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Alberta mine reclamation and abandonment requirements

R.H. Houlihan *Energy Resources Conservation Board, Canada*

C.E. Hale *Energy Resources Conservation Board, Canada*

Abstract

Under the umbrella of the Energy Resources Conservation Act, the Energy Resources Conservation Board (ERCB) regulates mine developments by adhering to the Oil Sands and Coal Conservation Acts and associated regulations. Oil sands and coal legislation assist the Government of Alberta in controlling pollution and ensure that both orderly and efficient development and safe and efficient mining practices occur and reflect the public interest. The legislation requires operators to submit applications to commence, suspend, or abandon mining sites, mining operations, and related processing plants; application requirements include conceptual reclamation plans. The ERCB works closely with Alberta Environment (AENV) and Sustainable Resource Development (SRD) in reviewing coal and oil sands mining applications, the operation of approved mines, and the reclamation and abandonment of mines. This paper reviews ERCB processes for mine regulation, Board decisions relating to reclamation and abandonment, and new regulations for tailings at oil sands mining operations. These regulations require fluid tailings accumulations to be reduced and formed into trafficable deposits that are ready for reclamation within five years of deposits being closed.

1 Introduction

In 2010, Alberta had nine active oil sands mines sites that produced approximately 440 million tonnes of oil sands per year from six producing mines and 10 major active coal mine sites that produced approximately 38.5 million tonnes of coal per year. Collectively these mine sites represented a disturbed area of approximately 1,700 km^2, all of which must ultimately be abandoned and reclaimed.

Oil sands mines are located in northeastern Alberta, north of Fort McMurray where oil sands deposits are close to the surface and overburden depths are minimal. Figure 1 is a map of the oil sands mines and the Surface Mineable Area of the Athabasca Oil Sands Deposits. Figure 2 is a map of the coal mines located throughout Central and Southern Alberta.

In 2010, the Surface Mineable Area of the Athabasca Oil Sands Deposit of Alberta had five oil sands mine development approvals for a total of nine mining sites, six of which are oil sands mine developments that produce bitumen. Three of the producing developments have onsite bitumen processing plants and one development sends its bitumen production to a processing plant in Fort Saskatchewan.

In Alberta, the first coal mine commenced operations in 1882, with over 1,800 coal mines known to have been in operation since that time. In 2010, Alberta had 10 active open pit coal mines operating in Central Alberta, with four open pit mines providing coal to power plants, two small mines selling to local consumers, and four coal mines in the foothills and mountains producing for export.

This paper presents an overview of how the oil sands and coal mining industries are regulated in Alberta, with an emphasis on abandonment and reclamation activities.

