Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 21-H6.3

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Oral Presentation

Written submission from the Métis Nation-Saskatchewan

In the Matter of the

Orano Canada Inc.,
McClean Lake Operation

Application for licence amendment for the expansion of the JEB Tailings Management Facility (TMF) at the McClean Lake Operation

Commission Public Hearing

October 4, 2021

Exposé oral

Mémoire de la Métis Nation-Saskatchewan

À l'égard de

Orano Canada Inc.,
Établissement minier de McClean Lake

Demande de modification de permis pour l'agrandissement de l'installation de gestion des résidus (IGR) JEB à l'établissement de McClean Lake

Audience publique de la Commission

4 octobre 2021

Canada

August 10, 2021

Canadian Nuclear Safety Commission
280 Slater Street, P.O. Box 1046, Station B
Ottawa, ON K1P 5S9

To the Canadian Nuclear Safety Commission,

Re: Orano McClean Lake TMF Licence Amendment Application: Written Intervention from the Métis Nation of Saskatchewan (CMD: CMD 21-H6.1)

To begin, we would like to acknowledge that the land on which our people live and work, and on which these proceedings for the licence amendment are taking place, is the traditional and current territory and Homeland of the Métis (the "Homeland").

The Métis emerged as a distinct Indigenous people and nation in the historic Canadian Northwest during the 18th and 19th centuries. Saskatchewan is a part of the "historic Métis homeland," which includes the three prairie provinces, Ontario, British Columbia, the Northwest Territories, and the northern United States. The Canadian government attempted to extinguish the historic Métis Nation through the issuance of "scrip" and land grants in the late 19th and 20th centuries. The Métis in Saskatchewan began organizing to address issues of Métis land rights and scrip in the 1930s and continued to grow and advocate for recognition as one of Canada's Aboriginal peoples. Now, nearly 150 years after the first issuance of scrip, the Métis in Saskatchewan have a recognized government (the Métis Nation – Saskatchewan, or "**MN-S**") that represents the political, socioeconomic, cultural, and educational interests of the provinces' 80,000+ Métis citizens through a representative system based on 12 Regions and approximately 130 Locals. The MN-S established a Constitution in 1993 and since then has worked towards implementing Métis self-government efforts. In 2018 Canada agreed, through the Framework Agreement for Advancing Reconciliation, to work with MN-S to address Métis land claims within Saskatchewan, including specifically the Northwest Métis Land Claim (the "**Northwest Land Claim**").[1] In 2019 Canada and MN-S signed the *Métis Government Recognition and Self-Government Agreement between Métis Nation – Saskatchewan and Canada* recognizing that MN-S

[1] https://metisnationsk.com/wp-content/uploads/2019/03/Framework-Agreement-for-Advancing-Reconciliation- 2018.07.pdf

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represents the Métis of Saskatchewan and that the Métis of Saskatchewan have an inherent right of self-government that isprotected by Section 25 and Section 35 of the *Constitution Act, 1982*.[2]

development of the uranium mining industry within the Métis Homeland, beginning in the 1940s, has occurred with little input, consideration, or participation of the Métis communities that have been impacted and which will continue to live with the effects of uranium mining and its long-term legacy.

As already introduced, MN-S is advancing the Northwest Land Claim and has an interest in preserving and protecting these lands and their resources for the use and benefit of future generations. Métis are known in history for their role in trade, barter, and the economic development of their communities. Métis are not against development where it is done in a manner consistent with their asserted rights, including under the Northwest Land Claim, and where such development respects Métis rights-based community, cultural, and economic activities.

In the preparation of this submission, the MN-S wants to draw to the attention of the CNSC to the principles by which it conducted its review and developed recommendations. These are summarized next. The MN-S has also summarized its recommendations at the end of this letter.

Review Principles

1. United Nations Declaration on the Rights of Indigenous Peoples (“Declaration”)

The Government of Canada in 2016 endorsed the Declaration with a commitment to its implementation. In December 2020, the Government of Canada introduced Bill C-15. On June 21, 2021, Bill C-15, the United Nations Declaration on the Rights of Indigenous Peoples Act received Royal Assent. MN-S is interested in the importance of understanding free, prior and informed consent (FPIC), and will express its interest in meaningful and effective participation in decision-making, including with respect to development, remediation, and storage of hazardous materials within the Homeland.

2. Reconciliation

In 2015, the Truth and Reconciliation Commission of Canada issued its 94 Calls to Action among which were recommendations for reconciliation in the mining industry. Specifically, the

[2] https://metisnationsk.com/wp-content/uploads/2019/06/M%C3%A9tis-Government-Recognition-and-Self- Government-Agreement-.pdf

MN-S looked at opportunities to promote reconciliation during this license amendment.

3. Métis as s.35 Rights Holders

Métis people are recognized as protected "Aboriginal peoples" under s.35 Constitution Act, 1982, and assert Aboriginal rights protected thereunder, including inter alia rights to harvest and gathering animals, plants, and materials for personal, social, ceremonial and trade purposes, rights to self- government, and rights to land (i.e., Aboriginal title).

Ongoing development of the Homeland increases the likelihood that when the Northwest Land Claim is eventually resolved, the Métis may find their lands and resources changed and denuded.[3] The Supreme Court of Canada has noted that "Governments and individuals proposing to use or exploit land, whether before or after a declaration of Aboriginal title, can avoid a charge of infringement or failure to adequately consult by obtaining the consent of the interested Aboriginal group."[4]

MN-S is also concerned that both historically and currently, Métis Aboriginal rights are often treated with lower priority as compared with the Aboriginal rights of First Nations, which is not defensible under Canadian law.

The review includes consideration of Métis rights and title.

4. Consultation and Engagement

The MN-S considered how it was consulted and engaged during the request for amendment process, and over the life of the Project to date. The MN-S is concerned with the extent to which Orano kept the MN-S informed about the McClean Lake Project and the TMF expansion. The MN-S reviewed the engagement efforts for adequacy and needs going forward.

Recommendation Summary

The following is a summary of the recommendations divided into the three themes. Each recommendation is numbered and proceeded by the rational for the reccommendation. They are all forward looking towards closure and decommissioning and establishing an ongoing relationship with the MN-S. The MN-S also suggests the need for support as might be required.

[3] Haida Nation v. British Columbia (Minister of Forests), 2004 SCC 73 at para 33.
[4] Tsilhqot'in Nation v. British Columbia, 2014 SCC 44 at para 97.

TMF Facility Integrity

This project does increase the risk of contamination to the surrounding area that is important to MN-S communities. In addition, this project aims to rely on passive techniques after decommissioning which may have additional risks that require quantification, mitigation and/or management. Therefore, long-term monitoring will be necessary to understand the effectiveness of passive techniques, mitigation, and management. It is noted that under the correct permitting and monitoring measures, the risk is consistent with expectations.

1. That Orano include MN-S in regular monitoring and reporting and organizes regular site visits by MN-S technical experts, Métis Citizens and Duty to Consult staff. This will allow MN-S to become familiar with the site and operations in preparation for eventual closure planning and decommissioning.

2. That Orano organizes regular briefings on the McClean Lake operations as it can be anticipated that the current TMF will need to be decommissioned and a new location will need to be identified. MN-S will want sufficient time to considered alternatives and options.

Given that, during operation, the infrastructure associated with maintaining the “hydraulic trap” (i.e., dewatering pumps, dewatering tunnel and raise, et cetera) is critical to contain contaminants, it is importance to have full confidence in the dewatering infrastructure.

3. That Orano ensures that there are robust inspection and maintenance protocols in place along with spare and/or redundant equipment in place in the event of a system or equipment failure, and that MN-S is kept informed and involved.

4. That Orano develop contingency plans in the event of a catastrophic failure of the TMF dewatering system (e.g., collapse of the dewatering tunnel), and that MN-S is kept informed and involved.

Human Health

Overall, the review completed for MN-S identified areas where more and better information sharing could be done, which would keep MN-S better informed of future plans including decommissioning and decommissioning success.

5. That Orano supports MN-S with a position for Human and Environmental Health in order to keep MN-S informed of uranium risks especially at closure.

The human health risk assessment modelling reviewed did not take into consideration Métis-specific land usages or traditional food consumption patterns, which may influence the outcomes of those results in the human receptor analyses and future decommissioning.

6. That Orano support MN-S with a Métis-specific Land Use Study inclusive of traditional food consumption patterns for purposes of closure planning.

The Project will result in the expanded TMF's berm to be 10 m from the high-water level of Fox Lake, which was assessed to pose no inappropriate risk to that water body. However, modelling available for review does not show if 10 m is sufficient if there are changes in water levels due to climate change and flood events. MN-S would like to have this confirmed to ensure that Fox Lake is not contaminated in the future.

7. That Orano provide confirmation that the 10 m buffer is sufficient and has been modelled for changes in water levels, and provide that information to MN-S.

MN-S understands that the protected leeching of COPC from the tailings will be for more than 10,000 years post-decommissioning with expectations of no significant risk to human health. This contamination legacy will be faced by the future generations of the local MN-S communities.

8. That Orano involves MN-S in decision-making processes where there is a level of uncertainty such as COPC, tailings integrity and passive closure planning, and selenium contamination.

MN-S understands that selenium released into the surrounding waterways has been raised as a concern several times. Independent environmental monitoring is now outdated, may not capture key Métis-specific food items, and does not include recent scientific advancements in the understanding of selenium speciation and the risks of bioaccumulation.

9. That Orano supports a food consumption study to look at the effects of selenium on Métis Citizens, and that fish concentrations be monitored, and cumulative exposure assessments be completed to ensure excessive selenium intake is not occurring.

10. That Orano, in the interim, improve selenium removal as part of Orano's Selenium Adaptive Treatment.

Engagement

The McClean Lake TMF application does have long-term implication on MN-S interests, and to date, Orano has had limited engagement and involvement of Métis Citizens and the MN-S. MN-S would like to have improved engagement, including access to all decision-making processes with respect to McClean Lake operations and TMF expansion, monitoring, decommissioning, and closure, through improved engagement, support, and knowledge exchange.

11. That Orano negotiates and/or arranges for an engagement agreement with the MN-S which will cover relationship matters for the remaining life of mine. The MN-S should include in the engagement agreement not only meeting dates but specific topics of discussion including training, employment, procurement, planning for closure and socio-economic closure needs, monitoring, Métis Knowledge studies and documentation, and other remaining life of mine subjects of interest.

In closing, the MN-S finds that Orano has proposed an amendment to the TMF that is well-designed, but not without risks. MN-S is looking into the future when it is facing the closure legacy of the Project and would like an involvement going forward to protect its long-term interests.

Sincerely,

Mark Calette

Senior Director Lands and Consultation Métis Nation – Saskatchewan

Attach.

1. Orano McClean Lake TMF Licence Amendment Application Review

2. Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF)

3. Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project

TWO WORLDS
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Orano McClean Lake TMF Licence Amendment Application Review

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August 10, 2021

Orano McClean Lake TMF Licence Amendment Application Review Prepared by Two Worlds Consulting

TWC has undertaken a review of the Orano McClean Lake TMF Licence Amendment Application. It is understood that Orano is seeking an amendment to their licence to authorize an increase in their JEB Tailings Management Facility (TMF), "Project". With the increased capacity the final elevation of the consolidated tailings will be approximately 452 meters above sea level (mASL) instead of the current 448 mASL. The final covered facility will have an elevation of 468 mASL. Orano previously submitted a project description and amendment request in 2011, then proceeded through technical review.

In 2014, forecasts for tailings production were reduced and therefore Orano considered alternatives. The selected alternative was embankment construction to allow an increase of capacity to 457.5 mASL. A notification for the embankment project was submitted to the CNSC and was subsequently accepted in 2017. The Saskatchewan Ministry of the Environment (SMOE) approved the request to construct the embankment project in 2019. Construction for the embankment was planned for spring or summer 2021.

In response to tailings from Cigar Lake requiring more capacity than anticipated and plans to accommodate future mining operations, Orano submitted a request in 2019 to conduct the expansion previously submitted in 2011. The expansion will extend the TMF beyond 2027. Based on the forecasted volumes, the TMF expansion will last until approximately 2034.

It is understood that Métis members and communities will be living with the legacy of this mine during operation and in the post-decommissioning period. The evaluation of the Project is organized into three topic areas: TMF facility integrity, human health, and engagement. Separate technical reviews were provided by experts on the facility integrity and human health (see attached reports)[1]. Orano's engagement records were reviewed to understand the consultation with MN-S. The documents reviewed for each topic are listed below. TWC based its review and recommendations on the following MN-S principles:

- United Nations Declaration on the Rights of Indigenous Peoples ("Declaration")
- United Nations Declaration on the Rights of Indigenous Peoples Act ("UNDRIPA Act")
- Reconciliation
- Métis as s.35 Rights Holders
- Consultation and Engagement

[1] Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF) and Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.

Documents Reviewed

The following documents were considered in the preparation of this review.

