OIL SANDS RECLAMATION
Associated challenges and mechanisms ensuring compliance

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Cover Photos:


Centre: Typical Shovel and Hauling Truck Working in an Oil Sands Mine Site. Courtesy of Syncrude Canada Inc.

Right: Reclaimed Section of Oil Sands Mine Site. Courtesy of Syncrude Canada Inc.
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1.0 Executive Summary

Land reclamation within the Alberta oil sands area north of Ft. McMurray offers formidable challenges due to the complexity associated with restoring biophysical contaminated sites, and human use components to a standard as close to the pre-disturbance state as possible. As a result, the reclamation process is a costly and time-consuming endeavour. Several mechanisms have been established that ensure reclamation is conducted in a timely and effective manner throughout the life cycle. The primary objectives of this study are to identify these challenges and mechanisms associated with the reclamation process in the Athabasca oil sands area north of Ft. McMurray, Alberta. An evaluation of the progress to date, along with identification of long-term concerns are also addressed.
2.0 Introduction

What is preventing Athabasca oil sands development from becoming the largest unreclaimed area in Canada? There have been many occasions in a variety of industrial sectors where companies have gone bankrupt and left a costly reclamation burden as their legacy, exemplifying the polar opposite of what is considered ‘sustainable development’. The concern over these abandoned industrial cites is of such concern, that it received special attention from the Canadian government in a recent speech from the throne:

“[The Federal Government] will undertake a 10-year, $3.5 billion program to clean up contaminated sites for which the Government is responsible. And the Government of Canada will augment this with a $500 million program of similar duration to do its part in the remediation of certain other sites, notably the Sydney tar ponds.”

Albertans in particular enjoy the economic benefits associated with oil sands development. However, what is preventing a similar throne speech from being announced long after the days of the black gold rush is over?

3.0 Primary Objectives

In order to achieve a greater understanding of the complexities of reclaiming oil sands mine sites, the primary challenges associated with the reclamation process will be identified. Subsequently, the mechanisms associated with land reclamation and as they pertain to the Athabasca oil sands north of Ft. McMurray, Alberta, area will be identified. These will include a review of Alberta provincial departments that legislate, regulate and enforce oil sands reclamation. From here, an assessment of the future risk associated with transferring reclamation liabilities from industry to the government and ultimately future tax paying Albertans will be provided.
4.0 Oil Sands Background

Oil sands were first identified by first nation people of the north, who used the bitumen found in outcroppings along the Athabasca River on their canoes.\(^2\) Early explorers also noted the bitumen outcroppings, but it was not until the mid 1930’s when oil began to be extracted from the oil sands by Absands Oil Limited. Today, the oil sands have been well mapped (Figure 1) and are estimated to contain an estimated 1.6 trillion barrels of bitumen.\(^3\) Of the 77,600 km\(^2\) area that includes oil sands, only 20% of is recoverable using surface mining.\(^4\) Surface mining is limited to the area north of Ft. McMurray (Figure 1) where overburden is generally less than 75 m.\(^5\) Where technology allows, the remaining 80% of the oil sands extract oil using drilling processes, such as Cyclic steam stimulation (CSS) and Steam Assisted Gravity Drainage (SAGD) processes.

Figure 1. Map of the Alberta oil sands and the operating leases in the Athabasca oil sand area.
5.0 Primary Reclamation Challenges

5.1 Geology
The geological formations composed of Clearwater formation, glacial sediments and recent sediments. During the mining phase of the oil extraction process, overburden is transferred to holding areas and drawn upon during the reclamation phase when the mine site is being back-filled. The transfer of overburden mixes the various geological layers, and thus cannot be reconstructed. The impacts of this reality relate to changes in the ground water flow, direction, and quality. In addition, the process of backfilling the mine leads to an overall increase in overall volume of material than in that of the material prior to disturbance. Thus, contouring the landscape will also pose as a potential challenge.

5.2 Ground Water
Two primary ground water issues arise as a result of reclaiming oil sand mines. First, ground water flow is closely associated with geological formations. Thus, the movement of ground water will likely change considerably once the mine site has been back filled. Ground water in reclaimed areas have not been fully recharged, so the true impacts of ground water alterations have yet to be determined. It is likely that the water table will either rise or fall, which will influence flow patterns, such as rate, volume and direction. Of primary concern is the 100-fold increase in permeability of sand once bitumen has been extracted. Lowered water tables have a direct impact on vegetation productivity following site reclamation. Second, the ground water system has the potential of becoming contaminated if leachates from tailing ponds enter the system. Manipulating ground water quality and flow have trans-boundary implications to surrounding waterbodies. For example, alterations of ground water flow rate and direction will
impact wetland recharging. Pre-disturbance quality of ground water ranged from 1,000 to 30,000 mg of saline per litre depending on the ground water zone, but the salinity of groundwater post site reclamation will be difficult to predict.

