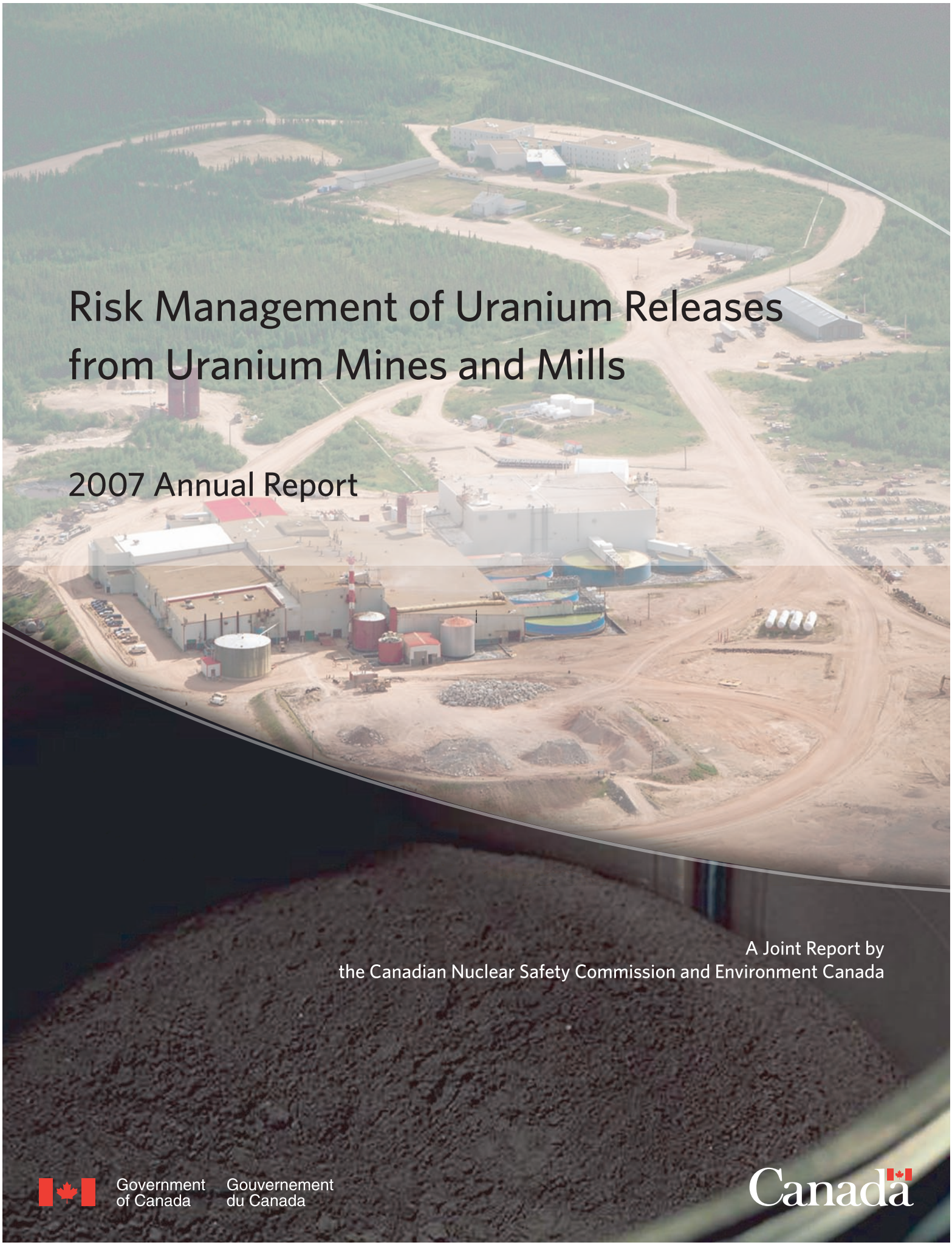

Risk Management of Uranium Releases from Uranium Mines and Mills

2007 Annual Report

A Joint Report by
the Canadian Nuclear Safety Commission and Environment Canada

Government of Canada Gouvernement du Canada

Canada

Risk Management of Uranium Releases from Uranium Mines and Mills
2007 Annual Report

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Top: Cameco Rabbit Lake mill facility and camp residence
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EXECUTIVE SUMMARY

The Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC) have independent, but related mandates for protecting the environment within the nuclear industry. The two organisations have developed and signed a Memorandum of Understanding (MOU), agreeing to work together on environmental regulation of nuclear facilities in Canada. This agreement was created to minimize regulatory duplication and to comply with the Government of Canada's policy requiring departments to coordinate their activities.

EC, with CNSC technical support, determined that uranium and uranium compounds in effluent from uranium mines and mills were entering the environment in quantities or concentrations or under conditions that have or may have an immediate or long-term effect on the environment or its biological diversity. It was determined that the continuous regulatory oversight and public licensing process required by the CNSC provided the best regulatory approach to identify and implement appropriate risk management activities. This decision was formalized in an Annex to the MOU that addressed the risk management of uranium released to the environment from uranium mining and milling facilities. The Annex identified risk-management activities for each facility and required an annual report to outline the progress of risk management activities. This document is the first such report.

This document, jointly published by EC and CNSC, introduces each body's regulatory roles relative to nuclear activities, provides background on the original toxicity assessment and conclusions resulting in the Annex to the MOU, and documents the risk management activities implemented to meet the Annex requirements. This report covers activities completed as of the end of 2007.

The original assessment and the Annex to the MOU recommended assigning a high priority to reducing exposure to uranium from uranium mines and mills. The Annex identified three facilities that required specific attention: the Rabbit Lake Operation, the Key Lake Operation, and the Cluff Lake Operation. The uranium issues at each of these facilities are unique and therefore were addressed separately.

Through a condition on the November 2003, Rabbit Lake Uranium Mine and Mill license, the CNSC required improvements to the effluent treatment to reduce uranium concentrations within a 42 month period. By May 2007, an 86% reduction in concentration of uranium in the effluent and an 85% reduction in total discharge of uranium to the environment had been achieved as a result of consistently reducing effluent uranium concentrations below the treatment objective of 100 µg/L.

CNSC staff conducted an assessment of the effectiveness of the Reverse Osmosis Plant at the Key Lake site in removing uranium from the dewatering water. The assessment

demonstrated that the plant has been operating with an average removal efficiency of 97% thereby preventing the release of over 2,500 kg of uranium to the environment. As a result of this treatment, receiving environment concentrations have been consistently below the Saskatchewan surface Water quality Objective (SSWQO) for uranium.

While the Cluff Lake Operation was not subject to immediate uranium risk management measures because it has ceased operation and is undergoing decommissioning, the CNSC continues to monitor environmental performance as part of the present decommissioning license. In comparison to the last three years of operation, a 67% reduction in uranium concentration is observed in Island Lake, the first water body into which treated effluent was discharged during operation. Water concentrations immediately downstream have continued to consistently meet the SSWQO for uranium.

CNSC staff reviewed the environmental emergency plans in place at uranium mines and mills as a CNSC license requirement and from expectations of the *Metal Mining Effluent Regulations.* This review confirmed that the licensees' programs conform to the requirements of the *Canadian Environmental Protection Act*.

EC and the CNSC, along with industry, have successfully met the uranium risk-management objectives. The initial phase of risk management activities addressed site-specific issues. Future activities will continue to focus on the facilities specified in the Annex, while expanding to review risk management practices for uranium in effluent within other sectors of the nuclear industry, to continue ensuring that uranium releases do not pose an unreasonable risk to the environment. This information on the 2008 reporting period will be provided in the next annual report.

INTRODUCTION

The Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC) have independent, but related mandates for protecting the environment within the nuclear industry. The two organizations have developed and signed a Memorandum of Understanding (MOU), agreeing to work together on environmental regulation of nuclear facilities in Canada. This agreement (see Appendix A) was created to minimize regulatory duplication and to comply with the Government of Canada's policy requiring departments to coordinate their activities.

The assessment of releases of radionuclides from nuclear facilities was added to the second Priority Substances List (PSL2) of the *Canadian Environmental Protection Act* (CEPA), in order to determine if they posed a significant risk to the environment in Canada. The evaluation was produced under the direction of CNSC technical specialists, and the final report, entitled "Releases of Radionuclides from Nuclear Facilities (Impact on Non-human Biota) (Ref. 1), concluded that releases of uranium and uranium compounds contained in effluent from uranium mines and mills are "toxic" as defined in Section 64 of CEPA. As part of the risk management activities required for CEPA toxic substances, an Annex was added to the existing MOU between EC and CNSC (Appendix A). The Annex identified specific risk management activities for each of the facilities associated with the conclusion of CEPA toxicity, and required the production of an annual report outlining the progress of these risk management activities.

This first Annual Report, published jointly by EC and the CNSC, demonstrates that the specific risk management activities identified within the Annex have been achieved. The report is structured in two parts. Part I includes an introduction to the regulatory roles of EC and CNSC relative to environmental protection and the nuclear industry. It also provides background on the PSL 2 assessment and conclusions that resulted in the Annex to the MOU and identifies the primary expectation of the Annex. Part II addresses the activities completed to meet the specific risk management requirements documented within the Annex of the MOU. This includes a review of the site specific risk management activities required for the Rabbit Lake, Key Lake and Cluff Lake facilities, followed by an analysis of regulatory expectations with respect to Environmental Emergency Response Plans, and a brief review of the joint regulatory annual meeting required within the Annex. Appendices B and C contain more detailed technical assessments of the activities and assessments completed for the Rabbit Lake and Key Lake operations, respectively. This report covers activities completed up to the end of 2007.

PART I. Regulatory Roles, Responsibilities and Coordination

Both the CNSC and EC have regulatory roles relative to nuclear facilities. The respective roles of these organizations are outlined in the following sections.

I-1. Canadian Nuclear Safety Commission

Parliament, through the *Nuclear Safety and Control Act* (NSCA), has made the development, production and use of nuclear energy, and the production and use of nuclear substances, prescribed equipment and prescribed information, the regulatory responsibility of the CNSC. The CNSC is mandated to:

i. prevent unreasonable risk to the environment and to the health and safety of persons;
ii. prevent unreasonable risk to national security; and
iii. achieve conformity with measures of control and international obligations to which Canada has agreed.

The NSCA, promulgated on May 31, 2000, replaced the *Atomic Energy Control Act* (AECA) and gave the CNSC expanded regulatory responsibilities which included environmental protection. This expanded role involves specific statements with respect to the protection of the environment from radionuclides (for example, rather than assuming that the protection of man protected the environment), and the additional responsibility of protecting the environment from non-radionuclide hazardous substances used or released at nuclear facilities.

I-2. Environment Canada

Under the *Department of the Environment Act*, EC is responsible for preserving and enhancing the natural environment, including water, air and soil quality and renewable resources. The latter specifically includes water, meteorology and migratory birds, and other non-domestic flora and fauna. EC is also responsible for enforcing rules and regulations arising from the advice of the International Joint Commission relating to boundary waters, and questions arising between the United States and Canada as they relate to preserving and enhancing environmental quality. EC regulates through the CEPA, with the mandate to:

i. ensure that preventive and remedial measures are taken to protect the environment;

ii. establish nationally consistent levels of environmental quality;
iii. apply knowledge, science and technology to resolve environmental problems;
iv. protect the environment from the release of toxic substances; and
v. assess whether substances in use in Canada are toxic or capable of becoming toxic.

EC is also directly involved in regulating of uranium mines, as a result of its responsibility to regulate the release of "deleterious" substances under the *Fisheries Act* and the Metal Mining Effluent Regulations (MMER). The CNSC participates in MMER activities at several levels, including participation on each uranium mine's Technical Advisory Panel, as well as recognizing MMER environmental requirements within CNSC-licensed environmental monitoring programs.

I-3. The Memorandum of Understanding

The CNSC and EC have overlapping jurisdictions on some aspects of the nuclear industry. To minimize regulatory duplication and use government resources more effectively, the two parties developed and signed a MOU wherein they agreed to collaborate on the overall environmental regulation of nuclear facilities in Canada. The original MOU was signed in 2003. A copy of the memorandum and the associated Annex is included in Appendix A, and a summary of the key elements appears provided below.

Within the MOU, CNSC and EC "agree to consult and cooperate" with respect to the identified principles "in order to minimize regulatory duplication and to use government resources effectively". These principles essentially involve:

- committing to cooperating and supporting each other in meeting our respective responsibilities relative to environmental conservation and protection;
- taking reasonable steps to ensure that environmental protection policies and measures are complementary and designed to provide effective environmental protection;
- providing each other the opportunity to advise on policies and programs that may affect the mandate of the other; and
- fostering strong working relations by establishing mechanisms and links to share information where appropriate.

The MOU contains specific commitments with respect to implementation of the MOU for each of the parties involved, and also outlines the agreement's final terms. The MOU and associated Annex are provided in Appendix A.

I-4. Priority Substances List 2 and the Determination of CEPA Toxicity

The CEPA requires federal Ministers of the Environment and of Health to prepare and publish a Priority Substance List (PSL), assess these substances, and determine if they are "toxic" or capable of becoming "toxic", as defined in Section 64 of the Act, which states:

"… a substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that:

- *have or may have an immediate or long-term harmful effect on the environment or its biological diversity;*
- *constitute or may constitute a danger to the environment on which life depends; or*
- *constitute or may constitute a danger in Canada to human life or health."*

Any substance identified as CEPA "toxic" may be considered for possible risk management activities such as virtual elimination, the development of regulations, guidelines, pollution prevention plans or codes of practice, aiming to control any aspect of the substance's life-cycle.

The assessment of releases of radionuclides from nuclear facilities was added to the second Priority Substances List (PSL2) of the CEPA, to determine if they posed a significant risk to the Canadian environment, with a specific focus on non-human biota. At the request of EC, the evaluation was produced under the direction of CNSC technical specialists. This assessment examined the release of radionuclides from nuclear facilities, including all aspects of the uranium fuel chain, from mining and milling to power generation and waste management.

The assessment, published in 2003 (Ref. 1), was completed on five operating uranium mines and mills, two uranium refineries and conversion plants, three stand-alone waste management facilities and five nuclear power plants. The assessment concluded the following:

"Based on available data concerning the effects from exposure to uranium, it has been concluded that:

i. *releases of uranium and uranium compounds contained in effluent from uranium mines and mills are entering the environment in quantities or concentrations or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity; and*
ii. *releases of uranium and uranium compounds from uranium refineries and conversion facilities, stand-alone waste management facilities, power reactors and their associated waste management facilities, and research reactors are not*

> *entering the environment in quantities or concentrations or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. Based on available data concerning the effects from exposure to ionizing radiation, it has been concluded that ionizing radiation emitted by radionuclides released from uranium mines and mills, uranium refineries and conversion facilities, stand-alone waste management facilities, power reactors and their associated waste management facilities, and research reactors is not entering the environment in quantities or concentrations or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity."*

The final conclusion of the assessment was:

> *"… that releases of uranium and uranium compounds contained in effluent from uranium mines and mills are "toxic" as defined in Section 64 of the Canadian Environmental Protection Act, 1999."*

This conclusion led to the general recommendation that a high priority be given to investigating options for reducing the exposure to uranium from these sources.

Discussions between EC and the CNSC were initiated to determine the most appropriate regulatory approach to meeting the risk management activities required for a CEPA toxic substance. To ensure rapid action with respect to identifying and implementing appropriate uranium risk management activities, an Annex to the MOU was developed and signed in 2004. Upon further discussion it was determined that the NSCA and its associated regulations, licenses, licence conditions and public licensing process, were the most appropriate means of ensuring long-term risk management activities were identified and implemented. The Final Ministerial recommendations regarding the risk management of this substance was published in the *Canada Gazette* on September 2, 2006 (Ref. 2).