TMF Facility Integrity Review

- McClean Lake Operations – Tailings Management Technical Information Document (TID), Version 03, Revision 00, cover letter dated May 25, 2020, including:
    - Chapters 1 through 9
    - Appendix A Detailed Facility Design and Description (May 2020)
    - Appendix B Reports on TMF Development
        - Section A – Overburden Stability Analysis – JEB Open Pit Mine (November 29, 1997)
        - Section B – JEB TMF Structural Mapping (November 1997 Version 1997.1)
        - Section C – Rock Stability Analysis – JEB Open Pit (November 29, 1997)
        - Section D – Construction Reports TMF Optimization Stage 1
        - Section E – Tailings Deposition Method A
    - Appendix C – Historical Geochemical Tailings Data
    - Appendix D – TOVP Studies and Supporting Data
    - Appendix E – Published Papers
    - Appendix F – TOVP Reports

Human Health Review

- 2021 Environmental Protection Review Report: License Amendment for the JEB TMF Expansion, CNSC
- 2019 Project Description, JEB TMF Expansion
- 2016 Technical Information Document Environmental Performance, volume 2 of 2, Version 3, Section 6 Human Health Risk Assessment
- 2011 AREVA, JEB TMF Expansion Project Description

Engagement Review

- The June 16th, 2021 Commission Hearing Document – Application for licence amendment for the expansion of the JEB Tailings Management Facility (TMF) at the McClean Lake Operation
- Appendix I Engagement, September 2019 Aboriginal and Public Involvement: Report on Engagement Activities Phase 1 and Phase 2, Version 2: June 2012, JEB TMF Expansion Project
- Orano presentation to MN-S – 20210708TMF Expansion_mns

1. TMF Facility Integrity

The details from the technical review of proposed expansion are available in the attached technical document.[2] The implications and summary sections are included below. Following the summary of the review of the facilities integrity, TWC has prepared recommendations based on the material from this review.

Technical Review – Implications of proposed JEB TMF Expansion[3]

The next (and presumably final) iteration of the JEB TMF expansion would further raise the perimeter containment and low permeability liner to allow tailings deposition to a maximum elevation of 468 mASL which would consolidate to elevation 462 mASL in the capped closure configuration.

Further expansion (i.e., raising of the perimeter containment) is limited due to the proximity of the downstream toe of the proposed perimeter containment dam to Fox Lake. The key element of the proposed JEB TMF expansion is the increased height of perimeter containment dams (and associated low permeability liner) to enable the placement of additional tailings within the JEB TMF.

The basic operating protocols are largely unchanged from the current tailings deposition strategy; however, the proposed expansion does result in additional (albeit manageable) risks to the environment. Some of the more readily identifiable risks associated with raising the JEB TMF perimeter dams and tailings ponds elevation include:

- Dam failure. Increased perimeter dam height will result in increased geotechnical risk associated with any failure of the dams. There is no indication that raising the dams presents any particular geotechnical challenge and, while detailed plans of the proposed dam construction have not been reviewed, it is reasonable to assume that it is possible to construct perimeter containment with a suitably high factor of safety.
- Groundwater mounding and advective flux. Greater thickness of deposited tailings will result in increased localized mounding of groundwater at closure and an associated increase in advective flux through the tailings (a contaminant transport mechanism that

[2] Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF)
[3] pg. 9, Section 3.3, Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF)

was essentially absent in the original JEB TMF design with consolidated tailings deposition to maximum elevation 434 mASL).

- Closure cover reliability. Greater potential for advective flux translates to a greater reliance on the Closure Cover to mitigate infiltration and the associated potential for contaminant migration from the JEB TMF once the dewatering system is turned off.
- Longer term active dewatering. Longer deposition/operational period will result in deferred closure and a longer timeframe during which the control of contaminant flux from the JEB TMF will rely on active dewatering of the JEB TMF under drain.

If the JEB TMF is operated as designed, the risks highlighted above can be quantified, mitigated and/or managed. Of note, success of the current and future JEB TMF operations relies significantly on the ability to maintain an inward hydraulic gradient (or "hydraulic trap") throughout the entire tailings deposition period and well into closure / post-closure until such time as the contaminant containment strategy effectively transitions to reliance on the pervious surround design.

Technical Review – Summary[4]
The JEB TMF design has been demonstrated to be robust and flexible – performing essentially as designed and as predicted by advanced numerical modelling. From initial start-up in 1999 to the present, the performance of the tailings preparation process (TPP) has consistently demonstrated compliance with applicable Action Levels for tailings pore water quality at the point of discharge from the mill and performance of the deposited tailings in the JEB TMF has been consistent with design and modelling prediction.

The approximately 20 years of operating experience, detailed modelling, and calibration of models with monitoring results provides confidence that the JEB TMF expansion is both technically feasible and expected to perform as predicted and operate in a manner that is protective of the environment.

As outlined in above section (i.e., *Technical Review – Implications of proposed JEB TMF Expansion*[5]), the proposed JEB TMF expansion[6] will result in some additional risk relative to the currently approved JEB TMF configuration; however, these risks are consistent with the currently accepted/permitted project risks and any increased risk is incremental in nature.

Recommendations:
Based on the information provided in the technical review of the TMF facility integrity, the following recommendations are made below.

1. This project does increase the risk of contamination to the surrounding area that is important to MN-S communities. In addition, this project aims to rely on passive techniques after decommissioning which may have additional risks that require

[4] pg. 10, Section 4.0, Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF).
[5] pg. 9, Section 3.3, Memorandum – Technical Review of Proposed Expansion of Orano's JEB Tailings Management Facility (TMF).
[6] In Orano's Licence amendment application.

quantification, mitigation and/or management. Therefore, long-term monitoring will be necessary to understand the effectiveness of passive techniques, mitigation, and management. It is noted that under the correct permitting and monitoring measures, the risk is consistent with expectations.

a. Recommendation: That Orano includes MN-S in regular monitoring and reporting and organizes regular site visits by MN-S technical experts, Métis Citizens and Duty to Consult staff. This will allow MN-S to become familiar with the site and operations in preparation for eventual closure planning and decommissioning.
    i. Target date: Arrange for a monitoring agreement between Orano and MN-S by six months after the licence conditions have been issued. Monitoring agreement should include financial support.

b. Recommendation: That Orano organizes regular briefings on the McClean Lake operations as it can be anticipated that the current TMF will need to be decommissioned and a new location will need to be identified. MN-S will want sufficient time to considered alternatives and options.

    i. Target date: Arrange for an engagement agreement between Orano and MN-S by six months after the licence conditions have been issued so that MN-S and Métis Citizens can stay informed of activities and operations.

2. Given that, during operation, the infrastructure associated with maintaining the "hydraulic trap" (i.e., dewatering pumps, dewatering tunnel and raise, et cetera) is critical to contain contaminants, it is importance to have full confidence in the dewatering infrastructure.

a. Recommendation: Ensure that there are robust inspection and maintenance protocols in place along with spare and/or redundant equipment in place in the event of a system or equipment failure, and that MN-S is kept informed and involved.
    i. Target date: Provide information on inspection and maintenance protocols and spare and/or redundant equipment within six months of hearing date.

b. Recommendation: Develop understanding of what contingency plans are in place in the event of a catastrophic failure of the TMF dewatering system (e.g., collapse of the dewatering tunnel), and that MN-S is kept informed and involved.
    i. Target date: Provide information on contingency plans within six months of hearing date.

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2. Human Health Review

The details from the human health review are available in the attached technical document.[7] This section includes information from the executive summary, the conclusion of the report, the selenium section, and recommendations from the report, as well as, TWC's reflections.

Synopsis from the Executive Summary[8]

Orano has followed all regulatory mechanisms for ensuring the safe operations of its TMF and is in good standing in terms of their past environmental and human health performance measures. Orano has participated with academic research to better understand how tailings interact with the environment[9], and they have an ongoing environmental monitoring system. The results of the research and monitoring are not easily accessed and prevented a more detailed review of health risks. The CNSC did compare Orano's monitoring program's results to an independent monitoring survey published in 2016 and found to be satisfactory. This independent monitoring initiative is now 5 years old, and new reports were not found.

The long-term modelling of the post-decommissioned tailings shows no substantial risk to the environment, with considerations of climate change and catastrophic events such as fire and flood. The decommissioned tailings will be contained using passive systems, limiting the requirements for long-term inputs. Orano and the CNSC acknowledge that long-term seepage is expected to occur from the decommissioned TMF into the surrounding water body(ies), but state that "CNSC staff are satisfied that the aquatic environment in Fox Lake and Pat Lake will remain protected".[10] Orano has projected, and the CNSC has acknowledged, that chemicals of potential concern (COPC) from the tailings will leech into surrounding ground water for more than 10,000 years post-decommissioning, albeit at no significant risk to human health.

Selenium[11]

Human health concerns for selenium were investigated due to concerns being previously raised for selenium contamination with respect to McClean Lake, several exceedances of the selenium concentration action level for McClean Lake effluent occurring in March 2020, and high background levels in the region leaving small margins for maintaining safe levels with additional input. Data from a 2016 Independent Environmental Monitoring program indicated that excessive selenium levels are present in fish species in and around the McClean Lake area.[12] The excessive amounts of selenium in McClean Lake fish contribute a larger percentage (i.e., 20-25% for one fish vs. 10-20% for one fish) to the recommended total daily intake (TDI).

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[7] Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.
[8] pg. 3, Section 1, Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.
[9] e.g., see: Jared Robertson, M. Jim Hendry, T. Kotzer & Kebbi A. Hughes (2019): Geochemistry of uranium mill tailings in the Athabasca Basin, Saskatchewan, Canada: A review, Critical Reviews in Environmental Science and Technology, https://doi.org/10.1080/10643389.2019.1571352.
[10] pg. 25, 2021 Environmental Protection Review Report: License Amendment for the JEB TMF Expansion, CNSC.
[11] pg. 16, Section 8, Selenium, Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.
[12] pg. 17, Section 8, Selenium, Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.

As other sources add to the cumulative exposure it is important to consider selenium for population that rely on fish.

Report Conclusion[13]
It appears that the necessary assessments and reviews to protect the health and safety of the local communities have been conducted, showing no significant health risk associated with the Project. Extensive modelling has been conducted to estimate risk thousands of years into the future which includes analysis that the decommissioned TMF will leech into the ground waters at an acceptable level of risk. However, given the limitations of the current best practices for uranium mine and TMF decommissioning, there is no way to determine this absolutely. The Project will ultimately result in an additional volume of 2.3 million m^3 of tails that will remain radioactive for thousands of years.

Recommendations:
Based on the human health review, the following recommendations are made.

1. Overall, the review identified areas where more and better information sharing could be done, which would keep MN-S better informed of future plans including decommissioning and decommissioning success.
    a. Recommendation: That a dedicated Human and Environmental Health person be appointed within the MN-S to track human health risks related to uranium operations.
    b. Recommendation: Seek support from Orano to support the Human and Environmental Health person in their duties to understand uranium risks especially at closure.
        i. Target date: Engagement agreement between Orano and the Human and Environmental Health person by six months after the licence conditions have been issued.
2. The human health risk assessment modelling did not take into consideration Métis-specific land usages or traditional food consumption patterns, which may influence the outcomes of those results in the human receptor analyses and future decommissioning.
    a. Recommendation: Conduct a Métis-specific Land Use Study inclusive of traditional food consumption patterns with support from Orano.
        i. Target date: Confirm study plans and funding by six months after the licence amendment hearing.
3. The Project will result in the expanded TMF's berm to be 10 m from the high-water level of Fox Lake, which was assessed to pose no inappropriate risk to that water body. However, modelling available for review does not show if 10 m is sufficient if there are changes in water levels due to climate change and flood events. MN-S should have this confirmed to ensure that Fox Lake is not contaminated in the future.
    a. Recommendation: Confirm that the 10 m buffer is sufficient and has been modelled for changes in water levels.

[13] pg. 21, Section 9, Human Health Technical Review – McClean Lake Tailing Management Facility Expansion Project.

        i. Target date: Complete assessment by six months after the licence amendment hearing.

4. The protected leeching of COPC from the tailings will be for more than 10,000 years post-decommissioning with expectations of no significant risk to human health. This contamination legacy will be faced by the future generations of the local communities.
    a. Recommendation: That Orano involves MN-S in decision-making processes where there is a level of uncertainty such as COPC, tailings integrity and passive closure planning, and selenium contamination.
        i. Target date: Agreement on engagement for MN-S future involvement in Orano operations.
5. Selenium released into the surrounding waterways has been raised as a concern several times. Independent environmental monitoring is now outdated, may not capture key Métis-specific food items, and does not include recent scientific advancements in the understanding of selenium speciation and the risks of bioaccumulation.
    a. Recommendation: That fish consumption in Métis Citizens be measured as part of monitoring for selenium levels, and that selenium levels in fish be monitored, and cumulative exposure assessments be completed to ensure excessive selenium intake is not occurring.
        i. Target date: Commence assessment by six months after the licence conditions have been issued.
    b. In the interim, recommend that improved selenium removal be undertaken as part of Orano's Selenium Adaptive Treatment.
        i. Target date: In service removal by six months after the licence amendment hearing.

3. Engagement Records Review

In reviewing engagement records, the focus was identifying points where Orano engaged Métis Citizens and MN-S since the beginning of the Project. TWC noted that Orano has a Collaborative Agreement with Kineepik (Pinehouse).