5.2.1 Tailing Ponds

Tailing ponds are created as dumping sites for waste created during several stages of oil recovery from bitumen deposits. Residual water and particulates separated from the oil are generally stored in large tailing ponds and combined with gypsum to allow consolidation of material. These ponds have high pH levels (8.4-9.3), and high pollutant concentrations, including: oil, sulphates, phenols, and iron. Currently, the plan is to cover these tailing ponds with overburden and revegetate these areas. The primary challenges with reclaiming these areas are associated with leachate transfer into groundwater and adjacent waterbodies. No plans are currently in place to ‘cap’ abandoned tailings pond as a measure to prevent leaching from occurring.

5.3 Rivers, Lakes and Wetlands

The Athabasca River is located adjacent to Syncrude lease areas, and several primary and secondary rivers and streams run through Syncrude lease areas, including: Beaver Creek, Muskeg River, Dover River and Mackay River. In addition, a number of different classes of wetlands also are present in the Syncrude lease area. In most cases, primary rivers are diverted (e.g. Beaver Creek), whereas secondary rivers and wetlands are typically removed altogether. The reclamation process is will require the development of a watershed plan, that will include the creation of new wetlands, re-establish diverted rivers and streams, and establish new flowing
water corridors. The planning phase of the watershed recovery will likely be relatively complex, and the contouring will likely be costly.

5.4 Soils

Soil type and depth are a function of two components: parent material and time. The spoil type varies considerably from one area to another and can change on a micro-site level. In the Syncrude lease area, approximately 80% of the soil was originally composed of orthic grey luvisols, organic, and organic cryosols, the remainder of which was composed of eluviated dystric, eluviated eutric brunisols, brunisolic gray luvisols, and gleyosolic soils. In addition, characteristics of these soils tend to vary in terms of their porosity, microbial community composition, and layering structure. Although overburden soil layers are separated and stored for eventual reclamation, the complexities of soil characteristics will be homogenized. Ultimately, this will affect the productivity of the landscape following site reclamation. Given that the soil located here is generally classified from a land capability of class 3 to class 7, which indicates a moderate to very low land capability, revegetation of the disturbed landscape may be intrinsically difficult.

5.5 Forest Lands

The Syncrude lease area lies within the boreal forest natural region. A large proportion of the oil sand lease area north of Ft. McMurray was originally composed of upland boreal forest, ranging from generally stand classifications of aspen dominated stands, to mixedwood stands of aspen and spruce, to spruce dominates stands. These stands tend to be composed of a mosaic of stand types and ages that resulted from a history of fire dynamics that was present since the last
glaciations. The dominant tree species found in the upland areas include trembling aspen, balsam poplar, white spruce, paper birch, balsam fir, Jack pine. From a forest harvesting industry perspective, these forest landscapes were originally classified as fair to medium in terms of productivity capability. The remainder of the forested landscape was composed of lowland boreal forest generally referred to as muskeg. These stands are often limited to areas of poor water drainage, but the stand ages are determined by fire dynamics. Black spruce and tamarack dominate these areas, and are typically classified as unmerchantable from a forestry perspective.

The primary challenge for reclamation will be to revegetate disturbed lands to a level of diversity and productivity that was present prior to disturbance. Establishment of upland boreal forest communities will likely be attainable. However, establishment of muskeg communities will not be attainable due to the challenges associated with emulating complex hydrological regimes associated with this community type. A review of the Syncrude environmental impact assessments did not lead to any studies conducted on non-tree flora, but given what we know now of the vascular and non-vascular plant species living in the oil sands area, there should be adequate sources of information from which to draw on for the re-vegetation component of the site reclamation. As with any human induced forest disturbance and subsequent revegetation attempts, the tendency is for homogenization of forest stand characteristics (e.g. stand age, species diversity, and stand structure), and introduction of exotic plant species.

