AN INTRODUCTION TO CONSERVATION AND RECLAMATION AT
ALBERTA’S MINEABLE OIL SANDS

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ABSTRACT

Alberta’s mineable oil sands have been discussed in every possible media forum and from various
perspectives. This paper is intended to provide a balanced view of the conservation and reclamation
issues and challenges faced in mineable oil sands development. A brief introduction to the mines, the
provincial regulatory foundation, and some of the operational issues associated with oil sands mining will
be provided.

This paper will also define some of the key words and phrases relevant to conservation and reclamation in
the mineable oil sands, provide summary statistics on land disturbed and reclaimed in the region (with a
description of the challenges associated with reporting those data), and offer a general description of the
process of conservation and reclamation planning and operations. Challenges specific to conservation
and reclamation activities at the mineable oil sands such as long timeframes, large scale, regional
planning and integration, competing land use goals, revegetation, byproduct management, tailings, and
process-affected water will be outlined. Some of the successes and potential solutions to these challenges
will also be discussed including reference to multi-stakeholder forums, research and monitoring,
reclamation certification, and regulatory adaptive management.

KEY WORDS

Mining, oilsands, tailings, tar sands, bitumen, multi-stakeholder forums, reclamation certification

INTRODUCTION

Alberta’s oil sands are comprised of three different deposits in the Athabasca, Peace River and Cold Lake
regions. There is an estimated 1.7 trillion barrels of bitumen in Alberta’s oil sands deposits. Based on
existing technologies, about 173 billion barrels are recoverable – enough to produce 2.5 million barrels
per day (bbl/d) for 190 years (Government of Alberta 2008b). In 2006 production reached 1.126 million
bbl/d and some estimate that production could reach 3.0 million bbl/d by 2020 and possibly even
5.0 million bbl/d by 2030 (Government of Alberta 2009).

Oil sands are naturally occurring mixtures of sand and clay, water, and a thick, heavy type of petroleum
called bitumen. In Alberta, bitumen is recovered in two ways. Relatively shallow oil sands in the
Athabasca region are mined by truck and shovel creating pits up to 80 metres deep. Deeper deposits
within each of the three oil sands regions are primarily accessed using a system of horizontal wells and
steam to extract the bitumen from the sand and pump it to the surface. Approximately 80% of Alberta’s
recoverable oil sands will be extracted through in situ technologies, while only 20% is recoverable by
mining (Government of Alberta 2008a). Individual insitu operations have a smaller footprint on the landscape than mines and do not produce tailings ponds. However, due to the potential for extensive future insitu development, the footprint of insitu facilities will accumulate over time.

Under Alberta Environment’s (AENV’s) Environmental Protection and Enhancement Act (EPEA) there are currently seven approvals issued to oil sands mine operators for the construction, operation, and reclamation of mines and associated processing facilities. There are numerous applications for new mines and facilities, expansions, and renewals currently within the regulatory process. EPEA is the regulatory Act through which impacts to air, water quality, land and waste management are regulated (Government of Alberta 2003a). AENV’s Water Act (Government of Alberta 2003b) regulates water withdrawals, usage, release, and diversions.

Alberta Environment works closely with a sister department, Alberta Sustainable Resource Development (ASRD) whose mandate is the conservation and management of fish and wildlife, forestry, and public lands. They deal with land use issues and regulate under several Acts. ASRD has expertise that AENV relies upon in the technical review of project applications and plans, and in field inspections.

EPEA outlines the regulatory process followed for project applications and Environmental Impact Assessments. These applications require detailed information about conservation and reclamation activities and conceptual life of mine closure plans. Applications are reviewed by a variety of specialists within AENV and ASRD and approvals that are issued for a project may cover a variety of activities and issues.

Under EPEA there is a duty to conserve and reclaim land used for oil sands mining and processing and there is a requirement for the oil sands mine operators to obtain a reclamation certificate. The Conservation and Reclamation Regulation of EPEA indicates that the objective of conservation and reclamation is to return the land to an equivalent land capability (Government of Alberta 1993).

Land reclamation is essentially the reconditioning of the land to a state fit for its former or other future uses, and includes the stabilization, contouring, maintenance, conditioning, reconstruction and revegetation of the surface of the land (Powter 2002). Equivalent land capability 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” (Government of Alberta 1993). Land capability is typically assessed using “an evaluation of the physical, chemical and biological characteristics of the land, including topography, drainage, hydrology, soils and vegetation” (Government of Alberta 1993).