The historic engagement record for the TMF expansion starts in 2011 describes activity in Phase 1 (i.e., engagement before the submission of the Project Description), Phase 2 (i.e., engagement after the submission of the Project Description) and Phase 3 (Follow-up to previous engagement). Phases 1 and 2 have activity during 2011 – 2012. Phase 3 was active 2012 – 2015. Additional activity for the September update indicated that Phase 3 activity started again in 2018.[14]

The first engagement with MN-S is described in the engagement activities for the 2019 application and contact has been made in 2020 and 2021, as specified below.[15]

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[14] Appendix I Engagement, September 2019 Aboriginal and Public Involvement: Report on Engagement Activities Phase 1 and Phase 2, Version 2: June 2012, JEB TMF Expansion Project

[15] Orano presentation to MN-S – 20210708TMF Expansion_mns and Appendix C, Appendix I Engagement, September 2019 Aboriginal and Public Involvement: Report on Engagement Activities Phase 1 and Phase 2, Version 2: June 2012, JEB TMF Expansion Project Appendix I Engagement, September 2019 Aboriginal and Public Involvement: Report on Engagement Activities Phase 1 and Phase 2, Version 2: June 2012, JEB TMF Expansion Project

- July 2020 – Cover letter and fact sheet mailed to MN-S Northern Region 1
- July 2020 – Cover letter and fact sheet mailed to MN-S President
- February 2021 - Email about Participant Funding for the JEB TMF Expansion sent to MN-S Environmental Minister and Northern Region 1
- July 2021 – MN-S introductory meeting with Orano

Based on this review, engagement with MN-S did not occur during Phases 1 and 2. Within Phase 3, McClean Lake TMF engagements started in 2019 with the Athabasca Environment and Engagement Subcommittee and Environmental Quality Committee, but MN-S were not engaged until 2020 and 2021. The majority of engagement has been limited to 'information sharing' in the form of cover letters and fact sheets. After Orano shared information, MN-S initiated a dialogue to better understand the Project and start a relationship with Orano.

Overall, from Orano's records, limited or no special consideration is given to Métis engagement including that of involving MN-S until this expansion while Métis locals are captured in 3 of 4 municipalities.[16] In their licence amendment documents Orano lists engagement with three groups as follows:[17]

Principle Target Audience Group – Indigenous communities

- Black Lake Denesuline Nation
- Fond du Lac Denesuline Nation
- Hatchet Lake Denesuline Nation

Principle Target Audience Group – Municipalities

- Northern Settlement of Camsell Portage
- Northern Hamlet of Stony Rapids (identified as Métis Northern Region I community)
- Northern Settlement of Uranium City (identified as Métis Northern Region I community)
- Northern Settlement of Wollaston Lake (identified as Métis Northern Region I community).

Considered in evaluation and engagement activities – Indigenous groups or communities

- English River First Nation
- Birch Narrows Denesuline Nation
- Buffalo River Denesuline Nation
- Lac La Ronge Indian Band

[16] pg.2-1, Section 2, The June 16th, 2021 Commission Hearing Document – Application for licence amendment for the expansion of the JEB Tailings Management Facility (TMF) at the McClean Lake Operation.
[17] pg. 73, Section 4.2, The June 16th, 2021 Commission Hearing Document – Application for licence amendment for the expansion of the JEB Tailings Management Facility (TMF) at the McClean Lake Operation.

- Metis-Nation of Saskatchewan
- Ya'thi Néné Lands and Resource Office; and
- Athabasca Joint Engagement and Environment Sub-committee.

TWC notes that MN-S has not been considered in the Principle Target Audience Group and been included in limited engagement activity with Orano. Due to MN-S's limited engagement on this Project, there has likely been missed opportunities to discuss economic opportunities (e.g., procurement, employment, training) that would be mutually beneficial to Orano and MN-S. This reflection is not directly relatable to the existing application but will be relevant to consider going forward given MN-S's interest in project and activity legacy. Directing mining-related business to local Northern communities will assist with lessening the boom-bust scenario that follows all mine closures. Applying pro-active measures now could consider preparing local businesses for decommissioning, closure, and remediation to create readiness in the communities for this next step in the mine lifecycle.

TWC understands that MN-S has had discussions with NR-3 regarding this application and that within Pinehouse there is community desire to participate in mining operations including a desire for more business opportunities, training, and procurement sessions to improve the chances of getting contracts.

TWC did consider current levels of Métis involvement at site and was not able to identify any specific information. None were referenced in the current application either. However, Orano indicates that they identify "Priority Recruitment Communities" within the Athabasca Basin in accordance with the provincial government's requirements for the Human Resource Development Agreement.[18] It is not clear which communities are considered priority. Additionally, Orano is in partnership with Northern Career Quest, a provider of training and employment programs to residents in Northern Saskatchewan.[19] Development of recruitment and training within an engagement agreement with MN-S would support Orano to in directing benefits to Northern Communities and could be supported by programs (e.g., Northern Career Quest), already in existence.

Overall, TWC sees the need for more engagement between Orano and MN-S to facilitate opportunities going forward.

Recommendations:
Based on the review of Orano's records, recommendations are made below.

1. The McClean Lake TMF application does have long-term implication on MN-S interests, and to date, Orano has had limited engagement and involvement of Métis Citizens and the MN-S. MN-S should have improved engagement, including access to all decision-

[18] pg.2-1, Section 2, The June 16th, 2021 Commission Hearing Document – Application for licence amendment for the expansion of the JEB Tailings Management Facility (TMF) at the McClean Lake Operation.
[19] https://canada.orano.group/EN/canada-207/orano-canada-incsustainabilitynorthern-saskatchewan-presence.html

making processes with respect to McClean Lake operations and TMF expansion, monitoring, decommissioning, and closure, through improved engagement, support, and knowledge exchange.

a. Recommendation: Negotiate and/or arrange for an engagement agreement in relation to the McClean Lake project. The MN-S should include in the engagement agreement not only meeting dates but specific topics of discussion including training, employment, procurement, planning for closure and socio-economic closure needs, monitoring, Métis Knowledge studies and documentation, and other remaining life of mine subjects of interest.
    i. Target date: Agreement on an engagement plan to support of future Métis involvement by six months after the licence conditions have been issued.

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July 28, 2021

Memorandum

To:	Heidi Klein	**From:**	Jim Theriault. P.Eng.
	Human and Community Well-Being Lead		Managing Principal, Mining Environment
Company:	Two Worlds Consulting (TWC)		
cc:			
Subject:	TECHNICAL REVIEW OF PROPOSED EXPANSION OF ORANO'S JEB TAILINGS MANAGEMENT FACILITY (TMF)		

1.0 INTRODUCTION

The McClean Lake Mine Operation is proposing an amendment to its current Tailings Management Facility (TMF). The amendment will allow for expansion of the TMF and support the continuation of mining activities. The license amendment will result in potential new impacts and risks to MN-S communities in the Northern Region 1 ("NR1") of Métis territory from the increased length of mining operations and amount of waste that will be produced. TWC will be supporting MN-S in reviewing technical documents and participating in the public Commission hearings.

SLR has been retained by TWC to support their broader project evaluation by reviewing pertinent background technical documents (provided by TWC) related to the design, construction, and operation of original Tailings Management Facility (TMF)along with the proposed plans for expansion. The SLR review focused on providing technical comment regarding potential geotechnical and environmental concerns, risks and uncertainties associated with the proposed JEB TMF expansion.

1.1 DOCUMENTS PROVIDED FOR REVIEWED

The following documents were provided by TWC for review:

McClean Lake Operations – Tailings Management Technical Information Document (TID), Version 03, Revision 00, cover letter dated May 25, 2020, including:

- Chapters 1 through 9
- Appendix A Detailed Facility Design and Description (May 2020)
- Appendix B Reports on TMF Development

  - Section A – Overburden Stability Analysis – JEB Open Pit Mine (November 29, 1997)
  - Section B – JEB TMF Structural Mapping (November 1997 Version 1997.1)
  - Section C – Rock Stability Analysis – JEB Open Pit (November 29, 1997)
  - Section D – Construction Reports TMF Optimization Stage 1
  - Section E – Tailings Deposition Method A
- Appendix C – Historical Geochemical Tailings Data
- Appendix D – TOVP Studies and Supporting Data
- Appendix E – Published Papers
- Appendix F – TOVP Reports

Given the tight review timeline and significant amount of material available for review, efforts were initially focused on the main body of the TID, with appendices referenced sparingly to confirm assumption and provide additional clarification of key concepts.

2.0 BACKGROUND

The JEB Tailings Management Facility (TMF) serves as a repository for tailings resulting from uranium processing at the McClean Lake Operation.

Orano Canada Inc. (Orano) has continuously operated the Tailings Management Facility (TMF) at its McClean Lake Operation in northern Saskatchewan since 1999. Over this operational period, the TMF has received tailings from the processing of ore from five uranium deposits developed on the McClean Lake Operation Surface Lease: the JEB, Sue C, Sue A, Sue E and Sue B open pit mines, as well as minor amounts of tailings from the processing of ore from the SABRE project. Processing of ore from the Cigar Lake Mine started in October 2014 and is ongoing.

The open pit is unlined but under drained, relying on active dewatering from the base of the TMF to create an inward hydraulic gradient ("hydraulic trap") to mitigate contaminant migration during operation. At closure, the TMF will mitigate the migration of contaminants from the deposited tailings by relying on a passive pervious surround concept where the consolidated tailings are orders of magnitude less permeable than the surrounding sandstone bedrock, thereby virtually eliminating advective flow of groundwater through the tailings.

Under these conditions for the long term, the consolidated tailings mass represents a low permeability plug in the sandstone which groundwater will preferentially flow around, via the surrounding host rock. Advective flow of groundwater through the tailings will be very limited, and the small amount of flow can be predicted through appropriate groundwater flow models and established material properties.

The hydraulic trap and pervious surround concepts are described in greater detail in Section 3, below along with a brief summary of how the JEB TMF deposition plan has evolved to allow for increased tailings storage capacity from initial conception through the proposed JEB TMF expansion plans.

3.0 TAILINGS MANAGEMENT FACILITY DESIGN CONCEPT

Prior to subaqueous deposition in the JEB TMF, the tailings are thickened, neutralized and treated to control radium-226, arsenic, and nickel concentrations. Tailings are disposed within the TMF constructed in the mined-out JEB pit using a barge system. Figure 1 presents a basic schematic of the basic TMF configuration and associated key infrastructure.

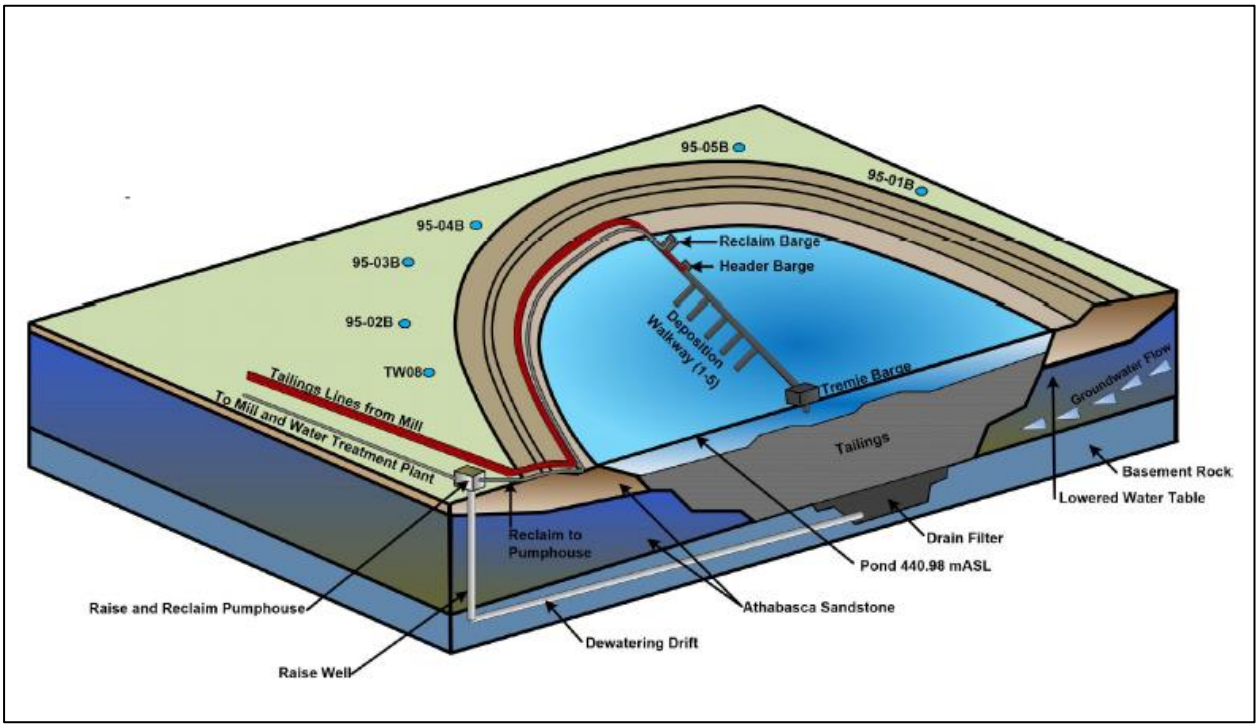


Figure 1: Block Diagram of Current JEB TMF Infrastructure Configuration (Adapted from Figure 2.3-9 Tailings Management TID)

The open pit has been modified to engineered to allow the deposited tailings to be dewatered from the base. A filter drain was constructed at the base of the pit and a horizontal drainage tunnel was connected to a vertical well that enables water from the base of the pit to be pumped back to surface for recirculation back to the mill or water treatment plant. Pumping from the base of the deposited tailings ensures hydraulic containment, by continually maintaining a hydraulic gradient in the groundwater towards the JEB TMF and enhances tailings consolidation throughout operations. In other words, seepage is inward during operations because of the hydraulic trap concept.

