foods. During the course of the program all major food types (barren ground and woodland caribou, fish, waterfowl) were sampled and analysed. The studies supported the view that traditional foods remain the best option for people in Déline. The project was repeated in 2011 and 2012 as part of a long-term monitoring program.

Radiological assessment of foods and the environment in Lutsel K'e and Baker Lake, NU (1998, 1999). Client: AANDC. Radiological exposure was estimated in two communities as part of an assessment of contaminants in traditional foods in the north. The community of Lutsel K'e was concerned about radiation from the COSMOS satellite which deposited radiation over Great Slave Lake in the late 1970s, and a local uranium exploratory mine (the Stark Lake mine). Background gamma radiation was measured in the communities, radon in some houses and community buildings and radionuclide levels in traditional foods.

Supplemental Services

Technical review of research and monitoring projects in the NWT and Nunavut for the Northern Contaminants Program (NCP). 2009 – present; ongoing. Client: AANDC. C. Macdonald is a member of a technical review committee that evaluates research projects for the NCP to ensure technical suitability. The objective of the NCP is to reduce or eliminate chemicals in traditional foods in Canada's North. Individual projects involve major issues such as climate change, mercury transport, toxicant levels in traditional foods like caribou, marine mammals (beluga, narwhal, ringed seal, polar bear), waterfowl and fish.

Review of environmental programs in the Fort McMurray region of Alberta for the Athabasca Tribal Council. 2003. Client: Athabasca Tribal Council. A program to communicate the results from monitoring programs of hydrocarbons in water, air and terrestrial monitoring programs of hydrocarbons was assembled for presentation to First Nations in the Fort McMurray area in conjunction with oil producers and First Nations in the region.

Country food monitoring workshop. 2001. Dr. Macdonald reported on the results of a Health Canada workshop on monitoring the safety and quality of country foods in Canada. Report for the Office of Ecosystem Initiatives and Health, Arctic Section, Ottawa, ON. February 2001.

Background documentation for Priority Substances List (PSL 2) assessment of uranium. 1998-2000. Dr. Macdonald extensively reviewed the literature on the toxicity of uranium to mammals, birds and fish to provide background data for the assessment of uranium toxicity. The review included the development of tolerable doses, hazard and risk to wildlife.

Examples of Recent Reports

Macdonald, C.R. 2016. Contaminant survey of Sahtu and South Slave moose, Sahtu mountain caribou and barren-ground caribou - a plain language summary. Report submitted to Environment and Natural Resources, Yellowknife. 42 pp.

Macdonald. C.R. 2015. Radiological assessment of risk to human health and the environment at the Farim phosphate Project. Report submitted to Knight Piésold Limited, North Bay.

Macdonald, C.R. 2015. Radionuclides and cadmium in caribou in Nunavut, Northern Saskatchewan and other northern jurisdictions, and human health risks related to consumption: a literature review (submitted section on natural radioactivity). Submitted to the Nunavut Department of Health in conjunction with Intrinsik Environmental Sciences, Inc. Iqaluit, NU. 68 pp.

Macdonald, C.R. 2014**.** Performance assessment of temporal trend monitoring data for the Northern Contaminants Program. Report submitted to the Northern Contaminants Program, Ottawa, ON.

Macdonald, C.R. 2014. Multi-element of wildlife and wetland plants at Colomac mine, NWT. Report submitted to AECOM, Calgary for site monitoring report.

Macdonald, C.R. 2014. Multi-element, radionuclide and stable isotope analysis of kidney and muscle in mountain goat (*Oreamnos americanus*) from the south Mackenzie Mountain region of the NWT. Report submitted to Environment and Natural Resources, Government of the Northwest Territories.

Macdonald, C.R. 2013. Activity report for the collection of wildlife at Colomac, September 2013. Report submitted to AECOM, Calgary as part of the summary of field activities.

Macdonald, C.R. 2013**.** Draft screening ecological risk assessment for Stark Lake mine. Assessment submitted to Dillon Consultants, Calgary for inclusion with Remedial Action Plan (RAP).

Macdonald, C.R. 2013. Metal and radionuclide concentrations in lake whitefish, lake trout and herring collected near Déline, NT in 2012. Report submitted to the Déline Renewable Resource Council. 36 pp.

Macdonald, C.R. 2013.Tier III risk assessment of human health and environmental protection in the URL holding pond discharge path. Project report submitted to ACSION Industries. 53 pp.

Macdonald, C.R. 2013. Strategic review of the environmental programs at the Colomac Mine site, NT 1999 – 2012. 71 pp.

Macdonald, C.R. 2012. Synthesis of climate change effects on the Canadian Arctic Archipelago (CAA) sub-basin. Submitted to Fisheries and Oceans Canada, Winnipeg. 41 pp.

Macdonald, C.R. 2012. Strategic review of priorities and emerging issues for the AMAP work plan 2013-2015. Report submitted to the Arctic Monitoring Assessment Program. Oslo, Norway. 81 pp.

Macdonald, C.R. 2011. Statistical analysis of physical parameters and potential chemicals of concern in sediment and surface waters at several sites near Snow Lake, Manitoba. Report prepared for AECOM, Winnipeg. 30 pp.

Macdonald, C.R. 2011. Assessment of environmental liabilities at a mine in northern Manitoba. Report prepared for AECOM (Winnipeg).

Macdonald, C.R. 2011. Organochlorine, metal and radionuclide concentrations in lake whitefish, lake trout and herring collected near Déline, NT in 2009 and 2010. Report submitted to the Déline Renewable Resource Council.

Macdonald, C.R. 2010. Terrestrial environment. Review and status report submitted to SENES Consultants as part of the NWT Environmental Audit and State of the Environment Report. July 2010.

Macdonald, C.R. 2010. Guide on the design of environmental assessment follow-up and effectiveness monitoring studies. Final report and Powerpoint Presentation submitted to Ecological Integrity Branch, Parks Canada, Ottawa.

Macdonald, C.R. 2010. Field sampling in support of environmental risk assessment at abandoned mines in the NWT. Federal Contaminated Sites Workshop. Montreal Québec. May 11, 2010.

Macdonald, C.R. 2010. Phase 1 environmental assessment for the Five Fish Lakes area of the Deh Cho, NT. Submitted to SENES Consultants as part of the combined Phase 1 Ecological and Renewable Resource assessment for the Protected Area Strategy.

Macdonald, C.R. 2009. Organochlorine, metal and radionuclide concentrations in herring (*Coregonus artedi*) and lake trout (*Salvelinus namaycush*) collected near Déline, NT in February 2009. Submitted to the Déline Renewable Resource Council. Déline, NT.

Macdonald, C.R. 2009. Review of the terrestrial and aquatic environment near Giant Mine in the NWT. Submitted to SENES Consultants as part of an environmental submission to Indian and Northern Affairs Canada.

Macdonald, C.R. 2008. Monitoring of the terrestrial system around the Prairie Creek Mine. Submitted to SENES Consultants as part of review of the cumulative effects of the Prairie Creek Mine near Nahanni Park, NT.

Macdonald, C.R. 2008. Cumulative effects of oil and gas activities near Norman Wells, NT. Submitted to SENES Consultants as part of a review of the cumulative impacts in Bosworth Creek watershed near Norman Wells, NT.

