

Progressive reclamation of the Éléonore mine filtered TSF: From theory to practice

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Outline

- Éléonore Mine
 - Progressive reclamation
 - Reclamation design
 - Progressive reclamation:
 - Advantages
 - Challenges
 - Closing remarks
 - Recommendations
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- Initially presented at Mines and Environment Symposium in Rouyn-Noranda (Quebec)
 - June 2025.

Éléonore Mine

Site location



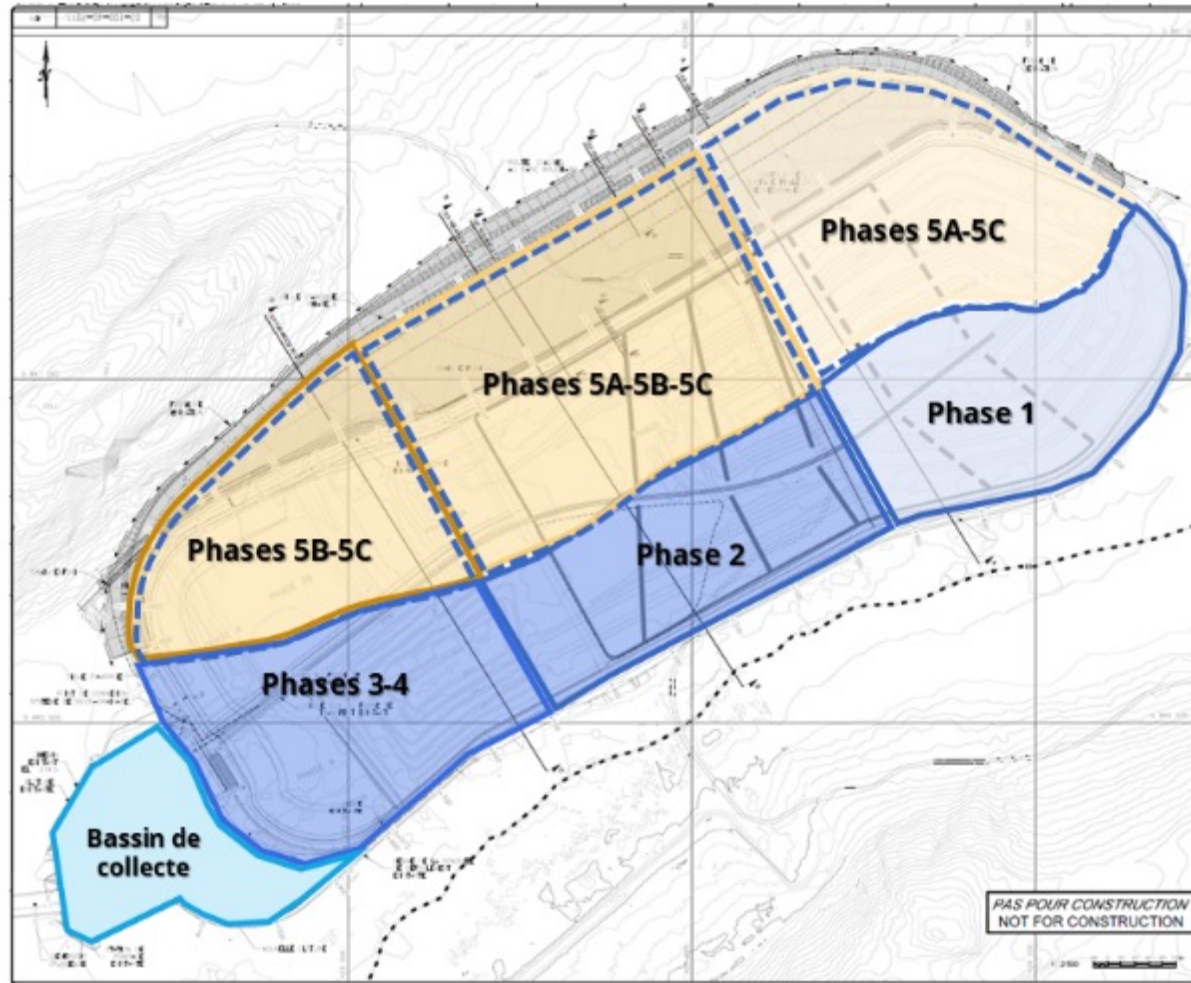
Éléonore Mine (cont'd)