5.6 Fish and Wildlife

Although the boreal forest natural region is composed of only nine tree species, this region is home to the largest diversity of birds in North America. Surveys prior to site disturbance
identified 197 species of birds in the area of Syncrude Canada Ltd. lease 17, and identified the area as a primary migratory route for waterbirds. This diversity is due to a number of factors, including: abundance of forage, high diversity of stand ages and types created by varying topography and fire history dynamics. A total of 44 mammal species have also been identified in the oil sands area. A total of approximately 23 to 27 fish species reside in the oil sands area, over 191 taxa of phytoplankton, and well over 50 taxa of benthic invertebrates.

Fish and wildlife diversity is highly related to habitat heterogeneity. Given the complexities of undisturbed habitat, the challenges of providing suitable habitat following mine site decommissioning is formidable. The direct result is a loss of habitat diversity and subsequent species richness and abundance. This poses a formidable challenge when reforestation the uplands and re-establishing a watershed system. Generally, time is the best healer for community re-establishment; however, this process can be improved and accelerated by the inclusion of heterogeneous habitat elements, such as mixed forest stand age and types, convoluted wetland shorelines, and varied topography. Species associated with muskegs, such as orchids and non-vascular species will not have the opportunity to re-establish themselves in reclaimed areas, since re-establishing muskeg stands is not possible given today knowledge.

5.7 Human Use

The degree of perceived success of any reclamation project often lies within the level of human use that is available on reclaimed lands. Prior to the oil sands development, relatively few people inhabited and used the area. Activities were largely limited to hunting, trapping, fishing, camping, and forestry. It is expected that people will be able to use and enjoy the reclaimed
lands as they once did. Most reclaimed lands currently have well-established interpretive trails, and stocked fishing ponds to attract some forms of human use. These sites are generally used as public relation mechanisms that are meant for education purposes as much as they are used for recreation. Quite often, challenges associated with revegetating reclaimed lands, and the pressure by local inhabitants to be able to subsist from these lands often leads to the establishment of farmland. From an ecological perspective, this is far removed from forested landscape that preceded development, but the intention is that some farmers and ranchers benefit financially as a result of this changed land-use. Again, the types of activities humans enjoy on reclaimed lands are often different following reclamation than prior to development, but again the intention often leans toward re-establishing some degree of aesthetic and recreative appeal for people.

6.0 Mitigative Mechanisms Used to Ensure Reclamation of Mined Oil Sands

6.1 Government Departments

When an oil company wishes to mine bitumen in the Athabasca oil sands area, several primary provincial and federal departments become involved in the initial application process, all the way to the final decommissioning and reclamation phase of the process. First, the interested oil company or joint venture group must submit an application to Alberta Energy and Utilities Board (AEUB). The AEUB generally evaluates the economic feasibility of the industrial development to ensure that the project is of benefit to Albertans. The mission statement of the AEUB is: “to ensure that the discovery, development, and delivery of Alberta's energy resources and utilities services takes place in a manner that is fair, responsible, and in the public interest.” Overall, the AEUB is concerned about the economic, social and environmental feasibility of energy related
projects. Once the AEUB approves the project proposal, other government departments assess the proposal based on their area of expertise.

Alberta Environment (AE) is generally the most involved among the remaining departments involved with the application and approval process. AE is responsible for land, air, and water, all of which are generally influenced by resource extraction projects. The primary role for AE is to ensure that the proposed project mitigates its impact on land, air, and water in such a way that future generations will also be able to enjoy these components of the landscape as current generations do. Other provincial departments that may also become involved in the application process include the Public Lands Division and Alberta Sustainable Resource Development. As the name of the division implies, the Public Lands Division evaluates projects that are planned for public lands. When forest resources and fish and wildlife are possibly affected by the proposed development, Alberta Sustainable Resource Development becomes involved.

As is often the case, waterbodies are affected by major industrial developments, such as the oil sands. As a result, the federal Department of Fisheries and Oceans becomes involved to ensure fish communities and their habitat are protected. Similarly, the Canadian wildlife service also becomes part of the application process if migratory birds and their habitat are affected by the proposed project.

6.2 Environmental Impact Assessments

As part of the application and approval process, an environmental impact assessment (EIA) must be conducted and ‘deemed complete’ by the various government departments involved.
According to Alberta Environment, EIAs: “provides a means of reviewing projects to assess their potential impact on the environment.”28 EIAs for large industrial projects, such as those submitted in the oil sands area, are often highly technical, detailed, voluminous, but are not legally binding documents.29 A typical EIA generally includes the following information:

- Proposed location of the project and associated land classification details;
- Atmospheric trends;
- Construction details;
- Technology that will be utilized during operation phases;
- Biophysical surveys for the area of interest;
- Identification of environmental impacts and mitigative measures that will be taken;
- Socio-economic impacts and mitigative measures for any negative impacts; and
- Proposed timeline for project initiation, operation, future expansions, and decommissioning;

Throughout this process, individuals and lobby groups alike have opportunities to voice their opinions and concerns of the proposed project. With regards to land reclamation, the details, goals and standards are also included in EIAs.