Macdonald, C.R., B. Elkin and A. Gunn. 2005. Analysis of the elemental composition of tissues and faecal ash in a moose (*Alces alces*) exposed to tailings at the abandoned Colomac Gold mine, NWT. Resources, Wildlife and Economic Development, GNWT. Manuscript Report No. 162. 39 pp.

Examples of Recent Published Papers and Conference Presentations

Larter, N., C.R. Macdonald, B. Elkin, D.C.G. Muir and X. Wang. 2017. Analysis of Cadmium, Mercury and Other Elements in Mackenzie Valley Moose Tissues Collected from 2005 to 2016. Report submitted to Environment and natural Resources. Yellowknife NT.

Macdonald, C.R. 2014. A critical review of the effects of oil and gas activity on caribou. U.S. – Canada Northern Oil and Gas Research Forum. Yellowknife, NT. Canada.

Larter, N., **C.R. Macdonald**, D. Muir and B.T. Elkin. 2014. Multi-element, radionuclide and stable isotope analyses of kidney and muscle tissue from mountain goats in Northwest Territories. Northern Wild Sheep and Goat Council's Proceedings (submitted).

Larter, N.C., **C.R. Macdonald**, B.T. Elkin, X. Wang, M. Gamberg and D.C.G. Muir. 2013. Elemental and radionuclide concentrations in tissues from four ungulate species from the southern Mackenzie Mountains, NT. Prepared for Northern Contaminants Program Conference, Ottawa, Sept. 2013.

Larter, N.C., **C.R. Macdonald**, B.T. Elkin, X. Wang, M. Gamberg and D.C.G. Muir. 2013. Elemental and radionuclide concentrations in tissues from four ungulate species from the southern Mackenzie Mountains, NT. Manuscript prepared for journal. (currently in review).

Larter, N.C., J.A. Nagy, B.T. Elkin and **C. Macdonald**. 2010. Differences in radionuclide and heavy metal concentrations found in the kidneys of barren-ground caribou over time. Rangifer 30: 61-66.

Macdonald, C.R. 2010. Radionuclide accumulation in barren-ground caribou in northern Canada: a review. 13th North American Caribou Workshop. Oct 25-28, 2010. Winnipeg, Manitoba.

Gunn, A and **C. Macdonald**. 2010. Site-specific variability in dust uptake by caribou: an issue for environmental assessments.

13th North American Caribou Workshop. Winnipeg, Manitoba.

Macdonald. C.R. 2010. Field sampling in support of environmental risk assessment at abandoned mines in the NWT. Federal Contaminated Sites Workshop, Montreal, QC. May 2010.

C.R. Macdonald, B.T. Elkin and B.L. Tracy. 2007. Radiocesium in caribou and reindeer in northern Canada, Alaska and Greenland from 1958 to 2000. Journal of Environmental Radioactivity 95:1-25.

Norstrom, R.J., Clark, T.P., Enright, M., Leung, B., Drouillard, K.G. and **C.R. Macdonald**. 2007. ABAM, a model for bioaccumulation of POPs in birds: validation for adult herring gulls and their eggs in Lake Ontario. Environ. Sci. Technol. 41:4339-4347.

G.A. Stern, **C.R. Macdonald**, B. Dunn, C. Fuchs, L. Harwood, B. Rosenberg, D.C.G. Muir, D. Armstrong. 2005. Spatial trends and factors affecting variation of organochlorine contaminant levels in Canadian Arctic beluga (Delphinapterus leucas). The Science of the Total Environment 351-352:344-368.

Gamberg, M., B. Braune, E Davey, B. Elkin, P.F. Hoekstra, D. Kennedy, **C. Macdonald**, D. Muir, A. Nirwal, M. Wayland and B. Zeeb. 2005. Spatial and temporal trends of contaminants in terrestrial biota from the Canadian Arctic. Science of the Total Environment 2005: 148-164.

Hebert, C.E., R.J. Norstrom, J. Zhu and **C.R. Macdonald.** 1999. Historical changes in PCB patterns in Lake Ontario and Green Bay, Lake Michigan, 1971 to 1982, from herring gull egg monitoring data. Journal of Great Lakes Research. 25(1):220-233.

Berti, P.R., H.M. Chan, O. Receveur and **C.R. Macdonald**. 1998. Population exposure to radioactivity from consumption of barrenland caribou in the Dene/Métis of the western Northwest Territories. Journal of Exposure Analysis and Environmental Epidemiology. Vol 8 (2):145-158.

Bird, G.A., P.A. Thompson, **C.R. Macdonald** and S.C. Sheppard. 2002. Ecological risk assessment approach for the regulatory assessment of the effects of radionuclides released from nuclear facilities.

Sheppard, S.C., W.G. Evenden and **C.R. Macdonald.** 1998. Variation among chlorine concentration ratios for native and agronomic plants. J. Environ. Radioact. 43:65-76.

Macdonald, C.R. and M.J. Laverock. 1998. Radiation exposure and dose in small mammals in radon-rich soils. Archives of Environmental Contamination & Toxicology. 35: 109-120.

Macdonald, C.R., L.L. Ewing, B. Elkin and A.M. Wiewel. 1996. Regional variation of radionuclides and radiation dose in caribou *(Rangifer tarandus)* in the Canadian Arctic. Sci. Total Environ. 182: 53-73.

Appendix B – Comment Tracking Table

Table 1. Comment and Response Tracking Table

Comment #	Issue	Question/Recommendation
AQUATIC ENVIRONMENT		
4.1.1	In evaluating options for the decommissioning of the WR-1 Reactor the Proponent has evaluated four (4) alternatives. Of these, ISD represents the highest risk to local aquatic systems because contaminated materials will reside permanently within the local environment. Permanent storage of radioactive contaminated material must be monitored indefinitely. Once the containment system fails, decaying radioactive material will have a direct pathway for contamination of groundwater. Over time, this contamination will likely migrate to surface water (e.g. through seepage to the Winnipeg River <500m), posing risks to aquatic wildlife and humans who consume these organisms. For example, based on predictions of mass loadings to the Winnipeg River, it is expected that Carbon-14 and Tritium are expected to be particularly high, with maximum groundwater concentrations (at point of discharge) of 147 Bq/L and 3,760 Bq/L respectively. The latter of which is expected to occur within 68 years during post-closure. Due to the risks associated with contaminated groundwater, a robust monitoring program must be in place. The Proponent is planning to conduct surface water monitoring and surficial sediment monitoring to test for contaminants during closure and post-closure	**Recommendation 4.1.1a** – The Proponent must clarify the location, frequency and timing at which surface water and sediment sampling will occur. This data must be presented in text and in the form of a map (similar to Figure 6.4.2-3) with locations of all proposed follow-up monitoring locations clearly marked. This must be accompanied by a description of the frequency of monitoring proposed for these stations. **Recommendation 4.1.1b** – The nearest downstream surface water and sediment sampling station in the Winnipeg River is too far for monitoring contamination of groundwater seepage. Additional surface water monitoring stations must be planned closer to the location of groundwater emissions. At minimum, we suggest these occur at the effluent outflow, the groundwater seep, 25m, 100m and 500m downstream on the Winnipeg River. **Recommendation 4.1.1c** – Water quality in trenches/ditches from the Waste Management Area must be monitored actively during closure and post-closure. The Proponent must provide additional details on locations and frequency of monitoring associated with the Waste Management Area. There should be clear adaptive management and contingency plans for responding to degrading water quality in these features such as capture and additional treatment.

