Cameco

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April 16, 2013

VIA COURIER

Mr. Robert Dwyer
Project Officer, Beaverlodge Project
Canadian Nuclear Safety Commission
Uranium Mines & Mills Division
Suite 520, 101 – 22nd Street East
Saskatoon, SK S7K 0E1

Mr. Dale Kristoff
Environmental Project Officer
Industrial Branch, Hazmat & Impacted Sites
6th Flr., 800 Central Avenue
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Prince Albert, SK S6V 6G1

Dir Tel 306-956-6784
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Dear Mr. Dwyer and Mr. Kristoff:

File no. BVL.42205 / BVL.42305

Beaverlodge: Year 27 Transition Phase Monitoring Annual Report (2012)

The Beaverlodge Year 27 Transition Phase Monitoring Annual Report is submitted to the Canadian Nuclear Safety Commission (CNSC) (two copies) in compliance with the WFOL-W5-2120.0/2013 signed September 25, 2012 and to the Saskatchewan Ministry of Environment (one copy) in compliance with the Beaverlodge Surface Lease Agreement dated December 24, 2006.

This annual report summarizes environmental conditions, site activities and status for the 12 month period from January 1, 2012 through December 31, 2012. Where applicable, historical environmental data has also been included and discussed as part of the overall assessment of the decommissioned sites. This report also provides an outlook regarding proposed projects, activities and remedial programs up to the end of 2013.

If you have any questions or comments, please contact the undersigned at (306) 956-6784.

Yours truly,

Michael Webster

Michael Webster
Reclamation Co-ordinator
Compliance and Licensing, SHEQ
Cameco Corporation

MW:sc

Attachments

c: Stony Rapids Conservation Officer – Saskatchewan Ministry of Environment (letter and cd)
N.Crocker – Labour Relations and Workplace Safety (letter and cd)
R. Ejeckam – Environment Canada (letter and cd)
C. Berryman – Fisheries & Oceans Canada (letter and cd)
D. Classen – Urdel Limited (letter and cd)
W. Kelly – Northern Mines and Monitoring Secretariat (letter and report)
Northern Settlement of Uranium City (letter and report)
Regulatory Records – Cameco (letter and report)

BEAVERLODGE

Cameco

Beaverlodge
2012 Annual Report

April 2013

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INTRODUCTION

INTRODUCTION

1.0 INTRODUCTION

This report is submitted in compliance with Canadian Nuclear Safety Commission (CNSC) Waste Facility Operating Licence WFOL-W5-2120.0/2013 issued to Cameco Corporation (Cameco) for the decommissioned Beaverlodge mine and mill site.

The report is also submitted in compliance with the Saskatchewan Beaverlodge Surface Lease Agreement dated December 24, 2006.

As discussed in the introduction section of the 2011 annual report, this report describes observations on the decommissioned Beaverlodge site between January 1, 2012 and December 31, 2012. To ensure relevance and timeliness of the information contained within this report it is being submitted prior to the end of April as opposed to the deadline of September 30, as identified in the current CNSC licence.

Results of environmental monitoring programs conducted for Beaverlodge during this period are provided in the report and, where applicable, historical environmental data has been included and discussed as part of the overall assessment of the decommissioned properties. The status of current projects and activities conducted as of the end of December 2012 are provided, along with an overview of anticipated activities planned for 2013.

SECTION 2.0
GENERAL INFORMATION

GENERAL INFORMATION

2.0 GENERAL INFORMATION

2.1 Organizational Information

2.1.1 CNSC Licence/Provincial Surface Lease

The CNSC Waste Facility Operating Licence WFOL-W5-2120.0/2013 and the Province of Saskatchewan - Beaverlodge Surface Lease, December 24, 2006 are issued to:

CAMECO CORPORATION
2121 - 11th Street West
Saskatoon, Saskatchewan
S7M 1J3
(306) 956-6200 (Phone)
(306) 956-6201 (FAX)

2.1.2 Officers and Directors

The officers and board of directors of Cameco as at December 31, 2012 are as follows:

Officers

President and Chief Executive Officer	T.S. Gitzel
Senior Vice-President and Chief Operating Officer	R.A. Steane
Senior Vice-President and Chief Commercial Officer	K.A. Seitz
Senior Vice-President and Chief Corporate Officer	A. Wong
Senior Vice-President and Chief Financial Officer	G.E. Isaac
Senior Vice-President, Chief Legal Officer, and Corporate Secretary	G.M.S. Chad

Board of Directors

T. S. Gitzel
V.J. Zaleschuk
D.R. Camus
J.H. Clappison
N.E. Hopkins
O. Hushovd
A.A McLellan
A.N. McMillan
J.F. Colvin
J.R. Curtiss
D.H.F. Deranger
J.K. Gowans
I. Bruce

2.2 CNSC Licence

At the February 2009 hearing the Commission granted exemption from further CNSC licensing of five minor former Eldorado Beaverlodge properties. This action allowed the properties to be released by Saskatchewan Ministry of Environment (SMOE) from further decommissioning and reclamation and to be transferred to the province of Saskatchewan’s Institutional Control (IC) program. The Saskatchewan Ministry of the Economy (ECON), formerly known as Saskatchewan Ministry of Energy and Resources is now the responsible authority for the administration of the five properties in the IC Program as described in the provincial *Reclaimed Industrial Sites Act.*

Following the November 2009 public hearing held in Ottawa, Ontario for the renewal of the waste management license for the decommissioned Beaverlodge mining and milling facility, Cameco was granted a renewed Waste Facility Operating License. The renewed license WFOL-W5-2120.0/2012 was valid from December 1, 2009 to November 30, 2012.

Following a hearing held in September 2012, the Commission granted Cameco a 6-month renewal of the Waste Facility Operating Licence for the former Beaverlodge mine and mill site. The renewed license WFOL-W5-2120.0/2013 is valid from December 1, 2012 to May 31, 2013. A CNSC public hearing is planned for April 2013 regarding renewal of the WFOL-W5-2120.0/2013 for a 10-year period.

2.3 Provincial Surface Lease

The current provincial surface lease for the decommissioned Beaverlodge properties was issued to Cameco on December 24, 2006 with an expiry date of December 24, 2026.

2.4 Background Information

The decommissioned Beaverlodge mine/mill properties are located north of Lake Athabasca, northeast of Beaverlodge Lake, in the northwest corner of Saskatchewan at approximately N59° 33’15” and W108° 27’15” (Figure 2.4.1).

Uranium-bearing minerals were first discovered in the Beaverlodge area in 1934. Since there was little demand for uranium at that time, further prospecting and development in the region was delayed for almost ten years until 1944 when Eldorado Mining and Refining Ltd., a crown corporation owned by the Government of Canada, commenced detailed exploration in the area of Fishhook Bay on the north shore of Lake Athabasca. Between 1944 and 1948 Eldorado Mining and Refining Ltd. continued to explore the area around Beaverlodge Lake discovering the Martin Lake and Ace Zones in 1946. In 1947 a prospecting incline was developed to explore the Ace orebody and the Dubyna claims were staked.

Exploration and initial development of a number of separate orebodies continued until 1951 when Eldorado Mining and Refining Ltd. developed the Fay shaft and headframe. The following year the foundations were laid for a 450 tonnes per day (t/day) carbonate-leach mill which started production in 1953. Mill production expanded to 680 t/day in 1954 and increased to 1800 t/day in 1956. A small acid-leach circuit was added in 1957 to handle a small amount of ore containing sulphides. Non-sulphide ore was sent directly to the carbonate circuit, while the sulphide concentrate was treated in the small acid-leach circuit.

During mining the primary focus was on an underground area north and east of Beaverlodge Lake where the Ace, Fay and Verna shafts were located. Production from these areas continued until 1982. Over the entire 30-year production period (1952-1982) the majority of the ore used to feed the mill came from these areas; however a number of satellite mines, primarily in the Ace Creek watershed were also developed and operated for shorter periods of time. During the mill operating period, approximately 60% of the tailings were placed into small waterbodies within the Fulton Creek watershed with the remainder being deposited underground.

During the early years of operation, uranium mining and milling activities conducted at the Beaverlodge site were undertaken using what were considered acceptable practices at the time. However, these practices did not have the same level of rigor for the protection of the environment as is currently expected. Although the Atomic Energy Control Board (AECB) licensed the Beaverlodge activities, environmental protection legislation and regulation did not exist either federally or provincially and therefore was not a consideration during the early operating period. It was not until the mid-1970s, some 22 years after operations began, that effluent treatment processes were initiated at the Beaverlodge site in response to discussions with provincial and federal regulatory authorities.

At the request of the AECB, a conceptual decommissioning plan was submitted in June 1981. On December 3, 1981 Eldorado Nuclear Limited (formerly Eldorado Mining and Refining Ltd.) announced that its operation at Beaverlodge would be shutdown.

Mining operations at the Beaverlodge site ceased on June 25, 1982 and the mill discontinued processing ores in mid-August 1982. At that time Eldorado Resources Limited (formerly Eldorado Nuclear Limited) initiated site decommissioning. The decommissioning and reclamation work was completed in 1985. Letters were issued by AECB indicating that the sites had been satisfactorily reclaimed (*MacLaren Plansearch 1987*). Transition-phase monitoring was initiated at that time and continues today.

On February 22, 1988 the Government of Canada and the Province of Saskatchewan publicly announced their intention to establish an integrated uranium company as the initial step in privatizing their respective uranium investments.

On October 5, 1988 Cameco Corporation, a Canadian Mining and Energy Corporation, was created from the merger of the assets of the Saskatchewan Mining Development Corporation and Eldorado Resources Ltd. Following the merger, management (monitoring and maintenance) of the decommissioned Beaverlodge properties became the responsibility of Cameco, while the Government of Canada, through Canada Eldor Inc. (CEI) retained responsibility for the financial liabilities associated with the properties.

In 1990 the corporate name was changed to simply Cameco Corporation (Cameco) with shares of Cameco being traded on both the Toronto and New York stock exchanges.

The management of the Beaverlodge monitoring program and any special projects associated with the properties is the responsibility of the Reclamation Co-ordinator, SHEQ - Compliance and Licensing, Cameco.

2.5 Confounding Factors

While Beaverlodge Lake is the receiving environment for water from the decommissioned Beaverlodge properties, it is also the receiving environment for contaminants discharged from at least nine other non-Eldorado abandoned uranium mine sites and one former uranium mill tailings area (Lorado Uranium Mining Ltd. mill site) within the Beaverlodge Lake watershed. These abandoned sites are managed by Saskatchewan Research Council (SRC) and are currently in the process of being remediated.

Previous experience has shown that at least some of the abandoned sites are likely contributing some level of contamination (heavy metals and radionuclides) to the watershed and ultimately to Beaverlodge Lake and Martin Lake, particularly during spring runoff and periods of heavy precipitation.

SECTION 3.0
DECOMMISSIONED AND RECLAIMED AREAS ACTIVITIES

DECOMMISSIONED AND RECLAIMED
AREAS ACTIVITIES

3.0 DECOMMISSIONED AND RECLAIMED AREAS ACTIVITIES

The performance of the decommissioned and reclaimed area of the Beaverlodge site is assessed through routine scheduled sampling/analysis as well as routine inspections conducted by Cameco personnel and the Joint Regulatory Group (JRG). In addition, special monitoring/investigation projects are completed to gather information to support characterizing the site and assessing the performance of specific components of the decommissioned areas. The following section outlines related activities around the Beaverlodge properties during the reporting period.

3.1 Joint Regulatory Group

The JRG is comprised of representatives of various federal and provincial regulatory agencies including

- Canadian Nuclear Safety Commission (CNSC)
- The Department of Fisheries and Oceans Canada (DFO)
- Environment Canada (EC), and
- Saskatchewan Ministry of Environment (SMOE).

3.1.1 Special Meetings with JRG

November 1 2012: Path Forward Meeting (Ottawa, Ontario)

The purpose of this meeting was to review with CNSC and SMOE the preliminary conclusions of the Beaverlodge Path Forward report and the associated rationale. The Beaverlodge Path Forward document forms the basis for the requested 10-year license term to be considered by the CNSC Commission during relicensing in 2013.

3.2 Regulatory Inspections

Performance of the historical decommissioning and reclamation activities at Beaverlodge, are assessed through routine visual inspection of the properties conducted by regulatory agencies and Cameco. Inspections are held in order to ensure that conditions on the properties do not impact the health and safety of people or protection of the environment and ensure the requirements of the license continue to be met.

3.2.1 2012 Inspection (Beaverlodge properties)

From June 5, 2012 to June 7, 2012, representatives from Cameco, the CNSC, and SMOE completed a Type-II compliance inspection of the Beaverlodge properties.

The focus of the inspection was to provide a general overview of the properties and the remaining issues that may prevent the property from transferring to IC. In addition, the properties were inspected to ensure they remained safe, secure and stable.

Following the inspection, the CNSC and SMOE provided Cameco with four recommendations. A formal response to the JRG recommendations outlining actions taken and plans to address outstanding items was provided to the JRG on November 22, 2012. The recommendations and a summary of the Cameco response are provided below:

1. *Cameco should monitor and investigate the clay boils on the Marie Tailings Delta as their existence may impede the properties designation to Institutional Control.*
    - During the 2013 JRG inspection it is proposed that the extent of the clay boils be determined with an annual follow-up inspection to monitor the condition of the Marie Tailings Delta in the subsequent two years.

      Cameco has committed to assessing potential remediation of the Marie Tailings Delta as part of the Path Forward for Beaverlodge. Decisions regarding potential remediation of this area will follow the Beaverlodge Management Framework and supporting documents; decisions will be based on an assessment of the expected site-specific risks and benefits.
2. *Cameco should inspect the track etch cup sampling and re-evaluate how they are held in place.*
    - All track-etch cup mounting brackets were replaced in July 2012.
3. *Cameco should evaluate the source of the elevated gamma signature between seeps 2 and 3 at the base of the Fay waste rock pile.*
    - A site-wide gamma survey will be completed in 2013/2014 to delineate elevated gamma sources on the Beaverlodge properties. Following that survey, site specific assessments will be conducted to determine reasonable remediation for areas with elevated gamma. Decisions regarding additional remediation will be informed by site-specific risk and cost.
4. *Cameco should review access to sample stations and make reasonable efforts to ensure access to sampling stations is available and adhered to by staff.*
    - Cameco has taken steps to ensure safe access to sampling locations. An access trail was created to ensure level access to the sampling location downstream of Minewater Reservoir and a tripping hazard was removed from the sampling location at the outflow of Ace Lake.

3.3 Geotechnical Inspection

In 2011 the frequency of the third-party inspections of the Fookes Delta and outlet structures at Marie and Fookes reservoirs was adjusted from every three years to every five years. To accommodate the change in frequency of third-party inspections, an inspection of the delta and outlet structures is completed annually by Cameco personnel during the JRG visit using a checklist developed by Cameco and SRK Consulting. The Geotechnical Inspection Checklist requires the assessment of the condition of the Fookes and Marie outlet structures and Fookes Delta. In addition, the checklist requires photographic record of each area. Should any changes to the deltas or to the outlet structures be observed, then a third-party inspection would be called in regardless of the regular schedule.

Water was flowing in both the Marie and the Fookes outlet structures during the 2012 inspection. The integrity of both of the outlet structures was maintained. There was no evidence of erosion and no concerns were noted. Grout-intruded rip-rap remained in place at both structures and is performing as designed. Photographic evidence was collected at both structures.

The Fookes delta was inspected for any evidence of tailings boils, tailings exposure, erosion of the cover, or any sand wash into the lake. No tailings boils were found and the settling features observed in 2011 were much less prominent. Vehicular traffic had gained access to the delta by driving over a berm put in place to eliminate traffic. Although vehicles had accessed the delta they did not appear to have compromised the integrity of the sand cover. The berm was repaired and made impassable to vehicular traffic prior to October 31, 2012.

The geotechnical inspection took place during the June 2012 JRG inspection with the results and photographic record included in Appendix C.

3.4 Studies

The following section provides a summary of the studies that were completed and provided to the regulatory agencies during the reporting period.

January 2012: 2011 Ace Lake Watershed Hydrometric Assessment

The 2011 Ace Lake watershed hydrometric assessment was completed in 2011 with the report being submitted in January of 2012. Work was conducted to evaluate the flow from various waterbodies feeding Ace Lake as well as the outflow from Ace Lake. Corresponding water chemistry, particularly that of four constituents of potential concern (COPC): radium-226, uranium, selenium and total dissolved solids (TDS) was also collected as part of this study (*Golder, 2012*).

January 2012: Results of Packed Borehole and Seep Monitoring near the Former Beaverlodge Eldorado Mine Follow-up

Borehole and seep monitoring was conducted in the vicinity of the main waste rock pile associated with the former Mine and Mill site in 2011. The report was finalized and submitted to the regulatory agencies in January of 2012. The purpose of this study was to gather information regarding the flow and water quality from the seeps at the base of the waste rock pile and to assess the conditions of the previously flowing boreholes (described in Section 3.5.1).

June 2012: 2011 Beaverlodge Deep Basin Sediment Sampling

CanNorth conducted the field work for this study from September 15 to October 1, 2011. Laboratory analysis of samples collected during this program took longer than anticipated therefore the report was submitted in June 2012. The purpose of this study was to gather sediment and water quality data from Ace, Dubyna, Pistol, and Verna lakes in support of the development of the Beaverlodge Quantitative Site Model (QSM). The dataset for the QSM was updated with this information although the outputs predicted by the QSM were not affected.

June 2012: 2011 Beaverlodge Aquatic Investigations in Beatrice and Pistol Lakes

To adequately characterize the former Hab mine site, a study was completed evaluating the water quality, sediment quality, benthic invertebrate, and fish communities in Beatrice and Pistol lakes. The focus was on Pistol Lake because it is downstream of the former Hab mine site, and waste rock was placed into it during the mine's operation. Beatrice Lake is upstream from the Hab Mine and was not affected by the mining activities at Eldorado (*CanNorth, 2012*) and provides relevant background conditions in the area.

June 2012: Uranium City Country Foods Study Year 2

The Country Foods Study Year 2 main objective was to collect information regarding country foods so that the Uranium City residents would know if it was safe to consume harvested country foods. The collection and analysis of a variety of country foods was completed. The Year 2 study was based upon the information gathered in Year 1, in terms of what types and how much of certain types of country foods the residents were consuming. The information from the lab analysis of the collected plant and animal specimens was then used to conduct a human health risk evaluation for the Beaverlodge area. The final conclusion of the study was that the consumption of country foods does not pose health risks to the residents of Uranium City, provided the posted fish consumption advisories are followed. This report was submitted in June 2012.

November 2012: Final Closure Report – Beaverlodge Mines – Martin Lake Adits Decommissioning and Reclamation

This document submitted in part as an application for a "Release from Decommissioning and Reclamation" from the Saskatchewan Ministry of Environment for two properties (RA 6 and RA 9) at the decommissioned Eldorado Resources Ltd. Beaverlodge uranium mine and mill site. Document includes a detailed discussion of decommissioning and reclamation activities and an analysis and evaluation of monitoring data generated during the post-decommissioning and reclamation period. It also includes an assessment of remaining environmental liabilities on the property and provides a proposed schedule of required institutional control inspection and monitoring (*ASKI, 2012*). Once this document is acceptable to the regulatory agencies it will form the basis for transferring the properties described within into the IC program.

November 2012: Back Bay Investigation

McElhanney Consulting Services Ltd. was retained to complete an investigation of a small bay (Back Bay) adjacent to Ace Bay of Beaverlodge Lake, to determine if there were any ongoing external sources of contamination that would prevent the sediment profile in this area from recovering faster. The specific conductivity of surface water within Back Bay was evaluated for the purpose of identifying potential contaminant sources (*McElhanney, 2012*). There were no significant variations in specific conductivity throughout Back Bay leading to the conclusion that there are no external contaminant sources contributing to the elevated contamination levels in sediment within Back Bay. It is likely that the sediment contamination within Back Bay is related to historical events.

3.5 2012 Activities

The following section provides a summary of the activities that were completed in 2012. Activities ranged from implementing additional remedial options to developing the path forward for managing the Beaverlodge properties towards eventual transfer to the IC program.

3.5.1 Beaverlodge Borehole Decommissioning

MDH Engineered Solutions Corp. was contracted by Cameco to seal flowing boreholes located on the Beaverlodge property in 2011. In total 14 boreholes were identified exhibiting artesian conditions. It is hypothesized that the flowing boreholes, drilled during initial exploration activities, were acting as a conduit for groundwater to flow from the flooded underground mine workings.

Most boreholes were permanently sealed in 2011; however, three boreholes were left with temporary plugs while a plan was developed to permanently seal them. MDH conducted the second phase of borehole sealing from June 13, 2012 to June 20, 2012. They removed the temporary plugs and installed permanent seals in the boreholes. Two additional flowing boreholes were identified in the spring 2012 and were sealed as well. All identified borehole locations near Beaverlodge Lake and Dubyna Lake were adequately sealed by inserting a plug and grouting to a 30m vertical depth to meet current provincial requirements, where achievable.

Inspections of these areas will be conducted during annual regulatory inspections to ensure these boreholes remain sealed and that no additional boreholes develop.

3.5.2 February 2012: Development of the Beaverlodge Quantitative Site Model

The development of the QSM and related report was a continuation of Part A that was presented in November 2011. Part B focused on taking the contaminant pathways information from Part A and assessing the ecological and human health risks from the properties.

The QSM was developed for Cameco by SENES Consultants Limited as a tool to predict changes in water and sediment quality and assess the potential ecological and human health risks associated with the decommissioned Beaverlodge properties. An important feature of the QSM was the model's ability to simulate potential remedial options and predict the expected benefit of implementation. This feature was critical to the assessment process of the Remedial Options Workshop and in the determination of the path forward at Beaverlodge.

The QSM report in its entirety, the Beaverlodge Quantitative Site Model, was revised based on regulatory and stakeholder feedback and re-submitted on June 18, 2012.

3.5.3 March 2012: Costing Study – Potential Remedial Options

The purpose of this activity was to develop cost estimates for various potential remedial options at Beaverlodge. The options considered in the cost assessment were largely derived from the 2009 Remedial Options Workshop where stakeholders were asked to identify options that may improve the conditions at the Beaverlodge site. The cost study of potential remedial options was used during the 2012 Remedial Options Workshop to inform discussions regarding the benefit and cost of potential remedial options being considered.

As part of this submission an assessment of potential options for the diversions of surface flows at several former Eldorado properties completed by SRK Consulting (Canada) Inc. in 2010 was included. Field surveys were conducted from May 26 to June 4, 2010, and included ground-truthing of several possible diversion options.

3.5.4 July 2012: Former Eldorado Beaverlodge Properties Remedial Options Evaluation & Feedback Workshop

Cameco Corporation hosted a remedial options workshop in Saskatoon on April 3 and 4, 2012. A report summarizing the two day workshop, which evaluated 14 different remedial option scenarios using the Beaverlodge QSM and the cost study report, was submitted to the regulatory agencies and workshop participants on July 20, 2012. The workshop and a summary of results are discussed in Section 3.7.3.

The results of the remedial options workshop have been considered by Cameco in developing the Beaverlodge Path Forward; a plan of activities to be carried out over the next CNSC license period, in accordance with the Beaverlodge – Management Framework with the goal of transferring properties to the Provincial Institutional Control (IC) program (*SRK, 2012*).

3.5.5 Development of the Beaverlodge Path Forward

Informed by the Remedial Options Workshop and other engagement activities, a path forward for the management of the Beaverlodge properties was developed by Cameco in consultation with Canada Eldor. Remedial options will be implemented where applicable in accordance with good engineering practice and to incrementally improve water quality in local water bodies.

As part of the Beaverlodge Path Forward Report, short-term and long-term performance objectives have been derived using predictions made by the QSM. Short-term performance objectives will evaluate the success of implementing site specific remedial activities, while long-term objectives provide expectations regarding the long-term recovery of the Beaverlodge area.

Implementation of the Beaverlodge path forward will ensure the properties are safe, stable and secure for the long term, thus facilitating their transfer to the IC Program.

The report describing the Beaverlodge Path Forward was submitted to the regulatory agencies on December 11, 2012.

3.6 Bolger Pit Waste Disposal

In February 2010 Cameco received approval from SMOE and the CNSC to use the Bolger Pit as a disposal location for loose debris encountered during inspection activities on the Beaverlodge sites. The Bolger Pit was selected as the disposal location as it was used by Eldorado Resources as a disposal area for similar materials during decommissioning.

A trench was excavated with dimensions of approximately 26 m long x 15 m wide x 1.5 m deep to dispose of any additional materials encountered during the clean-up of remaining debris on the Beaverlodge properties. A lockable gate at the entrance to the Bolger Pit was installed to control access to the area.

Cameco is required to provide information regarding the volume and type of material being disposed of in this area. No material was disposed of in Bolger pit in 2012.

3.7 Community Engagement and Consultation

3.7.1 Public Meetings

Two public meeting were held during the 2012 reporting period with the intent of providing an overview to the residents of Uranium City regarding the completed activities, an update on the current condition of the Beaverlodge properties, as well as the outlook for future planned activities. The first meeting, described below, was targeted towards Uranium City residents; the second meeting conducted in September 2012 (discussed in Section 3.7.2) was targeted towards Northern Saskatchewan Environmental Quality Committee (NSEQC) as well as the residents of Uranium City.

June 4, 2012: Public Meeting (Uranium City, Saskatchewan)

The 2012 public meeting was hosted by Cameco at the Ben McIntyre School in Uranium City, Saskatchewan. The attendees of the meeting included residents from Uranium City, a member of the AWG and EQC, members of the Mamawetan Churchill River Regional Health Authority, staff from SENES Consultants, CanNorth, and Cameco, and regulatory representatives from the CNSC and SMOE.

The purpose of this meeting was to engage the public in the ongoing activities at the Beaverlodge site, distribute information, and to address any concerns or interests that were raised by the participating parties. Three presentations were delivered during the public meeting.

Representatives from Cameco presented the progress on the Beaverlodge Management Framework and discussed the development of the Beaverlodge QSM and the results of the remedial options workshop held in Saskatoon in April 2012. The remedial options workshop is discussed in more detail in Section 3.7.3. Residents were informed that Cameco would be requesting a 10-year licence from the CNSC during the next public hearing with the CNSC Commission. Activities scheduled to occur is 2012 were discussed and included; plugging of flowing boreholes at Lower Ace and Dubyna, as well as gathering stream flow information in various watersheds in the region to contribute to the development of the Beaverlodge QSM.

CanNorth presented the results of the Uranium City - Country Foods Study, which was completed over a two-year period (2010 and 2011). Information regarding country food consumption habits and locations of country food harvesting were gathered during Year 1.

The focus of the Year 2 study was to complete the gathering of samples to determine if locally harvested country foods were safe to consume. Vegetation and animal samples were collected over a two-year period from the Beaverlodge properties, Camsell Portage, and around Uranium City and sent to Saskatchewan Research Council laboratory for chemical analysis. Maps of the sampling locations were also provided at the meeting to provide the attendees with a visual aid to see exactly what areas had been sampled. After the tissue sample results were provided by the lab, a risk assessment was conducted, determining the level of risk faced Uranium City residents by consuming locally harvested country foods. The conclusion found that consumption of country foods does not present health risks to Uranium City residents provided the fish consumption advisories in place are followed.

The last presentation was made by Dr. Irving of the Mamawetan Churchill River Regional Health Authority. He discussed the findings from the Northern Saskatchewan Health Indicators Report. The study was prepared by the Population Health Unit for Northern Saskatchewan and provides statistics and relevant information regarding the health and well-being of people in Uranium City and northern Saskatchewan. There was also time for attendees to ask Dr. Irvine questions.

3.7.2 Northern Saskatchewan Environmental Quality Committee Meetings

The NSEQC is made up of representatives from designated northern municipal and First Nation communities. The NSEQC is broken into three sub-committees, with the Athabasca Environment Quality Committee (AEQC) representing Uranium City and other Athabasca communities. The NSEQC enables northerners to learn about uranium mining activities and to see first-hand the environmental protection measures being employed, and the socio-economic benefits being gained. A meeting and tour of the Beaverlodge properties was conducted with the AEQC in September 2012 and is described below.

September 25, 2012: AEQC Meeting (Uranium City, Saskatchewan)

This meeting was held on September 25, 2012. There were five attendees from the AEQC, five community members, and representatives from SMOE, the CNSC, and the Northern Mines Monitoring Secretariat. It took place in Uranium City, Saskatchewan at the Ben McIntyre School.

The purpose of this meeting was to provide the AEQC and Uranium City residents information regarding the activities related to the management of the Beaverlodge properties. In addition a site tour was conducted to show the AEQC and local residents the Beaverlodge properties and respond to any questions regarding the management of the properties.

During the meeting a summary of the 2012 activities was provided to the group, including the most recent water quality sampling results. The conclusions of the Uranium City – Country Food Study were presented. A summary of the Remedial Options Workshop and the conclusions was provided to the attendees, followed by the path forward for the Beaverlodge sites regarding the planned implementation of additional remedial options and activities required in preparation of the properties for transfer the IC program.

During the meeting the AEQC and residents were informed that Cameco would be requesting a 10-year license from the CNSC during the next public hearing with the CNSC Commission, and that the hearing would likely be in April 2013.

3.7.3 Workshops

April 3/4, 2012: Remedial Options Workshop (Saskatoon, Saskatchewan)

On April 3 and 4, 2012 Cameco hosted a workshop in Saskatoon to review potential remedial options available for the Beaverlodge properties. In attendance at the workshop were ten community members from Uranium City, six members from the NSEQC, representatives from the Northern Mines Monitoring Secretariat, CNSC, Environment Canada, Natural Resources Canada, DFO, SMOE, Mamawetan Churchill River Regional Health Authority, SRC, CanNorth, Canada Eldor Inc., and Cameco.

As previously described Cameco and SENES Consultants Limited developed a QSM for the Beaverlodge properties as a means to assist Cameco and stakeholders in understanding the relationship between the historic contaminant loads from the licensed properties under current conditions and the receiving environment. In addition the QSM was developed as a tool allowing for the consideration of the potential benefit(s) which might result from implementing potential remedial activities. A concept-level costing study was also undertaken to provide context to potential remedial measures.

The objective of the workshop was to gather clear and documented feedback from a cross-section of stakeholders regarding the potential remediation options for the Beaverlodge properties (*SRK Consulting, 2012*). The general conclusions of this effort can be summarized as follows:

- participant groups felt that doing nothing was not an acceptable option as there were several minor activities with both measureable benefits and reasonable cost available
- participants did identify some options of which both the benefits and feasibility were uncertain, and
- large-scale remedial options were generally deemed to be too expensive for their projected benefits.

The information from this workshop was used by Cameco to prepare a final remediation plan that will be the basis for Cameco's request for a 10-year renewal of the CNSC license at the public hearing in 2013.

3.8 CNSC Meetings

3.8.1 CNSC Commision Meeting

At a CNCSC Commission meeting held in September 2012 Cameco was granted a 6-month licence valid from December 1, 2012 to May 31, 2013 to provide Cameco the opportunity to develop performance objectives and conduct consultation activities related to the Beaverlodge Path Forward plan.

SECTION 4.0
ENVIRONMENTAL MONITORING PROGRAMS

ENVIRONMENTAL MONITORING
PROGRAMS

4.0 ENVIRONMENTAL MONITORING PROGRAMS

Cameco retains a local contractor (Urdel Ltd.) to conduct the required water quality and radon sampling throughout the year. Employees from Urdel Ltd., while collecting samples, also perform cursory inspections and report any unusual conditions to Cameco.

4.1 Close-Out Objectives and Requirements

In 1982 Eldorado Nuclear Limited submitted a document which described their approach to decommissioning and reclamation of the Beaverlodge site (*ENL June 198*2). This document included proposed Close-Out Objectives (COOs). The AECB then issued close out requirements and objectives specific to the close-out of the Beaverlodge operation (*AECB, 1982*).

Table 4.1.1 provides a summary of the water quality COOs as originally established by the AECB in 1982 (*AECB 1982*). In the interest of completeness, the table also provides a summary of the most recent *Saskatchewan Surface Water Quality Objectives for the Protection of Aquatic Life (SSWQO)* and *General Surface Water Quality Objectives* (*Saskatchewan Environment, 2006*), the *Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2006*), the *Saskatchewan Municipal Drinking Water Quality Objectives* (*2002*) and the *Guidelines for Canadian Drinking Water Quality (Health Canada, 2007).*

As indicated in Section 2.3.3 of Volume 5, *Plan for the Close-Out of the Beaverlodge Site*, (*ERL 1983b*) it is predicted that at Station TL-7, radium-226 (^{226}Ra) and total dissolved solids (TDS) will not meet the COOs at any point in the foreseeable future and uranium (U) concentrations are expected to meet the COOs only in the long term (i.e. >200 years).

4.2 Transition-Phase Monitoring

During transition-phase monitoring, the results of four separate monitoring programs have been evaluated to assess the performance of the closed-out site. These are water quality, ambient radon, air quality, and gamma radiation surveys.

As of 2012 only two environmental monitoring programs continue:

1. water quality, and
2. ambient radon.

The air quality monitoring program for dust fall and high volume sampling was discontinued following the third year of the transition-phase monitoring as sampling results met the established close-out objectives. The original gamma radiation surveys were completed in the first year of the transition phase (1985/86) and are now only conducted in specific areas in support of applications to release specific properties from decommissioning and reclamation.

The following sections summarize results for the water and ambient radon monitoring programs.

4.3 Water Quality Monitoring Program

This section summarizes the results of the regulatory approved water sampling program at Beaverlodge. A revised water sampling program was approved by the CNSC and SMOE for implementation in 2011; the program was unchanged for 2012. The water quality summary in this section focuses on the four main parameters of concern: U, ^{226}Ra, TDS, and Se.

The two watersheds affected by the historical mining activities are Ace Creek and Fulton Creek. Figure 4.3 provides an overview of the various stations at which water quality is monitored. Within the Ace Creek watershed the routine sampling stations (from upstream to downstream) include:

- **AN-5** - Pistol Creek downstream of the decommissioned Hab mine site.
- **DB-6** - Dubyna Creek downstream of the decommissioned Dubyna mine site and before the creek enters Ace Creek upstream of Ace Lake.
- **AC-6A** - Verna Lake discharge to Ace Lake.
- **AC-8** - Ace Lake outlet to Ace Creek.
- **AC-14** - Ace Creek at the discharge into Beaverlodge Lake.

In May of 2010, Cameco began monitoring water quality at the Verna Lake discharge to Ace Lake. This station has been labelled as AC-6A, and is now part of the approved environmental monitoring program.

The Fulton Creek watershed contains the bulk of the decommissioned tailings deposited during operations. Within the Fulton Creek watershed the permanent, routinely sampled stations (from upstream to downstream) include:

- **AN-3** - Fulton Lake (represents un-impacted or background condition).
- **TL-3** - Discharge of Fookes Reservoir.
- **TL-4** - Discharge of Marie Reservoir.
- **TL-6** - Discharge of Minewater Reservoir (which flows into Meadow Fen).
- **TL-7** - Discharge of Meadow Fen upstream of Greer Lake.
- **TL-9** - Fulton Creek below the discharge of Greer Lake and before it enters Beaverlodge Lake.

Additional permanent sampling stations located downstream of the Beaverlodge site include:

- **BL-3** - Located in Fulton Bay, Beaverlodge Lake immediately opposite the Fulton Creek discharge.
- **BL-4** - Located in a central location within Beaverlodge Lake.
- **BL-5** – Outlet of Beaverlodge Lake.
- **ML-1** – Outlet of Martin Lake.
- **CS-1** – Crackingstone River at Bridge.
- **CS-2** – Crackingstone Bay in Lake Athabasca.

As part of the revised water sampling program in 2011, stations BL-5, ML-1, CS-1, and CS-2 were added while sampling of station AN-4, located in Martin Lake, was discontinued as a component of the environmental monitoring program moving forward.

Figures 4.3.1-1 to 4.3.3-20 are graphical representations of the historical annual average concentrations of U, ^{226}Ra, Se and TDS at each station compared to the relevant COOs or SSWQO values. In the interest of completeness, where data collected during the final six years of operation (1977-1982) was available, it has also been included in the graphs. It should be noted that selenium (Se) monitoring began at selected water stations in 1996. Prior to 1996 Se was not identified as a contaminant of concern at Beaverlodge. As there are no guidelines for ^{226}Ra or TDS under the current SSWQO no comparison to guidelines has been made.

Sections 4.3.1 to 4.3.2 cover the water quality results and trends at each of the water quality stations within each watershed. Trends are noted through visual interpretation of the graphs and include trends in the short term (less than 5 years) and in the long term-trends (10 to 30 years). For the purposes of this report, no statistical methods were applied in the discussion surrounding trends at each station.

Table 4.2.1 compares the 2012 average water quality concentrations for stations where COOs were established at the time of decommissioning. Operational and model predictions for the stations AC-14, TL-7, and BL-4 are presented in Table 4.3-1. Table 4.3-2 summarizes whether each station has met the COO in the current reporting year.

The detailed water quality results for the current reporting period, January 2012 to December 2012, are provided in Appendix A.

4.3.1 Ace Creek Watershed

AN-5

Station AN-5 is located in Pistol Creek downstream of the decommissioned Hab satellite mine (Figure 4.3). It is one of the four stations identified in the Eldorado decommissioning documents (*Eldorado 1982*) at which COOs are applied. During the 2012 reporting period, concentrations of U and TDS met their respective COOs while ^{226}Ra did not. The annual averages can be seen in Table 4.3.1-1. There were a total of six scheduled samples in 2012 with only five samples collected due to lack of water flow in March 2012.

Uranium values have shown seasonal fluctuation which affects the annual average resulting in the COO for U being met since 2009. Overall, the long-term trend for U at AN-5 has shown a decrease in concentrations post-decommissioning.

The long-term trend for ^{226}Ra has shown a gradually increasing trend with considerable fluctuation from year to year. In 2012, the average ^{226}Ra concentration was 0.554 Bq/L, decreasing from the 2011 ^{226}Ra average of 0.958 Bq/L.

As with U values, TDS concentrations exhibit seasonal fluctuation that affect the annual average; however, the long-term trend has remained relatively consistent and below the COO following decommissioning. This trend has continued for 2012.

Selenium values at AN-5 have followed the short-term trend, continuing to be well below the SSWQO of 0.001 mg/L since 2001.

All parameters, except for ^{226}Ra, are meeting the COOs for the current reporting period (Table 4.2.1). A historical summary of U, ^{226}Ra, TDS and Se concentrations at AN-5 are presented in Figures 4.3.1-1 to 4.3.1-4.

DB-6

Station DB-6 is located in Dubyna Creek, downstream of Dubyna Lake and the decommissioned Dubyna satellite mine, before the creek enters Ace Creek, upstream of Ace Lake (Figure 4.3). It is one of the four stations identified in the Eldorado decommissioning document (*Eldorado, 1982*) at which COOs are applied.

All parameters were at or below the established COOs during the 2012 reporting period at this station.

Uranium concentrations at DB-6 are currently below the COO for 2012 and have shown a steadily decreasing trend in the long term, with U levels meeting the COO in three of the last six years. The average U concentration decreased from 0.252 mg/L in 2011, to 0.197 mg/L in 2012. Efforts have been made in 2011 and 2012 to plug three flowing boreholes identified along the shoreline of Dubyna Lake. With these boreholes now plugged it is anticipated that U concentrations in Dubyna Lake should continue to decrease.

The long-term trend for ^{226}Ra and TDS at DB-6 has been consistent, with annual averages for ^{226}Ra and TDS meeting the COOs since 1981 and 1983 respectively. Concentrations of these parameters recorded during the 2012 reporting period are consistent with the long-term trend.

The water quality trend for Se at DB-6 has remained below the SSWQO since 2002.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station DB-6 are presented in Figures 4.3.1-5 to 4.3.1-8. The annual averages for 2007 to 2010 compared to this current reporting period can be seen in Table 4.3.1-2.

AC-6A

AC-6A is located at the discharge of Verna Lake to Ace Lake (Figure 4.3). Water quality monitoring at this station began in May 2010; however, due to low flow only the May 2010 sample was able to be collected. The station was dry in 2011 and no water samples were able to be collected or analysed. There is no data available prior to 2009 or for 2011. Two water samples were collected in 2012, with results showing considerable variation compared to data collected in 2010. This is presented in Table 4.3.1-3. Detailed results are provided according to sample date in Appendix A.

As station AC-6A was added to the water sampling program in 2010, there is not enough data to assess trends. As the current SSWQO do not include ^{226}Ra or TDS comparisons have been made to the COOs. The data is presented graphically in Figures 4.3.1-9 to 4.3.1-12.

AC-8

Station AC-8 is located at the discharge of Ace Lake into Ace Creek. Ace Lake is the receiving environment for waters discharged from DB-6, AN-5 and AC-6A (Figure 4.3). Annual averages for 2007 to 2011, as well with the averages from the current reporting period, can be found in Table 4.3.1-4. Long-term trends for concentrations of U and TDS have remained relatively stable at this station since 1982. The long term-trend for ^{226}Ra has shown a decrease in the annual concentrations at this station.

Selenium only recently became a part of the routine monitoring program at AC-8, in August of 2009. As a result, there are not enough data points to confidently discuss trends with respect to the long term; however, Se concentrations are below the SSWQO.

As the current SSWQO do not include 226Ra or TDS comparisons have been made to the COOs. A historical summary of U, ^{226}Ra, TDS, and Se annual average concentrations for station AC-8 are presented in Figures 4.3.1-13 to 4.3.1-16.

AC-14

AC-14 is located in Ace Creek at the discharge into Beaverlodge Lake (Figure 4.3). It is one of the four stations identified in the Eldorado decommissioning document (*Eldorado 1982*) at which COOs are applied. The long-term trend for annual average concentrations of U and TDS measured at this station has been consistent with concentrations below the COOs since the decommissioning of the Beaverlodge mine/mill complex. Concentrations of ^{226}Ra remained above the COOs until 1990-91, however; the long-term trend has shown concentrations near or below the objective since 1991.

During the 2012 reporting period, U, ^{226}Ra, and TDS were below the COOs, while Se was below the SSWQO. Annual average concentrations from 2007 to 2011, with the averages for 2012 can be found in Table 4.3.1-5.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station AC-14 are presented in Figures 4.3.1-17 to 4.3.1-20.

4.3.2 Fulton Creek Watershed

AN-3

AN-3 is located at the outflow of Fulton Lake prior to Fookes Reservoir and was not impacted by mining activities in the area (Figure 4.3). Water quality at this station is typical of background water quality in the region. Since 1986, sampling has been on an annual basis. Due to low flows in the region, samples were not able to be collected in 2010 or 2011. The only sample scheduled for 2012 was in September.

As expected with a reference location, the long-term trend for concentrations of U, TDS, Se and ^{226}Ra recorded at AN-3 have remained relatively stable and below the SSWQO. Selenium concentrations at AN-3 have been at or below detectable laboratory limits since routine analysis began in 2000.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station AN-3 are presented in Figures 4.3.2-1 to 4.3.2-4. The annual average values are also presented in Table 4.3.2-1 for the years of 2007 to 2009 and 2012.

TL-3

TL-3 is located at the discharge of Fookes Reservoir and is the first sampling location in the recovering tailings management system area (Figure 4.3). Water had not been flowing at TL-3 since May 2010, until freshet in the spring of 2012. Three samples were taken in 2012 due to a lack of flow in March 2012.

Overall, the long-term trend for mean concentrations of U, TDS, and Se has shown a decrease since 1990. The long-term trend for ^{226}Ra has been increasing slightly post-decommissioning.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station TL-3 are presented in Figures 4.3.2-5 to 4.3.2-8. The annual averages from, 2007 to 2010, and the average for the current reporting period can be found in Table 4.3.2-2.

TL-4

TL-4 is located within Fulton Creek drainage downstream of TL-3 and at the discharge of Marie Reservoir (Figure 4.3). Water had not been flowing at TL-4 since October 2010, thus there is no data available for the latter part of 2010 and for all of 2011. Water began flowing in the spring of 2012, as such, only three of the scheduled four samples were collected.

Annual concentrations of U and TDS at TL-4 have shown a considerable decrease over the long term. Selenium has shown a slow and steady reduction over time while ^{226}Ra has shown a slight increase since decommissioning.

The 2012 averages show a decrease in U, TDS, and Se compared to previous reporting periods. The comparison of these numbers can be seen in Table 4.3.2-3.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station TL-4 are presented in Figures 4.3.2-9 to 4.3.2-12.

TL-6

TL-6 is located at the discharge of Minewater Reservoir which was used for tailings deposition in 1953 and settling of treated mine water during the last 10 years of Beaverlodge mill operations (Figure 4.3). During decommissioning activities the water level in Minewater Reservoir reduced and efforts were made to relocate sediment sludge to the Fay shaft.

This water station generally exhibits ephemeral flows. As a result, only one sample was collected in 2010, with no water collected in 2011. Four samples have been collected in 2012. Despite the removal of contaminated sediment from Minewater Reservoir at decommissioning the long-term trend for U and TDS at TL-6 showed a sharp decrease in concentrations post-decommissioning.

The long-term trend for annual concentrations of ^{226}Ra has shown considerable fluctuation over the past fifteen years ranging from 1.3 Bq/L in 1996 to 5.6 Bq/L in 2010. In 2012, the average ^{226}Ra concentration is 5.35 Bq/L. During the same time period, concentrations of sulphate have been decreasing while barium has demonstrated a trend similar to that observed in ^{226}Ra. Cameco hypothesizes this is a result of dissolution of remnant barium-radium-sulphate precipitate that was generated during the active treatment of minewater during operations. The annual average concentrations for 2008 to 2010 and the current reporting period can be found in Table 4.3.2-4.

Monitoring of Se at TL-6 was initiated in 1996, with concentrations fluctuating until 2004. As with U and TDS, the short-term trend for Se concentrations has stabilized in recent years.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station TL-6 are presented in Figures 4.3.2-13 to 4.3.2-16.

TL-7

TL-7 is located at the discharge of Meadow Fen (Figure 4.3). It is one of the four stations identified in the Eldorado decommissioning document (*Eldorado 1982*) at which COOs are applied.

Out of the twelve scheduled samples for the 2012 reporting period, only eight samples were collected due to lack of water flow from January to March, and December. During the 2012 reporting period, ^{226}Ra and U did not meet the COOs established for this station, however the original predictions made by SENES in 1983 indicated that U concentrations would only meet the COOs in the long term (more than 200 years), while TDS and ^{226}Ra were not expected to meet COOs at any point in the foreseeable future.

As observed with stations TL-3, TL-4 and TL-6 mean annual U concentrations have shown a decreasing long-term trend since 1990. The 2011 average concentration for U was 0.197 mg/L, which is below the COO; however 2012 has seen a return to more historical concentrations at 0.264 mg/L. The annual averages for 2007 to 2011, and the current reporting period can be found in Table 4.3.2-5.

While the annual average for ^{226}Ra has been increasing overall since 1984, the 2011 and 2012 values have been lower than values reported since 2000.

The trend for TDS at TL-7 has been stable over the last 10 years. TDS was above the COO of 250 mg/L in 2010 and 2011, but in 2012 is below the objective, having decreased to 239 mg/L from 309 mg/L. Selenium concentrations at TL-7 have been stable with minor fluctuations. A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station TL-7 are presented in Figures 4.3.2-17 to 4.3.2-20.

TL-9

TL-9 is located downstream of Greer Lake immediately before the water enters Beaverlodge Lake. Sampling at this station began in 1981 and continued until 1985 at which time it was discontinued. Sampling resumed in 1990 in order to re-assess the water quality entering Beaverlodge Lake. There had not been any water flowing at TL-9 since May 2010, and it began to flow again in May 2012. As a result, there were only eight months out of twelve with reportable data. Average concentrations at TL-9 for 2007 to 2010, compared to 2012, can be found in Table 4.3.2-6.

The long-term trend for U at TL-9 has shown a decrease in concentration following decommissioning. Concentrations in the short term have been stable, with a decrease in U from 0.484 mg/L to 0.349 mg/L, between 2010 and 2012.

Radium concentrations have seen an overall increasing trend since 1990 and displayed some fluctuation over the past twenty years.

Concentrations of TDS have shown a decreasing trend in the long term. Annual average TDS concentration has been consistent in the short term, with a slight increase observed in 2010. The 2012 average followed the decreasing trend at 250 mg/L as compared to the 2010 average of 308 mg/L.

Routine monitoring of Se at TL-9 was not conducted until 1996 at which time it was identified as a contaminant of concern. Although Se concentrations are above SSWQO, as with U and TDS, Se had shown a decreasing trend over the long term.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station TL-9 are presented in Figures 4.3.2-21 to 4.3.2-24. Long term trends have been compared to COOs established for TL-7 water samples collected from TL-9 represent the water flowing into Beaverlodge Lake from the Tailings Management Area.

4.3.3 Other Transition Phase Monitoring Stations

BL-3

BL-3 is located in Beaverlodge Lake, approximately 100 m from the Fulton Creek discharge (TL-9) (Figure 4.3). Sampling at this station was originally carried out during the operational mining and milling phase in order to monitor the near-field impacts of operations on Beaverlodge Lake.

Post-decommissioning collection of samples at this location commenced during the 1998-99 reporting period, and has continued since that time. Sampling frequency increased from semi-annual to quarterly in 2004-05 in order to better assess the conditions in Beaverlodge Lake.

The long-term trend for annual average concentrations of U, TDS and Se at BL-3 has remained relatively consistent from 1998 to 2012. Concentrations of ^{226}Ra have trended downward over the last 10 years.

Concentrations of Se are typically around 0.003 mg/L and are elevated above the SSWQO.

A historical summary of U, ^{226}Ra, TDS and Se annual average concentrations for station BL-3 are presented in Figures 4.3.3-1 to 4.3.3-4. Table 4.3.3-1 displays a comparison between the 2007-2011 average concentrations and the current reporting period averages.

BL-4

Station BL-4 is located in the approximate center of the north end of Beaverlodge Lake (Figure 4.3). The sampling frequency was increased from semi-annual to quarterly in 2004-05 in order to better reflect any potential changes or trends. Following approval of the revised water sampling program, semi-annual sampling was resumed in 2011 at BL-4.

The long-term trend for U and ^{226}Ra at BL-4 has shown an overall decreasing trend, while TDS has been relatively consistent. Se concentrations have fluctuated over the long term; however, the recent short-term trend has remained stable. All of the measured parameters and their average concentrations at BL-4 for 2007 to 2011, and the current period can be found in Table 4.3.3-2.

Historical sampling results are presented in Figures 4.3.3-5 to 4.3.3-8.

BL-5

Station BL-5 is located at the Beaverlodge Lake outlet (Figure 4.3). It was implemented in the revised water sampling program in January 2011 in order to provide a point of reference to compare Beaverlodge Lake water quality and downstream Martin Lake water quality. As a result, there is only data for 2011 and 2012. Previous reporting period averages were not available for BL-5, so the average concentration for 2011 and 2012 are listed in Table 4.3.3-3.

Both U and Se exceed the SSWQO at BL-5. Discussion of trends is not yet appropriate since the only data available is for 2011 and 2012. The data is presented graphically in Figures 4.3.3-9 to 4.3.3-12.

ML-1

Station ML-1 is located at the outlet of Martin Lake. Sampling of this station began in 2011, thus there is no data available prior to this.

For the 2012 reporting period, U was above the SSWQO whereas Se was below at 0.0008 mg/L. Discussion of trends is not yet appropriate since the only data available is for 2011 and 2012. A table comparing the average concentrations for all measured parameters between 2011 and 2012 can be found on Table 4.3.3-4.

The data is presented graphically in Figures 4.3.3-13 to 4.3.3-16.

CS-1

Station CS-1 is located at the outlet of Martin Lake near the bridge in Crackingstone River (Figure 4.3). Its purpose is to monitor water quality downstream from Uranium City. This station was implemented as part of the water sampling program in January 2011 with the first sampling scheduled in September 2011.

The U concentration was measured at 0.057 mg/L, while the ^{226}Ra activity was measured to be 0.006 Bq/L. The figures for CS-1 can be found in the figures section under Figure 4.3.3-17 to 4.3.3-20. Selenium was measured to be 0.0009 mg/L, while TDS was 125 mg/L.

The measured parameter concentrations can be seen in Table 4.3.3-5.

CS-2

Station CS-2 is located in Crackingstone Bay in Lake Athabasca (Figure 4.3). As with station CS-1, station CS-2 is newly implemented and therefore the only data is from 2011 and 2012.

SSWQO for all parameters are met at this station. The U concentration measured in 2012 was 0.0048 mg/L, the ^{226}Ra activity in 2012 was measured to be 0.009 Bq/L, and the Se concentration was 0.0001 mg/L. The measured parameter concentrations can be seen in Table 4.3.3-6 with U, Se, ^{226}Ra and TDs trends presented in Figures 4.3.3-21 to 4.3.3-24.

4.4 Hydrology

4.4.1 Introduction

MacLaren Plansearch initially estimated the stream flows for various locations within the Ace Creek and Fulton Creek drainage basins in 1983 (*MacLaren Plansearch 1983*) as part of the Eldorado Resources Ltd. decommissioning documentation. During the 1996-97 reporting period revisions were made to both the Ace Creek and Fulton Creek stream flow estimates using 10 years of actual flow.