**CHALLENGES**

By the end of 2007, approximately 53,000 ha of land were cleared of trees or disturbed by oil sands mining, while approximately 6,500 ha had been reclaimed (as reported by the mineable oil sands operators in the 2008 annual reclamation progress tracking reports submitted to AENV). In March 2008,
106 ha of reclaimed land were certified by the Government of Alberta (the Government), meaning that the land has met the requirements for reclamation and has been returned to the Crown.

When tracking disturbance and reclamation at the oil sands mines, it has been found that consistent definitions are very important. Even something as simple as defining ‘land disturbed’ or ‘land reclaimed’ has its challenges. For example, does using the term ‘reclaimed’ mean that all soils are placed, and all the trees and shrubs are planted? Does it mean all physical work is complete and now the land is being monitored? Most operators have historically defined land as ‘reclaimed’ when soils have been placed, because this represents the most significant portion of the work and cost associated with reclamation. It is likely more appropriate to use the word ‘reclaimed’ when all reclamation activities are complete, including revegetation. Without consistent definitions the value of the information being reported by the operators to the Government and the public is difficult to compare from the regional perspective. The Government and the mineable oil sands operators are working together to better define the categories for tracking disturbance and reclamation across the region. This will include better representation of the age of land defined as ‘reclaimed’, as it is likely not appropriate to represent 20 year old ‘reclaimed’ land and 2 year old ‘reclaimed’ land as equal.

There are numerous reasons why more reclaimed land has not yet been certified by the Government; the primary reason is that operators are not applying for reclamation certificates. Once landforms are completed, soils are placed and vegetation is established, it is in both the operator’s and the Government’s best interest to ensure the land is on the trajectory towards a self-sustaining, locally common boreal forest ecosystem. In addition, much of the older reclamation that has well-established vegetation is still within the operational area of the mines, and public accessibility and safety would be an issue. Due to continued operations in the vicinity, companies may require access to reclaimed lands, or may need to re-disturb a portion of reclaimed lands, further limiting applications for reclamation certification at this time.

Notwithstanding the definition provided in the Conservation and Reclamation Regulation, there remains a question regarding what equivalent land capability means and how it will be assessed at certification. There are generally commonly agreed upon goals and objectives for reclamation but discussions about criteria and indicators for some of those goals and objectives continue. In the absence of some of these criteria and indicators, regulators and operators are working together to ensure appropriate plans for reclamation and closure are developed that are consistent with current EPEA approval requirements and guidelines related to soils, revegetation, and wetlands reclamation. As well, numerous plans for conservation and reclamation activities require authorization by the Government before they can be implemented by operators.

The process of oil sands mining is long and complicated and many of the activities, from beginning to end, can have a major impact on conservation and reclamation success. The process typically follows the path outlined in Figure 1 (although various activities occur concurrently): mine planning, conservation and reclamation planning, tree clearing, wetland drainage, soil salvage, storage or direct placement, overburden removal, mining of oil sands, landform construction (using overburden and tailings sand), soil placement, revegetation, monitoring, and certification. Oil sands mining represents a significant long-
term disturbance in northeastern Alberta and it is important to plan appropriately, as reclamation is the key mitigation for impacts to the land.

An EPEA approval is typically issued for a 10-year period. An oil sands mine may operate for 50 to 100 years as resources in one area are depleted, the land is reclaimed, and new areas within the project footprint are mined. During this period of time public and Government expectations will change, and adaptive management will need to be incorporated into EPEA approval requirements. One of the current EPEA approvals for an oil sands mine is 104 pages long, with 30 pages of conservation and reclamation clauses, including clauses related to tailings reclamation, wetlands reclamation, fish and wildlife habitat establishment, soil salvage and placement, revegetation, long-term reclamation and conceptual closure planning, and annual reporting. One of the challenges that may arise at certification is determining what standards and criteria will apply to any individual portion of land. It will likely be challenging for the operators to keep track of what land was disturbed and reclaimed during which approval period and what plans and guidelines were in place during that time. Keeping detailed and accurate records is very important. Spatial information systems may aid in tracking this type of information over time.

Figure 1. A typical mine conservation and reclamation planning process.

Some land may remain disturbed by oil sands mining for a significant period of time (e.g., tailings ponds and plant sites) whereas other landforms (e.g., overburden dumps) may be progressively reclaimed relatively quickly following construction. Tailings ponds, which account for a large area of the
disturbance, are typically operational for around 30 years. Utilization of tailings technologies such as consolidated tailings (CT) placed in-pit, may significantly reduce the time to reclamation. The length of time from initial disturbance through to certification may be very long, and monitoring after reclamation could take decades - at least until greater certainty is achieved with respect to reclamation performance on challenging materials such as fine tailings. The first tailings pond is targeted for terrestrial reclamation by the end of 2010 and the first pit lake will be capped with fresh water beginning in 2012.