I-5. Annex to the MOU: Development of Preventive or Control Measures

Both the PSL2 assessment and the Annex to the MOU recommended placing a high priority on investigating ways of reducing exposure to uranium mines and mills. The Annex further stated:

> *"The Commission will appoint a risk manager and initiate the process to develop preventive or control measures for releases of uranium and uranium compounds from specified uranium mines and mills where the effluent has been identified as likely to be causing harm to aquatic organisms, within three months of the date of the release of the final CEPA assessment report. These mines and mills include Rabbit Lake, Key Lake and Cluff Lake."*

The CNSC delegated a risk manager within the Environmental Risk Assessment Division (ERAD) of the Directorate of Environment and Radiation Protection and Assessment (DERPA). This risk manager coordinates site-specific activities through the involvement of each of the CNSC Project Officers responsible for the specific mine/mills identified in the Annex.

In anticipation of the requirements within the Annex, the CNSC contracted investigations into uranium in effluent treatment processes in order to assist CNSC staff in assessing any options proposed by the licensees. The result of this activity was the document entitled "Uranium in Effluent Treatment Process" (Ref. 3), which was delivered in 2006 and reviewed uranium mill and treatment performance internationally and nationally. This review indicated that, with few exceptions, mills using conventional precipitation treatment technologies were capable of maintaining uranium concentrations below 100 µg/L. Of significant note was the identification of the Rabbit Lake Operation as one of the few in the world not achieving this level. The report's conclusion was that:

> *"… the combination of lime and ferric sulphate be considered the best available technology when the process is adapted to site-specific conditions and water chemistry."*

Reverse osmosis and ion exchange processes were identified as supporting/alternative technologies with potential site-specific value, whose use was hampered by their inability to address complex waste streams. Ultrafiltration, sorption, and biological and chemical reduction were considered to have limited application in Canada, mainly because of the complex nature of the effluents and climatic influences on biological and chemical processes.

PART II. Risk Management Activities

II-1. Site-Specific Risk Management Activities

The Annex signed in 2004 identified three facilities requiring attention related to the release of uranium and uranium compounds:

- the Rabbit Lake Operation;
- the Key Lake Operation; and
- the Cluff Lake Operation.

As shown in Figure 1, these operations are all situated in the Athabasca Basin, located in northern Saskatchewan. The uranium issues at each of these facilities are unique, and will therefore be addressed separately in the following section.

II-1.1. Rabbit Lake Operation

The Rabbit Lake operation is located in northern Saskatchewan, near the west shore of Wollaston Lake. At the time of the PSL2 assessment, this facility's treated mill effluent contained the highest concentration and total loadings of uranium of all Canadian uranium mines. In response to the findings of the assessment report published in 2003 (ref.1), the CNSC included a condition on the November 2003 license for the Rabbit Lake uranium mine and mill requiring that the licensee take measures to reduce the concentration and total loadings of uranium in the treated mill effluent.

> *"The licensee shall identify and implement preventative control measures to reduce the amount of uranium released in the final treated effluent in accordance with the plan and schedule referred to in the documents in Appendix B[1]."*

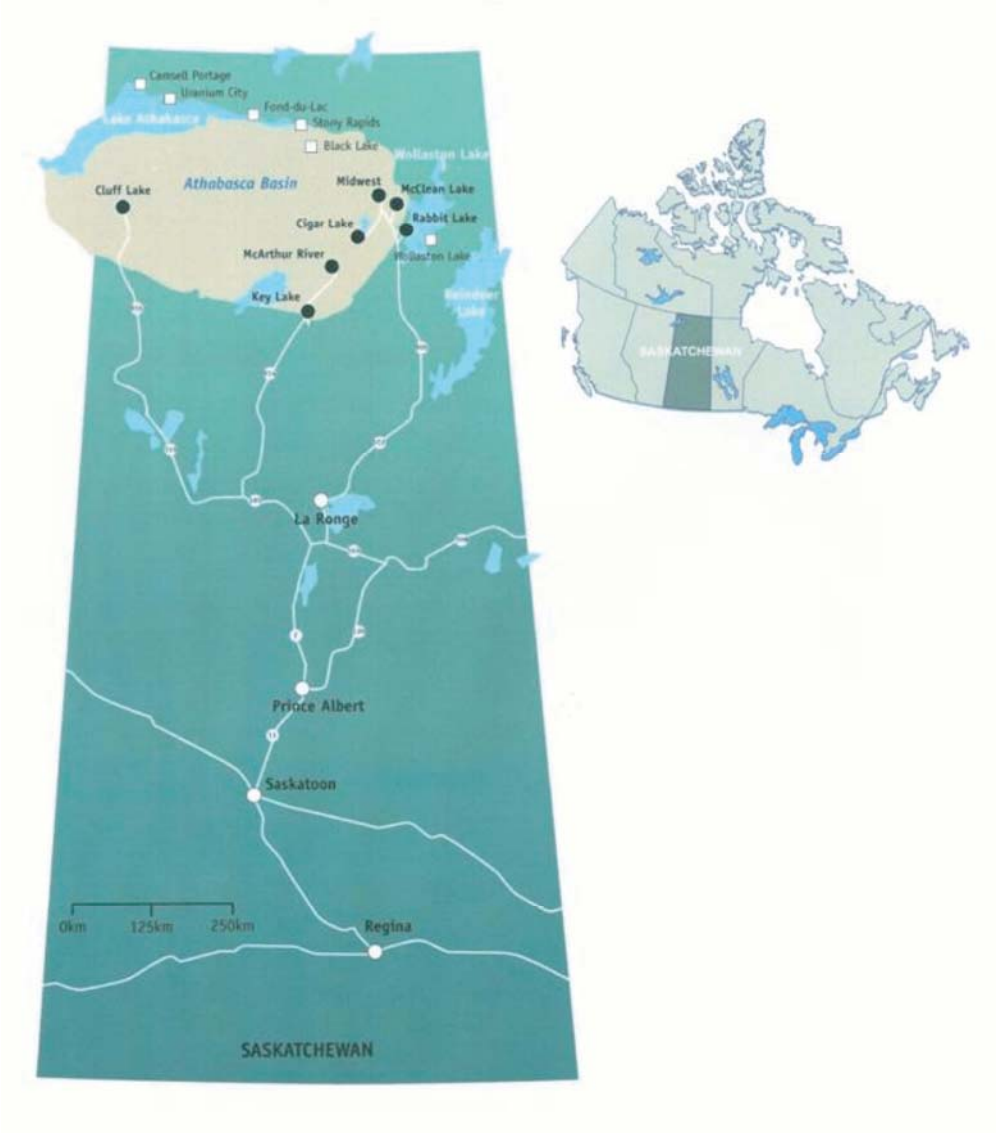
The specific Annex requirements relating to the Rabbit Lake Operation are as follows:

> *"In the case of the Rabbit Lake mine/mill, a study of technical options to improve the quality of effluent of the mine/mill will be completed within 26 months of November 1, 2003, which corresponds to the coming into force of the Rabbit Lake licence renewal. The design, installation and commissioning of the control measures will be completed within the following 16 months."*

[1] Details on the plan and schedule are provided in Appendix B of this report.

Based on this timeline, the study of technical options was to be completed by January 1, 2006, with the design, installation and commissioning completed by May 2007. These activities were completed on schedule under the project name "Uranium Reduction in Effluent". A brief description of the completion of the specific milestones and demonstration of effluent performance are provided in this document. A more detailed presentation of the many reports associated with this project is provided in Appendix B.

Figure 1. Location of uranium mine and/or milling operations in the Athabasca Basin of northern Saskatchewan.
From Rabbit Lake Solution Processing Project Environment Impact Statement: Executive Summary, January 2008.



While treatment options were investigated, prototyped and implemented, Cameco Rabbit Lake was required to include uranium in their effluent Code of Practice, to ensure that reasonable precautions were taken to minimize uranium releases within the capabilities of their existing treatment facility. This Code of Practice was also incorporated into the operating licence.

The Annex to the MOU required a study of technical options be completed within 26 months of November 1, 2003 which corresponds to January 1, 2006. This portion of the "Uranium Reduction in Effluent Project" was completed well ahead of schedule, with a series of reports being submitted:

- Uranium Reduction in the Rabbit Lake Effluent Progress Report. 2004 (Ref. 4).
- Uranium Reduction in the Lake Effluent Interim Report. 2005 (Ref. 5).
- Uranium Reduction in the Rabbit Lake Effluent Final Report. 2005 (Ref. 6).

The Uranium Reduction in Effluent project began with a comprehensive characterization of the Rabbit Lake wastewater management and treatment system, involving mass balance analyses, chemical speciation, and a review of industrial and scientific literature related to treatment of uranium bearing waters. This work led to several laboratory and pilot scale tests that identified appropriate treatment options and procedures for use at the Rabbit Lake Operation. The core of the uranium reduction program was based on substantial changes to the conventional chemical precipitation-based mine water treatment system. This was further supplemented by establishing a separate chemical precipitation (ferric sulphate) treatment for waters of the Above Ground Tailings Management Facility. Previously, these waters reported directly to the precipitation ponds, bypassing the chemical precipitation treatment circuits. Pilot plant studies continue to investigate further supplemental treatment of waste streams, using membrane filtration technologies, and are expected to reduce uranium and other contaminants even further in the future.

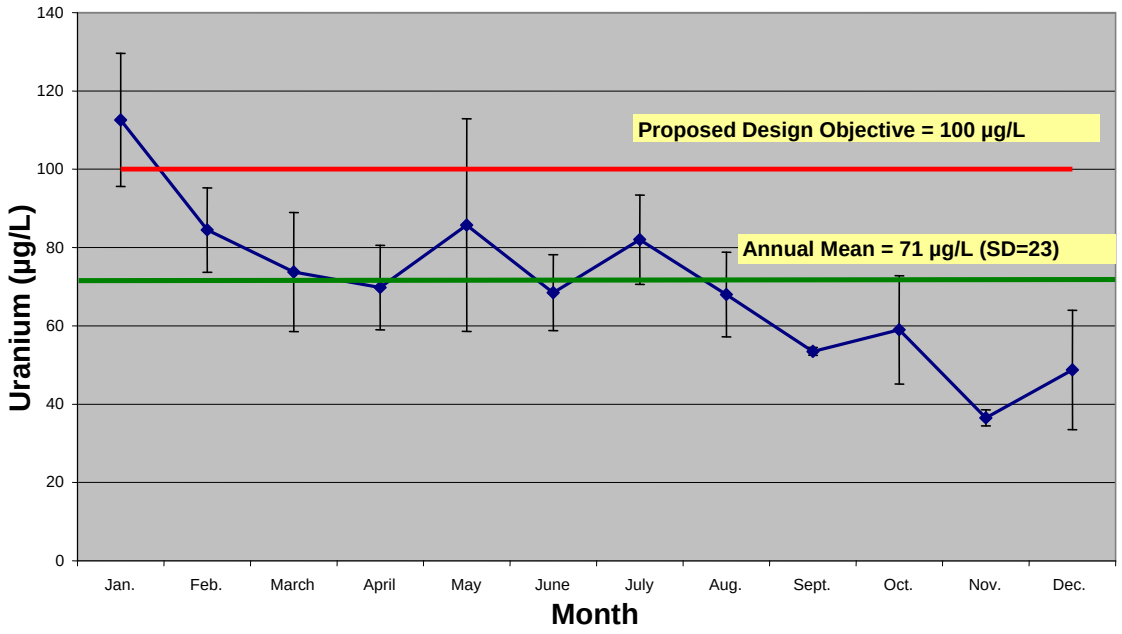
The risk management strategy outlined in the Annex required control measures to be installed and commissioned by May 2007. This was achieved with installation of the core treatment modifications and procedures in December 2006, and commissioning completed in the first quarter of 2007. Details of the modifications are provided in the following documentation:

- Uranium Reduction in the Rabbit Lake Effluent - Change Management. 2006 (Ref. 7).
- Uranium Reduction in the Rabbit Lake Effluent Project – AGTMF South Dam Seepage Collection System Design 2006 (Ref. 8)

- Uranium Reduction in the Rabbit Lake Effluent As-Built Report for the Uranium Reduction Phase, 2007 (Ref. 9).

With the completion of the first pilot plant investigations, it was proposed that a treatment objective of 100 µg/L was achievable. This represents a five-fold reduction in effluent release concentrations, relative to the pre-project baseline. CNSC staff completed a verification of performance, using the 2007 dataset to assess performance under a wide range of seasonal influences. The results are summarized in Figure 2. Once initial system difficulties were overcome in January, effluent quality with respect to uranium has been better than the objective, and continued to follow a downward trend as the year progressed.

Figure 2. Effluent Uranium Concentrations for First Full Year of Treatment (2007).



Compared to the pre-project 10-year baseline of approximately 500 µg/L, the 2007 annual mean of 70 µg/L represents a reduction of 86%. A substantial reduction in the total load of uranium released to the environment was also achieved. For example, between 2000 and 2002, 1.5 to 3 metric tonnes of uranium per year were being released to the environment, with a 10-year pre-project annual mean of approximately 1.7 metric tonnes. In 2007, the number dramatically declined to only 278 kg, a reduction of 81% to 91% relative to the 2000 to 2002 data, and a reduction of 85% relative to the 10 year pre-

project baseline. This marks a substantial reduction, especially considering that 2007 had the highest volume of waste water processing since 2000.

It is evident from the 2007 commissioning period that the core modifications to the minewater treatment system and the above ground tailings management facility (AGTMF) waste waters have been successful in decreasing uranium effluent concentrations and total loadings to the environment. Further improvements to uranium waste waters are expected, with upcoming modifications involving pre-treatment of specific waste streams. The use of membrane filtration procedures for pre-treatment will also reduce concentrations for a wide range of contaminants in addition to uranium.

The uranium reduction project also provided the opportunity to investigate the behaviour of other contaminants of interest in the effluent, in order to identify potential performance improvements beyond those related to uranium. This work resulted in additional activities related to reducing releases of molybdenum and selenium, as outlined in the following reports:

- Uranium Reduction in the Rabbit Lake Effluent Supplementary Report-Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2006 (Ref. 10)
- Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2007 (Ref. 11)

This work has already resulted in CNSC approval for modifications expected to substantially reduce molybdenum concentrations and loadings in the effluent. Additional studies and improvements are underway, with the expectation of further reducing overall contaminant concentrations. As these do not relate directly to the management of uranium, they are not addressed in detail within this report.

The risk management objectives within the Annex to the MOU related to the Rabbit Lake Operation were achieved within the required timeline through CNSC regulatory actions (e.g., licence condition) and engagement with the operator. Substantial reductions were made in uranium effluent concentrations and total load to the environment. Further reductions in uranium and other contaminant constituents are expected, as part of Cameco's continuous improvement commitments within its Environmental Management System. With the 2008 licence renewal the treated mill effluent Code of Practice was updated to reflect the improved uranium in effluent performance. The monitoring of uranium in effluent and the receiving environment will continue to be basic core requirements within the facility's licensed environmental monitoring program.