Comment #	Issue	Question/Recommendation
	(EIS, 2017, pp 6-203). However, it is unclear at what intervals this monitoring will occur. Moreover, the locations for water quality monitoring follow-up program are not sufficient. The nearest downstream surface monitoring location to the groundwater seep is 2 km downstream from the site boundary (monitoring station DS, Figure 6.4.2-3). This is unlikely to detect any contamination except from extreme events, nor to show any gradient or distribution of contamination.	
4.1.2	The Proponent has identified "No Linkage Pathway" to residual effects from runoff during closure (EIS, 2017, pp 6-186). However, there is an issue with this evaluation because there could be large loads of contaminated material and dust during active closure. These could be from building demolition, excess piping or other contaminated materials. If there is a significant precipitation or snowmelt while this material is present, it could result in a slug of contaminated runoff to the Winnipeg River. The Proponent has assumed that this would not occur because best practices would be in place. This includes, water management, containment barriers, and water testing.	The Proponent must prepare an Environmental Protection Plan (EPP) outlining in detail the mitigation strategies and actions that will be taken to prevent contaminated runoff from the site to receiving waters during closure. The EPP must be provided to the MMF so that there is an opportunity for review. Failing this, it will be necessary to incorporate potential effects of increased contamination to the Winnipeg River because of runoff, into the EA process.
4.1.3	Beginning during post-closure and continuing for a up to 500,000 years, groundwater contaminated from contact with the below grade building materials and WR-1 reactor will leach steadily into the Winnipeg River. Radionuclides released can result in harm to aquatic wildlife. In the Goldsim® (Version 11.1) mass balance and transport model for groundwater, only radionuclides with half lives	The mass balance and transport model for groundwater must include all radionuclides, including those with half lives shorter than a day.

Comment #	Issue	Question/Recommendation
	longer than 1 day were modelled. This excludes a large number of potentially damaging radionuclides which, if present in large quantities could contribute to radiological effects on aquatic wildlife in the Winnipeg River. Moreover, certain radionuclides with short half lives may decay into daughter radionuclides with longer half lives that continue to emit radiation. For example, I^{135} with a half life of 6.5 hours can decay through β− decay into Xe^{135} and Cs^{135}, the latter of which has a half life of 2.3 million years. Thus, by excluding short lived radionuclides from the modelling, the Proponent is potentially ignoring important sources of radioactive contamination and underestimating the potential risk to the aquatic environment.	
4.1.4	In their evaluation of the potential effects of surface water contamination (dispersion modelling), the Proponent only evaluated of concentrations of radionuclide and non-radionuclide contaminants at the Nearfield (50m downstream) and Farm A (approximately 3,100m downstream) locations. As a result, they were able to assume complete mixing of contaminants and utilize large dilution rates. For example, the dilution rate used for evaluation of contaminants for the nearfield site was 300,000:1. However, at the point where contaminated groundwater is being released into the Winnipeg River, the dilution will be much less. This will result in higher concentrations of contaminants in the water column (than shown in Table 6.4.2-12 and 6.4.2-13) and in sediment (shown in Table 6.4.2-14 and 6.4.2-15) (EIS, 2017). This is of concern for all	Recommendation 4.1.4a – By evaluating the concentrations of contaminants at the Nearfield location rather than in the immediate vicinity of the groundwater release, the Proponent is underestimating the potential effects of this Project. To evaluate these effects the Proponent must produce a dispersion model to predict the concentrations of contaminants between the point of groundwater release into the Winnipeg River and the Nearfield location (between 0 and 50m). These higher concentrations should be used to calculate contaminant concentrations in sediment within the mixing zone for groundwater seepage. This updated and more localized information would enable the Proponent to evaluate the potential effects within the immediate area of effect near the seep and whether any contaminants are above regulatory guidelines for either surface water or sediment.

Comment #	Issue	Question/Recommendation
	contaminants, but particularly for highly toxic contaminants for which concentrations in groundwater are above applicable guidelines such as cadmium and lead. These contaminants released through the groundwater seep may have locally high concentrations that could bioaccumulate in fish and benthic invertebrates causing harmful effects. Moreover, the accumulation of these contaminants in fish tissues represents a potential pathway for human consumption, including affecting MMC citizens who rely on fishing and harvesting aquatic resources for subsistence and as part of a traditional diet and lifestyle.	Recommendation 4.1.4b – If concentrations of contaminants (radiological and non-radiological) are found to be higher than what has been predicted at the Nearfield and Farm A locations, the Proponent must update the Human Health and Ecological Risk Assessment to evaluate the potential impacts of these higher concentrations.
4.1.5	Issue 5 – As part of the existing license for the CNL facility (NRTEDL-W5-8.04/2018), the Proponent engages in monitoring of fish tissue at upstream and downstream locations from the Project site. However, the Proponent is not planning to monitor fish tissues for contaminants during closure and post-closure (EIS, 2017, pp 6-231). Many individuals from the MMC fish regularly along the Winnipeg River for game species such as walleye, lake whitefish, smallmouth bass, and northern pike. The risk of health effects from consuming these contaminants is thus a serious concern for these fishermen and their families.	Due to the importance of fishing and fish consumption to the MMC, it is critical that monitoring of fish tissue occur and be designed accordingly so that the predictions of low contamination can be verified. The Proponent must engage in monitoring of fish tissues during closure and post-closure (institutional control) and have adaptive management plans in place to address unanticipated levels of contaminants in edible portions of fish in exposure areas. We recommend that the sampling locations currently used for monitoring associated with the existing license be maintained. Monitoring should occur every year during closure and at least every 10-years during post-closure.
WILDLIFE, VEGETATION AND WETLANDS		
4.2.1	Baseline terrestrial data for the WL property was gathered through incidental observations by staff and through targeted surveys for Species at Risk (SAR) in 2015 (Section 6.6.4.2/6-245). Desktop review was also completed to identify potential SAR within	**Recommendation 4.2.1a** – Conduct multi-season (spring/summer/fall/winter), baseline terrestrial surveys to provide a less biased and more comprehensive measure of site characteristics and an accurate representation of the ecological components potentially

Comment #	Issue	Question/Recommendation
	the RSA, however TEK or harvesting rights, practices and needs of MMC land users were not considered.	affected by the Project. This would provide a more comprehensive assessment of potential impacts to native vegetative species and species of traditional importance to the MMC. **Recommendation 4.2.1b** – Engage the MMF to identify and consider the MMCs extensive TEK, harvesting rights, current exercise of rights and ongoing needs and interests, during or in addition to the base-line surveys recommended in Recommendation 1a. There needs to be recognition of and accommodation measures provided for the Métis who live within the vicinity of and/or harvest within the Project assessment areas as part of determining the significance of net effects as a result of the Project.
4.2.2	'Traditional, cultural and heritage importance to Aboriginal peoples' was said to be considered in the selection of valued components (VCs/Section 2.5.1/2-11), yet no Traditional Knowledge or land use by the MMC has been included in the EIS. The MMC has longstanding use of the lands and waters in the vicinity of the Project that continue to be of ongoing importance to the MMC in exercising their constitutionally protected harvesting and other rights. These rights have the potential to be impacted by the decommissioning activities and yet have not yet been considered by the Proponent, nor have accommodation or mitigation measures been discussed with the MMF.	A Traditional Knowledge and Land Use study with the MMF must be undertaken to determine and understand Métis-specific land use and interests in the Project study area. Further discussions of accommodation and / or mitigation measures with the MMF may be needed.
4.2.3	Wildlife VECs focus on SAR, as per regulatory requirements, with no inclusion of wildlife species and habitats of traditional and cultural importance to the MMC. The MMF has expressed interest in	Complete a thorough effects assessment on species of traditional importance to the MMC identified in a Project specific Traditional Knowledge, Land Use and Occupancy Study (TKLUOS). Include monitoring and