After decommissioning the TMF will rely on a natural pervious surround system, which will maintain hydraulic containment by creating sufficient hydraulic conductivity contrast between the tailings and the surrounding host rock is established as a passive method to minimize the release of contaminants from the decommissioned facility in the long term. The placement of a low permeability liner is required around the perimeter of the open pit once the tailings pond rises above the bedrock contact. The purpose of the liner is to limit seepage of TMF pond water into the overburden during the operating period.

The original JEB TMF deposition plan called for tailings to be placed to a maximum final elevation (i.e., closure configuration after tailings consolidation) of elevation 434 mASL following the placement of a cover during decommissioning.

The existing approved TMF configuration (referred to as the 2013 JEB Optimization Project) allows for tailings to be deposited to a maximum consolidated elevation of 448 mASL, which is above the top of the bedrock, thereby requiring the addition of a low permeability liner (bentonite amended sand) around the upper till zone.

Figure 2 presents a simplified cross-section of the JEB TMF illustrating the relationship of the currently approved tailings deposition and tailings pond relative to the boundary between bedrock and the overlying till overburden.

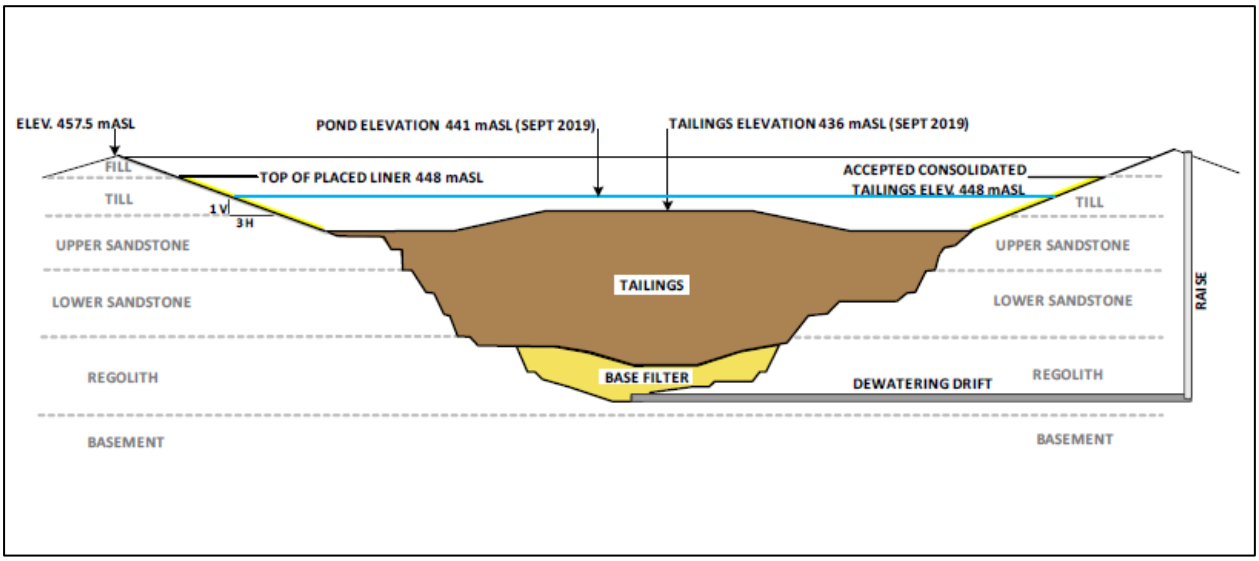


Figure 2: Approved Tailings Deposition Configuration from JEB Optimization (adapted from Figure 2.4-1 TID)

The proposed JEB TMF expansion would include the construction of an embankment to 468 mASL, which will allow for the top of consolidated tailings to be 462 mASL (at or below the natural high side of the TMF). The containment concept is similar to the existing JEB Optimization configuration; however, it will require the construction of additional perimeter containment as the topographic containment around the open pit is as low as approximately elevation 448 m. The maximum elevation of the new perimeter containment is set based on the decision to maintain a 10 m offset from the downstream toe of the berm to the shoreline of Fox Lake (see Figure 3).

For decommissioning, a contoured, water shedding, engineered cover will be placed over the tailings mass. A mass of waste rock will provide a surcharge on the tailings to promote consolidation prior to cover placement.

After decommissioning two passive techniques, geotechnical and geochemical, will control contaminant migration into the environment:

- Geotechnical Control: The low hydraulic conductivity of the consolidated tailings relative to the sandstone bedrock means the majority of groundwater will flow around the tailings acting passively to minimize the release of contaminants from the facility. Contaminant transport modelling assumes an average in-situ hydraulic conductivity of the consolidated tailings of $1x10^{-8}$ m/s (with sensitivity modelled as high as $1x10^{-7}$ m/s) while the hydraulic conductivity of the sandstone bedrock around the open pit is on the order of $1x10^{-5}$ m/s.
- Geochemical: The tailings are produced to reach a geochemically stable equilibrium over time. At equilibrium the major contaminants will be controlled through the precipitation of stable long-term mineral phases. Contaminants will be sparingly soluble in solution and therefore be transported only very slowly to the downstream environment.

The control of the vertical infiltration of meteoric water through the tailings at the time of decommissioning will be limited through cover design features. Landform design to divert runoff, the use of low-permeability materials, the establishment of a vegetative cover, compaction of surface materials, and the installation of drain layers all serve to reduce infiltration and limit advective transport. Net percolation through the cover is the primary contributor of advective flux, as advective flow of groundwater through the tailings is limited by TMF design (as described in Section 6.2.2.1 of the TID).

Operation of the under-drain system will need to be maintained to capture any expelled tailings porewater until such time that the tailings are adequately consolidated. Theoretically, at this point, the underdrain dewatering system could be turned off and the contaminant flux (i.e., contaminant in the tailings porewater) from JEB TMF would be passively mitigated since there would be negligible advective flux of tailings porewater since the tailings are significantly less pervious than the surrounding bedrock and groundwater would preferentially flow around the consolidated tailings.

Figure 3: Aeriel View of the Operating JEB TMF showing proximity Fox Lake in background at the top of photo (Adapted from Figure 2.3-11 of the 2020 TID)

Long-term solute concentrations within the tailings pore water are of importance as they represent the portion of constituents of potential concern available for transport from the tailings mass and into the

receiving environment. The tailings preparation process in the McClean Lake mill manufactures tailings such that the tailings geochemical characteristics provides for long term control of constituents of potential concern. Long-term control of soluble arsenic in the tailings has been the primary environmental concern and is discussed further, along with of contaminants of potential concern (COPCs) in Section .3.1.2.

3.1 CRITICAL DESIGN PARAMETERS AND MATERIAL PROPERTIES

Significant effort has been expended to advance the scientific understanding of the geochemical and geotechnical properties of the tailings, to identify controls on solute concentrations of constituents of concern, and to model their behaviour over the long-term.

3.1.1 Geotechnical Characterization of the Tailings Stream and Deposited Tailings

Most of the deposited tailings are from JEB/Sue deposit whereas more recent (since mill restart in 2014) and future tailings are from Cigar Lake, which are slightly finer and have slightly different properties. Consequently, the Cigar Lake tailings have been studies much less than previously deposited tailings and have experienced less time to consolidated.

The tailings geotechnical characterization work included a wide variety in laboratory testing including Atterberg limits, grain size distribution, specific gravity and bulk density, settling tests, seepage induced consolidation, large strain consolidation and creep tests. A 2018 round of in-situ hydraulic conductivity testing included 15 cone penetrometer (CPT) and an associated 98 pore pressure dissipation (PPD) tests.

The 2018 horizontal hydraulic conductivities of tailings were evaluated as a function of the depth and vertical effective stress. The horizontal hydraulic conductivity for the JEB/Sue tailings was measured to range from about 2x10-8 m/s to 1x10-7 m/s below 4 m depth. The horizontal hydraulic conductivity for the Cigar Lake tailings was measured to be 1x10-7 m/s to 1x10-5 m/s above 10 m depth.

Although there are some differences between the two types of tailings related to the particle size distribution, the observed variability in the hydraulic conductivity of the Cigar Lake tailings is presumed to be because of their more recent placement and consequently lower degree of consolidation, i.e., excess of pore water pressure was present at the Cigar Lake tailings at the time of the PPD tests. With increasing depth (i.e., JEB/Sue tailings), the horizontal hydraulic conductivity reduces reaching a consistent value of approximately $5x10^{-8}$ m/s.

Ongoing evaluation of the characteristics of deposited tailings suggests that the subaqueous deposition methods employed do not eliminated segregation of tailings during placement. Coarse tailings were encountered at and around deposition locations, which grade to fine tailings at the periphery of the tailings deposition point. This insight is important as it is imperative that the tailings around the perimeter of the TMF are suitably fine grained to ensure that there is sufficient contrast in hydraulic conductivity (i.e., at least 2 orders of magnitude) between the deposited/consolidated tailings and the more pervious sandstone bedrock.

It is noted that the particle size distribution of Cigar Lake tailings is generally finer grained than historical JEB/Sue tailings. Operational deposition constraints have ensured that fine tailings are deposited adjacent to the walls of the JEB TMF. Dredge sampling results from 2015 to 2019 indicate that the operational controls are effective and suggest that a minimum tailings deposition offset distance from the pit wall of 40 m be maintained to reduce the potential for coarser tailings to be deposited around the perimeter of the JEB TMF.

3.1.2 Geochemical Characterization of the Tailings (and Stabilization During Processing)

The movement of contaminants of potential concern (COPCs) from the TMF to the environment is also minimized by the chemical properties of the tailings and additional treatment during milling and processing. The preparation of tailings involves adjusting their chemistry in the mill such that COPCs (such as radium, uranium, nickel and arsenic) which may be dissolved in the liquid portion of the tailings chemically prefer to exist as stable solid mineral forms.

The geochemical stability of the tailings – both at time of deposition and over the long-term as the tailings age in situ after deposition - has been studied extensively and is thoroughly documented by routine monitoring, regular reporting and dozens of scholarly articles in peer reviewed technical journals.

Each individual mineral has its own natural balancing point, a set of chemical conditions above which it will tend to dissolve into the liquid and below which it will tend to stay as a solid. This threshold for dissolution (solubility limit) is studied and defined so that the concentrations of COPCs in the water within the tailings remains low and naturally controlled and the amount of each COPC expected to be present in the liquids can be predicted.

The principle contaminants of potential concern (COPC) in the tailings and tailings porewater are referred to as Group 2 COPs and include arsenic, molybdenum and uranium. These elements (along with a long list of additional potentially problematic elements) are tracked closely, subject to numerous operational controls, and research projects for validation and refinement.

Arsenic: Arsenic is found to be performing as predicted in both the JEB/Sue and Cigar Lake tailings. The amount of arsenic dissolved in the tailings liquids is compliant with regulatory requirements and the long- term concentration of arsenic is decreasing according to what is expected based on its tendency to exist as a solid. The levels of arsenic found in the tailings liquids do not pose a risk to the environment.

Uranium: Uranium is behaving as expected in both the JEB/Sue and Cigar Lake tailings. Processes in place in the mill control the uranium in the liquid portion of the tailings to a low level such that no risk is posed to the environment.

Molybdenum: The amount of molybdenum is understood to increase in the tailings liquids and then decrease again as a stable long-term mineral phase is formed. Both the JEB/Sue and Cigar Lake tailings pore water concentrations continue to evolve as predicted with the added observations that tailings at the bottom of the JEB TMF, which have been there the longest now, demonstrate consistently low values of molybdenum in the liquids portion.

In general, the chemical system used to make tailings is robust and well understood. The tailings produced are behaving in predictable ways which align with the research that has been conducted for both the JEB/Sue and Cigar Lake Tailings. The concentrations of key COPCs in the liquids are controlled and following trends which will achieve the goal of long-term stability. Work will continue to improve the understanding of arsenic, uranium, and molybdenum behavior in the tailings, focused on how the Cigar Lake tailings continue to change over time. New programs of research are now underway to also improve the understanding of how copper, lead, nickel, and selenium may change over time in the tailings.

3.1.3 Control of Hydraulic Gradient (Inward Gradient During Operation)

During operation it is imperative that an inward hydraulic gradient be maintained in the JEB TMF to prevent the migration of impacted tailings porewater from the TMF to the environment. It was noted that the inward

hydraulic gradient results from a relatively modest head difference between the JEB TMF and external groundwater level, typically on the order of 1.5 m difference in elevation.

Warning levels are set to inform operators if this inward gradient falls below 0.5 m of head difference; however, it is recognized that even under typical operating conditions, with the under drain and pumping system fully functional, the gradient could be quickly (and temporarily) reversed by a rapid rise in TMF pond level such as would be generated by a probably maximum precipitation (PMP) event.