6.3 Legislation

The Environment Protection and Enhancement Act (EPEA) is the primary provincial legislation within which oil sands mining projects must work, and is administered and enforced by AE. It is designed to ensure that industry conserves and reclaims land to a pre-determined level at the standards of the day, upon which a reclamation certificate is granted. This act stipulates equivalent land capability following site reclamation as compared to the original land capability. Under this act, proponent must first apply to be given the licence to emit a certain amount of pollution, and provide details as to how pollution levels will be mitigated. In addition, the proponent must also receive EPEA certification following reclamation before a site can be officially deemed ‘reclaimed’. This, however, does not remove the responsibility of the
proponent in the future if the site is deemed contaminated. Should a site be considered contaminated following EPEA certification, the proponent retains responsibility for site remediation.

Other legislation that applies to oil sands mining include: the Oil Sands Conservation Act, Water Act, Public Lands Act, Fish and Wildlife Act, Federal Fisheries Act, and Federal Migratory Birds Act, and the Federal Navigable Waters Act. All acts are legally binding, and are administered and enforced by government department represented by each act. Should any aspect of these acts be broken during operation of oil sands mining and reclamation phases of operation, the proponent is considered liable.

6.4 Guidelines

During the development of new industries, it is difficult to forecast all potential impacts of the industrial activities on the environment. This is due largely in part to the geographic uniqueness of each project, limited availability of scientific research and development, and the untold number of challenges associated with long-term planning. As a result, industry and government have embraced the philosophy of adaptive management: “Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.”\(^{30}\) The development of joint industry/government guidelines is one the outcomes of adaptive management. Given that the original EIAs did not provide the specific details of reclamation, a series of guidelines were developed specifically for the Athabasca oil sands area. Generally these documents are not legally binding, unless they have
been incorporated into the regulations or added to the EIA. Nevertheless, it is expected from the government and public’s perspective that guidelines will be followed.

An example of a jointly developed series of guideline are the: “Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region”, as a means of ensuring oil sand mine sites are adequately reclaimed to boreal mixedwood forest. The scope and goals of these guidelines are to ensure that commercial forests are established, a system of biophysical monitoring mechanism are established, and research and development of advanced reclamation practices are conducted in order to facilitate the most effective means of land reclamation in the Alberta oil sands context. A similar series of guidelines were developed for wetland reclamation, entitled: “Guidelines for Wetland Establishment on Reclaimed Oil Sands Leases”.

6.5 Monitoring, Regulations and Enforcement

Ultimately, most industries are now largely self-monitoring. Regular reports produced by operators are generally submitted to AE, and other relevant departments. Annual meeting are also held as a means of detailing the reclamation progress to date and future plans. In addition to the EPEA certification process, other regulations are often used to assess reclaimed sites, such as free to grow standards, surface water quality guidelines, and habitat suitability indices. AE is the primary department that enforces legislation, regulations, and guidelines pertaining to oil sands development. This is done by random site visits, and calibration of monitoring equipment to ensure accurate data collection. The trend now is to use independent third-party auditors to conduct inspections. All other acts that are relevant to the oil sands mining and reclamation are also enforceable. Should conditions of any relevant acts be broken, repercussions include
warnings, fines, legal court action, and administrative penalties. Ultimately, the goal of enforcement is corrective action.33

6.6 Corporate Ethics

Although several mechanisms are currently established to ensure a desired level of reclamation occurs on decommissioned oil sands mine sites, a great deal of good faith is required on the part of the operator. Most companies explicitly state their environmental policies. Below is an example of Syncrude’s environmental policy:

“We pledge to return the land we disturb to a stable, biologically self-sustaining state. This means creating a landscape that has a productive capability at least equal to its condition before mining began. Syncrude is working with government agencies, local communities and other stakeholder groups to ensure land reclamation achieves a wide range of land use capabilities, in tune with the needs and aspirations of the people in our region. The vision is to leave behind an area comprised of forests, parkland, wetland and lakes. This way the land will be able to support a new generation of economic and recreational uses, including forestry, bison ranching, hiking and fishing.”34

The importance of good corporate ethics is three-fold. First, this prevents negative repercussions associated with lawsuits, fines and other regulatory measures associated with poor corporate ethics. Second, the image of sustainable development is important on the global market. Finally, good corporate ethics permeate throughout an organization, achieve local support and buy-in, and become especially important when requests for project expansion are submitted.