Comment #	Issue	Question/Recommendation
	Indigenous values and rights, as identified in *the Summary of Key Interests and Concerns for the Manitoba Métis Federation* (Table 4.3.2-8/4-15) with regards to Valued Components (VCs) for the Project. The Proponent has determined that the "Project is not expected to have a substantial effect on an individual's land and resource use experience or on harvested species with because of mitigation and management practices put in place for the Project" (6.8.5.2.1/6-381), however without conducting a full effects assessment with applicable mitigation measures for traditionally valued species of the MMC specifically, we do not believe the Proponent can make this determination with respect to effects on the MMC.	follow-up programs for potential effects to culturally important terrestrial species, including objectives and any monitoring measures (i.e., thresholds) that will be implemented to verify the predictions of effects and evaluate the effectiveness of proposed mitigation measures.
4.2.4	The complete removal of the facility (Alternative 2) would improve the perceived suitability of the site for future socio-economic MMC interests because long-lived radioactive material will no longer be present within the former WR-1 Building footprint. In addition, the complete removal *may* allow this portion of the site to be released for unrestricted use which would allow safe use of the land for traditional land use activities and interests by the MMC such as hunting, berry picking, and medicinal plant gathering (EIS, 2017; Section 2.5.3.2/pp 2-18). There are concerns that the Proponent is choosing ISD due to estimated Project cost differences (in excess of $100 Million difference) rather than selecting a decommissioning alternative that is ecologically preferred or least impactful on the rights of Indigenous communities or best aligned with the	Further meaningful consultation and engagement with the MMC must occur, to identify their interest and preference in the complete removal of the facility, as outlined in the Comprehensive Study Report (CSR) and as identified in Alternative 2 of the EIS. This consultation and engagement should occur through the MMF and in accordance with MMF Resolution No. 8.

Comment #	Issue	Question/Recommendation
	long-term use and sustainability of the area for the MMC.	
4.2.5	The surrounding grounds that were disturbed during demolition and decommissioning activities will be graded and restored with a grass seed mixture, but information on the approach and/or seed mix has not been provided (EIS, 2017, pp 3-34, pp 6-266).	The MMF requests that native seed mixes be used for reclamation in the Project area. The incorporation of native floral and grass seed mixes in re-vegetation efforts would further enhance habitat/forage for wildlife, particularly for pollinators.
4.2.6	During reclamation, the Proponent has stated that the Project site and final vegetation cover will be graded to promote drainage from the site to the Winnipeg River (EIS, 2017; pp 3-34). An engineered cover will be installed over the former footprint of the WR-1 Building to minimize water infiltration and migration of contaminants to underlying aquifers (EIS, 2017; pp 3-33).	The engineered cover will not provide a barrier for release of contamination explicitly, but rather will be installed to limit additional water infiltration into the system and protect the barriers that are in place by resisting intrusion into the sub-surface structure. It is therefore recommended that for the same reason, this impermeable barrier should be installed around the entire grouted below-grade facility.
4.2.7	Changes in radiation and radioactivity levels during post-closure phases were predicted for wildlife VCs living on or near the WL site (Table 6.6.1-1/6-234). However, because species of traditional importance (i.e., commonly harvested by the MMC such as moose, deer, waterfowl, etc.) to the MMC were not specifically identified or considered as part of the post-closure plan, there are ongoing concerns regarding potential effects and exposure to animals in the long-term, and in particular that some specific species of importance to the MMC may not have been identified or considered.	Re-run the effects assessment of radioactive exposure to wildlife species of traditional importance to the MMC, as per the TKLUOS recommended in 3.2.2.
4.2.8	The Proponent has identified that wildlife collisions with vehicles will be monitored, for which adaptive management measures will be considered, however	Please provide adaptive management thresholds at which additional wildlife collision mitigation measures will be applied.

Comment #	Issue	Question/Recommendation
	no thresholds have been provided (EIS, 2017; pp 6-234).	
4.2.9	It is not clear what the Project schedule is for construction/decommissioning activity (Table 3.1-1/3-2). Loud decommissioning activity (i.e., jack hammering to remove deeply imbedded contaminants in concrete; Table 6.6.5-1/6-264) is expected. Consequently, there are considerable concerns over the potential disturbance and displacement of sensitive SAR species and to wildlife of traditional interest and importance to the MMC.	**Recommendation 3.2.9a** – Identify what consideration, if any, will be given to limit construction activity during sensitive timing periods for SAR, migratory birds and wildlife species of traditional importance to the MMC, such as during ungulate calving periods. It is recommended that a plan be developed to limit construction activity during sensitive timing periods as to minimize the potential for disturbance and displacement of species and wildlife in the Project area. **Recommendation 3.2.9b** – Provide clear communication and notification (minimum of 21 days) of the finalized construction scheduling to MMF for distribution to their membership, with follow-up communication on a weekly basis for any scheduling changes. There is concern that Manitoba Métis harvesters may have their harvesting rights and activities impacted when they travel to the Project area to hunt, and then find that the area they are travelling to is subject to construction activity which has disturbed or displaced the wildlife they are planning to hunt or harvest.
4.2.10	The Proponent has identified that bat surveys will be conducted in the year prior to initiation of Project decommissioning, during the 'appropriate season', and over multiple visits if necessary (EIS, 2017, pp 6-264 – 265, & pp 6-276). Additional measures could be implemented to mitigate effects of disturbance and mortality to SAR bat species which are not considered in the EIS.	**Recommendation 4.2.10a** – Please identify the exact timeframe and frequency at which bat monitoring surveys will be completed. Please note that the seasonal and daily pattern of bat activity and the use of different types of roosts at different times of the year will impact the appropriateness of survey methodologies. The optimum time for dusk surveys at buildings, particularly during early summer is for two hours after the first bats

Comment #	Issue	Question/Recommendation
		emerge as this will cover the emergence period as well as the first return to the roost for some species. The time of first emergence varies between species, with noctules leaving around sunset and others leaving about 1 hour after sunset. Bats using underground structure at the site during the summer may not emerge until later, upwards of 4 hours after dark. Towards dawn, many bats swarm outside their roosts and surveys beginning about 90 minutes before sunrise and continuing until 15 minutes after sunrise ('sunrise surveys') is recommended (Mitchell-Jones, 2004). During this time, it is recommended that continuous automated bio-acoustic detectors linked to data-loggers be used, so as to minimize missing the presence of SAR bats in the Project area. **Recommendation 4.2.10b** – The location and installation of the replacement roosts (bat boxes) should be chosen to maximise the chances of the bats finding and adopting it. Care should be taken to install boxes close to existing flight lines and have an entrance close to appropriate/preferred habitat types. Many bat species prefer to fly in dark areas straight into vegetation, so external lighting on the site close to boxes should be avoided. **Recommendation 4.2.10c** – If SAR bat species are identified during pre-decommissioning surveys, demolition of the facility should stop until individuals have left the area, roosts/nests are no longer active and/or adoption of habitat off-sets (bat boxes) have been confirmed.
4.2.11	Chemical and radiological contaminant release will be monitored as part of follow-up monitoring during	Please provide adaptive management measures and thresholds being considered for follow-up monitoring.