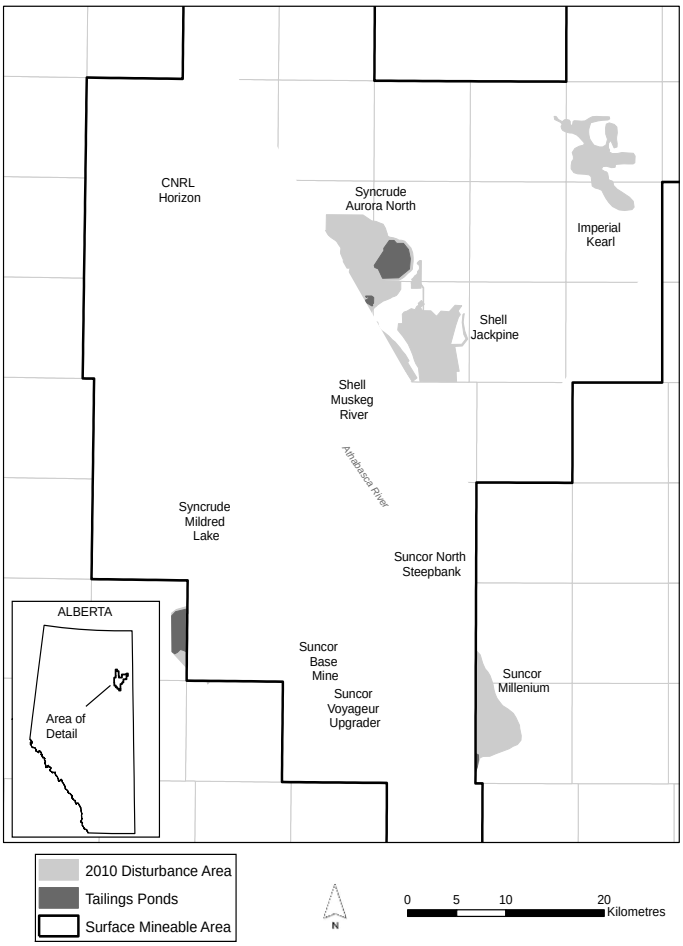

Figure 1 Oil sands mines of the surface mineable area

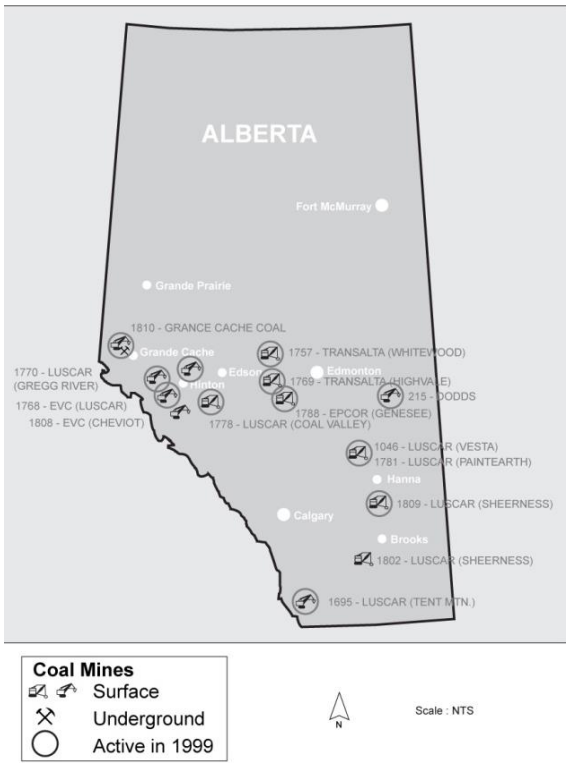

Figure 2 Coal mines of Alberta

2 Regulation of the oil sands and coal mining industry

Primary oversight of the oil sands and coal mining industries is the responsibility of the Energy Resources Conservation Board (ERCB) and Alberta Environment (AENV).

The ERCB regulates oil sands mining operations under the *Oil Sands Conservation Act* (*OSCA*) and the *Oil Sands Conservation Regulations* (*OSCR*), including the construction, operation, suspension, and abandonment of oil sands mine sites, oil sands mines, oil sands extraction plants, and bitumen processing plants. It also regulates coal mining operations under the *Coal Conservation Act* (*CCA*) and the *Coal Conservation Regulations* (*CCR*), including the construction, operation, suspension, and abandonment of coal mine sites, coal mines (both surface and underground), external mine dumps, and coal processing plants.

AENV regulates both oil sands and coal mining operations under the *Environmental Protection and Enhancement Act* (*EPEA*) and the *Water Act* (*WA*). AENV is primarily responsible for managing the environmental aspects of mining operations, including pollution prevention and control, water allocation, use and protection of potable water, conservation and reclamation planning, and the evaluation of air, water, and land for environmental performance reporting. It also administers the Mine Financial Security Program (MFSP), which addresses the financial liabilities associated with the suspension, abandonment, remediation, and surface reclamation of oil sands and coal mines and plants and the care and custody of the land until a reclamation certificate has been issued.

Sustainable Resource Development (SRD) regulates oil sands and coal mining operations under the *Public Lands Act*, the *Forests Act*, and the *Wildlife Act* and acts as the land manager through an approval for mine sites under the *Public Lands Act*. SRD provides advice to, and is represented by, AENV on the environmental management, development, and end land use requirements for mine applications.

The ERCB, AENV, and SRD have distinct responsibilities throughout the oil sands and coal mine development lifecycle, as shown in Figure 3. However, regulatory overlaps occur once a proposed oil sands or coal mining application is filed and remains throughout the operating life of the mine. These areas of overlap have been addressed through *Informational Letter IL 94-19: Dam Safety Accord* and *Informational Letter IL 96-07: Alberta Energy and Utilities Board (EUB)/Alberta Environmental Protection (AEP) Memorandum of Understanding on the Regulation of Oil Sands Developments* and clarify the respective regulatory roles governing, among other things:

- The location, layout, and design of facilities, dumps, and storage sites.
- The need, location, design, construction, and monitoring of impoundment structures such as tailings ponds, settling ponds, and water storage reservoirs.
- Abandonment and reclamation.