TSF overview

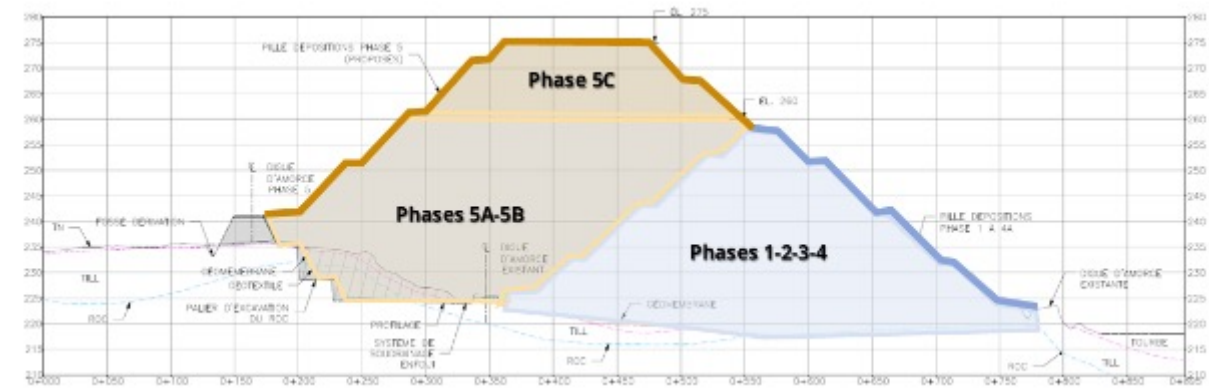


Éléonore Mine (cont'd)

Deposition plan



- 5 authorized phases.
- Part of Phase 1 reclaimed during summer 2025.
- Phase 5a: Construction underway – Sept. 2025.

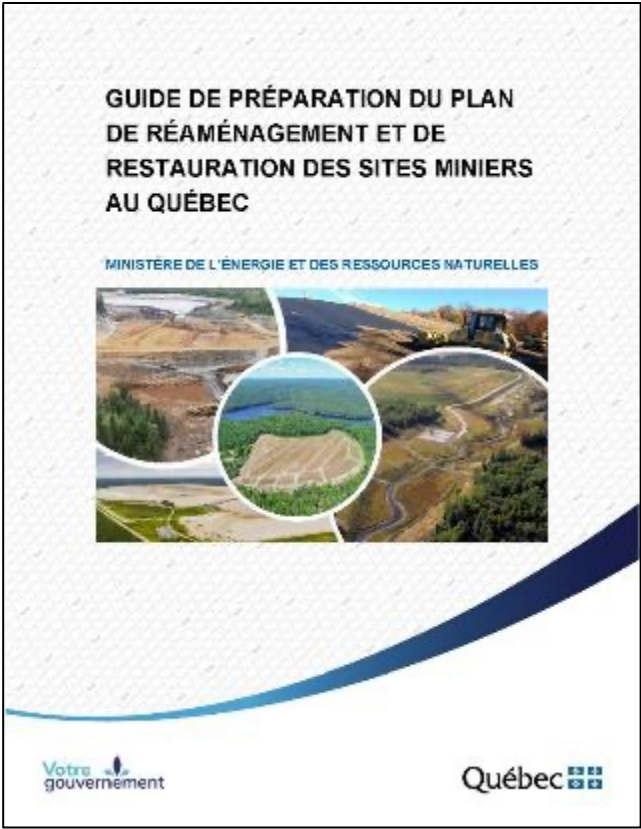


What is progressive reclamation?