A review of post closure monitoring was conducted using data from 1983 to 1996, and confirmed the 1983 estimates were low. A re-assessment of the hydrology in the Beaverlodge area was subsequently conducted as part of the *Current Period Environmental Assessment* (*Connor Pacific 1999*).

In summary, the original (1983) streamflow for the predicted shut down and reclamation scenarios (SENES 1983) were:

- 150 L/s at AC-14
- 7.5 L/s at TL-7

The revised (TAEM 1997) streamflow predictions were:

- 426 L/s at AC-14
- 16 L/s at TL-7

4.4.2 Hydrological Data and Loading Calculations

McElhanney Consulting Service Ltd. was retained by Cameco to complete an assessment of the stage and flow data for stream flow monitoring stations at Fulton Creek (TL-7) and Ace Creek (AC-8) for the period January 1, 2012 to December 31, 2012. The report can be found in Appendix B.

At AC-8, spring runoff waters were measured at the highest recording value for the past seven years. The May stream-flow discharge at AC-14 was 2467 L/s as compared to the May discharge in 2011 of 299 L/s. According to the McElhanney report, TL-7 appears to be recovering more slowly from the regional drought experienced over the last couple of years, which will result in the storage areas connected to this system recharging. The 2012 flow rates at TL-7 from May to December are the highest since 2009, but still below the long term average flow.

Using the monthly water quality monitoring data for AC-14 and TL-7 along with the corresponding average monthly streamflow data for Ace Creek and Fulton Creek the total loading of U, ^{226}Ra, Se and TDS can be calculated. The total loading from the former Eldorado properties to Beaverlodge Lake can then be calculated by adding both Ace Creek and Fulton Creek loadings, for each parameter.

Total environmental loadings of U, ^{226}Ra, TDS, and Se to Beaverlodge Lake in 2012 from TL-7 and AC-14 have been calculated and are reported in Tables 4.4.1 and 4.4.2 respectively.

Table 4.4.3 provides a comparison of the total 2012 loadings from AC-14 and TL-7 to model predictions made at the time of decommissioning. The loading requirement identified at decommissioning states “annual radioactive and non-radioactive contaminant loadings to the environment would not be greater after close-out than those which occurred during operations” *(Eldorado 1983)*. A review of this information shows the loading of U, 226Ra and TDS to Beaverlodge Lake in 2012 was below that measured during operations.

The loadings predicted for U under the maximum and minimum reclamation scenarios described in Table 4.4.3 were not met in 2012. The average concentration from Station AC-14 met the long term prediction. The higher than average flows in 2012 resulted in the measured load of uranium from this station being higher than the predictions made at decommissioning.

Comparisons for Se loadings with the estimated operational loadings and predicted shutdown loadings are not possible as Se was not monitored until after decommissioning.

4.5 Air Quality

This section presents a summary of the results of historic and on-going radon monitoring at ten separate locations in and around the mill site, various satellite areas and at Uranium City.

4.5.1 Ambient Radon Monitoring

As part of the transitional phase ongoing monitoring program, radon levels have been monitored on and around the Beaverlodge mine and mill site and at other locations in the region since 1985. The sampling regime uses Terrace, track-etch type radon gas monitors (Tech/Ops Landauer Inc. Glenwood, Illinois). Monitors are collected and replaced semi-annually from ten stations established throughout the area.

The ten radon monitoring stations are illustrated in Figure 4.5.1-1 and are located in the following areas:

- Airport Beacon
- Eldorado Town Site
- Northwest of the Airport
- Ace Creek
- Fay Waste Rock Pile
- Fookes Delta
- Marie Lake Delta
- Donaldson Lake
- Fredette Lake, and
- Uranium City.

Track-etch cups were set out at ten stations in the Beaverlodge area from January 2012 and to July 2012 then again from July 2012 to January 2013. Table 4.5.1 presents a summary of the radon monitoring conducted at the ten sites for the 2012 monitoring period and compares it to the previous six years data. Although the entire suite of stations monitored in 1982 is not applicable for comparison to the current monitoring results, applicable stations have been included in the summary and Figure 4.5.1-2 compares the most recent seven years of data to operational levels.

4.6 Five-Year Inspection of the Marie Reservoir Outlet structure and the Fookes Delta and Outlet Structure

The next third-party inspection of Marie Reservoir outlet structure and the Fookes Delta and outlet structure will occur in 2016.

Annual inspections of the Marie and Fookes Reservoir outlet structures and Fookes Delta are completed by Cameco during the JRG inspection and the results are provided in Appendix C of this document.

SECTION 5.0
2013 OUTLOOK

2013 OUTLOOK

5.0 2013 OUTLOOK

This section of the report describes those tasks planned for the next calendar year. A detailed list of studies and activities conducted from January 1, 2012 to December 31, 2012 are presented in Section 3.0.

5.1 Regular Scheduled Monitoring

Representatives of Cameco continue to implement the Beaverlodge Environmental Monitoring Program, assessing:

- water
- radon in air
- regional hydrology, and
- sealed boreholes and seeps

5.2 Planned Public and AEQC Meetings

A meeting will be held with AEQC and residents of Uranium City in January 2013 to discuss the additional remedial options and related performance objectives described in the Path Forward Report, which will form the basis for the 10-year license request at the CNSC public hearing planned for April 2013.

Each year in May or June Cameco hosts a public meeting in Uranium City to review the results of any activities completed since the previous meeting and to review the plans for the upcoming year, including any activities or planned studies that are to be completed.

A meeting is held, usually in September, with the AEQC and residents of Uranium City. At this meeting an update on current and planned activities is presented, followed by a tour of the licensed properties.

5.3 Planned Regulatory Inspections

The JRG conducts an annual inspection of the Beaverlodge properties in conjunction with the annual Uranium City public meeting in May/June. The regulatory inspection involves travelling to the Beaverlodge properties and checking that conditions remain in a safe, stable, and secure condition. In addition, activities to address previous inspection recommendations are assessed to confirm that the activity was completed to the satisfaction of the regulatory agencies.

As discussed in Section 4.5 annual inspections of the Marie and Fookes Reservoir outlet structures and Fookes Delta cover are completed by Cameco during the JRG inspection with the results provided in a report format. The next scheduled third party inspection of these areas is 2016.

5.4 2013 Work Plan

Cameco has prepared a path forward workplan which describes the site activities required to address residual human health and ecological risk while demonstrating conditions on the properties are stable and/or improving. The workplan has been vetted through the JRG and reviewed with local and regional stakeholders. Ultimately, the Beaverlodge properties are being managed for acceptance into the provincial IC program, and future works undertaken will support the management framework established to move towards this goal.

The following section provides a description of activities planned for 2013.

5.4.1 Development of Beaverlodge Program Documents

The Beaverlodge Facility License Manual (FLM) was submitted in 2012 and describes at a high level the key principles and programs in place for managing the properties associated with the decommissioned Beaverlodge mine/mill. The development of additional relevant program level documents for the management of the Beaverlodge site will be developed in early 2013 in support of CNSC re-licensing. The intent of the program documents is to describe, in more detail that the FLM, the processes and activities followed to ensure ongoing and successful management of the Beaverlodge properties.

Public Information Program (PIP)

Providing timely and relevant information to local stakeholders has always been a priority with the management of the Beaverlodge site. Development of the PIP will formalize the process currently being followed ensuring that Cameco’s activities or plans at the decommissioned Beaverlodge properties are effectively communicated to the public in a manner that complies with established guidelines. It will be based on the PLAN-DO-CHECK-ACT model outlined in internationally recognized management standards.

Property Description Manual (PDM)

Development of the PDM will document the boundaries of the current licensed properties as well as the key features within the decommissioned Beaverlodge mine/mill site. It will also provide clarification to the 2006 Beaverlodge Surface Lease Agreement property names and locations.

Environmental Monitoring Program (EMP)

Development of the EMP aims to provide the core environmental monitoring requirements for the decommissioned Beaverlodge mine/mill. It is intended to satisfy the requirements outlined in the Beaverlodge SLA as well as those changes to the water quality monitoring program approved by the CNSC and SMOE.

Quality Management Program (QMP)

The QMP is used to define and describe how the QMP provides organization and processes that are used to manage activities on the site and ensure consistent and systematic application of the Beaverlodge Management Framework. The QMP aims to align and integrate site management policies that are consistent with Cameco's SHEQ policy.

5.4.2 Reports and Documentation

State of Environment Report

The Beaverlodge Surface Lease Agreement with the Province of Saskatchewan requires Cameco to submit a State of Environment (SOE) report every five years summarizing the information gathered through routine monitoring and special studies during the previous term. The original SOE was prepared in 2008, summarizing all information gathered since decommissioning. The second SOE report is due in 2013 and will incorporate all information gathered from 2008 through the end of 2012. Most information gathered during the current SOE term supported the development of the Beaverlodge QSM, which will be used as the basis for preparing the 2013 SOE report.

Release of Eagle 12 Zone and Martin Lake Adits

In 2012 Cameco submitted a request to SMOE for release from decommissioning and reclamation of the Martin Lake adit sites, RA-6 and RA-9. Comments were received from SMOE and the CNSC requesting additional information. Cameco intends to provide a response to the SMOE and CNSC addressing their concerns, as well as prepare documentation to support transferring Eagle 12 Zone to the provincial IC program.

5.4.3 Activities in Support of the Path Forward

Site Wide Gamma Monitoring

Cameco intends to initiate a site-wide gamma scanning program to quantify residual site specific gamma levels. The initial focus of the program will be on areas of known tailings spills and elevated gamma. The results of this monitoring will be assessed through the Beaverlodge Management Framework to determine if additional site specific remediation is warranted. In addition, a detailed gamma survey of the licensed properties is required prior to transferring properties to the IC program.

Ace Creek Watershed Hydrologic Monitoring

This program will continue the monitoring that has been carried out since 2010 to improve the understanding of the flows originating in the various sub-watersheds feeding Ace Creek. This information is used to update the pathways model predictions for the Ace Creek area.

Shaft Cover Assessment

A plan and method for sealing surface openings was submitted and approved by the regulatory agencies in 1982. All horizontal and vertical openings are currently capped. The plan and method described in 1982 and approved by the regulatory agencies outlines a set of principles to be followed for closing mine openings but does not provide “as-built drawings” detailing exactly how the opening was decommissioned. The province of Saskatchewan will require engineer stamped documentation regarding the shaft closure method prior to properties being considered for transfer to the IC program.

Over the next two years (2013/2014) Cameco will locate and assess all vertical mine caps (raises and shafts) and develop a plan to replace the current caps with an engineer designed and stamped cover, with appropriate documentation to facilitate the properties transfer to the IC program. The timing of cap replacement will be prioritized based on an assessment of condition and potential risk.

Detailed engineering for the Zora/Verna stream diversion

As outlined in the Beaverlodge Path Forward Report (*Cameco 201*2), Cameco plans to re-establish the ephemeral flow path from Zora Creek into Verna Lake by excavating a channel through the Bolger waste rock pile. The Bolger waste rock pile currently impedes that flow path, which is traveling through the base of the pile and contributing a contaminant load to Verna Lake. SRK Consulting (Canada) developed conceptual level design and costs of this remedial option. Predicted costs were revised in the Path Forward document based on more detailed information.

This remedial option is predicted to have a measureable benefit to the water quality in Verna Lake and meets the standard of good engineering practice. In the first phase of implementing this option Cameco will engage qualified engineering firms to develop a detailed design and cost estimate to complete this project. It is anticipated the detailed engineering will be completed in 2013 and submitted to the regulatory agencies for approval, with implementation planned for 2014/2015.

Development of Regional Monitoring Program

In addition to the routine water quality monitoring described in the Beaverlodge Environmental Monitoring Program, Cameco, in partnership with Saskatchewan Research Council, will engage the JRG and local stakeholders to establish a regional monitoring program to monitor regional environmental recovery of the Uranium City mining district. The program will be initiated following consultation with relevant stakeholders and regulatory acceptance, and will likely continue after all licensed properties have been transferred to the IC program. The regional monitoring program will provide a tool for assessing the long-term recovery predictions made in the Beaverlodge Path Forward report for Beaverlodge Lake and the downstream environment.

SECTION 6.0
REFERENCES

REFERENCES

6.0 REFERENCES

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TABLES

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Table 4.1.1
Summary of Applicable Water Quality Objectives

Parameter	Units	Close Out Objectives[1]	SSWQO For the Protection of Aquatic Life[2]	Canadian Water Quality Guidelines for the Protection of Aquatic Life[3]	Saskatchewan Municipal Drinking Water Quality Objectives[4]	Guidelines for Canadian Drinking Water Quality[5]
Ammonia, Total	mg/L	-	-	1.37 at pH 8.0:10°C 2.20 at pH 6.5:10°C	-	-
Arsenic	mg/L	0.01	0.005	0.005	0.025	0.01
Barium	mg/L	-		-	1	1
Cadmium	mg/L	-	0.017 at [CaCO$_3$]=0-48.5 µg/L 0.032 at [CaCO$_3$]=48.5-97 µg/L 0.058 at [CaCO$_3$]= 97-194 µg/L 0.10 at [CaCo3] >194 µg/L	$10^{\{.86[\log(hardness)]-3.2\}}$	0.005	0.005
Chromium	mg/L	-	0.001 (Cr VI)	Cr(III) 0.0089 Cr(VI) 0.001	0.05	0.05
Copper	mg/L	0.02	0.002 at [CaCO$_3$]=0-120 mg/L 0.003 at [CaCO$_3$]=120-180 mg/L 0.004 at [CaCO$_3$] >180 mg/L	0.002 at [CaCO$_3$]=0-120 mg/L 0.003 at [CaCO$_3$]=120-180 mg/L 0.004 at [CaCO$_3$] >180 mg/L	1	1
Iron	mg/L	0.3	0.3	0.3	0.3	0.3
Lead	mg/L	0.05	0.001 at [CaCO$_3$]=0-60 mg/L 0.002 at [CaCO$_3$]=60-120 mg/L 0.004 at [CaCO$_3$]=120-180 mg/L 0.007 at [CaCO$_3$] >180 mg/L	0.001 at [CaCO$_3$]=0-60 mg/L 0.002 at [CaCO$_3$]=60-120 mg/L 0.004 at [CaCO$_3$]=120-180 mg/L 0.007 at [CaCO$_3$] >180 mg/L	0.01	0.01
Mercury	mg/L	-	0.000026	0.000026	0.001	0.001
Nickel	mg/L	-	0.025 at [CaCO$_3$]=0-60 mg/L 0.065 at [CaCO$_3$]=60-120 mg/L 0.110 at [CaCO$_3$]=120-180 mg/L 0.150 at [CaCO$_3$] >180 mg/L	0.025 at [CaCO$_3$]=0-60 mg/L 0.065 at [CaCO$_3$]=60-120 mg/L 0.110 at [CaCO$_3$]=120-180 mg/L 0.150 at [CaCO$_3$] >180 mg/L	-	-
pH	-	6.5 – 9.5	-	6.5 – 9.0	6.5 – 9.0	6.5 – 8.5
Radium 226	Bq/L	0.11	-	-	-	-
Selenium	mg/L	-	0.001	0.001	0.01	0.01
Silver	mg/L	-	0.0001	0.0001	-	-
TDS	mg/L	250	-	-	1500	500
TSS	mg/L	BkGd + 10	-	-	-	-
Uranium	mg/L	0.25	0.015	-	0.02 (Amended 2002)	0.02
Zinc	mg/L	0.05	0.03	0.03	5	5

1 Close Out Objectives, Atomic Energy Control Board, 1982
2 Saskatchewan Surface Water Quality Objectives for the Protection of Aquatic Life, Interim Edition, 2006.
3 Canadian Water Quality Guidelines for the Protection of Aquatic Life, CCME, 2006
4 Saskatchewan Drinking Water Quality Standards and Objectives EPB207/2002, 2002.
5 Guidelines for Canadian Drinking Water Quality, Health Canada, 2007.

Table 4.2.1
January 2012 – December 2012 Average versus Close-Out Objectives

Parameter	Unit	AC-14	AN-5	DB-6	TL-7	TL-9[1]	Close-Out Objective
Arsenic	(µg/L)	0.2	0.3	0.1	1.7	1.9	**10**
Barium	(mg/L)	0.024	0.112	0.047	0.199	1.099	**1**
Copper	(mg/L)	0.001	0.002	0.001	0.001	0.001	**0.02**
Iron	(mg/L)	0.070	0.149	0.017	0.148	0.055	**0.3**
Nickel	(mg/L)	0.00023	0.00058	0.00018	0.00069	0.00044	**0.05**
Lead	(mg/L)	0.0003	0.0002	0.0001	0.0004	0.0009	**0.025**
Radium 226	(Bq/L)	0.042	0.554	0.030	0.880	2.450	**0.11**
TDS	(mg/L)	87.08	158.20	155.5	239.38	250.38	**250**
TSS	(mg/L)	1.083	1.200	1.167	1.000	1.625	**Background + 10**
Uranium	(µg/L)	34.9	127.2	197.3	264.3	349.3	**250**
Zinc	(mg/L)	0.001	0.003	0.001	0.001	0.001	**0.05**

1-Close-out Objectives were not specified for TL-9, however it is included as it is located at the discharge of the decommissioned tailings management area, immediately before the water enters Beaverlodge Lake.

Table 4.3 – 1
Operational and Predicted Water Quality Values

Scenario	Ace Creek (AC14)			Meadow Lake (TL7)			Beaverlodge Lake (BL4)		
	U (mg/L)	^{226}Ra (Bq/L)	TDS (mg/L)	U (mg/L)	^{226}Ra (Bq/L)	TDS (mg/L)	U (mg/L)	^{226}Ra (Bq/L)	TDS (mg/L)
Operation Phase	0.65	0.22	174	4.06	0.44	1793	0.2	0.11	150
Predicted at Shutdown	0.035	0.06	129	3.16	0.53	1130	0.2	0.11	150
Minimum Reclamation (Long Term Predicted*)	0.035	0.06	129	0.1	0.38	389	0.03	0.06	128
Maximum Reclamation (Long Term Predicted*)	0.03	0.06	125	0.1	0.27	414	0.03	0.06	127

* Long term indicates a 200 year time period.

Table 4.3 – 2
Transition Phase Monitoring – Year 27 (January 2012-December 2012)

	AC14	*AN5*	*DB6*	*TL-7*	*AC14*	*TL-7*
	Close Out Objective Concentration				*Model Long Term* Concentration Predicted at Shutdown v. Actual Results*	
Parameter	Met	Met	Met	Met	Met	Met
Arsenic	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Barium	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Copper	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Iron	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Nickel	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Lead	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Radium-226	**Y**	**N**	**Y**	**N**	**Y**	**N**
TDS	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
TSS	**Y**	**Y**	**Y**	**Y**	**-**	**-**
Uranium	**Y**	**Y**	**Y**	**N**	**Y**	**N**
Zinc	**Y**	**Y**	**Y**	**Y**	**-**	**-**

Y – Yes **N** – No

* Long term indicates a 200 year time period.

Table 4.3.1 – 1 AN-5 Summary Statistics and Comparison to Historical Results

Hab Site - upstream of confluence of Hab and Pistol creeks

Physical Properties	**Previous Period Averages**					**Current Reporting Period**	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	281	287	195	313	260	235	5
pH-L (pH Unit)	7.82	7.77	7.66	7.60	7.51	7.61	5
TSS (mg/L)	1.167	5.833	2.000	2.167	4.750	1.200	5
Major Ions							
Alk-T (mg/L)	121.7	135.2	88.2	145.3	115.3	105.4	5
Ca (mg/L)	39.7	40.8	27.0	43.0	35.8	33.6	5
Cl (mg/L)	1.38	1.37	0.74	1.68	1.25	1.08	5
CO3 (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	5
Hardness (mg/L)	136	142	95	150	125	116	5
HCO3 (mg/L)	150.2	164.7	107.8	177.7	140.5	128.6	5
K (mg/L)	1.4	1.9	1.4	2.0	1.7	1.5	5
Mg (mg/L)	9.5	9.7	6.7	10.3	8.7	7.8	5
Na (mg/L)	5.3	5.2	3.2	6.0	4.8	4.2	5
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	5
SO4 (mg/L)	25.5	18.3	14.5	18.2	17.8	17.2	5
Sum of Ions (mg/L)	193	242	161	259	211	194	5
TDS (mg/L)	190.33	185.33	136.60	204.33	183.75	158.20	5
Metals							
As (µg/L)	0.3	0.5	0.3	0.5	0.4	0.3	5
Ba (mg/L)	0.167	0.167	0.115	0.178	0.148	0.112	5
Cu (mg/L)	0.001	0.002	0.001	0.001	0.001	0.002	5
Fe (mg/L)	0.219	0.447	0.180	0.557	0.287	0.149	5
Mo (mg/L)	-	-	-	0.003	0.003	0.003	5
Ni (mg/L)	0.00100	0.00100	0.00055	0.00052	0.00047	0.00058	5
Pb (mg/L)	0.0020	0.0020	0.0001	0.0003	0.0001	0.0003	5
Se (mg/L)	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	5
Zn (mg/L)	0.005	0.005	0.001	0.003	0.002	0.003	5
Nutrients							
NH3-N (mg/L)	-	-	-	0.06	0.08	0.01	1
NO3 (mg/L)	-	-	-	0.04	0.05	0.05	5
P-(TP) (mg/L)	-	-	-	0.03	0.01	0.01	1
Radionuclides							
Pb210 (Bq/L)	0.13	0.11	0.03	0.06	0.02	0.04	1
Po210 (Bq/L)	0.050	0.053	0.020	0.035	0.009	0.008	1
Ra226 (Bq/L)	0.695	1.015	0.762	1.142	0.958	0.554	5
U (µg/L)	277.0	294.5	109.0	184.8	140.5	127.2	5
Organics							
C-(org) (mg/L)	-	-	-	12.000	11.000	11.0	1

-Parameter was not analyzed.

Table 4.3.1 – 2 DB-6 Summary Statistics and Comparison to Historical Results

Dubyna Lake discharge at culvert

Physical Properties	Previous Period Averages					Current Reporting Period	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	225	224	218	232	240	230	6
pH-L (pH Unit)	7.95	7.96	7.85	7.80	7.76	7.73	6
TSS (mg/L)	1.200	1.000	1.000	1.000	1.000	1.167	6
Major Ions							
Alk-T (mg/L)	85.3	84.3	85.5	87.0	90.4	90.0	6
Ca (mg/L)	35.2	35.5	34.8	37.0	38.2	37.2	6
Cl (mg/L)	0.80	0.65	0.65	0.66	0.74	0.70	6
CO3 (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	6
Hardness (mg/L)	111	112	109	116	120	116	6
HCO3 (mg/L)	104.0	102.8	104.3	106.2	110.2	109.8	6
K (mg/L)	0.6	0.8	1.0	1.0	0.9	0.9	6
Mg (mg/L)	5.7	5.7	5.3	5.8	6.0	5.6	6
Na (mg/L)	2.2	2.3	2.1	2.2	2.2	2.1	6
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	6
SO4 (mg/L)	28.2	27.8	25.5	28.4	28.8	26.7	6
Sum of Ions (mg/L)	174	175	174	181	187	183	6
TDS (mg/L)	153.40	153.25	150.33	157.60	167.00	155.50	6
Metals							
As (µg/L)	0.1	0.1	0.1	0.1	0.1	0.01	6
Ba (mg/L)	0.047	0.046	0.047	0.047	0.051	0.047	6
Cu (mg/L)	0.001	0.002	0.001	0.001	0.001	0.001	6
Fe (mg/L)	0.016	0.021	0.020	0.015	0.012	0.017	6
Mo (mg/L)				0.002	0.002	0.002	6
Ni (mg/L)	0.00100	0.00100	0.00023	0.00018	0.00020	0.00018	6
Pb (mg/L)	0.0020	0.0020	0.0001	0.0001	0.0001	0.0001	6
Se (mg/L)	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	6
Zn (mg/L)	0.005	0.005	0.001	0.002	0.001	0.001	6
Nutrients							
NH3-N (mg/L)	-	-	-	0.05	0.05	0.01	2
NO3 (mg/L)	-	-	-	0.16	0.33	0.16	6
P-(TP) (mg/L)	-	-	-	0.02	0.01	0.01	2
Radionuclides							
Pb210 (Bq/L)	0.05	0.04	0.02	0.02	0.02	0.02	2
Po210 (Bq/L)	0.015	0.013	0.013	0.007	0.006	0.007	2
Ra226 (Bq/L)	0.040	0.037	0.035	0.030	0.033	0.030	6
U (µg/L)	307.4	280.0	215.5	247.6	252.4	197.3	6
Organics							
C-(org) (mg/L)	-	-	-	8.700	9.100	9.350	2

-Parameter was not analyzed.

Table 4.3.1 – 3 AC-6A Summary Statistics and Comparison to Historical Results

Verna Lake discharge to Ace Lake

Physical Properties	Previous Period Average	Current Reporting Period	
	2010	2012	Count
Cond-L (µS/cm)	298	207	1
pH-L (pH Unit)	7.77	7.19	2
TSS (mg/L)	1.000	1.000	1
Major Ions			
Alk-T (mg/L)	97.0	63.0	2
Ca (mg/L)	43.0	32.0	2
Cl (mg/L)	0.40	0.40	2
CO3 (mg/L)	1.0	1.0	2
Hardness (mg/L)	143	107	2
HCO3 (mg/L)	118.0	77.0	2
K (mg/L)	0.9	1.7	2
Mg (mg/L)	8.8	6.7	2
Na (mg/L)	2.4	1.8	2
OH (mg/L)	1.0	1.0	2
SO4 (mg/L)	51.0	41.0	2
Sum of Ions (mg/L)	225	161	2
TDS (mg/L)	199.00	203.50	2
Metals			
As (µg/L)	0.2	0.3	2
Ba (mg/L)	0.022	0.018	2
Cu (mg/L)	0.001	0.002	2
Fe (mg/L)	0.021	0.095	2
Mo (mg/L)	0.001	0.001	2
Ni (mg/L)	0.00010	0.00030	2
Pb (mg/L)	0.0001	0.0001	2
Se (mg/L)	0.0001	0.0003	2
Zn (mg/L)	0.001	0.001	2
Nutrients			
NH3-N (mg/L)	-	-	0
NO3 (mg/L)	0.04	0.04	2
P-(TP) (mg/L)	-	0.04	1
Radionuclides			
Pb210 (Bq/L)	-	0.04	1
Po210 (Bq/L)	-	0.030	1
Ra226 (Bq/L)	0.100	0.085	2
U (µg/L)	263.0	117.0	2
Organics			
C-(org) (mg/L)	-	-	0

- Parameter was not analyzed.

Table 4.3.1 - 4 AC-8 Summary Statistics and Comparison to Historical Results

Ace Lake discharge at weir

Physical Properties	Previous Period Average					Current Reporting Period	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	108	108	109	114	122	115	4
pH-L (pH Unit)	7.83	7.87	7.69	7.69	7.47	7.62	4
TSS (mg/L)	1.75	1	1.4	1	1	1	2
Major Ions							
Alk-T (mg/L)	47.8	46.5	50.4	49.8	52	50.5	4
Ca (mg/L)	15.5	15.5	15.6	16	17.5	16.8	4
Cl (mg/L)	0.93	1	0.92	1.02	1.3	1.08	4
CO3 (mg/L)	1	1	1	1	1	1	4
Hardness (mg/L)	51	51	52	53	58	55	4
HCO3 (mg/L)	58.3	56.5	61.4	60.5	63.5	61.5	4
K (mg/L)	0.6	0.6	0.6	0.8	0.7	0.8	4
Mg (mg/L)	3	3.1	3.1	3.2	3.4	3.2	4
Na (mg/L)	1.4	1.5	1.5	1.6	1.5	1.6	4
OH (mg/L)	1	1	1	1	1	1	4
SO4 (mg/L)	6.3	6.8	6.5	6.6	7	6.8	4
Sum of Ions (mg/L)	86	85	90	90	95	92	4
TDS (mg/L)	80	63.5	73	77	81.5	78	4
Metals							
As (µg/L)	-	-	0.1	0.2	0.2	0.1	4
Ba (mg/L)	-	-	0.022	0.039	0.025	0.023	4
Cu (mg/L)	-	-	0.001	0.001	0	0	4
Fe (mg/L)	-	-	0.027	0.287	0.027	0.034	4
Mo (mg/L)	-	-	0.001	0.001	0.001	0.001	4
Ni (mg/L)	-	-	0.00015	0.00015	0.00015	0.00013	4
Pb (mg/L)	-	-	0.0001	0.0002	0.0001	0.0001	4
Se (mg/L)	-	-	0.0001	0.0001	0.0002	0.0001	4
Zn (mg/L)	-	-	0.001	0.001	0.001	0.001	4
Nutrients							
NH3-N (mg/L)	-	-	-	0.06	0.07	0.02	1
NO3 (mg/L)	-	-	0.04	0.08	0.09	0.12	4
P-(TP) (mg/L)	-	-	-	0.01	0.01	0.01	3
Radionuclides							
Pb210 (Bq/L)	-	-	0.02	0.02	0.02	0.02	3
Po210 (Bq/L)	-	-	0.005	0.007	0.005	0.008	3
Ra226 (Bq/L)	0.014	0.014	0.014	0.015	0.015	0.009	4
U* (µg/L)	16	18.3	14.6	15.3	16.5	13.5	4
Organics							
C-(org) (mg/L)	-	-	-	7.55	6	8.1	1

-Parameter was not analyzed
* Note: An unusually high outlier was recorded in 1980 and has been removed from the graph in Figures

Table 4.3.1 - 5 AC-14 Summary Statistics and Comparison to Historical Results

Ace Creek discharge to Beaverlodge Lake

Physical Properties	**Previous Period Averages**					**Current Reporting Period**	
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**Count**
Cond-L (µS/cm)	124	116	115	121	132	129	12
pH-L (pH Unit)	7.91	7.86	7.79	7.72	7.74	7.71	12
TSS (mg/L)	1.462	1.083	1.385	2.917	1.273	1.083	12
Major Ions							
Alk-T (mg/L)	51.5	49.5	52.4	49.1	53.2	53	12
Ca (mg/L)	17	16.2	16.5	16.8	18	18.2	12
Cl (mg/L)	1.69	1.38	1.17	1.47	2	1.68	12
CO3 (mg/L)	1	1	1	1	1.3	1	12
Hardness (mg/L)	56	53	55	55	59	60	12
HCO3 (mg/L)	62.8	60.4	63.8	59.8	64.2	64.7	12
K (mg/L)	0.6	0.7	0.7	0.7	0.8	0.8	12
Mg (mg/L)	3.3	3.2	3.2	3.3	3.5	3.5	12
Na (mg/L)	2.6	1.9	1.8	2.1	2.3	2.2	12
OH (mg/L)	1	1	1	1	1	1	12
SO4 (mg/L)	9.6	7.8	7.5	8.8	9.1	9.5	12
Sum of Ions (mg/L)	97	92	95	93	100	101	12
TDS (mg/L)	84.15	71.58	78.08	82.25	86.82	87.08	12
Metals							
As (µg/L)	0.1	0.2	0.2	0.2	0.2	0.2	12
Ba (mg/L)	0.024	0.025	0.025	0.024	0.026	0.024	12
Cu (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	12
Fe (mg/L)	0.089	0.099	0.068	0.085	0.074	0.07	12
Mo (mg/L)			0.001	0.001	0.001	0.001	12
Ni (mg/L)	0.001	0.001	0.00033	0.00017	0.00024	0.00023	12
Pb (mg/L)	0.002	0.002	0.0006	0.0008	0.0005	0.0003	12
Se (mg/L)	0.0003	0.0002	0.0002	0.0002	0.0002	0.0001	12
Zn (mg/L)	0.005	0.005	0.002	0.001	0.002	0.001	12
Nutrients							
NH3-N (mg/L)	-	-	-	0.08	0.05	0.09	4
NO3 (mg/L)	-	-	0.04	0.14	0.13	0.09	12
P-(TP) (mg/L)	-	-	-	0.01	0.01	0.01	4
Radionuclides							
Pb210 (Bq/L)	0.02	0.02	0.02	0.03	0.02	0.02	4
Po210 (Bq/L)	0.016	0.014	0.011	0.01	0.008	0.008	4
Ra226 (Bq/L)	0.057	0.048	0.034	0.046	0.072	0.042	12
U (µg/L)	41.1	27.6	23.8	32.1	33.2	34.9	12
Organics							
C-(org) (mg/L)	-	-	-	7.5	7.4	8.25	4

Table 4.3.2-1 AN-3 Summary Statistics and Comparison to Historical Results

Fulton Lake discharge

Physical Properties	**Previous Period Averages**			**Current Reporting Period**	
	2007	**2008**	**2009**	**2012**	**Count**
Cond-L (µS/cm)	139	137	136	144	1
pH-L (pH Unit)	8.02	7.88	7.88	7.63	1
TSS (mg/L)	2.000	2.000	1.000	1.000	1
Major Ions					
Alk-T (mg/L)	70.0	67.0	69.0	71.0	1
Ca (mg/L)	20.0	21.0	20.0	21.0	1
Cl (mg/L)	0.70	0.70	0.60	0.70	1
CO3 (mg/L)	1.0	1.0	1.0	1.0	1
Hardness (mg/L)	68	70	68	72	1
HCO3 (mg/L)	85.0	82.0	84.0	87.0	1
K (mg/L)	0.8	0.7	0.8	0.9	1
Mg (mg/L)	4.5	4.4	4.5	4.9	1
Na (mg/L)	1.8	1.8	1.8	2.0	1
OH (mg/L)	1.0	1.0	1.0	1.0	1
SO4 (mg/L)	4.3	4.6	4.3	4.5	1
Sum of Ions (mg/L)	117	115	116	121	1
TDS (mg/L)	84.00	94.00	89.00	105.00	1
Metals					
As (µg/L)	0.1	0.1	0.1	0.1	1
Ba (mg/L)				0.017	
Cu (mg/L)	0.001	0.001	0.001	0.001	1
Fe (mg/L)	0.023	0.029	0.013	0.011	1
Mo (mg/L)	-	-	-	0.002	1
Ni (mg/L)	0.00100	0.00100	0.00010	0.00020	1
Pb (mg/L)	0.0020	0.0020	0.0001	0.0001	1
Se (mg/L)	0.0001	0.0001	0.0001	0.0001	1
Zn (mg/L)	0.005	0.005	0.001	0.003	1
Nutrients					
NH3-N (mg/L)	-	-	-	0.02	1
NO3 (mg/L)	-	-	-	0.04	1
P-(TP) (mg/L)	-	-	-	0.01	1
Pb210 (Bq/L)	0.02	0.02	0.02	0.02	1
Po210 (Bq/L)	0.005	0.005	0.006	0.005	1
Ra226 (Bq/L)	0.005	0.005	0.005	0.006	1
U (µg/L)	1.5	2.0	1.6	1.6	1
Organics					
C-(org) (mg/L)	-	-	-	7.600	1

-No water available for collection in 2010 or 2011

-Parameter was not analyzed.

Table 4.3.2 – 2 TL-3 Summary Statistics and Comparison to Historical Results

Fookes Reservoir discharge

	Previous Period Averages				Current Reporting Period	
Physical Properties	**2007**	**2008**	**2009**	**2010**	**2012**	**Count**
Cond-L (µS/cm)	363	366	349	334	353	3
pH-L (pH Unit)	8.29	8.21	8.18	8.08	8.11	3
TSS (mg/L)	1.917	1.167	1.417	1.000	1.333	3
Major Ions						
Alk-T (mg/L)	135.6	140.7	135.1	129.0	140.3	3
Ca (mg/L)	25.8	28.0	26.2	27.0	27.3	3
Cl (mg/L)	4.25	4.17	4.17	3.64	4.33	3
CO3 (mg/L)	2.5	1.0	1.0	1.0	1.0	3
Hardness (mg/L)	85	91	86	89	91	3
HCO3 (mg/L)	162.3	171.6	164.9	157.6	171.0	3
K (mg/L)	1.3	1.3	1.4	1.2	1.4	3
Mg (mg/L)	5.0	5.2	5.0	5.2	5.5	3
Na (mg/L)	46.4	44.2	42.6	36.6	43.7	3
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	3
SO4 (mg/L)	46.2	44.9	44.2	38.2	43.0	3
Sum of Ions (mg/L)	290	299	289	270	296	3
TDS (mg/L)	226.33	228.33	220.25	210.60	227.67	3
Metals						
As (µg/L)	-	-	1.1	0.9	1.0	3
Ba (mg/L)	0.035	0.035	0.036	0.034	0.036	3
Cu (mg/L)	-	-	0.001	0.001	0.002	3
Fe (mg/L)	-	-	0.008	0.006	0.011	3
Mo (mg/L)	-	-	0.019	0.015	0.017	3
Ni (mg/L)	-	-	0.00040	0.00028	0.00030	3
Pb (mg/L)	-	-	0.0006	0.0004	0.0007	3
Se (mg/L)	0.0041	0.0049	0.0043	0.0037	0.0043	3
Zn (mg/L)	-	-	0.001	0.001	0.001	3
Nutrients						
NH3-N (mg/L)	-	-	-	-	0.01	1
NO3 (mg/L)	-	-	0.04	0.10	0.04	3
P-(TP) (mg/L)	-	-	-	0.03	0.01	1
Radionuclides						
Pb210 (Bq/L)	-	-	-	0.07	0.08	1
Po210 (Bq/L)	-	-	-	0.040	0.040	1
Ra226 (Bq/L)	1.107	1.122	1.198	1.070	1.300	3
U (µg/L)	408.8	423.3	393.9	341.8	387.7	3
Organics	-	-				
C-(org) (mg/L)	-	-		9.500	8.500	1

-No water available for collection in 2011
-Parameter was not analyzed.

Table 4.3.2 – 3 TL-4 Summary Statistics and Comparison to Historical Results

Marie Reservoir Outflow

	Previous Period Averages				**Current Reporting Period**	
Physical Properties	**2007**	**2008**	**2009**	**2010**	**2012**	**Count**
Cond-L (µS/cm)	360	358	341	445	329	3
pH-L (pH Unit)	8.28	8.14	8.13	7.79	7.97	3
TSS (mg/L)	1.667	2.083	1.273	2.000	1.333	3
Major Ions						
Alk-T (mg/L)	136.8	140.3	136.8	146.6	139.3	3
Ca (mg/L)	22.7	23.8	22.0	38.6	18.0	3
Cl (mg/L)	4.42	4.35	4.18	4.70	4.00	3
CO3 (mg/L)	2.1	1.1	1.0	1.0	1.0	3
Hardness (mg/L)	77	81	77	124	68	3
HCO3 (mg/L)	164.7	170.3	165.1	178.8	170.0	3
K (mg/L)	1.3	1.4	1.5	1.5	1.5	3
Mg (mg/L)	5.1	5.3	5.2	6.6	5.6	3
Na (mg/L)	49.3	47.5	45.2	47.0	47.7	3
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	3
SO4 (mg/L)	43.9	40.8	39.7	78.1	33.3	3
Sum of Ions (mg/L)	289	294	286	355	280	3
TDS (mg/L)	228.67	225.67	227.27	289.63	219.67	3
Metals						
As (µg/L)	-	-	1.7	1.6	1.9	3
Ba (mg/L)	0.055	0.083	0.066	0.108	0.077	3
Cu (mg/L)	-	-	0.001	0.001	0.001	3
Fe (mg/L)	-	-	0.028	0.311	0.099	3
Mo (mg/L)	-	-	0.014	0.011	0.010	3
Ni (mg/L)	-	-	0.00060	0.00126	0.00057	3
Pb (mg/L)	-	-	0.0008	0.0004	0.0003	3
Se (mg/L)	0.0060	0.0038	0.0025	0.0031	0.0020	3
Zn (mg/L)	-	-	0.001	0.003	0.001	3
Nutrients						
NH3-N (mg/L)	-	-	-	0.05	0.03	1
NO3 (mg/L)	-	-	0.04	0.05	0.04	3
P-(TP) (mg/L)	-	-	-	0.02	0.01	1
Radionuclides						
Pb210 (Bq/L)	-	-	-	0.23	0.02	1
Po210 (Bq/L)	-	-	-	0.055	0.030	1
Ra226 (Bq/L)	1.332	1.433	1.582	1.650	1.567	3
U (µg/L)	382.4	324.3	344.5	419.8	270.0	3
Organics						
C-(org) (mg/L)	-	-	-	8.800	12.000	1

-No water available for collection in 2011
-Parameter was not analyzed.

Table 4.3.2 – 4 TL-6 Summary Statistics and Comparison to Historical Results
Minewater Lake discharge

Physical Properties	Previous Period Averages			Current Reporting Period	
	2008	2009	2010	2012	Count
Cond-L (µS/cm)	794	765	791	780	4
pH-L (pH Unit)	8.07	7.94	7.94	7.73	4
TSS (mg/L)	3.000	5.000	2.000	8.000	3
Major Ions					
Alk-T (mg/L)	312.0	289.5	306.0	286.0	4
Ca (mg/L)	54.0	47.0	46.0	41.8	4
Cl (mg/L)	54.00	56.00	54.00	59.50	4
CO3 (mg/L)	1.0	1.0	1.0	1.0	4
Hardness (mg/L)	184	165	160	152	4
HCO3 (mg/L)	381.0	353.0	373.0	348.8	4
K (mg/L)	2.6	2.8	3.1	3.4	4
Mg (mg/L)	12.0	11.6	11.0	11.6	4
Na (mg/L)	112.0	110.5	118.0	122.8	4
OH (mg/L)	1.0	1.0	1.0	1.0	4
SO4 (mg/L)	48.0	43.5	41.0	53.5	4
Sum of Ions (mg/L)	664	625	646	641	4
TDS (mg/L)	516.00	526.00	529.00	541.75	4
Metals					
As (µg/L)	-	-	1.2	3.3	4
Ba (mg/L)	1.110	1.140	1.160	1.165	4
Cu (mg/L)	-	-	0.000	0.001	4
Fe (mg/L)	-	-	0.710	3.543	4
Mo (mg/L)	-	-	0.002	0.002	4
Ni (mg/L)	-	-	0.00030	0.00045	4
Pb (mg/L)	-	-	0.0001	0.0010	4
Se (mg/L)	0.0022	0.0023	0.0022	0.0052	4
Zn (mg/L)	-	-	0.001	0.001	4
Nutrients					
NH3-N (mg/L)	-	-	-	0.08	2
NO3 (mg/L)	-	-	0.04	0.07	4
P-(TP) (mg/L)	-	-	-	0.01	3
Radionuclides					
Pb210 (Bq/L)	-	-	-	0.11	3
Po210 (Bq/L)	-	-	-	0.090	3
Ra226 (Bq/L)	6.200	5.550	5.600	5.350	4
U (µg/L)	273.0	210.0	248.0	237.5	4
Organics					
C-(org) (mg/L)	-	-	-	39.000	2

-No water available for collection in 2011
-Parameter was not analyzed.

Table 4.3.2 – 5 TL-7 Summary Statistics and Comparison to Historical Results

Meadow Lake discharge at weir

Physical Properties	Previous Period Averages					Current Reporting Period	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	383	402	352	454	475	369	8
pH-L (pH Unit)	8.13	8.17	8.00	7.87	7.99	7.82	8
TSS (mg/L)	1.538	1.750	1.364	1.333	1.333	1.000	8
Major Ions							
Alk-T (mg/L)	146.4	153.4	140.1	150.4	148.3	138.1	8
Ca (mg/L)	25.2	29.3	23.5	36.9	41.8	25.8	8
Cl (mg/L)	7.68	6.33	5.80	7.40	10.55	13.59	8
CO3 (mg/L)	1.5	1.3	1.0	1.0	1.0	1.0	8
Hardness (mg/L)	86	98	81	123	140	92	8
HCO3 (mg/L)	177.2	186.5	170.9	183.4	180.8	168.5	8
K (mg/L)	1.4	1.4	1.5	1.5	2.4	1.7	8
Mg (mg/L)	5.7	6.0	5.5	7.6	8.7	6.8	8
Na (mg/L)	51.7	50.4	45.5	50.0	47.2	45.0	8
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	8
SO4 (mg/L)	43.6	47.9	39.2	74.7	86.3	38.0	8
Sum of Ions (mg/L)	311	328	292	362	378	299	8
TDS (mg/L)	241.08	249.58	222.00	297.11	309.50	239.38	8
Metals							
As (µg/L)	1.7	1.4	1.5	1.4	1.1	1.7	8
Ba (mg/L)	0.176	0.356	0.162	0.353	0.352	0.199	8
Cu (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	8
Fe (mg/L)	0.157	0.064	0.055	0.177	0.092	0.148	8
Mo (mg/L)			0.013	0.011	0.008	0.009	8
Ni (mg/L)	0.00100	0.00100	0.00064	0.00063	0.00062	0.00069	8
Pb (mg/L)	0.0020	0.0020	0.0007	0.0004	0.0002	0.0004	8
Se (mg/L)	0.0046	0.0038	0.0024	0.0053	0.0055	0.0033	8
Zn (mg/L)	0.005	0.005	0.001	0.002	0.001	0.001	8
Nutrients							
NH3-N (mg/L)	-	-	-	0.03	0.21	0.03	2
NO3 (mg/L)	-	-	0.04	0.06	0.28	0.04	8
P-(TP) (mg/L)	-	-	-	0.02	0.01	0.01	2
Radionuclides							
Pb210 (Bq/L)	0.07	0.05	0.06	0.07	0.02	0.05	2
Po210 (Bq/L)	0.045	0.037	0.043	0.020	0.015	0.060	2
Ra226 (Bq/L)	1.261	1.719	1.273	1.621	0.857	0.880	8
U (µg/L)	360.4	313.8	327.5	274.9	196.8	264.3	8
Organics							
C-(org) (mg/L)	-	-	-	9.667	11.000	13.000	2

Table 4.3.2 – 6 TL-9 Summary Statistics and Comparison to Historical Results

Greer Lake discharge at Beaverlodge Lake

Physical Properties	Previous Period Averages				Current Reporting Period	
	2007	2008	2009	2010	2012	Count
Cond-L (µS/cm)	356	372	348	464	374	8
pH-L (pH Unit)	8.26	8.16	8.11	8.04	8.00	8
TSS (mg/L)	2.167	1.600	1.375	1.250	1.625	8
Major Ions						
Alk-T (mg/L)	136.7	143.6	139.0	186.5	152.6	8
Ca (mg/L)	22.0	25.1	22.6	32.5	24.8	8
Cl (mg/L)	6.86	6.70	6.63	9.25	9.00	8
CO3 (mg/L)	1.7	1.0	1.0	1.0	1.0	8
Hardness (mg/L)	80	88	82	122	93	8
HCO3 (mg/L)	165.6	175.1	169.5	227.5	186.0	8
K (mg/L)	1.3	1.4	1.5	2.3	1.8	8
Mg (mg/L)	6.4	6.3	6.3	9.8	7.6	8
Na (mg/L)	47.7	46.2	43.4	57.3	46.8	8
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	8
SO4 (mg/L)	40.0	41.6	36.8	46.0	34.9	8
Sum of Ions (mg/L)	287	303	287	385	311	8
TDS (mg/L)	225.67	212.00	220.63	308.00	250.38	8
Metals						
As (µg/L)	1.9	1.9	1.7	1.1	1.9	8
Ba (mg/L)	0.703	0.597	0.824	0.563	1.099	8
Cu (mg/L)	0.001	0.003	0.001	0.001	0.001	8
Fe (mg/L)	0.061	0.140	0.047	0.020	0.055	8
Mo (mg/L)	-	-	-	0.011	0.014	8
Ni (mg/L)	0.00100	0.00100	0.00057	0.00047	0.00044	8
Pb (mg/L)	0.0020	0.0020	0.0012	0.0003	0.0009	8
Se (mg/L)	0.0047	0.0036	0.0032	0.0048	0.0045	8
Zn (mg/L)	0.005	0.005	0.002	0.001	0.001	8
Nutrients						
NH3-N (mg/L)	-	-	-	-	0.07	3
NO3 (mg/L)	-	-	-	0.13	0.24	8
P-(TP) (mg/L)	-	-	-	0.03	0.01	3
Radionuclides						
Pb210 (Bq/L)	0.09	0.13	0.07	0.06	0.08	3
Po210 (Bq/L)	0.068	0.042	0.040	0.020	0.060	3
Ra226 (Bq/L)	1.858	1.860	2.075	0.980	2.450	8
U (µg/L)	316.9	311.9	296.4	483.8	349.3	8
Organics						
C-(org) (mg/L)	-	-	-	14.000	14.000	3

-No water available for collection in 2011
-Parameter was not analyzed.

Table 4.3.3 – 1 BL-3 Summary Statistics and Comparison to Historical Results

Beaverlodge Lake - 100m out from TL-9

Physical Properties	**Previous Period Averages**					**Current Reporting Period**	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	259	254	253	252	250	245	4
pH-L (pH Unit)	8.12	8.08	7.97	7.98	7.79	7.80	4
TSS (mg/L)	1.000	1.000	1.000	1.000	1.000	1.000	4
Major Ions							
Alk-T (mg/L)	71.8	72.8	74.3	72.7	70.7	72.3	4
Ca (mg/L)	21.8	21.5	22.5	22.0	21.8	21.8	4
Cl (mg/L)	14.25	14.50	14.25	13.67	13.50	13.25	4
CO3 (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	4
Hardness (mg/L)	77	75	79	77	77	77	4
HCO3 (mg/L)	87.8	88.8	90.5	89.0	86.0	88.0	4
K (mg/L)	1.1	1.2	1.2	1.2	1.1	1.2	4
Mg (mg/L)	5.4	5.3	5.5	5.5	5.4	5.5	4
Na (mg/L)	21.3	20.8	20.5	20.0	19.8	19.5	4
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	4
SO4 (mg/L)	34.0	32.0	34.3	33.7	33.0	32.8	4
Sum of Ions (mg/L)	186	184	189	185	178	182	4
TDS (mg/L)	146.50	149.50	151.25	150.33	151.33	147.50	4
Metals							
As (µg/L)	0.3	0.3	0.3	0.5	0.3	0.3	4
Ba (mg/L)		0.035		0.039	0.035	0.037	4
Cu (mg/L)	0.002	0.004	0.001	0.002	0.003	0.001	4
Fe (mg/L)	0.007	0.048	0.010	0.007	0.008	0.003	4
Mo (mg/L)				0.004	0.004	0.004	4
Ni (mg/L)	0.00550	0.00575	0.00178	0.00330	0.00347	0.00140	4
Pb (mg/L)	0.0020	0.0020	0.0006	0.0002	0.0003	0.0001	4
Se (mg/L)	0.0029	0.0030	0.0031	0.0029	0.0028	0.0027	4
Zn (mg/L)	0.005	0.005	0.004	0.005	0.006	0.002	4
Nutrients							
NH3-N (mg/L)	-	-	-	0.22	0.21	0.08	1
NO3 (mg/L)	-	-	-	0.04	0.06	0.04	4
P-(TP) (mg/L)	-	-	-	0.01	0.01	0.01	1
Radionuclides							
Pb210 (Bq/L)	0.02	0.02	0.02	0.02	0.02	0.02	1
Po210 (Bq/L)	0.005	0.005	0.005	0.004	0.005	0.005	1
Ra226 (Bq/L)	0.033	0.052	0.052	0.048	0.023	0.025	4
U (µg/L)	146.0	146.5	152.0	145.3	140.5	138.0	4
Organics							
C-(org) (mg/L)	-	-	-	3.550	3.800	3.400	1

-Parameter was not analyzed.