II-1.2. Key Lake Operation

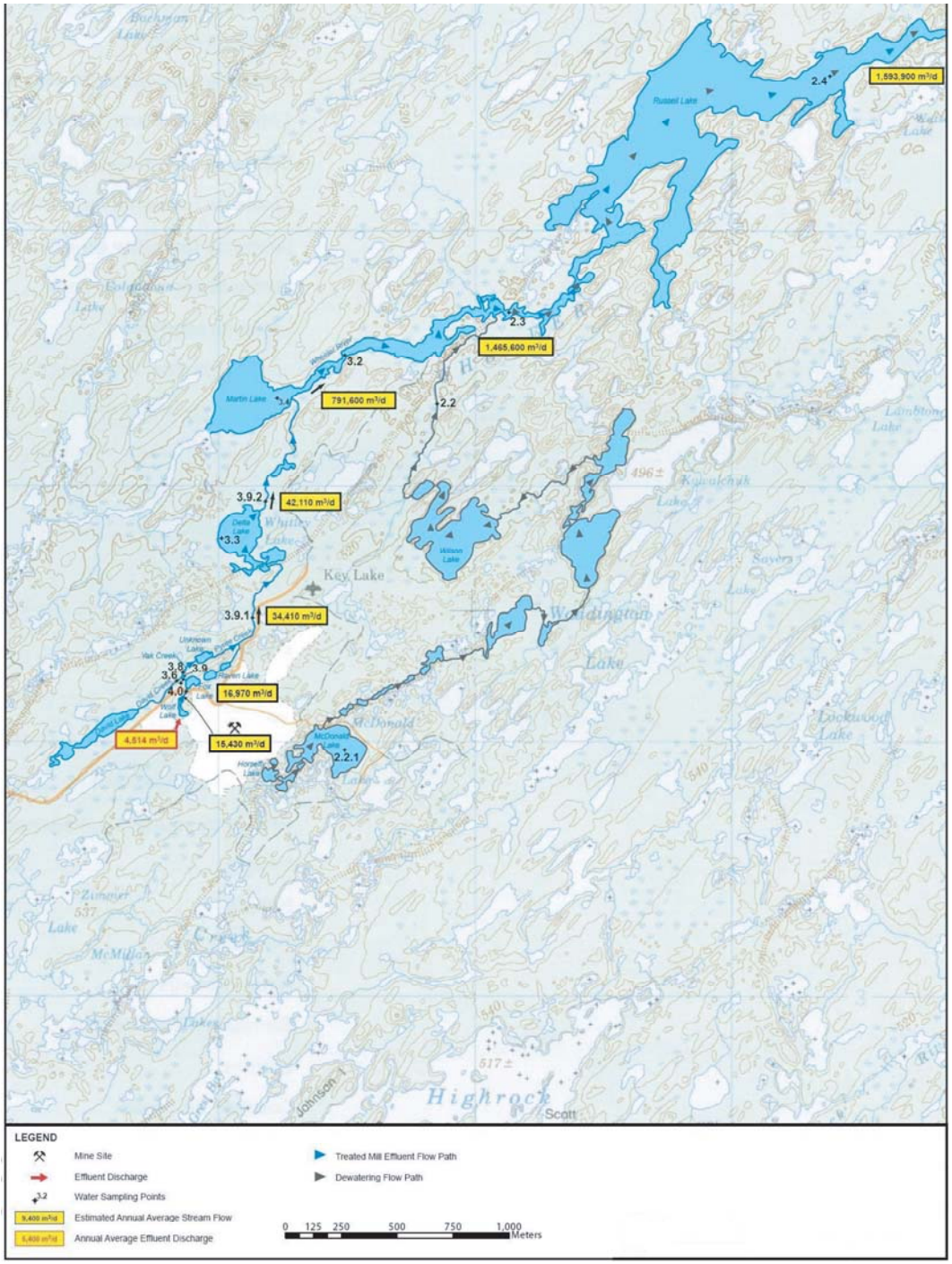
The Key Lake milling operation is located in north-central Saskatchewan, approximately 70 km east-southeast of Cree Lake (see Figure 1). Mining at Key Lake ceased in 1997, with the milling of Key Lake ore continuing into 1998/99. In 2000, Key Lake commenced milling ore from the nearby McArthur River underground mine. Specific Annex requirements relating to the Key Lake Operation are as follows:

"*In the case of the Key Lake mine/mill, […] Commission Staff will verify that effluent management improvements and the treatment facilities that have been installed are effective and that the effluent is no longer causing significant toxicity."*

The requirements of this portion of the Annex have been and continue to be successfully achieved. The CNSC provided EC with a report in August 2007 that demonstrated the completion of this Annex requirement within the designated timeframe. A summary of this report is provided here, with the complete report provided in Appendix C.

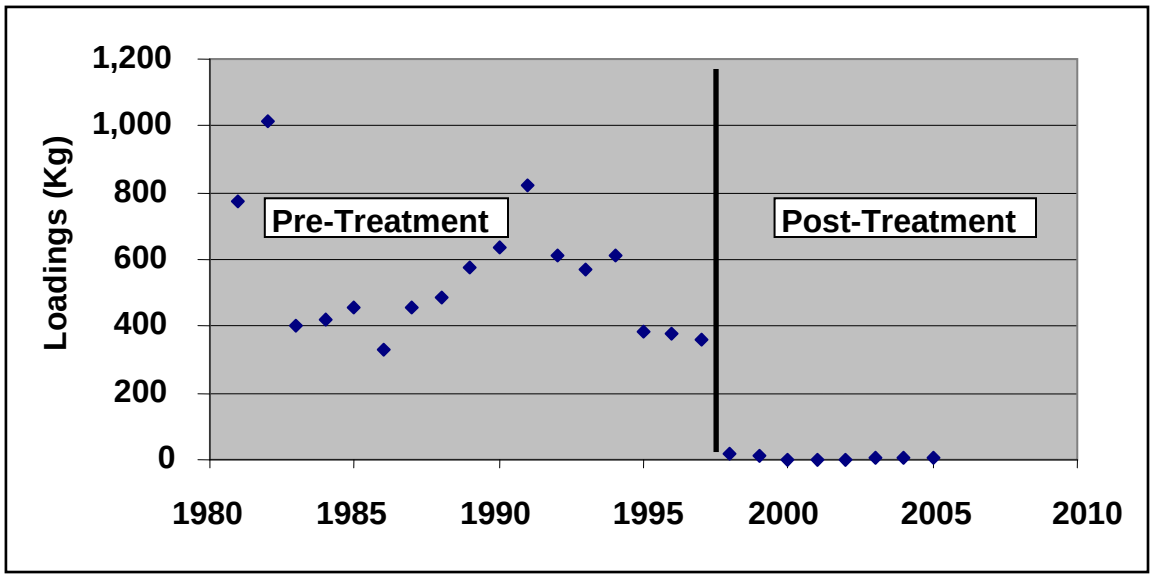
The Key Lake operation has two primary release points to the aquatic environment: the treated mill effluent, released to the David Creek drainage and the treated dewatering water (groundwater), released to Horsefly Lake through the McDonald Lake drainage (see Figure 3). Before the late 1990s, the dewatering water from the pumping wells surrounding the pits was discharged directly to the environment at Horsefly Lake, via the McDonald Lake drainage. Concern over rising concentrations of nickel led to the construction and operation of a reverse osmosis (RO) treatment system for dewatering flows, in 1996/97. While the RO plant was required to address nickel concerns, it has provided the added benefit of substantially decreasing all metal releases in the dewatering water.

Figure 3. Treated effluent and dewatering water release points and flow paths for the Key Lake Operation



The information in the submitted report (see Appendix C) verified the successful commissioning and operation of the RO treatment plant. This plant has operated with an average removal efficiency[2] of 97%, preventing the release of over 2,500 kg of uranium to the receiving environment. The analysis of the historical dataset indicates that, out of the total number of kg of dewatering water uranium discharged to the McDonald drainage since 1982 (estimated at 9,330 Kg), over 90% was released during the pre-treatment period. Since the introduction of the RO plant, the mean annual load has decreased by more than 90%, with a 99% reduction relative to the pre-treatment period occurring over the last eight years (1999-2006), after the initial commissioning difficulties of 1997-1998 were overcome. Hence, the RO plant has been very successful in decreasing uranium releases to the environment, as demonstrated in Figure 4:

Figure 4. Dewatering water annual uranium loadings (kg).



The reduction in uranium effluent concentrations and loadings has resulted in substantial decrease in receiving environment concentrations, insofar that direct water exposure does not pose a risk to biota. Before installing the RO treatment plant, uranium water concentrations in Horsefly Lake posed a year-round risk to biota, with concentrations in Little McDonald Lake posing a periodic risk during periods of low flow such as ice-covered seasons. With the RO plant, uranium water concentrations no longer pose a

[2] Removal efficiency is based on the concentration of uranium in the clean water released from the RO plant to the environment relative to the concentration in the dirty waste stream entering the RO plant.

direct risk to biota, even in the first receiving waterbody (Horsefly Lake). A detailed presentation of this appears in Appendix C.

The Annex to the MOU further stated that *"Environmental performance objectives identified in the preventive or control measures will be based on implementation of all reasonable precautions to control the release of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment as a result of a Commission-licensed activity."*

This requirement for performance objectives has been achieved through incorporating uranium into the Code of Practice for the dewatering treatment system. Performance objectives, in the form of administrative and action levels, will ensure that the RO treatment system's performance is tracked and managed to minimize releases and prevent loss of control.

An administrative level represents a concentration that indicates effluent quality is approaching the upper range of concentrations expected under normal operating conditions. Action levels are defined as a specific concentration that, if reached, may indicate a loss of control. If administrative or action levels are exceeded, specifically defined activities documented in the Code of Practice must be implemented to return effluent performance to previous norms. The exceedance of an administrative level, and the procedures implemented as a result, must be documented in the facilities' records for non-conformances within their Environmental Management System. Exceedance of an action level must be officially reported to the CNSC within 24 hours, with immediate investigation and implementation of actions to return the effluent back to a state of control. Follow-up reporting is required and regulatory oversight continues until the treatment performance can be demonstrated to be back under control.

The RO plant results in uranium concentrations at or near the analytical detection limit hampering the use of statistical procedures for developing Administrative and Action Levels. Instead a value of 20 µg/L was selected as this produces receiving environment concentrations that do not pose a risk to aquatic biota and is equivalent to the Canadian drinking water guideline for uranium. The Administrative level is triggered if the weekly sample exceeds 20 µg/L, with the Action Level triggered if the 7-day sampling mean exceeds 20 µg/L. Details on the Administrative and Action Levels including the steps to be taken should they be exceeded are provided in Appendix C.

In addition, receiving environment monitoring programs are in place, and have been expanded to ensure that the confirmed improvements in the treatment of uranium in the dewatering water are also reflected in the receiving environment. The design of these programs has been approved by the CNSC and other relevant regulatory bodies (for

example Saskatchewan Ministry of Environment), and the results are reported to both the CNSC and the province of Saskatchewan for review.

The risk management objectives in the Annex to the MOU related to the Key Lake Operation have been achieved within the required timeline. The RO treatment plant's effectiveness at removing uranium has been confirmed. The operation of the RO plant has resulted in receiving environment water concentrations which do not pose a direct exposure risk to biota. The requirement for performance objectives has been achieved through the incorporation of uranium into the Code of Practice for the dewatering treatment system. The monitoring of uranium in effluent and the receiving environment will continue to be basic core requirements within the facility's licensed environmental monitoring program.

II-1.3. Cluff Lake Operation

The Cluff Lake Operation is located in northern Saskatchewan, approximately 75 km south of Lake Athabasca, and 15 km east of the provincial border with Alberta (see Figure 1).

The Annex requirements relating to the Cluff Lake Operation are as follows:

> *"In the case of the Cluff Lake mine/mill, the mine/mill has ceased operations and was granted a decommissioning license for a five-year term, valid until July 31, 2009. The Cluff Lake mine/mill is, therefore, not subject to immediate risk management measures."*

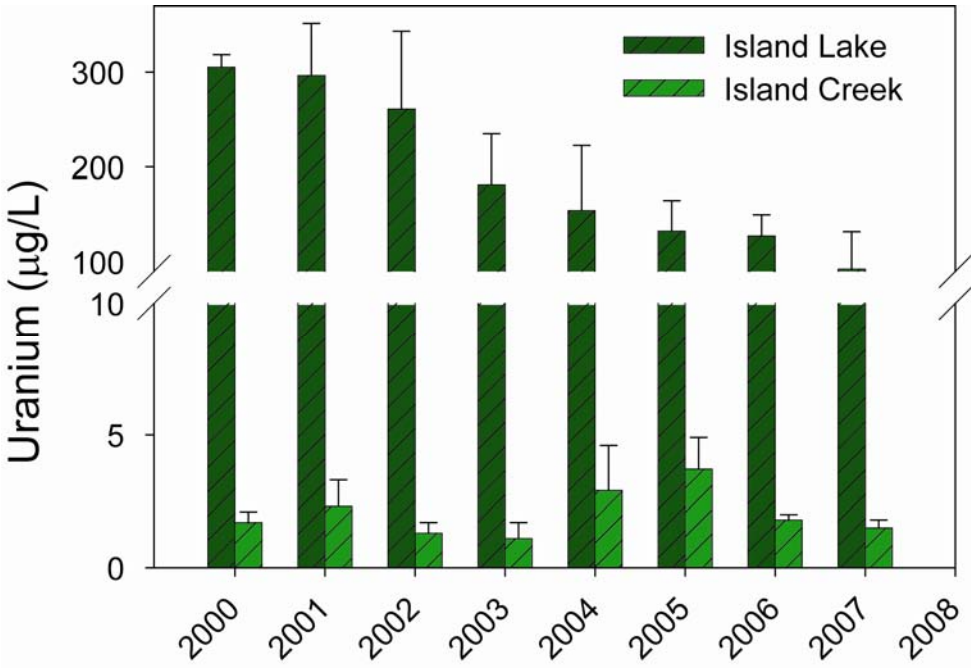
While the Cluff Lake Operation is not subject to immediate uranium risk management measures, the CNSC continues to monitor environmental performance as part of the present decommissioning licence. The licence requires the monitoring of potential impacts associated with the decommissioning activities, and long-term environmental monitoring (to assess the success of the decommissioning activities and the recovery of any impacted systems). In addition, an extensive follow-up program has been implemented to verify modeling parameters and predictions in order to meet the requirements of the NSCA and the Canadian Environmental Assessment Act. (CEAA). The results of this program are reviewed by CNSC staff on an ongoing basis, with extensive remodelling planned for 2009 based on the data from the follow-up programs.

The last of the Cluff Lake ore was processed in December 2002, after which the mill was shut down and decommissioned. The primary treatment system has not been used since 2003, and the secondary treatment plant was mothballed in October 2005. The operational monitoring program indicated that uranium concentrations were elevated in

Island Lake, the first water body receiving treated effluent (see Figure 5). Reductions in Island Lake uranium concentrations are evident, commencing with the cessation of milling, and have continued as releases of treated waters have declined. The 2007 Island Lake concentration (97 µg/L) represents a 67% reduction compared to the average for the last 3 years of operation (i.e., 288 µg/L).

Operational monitoring demonstrated that water quality immediately downstream of Island Lake was not substantially influenced by effluent releases due to the presence of a large fen at the outflow of Island Lake. Uranium concentrations downstream, in Island Creek, have consistently been 98% to 99% lower than those in Island Lake, with an annual mean of 1.5 µg/L (SD=0.3).

Figure 5. Surface water annual average concentrations.



Decommissioning, monitoring and follow-up activities continue at the site. Extensive re-assessment of decommissioning activities, along with environmental performance and predictive modeling, will be completed prior to the relicensing in 2009.

II-2. Environmental Emergency Plans

A portion of the Annex to the MOU specifically refers to Environmental Emergency Plans, stating:

"Preventative or control measures will include an environmental emergency plan to prevent or mitigate the effects of accidental releases of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment."

An environmental emergency plan, under CEPA, is defined as:
"a plan respecting the prevention of, response to and recovery from an environmental emergency in respect of a substance."

As indicated by the definition, and as outlined in Environment Canada's implementation guideline for the development of emergency response plans (Ref. 13), four main elements are considered essential:

- prevention,
- preparedness,
- response; and
- recovery.

To determine whether the Annex requirement for emergency response plans is already addressed by regulatory expectations for uranium mines and mills, a review of emergency planning expectations was completed. Uranium mines and mills are required to have emergency response plans under both the *Nuclear Safety and Control Act* and associated Regulations, as well as under Environment Canada's Metal Mining Effluent Regulations. These existing regulatory requirements and expectations were reviewed to see if the above mentioned four key elements were addressed.