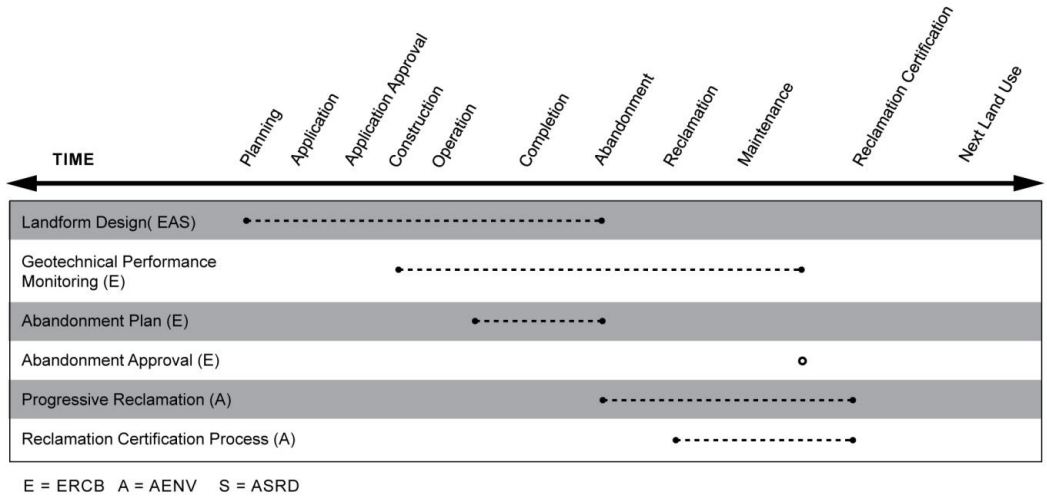

Figure 3 Regulatory process and timelines for oil sands and coal mines

3 Abandonment and reclamation of oil sands and coal mine sites

The ERCB is responsible for approving the abandonment of oil sands and coal mine sites. It defines the abandonment of an oil sands or coal mine site to mean the permanent dismantling of the mine or mine site, carrying out any measures required to ensure that the site is left in a permanently safe and secure condition.

When an oil sands or coal mining operator is ready to abandon all or a portion of its mine site, the operator submits an abandonment plan to the ERCB detailing the abandonment activities it intends to undertake. The ERCB reviews the abandonment plan to ensure that:

- All economically recoverable oil sands or coal has been recovered or conserved.
- All structures will be removed and the site left in a safe and secure, reclaimable condition.
- Monitoring demonstrates that all landforms will be left in a geotechnically stable condition.
- The proposed abandonment plan will meet the end land use considerations, such as those for end-pit lake criteria and landform design, consistent with AENV's requirements.

If all of these conditions have been met, the operator is allowed to begin abandonment work consistent with an AENV approved closure plan. Activities that an operator would be expected to undertake as part of its abandonment plan include:

- Removal of waste material to an appropriate land fill, recycling, or disposal site.
- Decommissioning and removal of surface facilities, including removal of foundations and monitoring installations.
- Remediation of tailings ponds to leave them with a trafficable surface.
- Removal or breaching of all above surface impoundment structures.
- Breaching mine pits or allowing the pits to be filled with water to serve as end-pit lakes.
- Leaving high walls, dumps, and slopes in a geotechnically safe and secure manner.
- Landform design contouring to achieve land use objectives, including watershed design, through activities such as the removal of benching or access.

An example of an overburden structure that was assessed by the ERCB to be suitable for abandonment is Syncrude's Gateway Hill at the Mildred Lake Oil Sands Mine (Figure 4).

Figure 4 Syncrude's gateway hill at the Mildred Lake Oil Sands Mine

An example of a coal mine that was assessed by the ERCB as suitable for abandonment is the Gregg River Coal mine (Figure 5).

Figure 5 Gregg River Coal Mine structure

Once abandonment work is completed, the ERCB ensures that this work was completed in accordance with the abandonment plan.

At this point, AENV governs reclamation of the site to ensure that it meets its approved closure plan and its *EPEA* approval requirements, recognising that reclamation activities occur during mine development and throughout the course of abandonment.

The objective of land reclamation is to return the land to "an equivalent land capability." This means that the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical.

Land reclamation activities include:

- Stabilisation, contouring, maintenance, and conditioning.
- Watershed design and controls to prevent erosion.
- Replacement of topsoil.
- Revegetation.