Table 4.3.3 – 2 BL-4 Summary Statistics and Comparison to Historical Results

Beaverlodge Lake - middle - composite of top, middle, bottom

Physical Properties	Previous Period Averages					Current Reporting Period	
	2007	2008	2009	2010	2011	2012	Count
Cond-L (µS/cm)	249	249	244	246	246	241	2
pH-L (pH Unit)	8.09	8.06	7.98	7.94	7.70	7.84	2
TSS (mg/L)	1.250	1.000	1.000	1.000	1.000	1.000	2
Major Ions							
Alk-T (mg/L)	69.8	68.8	71.0	69.5	67.5	69.5	2
Ca (mg/L)	21.0	21.0	21.3	21.3	21.5	21.5	2
Cl (mg/L)	13.50	14.00	13.50	14.00	14.00	14.00	2
CO3 (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	2
Hardness (mg/L)	74	73	75	75	76	76	2
HCO3 (mg/L)	85.0	84.0	86.5	85.0	82.0	85.0	2
K (mg/L)	1.1	1.1	1.2	1.2	1.1	1.3	2
Mg (mg/L)	5.2	5.2	5.3	5.3	5.3	5.4	2
Na (mg/L)	20.5	20.0	19.5	19.5	19.5	20.0	2
OH (mg/L)	1.0	1.0	1.0	1.0	1.0	1.0	2
SO4 (mg/L)	32.8	32.0	32.8	33.0	32.5	33.5	2
Sum of Ions (mg/L)	179	177	180	179	176	181	2
TDS (mg/L)	138.75	143.00	142.00	147.00	143.00	140.50	2
Metals							
As (µg/L)	0.2	0.3	0.3	0.3	0.3	0.3	2
Ba (mg/L)		0.034		0.035	0.034	0.034	2
Cu (mg/L)	0.002	0.002	0.002	0.001	0.001	0.002	2
Fe (mg/L)	0.006	0.006	0.014	0.043	0.003	0.005	2
Mo (mg/L)				0.004	0.004	0.004	2
Ni (mg/L)	0.00225	0.00250	0.00235	0.00173	0.00220	0.00240	2
Pb (mg/L)	0.0020	0.0020	0.0006	0.0002	0.0001	0.0002	2
Se (mg/L)	0.0029	0.0030	0.0030	0.0028	0.0028	0.0027	2
Zn (mg/L)	0.005	0.005	0.006	0.005	0.002	0.004	2
Nutrients							
NH3-N (mg/L)	-	-	-	0.06	0.08	0.04	2
NO3 (mg/L)	-	-	-	0.05	0.42	0.04	2
P-(TP) (mg/L)	-	-	-	0.01	0.01	0.01	2
Radionuclides							
Pb210 (Bq/L)	0.02	0.02	0.02	0.03	0.03	0.02	2
Po210 (Bq/L)	0.005	0.005	0.005	0.005	0.005	0.005	2
Ra226 (Bq/L)	0.033	0.025	0.025	0.035	0.025	0.030	2
U (µg/L)	142.0	140.5	143.8	143.8	142.0	138.5	2
Organics							
C-(org) (mg/L)	-	-	-	3.300	3.400	3.450	2

-Parameter was not analyzed.

Table 4.3.3 – 3 BL-5 Summary Statistics and Comparison to Historical Results

Beaverlodge Lake Outlet

Physical Properties	Previous Period Averages		Current Reporting Period	
	2011	Count	2012	Count
Cond-L (µS/cm)	227	3	248	4
pH-L (pH Unit)	7.65	3	7.84	4
TSS (mg/L)	2.333	3	1.000	4
Major Ions				
Alk-T (mg/L)	66.7	3	70.5	4
Ca (mg/L)	21.0	3	21.8	4
Cl (mg/L)	11.47	3	14.00	4
CO3 (mg/L)	1.0	3	1.0	4
Hardness (mg/L)	73	3	77	4
HCO3 (mg/L)	81.3	3	86.0	4
K (mg/L)	1.1	3	1.2	4
Mg (mg/L)	5.0	3	5.5	4
Na (mg/L)	16.0	3	20.0	4
OH (mg/L)	1.0	3	1.0	4
SO4 (mg/L)	27.0	3	33.5	4
Sum of Ions (mg/L)	163	3	182	4
TDS (mg/L)	135.33	3	145.50	4
Metals				
As (µg/L)	0.3	4	0.3	4
Ba (mg/L)	0.038	4	0.034	4
Cu (mg/L)	0.001	4	0.000	4
Fe (mg/L)	0.008	4	0.001	4
Mo (mg/L)	0.003	4	0.004	4
Ni (mg/L)	0.00020	4	0.00018	4
Pb (mg/L)	0.0001	4	0.0001	4
Se (mg/L)	0.0023	4	0.0028	4
Zn (mg/L)	0.001	4	0.001	4
Nutrients				
NH3-N (mg/L)	0.06	1	0.01	1
NO3 (mg/L)	1.07	3	0.04	4
P-(TP) (mg/L)	0.01	1	0.01	1
Radionuclides				
Pb210 (Bq/L)	0.02	1	0.02	1
Po210 (Bq/L)	0.005	1	0.005	1
Ra226 (Bq/L)	0.021	4	0.033	4
U (µg/L)	143.3	3	139.3	4
Organics				
C-(org) (mg/L)	2.900	1	3.300	1

-Parameter was not analyzed.

Table 4.3.3 – 4 ML-1 Summary Statistics and Comparison to Historical Results

Martin Lake outlet (North basin)

Physical Properties	Previous Period Averages	Current Reporting Period	
	2011	2012	Count
Cond-L (µS/cm)	213	174	4
pH-L (pH Unit)	7.78	7.67	4
TSS (mg/L)	1.000	1.000	4
Major Ions			
Alk-T (mg/L)	68.3	63.0	4
Ca (mg/L)	20.5	19.5	4
Cl (mg/L)	10.30	5.20	4
CO3 (mg/L)	1.0	1.0	4
Hardness (mg/L)	71	66	4
HCO3 (mg/L)	83.5	76.8	4
K (mg/L)	1.1	1.1	4
Mg (mg/L)	4.8	4.3	4
Na (mg/L)	14.5	9.3	4
OH (mg/L)	1.0	1.0	4
SO4 (mg/L)	23.3	15.1	4
Sum of Ions (mg/L)	158	132	4
TDS (mg/L)	129.75	113.75	4
Metals			
As (µg/L)	0.2	0.2	4
Ba (mg/L)	0.042	0.042	4
Cu (mg/L)	0.000	0.001	4
Fe (mg/L)	0.006	0.016	4
Mo (mg/L)	0.003	0.002	4
Ni (mg/L)	0.00013	0.00015	4
Pb (mg/L)	0.0001	0.0015	4
Se (mg/L)	0.0016	0.0008	4
Zn (mg/L)	0.001	0.002	4
Nutrients			
NH3-N (mg/L)	0.07	0.06	4
NO3 (mg/L)	0.20	0.10	4
P-(TP) (mg/L)	0.01	0.01	4
Radionuclides			
Pb210 (Bq/L)	0.02	0.02	4
Po210 (Bq/L)	0.005	0.005	4
Ra226 (Bq/L)	0.009	0.007	4
U (µg/L)	69.3	48.8	4
Organics			
C-(org) (mg/L)	4.775	7.325	4

Table 4.3.3 – 5 CS-1 Summary Statistics and Comparison to Historical Results

Crackingstone River at bridge

Physical Properties	Previous Period Average	Current Reporting Period	
	2011	2012	Count
Cond-L (µS/cm)	211	199	1
pH-L (pH Unit)	7.78	7.76	1
TSS (mg/L)	1.000	1.000	1
Major Ions			
Alk-T (mg/L)	85.0	64.0	1
Ca (mg/L)	28.0	20.0	1
Cl (mg/L)	7.80	7.60	1
CO3 (mg/L)	1.0	1.0	1
Hardness (mg/L)	96	68	1
HCO3 (mg/L)	104.0	78.0	1
K (mg/L)	1.2	1.1	1
Mg (mg/L)	6.3	4.5	1
Na (mg/L)	6.4	11.0	1
OH (mg/L)	1.0	1.0	1
SO4 (mg/L)	11.0	17.0	1
Sum of Ions (mg/L)	165	139	1
TDS (mg/L)	135.00	125.00	1
Metals			
As (µg/L)	0.2	0.2	1
Ba (mg/L)	0.056	0.042	1
Cu (mg/L)	0.000	0.000	1
Fe (mg/L)	0.100	0.026	1
Mo (mg/L)	0.003	0.002	1
Ni (mg/L)	0.00030	0.00010	1
Pb (mg/L)	0.0001	0.0001	1
Se (mg/L)	0.0003	0.0009	1
Zn (mg/L)	0.001	0.001	1
Nutrients			
NH3-N (mg/L)	0.08	0.03	1
NO3 (mg/L)	0.04	0.04	1
P-(TP) (mg/L)	0.01	0.01	1
Radionuclides			
Pb210 (Bq/L)	0.02	0.02	1
Po210 (Bq/L)	0.005	0.005	1
Ra226 (Bq/L)	0.005	0.006	1
U (µg/L)	47.0	57.0	1
Organics			
C-(org) (mg/L)	11.000	6.200	1

Note: This station was implemented in 2011.

Table 4.3.3 – 6 CS-2 Summary Statistics and Comparison to Historical Results

Crackingstone Bay in Lake Athabasca

Physical Properties	Previous Period Averages	Current Reporting Period	
	2011	2012	Count
Cond-L (µS/cm)	68	81	1
pH-L (pH Unit)	7.45	7.51	1
TSS (mg/L)	1.000	1.000	1
Major Ions			
Alk-T (mg/L)	28.0	31.0	1
Ca (mg/L)	7.1	8.3	1
Cl (mg/L)	2.00	3.60	1
CO3 (mg/L)	1.0	1.0	1
Hardness (mg/L)	27	30	1
HCO3 (mg/L)	34.0	38.0	1
K (mg/L)	0.5	0.8	1
Mg (mg/L)	2.2	2.4	1
Na (mg/L)	2.4	3.5	1
OH (mg/L)	1.0	1.0	1
SO4 (mg/L)	3.5	5.0	1
Sum of Ions (mg/L)	52	62	1
TDS (mg/L)	220.00	64.00	1
Metals			
As (µg/L)	0.3	0.2	1
Ba (mg/L)	0.011	0.014	1
Cu (mg/L)	0.001	0.000	1
Fe (mg/L)	0.013	0.006	1
Mo (mg/L)	0.000	0.000	1
Ni (mg/L)	0.00040	0.00030	1
Pb (mg/L)	0.0001	0.0001	1
Se (mg/L)	0.0001	0.0001	1
Zn (mg/L)	0.001	0.001	1
Nutrients			
NH3-N (mg/L)	0.06	0.01	1
NO3 (mg/L)	0.04	0.04	1
P-(TP) (mg/L)	0.02	0.01	1
Radionuclides			
Pb210 (Bq/L)	0.02	0.02	1
Po210 (Bq/L)	0.005	0.005	1
Ra226 (Bq/L)	0.005	0.009	1
U (µg/L)	0.3	4.8	1
Organics			
C-(org) (mg/L)	2.800	3.500	1

Note: This station was implemented in 2011.

Table 4.4.1
January 2012 - December 2012 Monthly Loading Calculations at TL-7

Month	***Days in Month***	***Average Flows (L/s)***	***Uranium (mg/L)***	***U Loadings (kg)***	***^{226}Ra (Bq/L)***	***^{226}Ra Loadings (Bq) x 10^7***	***TDS (mg/L)***	***TDS Loadings (kg) x 10^4***	***Se (mg/L)***	***Se Loadings (kg)***	***Comments***
January	31	0	-	-	-	-	-	-	-	-	*no water*
February	29	0	-	-	-	-	-	-	-	-	*no water*
March	31	0	-	-	-	-	-	-	-	-	*no water*
April	30	0.03	0.214	0.0166	0.22	0.0017	184	0.0014	0.006	0.0005	
May	31	3.95	0.417	4.4117	0.45	0.4761	301	0.3184	0.0051	0.0540	
June	30	8.96	0.216	5.0165	0.89	2.0670	228	0.5295	0.0029	0.0674	
July	31	10.7	0.172	4.9293	0.83	2.3787	232	0.6649	0.0025	0.0716	
August	31	4.17	0.149	1.6642	1.6	1.7870	231	0.2580	0.0028	0.0313	
September	30	7.94	0.248	5.1040	1.3	2.6755	225	0.4631	0.0021	0.0432	
October	31	3.93	0.361	3.7999	0.76	0.8000	272	0.2863	0.0027	0.0284	
November	30	4.72	0.337	4.1229	0.99	1.2112	242	0.2961	0.0025	0.0306	
December	31	4.07	-	-	-	-	-	-	-	-	*no water*
2012 Annual Summary		4.0	0.264	29.07	0.88	11.40	239	2.82	0.0033	0.33	

Table 4.4.2
January 2012- December 2012 Monthly Loading Calculations at AC-14

Month	Days in Month	Average Flows (L/s)	Uranium (mg/L)	U Loadings (Kg)	^{226}Ra (Bq/L)	^{226}Ra Loadings (Bq) x 10^7	TDS (mg/L)	TDS Loadings (kg) x 10^4	Se (mg/L)	Se Loadings (kg)*	Comments
January	31	259	0.025	17.34	0.04	2.775	89	6.1740	0.0001	0.0694	
February	29	221	0.023	12.74	0.03	1.661	96	5.3159	0.0001	0.0554	
March	31	215	0.027	15.55	0.03	1.728	90	5.1827	0.0001	0.0576	
April	30	248	0.101	64.92	0.06	3.857	96	6.1710	0.0005	0.3214	
May	31	2467	0.023	151.98	0.03	1.982	84	5.5504	0.0001	0.0661	
June	30	1114	0.026	75.07	0.06	1.732	68	1.9635	0.0001	0.0289	
July	31	699	0.025	46.81	0.03	5.617	77	14.4160	0.0001	0.1872	
August	31	560	0.057	85.49	0.07	10.499	92	13.7991	0.0002	0.3000	
September	30	666	0.027	46.61	0.07	12.084	77	13.2923	0.0001	0.1726	
October	31	517	0.043	59.54	0.04	5.539	98	13.5704	0.0001	0.1385	
November	30	621	0.022	35.41	0.02	3.219	91	14.6477	0.0001	0.1610	
December	31	535	0.02	28.66	0.03	4.299	87	12.4666	0.0001	0.1433	
2012 Annual Summary		676.833	0.035	640.124	0.04	54.992	87	112.549	0.0001	1.70	

* - Where selenium concentrations were below the detection limit for a given month (0.0001mg/L), the detection limit value was used as a proxy for the actual concentration to calculate the monthly loadings. The calculation method described will likely result in a significant overestimation of the actual selenium loadings.

Table 4.4.3
Comparison of Predicted Loadings to Actual January 2012 - December 2012 Loadings

Scenario	Parameter	AC-14			TL-7			Site Total Loadings
		Average Flows (L/s)	Average Concentration	Loadings	Average Flows (L/s)	Average Concentration	Loadings	
Predicted Loadings								
During Operations	U (mg/L)	215	0.65	4.41E+03	89.4	4.1	1.16E+04	1.60E+04
	Ra226 (Bq/L)	215	0.22	1.49E+09	89.4	0.44	1.24E+09	2.73E+09
	TDS (mg/L)	215	174	1.18E+06	89.4	1793	5.06E+06	6.23E+06
At Shutdown (Predicted)	U (mg/L)	426	0.035	4.70E+02	16	3.16	1.59E+03	2.06E+03
	Ra226 (Bq/L)	426	0.06	8.06E+08	16	0.53	2.67E+08	1.07E+09
	TDS (mg/L)	426	129	1.73E+06	16	1130	5.70E+05	2.30E+06
Minimum Reclamation (Long Term Predicted)	U (mg/L)	426	0.035	4.70E+02	16	0.1	5.05E+01	5.21E+02
	Ra226 (Bq/L)	426	0.06	8.06E+08	16	0.38	1.92E+08	9.98E+08
	TDS (mg/L)	426	129	1.73E+06	16	389	1.96E+05	1.93E+06
Max. Reclamation (Long Term Predicted)	U (mg/L)	426	0.03	4.03E+02	16	0.1	5.05E+01	4.53E+02
	Ra226 (Bq/L)	426	0.06	8.06E+08	16	0.27	1.36E+08	9.42E+08
	TDS (mg/L)	426	125	1.68E+06	16	414	2.09E+05	1.89E+06
Actual (January – December 2012) *	U (mg/L)	677	0.035	6.40E+02	4.0	0.264	2.91E+01	6.69E+02
	Ra226 (Bq/L)	677	0.04	8.84E+08	4.0	0.88	1.14E+08	9.98E+08
	TDS (mg/L)	677	87	1.80E+06	4.0	239	2.82E+04	1.83E+06

**Note: Loading values in this table were calculated using monthly flow volumes, not the annual averages that are presented in this table.*
Units:
U [=] mg/L, Ra226 [=] Bq/L, TDS [=] mg/L
Loadings U [=] Kg, Loadings Ra226 [=] Bq, Loadings TDS [=] Kg

Table 4.5.1
Radon Track Etch Cup Summary

	Annual Average pCi/L							
Location	1982	2006	2007	2008	2009	2010	2011	2012
Airport Beacon	1.4	0.4	0.3	0.5	0.5	0.3	0.2	0.9
Eldorado Townsite	3.7	0.7	0.4	0.7	0.7	0.5	0.5	0.5
Northwest of Airport	2.4	0.4	0.2	0.3	0.4	0.3	0.2	1.1
Ace Creek	10.7	6.3	4.9	6.7	5.3	5.4	7.0	4.1
Fay Waste Rock	5.1	1.4	1.1	1.2	1.2	0.9	1.0	1.1
Fookes Delta	5.1	3.1	1.8	3.0	2.9	2.0	1.9	2.1
Marie Reservoir	5.1	2.5	2.5	2.7	2.5	5.8	5.5	2.8
Donaldson Lake	5.1	0.3	0.2	0.7	0.6	0.2	0.2	0.2
Fredette Lake	5.1	0.4	0.2	0.3	0.8	1.2	0.8	0.2
Uranium City	5.1	0.2	0.2	0.3	1.2	0.3	0.2	0.2

Note: Values presented are an average of two 6 month samples collected through the calendar year.