Nuclear facilities operating in Canada must meet extensive regulations associated with environmental protection, including the need for emergency response plans. Both the *Class I Nuclear Facilities Regulations* (Section 6k) and the *Uranium Mines and Mills Regulations* (Sections 3c(x)) require licensees to have submitted and approved documentation containing:

"… the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to

- *assist off-site authorities in planning and preparing to limit the adverse effects of an accidental release,*
- *notify off-site authorities of an accidental release or the imminence of an accidental release,*
- *report information to off-site authorities during and after an accidental release,*

- *assist off-site authorities in dealing with the adverse effects of an accidental release, and*
- *test the implementation of the measures to control the adverse effects of an accidental release […]"*

CNSC document G-225 (*Emergency Planning at Class I Nuclear Facilities and Uranium Mines and Mills*, Ref. 12) provides licensees guidance on the requirements for emergency response planning. The core elements, required and reviewed by CNSC staff for adequacy in an emergency response plan for CNSC licensees, are:

- documentation of the emergency plan,
- basis for emergency planning,
- personnel selection and qualification,
- emergency preparedness and response organizations,
- staffing levels,
- emergency training, drills and exercises,
- emergency facilities and equipment,
- emergency procedures,
- assessment of emergency response capability,
- assessment of accidents,
- activation and termination of emergency responses,
- protection of facility personnel and equipment,
- interface with off-site organizations,
- recovery program,
- public information program, and
- public education program.

Uranium mines and mills are also required to have emergency response plans under the Metal Mining Effluent Regulations (MMER). Section 30 of the MMER outlines expectations for Emergency Response Plans as follows:

1) The owner or operator of a mine shall prepare an emergency response plan that describes the measures to be taken in respect of a deleterious substance within the meaning of subsection 34(1) of the Act to prevent any deposit out of the normal course of events of such a substance or to mitigate the effects of such a deposit.
2) The emergency response plan shall include the following elements:
    a. the identification of any deposit out of the normal course of events that can reasonably be expected to result in damage or danger to fish habitat or

fish or the use by man of fish, and the identification of the damage or danger;

b. a description of the measures to be used to prevent, prepare for and respond to a deposit identified under paragraph (a);
c. a list of the individuals who are to implement the plan in the event of a deposit out of the normal course of events, and a description of their roles and responsibilities;
d. the identification of the emergency response training required for each of the individuals listed under paragraph (c);
e. a list of the emergency response equipment included as part of the plan, and the equipment's location; and
f. alerting and notification procedures including the measures to be taken to notify members of the public who may be adversely affected by a deposit identified under paragraph (a).

3) The owner or operator shall complete the emergency response plan and have it available for inspection no later than 60 days after the mine becomes subject to this section.
4) the owner or operator shall update and test the emergency response plan at least once each year to ensure that the plan continues to meet the requirements of subsections (2).
5) If a mine has not been subject to the requirements of this section for more than one year, a new emergency response plan shall be prepared and completed no later than 60 days after the day on which the mine again becomes subject to this section.

It is clear from the above review of NSCA and MMER requirements/expectations that the four main elements for CEPA environmental emergency response plans (prevention, preparedness, response and recovery) are incorporated into the present regulatory requirements of uranium mines and mills. The *Class I Nuclear Facilities Regulations* and *Uranium Mines and Mills Regulations* meet and in certain instances exceed CEPA requirements. Similarly, the MMER requirements are also comparable to those provided within the EC implementation guideline. As part of routine CNSC regulatory activities, CNSC project officers and emergency response specialists have completed desk top reviews of the emergency response plans for each of the facilities identified in the Annex. In addition, on-site inspections and audits have been completed, and CNSC staff has overseen and participated in emergency response exercises. Since the 2002 promulgation of the MMER, Environment Canada staff (Regina) have completed on-site inspections of the emergency response programs at the Saskatchewan uranium mines, and found them to conform with MMER expectations.

II-3. CNSC and EC Risk Management Meetings

The Annex states that:

> *"The Department and Commission staff will meet annually or more frequently by mutual consent to assess progress on the implementation of this Annex and on the effectiveness of the control measures to reduce the effluent toxicity of the above-mentioned facilities."*

CNSC staff (from the Directorate of Environmental and Radiation Protection and Assessment) and EC staff (from the Environmental Protection Operations Division, Ontario) meet formally at least once a year. At these meetings, any issues relating to the Annex to the Memorandum of Understanding are being addressed. In addition, numerous other activities related to sharing regulatory and technical expertise are coordinated. The 2007 meeting occurred at CNSC headquarters, on March 20.

These meetings have also served as an ideal venue for the coordination of additional cooperative activities not specific to the Annex. In 2007, routine coordinated regulatory activities continued with respect to CNSC licensees and cooperation with the Canadian Environmental Assessment Agency. Additional special activities in 2007 included:

- participation in the National Metal Mining Environmental Effects Review Team;
- participation within the Technical Advisory Panels for each of the uranium mine environmental effects programs associated with the metal mining effluent regulations; and
- the provision of technical support and information to the Canadian Council of Ministers of the Environment, for the development of a national uranium water quality guideline.

CNSC staff approached the Saskatchewan Northern Mines Monitoring Secretariat (NMMS), requesting permission to participate in their scheduled meeting, as a means to inform and consult with the Environmental Quality Committees[3] (EQCs) associated with each of these sites. The EQCs are comprised of representatives from "impact communities" (municipal and First Nations) associated with each of the uranium mining and/or milling operations in Northern Saskatchewan. A presentation and discussion, focused on the information related to the site-specific activities within this report, occurred on May 26, 2008.

[3] http://www.northern.gov.sk.ca/Default.aspx?DN=24bdced4-dad1-4104-80ce-c766bbea8b42

CONCLUSION and FUTURE ACTIVITIES

To minimize regulatory duplication and use government resources more effectively, EC and the CNSC developed and signed a MOU, wherein the parties agreed to consult and cooperate with respect to the overall regulation of nuclear facilities in Canada. With the determination that uranium releases from uranium mines and mills were CEPA toxic, it was decided that the most appropriate regulatory approach to meeting the required CEPA risk management activities were the NSCA, its associated regulations, licenses, licence conditions and public licensing process. This decision was formalized in an Annex to the MOU that addressed the risk management of uranium released to the environment from uranium mining and milling facilities. The Annex identified specific risk management activities for each of the facilities associated with the conclusion of CEPA toxicity, and required the production of an annual report outlining the progress of risk management activities. This document is the first of such reports.

All required risk management activities associated with the Annex have been completed on schedule. This includes the completion of a view of national and international uranium treatment technologies and a review of environmental emergency plan requirements for uranium mines and mills. Appropriate treatment technologies were identified and implemented for the Rabbit Lake Operation. The performance of the dewatering water treatment system at the Key Lake operation was reviewed, to demonstrate the successful management of uranium within these waters and the resultant improvement in downstream water quality. The gradual recovery of the downstream waterbodies at the Cluff Lake Operation, following the decommissioning of the mill and treatment system, was also presented.

With the completion of the site-specific activities identified in the Annex, the focus for future activities will shift to the generic management of uranium within the broader nuclear fuel cycle. Overall control of uranium emissions involves the prevention of unplanned or uncontrolled releases and the minimization of controlled releases.

The prevention of accidental or uncontrolled releases involves facility designs incorporating engineered controls and barriers, and administrative procedures such as preventative maintenance programs, documentation and training on operating procedures. Thus, one of the risk management activities to be initiated in 2008 will involve site-specific reviews of facility design and management practices, focusing on uranium solutions and mixtures, to ensure Best Practices are being implemented by CNSC licensees.

The second risk management initiative, commencing in 2008, will focus on controlled releases of uranium from CNSC licenced waste management facilities. CNSC staff reviews indicate that present licensed facilities are not releasing uranium in effluent that would pose an unreasonable risk to the environment. However, licensees are further expected to "take all reasonable precautions to control releases" and to keep all releases (including hazardous substances) ALARA (As Low As Reasonably Achievable). As available treatment technologies are being continuously developed, it is necessary to periodically review present practices to ensure that facilities continue to utilise modern Best Practicable Technologies (BPT). Thus, site-specific assessments on uranium-bearing effluents and associated treatment practices for waste management facilities will continue to be reassessed as changes or opportunities for improvement arise to determine whether treatment practices meet present day expectations of BPT.

In summary, the risk management activities moving forward in 2008 are:

- Ongoing assessments of facility design and management practices, specifically associated with the handling of uranium solutions and mixtures, to ensure that Best Practices remain in place, or can be identified as early as practical.
- Continued assessments of uranium effluent concentrations and present treatment practices at waste management facilities, to confirm that treatment activities continue to meet present day expectations of BPT.

GLOSSARY

ALARA (As Low As Reasonably Achievable)	Every reasonable effort to maintain exposures as far below the regulated dose limits as practical, taking into account the state of technology; economics of improvements in relation to the state of technology; economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations; and in relation to the use of nuclear energy and licensed material in the public interest.
Code of Practice: Effluent	An administrative framework applied to identify when effluent quality is deteriorating, indicating the potential loss of treatment control. Effluent contaminant concentrations are identified and, if exceeded, require the operator to perform specific actions (as documented in the Code of Practice) to decrease contaminant concentrations. The Code of Practice identifies specific treatment plant actions as well as reporting requirements to the CNSC.
µg/L (micrograms per litre)	A concentration measurement which describes the quantity of a substance within a liquid media. 1µg/L is the same as one part per billion (1 ppb), meaning there would be 1 g of uranium distributed in 1 billion litres of water.
Biota	All living organisms, including humans
CEPA toxic	Substance determined to be toxic as defined under the *Canadian Environmental Protection Act* (CEPA 1999) *"A substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that* *(*a*) have or may have an immediate or long-term harmful effect on the environment or its biological diversity;* *(*b*) constitute or may constitute a danger to the environment on which life depends; or* *(*c*) constitute or may constitute a danger in Canada to human life or health."*

Chemical speciation	A process which determines the chemical form(s) of a substance (that is, changes to oxidation state, chemical structure, or isotopic composition). The composition of chemical forms (speciation) of a substance is dependent upon the physical and chemical conditions of the system (for example, pH, temperature, etc.). The speciation or chemical form of an element greatly influences the way it behaves within a treatment plant or in the environment.
Class I nuclear facility	These facilities include the following: • nuclear fission or fusion reactors, and vehicles equipped with reactors • particle accelerators • uranium, thorium or plutonium processing and product manufacturing plants • disposal facilities for nuclear substances generated at another nuclear facility
Commissioning	The process during which systems and components of facilities and activities, having been constructed, are made operational and verified to be in accordance with design specifications and to have met the required performance criteria. Commissioning may include both non-radioactive and radioactive testing.
Decommissioning	Administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility. This does not apply to a repository or to certain nuclear facilities used for mining and milling of radioactive materials, for which closure is used.
Deleterious substances	A substance is deleterious if it is harmful to fish, if it limits the use of fish by humans (for example contamination of fish by dioxins or shellfish by *E. coli*), or if by going through some process of degradation, it harms the water quality (for example, oxygen-depleting wastes). A substance is also deleterious if it exceeds a level prescribed by regulation. Some examples of substances that can kill fish are: o pesticides; o petroleum products; o concrete wash-water;

	o chlorinated water (e.g. from swimming pools); cleaning supplies like bleach and detergents; o wood preservatives; o heavy metals. Other substances can cause conditions that are lethal to fish. For example, when animal manure or other organic material like food processing wastes decompose, they can deplete the dissolved oxygen in the water, and in so doing suffocate fish and other aquatic organisms. Yet other substances, or non-acutely lethal levels of the above substances, can also be considered deleterious if, for instance, they impair a fish's ability to reproduce, to capture its food, to make the transition from freshwater to the sea, or if they cause a fish to be more susceptible to disease or predation.
Dewatering water	Groundwater intercepted by pumps to prevent it from flowing into open pits or into the underground workings of a mine.
Effluent	The waste stream (in particulate, gaseous, or liquid form) from a facility released into the environment.
Ion exchange process	A usually reversible exchange of one ion with another, either on a solid surface, or within a lattice. A commonly used method for treatment of liquid waste.
Loadings	A quantity of a substance (for example, water, sediment, nutrients, pollutants, etc.) introduced into a receiving media. Loading may be from humans (for example, pollutant loading) or natural (for example, natural background loading) sources, and is typically described as the mass (of introduced substance) per unit volume air or water (the receiving media). Liquid effluent loadings are calculated by multiplying the concentration of a contaminant in the effluent by the volume of effluent released. For example, releasing 20,000 L of effluent containing 1 µg/L of uranium results in the release of 20 g of

	uranium to the environment; hence, the loading to the environmental system in this case is 20g.
Mass balance analyses	A scientific approach that studies the sources, movement, and destination of any substance, such as a contaminant, within a system. The system may be an artificial one such as a treatment plant or a natural system such as a lake. For example, a mass balance budget for a particular pollutant is the amount that enters a lake minus the amount that is tied-up in the sediment, broken down by chemical or biological processes, or removed by some other means. This should equal the amount that flows out of the lake system. This exercise enables scientists to assess the possible long-term effects of a pollutant and possible remediation actions.
Memorandum of Understanding (MOU)	A document describing a bilateral or multilateral agreement between parties. It expresses a convergence of will between the parties, indicating an intended common line of action.
Modelling parameters	Numerical values used to characterize properties of contaminants (for example, octanol-water partitioning coefficient) and environmental media (for example, organic matter fraction of soil) that are used in models to predict the environmental fate and transport of contaminants for the environmental risk assessment.
Molybdenum (Mo)	Metallic chemical element. Trace element commonly present in soil and pasture grasses. Excess amounts can be toxic in animals.
Northern Mines Monitoring Secretariat (NMMS)	A Saskatchewan government inter-ministerial committee chaired by Northern Affairs that is dedicated to informing northerners about Saskatchewan's uranium mining industry. The NMMS includes several provincial ministries which regulate and/or support the uranium industry, and also the federal Canadian Nuclear Safety Commission. The NMMS has a small staff complement based within Northern Affairs in La Ronge. The staff's mission is to help the Environmental Quality Committee (EQC) members understand uranium mining and to assist the EQC in making informed comments about the industry.

Precipitation pond	A precipitation pond retains treated water allowing increased time for chemical reactions to occur between treatment agents and contaminants resulting in the "precipitation" or settling of solids and associated contaminants from the water column.
Priority Substances Lists (PSL1 and PSL2)	The Priority Substances Lists (PSL1 and PSL2) were established by the Ministers of the Environment and of Health. They identify substances to be assessed on a priority basis to determine whether they are toxic (as defined under Section 64 of the CEPA) and pose a risk to the health of Canadians or to the environment.
radionuclide	A nucleus (of an atom) that possesses properties of spontaneous disintegration (radioactivity). Nuclei are distinguished by their mass and atomic number.
Reverse osmosis	Movement of a solvent out of a solution under pressure through a semi-permeable membrane into pure solvent or a less concentrated solution at lower pressure. This process can be used to increase the radionuclide concentration in a solution.
Selenium (Se)	Non-metallic chemical element commonly present in rocks and soil. Se is an essential nutrient, but can be toxic when present at concentrations exceeding nutritional requirements.

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APPENDIX A

Copy of the Memorandum of Understanding and Associated Annex

Note: Digital version available at http://www.ec.gc.ca/Toxics/docs/substances/RN/EN/mou.cfm

APPENDIX A: Memorandum of Understanding (MOU) Between the Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC)

WHEREAS the Canadian Nuclear Safety Commission (hereinafter, "the Commission") and Environment Canada (hereinafter, "the Department") have independent but related mandates in regard to the protection of the environment and activities carried out under their respective mandates have the potential to affect the programs and responsibilities of the other;

WHEREAS the Regulatory Policy[1] of the Government of Canada requires that federal departments and agencies take full advantage of opportunities to coordinate their activities with each other;

WHEREAS the Commission regulates, pursuant to the *Nuclear Safety and Control Act* (NSCA), the development, production and use of nuclear energy and the production and use of nuclear substances, prescribed equipment and prescribed information in order to:

i. prevent unreasonable risk to the environment and to the health and safety of persons,
ii. prevent unreasonable risk to national security and
iii. achieve conformity with measures of control and international obligations to which Canada has agreed;

WHEREAS the Department under the *Department of the Environment Act* has powers, duties and functions relating to the preservation and enhancement of the quality of the natural environment, including water, air and soil quality; renewable resources, including migratory birds and other non-domestic flora and fauna; water; meteorology; the enforcement of rules and regulations arising from the advice of the International Joint Commission relating to boundary waters and questions arising between the United States and Canada in so far as they relate to the preservation and enhancement of environmental quality;

WHEREAS the Department regulates, pursuant to the *Canadian Environmental Protection Act* (CEPA, 1999), has the mandate to:

i. ensure that preventive and remedial measures are taken to protect the environment,
ii. establish nationally consistent levels of environmental quality,
iii. apply knowledge, science and technology to resolve environmental problems,
iv. protect the environment from the release of toxic substances, and

v. assess whether substances in use in Canada are toxic or capable of becoming toxic;

WHEREAS the Department has been assigned responsibility for the administration and enforcement of subsection 36(3) of the *Fisheries Act*, which deals with the deposit of deleterious substances into water frequented by fish;

THEREFORE, the Commission and the Department agree to consult and cooperate in accordance with the following sections of this Memorandum of Understanding in order to minimize regulatory duplication and to use government resources effectively.