One of the key challenges operators face in reclamation planning is spatial and temporal integration. Integration with adjacent operators remains the biggest challenge, where landform and landscape level design to a natural appearance, with integrated drainage and vegetation, poses challenges for planning, operational scheduling, and of course, liability. Integration with surrounding undisturbed land is less of a challenge but just as important. In the past, plans for integration between neighboring oil sands mining operations have been very conceptual and over the past few years, the Government has raised this as a significant concern that needs to be better addressed by the oil sands mine operators.

Most of the oil sands mines have the EPEA approval requirement to submit an updated mine reclamation plan and conceptual closure plan by December 2011. By providing a consistent date and sufficient lead-time for the operators to develop these updated plans, the Government expects that these plans will be better coordinated and integrated within individual lease boundaries, and also with adjacent lease holder’s boundaries and natural areas. The Government is working with the operators in advance to ensure a common understanding of the Government’s expectations in the development of these plans. These reclamation and conceptual life of mine closure plans will address all aspects of reclamation and closure including geotechnical stability, surface water, groundwater, wetlands, end pit lakes, soils, vegetation, fish and wildlife, land use, and integration of landforms, topography, vegetation, waterbodies, and watercourses within the lease and with adjacent leases and natural areas.

End land uses often overlap and are sometimes complementary; they are rarely, if ever, independent of each other. A commercial forestry end land use may provide for wildlife and traditional use while the trees are growing, and a wetland, as a component of a non-commercial forest, may provide for both wildlife and traditional use throughout its life. This sometimes poses challenges for the Government and operators in communicating reclamation objectives and in determining which reclamation criteria to apply in assessing success.

ASRD does not allow for the use of non-native species in reclamation, and there is increasingly reduced opportunity for natural ingress due to the regional extent of disturbance. There is concern that the demand for future native seeds will eventually be greater than the supply. Considerable research has been undertaken on the propagation and establishment of some native species (Geographic Dynamics Corp. 2002; Smreciu and Gould 2003), and although some species are successful, others are not. The Canadian Oil Sands Network for Research and Development (CONRAD) Environmental and Reclamation Research Group (ERRG) is in the early stages of developing a seed co-op in the region and the future could see the expansion of seed collection and storage capacity of native seeds, including the development of seed orchards for specific species. The use of upland surface soil, including the LFH layer, as a propagule source is most successful when the soils are salvaged and immediately placed, not
stockpiled. The Government is now requiring the salvage of all upland surface soil and is encouraging the oil sands mine operators to use it through direct placement whenever opportunities arise, rather than stockpiling it for future use.

Coke and sulphur are byproducts of the oil sands upgrading process and they must be properly managed. The Energy Resources Conservation Board (ERCB) considers coke to be an energy resource as it is primarily carbon, and it must be stored (or reclaimed) so that future access to the product is possible. Sulphur is also considered a resource that must be conserved, and as such, it is sold on the market or stockpiled for future sale. AENV and ERCB collaborate on the regulation of these two byproducts and research and monitoring for any potential impacts of long-term storage of these byproducts in the environment is currently underway.

Tailings are another byproduct of oil sands processing and they can vary depending on the technology used at the facility. At the end of 2007, about 25% of the land disturbed by oil sands mining was occupied by tailings ponds (including both out-of-pit and in-pit tailings) (Government of Alberta 2008b). Tailings are contained in ponds which serve four basic functions: a place to store water for recycling and reuse in the oil sands extraction process; a settling pond (which through time allows water to separate from the sands and fines); a disposal area for coarse and fine tailings; and a place to contain potential contaminants during operations (Government of Alberta 2008b). Coarse tailings sand is used in dyke construction and is placed in out-of-pit disposal areas until mined out pits (e.g., in-pit disposal areas) become available. The mature fine tailings (clays and silts) consolidate to approximately 30% to 35% solids relatively quickly, but then may take anywhere from a few decades to a century to further settle to a material with sufficient strength for terrestrial reclamation (Fine Tailings Fundamentals Consortium 1995). Recently incorporated technology includes the mixing of mature fine tailings (MFT) or thickened tailings (TT) with chemical coagulants (e.g., gypsum is often used) and coarse tailings sand to produce composite or consolidated tailings (CT). This technology is used to bring the fine tailings to a trafficable surface much sooner (potentially within 3 to 5 years) by enabling the excess water to be released from the fines. The ERCB recently released a Directive on tailings which requires operators to manage dedicated tailings ponds in a manner such that they become trafficable surfaces quickly (Energy Resources Conservation Board 2009). Tailings technologies are largely unproven at a large scale and over a long period of time, however current mine and reclamation plans are generally based on these technologies.