Reclamation of the mine wastes storage areas (e.g., TSFs or mine rock piles) during the life of mine. Progressive reclamation of certain areas is ongoing while other areas are under operation or construction.

Progressive reclamation requirements

- Guide de préparation du plan de réaménagement et de restauration des sites miniers du Québec (MRNF, 2022):



La restauration des aires d'accumulation doit être préférablement mise de l'avant pendant les activités d'opération et constituer lorsque c'est possible, un paramètre de conception, afin de concevoir les ouvrages qui favoriseront la restauration progressive et permettront de minimiser le potentiel de DMA et de DNC.

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4.6.3 Techniques de restauration

Le choix des techniques de restauration doit se faire parmi des méthodes éprouvées et adaptées aux conditions du site. Au besoin, plusieurs techniques de restauration peuvent être présentées pour tenir compte des particularités des secteurs à restaurer.

La conception doit se faire selon les meilleures techniques de restauration disponibles, puis être techniquement et économiquement réalisable. Des validations par essais en laboratoire et sur le terrain sont parfois requises pour confirmer certains éléments de la conception. Dans certains cas, des modélisations peuvent être utiles afin d'évaluer l'efficacité de certains paramètres dans la méthode proposée, et cela sous diverses conditions d'exposition. Par exemple, il est fortement recommandé de simuler les changements climatiques, le comportement géochimique ou des conditions de stabilité géotechnique à court, à moyen et à long terme.

L'innovation technologique est encouragée, mais des études scientifiques et techniques faites par des professionnels doivent avoir démontré le potentiel pour atteindre les objectifs de la restauration et ainsi assurer l'efficacité et l'intégrité à long terme.

Dans tout développement minier, la restauration progressive doit être envisagée; si elle n'est pas privilégiée, il appartient au requérant d'en justifier les raisons.

La sélection et la conception de la technique de restauration doivent se faire avec les professionnels membres d'un ordre professionnel qui ont l'expertise, la formation et l'expérience requises et pertinentes. Les bases de conception et les hypothèses retenues pour le choix des techniques de restauration et la conception doivent être présentées avec la documentation appropriée, en annexe du plan de restauration.

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Progressive reclamation requirements (cont'd)

- GISTM (2020):

Requirement 5.6	Design the closure phase in a manner that meets all the Requirements of the Standard with sufficient detail to demonstrate the feasibility of the closure scenario and to allow implementation of elements of the design during construction and operation as appropriate. The design should include progressive closure and reclamation during operations.
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Progressive reclamation of the Éléonore Mine TSF

- Began early in the process, translation of first reclamation plan submitted to authorities :
« The TSF will be progressively reclaimed during operations. Reclamation works are planned every 3 to 5 years. Tailings will be covered with a geomembrane, natural soils and vegetation once they attain their final elevation. » (Mines Opinaca, 2011)
- Simplified timeline of Éléonore TSF operation:
 - Start of operation: 2014.
 - Phase 1 final elevation: 2019.
 - Start of engineering of Phase 1 reclamation: Sept. 2020.
 - Phase 1 reclamation: June – Sept. 2025.
 - Longer than expected but many learnings.