I PRINCIPLES

1. The parties, in carrying out their respective mandates will cooperate and support each other, as appropriate, in meeting their responsibilities in relation to environmental conservation and protection and in other areas of mutual interest.

2. The parties will take all reasonable steps, consistent with their respective mandates, to see that their environmental protection policies and measures are complementary and designed to provide effective environmental protection.

3. The parties will provide each other the opportunity to advise on policies and programs that may affect the mandate of the other, in a manner that allows for timely and substantive advice.

4. The parties will foster strong working relations by establishing mechanisms and links to share information, taking into account legal constraints on the sharing of confidential business information.

II IMPLEMENTATION

The Department agrees to:

1. Inform and advise the Commission on the Department's current policies, programs, standards and regulations concerning the protection of the environment, and the management of toxic substances of concern to the Commission;

2. Provide the opportunity to the Commission to provide guidance, information and advice prior to developing, amending or terminating the policies, programs, standards or regulations referred to in the above paragraph that may affect the facilities and activities regulated by the Commission;

3. Cooperate with the Commission on regulatory matters of mutual concern involving the nuclear industry, including:
    a. developing and managing programs and processes for the implementation of obligations pursuant to the *Canadian Environmental Protection Act* (CEPA,1999), as they relate to facilities and activities regulated by the Commission;
    b. consulting with the Commission, on request, in the review of applications before the Commission, and where appropriate, providing advice on matters concerning the protection of the environment;
    c. promoting awareness among licensees of the Commission of the Department's mandated requirements;
    d. verifying compliance with the regulatory requirements of either the Commission or the Department;
    e. sharing environmental information
    f. informing the Commission of any review or investigation by the Department of a non-compliance incident under its jurisdiction that may have occurred at a facility regulated by the Commission; and where appropriate, consulting and coordinating with the Commission, prior to taking regulatory enforcement actions at facilities, or on activities licensed by the Commission;

4. Consult and cooperate with the Commission in the development of any national or international standard, agreement, convention, or commitment that could affect the regulation of the nuclear industry by the Commission;

5. Cooperate with the Commission in matters of mutual interest related to nuclear emergency preparedness and response;

6. Cooperate with the Commission on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of the nuclear industry, and in the sharing of expert assistance and financial resources for such purpose; and

7. Coordinate public communication and consultation activities with the Commission on matters of mutual interest and responsibility.

The Commission agrees to:

1. Inform and advise the Department on the Commission's current policies, programs, standards and regulations concerning the protection of the environment and the management of toxic substances in relation to nuclear facilities and activities;

2. Provide the opportunity to the Department to provide guidance, information and advice prior to developing, amending or terminating the policies, programs, standards or regulations referred to in the above paragraph that may involve the use, release or management of substances designated as toxic under CEPA, and other contaminants of mutual environmental concern;

3. Cooperate with the Department on joint regulatory matters concerning the nuclear industry, including:
    a. developing and managing programs and processes for the implementation of obligations pursuant to the Nuclear Safety and Control Act (NSCA), as they relate to facilities and activities regulated by the Department;
    b. providing the Department with the opportunity, on request and where appropriate, to review applications before the Commission and provide advice on matters concerning the protection of the environment;
    c. promoting awareness of the Department's requirements among licensees of the Commission ;
    d. verifying licensee compliance with the regulatory requirements of either the Commission or the Department;
    e. providing the Department with the opportunity, on request and where appropriate, to participate in joint compliance inspections of facilities and activities licensed by the Commission;
    f. sharing environmental information;
    g. informing the Department of any review or investigation by the Commission of a non-compliance incident under its jurisdiction that may involve substances designated as toxic under CEPA or other contaminants of mutual environmental concern; and where appropriate, consulting and coordinating with the Department, prior to taking regulatory enforcement actions involving the environment.

4. Consult and cooperate with the Department in the development of any national or international standards, agreements or conventions concerning the protection of the environment;

5. Cooperate with the Department in matters of mutual interest related to nuclear emergency preparedness and response;

6. Cooperate with the Department on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of nuclear facilities and activities, and in the sharing of expert assistance and financial resources in the conduct of these studies, assessments or research projects; and

7. Coordinate public communication and consultation activities with the Department on matters of mutual interest and responsibility.

III TERMS OF THE MOU

1. The primary points of contact under this MOU, and responsible for its administration, are the Vice-President, Operations Branch, CNSC, and the Regional Director General, Ontario Region, Environment Canada who will meet annually during the normal planning process.

2. The parties will make every reasonable effort to resolve at the working level any conflicts that arise from this Memorandum of Understanding. Failing resolution at

the working level, conflicts may be referred for resolution to the offices named pursuant to paragraph 1 above, or to the signatories to this Memorandum.

3. Subject to paragraph 4, the parties will provide or honour without charge to the other party the services agreed to and the commitments made in this Memorandum of Understanding.

4. The parties recognize that the delivery of certain services agreed to in this Memorandum of Understanding, or the honouring of certain commitments made in this Memorandum, may be subject to cost recovery regulations or may require, on a case by case basis, financial arrangements between the Commission and the Department to offset, in whole or part, the associated costs. Where such arrangements are necessary, the parties agree to consult and cooperate to develop mutually satisfactory arrangements

5. The parties agree to consult in advance concerning any significant changes in the level or nature of service that either party may request, or intends to request, of the other party pursuant to this Memorandum of Understanding.

6. The parties agree to collaborate on identifying opportunities for training and staff exchanges in areas of mutual interest.

7. This Memorandum of Understanding becomes effective on the date of the last signature, and shall remain in effect until modified or withdrawn. The Memorandum may be revised by the mutual consent of the Department and the Commission. Either party may withdraw from the agreement by providing at least six (6) months notice in writing to the other party, specifying its intention to withdraw and the effective date of withdrawal.

Signed in duplicate in the English and French languages.

Signed on: 23/09/03

For the Canadian Nuclear Safety Commission:

President

Signed on: 10/7/03

For Environment Canada:

Deputy Minister

Annex 1 to the Memorandum Of Understanding (MOU) Between Environment Canada And The Canadian Nuclear Safety Commission - Risk Management Process For Radionuclides As Assessed Under The *Canadian Environmental Protection Act, 1999*

Assessment of Radionuclides under the Canadian Environmental Protection Act, 1999

Pursuant to the provisions of the *Canadian Environmental Protection Act, 1999* (CEPA, 1999), Environment Canada (the Department) completed an assessment of releases of radionuclides from nuclear facilities, consisting of sectoral assessments for impacts on non-human biota.

The assessment concludes that uranium and uranium compounds contained in effluents from uranium mines and mills meet the environmental toxicity criteria set out in paragraph 64(*a*) of CEPA, 1999. The assessment recommends that the investigation of options to reduce exposure to uranium and uranium compounds contained in effluents from such facilities be considered a high priority.

Considerations / Principles for Cooperation

Pursuant to paragraph 3(*a*) under Section II (Implementation) of the MOU between the Department and the Canadian Nuclear Safety Commission (the Commission) and under the terms of this Annex, the Department and the Commission agree to develop and implement a program to reduce or control the exposure of non-human biota to uranium and uranium compounds contained in effluents from such facilities.

Under the *Nuclear Safety and Control Act* (NSCA), the Commission has the mandate to ensure that the operation of nuclear facilities, such as uranium mines and mills, does not pose unreasonable risks to the environment. The NSCA came into force on May 31, 2000. Environmental protection is integral to the new regulatory mandate, and the NSCA provides a broad range of regulatory powers respecting environmental protection.

It has been determined that it is possible to prevent or control the amount of uranium and uranium compounds released to the environment in effluents from uranium mines and mills under the NSCA. The Department and the Commission will work cooperatively to ensure preventive or control measures are developed and implemented in a manner that is consistent with and comparable to CEPA 1999.

It is on this basis, and to avoid regulatory duplication, that it has been recommended that the Minister of the Environment and the Minister of Health take no further action at this time, pursuant to subsection 77(6) of CEPA 1999. The Commission will develop preventive or control measures under the NSCA with support from the Department.

Nothing in this Annex modifies or restricts the mandate, responsibilities or authorities of the Minister of the Environment, of the Minister of Health or of the Canadian Nuclear Safety Commission.

Development of Preventive or Control Measures

The Commission will appoint a risk manager and initiate the process to develop preventive or control measures for releases of uranium and uranium compounds from specified uranium mines and mills where the effluent has been identified as likely to be causing harm to aquatic organisms, within three months of the date of the release of the final CEPA assessment report. These mines and mills include Rabbit Lake, Key Lake and Cluff Lake.

Commission staff will consult with stakeholders on the proposed preventive or control measures in a public process.

Commission staff will consult with the Department during the options review and approval process.

While developing the preventive or control measures under the NSCA, the Commission can utilize, depending on the circumstances, licence conditions, orders, or requests for analyses and modification of designs, equipment or procedures, to ensure that effluent releases are not likely to cause significant environmental harm.

Preventive or control measures will include an environmental emergency plan to prevent or mitigate the environmental effects of accidental releases of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment.

In the case of the Rabbit Lake mine/mill, a study of technical options to improve the quality of effluent of the mine/mill will be completed within 26 months of November 1 2003, which corresponds to the coming into force of the Rabbit Lake licence renewal. The design, installation and commissioning of the control measures will be completed within the following 16 months.

In the case of the Key Lake mine/mill, environmental performance objectives will be developed and implemented within 12 months of the date of release of the CEPA assessment report. Commission staff will verify that effluent management improvements and the treatment facilities that have been installed are effective and that the effluent is no longer causing significant toxicity.

Environmental performance objectives identified in the preventive or control measures will be based on implementation of all reasonable precautions to control the release of

uranium and uranium compounds in effluent within the site of the licensed activity and into the environment as a result of a Commission-licensed activity.

In the case of the Cluff Lake mine/mill, the mine/mill has ceased operations and was granted a decommissioning licence for a five-year term, valid until July 31, 2009. The Cluff Lake mine/mill is, therefore, not subject to immediate risk management measures.

The Commission will continue to ensure that uranium and uranium compounds contained in effluent from all nuclear facilities are not causing significant environmental harm.

The Department will identify a point of contact to coordinate assistance to the Commission.

The Department will assist the Commission through the provision of training and guidance documents, and/or the conduct of specific studies.

The Department and Commission staff will meet annually or more frequently by mutual consent to assess progress on the implementation of this Annex and on the effectiveness of the control measures to reduce the effluent toxicity of the above-mentioned facilities.

Releases of radionuclides from nuclear facilities will be regularly monitored by the Commission to evaluate whether risk management initiatives are needed for ionizing radiation. The Department and Commission staff will meet annually or more frequently by mutual consent to review and assess any new information related to the environmental risk from ionizing radiation and take action if necessary.

The Department and the Commission agree to prepare and make public a joint annual report outlining progress on the implementation of this Annex within six months after the end of the calendar year for which it is prepared. Signed in duplicate in the English and French languages.

Signed on: Dec 13, 2004

For the Canadian Nuclear Safety Commission:

President

Signed on: DEC 0 2 2004

For Environment Canada:

Deputy Minister

1. Government of Canada Regulatory Policy, 1999

APPENDIX B

Risk Management Activities at the Rabbit Lake Operation

Appendix B:
Summary Report on the Risk Management Activities Associated With the Reduction of Uranium in Effluent at the Rabbit Lake Operation, Saskatchewan

Related to the Memorandum of Understanding (MOU)
Between
Environment Canada and the Canadian Nuclear Safety Commission

Canadian Nuclear Safety Commission

April 2008

APPENDIX B: Summary Report on the Risk Management Activities Associated With the Reduction of Uranium in Effluent at the Rabbit Lake Operation, Saskatchewan

1.0 Introduction

The Priority Substance List Assessment Report on the Releases of Radionuclides from Nuclear Facilities (Impact on Non-human Biota) concluded that "releases of uranium and uranium compounds contained in effluent from uranium mines and mills are "toxic" as defined in Section 64 of the *Canadian Environmental Protection Act,* 1999 (CEPA 1999)". In order to avoid regulatory duplication, a Memorandum of Understanding between the Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC) was signed to manage this CEPA toxic substance (Appendix A). The Annex to this MOU identified specific risk management activities for each of the identified facilities associated with the conclusion of CEPA toxicity. This report addresses the risk management activities specifically associated with the release of treated effluent from Cameco Corporation's Rabbit Lake Operation in Northern Saskatchewan.

Annex 1 of the MOU identified facility specific requirements stating that:

"In the case of the Rabbit Lake mine/mill, a study of technical options to improve the quality of effluent of the mine/mill will be completed within 26 months of November 1 2003, which corresponds to the coming into force of the Rabbit Lake licence renewal. The design, installation and commissioning of the control measures will be completed within the following 16 months."

This report provides a summary of the documentation and reporting demonstrating completion of the Rabbit Lake Operation uranium risk management objectives. An analysis of effluent performance was completed by CNSC staff and is provided herein to demonstrate that the treatment plant modifications have been successful in substantially reducing concentrations and loadings of uranium and uranium compounds to the environment. Detailed technical information pertaining to the investigations and implementation of the identified treatment technologies and practices can be obtained from the original reports.

2.0 Reporting Timeline

The Annex to the MOU required that a study of technical options be completed within 26 months of November 1, 2003, which corresponds to January 1, 2006. This portion of the project, now identified as "Uranium Reduction in Effluent", was completed ahead of schedule, via a series of reports submitted by Cameco to the CNSC for review. These are identified below:

- Uranium Reduction in the Rabbit Lake Effluent Progress Report. 2004 (Ref. 1).
- Uranium Reduction in the Lake Effluent Interim Report. 2004 (Ref. 2).
- Uranium Reduction in the Rabbit Lake Effluent Final Report. 2005 (Ref. 3).

The risk management strategy required the installation and commissioning of the control measures be May 2007. Core treatment modifications and procedures were completed in December 2006 and commissioning was completed in the first quarter of 2007, Details of the modifications are provided in the following documentation:

- Uranium Reduction in the Rabbit Lake Effluent - Change Management. 2006 (Ref. 4).
- Uranium Reduction in the Rabbit Lake Effluent Project – AGTMF South Dam Seepage Collection System Design 2006 (Ref. 5)
- Uranium Reduction in the Rabbit Lake Effluent As-Built Report for the Uranium Reduction Phase, 2007 (Ref. 6).

The design objective of a monthly mean concentration of uranium in effluent below 100 µg/L was consistently achieved, once the initial start-up variability in January 2007 was addressed. Further information on effluent performance is provided in Section 5.0 of this report using the complete 2007 database to provide a performance assessment capturing the variability known to be associated with seasonal influence on uranium wastewater quality and quantity.

The behaviour of other effluent contaminants of interest was also investigated in order to identify potential performance improvements beyond those related to uranium. This work resulted in additional activities related to reducing releases of molybdenum and selenium, outlined in the following reports:

- Uranium Reduction in the Rabbit Lake Effluent Supplementary Report - Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2006 (Ref. 7)
- Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2007 (Ref. 8)

These reports do not relate directly to the management of uranium, therefore they are not addressed in detail in this report.