The consequences of a temporary reversal of the hydraulic gradient are considered minimal as any tailings water that would migrate out of the TMF under an outward hydraulic gradient would be pulled back in once the inward hydraulic gradient is restored.

While the risks associated with a short-term reversal of hydraulic gradient (i.e., flow of tailings porewater moving out of the JEB TMF) are considered negligible. However, the ease and rapidity with which the hydraulic gradient can be reversed highlights the critical important of maintaining dewatering and underdrainage of the JEB TMF to mitigate the risk of impacted tailings porewater from migrating to the environment. It is further noted that the risks associated with the losing hydraulic containment (i.e., the "hydraulic trap") is increasingly magnified the higher the water level in the JEB TMF is raised above the surrounded groundwater level in the pervious sandstone bedrock around the TMF.

3.2 JEB TMF OPERATIONAL PERFORMANCE TO DATE

Over the operation of the TMF, the operational effects of this facility have been found to be minimal and within regulatory guidelines as described in the Environmental Performance TID (AREVA, 2016a). Efforts of continual improvement are ongoing to evaluate new methods of mitigating environmental impacts, as shown by changes recently made to water management using the TMF to eliminate surges to the water treatment plant. The entire tailings system is carefully monitored and inspected for upset conditions, accidents, and malfunctions and, as such, neither loss of hydraulic containment nor major reportable spills have occurred.

The 20 plus years of monitoring of environmental performance of the JEB TMF has provided a high degree of confidence in the predictive modelling of groundwater flow and contaminant flux and allowed for ongoing improvement and calibration of the predictive modelling used to support the JEB TMF expansion and closure planning.

3.2.1 Groundwater Flow and Contaminant Flux Modelling

Solute transport analyses describe the migration of solute in groundwater between a source and receptor, considering advective and diffusive transport mechanisms, and attenuation due to sorption behaviour and decay in transit. Solute release may be due to advection, which is a function of groundwater movement, and/or molecular diffusion, which is a function of chemical gradients. As such, factors that may influence solute mass flux out of the source include the groundwater flow in and around the source, the development of chemical gradients and the chemical properties of the solute.

Predicted long-term water quality is within SEQG for all COPCs. Arsenic and uranium are considered key COPCs of interest as base case predictions approach 20% of objective values and upper bound values approach 40% of the surface water arsenic guideline and 80% of the surface water uranium guideline.

The model was calibrated to various dewatering conditions observed during the operation of the JEB TMF and used to assess the predicted inflow to the base drain during operations. The assessment validated that hydraulic containment would be maintained throughout operations as the TMF is expanded to 468 mASL, and the inflow rates are well within pumping system capabilities. Groundwater flow and contaminant transport modelling, using pore water source inputs from the TOVP (Section 5; Appendix D, Section C),

validates that the decommissioned TMF will be protective of the downstream environment. The model will continue to be updated through an iterative process with the completion of each future TOVP campaign.

Groundwater pathline analysis presented in Section 7 of the TID indicates that groundwater discharge from the expanded JEB TMF is anticipated to migrate west and south towards Fox and Pat lakes, respectively. Approximately 70% and 30% of the groundwater flow discharges to Fox Lake and Pat Lake, respectively; however, 100% of the flow will ultimately reach Pat Lake (i.e., surface flow from Fox Lake).

3.3 IMPLICATIONS OF THE PROPOSED JEB TMF EXPANSION

The next (and presumably final) iteration of the JEB TMF expansion would further raise the perimeter containment and low permeability liner to allow tailings deposition to a maximum elevation of 468 mASL which would consolidate to elevation 462 mASL in the capped closure configuration.

Further expansion (i.e., raising of the perimeter containment) is limited due to the proximity of the downstream toe of the proposed perimeter containment dam to Fox Lake. The key element of the proposed JEB TMF expansion is the increased height of perimeter containment dams (and associated low permeability liner) to enable the placement of additional tailings within the JEB TMF.

The basic operating protocols are largely unchanged from the current tailings deposition strategy; however, the proposed expansion does result in additional (albeit manageable) risks to the environment. Some of the more readily identifiable risks associated with raising the JEB TMF perimeter dams and tailings ponds elevation include:

- Increased perimeter dam height will result in increased geotechnical risk associated with any failure of the dams. There is no indication that raising the dams presents any particular geotechnical challenge and, while detailed plans of the proposed dam construction have not been reviewed, it is reasonable to assume that it is possible to construct perimeter containment with a suitably high factor of safety.
- Greater thickness of deposited tailings will result in increased localized mounding of groundwater at closure and an associated increase in advective flux through the tailings (a contaminant transport mechanism that was essentially absent in the original JEB TMF design with consolidated tailings deposition to maximum elevation 434 mASL).
- Greater potential for advective flux translates to a greater reliance on the Closure Cover to mitigate infiltration and the associated potential for contaminant migration from the JEB TMF once the dewatering system is turned off.
- Longer deposition/operational period will result in deferred closure and a longer timeframe during which the control of contaminant flux from the JEB TMF will rely on active dewatering of the JEB TMF under drain.

If the JEB TMF is operated as designed, the risks highlighted above can be quantified, mitigated and/or managed. Of note, success of the current and future JEB TMF operations relies significantly on the ability to maintain an inward hydraulic gradient (or "hydraulic trap") throughout the entire tailings deposition period and well into closure / post-closure until such time as the contaminant containment strategy effectively transitions to reliance on the pervious surround design.

Given the critical natural of the infrastructure associated with maintaining the "hydraulic trap" (i.e., dewatering pumps, dewatering tunnel and raise, et cetera) it is importance to have full confidence in the dewatering infrastructure, ensure that there is are robust inspection and maintenance protocols in place along with spare and/or redundant equipment in place in the event of a system or equipment failure. It is also worth understanding what contingency plans are in place in the event of a catastrophic failure of the TMF dewatering system (e.g., collapse of the dewatering tunnel)

4.0 SUMMARY

The JEB TMF design has been demonstrated to be robust and flexible – performing essentially as designed and as predicted by advanced numerical modelling. From initial start-up in 1999 to the present, the performance of the tailings preparation process (TPP) has consistently demonstrated compliance with applicable Action Levels for tailings pore water quality at the point of discharge from the mill and performance of the deposited tailings in the JEB TMF has been consistent with design and modelling prediction.

The approximately 20 years of operating experience, detailed modelling, and calibration of models with monitoring results provides confidence that the JEB TMF expansion is both technically feasible and expected to perform as predicted and operate in a manner that is protective of the environment.

As discussed in Section 3.3, the proposed JEB TMF expansion will result in some additional risk relative to the currently approved JEB TMF configuration; however, these risks are consistent with the currently accepted/permitted project risks and any increased risk is incremental in nature.

Regards,

James (Jim) Theriault, P.Eng.

Managing Principal

Human Health Technical Review

McClean Lake Tailing Management Facility Expansion Project

Prepared by: Paleah Black Moher, PhD, Consultant

For: Two Worlds Consulting

July 23, 2021

Contents

1. Executive Summary

Orano Canada Inc. is proposing an expansion of their existing JEB tailings management facility (TMF) from the currently approved elevation of 457.5 meters above sea level (mASL) up to an elevation of 468 mASL, which would allow for the height of the consolidated tailings to increase from 448 mASL to 462 mASL, "Project".

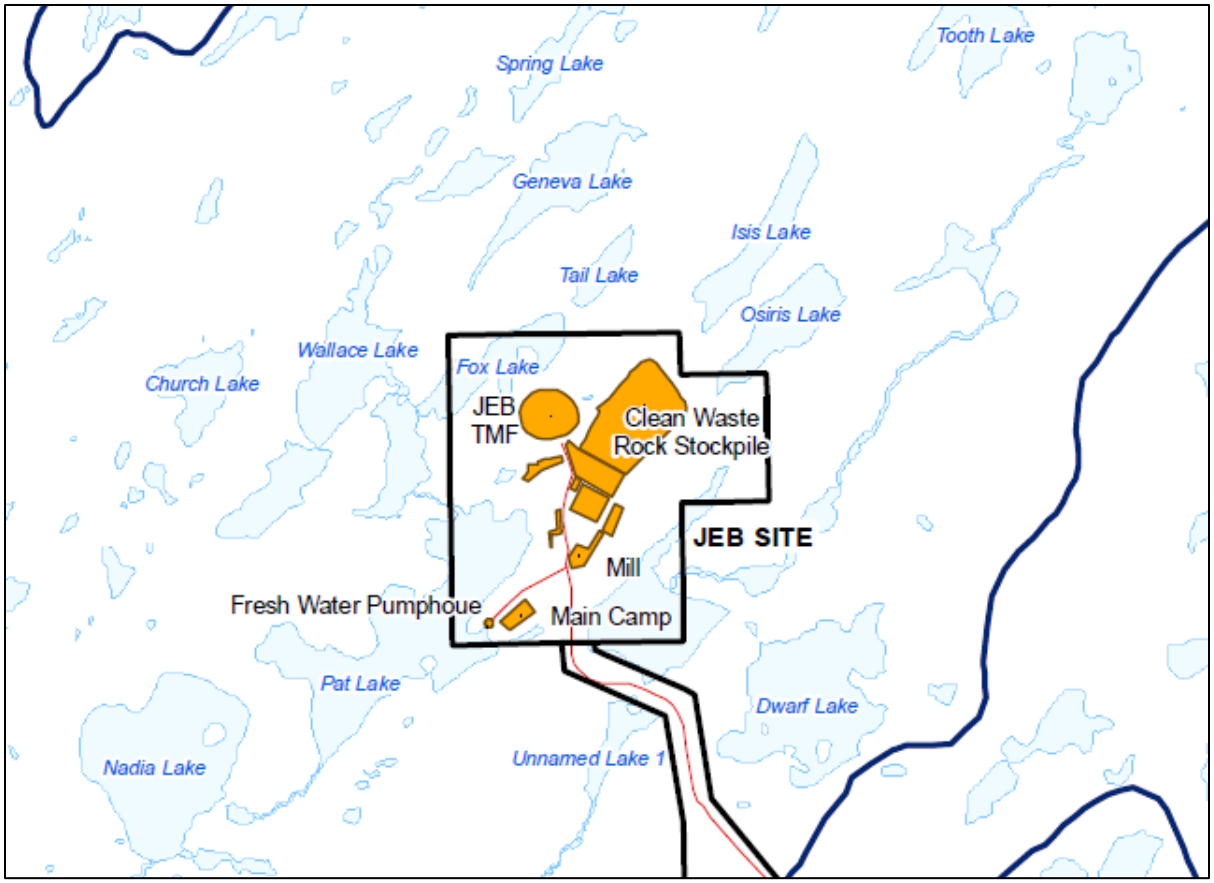
The Canadian Nuclear Safety Commission (CNSC) and the Government of Saskatchewan's Ministry of Environment (SMOE) are responsible for ensuring Orano's licencing and compliance with respect to environmental and human health safety and protection.

It appears that Orano has followed all regulatory mechanisms for ensuring the safe operations of its TMF and is in good standing in terms of their past environmental and human health performance measures. Orano's Cluff Lake uranium mine in northern Saskatchewan has been successfully decommission with minimal environmental contamination and risk to public health [CNSC, 2003; CNSC 2018].

In addition, Orano has participated with academic research to better understand how tailings interact with the environment (e.g. see: Robertson et al, 2019), and they have an ongoing environmental monitoring system, although the transparency of their results needs to be improved. The CNSC compared Orano's monitoring program's results to an independent monitoring survey published in 2016, and found to be satisfactory. This independent monitoring initiative is instrumental in ensuring public support and environmental and human health protection, and is now 5 years old.

The long-term modelling of the post-decommissioned tailings show no substantial risk to the environment, with considerations of climate change and catastrophic events such as fire and flood. The decommissioned tailings will be contained using passive systems, limiting the requirements for long-term inputs. Orano and the CNSC acknowledge that long-term seepage is expected to occur from the decommissioned TMF into the surrounding water body(ies), but state that "CNSC staff are satisfied that the aquatic environment in Fox Lake and Pat Lake will remain protected" [pg. 25, 2021 Environmental Protection Review Report: License Amendment for the JEB TMF Expansion, CNSC)

Orano has conducted several past community consultation events, which, at times, may have included Métis representatives. However, given the projected long-term impacts of the Project, and the potential for culturally specific impacts both now and into the future, engagement and transparency should be discussed with the Métis Nation Saskatchewan (MN-S) governing body, and include funding for dedicated Health and Safety personnel.



Map of McClean Lake Uranium mine operation (Figure from AREVA, JEB TMF Expansion Project Description, August 2011)

There are a number of suggestions to which the MN-S may consider raising. These suggestions must be reviewed in terms of their cultural, economic, and political context by the MN-S, and used and adjusted as appropriate. Further details of each suggestion, and additional suggestions, are found within the text body of the report.