Comment #	Issue	Question/Recommendation
	the closure phase to verify effects predictions and to provide information for use in adaptive management measures to address unforeseen effects. Adaptive management approaches have been proposed, yet thresholds at which implementation of these approaches have not been provided in the EIS (EIS, 2017; Table 6.6.5-1/pp 6-265).	
4.2.12	There are ongoing concerns with airborne contaminants that could deposit to soil, and water, where they could affect vegetation and wildlife/wildlife habitat of interest and importance to the MMC (EIS, 2017; pp 6-273). What Emergency response protocols are in place to notify the MMC in the event that monitoring values exceed radiation benchmark values and applicable environmental guidelines?	An Emergency Response Plan must be developed in consultation with the
4.2.13	General Comment.	Provide opportunities to the MMC to build capacity and knowledge in decommissioning activities and reclamation of Project components. Opportunities to build MMC capacity and knowledge in efforts that are of importance to the Manitoba Métis, such as participation in seeding, planting and monitoring in follow-up programs should be explored with the MMF.
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSEMENT		
4.3.1	The safety case for the WR-1 decommissioning relies to a large extent on the conclusions of the 2001 Comprehensive Study report for the WL site. Two areas with elevated radioactivity were expected to remain on the WL site: the contaminated Winnipeg River sediments and the Low-Level Waste Management Area. The conclusions from that study were based on the assumption that all high-level	Although the WR-1 decommissioning is a separate component of the Comprehensive Study, exposure models should be assessed in terms of the other sources of radioactivity on the site (LLWM area, Winnipeg sediment, sewage lagoon and other sources of radioactive and noon-radioactive contaminants).

Comment #	Issue	Question/Recommendation
	waste would be removed from the site and sent to a national disposal site within a number of years. As no facility has been selected or developed, leaving the high-level waste would change the conditions for the Comprehensive Study for the WL site, which should be re-examined as it forms the basis for the long-term plan for the site.	
4.3.2	The Comprehensive Study Report ("CSR") names the CNSC and Fisheries & Oceans Canada as Responsible Authorities (RA) (Introduction, section 1-1), although in the Appendices to the CSR, CNSC is named as the only RA. Given the importance of the aquatic transport pathway in the Post-Closure period, and the potential for contamination of the Winnipeg River and the reliance of MMC harvesters on fish and aquatic resources, the RA for the Project requires clarification and consistency.	Please clarify if Fisheries and Oceans Canada is a Responsible Authority for the WR-1 Decommissioning.
4.3.3	The Proponent states that "ISD is a permanent, passive decommissioning end state [and] CNL is proposing a revised approach to the WR-1 decommissioning that includes partial dismantling and demolition, along with passive, permanent disposal of the below-grade portions of the facility (the Project)" (EIS, 2017; pp 1-1, emphasis added). The WR-1 decommissioning is not a "permanent disposal" of the high-level waste in the reactor. It is a long-term storage in which the radioactivity is not isolated from the biosphere but will be released to the environment through time. Conditions of the high-level waste disposal program by the CNSC in the 1990s stipulated that the waste must be isolated	Recommendation 4.3.3a – The CNSC should provide guidance on whether the long-term storage of high level waste in this form is acceptable, given the knowledge that radioactivity will be released to the Winnipeg River in the future. Recommendation 4.3.3b – Alternatives to ISD, such as moving the radioactive material to a final disposition site should be considered as viable options for the WR-1 Reactor decommissioning. The CNSC should make recommendations to reconsider the alternatives to in situ storage of WR-1 Reactor and examine the possibility of removing and storing the highly radioactive components with other high-level waste

Comment #	Issue	Question/Recommendation
	from the biosphere and should not be a burden on future generations. The WR-1 decommissioning as described in the EIS will not isolate the waste from the biosphere and requires monitoring of the site until 2324. This places a commitment on future generations and a possibility of exposure of released radionuclides to the public, particularly to those that harvest fish in the river and may harvest aquatic plants, including wild rice. As already identified throughout this review, the MMC has rights in the Project vicinity that include practices of harvesting fish and other aquatic resources from (among other locations) the Winnipeg River. The ISD plan for the Project has the potential to create additional impacts on the MMC and future harvesters, which are possibly greater than a disposal or decommissioning plan that does not involve in-situ options for decommissioning. While the ISD plan meets one of the CNL Integrated Waste Strategy Objectives by providing a disposition route for the WR-1 Reactor components and systems (EIS, 2017; pp 2-1), it does not meet the objectives of "limiting nuclear legacy obligations for future generations" but requires monitoring and maintenance of the site for at least 100 years, and possibly as long as 300 years. This long-term monitoring requires ongoing resources and may lead to significant resource costs to correct any deficiencies. The alternative of moving the radioactive material to a final disposal site should be seriously considered.	from other sites. This would significantly reduce monitoring and maintenance costs.

Comment #	Issue	Question/Recommendation
4.3.4	The EIS identifies that "Although the installation of the engineered cover at the WR-1 Building is expected to slightly alter the drainage rates and flow patterns and discharge volume to the Winnipeg River; the changes are expected to be within the natural range of variation" (Executive Summary). The data used to justify this statement only cover a few years of when the Proponent has managed the site. It is unclear whether these assumptions will withstand the passage of time, particularly over 300 years given climate change and possible land-use changes in the area. It is unlikely that the surrounding environment and the land use will remain the same. The flow of the Winnipeg River may change with drier or wetter climate, and changes in the dams on the river. This uncertainty will also affect the Project description and other aspects of the Project over time as they are described, assessed and form conclusions in the EIS.	Recommendation 4.2.4a – The EIS should be revised to explicitly include acknowledgement that the uncertainty of the estimates increases over time. It is not possible to make conclusions on environmental and climatic conditions 300 years in the future with any certainty and the EIS should identify this limitation. Recommendation 4.2.4b - The CNSC should consider this uncertainty in the conditions that it imposes on the decommissioning plan for the Project, including by imposing conditions or requiring options that include the removal of highly radioactive material to a permanent disposal site.
4.3.5	The summary of the EIS does not discuss the other sources of radioactivity already stored on the site. The CSR indicates that, after decommissioning, there will be two sources of radioactivity that remain on the site: the Low Level Waste Management Area and the contamination in the Winnipeg River Sediment. There is no mention of these radiation sources or their influence on the risks from the WR-1 decommissioning. These existing sources of radioactivity present the potential for additional radioactive material and effects that requires consideration as it may result in additional cumulative effects on the environment and	Although the EIS is written specifically for the WR-1, it must be reviewed in the context of the larger site and other sources of contamination. At the very least, it is recommended that the description of the site and exposure models should include all sources of contamination and their management plans including identifying the long-term plans for the irradiated fuel currently on-site and the Winnipeg River sediment