3.0 Rabbit Lake Mill and Treatment System History

The Rabbit Lake Operation is a uranium mining and milling facility located in northern Saskatchewan on the west side of Wollaston Lake, approximately 450 km north of La Ronge, Saskatchewan. Rabbit Lake is the oldest active uranium mining and milling operation in Canada, and therefore has numerous historical and operating wastewater sources. Construction commenced in 1972, with milling staring in 1975. Since 1975, the mill has processed material from five different ore bodies. Major modifications were made to the mill in the 1980s, to accommodate the more complex arsenic/nickel deposits being processed at that time. This required a change in the mill circuit from an ammonia stripping/precipitation system to the present system of acid stripping coupled with peroxide precipitation.

There have been two extended shutdown periods in Rabbit Lake's history: the first from July 1989 to July 1991, the second from June 2001 to September 2002. During the shutdown periods, the mill was operated in a care and maintenance mode. Currently, the mill is operated on a week-on-week-off basis. The water treatment plant operates on a continuous basis, which includes continuous release of the treated waters from Precipitation Pond #3 to the receiving environment. Unlike batch-release systems, this continuous operation precludes the testing and recycling of pond waters not meeting water quality expectations. Instead, effluent quality relies on monitoring throughout the process, to control reagent addition and precipitate removal effectiveness, as well as on the use of relatively large final settling and buffering ponds.

With the commencement of the Uranium Reduction in Effluent Project in 2003, a review of historical uranium in effluent concentration was completed, to establish a baseline to judge the performance of selected treatment options. To account for the influences of seasonality and the various shutdown periods, the baseline uranium concentrations were determined using the ten year dataset from 1992 to 2002. The annual mean uranium concentrations in the final treated effluent over this time period are provided in Table 1.

Table 1: The annual mean uranium concentration in the final treated effluent and annual load to the environment.

Year	Mean (µg/L)	Annual Load (kg)
1992	317.8	764
1993	287.6	608
1994	386.9	921
1995	727.1	1,700
1996	353.4	1,080
1997	820.7	2,930
1998	572.5	1,870
1999	690.1	2,478
2000	885.4	3,188
2001	874.8	2,444
2002	543.3	1,466
Ten Year Annual Mean	**587.2**	**1,768**

Over this ten year period, mean annual uranium concentrations have ranged from 287.6 to 885.4 µg/L. The uranium concentrations varied according to the specific ore bodies being processed, as well as seasonal weather effects. The high uranium in effluent years were characterized by a few very high release periods, rather than consistently elevated uranium concentrations throughout the year. The ten year annual mean of approximately[4] 500 µg/L was selected as the baseline for the performance assessment in the uranium reduction in effluent project (Ref. 1).

The total load of uranium (i.e. concentration times volume) to the environment is equally if not more important than effluent concentration. Over the ten year period preceding the uranium reduction project, the annual uranium load to the environment ranged from approximately 600 to 3,200 kg, with a ten year mean of approximately 1,700 kg.

[4] Note: Cameco determined project ten-year baseline by averaging annual means determined from monthly means (Ref. 1). Table 1 ten-year annual mean is the average of annual means determined calculated from the combined annual dataset rather than from monthly means.

4.0 Waste Water Treatment

The long operating history has resulted in a wide range of waste streams requiring treatment at the Rabbit Lake Operation. Treating this complex mix of waste streams can be a challenge. There are seven primary contaminant waste streams reporting to the water treatment circuit:

1. minewater and other waters, collected from Eagle Point mine and surrounding area;
2. flooded pit waters, wasterock seepage and surface runoff from B-Zone area;
3. flooded pit waters, wasterock seepage and surface runoff from D-Zone area;
4. raise waters, consisting of tailings porewater collected from the rock drain system of the Rabbit Lake In-pit Tailings Management Facility (RLITMF);
5. process waste streams (e.g., raffinate and barren strip solutions), from the mill circuit used to extract uranium;
6. seepage and surface waters, collected from the inactive Above Ground Tailings Management Facility (AGTMF); and
7. sewage, collected from the mining property.

The volume and contaminant compositions among these waste streams vary considerably. Volume and contaminant concentrations can also vary considerably within a specific waste stream, due to operational or seasonal influences. The Rabbit Lake water treatment system is further challenged by the operation of the mill circuit on a week-on-week-off basis.

The site specific characterization of uranium chemistry within the Rabbit Lake waste streams and the mill and water treatment plant, combined with the review of operations at other uranium mills and the scientific and professional literature, identified potential treatment options worthy of further investigation. Conventional precipitation processes were identified as the primary practical means of achieving substantial reduction in final effluent uranium concentrations. Options for pre-treating various waste streams prior to their entrance into the core water treatment system were also investigated, to further supplement treatment performance.

4.1. Core Water Treatment System: Conventional Precipitation

Investigations into precipitation processes were completed in two phases. Phase I involved laboratory scale batch tests and continuous flow tests, to characterize the behaviour of various constituents of effluent water under different chemical environments related to specific waste streams and/or treatment options. Phase II involved testing with larger scale continuous flow systems, using mill effluent and reagent feeds to confirm the applicability and sustainability of the findings from the modeling and laboratory testing.

The chemical characterization, geochemical modeling and laboratory scale testing, indentified carbonate, primarily in raise water, as the primary limiting factor in the efficiency of the present water treatment system. As such, the removal of carbonate and the use of the adsorption properties of ferric hydroxide were investigated in laboratory studies. The lessons learned in the laboratory bench scale tests were assessed in a scaled-up dynamic system, using a custom built pilot plant. The pilot plant testing identified the solid/liquid separation process as the overall controlling factor. Clarification system specialists were contracted, with the objective of identifying the equipment and configuration changes and operational parameters required for optimization of solid/liquid separation, leading to the lowest possible total suspended solids and uranium concentrations in the final effluent.

The pilot plant testing program indicated that the proposed plant modifications and improved operational control procedures of the circuit could successfully reduce the annual average final effluent concentration for total uranium to levels below 100 µg/L. The modifications and control procedures can be summarized in the following major categories:

- modifications to feed water conditioning;
- solution Pachuca modifications;
- solution recovery thickener (SRT) modifications;
- effluent control modifications to wastewater from the AGTMF.

4.2. Supplemental Treatment Options

Three alternative treatment technologies; membrane filtration, ion exchange and pre-treatment precipitation were further pursued as possible supplemental treatment activities for waste streams, prior to their entrance into the mine water precipitation treatment plant.

Membrane filtration technologies have the dual benefit of removing a wide range of impurities from waste streams, without the use of potentially toxic chemical reagents. Membrane filtration is a separation process, which uses a semi-permeable membrane to split a solution feed into two streams; a permeate that contains the purified water passed through the membrane, and a concentrate (reject) consisting of the components blocked by the membrane. The latter stream requires secondary treatment, usually through traditional precipitation technologies; however, these precipitation processes are usually more efficient on concentrated waste streams.

The feasibility of pre-treating certain waste streams was tested on raise water, minewater, SRT overflow, AGTMF barge water and AGTMF toe water. Laboratory bench results were promising for the raise water, minewater and AGTMF waste streams, with regard to uranium and a wide range of other contaminants. Waste streams with a high pH and high

in suspended solids resulted in membrane fouling and low recoveries, indicating that this technology was not suited to treating the SRT overflow. In general, the laboratory scale tests identified membrane filtration as a potential valuable supplement to the conventional precipitation treatment plant, meriting further investigations at the pilot scale level. These investigations are continuing.

Early laboratory investigations using ion exchange processes indicated these may be of use for pre-treatment of raise water. Additional investigations demonstrated reasonable effectiveness with respect to uranium removal; however, the removal of other contaminants ranged from poor (Mo) to negligible (e.g., As, Ni, radium-226). Therefore, it was concluded that ion exchange processes were not worth pursuing further, in light of the more positive results with the membrane filtration experiments.

The early mass balance investigations indicated that ponded surface water or toe drain water from the above ground tailings management facility (AGTMF), were a periodic source (e.g., during summer months) of high uranium concentrations. These waters were pumped directly to Precipitation Pond #1, thus bypassing the core of the minewater treatment facility. While waters from the precipitation ponds received further treatment (i.e., barium chloride for radium-226 removal and passage through sand filters), they did not receive treatments which would influence uranium concentrations. Hence, uranium from the AGTMF remained essentially untreated. Laboratory testing and field trials using ferric sulphate for the precipitation of uranium combined with barium chloride for radium-226 removal showed substantial reductions in both uranium and radium-226. Consequently, pumping and piping facilities were added or modified, to collect and pump AGTMF ponded waters and toe drain waters to the effluent treatment building, in order to be mixed with ferric sulphate prior to release to Precipitation Pond #1.

4.3. Treatment Modifications and Results

The Uranium Reduction in Effluent Project commenced with a comprehensive characterization of the Rabbit Lake waste water management and treatment system, involving mass balance analyses, chemical speciation and a review of industrial and scientific literature related to treatment of uranium bearing waters. This work led to a number of laboratory and pilot scale tests, which successfully identified appropriate treatment options and procedures for use at the Rabbit Lake Operation. The core of the Uranium Reduction Program was based on substantial changes to the conventional chemical precipitation-based minewater treatment system. These included chemical and process flow changes, as well as improvements to the solid/liquid separation aspects of the mine water treatment plant. This was further supplemented by establishing a separate chemical precipitation (ferric sulphate) treatment for the AGTMF waters, which had previously received no treatment prior to being added to Precipitation Pond #1. Pilot plant studies continue to investigate further supplemental treatment of waste streams using membrane filtration technologies, and are expected to reduce uranium and other contaminants even further in the future.

The studies and reports associated with the Uranium Reduction in Effluent Project were reviewed and approved by the CNSC and Environment Canada (EC). Cameco submitted change management documents (Ref. 4, 5, 7) for CNSC review which was followed by an "As-Built" report (Ref. 6) upon completion of the modifications. The implemented changes can be characterized in 21 elements. These are provided below to demonstrate the breadth of the changes. For details on each of these elements, the "As-Built" report (Ref. 6) should be consulted.

Element #1 Organic Removal Mechanism on Scrub Aqueous Stream

Element #2 Organic Removal Mechanism on Raffinate Stream

Element #3 Oil Inputs From Wash Bay Pump

Element #4 UBS Tank Overflow Line to Secondary Repulp Tank

Element #5 Pre-Reaction Mixing Tank for Neutralization Circuit

Element #6 Larger Solution Pachuca Feed Box

Element #7 Mechanical Mixer on Water Pachuca

Element #8 Barium Chloride to Solution Pachuca

Element #9 Upgrade pH Probes/Monitoring Systems

Element #10 Extend Solution Pachuca Upcomer Heights

Element #11 Inspection and Potential Cleaning of Pachucas

Element #12 Upgrading Solution Pachuca Feed Box

Element #13 Conversion of SRT to Fluidized Bed Clarifier

Element #14 New Flocculent Mixing System

Element #15 SRT Overflow Piping to Pump Box

Element #16 Use of CCD #5 Thickener as Temporary SRT

Element #17 In-Line Turbidity analyzer on SRT Overflow Steam

Element #18 SRT Underflow Recirculation System

Element #19 SRT Feed Line Trash Screen

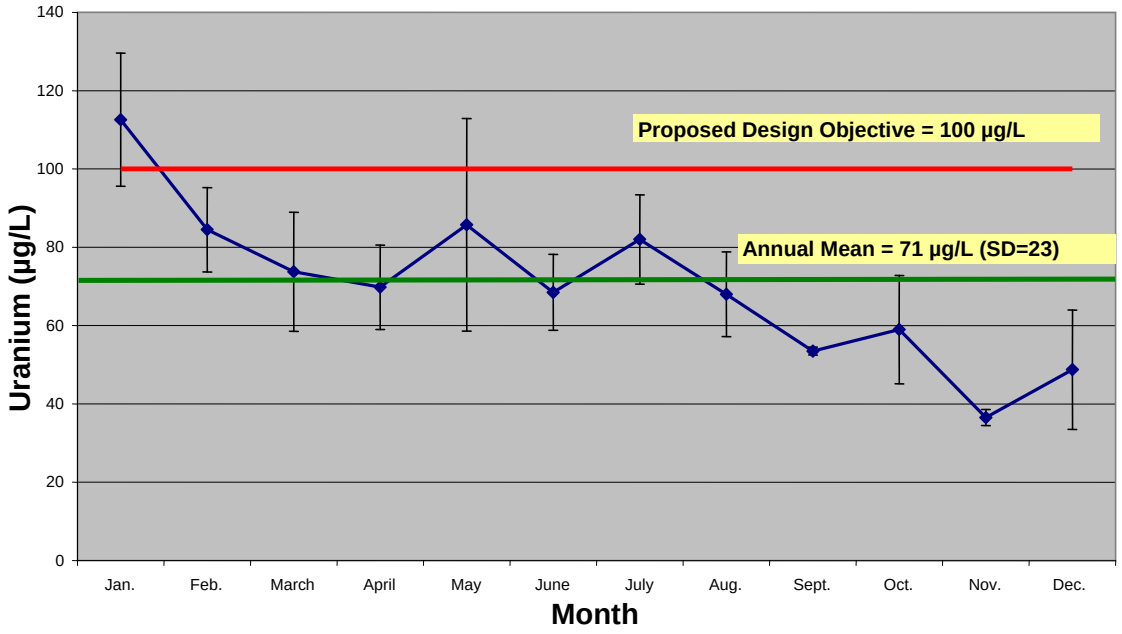
Element #20 AGTMF Source Piping and Ferric Sulphate Treatment System

Element #21 AGTMF Toe Drain Pump System

5.0 Commissioning and Demonstration of Performance

With the completion of the first pilot plant investigations, it was proposed that a treatment objective of 100 µg/L was achievable. This represents a five-fold reduction in effluent uranium concentrations, relative to the pre-project baseline. The core elements described above were completed in December 2006, therefore the year 2007 represented the one year commissioning period. Figure 1 provides the mean monthly uranium concentrations in the released effluent for this period. Once initial system difficulties were overcome in January, the mean monthly uranium concentration in effluent was below the 100 µg/L objective, and continued to trend further downward as the year progressed.

Figure 1. Effluent Uranium Concentrations for First Full Year of Treatment (2007).



In comparison to the pre-project baseline for uranium of 500 µg/L, the 2007 annual mean of 70 µg/L represents a reduction of 86%. A more detailed comparison of effluent performance over the last seven years is provided in Table 2. A steady decrease in mean uranium concentrations is evident since the commencement of the project in 2003. Initial improvements were the result of administrative controls to the effluent code of practice, related to optimizing the present treatment system. The improvements continued, while pilot scale tests further decreased uranium concentrations, with clear benefits occurring as modifications were phased in over 2005 and 2006.

Reductions in effluent concentrations are of little value if the total loads of uranium are not also decreased. However, it is evident from Table 2 that there has also been a substantial reduction in the total load of uranium released to the environment. Between 2000 and 2002, 1.5 to 3 metric tonnes of uranium were being released to the environment annually, with a 10-year pre-project mean of approximately 1.7 metric tonnes. In 2007, this declined dramatically to only 278 kg, a reduction of 81% to 91% relative to the 2000 to 2002 data and a reduction of 85% relative to the pre-project baseline. This marks a substantial reduction, especially when one considers that 2007 processed the highest waste water volume over the 2000 to 2007 period.

Table 2: Uranium in effluent. Comparison of commissioning performance to previous years.

Year	Annual Monthly Mean Concentration	Annual Volume	Annual Load
	µg/L	m^3	kg
2000	885	3,601,180	3,190
2001	897	2,793,310	2,508
2002	546	2,653,203	1,451
2003	446	3,215,539	1,434
2004	321	3,820,491	1,227
2005	289	3,797,194	1,098
2006	195	3,215,539	628
2007	**70**	**3,960,157**	**278**

It is evident from the 2007 commissioning period that the core modifications to the minewater treatment system and the AGTMF waste waters have been successful in decreasing uranium effluent concentrations and total loadings to the environment. Further improvements to uranium waste waters are expected, with upcoming modifications involving pre-treatment of specific waste streams. The use of membrane filtration procedures for pre-treatment could also reduce concentrations for a wide range of other contaminants, in addition to uranium. Further investigations of a number of other effluent contaminants (including, but not restricted to molybdenum and selenium)

were also completed, in conjunction with the uranium reduction project (Ref. 7). This has already resulted in the receipt of CNSC approval for modifications expected to substantially reduce molybdenum concentrations and loadings in the effluent. Additional studies and improvements are underway, with the expectation of further overall reduction in effluent contaminant concentrations.