Potential suggestions:

1. Overall, the MN-S should have **improved engagement** with access to all decision-making processes with respect to McClean Lake operations and TMF expansion, decommissioning, and closure, through improved engagement, support, and knowledge exchange. Suggest that a dedicated Human and Environmental Health person be appointed within the MN-S to act on their behalf on relevant matters.
2. Specifically, human health risk assessment modeling did not take into consideration **Métis-specific land usages or traditional food consumption** patterns, which may influence the outcomes of those results in the human receptor analyses.
3. The Project will result in the expanded TMF's berm to be 10 m from the high-water level of Fox Lake, which was assessed to pose no inappropriate risk to that water body.

However, modelling does not appear to take into account the potential for the high-water level to increase, for example, due to climate change and flood events. This would reduce the distance to Fox Lake and trigger additional regulatory processes. Suggest that the **10 m buffer be extended** and an independent environmental assessment be conducted to ensure that Fox Lake and surrounding waterbodies will not be impacted. This assessment may integrate Métis-specific Traditional Ecological Knowledge (TEK) and water level changes in the area.

4. Orano has projected, and the CNSC has acknowledged, that chemicals of potential concern (COPC) from the tailings will **leech into surrounding ground water for more than 10,000 years** post-decommissioning, albeit at no significant risk to human health. Since this contamination legacy will be faced by the future generations of the local communities, suggest that the MN-S engage with all decision-making processes and have access to fair compensation for this risk, accounting for a significant level of uncertainty.
5. The radon concentrations from the TMF are not expected to cause any human health risk. However, radon can accumulate in indoor air, which does not appear to have been evaluated in this area. Although not directly related to the TMF, suggest that **indoor radon testing** and remediation measures be conducted and/or offered in all homes and buildings in surrounding communities, as this would limit unnecessary radiation risk and exposure to this lung carcinogen.
6. **Selenium released** into the surrounding waterways has been raised as a concern several times. Independent environmental monitoring is now outdated, may not capture key Métis-specific food items, and does not include recent scientific advancements in the understanding of selenium speciation and the risks of bioaccumulation. Suggest that fish intake be assessed for local populations, fish concentrations be monitored, and cumulative exposure assessments be completed to ensure excessive selenium intake is not occurring. In the interim, suggest that improved removal be undertaken as part of Orano's Selenium Adaptive Treatment.

In conclusion, it appears that all of the necessary assessments and reviews to protect the health and safety of the local communities have been conducted, showing no significant health risk associated with the Project. Extensive modelling has been conducted to estimate risk thousands of years into the future, demonstrating that the decommissioned TMF will leech into the ground waters at an acceptable level of risk. However, the limitations of the current best practices in these approaches are notable, such that the level of uncertainty is large. In other words, although the EAs and TID's have not predicted any significant risk associated with the Project, there is no way to determine this absolutely. As we have seen in multiple past experiences with uranium mining, and mining in general, the risk of environmental contamination and human health impact is always possible. The Project will ultimately result in an additional volume of 2.3 million m^3 of tails that will remain radioactive for thousands of years, on the surrounding lands and waters of the local communities.

2. Overview

Uranium mining has the potential to impact human health. These impacts can be specific to uranium mining, such as radiological hazards, or non-specific to general mining operations, such as exposures to noise, dust, and non-radiological hazards. These health risks are generally most relevant to people who work at the mine site (occupational exposure), but certain exposures and their associated risks can extend to the general population (environmental exposure).

Exposure pathways are the ways in which a person can come into contact with a hazard. In the case of uranium (U) mining, this can include the inhalation, ingestion, absorption through the skin, and gamma radiation exposure. Ingestion of local foods can be an important route of exposure, the amount of which depends on how much of the food being consumed and its hazard level. Special consideration of people who participate in activities such as hunting, gathering, and fishing, need special consideration for accurate risk assessment.

The proposed Project would increase the capacity of the JEB tailings management facility (TMF) to provide the ability to store tailings above the currently approved elevation for consolidated tailings of 448 metres above sea level (mASL) to 462 mASL, or an additional 14 m. This would be achieved with the construction of an embankment around the JEB TMF perimeter with a soil-bentonite liner, up to a height of 468 mASL. This expansion will result in approximately 2.3 million m^3 of additional unconsolidated tailings. [Project Description, Orano, October 2019]

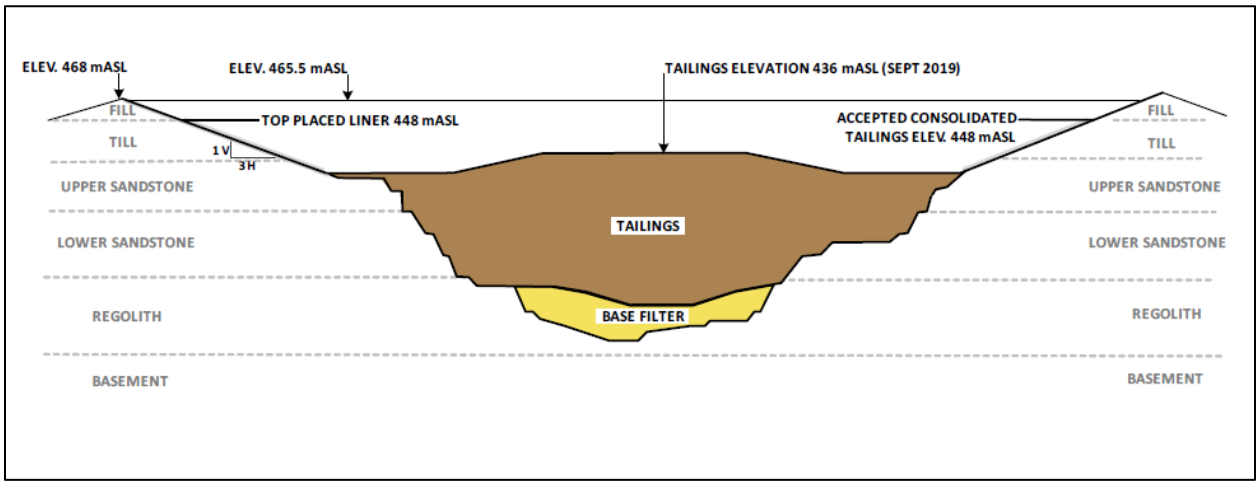


Figure of cross section of TMF [Figure 4.1-1, Project Description, Orano, October 2019]

3. Technical Review Methods

General Approach

The purpose of this technical review is to provide commentary on the Project's Environmental Assessments (EA) and Technical Information Document (TID) in terms of human health risk of Elements of Concern (EOC) and Control Constituents of Potential Concern (COPCs). Documents were assessed for scope, completeness, approach and limitations. Parallel assessments or monitoring were also assessed to confirm the general conclusions of the EAs. An in-depth investigation into the data quality, risk calculations, or quality control was not possible, and were assumed to be accurate and appropriate.

The documents reviewed include:

- 2021 Environmental Protection Review Report: License Amendment for the JEB TMF Expansion, CNSC
- 2019 Project Description, JEB TMF Expansion
- 2016 Technical Information Document Environmental Performance, volume 2 of 2, Version 3, Section 6 Human Health Risk Assessment
- 2011 AREVA, JEB TMF Expansion Project Description

Additional documents and literature were reviewed to add scope, context, monitoring data, and scientific support. A reference list is included at the end of the report. The development of the various U mining operations and TMFs in the Athabasca region has been accompanied by academic and industry-lead research programs to better understand the fate of U tailings. The scientific literature provides insight to the long-term fait of these tails. Several working groups and committees are also established and active in this field, and have submitted Interventions to previous McClean Lake public hearings or published relevant materials, which were also considered.

Limitations

This report was prepared solely by Paleah Black Moher, PhD, Consultant for Two Worlds Consulting. The information presented herein represents the information provided and available at the time of writing. Referencing is provided throughout the document. Every reasonable effort was made to present this information in an accurate and transparent manner, as a professional consultant in good standing. All provided data and reports were assumed to be accurate, complete and correct. Due to the volume of documentation available and the constraint of time, all potential risks to human health were not evaluated. The author takes no responsibility for any errors or omissions, or any actions or decisions made based on this report.

4. REVIEWED DOCUMENT: 2021 Environmental Protection Review Report: License Amendment for the JEB TMF Expansion, CNSC

In 2021 the CNSC published a review detailing the environmental protection aspects of the proposed TMF expansion. Although not a formal environmental assessment, it covers many technical details of an environmental risk assessment and human health risk assessment.

In reviewing this document, a couple of questions and cautions were raised, for consideration.

In Section 3.2.3 Surface Water and Aquatic Environment:

"The proposed JEB TMF expansion will result in the toe of the embankment being 10 m from the high-water mark of Fox Lake, which will provide the minimum buffer necessary to minimize impacts to the lake." [pg.18]

- It does not appear that climate change scenarios, specifically water level rising and normalized flood events, were considered with respect to the distance to Fox Lake. This 10 m set back also appears to be the minimum buffer to meet legislative requirements. Suggest that this set back be increased.

"As discussed in section 3.2.2, after closure and decommissioning of the JEB TMF, COPCs will slowly move from the tailings to groundwater and subsequently to the surface water and sediments of Fox Lake and Pat Lake. The average arrival time of a groundwater plume reaching Fox and/or Pat Lake is predicted to vary for each COPC depending on its' attenuation. Unattenuated COPCs such as chloride and sulphate is predicted to reach the lakes in approximately 200 years. As depicted in figure 3.1, moderately attenuated COPCs such as arsenic and nickel are predicted to reach the lakes in 200 to 300 years (average arrival time). Radium-226 is predicted to be at maximum concentration in the lakes after 10,000 years [3]. The timing of the movement of the groundwater plume to Fox and Pat Lakes is similar to that of the currently accepted and approved JEB TMF [20]." [Pg. 19]

- Note that the Project will contribute towards this leeching, although projected to be "similar".
- Note that both the CNSC and Orano acknowledge that there will be long-term contamination legacy from the decommissioned tailings. These predictions have previously been demonstrated (through modeling) and accepted as part of the environmental assessment and relicensing processes that the MN-S have not fully participated.
- Note that long-term contamination of local waters will be the burden of local communities who utilize this area, projected to peak (in the case of Radium-226) in 10,000 years.
- Note that long term timescales such as these contain a large degree of scientific uncertainty in the modelling.
- Suggest that the local communities, including the MN-S, be adequately consulted and compensated.

Further to discussion above on long-term seepage of COPC into nearby waterbodies, Section 3.2.3. continues:

"As a result, it is expected that there will be an accumulation of contaminants in sediments overtime. As required by CNSC staff, and pending Commission approval of the project, Orano has agreed to conduct a long-term assessment of the base case scenario and upper bound scenario of the flux of COPCs via groundwater to predict concentrations of COPCs in Fox Lake and Pat Lake sediments and assess the risk to aquatic receptors due to sediment COPC predictions. In the event that the sediment concentration predictions result in an unreasonable risk to aquatic receptors over the long term, Orano must consider additional mitigation measures on their design to prevent these from occurring. CNSC staff are satisfied that the aquatic environment in Fox Lake and Pat Lake will remain protected." [pg.25]

- Note the CNSC are satisfied that the aquatic environments will remain protected even before seeing the results of sediment COPC prediction modelling. In the event that sediment predictions result in an unreasonable long-term risk, it is possible that "additional mitigation measures" may not be adequate. Suggest that modelling be reviewed by the CNSC before approval.

In Section 3.2.4 Human Health:

"The potential impact to human health for the currently approved JEB TMF was assessed in the 2016 ERA and found to be negligible." [pg.25]

- Note the 2016 ERA document was reviewed below.

CNSC evaluated Orano's documentation and found their results to be satisfactory in the protection of human health.

"During the JEB TMF's expansion, the construction, operation, and decommissioning will not result in any impacts of human health." [pg. 25]

"Radiological hazards to workers nor the general public are also no expected to be elevated due to the Project during operations or in post-decommissioning." [pg.26]

"These post-closure radiological objectives for members of the public were selected following workshops with local stakeholders to develop occupancy scenarios for post-closure traditional land use." [pg. 26]

- Since engagement of the MN-S postdated many of these public engagement activities, it is suggested that they be revisited with a Métis-specific land use scenario in their Human Receptor analyses.

"The radon concentration in air above the tailings, taking into account the characteristics of the tailings and cover, and the meteorological conditions, was modelled for a base case, which represents average meteorological conditions observed at McClean Lake. These were assessed to be between approximately 20 Bq/m^3 and 30 Bq/m^3. This is similar to the upper range of

background concentrations from pre-operational (baseline) radon measurements in the McClean Lake area which ranged from < 7.4 to 25 Bq/m^3." [Pg. 27]

- The radon concentrations in outdoor air are not expected to cause any human health risk. However, due to the chemical characteristics of radon, it accumulates in indoor air. Although this is not directly applicable to the TMF, it may be of interest to ensure all indoor air spaces, including those of the homes and facilities in nearby communities are meeting indoor radon guidelines values of 200 Bq/m^3 [Health Canada, 2017]. Radon levels in Saskatchewan are some of the highest levels in the world [CAREX Canada, 2018]. is Radon in indoor spaces is the second leading cause of lung cancer in Canada, and reducing this exposure would be a simple way to reduce overall human health risk [Health Canada, 2017].