Comment #	Issue	Question/Recommendation
	specifically the MMC members that rely on the natural environment for the exercise of their rights and subsistence. The EIS further identifies that the "decommissioning approach for the WL site as described in the Comprehensive Study Report (CSR) was to remove all facilities entirely from the WL site with the exception of low level waste trenches in the Waste Management Area, which may be managed through on-site in situ disposal (AECL 2001). Over a 10-year period, multiple buildings and facilities at the WL site have been decommissioned and the occupied space has been remediated, in an effort to meet this objective" (EIS, 2017; pp 2-2). The Winnipeg River sediment is not mentioned here although it was identified in the CSR as remaining after site closure. It is also not clear what the long-term plans are for the irradiated fuel remaining on-site.	
4.3.6	The EIS identifies that "AECL has asked CNL to perform the work, and in keeping with international best practices (IAEA 2004, 2006), the decommissioning timeframe has been accelerated with the goal of completing decommissioning of the WL site by 2024" (EIS, 2017; pp 1-7). It appears that this timeframe is the key component for the plan to decommission the WR-1. The timeframe may not allow for a consideration of other alternative decommissioning or disposal options that have less potential for contamination effects on the local environment, and correspondingly less potential impacts to the MMC and other members of the public. ISD is the only alternative identified by the	The CNSC, AECL and CNL should consider extending the timeframe for site decommissioning if it provides the best solution to WR-1 decommissioning.

Comment #	Issue	Question/Recommendation
	Proponent which will allow the decommissioning of the site by 2024.	
4.3.7	The Proponent is proposing ISD of the WR-1 to achieve the closure of the WL site by 2024. The EIS considered, among other factors, worker safety when undertaking ISD. This review does not dispute that worker safety is of importance, however the EIS has not presented evidence of the dose rates to workers currently in the building when performing maintenance or monitoring, or what the doses to workers were when removing the fuel from the WR-1 Reactor or transporting the fuel to its current location, and what the doses will be when transporting the fuel off-site (or where the fuel will be moved to). This information is required to make informed decisions about the preferred options for the WR-1 Reactor. If this information is available in supporting documents, it should be summarised here. Other alternatives, such as leaving the reactor in place until a permanent national depository is available, should be re-considered, and affects of these options on worker safety should be identified and considered. The MMF has expressed an interest in having MMC citizens build capacity and knowledge in the decommissioning activities, over the lifecycle of the Project. As such the potential effects of various options for decommissioning on the workers is of interest and concern to the MMF. Additionally, the EIS states that "While the complete removal of the facility will result in positive effects to the environment, the environmental liabilities	Consider and provide information about the effects on workers of alternative decommissioning options that do not involve ISD.

Comment #	Issue	Question/Recommendation
	associated with the removed wastes will be transferred to another offsite facility that has not been constructed yet. It is not yet known if this future facility will be within an industrial setting or a green-field site which could result in additional adverse environmental effects (e.g., vegetation clearing required at a green-field site)" (EIS, 2017; pp 2-15). Given that any potential off-site facility is unknown, and removal has not been sufficiently detailed or considered as an option for decommissioning throughout the EIS, it isn't clear whether removal of the WR-1 Reactor would result in adverse environmental effects that would be more significant than the current ISD plan. A future facility would presumably consist of more than removing vegetation from the site, however with such a location underdetermined, any potential effects are speculative and uncertain.	
4.3.8	The EIS outlines a consideration of cost estimates of the preferred method (ISD) and alternatives (EIS, 2017; Table 2.6.3.1). The preferred option of ISD has been identified by the Proponent as the cheapest and quickest method to decommission the WR-1 Reactor, but there is no explanation of individual costs. For example, monitoring of Alternative #1 is stated to be $1, but $7 for Alternative #3, however it is unclear what the units are. Alternative #3 has no surveillance after 2024 and no further details are provided. Presumably monitoring will continue on the site after 2024 as part of the site license and because of the legacy contamination in the lagoon, low level waste management area, cesium ditch, etc.	**Recommendation 4.3.8a** – More complete costing details need to be provided, including identifying individual costs and whether ongoing monitoring has been included. In addition, there needs to be greater transparency about allocated costs. Also, estimates of how costs are allocated 100 to 300 years in the future should be described, along with an explanation of how future costs are being estimated for the next 100 years. **Recommendation 4.3.8b**- The cost estimates should be audited and validated by an independent source.

Comment #	Issue	Question/Recommendation
	however it is not clear whether the cost estimates include this ongoing monitoring. Also, if it has not already been undertaken, the cost estimates should be audited and validated by an independent source.	
4.3.9	The rationale for ISD relies on maintenance and monitoring of the installation for 300 years and states that "control" will last "indefinitely" (EIS, 2017; section 3.1.2). It is not clear how the Proponent is prepared to make this commitment for the post-closure after 2124 or, in particular, after 2324. Environmental regulations change with each government, and it is possible that future governments may choose to not allocate funding to maintaining and monitoring the WL site. There is no way to guarantee future commitment of resources.	Additional clarity is required for the post-closure phase activities and plan, in particular how long-term performance monitoring and maintenance activities are expected to be carried out. The EIS should further consider and acknowledge that the uncertainty in being able to guarantee the sufficiency of these planned activities increases over time given the potential for changes in priorities, funding, and environmental requirements. The CNSC should consider this uncertainty when identifying conditions to apply to the Project.
4.3.10	The EIS identifies that "Project-specific effects can be quantified (e.g., incremental changes to ground and surface water quality, air quality, and fish and wildlife habitat). Because the socio-economic status of different communities, subpopulations and individuals may vary, a socio-economic effect may have positive aspects and negative aspects. An effect on a biophysical discipline is typically constrained to being negative or positive" (EIS, 2017; pp 6-2). This introductory text is meant to provide support to later conclusions in the EIS, but it overstates the levels of confidence in the analysis. For example: "Project-specific effects…fish and wildlife habitat" are identified however the subsequent analysis does not quantify effects to fish and wildlife habitat. In fact, there are no formal surveys of fish and wildlife habitat for the WL site described in the EIS, and no	**Recommendation 4.3.10a** – The EIS needs to be reviewed, particularly the text in the Assessment section (Section 6) for conclusions that overstate its accuracy or imply that the analysis will be rigorous and predict impacts with any accuracy or precision. For example, no surveys of fish or wildlife distribution have been conducted for this EIS so the text should not imply or include conclusions based on survey's that have not been undertaken; Log books by staff are not accurate indicators of wildlife presence, abundance, or distribution at the site; etc. **Recommendation 4.3.10b** – To the extent that the conclusions identified in section 6 require surveys or assessment activities that have not be undertaken regarding the Project site and/or effects, these formal surveys, assessments etc. should be undertaken by experienced personnel. Risk assessment models for the