6.0 References

1. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in the Rabbit Lake Effluent Progress Report. 2004, November. 22. CNSC E-Doc # 1240449.

2. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in the Lake Effluent Interim Report. 2005, February 27. CNSC E-Doc # 1179311.

3. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in the Rabbit Lake Effluent Final Report. 2005, October, 27. CNSC E-Doc #1241487.

4. Cameco Corporation. Rabbit Lake Operations: Uranium Reduction in the Rabbit Lake Effluent- Change Management. 2006, January, 12. CNSC E-Doc # 1241751.

5. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in Rabbit Lake Effluent Project – AGTMF South Dam Seepage Collection System Design. 2006, June 5. E-Doc #1242171.

6. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in the Rabbit Lake Effluent As-Built Report for the Uranium Reduction Phase. 2007, October. CNSC E-Doc #3106981.

7. Cameco Corporation. Rabbit Lake Operation: Uranium Reduction in the Rabbit Lake Effluent Supplementary Report-Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2006, December 12. CNSC E-Doc #1240292.

8. Cameco Corporation. Rabbit Lake Operation: Molybdenum and Selenium Reduction in the Rabbit Lake Effluent. 2007, April, 30.CNSC E-Doc #3048659

APPENDIX C

Copy of:
Report on the Management of Environmental Risk Associated with the Release of Dewatering Water at the Key Lake Uranium Mine/Mill, Key Lake, Saskatchewan.

File 5.03.01

Report on the Management of Environmental Risk Associated with Release of Dewatering Water at the Key Lake Uranium Mine/Mill, Key Lake, Saskatchewan

Related To The Memorandum Of Understanding (MOU)
Between
Environment Canada And The Canadian Nuclear Safety Commission

Canadian Nuclear Safety Commission

Version 1: August 2007[5]
Version 2: June 2008[6]

[5] Originally Submitted to Environment Canada in August 2007.
[6] Version 2 contains improved Figures 1 and 2, a minor correction to the information in the paragraph following Figure 2 (85% changed to 90%), along with grammar edits.

APPENDIX C: Report on the Management of Environmental Risk Associated with Release of Dewatering Water at the Key Lake Uranium Mine/Mill, Key Lake, Saskatchewan

1.0 Introduction

The Priority Substance List Assessment Report on the Releases of Radionuclides from Nuclear Facilities (Impact on Non-human Biota) concluded that "releases of uranium and uranium compounds contained in effluent from uranium mines and mills are "toxic" as defined in Section 64 of the *Canadian Environmental Protection Act*, 1999 (CEPA 1999)". As part of the risk management activities required for CEPA toxic substances a Memorandum of Understanding between the Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC) was signed (Appendix A). The Annex to this MOU identified specific risk management activities for each of the identified facilities associated with the conclusion of CEPA toxicity. This report addresses the risk management activities specifically associated with the release of dewatering water at the Key Lake mine/mill in northern Saskatchewan.

Annex 1 of the MOU identified facility specific requirements stating that:

In the case of the Key Lake mine/mill, environmental performance objectives will be developed and implemented within 12 months of the date of release of the CEPA assessment report. Commission staff will verify that effluent management improvements and the treatment facilities that have been installed are effective and that the effluent is no longer causing significant toxicity.

Environmental performance objectives identified in the preventive or control measures will be based on implementation of all reasonable precautions to control the release of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment as a result of a Commission-licensed activity.

1.1 Scope

To meet the requirements of the Annex, this report will provide a brief history of the dewatering releases to the McDonald drainage, including a summary of pre- and post-treatment uranium concentrations and loadings, a presentation of the performance of the treatment facility (reverse osmosis) with respect to uranium removal, and environmental performance objectives for the effluent release within the Code of Practice for the operation of the reverse osmosis facility. Pre- and post- treatment receiving environment uranium water concentrations will also be presented, along with receiving environment monitoring requirements for ongoing operation of the facility.

1.2 History of Dewatering Releases

Cameco Corporation's (Cameco) Key Lake operation is located on the southern boundary of the Athabasca Basin geological formation in northern Saskatchewan, and was originally constructed and licensed to operate as a mining and milling facility. The development of the two open pits, Gaertner and Deilmann, during the 1980s, required the draining of lakes in proximity to the open pits, and the continued removal of groundwater - for water management purposes.

After the two open pits were mined out, they became storage areas for waste rock (the Gaertner pit) and tailings (the Deilmann Talings Management facility of DTMF). Tailings placement in the DTMF began in 1995, while nickel rich waste rock was placed in the Gaertner pit in 1998. Water levels in the Gaertner and Deilmann pits were allowed to rise in the late 1990s, resulting in decreased dewatering requirements, lower flow rates and the partial recovery of the groundwater table and lakes near the Gaertner and Deilmann pits. As water levels approached the design levels, the pit dewatering flows increased in 2004, and pumping was conducted to maintain those levels.

Prior to the late 1990s, the water from the pumping wells surrounding the pits was discharged directly to the environment, at Horsefly Lake. Concern over rising concentrations of nickel led to the construction and operation of a reverse osmosis (RO) treatment system for dewatering flows in 1996/97. From 1997 to 2002, the discharge to Horsefly consisted of a blend of dewatering water, treated through the reverse osmosis system, and untreated dewatering water (wells with the best water quality). After 2002, all discharges to Horsefly Lake have been treated by the reverse osmosis plant.

2.0 Demonstration of Uranium Effluent Control

2.1 Performance of the Reverse Osmosis System

The reverse osmosis (RO) system was initially activated in 1996/97, with 1997 being the first full year of operation. A number of difficulties were encountered with the commissioning of the RO system, primarily associated with reductions in treatment capacity and availability relative to the design objectives. The majority of these difficulties were overcome by 1998, with treatment performance statistics (e.g., % contaminants removed and kilograms removed) available from 1998 to the present (Table 1). Over the last nine years, the facility's performance, based on the percentage of uranium removed, has been excellent, with a mean removal of 97.3% (SD 1.4%). This represents an approximate removal of 2,500 kg of uranium that would have been released to the environment via the McDonald drainage.

While treatment performance based on percent removal of contaminants was high in 1997 and 1998, difficulties with the availability of the system (i.e., pumping limitations and shutdowns) reduced the amount of dewatering water that was actually treated during this commissioning period. This accounts for the continued high uranium concentrations and loadings during 1997 and 1998, which are discussed in the following section.

Table 1. Performance of the reverse osmosis water treatment system.

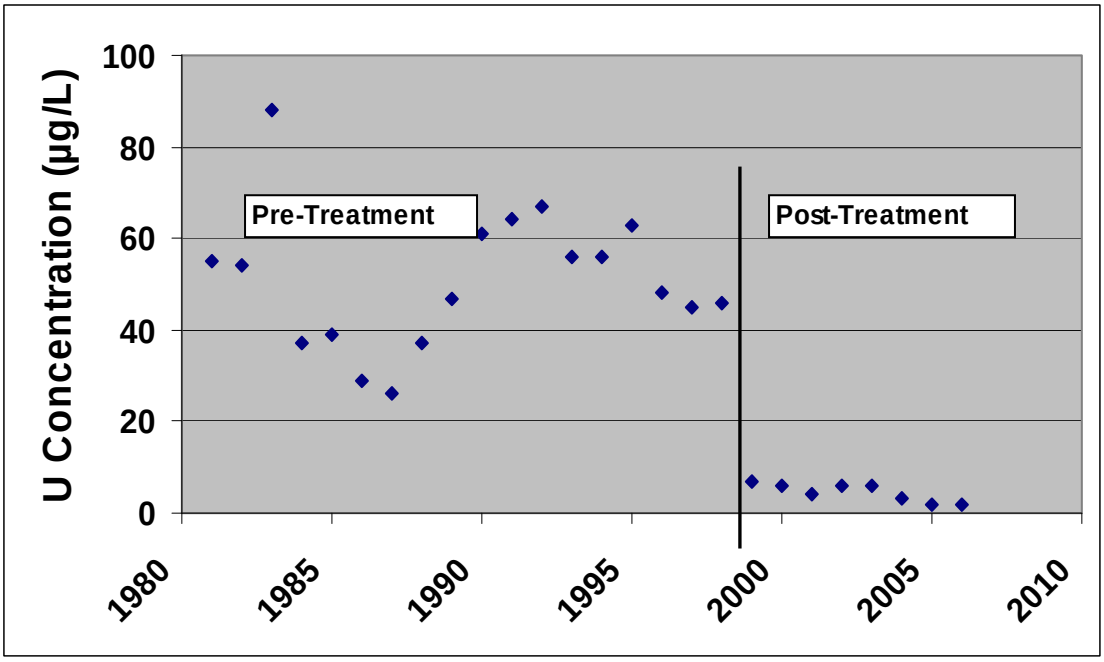
Year	Percent Removal	U Removed (kg)
1998	98.5	508
1999	98.9	458
2000	97.0	177
2001	97.1	65
2002	95.5	65
2003	94.9	48
2004	97.8	247
2005	97.5	363
2006	98.5	569
Mean	**97.3**	**278**
Standard Deviation	1.4	204
Total Kg Removed		**2,500**

2.2 Effluent Concentrations Pre- and Post-Installation of the RO System

For the purpose of the following discussion, the post treatment period is considered to extend from 1997 to the present, as 1997 marked the first full year of operation.

Annual mean uranium water concentrations (mg/L) are presented in Figure 1, listing data from the early 1980s to 2006. Pre-treatment concentrations ranged from 0.028 to 0.088 U mg/L, with an annual mean of 0.05 (SD=0.016) U mg/L. Post treatment concentrations ranged from 0.002 to 0.046 U mg/L, with an annual mean of 0.013 (SD=0.017) U mg/L. Over the most recent eight years, the concentrations have dramatically decreased to a mean of 0.0045 (SD= 0.002) mg/L. This represents approximately 75% reduction in mean annual uranium concentration since 1997, and a 91% reduction relative to the pre-treatment period for the last eight years.

Figure 1. Dewatering water mean annual uranium concentrations (µg/L).

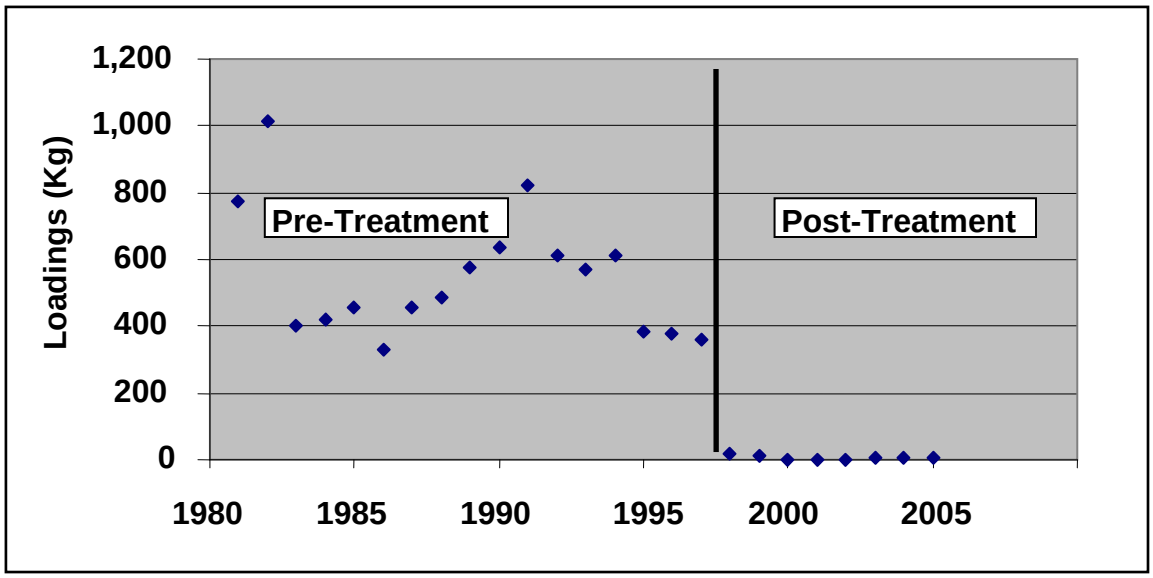


When addressing contaminants released to the environment, it is important to consider loadings (volume discharge multiplied by concentration) as well as concentrations. Annual mean loadings in kilograms are presented in Figure 2, listing data from the early 1980s to 2006. Annual pre-treatment loadings ranged from 384 kg to 1,012 kg, with a mean of 570 kg (SD=186). Since the commissioning of the RO facility, annual loadings have ranged from a low of 0.8 kg in 2001, to a high of 378 kg, in 1997.

The annual mean uranium loading has been 79 kg (SD=153), with the mean being strongly skewed by the high loads produced in the first two years of operation. The annual mean has declined substantially to 6.0 kg (SD=6) uranium per year, over the last eight years.

Of the total number of kilograms of dewatering water uranium discharged to the McDonald drainage since 1982, approximately 90% was released during the pre-treatment period (~ 9,330 kg; no discharge data available for 1981). Once the initial commissioning difficulties were overcome, a 99% reduction in mean annual load has been achieved (relative to the pre-treatment period). Therefore, the RO plant has been very successful in decreasing uranium releases to the environment.

Figure 2. Dewatering water annual uranium loadings (kg).



2.3 Receiving Environment Water Concentrations Pre- and Post- RO System

The treated dewatering water is discharged into a small water body, known as Horsefly Lake, then flows into Little McDonald Lake, McDonald Lake, through McDonald Creek, towards Outlet Creek and the Wheeler River. Background uranium concentrations in the Key Lake area are generally at or below the most common analytical method detection limit of 2 µg/L. The Interim Saskatchewan Surface Water Quality Objective (SSWQO) for the protection of aquatic life of 15 µg/L, or the lowest (i.e., low water hardness) PSL2 Estimated No Effect Value (ENEV) of 11 µg/L can be used as a general benchmark for the potential risk associated with the reported receiving water concentrations.

The water quality in the receiving environment has been monitored for a wide range of contaminants over the operational history of the mine. Uranium results have been strongly influenced by substantial variations in monitoring locations, frequencies and method detection limits over the years. As a result, there is little value in the application of complex statistics. In the following section, tables of summary statistics are provided

when multiple and seasonally-consistent samples were collected with minimal variation in the analytical method detection limit.

If this was not the case, scatter plots allow clear visual identification of values within year variation and method detection limits (MDL). The influence of the MDLs must always be considered when the means (MDL values used in the mean calculations) are discussed, in the following section.

Water quality measurements commenced at the outflow of Horsefly Lake in 1997, after the installation of the RO plant. A minimum of a monthly sample has been collected

been collected at this station, with the analytical detection limit consistently being 2 µg/L (with one exception). Summary statistics are provided in Table 2.

A substantial decrease in uranium concentrations over time is clearly evident. While the lack of data prior to 1997 prevents pre- and post-RO comparisons, it is evident that concentrations have been declining since 1997. The substantial decline in concentrations from 1999 relative to the two previous years corresponds well with the two year time lag evident in the quality of the dewatering effluent. Concentrations from 2004 to 2006 have decreased such that half or more of the values have been less than the method detection limit of 2 µg/L. Table 2 indicates that annual mean concentrations have been below the SSWQO and the PSL2 ENEV since 1999, as have all maximum monthly samples since 2002, indicating that these water concentrations posed little direct risk to aquatic biota:

Table 2: Uranium concentration (µg/L) at the outlet of Horsefly Lake.