"The water cover prevents tailings from drying and consequently becoming airborne. This is the case during the operations phase. Post-closure, several meters of waste rock, as well as top layers of clean sand-bentonite and till will cover the tailings. As a result, no exposures to long-lived radioactive dust exposure are expected on the surface." [Pg. 27]

- No mentioning of native plant cover to prevent erosion of the cover material, although it is noted elsewhere. Suggest that MN-S members with Traditional Ecological Knowledge (TEK) and an ethnobotanist who specialises in the restoration of native ecosystems be consulted to ensure long-term success of the naturalization of the area to match the local ecosystem. Pulling TEK into Environmental Risk Assessments (ERA) is possible and guidance documents are available. (e.g. see: Mary Claire Buell et al., 2020).

"From a human health perspective, *Health Canada's Guidelines for Canadian Drinking Water Quality* [9] would also be exceeded in Fox Lake for most COPCs and in Pat Lake for radium-226 and polonium-210 for up to 16 months. Orano predicted that 2 years after a hypothetical embankment failure, COPCs concentrations in surface water would be protective of aquatic life and suitable for use as drinking water." [Pg 27]

- In the case of an embankment failure, the contamination of Pat and Fox Lakes would receive a large amount of COPCs, which would require significant resources to remediate. For example, the remediation efforts at Gunnar, a closed uranium mine located in northwestern Saskatchewan that led to the contamination of Lake Athabasca, was originally estimated to be $24.6 million is now estimated to be $208.5 million [Natural Resources Canada (NRC), Evaluation of Gunnar Mine Site Rehabilitation Project, 2012]. Suggest that an analysis be completed to ensure adequate funding is available in the case of embankment failure. Orano has posted a $107 million trust in 2018 [NSEQC, 2018 Report to Communities, pg. 18].

In Section 4.0 Conclusion:

"This EPR focused on items of current public and regulatory interest, including airborne and waterborne releases from the proposed JEB TMF Expansion. CNSC staff conclude that the potential risks to human health and the environment from radiological and hazardous releases to the atmospheric, terrestrial, hydrogeological and aquatic environments from the proposed JEB TMF expansion are low to negligble." [pg. 33]

5. REVIEWED DOCUMENT: 2019 Project Description, JEB TMF Expansion

In section 1.2.1.5 Environmental Monitoring:

"Environmental monitoring provides the information necessary to determine the extent of environmental effects over the lifespan of a development. The environmental monitoring requirements are integrated into the McClean Lake Operation Environmental Monitoring Program (EMP). The EMP framework at the McClean Lake Operation was developed in consultation with regulatory agencies during the initial environmental assessment (Minatco 1991) and during the subsequent licensing process. In 2016-2018 the EMP was updated to align with CSA standards for environmental monitoring programs at uranium mines and mills."

- See commentary about Environmental Monitoring below.

In section 2, the Canadian Nuclear Safety Commission (CNSC) and the Saskatchewan Ministry of Environment (SMOE) are responsible for conducting regulatory approvals and ensuring adequate measures are taken to protect the environment and health of mining operations.

The CNSC issued Orano an operation licence (UMOL-MINEMILL-McCLEAN.01/2027) in 2017 for 10 years. This decision was based on the review of an Environmental Assessment completed in 2017. The proponent is asking for the current Project to be approved without a formal EA.

In section 2.1 CNSC: "The McClean Lake Operation's operating licence LCH issued by the CNSC authorizes Orano to maintain the facility in accordance with the licensing basis for the facility and the intent of the licence. Orano understands that if the CNSC determines that the scope of the Project is not within the Licensing Basis then Commission approval will be required to change the licence basis, and if the Project is within the Licensing Basis, acceptance of the Project could be provided by CNSC staff."

- Since the completion of the 2017 Environmental Assessment, several notable changes have been made in the science and regulatory process that may impact the outcome of an EA. These factors should be considered now. For example, several research initiatives have begun to characterize the land use of the Métis, including traditional food harvesting and consumption. (https://www150.statcan.gc.ca/n1/pub/89-653-x/89-653-x2019001-eng.htm) Integration of this type of specific health-risk information will

ensure the EA's are relevant and adequate in the protection of Métis health and environment.
- Also noted that no regulatory action has been documented against Orano or the McClean Lake operation by the CNSC. https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-action/index.cfm

The Project was originally submitted for review in 2011 by the Environmental Assessment Branch of the Saskatchewan Ministry of Environment, who decided that an EA was not required to proceeded to licencing.

In the executive summary:

"Following the submission of the Project Description in 2011, the provincial Environmental Assessment Branch (EAB), Saskatchewan Ministry of Environment (MOE) completed an environmental screening of the proposed change to the currently approved development. Based on the description of the Project and the environmental protection commitments, the EAB determined that the Project is not a development as defined in Section 2(d) of the *Saskatchewan Environmental Assessment Act (Chapter E-10.1).* Accordingly, the province did not require an environmental assessment (EA) for the Project." [pg. vii]

- The SMOE should reassess their evaluation of the Project since a decade has passed since its original submission, to determine if a screening level or full EA is warranted.

In section 2.3 Public Information Program, the report states: "To meet Orano's Corporate Social Responsibility policy and the requirements of regulatory approval processes, Orano has developed a Public Information Program (PIP) for the McClean Lake Operation in accordance with the CNSC's REGDOC 3.2.1 Public Information and Disclosure."

- The MN-S should be consulted within the PIP and involved within this process.

In section 3, Orano has undergone extensive work into investigating 27 potential options for the long-term management of tailings in an initial screening study conducted in 2010, and a follow up assessment of the top 6 options in 2014. Options were assessed against considerations for the environmental impact, technical ability, and cost (see sections 3.3.1-3.3.3). Based on these criteria, the current Project was deemed the most desirable (section 3.7).

- Table 3.6-1 indicates that the Project was ranked the worst for "post closure failures", "perception & acceptance – regulatory", "perception & acceptance – public", and "proximity to sensitive environment". Since these option components were ranked the lowest, and this option was ultimately selected, it is prudent to ensure that special consideration of the protection and mitigation of these risks be noted. Suggest that Orano speaks to the impact of the Project on these factors.

In section 4 they outline the environmental and human health risk depends on the long-term stability of the proposed TMF embankment and water treatment to prevent releases into the

environment. Orano has conduced field and material characterizations, slope stability analysis, seismic slope stability analysis, probabilistic slope stability analysis, pond containment, expansion staging, surface water management, storm water storage pond modifications, mill site runoff pond, other affected infrastructure, expanded JEB TMF operation considerations, and decommissioning (section 4.2-4.4).

The engineering and technical details of construction and operation are beyond the scope of this review. Their accuracy cannot be verified or assessed, however the risk to the environment and human health directly depends on the integrity of each of these features.

There are four U mines in Saskatchewan that are in the closed phase of their life cycle according to the CNSC: Gunnar, Lorado, Cluff Lake, and Beaverlodge. (http://www.nuclearsafety.gc.ca/eng/waste/uranium-mines-and-millswaste/index.cfm#Closed)

Of the four, only Cluff Lake is owned by Orano. Cluff Lake may then provide insight into the abilities of the company in their decommissioning and closure processes, to return an operational U mine into an acceptable and safe environment. The CNSC has stated that the Cluff Lake decommissioning was successful with minimal environmental contamination and risk to public health [CNSC, 2003]. These general findings about Cluff Lake were mirrored in an Independent Monitoring Program in 2018 [CNSC, 2018].

- The successful closure of Cluff Lake supports the notion that Orano will be able to successfully decommission and close McClean Lake and it's TMF.

Table 4.4-5 and 4.4-6 Expanded JEB TMF (Upper Bound) Predicted Receptor Surface Water Quality – all fall below guideline values.

- Note they do not necessarily meet drinking water standards. Regardless of if Fox and Pat Lakes are or aren't used as a drinking water source at this time, future modeling should include the possibility that these may pose an exposure route in the future.
- See additional information in the monitoring section below.

Section 5 of the report covers the TID, volume 2, which includes Human Health Risk Assessment.

- see below as a separately reviewed document

Section 6 of the report covers the monitoring programing.

- See commentary below on Monitoring

6. REVIEWED DOCUMENT: 2016 Technical Information Document Environmental Performance, volume 2 of 2, Version 3, Section 6 Human Health Risk Assessment

In Section 6.1 Exposure Assessment:

“In this assessment, soil and inhalation exposures as well as water intakes and diet obtained from local sources (meat, fish, berries, and other traditional food consumption) over the year were evaluated, as well as the dermal pathway (a relatively insignificant pathway for non-volatile chemicals); supermarket foods and some background exposures were not considered.”

- Receptors, routes of exposure, and approach are appropriate for this assessment, however the specific characteristics of Métis people in the area needs to be surveyed to ensure appropriate reflection in the risk calculation assumptions (e.g. traditional food intakes, land use behaviours). Suggest that MN-S is engaged to conduct surveys for updated risk assessments.
- Background exposures may be an important factor to ensure any additional exposures do not cause an exceedance of safety guideline values. This may be particularly important for COPC such as selenium. See section on selenium for additional suggestions.

In section 6.3.1 Radiation Dose Effects:

“Annual incremental doses (i.e. above baseline) for the McClean Lake Operation were evaluated for exposure to radionuclides… All predicted mean and 95th percentile incremental annual doses are below the recommended incremental dose limit of 1000 µSv/year and the dose constraint of 300 µSv/year, and are expected to be within the range of variability of radiation dose from natural sources.”

In Section 6.3.2 Non-Carcinogenic Effects, they report specific risks associated with zinc, nickel, and selenium:

“For nickel and zinc, consideration of intakes for the general Canadian with the exposures from baseline result in intakes above the TRV for the Wollaston Lake child and toddler receptors – Wollaston Lake Resident, Wollaston Lake Trapper, and Wollaston Lake Lodge Operator – as well as the Hatchet Lake Lodge Operator child and toddler receptors. However, the project increment is imperceptible and therefore, the McClean Lake Operation future activities are not expected to have a negative effect on human receptors.”

- Suggest a proactive approach to the risk of zinc and nickel with further investigations into the main route of exposure, how the local communities including the Métis may or may not have an exacerbated exposure due to differing land and food usage, and explore options for food advisories for people to make their own informed decisions.

“For selenium, the general Canadian exposure contributes a significant portion of the total exposure for the receptors. In the Base Case selenium scenario, the project increment from the ingestion of fish and mallard by the Wollaston Lake Trapper receptors contribute an additional portion to the total intake for these receptors, such that the mean and 95th percentile intakes for the toddler exceed the TRV and the 95th percentile intake for the child is above the TRV. “

- See section below on selenium for additional information and context.
- Suggest that additional measures be taken to prevent Se from entering the local waters.
- In 2015 a large national traditional food survey for First Nation's Peoples in Canada was completed called the First National Food, Nutrition and Environment Study (FNFNES). (http://www.fnfnes.ca/download), including Nations residing in the Boreal Shield such as Black Lake and Lac La Ronge. The food use patterns of the Métis may be different than those reported within the report, however they may highlight potential areas of interest with respect to risk assessment. They report that the most commonly consumed fish reported by their study participants was Walleye. Walleye was not sampled or modeled in this risk assessment. Suggest an analysis into the contribution of Walleye to total daily intake of Se and other COPCs.

"In Scenario 2 for selenium, which assumes a selenium treatment option is implemented in May 2020 and achieves effluent concentrations of 10 µg/L, the project increment from intakes of fish and mallard are, as expected, lower for the Wollaston Lake Trapper receptors and the total mean intake for the toddler remains below the TRV."

- Suggest the adoption of the selenium treatment option to control effluent concentrations of 10 ug/L, the lowest possible risk level, and continual monitoring of fish tissue concentrations with results published and publicly available.

"The appropriate TRVs are also indicated in Figure 6.3-3 for comparison. The figure shows that the predicted intakes for all human receptors are below the applicable TRVs for arsenic, cobalt, copper, lead, molybdenum, and uranium."

- In 2015 a large national traditional food survey for First Nation's Peoples in Canada was completed called the First National Food, Nutrition and Environment Study (FNFNES). (http://www.fnfnes.ca/download), including Nations residing in the Boreal Shield such as Black Lake and Lac La Ronge. The food use patterns of the Métis may be different than those reported within the report, highlighting the need for a Métis specific assessment, however they may highlight potential areas of interest with respect to risk assessment. The study notes that caribou meat is consumed by 56/163 people interviewed (Table 6), and caribou meat was a significant source of arsenic (56% of intake). A Métis specific receptor should be assessed in case the exposure scenario leads to TRV exceedances.

7. REVIEWED DOCUMENT: 2011 AREVA, JEB TMF Expansion Project Description

- The document: "2019 Project Description, JEB TMF Expansion" represents the most current version of the Project, including revisions following submission to the CNSC and the SMOE, which was reviewed above.

8. Environmental Monitoring

Selenium

At several occasions' selenium (Se) has been raised as a potential for concern in the McClean Lake operations.

Se has been a serious concern for other mining operations in Canada (e.g. Teck mine in Elk Valley, BC), and uranium mines in northern Saskatchewan (e.g. Muscatello and Janz 2008). Similar to other heavy metals such as mercury, the organic form of selenium, such as seleno-L-methionine and selenocysteine can bioaccumulate, leaving fish and people who eat fish at an increased risk of excessive Se exposure. The background levels of Se in northern Saskatchewan are high, leaving less room for additional Se to safely enter the surrounding environment.