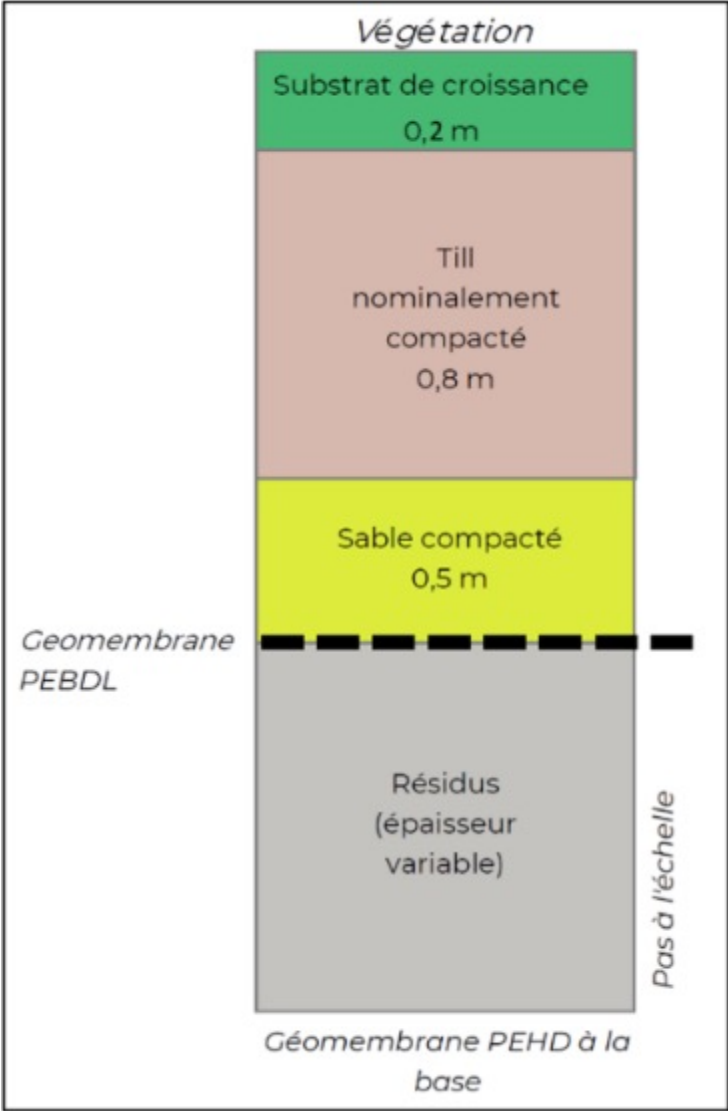