FIGURES

FIGURES

Figure 2.4.1
Beaverlodge Location Map

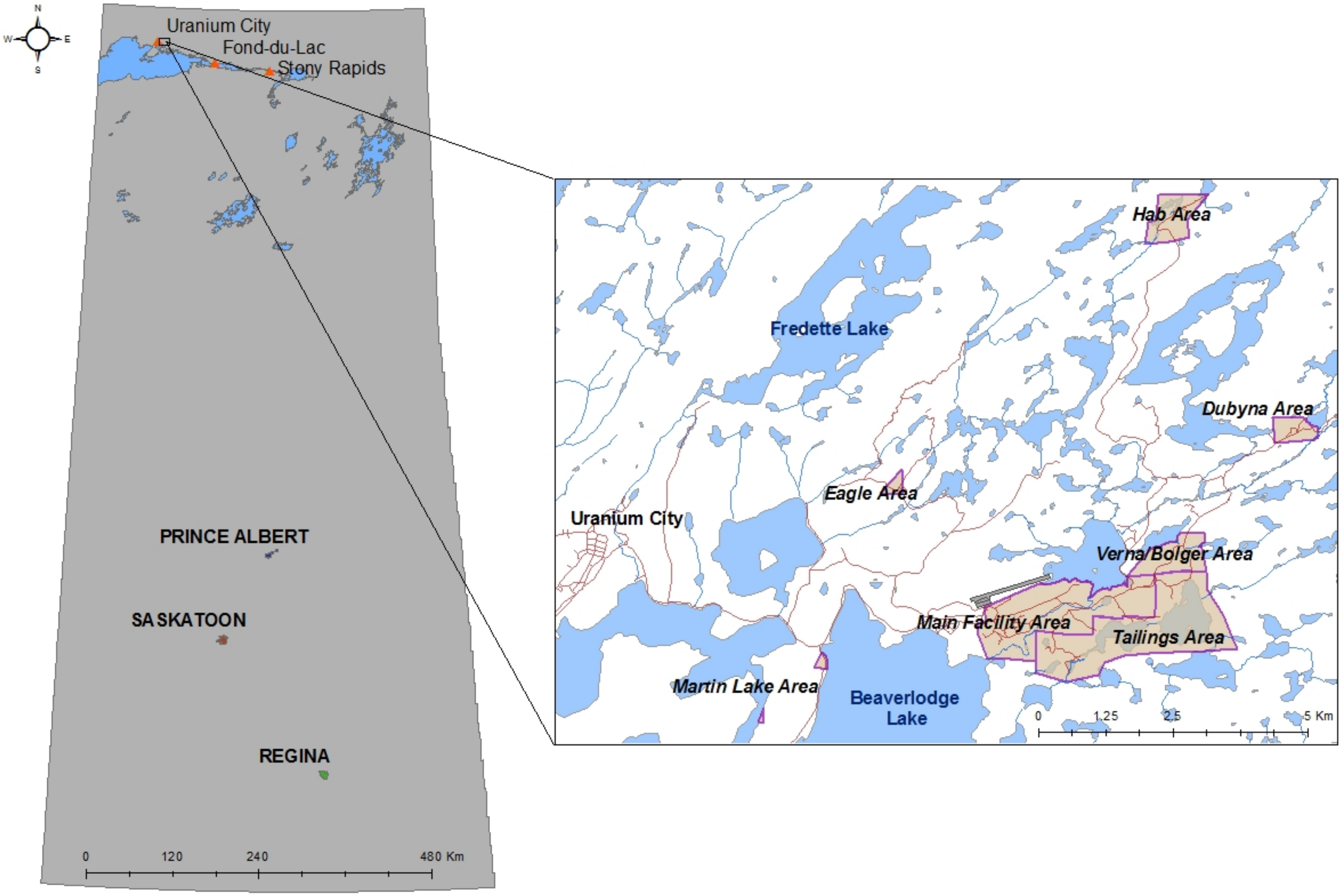


Figure 4.3
Aquatic Sampling Station Locations

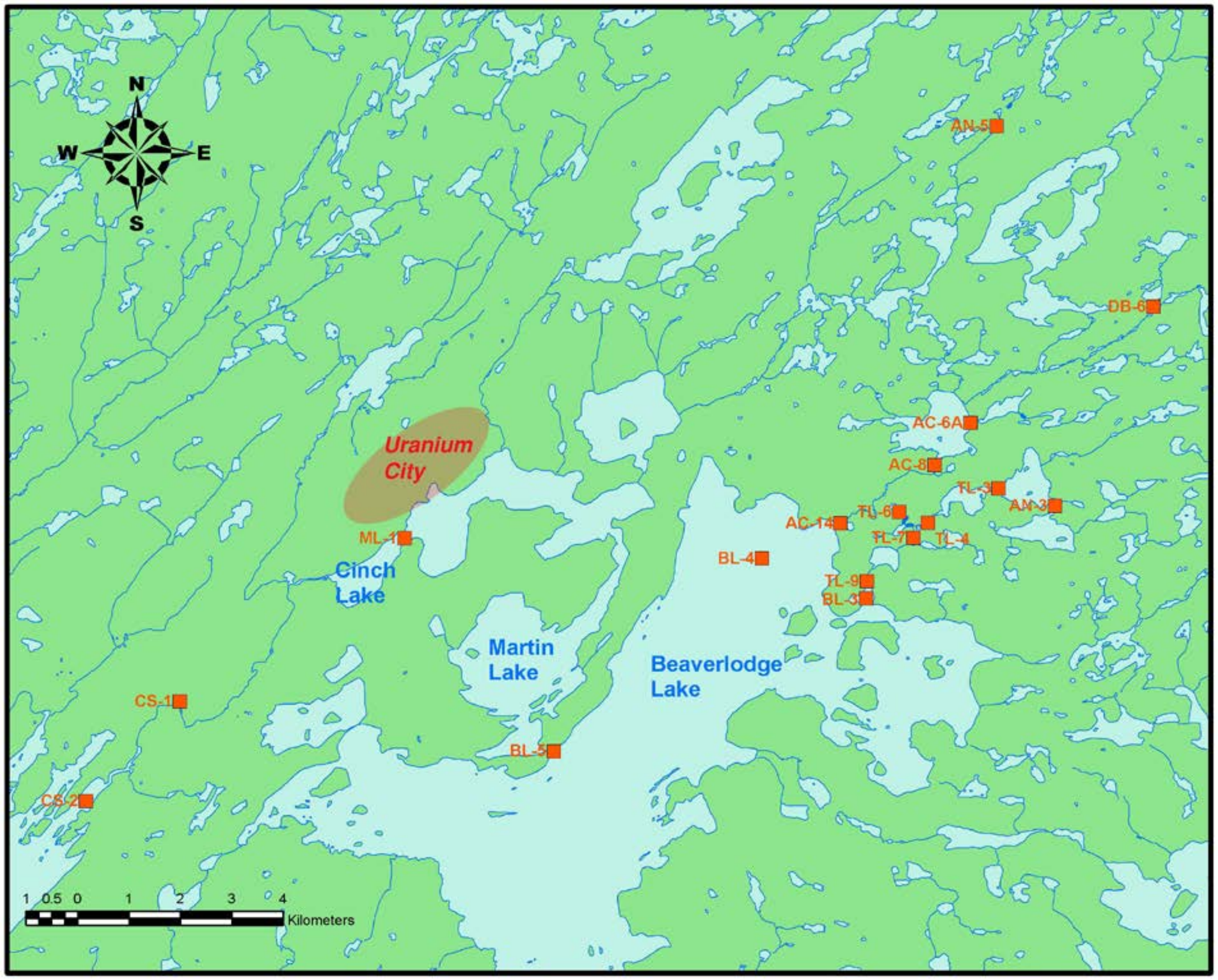


Figure 4.3.1-1 AN-5 - Pistol Creek below Hab Site

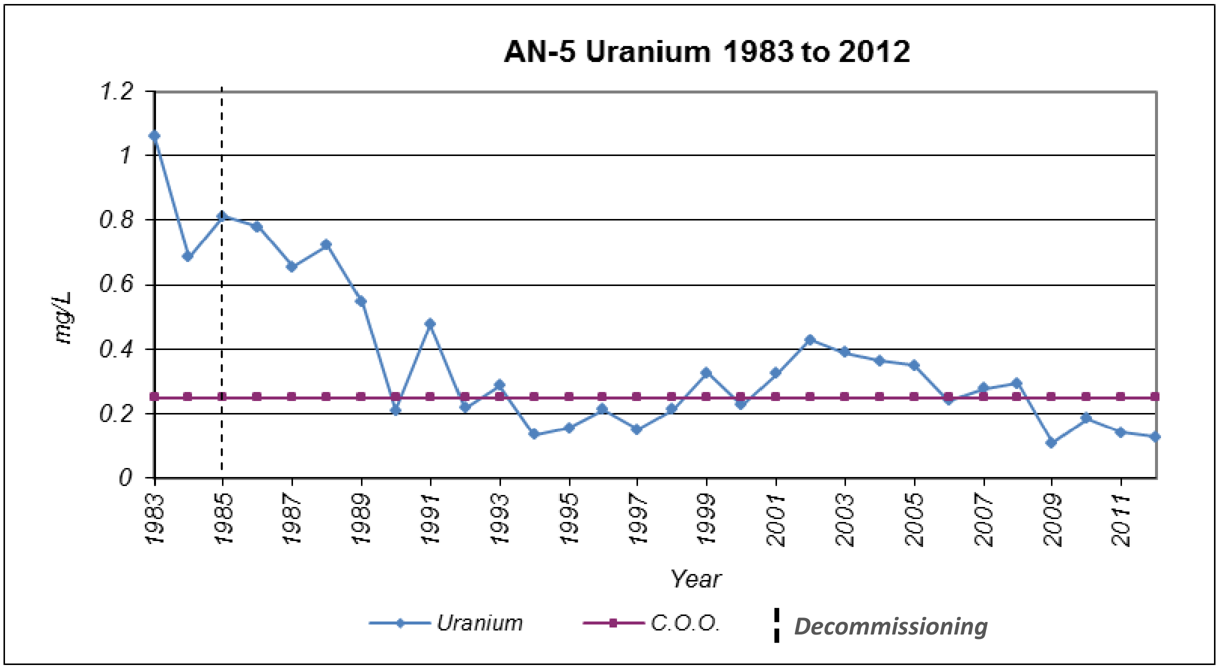


Figure 4.3.1-2 AN-5 - Pistol Creek below Hab Site

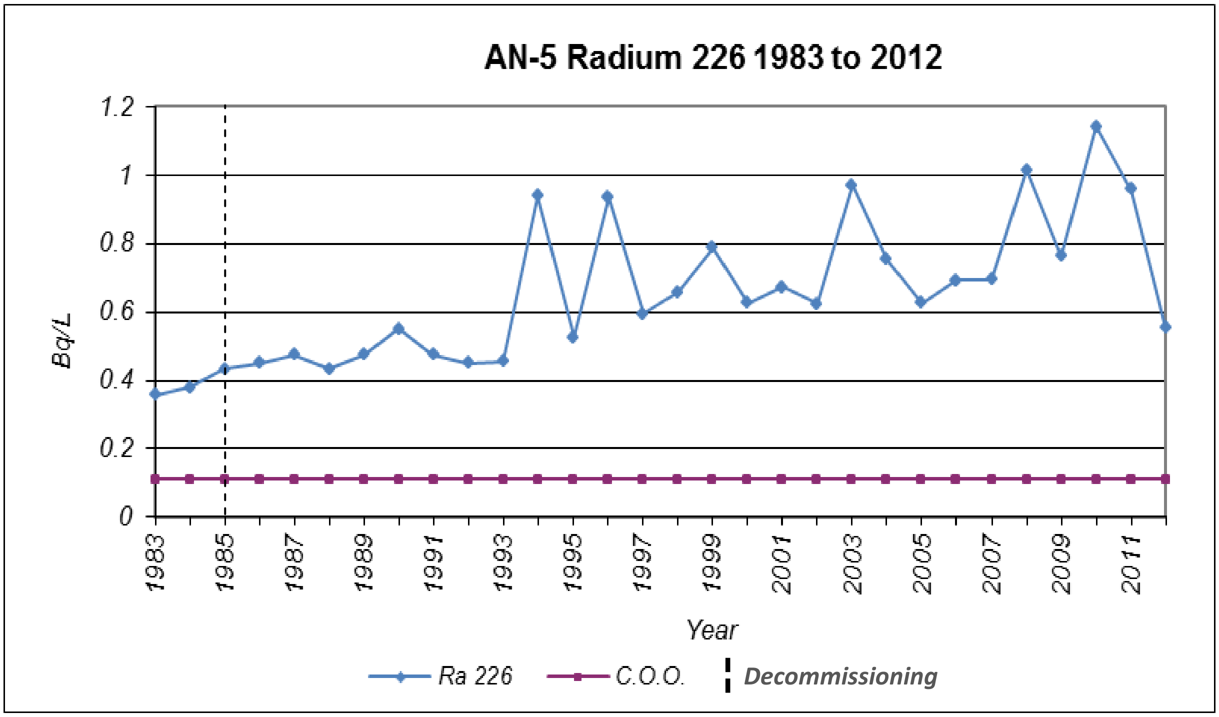


Figure 4.3.1-3 AN-5 - Pistol Creek below Hab Site

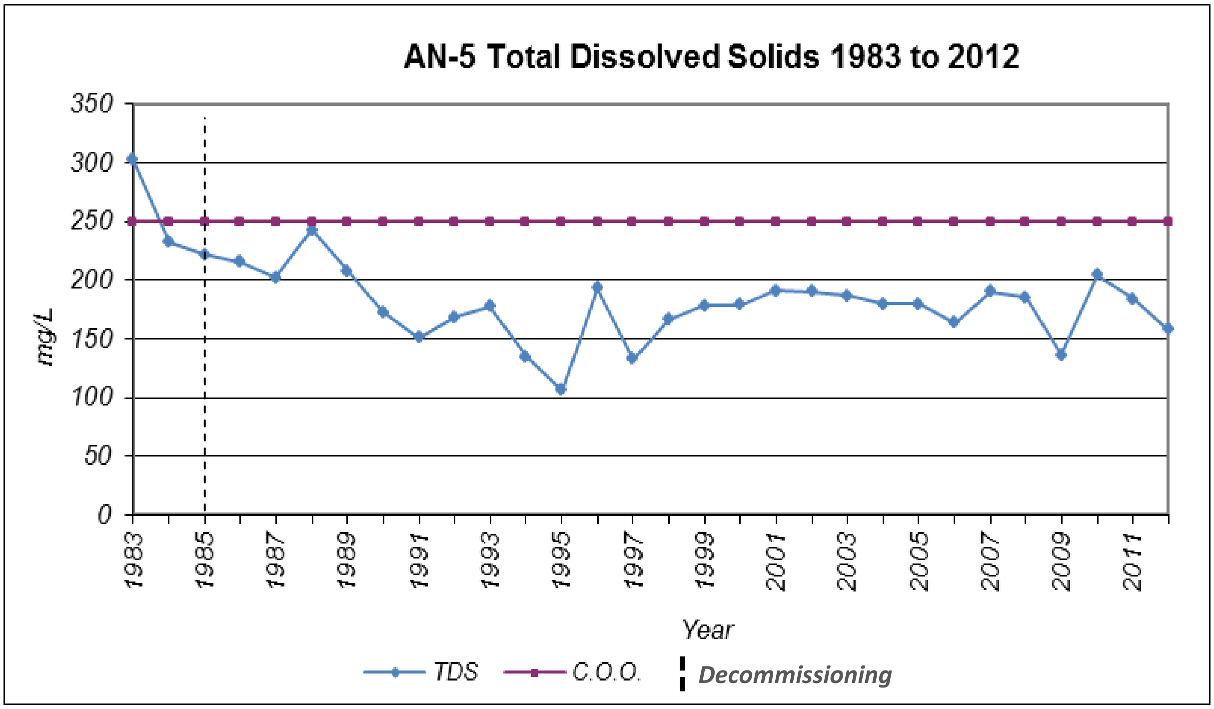


Figure 4.3.1-4 AN-5 - Pistol Creek below Hab Site

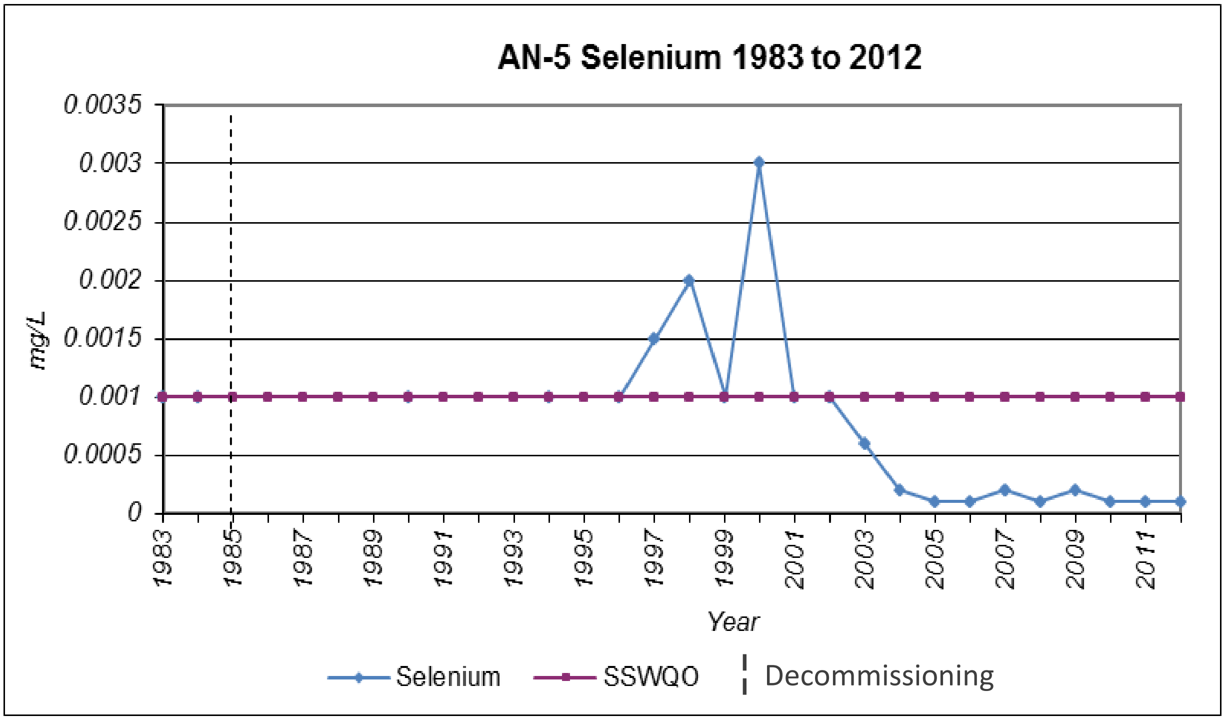


Figure 4.3.1-5 DB-6 - Dubyna Creek

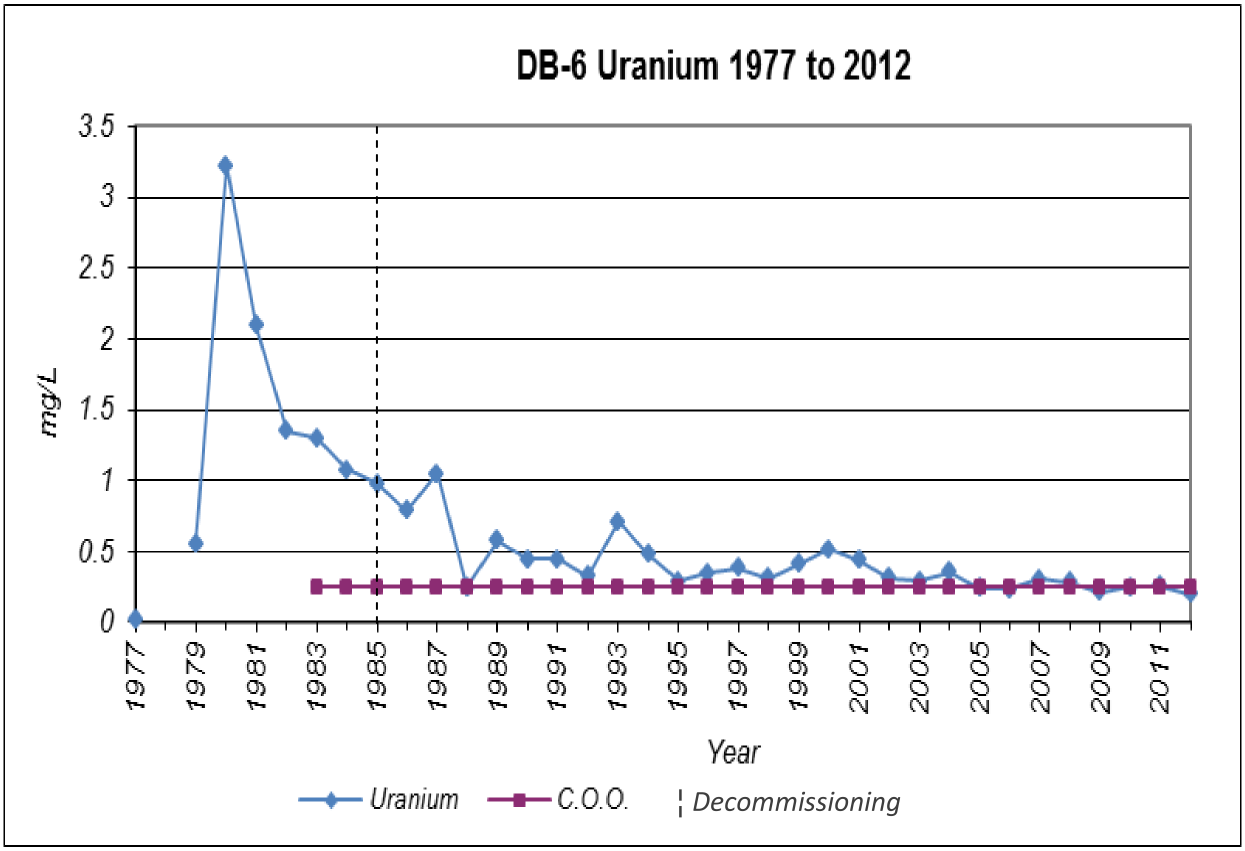


Figure 4.3.1-6 DB-6 - Dubyna Creek

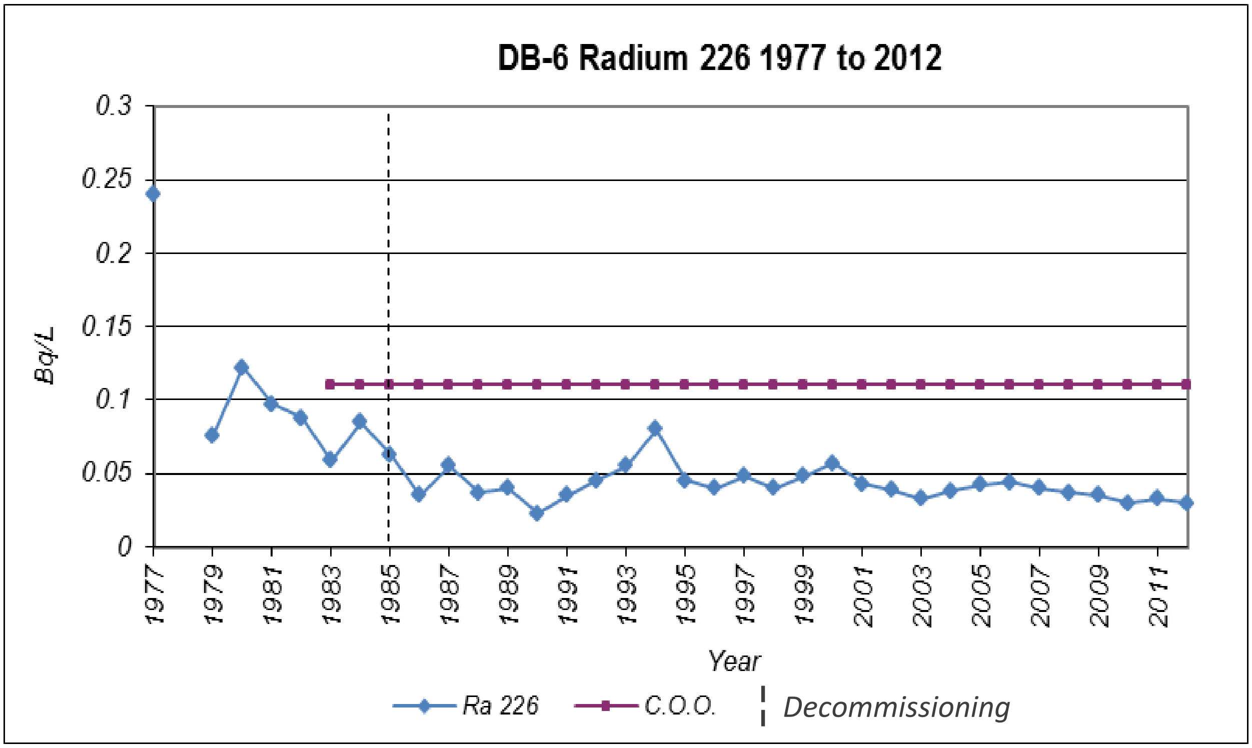


Figure 4.3.1-7 DB-6 - Dubyna Creek

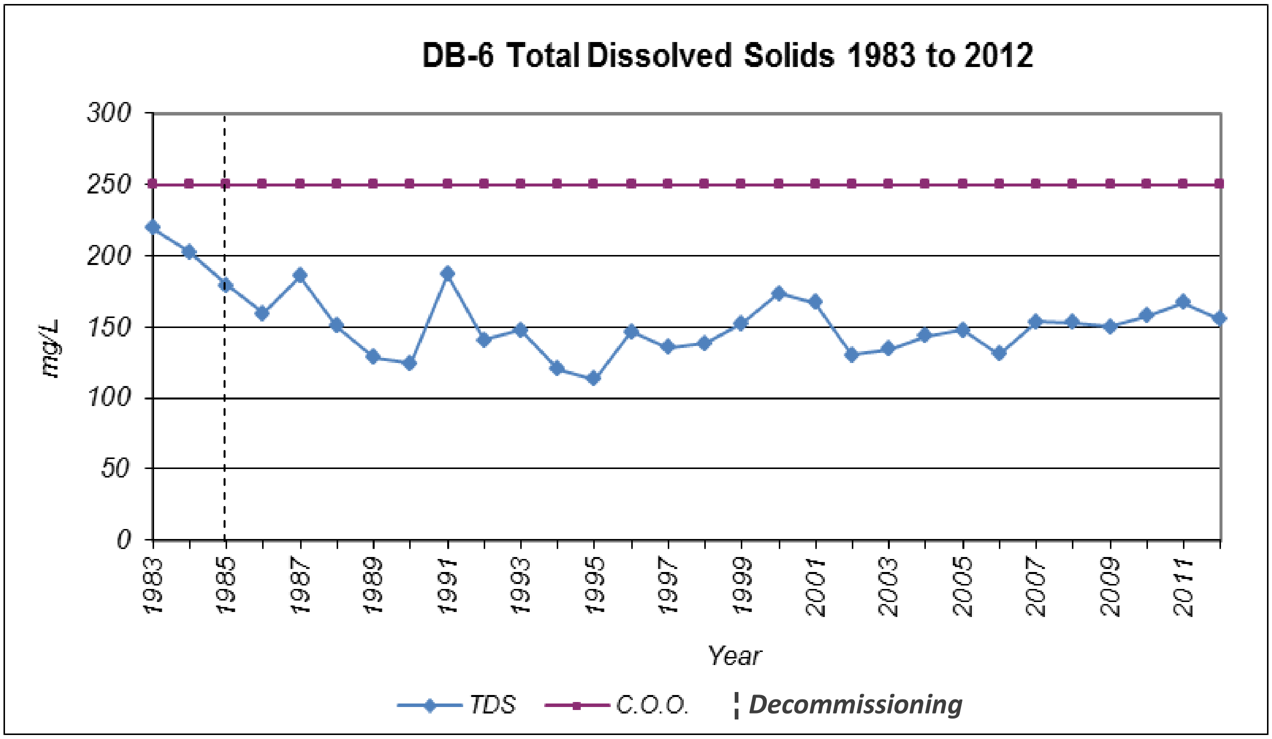


Figure 4.3.1-8 DB-6 - Dubyna Creek

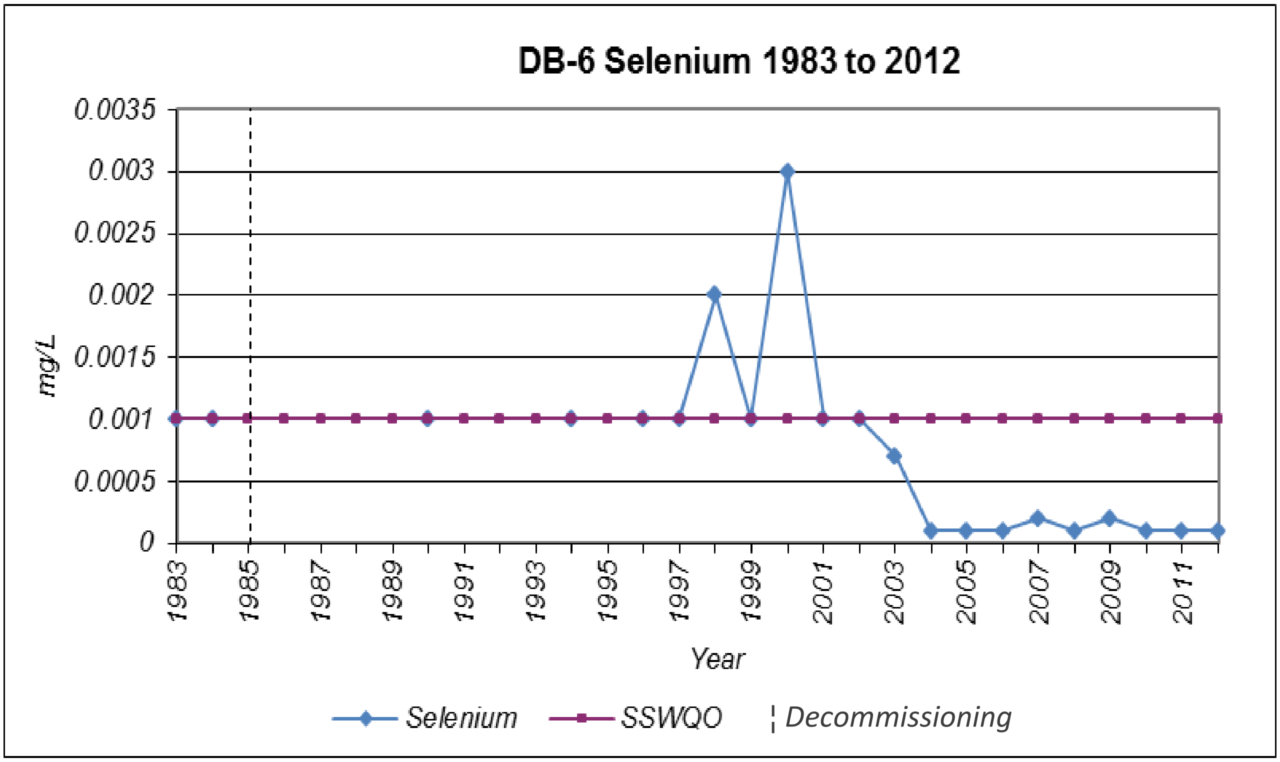


Figure 4.3.1-9 AC-6A- Verna Lake Discharge to Ace Lake

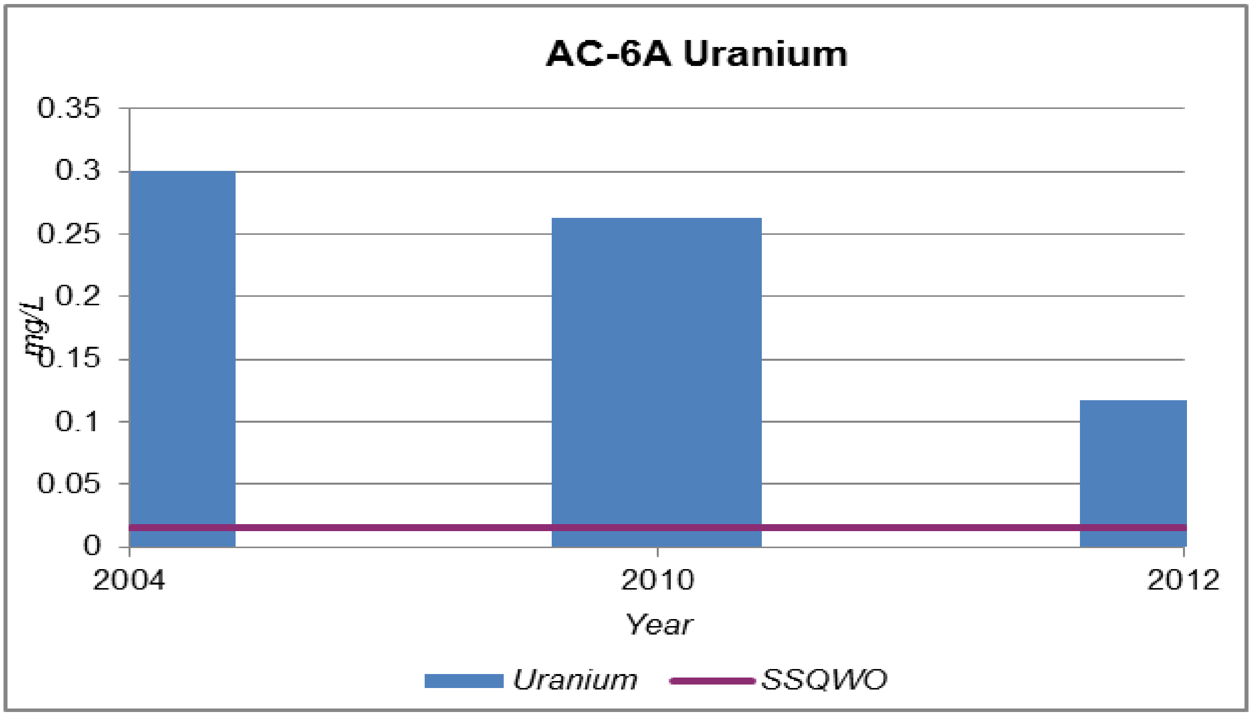


Figure 4.3.1-10 AC-6A- Verna Lake Discharge to Ace Lake

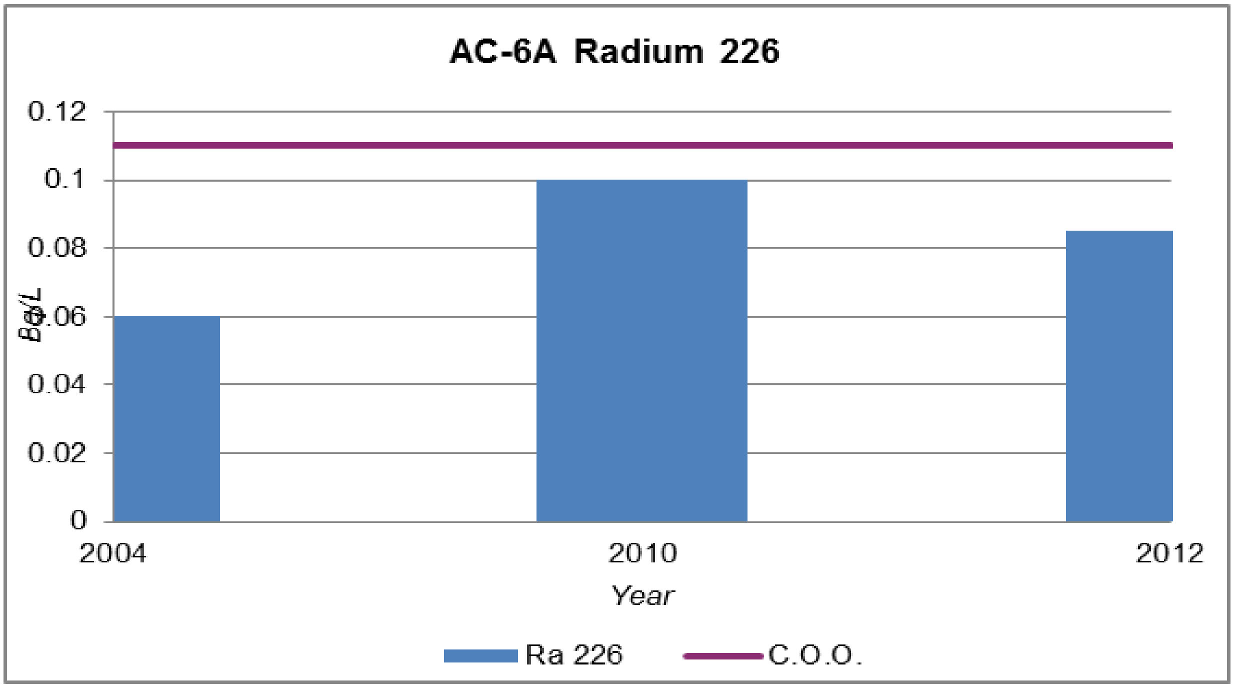


Figure 4.3.1-11 AC-6A- Verna Lake Discharge to Ace Lake

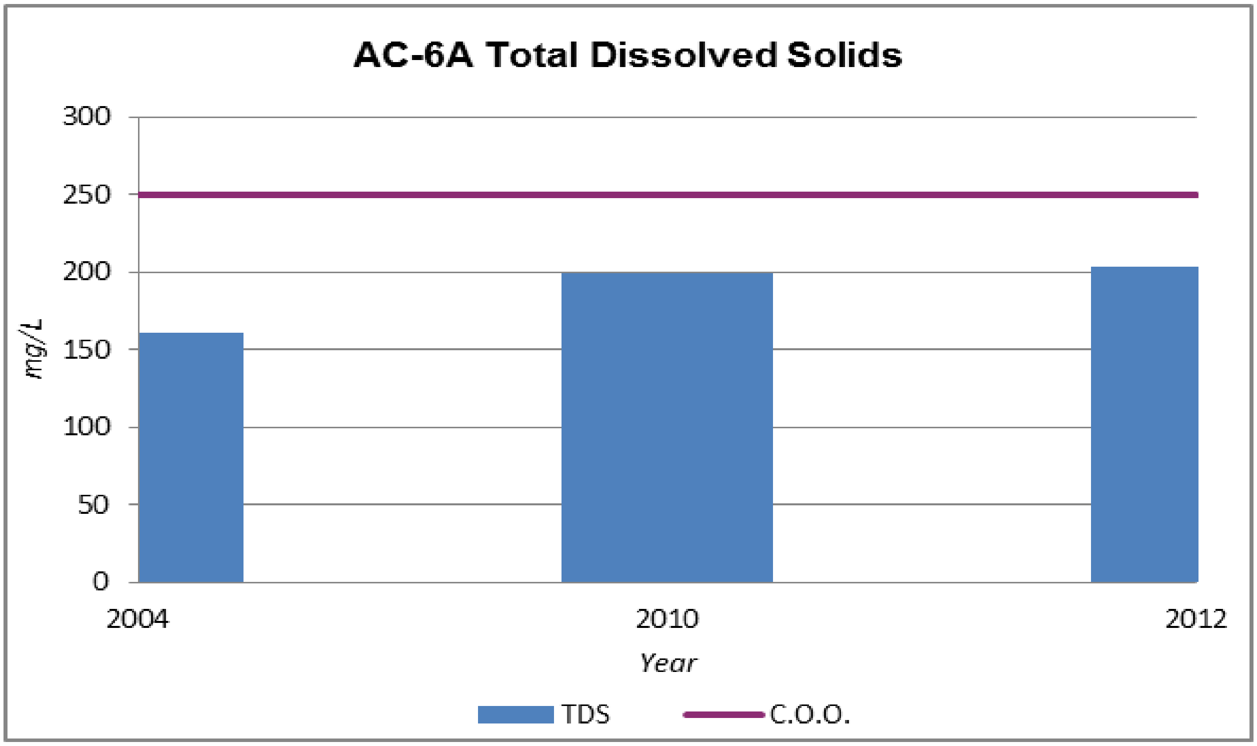


Figure 4.3.1-12 AC-6A- Verna Lake Discharge to Ace Lake

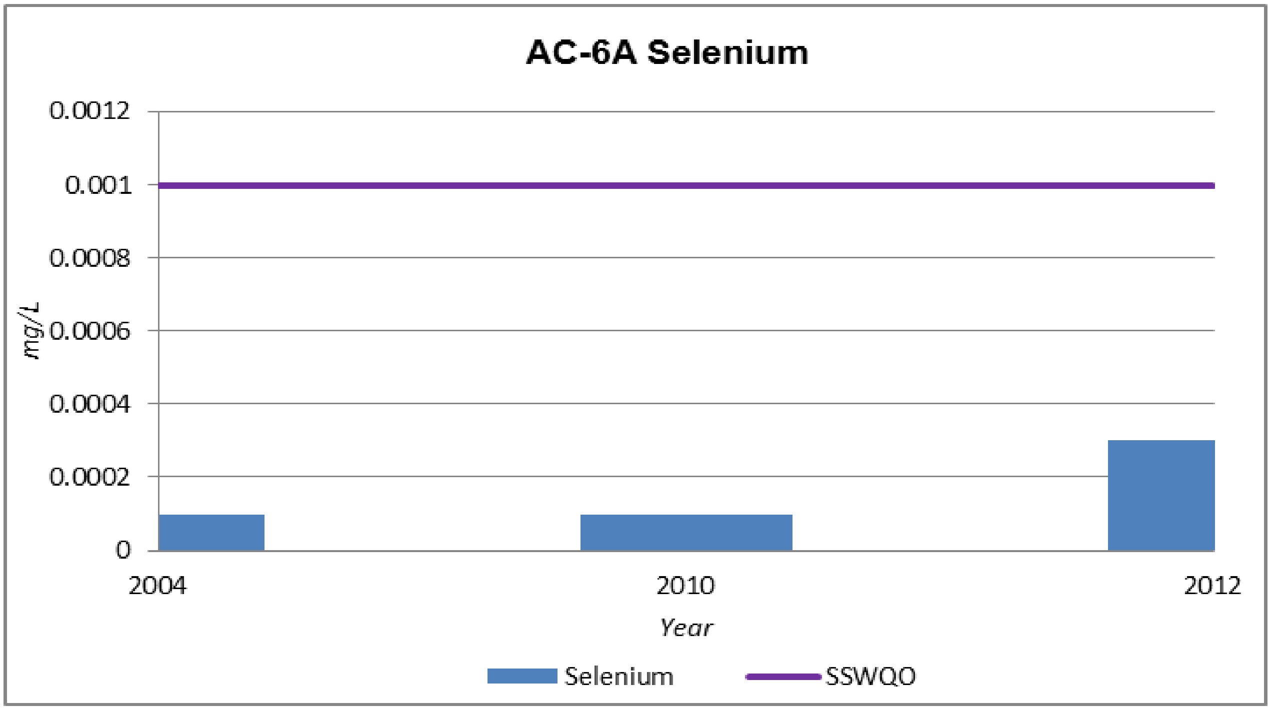


Figure 4.3.1-13 AC-8 - Ace Lake Outlet to Ace Creek

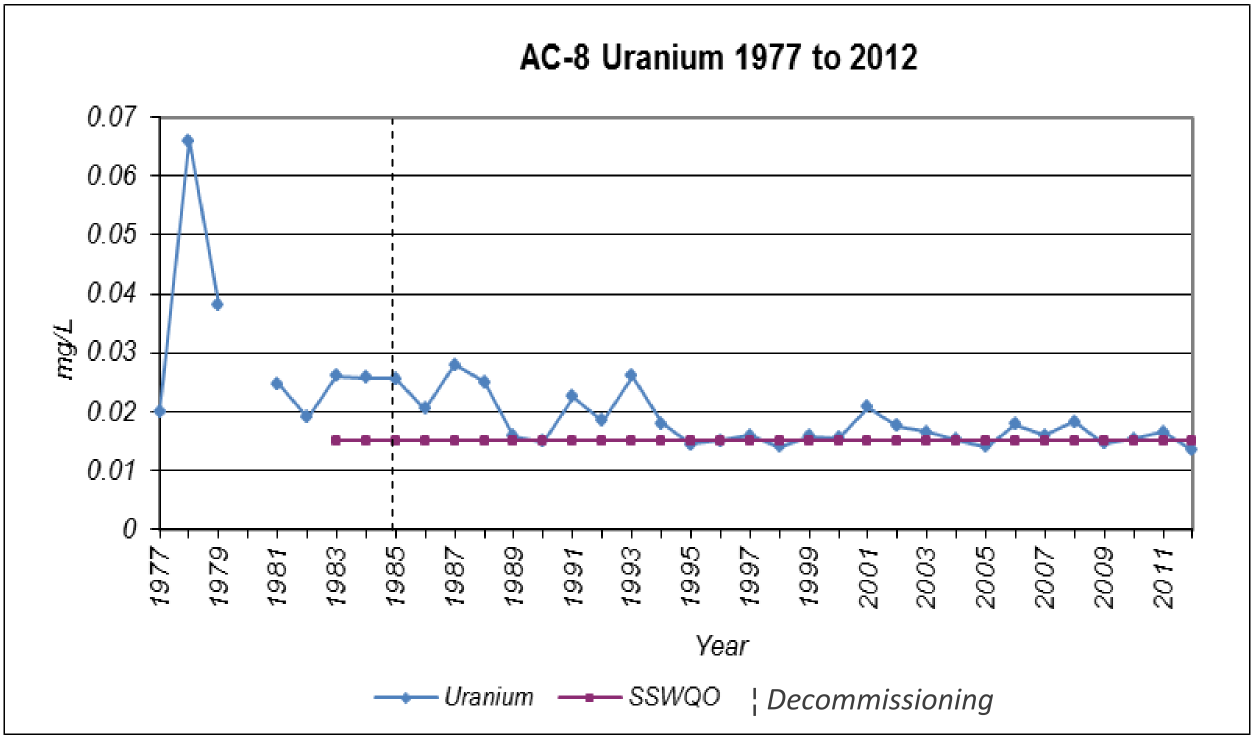


Figure 4.3.1-14 AC-8 - Ace Lake Outlet to Ace Creek

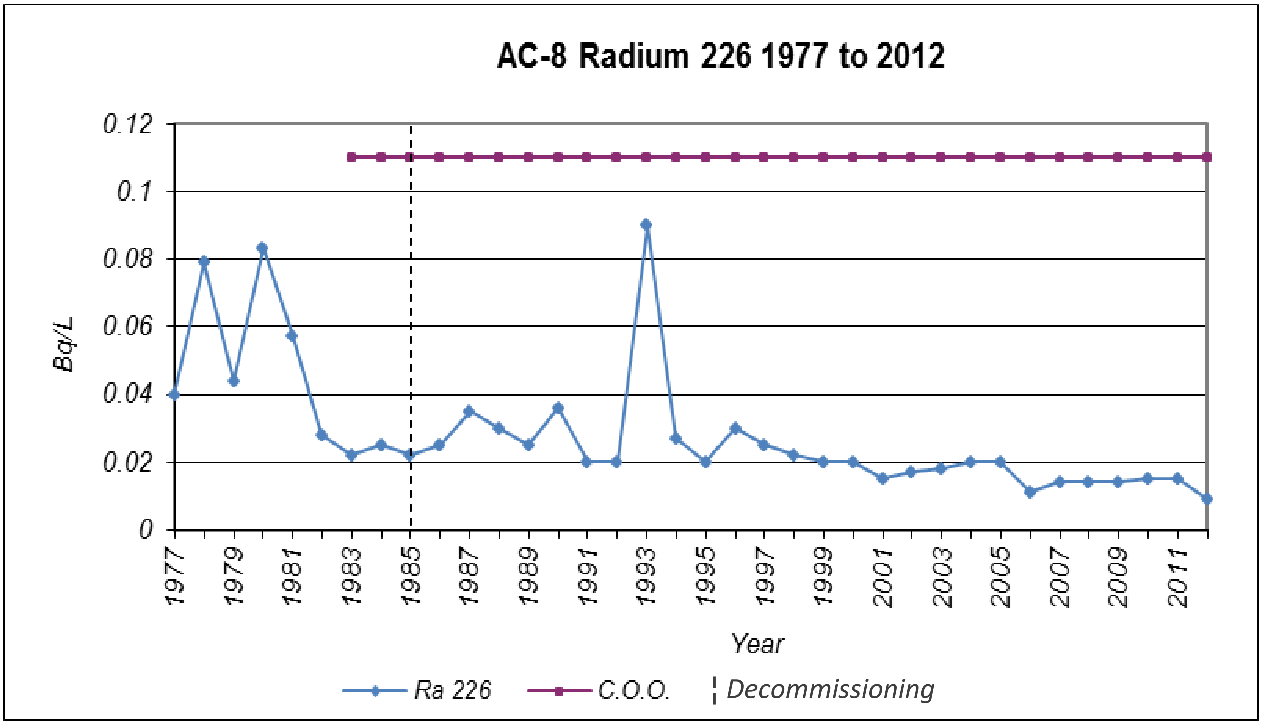


Figure 4.3.1-15 AC-8 - Ace Lake Outlet to Ace Creek

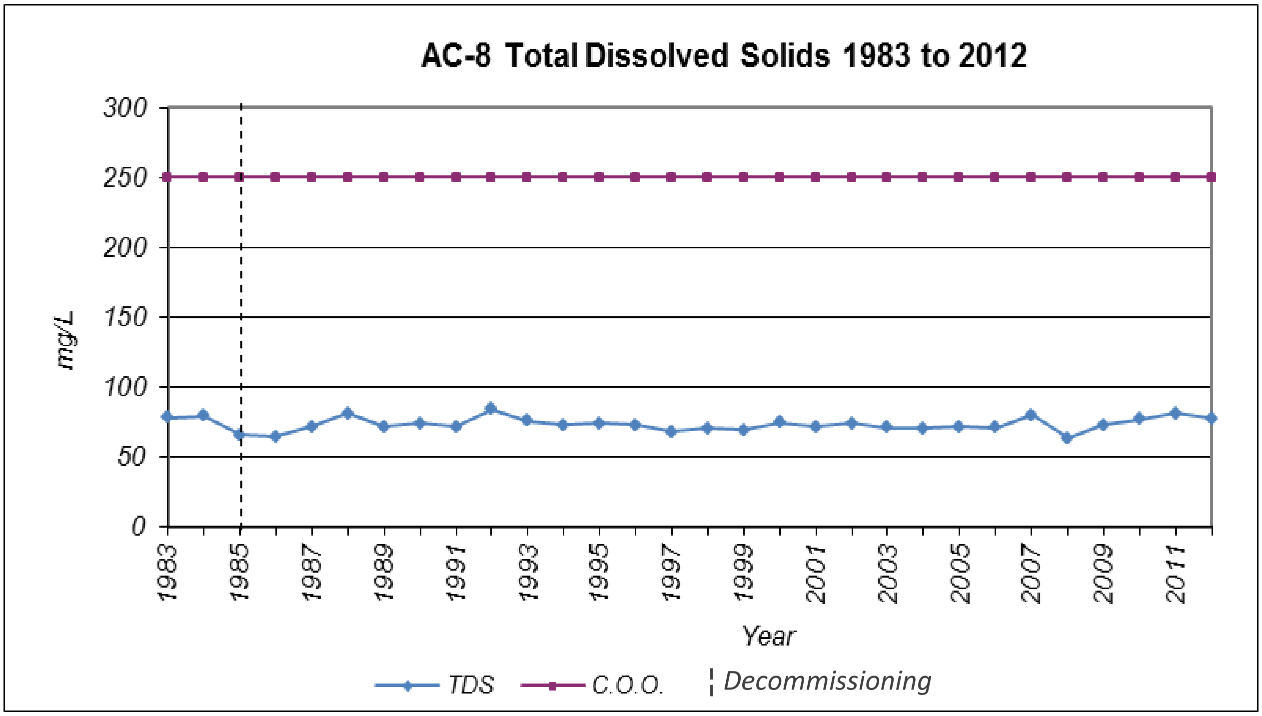


Figure 4.3.131-16 AC-8 - Ace Lake Outlet to Ace Creek

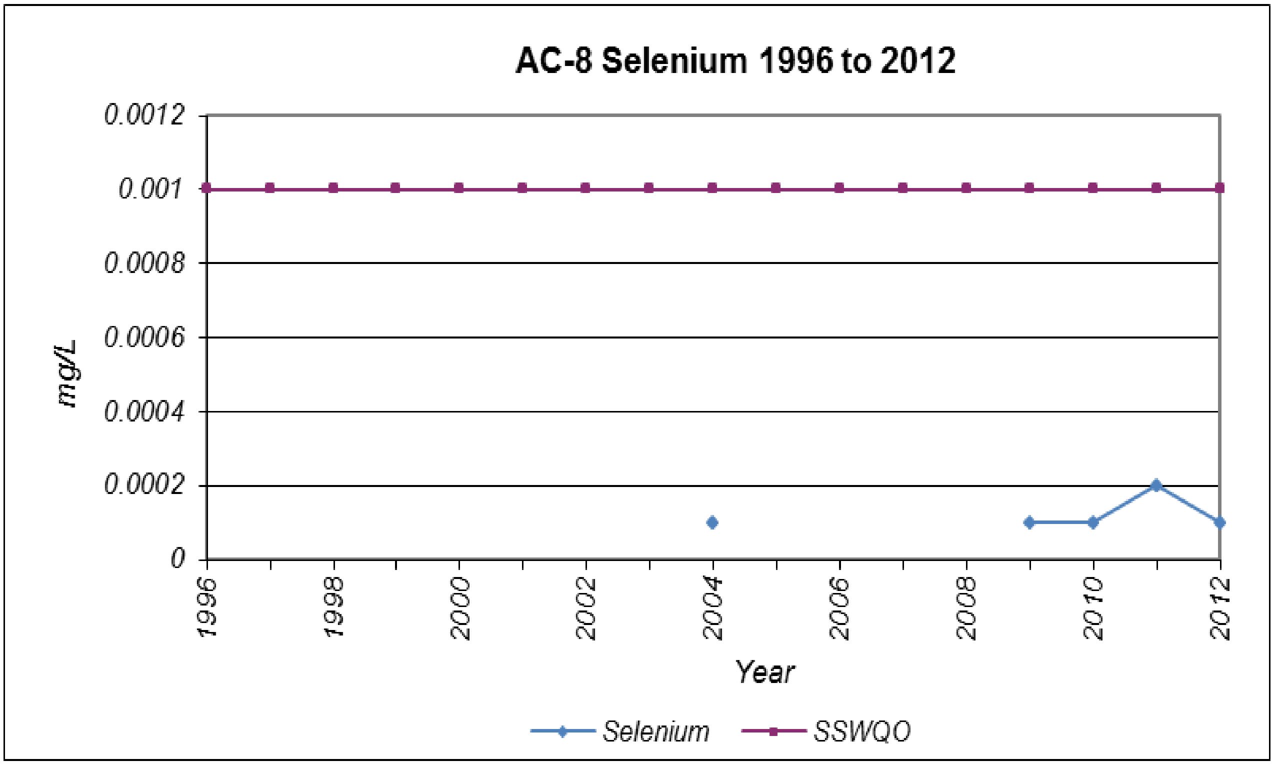


Figure 4.3.1-17 AC-14 - Ace Creek

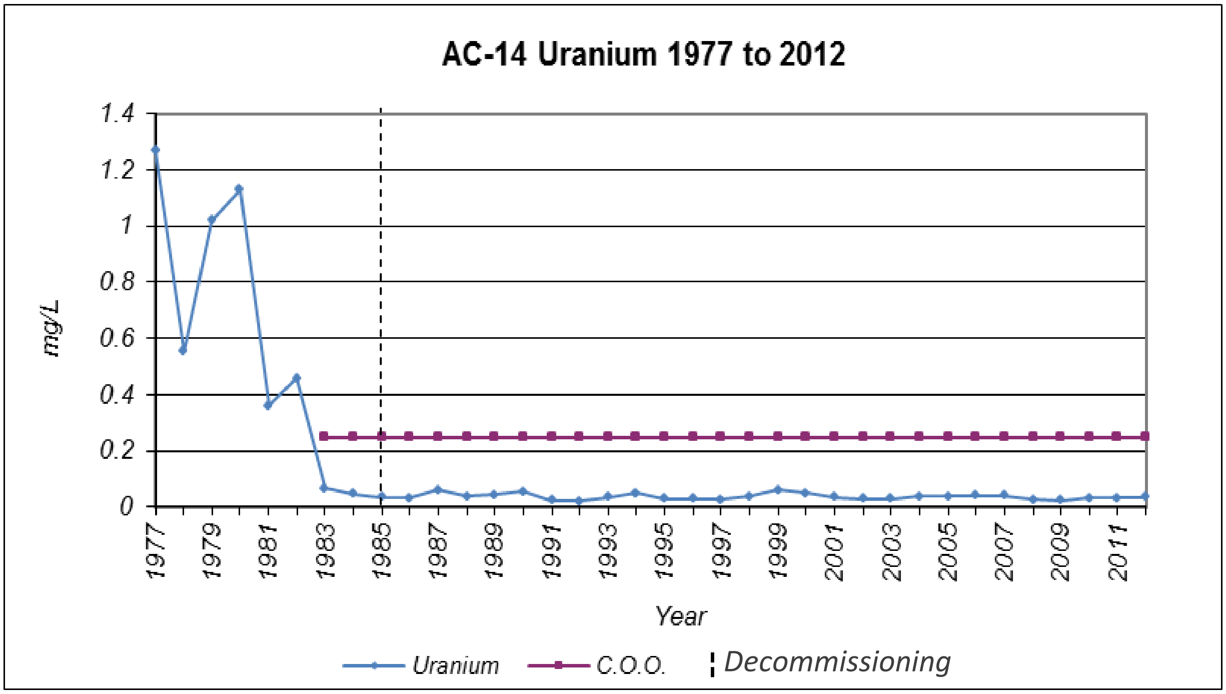


Figure 4.3.1-18 AC-14 - Ace Creek

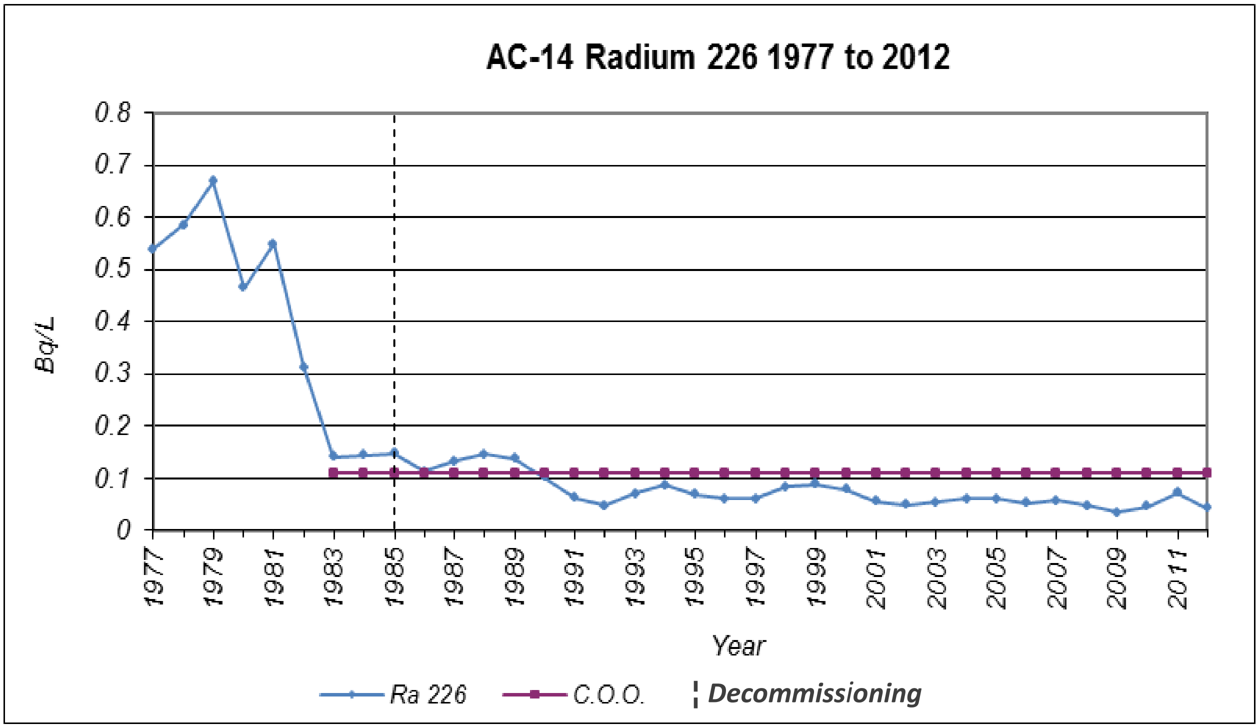


Figure 4.3.1-19 AC-14 - Ace Creek

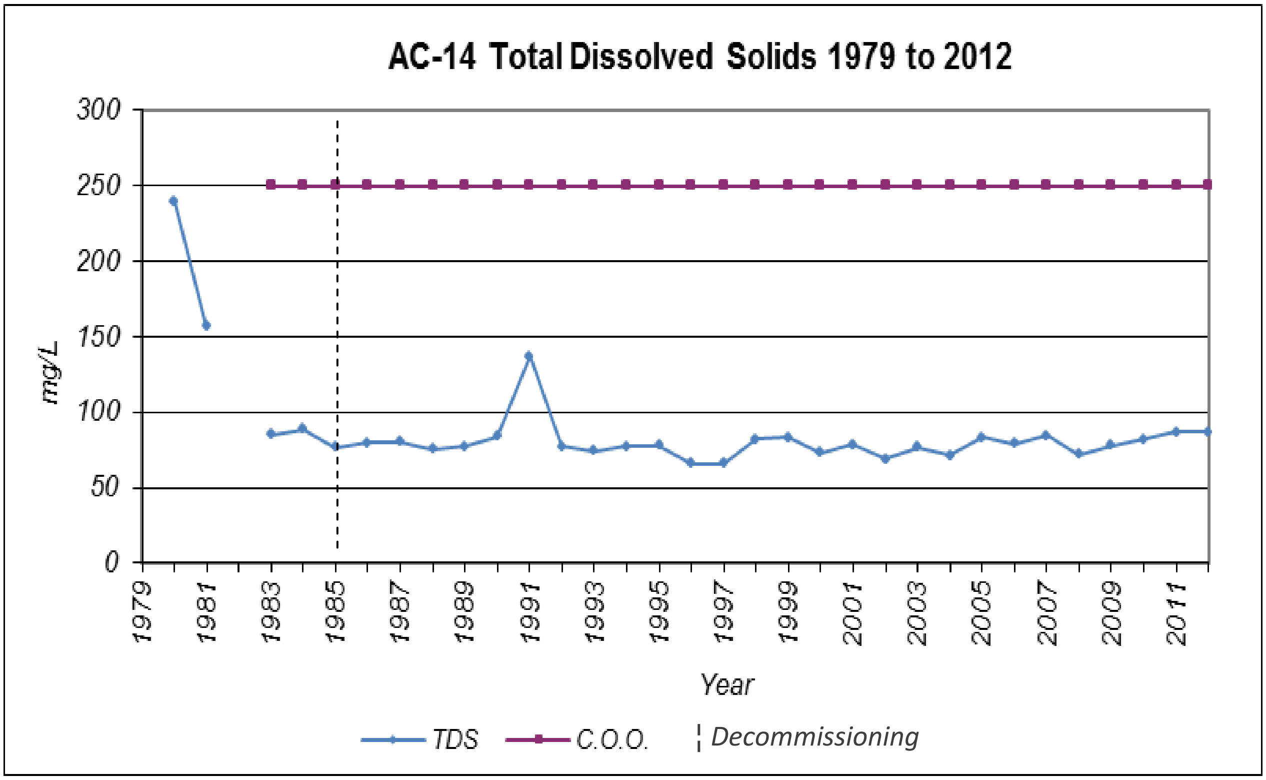


Figure 4.3.1-20 AC-14 - Ace Creek

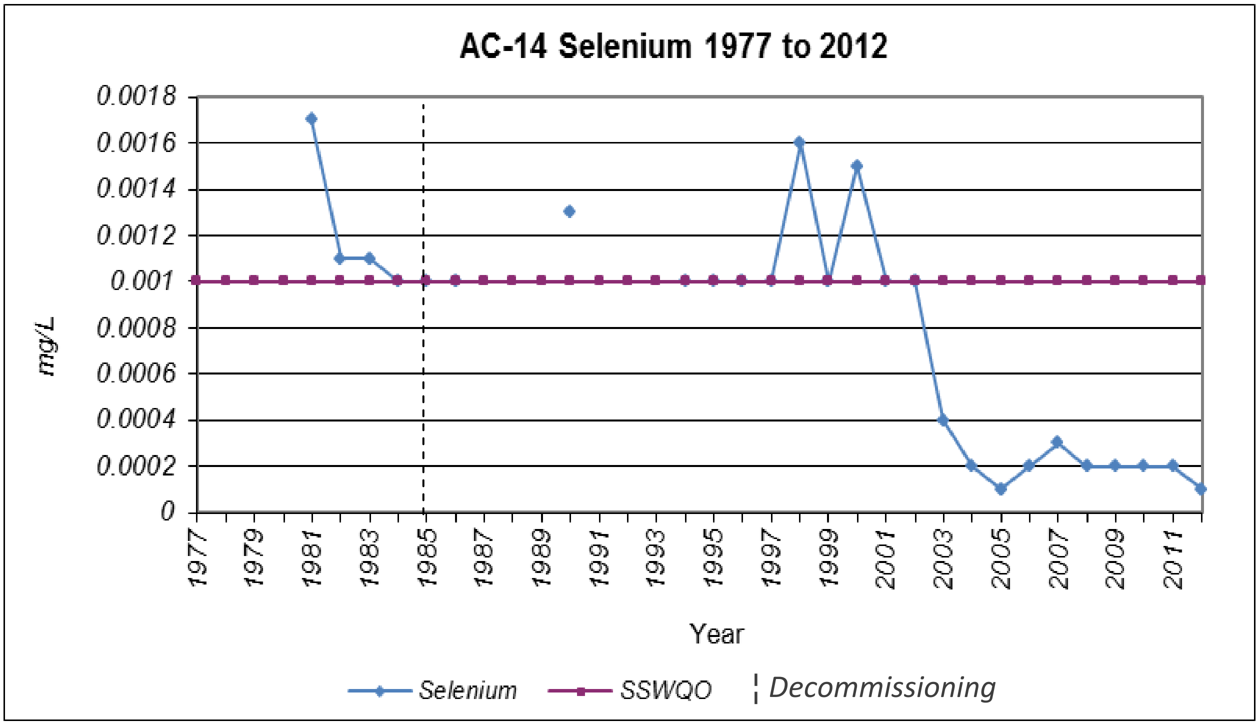
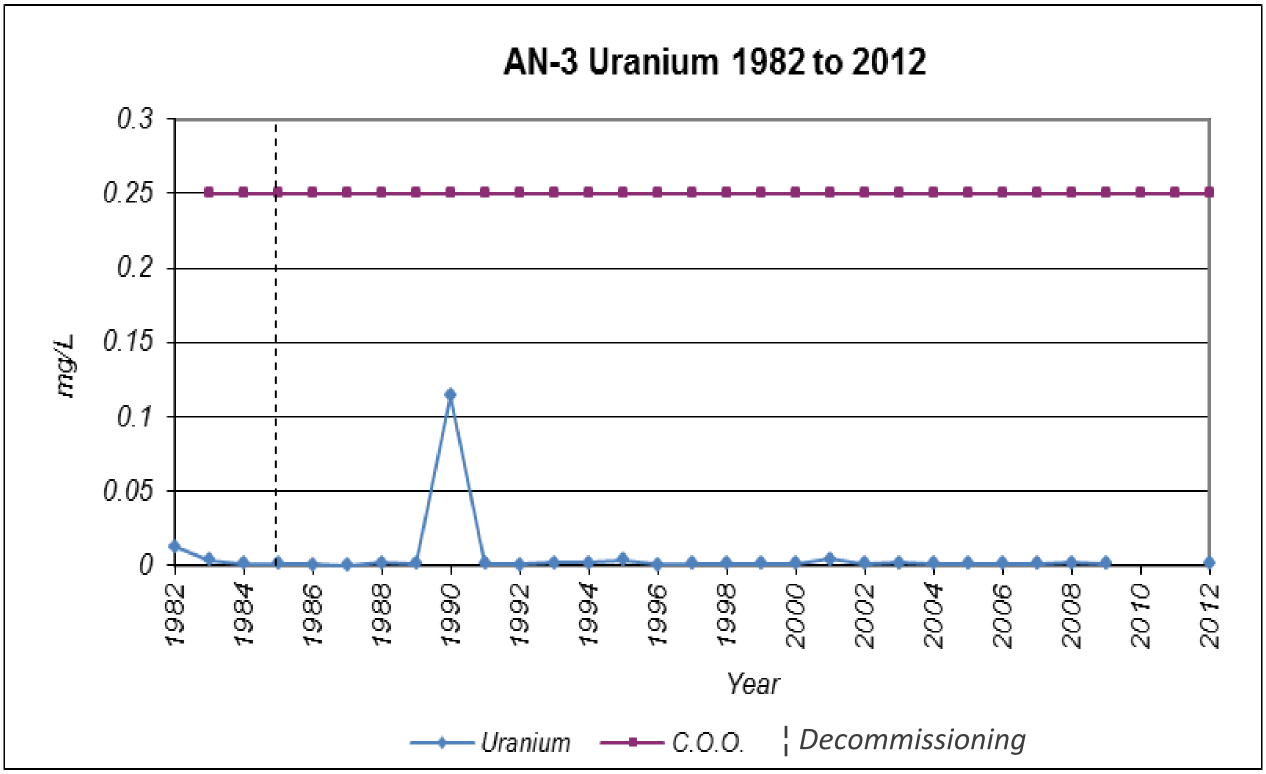
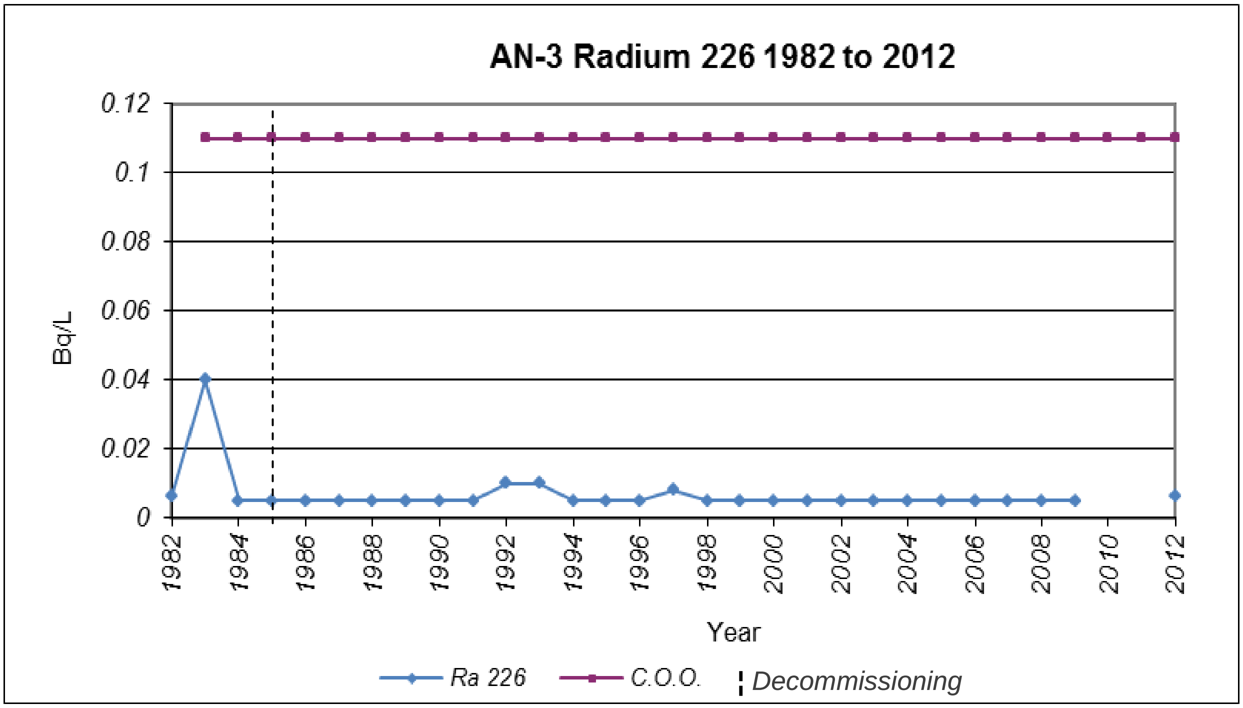


Figure 4.3.2-1 AN-3 - Fulton Lake (upstream of TL Stations)



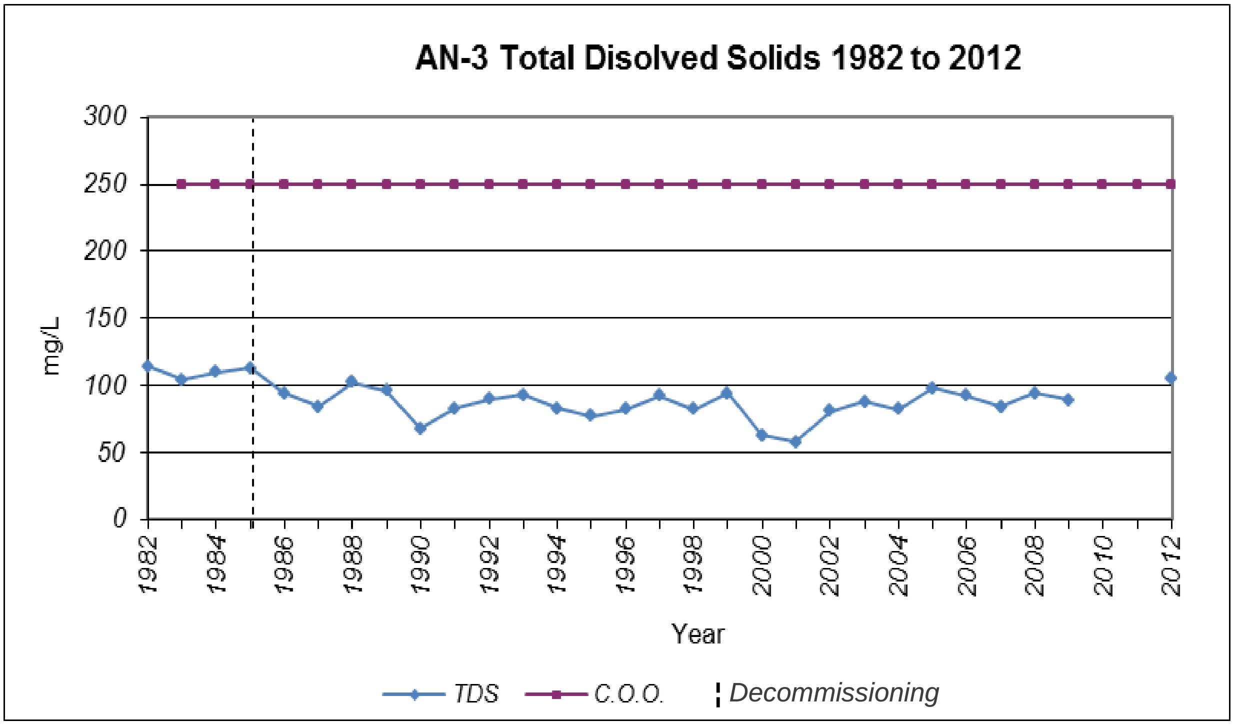
**The 2010 and 2011 scheduled sampling was not completed due to a lack of water flow*

Figure 4.3.2-2 AN-3 - Fulton Lake (upstream of TL Stations)



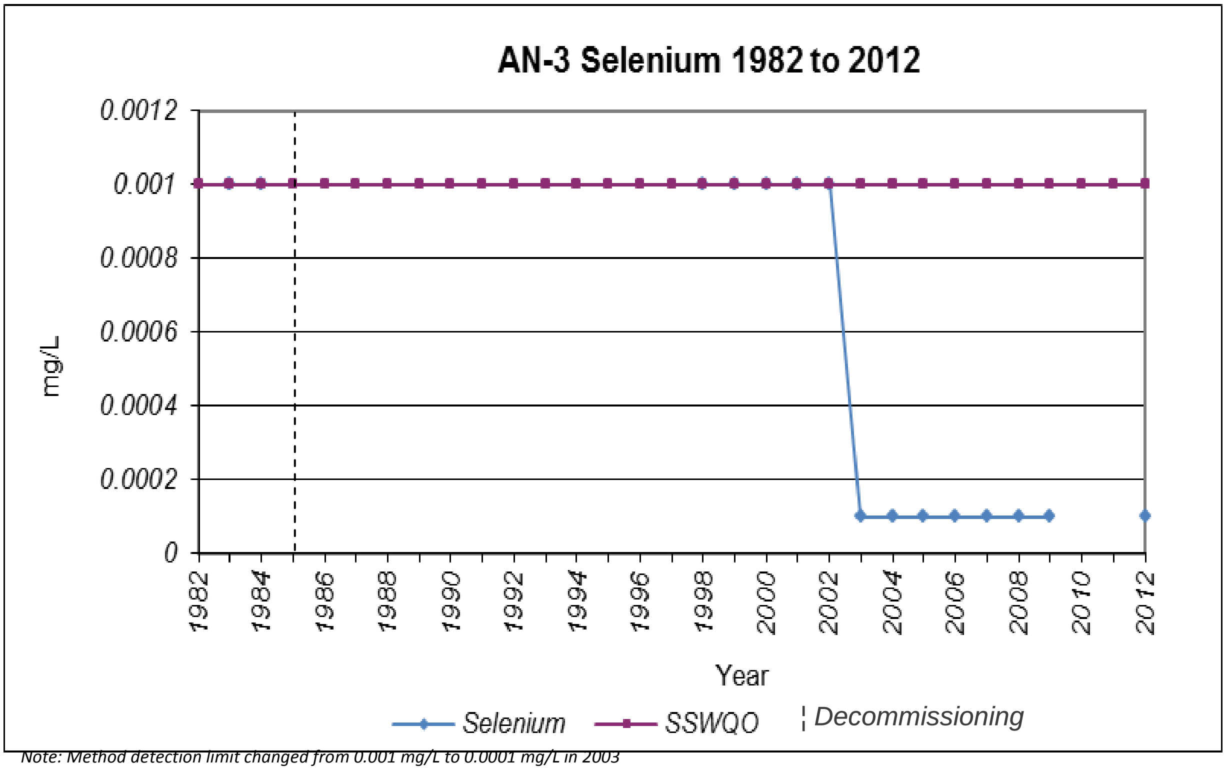
**The 2010 and 2011 scheduled sampling was not completed due to a lack of water flow.*

Figure 4.3.2-3 AN-3 - Fulton Lake (upstream of TL Stations)



**The 2010 and 2011 scheduled sampling was not completed due to a lack of water flow*

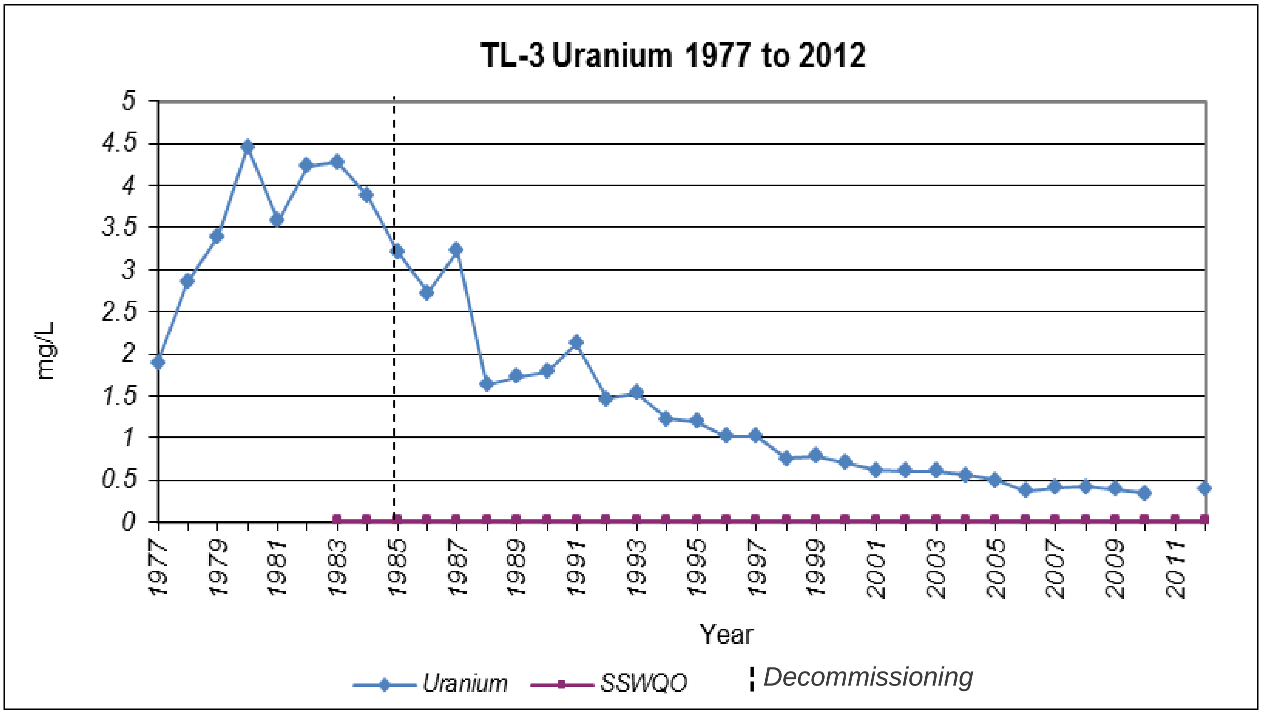
Figure 4.3.2-4 AN-3 - Fulton Lake (upstream of TL Stations)



Note: Method detection limit changed from 0.001 mg/L to 0.0001 mg/L in 2003

**The 2010 and 2011 scheduled sampling was not completed due to a lack of water flow*

Figure 4.3.2-5 TL-3 - Fookes Reservoir Discharge



**No data available for 2011 due to a lack of water flow*

Figure 4.3.2-6 TL-3 - Fookes Reservoir Discharge

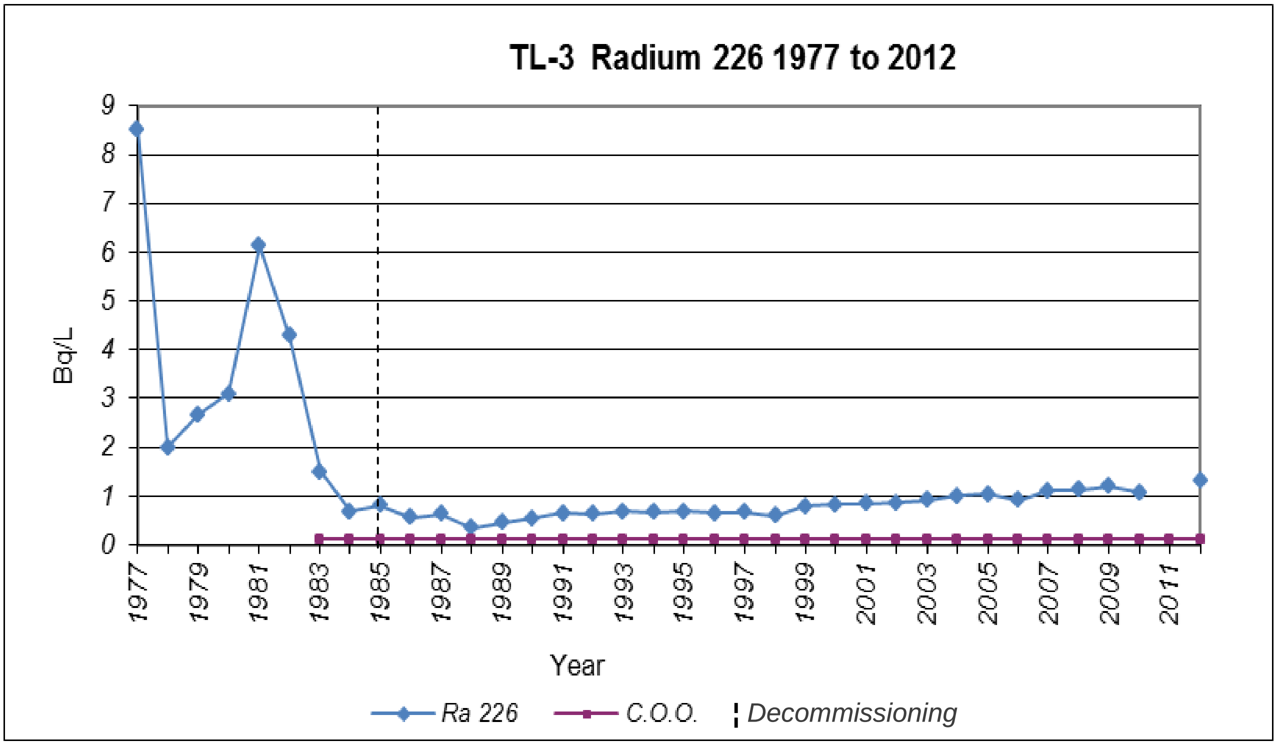


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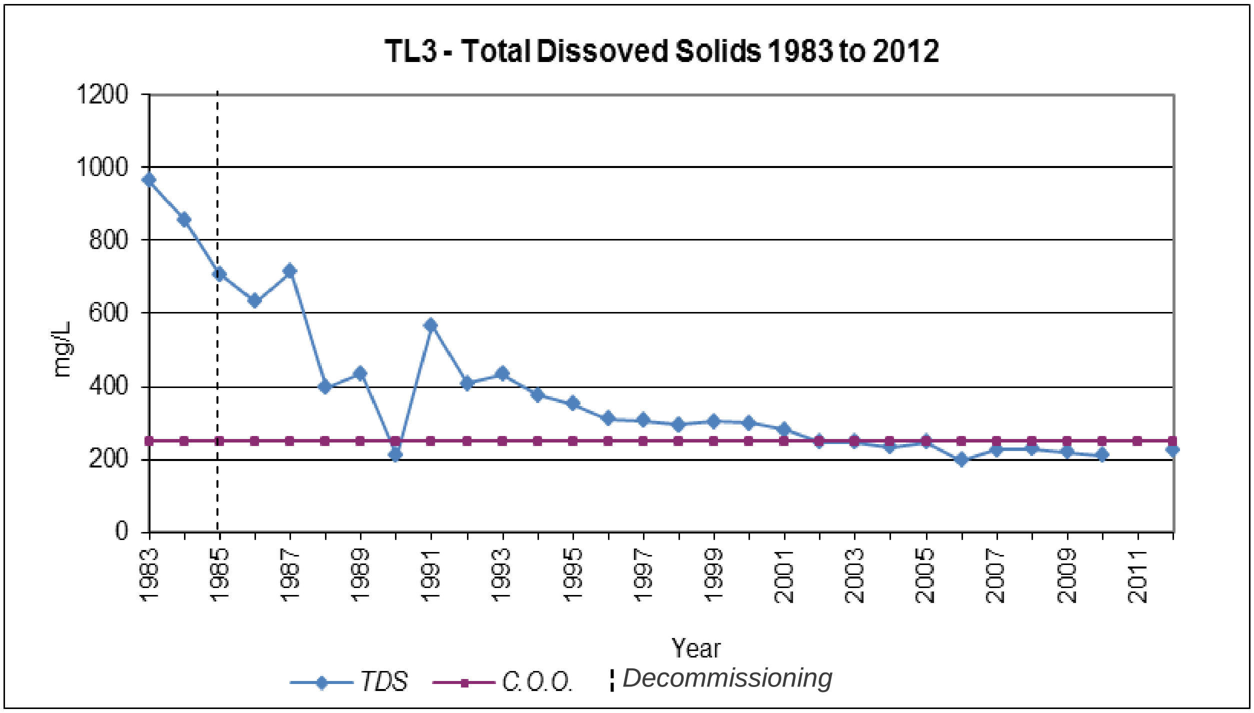
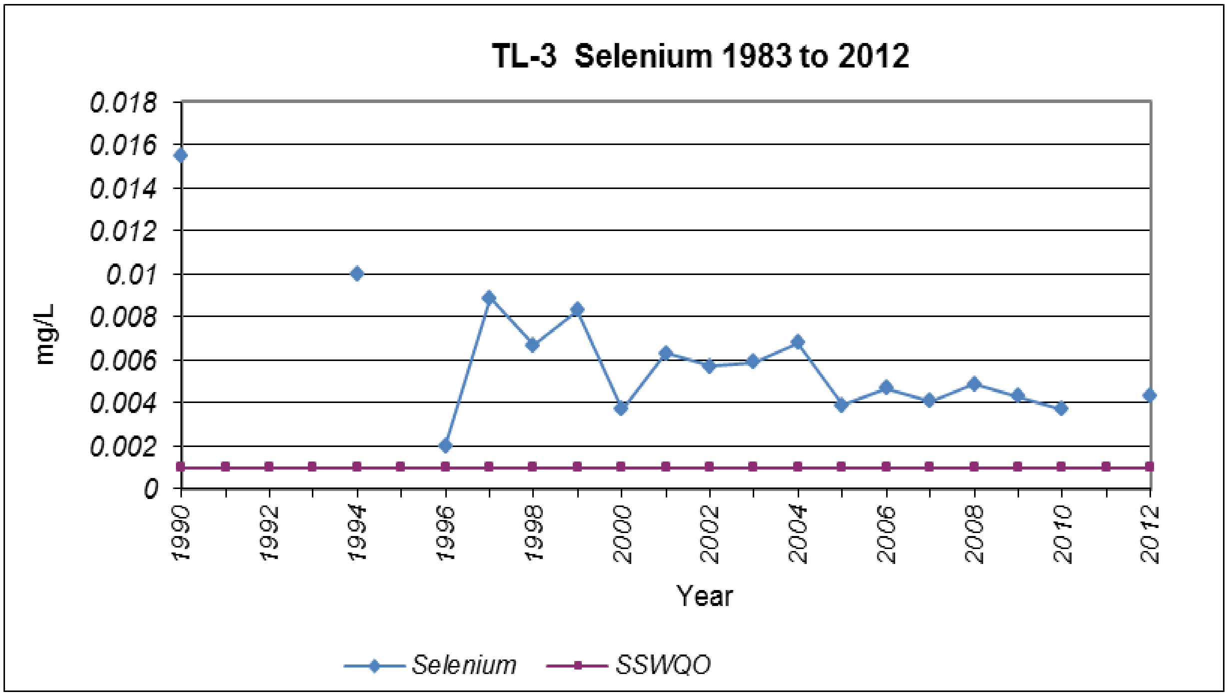
Figure 4.3.2-7 TL-3 - Fookes Reservoir Discharge