Comment #	Issue	Question/Recommendation
	methods for estimating effects to habitat, either in 2024 or in the future. This presents problems for later conclusions in the EIS, such as, for example, related to the protection of fish and fish habitat (EIS, 2017; Table 6.1.2.1); while identified as an issue to be assessed and considered in the EIS, the subsequent analysis does not specifically address changes to fish habitat in the Winnipeg River. It estimates the radiation dose to fish in the river (and the concentration of non-radioactive chemicals) and concluded that doses will not cause effects in adult fish. Later in the report (EIS, 2017; pp 6-215) it is stated that "Fish habitat is generally similar throughout the RSA" However it provides no evidence for this conclusion. A consideration of the evidence from the scouring (near the plant site) and depositional zones (further downstream) in several places in the river could be considered as it relates to supporting or refuting this conclusion.	WL site should use site specific surveys of species distribution for both the aquatic and terrestrial environments to provide some conceptual support for the models. The ecological risk assessment uses data from other studies and anecdotal reports to estimate exposure and does to VCs. These surveys or assessment activities should, as much as possible, be at locations specific to the Project site and not drawn from other locations that may or may not provide comparable data (for example, pp 6-216 Fish Community data is drawn from other locations in the Winnipeg River and it is unclear if the fish population at the Project site are similar or comparable to the location of this data source).
4.3.11	Section 1.5 (EIS, 2017) is intended to leave the impression that the risk assessment methods used here are rigorous and that the conclusions on exposure and effects are fully justified. However, most of the text glosses over the fact that conclusions are made without justification, a rationale or supported by data specific to the WL site. For example, phrases like "either because there was no linkage initially or because environmental design features or mitigation will remove the pathway, are not advanced for further assessment" or "pathways determined to have no linkage to a VC or those that are considered secondary are not	The EIS needs to be reviewed and revised so that statements of professional judgement are based on and linked to evidence that is put into the EIS.

Comment #	Issue	Question/Recommendation
	expected to result in environmentally significant effects on the assessment endpoint of VCs" (EIS, 2017; section 6.1.5) result in pathways being removed without sufficient justification. Statements and conclusions must be based on evidence if they are to be relied on to support conclusions that there will be no, or limited, impacts on factors of importance to the MMC, its rights, interests or health and well-being.	
4.3.12	The EIS identifies that "From 1976 to 1982, downstream fish flesh concentrations of Cs-137 were greater than upstream concentrations for all fish species. However, the estimated dose from fish consumption (<0.005 mSv/a) remained far below (0.01%) the occupational dose limit, so the fish remained safe to eat (AECL 1983). Concentrations in water decreased subsequent to improvements to effluent treatment at the ALWTC in 1982, similar to levels observed between 1962 and 1972 (AECL 1983)" (EIS, 2017; section 6.5.4.2.3). This is a significant observation which connects releases of Cs-137 from the plant to fish consumed by fishers. The data presented in Table 6.5.4.1 were collected from 2010 to 2015 and do not include the data prior to 2010 even though AECL has been monitoring fish since 1976. Presumably these data are available and would provide additional details regarding the concentrations of contaminants in fish over longer periods of time. Such information would be relevant to the consideration of the long-term effects of contamination on fish populations, over the 300 years of the Project decommissioning, and the	Please provide and include a summary of the details of the historic concentrations in fish and the amount of fish consumed in the risk assessment models in the EIS. Monitoring of fish species has been conducted since the early 1970s but only the later data have been used for the assessment. The exposure models should use site specific data on species caught and amounts consumed, not generic values from the CSA.

Comment #	Issue	Question/Recommendation
	potential adverse effects on members of the MMC who harvest and consume fish as part of a traditional diet. The total incremental dose due to fish ingestion was identified as 1.14 x 10-4 mSv/a for adults (EIS, 2017; section 6.5.4.2.3) Additional information for this assessment is required, including, sample sizes, species consumed, amount of fish consumed, and the other nuclides assessed. This information is vital for estimating exposure in MMC citizens, and others harvesting fish as radionuclides are released from WR-1.	
4.3.13	The EIS identifies that "CNL's current environmental monitoring program includes collecting water samples at one location upstream and three locations at varying distances downstream of the WL site. Surficial sediment is also collected at two locations upstream, at the outfall, and nine locations downstream. In addition, CNL has committed to collecting cores in depositional areas in 2026, 2046, and 2066 at Sylvia Lake and upstream and downstream of the waterbody Lac du Bonnet" (EIS, 2017; pp 6-205). It is unclear if the collection of samples as described is adequate to detect changes in water chemistry if the WL-1 Reactor releases radionuclide and non-rad components more quickly than predicted. Past monitoring programs may be considered to justify or refute the conclusion that the collecting sampling plan and timelines are sufficient to guard against the risks involved. Collecting cores every 20 years is unlikely to detect changes in water	The Proponent should consider data from past monitoring programs to justify a sampling schedule that will allow detection of any releases. Where indicated by these past monitoring programs, a sampling plan collecting cores more frequently than every 20 years should be implemented.

Comment #	Issue	Question/Recommendation
	chemistry or deposition of contaminants and won't allow for quick adaptive actions to correct releases.	
4.3.14	The EIS uses the benchmark dose to non-human species from UNSCEAR and CSA (EIS, 2017; pp 6-221), however there have been more quantitative assessments completed. Environment Canada and the AECB used more conservative benchmark values for the Priority Substances List assessment for the protection of the environment around nuclear facilities (EC 2001). Specifically, the Radiation Benchmarks used in section 6.3.2 are very selective in the literature that it uses to rationalize the UNSCEAR 1996 values, which are seriously outdated. EcoMetrix 2017, in Table 7-2 - Assessment endpoints, measurement endpoints, etc. includes a line of evidence for the radiological dose of growth, survival and reproduction that is not supported by the UNSCEAR benchmark. More conservative benchmarks are more protective and are considerably more quantitative. A more quantitative approach by the European Community (cited by Ecometrix) combined a detailed literature review, species sensitivity analysis and an added safety factor of 5, consistent with the assessment of other contaminants, to provide a chronic incremental screening dose of 10 µGy/h for the protection of all ecosystems (protective of 95% of species) using the ERICA approach (Brown et al. 2008, Garnier-LaPlace and Gilbin 2006, Garnier-LaPlace et al. 2006). It was recognised that this dose rate could also allow some cytogenetic effects in	Given the uncertainties in predicting background and incremental doses in the future, the use of a more conservative benchmark should be used.

Comment #	Issue	Question/Recommendation
	sensitive vertebrate species (Sazykina 2005, Sazykina et al. 2009).	
4.3.15	The EIS and Ecometrix report indicate that land use plans and institutional control is clearly defined and will continue during Post-Institutional period (300+ years) and will be designated for other uses after 300 years (EIS, 2017 pp 6-225; EcoMetrix section 5). The EIS also acknowledges that the government might not maintain control over the site in which case monitoring programs might not continue and that people may "be present on-site and make some use of local resource" (EIS, 2017; pp 6-305). Given this uncertainty**,** predicting social, political and environment conditions 300 years into the future is very problematic. In terms of exposure modelling and access to the site, it seems to be more conservative to adopt a model that allows for no controls and unrestricted access to the site. The long-term plan or "end use" for the WL site is also unclear, and where possible should be clearly identified in the EIS as this "end use" state will be of importance to the MMF and ultimately affect what traditional uses and activities can be carried out there by MMC citizens.	**Recommendation 4.3.15a –** The EIS should be revised to include, as a possibility, an institutional control model with no controls and unrestricted access to the site, to take into account the uncertainty of the end state of the WL site. **Recommendation 4.3.15b** – If possible, the long-term plan or "end use" of the WL site should be clearly identified, including a timeline leading up to this end use state. Limitations on the MMC use of the lands and resources resulting from this anticipated "end use" state should be clearly identified.
4.3.16	The EIS identifies the harvesting practices of First Nations proximate to the Project site, and the potential effects on the harvesting and other rights of First Nations. For example, Table 6.7.1.1, identifies how **"**Sagkeeng FN harvest wild rice and medicinal plants in the area." As is identified throughout this review, the MMC has constitutionally protected rights and interests, and exercise those rights and interests in the vicinity of the Project area. Much like	Work with the MMF to identify and consider the rights, interests and activities of the MMC that may be impacted by the Project. These need to be included in the EIS, along with a consideration of how these harvesting activities and practices may be impacted by the presence of contaminants and consequently affect the health and well-being of the MMC. Accommodation and mitigation options may be required.