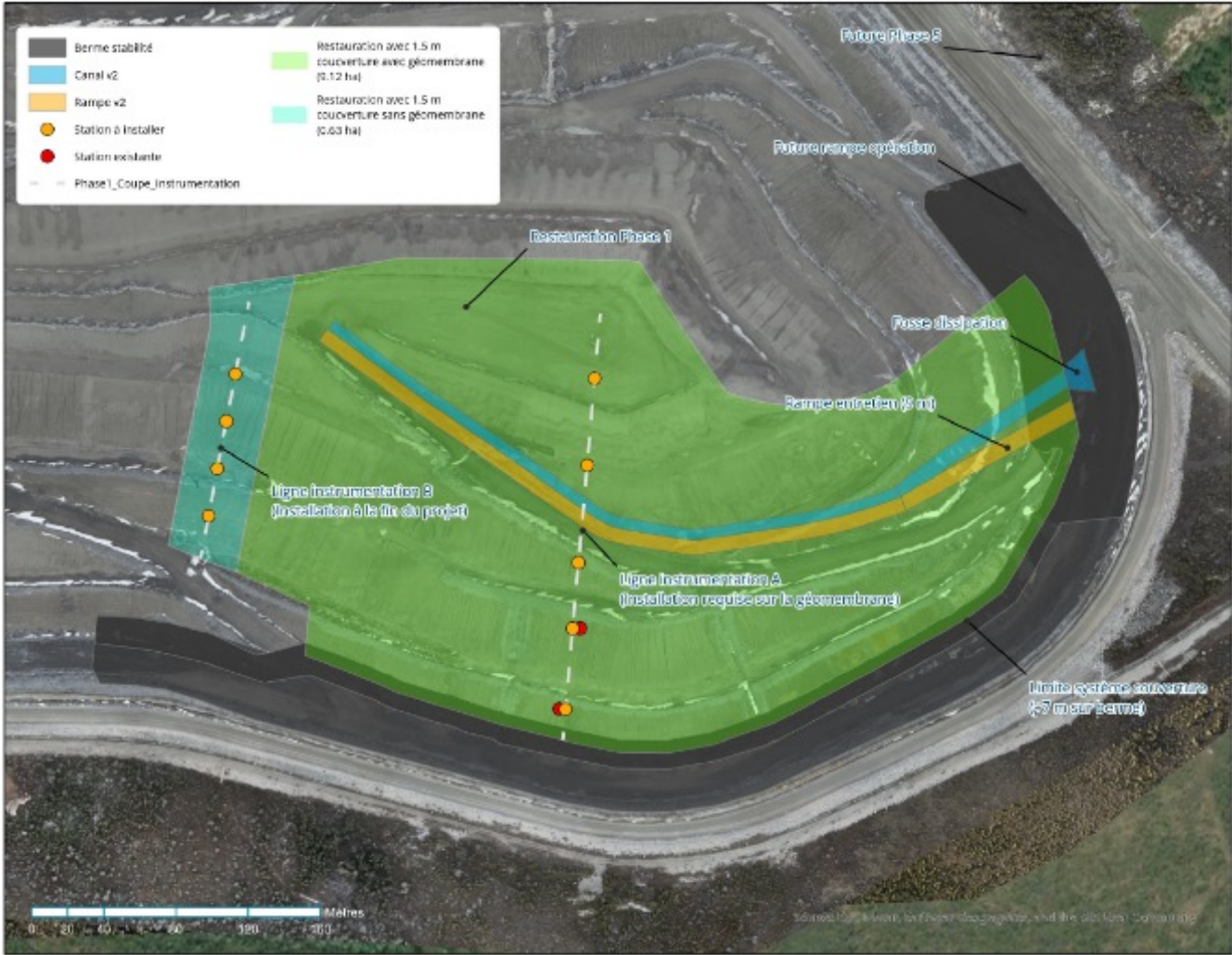
Objectives of the presentation:

*Discuss the challenges encountered during planning of progressive reclamation of the Éléonore Mine TSF.
Share the experience in the hope that the learnings will be helpful for other operations planning progressive reclamation of their sites.*



Reclamation concept

Dhilmar & WSP (2025)



Reclamation concept (cont'd)

Cover construction



Progressive reclamation - Advantages

- Integrated the reclamation concept to operations
- Decrease erosion caused by wind & runoff
- Maintain geotechnical stability (limiting rise of water table)
- Reduce leachate volumes
- Reduce risk (👉 liability & insurance costs)
- Optimise the concept for future reclamation phases
- Improve social acceptability by surrounding communities

Progressive reclamation – Challenges

- Many challenges associated to progressive reclamation
- Four categories presented today:
 - Regulatory
 - Standards & governance
 - Planning, design & operation
 - Financial
- Other challenges not discussed today

Challenges – Regulatory

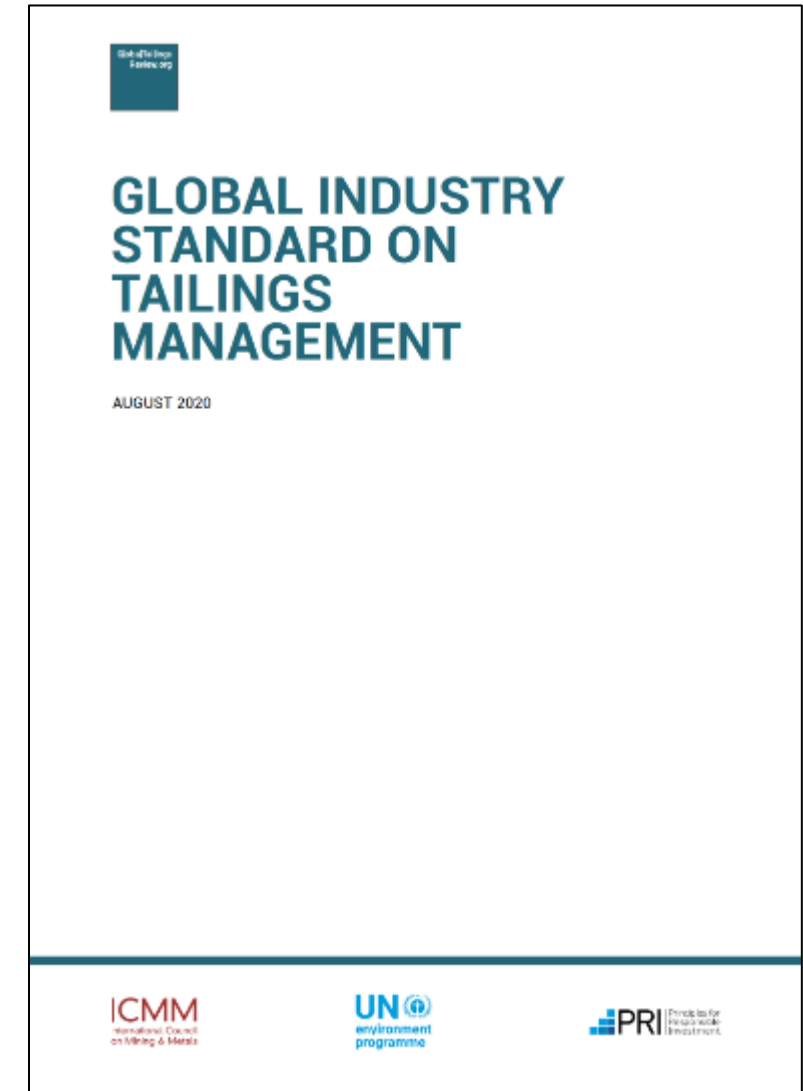
- Initial objective: decrease the amount of water to manage & treat
- According to regulation (Canada & Quebec): Progressive reclamation is not considered actual closure:
 - Requires management of another mine effluent
 - At Éléonore: not optimal considering TSF configuration

Should be planned at the beginning of the TSF design to facilitate integration



Challenges – Standards and gouvernance

- Standards (e.g., GISTM or TSF) and independent reviews (e.g., ITRB & audits) very relevant for industry:
 - Improve transparency & communications
 - Increase knowledge (globally & locally)
 - Reduce risks
- However:
 - Requires time (e.g., preparation, participation, respond to experts, etc.)
 - Many people involved
- Need to communicate early & often to all parties (e.g., owner, designer, operator, RTFE, EOR, communities, etc.)
- Vision, objectives & design criteria should be defined early in the life of the project



Challenges – Planning, Design & Operation

- Questions to ask ourselves:
 - What is the **reclamation vision**? What will be the **final shape** of the landform?
 - What are the **reclamation stages**? Active vs. passive.
 - What are the **simultaneous activities** in the area? E.g., deposition or construction.
 - Are the **services** (e.g., roads, electricity, ditches, pump lines, etc.) placed to help or hinder progressive reclamation?
 - What about **TSF expansion**? Where will it be built?
- Must be fully integrated to the filtered TSF construction cycle.

Challenges – Financial

- Fixed mobilization costs for each reclamation cycle.
- Increase in unit costs (e.g., geomembrane) & wages.
- Changes to:
 - Company (e.g., Newmont to Dhillmar)
 - Personnel
 - Regulations & standards
 - Concept

Final Remarks

- Progressive reclamation is an important & necessary change of paradigm → Many advantages outweigh the challenges:
 - Reduction of environmental impacts (e.g., dust generation)
 - Reduction of risk (geotechnical & geochemical)
 - Optimization of concept
- Clear reclamation objectives are necessary
- Process must start early in the life of the landform and be fully integrated to the landform design
- Remain humble & open to changes



Recommendations

- Communicate early and often, involve all the interested parties in the process
- Do not hesitate to review the concept during operation
- Have the flexibility to adapt to change



Chiniskumitin! Merci! Thank you!