**No data available for 2011 due to a lack of water flow*

Figure 4.3.2-8 TL-3 - Fookes Reservoir Discharge



**No data available for 2011 due to a lack of water flow*

Figure 4.3.2-9 TL-4 - Marie Reservoir Discharge

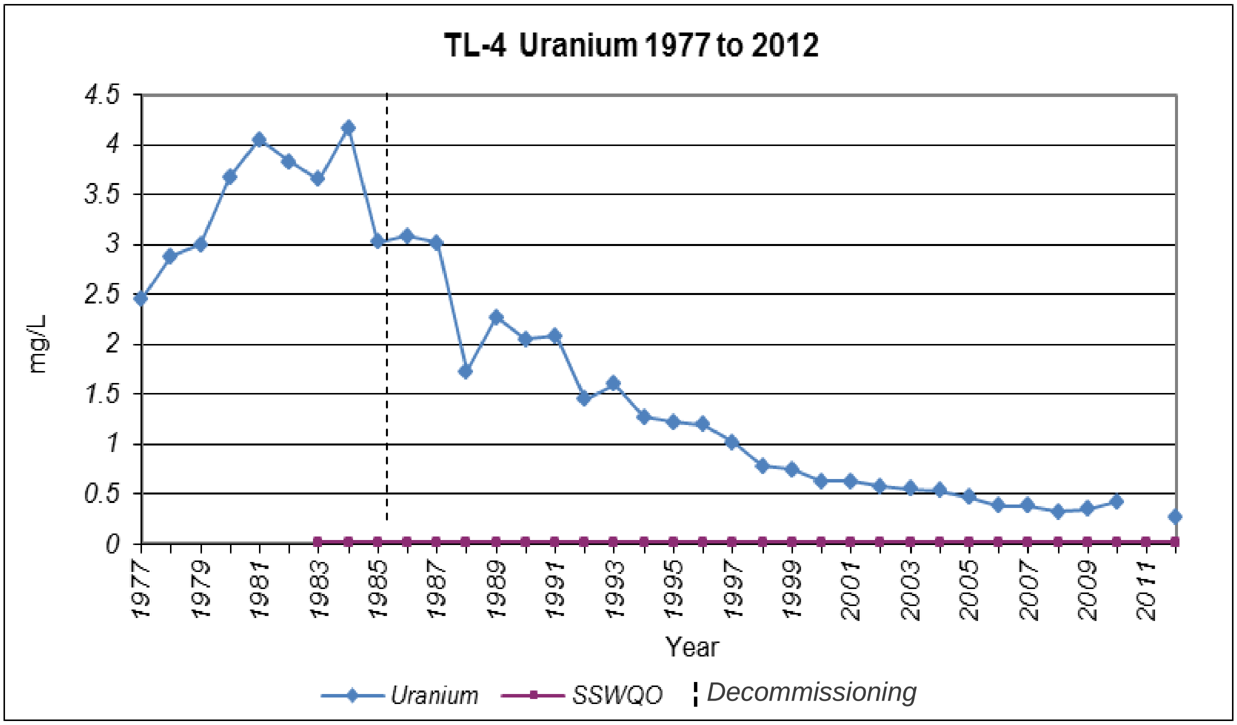


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Figure 4.3.2-10 TL-4 - Marie Reservoir Discharge

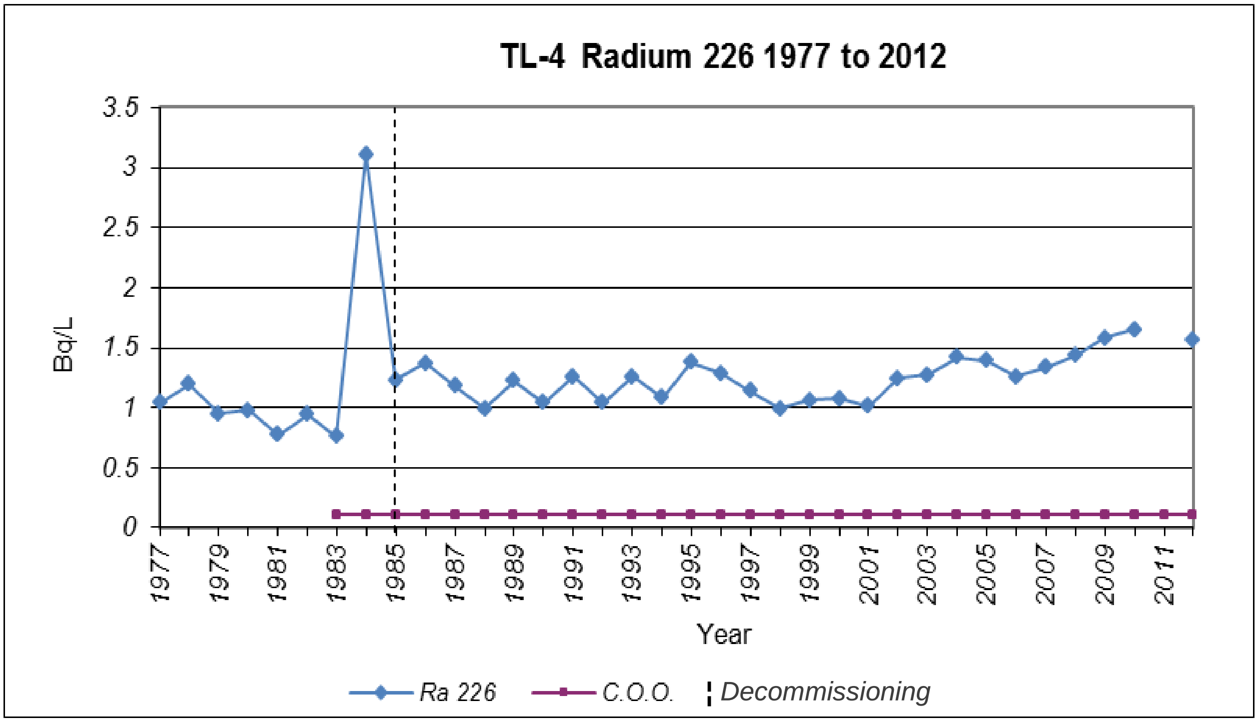

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Figure 4.3.2-11 TL-4 - Marie Reservoir Discharge

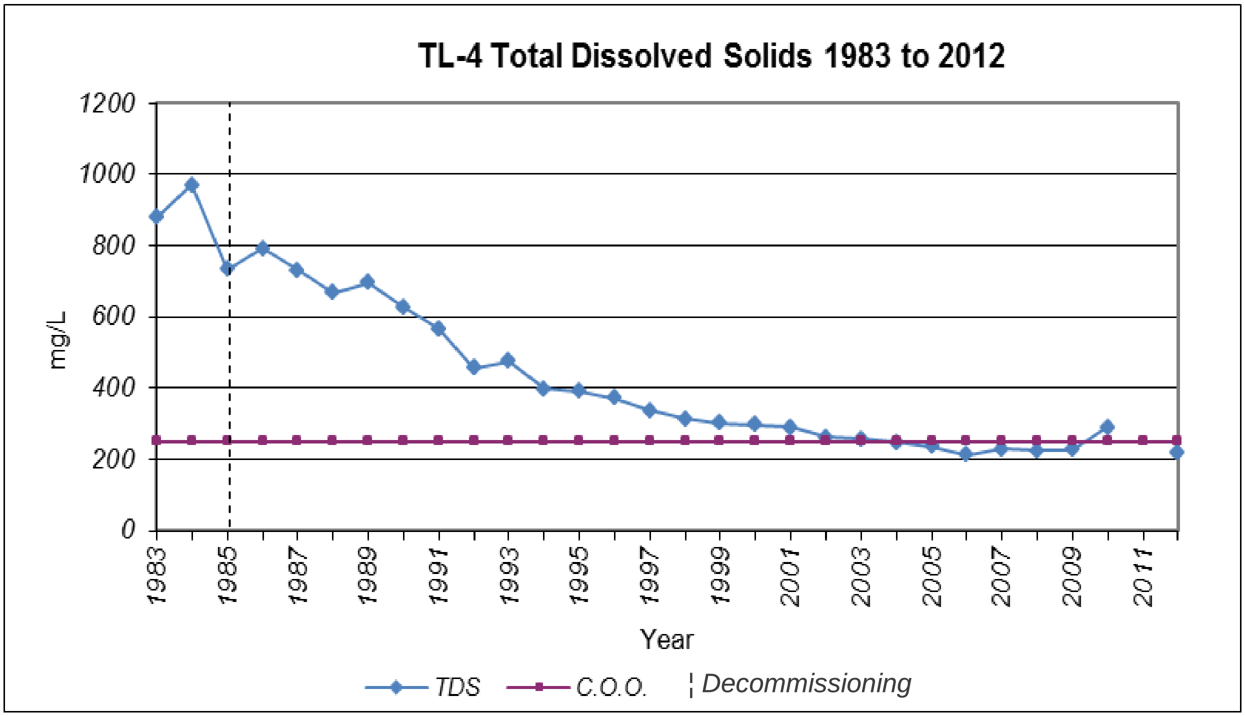

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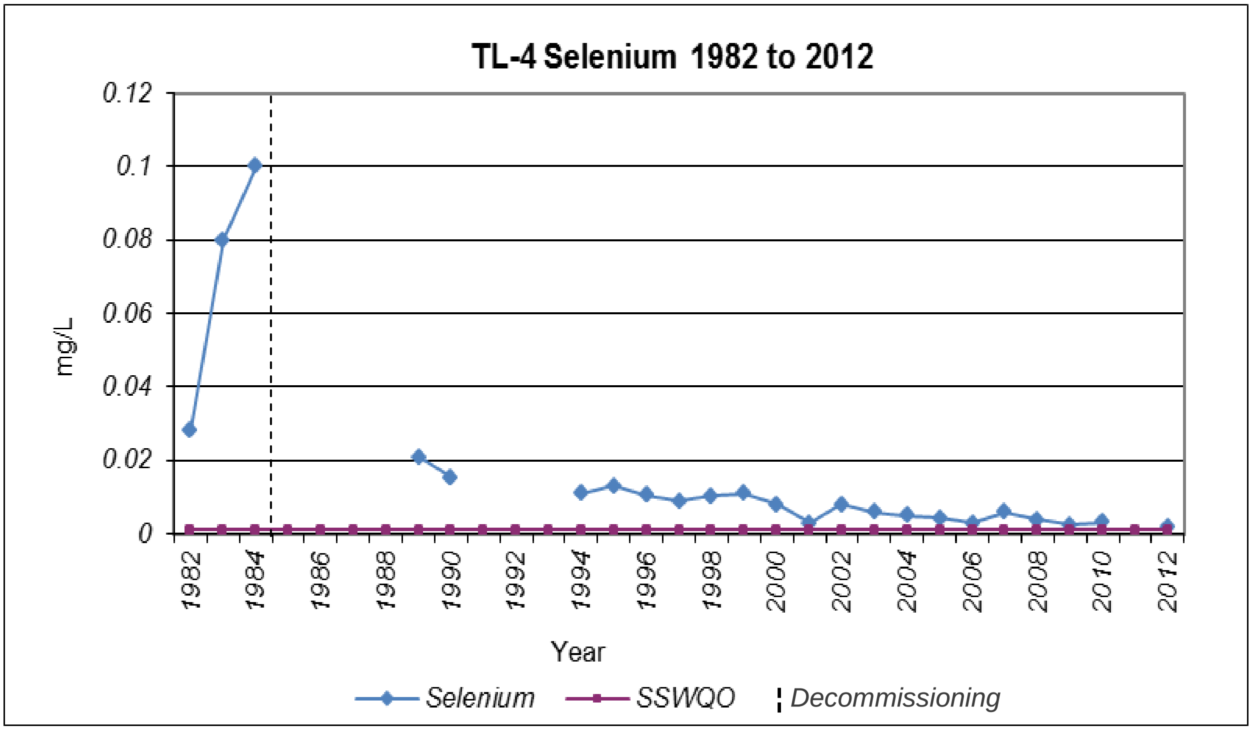
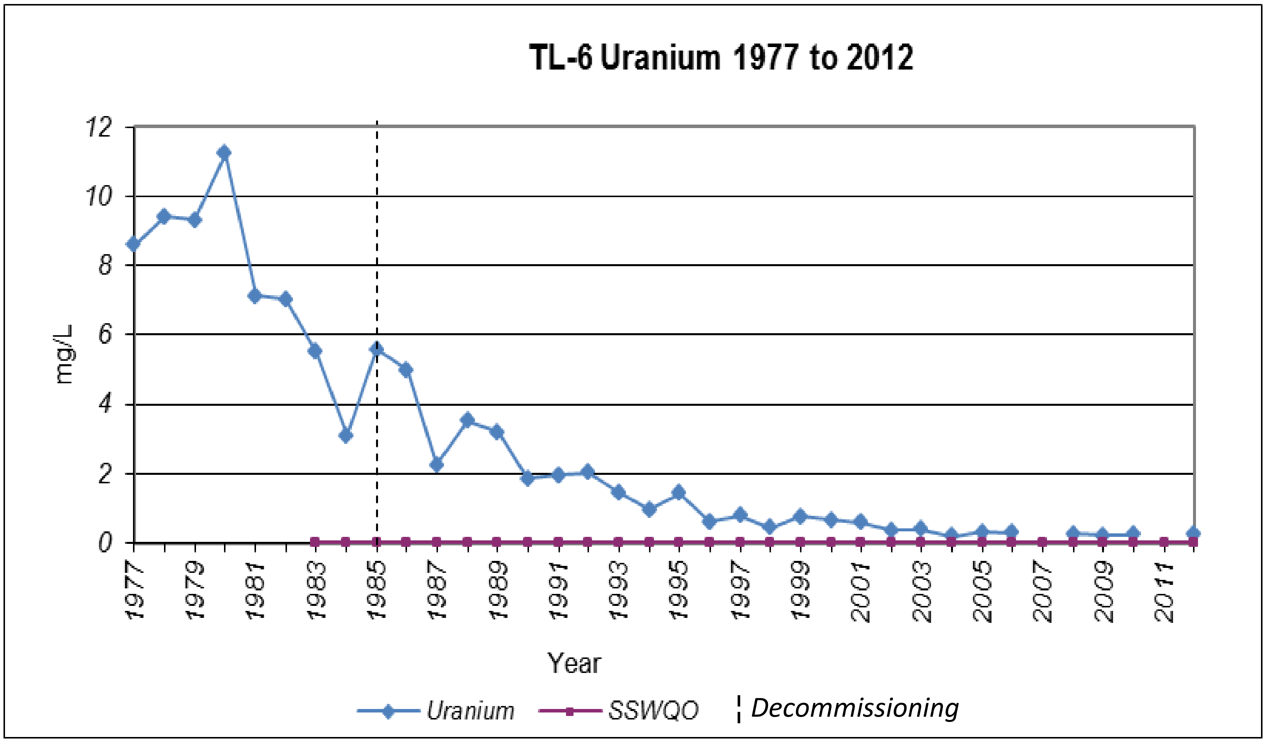
Figure 4.3.2-12 TL-4 - Marie Reservoir Discharge



**No data available for 2011 due to a lack of water flow*

Figure 4.3.2-13 TL-6 - Minewater Reservoir Discharge



**No data available for 2007 and 2011 due to a lack of water flow*

Figure 4.3.2-14 TL-6 - Minewater Reservoir Discharge

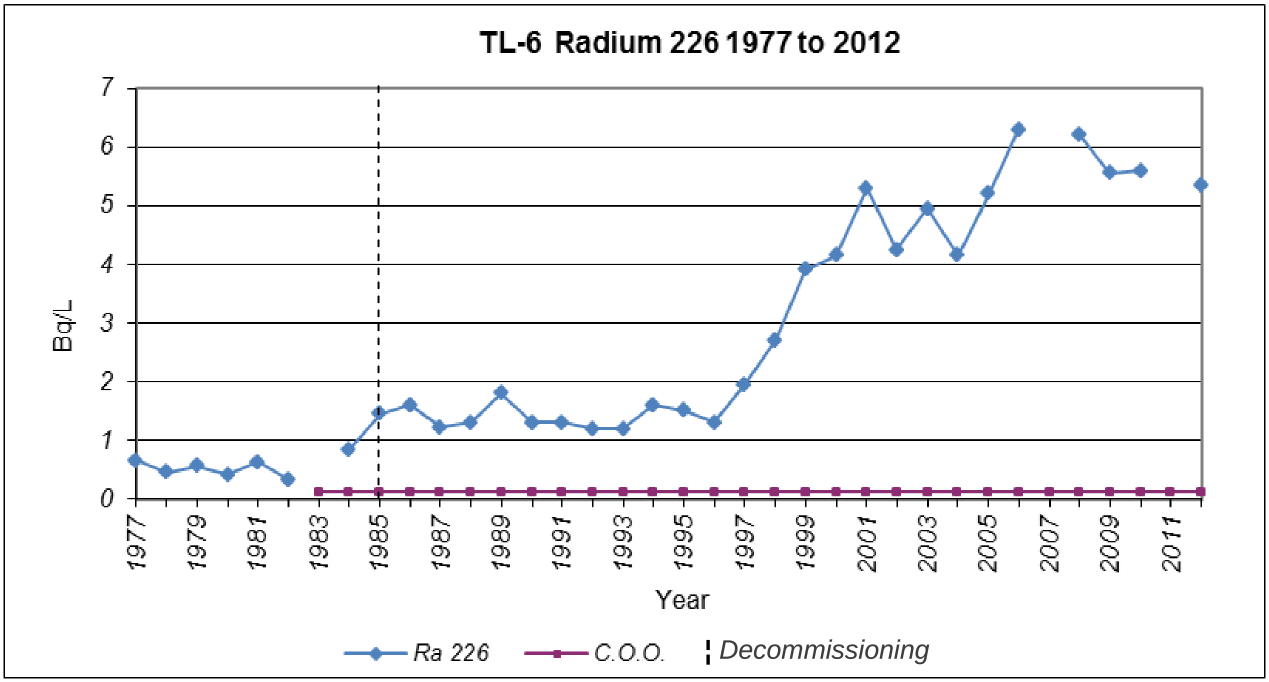


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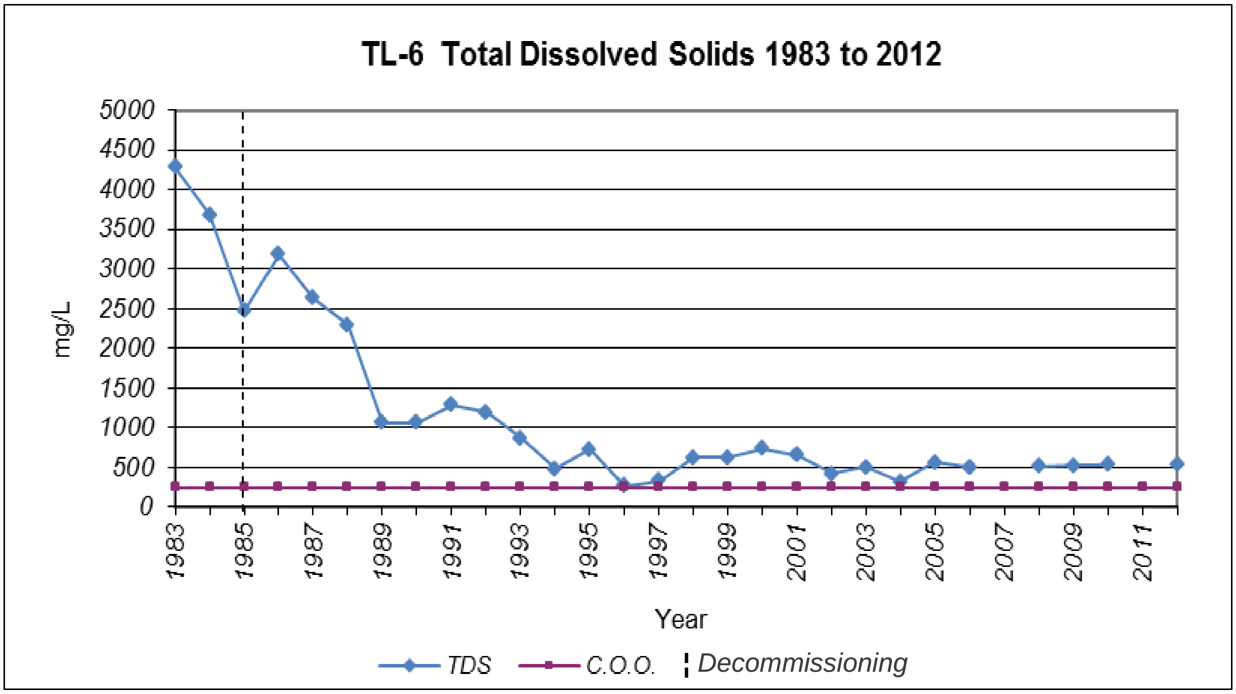
Figure 4.3.2-15 TL-6 - Minewater Reservoir Discharge



**No data available for 2007 and 2011 due to a lack of water flow*

Figure 4.3.2-16 TL-6 - Minewater Reservoir Discharge

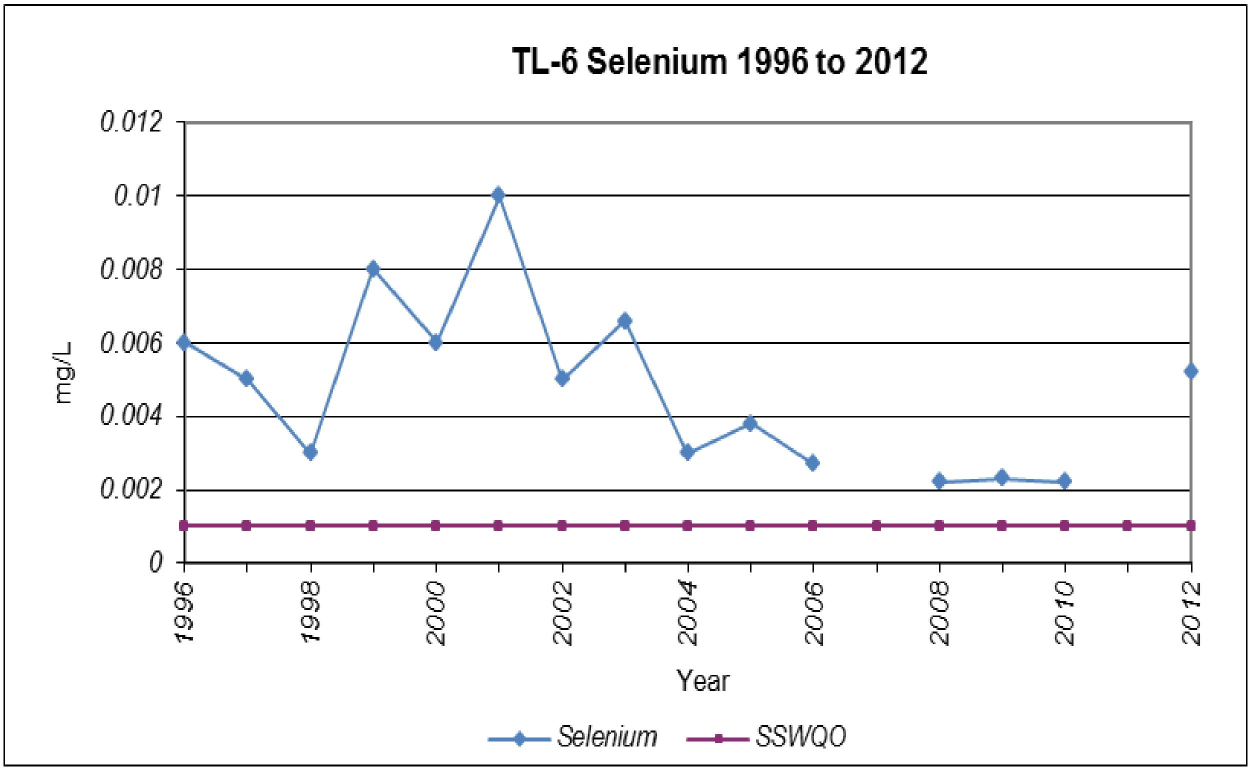


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Figure 4.3.2-17 TL-7 - Meadow Lake Discharge

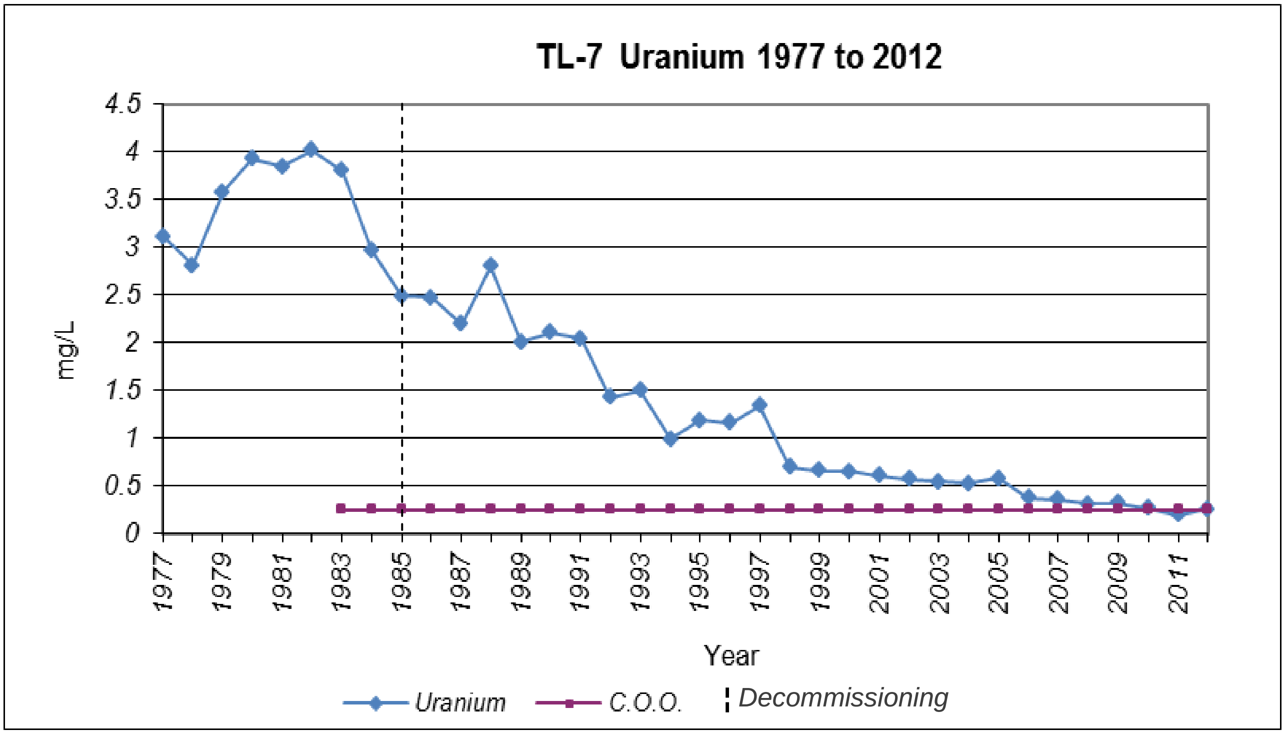


Figure 4.3.2-18 TL-7 - Meadow Lake Discharge

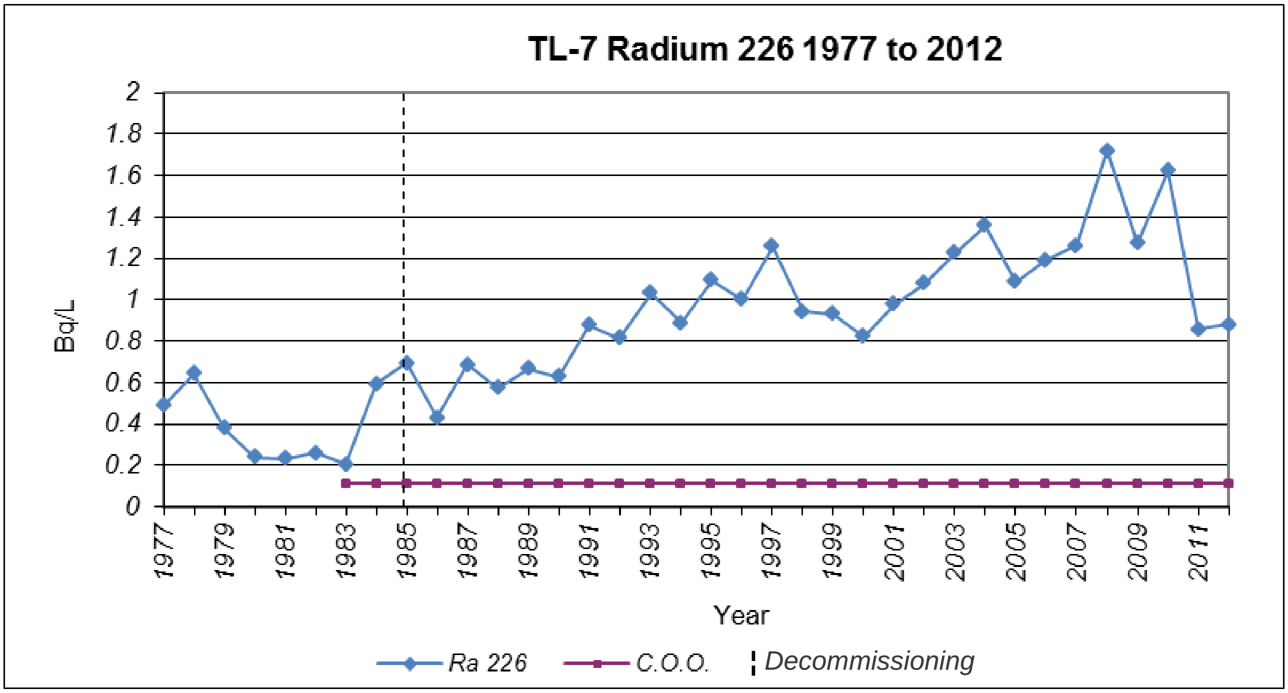


Figure 4.3.2-19 TL-7 - Meadow Lake Discharge

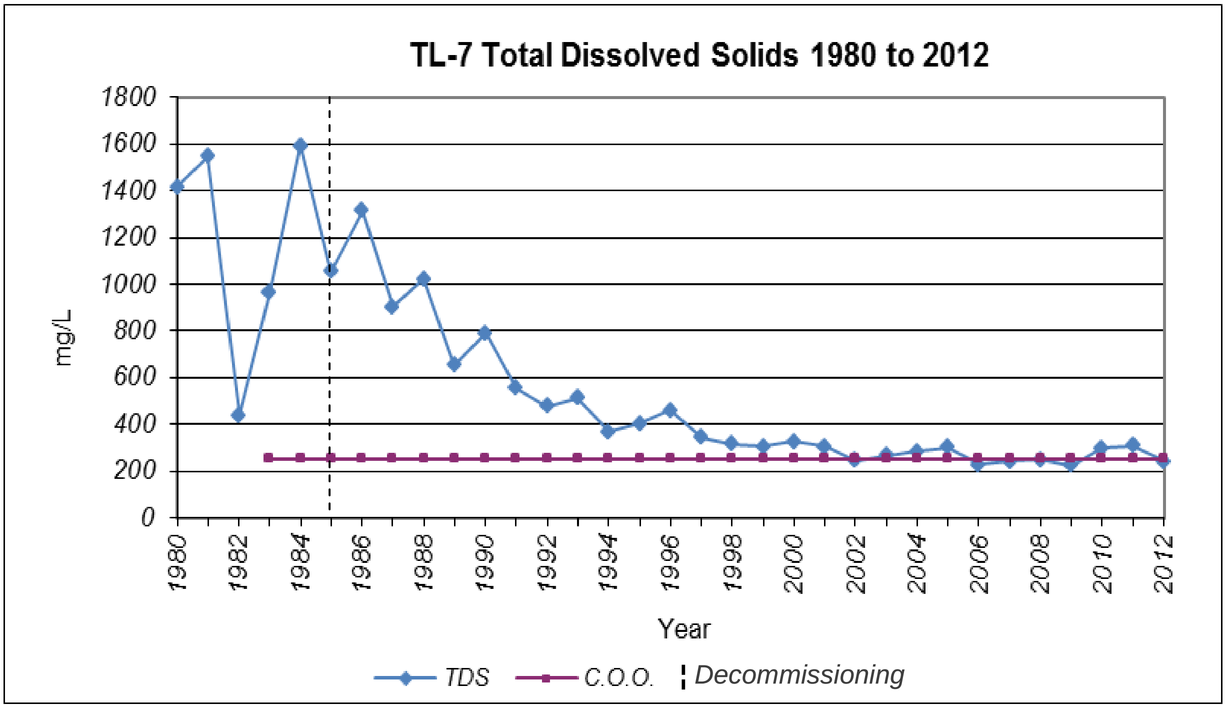


Figure 4.3.2-20 TL-7 - Meadow Lake Discharge

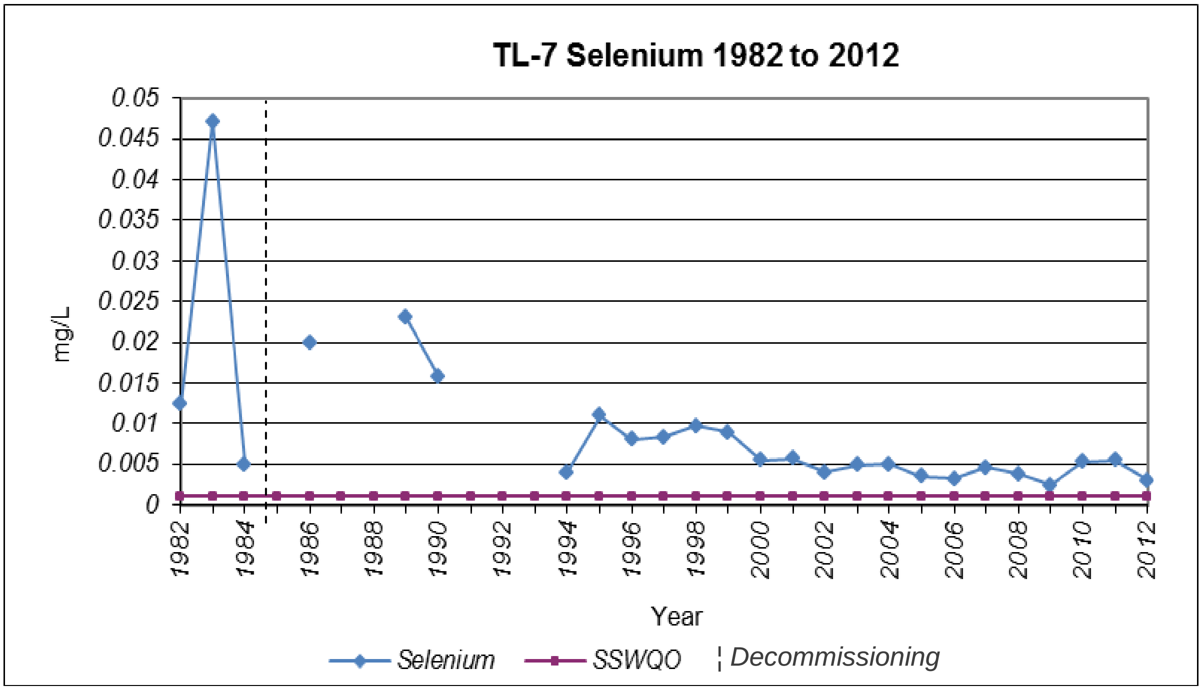
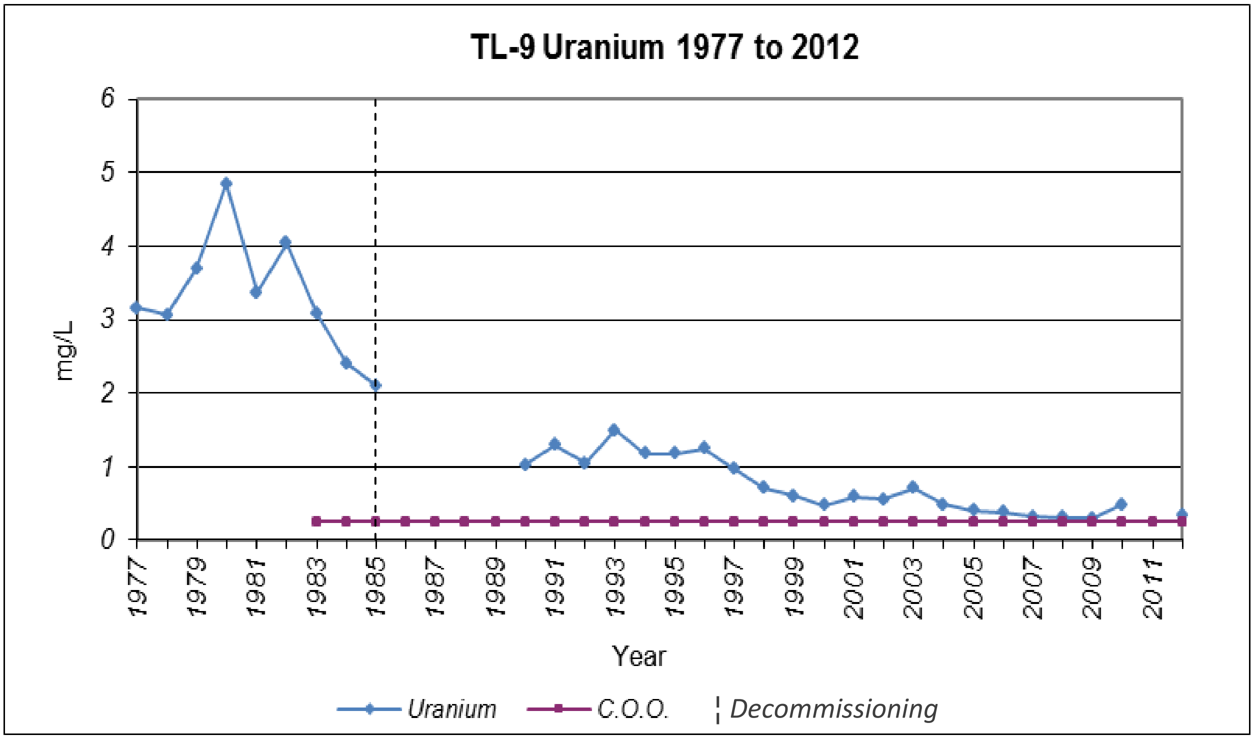
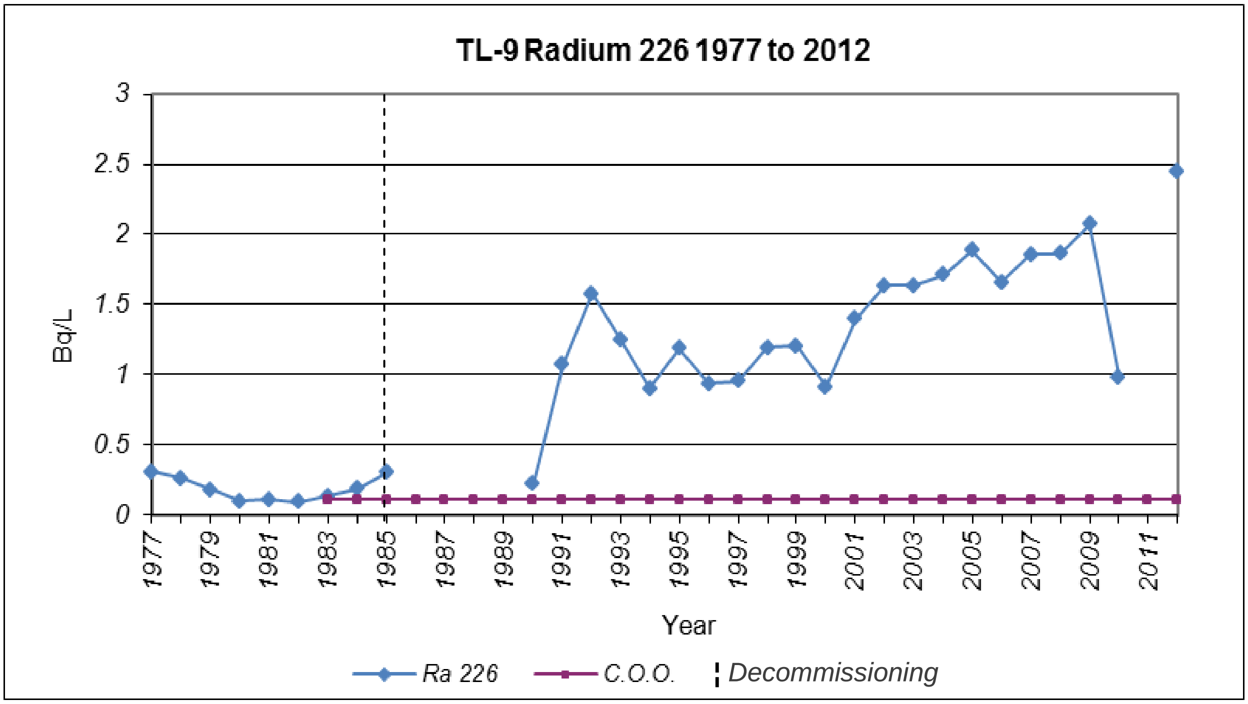


Figure 4.3.2-21 TL-9 - Fulton Creek Below Greer Lake



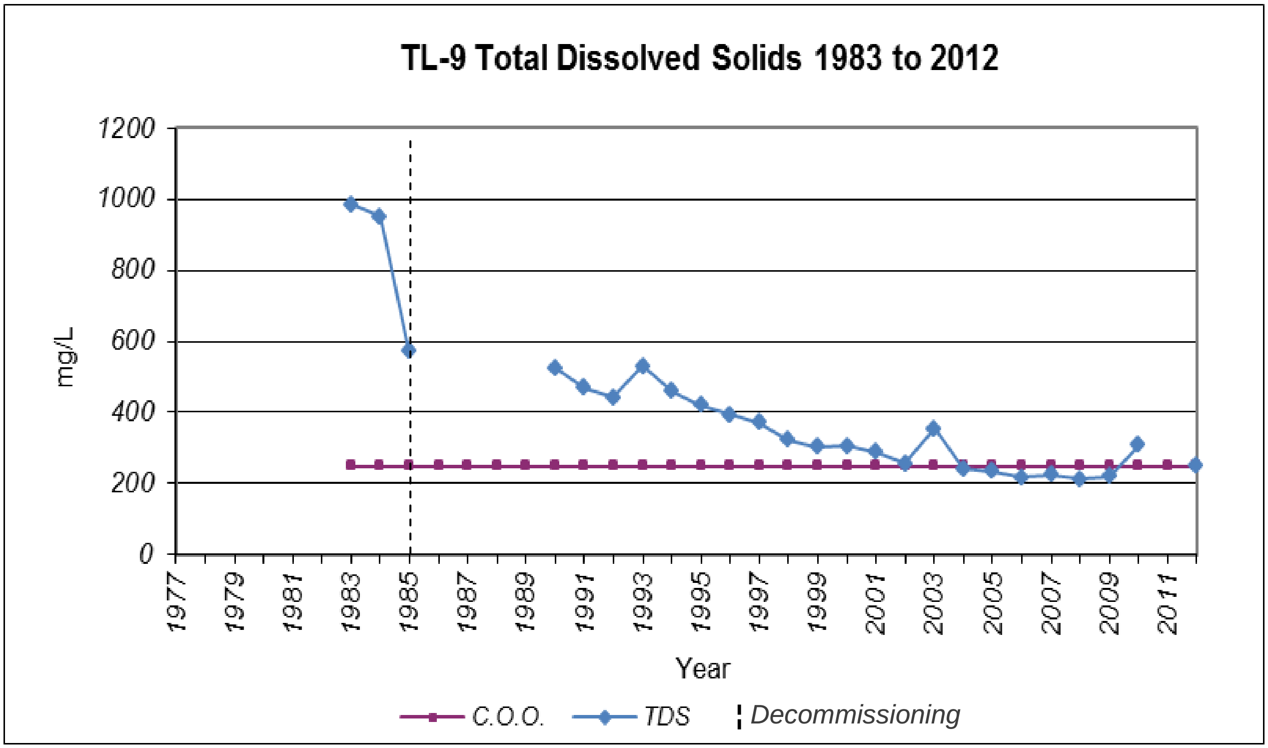
**There was not water flow at TL-9 in 2011.*

Figure 4.3.2-22 TL-9 - Fulton Creek Below Greer Lake



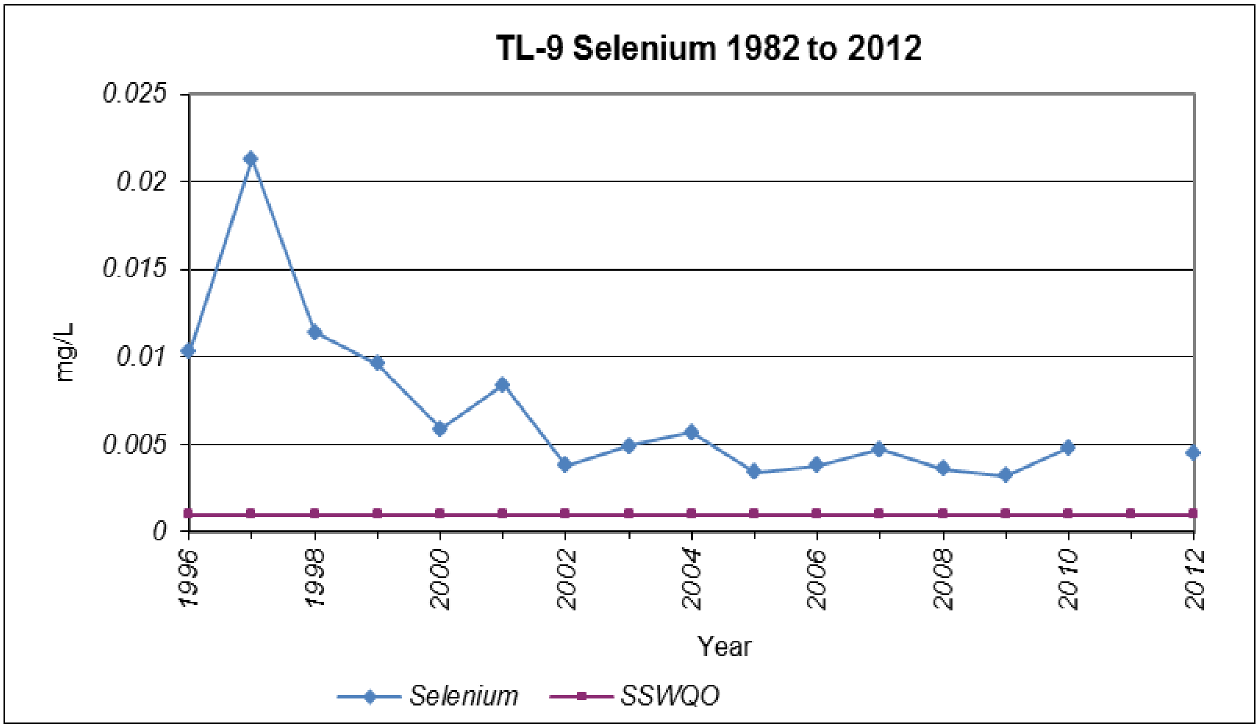
**There was not water flow at TL-9 in 2011.*