Once reclamation is complete, monitoring activities begin. Depending on the dump design, it can take many years to demonstrate that a landform is acceptably stable. If a landform is acceptably stable, the ERCB authorises abandonment. AENV issues reclamation certificates when monitoring demonstrates that the reclaimed land meets its approval requirements, including objectives for sustainable and equivalent land capability. Several Alberta coal mines have been approved for abandonment and certified by AENV as reclaimed.

4 Directive 074: tailings performance criteria and requirements for oil sands mining schemes

The management of tailings ponds is a significant issue when abandoning and reclaiming mining sites, particularly oil sands mining sites. Volumes of fluid tailings generated by the oil sands mining industry were growing and needed to be addressed. In 2009, the ERCB released *Directive 074: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes* to address these growing volumes, with the aim of reducing the volume of fluid tailings stored over the long term (Houlihan and Mian, 2008; Houlihan et al.,

2010). The directive, prepared in collaboration with AENV, and copies of the tailings plans submitted to the ERCB can be found on the ERCB's website at www.ercb.ca.

Figure 6 shows the total projected fluid tailings volume of oil sands mine developments that have accumulated to date and how, with *Directive 074* and approved tailings plans, the rate of fluid tailings accumulation is predicted to decrease over time, even though the overall volume will continue to increase.

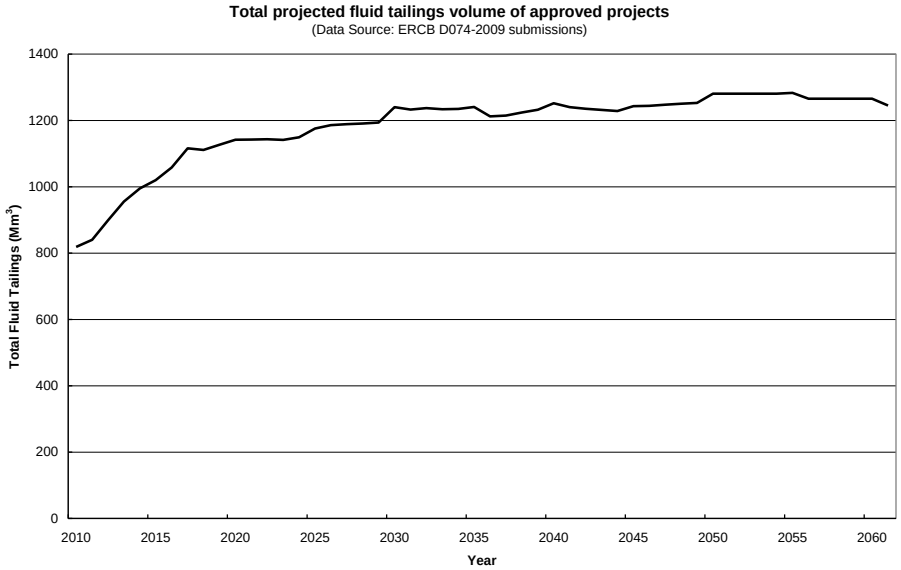

Figure 6 Total projected fluid tailings volume of approved projects

A key element of *Directive 074* is to require mining operators to develop dedicated disposal areas (DDAs) to reduce the volume of fluid tailings and form trafficable deposits ready for reclamation. DDAs must capture 50% by weight of the fines in the oil sands processed. Fines are defined as mineral solids with particle sizes equal to or less than 44 micrometres. The fines captured in the DDAs are in addition to the fines captured in hydraulically placed sand dikes and beaches.

DDAs must be formed in a manner that ensures trafficable deposits in accordance with the following criteria:

- Minimum undrained shear strength of 5 kilopascals (kPa) for the material deposited in the previous year (a value of 5 kPa was chosen to ensure that the DDA deposit material was no longer in the fluid phase).
- Removal or remediation of material deposited in the previous year that does not meet the 5 kPa requirement.
- Deposit ready for reclamation within five years after active deposition has ceased.
- Deposit will have the strength, stability, and structure necessary to establish a trafficable surface.
- The trafficable surface layer must have a minimum undrained shear strength of 10 kPa.

Figure 7 is an example of a tailings pond in the process of being reclaimed. In this example, Suncor removed the fluid tailings that had been stored within its Pond One and refilled the pond with tailings sand and overburden materials to create a trafficable surface.

Although an operator can accomplish the *Directive 074* requirements with one technology, the ERCB encourages a suite of technologies be adopted to mitigate implementation risk factors and increase operational flexibility.

The ERCB requires operators to file applications to abandon DDAs after the trafficable surface layer has been achieved. Further details and reporting requirements are contained in the directive.