Comment #	Issue	Question/Recommendation
	First Nations, these rights and interests and the health and wellbeing of the MMC stands to be impacted by the Project activities and resulting accumulation of contaminants in the environment and resources relied on by the MMC. Métis may have similar concerns and wish to harvest wild rice from depositional areas of the Winnipeg River downstream of WL site, which needs to be taken into account by the Proponent and included in the EIS	
4.3.17	The EIS states that the "Results of the Comprehensive Study Report (AECL 2001) indicated that no public health threats were predicted from the decommissioning and reclamation activities for the WL site. Releases are well within regulatory limits for the protection of human health and regular monitoring provides that any aberrations are detected immediately (AECL 2001)" (EIS, 2017; pp 6-288). It further identifies that the "Results of the Comprehensive Study Report ["CSR"] indicated no residual effects on public health are expected as a result of the closure of the WL site" (EIS, 2017; pp 6-294). This is a misrepresentation of the results of the CSR. The CSR determined that there would only be the LLW area and the Winnipeg River sediment as two remaining sources of radioactivity on the site. All high-level waste was to be removed to a national disposal site that would isolate the waste from the biosphere. Because of those assumptions, there would be no long-term impact on public health at WL site. Those assumptions have now been changed with the long-term ISD storage of WR-1 Reactor.	The 2001 conclusions were based on the removal of high level radioactive concerns on the WL site to a national site. This WR-1 Reactor decommissioning was not part of the 2001 Comprehensive Study. The in situ WR-1 Reactor decommissioning should be analyzed in terms of the sources of radiation on the site (LLWM, the Winnipeg River sediment, lagoon, etc.). Also, the CSR should be re-visited with updated data.

Comment #	Issue	Question/Recommendation
4.3.18	The EIS acknowledges that "Harvesters represent traditional users of the area who may be exposed through harvesting of country foods" (EIS, 2017; pp 2-697). The EIS (pp 6-297) and Ecometrix Report (section 5.2.2) make a series of assumptions about land-use location, duration, and frequency of harvesting activities. The time spent by traditional harvesters at the WL site in the exposure model is very restrictive. The HHRA for the harvester assumes land use practices in 2324 to be similar to those in 2024 but they may be completely different. It should be possible to conduct several land use practices using the transport models to determine if time of residency in the area and a more traditional diet will affect exposure. The EIS further states that "Recreational users such as swimmers, anglers, and boaters that occasionally carry out recreational activities along the Winnipeg River at locations close to the WL site, as compared to the most critical group locations (Farm A and Farm F), are not directly considered for the assessment because these activities are not representative of population groups in the area" (EIS, 2017; pp 6-297). Given the potential for the change in land-use over time, these recreational activities should be considered as part of the assessment. As the Project-site and surrounding area becoming available for these uses, there is the potential for the recreational use of the area by the MMC to increase.	**Recommendation 4.3.18a –** Land use studies should be conducted to determine if time of residency in the area and a more traditional diet will affect exposure. **Recommendation 4.3.18b –** Recreational users and the potential increase in the recreational land use of the area should be considered in the land use studies undertaken.
4.3.19	Table 5-20 of the Ecometrix Report identifies that the dominant contributor to the total dose is carbon-14 through the ingestion of terrestrial plants and	Further information is needed, including the diet for the infant harvester, and the identification of the family

Comment #	Issue	Question/Recommendation
	animals, and fish, except for the 3-month-old drinking formula, which has tritium as the dominant contributor to dose. Why is the dose not calculated for the nursing infant of the harvester? The hazard quotients derived for constituents of potential concern were below the protective benchmark for all receptors, with the exception of a toddler harvester during post-closure, which slightly exceeded the benchmark. For the toddler harvester, the total ingestion HQ slightly exceeded 0.2 for lead (HQ = 0.24) (EIS, 2017; pp 6-314). The EIS further identified that "with the exception of a toddler harvester during post-closure, which slightly exceeded the benchmark. If only the Project contribution is considered, the HQs are reduced even further and hazard quotients are well below for all receptors (the Project contribution to the total is 0.0021% for cadmium and 0.00002% for lead)" (EIS, 2017; pp 6-314). This gap in the modelling scenario is significant as there does not appear to be a pathway for the nursing infant for the harvester scenario. A rationale for this was not located, nor was a description of the infant diet for the harvester. It is assumed that the "harvester" is represented by a family with adults, a toddler and a breastfeeding infant, however this assumption needs to be confirmed and clearly identified in the EIS. Given the reliance of the MMC on harvesting activities, and the importance of protecting and preserving the harvesting rights and activities of the MMC for future generations of Métis harvesters, the data related to pathways for	grouping considered, the pathway for the nursing harvester, etc.

Comment #	Issue	Question/Recommendation
	contaminates between adults and nursing infants is significant in terms of potential long-term health effects on members of the MMC.	
4.3.20	The Ecometrix Report and the EIS both often use the term conservative when describing uncertainty without explanation or evidence. For example, page 7.1.6 of the Ecometrix Report: "The EcoRA problem formulation is conservative in its assumptions to accommodate uncertainties and meet the objective of protecting ecological health during the post-closure period" and "There is uncertainty in the radiological and non-radiological release rates to the surface water environment; however, the estimates are expected to be conservative." Also In a previous section of the Ecometrix Report, entitled Uncertainty in Exposure Assessment, sentences such as "This is considered appropriate" and "Dose coefficients were obtained from reputable sources" are not convincing and cannot be reviewed. Page 6-344 of the EIS states that: "Although uncertainties in the assessment exist, conservatism has been included in the modelling so that residual effects are not greater than predicted. Overall, residual effects are considered to be not significant for all ecological health VCs during the closure and post-closure phases. Monitoring and follow-up programs include implementation of CNL's existing Environmental Monitoring Program. These activities will verify effects predictions for ecological health." There needs to be some support for these types of categorical statements. Evaluating conservatism needs to be expressed relative to another set of	The EIS needs to be reviewed for consistency in the use of the term "conservative" when describing uncertainty of various aspects of the Project. Evaluating conservatism needs to be expressed relative to another set of conditions.

Comment #	Issue	Question/Recommendation
	conditions. Here it is stated, without support. For the statement on page 6-344, there is no support for the observation of “residual effects are not greater than predicted” without some reference.	