Figure 4.3.2-23 TL-9 - Fulton Creek Below Greer Lake



**There was not water flow at TL-9 in 2011.*

Figure 4.3.2-24 TL-9 - Fulton Creek Below Greer Lake



**There was not water flow at TL-9 in 2011.*

Figure 4.3.3-1 BL-3 - Beaverlodge Lake Opposite Fulton Creek Discharge

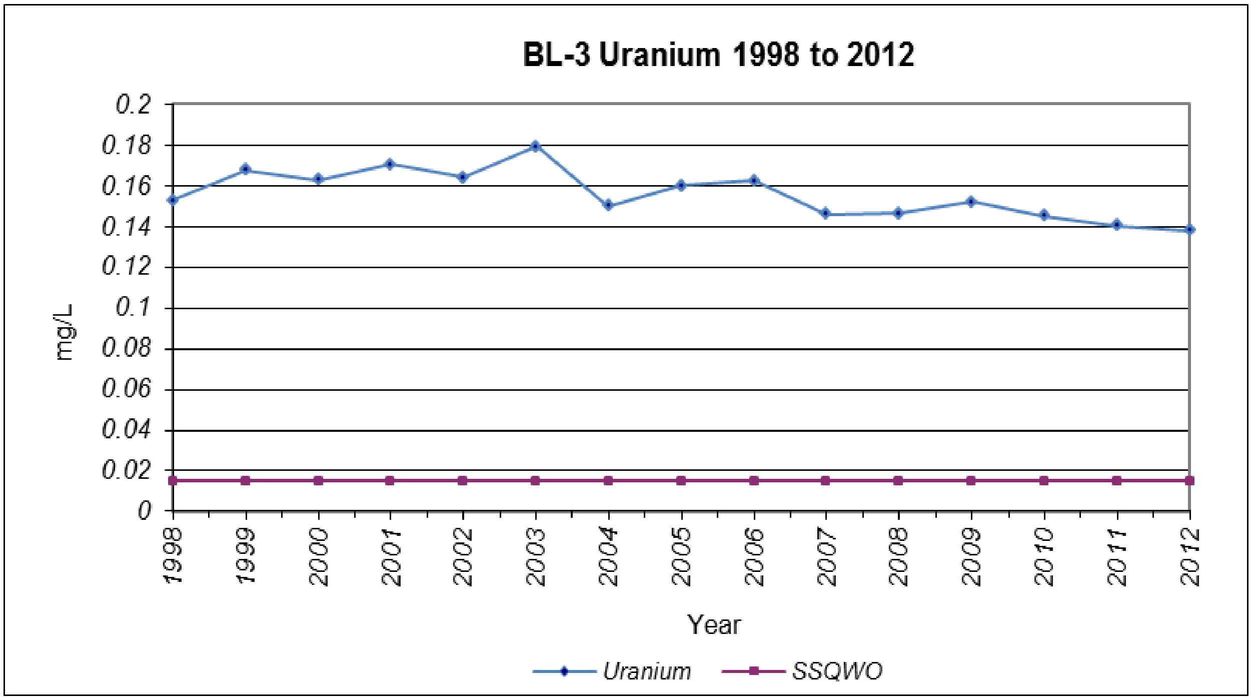


Figure 4.3.3-2 BL-3 - Beaverlodge Lake Opposite Fulton Creek Discharge

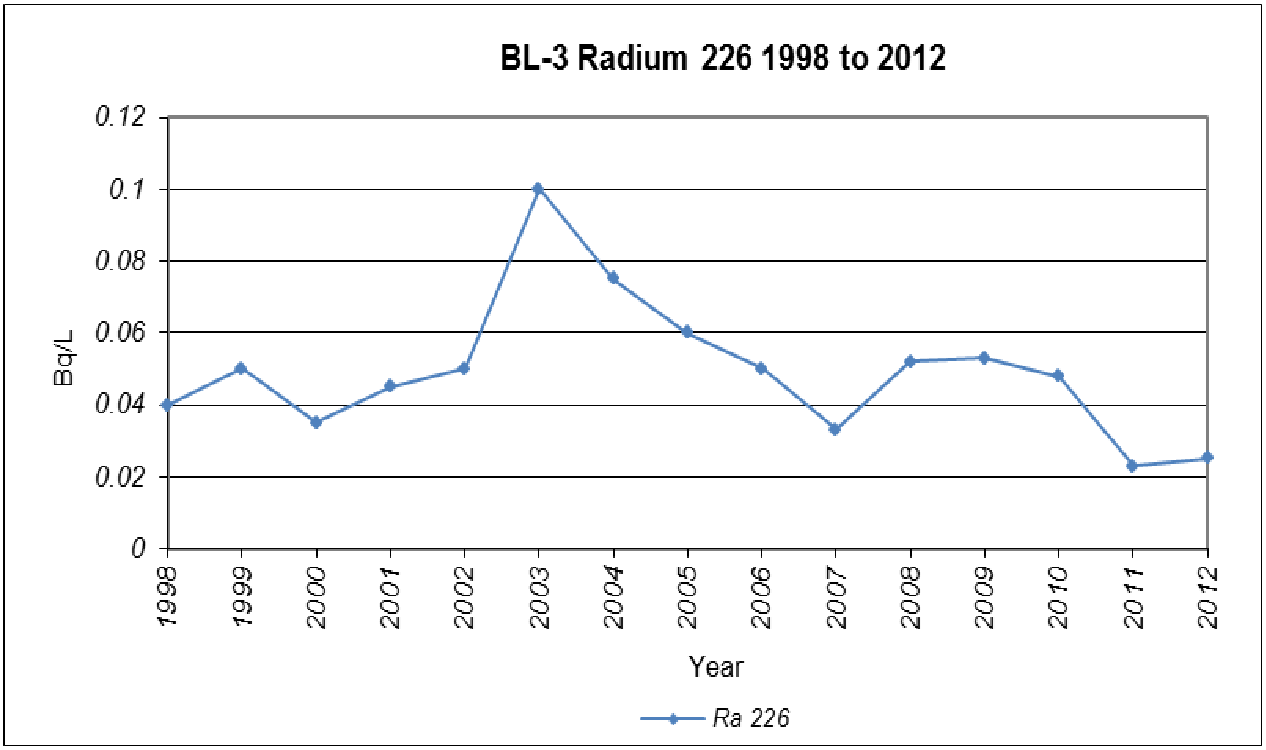


Figure 4.3.3-3 BL-3 - Beaverlodge Lake Opposite Fulton Creek Discharge

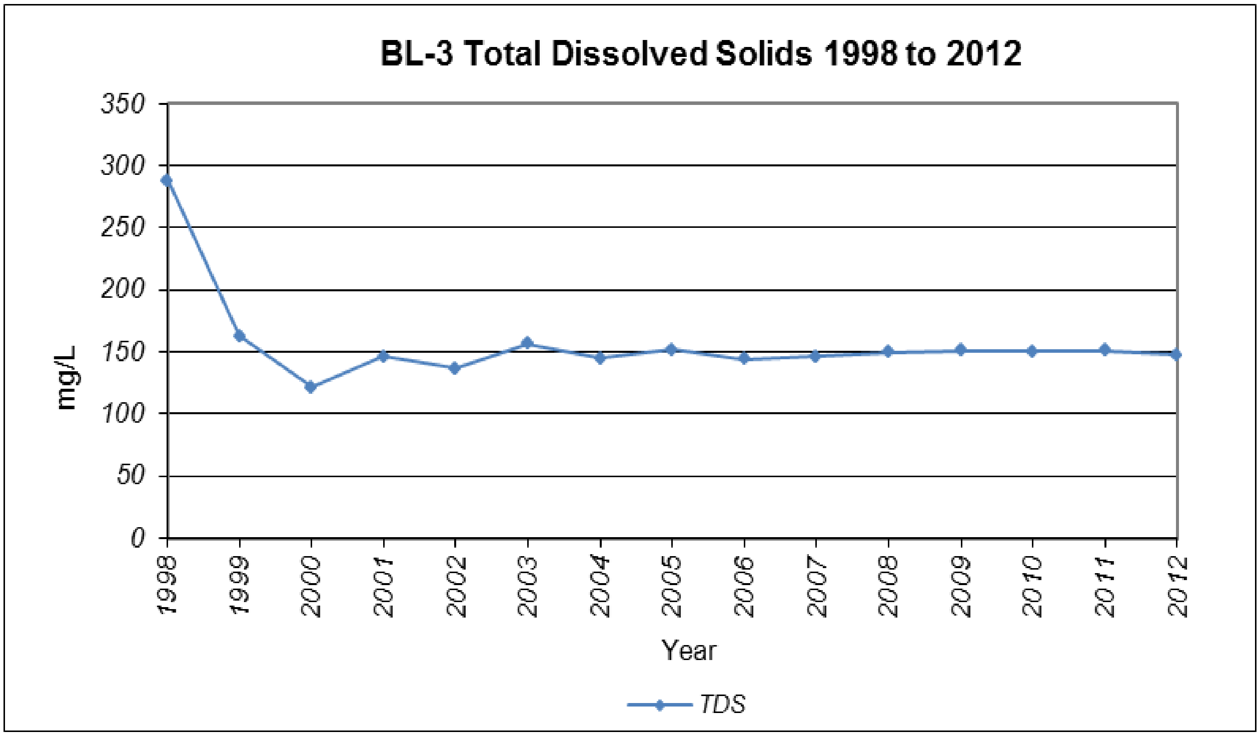
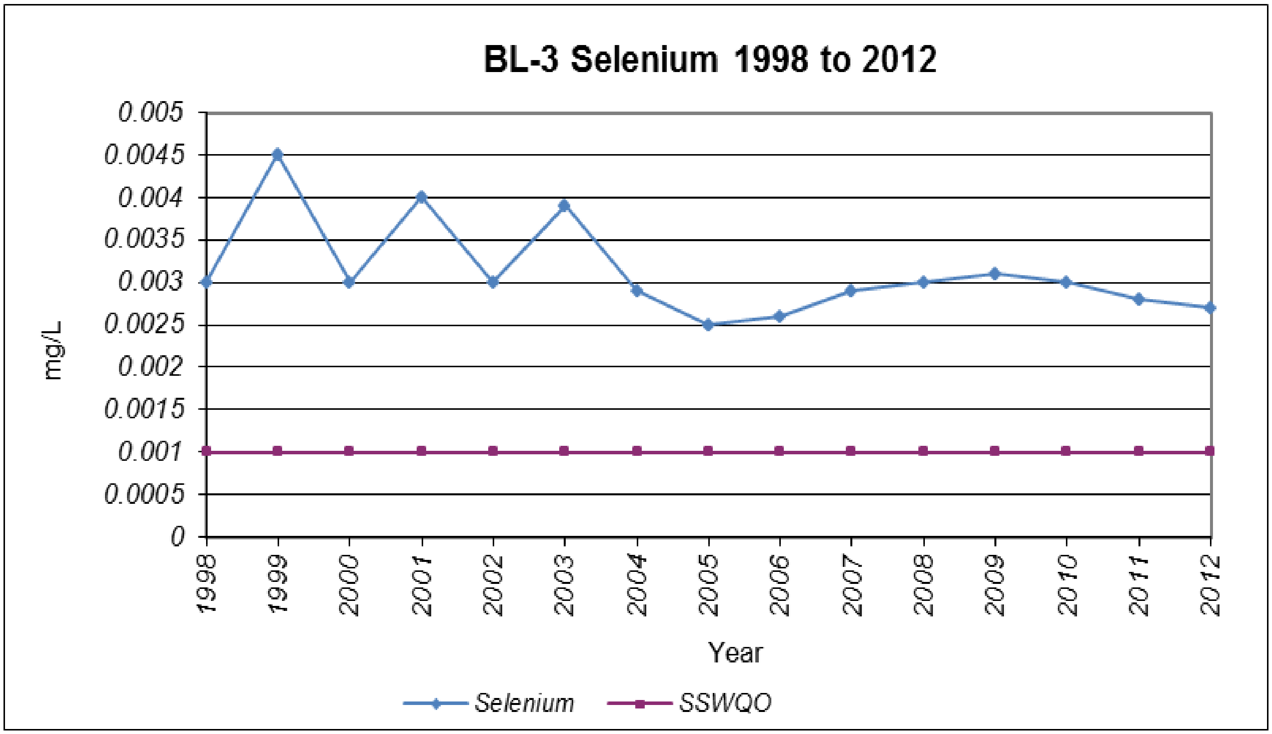


Figure 4.3.3-4 BL-3 - Beaverlodge Lake Opposite Fulton Creek Discharge



Note: Method detection limit changed from 0.001mg/L to 0.0001mg/L in 2003.

Figure 4.3.3-5 BL-4 - Beaverlodge Lake Centre

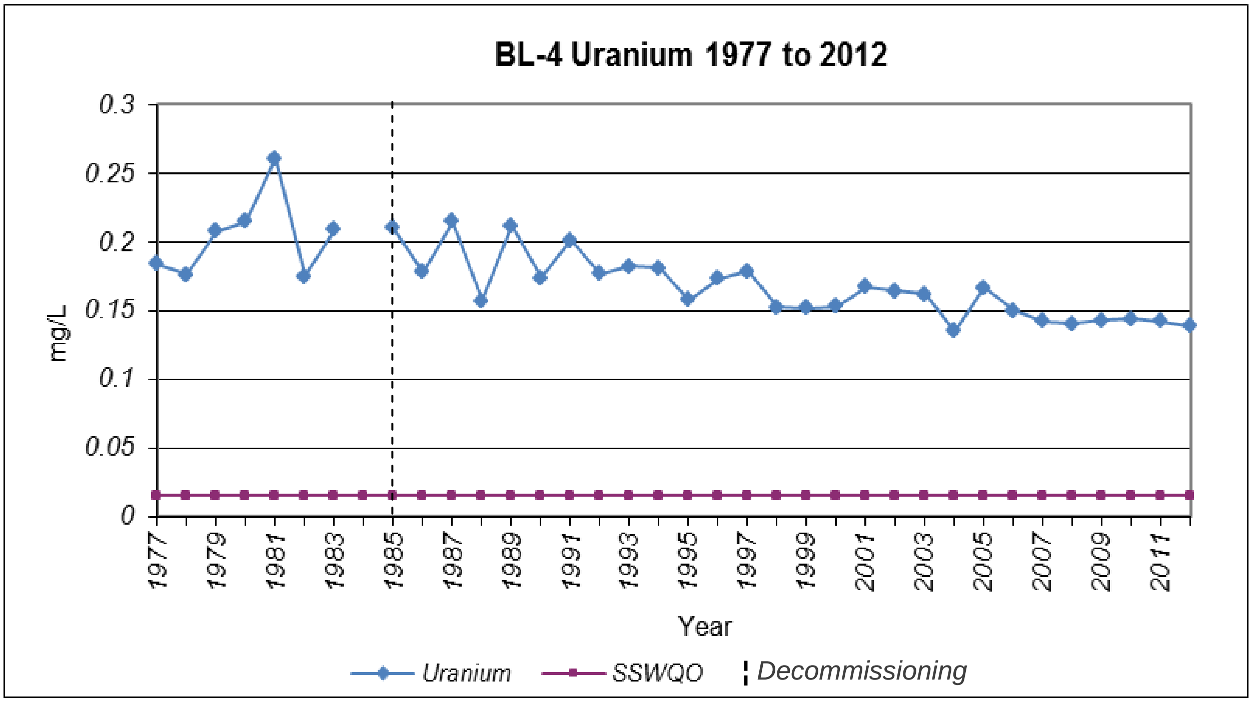


Figure 4.3.3-6 BL-4 - Beaverlodge Lake Centre

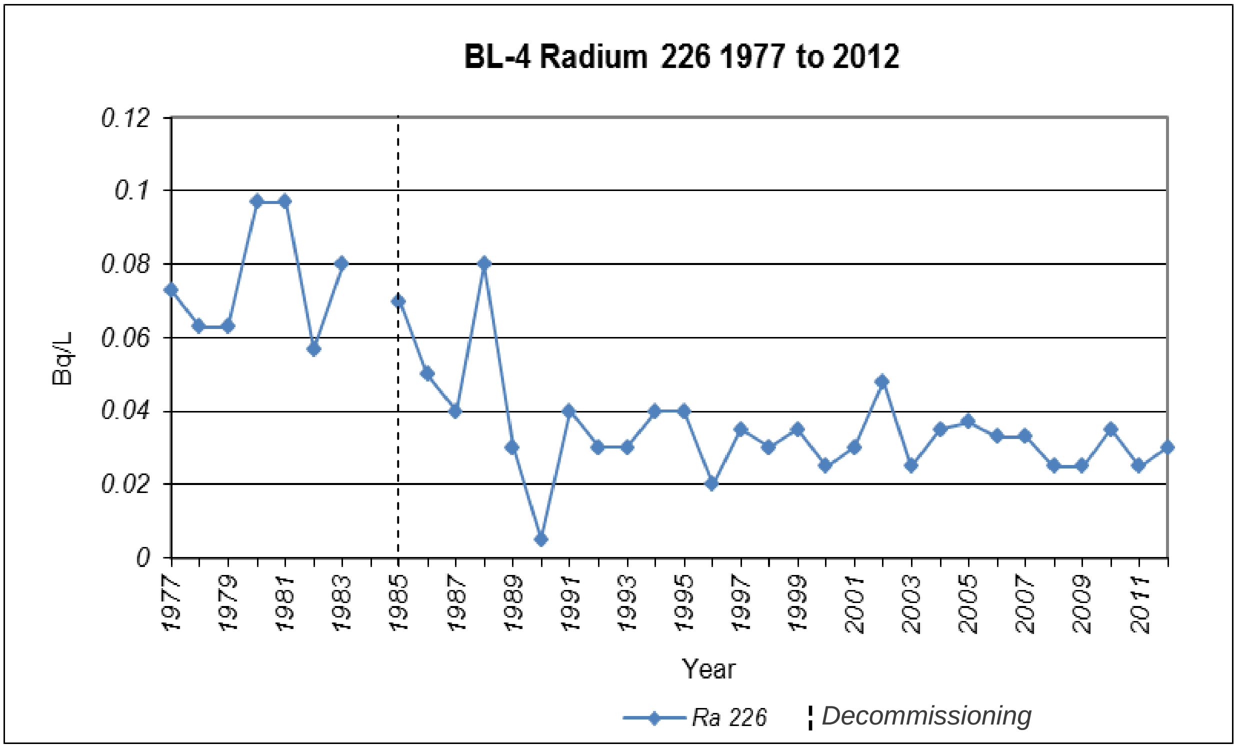


Figure 4.3.3-7 BL-4 - Beaverlodge Lake Centre

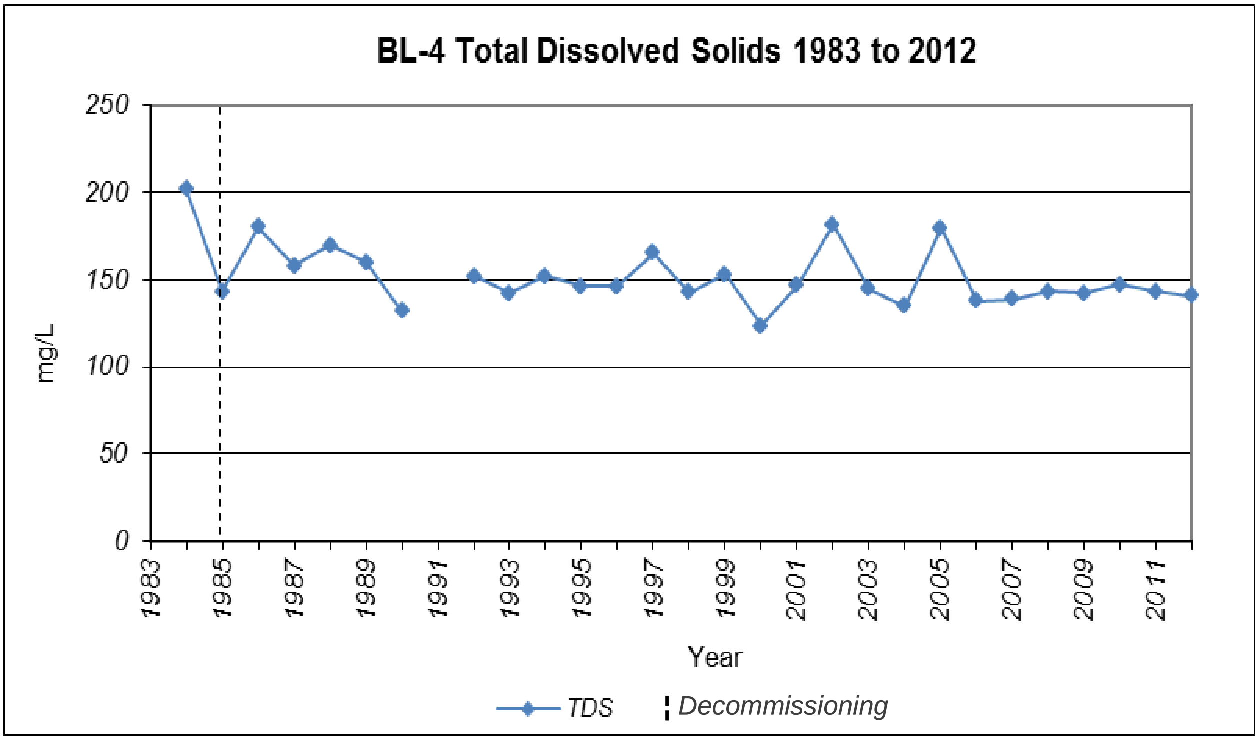
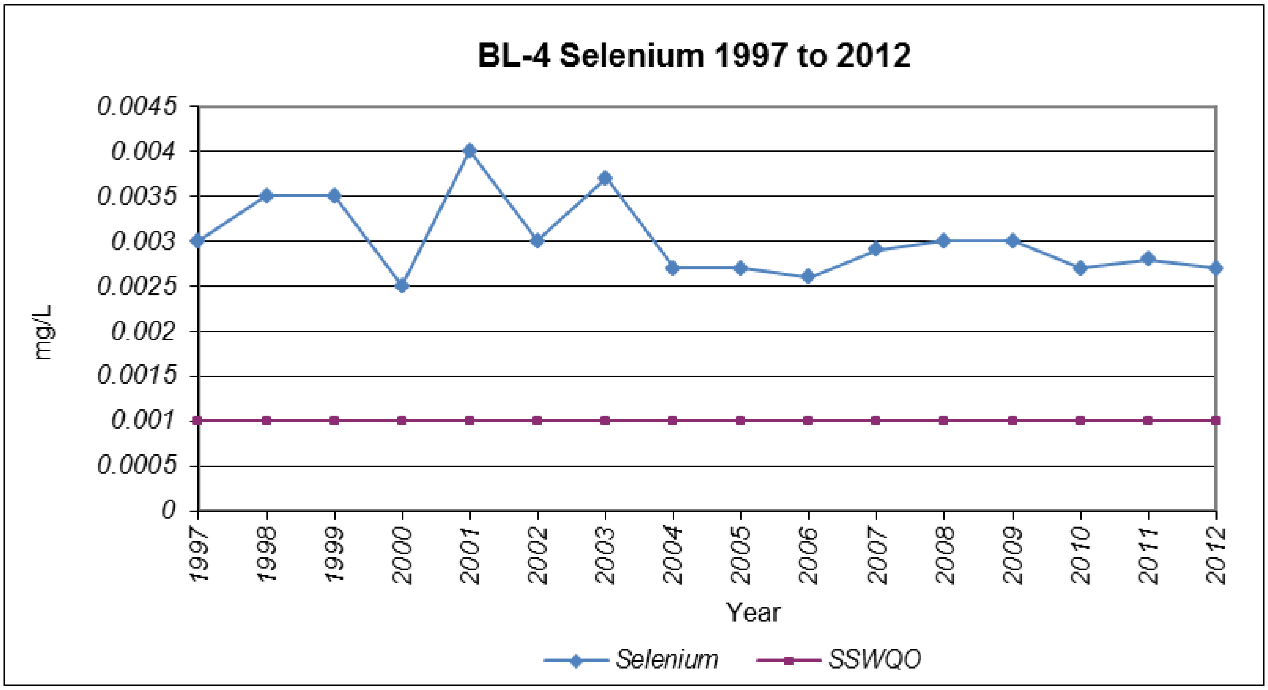
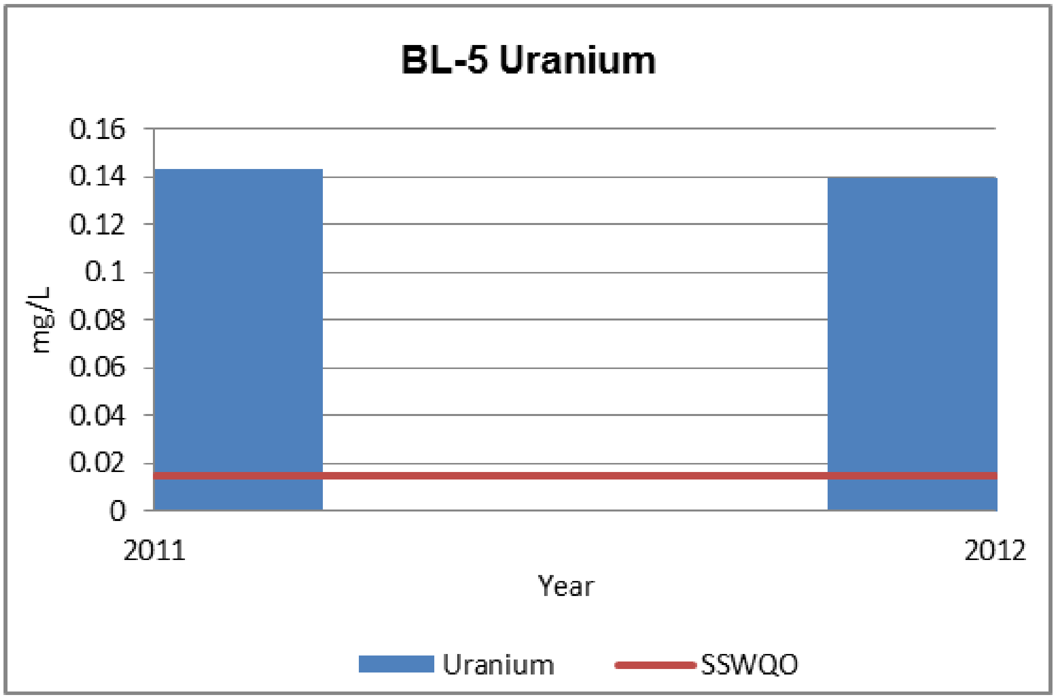


Figure 4.3.3-8 BL-4 - Beaverlodge Lake Centre



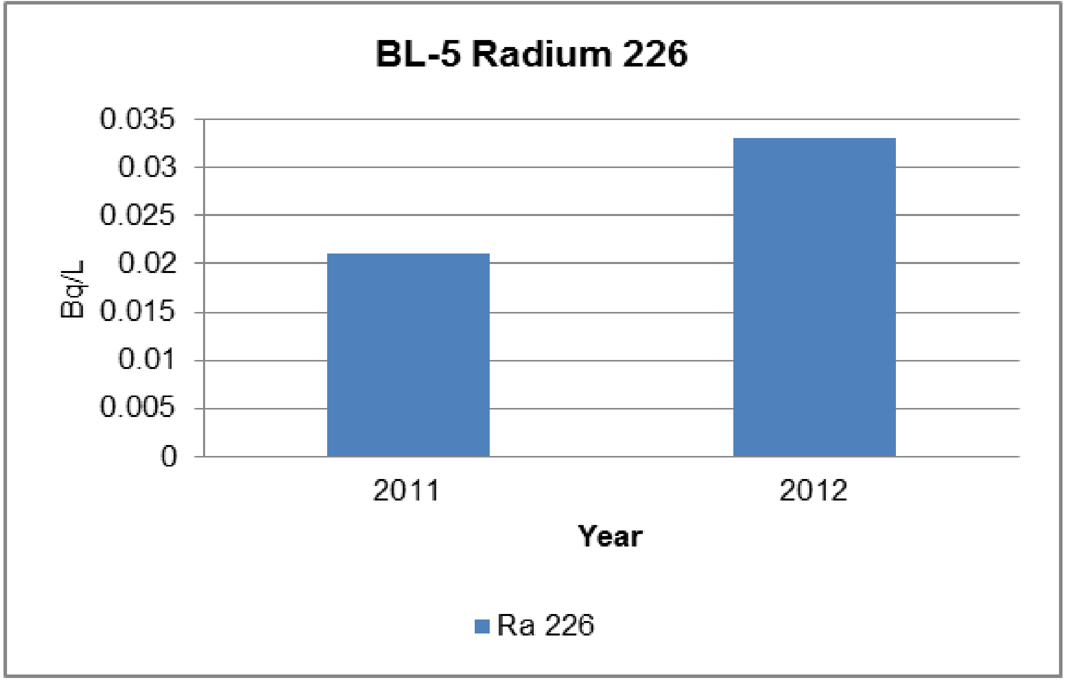
Note: Method detection limit changed from 0.001mg/L to 0.0001mg/L in 2003.

Figure 4.3.3-9 BL5-Beaverlodge Lake Outlet



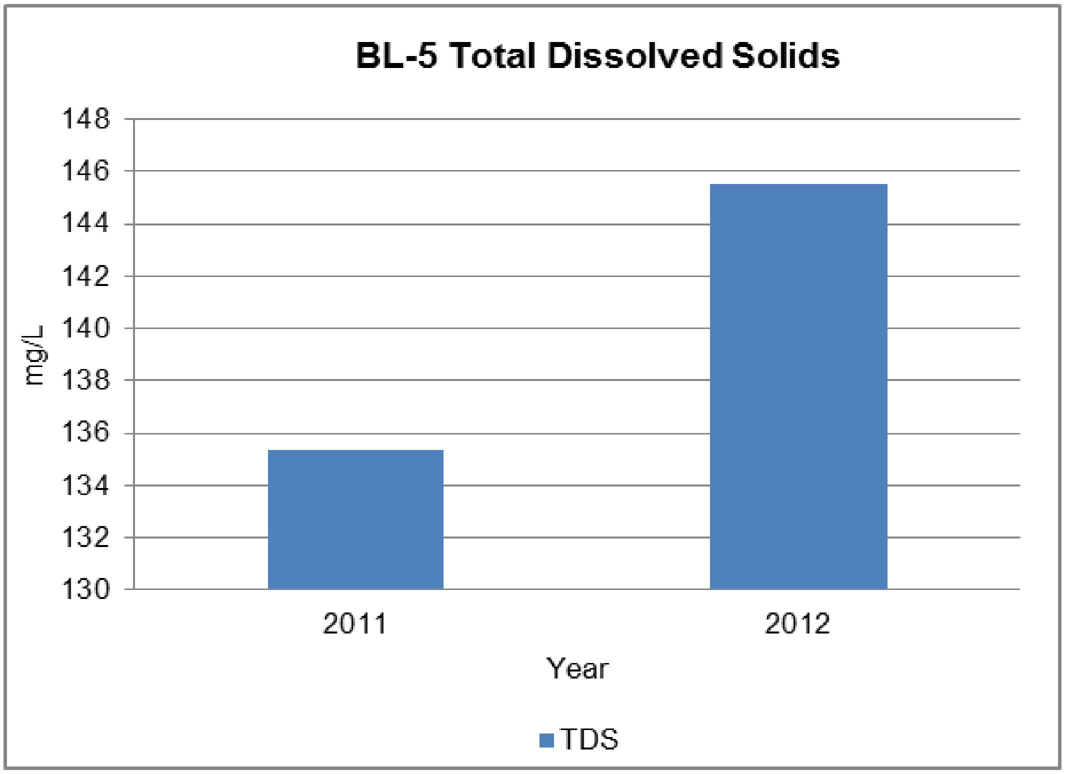
** Station implemented in water sampling program in 2011*

Figure 4.3.3-10 BL5-Beaverlodge Lake Outlet



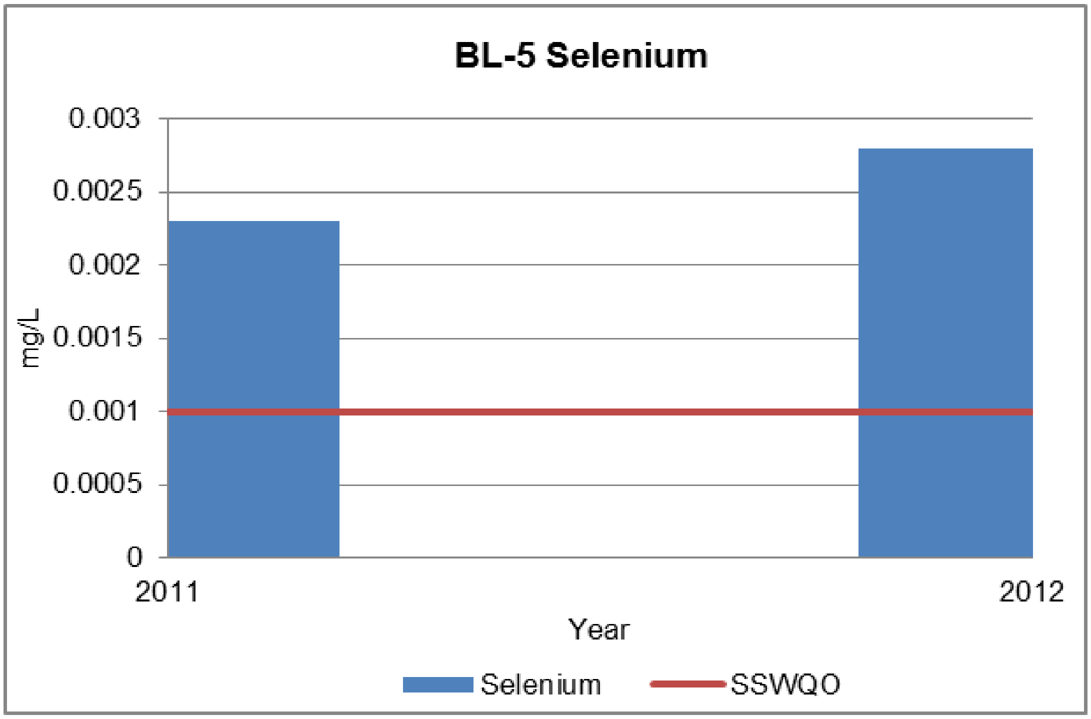
** Station implemented in water sampling program in 2011*

Figure 4.3.3-11 BL5-Beaverlodge Lake Outlet



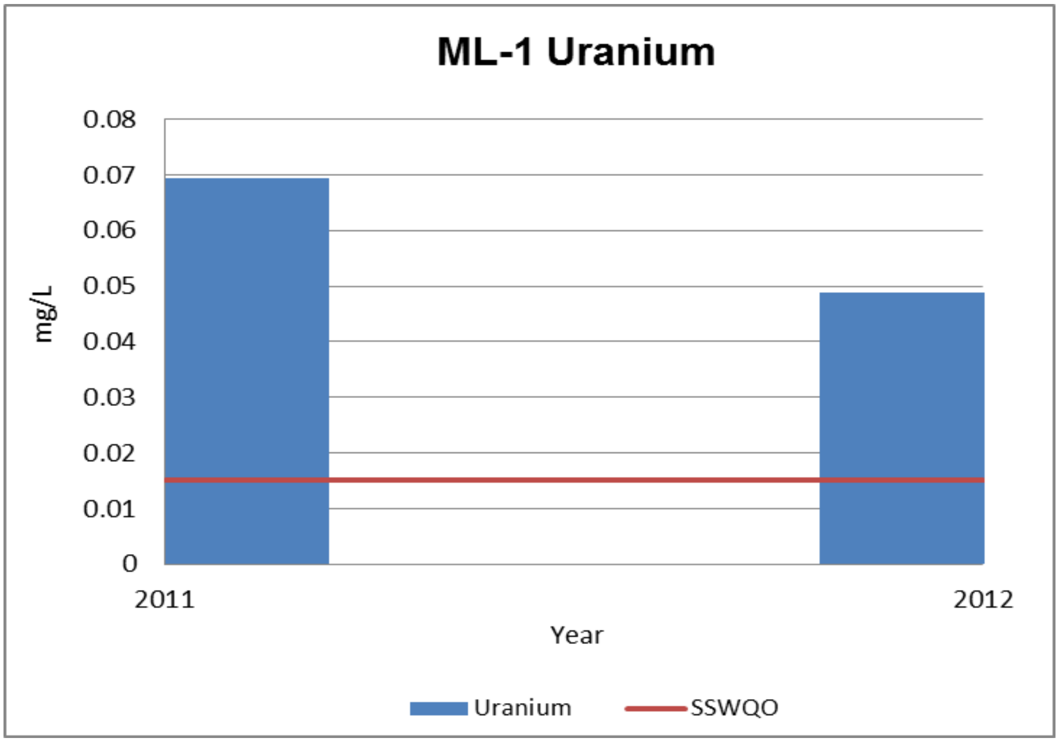
** Station implemented in water sampling program in 2011*

Figure 4.3.3-12 BL5-Beaverlodge Lake Outlet



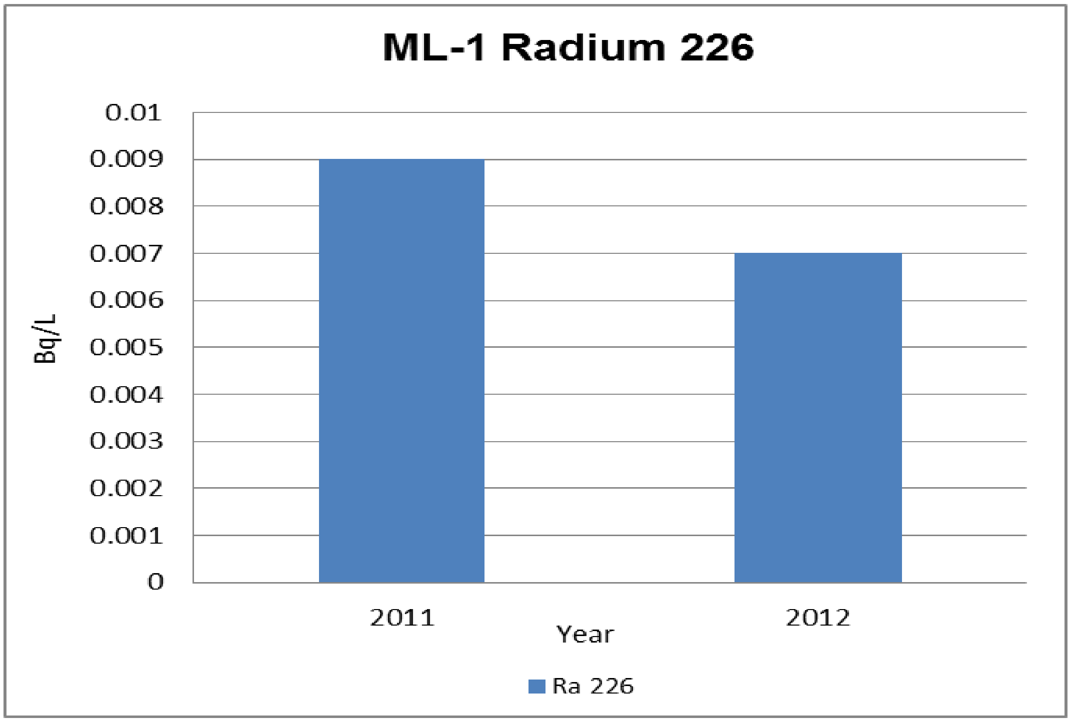
** Station implemented in water sampling program in 2011*

Figure 4.3.3-13 ML-1 Outlet of Martin Lake



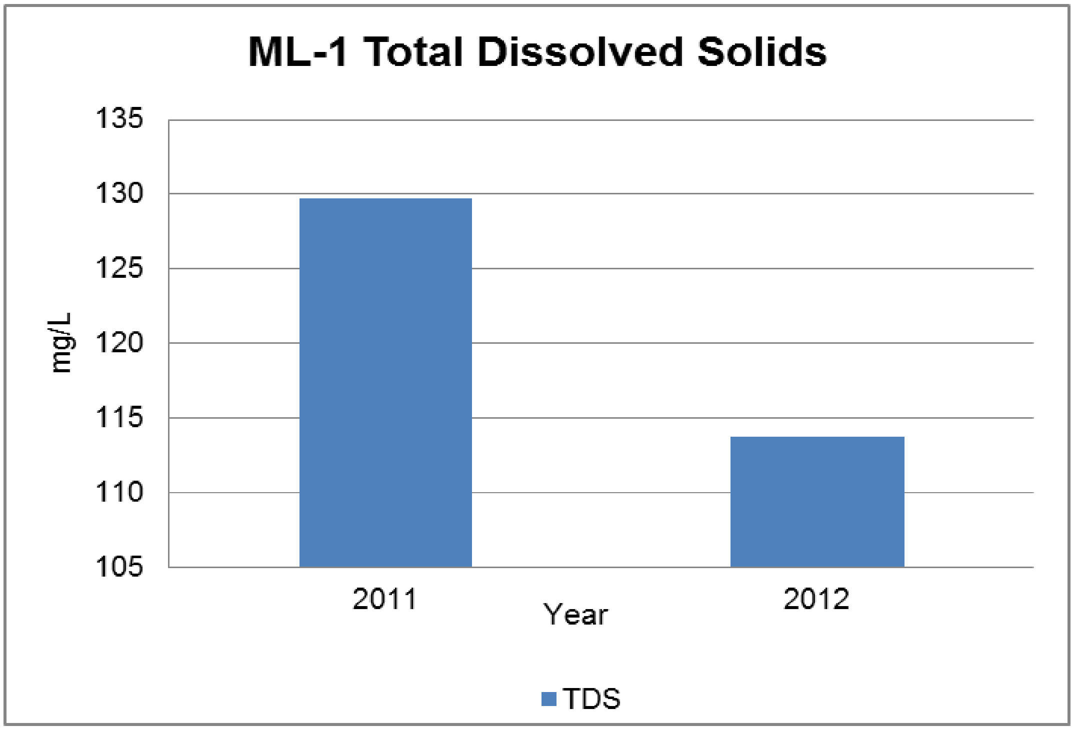
**Station implemented in water sampling program in 2011*

Figure 4.3.3-14 ML-1 Outlet of Martin Lake



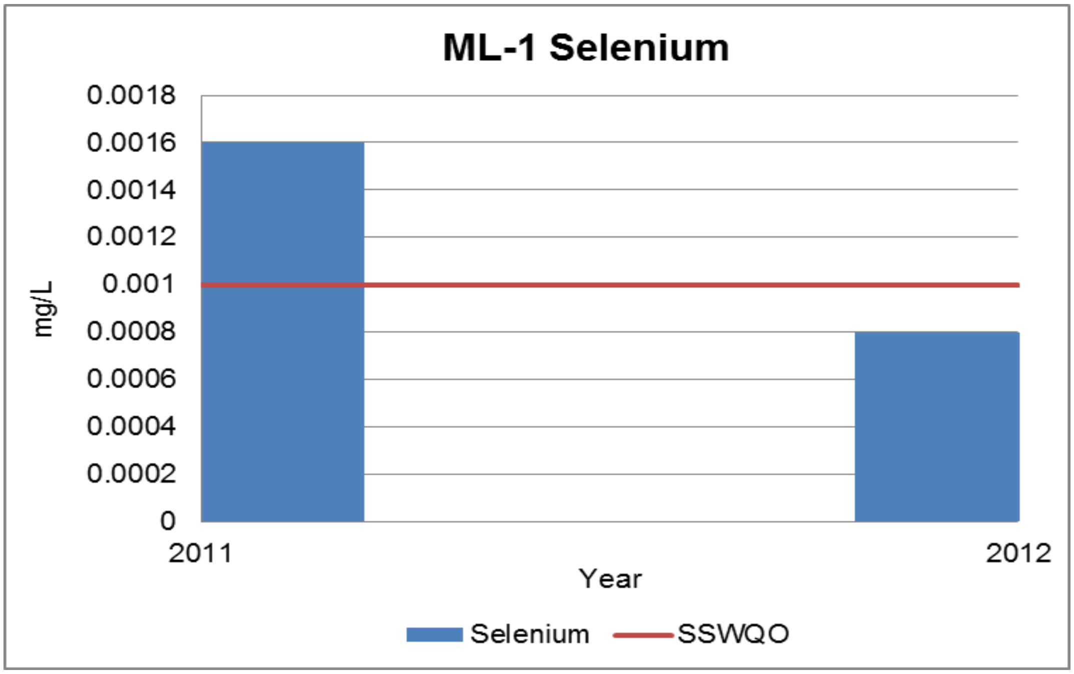
**Station implemented in water sampling program in 2011*

Figure 4.3.3-15 ML-1 Outlet of Martin Lake



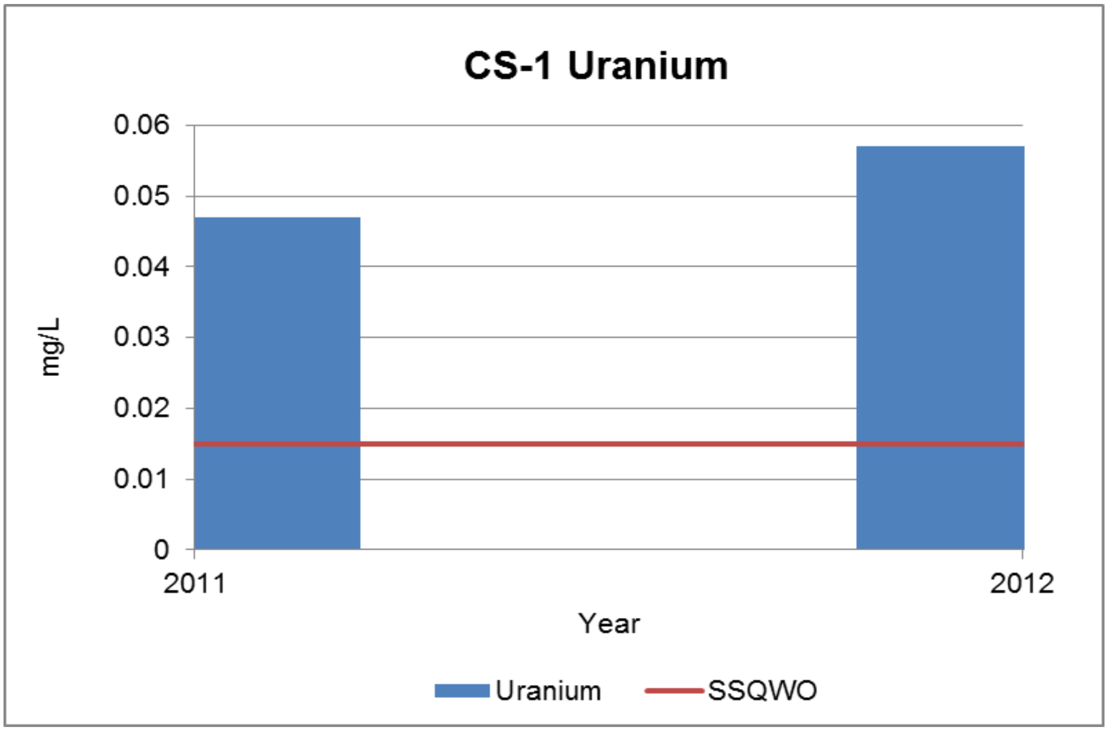
**Station implemented in water sampling program in 2011*

Figure 4.3.3-16 ML-1 Outlet of Martin Lake



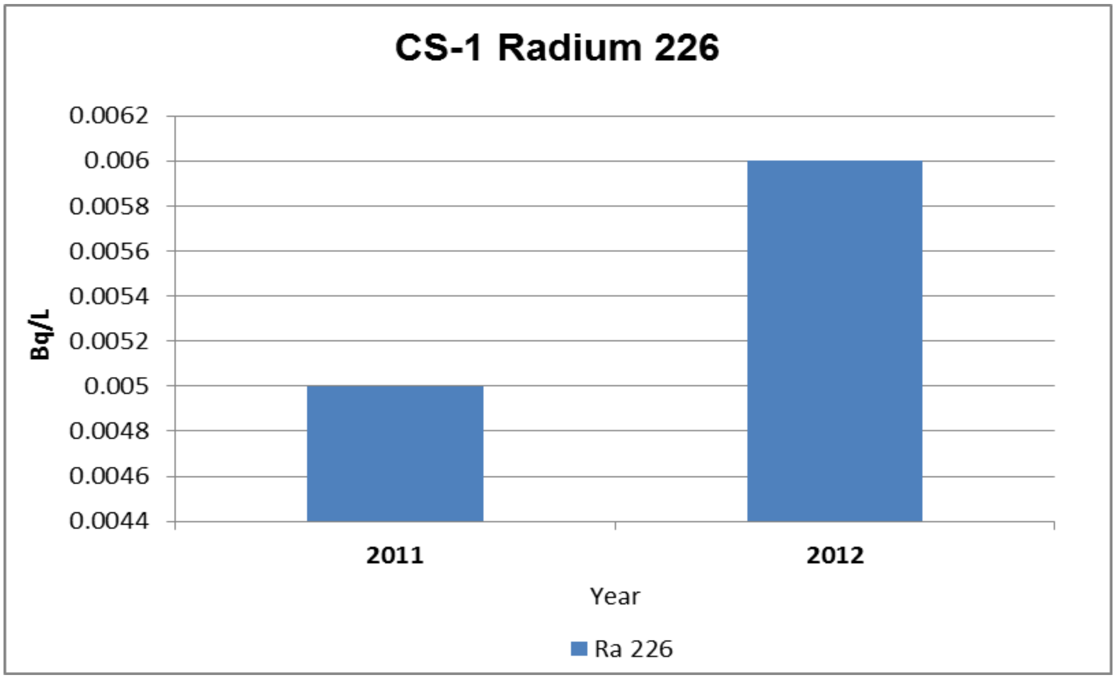
**Station implemented in water sampling program in 2011*

Figure 4.3.3-17 CS-1 Crackingstone Bay



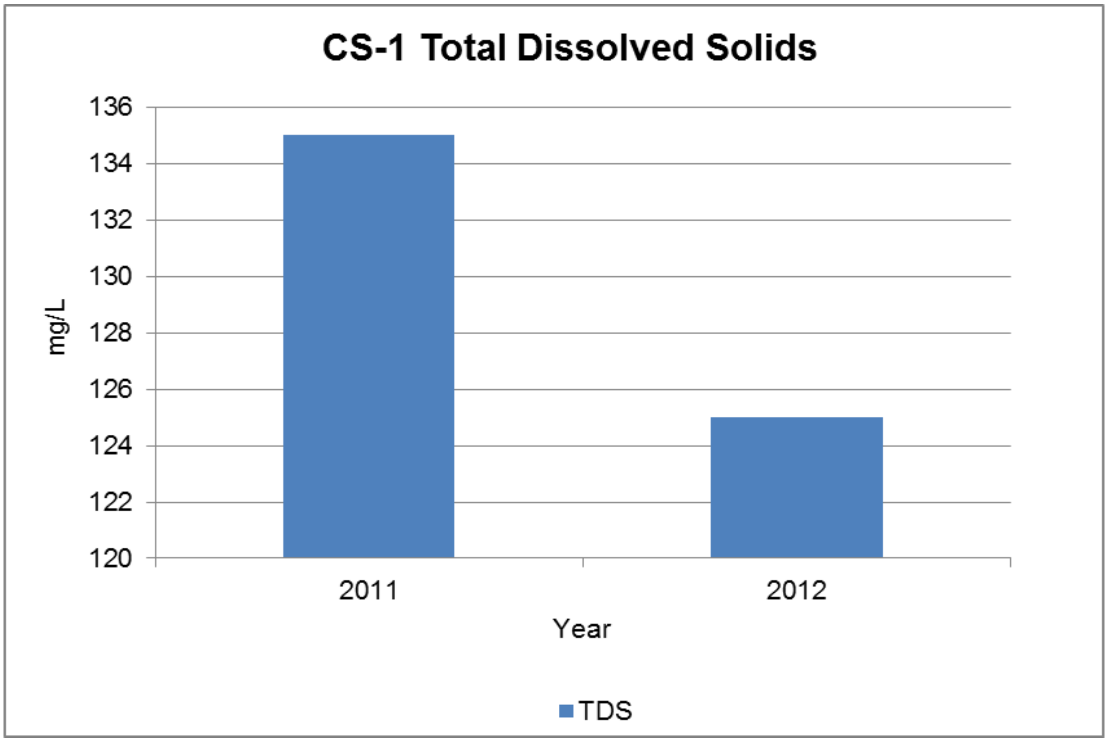
**Station implemented in water sampling program in 2011*

Figure 4.3.3-18 CS-1 Crackingstone Bay



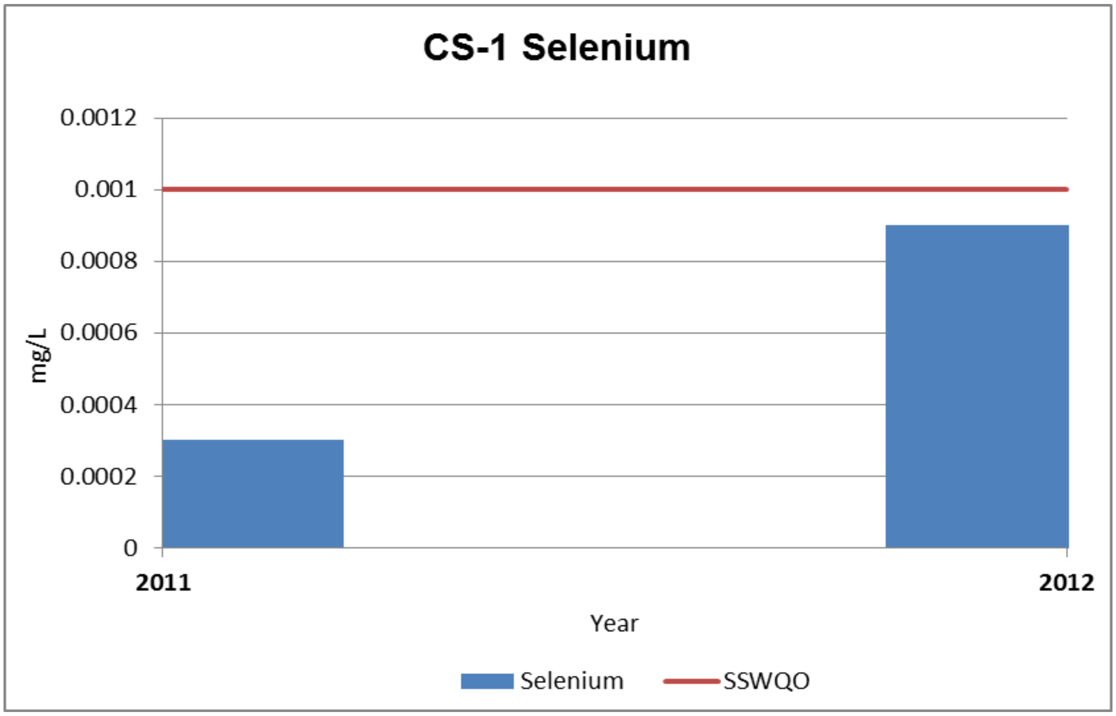
**Station implemented in water sampling program in 2011*

Figure 4.3.3-19 CS-1 Crackingstone Bay



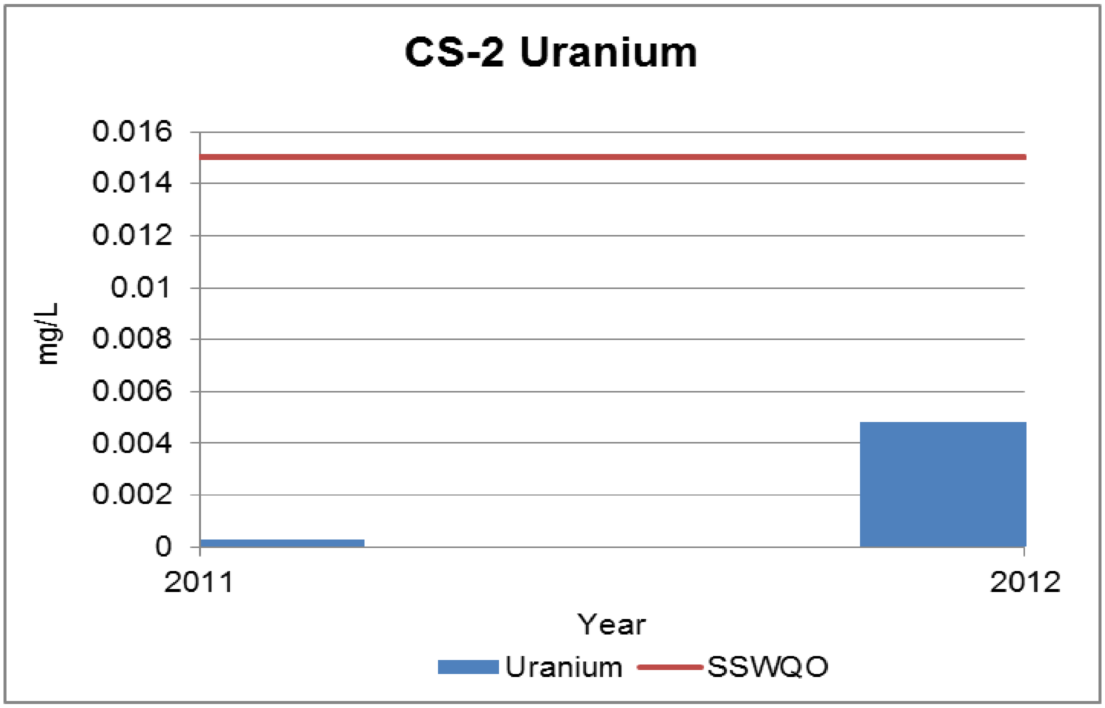
**Station implemented in water sampling program in 2011*