Process-affected water, which is a result of the processing of the bitumen, may contain polycyclic aromatic hydrocarbons (PAH’s), naphthenic acids, salts and residual bitumen. Due to continued recycle and reuse of process affected water through the extraction process, these compounds tend to concentrate. Currently, AENV does not allow process-affected water to flow from any of the oil sands mine sites into the environment and all water is maintained within a closed circuit system. This means that long-term management and storage of the water by operators is required, and sometimes finding the space for holding this water is a challenge. In the future, reclaimed lands will need to be integrated with adjacent lands, meaning that the drainage systems will need to be integrated as well. Process-affected water will need to be treated or managed through wetlands for example, in order to meet water quality criteria for release.
End pit lakes are typically expected at the end of mine life. However, their contents will influence their success. At this point, many mine closure plans indicate that end pit lakes will have residual mature fine tailings placed at the bottom, with a fresh water cap placed on top. This process is unproven, with the exception of one pit lake in the region that will be used as a demonstration site, starting in 2012. The end goal is that they become self-sustaining water bodies with water quality that meets release criteria so that they can have inflows and outflows integrated with the surrounding drainage system.

**SUCCESSES**

Within the mineable oil sands region, multi-stakeholder forums are key to the progression of monitoring, research and development, and the sharing of knowledge and information. These multi-stakeholder forums are typically funded by industry, but are made up of government, First Nations, Métis, industry, and non-governmental organizations that live or work within the region.

The Wood Buffalo Environmental Association (WBEA) (www.wbea.org) monitors air quality across the region. The Regional Aquatics Monitoring Program (RAMP) (www.ramp-alberta.org) integrates and shares the information from aquatic monitoring activities by the different operators. The Cumulative Environmental Management Association (CEMA) (www.cemaonline.ca) studies the cumulative effects of industrial development in the region and develops guidelines and management frameworks to recommend to the Government of Alberta. CEMA looks at impacts to air, water, and land across the region and is currently looking at developing more criteria and indicators for reclamation. The Canadian Oil Sands Network for Research and Development (CONRAD) Environmental and Reclamation Research Group (ERRG) (www.conrad-errg.ca) is an industry-only forum for research and development addressing the conservation and reclamation challenges faced by oil sands mine operators. Recently, the Government has established the Oil Sands Research and Information Network, administered through the University of Alberta, providing them with a $4.5 million grant. They will focus on developing an integrated research program on oil sands tailings and reclamation.

Key products of the emerging knowledge on conservation and reclamation activities are the development and revisions of important decision and regulatory support tools including frameworks, guidelines and manuals which assist reclamation planning and operations. Frameworks have been developed for the assessment of pre-disturbance and reclaimed soil capability specific to the oil sands region (Alberta Environment 2006) and for landscape design (Landscape Design Subgroup 2005). Guidelines for the reclamation of terrestrial (OSVRC 1998) and wetland (Alberta Environment 2008) habitats represent best management practices for planning and executing reclamation in the oil sands. Additional resources are available (www.cemaonline.ca) and are in development, including a best management practices manual for soil salvage, storage and placement.

Reclamation research and operational field trials have been occurring for decades (Macyk and Kwiatkowski 2008) with success. Topics include revegetation, soil salvage, stockpiling and placement, tailings reclamation, end pit lakes, wetlands, biodiversity and wildlife, and traditional ecological knowledge. Some of the research topics are specifically outlined within the oil sands mine operators’ EPEA approvals.
In March 2008 the first reclamation certificate was issued to Syncrude Canada Ltd. for a 106 ha parcel of land known as Gateway Hill. The overburden dump was one of the first overburden dumps associated with the original Syncrude mine area.

Through EPEA approval renewals and major project amendments, AENV, in cooperation with ASRD, have implemented the concept of adaptive management, using the learnings gathered through research and monitoring in the region, to implement new soil salvage and placement requirements. These new requirements (since 2007) require operators to salvage all upland surface soil and all upland subsoil rated good or fair (based on soil chemical and physical parameters), placing a high preference on using direct placement as a means to maintain the value of the plant propagules in the surface soil. The majority of the reclamation in the region however, will be done with a blend of peat and mineral soil, due to the prevalence of peatlands in the pre-disturbance landscape.

Alberta Environment is currently working with the oil sands mine operators to develop a more consistent format for conservation and reclamation reporting across the region including development of definitions related to disturbance and reclamation tracking. This consistency will make it much easier for AENV to make the information more accessible through a public website, and it will allow for comparison among the oil sands mine operators. As well, AENV is working on developing a geospatial database system that will allow for even better access to company reclamation and closure plans and disturbance and reclamation tracking, both requisites for regional assessments including cumulative effects management.

REFERENCES