The risk of Se has been raised in several hearing submissions and EA's conducted for McClean Lake licencing. For example, the Ya'thi Néné Land and Resource Office Submission (November 13th, 2018).

Orano is required to report on the performance of their Selenium Adaptive Treatment Plan, and (see section 6.21.1 of the 2020 McClean Lake Operation Annual Report). They report that in March 2020 the Se concentration exceeded the "action level", and on several additional occasions throughout 2019-2020 it exceeded the "administrative level". The report states that COVID-19 played a factor in these exceedances.

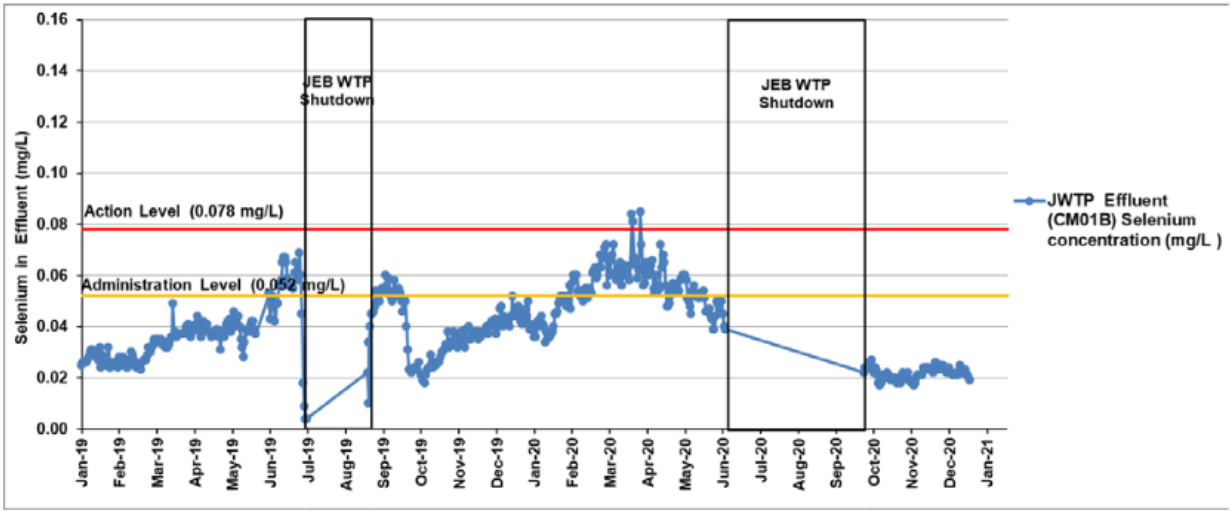
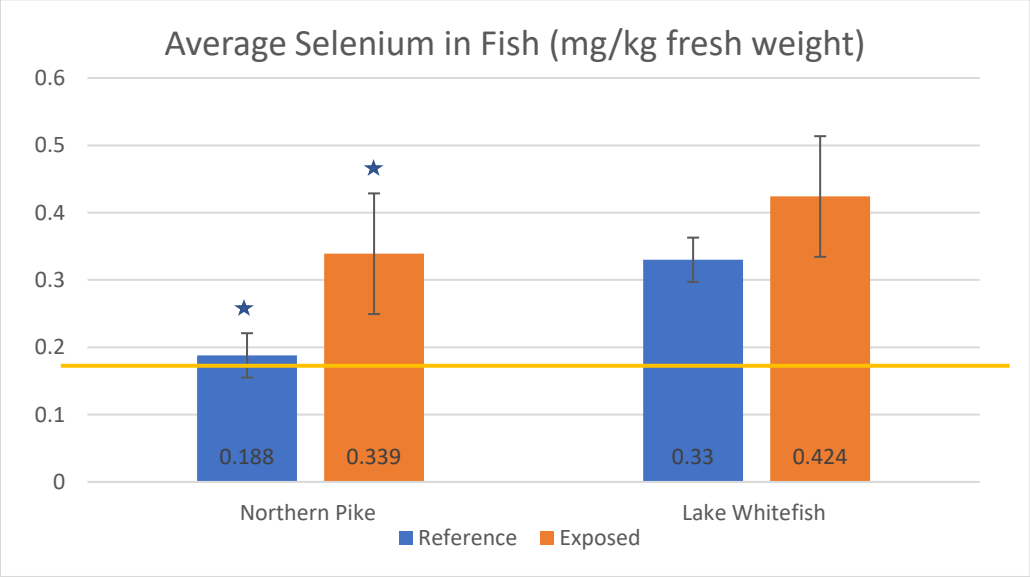


Figure 6.21.1 Selenium Concentrations at the JEB WTP Final Discharge Point (CM01B)

(Figure from the 2020 McClean Lake Operation Annual Report)

The CNSC has reviewed the Se risk assessment and determined that Orano's mitigation plans were sufficient. (Section 3.2.3. pg 19, Environmental Protection Review Report, CNSC, June 2021)

In 2016 the Independent Environmental Monitoring Program assessed the levels of Se in fish from nearby McClean Lake (exposed) and control locations (reference). This data was accessed and assessed. That data demonstrates that excessive Se levels are found in fish species in and around the McClean Lake area (see figure below). In both Northern Pike and Lake Whitefish, concentrations of Se are higher in the McClean Lake area than control, although this difference was statistically significant in the Northern Pike (ANOVA, $P<0.05$). The guideline reference level is 0.184 mg/kg w.w (yellow line), which is exceeded by the average of both fish species for both reference and exposed collected samples.



Average Selenium concentrations in two fish species, Northern Pike and Lake Whitefish, with standard deviation error bars (n = 10 for each category). The difference between the reference and exposed Se values for Northern Pike were significant (ANOVA, $P<0.05$).

To protect human health, the maximum tolerable amount of Se that a person should not exceed on a daily basis (TDI) is 0.40 mg [BC Ministry of Environment, Ambient Water Quality Guidelines for Selenium Technical Document].

The concentrations of Se in the fish sampled here are such that they contribute a significant amount towards this upper limit TDI. Using standard exposure parameters, eating one fish meal from the McClean Lake area represents 20-25% of the tolerable selenium daily intake (TDI). Many other sources of Se may exist, but the cumulative exposure was not assessed. The fish collected from the reference site (control) represent 10-20% of the TDI.

To ensure that excessive Se intake is not occurring, particularly with populations who rely on fishing or otherwise have a higher fish intake, fish intake patterns need to be better characterized. Due to reported Se releases into the environment at McClean Lake, and the age of the 2016 dataset, additional independent monitoring would be prudent.

- Suggest that fish intake be assessed for local populations who may consume more than standard parameters, or different species of fish, and cumulative exposure assessments be completed to ensure excessive Se intake is not occurring.
- Suggest that improved Se removal be undertaken as part of the Selenium Adaptive Treatment.
- Suggest that Se speciation be measured and modelled, as organo-selenium compounds have been demonstrated to be far more bioavailable than inorganic-selenium compounds. Several cautionary case reports on mining effluent and Se bioaccumulation have been issued [Martin et al. 2018].
- Suggest that fish advisories be considered in consultation with the community and in balancing with the health benefits of fish, if excessive Se intake, or other COPC, are predicted.
- Suggest that the 2016 the Independent Environmental Monitoring Program be updated with current data that include Se and Se speciation in water and biota.

Orano's Environmental Monitoring Program (EMP)

Orano conducts its own environmental monitoring program (EMP), which includes the sampling of water, tailings, air and wildlife. The results of this EMP are not accessible. https://canada.orano.group/EN/canada-119/orano-canada-incactivitiesoperations-partnerships-and-overviews.html

Independent Environmental Monitoring Program (IEMP)

The Independent Environmental Monitoring Program (IEMP) results for 2016 indicate that the public and the environment in the vicinity of McClean Lake Operation are protected and that there is no unreasonable risk to health and the environment. The data is readily available; however, it is now outdated and should be repeated with some improvements in scope and COPC sampling.

https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/mcclean-lake.cfm

Canadian Nuclear Safety Commission's (CNSC) Releases of Radionuclides

The Canadian Nuclear Safety Commission (CNSC) publishes total annual releases of radionuclides released directly to the environment from nuclear facilities. They report that McClean Lake mine site had 40 release events from 2013-2020 where uranium, thorium-230, lead-210 and other radioactive materials were released into the environment.

https://open.canada.ca/data/en/dataset/6ed50cd9-0d8c-471b-a5f6-26088298870e/resource/1f44948a-0a10-4d1e-87f1-f7fde016fef3

Eastern Athabasca Regional Monitoring Program (EARMP)

"The EARMP is an independent environmental monitoring program funded by the Province of Saskatchewan with industry partners. The EARMP is comprised of a community program and a technical program. The objective of the community program is to ensure the safety of traditionally harvested foods by monitoring and testing foods gathered by communities in the eastern Athabasca region of northern Saskatchewan. The technical program was designed to provide long-term environmental data and identify potential cumulative impacts downstream of uranium mining and milling operations. "

In their 2019-2000 Report to the Communities, they published various EOC concentrations in water, fish, and berries in and around Wollaston/Hatchet Lake between the years 2011-2019.

Aluminum, arsenic, copper, iron, lead, uranium, and zinc, radium-226, were found to be at safe levels below drinking water guidelines. Nickel and ammonia were found to be at safe levels below environmental water guidelines. Molybdenum exceeded its environmental guideline level from 2011-2014, however in 2015-2019 was below it and continues in a downward trend (see Appendix B, Figure 1).

Testing for EOC in fish samples and berry samples demonstrated safe levels. The committee concluded that the traditional foods in the Athabasca region were safe to eat.

https://www.earmp.ca/

Northern Saskatchewan Environmental Quality Committee (NSEQC)

From the NSEQC website: "The NSEQC is a partnership between the provincial government, northern municipalities, First Nations, **Métis** communities and the mining sector. It is intended to foster mutual understanding of mining developments in the region with a focus on the environmental protection efforts." (https://www.saskatchewan.ca/government/partnerships-for-success/profiles/northern-saskatchewan-environmental-quality-committee)

Their 2018 Report to the Communities includes information on McClean Lake and the Project. They note that their last visit to the site was in 2013, and Orano's current financial assurance for McClean Lake to be over 100 million dollars. (https://www.saskatchewan.ca/residents/first-

nations-citizens/saskatchewan-first-nations-metis-and-northern-initiatives/northern-saskatchewan-environmental-quality-committee)

Athabasca joint engagement and environment subcommittee (AJES)

From the AJES/Ya'thi Néné website: "the Athabasca Joint Engagement and Environment Sub-committee (AJES) is focused solely on the environment. It is responsible for reviewing information from environmental monitoring programs such as the Community Based Environmental Monitoring Program (CBEMP), information updates from all Cameco and Orano mine site and exploration programs and providing feedback on behalf of community members. The committee also shares this information with communities and their members. This committee meets four times per year." (https://www.yathinene.ca/monitoring)

In a letter to the CNSC, entitled Ya'thi Néné Land and Resource Office Submission of the Regulatory Oversight Report Feedback November 13th, 2018, they note: "On the topic of information sharing and environmental programs, Ya'thi Néné would like to remain engaged and notified of any updates regarding the selenium adaptive management plan as outlined on page 96 in Section 7.3. The selenium adaptive management plan outlines selenium-related continual improvement and adaptive management actions taken at the McClean Lake Operation…"

- Note that it appears there is no Métis representation on the AJES.

Saskatchewan Environmental Society (SES)

From their website: "For the past 50 years, the SES has been *building a sustainable future* by doing research, providing sought after insight, developing programs, and providing rational solutions. SES has established a reputation for sound science, good management, civility, and an ability to work collaboratively." (https://environmentalsociety.ca/)

During the 2017 relicensing hearing for Orano's McClean Lake, the SES provided a 37-page submission detailing their concerns for the site's operations. (https://nuclearsafety.gc.ca/eng/the-commission/hearings/documents_browse/results.cfm?dt=7-Jun-2017&yr=2017)

With respect to human health risk and the expansion of the TMF, they specifically note the issue of excessive selenium. They also state:

"Our two major concerns about the JEB Tailings Management Facility expansion are (1) embankment failure and release of pond water and tailings solids to the environment and (2) groundwater contamination above the till/sandstone contact." (pg 25) and

"Finally, SES recommends that any further request to expand the JEB Tailings Management Facility should be denied." (pg 26)

- See section on Selenium for specific suggestions

9. Conclusion

In conclusion, it appears that all of the necessary assessments and reviews to protect the health and safety of the local communities have been conducted, with all appropriate regulatory bodies deciding that there are no significant health risk associated with the Project. Extensive modelling has been conducted to estimate risk thousands of years into the future, demonstrating that the closed TMF will leech into the ground waters at an acceptable level of risk. However, the limitations of the current best practices in these approaches are notable, such that the level of uncertainty is large. In other words, although the EAs and TID's have not predicted any significant risk associated with the Project, there is no way to determine this absolutely. As we have seen in multiple past experiences with uranium mining, and mining in general, the risk of environmental contamination and human health impact is always possible. The Project will ultimately result in an additional volume of 2.3 million m^3 of tails that will remain radioactive and leech COPC for thousands of years, into the surrounding areas of the local communities.

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