Figure 4.3.3-20 CS-1 Crackingstone Bay



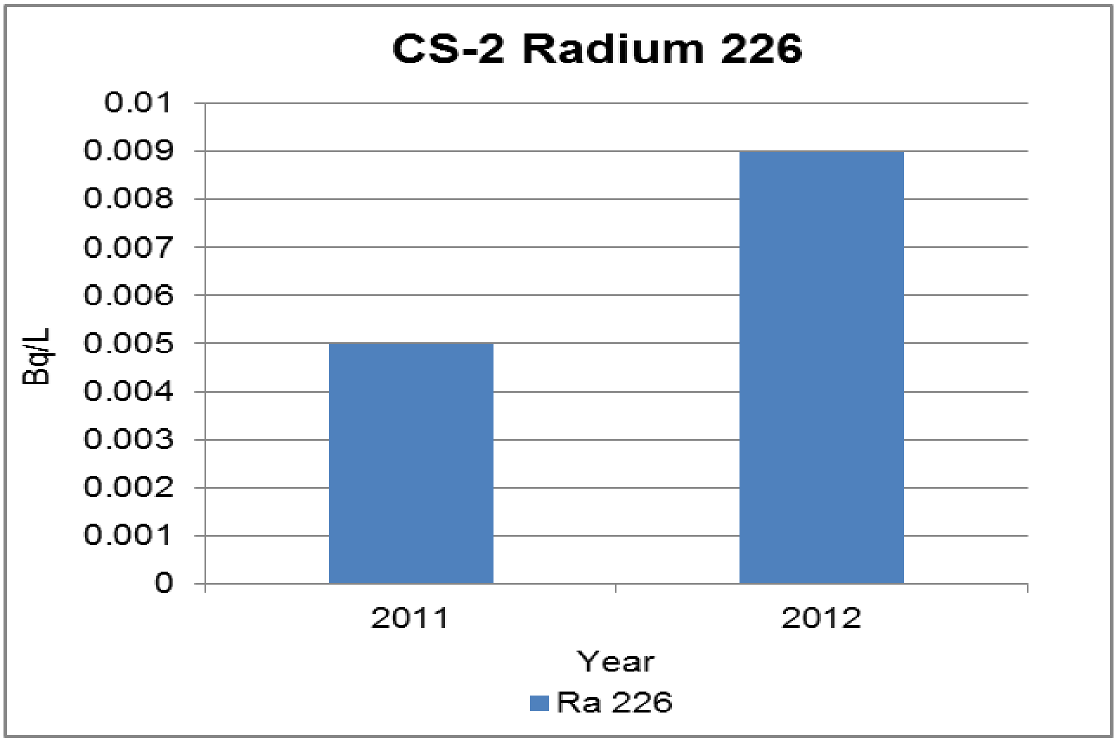
**Station implemented in water sampling program in 2011*

Figure 4.3.3-21 CS-2 Crackingstone Bay



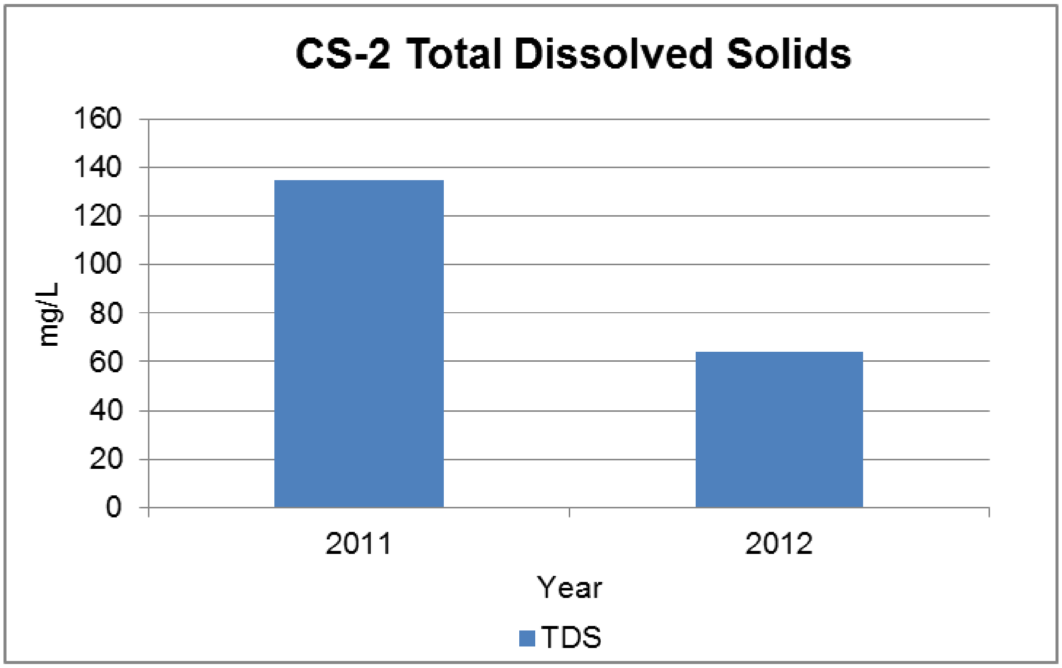
**Station implemented in water sampling program in 2011*

Figure 4.3.3-22 CS-2 Crackingstone Bay



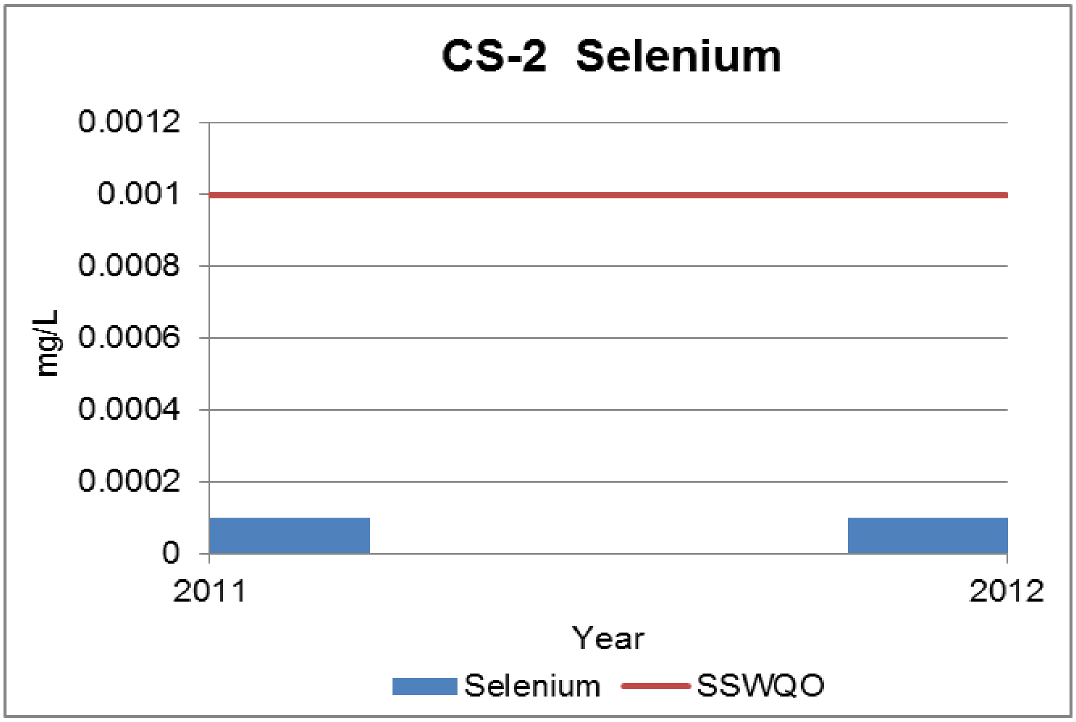
**Station implemented in water sampling program in 2011*

Figure 4.3.3-23 CS-2 Crackingstone Bay



**Station implemented in water sampling program in 2011*

Figure 4.3.3-24 CS-2 Crackingstone Bay



**Station implemented in water sampling program in 2011*

Figure 4.5.1-1 - Air Sampling Locations

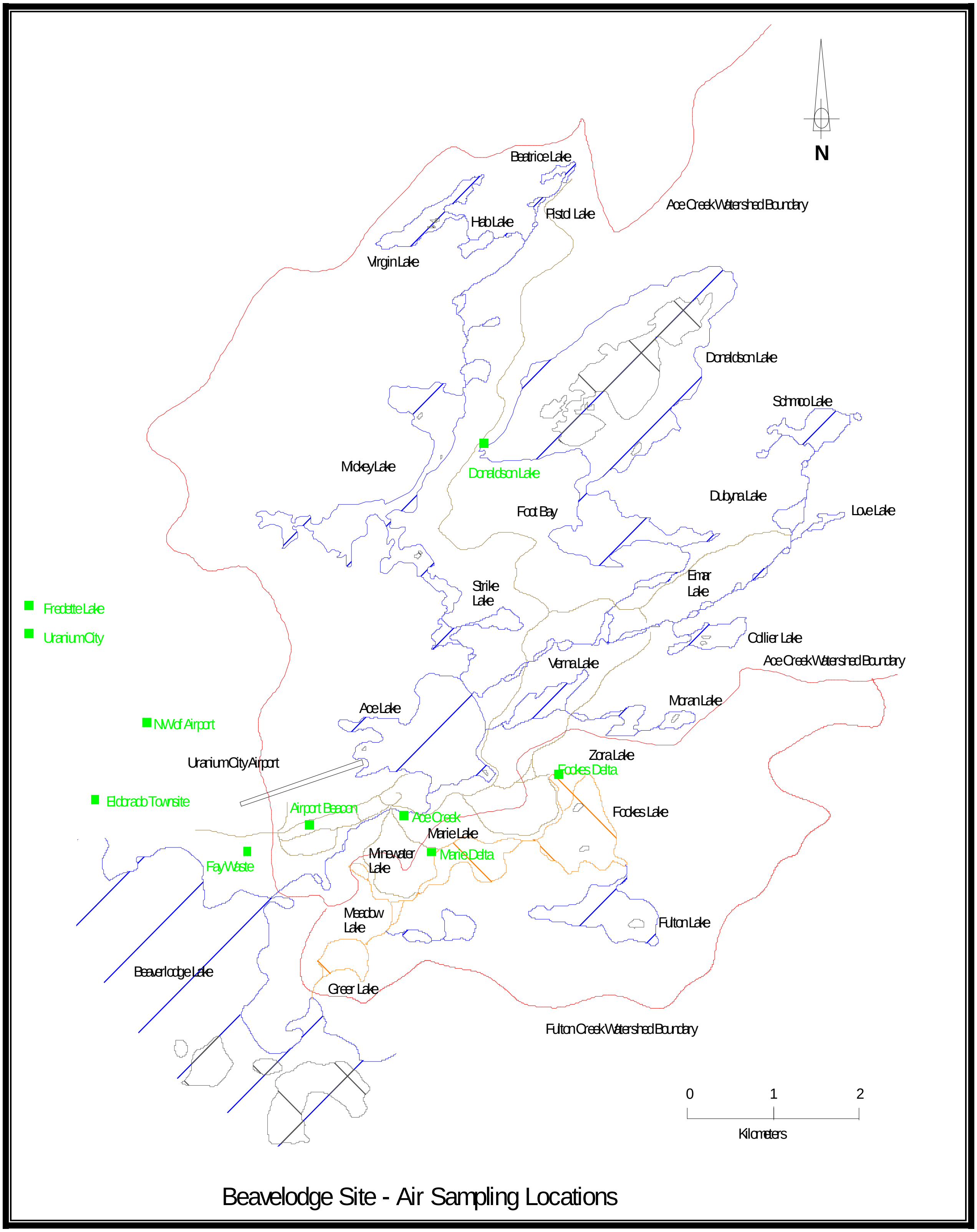
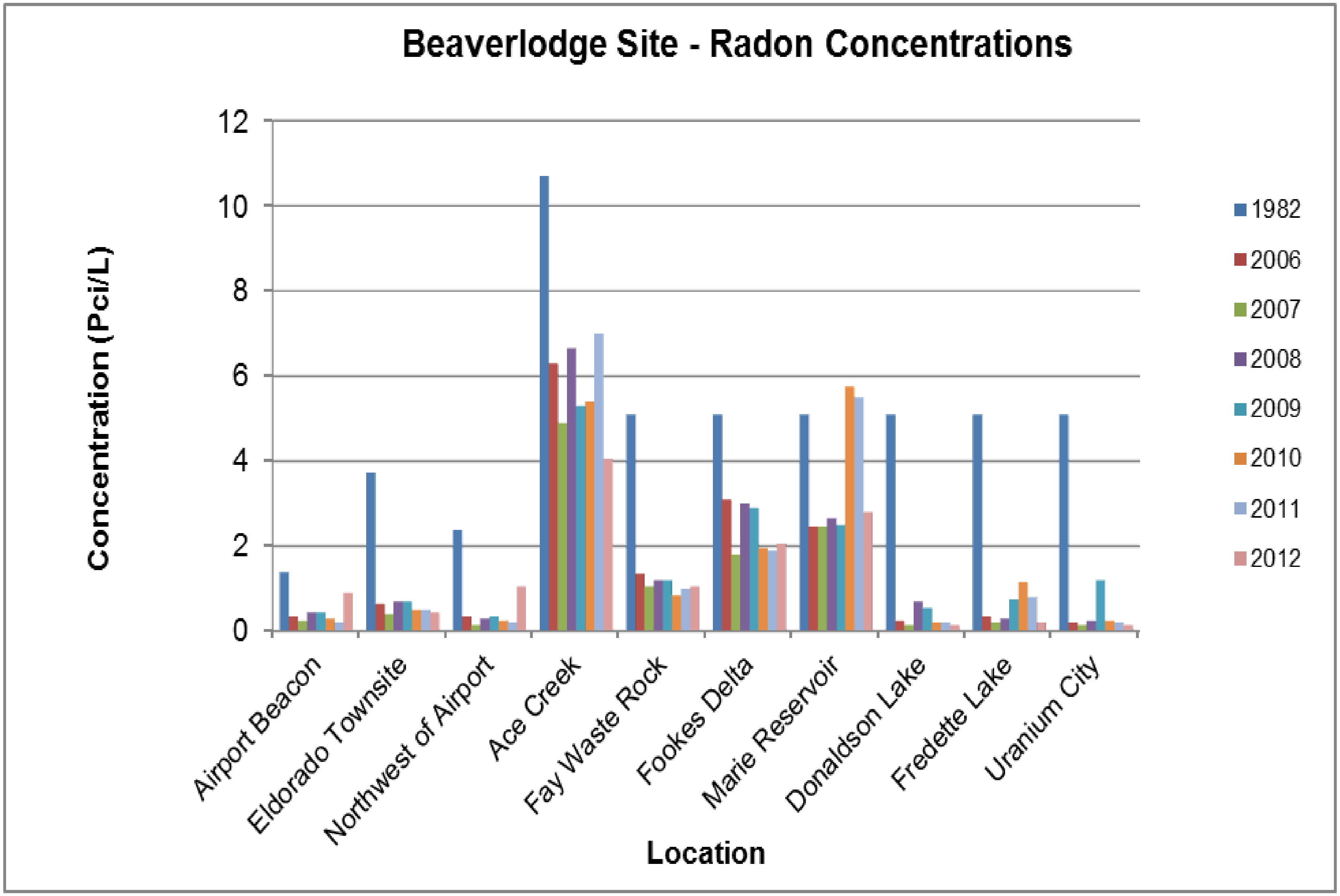


Figure 4.5.1-2
Radon Summary (2007 – 2012 versus 1982)



APPENDIX A
WATER QUALITY DATA

WATER QUALITY DATA

Station: AC-14

	2012-01-31	2012-02-29	2012-04-03	2012-04-27	2012-05-25	2012-06-29	2012-07-31	2012-08-30	2012-09-28	2012-10-24	2012-11-30	2012-12-29
Alk-T (mg/L)	56	57	54	57	48	49	49	53	52	54	55	52
As (µg/L)	0.2	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.1
Ba (mg/L)	0.026	0.026	0.025	0.026	0.022	0.023	0.024	0.026	0.025	0.023	0.023	0.024
C-(org) (mg/L)			8			9.5			8.1			7.4
Ca (mg/L)	18	19	19	21	16	17	17	20	18	18	18	17
Cl (mg/L)	1.4	3	2.2	3.2	1.1	1.1	1.2	2.2	1.3	1.3	1.1	1.1
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	134	134	134	157	113	118	118	141	122	125	130	124
Cu (mg/L)	0.001	<0.000	0	0	0.001	0.001	0	0	0	0.001	0.001	0.001
Fe (mg/L)	0.045	0.035	0.041	0.071	0.056	0.1	0.13	0.13	0.054	0.057	0.054	0.062
Hardness (mg/L)	60	62	62	69	53	56	56	65	59	59	59	57
HCO3 (mg/L)	68	70	66	70	58	60	60	65	63	66	67	63
K (mg/L)	0.9	0.9	0.9	0.7	0.7	0.8	0.4	0.8	0.9	0.9	0.8	0.8
Mo (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Na (mg/L)	1.9	2.2	2.6	3.7	1.6	2	1.7	3.1	2	2.3	1.8	1.7
NH3-N (mg/L)			<0.04			0.06			0.15			0.1
Ni (mg/L)	0.0002	0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	0.0003	0.0002	0.0002	0.0001	0.0008
NO3 (mg/L)	<0.04	0.22	0.22	0.26	<0.04	<0.04	0.04	<0.04	<0.04	<0.04	0.04	0.04
OH (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)			<0.01			<0.01			<0.01			<0.01
Pb (mg/L)	0.0003	0.0002	0.0002	0.0005	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0004
Pb210 (Bq/L)			<0.02			<0.02			<0.02			<0.02
pH-L (pH Unit)	7.79	7.66	7.78	7.96	7.72	7.8	7.48	7.46	7.64	8.08	7.76	7.45
Po210 (Bq/L)			<0.005			0.01			0.01			<0.005
Ra226 (Bq/L)	0.04	0.03	0.03	0.06	0.03	0.06	0.03	0.07	0.07	0.04	0.02	0.03
Se (mg/L)	0.0001	<0.0001	0.0001	0.0005	0.0001	0.0001	<0.0001	0.0002	0.0001	0.0001	<0.0001	0.0001
SO4 (mg/L)	7.9	8.4	9.7	16	7.4	8.1	8.1	14	9.1	10	7.9	7.7
Sum of Ions (mg/L)	102	107	104	119	88	92	92	109	98	102	100	95
TDS (mg/L)	89	96	90	96	84	68	77	92	77	98	91	87
TSS (mg/L)	2	<1.000	1	<1.000	1	<1.000	<1.000	1	<1.000	<1.000	<1.000	1
U (µg/L)	25	23	27	101	23	26	25	57	27	43	22	20
Zn (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001	0.002

Station: AC-6A

	2012-05-09	2012-06-29	2012-07-31	2012-08-30	2012-09-28
Alk-T (mg/L)	28	98			
As (µg/L)	0.4	0.2			
Ba (mg/L)	0.014	0.023			
C-(org) (mg/L)					
Ca (mg/L)	19	45			
Cl (mg/L)	0.4	0.4			
CO3 (mg/L)	<1.0	<1.0			
Cond-L (µS/cm)	116	298			
Cu (mg/L)	0.003	0.001			
Fe (mg/L)	0.15	0.04			
Hardness (mg/L)	62	152			
HCO3 (mg/L)	34	120			
K (mg/L)	2.3	1.1			
Mo (mg/L)	0	0.001			
Na (mg/L)	1	2.5			
NH3-N (mg/L)					
Ni (mg/L)	0.0005	<0.00010			
NO3 (mg/L)	<0.04	<0.04			
OH (mg/L)	<1.0	<1.0			
P-(TP) (mg/L)	0.04				
Pb (mg/L)	<0.0001	<0.0001			
Pb210 (Bq/L)	0.04				
pH-L (pH Unit)	6.8	7.58			
Po210 (Bq/L)	0.03				
Ra226 (Bq/L)	0.04	0.13			
Se (mg/L)	0.0004	0.0002			
SO4 (mg/L)	24	58			
Sum of Ions (mg/L)	84	237			
TDS (mg/L)	204	203			
TSS (mg/L)		<1.000			
U (µg/L)	48	186			
Zn (mg/L)	0.001	<0.001			

Station: AC-8

	2012-04-03	2012-05-09	2012-09-28	2012-09-29
Alk-T (mg/L)	55	50	49	48
As (µg/L)	0.1	0.1	0.1	0.2
Ba (mg/L)	0.024	0.022	0.023	0.024
C-(org) (mg/L)			8.1	
Ca (mg/L)	17	17	16	17
Cl (mg/L)	1.2	1.1	1.1	0.9
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	126	113	112	109
Cu (mg/L)	0	0	<0.000	<0.000
Fe (mg/L)	0.046	0.028	0.024	0.036
Hardness (mg/L)	56	55	53	56
HCO3 (mg/L)	67	61	60	58
K (mg/L)	0.9	0.6	0.8	0.8
Mo (mg/L)	0.001	0.001	0.001	0.001
Na (mg/L)	1.7	1.5	1.5	1.5
NH3-N (mg/L)			0.02	
Ni (mg/L)	0.0001	0.0001	0.0002	0.0001
NO3 (mg/L)	0.22	0.18	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)		<0.01	<0.01	<0.01
Pb (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001
Pb210 (Bq/L)		<0.02	<0.02	<0.02
pH-L (pH Unit)	7.53	7.63	7.59	7.71
Po210 (Bq/L)		0.008	<0.005	0.01
Ra226 (Bq/L)	0.01	0.01	<0.005	0.01
Se (mg/L)	<0.0001	<0.0001	0.0001	<0.0001
SO4 (mg/L)	7.1	7.1	6.5	6.7
Sum of Ions (mg/L)	98	92	89	88
TDS (mg/L)	80	81	72	79
TSS (mg/L)	<1.000		<1.000	
U (µg/L)	14	16	12	12
Zn (mg/L)	<0.001	<0.001	<0.001	<0.001

Station: AN-3

	2012-09-28
Alk-T (mg/L)	71
As (µg/L)	0.1
Ba (mg/L)	0.017
C-(org) (mg/L)	7.6
Ca (mg/L)	21
Cl (mg/L)	0.7
CO3 (mg/L)	<1.0
Cond-L (µS/cm)	144
Cu (mg/L)	0.001
Fe (mg/L)	0.011
Hardness (mg/L)	72
HCO3 (mg/L)	87
K (mg/L)	0.9
Mo (mg/L)	0.002
Na (mg/L)	2
NH3-N (mg/L)	0.02
Ni (mg/L)	0.0002
NO3 (mg/L)	<0.04
OH (mg/L)	<1.0
P-(TP) (mg/L)	<0.01
Pb (mg/L)	<0.0001
Pb210 (Bq/L)	<0.02
pH-L (pH Unit)	7.63
Po210 (Bq/L)	<0.005
Ra226 (Bq/L)	0.006
Se (mg/L)	<0.0001
SO4 (mg/L)	4.5
Sum of Ions (mg/L)	121
TDS (mg/L)	105
TSS (mg/L)	<1.000
U (µg/L)	1.6
Zn (mg/L)	0.003

Station: AN-5

	2012-01-31	2012-05-25	2012-07-31	2012-09-28	2012-11-30
Alk-T (mg/L)	145	80	96	99	107
As (µg/L)	0.3	0.3	0.4	0.3	0.2
Ba (mg/L)	0.14	0.091	0.11	0.11	0.11
C-(org) (mg/L)				11	
Ca (mg/L)	45	26	30	32	35
Cl (mg/L)	2	0.8	0.7	0.9	1
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	313	184	209	219	251
Cu (mg/L)	0.001	0.004	0.002	0	0.002
Fe (mg/L)	0.2	0.17	0.16	0.077	0.14
Hardness (mg/L)	153	90	104	111	121
HCO3 (mg/L)	177	98	117	121	130
K (mg/L)	2	1.2	1.3	1.4	1.5
Mo (mg/L)	0.004	0.005	0.003	0.003	0.003
Na (mg/L)	5.5	3.4	3.7	3.8	4.4
NH3-N (mg/L)				<0.01	
Ni (mg/L)	0.0005	0.0007	0.0007	0.0004	0.0006
NO3 (mg/L)	<0.04	<0.04	<0.04	<0.04	0.09
OH (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)				<0.01	
Pb (mg/L)	<0.0001	0.0004	0.0004	<0.0001	0.0001
Pb210 (Bq/L)				0.04	
pH-L (pH Unit)	7.75	7.58	7.59	7.51	7.61
Po210 (Bq/L)				0.008	
Ra226 (Bq/L)	0.68	0.55	0.6	0.47	0.47
Se (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
SO4 (mg/L)	19	15	12	19	21
Sum of Ions (mg/L)	260	150	172	186	201
TDS (mg/L)	202	114	147	163	165
TSS (mg/L)	2	1	1	<1.000	<1.000
U (µg/L)	265	81	49	78	163
Zn (mg/L)	0.001	0.004	0.006	0.001	0.003

Station: BL-3

	2012-04-03	2012-06-29	2012-09-28	2012-12-29
Alk-T (mg/L)	77	66	68	78
As (µg/L)	0.3	0.3	0.3	0.3
Ba (mg/L)	0.035	0.034	0.036	0.041
C-(org) (mg/L)			3.4	
Ca (mg/L)	23	21	21	22
Cl (mg/L)	13	13	13	14
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	248	236	229	265
Cu (mg/L)	0.001	0.001	0.001	0.001
Fe (mg/L)	0.004	0.003	0.004	0.003
Hardness (mg/L)	80	75	74	78
HCO3 (mg/L)	94	80	83	95
K (mg/L)	1.3	1.2	1.2	1.2
Mo (mg/L)	0.004	0.004	0.004	0.004
Na (mg/L)	19	19	19	21
NH3-N (mg/L)			0.08	
Ni (mg/L)	0.001	0.001	0.0026	0.001
NO3 (mg/L)	<0.04	<0.04	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)			<0.01	
Pb (mg/L)	<0.0001	<0.0001	<0.0001	0.0001
Pb210 (Bq/L)			<0.02	
pH-L (pH Unit)	7.84	7.84	7.86	7.67
Po210 (Bq/L)			<0.005	
Ra226 (Bq/L)	0.03	0.01	0.02	0.04
Se (mg/L)	0.0026	0.0027	0.0026	0.003
SO4 (mg/L)	33	32	32	34
Sum of Ions (mg/L)	189	172	175	193
TDS (mg/L)	145	135	149	161
TSS (mg/L)	<1.000	<1.000	<1.000	1
U (µg/L)	136	135	131	150
Zn (mg/L)	0.002	0.001	0.002	0.002

Station: BL-4

	2012-04-03	2012-09-28
Alk-T (mg/L)	71	68
As (µg/L)	0.3	0.2
Ba (mg/L)	0.034	0.033
C-(org) (mg/L)	3.7	3.2
Ca (mg/L)	22	21
Cl (mg/L)	15	13
CO3 (mg/L)	<1.0	<1.0
Cond-L (µS/cm)	254	228
Cu (mg/L)	0.003	0.001
Fe (mg/L)	0.006	0.004
Hardness (mg/L)	77	74
HCO3 (mg/L)	87	83
K (mg/L)	1.3	1.2
Mo (mg/L)	0.004	0.004
Na (mg/L)	21	19
NH3-N (mg/L)	0.06	0.02
Ni (mg/L)	0.003	0.0018
NO3 (mg/L)	<0.04	<0.04
OH (mg/L)	<1.0	<1.0
P-(TP) (mg/L)	<0.01	<0.01
Pb (mg/L)	0.0002	<0.0001
Pb210 (Bq/L)	<0.02	<0.02
pH-L (pH Unit)	7.87	7.8
Po210 (Bq/L)	<0.005	<0.005
Ra226 (Bq/L)	0.03	0.03
Se (mg/L)	0.0028	0.0026
SO4 (mg/L)	35	32
Sum of Ions (mg/L)	187	175
TDS (mg/L)	146	135
TSS (mg/L)	<1.000	<1.000
U (µg/L)	145	132
Zn (mg/L)	0.006	0.002

Station: BL-5

	2012-04-03	2012-06-29	2012-09-28	2012-12-29
Alk-T (mg/L)	73	66	68	75
As (µg/L)	0.3	0.2	0.2	0.3
Ba (mg/L)	0.035	0.031	0.033	0.037
C-(org) (mg/L)			3.3	
Ca (mg/L)	22	21	21	23
Cl (mg/L)	14	14	13	15
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	256	236	226	273
Cu (mg/L)	0	0	<0.000	0
Fe (mg/L)	0.001	0.001	0.003	0.001
Hardness (mg/L)	78	74	74	81
HCO3 (mg/L)	89	80	83	92
K (mg/L)	1.3	1.2	1.1	1.3
Mo (mg/L)	0.004	0.004	0.004	0.004
Na (mg/L)	21	19	19	21
NH3-N (mg/L)			<0.01	
Ni (mg/L)	0.0002	<0.00010	0.0002	0.0002
NO3 (mg/L)	<0.04	<0.04	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)			<0.01	
Pb (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001
Pb210 (Bq/L)			<0.02	
pH-L (pH Unit)	7.95	7.87	7.86	7.68
Po210 (Bq/L)			<0.005	
Ra226 (Bq/L)	0.03	0.04	0.02	0.04
Se (mg/L)	0.0028	0.0027	0.0027	0.003
SO4 (mg/L)	36	32	32	34
Sum of Ions (mg/L)	189	172	174	192
TDS (mg/L)	147	133	145	157
TSS (mg/L)	<1.000	<1.000	<1.000	1
U (µg/L)	146	130	134	147
Zn (mg/L)	<0.001	<0.001	<0.001	0.001

Station: CS-1

	2012-09-28
Alk-T (mg/L)	64
As (µg/L)	0.2
Ba (mg/L)	0.042
C-(org) (mg/L)	6.2
Ca (mg/L)	20
Cl (mg/L)	7.6
CO3 (mg/L)	<1.0
Cond-L (µS/cm)	181
Cu (mg/L)	<0.000
Fe (mg/L)	0.026
Hardness (mg/L)	68
HCO3 (mg/L)	78
K (mg/L)	1.1
Mo (mg/L)	0.002
Na (mg/L)	11
NH3-N (mg/L)	0.03
Ni (mg/L)	0.0001
NO3 (mg/L)	<0.04
OH (mg/L)	<1.0
P-(TP) (mg/L)	<0.01
Pb (mg/L)	<0.0001
Pb210 (Bq/L)	<0.02
pH-L (pH Unit)	7.76
Po210 (Bq/L)	<0.005
Ra226 (Bq/L)	0.006
Se (mg/L)	0.0009
SO4 (mg/L)	17
Sum of Ions (mg/L)	139
TDS (mg/L)	125
TSS (mg/L)	<1.000
U (µg/L)	57
Zn (mg/L)	<0.001

Station: CS-2

	2012-09-28
Alk-T (mg/L)	31
As (µg/L)	0.2
Ba (mg/L)	0.014
C-(org) (mg/L)	3.5
Ca (mg/L)	8.3
Cl (mg/L)	3.6
CO3 (mg/L)	<1.0
Cond-L (µS/cm)	81
Cu (mg/L)	<0.000
Fe (mg/L)	0.006
Hardness (mg/L)	30
HCO3 (mg/L)	38
K (mg/L)	0.8
Mo (mg/L)	0
Na (mg/L)	3.5
NH3-N (mg/L)	<0.01
Ni (mg/L)	0.0003
NO3 (mg/L)	<0.04
OH (mg/L)	<1.0
P-(TP) (mg/L)	<0.01
Pb (mg/L)	<0.0001
Pb210 (Bq/L)	<0.02
pH-L (pH Unit)	7.51
Po210 (Bq/L)	<0.005
Ra226 (Bq/L)	0.009
Se (mg/L)	0.0001
SO4 (mg/L)	5
Sum of Ions (mg/L)	62
TDS (mg/L)	64
TSS (mg/L)	<1.000
U (µg/L)	4.8
Zn (mg/L)	<0.001

Station: DB-6

	2012-01-31	2012-04-03	2012-05-25	2012-07-31	2012-09-28	2012-11-30
Alk-T (mg/L)	98	96	79	85	88	94
As (µg/L)	0.1	0.1	<0.1	0.1	0.1	0.1
Ba (mg/L)	0.056	0.05	0.041	0.044	0.046	0.045
C-(org) (mg/L)		9.3			9.4	
Ca (mg/L)	39	40	33	36	37	38
Cl (mg/L)	0.8	0.7	0.7	0.6	0.7	0.7
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	257	245	208	212	215	240
Cu (mg/L)	0.001	0.001	0.001	0	0	0.001
Fe (mg/L)	0.01	0.022	0.014	0.022	0.012	0.02
Hardness (mg/L)	122	124	103	113	115	118
HCO3 (mg/L)	120	117	96	104	107	115
K (mg/L)	0.9	1	0.8	0.9	0.9	0.9
Mo (mg/L)	0.002	0.002	0.002	0.002	0.002	0.002
Na (mg/L)	2.3	2.3	1.8	2	2	2.2
NH3-N (mg/L)		0.02			<0.01	
Ni (mg/L)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
NO3 (mg/L)	<0.04	0.58	<0.04	0.09	<0.04	0.18
OH (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)		<0.01			<0.01	
Pb (mg/L)	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
Pb210 (Bq/L)		<0.02			<0.02	
pH-L (pH Unit)	7.86	7.51	7.8	7.63	7.86	7.73
Po210 (Bq/L)		0.01			<0.005	
Ra226 (Bq/L)	0.04	0.04	0.02	0.04	0.02	0.02
Se (mg/L)	0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
SO4 (mg/L)	29	29	24	26	26	26
Sum of Ions (mg/L)	198	196	161	175	179	188
TDS (mg/L)	176	165	135	147	147	163
TSS (mg/L)	2	<1.000	<1.000	<1.000	<1.000	<1.000
U (µg/L)	261	196	186	195	196	150
Zn (mg/L)	<0.001	<0.001	0.002	<0.001	<0.001	0.001

Station: ML-1

	2012-04-03	2012-06-29	2012-09-28	2012-12-29
Alk-T (mg/L)	64	60	64	64
As (µg/L)	0.2	0.2	0.2	0.2
Ba (mg/L)	0.042	0.04	0.042	0.043
C-(org) (mg/L)	8	5.9	5.8	9.6
Ca (mg/L)	20	19	19	20
Cl (mg/L)	6.9	6.4	3.7	3.8
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	180	178	177	162
Cu (mg/L)	0.001	0	0.001	0.004
Fe (mg/L)	0.015	0.008	0.02	0.022
Hardness (mg/L)	68	65	65	66
HCO3 (mg/L)	78	73	78	78
K (mg/L)	1.2	1	1	1.1
Mo (mg/L)	0.002	0.002	0.002	0.001
Na (mg/L)	10	11	11	5.2
NH3-N (mg/L)	0.03	0.04	0.01	0.14
Ni (mg/L)	<0.00010	<0.00010	0.0002	0.0002
NO3 (mg/L)	0.04	0.13	<0.04	0.18
OH (mg/L)	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)	<0.01	<0.01	<0.01	0.01
Pb (mg/L)	<0.0001	<0.0001	0.0056	0.0002
Pb210 (Bq/L)	<0.02	<0.02	<0.02	<0.02
pH-L (pH Unit)	7.4	7.9	7.87	7.5
Po210 (Bq/L)	<0.005	<0.005	<0.005	<0.005
Ra226 (Bq/L)	<0.005	0.008	0.01	<0.005
Se (mg/L)	0.0007	0.001	0.001	0.0004
SO4 (mg/L)	16	18	17	9.3
Sum of Ions (mg/L)	137	133	134	122
TDS (mg/L)	113	103	128	111
TSS (mg/L)	<1.000	<1.000	<1.000	1
U (µg/L)	47	62	62	24
Zn (mg/L)	<0.001	<0.001	0.002	0.004

Station: TL-3

	2012-06-29	2012-09-28	2012-12-29
Alk-T (mg/L)	134	140	147
As (µg/L)	1	1	1.1
Ba (mg/L)	0.034	0.036	0.039
C-(org) (mg/L)		8.5	
Ca (mg/L)	26	27	29
Cl (mg/L)	5	4	4
CO3 (mg/L)	<1.0	<1.0	<1.0
Cond-L (µS/cm)	348	330	381
Cu (mg/L)	0.001	0.001	0.002
Fe (mg/L)	0.009	0.012	0.012
Hardness (mg/L)	86	90	96
HCO3 (mg/L)	163	171	179
K (mg/L)	1.3	1.4	1.4
Mo (mg/L)	0.017	0.018	0.017
Na (mg/L)	42	44	45
NH3-N (mg/L)		<0.01	
Ni (mg/L)	0.0002	0.0003	0.0004
NO3 (mg/L)	<0.04	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0
P-(TP) (mg/L)		<0.01	
Pb (mg/L)	0.0004	0.0009	0.0007
Pb210 (Bq/L)		0.08	
pH-L (pH Unit)	8.16	8.21	7.96
Po210 (Bq/L)		0.04	
Ra226 (Bq/L)	1.4	1.2	1.3
Se (mg/L)	0.0042	0.0042	0.0045
SO4 (mg/L)	42	43	44
Sum of Ions (mg/L)	284	296	308
TDS (mg/L)	216	229	238
TSS (mg/L)	<1.000	<1.000	2
U (µg/L)	377	388	398
Zn (mg/L)	<0.001	<0.001	0.002

Station: TL-4

	2012-06-29	2012-09-28	2012-12-29
Alk-T (mg/L)	133	135	150
As (µg/L)	2.2	1.6	2
Ba (mg/L)	0.076	0.073	0.081
C-(org) (mg/L)		12	
Ca (mg/L)	18	17	19
Cl (mg/L)	4	4	4
CO3 (mg/L)	<1.0	<1.0	<1.0
Cond-L (µS/cm)	321	303	362
Cu (mg/L)	0.001	0	0.001
Fe (mg/L)	0.21	0.072	0.014
Hardness (mg/L)	67	65	71
HCO3 (mg/L)	162	165	183
K (mg/L)	1.5	1.5	1.6
Mo (mg/L)	0.01	0.009	0.01
Na (mg/L)	47	47	49
NH3-N (mg/L)		0.03	
Ni (mg/L)	0.0006	0.0005	0.0006
NO3 (mg/L)	<0.04	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0
P-(TP) (mg/L)		<0.01	
Pb (mg/L)	0.0004	0.0002	0.0003
Pb210 (Bq/L)		0.02	
pH-L (pH Unit)	7.9	8.1	7.9
Po210 (Bq/L)		0.03	
Ra226 (Bq/L)	1.6	1.4	1.7
Se (mg/L)	0.0022	0.0017	0.002
SO4 (mg/L)	33	33	34
Sum of Ions (mg/L)	271	273	296
TDS (mg/L)	213	218	228
TSS (mg/L)	<1.000	<1.000	2
U (µg/L)	244	265	301
Zn (mg/L)	<0.001	<0.001	<0.001

Station: TL-6

	2012-05-09	2012-05-25	2012-07-31	2012-09-28
Alk-T (mg/L)	191	294	293	366
As (µg/L)	2.1	1.7	7.3	2.2
Ba (mg/L)	0.65	1.09	1.65	1.27
C-(org) (mg/L)		36		42
Ca (mg/L)	29	47	49	42
Cl (mg/L)	38	62	62	76
CO3 (mg/L)	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)	566	861	739	953
Cu (mg/L)	0.001	0.001	0	<0.000
Fe (mg/L)	0.62	0.97	11.3	1.28
Hardness (mg/L)	102	166	176	162
HCO3 (mg/L)	233	359	357	446
K (mg/L)	2.8	3.9	2.7	4.2
Mo (mg/L)	0.002	0.003	0.001	0.001
Na (mg/L)	87	125	105	174
NH3-N (mg/L)		0.08		0.08
Ni (mg/L)	0.0004	0.0006	0.0004	0.0004
NO3 (mg/L)	0.18	<0.04	<0.04	<0.04
OH (mg/L)	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)	0.02	0.01		0.01
Pb (mg/L)	0.0027	0.0008	0.0003	0.0002
Pb210 (Bq/L)	0.21	0.09		0.04
pH-L (pH Unit)	7.82	7.83	7.39	7.88
Po210 (Bq/L)	0.18	0.06		0.03
Ra226 (Bq/L)	3.4	5.6	6.6	5.8
Se (mg/L)	0.011	0.0054	0.0024	0.002
SO4 (mg/L)	47	73	19	75
Sum of Ions (mg/L)	444	682	608	831
TDS (mg/L)	382	566	532	687
TSS (mg/L)		2	21	<1.000
U (µg/L)	293	396	43	218
Zn (mg/L)	0.001	0.001	0.002	0.001

Station: TL-7

	2012-01-31	2012-02-29	2012-04-27	2012-05-25	2012-06-29	2012-07-31	2012-08-30	2012-09-28	2012-10-24	2012-11-30
Alk-T (mg/L)			96	130	139	142	153	148	145	152
As (µg/L)			1.5	1.1	2.4	2.4	1.8	1.2	1.2	1.8
Ba (mg/L)			0.1	0.15	0.18	0.25	0.27	0.3	0.21	0.13
C-(org) (mg/L)					13			13		
Ca (mg/L)			30	37	22	21	24	25	26	21
Cl (mg/L)			4.3	35	7	7	11	16	24	4.4
CO3 (mg/L)			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)			290	488	347	331	357	350	415	375
Cu (mg/L)			0.001	0.002	0.001	0.001	0	0	0.001	0.001
Fe (mg/L)			0.31	0.15	0.29	0.18	0.12	0.055	0.046	0.031
Hardness (mg/L)			100	128	78	77	87	92	97	77
HCO3 (mg/L)			117	159	170	173	187	180	177	185
K (mg/L)			2.2	1.9	1.4	1.6	1.7	1.6	1.6	1.7
Mo (mg/L)			0.006	0.014	0.012	0.008	0.006	0.008	0.009	0.011
Na (mg/L)			20	51	48	46	46	48	49	52
NH3-N (mg/L)					0.04			<0.01		
Ni (mg/L)			0.0004	0.0011	0.0009	0.0007	0.0006	0.0005	0.0006	0.0007
NO3 (mg/L)			0.04	<0.04	<0.04	0.04	<0.04	<0.04	<0.04	<0.04
OH (mg/L)			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)					<0.01			<0.01		
Pb (mg/L)			0.0003	0.0008	0.0009	0.0004	0.0001	0.0002	0.0003	0.0004
Pb210 (Bq/L)					0.07			0.02		
pH-L (pH Unit)			7.92	7.84	7.66	7.73	7.36	7.95	8.2	7.87
Po210 (Bq/L)					0.1			0.02		
Ra226 (Bq/L)			0.22	0.45	0.89	0.83	1.6	1.3	0.76	0.99
Se (mg/L)			0.006	0.0051	0.0029	0.0025	0.0028	0.0021	0.0027	0.0025
SO4 (mg/L)			43	67	36	28	26	34	34	36
Sum of Ions (mg/L)			223	360	290	283	302	312	319	306
TDS (mg/L)			184	301	228	232	231	225	272	242
TSS (mg/L)			<1.000	<1.000	<1.000	<1.000	1	<1.000	<1.000	<1.000
U (µg/L)			214	417	216	172	149	248	361	337
Zn (mg/L)			0.002	0.001	0.003	0.001	<0.001	<0.001	<0.001	0.002

Station: TL-9

	2012-01-31	2012-02-29	2012-04-27	2012-05-25	2012-06-29	2012-07-31	2012-08-30	2012-09-28	2012-10-24	2012-11-30	2012-12-29
Alk-T (mg/L)				142	148	143	140	155	157	170	166
As (µg/L)				1.5	1.7	2.5	2.7	1.8	1.8	1.7	1.7
Ba (mg/L)				0.24	0.97	1.28	1.01	1.53	1.48	1.4	0.88
C-(org) (mg/L)					14			15			13
Ca (mg/L)				26	23	21	21	26	26	28	27
Cl (mg/L)				9	9	9	9	9	9	10	8
CO3 (mg/L)				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cond-L (µS/cm)				373	364	342	342	346	391	423	411
Cu (mg/L)				0.002	0.001	0.001	0.001	0	0.001	0.001	0.001
Fe (mg/L)				0.019	0.035	0.085	0.1	0.061	0.078	0.03	0.032
Hardness (mg/L)				96	86	83	83	98	97	104	99
HCO3 (mg/L)				173	180	174	171	189	192	207	202
K (mg/L)				1.6	1.7	1.6	1.8	1.8	1.7	2	1.8
Mo (mg/L)				0.016	0.013	0.013	0.012	0.015	0.017	0.016	0.013
Na (mg/L)				44	45	46	43	46	45	50	55
NH3-N (mg/L)					0.04			0.03			0.14
Ni (mg/L)				0.0005	0.0004	0.0005	0.0005	0.0004	0.0003	0.0004	0.0005
NO3 (mg/L)				<0.04	0.35	0.4	0.4	0.4	0.22	0.04	0.04
OH (mg/L)				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
P-(TP) (mg/L)					<0.01			<0.01			0.01
Pb (mg/L)				0.0012	0.001	0.0015	0.0007	0.0008	0.0013	0.0004	0.0006
Pb210 (Bq/L)					0.04			0.1			0.09
pH-L (pH Unit)				8.03	7.98	7.81	7.9	8.11	8.3	8.03	7.8
Po210 (Bq/L)					0.08			0.06			0.04
Ra226 (Bq/L)				2.8	2.7	2.9	1.4	1.1	3.4	3.1	2.2
Se (mg/L)				0.013	0.0045	0.0029	0.0034	0.0022	0.0031	0.0035	0.0033
SO4 (mg/L)				43	34	31	29	34	33	37	38
Sum of Ions (mg/L)				304	300	290	283	314	315	342	340
TDS (mg/L)				243	243	244	229	234	267	273	270
TSS (mg/L)				<1.000	<1.000	2	3	<1.000	2	<1.000	2
U (µg/L)				497	243	208	207	342	426	457	414
Zn (mg/L)				0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001

APPENDIX B
2011/12 STREAMFLOW ASSESSMENT NEAR BEAVERLODGE MINE

2011/12 STREAMFLOW ASSESSMENT
NEAR BEAVERLODGE MINE

Report on

2011/12 Streamflow Assessment near Beaverlodge Mine

Project No. 2711-13003-0
Cameco Corporation | Michael Webster | (306) 956-6200
April 12, 2013

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As a world leading uranium producer, Cameco Corporation (Cameco) provides approximately 16% of the world's production from its mines in Canada and the US. Cameco's goal is to be the supplier, partner, investment and employer of choice in the nuclear industry and is committed to providing a safe, healthy and rewarding workplace, a clean environment, supportive communities and outstanding financial performance. Cameco was formed in 1988 as a merger of the Saskatchewan Mining Development Corporation and Eldorado Nuclear Limited, both crown corporations of the Saskatchewan and Canadian governments, respectively. (Cameco, 2012a)

1 INTRODUCTION

Development of uranium mines in the area of Beaverlodge Lake, Saskatchewan near Uranium City began in the 1950s. At that time, operations were owned by Eldorado Mining and Refining Ltd., a crown corporation owned by the Government of Canada. The milling and local mine sites were closed in 1982 and decommissioning and reclamation works were completed in 1985. The project transferred into a monitoring and maintenance phase following decommission and reclamation. The site is currently managed by Cameco on behalf of the Government of Canada. (SRK Consulting, 2009)

Post-closure monitoring activities have continued since the decommissioning of the site and include routine sampling and/or measurement of local parameters including water quality and flow. Cameco has retained McElhanney Consulting Services Ltd. (MCSL) for the reporting of 2011/12 streamflow data for Ace Creek at Station AC-8 and Fulton Creek at Station TL-7. This report summarizes the data collected in 2011 and 2012 for each station. This report also presents climatic data collected for the communities of Uranium City and Stony Rapids, Saskatchewan. Climate data, presented as precipitation, allows for presentation of the flow monitoring data in context of whether the monitoring period has been relatively wet or dry with respect to normal precipitation values.

2 CLIMATIC CONDITIONS

Environment Canada operates meteorological stations at Uranium City and at Stony Rapids, Saskatchewan. Meteorological data from these sites provide an indication of climatic conditions through the hydrological monitoring period. The station near Uranium City is automated and has been subject to problems in the past resulting in meteorological data gaps. Stony Rapids station in the past few years has become somewhat less reliable as well, but combined these weather stations provide sufficient record of recent precipitation at the Beaverlodge area. Table 1 provides mean and annual total precipitation (rain and snow) totals for Uranium City and Stony Rapids as well as the number of recorded days of data with respect to the number of possible days of record (Environment Canada 2013). Normal annual totals for precipitation are provided as presented by Golder Associates Ltd. (2011).

As indicated in Table 1, annual precipitation totals appear to be below normal for both Uranium City and Stony Rapids; however, there are gaps in the data available which makes both records incomplete. In particular, missing data should be taken into consideration for Uranium City in 2012 where approximately 60% of the data is unavailable including all of February and March, while Stony Rapids 2011 and 2012 data is missing approximately 9% of the data. Visual assessment of the daily record for Stony Rapids in the winter of 2012 indicates a continuous series of zero reported precipitation; consecutive days with no precipitation, while plausible, tends to be unlikely and it is probable that there is an error in the measurement during the months of November and December. In 2011, both stations show above average precipitation for the months of July and August with below average totals for the remainder of the year. April 2012 total precipitation for Stony Rapids is approximately average while Uranium City is well below average but missing 15 days out of 30; both stations are below normal values for both 2011 and 2012.

Residents of Uranium City indicated during the spring 2012 field program that there was more snow than usual during the winter of 2011/2012. This may indicate that data was missed during important periods at the Uranium City station which does not fully describe the snowpack for the winter. The data reported in Table 1 is a summary of the daily reported data from Environment Canada and was not subjected to in-filling or extrapolation to complete the record. Furthermore, the residents of Uranium City indicated that a thunder storm in July 2012 generated runoff. McElhanney is aware of another private climate data set near Uranium City which indicated that a July rain event occurred which does not appear in the data reported in Table 1.

Table 1. Precipitation Data

Year	Month	Uranium City				Stony Rapids			
		Precipitation (mm)	Normal Precipitation (mm)(a)	Percent of Normal	Recorded Days of Data	Precipitation (mm)	Normal Precipitation (mm)(b)	Percent of Normal	Recorded Days of Data
2011	January	7.6	19.3	39.4	31/31	2.4*	18.1	13.3	17/31
	February	4.3	15.5	27.7	28/28	1.9*	13.3	14.3	22/28
	March	3.6*	17.8	20.2	30/31	2.6*	18.2	14.3	26/31
	April	1.4	16.9	8.3	30/30	0.0*	18	0.0	28/30
	May	2.1*	17.5	12.0	30/31	2.8*	26.3	10.6	30/31
	June	5.6	31.3	17.9	30/30	11.6	44.4	26.1	30/30
	July	47.9	47.1	101.7	31/31	72.5	56.3	128.8	31/31
	August	74.4*	42.4	175.5	29/31	118.4	63.9	185.3	31/31
	September	9.1	33.7	27.0	30/30	17.3	48.4	35.7	30/30
	October	13.0*	29.1	44.7	30/31	15.8*	30.1	52.5	30/31
	November	18	28	64.3	30/30	7.0*	27.6	25.4	29/30
	December	17.7	23.6	75.0	31/31	7.5*	18.7	40.1	27/31
Total		204.7*	322.2	63.5	360/365	259.8*	383.3	67.8	331/365
2012	January	6.6*	19.3	34.2	29/31	2.3*	18.1	12.7	26/31
	February	0.0*	15.5	0.0	0/29	0.0*	13.3	0.0	28/29
	March	0.0*	17.8	0.0	0/31	8.7*	18.2	47.8	29/31
	April	4.9*	16.9	29.0	15/30	18.5	18	102.8	30/30
	May	4.7*	17.5	26.9	24/31	7.5*	26.3	28.5	30/31
	June	30.8*	31.3	98.4	21/30	28.0*	44.4	63.1	29/30
	July	0.9*	47.1	1.9	11/31	33.9*	56.3	60.2	26/31
	August	76.9*	42.4	181.4	30/31	49.6*	63.9	77.6	28/31
	September	21.3	33.7	63.2	30/30	17.7*	48.4	36.6	29/30
	October	39.2*	29.1	134.7	29/31	25.7*	30.1	85.4	28/31
	November	20.1*	28	71.8	27/30	2.0*	27.6	7.2	28/30
	December	0.0*	23.6	0.0	2/31	0.0*	18.7	0.0	23/31
Total		205.4*	322.2	63.7	218/366	193.9*	383.3	50.6	334/366

Notes: (a) Uranium City Normals, Golder (2011); (b) Stony Rapids Normals, Golder (2011); * indicates incomplete data set.