Year	Flag[a]	Mean	SD	Min	Max
1997	0 / 12	29.4	10.9	13	58
1998	0 / 13	28.7	8.3	13	44
1999	1 / 13	7.1	4.6	1.8	14
2000	3 / 12	6.3	5.4	2	17
2001	5 / 12	3	2.6	2	11
2002	3 / 12	2.6	0.9	2	5
2003	2 / 12	3.7	1.9	2	9
2004	6 / 13	2.8	1.2	1.1	5
2005	7 / 12	2.3	0.5	2	3.4
2006	6 / 12	2.5	0.7	2	4

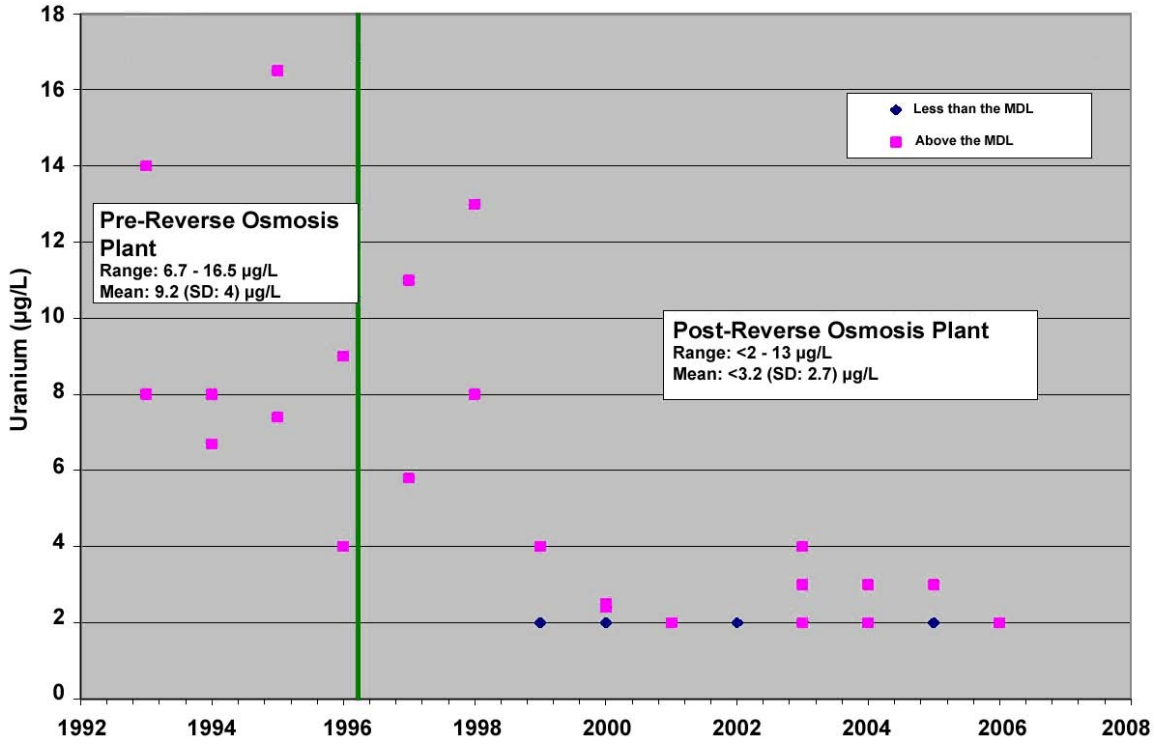
[a] Number samples < MDL / Total number of samples.

Unlike Horsefly Lake, uranium concentrations data was available for Little McDonald Lake and McDonald Lake prior to the installation of the RO plant. Samples have been

collected from Little McDonald Lake from 1992 to the present, on a bi-annual or quarterly basis. Due to the lack of consistency in the number of samples and the months of their collection, the data for these two sampling locations are shown as scatter plots, rather than as annual means (Figures 3 and 4).

Concentrations prior to the installation of the RO plant exceeded method detection limits, being clearly influenced by the releases of uranium in the dewatering water (Figure 3). Uranium concentrations prior to 1997 ranged from 6.7 to 16.5 µg/L, with a mean of 9.2 µg/L. With the operation of the RO plant, uranium concentrations declined, demonstrating again the two year delay in effluent quality improvement arising from the early commissioning difficulties. The post RO plant concentrations have been consistently below the water toxicity benchmarks, once the commissioning difficulties were overcome.

Figure 3. Uranium Water Concentrations at Little McDonald Lake.

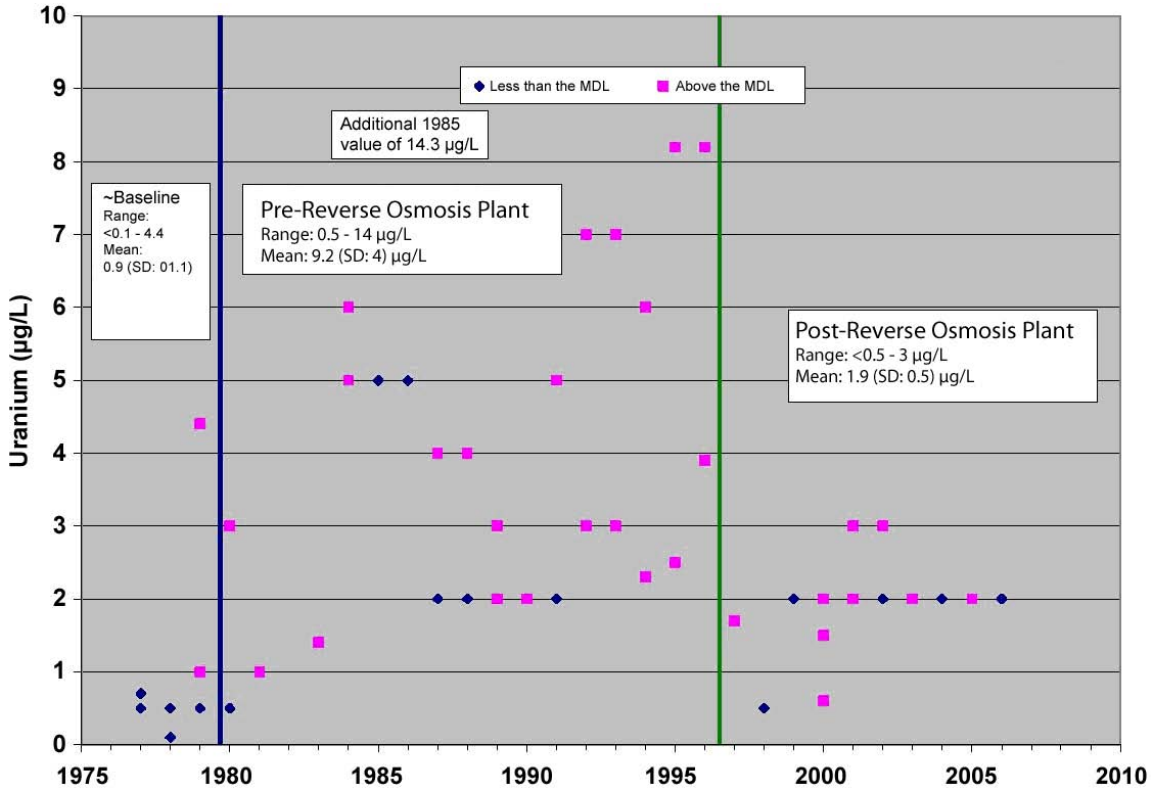


McDonald Lake water quality has been monitored at the inflow basin throughout the pre-operational and operational history of the Key Lake mine. These uranium water concentrations collected since 1975 are shown in Figure 4. Baseline data sets for McDonald Lake are reported as ranging from < 0.1 mg/L to 1 mg/L, with an unusually high value of 4.0 mg/L reported in 1979. The pre-operational baseline uranium concentration for this station averaged < 0.9 mg/L. The increase in uranium

concentrations in the water body with the release of dewatering water is evident. Concentrations varied substantially, ranging from <0.05 to 14 µg/L with an average of 4.2 mg/L. With the operation of the RO plant, concentrations decreased ranging from < 0.5 µg/L to 3 µg/L, with a mean of 1.9 µg/L. Thus, McDonald Lake water concentrations have consistently been below the water toxicity benchmarks, and have approached or achieved the analytical MDL since the operation of the RO plant.

Unlike the further upstream stations, the data for this station does not correspond well to the pattern of improved effluent quality, as 1997 and 1998 exhibit two of the lowest uranium concentrations, despite these years having the highest effluent releases for the post-RO period. This demonstrates the strong seasonal influence that appears in the database. Higher concentrations are evident in the ice-covered periods, and the single samples measured in these two years were collected in July.

Figure 4. Uranium Water Concentrations at McDonald Lake.



The monitoring history for McDonald Creek, from 1990 to 2006, is presented in Table 3 as summary statistics, since sampling was completed on a consistent monthly basis at this station. Uranium releases in the dewatering water appear to have had little influence on uranium concentrations at this distance downstream. Mean annual concentrations have generally been less than 2 µg/L, with most measurements being less than the MDL (Note

that MDL was lowered from 2 to 0.5, in the 1996 to 2001 period). At these concentrations, uranium does not pose a risk to biota.

Table 3: Uranium concentration (µg/L) at McDonald Creek (St'n 2.5).

Year	Flag[a]	Mean	SD	Min	Max
1990	5 / 12	3.00	1.21	<2	5
1991	5 / 12	2.92	1.73	<2	8
1992	4 / 12	2.33	0.49	<2	3
1993	4 / 12	2.58	0.79	<2	4
1994	3 / 12	1.76	0.87	<2	4
1995	2 / 12	1.44	0.40	<2	2
1996	3 / 12	1.49	1.60	<0.5	5.8
1997	0 / 12	1.27	0.68	0.57	2.9
1998	4 / 12	0.96	0.52	<0.5	1.6
1999	7 / 12	1.10	0.72	<0.5	2.2
2000	8 / 12	1.67	0.75	<0.5	3
2001	11 / 12	1.64	0.65	<0.5	<2
2002	10 / 12	2.08	0.67	<1	4
2003	10 / 12	2.00	0.00	<2	2
2004	10 / 12	2.17	0.58	<2	4
2005	10 / 12	2.08	0.29	<2	3
2006	11 / 12	2.00	0.00	<2	2

[a] Number samples less than MDL / Total number of samples.

3.0 Continued Verification of Adequate Control

The review of effluent and water concentrations demonstrates that the RO treatment facility has been effective in reducing effluent and receiving environment uranium concentrations. Prior to the installation of the reverse osmosis treatment plant, water concentrations in Horsefly Lake posed a risk to biota year round, with concentrations in Little McDonald posing a periodic risk (although likely restricted to periods of low flow, such as ice-covered seasons.) With the operation of the RO plant, uranium water, concentrations do not pose a direct risk to biota, even at the near field Horsefly Lake monitoring station.

To continue to ensure adequate control of dewatering water effluent, uranium has been incorporated into the Code of Practice and continues to be included in the receiving environment monitoring program.

3.1 Dewatering Water Code of Practice

The CNSC requires licensees to have a Code of Practice for primary effluent releases, which should provide an administrative framework to prevent loss of control situations. To ensure that Cameco continues to adequately manage the risk associated with releases of uranium in dewatering waters, CNSC has required the Key Lake operation to include uranium in the Code of Practice for the dewatering water treatment system.

3.1.1 Administrative Level

An administrative level is a contaminant concentration that indicates effluent quality is approaching the upper range of concentrations expected under normal operating conditions. The Key Lake administrative corrective actions will be triggered if the weekly dewatering water sample exceeds 20 µg/ L. This approximates the upper 95th percentile confidence interval for effluent quality since 2002, and therefore indicates that uranium performance is approaching the upper bound of concentrations documented under normal operating conditions. This does not pose an unreasonable risk to the environment, since it is equivalent to the Canadian Drinking Water Guidelines for human consumption and modeling and operational experience have demonstrated that releases at this concentration result in receiving environment concentrations well below those recognized as protective of aquatic life (i.e., SSWQO and PSL2 ENEV).

The exceedence of this administrative number in a weekly sample will require the following actions:

- Increase in sampling frequency from weekly to daily, and ongoing tracking of uranium concentrations to determine whether an Action Level has been exceeded;
- Investigation to determine the cause of the exceedence;
- Implementation of any identified corrective actions to return dewatering water uranium concentrations to below the administrative level;
- Documentation of the exceedence in the regulatory monitoring report for the period in which the administrative level was exceeded.

3.1.2 Action Levels

Action levels are defined as a specific concentration that, if reached, may indicate a possible loss of control and triggers a requirement for specific action to be taken. For the purpose of the dewatering water Code of Practice, possible loss of control is indicated by a prolonged inability to maintain effluent uranium concentrations below 20µg/L. The Key Lake Action Level is triggered when an exceedence of the administrative level occurs and the average of seven consecutive daily samples exceeds the administrative level. The inability to return uranium dewatering water effluent to below the

administrative level after seven days (i.e., 7 day mean > Admin. Level) indicates the potential loss of control, and requires the following actions:

- Reporting of the incident to the CNSC project officer within 24 hours;
- Investigation to determine the ongoing cause of the exceedence;
- Implementation of corrective action, to restore the concentrations of all contaminants in the effluent to levels below the specified level; and
- Submission of a report identifying the cause of the exceedence, listing the corrective measures and the steps taken to prevent re-occurrence.

In this manner, the Code of Practice ensures that the licensee monitors, tracks, and responds to uranium effluent concentrations in a risk informed manner, to minimize the potential for harmful releases to the environment.

3.2 Receiving Environment Monitoring

The Cameco Key Lake Operation is required to have a receiving environment monitoring program, in order to meet CNSC and Saskatchewan Environment regulatory requirements. The present monitoring program includes:

- surface water chemistry (including U) at a number of stations along the McDonald drainage;
- cyclical monitoring (3 years) of the following abiotic and biotic media at a number of locations along the McDonald drainage:
    - benthic macroinvertebrate community composition;
    - surficial sediment chemistry (including U) in sediments associated with the benthic invertebrate sampling locations;
    - large fish tissue and bone analytical chemistry (includes U); and
    - a small forage fish sentinel program (similar to MMER[7] EEM program).

The PSL2 assessment report identified uranium sediment concentrations as one of the primary exposure pathways for biota. This is a result of the accumulation of uranium over time, due to the high loadings which occurred prior to the commissioning of the reverse osmosis plant. With the substantial decrease in loadings, sediment recovery through downstream dispersion and burial is expected to result in a decrease in sediment concentrations over time. To confirm this the 2007/8 sampling program will include the collection of deep water cores to 20 cm depth, with chemical analyses of a number of vertical horizons, to document the historical deposition of released contaminants including uranium and to establish the present contaminant burial pattern as baseline for future long-term follow-up monitoring.

[7] Environment Canada: Metal Mining Effluent Regulations, Environmental Effects Monitoring

4.0 Conclusion

The Annex to the MOU requires that Commission Staff:

> "*[…]verify that effluent management improvements and the treatment facilities that have been installed are effective and that the effluent is no longer causing significant toxicity.*"

The information in this report verifies the successful commissioning and operation of the reverse osmosis treatment plant. The review of the effluent and receiving environment quality demonstrates that the treatment plant has been successful in preventing the release of over 2,500 kg of uranium to the receiving environment.

It has been demonstrated that the reduction in uranium effluent concentrations and loadings has resulted in substantial decrease in receiving environment concentrations, such that direct water exposure does not pose a risk to biota.

The Annex further requires that:

> *"Environmental performance objectives identified in the preventive or control measures will be based on implementation of all reasonable precautions to control the release of uranium and uranium compounds in effluent within the site of the licensed activity and into the environment as a result of a Commission-licensed activity.*"

This requirement for performance objectives has been achieved through the incorporation of uranium into the Code of Practice for the dewatering treatment system. Performance objectives, in the form of administrative and action levels, will ensure that the performance of the RO treatment system is tracked and managed to minimize releases and prevent loss of control situations from developing. In addition, receiving environment monitoring programs are in place, and have been expanded to ensure that the confirmed improvements in the treatment of uranium in the dewatering water are also reflected in the receiving environment.

CNSC will continue to keep Environment Canada informed of the performance of the RO treatment system and the associated effluent, as well as the results of the environmental monitoring program relative to uranium, during the annual or more frequent meetings, mandated by the Annex to the MOU.