2004 2010

Figure 7 Suncor's Pond One during operations and after reclamation

Directive 074 is a first step in reducing fluid tailings accumulations at oil sands mining sites. Over the next several years, government policy is expected to provide further direction to regulators. Information gathered through performance compliances will be used to consider future updates and revisions to the directive to better reflect DDA material characteristics and address the large volumes of existing fluid tailings. Based on current oil sands development applications, Figure 8 shows tailings ponds planned for oil sands mines in 2020.

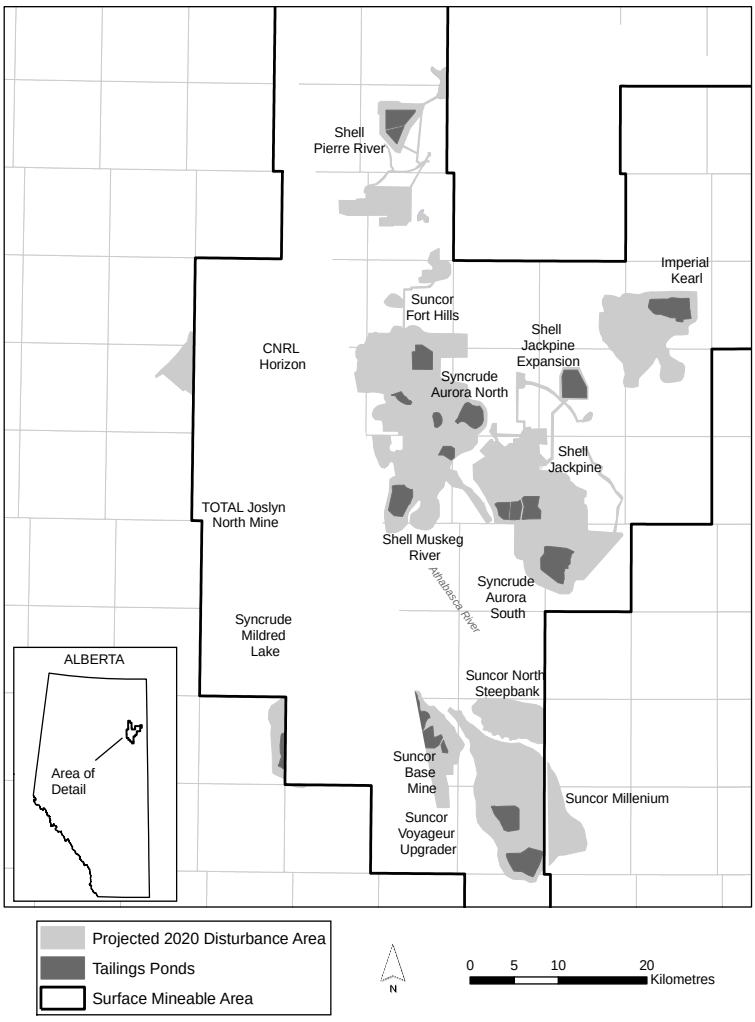

Figure 8 Tailings ponds planned for oil sands mines in 2020

5 Conclusions

The ERCB and AENV are the primary regulators responsible for overseeing oil sands and coal mining operations. The ERCB has the primary responsibility for the abandonment of oil sands and coal mining sites, while AENV has the primary responsibility for their reclamation, assessment, and certification.

Managing fluid tailings ponds is a significant issue when abandoning and reclaiming mining sites, particularly oil sands mining sites. *Directive 074* was introduced in 2009 to address the growing volumes of fluid tailings being generated by the oil sands mining industry, and the need to restrict the growth and ultimately to reduce the volume of fluid tailings being stored over the long term.

The ERCB continues collaborative efforts with other Alberta Government agencies and multi-stakeholders on tailings management, end pit lakes, dike, and dam management that will clarify future stewardship strategies to improve environmental outcomes.

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References

Houlihan, R. and Mian, H. (2008) Past, Present, Future Tailings Regulatory Perspective. First International Oil Sands Tailings Conference, Edmonton, Canada, December 2008.

Houlihan, R.H., Mian, M.H. and Lord, E.R. (2010) Oil sands tailings - technology developments and regulations. Proceedings 13th International Seminar on Paste and Thickened Tailings (Paste2010), R.J. Jewell and A.B. Fourie (eds), 3–6 May 2010, Toronto, Canada, Australian Centre for Geomechanics, Perth, pp 423–435.