3 STREAMFLOW MONITORING

Streamflow monitoring at Ace Creek (AC-8) and Fulton Creek (TL-7) is maintained as a part of the site monitoring program. The station known as AC-8 is located at the outlet of Ace Lake where the outlet configuration is a rectangular concrete weir. The drainage area reporting to Ace Lake is approximately 152 km². Solinst Leveloggers have been used to record stage height at AC-8 since approximately 2004 and prior to that time a Steven's recorder was operated at the site. The stage height record is used to calculate discharge via a stage-discharge rating curve. The rating curve used to estimate discharge from the stage data is presented in Figure 1 and is based on manual measurements of stage and discharge since 2005 (Table 2).

Figure 1:Stage-Discharge Rating Curve at AC-8

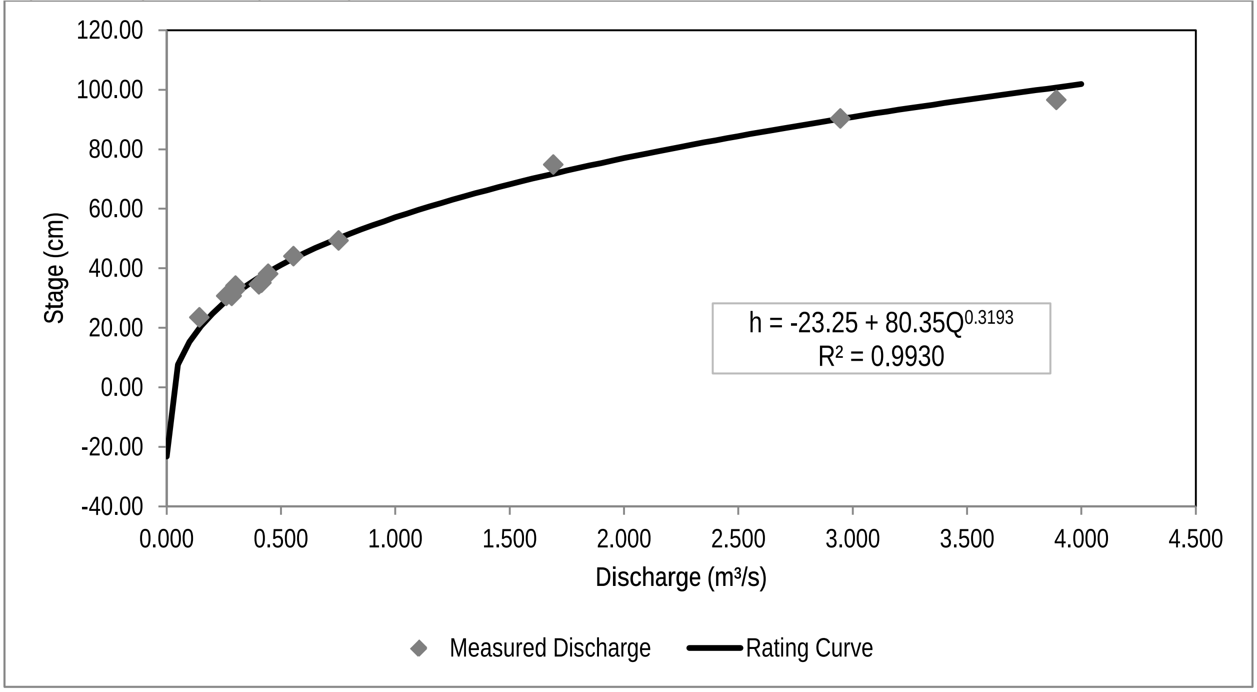


Table 2. Stage and Discharge Measurement Summary at AC-8

Date	Time	Staff Gauge (cm)	Discharge (m^3/s)
16-Aug-05	Not Recorded	35.0	0.415
24-Jan-06	Not Recorded	34.5	0.404
24-May-06	Not Recorded	74.7	1.691
30-Apr-10	Not Recorded	49.2	0.753
1-Jul-10	Not Recorded	30.6	0.286
11-Sep-10	10:15	23.4	0.144
16-May-11	15:30	34.1	0.303
22-May-11	8:11	38.0	0.444
28-Aug-11	10:30	30.6	0.261
3-Oct-11	Not Recorded	32.7	0.301
8-May-12	15:09	90.2	2.947
10-May-12	8:57	96.5	3.891
29-Sept-12	11:20	44.0	0.556

At TL-7, a large v-notch weir controls discharge and is also monitored with a staff gauge and data logger. The catchment area contributing to TL-7 is approximately 14 km². A rating curve for this station has not been developed so discharge is calculated using the standard equation for a 90° v-notch weir shown below as Equation [1] (Smith, 1995). The datalogger for this station is only installed during the open water season to limit potential damage which may occur when ice forms upstream of the weir structure. Three recent volumetric discharge measurements were performed at TL-7 and those measurements, along with measured stage heights, are provided in Table 3.

$$[1] \qquad Q = 1.37 \cdot h^{2.5}$$

Table 3. Discharge Measurement Summary at TL-7

Date	Time	Stage Height (cm)	Discharge (L/s)
21-May-11(a)	15:40	5.4	1.16
3-Oct-11(a)	14:30	3.0	0.20
27-Sept-12	17:30	11.5	8.20

(a) Golder, 2012.

3.1 ACE CREEK – STATION AC-8 RESULTS

The datalogger installed at AC-8 remained intact and without detrimental malfunction for the course of the monitoring period (Jan 1, 2011 to December 31, 2012). The addition of two high flow manual discharge measurements at the site in May of 2012 is of benefit to the rating curve for estimation of discharge during periods of high stage. The stage-discharge rating curve equation used to estimate discharge at AC-8 is presented in Figure 1. The daily average discharges at AC-8 for 2011 and 2012 are presented in Tables 4 and 5, respectively while historical mean monthly flows are presented in Table 6. Monthly mean flows prior to the monitoring period are taken from Golder (2011). The hydrograph for the monitoring period is presented as Figure 2 and is a graphical representation of the data provided in Tables 4 and 5. In general terms, discharge during May of 2012 is high relative to historical values.

Table 4. 2011 Daily Average Discharges (m^3/s) for Ace Creek (AC-8)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.183	0.158	0.130	0.101	0.088	0.455	0.228	0.279	0.340	0.321	0.260	0.275
2	0.182	0.155	0.129	0.101	0.091	0.456	0.215	0.280	0.353	0.311	0.255	0.285
3	0.180	0.155	0.127	0.102	0.093	0.440	0.212	0.289	0.366	0.309	0.253	0.283
4	0.178	0.154	0.126	0.102	0.101	0.425	0.226	0.283	0.383	0.317	0.253	0.282
5	0.178	0.152	0.125	0.101	0.107	0.411	0.237	0.278	0.401	0.320	0.248	0.281
6	0.179	0.151	0.123	0.101	0.115	0.395	0.238	0.274	0.420	0.315	0.245	0.281
7	0.180	0.148	0.122	0.100	0.124	0.380	0.237	0.266	0.436	0.313	0.244	0.282
8	0.180	0.145	0.122	0.100	0.134	0.372	0.236	0.258	0.450	0.310	0.245	0.281
9	0.179	0.144	0.121	0.098	0.147	0.364	0.233	0.257	0.460	0.303	0.245	0.279
10	0.179	0.142	0.119	0.098	0.162	0.358	0.234	0.262	0.461	0.301	0.249	0.278
11	0.178	0.140	0.117	0.099	0.184	0.353	0.229	0.275	0.462	0.297	0.258	0.276
12	0.179	0.139	0.116	0.097	0.206	0.342	0.225	0.268	0.471	0.294	0.258	0.275
13	0.179	0.137	0.116	0.097	0.227	0.337	0.219	0.269	0.464	0.295	0.259	0.279
14	0.180	0.137	0.115	0.096	0.251	0.334	0.216	0.262	0.454	0.293	0.259	0.278
15	0.177	0.136	0.116	0.094	0.277	0.325	0.218	0.265	0.444	0.290	0.260	0.277
16	0.176	0.136	0.115	0.092	0.299	0.307	0.227	0.290	0.438	0.287	0.259	0.276
17	0.174	0.135	0.113	0.091	0.336	0.292	0.229	0.298	0.437	0.283	0.258	0.275
18	0.172	0.134	0.111	0.089	0.370	0.288	0.236	0.292	0.431	0.280	0.257	0.276
19	0.170	0.133	0.110	0.088	0.398	0.281	0.246	0.283	0.427	0.277	0.255	0.277
20	0.168	0.131	0.109	0.086	0.425	0.271	0.246	0.277	0.419	0.275	0.255	0.276
21	0.165	0.132	0.107	0.085	0.449	0.266	0.247	0.273	0.409	0.273	0.258	0.278
22	0.163	0.134	0.105	0.084	0.463	0.264	0.246	0.274	0.401	0.269	0.255	0.276
23	0.165	0.133	0.104	0.083	0.462	0.269	0.246	0.271	0.391	0.266	0.264	0.274
24	0.166	0.132	0.104	0.081	0.473	0.260	0.248	0.269	0.384	0.266	0.265	0.272
25	0.167	0.131	0.102	0.080	0.475	0.253	0.253	0.273	0.376	0.265	0.268	0.274
26	0.166	0.132	0.103	0.080	0.479	0.232	0.258	0.274	0.364	0.265	0.269	0.274
27	0.167	0.133	0.101	0.080	0.483	0.219	0.262	0.272	0.356	0.266	0.274	0.273
28	0.169	0.132	0.100	0.082	0.474	0.210	0.261	0.270	0.348	0.265	0.274	0.278
29	0.167		0.100	0.084	0.470	0.207	0.263	0.268	0.340	0.263	0.275	0.277
30	0.164		0.100	0.087	0.461	0.206	0.269	0.296	0.332	0.263	0.275	0.276
31	0.161		0.101		0.460		0.270	0.311		0.264		0.275
Mean	0.173	0.140	0.113	0.092	0.299	0.319	0.239	0.276	0.407	0.288	0.258	0.277

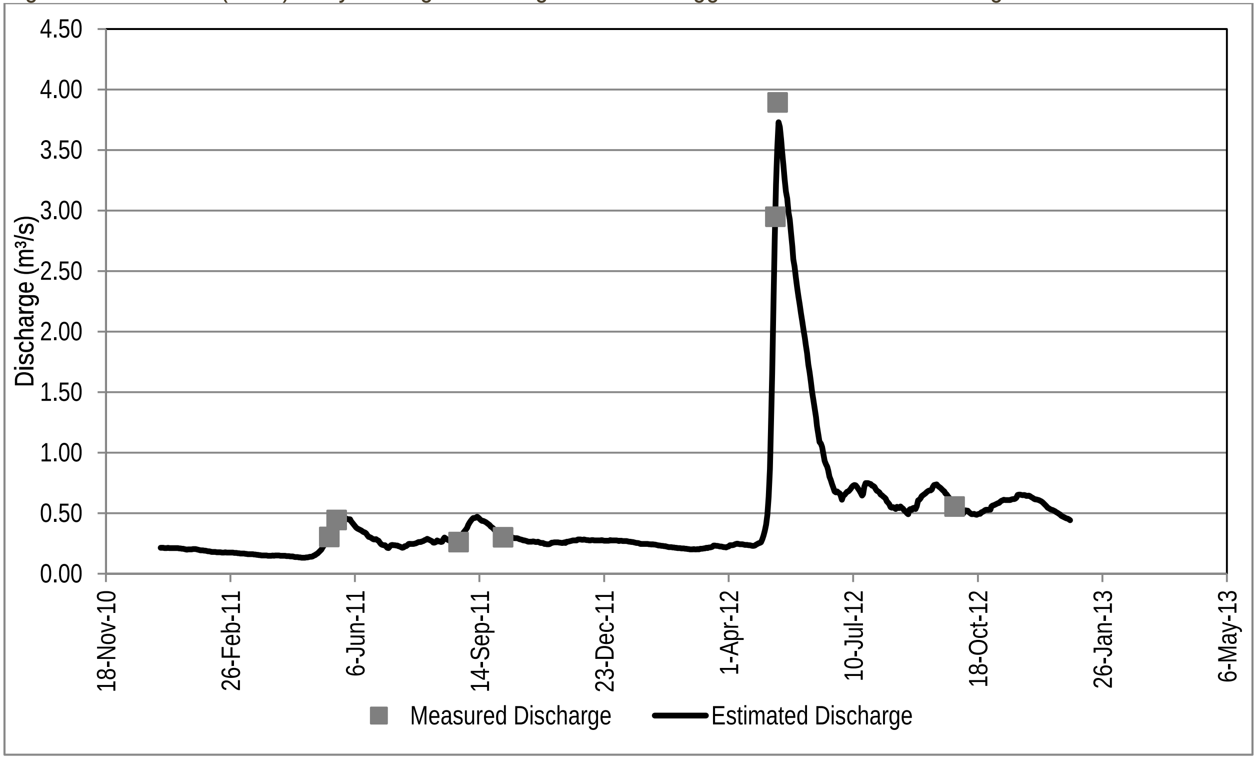
Table 5. 2012 Daily Average Discharges (m³/s) for Ace Creek (AC-8)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.275	0.241	0.202	0.225	0.405	1.949	0.611	0.654	0.611	0.555	0.573	0.628
2	0.275	0.240	0.201	0.237	0.488	1.892	0.647	0.649	0.625	0.548	0.578	0.620
3	0.272	0.237	0.201	0.235	0.635	1.824	0.651	0.638	0.641	0.530	0.583	0.614
4	0.271	0.236	0.203	0.235	0.865	1.727	0.664	0.630	0.648	0.518	0.584	0.614
5	0.273	0.234	0.202	0.238	1.192	1.664	0.677	0.618	0.655	0.505	0.594	0.612
6	0.272	0.233	0.202	0.245	1.650	1.585	0.681	0.599	0.664	0.496	0.604	0.610
7	0.270	0.231	0.203	0.247	2.220	1.498	0.690	0.587	0.675	0.508	0.607	0.605
8	0.270	0.230	0.203	0.248	2.768	1.431	0.703	0.573	0.682	0.524	0.613	0.599
9	0.270	0.229	0.205	0.247	3.219	1.363	0.717	0.551	0.689	0.521	0.610	0.590
10	0.269	0.227	0.208	0.245	3.517	1.294	0.726	0.546	0.687	0.521	0.609	0.580
11	0.268	0.225	0.207	0.244	3.728	1.220	0.733	0.552	0.695	0.509	0.608	0.569
12	0.266	0.222	0.209	0.244	3.690	1.154	0.730	0.544	0.717	0.500	0.609	0.558
13	0.264	0.221	0.209	0.240	3.585	1.087	0.718	0.536	0.733	0.493	0.609	0.545
14	0.263	0.220	0.214	0.238	3.489	1.076	0.701	0.553	0.737	0.493	0.613	0.541
15	0.262	0.219	0.213	0.237	3.377	1.047	0.687	0.545	0.737	0.495	0.616	0.534
16	0.260	0.218	0.217	0.237	3.256	0.990	0.666	0.543	0.726	0.490	0.616	0.530
17	0.258	0.217	0.217	0.236	3.157	0.931	0.647	0.555	0.718	0.488	0.619	0.527
18	0.255	0.214	0.219	0.235	3.100	0.904	0.656	0.545	0.708	0.492	0.627	0.521
19	0.253	0.214	0.221	0.233	2.987	0.883	0.721	0.537	0.697	0.494	0.652	0.516
20	0.251	0.213	0.232	0.231	2.926	0.856	0.748	0.522	0.689	0.495	0.654	0.509
21	0.248	0.213	0.233	0.230	2.813	0.803	0.750	0.516	0.679	0.507	0.654	0.502
22	0.247	0.212	0.232	0.234	2.702	0.775	0.748	0.501	0.665	0.511	0.652	0.495
23	0.246	0.211	0.230	0.241	2.598	0.742	0.743	0.493	0.656	0.520	0.650	0.489
24	0.246	0.210	0.229	0.247	2.536	0.713	0.741	0.530	0.641	0.526	0.651	0.479
25	0.247	0.208	0.227	0.252	2.446	0.681	0.727	0.536	0.628	0.528	0.649	0.474
26	0.247	0.208	0.224	0.254	2.366	0.672	0.724	0.526	0.617	0.526	0.644	0.469
27	0.246	0.206	0.223	0.260	2.290	0.681	0.716	0.543	0.606	0.528	0.643	0.463
28	0.244	0.205	0.221	0.283	2.224	0.669	0.701	0.545	0.596	0.529	0.645	0.458
29	0.243	0.204	0.220	0.314	2.150	0.664	0.684	0.536	0.588	0.555	0.641	0.455
30	0.242		0.217	0.354	2.085	0.645	0.680	0.558	0.568	0.563	0.634	0.451
31	0.243		0.222		2.014		0.673	0.605		0.566		0.443
Mean	0.259	0.221	0.215	0.248	2.467	1.114	0.699	0.560	0.666	0.517	0.621	0.535

Table 6. Historical Monthly and Annual Mean Discharges (m^3/s) for Ace Creek (AC-8)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1980	0.151	0.150	0.149	0.221	0.204	0.156	0.145	0.145	0.145	0.163	0.151	0.146	0.161
1981	0.146	0.145	0.145	0.169	0.392	0.178	0.182	0.192	0.194	0.190	0.198	0.188	0.193
1982	0.169	0.167	0.176	0.196	0.577	0.459	0.279	0.185	0.146	0.157	0.154	0.162	0.236
1983	0.177	0.164	0.151	0.223	0.750	0.574	0.414	0.334	0.251	0.226	0.206	0.194	0.305
1984	0.189	0.192	0.208	0.413	0.501	0.723	0.789	0.564	0.399	0.571	0.790	0.725	0.505
1985	0.471	0.378	0.335	0.395	2.768	1.366	0.551	0.332	0.256	0.215	0.174	0.169	0.618
1986	0.181	0.186	0.185	0.218	0.462	0.541	0.608	0.544	0.343	0.233	0.201	0.193	0.325
1987	0.191	0.208	0.221	0.219	1.988	0.685	0.260	0.116	0.102	0.103	0.135	0.138	0.364
1988	0.154	0.114	0.108	0.100	0.361	0.817	1.120	0.819	0.254	0.181	0.202	0.191	0.368
1989	0.178	0.176	0.156	0.160	1.912	1.427	0.361	0.166	0.115	0.120	0.154	0.172	0.425
1990	0.197	0.183	0.169	0.108	0.556	0.764	0.317	0.175	0.145	0.151	0.250	0.333	0.279
1991	0.262	0.219	0.207	0.436	2.038	1.962	0.788	0.395	0.393	0.431	0.464	0.398	0.666
1992	0.319	0.254	0.215	0.247	2.634	1.386	0.663	0.489	0.408	1.223	0.985	0.508	0.778
1993	0.302	0.221	0.183	0.190	0.862	0.513	0.356	1.006	0.594	0.314	0.382	0.400	0.444
1994	0.277	0.225	0.205	0.186	3.014	1.459	0.339	0.117	0.097	0.105	0.130	0.131	0.524
1995	0.113	0.106	0.104	0.129	1.698	1.401	0.900	0.493	1.002	0.511	0.378	0.325	0.597
1996	0.252	0.190	0.155	0.146	0.272	0.524	1.408	0.499	0.341	0.286	0.293	0.262	0.386
1997	0.229	0.202	0.167	0.171	0.593	0.970	1.251	1.897	4.109	3.439	1.629	0.617	1.273
1998	0.369	0.291	0.246	0.279	1.236	0.410	0.614	0.404	0.260	0.208	0.208	0.199	0.394
1999	0.169	0.160	0.165	0.156	0.467	0.608	0.408	0.216	0.203	0.161	0.153	0.166	0.253
2000	0.166	0.136	0.129	0.136	0.307	0.305	0.267	0.274	0.674	0.824	1.211	0.744	0.431
2001	0.365	0.298	0.236	0.203	1.176	0.763	0.457	0.360	0.355	0.597	0.457	0.365	0.469
2002	0.350	0.220	0.176	0.189	1.304	2.353	0.516	2.216	1.102	0.688	0.561	0.437	0.843
2003	0.288	0.246	0.201	0.179	2.240	2.284	0.668	0.522	0.458	0.422	0.410	0.345	0.689
2004	0.253	0.250	0.301	0.214	0.206	1.996	0.455	0.219	0.169	0.170	0.176	0.166	0.381
2005	0.143	0.164	0.150	0.191	1.158	1.077	0.549	0.443	0.456	0.464	0.728	0.579	0.509
2006	0.433	0.321	0.229	0.397	2.280	0.978	0.365	0.240	0.226	0.228	0.220	0.200	0.510
2007	0.199	0.171	0.156	0.175	0.734	0.573	0.370	0.321	0.477	0.483	0.874	0.635	0.431
2008	0.463	0.343	0.294	0.252	1.110	1.125	0.361	0.318	0.265	0.509	0.735	0.495	0.523
2009	0.242	0.180	0.124	0.175	1.066	0.852	1.478	0.681	0.454	0.432	0.431	0.414	0.544
2010	0.341	0.280	0.217	0.309	0.744	0.430	0.238	0.105	0.167	0.199	0.178	0.181	0.282
2011	0.173	0.140	0.113	0.092	0.299	0.319	0.207	0.240	0.358	0.250	0.224	0.241	0.221
2012	0.259	0.221	0.215	0.248	2.467	1.114	0.699	0.560	0.666	0.517	0.621	0.535	0.676
Mean	0.248	0.209	0.188	0.216	1.163	0.942	0.557	0.472	0.472	0.448	0.426	0.332	0.473

Figure 2:Ace Creek (AC-8) Daily Average Discharge from Datalogger and Measured Discharge



3.2 FULTON CREEK – STATION TL-7 RESULTS

Although flow through Fulton Creek is reduced during the winter, TL-7 is known to flow through the winter in most years, it is common practice to remove the datalogger at the end of each open water season prior to freeze up. This prevents damage to the datalogger as a result of glaciation through the v-notch weir. In 2011, the datalogger was installed in May and removed in October while the logger was installed in May of 2012 and removed in late September. To estimate the magnitude of discharges through TL-7 during the winter months a correlation has been developed (Golder 2011) with AC-8 allowing for winter discharge at TL-7 to be calculated. The equations to correlate AC-8 to TL-7 are as follows:

[2] $Q_{TL-7} = 0.034Q_{AC-8} - 0.0086$; for Q_{AC-8} <0.396 m³/s; and,

[3] $Q_{TL-7} = 0.0076Q_{AC-8}$; for Q_{AC-8} >= 0.396 m³/s.

As indicated, Equation [2] is to be used when flows at AC-8 are lower than 0.396 m³/s. As such, it is possible for this equation to predict flows at TL-7 that have a negative magnitude. In those instances, the minimum value estimated for the flow record is zero based on professional judgment. Tables 7 and 8 present the 2011 and 2012 daily average discharges while Table 9 presents the monthly and annual historic means. Figure 3 presents the calculated and measured data for the daily average hydrograph for the monitoring period including observed discharge. Professional judgment is incorporated into the interpretation of flow for TL-7 when using AC-8 data is a proxy. The current monitoring period indicates that discharge is quite low when compared to monthly mean values in Table 9. If this trend persists for several years, while AC-8 experiences higher discharges, it may warrant an investigation into the local drainage system contributing to TL-7; however, recent observations indicate that the Fulton Creek drainage may be recovering from a period of drought (Cameco, 2012b).

Table 7. 2011 Daily Average Discharges (L/s) for Fulton Creek (TL-7)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.28	0.09	0.00	0.00	0.00	0.41	0.15	0.35	1.38	0.23	0.00	0.00
2	0.27	0.07	0.00	0.00	0.00	0.43	0.15	0.38	0.86	0.24	0.00	0.02
3	0.26	0.06	0.00	0.00	0.00	0.33	0.06	0.52	0.70	0.48	0.00	0.00
4	0.24	0.06	0.00	0.00	0.00	0.31	1.30	0.27	0.56	0.79	0.00	0.00
5	0.24	0.05	0.00	0.00	0.00	0.32	1.08	0.23	0.46	0.86	0.00	0.00
6	0.25	0.04	0.00	0.00	0.00	0.31	0.79	0.08	0.38	0.72	0.00	0.08
7	0.26	0.02	0.00	0.00	0.00	0.32	0.60	0.00	0.30	0.67	0.00	0.10
8	0.25	0.02	0.00	0.00	0.00	0.34	0.47	0.00	0.22	0.57	0.00	0.00
9	0.25	0.00	0.00	0.00	0.00	0.23	0.50	0.00	0.18	0.38	0.00	0.00
10	0.25	0.00	0.00	0.00	0.00	0.24	0.44	0.46	0.15	0.29	0.00	0.00
11	0.24	0.00	0.00	0.00	0.00	0.40	0.29	0.72	0.17	0.19	0.00	0.00
12	0.24	0.00	0.00	0.00	0.00	0.28	0.20	0.33	0.42	0.09	0.00	0.00
13	0.25	0.00	0.00	0.00	0.00	0.21	0.14	0.36	0.22	0.11	0.00	0.00
14	0.25	0.00	0.00	0.00	0.05	0.19	0.09	0.22	0.15	0.05	0.00	0.00
15	0.24	0.00	0.00	0.00	0.23	0.21	0.34	0.52	0.15	0.01	0.00	0.00
16	0.22	0.00	0.00	0.00	0.40	0.14	0.53	0.44	0.15	0.00	0.00	0.00
17	0.21	0.00	0.00	0.00	0.65	0.15	0.39	0.35	0.43	0.00	0.00	0.00
18	0.20	0.00	0.00	0.00	0.58	0.15	0.39	0.29	0.33	0.00	0.00	0.00
19	0.18	0.00	0.00	0.00	0.68	0.15	0.54	0.17	0.28	0.00	0.00	0.00
20	0.17	0.00	0.00	0.00	0.67	0.11	0.32	0.07	0.21	0.00	0.00	0.00
21	0.14	0.00	0.00	0.00	0.74	0.12	0.44	0.08	0.20	0.00	0.00	0.00
22	0.13	0.00	0.00	0.00	0.75	0.26	0.17	0.28	0.19	0.00	0.00	0.00
23	0.14	0.00	0.00	0.00	0.74	0.28	0.08	0.12	0.29	0.00	0.00	0.00
24	0.15	0.00	0.00	0.00	0.69	0.18	0.07	0.04	0.29	0.00	0.00	0.00
25	0.15	0.00	0.00	0.00	0.67	0.14	0.07	0.39	0.23	0.00	0.00	0.00
26	0.15	0.00	0.00	0.00	0.58	0.03	0.03	0.32	0.31	0.00	0.00	0.00
27	0.16	0.00	0.00	0.00	0.52	0.03	0.00	0.14	0.31	0.00	0.00	0.00
28	0.17	0.00	0.00	0.00	0.50	0.02	0.00	0.07	0.30	0.00	0.00	0.00
29	0.16		0.00	0.00	0.53	0.09	0.00	0.27	0.19	0.00	0.00	0.00
30	0.13		0.00	0.00	0.45	0.07	0.00	2.23	0.21	0.00	0.00	0.00
31	0.11		0.00		0.44		0.10	1.43		0.00		0.00
Mean	0.20	0.01	0.00	0.00	0.32	0.22	0.31	0.36	0.34	0.18	0.00	0.01

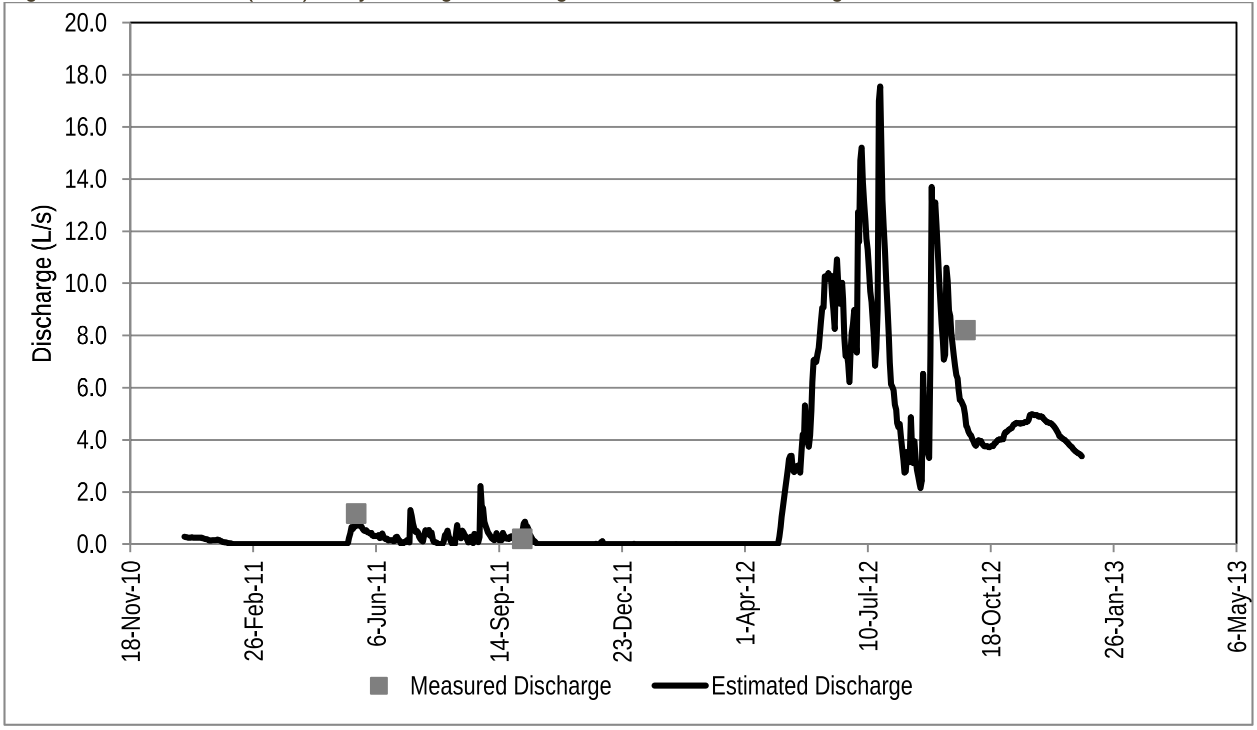
Table 8. 2012 Daily Average Discharges (L/s) for Fulton Creek (TL-7)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.00	0.00	0.00	0.00	1.04	7.95	7.34	5.34	11.62	4.22	4.35	4.77
2	0.01	0.00	0.00	0.00	1.42	8.55	12.74	5.16	12.93	4.16	4.39	4.72
3	0.00	0.00	0.00	0.00	1.79	9.07	11.59	4.64	13.11	4.03	4.43	4.66
4	0.00	0.00	0.00	0.00	2.17	9.08	14.72	4.49	12.22	3.94	4.44	4.67
5	0.00	0.00	0.00	0.00	2.55	10.27	15.21	4.60	11.25	3.84	4.52	4.65
6	0.00	0.00	0.00	0.00	2.92	10.27	13.87	4.09	10.22	3.77	4.59	4.63
7	0.00	0.00	0.00	0.00	3.26	10.17	13.07	3.64	9.32	3.86	4.61	4.60
8	0.00	0.00	0.00	0.00	3.38	10.39	12.38	3.20	8.45	3.98	4.66	4.55
9	0.00	0.00	0.00	0.00	3.40	10.22	11.72	2.74	7.79	3.96	4.64	4.48
10	0.00	0.00	0.00	0.00	2.83	10.29	11.28	2.78	7.07	3.96	4.63	4.41
11	0.00	0.00	0.00	0.00	2.76	9.49	10.52	3.54	7.26	3.87	4.62	4.32
12	0.00	0.00	0.00	0.00	2.81	8.96	9.70	3.26	10.61	3.80	4.63	4.24
13	0.00	0.00	0.00	0.00	2.85	8.25	9.29	3.15	10.08	3.75	4.63	4.14
14	0.00	0.00	0.00	0.00	3.01	10.18	8.54	4.86	8.96	3.75	4.66	4.11
15	0.00	0.00	0.00	0.00	3.01	10.92	8.00	3.52	8.75	3.76	4.68	4.06
16	0.00	0.00	0.00	0.00	2.73	9.96	6.84	3.10	8.13	3.73	4.68	4.03
17	0.00	0.00	0.00	0.00	3.52	9.23	7.51	3.94	7.68	3.71	4.71	4.00
18	0.00	0.00	0.00	0.00	4.20	9.73	8.96	3.25	7.23	3.74	4.77	3.96
19	0.00	0.00	0.00	0.00	4.08	10.02	17.00	2.84	6.83	3.75	4.95	3.92
20	0.00	0.00	0.00	0.00	5.32	9.41	17.55	2.59	6.49	3.76	4.97	3.87
21	0.00	0.00	0.00	0.00	4.45	7.91	15.09	2.32	6.36	3.86	4.97	3.81
22	0.00	0.00	0.00	0.00	3.92	7.21	13.21	2.15	5.94	3.89	4.96	3.76
23	0.00	0.00	0.00	0.00	3.74	7.32	12.17	2.43	5.53	3.95	4.94	3.72
24	0.00	0.00	0.00	0.00	4.16	6.92	11.24	6.53	5.49	4.00	4.95	3.64
25	0.00	0.00	0.00	0.00	5.11	6.22	10.05	5.13	5.39	4.01	4.93	3.60
26	0.00	0.00	0.00	0.00	6.22	7.23	9.06	4.36	5.27	4.00	4.89	3.56
27	0.00	0.00	0.00	0.00	7.05	8.10	7.99	3.86	4.99	4.02	4.89	3.52
28	0.00	0.00	0.00	0.01	7.09	8.44	6.97	3.49	4.53	4.02	4.91	3.48
29	0.00	0.00	0.00	0.29	6.99	8.98	6.13	3.31	4.47	4.22	4.87	3.46
30	0.00		0.00	0.66	7.29	8.09	6.03	7.24	4.31	4.28	4.81	3.42
31	0.00		0.00		7.53		5.90	13.70		4.30		3.37
Mean	0.00	0.00	0.00	0.03	3.95	8.96	10.70	4.17	7.94	3.93	4.72	4.07

Table 9. Historical Monthly and Annual Mean Discharges (L/s) for Fulton Creek (TL-7)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1980	3.7	3.7	3.6	6.1	5.4	3.8	3.5	3.5	3.5	4.1	3.7	3.5	4.0
1981	3.5	3.5	3.5	4.4	12.4	4.6	4.7	5.0	5.1	4.9	5.2	4.9	5.1
1982	4.3	4.2	4.5	5.1	20.1	15.1	8.0	4.8	3.5	3.9	3.8	4.1	6.8
1983	4.5	4.1	3.7	6.4	27.9	20.0	13.2	10.1	7.0	6.1	5.5	5.1	9.5
1984	4.9	5.0	5.5	13.5	16.8	26.7	29.7	19.5	12.6	20.3	29.7	26.7	17.6
1985	15.6	11.7	10.1	12.7	145.2	59.8	19.0	10.0	7.2	5.8	4.4	4.3	25.5
1986	4.6	4.8	4.8	5.9	15.1	18.7	21.6	17.4	8.9	6.4	5.3	5.0	9.9
1987	5.0	5.5	6.0	5.9	82.8	24.9	10.1	0.4	0.1	0.0	3.2	3.3	12.3
1988	3.9	2.6	2.4	2.2	18.0	33.6	37.6	24.2	9.5	4.7	5.3	5.0	12.4
1989	4.5	4.5	3.8	4.0	98.9	64.6	11.3	4.2	2.6	2.8	3.8	4.3	17.4
1990	5.2	4.7	4.4	2.4	20.1	28.8	9.5	4.5	3.5	3.7	7.0	10.0	8.7
1991	7.4	5.9	5.5	14.4	99.3	94.2	29.9	12.5	12.4	13.9	15.2	12.5	26.9
1992	9.5	7.1	5.8	6.9	113.3	39.6	32.4	16.7	22.7	73.0	70.8	18.9	34.7
1993	8.9	6.0	4.7	5.0	33.9	17.5	10.9	41.3	21.0	9.3	11.9	12.6	15.3
1994	8.0	6.1	5.4	4.8	211.5	53.0	6.9	3.2	2.3	3.0	3.1	3.1	25.9
1995	2.6	2.4	2.3	3.0	82.2	67.2	68.7	62.1	40.7	17.1	11.7	9.7	30.8
1996	7.1	4.9	3.8	3.5	16.0	16.8	35.0	29.2	10.3	8.3	8.5	7.4	12.6
1997	6.3	5.3	4.2	4.3	20.7	38.5	53.0	89.6	237.3	189.7	74.0	21.8	62.1
1998	11.4	8.4	6.8	8.0	52.2	13.0	21.6	12.9	7.4	5.6	5.6	5.3	13.2
1999	4.3	4.0	4.1	3.8	15.7	21.4	13.0	5.8	5.4	4.0	3.8	4.2	7.5
2000	4.2	3.3	3.0	3.2	9.1	9.0	7.6	8.2	8.9	48.0	96.2	8.9	17.5
2001	6.7	5.6	5.3	6.2	81.7	44.3	9.3	11.0	4.1	1.6	14.9	11.2	16.8
2002	10.7	6.0	4.5	4.9	55.9	24.4	12.1	63.2	44.6	5.6	19.3	14.1	22.1
2003	8.3	6.8	5.3	4.6	110.5	113.2	51.8	29.6	24.7	24.7	13.0	10.4	33.6
2004	7.1	7.0	8.8	5.7	5.5	45.6	7.6	2.6	1.8	1.3	4.5	4.2	8.5
2005	3.5	4.1	3.7	5.0	48.1	43.8	18.4	13.9	14.4	14.7	26.3	19.6	18.0
2006	13.4	9.0	5.7	13.3	115.4	45.9	12.4	7.3	6.2	6.2	6.0	5.3	20.5
2007	5.2	4.5	4.1	5.1	36.4	21.2	5.2	1.7	3.0	18.7	38.0	22.6	13.8
2008	15.2	10.4	8.6	7.1	48.9	47.4	11.2	9.5	7.5	17.3	27.2	16.6	18.9
2009	2.9	2.2	1.5	2.1	27.7	20.4	42.2	14.6	6.9	6.1	6.1	5.5	11.5
2010	4.1	3.4	2.6	4.6	16.7	6.6	0.2	0.1	0.2	0.4	0.2	0.3	3.3
2011	0.2	0.0	0.0	0.0	0.3	0.2	0.3	0.4	0.3	0.2	0.0	0.0	0.2
2012	0.0	0.0	0.0	0.0	4.0	9.0	10.7	4.2	7.9	3.9	4.7	4.1	4.0
Mean	6.3	5.1	4.5	5.6	50.5	33.1	19.3	16.5	16.8	16.2	16.3	8.9	16.5

Figure 3:Fulton Creek (TL-7) Daily Average Discharge and Measured Discharge



4 SUMMARY

This assessment provides discharges and precipitation records for the monitoring period of January 1, 2011 to December 31, 2012 for AC-8 and TL-7. Precipitation records from Uranium City and Stony Rapids, SK and local knowledge indicate that the north has experienced below normal annual total precipitation in the past few years though local knowledge also indicate that snowfall through the winter of 2011/2012 was higher than normal. This observation is contrary to the climate data record but the climate record is a relatively incomplete dataset. Spring runoff waters from AC-8 were measured to be among the highest flows since 2005 and TL-7 appears to be recovering from a period of drought where storage areas in the system are likely recharging.

For future assessment purposes it may improve the accuracy of the stations to perform the following work items:

- Continue to improve the rating curve at AC-8; and,
- Updating of the Ace Creek to Fulton Creek relationship based on newly measured data.

5 CLOSURE

MCSL appreciates the opportunity to work with Cameco on this project. If there are any questions regarding this assessment please do not hesitate to contact the undersigned.

McElhanney Consulting Services Ltd.

Prepared By	Reviewed By
Original signed by:	Original signed by:
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APPENDIX C
GEOTECHNICAL INSPECTION REPORT

GEOTECHNICAL INSPECTION REPORT

TABLE OF CONTENTS

1.0 INTRODUCTION

In June 2012 Cameco along with representatives of the Canadian Nuclear Safety Commission (CNSC) and the Saskatchewan Ministry of Environment (SMOE) conducted an annual inspection of the cover at the Fookes tailings delta and the two outlet spillways at Fookes and Marie reservoirs.

Previously the geotechnical inspection was completed on a three-year schedule by a qualified engineer. Past inspections of these areas were conducted by SRK Consulting in September 1998, September 2001, June 2004, August 2007 and May 2010 (*SRK, 2010),* with all reports being submitted to the regulatory agencies.

Following the May 2010 inspection SRK Consulting recommended the frequency of formal inspections by a qualified engineer to be reduced from three years to five years. In addition SRK Consulting recommended that Cameco and/or the JRG conduct annual inspections of the area to ensure structures were behaving as expected. SRK Consulting and Cameco collaborated in the development of an inspection checklist and the checklist was reviewed and accepted by the CNSC and SMOE.

In 2011 Cameco initiated internal annual inspections of these areas using a criterion based checklist prepared by a qualified engineer. The 2012 inspection of the Fookes tailings delta and the outlet structures at Marie and Fookes reservoirs represent the second year of internal inspections.

With respect to the outlet spillway structures the specific elements evaluated during this inspection included the following:

- The condition of the spillway channel, with a view to confirming the grout-intruded rip-rap is still in place
- The condition of the rip-rap on either side of the spillway, with a view to confirming no erosion has occurred due to overtopping associated with an extreme flood event.

With respect to the Fookes delta, the specific elements that evaluated during this inspection included the following:

- The potential presence of new tailings boils or tailings exposures due to frost action, etc.
- Significant erosion of the cover, including the diversion ditches in the northern part of the cover and the cover limit along its contact with Fookes Reservoir
- The condition of the water bars along the access road at the northwest corner of the site, as well as the two associated diversion ditches and the tailings cover immediately adjacent to this access road.

This report summarizes the observations and recommendations made during the June 5, 2012 inspection of these areas.

2.0 OUTLET STRUCTURE INSPECTIONS (FOOKES & MARIE RESERVOIR)

Both spillway structures consist of a rip-rap lined open channel (with trapezoidal cross-section) discharging into a rip-rap lined stilling basin. The rip-rap lining in both the spillway channels and the stilling basins was intruded with grout for added erosion protection; however the rip-rap in the spillway was designed to be stable in the absence of grout intrusion. The spillways are capable of passing a 500-year flood event with a depth of 0.3 m (680 L/sec) and 0.35 m (760 L/sec) at the entrances of the Fookes and Marie reservoir outlet spillways, respectively. In the event of embankment overtopping, the coarse rip-rap will resist erosion of the upper surfaces and downslope embankments.

It should be noted that cracking and displacement of the grout-intruded rip-rap was anticipated in the original design and does not affect the performance of the outlet spillway. The grout that was intruded into the rip-rap is meant to serve purely as a binding agent to increase the effective block size of the rip-rap, allowing it to more effectively resist erosion. It has been acknowledged by SRK that additional cracking and grout degradation will occur with time. (*SRK 2010*)

2.1 General Observations

During the 2011 inspection it was noted that water was not flowing in the Fookes or Marie outlet structures and significant recharge had to occur before flow would begin. Flow measurements and observations through the summer of 2011 showed that water did not flow through these structures during the summer of 2011. Uranium City saw an increased snow pack, compared to previous years, through the winter if 2011/2012 which resulted in hydraulic recharge of the areas and flow through these outlet structures resumed.

2.2 Inspection Checklist

- Check the condition of the spillway channel, with a view to confirming the grout-intruded rip-rap is still in place.
- Check the condition of the rip-rap on either side of the spillway, with a view to confirming no erosion has occurred due to overtopping associated with an extreme flood event.
- Document conditions with photographs

2.3 Marie Reservoir Outlet Structure Checklist

2.3.1 Check the condition of the spillway channel, with a view to confirming the grout-intruded rip-rap is still in place

Photos 1 to 3, taken during the June 5, 2012 inspection, provide photographic record of the condition of the Marie Reservoir spillway channel.

Previously SRK Consulting identified that the grout-intruded rip-rap is relatively intact except near the spillway entrance where one large block and several smaller ones on the right side of the spillway (looking downstream from Marie Reservoir) continue to displace due to ice-jacking.

The photographic record supports the observations made by SRK Consulting and the spillway continues to perform as designed.

Photo 1 – Marie Reservoir Spillway looking upstream

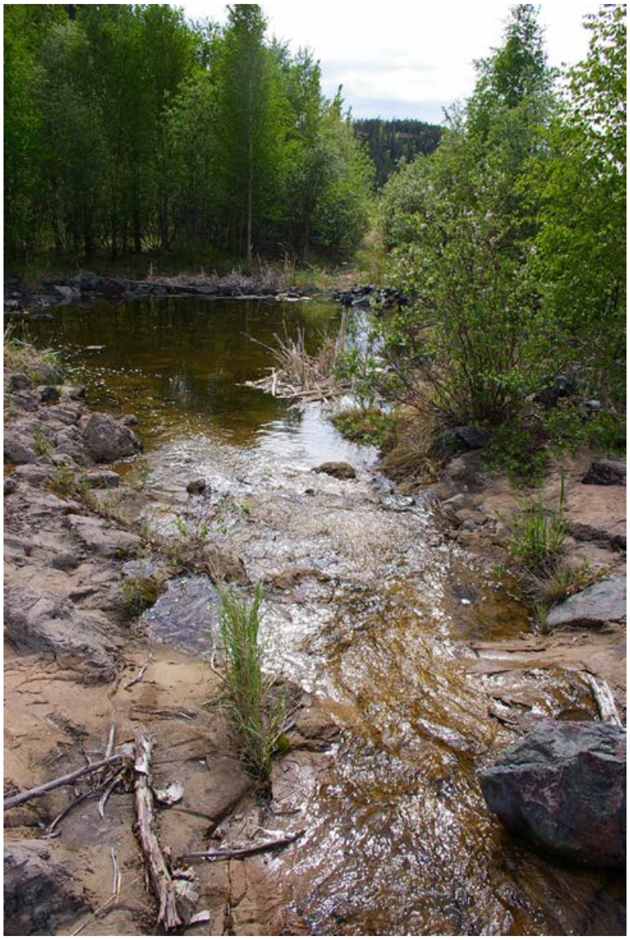

Photo 2 – Marie Reservoir Spillway (water flowing into stilling basin)

Photo 3 – Ice-jacked block on north side of Marie Spillway

2.3.2 Check the condition of the rip-rap on either side of the spillway, with a view to confirming no erosion has occurred due to overtopping associated with an extreme flood event

Given the extremely low water levels experienced in 2011 and the water levels observed during the June 5, 2012 inspection there was no evidence that overtopping of the rip-rap occurred since the June 2011 inspection.

2.4 Fookes Reservoir Outlet Structure Checklist

2.4.1 Check the condition of the spillway channel, with a view to confirming the grout-intruded rip-rap is still in place

Photos 4 and 5, taken during the June 5, 2012 inspection, provide photographic record of the condition of the Fookes Reservoir spillway channel.

Previously SRK Consulting identified that the grout-intruded rip-rap along the length of the Fookes Reservoir outlet spillway show signs of cracking. In addition, there has been some ice-jacking, with the most significant displacements located near the upper part of the spillway, i.e., on the sides of the spillway, within 5 to 6 m of the spillway entrance.

The photographic record shows there has been no change in the condition of the spillway from previous inspections and the spillway continues to perform as designed.

Photo 4 – Fookes Reservoir Spillway looking upstream

Photo 5 – Fookes Reservoir Spillway looking downstream towards the stilling basin

2.4.2 Check the condition of the rip-rap on either side of the spillway, with a view to confirming no erosion has occurred due to overtopping associated with an extreme flood event

Given the extremely low water levels experienced in 2011 and the water levels observed during the June 5, 2012 inspection there was no evidence that overtopping of the rip-rap occurred since the June 2011 inspection.

Of note, when photos taken during the 2011 inspection are compared to the 2012 inspection photos, the debris in the channel of the spillway is in exactly the same position, indicating this area has been subjected to very low flows since the previous inspection.

3.0 TAILINGS DELTA

3.1 General Observations

After a period of drought which saw water levels in Fookes Reservoir drop in 2011, water levels in returned to a normal level this spring following freshet. Generally the cover was in good condition showing no areas of excessive erosion. Past vehicular traffic was evident on the delta with access gained by driving over a three-foot berm on the east side of the delta. This berm will be repaired and reinforced to prevent traffic from accessing the delta. Although vegetation on the delta remains sparse over much of the area it is well established within 50 m of the Fookes Reservoir shoreline, and the engineered drainage structures. Photos 6 and 7 show the vegetation growth on the cover.

Photo 6 – Vegetation on the Fookes delta (looking NW)

Photo 7 – Vegetation on the Fookes delta (looking SW)

3.2 Inspection Checklist

- Check for evidence of new tailing boils or tailings exposure due to frost action
- Check for evidence of significant erosion of the cover material
    - Trench along the northeast edge of the delta (sand flows, erosion of waste rock, slumping, etc.) – maintain photographic and GPS record (identify areas of concern on map).
    - Cover limit along its contact with Fookes Reservoir – maintain photographic and GPS record (identify areas of concern on map) where sand from the delta cover extends into the reservoir.
- Ensure erosion-protection devices are performing as expected on former north access road
    - Waterbars (chevrons)
    - Diversion ditches
    - Erosion of cover adjacent to the former access road
- Ensure earthen berms are in place to limit access to the delta

3.2.1 Check for evidence of new tailing boils or tailings exposure due to frost action

No new tailings boils were noted on the cover.

3.2.2 Check for evidence of significant erosion of the cover material

In general the sand cover was in good condition and showed no signs of excessive erosion. As mentioned previously Fookes Reservoir water levels returned to normal in 2012. Photo 8 shows the shoreline where the water level meets the sand cover. A small amount of erosion of the sand cover can be seen due to wave action, which is to be expected. It is not anticipated that this small amount of erosion will affect the performance of the sand cover. As vegetation continues to encroach on the shoreline it will provide additional armoring and increase the stability of the cover.

Photo 8 – Fookes Reservoir shoreline

Small fractures in the sand cover noted during the 2011 inspection were not prevalent in 2012, supporting the theory that they were caused by a low regional water table, which has rebounded in 2012.

A drainage trench is located along the east side of the Fookes delta to channel surface water runoff during heavy precipitation events and spring freshet. It was noted in previous inspections that sand has flowed along the base of the drainage trench that has a rock-fill base. This sand flow is not expected to threaten the functionality of the ditch in the medium term. In the longer term, as vegetation continues to establish itself, the risk to ditch functionality will diminish further. There were no new sand flows identified in the drainage trench during the 2012 inspection. Photo 9 shows the vegetation growth in and around the drainage trench.

Photo 9 – Vegetation growth near drainage trench on the Fookes delta

3.2.3 Ensure erosion protection devices are performing as expected on former north access road

As part of the design and installation of the covers in 2005 and 2007, the area considered most vulnerable to erosion was in the area on and below the access ramp at the northwest corner of the tailings delta (*SRK 2010*). The general condition of the ramp is very good. Access to this ramp is closed off by a windrow of material at the top of the ramp. The water bars (chevrons) are performing as expected and show little sign of erosion (Photo 10). In addition to the chevrons, run-out structures were installed to carry away excessive water during extreme run-off events. These run-out structures are also in good shape and have seen no additional eroded material beyond that observed during previous inspections (Photo 11).

Photo 10 – Chevrons in place on north access point to the Fookes delta

Photo 11 – Run-out structure along north access road

3.2.4 Ensure earthen berms are in place to limit access to the delta

During the 2011 inspection it was noted that vehicles were accessing the Fookes delta via the west access road from Marie Reservoir. Following the 2011 inspection an additional earthen berm was placed on the west access road to prevent vehicles from entering the Fookes delta area. This berm was inspected during the 2012 inspection and found to be in good condition with no evidence that vehicles are by-passing the berm.

At the north access point the potential exists for truck to by-pass the earthen berm; however the road access is filled with chevrons, as discussed previously, making access at this point difficult. There was no evidence of fresh vehicle tracks in this area.

During the 2012 inspection it was discovered that the east access berm had been compromised and vehicles had gained access to the delta from this point (photo 12). Although vehicles had accessed the delta they did not appear to have compromised the integrity of the sand cover.

Photo 12 – East berm showing tire tracks driving over control point

Following the inspection Cameco hired a local contractor to place repair and improve the berm along the east access point to prevent further access. This work will be completed in prior to September 15, 2012 and will be inspected during the 2013 annual JRG inspection.

4.0 REFERENCES

SRK Consulting (2010). Beaverlodge Project: Inspection of Fookes Delta and Outlet Structures at Fookes Reservoir and Marie Reservoir. Report prepared for Cameco Corporation, September, 2010.