6.7 Securities

The final mechanism associated with land reclamation of mined oil sands area is the payment of securities. Each year, oil sand mine operators provide funding to the Alberta government that
equate to the expected cost of reclaiming the total area mined that year. In the future, when the
mine site is decommissioned and the EPEA certificate of reclamation is issued for the entire
mine site, the operator will be eligible to receive the securities funds. To date, there
approximately $177 million in the securities fund. Due to the uncertainties associated with
reclamation and the economics associated with providing securities funding, it is unclear whether
adequate resources are being collected by the securities program should mine sites be abandoned
without full reclamation.

7.0 Reclamation Progress to Date – Syncrude Case Study

Using Syncrude Canada Ltd. as an example, they have currently reclaimed approximately 3,300
ha of land, and plan to reclaim 6,900 ha by 2010. In addition, Syncrude has planted more than
2.5 million trees and shrub seedlings on reclaimed lands to date, in addition to an interpretive
network of walking trails. As an ancillary note, it currently costs Syncrude approximately
$3/tonne to reclaim land in their existing mine sites, which equates to approximately $25
million/year or $0.30/barrel.

8.0 Conclusion

The reclamation of oil sands is a formidable task on a number of different fronts. Most people
would agree that significant environmental and socio-economic impacts result of mine-based oil
extraction. As such, there are a number of mechanisms in place that promote, regulate, and
monitor the minimization of these impacts. The effectiveness of these mechanisms are difficult
to quantify, but given that much of the mined lands have yet to be reclaimed, there is caused for
concern over the long-term. The importance of maintaining cost-effective operations, in an sector
with huge capital costs is reason enough to wonder if companies are truly willing and able to reclaim mined lands to the extent and quality that has been promised and expected. When time is fast forward to the point near the end of Athabasca oil sands life cycle, will future generations agree that we ‘sustainably developed’ the Athabasca Oil Sands? Will the throne speech of the day be identifying this area as an abandoned environmental catastrophe whose burden of reclamation and remediation will be borne on Canadian citizens? These are very real questions that the current mechanisms established today are trying to address so that the answers will be positive ones.

There will always be a fine balance between the rewards of economic benefits associated with resource extraction and the environmental consequences that result. In Alberta, a dynamic series of mechanisms have been established for oil sands reclamation, with some arguing that they are among the best in the world. The system of securities is likely the most effective ‘insurance’ mechanism for site reclamation upon site decommissioning. Not only does it force resource managers to estimate the cost of reclamation today, it also provides and incentive for companies to fulfill their obligations in order to claim back their securities. Nevertheless, securities tend to be a ‘hot topic’ of discussion in the oil sands, and it is easy to see why: operators want to run a cost-effective business, and the government wants to ensure operators are held accountable for reclamation. The subject of securities likely requires additional research and evaluation in order to fine-tune the estimate of costs associated with mine site reclamation.

In the interim, it is imperative that oil sands operators are encouraged to reclaim as much land now while the strength of the economy and operators is high, as opposed to the end of the oil
sands life cycle when the funds to support the behemoth task of reclamation would be a limiting factor. In addition, an added benefit of reclaiming land now is the associated research and development that dovetails the process. Given the complexities and challenges associated with reclaiming oil sand mines, there is a sizeable knowledge gap that needs to be filled before regulatory bodies can accurately deem sites to be ‘reclaimed’. In the end, I am cautiously optimistic that a degree of reclamation will be achieved in the Athabasca oil sands; however, success will require continual cooperation between industry and government, research and development, and a strong willingness to achieve a common goal of sustainable development.
9.0 End Notes


5 Ibid.


10 Ibid. p114.

11 Syncrude Canada Ltd. 1984. Biophysical impact assessment for the new facilities at the Syncrude Canada Ltd. Mildred Lake Plant. Syncrude Canada Ltd. Fort McMurray, AB. P.79


15 Syncrude Canada Ltd. 1984. p90.


18 Crites, S., and S. Hanus. Succession of herbaceous, shrub, and tree communities following combined treatments of fire and harvesting. Alberta Research Council. Vegreville, AB.

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Syncrude Canada Ltd. 1984. p127

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